DS-TMF-GF80-GF81-Series-MFC-eng
January, 2017

Data Sheet

GF80/GF81

Thermal Mass Flow

Metal Seal
Digital Mass Flow Controllers and Meters

Overview

Brooks® GF80 and GF81 thermal mass flow controllers (MFCs) and thermal mass flow meters (MFMs) achieve unprecedented performance, reliability, and flexibility in many gas flow measurement and control applications.

At the heart of the GF80 is Brooks' patented 4th generation MultiFlo™ capable device. MultiFlo overcomes a long-standing limitation of many thermal MFCs – when changing gas types, a simple correction factor, such as the ratio of heat capacities between the calibration gas and new gas, cannot account for accuracy-robbing viscosity and density differences. The Brooks MultiFlo database is built on thousands of native gas runs to establish correction functions that account for both thermal and physical differences among gases making the GF80 Series among the most accurate and flexible MFCs/MFMs available today.

The Brooks GF80/GF81 Series is the perfect choice for customers who use thermal mass flow controllers or thermal mass flow meters on a variety of gases, who need to change gas type frequently, or who need to re-range while preserving gas measurement and control accuracy. Some examples:

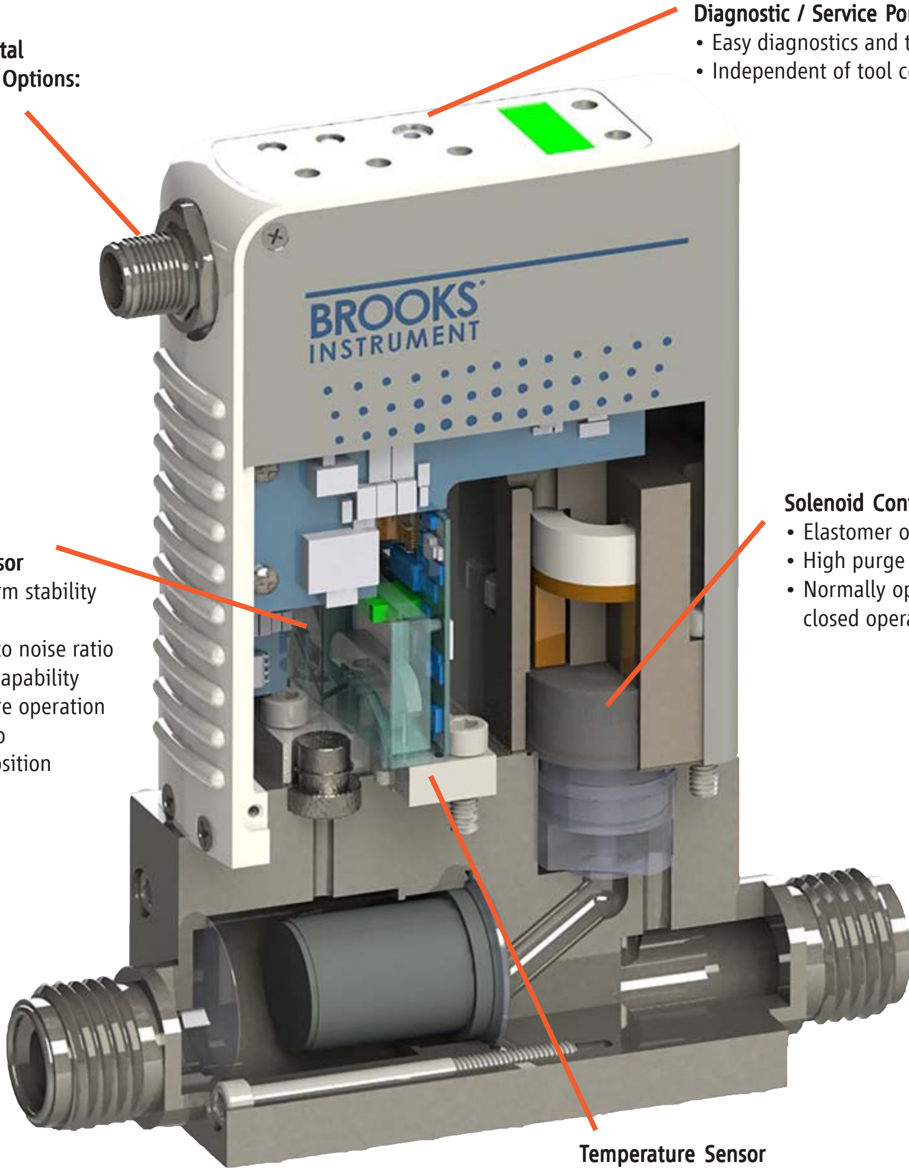
- OEMs will reduce the number of gas and range-specific MFCs that they inventory
- Solar, biotech, CVD, plasma, glass, web coating, nanotechnology, vacuum processing and similar large users of mass flow meters and mass flow controllers will greatly reduce their gas- and range-specific spares inventory
- R&D, research, and laboratory users can quickly change experiment conditions and achieve much better actual process gas accuracy vs. traditional mass flow devices

MultiFlo programming is simple and fast – a new gas and range can be programmed under 60 seconds plus the device can be programmed without removing it from service or disconnecting the device from any process or tool control system.

Product Description

The Brooks GF80/GF81 Series features a corrosion-resistant Hastelloy C-22 sensor for durable, long-term operation. Sub-1 second settling times and 1% of set point accuracy ensure that the GF80/GF81 will provide reliable flow measurement or flow control in demanding gas flow applications. Both GF80 and GF81 achieve excellent internal to external leak integrity for challenging process gases as found in CVD, solar, and other processes. With a wide range of digital and analog I/O options available, the GF80/GF81 represents an extremely powerful, yet easy, upgrade for existing MFCs or MFMs.

Features and Benefits



Features	Benefits
Metal Seal	High internal to external leak integrity. No periodic replacement of aging seals necessary
Adaptable Mechanical Configurations	Compact footprint enables easy retrofit to existing systems
Metrology	Measurement accuracy is traceable to international standards
MultiFlo Gas and Range Programmabilty with Advanced Diagnostics and User Accessible Service Port	Select new gas calibrations and full-scale ranges without the trouble and cost of removing the mass flow controller from the gas line. Convenient interface to diagnostics port for maximum uptime.
Corrosion resistant Hastelloy® Sensor	Provides unmatched long-term sensor stability ensuring maximum yield and throughput.

Product Description (Continued)

MultiFlo™ Gas and Range Configurability

A major advancement over traditional single point gas conversion factors, Brooks MultiFlo technology delivers up to a three-times improvement in process gas accuracy. This is achieved through advanced gas modeling plus extensive actual gas testing protocols that provide extremely accurate compensation. MultiFlo also allows the device to be quickly and easily configured for another gas and/or flow range without sacrificing accuracy or range-ability. Selecting a new gas automatically creates a new calibration curve, establishes optimized PID settings for dynamic control, compensates for gas density and viscosity effects, and ensures smooth, overshoot-free transitions between flow rates with excellent steady state stability.

Brooks MultiFlo technology offers unparalleled flexibility; a single device can be configured for thousands of different gas and flow range configurations.

Re-programming is simple and fast; a new gas and range can be programmed in under 60 seconds. Brooks provides an enormous gas database to ensure the maximal value of MultiFlo is realized:

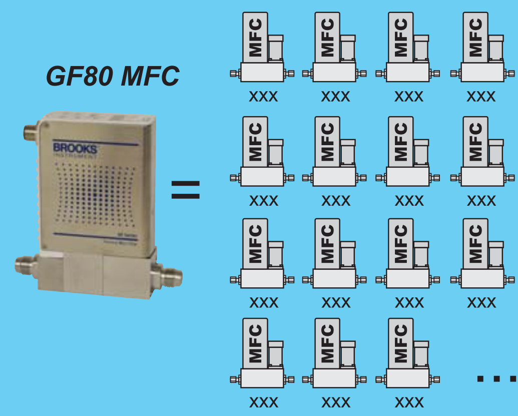
- Dramatically reduces inventory or spares expense
- The MFC full scale flow range can be scaled down typically by a factor of 3:1 with no impact on accuracy, turndown or leak-by specifications for tremendous process flexibility
- Native gas calibration is not required
- Maximum flexibility for research applications

MultiFlo™ Configurator Accessories

MultiFlo kits are available in the following configurations:

778Z010ZZZ	**Basic MultiFlo Configurator Kit**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
778Z012ZZZ	**GF0xx RS485 Analog/Profibus® MultiFlo Configurator Kit w/Power Supply 24 Vdc**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
641Z117AAA	Power Supply 24 Vdc with DB-15 female
778Z014ZZZ	**GF0xx DeviceNet™ MultiFlo Configurator Kit w/Power Supply 24 Vdc**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
641Z117AAA	Power Supply 24 Vdc with DB-15 female
124Z171AAA	Cable, Power, DeviceNet to DB-15 male

*MultiFlo configurator software is available on the Brooks Instrument website at: www.BrooksInstrument.com/MultiFlo



MultiFlo™ technology allows your GF80 to be programmed for thousands of different gases and flow ranges

# of Platforms	Gf80 Range	Competitor A 2 Models Range	Competitor B 4 Models Range
1	3 - 10	10	1 - 5
2	11 - 30	17.5	6 - 14
3	31 - 92	30	15 - 27
4	93 - 280	55	28 - 38
5	281 - 860	100	39 - 71
6	861 - 2,600	175	72 - 103
7	2,601 - 7,200	300	104 - 192
8	7,201 - 15,000	550	193 - 279
9	15,001 - 30,000	1,000	280 - 754
10	30,001 - 40,000	1,750	755 - 2,037
11	40,001 - 55,000	3,000	2,038 - 5,500
12		5,500	5,501 - 11,000
13		10,000	11,001 - 30,000
14		22,000	30,0001 - 50,000
15		30,000	
16		50,000	

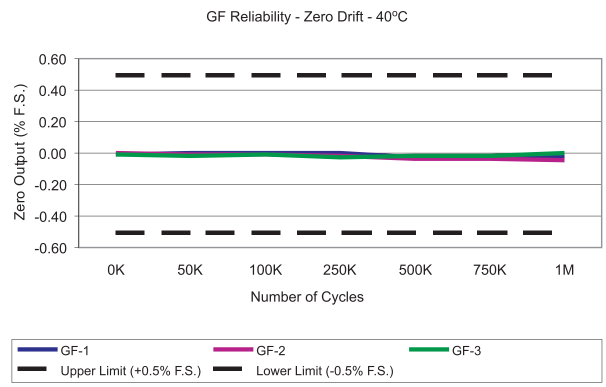
The Brooks Advantage! Fewer platforms means more process flexibility and lower cost of spares.

Product Description (Continued)

Advanced Thermal Flow Measurement Sensor

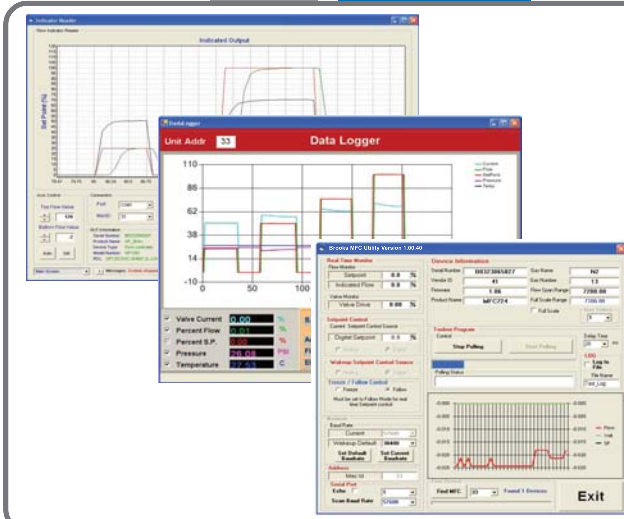
Brooks' proprietary sensor technology combines:

- Improved signal to noise performance for improved accuracy at low setpoints
- Improved reproducibility at elevated temperatures through new isothermal packaging, onboard conditioning electronics with ambient temperature sensing and compensation
- Improved long-term stability through an enhanced sensor manufacturing process
- Highly corrosion resistant Hastelloy C-22 sensor tube
- Optimized temperature profile for gases prone to thermal decomposition



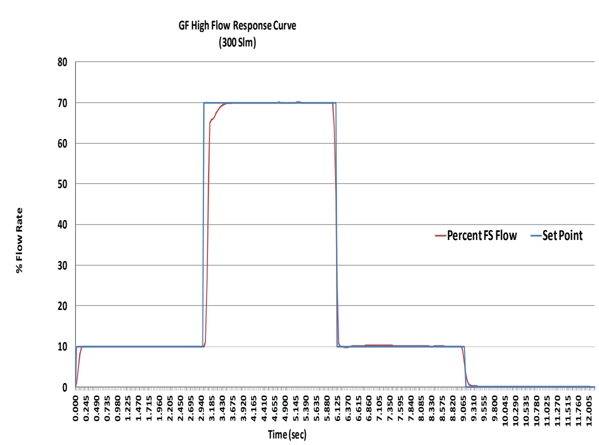
Enhanced Diagnostics

The mass flow controller remains one of the most complex and critical component in gas delivery systems; removing the mass flow controller to determine if it is faulty should be the last resort. In response to this fact, Brooks pioneered smarter mass flow controllers with embedded self test routines and introduced an independent diagnostic/service port to provide the user with access to diagnostic data for troubleshooting without interrupting flow controller operation.



Precise Flow Control

Speed of response and gas stability are often critical requirements for advanced process control applications. GF81 addresses traditional hi-flow control issues such as overshoot/ undershoot and long flow stabilization times with its ultrafast <1 second flow settling time eliminating wasted gas and process variability.



Product Applications

Solar Cell / CVD

Developed to meet the diverse process requirements for solar cells, fiber optics, and the glass and metal coatings markets, the GF80 and GF81 mass flow controllers offer a single platform solution for diffusion furnaces, thin film deposition, and other difficult applications.

With the GF80/GF81 offering metal seals, this single platform can cover complex gas distribution systems. The MultiFlo feature can minimze costly inventory while providing industry leading actual gas accuracy.

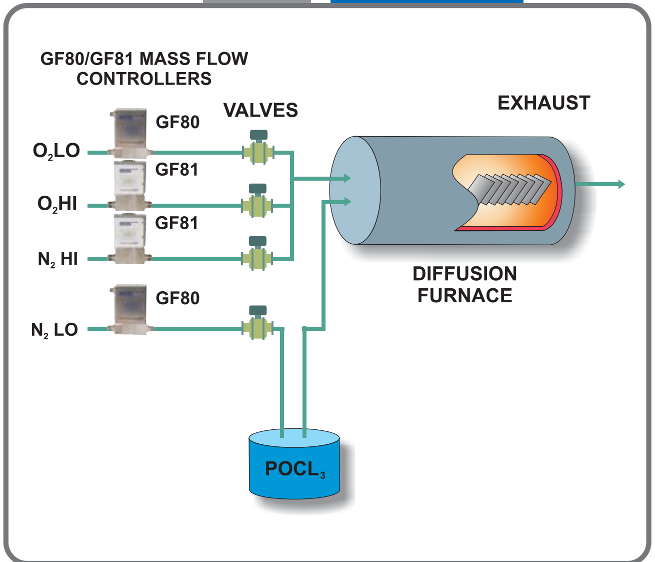
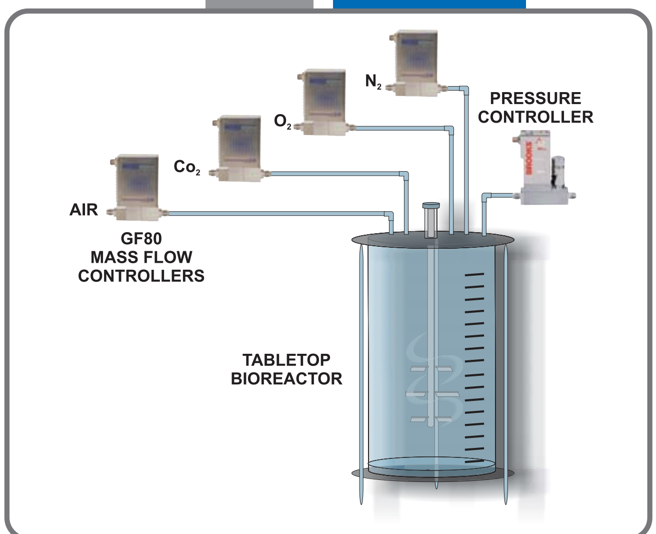


Table Top Bioreactors

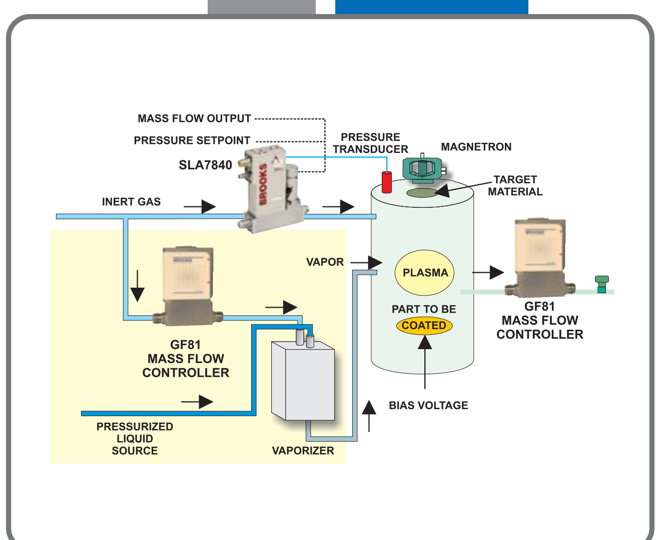
Brooks has earned the leading reputation in controlling gas flows for bioreactor applications. The GF80 mass flow controllers are perfect for controlling dissolved oxygen and pH. The MultiFlo capability can greatly simplify spares inventory and the ordering process. With multiple digital protocol communication options and other advanced features, the GF80 is an ideal device for the bioreactor process.



Vacuum Processes

Brooks offers many products that deliver exceptional performance for vacuum processes. The GF80/GF81 mass flow controllers are no exception. With high flow and low flow options, several digital communication protocols offerings, and the MultiFlo capability, the GF80/GF81 can serve a wide variety of vacuum porcesses.

With other products like the XacTorr® capacitance manometer and SLA7800 Series pressure controllers, the GF80/GF81 makes Brooks a one-stop-shop for instrumentation in vacuum processes.



Product Specifications

Performance

	GF80	GF81
Full Scale Flow Range (N_2 Eq.)	3 sccm to 55 slm	51 - 300 slm
Flow Accuracy	±1% S.P. 35-100%, ±0.35% F.S. 2-35%	±1% S.P. 35-100% , ±0.35% F.S. 5-35%
Repeatability & Reproducibility	< ± 0.2% S.P.	0.15% S.P.
Linearity	± 0.5% F.S. (included in accuracy)	
Response Time (Settling Time)	Normally Closed Valve < 1 sec. (within 2% for steps 0-10 through 0-100%)	< 1 second
Control Range	2-100%	5% - 100%
MultiFlo	optional	N/A
Number of Bins	11 bins	4 bins
Valve Shut Down	< 1% of F.S.	<4% of Standard Configuration F.S. @ 30 psig/atm out N_2 eq.
Zero Stability	< ± 0.5% F.S. per year	
Pressure Coefficient	0.03% per psi (0-50psi N_2)	
Attitude Sensitivity	<0.25% span change @ 90° after rezeroing (N_2 @ 50 psi)	
Auto Zero:	Optional: (When Auto Zero is enabled the device performs the zero function once every time the set point returns to zero. To accomplish, simply provide a zero set point.)	
Auto shut-off:	The Auto Shut-off feature closes the GF80 valve when the set point drops below 1.5% of full scale	The Auto Shut-off feature closes the GF81 valve when the set point drops below 2% of full scale.
Available Gases:	MultiFlo Capable	N_2, H_2, Ar, He, O_2, NH_3 (consult factory for other gases)

Ratings

Operating Temperature Range	5-50°C (41-122°F)	
Maximum Operating Pressure*	150 psig (10 bar)	Controller: 75 psig (5 bar) / Meter: 150 psig (10 bar)
Differential Pressure Range*	3-860 sccm = 7-45 psid, 861-7200 sccm = 15-45 psid, 7201-50000 sccm = 25-45 psid Typical pressure drop, high density gases like Argon gas applications require an additional 10 psid differential pressure	30 - 90 psid
Leak Integrity (External)	$1x10^{-10}$ atm. cc/sec He	

Mechanical

Valve Type	Normally Closed, Meter	
Primary Wetted Materials	316 Stainless Steel, Hastelloy C-22, 17-7 PH, 430SS	316 Stainless Steel, Hastelloy C-22, KM45
External Seals	316 Stainless Steel	
Internal Seals/Valve Seat	316 Stainless Steel	
Surface Finish	16μ inch Ra	

Diagnostics & Display

Status Lights:	MFC Health, Network Status
Alarms*:	Sensor Output, Control Valve Output, Over Temperature, Power Surge/Sag, Network Interruption
Diagnostic / Service Port:	RS485 via 2.5mm jack

Compliance

Environmental Compliance:	CE: EN6126: 2006 (FCC Part 15 & Canada IC-subset of CE testing)
	Safety EN61010-1
	RoHS

* Note: Application specific lower supply pressure and/or lower differential pressure operation available through Brooks Customer Special Request (CSR) process.

Product Specifications (Continued)

Communication Protocol	RS485*	Profibus®	DeviceNet™
Electrical Connection	1 x 15-pin Male Sub-D, (A)	1 x 15-pin Male Sub-D/ 1 x 9-pin Female Sub-D	1 x M12 with threaded coupling nut (B)
Analog I/O	0-5 V, 0-10 V, 0-20 mA, 4-20 mA	0-5 V, 0-20 mA, 4-20 mA	
GF80 Power Max./Purge	From +12 Vdc to +24 Vdc: 7 Watt/8 Watt	From +13.5 Vdc to +27 Vdc: 7 Watt/8 Watt	From +11 Vdc to +25 Vdc: 13.6 Watt/15.0Watt
GF81 Power Max./Purge	From +12 Vdc to +24 Vdc: 3.3 Watt/10.2 Watt	From +13.5 Vdc to +27 Vdc: 3.3 Watt/10.2 Watt	From +11 Vdc to +25 Vdc: 3.3 Watt/10.2 Watt
Voltage Set Point Input Specification			
Nominal Range	0-5 Vdc or 0-10 Vdc	0-5 Vdc	N/A
Full Range	0-11 Vdc	0-5.5 Vdc	N/A
Absolute Max.	25 V (without damage)		N/A
Input Impedence	192 kOhms		N/A
Required Max. Sink Current	0.002 mA		N/A
Current Set Point			
Nominal Range	4-20 mA or 0-20 mA		N/A
Full Range	0-22 mA		N/A
Absolute Max.	25 mA (without damage)		N/A
Input Impedence	250 Ohms	125 Ohms	N/A
Flow Output (Voltage) Specifications			
Nominal Range	0-5 Vdc or 0-10 Vdc	0-5 Vdc	N/A
Full Range	(-0.5)-11 Vdc	0-5.5 Vdc	N/A
Min Load Resistance	1 kOhms	1 kOhms	N/A
Flow Output (Current) Specifications			
Nominal Range	0-20 mA or 4-20 mA		N/A
Full Range	0-22 mA (@ 0-20 mA); 3.8-22 mA (@ 4-20 mA)		N/A
Max. Load	400 Ohms (for supply voltage: 12-24 Vdc		N/A
Analog I/O Alarm Ouput**			
Type	Open Collector		N/A
Max. Closed (On) Current	25 mA		N/A
Max. Open (Off) Leakage	1µA		N/A
Max. Open (Off) Voltage	30 Vdc		N/A
Analog I/O Valve Override Signal Specifications***			
Floating/Unconnected	Instrument controls valve to command set point		N/A
VOR < 1.40 Vdc	Valve Closed		N/A
1.70 Vdc < VOR < 2.90 Vdc	Valve Normal		N/A
VOR > 3.20 Vdc	Valve Open		N/A
Input Impedence	800 kOhms		N/A
Absolute Max. Input	(-25 Vdc) < VOR < 25 Vdc (without damage)		N/A

*There are three (3) RS485 Protocols:
S-Protocol is a RS485 communication based on HART® command set.
L-Protocol is a RS485 communication compatible with legacy Unit® and Celerity® devices.
A-Protocol is a RS485 communication compatible with Aera® mass flow devices.

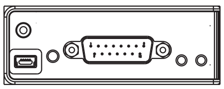
**The Alarm Output is an open collector or "contact type" that is CLOSED (on) whenever an alarm is active. The Alarm Output may be set to indicate any one of various alarm conditions.

*** The Valve Override Signal (VOR) is implemented as an analog input which measures the voltage at the input and controls the valve based upon the measured reading as shown in this section.

Electrical Interface Options

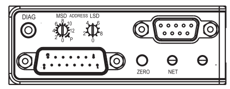
Base I/O Options

Analog / RS485
(S, L, and A Protocols)



Pin No.:	Signals:
1	SETPOINT COMMON
2	FLOW OUTPUT (0-5V, 0-10V)
3	ALARM OUT
4	FLOW OUTPUT (0-20mA, 4-20mA)
5	POWER SUPPLY (+12V to +24Vdc)
6	NC
7	SETPOINT INPUT (0-20mA, 4-20mA)
8	SETPOINT INPUT (0-5V, 0-10V)
9	POWER COMMON
10	FLOW OUT COMMON
11	NC
12	VALVE OVERRIDE INPUT
13	RESERVED
14	RS485B
15	RS485A

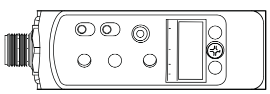
Profibus



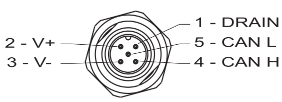
Pin No.:	Signals:
1	SETPOINT COMMON
2	FLOW OUTPUT (0-5V)
3	ALARM OUT
4	FLOW OUTPUT (0-20mA, 4-20mA)
5	POWER SUPPLY (13.5-27V)
6	NC
7	SETPOINT INPUT (0-20mA, 4-20mA)
8	SETPOINT INPUT (0-5V)
9	POWER COMMON
10	FLOW OUT COMMON
11	NC
12	VALVE OVERRIDE INPUT
13	RESERVED
14	NC
15	NC

Pin No.:	Signals:
1	NC
2	NC
3	RXD/TXD - B - red wire
4	NC
5	Ground
6	+5Vdc
7	NC
8	RXD/TXD - A - green wire
9	NC

DeviceNet



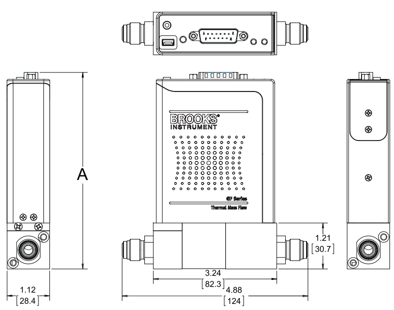
Pin No.:	Signals:
1	DRAIN
2	V+ (11-25 Vdc)
3	V-
4	CAN-H
5	CAN-L



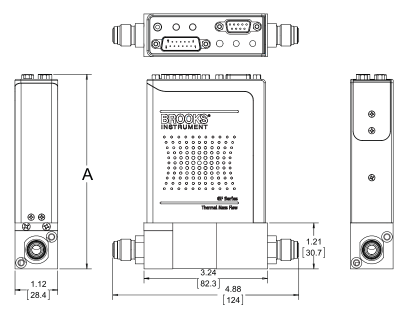
Product Dimensions

GF80 Configurations

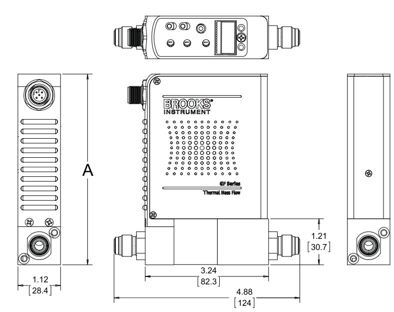
Analog / RS485

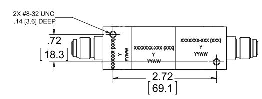


Profibus



DeviceNet



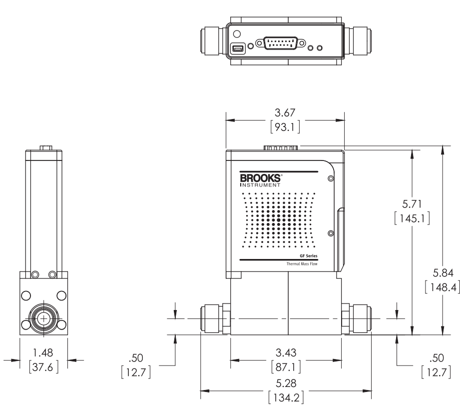


Analog/RS485, Profibus and DeviceNet Models

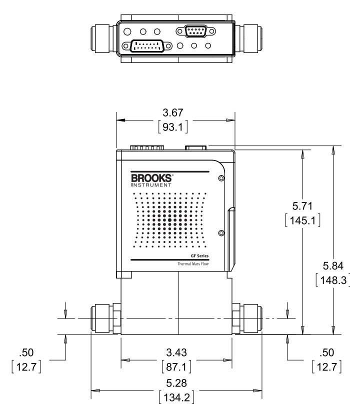
	Dim "A" in [mm]
Analog / RS485	5.16 [131.1]
Profibus	5.11 [129.8]
DeviceNet	5.00 [127]

GF81 Configurations

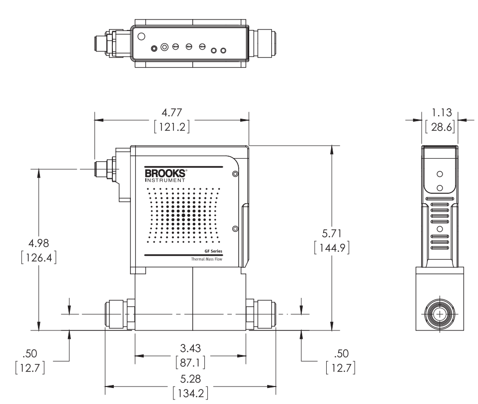
Analog / RS485

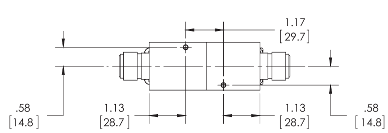


Profibus



DeviceNet





Model Code - GF80

Code	Description	Code Option	Option Description
I.	Base Model Code	GF080	Metal / Range Flow (0-55 slpm)
II.	Configurability	C	MultiFlo Capable. Standard Bins or specific gas range may be selected
		X	Not MultiFlo Capable. Specific gas/range required
III.	Special Application	XX	Standard
IV.	Valve Configuration	C	Normally Closed Valve
		M	Meter (No Valve)
V.	Gas or SH MultiFlo Bin	XXXX XXXX	Specific Gas Code & Range, i.e. "0004" = Argon and "010L" = 10 slpm
		SH40 010C	Standard Configuration #40, 3-10 sccm Nitrogen Equivalent (0° C Reference)
		SH41 030C	Standard Configuration #41, 11-30 sccm Nitrogen Equivalent (0° C Reference)
		SH42 092C	Standard Configuration #42, 31-92 sccm Nitrogen Equivalent (0° C Reference)
		SH43 280C	Standard Configuration #43,93-280 sccm Nitrogen Equivalent (0° C Reference)
		SH44 860C	Standard Configuration #44, 281-860 sccm Nitrogen Equivalent (0° C Reference)
		SH45 2.6L	Standard Configuration #45, 861-2600 sccm Nitrogen Equivalent (0° C Reference)
		SH46 7.2L	Standard Configuration #46, 2601-7200 sccm Nitrogen Equivalent (0° C Reference)
		SH47 015L	Standard Configuration #47, 7201-15000 sccm Nitrogen Equivalent (0° C Reference)
		SH48 030L	Standard Configuration #48, 15001-30000 sccm Nitrogen Equivalent (0° C Reference)
		SH49 040L	Standard Configuration #49, 30001-40000 sccm Nitrogen Equivalent (0° C Reference)
		SH50 055L	Standard Configuration #50, 40001-55000 sccm Nitrogen Equivalent (0° C Reference)
VI.	Fitting	VX	1/4" VCR
VII.	Downstream Condition	A	Atmosphere
		V	Vacuum
		P	Positive Pressure
VIII.	External Seals, Valve Seat	S	Seal Metal / Seat Metal (316 SS)
IX.	Communications / Connector	P5	Profibus / Analog (Input 0-5 V; Output 0-5 V); 9-Pin Female D conn. / 15-Pin Male D conn.
		P0	Profibus / Analog (Input 0-20 mA; Output 0-20 mA); 9-Pin Female D conn. / 15-Pin Male D conn.
		P4	Profibus / Analog (Input 4-20 mA; Output 4-20 mA); 9-Pin Female D conn. / 15-Pin Male D conn.
		S5	RS485: (S-Protocol)/Analog (Input 0-5 V; Output 0-5 V)15-Pin Male D (Brooks® Protocol)
		S1	RS485: (S-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Brooks® Protocol)
		S0	RS485 (S-Protocol)/Analog (Input 0-20 mA ; Output 0-20 mA); 15-Pin Male D (Brooks® Protocol)
		S4	RS485 (S-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Brooks® Protocol)
		L5	RS485 (L-Protocol)/Analog (Input 0-5 V; Output 0-5 V); 15-Pin Male D (Celerity®/Legacy Protocol)
		L1	RS485 (L-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Celerity®/Legacy Protocol)
		L0	RS485 (L-Protocol)/Analog (Input 0-20 mA; Output 0-20 mA); 15-Pin Male D (Celerity®/Legacy Protocol)
		L4	RS485 (L-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Celerity®/Legacy Protocol)

DeviceNet Standard Configuration Parameters

Code Option	I/O	Connector	Power On State	Full Scale Setting	Full Scale Setting	Full Scale Setting	Poll IO Instance Producer	Poll IO Instance Consumer	Poll IO State Transition	External Baud Rate
D0	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	2	7	Executing	500KB
D1	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	21	7	Executing	500KB
D2	DeviceNet	5 Pin Micro	Idle	SCCM	Float	7FFFh	13	19	Executing	500KB
D3	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	7	Executing	500KB
D4	DeviceNet	5 Pin Micro	Executing	Count	Integer	6000h	22	8	Executing	500KB
D5	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	6	8	Executing	500KB
D6	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	3	7	Executing	500KB
D7	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	6	8	Executing	500KB
D8	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	3	7	Executing	500KB
D9	DeviceNet	5 Pin Micro	Executing	Count	Integer	6000h	2	7	Executing	500KB
DA	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	22	7	Executing	500KB
DB	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	8	Executing	500KB
DC	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	3	7	Idle	500KB
DD	DeviceNet	5 Pin Micro	Executing	Count	Integer	7FFFh	22	8	Executing	500KB
DE	DeviceNet	5 Pin Micro	Executing	Sccm	Float	6000h	15	19	Executing	500KB
DX	DeviceNet	5 Pin Micro	To be defined by CSR							

Code	Description	Code Option	Option Description
X.	Customer Special Request	XXXX	Customer Special Request Number
XI.	Auto Shut-Off	A	Auto Shut-Off (Included)
		X	Auto Shut-Off (Not Included)
XII.	Auto Zero	X	Auto Zero (Not Included)
XIII.	Reference Temperature	00C	0°C Reference
		15C	15°C Reference
		20C	20°C Reference
		70F	21.1°C Reference / 70°F Reference

Example Model Code

I	II	III	IV		V		VI	VII	VIII	IX		X	XI	XII		XIII
GF080	C	XX	C	-	0013300C	-	T2	A	S	P5	-	XXXX	X	X	-	20C

Model Code - GF81

Code	Description	Code Option	Option Description
I.	Base Model Code	GF081	Metal/Hi-flow (51-300 slpm N_2 Eq)
II.	Configurability	X	Specific Gas & Range Required
III.	Special Application	XX	Standard
IV.	Valve Configuration	C	Normally Closed Valve
		M	Meter (No Valve)
V.	Gas or Range	XXXX XXXX	Specific Gas Code & Range, example: "0007" = Hydrogen and "200L" = 200 slpm
VI.	Fitting	V1	1 -1/2" body width, 1/2" VCR, 134.2 mm
VII.	Downstream Condition	A	Atmospheric
		V	Vacuum
		P	Positive Pressure
VIII.	External Seal/Valve Seat	S	Metal Seal/Metal Seat
IX.	Communications/ Connector	P5	Profibus/Analog (Input 0-5 V; Output 0-5 V); 9-Pin Female D conn./15-Pin Male D conn.
		P0	Profibus/Analog (Input 0-20 mA; Output 0-20 mA); 9-Pin Female D conn./15-Pin Male D conn.
		P4	Profibus/Analog (Input 4-20 mA; Output 4-20 mA); 9-Pin Female D conn./15-Pin Male D conn.
		L5	RS485 (L-Protocol)/Analog (Input 0-5 V; Output 0-5 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		L1	RS485 (L-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Pin alignment with Celerity® Power)
		L0	RS485 (L-Protocol)/Analog (Input 0-20 mA; Output 0-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		L4	RS485 (L-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		A5	RS485 (A-Protocol)/Analog (Input 0-5 V; Output 0-5 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		A1	RS485 (A-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		A0	RS485 (A-Protocol)/Analog (Input 0-20 mA; Output 0-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		A4	RS485 (A-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		S5	RS485 (S-Protocol)/Analog (Input 0-5 V; Output 0-5 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		S1	RS485 (S-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		S0	RS485 (S-Protocol)/Analog (Input 0-20 mA; Output 0-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		S4	RS485 (S-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)

DeviceNet Standard Configuration Parameters

Code Option	I/O	Connector	Power On State	Full Scale Setting	Full Scale Setting	Full Scale Setting	Poll IO Instance Producer	Poll IO Instance Consumer	Poll IO State Transition	External Baud Rate
D0	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	2	7	Executing	500KB
D1	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	21	7	Executing	500KB
D2	DeviceNet	5 Pin Micro	Idle	SCCM	Float	7FFFh	13	19	Executing	500KB
D3	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	7	Executing	500KB
D4	DeviceNet	5 Pin Micro	Executing	Count	Integer	6000h	22	8	Executing	500KB
D5	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	6	8	Executing	500KB
D6	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	3	7	Executing	500KB
D7	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	6	8	Executing	500KB
D8	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	3	7	Executing	500KB
D9	DeviceNet	5 Pin Micro	Executing	Count	Integer	6000h	2	7	Executing	500KB
DA	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	22	7	Executing	500KB
DB	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	8	Executing	500KB
DC	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	3	7	Idle	500KB
DD	DeviceNet	5 Pin Micro	Executing	Count	Integer	7FFFh	22	8	Executing	500KB
DE	DeviceNet	5 Pin Micro	Executing	Sccm	Float	6000h	15	19	Executing	500KB
DX	DeviceNet	5 Pin Micro	To be defined by CSR							

Code	Description	Code Option	Option Description
X.	Customer Special Request	XXXX	Customer Special Request Number
XI.	Auto Shut-Off	A	Auto Shut-Off (Included)
		X	Auto Shut-Off (Not Included)
XII.	Auto Zero-Off	X	Auto Zero (Not Included)
XII.	Reference Temperature	00C	0 Deg C Reference
		15C	15 Deg C Reference
		20C	20 Deg C Reference
		70F	21.1 Deg C/70 Deg F Reference

Example Model Code

I	II	III	IV		V		VI	VII	VIII	IX		X	XI	XII		XIII
GF081	X	XX	C	-	0013 100L	-	V1	A	5	P5	-	XXXX	A	X	-	00C

Brooks Service and Support

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Brooks Instrument can provide start-up service prior to operation when required. For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

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Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

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Installation and Operation Manual
X-DPT-DeviceNet-GF40-GF80-MFC-eng
Part Number: 541B168AAG
December, 2011

DeviceNet™ Supplemental Manual for GF40/GF80 Series Mass Flow Controllers and Meters

Brooks® GF40/GF80 Series with DeviceNet

BROOKS®
INSTRUMENT

Dear Customer,

We recommend that you read this manual in its entirety as this will enable efficient and proper use of the DeviceNet Mass flow controllers and meters. Should you require any additional information concerning the DeviceNet Mass flow controllers and meters, please feel free to contact your local Brooks Sales and Service Office; see back cover for contact information, or visit us on the web at www.BrooksInstrument.com. We appreciate this opportunity to service your fluid measurement and control requirements, and trust that we will be able to provide you with further assistance in future.

Yours sincerely,
Brooks Instrument

Contents

8 S-Analog Actuator Object (Class 0x32)

9 S-Single Stage Controller Object (Class 0x33)

10 S-Gas Calibration Object (Class 0x34)

11 References

Contact Information

1 Introduction

This document and the DeviceNet Statement of Compliance (SOC) from the Open DeviceNet Vendors Association (ODVA) provide a complete interoperability specification for the GF40/GF80 Series Digital Mass Flow Controller device from Brooks. This device is defined by the ODVA specification in the Device Profiles chapter, section entitled "Enhance Mass Flow Controller, Type: 27_{hex}". The primary difference in this profile from the original Mass Flow Controller profile, type = $1A_{hex}$, is that this device profile supports a flow and temperature instance of the S-Analog Sensor Object. Information contained in this document was derived from the following sources:

<u>DeviceNet Specification Enhancements for the S-Device Supervisor Objects:</u>

- <u>S-Device Supervisor Object (DSE-93-01)</u> [1]
- <u>S-Analog Sensor Object (DSE-93-02)</u> [2]
- <u>S-Analog Actuator Object (DSE-93-03)</u> [3]
- <u>S-Single Stage Controller Object (DSE-93-04)</u> [4]
- <u>S-Gas Calibrator Object (DSE-93-05)</u> [5]

<u>ODVA Mass Flow Controller Device Profile (DSE 93-06)</u> [6]

<u>ODVA DeviceNet Specifications Version 2.0</u> [7]

<u>ODVA Enhanced Mass Flow Controller Device Profile (Edition 3.4, CIP Spec.)</u>

<u>AMAT (various docs)</u>

This device also complies with the ODVA Semiconductor SIG Interface Guidelines for DeviceNet Devices on Semiconductor Manufacturing Tools.

The GF40/GF80 Series Digital Mass Flow Controller (hereafter referred to as GF40/GF80 Series) supports the following DeviceNet objects: Identity, DeviceNet, Connection, and Assembly. In addition, support is also provided for the S-Device Supervisor, S-Analog Sensor, S-Analog Actuator, S-Single Stage Controller, and S-Gas Calibration objects. Supported objects are summarized in the following table.

Object Class	Subclass		Optional/Required	# of Instances
	Class	Inst		
Identity	-	-	Required	1
Message Router	-	-	Required	1
DeviceNet	-	-	Required	1
Connection	-	-	Required (note 1)	at least 1 I/O Polled and 1 Explicit
Acknowledge Handler Object	-	-	Conditional (note 2)	1
Assembly	-	-	Required	at least 1 Input and 1 Output
S-Device Supervisor	-	-	Required	1
S-Gas Calibration	-	01	Optional (Supported)	0 or More
S-Analog Sensor	-	01	Required (note 3)	3
S-Analog Actuator	-	-	Conditional (note 4) (Supported)	1
S-Single Stage Controller	-	-	Conditional (note 4) (Supported)	1

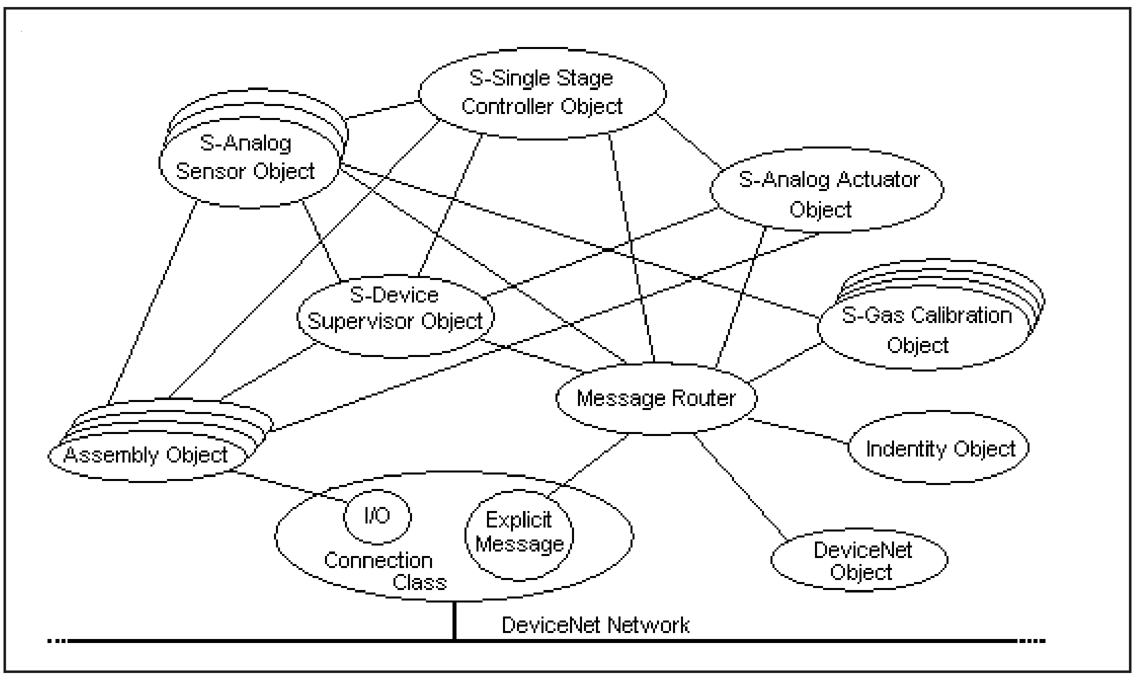
Notes:

1. GF40/GF80 Series supports one I/O Polled and one Explicit Connection
2. Required for Change-of-State/Cyclic I/O connection support. (Not supported).
3. The GF40/GF80 Series supports three instances of the S-Analog Sensor object; instance 1 for flow, instance 2 for pressure and instance 3 for temperature. This conforms to the Enhanced MFC profile, device type = 27_{hex}.
4. Required for a Mass Flow Controller, a device that contains a Valve and a Controller. Not supported in a Mass Flow Meter Device (an MFC without a Valve or a Controller).

1.1 Device Profile –Enhanced Mass Flow Controller Device (Type 0x27)

A Mass Flow Controller is a device that measures and controls the mass flow rate of gas or liquid. The MFC contains three principle components: a mass flow rate sensor, a metering valve, and a closed-loop controller. The sensor can consist of a variety of types, including thermal or pressure-based. Flow can be regulated by a variety of actuator types, including solenoid, voice coil, or piezoelectric transducer. The closed-loop controller accepts a setpoint from the host and controls the flow to that setpoint. Control is accomplished by monitoring the flow and adjusting the valve position to reduce the error between the setpoint flow value and actual flow value.

1.2 Object Model for Mass Flow Controller



Object Model for the MFC Device

1.3 How Objects Affect Behavior

Object	Effect on behavior
Identity	Supports the Reset service. Upon receipt of a *Reset* Service Request of any *Type*, the Identity Object sends a *Reset* Service Request to the S-Device Supervisor.
Message Router	No effect
DeviceNet	Configures port attributes (node address, data rate, and BOI)
Connection Class	Contains the number of logical ports into or out of the device
Acknowledge Handler	Used to manage the reception of I/O message acknowledgements. (Not used or required in the GF40/GF80 Series).
Assembly	Defines input/output and configuration data format
S-Device Supervisor	Supports the Stop, Start, Reset, Abort, Recover and Perform_Diagnostic services for ALL Application Objects in the device and consolidates the Exception Conditions and Application Objects' Status. This object behaves differently from the Identity Object in that the S-Device Supervisor object provides a single point of access to the Application Objects only; it does not effect the DeviceNet specific objects (i.e., Identity, DeviceNet, Connection, etc.).
S-Gas Calibration	Modifies the correction algorithm of the S-Analog Sensor object which includes the selection mechanism to enable an S-Gas Calibration object instance.
S-Analog Sensor	Feeds the process variable to the Single Stage Controller object
S-Single Stage Controller	Feeds the control variable to the Analog Actuator object
S-Analog Actuator	Operates the Flow Control Valve of the device

2 Identity Object (Class 0x01)

The Identity Object provides general information about the identity of a device. This object is summarized in the following tables.

2.1 Instance Attributes

Attribute ID	Need in implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute
1	Required	Get	Vendor ID	UINT	ODVA Assigned Vendor Number = 41 (0x29)
2	Required	Get	Device Type	UINT	ODVA Assigned Device Number = 26 (0x1A)
3	Required	Get	Product Code	UINT	Brooks Assigned Product Number = 726
4	Required	Get	Revision	STRUCT of:	Product Revision
			Major Rev	USINT	(byte)
			Minor Rev	USINT	(byte)
5	Required	Get	Status	WORD	DeviceNet Status
6	Required	Get	Serial Number	UDINT	DeviceNet Device Serial Number
7	Required	Get	Product Name	SHORT STRING	“GF40” or “GF80” (1-32 characters)

2.2 Common Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
$0E_{hex}$ 14_{dec}	Conditional	Required	Get_Attributes_Single	Returns the contents of the specified attribute.
05_{hex} 05_{dec}	n/a	Required	Reset	Resets the device to the **Self-Testing** state.

RESET Request Service Data Field Parameters

Parameter	Required	Data Type	Description	Semantics of Values
Type	Required	USINT	Type of Reset	0 = Power Cycle type [default if parameter omitted] 1 = Out-of-Box type

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3 DeviceNet Object (Class 0x03)

The DeviceNet Object maintains configuration and status of physical attachments to DeviceNet. It also allocates and releases connection instances associated with the Predefined Master/Slave Connection Set.

3.1 Instance Attributes

Attribute ID	Need in implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute
1	Required	Set	MAC ID	USINT (byte)	Values 0-63 or "P" (Programmable Mac Id) See Semantics
2	Required	Set	Baud Rate	USINT (byte)	Values 0,1,2 or "P" See Semantics
3	Required	Set	BOI	USINT (byte)	Bus Off Interrupt
4	Required	Set	Bus-off Counter	USINT (byte)	Number of times CAN chip went to bus off state
5	Required	Get	Allocation Information	USINT (byte)	Indicates whether or not the Predefined Master/Slave Connection Set has been allocated
6	Conditional (supported)	Get	MAC ID switch changed (note 1)	BOOL	Indicates the Node ID switches have changed since last power-up or reset. 0=no change, 1=change
7	Conditional (supported)	Get	Baud Rate switch changed (note 1)	BOOL	Indicates the baud rate switch has changed since last power-up or reset. 0=no change, 1=change
8	Conditional (supported)	Get	MAC ID switch value	USINT (byte)	Actual value of the Node address switches, (0-99)
9	Conditional (supported)	Get	Baud rate switch value	USINT (byte)	Actual value of the baud rate switch, (0-9)

Note

1. When either one of these two attributes are true (=1), then the module LED will flash red to indicate the status. See section 3.4, Module LED, for more information.

3.2 Common Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
$0E_{hex}$ 14_{dec}	Conditional	Required	Get_Attributes_Single	Returns the contents of the specified attribute.
10_{hex} 16_{dec}	n/a	Required	Set_Attributes_Single	Sets the attribute to the specified value
$4B_{hex}$ 75_{dec}	n/a	Required	Allocate_Master/Slave _Connection_Set	This is the Service utilized to perform the allocation of the Predefined Master/Slave Connection Set.
$4C_{hex}$ 76_{dec}	n/a	Required	Release_Master/Slave _Connection_Set	This service is used to deallocate the Predefined Master/Slave Connection Set within a Slave

3.3 Semantics

The MAC ID and Baud Rate are switch selectable. Baud Rate will be 125K, 250K, or 500K baud if the switch is set to 1,2,5 respectively. The MAC ID switch sets the unit's DeviceNet address to 0-63, according to the switch settings. Both switches may be placed in the "P" position, which selects "programmable" MAC ID or Baud Rate. If the switch is placed in the "P" position, the MAC ID or Baud Rate will assume the last valid value.
MAC ID and Baud Rate attributes are software settable ONLY when the switches are in the "P" position. Behavior related to the MAC ID and the Baud Rate attributes conforms to the requirements defined in the Open DeviceNet Vendor Association Semiconductor Special Interest Group (SIG) Interface Guidelines Conformance Test Procedure (Section 5.6).

3.4 Module Status LED

The module status LED indicates the status of the MFC Module.

Module Status	LED State	Description
Power Off	Off	No Power applied to device
Device Self-test	Flashing Green-Red	Device is in Self-test. The Module LED will flash Green for 250mSec, followed by RED for 250mSec. If the device passes the self-test, LED will stay Green
Device Operational	**Green**	**Device is operating normally.**
Recoverable Fault	Flashing Red	The Node (MAC ID) address or baud rate switches have changed since the last power-up/reset.
Unrecoverable Fault	**Red**	**Device has detected an unrecoverable fault.**

3.5 Net Status LED

The Network status LED indicates the status of the MFC DeviceNet Connection.

Network Status	LED State	Description
Power Off	Off	No Power applied or device is the only node on the network.
On-line Not Connected	Flashing Green	Device is Operating normally. It is on-line, but no connections have been established to the Device.
Device Operational	**Green**	**Device is operating normally.**
Connection Timeout	Flashing Red	One or more connections have timed out.
Unrecoverable Fault	**Red**	**Device cannot communicate on the network. Duplicate MacId or Bus-off condition**

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4 Assembly Object (Class 0x04)

The Assembly Object groups attributes of multiple objects into a single block of data, which can be produced and consumed over an I/O connection. Various combinations of S-Device Supervisor Attributes are grouped together to form the assemblies supported by GF40/GF80. Both the MFC and EMFC device profiles do NOT allow “mixed” integer and real assemblies to be allowed at the same time. That is, it is not allowed to produce an integer assemble and consume a floating-point assembly over a polled connection. See the EMFC Device Profile in the ODVA DeviceNet specification for more detail.

4.1 Instance Attributes

Number	Required	Supported	Type	# bytes	Name
1	N	Y	Input	2	Flow
2	Y (default)	Y	Input	3	Status and Flow
3	N	Y	Input	5	Status, Flow and Valve
4	N	Y	Input	5	Status, Flow, and Setpoint
5	N	Y	Input	7	Status, Flow, Setpoint and Valve
6	Y	Y	Input	8	Status, Flow, Setpoint, Override and Valve
7	Y (default)	Y	Output	2	Setpoint
8	Y	Y	Output	3	Override and Setpoint
9	N	Y	Input	1	Status
10	N	Y	Input	8	Exception Detail Alarm
11	N	Y	Input	8	Exception Detail Warning
12	N	Y	Input	15	Exception Detail Alarm and Exception Detail Warning
13	N	Y	Input	4	FP Flow
14	Y	Y	Input	5	Status, FP Flow
15	N	Y	Input	9	Status, FP Flow and FP Valve
16	N	Y	Input	9	Status, FP Flow, and FP Setpoint
17	N	Y	Input	13	Status, FP Flow, FP Setpoint and FP Valve
18	Y	Y	Input	14	Status, FP Flow, FP Setpoint, Override and FP Valve
19	Y	Y	Output	4	FP Setpoint
20	Y	Y	Output	5	Override and FP Setpoint

The number of bytes indicates how many data bytes are produced or consumed for each assembly. The “FP” abbreviation is for Floating Point, or real data. Each real data value will consist of 4 bytes of IEEE 754 single precision data.

4.2 Common Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
$0E_{hex}$ 14_{dec}	Conditional	Required	Get_Attributes_Single	Returns the contents of the specified attribute.

4.3 Object Instances

Producing Object Instances must be one of the following: 1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, or 18. These instances send data to the master. Consuming Object Instances must be one of the following: 7, 8, 19, or 20. These instances receive data from the master. As mentioned before, both the Produced and Consumed Paths must reference either integer OR real assemblies. The following section details each assembly and its data type. The “FP” designation will indicate a real, floating point value. Otherwise, the data will be an integer or, in the case of the “status” byte, a bit-mapped value.

4.4 I/O Assembly Object Instance Data Attribute Format

The manufacturer of a Mass Flow Controller Device must specify which Assembly instances are supported by the device. GF40/GF80 supports the following assemblies.

The I/O Assembly DATA attribute has the format shown below.

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0	Flow (low byte)							
	1	Flow (high byte)							
2	0	Status							
	1	Flow (low byte)							
	2	Flow (high byte)							
3	0	Status							
	1	Flow (low byte)							
	2	Flow (high byte)							
	3	Valve (low byte)							
	4	Valve (high byte)							
4	0	Status							
	1	Flow (low byte)							
	2	Flow (high byte)							
	3	Setpoint (low byte)							
	4	Setpoint (high byte)							
5	0	Status							
	1	Flow (low byte)							
	2	Flow (high byte)							
	3	Setpoint (low byte)							
	4	Setpoint (high byte)							
	5	Valve (low byte)							
	6	Valve (high byte)							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
6	0	Status							
	1	Flow (low byte)							
	2	Flow (high byte)							
	3	Setpoint (low byte)							
	4	Setpoint (high byte)							
	5	Override							
	6	Valve (low byte)							
	7	Valve (high byte)							
7	0	Setpoint (low byte)							
	1	Setpoint (high byte)							
8	0	Override							
	1	Setpoint (low byte)							
	2	Setpoint (high byte)							
9	0	Status							
10	0	Status							
	1	Exception Detail Alarm 0 (size, common)							
	2	Exception Detail Alarm 1 (common 0)							
	3	Exception Detail Alarm 2 (common 1)							
	4	Exception Detail Alarm 3 (size, device)							
	5	Exception Detail Alarm 4 (device 0)							
	6	Exception Detail Alarm 5 (size, manufacturer)							
	7	Exception Detail Alarm 6 (manufacturer, 0)							
11	0	Status							
	1	Exception Detail Warning 0 (size, common)							
	2	Exception Detail Warning 1 (common 0)							
	3	Exception Detail Warning 2 (common 1)							
	4	Exception Detail Warning 3 (size, device)							
	5	Exception Detail Warning 4 (device 0)							
	6	Exception Detail Warning 5 (size, manufacturer)							
	7	Exception Detail Warning 6 (manufacturer, 0)							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
12	0	Status							
	1	Exception Detail Alarm 0 (size, common)							
	2	Exception Detail Alarm 1 (common 0)							
	3	Exception Detail Alarm 2 (common 1)							
	4	Exception Detail Alarm 3 (size, device)							
	5	Exception Detail Alarm 4 (device 0)							
	6	Exception Detail Alarm 5 (size, manufacturer)							
	7	Exception Detail Alarm 6 (manufacturer, 0)							
	8	Exception Detail Warning 0 (size, common)							
	9	Exception Detail Warning 1 (common 0)							
	10	Exception Detail Warning 2 (common 1)							
	11	Exception Detail Warning 3 (size, device)							
	12	Exception Detail Warning 4 (device 0)							
	13	Exception Detail Warning 5 (size, manufacturer)							
	14	Exception Detail Warning 6 (manufacturer, 0)							
13	0	FP Flow (low byte)							
	1	FP Flow							
	2	FP Flow							
	3	FP Flow (high byte)							
14	0	Status							
	1	FP Flow (low byte)							
	2	FP Flow							
	3	FP Flow							
	4	FP Flow (high byte)							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
15	0	Status							
	1	FP Flow (low byte)							
	2	FP Flow							
	3	FP Flow							
	4	FP Flow (high byte)							
	5	FP Valve (low byte)							
	6	FP Valve							
	7	FP Valve							
	8	FP Valve (high byte)							
16	0	Status							
	1	FP Flow (low byte)							
	2	FP Flow							
	3	FP Flow							
	4	Flow (high byte)							
	5	FP Setpoint (low byte)							
	6	FP Setpoint							
	7	FP Setpoint							
	8	FP Setpoint (high byte)							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
17	0	Status							
	1	FP Flow (low byte)							
	2	FP Flow							
	3	FP Flow							
	4	FP Flow (high byte)							
	5	FP Setpoint (low byte)							
	6	FP Setpoint							
	7	FP Setpoint							
	8	FP Setpoint (high byte)							
	9	FP Valve (low byte)							
	10	FP Valve							
	11	FP Valve							
	12	FP Valve (high byte)							
18	0	Status							
	1	FP Flow (low byte)							
	2	FP Flow							
	3	FP Flow							
	4	FP Flow (high byte)							
	5	FP Setpoint (low byte)							
	6	FP Setpoint							
	7	FP Setpoint							
	8	FP Setpoint (high byte)							
	9	Override							
	10	FP Valve (low byte)							
	11	FP Valve							
	12	FP Valve							
	13	FP Valve (high byte)							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
19	0	FP Setpoint (low byte)							
	1	FP Setpoint							
	2	FP Setpoint							
	3	FP Setpoint (high byte)							
20	0	Override							
	1	FP Setpoint (low byte)							
	2	FP Setpoint							
	3	FP Setpoint							
	4	FP Setpoint (high byte)							

5 Connection Object (Class 0x05)

The Connection Class allocates and manages internal resources associated with both I/O and Explicit Messaging connections. The Explicit and I/O Connection Objects manage the communication aspects associated with a particular application to application network relationships. The GF40/GF80 supports both the Explicit and Polled or I/O Connections.

5.1 Instance Attributes (Explicit Connection, Instance 1

Attribute ID	Need in implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute
1	Required	Get	State	USINT (byte)	State of the object
2	Required	Get	Instance Type	USINT (byte)	Indicates either I/O or Messaging Connection
3	Required	Get	Transport Class Trigger	Byte	Defines behavior of the Connection
4	Required	Get	Produced Connection ID	UINT	Placed in CAN Identifier Field when connection transmits
5	Required	Get	Consumed Connection ID	UINT	CAN Identifier Field value that denotes message to be received
6	Required	Get	Initial Comm. Characteristics	Byte	Defines the Message Group(s) across which productions and consumptions associated with this Connection occur
7	Required	Get	Produced Connection Size	UINT	Maximum number of bytes transmitted across this connection
8	Required	Get	Consumed Connection Size	UINT	Maximum number of bytes transmitted across this connection
9	Required	Set	Expected Packet Rate	UINT	Defines timing associated with this Connection
12	Required	Set	Watchdog time-out Action	USINT (byte)	Defines how to handle Inactivity/Watchdog timeouts
13	Required	Get	Produced Path Length	UINT	Number of bytes in the produced_connection_path length
14	Required	Get	Produced Connection Path	Array of USINT	Specifies the Application Object(s) whose data is to be produced by this Connection Obj.
15	Required	Get	Consumed Path Length	UINT	Number of bytes in the consumed_connection_path attr.
16	Required	Get	Consumed Connection Path	Array of USINT	Specifies the Application Objs that are to receive data consumed by this Connection Obj.
17	Conditional (supported)	Get	Production Inhibit time	UINT	Defines minimum time between new data production. This attribute is required for I/O Client Connections. (default = 0)

5.2 Instance Attributes (Polled Connection, Instance 2)

Attribute ID	Need in implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute
1	Required	Get	State	USINT (byte)	State of the object
2	Required	Get	Instance Type	USINT (byte)	Indicates either I/O or Messaging Connection
3	Required	Get	Transport Class Trigger	Byte	Defines behavior of the Connection, (server, class 2)
4	Required	Get	Produced Connection ID	UINT	Placed in CAN Identifier Field when connection transmits
5	Required	Get	Consumed Connection ID	UINT	CAN Identifier Field value that denotes message to be received
6	Required	Get	Initial Comm. Characteristics	Byte	Defines the Message Group(s) across which productions and consumptions associated with this Connection occur
7	Required	Get	Produced Connection Size	UINT	Maximum number of bytes transmitted across this connection
8	Required	Get	Consumed Connection Size	UINT	Maximum number of bytes transmitted across this connection
9	Required	Set	Expected Packet Rate	UINT	Defines timing associated with this Connection
12	Required	Get	Watchdog time-out Action	USINT (byte)	Defines how to handle Inactivity/Watchdog timeouts
13	Required	Get	Produced Path Length	UINT	Number of bytes in the produced_connection_path length
14	Required	Set (*)	Produced Connection Path	Array of USINT	Specifies the Application Object(s) whose data is to be produced by this Connection Obj.
15	Required	Get	Consumed Path Length	UINT	Number of bytes in the consumed_connection_path attr.
16	Required	Set(*)	Consumed Connection Path	Array of USINT	Specifies the Application Objs that are to receive data consumed by this Connection Obj.
17	Conditional (supported)	Get	Production Inhibit time	UINT	Defines minimum time between new data production. This attribute is required for I/O Client Connections. (default = 0)

(*) Note:

Produced and Consumed Connection Path attributes are settable ONLY when the I/O connection is in the "Configuring" State. These attributes must reference consistent data types at the time the I/O connection transitions to the Established State. See MFC Device Profile, Version J for more information regarding consistent data types.

5.3 Common Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
$0E_{hex}$ 14_{dec}	Conditional	Required	Get_Attributes_Single	Returns the contents of the specified attribute.
10_{hex} 16_{dec}	n/a	Required	Set_Attributes_Single	Sets the attribute to the specified value
05_{hex} 05_{dec}	n/a	Optional (supported)	Reset	Dependent on watchdog timeout action.

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6 Device Supervisor Object (Class 0X30)

This object models the interface, functions and behavior associated with the management of application objects for devices within the “*Hierarchy of Semiconductor Equipment Devices*”. Throughout this DeviceNet Standard, objects belonging to this hierarchy are identified as such by a naming convention that includes a prefix of “S-” in the object class name. This “*Hierarchy of Semiconductor Equipment Devices*” is completely defined in this object definition such that all objects belonging to this hierarchy require the existence of an S-Device Supervisor object to manage its functions and behaviors.

The S-Device Supervisor object centralizes application object state definitions and related status information, exception status indications (alarms and warnings), and defines a behavior model which is assumed by objects identified as belonging to the *Hierarchy of Semiconductor Equipment Devices*. If a reset is requested of the S-Device Supervisor object instance, it will reset this object instance as well as all of its associated application objects.

Similarly, the Identity object provides an interface to the S-Device Supervisor object. A reset request to the Identity object (of any type) causes a reset request to the S-Device Supervisor object. Further relationships are specified in the Behavior section below.

Additionally, some device attributes are defined which are required in order to specify device models such that they are compliant with the SEMI S/A Network Standard *, from which the *Hierarchy of Semiconductor Equipment Devices* is derived. Objects defined to exist within the *Hierarchy of Semiconductor Equipment Devices* are done so in order to simplify the management and description of object behavior while insuring compliance with the SEMI Standard.

NOTE: By association with this object, the Start, Stop, Reset, Abort, Recover and Perform_Diagnostic Services are inherently supported by all objects within the *Hierarchy of Semiconductor Equipment Devices*. These services are not accessible over the network for the associated object instances.

* Semiconductor Equipment and Materials International, Mountain View CA, Standard E54: *Sensor/Actuator Network Common Device Model.*

6.1 S-Device Supervisor Class Attributes

The Object Class Attribute ID 1-7 are reserved. See DeviceNet Volume II, Section 5-4.1. for more specification detail on these attributes.

Attribute ID	Need in implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute
1 thru 7	These class attributes are either optional or conditional and are described in chapter 5 of this specification.				
97 & 98	Reserved by DeviceNet				
99	Conditional* (Not Supported)	Get	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.

* If the value of Subclass is 00 which identifies “no subclass”, then this attribute is OPTIONAL in implementation, otherwise, this attribute is REQUIRED.

6.2 S-Device Supervisor Instance Attribute

DeviceNet reserves Attribute ID 100-199 (64_{hex}-$C7_{hex}$) for Vendor Defined Attributes. See Volume II, Section 7 for more information on Object Definitions.

Note: All required attributes are supported. Optional attributes are indicated as (Supported) or (Not Supported).

Attr ID	Need in implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute
1	Optional (Supported)	Get	NV	Number of Attributes	USINT (byte)	Number of Attributes supported by the object instance
2	Optional (Supported)	Get	NV	Attribute List	Array of USINT (bytes)	List of attributes supported by the object instance
3	Required	Get	NV	Device Type	SHORT STRING	ASCII Text, Max. 8 Characters, see “Semantics” section
4	Required	Get	NV	SEMI Standard Revision Level	SHORT STRING	Specifies the revision level of the SEMI S/A Network Standard to which the device complies. For this revision, this attribute must be: “E54-0997”
5	Required	Get	NV	Manufacturer’s Name	SHORT STRING	ASCII Text, Max. 20 Characters, see “Semantics” section
6	Required	Get	NV	Manufacturer’s Model Number	SHORT STRING	ASCII Text, Max. 20 Characters, Manufacturer Specified
7	Required	Get	NV	Software Revision Level	SHORT STRING	ASCII Text, Max. 6 Characters, see “Semantics” section
8	Required	Get	NV	Hardware Revision Level	SHORT STRING	ASCII Text, Max. 6 Characters, see “Semantics” section
9	Optional (Supported)	Get	NV	Manufacturer’s Serial Number	SHORT STRING	ASCII Text, Max. 30 Characters, Manufacturer Specified, see “Semantics” section
10	Optional (Supported)	Get	NV	Device Configuration	SHORT STRING	ASCII Text, Max. 50 Characters, Manufacturer Specified. Optional additional information about the device configuration.
11	Required	Get	V	Device Status	USINT (byte)	See “Semantics” section
12	Required	Get	V	Exception Status	BYTE	See “Semantics” section

* NV = Nonvolatile; attribute value is maintained through power cycles; V = Volatile.

Attr ID	Need in implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute
13	Conditional based on Exception Status Bit 7 (Supported)	Get	V	**Exception Detail Alarm**	STRUCT of:	A Structure of three Structures containing a bit mapped representation of the alarm detail
				Common Exception Detail	STRUCT of:	
				Size	USINT (byte)	Number of Common Detail Bytes (size = 2)
				Detail	ARRAY of:	See “Semantics” section
				Detail n	BYTE	See “Semantics” section
				Device Exception Detail	STRUCT of:	
				Size	USINT (byte)	Number of Device Detail Bytes (size = 1)
				Detail	ARRAY of:	See Device Profile
				Detail n	BYTE	See Device Profile
				Manufacturer Exception Detail	STRUCT of:	
				Size	USINT (byte)	Number of Manufacturer Detail Bytes (size = 1)
				Detail n	BYTE	Manufacturer Specified

* NV = Nonvolatile; attribute value is maintained through power cycles; V = Volatile.

Note:
The GF40/GF80 Series Device Profile specifies two bytes of Common Detail, two bytesof Device Exception Detail, and one byte of Manufacturer Specified Detail. See Semantics for more information.

Attr ID	Need in implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute
14	Conditional based on Exception Status Bit 7 (Supported)	Get	V	**Exception Detail Warning**	STRUCT of:	A Structure of three Structures containing a bit mapped representation of the warning detail
				Common Exception Detail	STRUCT of:	
				Size	USINT (byte)	Number of Common Detail Bytes (size = 2)
				Detail	ARRAY of:	See “Semantics” section
				Detail n	BYTE	See “Semantics” section
				Device Exception Detail	STRUCT of:	
				Size	USINT (byte)	Number of Device Detail Bytes (size = 1)
				Detail	ARRAY of:	See Device Profile
				Detail n	BYTE	See Device Profile
				Manufacturer Exception Detail	STRUCT of:	
				Size	USINT (byte)	Number of Manufacturer Detail Bytes (size = 1)
				Detail n	BYTE	Manufacturer Specified

* NV = Nonvolatile; attribute value is maintained through power cycles; V = Volatile.

Note:
The GF40/GF80 Series Device Profile specifies two bytes of Common Detail, two bytes of Device Exception Detail, and one byte of Manufacturer Specified Detail. See Semantics for more information.

Attr ID	Need in implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute
15	Required	Set	NV	Alarm Enable	BOOL	See “Semantics” section
16	Required	Set	NV	Warning Enable	BOOL	See “Semantics” section
17	Optional (Not Supported)	Set	**	Time	DATE_AND_TIME	The value of the device’s internal real-time clock. See “Semantics” section
18	Optional (Not Supported)	Get	NV	** Clock Behavior	USINT (byte)	0 = [default] clock always resets during power cycle 1 = clock value is stored in non-volatile memory at power down 2 = clock is battery-backed and runs without device power. 3-255 - not defined
19	Optional (Not Supported)	Get	NV	Last Maintenance Date	DATE	The date on which the device was last serviced.
20	Optional (Not Supported)	Get	NV	Next Scheduled Maintenance Date	DATE	The date on which it is recommended that the device next be serviced.
21	Optional (Not Supported)	Get	NV	Scheduled Maintenance Expiration Timer	INT	See “Semantics” section
22	Conditional – Required if Calibration Expiration is supported (Not Supported)	Set	NV	Scheduled Maintenance Expiration Warning Enable	BOOL	See “Semantics” section
23	Optional (Not Supported)	Get	NV	Run Hours	UDINT	An indication of the number of hours that the device has had power applied. It has a resolution of 1 hour. This value shall be maintained in nonvolatile memory.

* NV = Nonvolatile; attribute value is maintained through power cycles; V = Volatile.

** If the value of Subclass is 00 which identifies “no subclass”, then this attribute is OPTIONAL in implementation, otherwise, this attribute is REQUIRED.

Attr ID	Need in implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute
97-98	Reserved by DeviceNet					
99	Conditional ** (Not Supported)	Get	NV	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.

* NV = Nonvolatile; attribute value is maintained through power cycles; V = Volatile.

** If the value of Subclass is 00 which identifies "no subclass", then this attribute is OPTIONAL in implementation, otherwise, this attribute is REQUIRED.

6.3 Semantics

Device Type

The Device Type attribute identifies the Specific Device Model to which the device is modeled within the *Hierarchy of Semiconductor Equipment Devices*. The value returned for this attribute is "MFC" or "MFM", depending upon the configuration of the device.

Manufacturer's Name

The Manufacturer's Name attribute identifies the manufacturer of the device. The value returned for this attribute is "Brooks Instrument".

The Device Manufacturer attribute is not guaranteed, by specification, to be unique. Therefore, it is not a substitute for the corresponding attribute of the Identity Object and should not be used for identification purposes.

Software Revision Level

This is an ASCII coded text string representing the revision of the software corresponding to the specific device identified by the Identity object and the S-Device Supervisor object.

Hardware Revision Level

This is an ASCII coded text string representing the revision of the hardware, which is identified by the Identity object and the S-Device Supervisor object.

Manufacturer's Serial Number

This attribute is a string representation of the serial number of the device. This is not the same as the Identity Object's serial number, which is used to uniquely identify the device in the network environment.

Device Status

This attribute represents the current state of the device. Its value changes as the state of the device changes. The following values are defined:

Attribute Value	State
0	Undefined
1	Self Testing
2	Idle
3	Self-Test Exception
4	Executing
5	Abort
6	Critical Fault
7-50	Reserved by DeviceNet
51-99	Device Specific (None Used)
100-255	Vendor Specific (None Used)

Exception Status

A single byte attribute whose value indicates that the status of the alarms and warnings for the device. This indication may be provided in one of two methods: Basic or Expanded. The GF40/GF80 Series Devices always report the Exception status in the Expanded Method
For the *Expanded Method*, bit seven of Exception Status attribute is set to one; exceptions are reported through the communication of this Exception Status attribute, formatted as specified in the table below. In addition, the Exception Detail attributes are supported. The Exception Status bits are determined by a logical "OR" of the related Exception Detail bits, as indicated.

	Exception Status Bit Map, Bit 7 set to 1
bit	*Function*
0	ALARM/device-common*
1	ALARM/device-specific
2	ALARM/manufacturer-specific
3	reserved -- set to 0
4	WARNING/device-common*
5	WARNING/device-specific
6	WARNING/manufacturer-specific
7	1 == Expanded Method

* The alarm or warning is not specific to the device type or device type manufacturer.

Exception Detail Alarm and Exception Detail Warning

The formats of these two attributes are identical. Therefore, they are described together here:

Attributes that relate the detailed status of the alarms or warnings associated with the device. Each attribute is a structure containing three members; these three members respectively relate the detailed status of exceptions that are common (i.e., not device-specific), device-specific but not manufacturer-specific, and manufacturer-specific. The common detail is defined below. The device-specific detail is defined in the appropriate Device Profile. The manufacturer defines the manufacturer-specific detail. A SIZE value of zero indicates that no detail is defined for the associated exception detail structure.

Each of the three structure members is defined as a structure containing an ordered list (i.e., array) of bytes of length SIZE, and an unsigned integer whose value is SIZE. Each of the bytes in each array has a specific mapping. This mapping is formatted as 8 bits, which represents 8 independent conditions. A value of 1 indicates that the condition is set (or present), and a value of 0 indicates that the condition is cleared (or not present). Note that if a device does not support an exception detail, the corresponding bit is never set. The bitmaps for alarms and warnings in the corresponding attributes are structured in parallel so that a condition may have either alarm or warning set depending on severity. If a condition inherently cannot be both alarm and warning, then the parallel bit position corresponding to the other state will remain "0."
The existence of an exception detail variable structure is dependent on the value of the Exception Status Attribute. The existence of an exception detail variable structure is only required if bit seven of the Exception Status attribute is set to 1, indicating the Expanded method reporting. Bits 0-6 of the Exception Status attribute correspond to the particular exception type.

Common Exception Detail

This structure relates exception conditions (i.e., alarms or warnings) which are common to all devices within the *Hierarchy of Semiconductor Equipment Devices*. The Detail element of the structure is an ordered list (i.e., array) of bytes of length [SIZE], which is the value of the structure element Size. For each byte in the Detail field, all bits not identified are reserved for future standardization.
The first byte in this attribute is CommonExceptionDetail[0]. Additional exception details, if provided, are named CommonExceptionDetail[1], . . . CommonExceptionDetail[SIZE]. The specific exception associated with each of the bitmaps is given in the table below. The SIZE for this revision is one, (1). The criteria details for each exception condition are outside the scope of this document. If a device does not support an exception detail, the corresponding bit is never set.

Common Exception Detail Attribute Values

Bit	*Common Exception Detail [0]*
0	internal diagnostic exception
1	Microprocessor exception
2	EPROM exception
3	EEPROM exception (**)
4	RAM exception
5	Reserved by DeviceNet
6	Internal real-time exception
7	Reserved by DeviceNet

** Exception Supported

bit	*Common Exception Detail [1]*
0	power supply overcurrent
1	reserved power supply
2	power supply output voltage (**)
3	power supply input voltage
4	scheduled maintenance due
5	notify manufacturer
6	reset exception
7	reserved by DeviceNet

** Exception Supported

Device Exception Detail
This structure, similar in form to Common Exception Detail, relates exception conditions, which are specific to individual devices on the network and are defined in their respective device profiles. The Detail element of the structure is an ordered list (i.e., array) of bytes of length [SIZE], which is the value of the structure element size. For a detailed description of this attribute, consult the appropriate specific device profile.

Manufacturer Exception Detail
This structure, similar in form to Common Exception Detail, relates exception conditions, which are specific to the manufacturers of individual devices on the network and are defined by them in their product documentation. The Detail element of the structure is an ordered list (i.e., array) of bytes of length [SIZE], which is the value of the structure element Size.

Exception Detail Format Summary

Data Component	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MFC Device Exception Detail Size	0	0	0	0	0	0	0	1
MFC Device Exception Detail Byte 0	Reserved 0	Reserved 0	Valve High S-Analog Actuator	Valve Low SAnalog Actuator	Flow Control S-Single Stage Controller	Flow High S-Analog Sensor	Flow Low S-Analog Sensor	Not Reading Valid* S-Analog Sensor
Manufacturer Exception Detail Size	0	0	0	0	0	0	0	1
Manufacturer Exception Detail	0	0	0	0	0	0	0	0

* Only used in the Warning Exception Detail, this bit is always = 0 in the Alarm Exception Detail

Valve High indicates that the Actuator current has exceeded the upper alarm or warning limit.

Valve Low condition never occurs, because low valve current is not an alarm or warning condition.

Flow Control indicates that the closed-loop control system is not able to control the flow within the desired specification. GF40/GF80 Series only supports the alarm condition.

Flow High indicates that the flow value reported by the S-Analog Sensor Object, Instance 1 has exceeded the upper alarm or warning limit.

Flow Low indicates that the flow value reported by the S-Analog Sensor Object, Instance 1 has fallen below the lower alarm or warning limit.

Alarm Enable and Warning Enable
These Boolean attributes are used to enable (1) or disable (0) the S-Device Supervisor object's process of setting Exception bits. When disabled, corresponding bits are never set; and, if they were set, disabling clears them. Also, alarm and warning states are not retained; when enabled, bits will be set only if the corresponding condition is true.
The default-state for these Enable attributes is enabled (1).

Time
This optional attribute represents the value of the time and date as maintained by the device's realtime clock with a resolution of one millisecond. The default value for the Time attribute is zero (0), corresponding to 12:00AM, January 1, 1972, as specified by DeviceNet Volume I, Appendix J.

Scheduled Maintenance Expiration Timer
This attribute, with a resolution of one hour, is used to cause a warning, which indicates that a device calibration is due. A S-Device Supervisor timer decrements this attribute once per hour while power is applied. When the attribute is no longer positive and the Scheduled Maintenance Expiration Warning Enable attribute is set to enabled, a Scheduled Maintenance Expiration Warning condition is generated. This causes the Scheduled Maintenance Due Warning bit to be set.
The attribute will not wrap; when the attribute reaches its most negative value, it no longer decrements. The attribute will continue to decrement irrespective of the state of the Scheduled Maintenance Expiration Warning Enable attribute. The value shall be maintained in nonvolatile memory.

Scheduled Maintenance Expiration Warning Enable
This Boolean attribute is used to enable (1) or disable (0) the S-Device Supervisor object's process of setting the Scheduled Maintenance Due Exception bit. When disabled, the corresponding bit is never set; and, if it was set, disabling clears it. When enabled, the bit will be set only if the corresponding condition is true.
The default-state for this Enable attribute is enabled (1).

6.4 S-Device Supervisor Common Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
0Ehex 14dec	Conditional	Required	Get_Attributes_Single	Returns the contents of the specified attribute.
10hex 16dec	n/a	Required	Set_Attributes_Single	Modifies an attribute value.
5	n/a	Required	Reset	Resets the device to the **Self-Testing** state.
6	n/a	Required	Start	Starts the device execution by moving the device to the **Executing** state. Equivalent to SEMI S/A Network Execute Service
7	n/a	Optional Supported	Stop	Moves the device to the **Idle** state

See the DeviceNet Communication Model and Protocol for definitions of these common services.

6.5 S-Device Supervisor Common Object-Specific Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
4Bhex 75dec	n/a	Required	Abort	Moves the device to the **Abort** state
4Chex 76dec	n/a	Required	Recover	Moves the device out of the **Abort** state
4Ehex 78dec	n/a	Required	Perform_Diagnostics	Causes the device to perform a set of diagnostic routines

DS Object Service Parameter Dictionary

Parameter	*Form*	*Description*
TestID	USINT (byte)	Type and possibly detail of diagnostic test to be performed

Abort - Used to transition the device application objects to the aborted state. This service request may be (and generally will be) originated internally, from application objects.

Recover - Used to transition the device application objects from the abort state to the idle state. This service request may be originated internally, from application objects.

Perform_Diagnostics - Used to instruct the S-Device Supervisor object to perform a diagnostic test. A diagnostic test is either of type *common* or *device-dependent*. Common diagnostic tests include RAM, EPROM, non-volatile memory, and communications. Common diagnostic tests are implementation-specific. All detail of *device-dependent* diagnostics is outside the scope of this document.

TestID Parameter

The following values are defined for the TestID parameter for the Perform_Diagnostics Service Request:

Attribute Value	State
0	Standard
1-63	Reserved
64-127	Device Specific (defined in Device Profile)
128-255	Manufacturer Specific (defined by manufacturer)

Type “Standard” is specified if there is only one type of diagnostic defined or if there is more than one including a type standard. Additional diagnostic types may be defined in the device profile or by the manufacturer.

7 S-Analog Sensor Object (Class 0x31)

The S-Analog Sensor Object models the acquisition of a reading from a physical sensor in a device. Associated with an analog sensor is a reading that has been acquired and corrected with an offset and a gain coefficient, optionally, settable in the object. Additional correction algorithms may be specified by other objects identified in the device profile or as extensions specified by the manufacturer.

The GF40/GF80 Series supports two instances of the S-Analog Sensor Object. Instance 1 is associated with the flow sensor. Instance 3 is associated with the temperature sensor.

This object is a member of the *Hierarchy of Semiconductor Equipment Devices*. The S-Device Supervisor Object manages the behavior of the S-Analog Sensor Object. See Section 6 of this document.

7.1 S-Analog Sensor Class Attributes

The Object Class Attribute ID 1-7 are reserved. See DeviceNet Volume II, Section 5-4.1. for more specification detail on these attributes.

Attribute ID	Need in implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute
1 thru 7	These class attributes are either optional or conditional and are described in chapter 5 of this specification.				
97 & 98	Reserved by DeviceNet				
99	Conditional* (Not supported)	Get	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.

* If the value of Subclass is 00, which identifies "no subclass", then this attribute is OPTIONAL in implementation, otherwise, this attribute is REQUIRED.

7.2 S-Analog Sensor Instance Attributes

All required attributes must be supported as specified. All listed attributes are supported for all instances, unless otherwise noted.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
1	Optional (Supported)	Get	NV	Number of Attributes	USINT (byte)	Number of attributes supported	The number of attributes supported by this object instance
2	Optional (Supported)	Get	NV	Attribute List	ARRAY OF USINT (bytes)	List of attributes supported by this object instance	List of attributes supported by this object instance
3	Optional (Supported)	See Semantics Set[1]	NV	Data Type	USINT (byte)	Determines the Data Type of *Value* and all related attributes as specified in this table.	see Semantics section [default] = INT (0xC3) INT and Real supported
4	Optional (Supported)	See Semantics Set[1]	NV	Data Units	UINT	Determines the Units context of *Value* and all related attributes.	see Semantics section [default] = Counts (0x1001) Counts or SCCM supported
5	Required	Get	V	Reading Valid	BOOL	Indicates that the *Value* attribute contains a valid value.	0 = invalid 1 = valid (invalid: e.g., not warmed up yet)
6	Required	Get	V	Value (Dependent on instance – see Semantics section)	INT or specified by *Data Type* if supported	Analog input value	The corrected, converted, calibrated final value of the sensor. Default range is: **0-6000H (0 – 100%)** see Semantics section
7	Required	Get	V	Status	BYTE	Alarm / Warning State of this object instance	see Semantics section
8	Optional (Supported)	Set	NV	Alarm Enable	BOOL	Enables the setting of the Alarm Status Bits	0 = disable [default] 1 = enable

* NV = Nonvolatile; attribute value is maintained through power cycles; V = Volatile.

1 Data Type and Data Units are ONLY settable under certain conditions (see Semantics).

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
9	Optional (Supported)	Set	NV	Warning Enable	BOOL	Enables the setting of the Warning Status Bits	0 = disable [default] 1 = enable
10	Optional (Supported)	Get	NV	Full Scale	INT or specified by *Data Type* if supported	The *Value* of Full Scale for the sensor.	The value of attribute *Value* corresponding to the Full Scale calibrated measurement of the sensor. [default] = maximum allowable value for the *Data Type* see Semantics section
11	Optional (Supported)	Get	NV	Offset-A Data Type	USINT (byte)	Determines the Data Type of attribute *OffsetA*	see Semantics section [default] = INT
12	Optional (Supported)	Set	NV	Offset-A	INT or specified by *Offset-A Data Type* if supported	An amount added prior to *Gain* to derive *Value*	see Semantics section 0 = [default]
13	Required if Attribute “Gain” is other than REAL (Supported)	Get	NV	Gain Data Type	USINT (byte)	Determines the Data Type of attribute *Gain*	see Semantics section [default] = REAL
14	Optional (Supported)	Set	NV	Gain	REAL or specified by *Gain Data Type* if supported	An amount scaled to derive *Value*	see Semantics section 1.0 = [default]
15	Required if Attribute “Gain” is other than REAL (Not Supported)	Get	NV	Unity Gain Reference	REAL or specified by *Gain Data Type* if supported	Specifies the value of the *Gain* attribute equivalent to a gain of 1.0	Used for normalizing the *Gain* attribute. [default] = 1.0 e.g., for an UINT type Gain, a Unity Gain Reference may be 10000, allowing a gain of 0.0001 to 6.5535.
16	Optional (Not Supported)	Set	NV	Offset-B	INT or specified by *Data Type* if supported	An amount added to derive *Value*	see Semantics section 0 = [default]

* NV = Nonvolatile; attribute value is maintained through power cycles.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
17	Optional (Supported)	Set	NV	Alarm Trip Point High	INT or specified by *Data Type* if supported	Determines the Value above which an Alarm Condition will occur	see Semantics section [default] = Maximum value for its data type.
18	Optional (Supported)	Set	NV	Alarm Trip Point Low	INT or specified by *Data Type* if supported	Determines the Value below which an Alarm Condition will occur	see Semantics section [default] = Minimum value for its data type.
19	Optional (Supported)	Set	NV	Alarm Hysteresis	INT or specified by *Data Type* if supported	Determines the amount by which the *Value* must recover to clear an Alarm Condition	see Semantics section [default] = 0
20	Optional (Supported)	Set	NV	Alarm Settling Time	UINT	Determines the time that the *Value* must exceed the Trip Point before the exception condition is generated.	Time in milliseconds see Semantics section [default] = 0
21	Optional (Supported)	Set	NV	Warning Trip Point High	INT or specified by *Data Type* if supported	Determines the *Value* above which a Warning Condition will occur	see Semantics section [default] = Maximum value for its data type.
22	Optional (Supported)	Set	NV	Warning Trip Point Low	INT or specified by *Data Type* if supported	Determines the *Value* below which a Warning Condition will occur	see Semantics section [default] = Minimum value for its data type.
23	Optional (Supported)	Set	NV	Warning Hysteresis	INT or specified by *Data Type* if supported	Determines the amount by which the *Value* must recover to clear a Warning Condition	see Semantics section [default] = 0

* NV = Nonvolatile; attribute value is maintained through power cycles.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
24	Optional (Supported)	Set	NV	Warning Settling Time	UINT	Determines the time that the *Value* must exceed the Trip Point before the exception condition is generated.	Time in milliseconds see Semantics section [default] = 0
25	Optional (Not Supported)	Set	NV	Safe State	USINT (byte)	Specifies the behavior for the *Value* for states other than Execute	see Semantics section [default] = 0
26	Optional (Not Supported)	Set	NV	Safe Value	INT or specified by *Data Type* if supported	The Value to be used for Safe State = Safe Value	see Semantics section [default] = 0
27	Optional (Supported)	Set	NV	Autozero Enable	BOOL	Enables the Auto zero	see Semantics section 0 = disable [default] 1 = enable
28	Optional (Supported)	Get	V	Autozero Status	BOOL	Indicates the status of the automatic nulling	see Semantics section [default] = 0
29	Optional (Not Supported)	Set	NV	Autorange Enable	BOOL	Enables the automatic range switching	see Semantics section 0 = disable [default] 1 = enable
30	Optional (Not Supported)	Get	V	Range Multiplier	REAL	Indicates the current range multiplier	see Semantics section [default] = 1.0
31	Optional (Not Supported)	Set	NV	Averaging Time	UINT	Specifies the time over which analog samples are averaged.	Time in Milliseconds of a moving-window average. 0 = disable averaging [default] Values less than the sample rate of the device also disable averaging.

* NV = Nonvolatile; attribute value is maintained through power cycles; V = Volatile.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
32	Optional (Supported)	Get	NV	Overrange	INT or specified by *Data Type* if supported	Specifies the highest valid *Value*	The value above which attribute *Reading Valid* is set to invalid. [default] = maximum allowable value for the *Data Type*
33	Optional (Supported)	Get	NV	Underrange	INT or specified by *Data Type* if supported	Specifies the lowest valid *Value*	The value below which attribute *Reading Valid* is set to invalid. [default] = minimum allowable value for the *Data Type*
34	Optional (Not Supported)	Set	NV	Produce Trigger Delta	INT or specified by *Data Type* if supported	The amount by which *Value* must change before a Change of State Production is triggered	0 = Disabled [default] See Semantics section
35	Conditional[2] (Supported)	Set	NV	Gas Calibration Object Instance	UINT	Indicates which Gas Calibration object instance is active for this object	0 = Disabled [default] See Semantics section
97-98	Reserved by DeviceNet						
99	Conditional[3] (Supported)	Get	NV	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.	0 = No subclass n = subclass as defined herein Instance 1, subclass=1 see section 7.7 Instance 3 subclass=0
110	Optional (Not supported)	Get	NV	Full Scale	Struct: real, uint	Full scale amount (real) and data units (uint)	Default = 0, 0.

* NV = Nonvolatile; attribute value is maintained through power cycles; V = Volatile.

2 Attribute is settable; however, it should only be set while in the Idle state (see Semantics).

3 If the value of Subclass is 00, then this attribute is OPTIONAL in implementation, otherwise, this attribute is REQUIRED.

7.3 Semantics

Data Type
All Data Type attributes, including *Data Type*, *Offset-A Data Type* and *Gain Data Type*, use the enumerated values specified in DeviceNet Vol. I, Appendix C-6.1.

The *Data Type* attribute is settable only in the *Idle State* and only if no attribute belonging to the object instance is the endpoint of an I/O connection in the *Established State*.

The *Data Type* attribute may change automatically based upon established I/O connections. See Behavior section for more information on this mechanism.

Data Units
Specifies the context of *Value* and related attributes (such as, offset and trip points) for this object instance. See the following table for a list of valid values for each object instance. A request to set attribute to an unsupported value will return an error response.

The *Data Units* attribute is settable only in the *Idle State*.

Instance	Supported Data Units
1 - Flow	Counts (0x1001)
	Percent (0x1007)
	SCCM (0x1400)
	SLM (0x1401)
3 - Temperature	Counts (0x1001)
	Percent (0x1007)
	Degree Celsius (0x1200)
	Degree Fahrenheit (0x1201)
	Degree Kelvin (0x1202)
	Degree Rankine (0x1203)

Value, Offset (A and B) and Gain
An S-Analog Sensor object instance derives a reading from a physical analog sensor. The reading is converted to the data type and units specified for the *Value* attribute. The *Offset-A*, *Offset-B* and *Gain* attributes are applied to the sensor reading as specified by the following formula:

Value = *Gain* " (Sensor Reading + *Offset-A*) + *Offset-B*

Typically, the *Offset-A* or *Offset-B* attributes are modified by the Zero-Adjust service and the *Gain* attribute is modified by the Gain_Adjust services; particularly, when the device utilizes a non-linear conversion algorithm. However, support of these services is not required. See the Behavior section.

Value, flow, instance 1

The flow value is normalized based on the rated maximum flow for the device. When Data Units are set to Counts, the default range 0 to 0x6000 defines the 0 to 100% of rated flow.

Data Type values supported are Integer (0xC3) and Real (0xCA). Data Units supported are Counts (0x1001), SCCM (0x1400), and SLM (0x1401). Both Data Type and Data Units attributes are settable.The full-scale range for indicated flow is determined by the full-scale attribute (31H, 1,10).

Value, temperature, instance 3

The temperature instance is scaled so that the maximum reported count value of 0x6000 will equal 500 degrees Kelvin when Data Units are set to Counts or Percent.

Status

A bit mapped byte, which indicates the Alarm and Warning Exception status of the object instance. The following definition applies:

Bit	Definition
0	High Alarm Exception: 0 = cleared; 1 = set
1	Low Alarm Exception: 0 = cleared; 1 = set
2	High Warning Exception: 0 = cleared; 1 = set
3	Low Warning Exception: 0 = cleared; 1 = set
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Trip Points, Hysteresis and Settling Time

Trip Point High is the level above which the *Value* attribute will cause an Alarm or Warning exception condition.

Trip Point Low is the level below which the *Value* attribute will cause an Alarm or Warning exception condition.

A Hysteresis value specifies the amount by which the *Value* attribute must transition in order to clear an Alarm or Warning condition. For example: A Trip Point High value of 100 and a hysteresis value of 2 will result in an exception condition being set when the *Value* is above 100 and cleared when the Value drops below 98. Similarly, A Trip Point Low value of 100 and a hysteresis value of 2 will result in an exception condition being set when the *Value* is below 100 and cleared when the *Value* increases above 102.

The Settling Time determines the amount of time that the *Value* attribute must exceed the Trip Point before the exception condition is generated. The Settling Time also applies to the clearing of the condition.

Safe State

This attribute specifies what value will be held in *Value* for states other than Executing. See the S-Device Supervisor object definition in Section 6 for a description of object states. The purpose of this mechanism is to allow other devices, that may be using this Value, to transition to, or remain in, a safe state in the event of this device transitioning to a FAULT, IDLE, or ABORT state. The following values are defined:

Attribute Value	State
0	Zero
1	Full Scale
2	Hold Last Value
3	Use Safe Value
4-50	Reserved
51-99	Device Specific
100-255	Vendor Specific

Safe Value

For Safe State set to Use Safe Value, this attribute holds the value to which the *Value* attribute will be set for object instance states other than Executing.

Autozero Enable and Autozero Status

When the autozero is enabled, the device will automatically invoke a Zero_Adjust service request (no parameter) contingent upon a set of conditions specified by the manufacturer. These conditions may be determined by the value of an attribute (e.g., setpoint) or some other mechanism defined by the manufacturer. See Zero_Adjust service.

GF40/GF80 Series uses the Autozero Status attribute to convey the status of the Zero-Adjust Service operation. If the device receives an explicit message from the host to perform a Zero-Adjust Service, the GF40/GF80 Series will perform the service and set the Autozero Status to 1 for the duration of the service. After the Zero-Adjust service has completed, the Autozero Status will be set to zero. The MFC Device Profile appears to indicate that the Autozero Status attribute is only to be used for an internally triggered Zero-Adjust Service; however, the GF40/GF80 Series uses the Autozero Status to convey the status of the Zero-Adjust Service, no matter how the service was triggered.

Autorange Enable and Range Multiplier

When the autorange is enabled, the device will automatically switch full scale range based on a set of conditions specified by the manufacturer. The Range Multiplier indicates the range scale. An example of how Autorange may work is: when the *Value* is less than 9% with a *Range Multiplier* of 1.0, the *Range Multiplier* switches to 10.0 (the *Value* then reads 90% of the 10X range). When the *Value* then reaches 100% with a *Range Multiplier* of 10.0, the *Range Multiplier* returns to 1.0 (the *Value* then reads 10% of the 1X range).

Produce Trigger Delta

This attribute is used in conjunction with the "Change of State" production trigger type. Upon transition of the associated connection object instance (any Change of State connection pointing to the S-Analog Sensor object *Value* attribute) to the established state, a production is immediately triggered and this reported *Value* is stored internally for the determination of the next production trigger. When the *Value* changes by an amount of at least the *Produce Trigger Delta* (i.e., the *Value* as compared to the internally stored previously produced *Value*), a new production is triggered, and this reported *Value* becomes the new internally stored *Value* for the determination of the next production trigger.

Gas Calibration Object Instance

This attribute is used to select an instance of the S-Gas Calibration object. The selected S-Gas Calibration object instance provides the data with which an S-Analog Sensor object instance enacts the appropriate calibration algorithm for a given gas type.

A Set_Attribute_Single request, specifying a value not supported, will return an "invalid attribute value" error response. A list of acceptable values for this attribute is derived from a class level service request to the S-Gas Calibration object.

Conditionally Required: If a device profile specifies an S-Gas Calibration object relationship for an S-Analog Sensor object instance, then this attribute is required.

See the S-Gas Calibration object definition for more information.

Caution:
Care should be taken when changing the gas instance. The Thermal Mass Flow Device profile allows the user to change the gas instance at any time; however, the attribute should only be changed when the device is Idle. Unpredictable results may occur if the gas instance is changed while the Thermal Mass Flow Device is in the Execute State.

7.4 S-Analog Sensor Common Services

The S-Analog Sensor Object provides the following Common Services:

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
0Ehex 14dec	Conditional*	Required	Get_Attribute_Single	Returns the contents of the specified attribute.
10hex 16dec	n/a	Required	Set_Attribute_Single	Modifies an attribute value.

*The Get_Attribute_Single service is REQUIRED if any attributes are implemented.

See the DeviceNet Communication Model and Protocol for definitions of these common services.

7.5 S-Analog Sensor Object-Specific Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
4Bhex 75dec	n/a	Optional (Supported)	Zero_Adjust	Causes the device to modify attribute *Offset-A* and/or *Offset-B* such that attribute *Value* equals the Target Value sent with the request.
4Chex 76dec	n/a	Optional (Not Supported)	Gain_Adjust	Causes the device to modify attribute *Gain*, such that attribute *Value*, equals the Target Value sent with the request.

The Zero_Adjust and Gain_Adjust services are used to cause the S-Analog Sensor Object device to modify its *Offset-A* and/or *Offset-B* and *Gain* attribute values based upon manufacturer specific algorithms. The target value specified in the service request represents the actual parametric measurement that the physical sensor should be reporting at the time of the request.

There are no state transitions associated with the invocation of these services. It is, therefore, incumbent upon the user to establish the device into the desired configuration prior to, and during, the execution of these services. This will generally involve exposing the sensor to a known environment and treating the values read during execution of the services accordingly.

A success service response indicates that the service was accepted and the application process started.

7.5.1 Zero_Adjust Request Service Data Field Parameters

Parameter	Required	Data Type	Description	Semantics of Values
Target Value	Optional (Supported)	Specified by the value of attribute *Data Type*	The target value for the zero calibration	The value to which the *Value* attribute will be set. If not specified, the default value of zero is used.

7.5.2 Gain_Adjust Request Service Data Field Parameters

Parameter	Required	Data Type	Description	Semantics of Values
Target Value	Required	Specified by the value of attribute *Data Type*	The target value for the gain calibration	The value to which the *Value* attribute will be set.

Note: Support of the Zero Adjust Service - target Value must be zero. To invoke Zero Adjust, the user should put the MFC in a steady-state condition with zero flow, prior to sending the Service.

Example: Using the Zero Adjust Service

If Data Type is Integer:

ServiceCode=4BH, Class=31H, Instance=1, service data or Target Value = (00 00).

If Data Type is Real:

ServiceCode=4BH, Class=31H, Instance=1, service data or Target Value = (00 00 00 00).

7.6 Behavior

The S-Device Supervisor Object manages the behavior of the S-Analog Sensor Object. See section 6 of this document.

An S-Analog Sensor object instance acquires a reading from a physical sensor, as identified by the application of the object, and applies an algorithm to modify the reading into the appropriate *Data Type* and *Data Units*. Optionally, additional corrective algorithms are applied to further correct for various calibration effects. These additional algorithms are specified in other objects, as identified in the device profile, or as extensions, specified by the manufacturer.

All Full Scale, Trip Point, Overrange and Underrange calculations, as specified above, utilize the *Value* attribute.

Data Type

If the implementation of this object specifies more than one valid Data Type value, in the device profile or by vendor, then the following behavior with respect to Data Type applies: The *Data Type* value will be set automatically based upon the first valid I/O connection established by the device. This configuration will then remain in effect for this object instance, even after all I/O connections are lost. For devices that support only one Data Type, this behavior is not supported.

If no established I/O connections exist, which include an attribute from this object, then the Data Type attribute is settable provided that the object is in the *Idle State*.

The following example demonstrates this behavior:

A device profile specifies an instance of the S-Analog Sensor object as well as two static Assembly object instances, both with data attribute components mapped to this object instance. Assembly object instance ID 1 specifies INT data types and Assembly object instance ID 2 specifies REAL data types.

After the device is On-Line, it is configured with an I/O connection to Assembly instance ID 2. When the connection transitions to the *Established State*, this object instance attribute *Data Type* is automatically set with the value for REAL before any data is communicated to, or from, the object instance.

7.7 S-Analog Sensor Object Instance Subclass 01

The following specification applies to a subclass of this object for application in Mass Flow Controller devices.

7.7.1 Subclass 01 Instance Attributes

The following Instance Attributes are specified for this object subclass.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
95	Optional (Supported)	Get	NV	Flow Totalizer	ULINT	Total gas flowed through the device since this value was last set to zero	Units are Standard CCs see Behavior section default = 0
96	Optional (Not Supported)	Set	NV	Flow Hours	UDINT	Total time device has been powered and flowing gas since this value was last set to zero	Resolution is one hour see Behavior section default = 0

* NV = Nonvolatile; attribute value is maintained through power cycles.

7.7.2 Subclass 01 Services

There are no additions or restrictions to the Object Services for this object subclass.

7.7.3 Subclass 01 Behavior

Flow Totalizer and Flow Hours Process

The factory configured out-of-box values for the Flow Totalizer and Flow Hours attributes are both zero. The attributes are only modifiable with *set_attribute_single* service requests; they are not altered by the *Reset* service, including power-cycle, of either the Identity or the S-Device Supervisor objects.

The Flow Totalizer attribute is incremented, at a rate of once every cubic centimeter of gas flow, by the S-Analog Sensor object instance to reflect the amount of gas that has flowed through the device. Upon reaching its maximum value, the Flow Totalizer value is no longer incremented and remains at its maximum value.

The Flow Hours attribute is incremented, at a rate of once every hour, by the S-Analog Sensor object instance to reflect the amount of time that gas has flowed through the device. This condition is determined by the *Value* attribute being greater than 0.5% of full scale. Upon reaching its maximum value, the Flow Hours value is no longer incremented and remains at its maximum value.

8 S-Analog Actuator Object (Class 0x32)

The S-Analog Actuator Object models the interface to a physical actuator in a device. Associated with an analog actuator is a value, which is corrected with an offset and a gain coefficient, optionally settable in the object before it is output to the physical actuator. Manufacturers may specify additional correction algorithms as extensions to this object.

Additionally, the S-Analog Actuator Object provides two sets of trip-point definitions. The behavior associated with these trip points is described in sections below.

This object is a member of the *Hierarchy of Semiconductor Equipment Devices*. The S-Device Supervisor manages the behavior of the S-Analog Actuator Object. See Section 6 of this document.

8.1 S-Analog Actuator Class Attributes

The Object Class Attribute ID 1-7 are reserved. See DeviceNet Volume II, Section 5-4.1. for more specification detail on these attributes.

Attribute ID	Need in implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute
1 thru 7	These class attributes are either optional or conditional and are described in chapter 5 of this specification.				
97 & 98	Reserved by DeviceNet				
99	Conditional* (Supported)	Get	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.

* If the value of Subclass is 00, which identifies “no subclass”, then this attribute is OPTIONAL in implementation, otherwise, this attribute is REQUIRED.

8.2 S-Analog Actuator Instance Attributes

Certain minimal implementations may support any optional "Set" attributes as "Get" only and still be compliant with this object specification.
All required attributes must be supported as specified.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
1	Optional (Supported)	Get	NV	Number of Attributes	USINT (byte)	Number of supported attributes	The number of attributes supported by this object instance
2	Optional (Supported)	Get	NV	Attribute List	ARRAY OF USINT (byte)	List of supported attribute	List of attributes supported by this object instance
3	Optional (Supported)	See Semantics Set[1]	NV	Data Type	USINT (byte)	Determines the Data Type of *Value* and all related attributes as specified in this table.	See Semantics section [default] = INT INT or Real supported
4	Optional (Supported)	See Semantics Set[1]	NV	Data Units	UINT	Determines the context of *Value*	See Semantics section [default] = Counts Counts or Percent supported
5	Required	Set	V	Override	USINT (byte)	Specifies an override for the physical actuator. For values other than zero (normal control), the *Value* attribute is ignored.	0 = normal [default] see Semantics section
6	Required	Set	V	Value	INT or specified by *Data Type* if supported	Analog output value	The uncorrected value. see Semantics section [default] = 0
7	Required	Get	V	Status	BYTE	Alarm and Warning State of this object instance	See Semantics section [default] = 0
8	Optional (Supported)	Set	NV	Alarm Enable	BOOL	Enables the setting of the Alarm Bit	0 = disable [default] 1 = enable

*NV = Nonvolatile; value is maintained through power cycle; V = Volatile.

1 Data Type and Data Units Attribute are settable **ONLY** under certain conditions (see Semantics).

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
9	Optional (Supported)	Set	NV	Warning Enable	BOOL	Enables the setting of the Warning Bit	0 = disable [default] 1 = enable
10	Optional (Not Supported)	Set	NV	Offset	INT or specified by *Data Type* if supported	An amount to be added to *Value* prior to the application of gain	See Semantics section 0 = [default]
11	Optional (Not Supported)	Set	NV	Bias	INT or specified by *Data Type* if supported	An amount to be added to *Value* prior to the application of gain	See Semantics section 0 = [default]
12	Required if Attribute “Gain” is other than REAL (Not Supported)	Get	NV	Gain Data Type	USINT (byte)	Determines the Data Type of attribute *Gain*	See Semantics section [default] = REAL
13	Optional (Not Supported)	Set	NV	Gain	REAL or specified by *Gain Data Type* if supported	An amount by which *Value* is scaled prior to driving the physical actuator	See Semantics section 1.0 = [default]
14	Required if Attribute 12 is other than REAL (Not Supported)	Get	NV	Unity Gain Reference	REAL or specified by *Gain Data Type* if supported	Specifies the value of the *Gain* attribute equivalent to a gain of 1.0	Used for normalizing the *Gain* attribute. see Semantics section [default] = 1.0
15	Optional (Supported)	Set	NV	Alarm Trip Point High	INT or specified by *Data Type* if supported	Determines the Value above which an Alarm Condition will occur	See Semantics section [default] = Maximum value for its data type.
16	Optional (Supported)	Set	NV	Alarm Trip Point Low	INT or specified by *Data Type* if supported	Determines the Value below which an Alarm Condition will occur	See Semantics section [default] = Minimum value for its data type.
17	Optional (Supported)	Set	NV	Alarm Hysteresis	INT or specified by *Data Type* if supported	Determines the amount by which the Value must recover to clear an Alarm Condition	See Semantics section [default] = 0

*NV = Nonvolatile; value is maintained through power cycle; V = Volatile.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
18	Optional (Supported)	Set	NV	Warning Trip Point High	INT or specified by *Data Type* if supported	Determines the Value above which a Warning Condition will occur	See Semantics section [default] = Maximum value for its data type.
19	Optional (Supported)	Set	NV	Warning Trip Point Low	INT or specified by *Data Type* if supported	Determines the Value below which a Warning Condition will occur	See Semantics section [default] = Minimum value for its data type.
20	Optional (Supported)	Set	NV	Warning Hysteresis	INT or specified by *Data Type* if supported	Determines the amount by which the Value must recover to clear a Warning Condition	See Semantics section [default] = 0
21	Optional (Supported)	Set	NV	Safe State	USINT (byte)	Specifies the behavior of the physical actuator for states other than Execute	See Semantics section 0 = [default]
22	Optional (Supported)	Set	NV	Safe Value	INT or specified by *Data Type* if supported	The Value to be used for Safe State = Safe Value	See Semantics section 0 = [default]
97-98	Reserved by DeviceNet						
99	Conditional[2] (Supported)	Get	NV	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.	0 = No subclass n = subclass as defined herein

*NV = Nonvolatile; value is maintained through power cycle; V = Volatile.

2 If the value of Subclass is 00, then this attribute is **OPTIONAL** in implementation, otherwise, this attribute is **REQUIRED**.

8.3 Semantics

Data Type

All Data Type attributes, including *Data Type* and *Gain Data Type*, use the enumerated values specified in DeviceNet Vol. I, Appendix J-6.1.

The *Data Type* attribute is settable only in the *Idle State* and only if no attribute belonging to the object instance is the endpoint of an I/O connection in the *Established State*.

The *Data Type* attribute may change automatically based upon established I/O connections. See Behavior section for more information on this mechanism.

Data Units

Specifies the context of *Value* and related attributes (such as, offset and trip points) for this object instance. See Appendix K for a list of values. A request to set attribute to an unsupported value will return an error response.

The *Data Units* attribute is settable only in the *Idle State*.

Value, Offset, Gain, Bias and Unity Gain Reference

The *Offset, Gain* and *Bias* attributes are applied to the *Value* attribute to derive the actual signal, which drives the physical actuator. The gain is normalized using the *Unity Gain Reference* attribute value. (For example, for an UINT type *Gain*, a *Unity Gain Reference* value may be 10000, allowing an effective gain of 0.0001 to 6.5535.)

The following formula applies:

$$\text{physical actuator drive signal} = \boldsymbol{Gain_N} \cdot (\ \boldsymbol{Value} + \boldsymbol{Offset}\ ) + \boldsymbol{Bias}$$

$$\text{where: } \boldsymbol{Gain_N} = \boldsymbol{Gain} \,/\, \boldsymbol{Unity\ Gain\ Reference}$$

There may be additional nonlinear conversions applied to the drive signal as specified by the manufacturer.

Status

A bit mapped byte, which indicates the Alarm and Warning Exception status of the object instance. The following definition applies:

Bit	Definition
0	High Alarm Exception: 0 = cleared; 1 = set
1	Low Alarm Exception: 0 = cleared; 1 = set
2	High Warning Exception: 0 = cleared; 1 = set
3	Low Warning Exception: 0 = cleared; 1 = set
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Trip Points and Hysteresis

Trip Point High is the level above which the *Value* attribute will cause an Alarm or Warning exception condition.

Trip Point Low is the level below which the *Value* attribute will cause an Alarm or Warning exception condition.

A *Hysteresis* value specifies the amount by which the *Value* attribute must transition in order to clear an Alarm or Warning condition.

For example: A *Trip Point High* value of 90 and a *Hysteresis* value of 2 will result in an exception condition being set when the *Value* is above 90 and cleared when the *Value* drops below 88. Similarly, A *Trip Point Low* value of 90 and a *Hysteresis* value of 2 will result in an exception condition being set when the *Value* is below 90 and cleared when the *Value* increases above 92.

Override

This attribute is used to override the function of the *Value* attribute in driving the physical actuator. The primary application of this feature is in devices where the object instance is being driven by another object such as an S-Single Stage Controller object instance.

The *Safe State* attribute provides a mechanism for override depending upon object state and will take precedents over this. That is, if an object instance implements the *Safe State* attribute and related behavior, then this *Override* attribute and related behavior will only function in the Executing State.

Attribute Value	State
0	Normal (Supported)
1	Off / Closed (Supported)
2	On / Open (Supported)
3	Hold
4	Safe State
5-63	Reserved
64-127	Device Specific
128-255	Vendor Specific

Safe State

This attribute specifies the behavior of the drive to the physical actuator for states other than Executing. See the S-Device Supervisor object definition in Section 6-48 for a description of object states. The following values are defined:

Attribute Value	State
0	Zero / Off / Closed
1	Full Scale / On / Open
2	Hold Last Value
3	Use Safe Value
4-63	Reserved
64-127	Device Specific
128-255	Vendor Specific

The device supports the Safe State Attribute as a Get Only attribute that returns a value of zero or “closed”.

Safe Value

For *Safe State* set to “Use Safe Value”, this attribute holds the value to which the actuator will be driven for object instance states other than Executing. Specifically, this attribute value will become the value of the *Value* attribute. Therefore, the correction formula specified above applies.

8.4 S-Analog Common services

The S-Analog Actuator Object provides the following Common Services:

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
0Ehex 14dec	Conditional*	Required	Get_Attribute_Single	Returns the contents of the specified attribute.
10hex 16dec	n/a	Required	Set_Attribute_Single	Modifies an attribute value.

*The Get_Attribute_Single service is REQUIRED if any attributes are implemented.

See the DeviceNet Communication Model and Protocol for definitions of these common services.

8.5 S-Analog Actuator Object-Specific Services

The S-Analog Actuator Object provides no Object–Specific services.

8.6 S-Analog Actuator Behavior

The S-Device Supervisor Object manages the behavior of the S-Analog Actuator Object. See Section 6-48.5.

An S-Analog Actuator object instance modifies the *Value* by applying the formula specified above with the associated attribute values. *Value* is specified as *Data Type* and *Data Units*. Optionally, additional corrective algorithms are applied to further correct for various calibration effects. These additional algorithms are specified in other objects, as identified in the device profile, or as extensions, specified by the manufacturer.

All Trip Point calculations, as specified above, utilize the *Value* attribute before the application of *Offset* and *Gain*.

Data Type

If the implementation of this object specifies more than one valid Data Type value, in the device profile or by vendor, then the following behavior with respect to *Data Type* applies. The Data Type value will be set automatically based upon the first valid I/O connection established by the device. This configuration will then remain in effect for this object instance, even after all I/O connections are lost. For devices that support only one Data Type, this behavior is not supported.

If no established I/O connections exist, which include an attribute from this object, then the *Data Type* attribute is settable provided that the object is in the *Idle State*.

The following example demonstrates this behavior:

A device profile specifies an instance of the S-Analog Actuator object as well as two static Assembly object instances, both with data attribute components mapped to this object instance. Assembly object instance ID 1 specifies INT data types and Assembly object instance ID 2 specifies REAL data types.

After the device is On-Line, it is configured with an I/O connection to Assembly instance ID 2. When the connection transitions to the *Established State*, this object instance attribute *Data Type* is automatically set with the value for REAL before any data is communicated to, or from, the object instance.

GF40/GF80 Series Implementation

Data Type values supported are Integer (0xC3) and Real (0xCA). Data Units supported are Counts (0x1001) and Percent (0x1007). Data Type and Data Units attributes are settable. The supported combinations of Data Type and Data Units on the device are Integer-Counts (default), Real-Percent, Integer-Percent, and Real-Counts. The Real-Percent values range from 0.0 to 100.0, where the value represents percent of full-scale that the actuator is being driven. Integer-Percent value range is 0 to 100 integer. Integer-Counts value range is 0 to 0x7FFF. Typical count range is 0 to 24576, (0x6000).

9 S-Single Stage Controller Object (Class 0x33)

The S-Single Stage Controller Object models a closed-loop control system within a device. Associated with a single stage controller is a Process Variable, a Setpoint and a Control Variable. As normally described by *classic control theory*, a closed-loop controller will drive the Control Variable in order to affect the value of the Process Variable such that it is made to equal the Setpoint. See the Semantics section, below, for more information regarding these variable definitions. Manufacturers may specify additional correction algorithms as extensions to this object.

This object is a member of the *Hierarchy of Semiconductor Equipment Devices*. The S-Device Supervisor Object manages the behavior of the S-Single Stage Controller Object. See Section 6.

9.1 S-Single Stage Controller Object (Class 0x33)

The Object Class Attribute IDs 1-7 are reserved. See DeviceNet Volume II, Section 5-4.1 for more specification detail on these attributes.

Attribute ID	Need in implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute
1 thru 7	These class attributes are either optional or conditional and are described in chapter 5 of this specification.				
97 & 98	Reserved by DeviceNet				
99	Conditional* (Supported)	Get	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.

* If the value of Subclass is 00, which identifies “no subclass”, then this attribute is OPTIONAL in implementation, otherwise, this attribute is REQUIRED.

9.2 S-Single Stage Controller Instance Attributes

Certain minimal implementations may support any optional “Set” attributes as “Get” only and still be compliant with this object specification. All required attributes must be supported as specified.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
1	Optional (Supported)	Get	NV	Number of Attributes	USINT (byte)	Number of supported attributes	Number of attributes supported in this object instance
2	Optional (Supported)	Get	NV	Attribute List	ARRAY OF USINT (byte)	Attribute List	List of attributes supported in this object instance
3	Optional (Supported)	See Semantics Set[1]	NV	Data Type	USINT (byte)	Determines the Data Type of *Setpoint*, *Process Variable* and related attributes	See Semantics section [default] = INT INT and Real supported
4	Optional (Supported)	See Semantics Set[1]	NV	Data Units	UINT	Determines the context of the Process related variables such as Setpoint and Process Variable	See Appendix K [default] = Counts Counts and SCCM supported
5	Optional (Supported)	Set	NV	Control Mode	USINT (byte)	Specifies the operational mode of the controller	See Semantic section [default] = Normal (0)
6	Required	Set	V	Setpoint	INT or specified by *Data Type* if supported	The setpoint to which the process variable will be controlled	See Semantics section. See Behavior section. 0 = [default] Range is one of: **0-6000H (0 – 100%)** **0-7FFFH (0-100%)**

*NV = Nonvolatile; value is retained through power cycle; V = Volatile.

1 Data Type and Data Units Attribute are settable **ONLY** under certain conditions (see Semantics).

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
7	Conditional[2] (Not Supported – not applicable to device profile 0x27)	Set	V	Process Variable	INT or specified by *Data Type* if supported	The measured process parameter	The device profile must specify the data connection for this attribute. It may be internally linked to a sensor. See Semantics section. 0 = [default]
8	Optional (Not Supported)	Get	NV	CV Data Type	USINT (byte)	Determines the Data Type of *Control Variable*	See Semantics section [default] = INT
9	Conditional[2] (Not Supported)	Get	V	Control Variable	INT or specified by CV *Data Type* if supported	The drive signal output of this object. The algorithm by which this attribute is calculated is manufacturer specific.	The device profile must specify the data connection for this attribute. It may be internally linked to an actuator. [default] = 0 See Semantics section.
10	Required	Get	V	Status	BYTE	Alarm and Warning State of this object instance	See Semantics section [default] = 0
11	Optional (Supported)	Set	NV	Alarm Enable	BOOL	Enables the setting of the Alarm Status Bit	0 = disable [default] 1 = enable
12	Optional (Supported)	Set	NV	Warning Enable	BOOL	Enables the setting of the Warning Status Bit	0 = disable [default] 1 = enable
13	Optional (Supported)	Set	NV	Alarm Settling Time	UINT	Number of Milliseconds allowed for the control-loop to settle to within the error band	See Behavior section [default] = 0
14	Optional (Supported)	Set	NV	Alarm Error Band	INT or specified by *Data Type* if supported	The amount by which the *Setpoint* must equal the *Process Variable*	See Behavior section [default] = 0

*NV = Nonvolatile; value is retained through power cycle; V = Volatile.

2 The *Process Variable* is only optional if this device includes an internal sensor. Otherwise, the Process Variable is required. Similarly, the *Control Variable* is only optional if this device includes an internal actuator. Otherwise, the *Control Variable* is required.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
15	Optional (Supported)	Set	NV	Warning Settling Time	UINT	Number of Milliseconds allowed for the control-loop to settle to within the Error Band	See Behavior section [default] = 0
16	Optional (Supported)	Set	NV	Warning Error Band	INT or specified by *Data Type* if supported	The amount by which the *Setpoint* must equal the *Process Variable*	See Behavior section [default] = 0
17	Optional (Supported)	Set	NV	Safe State	USINT (byte)	Specifies the Control Variable behavior for states other than Execute	See Semantics section 0 = [default]
18	Optional (Supported)	Set	NV	Safe Value	INT or specified by *Data Type* if supported	The value to be used for Safe State = Safe Value	See Semantics section 0 = [default]
19	Optional (Supported)	Set	NV	Ramp Rate	UDINT (4-bytes)	Time in Milliseconds to reach Setpoint	0 = Disabled [default] x = value in milliseconds **Where: 0 < x < 7FFF** DeviceNet specifies 4 bytes of data, but only 2 are used. See Behavior section
97-98	Reserved by DeviceNet						
99	Conditional[3] (Supported)	Get	NV	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.	0 = No subclass n = subclass as defined herein

*NV = Nonvolatile; value is retained through power cycle.

3 If the value of Subclass is 00, then this attribute is OPTIONAL in implementation, otherwise, this attribute is REQUIRED.

9.3 Semantics

Data Type

All Data Type attributes, including *Data Type* and *CV Data Type*, use the enumerated values specified in DeviceNet Vol. I, Appendix J-6.1.

The *Data Type* attribute is settable only in the *Idle State* and only if no attribute belonging to the object instance is the endpoint of an I/O connection in the *Established State*.

The *Data Type* attribute may change automatically based upon established I/O connections. See Behavior section for more information on this mechanism.

Data Units

Specifies the context of *Setpoint and Process Variable* and related attributes (such as, offset and trip points) for this object instance. See Appendix K for a list of values. A request to set attribute to an unsupported value will return an error response.

The *Data Units* attribute is settable only in the *Idle State*.

In applications where this object is used in a relationship with an S-Analog Sensor object, this attribute may be specified as Get only, by the device profile or the vendor, where the value mirrors that of the S-Analog Sensor object *Data Units* attribute.

Setpoint, Process Variable and Control Variable

These three attributes compose the primary aspects of basic closed-loop control. The *Process Variable* is the measured parameter of the process or system being controlled. The *Setpoint* is the desired value for the measured parameter. By affecting the value of the *Control Variable*, the closed-loop controller drives the process or system to the desired state of:

Process Variable = Setpoint

The *Control Variable* is, therefore, connected to the process or system in such a way that it affects the value of the *Process Variable*. Examples of *Control Variable / Process Variable* combinations include: heater / temperature; valve / flow; or regulator / pressure.

Status

A bit mapped byte, which indicates the Alarm and Warning Exception status of the object instance. The following definition applies:

Bit	Definition
0	Alarm Exception: 0 = cleared; 1 = set
1	Warning Exception: 0 = cleared; 1 = set
2	Reserved
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Control Mode

This attribute is used to override the value of the *Control Variable* attribute. Further, it may cause the object to modify the internal control algorithm such that a smooth, or “bumpless” transitions occurs upon activating control to setpoint.

The *Safe State* attribute provides a mechanism for override depending upon object state and will take precedents over this. That is, if an object instance implements the *Safe State* attribute and related behavior, then this *Override* attribute and related behavior will only function in the Executing State.

Attribute Value	State
0	Normal
1	Zero / Off / Closed
2	Full / On / Open
3	Hold
4	Safe State
5-63	reserved
64-127	Device Specific (specified by device profile)
128-255	Vendor Specific

Safe State

This attribute specifies what value will be held in the *Control Variable* attribute for states other than Executing. See the S-Device Supervisor object definition in Section 6-48. for a description of object states. The following values are defined:

Attribute Value	State
0	Zero / Off
1	Full Scale / On
2	Hold Last Value
3	Use Safe Value
4-63	Reserved
64-127	Device Specific (specified by device profile)
128-255	Vendor Specific

Safe Value

For Safe State set to Use Safe Value, this attribute holds the value to which the Control Variable attribute will be set for object instance states other than Executing.

Ramp Rate

The ramp rate is limited to values 0 through 32,767. See the Behavior section.

9.4 S-Single Stage Controller Common Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
0Ehex 14dec	Conditional*	Required	Get_Attribute_Single	Returns the contents of the specified attribute.
10hex 16dec	n/a	Required	Set_Attribute_Single	Modifies an attribute value.

*The Get_Attribute_Single service is REQUIRED if any attributes are implemented.

See the DeviceNet Communication Model and Protocol for definitions of these common services.

9.5 S-Single Stage Controller Object-Specific Services

The S-Single Stage Controller Object provides no Object–Specific services.

9.6 Behavior

The S-Device Supervisor Object manages the behavior of the S-Single Stage Controller Object. See Section 6. Additionally, this object exhibits the following behavior:

Alarm and Warning Exception Conditions

While in the Executing State as defined by the S-Device Supervisor Object: Immediately upon detecting that the Setpoint does not equal the Process Variable by an amount plus-or-minus the associated (alarm or warning) Error Band, a timer is started.This internal timer is incremented as long as the above condition exists. If the timer exceeds the amount indicated by the associated (alarm or warning) Settling Time and the associated (alarm or warning) Exception Enable is set, then the appropriate (alarm or warning) Exception Condition is set. Note that two internal timers are required in order to support both Alarm and Warning Exception reporting.

This behavior is modified for Ramp Rate values not equal to zero. In such cases, the timer is not enabled until after the expiration of the Ramp Time (see Behavior description below).

Ramp Rate

For Ramp Rate values other than zero, the S-Single Stage Controller Object internally modifies the Setpoint value in such a way that the Process Variable is “ramped” to its final value. An example follows. A Ramp Rate of 1000 is set and a new Setpoint is sent to the MFC. The setpoint feed to the controller will be internally (transparently) modified, in whatever time increments the object is able to sustain, in order to affect a smooth transition over one second from the old Setpoint to the new Setpoint, finally reaching the new Setpoint at the one second mark.

Note: GF40/GF80 Series supports Ramp Rates from 1000ms to 32767ms. Rates greater than 7FFFh will return an error. Rates below 1000ms will be accepted; however, the ramping algorithm will not be invoked.

Data Type

If the implementation of this object specifies more than one valid Data Type value, in the device profile or by vendor, then the following behavior with respect to *Data Type* applies. The Data Type value will be set automatically based upon the first valid I/O connection established by the device. This configuration will then remain in effect for this object instance even, after all I/O connections are lost. For devices that support only one Data Type, this behavior is not supported.

If no established I/O connections exist, which include an attribute from this object, then the *Data Type* attribute is settable provided that the object is in the *Idle State*.

The following example demonstrates this behavior:

A device profile specifies an instance of the S-Single Stage Controller object as well as two static Assembly object instances, both with data attribute components mapped to this object instance. Assembly object instance ID 1 specifies INT data types and Assembly object instance ID 2 specifies REAL data types.

After the device is On-Line, it is configured with an I/O connection to Assembly instance ID 2. When the connection transitions to the *Established State*, this object instance attribute *Data Type* is automatically set with the value for REAL before any data is communicated to, or from, the object instance.

GF40/GF80 Series Implementation

Data Type values supported are Integer (0xC3) and Real (0xCA). Data Units supported are Counts (0x1001) and SCCM (0x1400). Data Type and Data Units attributes are settable. The supported combinations of Data Type and Data Units on the GF40/GF80 Series are Integer-Counts (default), Real-SCCM, Integer-SCCM, and Real-Counts. The full-scale range for Integer-Counts is either 0x6000 or 0x7FFF, depending on the configuration. The MFC Device Profile specifies that the full-scale range for the setpoint is 0x7FFF; however, the default GF40/GF80 Series configuration supports a full-scale setpoint range of 0 to 0x6000.

Control

The application of this object is further specified in the applicable device profile; primarily, the interfaces and object relationships are defined. Generally, the *Process Variable* attribute is restricted to “Get Only” access and an internal connection is defined to another object. Similarly, the *Control Variable* is generally not supported due to internal connections.

When in the EXECUTING state, this object is running an application process designed to cause the *Process Variable* to be driven to the value of the *Setpoint*. In any state other than EXECUTING, the application process is stopped and the *Safe State* is activated for the output of the object.

Any fault detected by the object application process causes the object to transition to the appropriate state as defined by the managing S-Device Supervisor object.

10 S-Gas Calibration Object (Class 0x34)

An S-Gas Calibration Object affects the behavior of an associated S-Analog Sensor object instance; a device profile will show a relationship between these two objects where an S-Gas Calibration Object is used. The S-Analog Sensor object uses a selection attribute as the gas type selection mechanism. The S-Gas Calibration Object provides the data with which a device enacts the appropriate calibration algorithm for a given gas type. Each S-Gas Calibration Object Instance contains a set of attribute values for one particular calibration set; each identified by the Gas Standard Number.

The S-Gas Calibration class level object provides a service for retrieving a list of all valid object instances. The service response includes a list of elements. Each element includes the Instance ID, Gas Standard Number and the valid S-Analog Sensor object instance ID for which the instance is valid.

There may be more than one instance with the same Gas Standard Number. These instances may be differentiated by Full Scale, Gas Symbol, Additional Scaler and/or other parametric distinctions, including valid S-Analog Sensor object instance ID. The distinctions may, or may not, be evident in the Get_All_Instances service response, depending upon what the distinction is.

S-Gas Calibration Objects most often utilize the region of Manufacturer Specified Attributes (ID > 100) for specific calibration parameters.

This object is a member of the *Hierarchy of Semiconductor Equipment Devices*. As such, its behavior is managed by the Device Supervisor Object. See Section 6-48.

The S-Gas Calibration object makes use of a list of Standard Gas Type Numbers. This list is described in publication:

SEMI E52-95 “Practice for Referencing Gases Used in Digital Mass Flow Controllers”, Semiconductor Equipment and Materials International (SEMI), Mountain View, CA 94043-4080.

NOTE: It is implied that the reference above is to the latest revision as specified by SEMI.

10.1 S-Gas Calibration Class Attributes

The Object Class Attribute IDs 1-7 are reserved. See DeviceNet Volume II, Section 5-4.1 for more specification detail on these attributes.

Attribute ID	Need in implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute
1 thru 7	These class attributes are either optional or conditional and are described in chapter 5 of this specification.				
97 & 98	Reserved by DeviceNet				
99	Conditional* (Supported)	Get	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.
170	Optional (Supported)	Get	Bin ID	INT	Specifies the Device Bin number. This value is vendor specific.**

* If the value of Subclass is 00, which identifies “no subclass”, then this attribute is OPTIONAL in implementation, otherwise, this attribute is REQUIRED.

** This class attribute is required for certain customer applications, such as the “multi-gas, multi-range” application.

10.2 S-Gas Calibration Instance Attributes

Certain minimal implementations may support any optional "Set" attributes as "Get" only and still be compliant with this object specification. All required attributes must be supported as specified.

The GF40/GF80 Series supports 9 instances of the S-Gas Calibration Object

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
1	Optional (Supported)	Get	NV	Number of Attributes	USINT	Number of attributes supported	Number of attributes supported in this object instance
2	Optional (Supported)	Get	NV	Attribute List	ARRAY OF USINT	List of attributes supported by this object instance	List of attributes supported in this object instance
3	Required	Get	NV	Gas Standard Number	UINT	Gas Type Number	[default] = 0 (no gas type specified) See Semantics section
4	Required	Get	NV	Valid Sensor Instance	UINT	S-Analog Sensor object instance ID for which this object instance is valid	0 = No Valid Sensor n = Instance ID See Semantics section [default] = 0
5	Optional (Supported)	Set	NV	Gas Symbol	SHORT STRING	Gas Type Name	See Semantics section [default] = null
6	Optional (Supported)	Get	NV	Full Scale	STRUCT of:	Full Scale of the device using this object instance	See Semantics section [default] = 0, 0
					REAL	Amount	The amount of measured parameter corresponding to full scale.
					UINT	Units	The units for the above. See Data Units Appendix K.

* NV = Nonvolatile; value is maintained through power cycle.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
7	Optional (Not Supported)	Set	NV	Additional Scaler	REAL	Additional Correction Factor	In addition to the correction algorithm, this amount is multiplied to the reading. Generally used for Gas Correction for a gas other than the type identified for the object instance by attribute 3. (e.g., scale a nitrogen object instance to measure argon). Default = 1.0
8	Optional (Supported)	Get	NV	Calibration Date	DATE	Date of Calibration	The date this object instance was last calibrated [default] = 0
9	Optional (Supported)	Get	NV	Calibration Gas Number	UINT	Calibration Gas	The gas number of the gas used to calibrate this object instance. [default] = 0
10	Optional (Not Supported)	Get	NV	Gas Correction Factor	REAL	Gas Correction Factor For devices that support simple correction factors (as opposed to algorithms) for gas selection.	[default] = 1.0

* NV = Nonvolatile; value is maintained through power cycle.

Attr ID	Need in Implementation	Access Rule	NV*	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
97-98	Reserved by DeviceNet						
99	Conditional** (Supported)	Get	NV	Subclass	UINT	Identifies a subset of additional attributes, services and behaviors. The subclasses for this object are specified at the end of this object specification section.	0 = No subclass n = subclass as defined herein

* NV = Nonvolatile; value is maintained through power cycle.

** If the value of Subclass is 00, then this attribute is **OPTIONAL** in implementation, otherwise, this attribute is **REQUIRED**.

10.3 Semantics

Gas Standard Number

Used to identify a gas standard number, for which the object instance is currently calibrated. See Instance Application Example below.

The actual coding of the values are described in the following publication:

See introduction section (above) for reference to the SEMI publication: “Practice for Referencing Gases Used in Digital Mass Flow Controllers”.

Since the actual attributes, and their context, for the parameterization of object instances for particular gas types is beyond the scope of this standard (i.e., vendor specific) the Access Rule for this attribute has been specified as Get. Vendors may choose to specify an Access Rule of Set for this attribute.

Valid Sensor Instances

This attribute specifies the S-Analog Sensor object instance for which the S-Gas Calibration object instance is valid. An S-Gas Calibration object instance will be valid for zero or one S-Analog Sensor object instances.

Gas Symbol

This optional attribute is a string-coded representation of the name of the gas for which the object instance has been configured. It is coded as a user defined text symbol or it is coded as defined in the above referenced SEMI publication.

This attribute may indicate a different gas from the one, which has been specified by the Gas Standard Number. See Instance Application Example below.

Full Scale

This optional attribute identifies the amount of measured parameter (e.g., Mass Flow) corresponding to the Full Scale of the associated S-Analog Sensor object. A primary purpose for this attribute is to allow for simple S-Analog Sensor object implementations where the Value is reported in raw units; this attribute allows a mapping to engineering units.

For example, the Full Scale for a S-Gas Calibration object may be 100 SCCM, while the Full Scale for the associated S-Analog Sensor object may be 0x6000 counts (i.e., S-Analog Sensor object Data Type = INT and Data Units = Counts).

Instance Application Example

The following is an example to demonstrate the usage of Gas Calibration object instances and their attributes:

A device has been supplied with three gas calibration object instances: nitrogen (13)*, helium (1)* and argon (4)*. The user wishes to use the device for silane (39)* and knows that a correction factor of 0.60 will properly convert a nitrogen calibration for this application. The object instance for nitrogen would be selected and the Additional Scaler attribute for this instance would be set to 0.60. To identify this modification, the Gas Symbol may be set to read “silane”, “SiH4”, or “39”.

* (Gas Standard Number)

10.4 S-Gas Calibration Common Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
0Ehex 14dec	Required	Required	Get_Attribute_Single	Returns the contents of the specified attribute.
10hex 16dec	Required	Required	Set_Attribute_Single	Modifies an attribute value.

See the DeviceNet Communication Model and Protocol for definitions of these common services.

10.5 S-Gas Calibration Object-Specific Services

Service Code	Need in Implementation		Service Name	Description of Service
	Class	Instance		
4Bhex 75dec	Required	n/a	Get_All_Instances	Requests a list of all available object instances with their respective gas numbers

If a gas instance is changed or added, the device must be reset before performing the “get_all_instances” service.

Success Response Service Data Field Parameters

Parameter	Required	Data Type	Description	Semantics of Values
Size of List	Required	UINT	Specifies the number of elements in the Array	Number of gas calibrations in the list
List of Gas Calibrations	Required if Size > 0	ARRAY of	Supported List	The list of gas calibrations
		STRUCT of	Supported Gas Type	
		UINT	S-Gas Calibration Object Instance ID	[34-n-4], where n is the instance value 1 – 6.
		UINT	Gas Standard Number	[34-n-3], where n is the instance value 1 – 6.
		UINT	Valid Sensor Instance	Always =1 for the GF125.

On the GF40/GF80 Series: Gas instance 6 is considered the “test” gas instance.

There are a total of 6 gas instances, (sometimes referred to as “gas pages”) available.

10.6 S-Gas Calibration Object Behavior

The behavior of this object is managed by the Device Supervisor Object, defined in Section 6-48.5.

10.7 S-Gas Calibration Object Instance Subclass 01

The following specification applies to a subclass of this object for application in Mass Flow Controller devices.

10.7.1 Subclass 01 Instance Attributes

Attribute ID	Need in Implementation	Access Rule	Name	DeviceNet Data Type	Description of Attribute	Semantics of Values
95	Optional (Supported)	Get	Calibration Pressure	REAL	The gas pressure in KiloPascal	The Standard Pressure with respect to the calibration conditions. Default = 101.32, (14.7 PSIA).
96	Optional (Supported)	Get	Calibration Temperature	REAL	The Gas Temperature in Degrees C	The Standard Temperature with respect to the calibration conditions. Default = 0.0
99	Conditional (Supported)	Get	Subclass	UINT	Identifies subset of additional attributes, services and behaviors.	0=no subclass 1=standard T & P 2-65535=reserved (default = 1)

10.7.2 Subclass 01 Instance ervices

There are no additions or restrictions to the Object Services for this object subclass.

10.7.3 Subclass 01 Behavior

There are no additions or restrictions to the Behavior for this object subclass.

11 References

[1] S-Device Supervisor Object. Open DeviceNet Venders Association (ODVA) DeviceNet Specification Enhancement 93-01. Version J. 1/27/1999.

[2] S-Analog Sensor Object. Open DeviceNet Venders Association (ODVA) DeviceNet Specification Enhancement 93-02. Version J. 1/27/1999.

[3] S-Analog Actuator Object. Open DeviceNet Venders Association (ODVA) DeviceNet Specification Enhancement 93-03. Version J. 1/27/1999.

[4] S-Single Stage Controller Object. Open DeviceNet Venders Association (ODVA) DeviceNet Specification Enhancement 93-04. Version J. 1/27/1999.

[5] S-Gas Calibration Object. Open DeviceNet Venders Association (ODVA) DeviceNet Specification Enhancement 93-05. Version J. 1/27/1999.

[6] Mass-Flow Controller Device Profile. Open DeviceNet Venders Association (ODVA) DeviceNet Specification Enhancement 93-06. Version J. 1/27/1999.

[7] Open DeviceNet Venders Association (ODVA) DeviceNet Specification, Volume 1 and 2. Version 2.0. 12/2/1998.

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LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller.

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller.

BROOKS SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.
For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons.

Please contact your nearest sales representative for more details.

HELP DESK

In case you need technical assistance:

USA	☎ 888 275 8946	Korea	☎ +82 31 708 2521
Netherlands	☎ +31 (0) 318 549290	Taiwan	☎ +886 3 5590 988
Germany	☎ +49 351 215 2040	China	☎ +86 21 5079 8828
Japan	☎ +81 3 5633 7100	Singapore	☎ +6297 9741

ISO 9001 QUALITY SYSTEM

Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

TRADEMARKS

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ODVA .... Open DeviceNet Vendors Association, Inc.

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BROOKS® INSTRUMENT

Installation and Operation Manual
X-DPT-EtherCAT-GF40-GF80-MFC-eng
Part Number: 541B170AAG
August, 2012

EtherCAT® Supplemental Manual for Brooks® GF40/GF80 Series Mass Flow Controllers and Meters

Brooks® GF40/GF80 Series with EtherCAT® Communications

Essential Instructions

Read this page before proceeding!

Brooks Instrument designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using and maintaining Brooks Products.

- Read all instructions prior to installing, operating and servicing the product. If this instruction manual is not the correct manual, please see back cover for local sales office contact information. Save this instruction manual for future reference.
- If you do not understand any of the instructions, contact your Brooks Instrument representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation and maintenance of the product.
- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Brooks Instrument.
- Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

ESD (Electrostatic Discharge)

CAUTION

This instrument contains electronic components that are susceptible to damage by electricity. Proper handling procedures must be observed during the removal, installation, or other handling of internal circuit boards or devices.

Handling Procedure:

1. Power to the unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

Comments:

This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

Dear Customer,

We recommend that you read this manual in its entirety as this will enable efficient and proper use of the EtherCAT® thermal mass flow controllers and meters. Should you require any additional information concerning the EtherCAT thermal mass flow controllers and meters, please feel free to contact your local Brooks Sales and Service Office; see back cover for contact information, or visit us on the web at www.BrooksInstrument.com. We appreciate this opportunity to service your fluid measurement and control requirements, and trust that we will be able to provide you with further assistance in future.

Yours sincerely,
Brooks Instrument

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1.1 Introduction

Many applications of Flow Controllers/Meters are moving to increasing use of automation. Automation comes in many forms: PLC's (Programmable Logic Controllers such as the Siemens S7 300/4000), DCS's (Distributed Control Systems, such as Emerson's Digital V), PC based solutions (National Instrument's Labview™) and Ethernet based field buses. Digital communications from these varied systems and the devices they measure and control, are a very effective means of not only accomplishing more effective and rapid system integration, but also providing greatly improved system diagnostics and maintainability. EtherCAT is an Ethernet based communication system and is known for its high cycle time and cost efficient cabling and master application solutions. Brooks Instrument now introduces the EtherCAT interface on its GF Series platform.

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2.1 Definition of Terms

Abbreviation	**Description**
MFC/MFM	Mass Flow Controller/Meter device
MSB	Most Significant Bit
LSB	Least Significant Bit
PDO	Process Data Object
SDO	Service Data Object
CoE	CanOpen on EtherCAT
ESI	EtherCAT Slave Information (device description in XML format)
ESC	EtherCAT Slave Controller

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3 Before Starting

3.1 Background & Assumptions

This manual is a supplement to the Brooks GF40/GF80 Series installation and operation manual. It is assumed that the owner of this EtherCAT MFC/MFM is thoroughly familiar with the theory and operation of this device. If not, it is recommended that the owner read the installation and operation manual first before continuing with this supplement.

This manual assumes basic knowledge and understanding of EtherCAT (its topology and its method of logically accessing the data or parameters contained within the device). This manual is not intended to be a replacement to the EtherCAT specifications. It is recommended but not required for the purposes of this manual, that the user obtains a copy of the EtherCAT specifications (www.ethercat.org).

This manual does not make any assumptions about any particular manufacturer of equipment or custom software used by the user to communicate with the Brooks device, but assumes the user has thorough understanding of such equipment and any configuration software.

Application Notes and FAQ's are available at the Brooks Instrument web site (www.BrooksInstrument.com).

3.2 Numbers

Numeric values used throughout this manual will be clearly denoted as to the base numeric system it represents. All hexadecimal numbers (base 16) will be prefixed with a 0x, like 0xA4. All binary numbers (base 2) will be suffixed with a b, like 1001b. All other numbers not annotated this way will be assumed decimal (base 10).

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4 Quick Start

This section assumes the owner of the Digital Series device has a fully operational and trouble-free communications network with appropriate power supplies. This section also assumes that an EtherCAT master application is connected to the network capable of PDO and mailbox data communication. Both types of data communication modes are supported by the Brooks GF40/GF80 EtherCAT device

4.1 Master Hardware

Various companies provide EtherCAT master applications, e.g. TwinCAT from Beckhoff, or offer EtherCAT master stacks to develop a master application, e.g. Acontis. A PC can be used to run most EtherCAT master applications but needs dedicated Ethernet hardware to support the high cycle times and kernel mode operation of the master application, see wwww.beckhoff.com. Screendumps of master applications used in this manual are taken from the EtherCAT configurator tool from Beckhoff.

4.2 Physical Interfaces

The available physical interfaces on the EtherCAT device are listed below:

- 5 pin M8 threaded male connector for power and analog I/O, indicated by PWR
- IN and OUT ports with RJ45 connectors
- ZERO push button, refer to the GF40/80 Series installation and operation manual for more details
- 2.5mm female jack for RS485 diagnostics port indicated by DIAG, refer to the GF40/GF80 Series installation and operation manual for more details

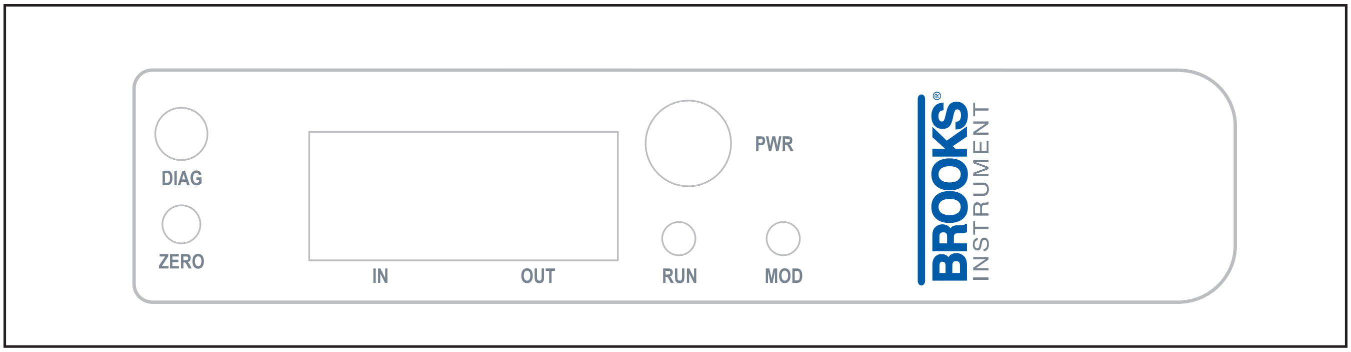

Figure 4-1 EtherCAT Label on Cover

4.2.1 Power Supply and Analog I/O

Power needs to be supplied via the M8 connector. This connector also provides access to analog I/O signals, see Table 4-1.

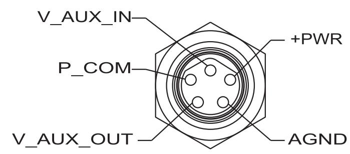

Figure 4-2 M8 Male Device Connector Pin Layout, Pin Side View

Table 4-1 Pin Labeling of M8 Male Device and Female Mating Cable Connector

Pin Label	Function at Remote Connector
P_COM	Power Supply Common
+VPWR	Positive Power Supply Voltage
V_AUX_OUT	Flow Output 0-5V
AGND	Analog I/O Common
V_AUX_IN	Auxiliary Input 0-5/10V for Future Use

M8 mating cables can be purchased as a second line item, details given below.

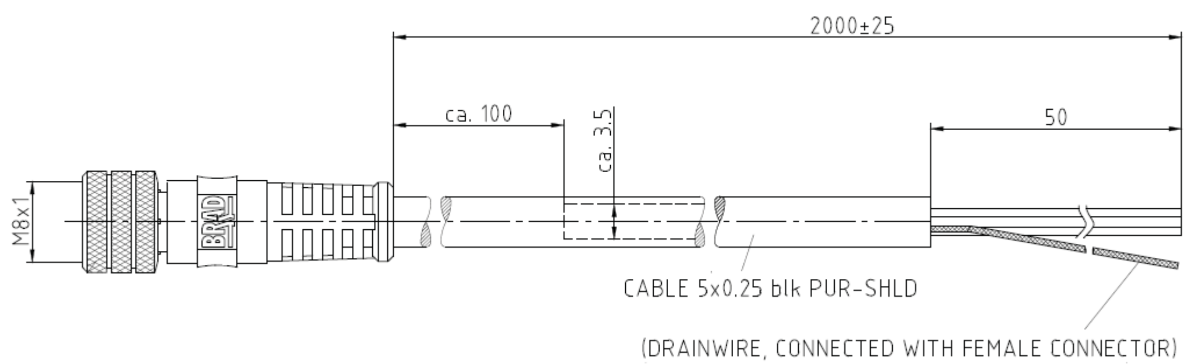

Figure 4-3 M8 Female Mating Cable

Mating Side Female Cable Connector

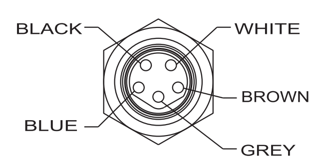

Figure 4-4 M8 Female Mating Cable Connector Pin Layout

Table 4-2 Wire Labeling of M8 Female Mating Cable Connector

Wire Color	Wire Label	Function at Remote Connector
Blue	P_COM	Power Supply Common
Brown	+VPWR	Positive Power Supply Voltage
Black	V_AUX_OUT	Flow Output 0-5V
White	AGND	Analog I/O Common
Grey	V_AUX_IN	Auxiliary Input 0-5/10V for Future Use

Table 4-3 M8 Female Mating Cable Part Numbers

Supplier	Part Number	Description
Brooks Instrument	124X049AAA	M8 Mating Cable 2m
	124X050AAA	M8 Mating Cable 5m

4.2.2 RUN and MOD LEDs

The device supports a RUN and MOD LED to indicate the status of network communication and the device. The RUN LED will indicate the following:

Table 4-4 RUN LED Specification

Flash Code	Description
Off	The device is in state INIT
Blinking	The device is in state PRE-OPERATIONAL
Single Flash	The device is in state SAFE-OPERATIONAL
On	The device is in state OPERATIONAL
Flickering	The device is booting and has not yet entered the INIT state
Triple Flash	User can set this state from the master to locate the specific slave

The MOD LED will indicate the following:

Table 4-5 MOD LED Specification

Flash Code	Description
Flashing Red/Green	The device is in the Self-Test mode
Solid Green	All self-tests have passed. No faults have been detected
Flashing Red	A recovering alarm has been detected
Flashing Green	A recoverable warning has been detected
Solid Red	An unrecoverable fault has occured

4.2.3 EtherCAT MFC Slave Hardware

The main parts of the EtherCAT MFC are:
• Standard Ethernet Physical Layer Components
• EtherCAT Slave Controller (ESC) and EEPROM (ESC configuration data and application specific data)
• For intelligent slaves with an application controller: Host controller

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5.1 Introduction

Based on the information provided by the EtherCAT Slave Information file (ESI, device description in XML format) and/ or the EEPROM, master applications are able to configure the EtherCAT network.

For the EtherCAT network configuration of the GF40/80 Series devices the following ESI file is provided on the Brooks website (www.BrooksInstrument.com):
• 'Brooks GF04x.xml' – GF40/80 Series Mass Flow Controller/Meter

5.2 Outputs (Master Side)

The request message, sent from master to slave, consists of the fields indicated in Figure 5-1, these fields will be described in the sections below.

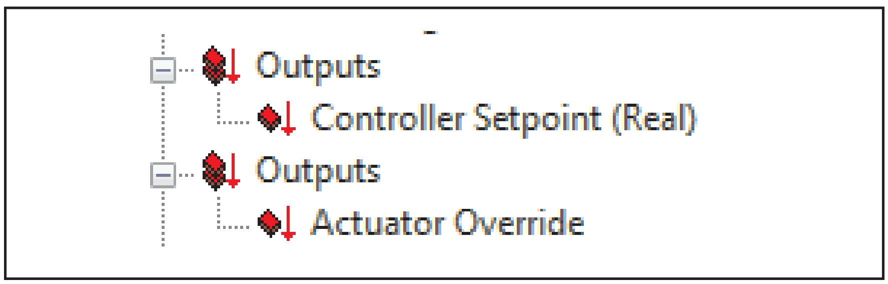


Figure 5-1 Output PDOs

Output PDO	Data Units	Description
Controller Setpoint	Specified by Setpoint Controller Data Units	Setpoint specified in the selected Data Units
Actuator Override	vdOverride Table 5-1 Valve Override Values (vdOverride)	Valve override

5.3 Inputs (Master Side)

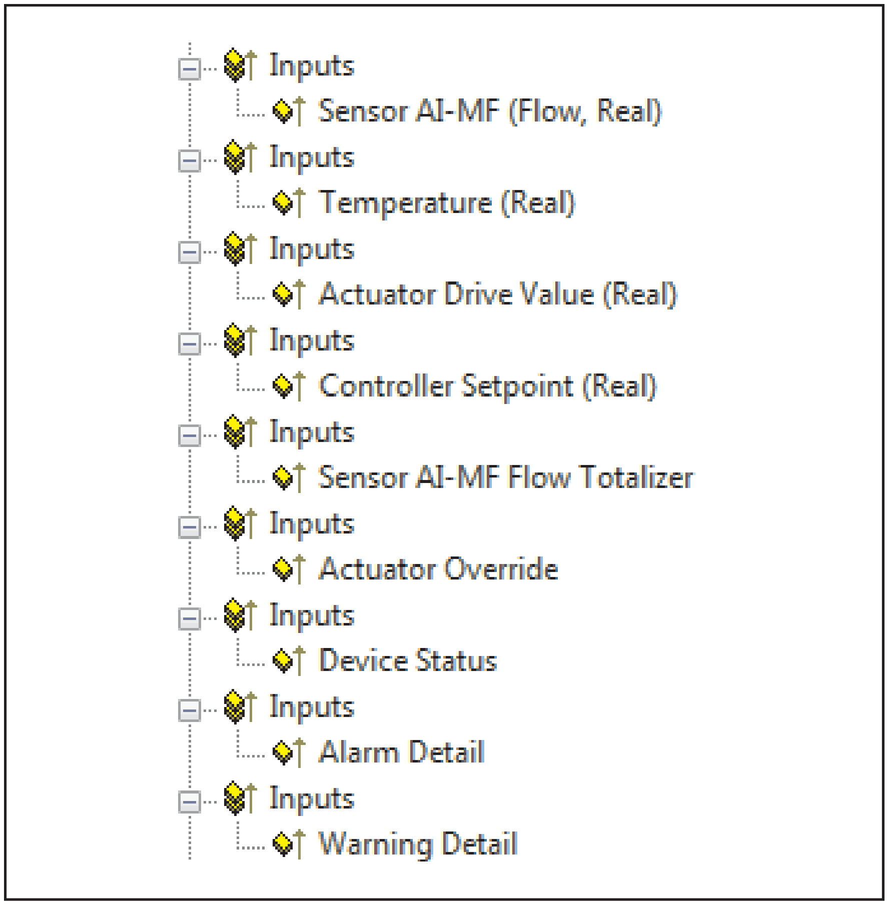


Figure 5-2 Input PDOs

Input PDO	Data Units	Description
Sensor AI-MF (Flow, Real)	Specified by Flow Sensor Data Units	Flow specified in Flow Sensor Data Units
Temperature (Real)	Specified by Temperature Sensor Data Units	Temperature specified in Temperature Sensor Data Units
Actuator Drive Value (Real)	%	Valve drive value
Controller Setpoint (Real)	Specified by Setpoint Controller Data Units	Setpoint specified in Setpoint Controller Data Units
Sensor AI-MF Flow Totalizer	cm^3	Flow totalizer value
Actuator Override	vdOverride Table 5-1 Valve Override Values (vdOverride)	Valve override
Exception Status	bit mask	Summary of Alarm and Warning Detail
Alarm Detail	bit mask	alarms
Warning Detail	bit mask	warnings

5.3 COE Online Attributes

5.3.1 Device Attributes

1000	Device type	RO	0x00000000 (0)
1001	Error register	RO	0x00 (0)
1008	Device name	RO	GF_SA4x
1009	Hardware version	RO	A
100A	Software version	RO	1.14
1018:0	Identity	RO	> 4 <
1018:01	Vendor ID	RO	0x00000602 (1538)
1018:02	Product code	RO	0x000002D6 (726)
1018:03	Revision	RO	0x00000E01 (3585)
1018:04	Serial number	RO	0x482499FB (1210358267)
F901	Device Type (DmA1)	RO	MFC
F902	Standard Revision Level (DmA2)	RO	E54-0997
F903	Device Manuf. Identifier (DmA3)	RO	Brooks Instrument
F904	Manufacturer Model Num (DmA4)	RO	GF080CXXC
F907	Serial Number (DmA7)	RO	3F1316204001
F920	Device Configuration (DmA8)	RO	GF080CXXC-SA44860C-VXVZE5...

Figure 5-3 Device Attributes

5.3.2 Flow Sensor

8000:0	AI Error Settings	RO	> 2 <
8000:01	sasAlarmEnable	RW	FALSE
8000:02	sasWarningEnable	RW	FALSE
8004:0	Sensor AI-MF Settings	RO	> 37 <
8004:08	Alarm Trip Point High	RW	
8004:09	Alarm Trip Point Low	RW	
8004:0B	Warning Trip Point High	RW	
8004:0C	Warning Trip Point Low	RW	
8004:21	Data Type	RO	0x00CA (202)
8004:22	Data Units	RW	0x1007 (4103)
8004:23	Alarm Setting Time	RW	0x0000 (0)
8004:24	Warning Setting Time	RW	0x0000 (0)
8004:25	Reset Flow Totalizer	RW	00 00 00 00 00 00 00 00

Figure 5-4 Flow Sensor Attributes

Flow sensor attributes	Data Units	Description
sasAlarmEnable	Enable (1) Disable (0)	Enable/disable the high and low flow alarm
sasWarningEnable	Enable (1) Disable (0)	Enable/disable the high and low flow warning
Alarm Trip Point high	To be specified in selected flow data units	Flow alarm high limit
Alarm Trip Point low	To be specified in selected flow data units	Flow alarm low limit
Warning Trip Point High	To be specified in selected flow data units	Flow warning high limit
Warning Trip Point Low	To be specified in selected flow data units	Flow warning low limit
Data Type	Real (202)	Data type is fixed to Real
Data Units	fmUnits Table 5-2 Flow Data Units (fmUnits)	Flow data units
Alarm Settling Time	Time:ms	Time in milliseconds that the alarm condition needs to be present before the alarm is raised
Warning Settling Time	Time:ms	Time in milliseconds that the warning condition needs to be present before the warning is raised
Reset Flow Totalizer	0	Writing the value 0 to this attribute will reset the flow totalizer

5.3.2.1 Flow Sensor Zero Adjust

B000:0	Service transfer	RO	> 5 <
B000:01	Perform Zero	WO	

Figure 5-5 Flow Sensor Zero Adjust Attribute

Service transfer attribute	Data Units	Description
Perform Zero	1	The flow sensor can be zero adjusted by writing a 1 to this attribute. Refer to the instruction manual for proper instructions.

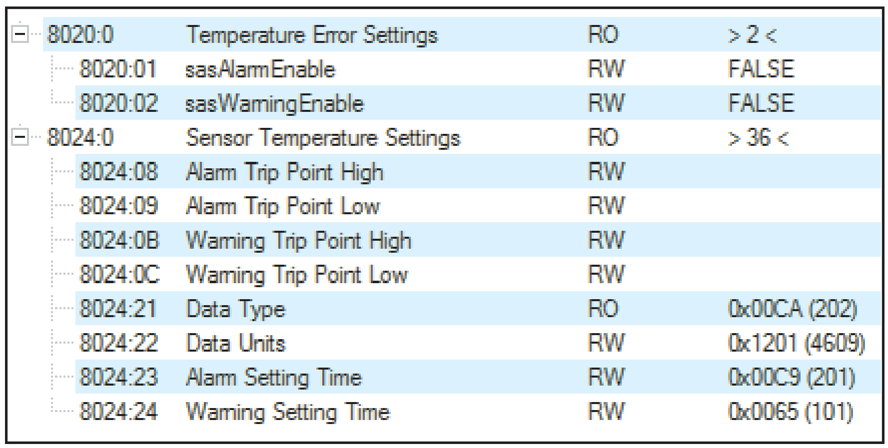
5.3.2.2 Flow Sensor Status

A000:0	AI-MF Status	RO	> 33 <
A000:01	Status	RO	0x0002 (2)
A000:21	Zeroing Status	RO	0x0000 (0)

Figure 5-6 Flow Sensor Status Attributes

Flow sensor status attributes	Data Units	Description
Status	 b00000001 (0x01) b00000010 (0x02) b00000100 (0x04) b00001000 (0x08)	Flow sensor status bit mask indicating high and low flow alarms and warnings High flow alarm Low flow alarm High flow warning Low flow warning
Zeroing Status	0 1	0 = idle 1 = zero adjust in progress

5.3.3 Temperature Sensor



8020:0	Temperature Error Settings	RO	> 2 <
8020:01	sasAlarmEnable	RW	FALSE
8020:02	sasWarningEnable	RW	FALSE
8024:0	Sensor Temperature Settings	RO	> 36 <
8024:08	Alarm Trip Point High	RW	
8024:09	Alarm Trip Point Low	RW	
8024:0B	Warning Trip Point High	RW	
8024:0C	Warning Trip Point Low	RW	
8024:21	Data Type	RO	0x00CA (202)
8024:22	Data Units	RW	0x1201 (4609)
8024:23	Alarm Setting Time	RW	0x00C9 (201)
8024:24	Warning Setting Time	RW	0x0065 (101)

Figure 5-4 Flow Sensor Attributes

Temperature sensor attributes	Data Units	Description
sasAlarmEnable	Enable (1) Disable (0)	Enable/disable the high and low temperature alarm
sasWarningEnable	Enable (1) Disable (0)	Enable/disable the high and low temperature warning
Alarm Trip Point high	To be specified in selected temperature data units	Temperature alarm high limit
Alarm Trip Point low	To be specified in selected temperature data units	Temperature alarm low limit
Warning Trip Point High	To be specified in selected temperature data units	Temperature warning high limit
Warning Trip Point Low	To be specified in selected temperature data units	Temperature warning low limit
Data Type	Real (202)	Data type is fixed to Real
Data Units	tmUnits Table 5-3 Temperature Data Units (tmUnits)	Temperature data units
Alarm Settling Time	Time:ms	Time in milliseconds that the alarm condition needs to be present before the alarm is raised
Warning Settling Time	Time:ms	Time in milliseconds that the warning condition needs to be present before the warning is raised

5.3.3.1 Temperature Sensor Status

A020:0	Temperature Status	RO	> 1 <
A020:01	Status	RW	0x0000 (0)

Figure 5-8 Temperature Sensor Status Attribute

Temperature sensor status attributes	Data Units	Description
Status		Temperature sensor status bit mask indicating high and low flow alarms and warnings
	b00000001 (0x01)	High temperature alarm
	b00000010 (0x02)	Low temperature alarm
	b00000100 (0x04)	High temperature warning
	b00001000 (0x08)	Low temperature warning

5.3.4 Setpoint Controller

8030:0	Controller Error Settings	RO	> 2 <
8030:01	sasAlarmEnable	RW	FALSE
8030:02	sasWarningEnable	RW	FALSE
8033:0	Sensor Controller Settings	RO	> 36 <
8033:01	Alarm Settle Time	RW	0x0000 (0)
8033:02	Alarm Error Band	RW	
8033:03	Warning Settle Time	RW	0x0000 (0)
8033:04	Warning Error Band	RW	
8033:21	Data Type	RO	0x00CA (202)
8033:22	Data Units	RW	0x1007 (4103)
8033:23	Control Mode	RW	0x0000 (0)
8033:24	Ramp Time	RW	0x0000 (0)

Figure 5-9 Setpoint Controller Attributes

Setpoint controller attributes	Data Units	Description
sasAlarmEnable	Enable (1) Disable (0)	Enable/disable the setpoint error band alarm
sasWarningEnable	Enable (1) Disable (0)	Enable/disable the setpoint error band warning
Alarm Settling Time	Time:ms	Time in milliseconds that the alarm condition needs to be present before the alarm is raised
Alarm Error Band	To be specified in selected data units	Setpoint alarm error band
Warning Settling Time	Time:ms	Time in milliseconds that the warning condition needs to be present before the warning is raised
Warning Error Band	To be specified in selected data units	Setpoint warning error band
Data Type	Real (202)	Data type is fixed to Real
Data Units	fmUnits Table 5-2 Flow Data Units (fmUnits)	Setpoint controller data units
Control Mode	fcControlMode Table 5-4 Setpoint Control Mode (fcControlMode)	The setpoint control is fixed to the digital EtherCAT interface (future enhancement: analog setpoint source)
Ramp Time	Time:ms	Time in milliseconds to reach a newly configured setpoint

5.3.4.1 Setpoint Controller Status

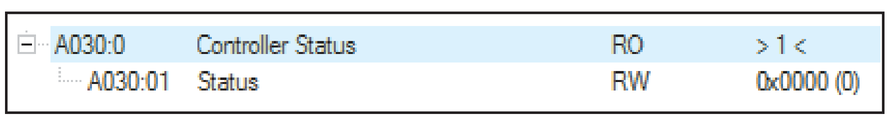


Figure 5-10 Setpoint Controller Status Attribute

Setpoint controller status attributes	Data Units	Description
Status	 b00000001 (0x01) b00000010 (0x02)	Setpoint controller status bit mask Setpoint error band alarm Setpoint error band warning

5.3.5 Valve Actuator Attributes

8040:0	Actuator Error Settings	RO	> 2 <
8040:01	sasAlarmEnable	RW	FALSE
8040:02	sasWarningEnable	RW	FALSE
8044:0	Sensor Actuator Settings	RO	> 40 <
8044:21	Data Type	RO	0x00CA (202)
8044:22	Data Units	RW	0x1007 (4103)
8044:23	Alarm Trip Point High	RW	
8044:24	Alarm Trip Point Low	RW	
8044:26	Warning Trip Point High	RW	
8044:27	Warning Trip Point Low	RW	

Figure 5-11 Valve Actuator Attributes

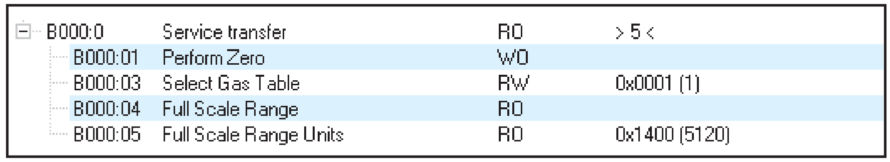
Valve actuator attributes	Data Units	Description
sasAlarmEnable	Enable (1) Disable (0)	Enable/disable the high and low valve drive alarm
sasWarningEnable	Enable (1) Disable (0)	Enable/disable the high and low valve drive warning
Data Type	Real (202)	Data type is fixed to Real
Data Units	vdUnits Table 5-5 Valve Drive Data Units (vdUnits)	Valve drive data units, fixed to percent
Alarm Trip Point high	To be specified in selected valve drive data units	Valve drive alarm high limit
Alarm Trip Point low	To be specified in selected valve drive data units	Valve drive alarm low limit
Warning Trip Point High	To be specified in selected valve drive data units	Valve drive warning high limit
Warning Trip Point Low	To be specified in selected valve drive data units	Valve drive warning low limit

A040:0	Actuator Status	RO	> 1 <
A040:01	Status	RW	0x0000 (0)

Figure 5-12 Valve Actuator Status Attributes

Valve actuator status attributes	Data Units	Description
Status		Valve actuator status bit mask indicating high and low valve drive alarms and warnings
	b00000001 (0x01)	High valve drive alarm
	b00000010 (0x02)	Low valve drive alarm
	b00000100 (0x04)	High valve drive warning
	b00001000 (0x08)	Low valve drive warning

5.3.6 Service Transfer Attributes

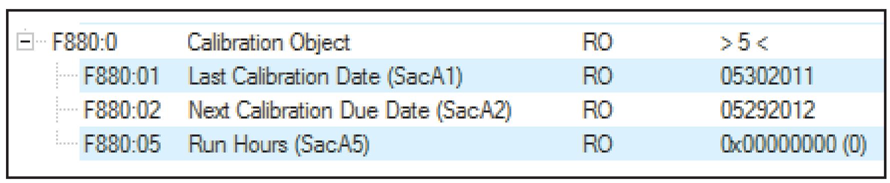


B000:0	Service transfer	RO	> 5 <
B000:01	Perform Zero	WO	
B000:03	Select Gas Table	RW	0x0001 (1)
B000:04	Full Scale Range	RO	
B000:05	Full Scale Range Units	RO	0x1400 (5120)

Figure 5-13 Service Transfer Attributes

Service transfer attribute	Data Units	Description
Perform Zero	1	Refer to Section 5.3.2.1 Flow Sensor Zero Adjust
Select Gas Table	1..6	Selected process gas page
Full Scale Range	Real	Full scale range being the flow at 100% setpoint
Full Scale Range Units	Table 5-2 Flow Data Units (fmUnits)	Data unit of the full scale range

5.3.7 Calibration Object Attributes



F880:0	Calibration Object	RO	> 5 <
F880:01	Last Calibration Date (SacA1)	RO	05302011
F880:02	Next Calibration Due Date (SacA2)	RO	05292012
F880:05	Run Hours (SacA5)	RO	0x00000000 (0)

Figure 5-14 Calibration Object Attributes

Calibration object attributes	Data Units	Description
Last Calibration Date	Date	Date at which the device was calibrated
Next Calibration Due Date	Date	Date at which the device needs to be recalibrated
Run Hours	Time:hours	Time that the device has observed flow in the range of 0-100%

5.3.8 Exceptions

5.3.8.1 Alarm- and Warning Details

The device, flow, temperature, setpoint controller and valve actuator related exceptions are collected in the alarm- and warning detail byte sequences. The bitmasks are shown below

	Byte nr	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Common Exception Detail Size	0	0	0	0	0	0	0	1	0
Common Exception Detail 1st byte	1	0	0	0	0	EEPROM	0	0	Internal Diagnosti c
Common Exception Detail 2nd byte	2	0	0	0	0	0	Power supply output	0	0
Device Exception Detail Size	3	0	0	0	0	0	0	0	1
Device Exception Detail Size	4	0	0	Valve alarm high	Valve alarm low	Flow control alarm	Flow alarm high	Flow alarm low	Flow sensor reading not valid
Manuf. Exception Detail Size	5	0	0	0	0	0	0	1	0
Manuf. Exception Detail 1st byte	6	0	0	0	0	Temp alarm high	Temp alarm low	0	0
Manuf. Exception Detail 2nd byte	7	0	0	0	0	0	0	0	0

5.3.8.2 Exception Status

The exception status is a one byte summary of the alarm- and warning details.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Exception status	0	Manuf. specific warning	Device specific warning	Common exception warning	0	Manuf. specific alarm	Device specific alarm	Common exception alarm

Table 5-1 Valve Override Values (vdOverride)

Value	Description
0	Normal
1	Off
2	Purge

Table 5-2 Flow Data Units (fmUnits)

Value	Description
4103	Percent
5120	SCCM
5121	SLM

Table 5-3 Temperature Data Units (tmUnits)

Value	Description
4608	Celsius
4609	Fahrenheit
4610	Kelvin

Table 5-4 Setpoint Control Mode (fcControlMode)

Value	Description
0	Digital
128	Analog (future)

Table 5-5 Valve Drive Data Units (vdUnits)

Value	Description
4103	Percent

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LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller.

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller.

BROOKS SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.
For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons.

Please contact your nearest sales representative for more details.

HELP DESK

In case you need technical assistance:

USA	☎ 888 275 8946	Korea	☎ +82 31 708 2521
Netherlands	☎ +31 (0) 318 549 290	Taiwan	☎ +886 3 5590 988
Germany	☎ +49 351 215 2040	China	☎ +86 21 5079 8828
Japan	☎ +81 3 5633 7100	Singapore	☎ +6297 9741

Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

TRADEMARKS
Brooks .... Brooks Instrument, LLC
HART .... HART Communications Foundation

ISO 9001 QUALITY SYSTEM

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BROOKS® INSTRUMENT

Installation and Operation Manual
X-TMF-GF80-GF81-Series-MFC-eng
Part Number: 541B196AAG
September, 2014

Brooks® GF80/GF81 Series MultiFlo™ Capable Digital Thermal Mass Flow Devices

Brooks® GF80/GF81 Series available with RS485, DeviceNet™, Profibus® or EtherCAT® I/O

Essential Instructions
Read before proceeding!

Brooks Instrument designs, manufactures and tests its products to meet many national and international standards. These products must be properly installed, operated and maintained to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, operating and maintaining Brooks Instrument products.

- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- Read all instructions prior to installing, operating and servicing the product. If this instruction manual is not the correct manual, please see back cover for local sales office contact information. Save this instruction manual for future reference.

⚠ **WARNING: Do not operate this instrument in excess of the specifications listed in the Instruction and Operation Manual. Failure to heed this warning can result in serious personal injury and / or damage to the equipment.**

- If you do not understand any of the instructions, contact your Brooks Instrument representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.
- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- Operation: (1) Slowly initiate flow into the system. Open process valves slowly to avoid flow surges. (2) Check for leaks around the flow meter inlet and outlet connections. If no leaks are present, bring the system up to the operating pressure.
- Please make sure that the process line pressure is removed prior to service. When replacement parts are required, ensure that qualified people use replacement parts specified by Brooks Instrument. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place to prevent electrical shock and personal injury, except when maintenance is being performed by qualified persons.

⚠ **WARNING: For liquid flow devices, if the inlet and outlet valves adjacent to the devices are to be closed for any reason, the devices must be completely drained. Failure to do so may result in thermal expansion of the liquid that can rupture the device and may cause personal injury.**

European Pressure Equipment Directive (PED)

All pressure equipment with an internal pressure greater than 0.5 bar (g) and a size larger than 25mm or 1" (inch) falls under the Pressure Equipment Directive (PED).

- The Specifications Section of this manual contains instructions related to the PED directive.
- Meters described in this manual are in compliance with EN directive 97/23/EC.
- All Brooks Instrument Flowmeters fall under fluid group 1.
- Meters larger than 25mm or 1" (inch) are in compliance with PED category I, II or III.
- Meters of 25mm or 1" (inch) or smaller are Sound Engineering Practice (SEP).

European Electromagnetic Compatibility (EMC)

The Brooks Instrument (electric/electronic) equipment bearing the CE mark has been successfully tested to the regulations of the Electro Magnetic Compatibility (EMC directive 2004/108/EC).
Special attention however is required when selecting the signal cable to be used with CE marked equipment.
Quality of the signal cable, cable glands and connectors:
Brooks Instrument supplies high quality cable(s) which meets the specifications for CE certification.
If you provide your own signal cable you should use a cable which is overall completely screened with a 100% shield.
"D" or "Circular" type connectors used should be shielded with a metal shield. If applicable, metal cable glands must be used providing cable screen clamping.
The cable screen should be connected to the metal shell or gland and shielded at both ends over 360 Degrees.
The shield should be terminated to an earth ground.
Card Edge Connectors are standard non-metallic. The cables used must be screened with 100% shield to comply with CE certification.
The shield should be terminated to an earth ground.
For pin configuration : Please refer to the enclosed Instruction Manual.

ESD (Electrostatic Discharge)

⚠ **CAUTION: This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.**

Handling Procedure:

1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

Comments
This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

Dear Customer,

We appreciate this opportunity to service your flow measurement and control requirements with a Brooks Instrument device. Every day, flow customers all over the world turn to Brooks Instrument for solutions to their gas and liquid low-flow applications. Brooks provides an array of flow measurement and control products for various industries from biopharmaceuticals, oil and gas, fuel cell research and chemicals, to medical devices, analytical instrumentation, semiconductor manufacturing, and more.

The Brooks product you have just received is of the highest quality available, offering superior performance, reliability and value to the user. It is designed with the ever changing process conditions, accuracy requirements and hostile process environments in mind to provide you with a lifetime of dependable service.

We recommend that you read this manual in its entirety. Should you require any additional information concerning Brooks products and services, please contact your local Brooks Sales and Service Office listed on the back cover of this manual or visit www.BrooksInstrument.com.

Yours sincerely,

Brooks Instrument

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1-1 Introduction

Based upon Brooks award-winning GF100 Series, the GF80/GF81 Series is a performance/value MFC platform designed for OEM applications, delivering the following class leading features:

- MultiFlo™ process gas and flow range programmability, enabling customers to re-configure the MFC for new gases and full scale flow rates for unparalleled process flexibility.
- A high-performance, corrosion-resistant flow measurement sensor delivers improved reproducibility and stability.
- Metal seal MFCs (GF80/GF81) provide customers with maximum durability and corrosion resistance for both aggressive and non-aggressive gas applications.
- Full range of industrial communication protocols (DeviceNet, Profibus DP-V1, and EtherCAT).
- An independent service/diagnostic port enables on-tool reconfiguration/optimization, data logging, and troubleshooting without having to remove the MFC from the gas line.

Figure 1-1 GF80 Series MultiFlo™ Capable Digital Thermal Mass Flow Devices

1-2 How to Use This Manual

This manual is intended to provide the user with all the information necessary to install, operate, troubleshoot and maintain these thermal mass flow devices. The manual is organized in the following sections:

Section 1 Introduction

Section 2 Installation

Section 3 Operation

Section 4 Maintenance and Troubleshooting

Section 5 Product Description Code

Appendix A GF80 Series Gas Table

Appendix B GF80/GF81 Series Patents

Appendix C Essential Instructions

Warranty, Local Sales/Service Contact Information

It is recommended that this manual be read in its entirety before attempting to operate or repair these devices.

1-3 Product Support References

Refer to www.BrooksInstrument.com for Brooks sales and service locations and to obtain other documents that support the GF80/GF81 Series. Those documents include:

- Brooks MultiFlo™ Configurator Quick Start Manual (X-SW-MultiFlo-Config-QS-eng; part number 541B167AAG)
- Brooks GF80/GF81 Series data sheet (DS-TMF-GF80-GF81-Series-MFC-eng)
- DeviceNet™ Supplemental Manual for GF40/GF80/GF81 Series Mass Flow Controllers and Meters (X-DPT-DeviceNet-GF40-GF80-MFC-eng; part number 541B168AAG)
- Profibus® Supplemental Manual for Brooks® GF40/GF80/GF81 Series Mass Flow Controllers and Meters (X-DPT-Profibus-GF40-GF80-MFC-eng; part number 541B162AAG)
- RS485 Supplemental Manual for GF40/GF80/GF81 Series Mass Flow Controllers and Meters (X-DPT-RS485-GF40-GF80-MFC-eng; part number 541B169AAG)
- EtherCAT Supplemental Manual for Brooks® GF40/GF80 Series Mass Flow Controllers and Meters (X-DPT-EtherCAT-GF40-GF80-MFC-eng; part number 541B170AAG)

1-4 Warning, Caution and Notice Statements

Warning, caution and notice statements are located throughout this manual in the ANSI format. A WARNING statement indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury. A CAUTION statement indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury. It may also be used to alert against unsafe practices. A NOTICE statement describes specific information that requires special attention.

1-5 Product Warranty

Product warranty information can be found on the Back Cover of this Manual and on the Brooks website at **www.BrooksInstrument.com**. This information provides general warranty information, limitations, disclaimers, and applicable warranty periods according to product group.

1-6 How to Order a GF80/GF81 Series Device

Refer to Section 5.

1-7 Industry Standard References

Refer to Table 1-1.

1-8 GF80 Devices Gas Table

Refer to Appendix A.

1-9 Glossary of Terms and Acronyms

Refer to Table 1-2

Table 1-1 Industry Standard References

Reference Number	Reference Description
MIL-STD-810	Method 514.4, Category 1, Transportation Requirement Method 516.4, Procedure 1, Functional Shock Test Requirement
SEMI E12	Standard temperature and pressure
SEMI E16	Guideline for determining and describing MFC leak rates
SEMI E17	Guideline for MFC transient characteristics tests
SEMI E18	Guideline for temperature specifications of the MFC
SEMI E27	Standard for MFC and MFM linearity
SEMI E28	Guideline for pressure specifications for the MFC
SEMI E52	Practice for referencing gases used in digital MFCs
SEMI E54	Sensor actuator network connections for DeviceNet
SEMI E56	Test method for detemining accuracy, linearity, repeatability, short-term reproducibility, hystereses of thermal MFCs
SEMI E66	Test method for determining particle contribution by MFCs
SEMI E67	Test method for determining reliabilty of MFCs
SEMI E68	Test method for determining warm-up time of MFCs
SEMI E69	Test method for reproducibilty and zero drift for thermal MFCs
SEMI E80	Test method for determining attitude sensitivity of MFCs
SEMI E16-90	Guidelines for determining and describing mass flow controllers leak rates
SEMI F36	Guide for dimensions and connections of gas distribution components
SEMI F44	Guideline for standardization of machined stainless steel weld fittings
SEMI F45	Guideline for standardization of machined stainless steel reducing fittings
SEMI F47	Specifications for semiconductor processing equipment voltage sag immunity
SEMI S2	Environmental, Health and Safety Guidelines
SEMI S9	Dielectric testing
SEMI S10	Risk assessment
SEMI S12	Decontamination of fielded products

Table 1-2 Terms and Acronyms

Term or Acronym	Definition
CSR	Customer Special Requirement.
CVD	Chemical Vapor Deposition.
DSP	Digital Signal Processor.
EPI Epitaxy (EPI).	A process technology where a pure silicon crystalline structure is deposited or "grown" on a bare wafer, enabling a high-purity starting point for building the semiconductor device.
HBD	Horizontal Base Down.
HLD	Horizontal Label Down.
HLU	Horizontal Label Up.
HUD	Horizontal Upside Down.
GF80 Series	MultiFlo capable digital device.
GF81 Series	High Flow Digital Device.
F.S.	Full Scale.
LED	Light Emitting Diode.
MFC	Mass Flow Controller.
MultiFlo Configurator	I/O communication software package that configures gas and flow ranges.
MultiFlo Technology	A physics-based calibration methodology that enables gas and flow range configuration within a defined standard configuration.
PID	Proportional Integral Derivative Controller.
PSIA	Pounds per Square Inch Absolute.
PSID	Pounds per Square Inch Differential.
PSIG	Pounds per Square Inch Gauge.
ROR	As pressure increases, flow increases at a pressure rate of rise, or ROR.
HC	Standard Configuration w/ Hastelloy® sensors (to reduce reaction to corrosive gases).
S.P.	Setpoint.
Step Technology	Enables fast set point control through a high speed DSP.
VID	Vertical mounting attitude with inlet side facing down.
VIU	Vertical mounting attitude with inlet side facing up.

1-10 Description

Control

The GF80/GF81 Series brings together Brooks high-performance, patented ultra-fast T-rise flow sensor, high-speed ARM based digital architecture, and a fast-acting diaphragm-free solenoid valve to deliver:

- Fast reproducible transitions between setpoints without overshoot or ringing
- User-programmable ramp functions for processes requiring a slow-ramp in flow or time critical transitions

MultiFlo™ Gas and Range Configurability

The Brooks MultiFlo technology delivers exceptional improvement in process gas accuracy for linear and non-linear gases. This is achieved through advanced gas modeling and optimized through actual gas testing. Brooks MultiFlo™ allows the device to be quickly and easily configured for another gas and/or flow range without sacrificing accuracy or rangability. Selecting a new gas automatically creates a new calibration curve, establishes optimized PID settings for dynamic control, automatically compensates for gas density effects, and ensures smooth overshoot-free transitions between flow rates with excellent steady-state stability. Brooks MultiFlo technology offers unparalleled flexibility. An extensive gas database is provided and a single device can be quickly programmed for thousands of different gas and flow range combinations. Process benefits achieved include:

- Mass flow controller full scale full range can be rescaled down typically by a factor of 3:1 with no impact on accuracy, turndown or leak by specifications
- Optimum process and inventory flexibility resulting in dramatically reduced inventory costs
- Fewer configurations/bin sizes required to support many different processes
- Less down-time with rapid process recovery

MultiFlo™ Support References: Brooks MultiFlow Configurator Quick Start Guide (X-SW-MultiFlo-Config-QS-eng [Part Number: 541B167AAG])

MultiFlo™ Configurator Accessory Kits:

MultiFlo kits are available in the following configurations:

778Z010ZZZ	**Basic MultiFlo Configurator Kit**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
778Z012ZZZ	**GF0xx RS485 Analog/Profibus® MultiFlo Configurator Kit w/Power Supply 24 Vdc**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
641Z117AAA	Power Supply 24 Vdc with DB-15 female

778Z013ZZZ	**GF0xx EtherCAT® MultiFlo Configurator Kit w/Power Supply 24 Vdc**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
641Z117AAA	Power Supply 24 Vdc with DB-15 female
124Z170AAA	Cable, Power, EtherCAT to DB-15 male
778Z014ZZZ	**GF0xx DeviceNet™ MultiFlo Configurator Kit w/Power Supply 24 Vdc**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
641Z117AAA	Power Supply 24 Vdc with DB-15 female
124Z171AAA	Cable, Power, DeviceNet to DB-15 male

* MultiFlo Configurator Software is available on the Brooks Instrument website at: www.BrooksInstrument.com/MultiFlo

www.BrooksInstrument.com/Documentation&Downloads

Advanced Thermal Measurement Sensor

Brooks high-performance thermal flow sensor brings together key design elements to deliver the accurate, repeatable measurement under challenging process conditions:

- Improved accuracy at elevated temperatures through isothermal packaging and ambient temperature sensing and compensation
- Enhanced signal-to-noise performance enables improved low setpoint accuracy
- A large bore, corrosion resistant, Hastelloy® C-22 sensor tube ensures long life and reliability
- Optimized temperature profile for gases prone to thermal decomposition
- Onboard electronics store sensor calibration data for ease of service

Enhanced Diagnostics and User Interface

The mass flow controller is typically the most complex and critical component in a gas delivery system, When dealing with toxic or reactive gases, removing the MFC to access its functionality should be the last resort. To address this, Brooks GF Series devices include self-diagnostics and an independent service port for in-situ device evaluation and troubleshooting:

- Embedded self-test routines at power-up
- Independent RS485 service port that can be accessed while the MFC is in operation for data logging and troubleshooting
- A convenient Zero button to enable easy re-zeroing during scheduled maintenance

Communication Interfaces

The GF80/GF81 Series supports 0-5 Vdc, 0-10 Vdc, 4-20 mA, 0-20 mA, RS485, DeviceNet, EtherCAT, and Profibus communication protocols. DeviceNet, Profibus, EtherCAT and RS485 are multi-drop connections that allow a maximum of 64 devices for DeviceNet, 128 devices for Profibus, 32 devices for RS485, and 65,535 devices for EtherCAT to be connected on the same network.

Brooks Instruments' DeviceNet profile has been certified by the ODVA (Open DeviceNet Vendor's Association).

Brooks Instrument Profibus interface has been certified by the PNO (Profibus User Organization).

The Brooks Instrument EtherCAT interface has been successfully tested by the EtherCAT Conformance Test application version 1.20.30.0.

1-11 Product Description for GF81 Series Devices

The Brooks GF81 Series is a high flow version of the GF80 featuring a corrosion-resistant Hastelloy C-22 for durable, long term operation. Sub-1 second settling times and 1% of reading accuracy ensures that the GF81 will provide reliable flow measurement or control in demanding gas flow applications. The GF81 achieves excellent internal to external leak integrity for challenging process gases as found in CVD, solar, and other processes. With a wide range of digital and analog I/O options available, the GF81 represents an extremely powerful, yet easy, upgrade for existing MFCs or MFMs.

1-12 Specifications for GF80/GF81 Series Devices

⚠ WARNING

Do not operate this instrument in excess of the specifications listed below. Failure to heed this warning can result in serious personal injury and/or damage to the equipment.

⚠ CAUTION

It is the user's responsibility to select and approve all materials of construction. Careful attention to metallurgy, engineered materials and elastomeric materials is critical to safe operation.

See Tables 1-3 thru 1-5 for specifications for the GF80/GF81 Series.

See Figures 1-2 thru 1-4 for dimensions for the GF80/GF81 Series.

Table 1-3 Specifications for Standard GF80/GF81 Series

Performance	GF80	GF81
Full Scale Flow Range (N_2 Eq.)	3 sccm to 55 slm	51 - 300 slm
Flow Accuracy	±1% S.P. 35-100%, ±0.35% F.S. 2-35%	±1% S.P. 35-100% , ±0.35% F.S. 5-35%
Repeatability & Reproducibility	< ± 0.2% S.P.	0.15% S.P.
Linearity	± 0.5% F.S. (included in accuracy)	
Response Time (Settling Time)	Normally Closed Valve < 1 sec. (within 2% for steps 0-10 through 0-100%)	< 1 second
Control Range	2-100%	5% - 100%
MultiFlo	optional	N/A
Number of Bins	11 bins	4 bins
Valve Shut Down	< 1% of F.S.	<2% of Standard Configuration F.S. @ 30 N_2 psig/atm out
Zero Stability	< ± 0.5% F.S. per year	
Pressure Coefficient	0.03% per psi (0-50psi N_2)	
Attitude Sensitivity	<0.25% span change @ 90° after rezeroing (N_2 @ 50 psi)	
Auto Zero:	Optional: (When Auto Zero is enabled the device performs the zero function once every time the set point returns to zero. To accomplish, simply provide a zero set point.)	
Auto shut-off:	The Auto Shut-off feature closes the GF80 valve when the set point drops below 1.5% of full scale	The Auto Shut-off feature closes the GF81 valve when the set point drops below 2% of full scale.
Available Gases:	MultiFlo Capable	N_2, H_2, Ar, He, O_2, NH_3 (consult factory for other gases)

Ratings		
Operating Temperature Range	5-50°C (41-122°F)	
Maximum Operating Pressure*	150 psig (10 bar)	Controller: 75 psig (5 bar) / Meter: 150 psig (10 bar)
Differential Pressure Range*	3-860 sccm = 7-45 psid, 861-7200 sccm = 15-45 psid, 7201-50000 sccm = 25-45 psid Typical pressure drop, high density gases like Argon gas applications require an additional 10 psid differential pressure	30 - 90 psid
Leak Integrity (External)	$1x10^{-10}$ atm. cc/sec He	

Mechanical		
Valve Type	Normally Closed, No Valve (Meter)	Normally Closed, Meter
Primary Wetted Materials	316 Stainless Steel, Hastelloy C-22, 17-7 PH, 430SS	316 Stainless Steel, Hastelloy C-22, KM45
External Seals	316 Stainless Steel	
Internal Seals/Valve Seat	316 Stainless Steel	
Surface Finish	16µ inch Ra	

Diagnostics & Display	
Status Lights:	MFC Health, Network Status
Alarms*:	Sensor Output, Control Valve Output, Over Temperature, Power Surge/Sag, Network Interruption
Diagnostic / Service Port:	RS485 via 2.5mm jack

Compliance	
Environmental Compliance:	CE: EN6126: 2006 (FCC Part 15 & Canada IC-subset of CE testing)
	Safety EN61010-1
	RoHS

* Note: Application specific lower supply pressure and/or lower differential pressure operation available through Brooks Customer Special Request (CSR) process.

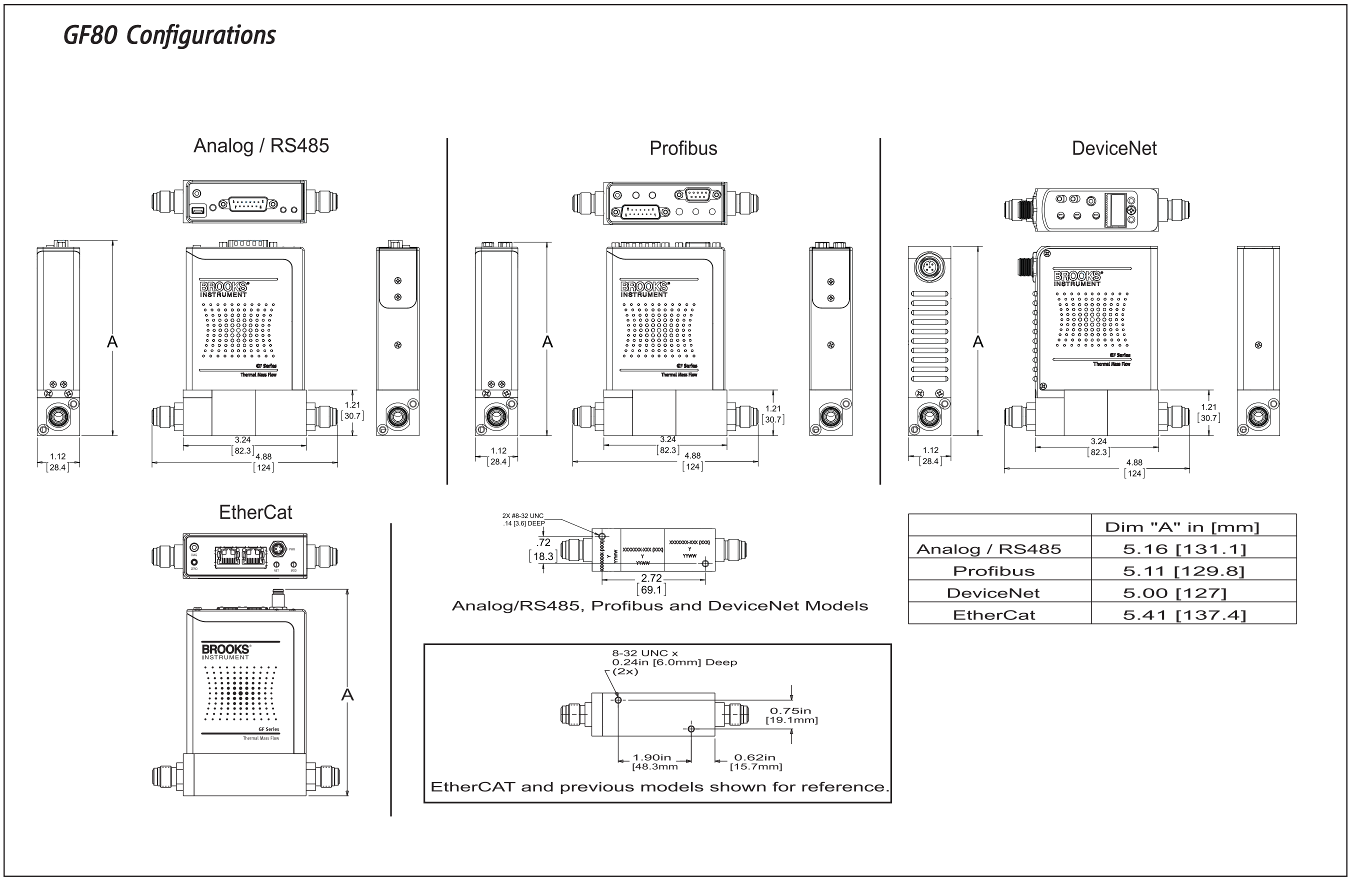
Table 1-4 GF80/GF81 Electrical Specifications

Communication Protocol	RS485*	Profibus®	DeviceNet™	EtherCAT®
Electrical Connection	1 x 15-pin Male Sub-D, (A)	1 x 15-pin Male Sub-D/ 1 x 9-pin Female Sub-D	1 x M12 with threaded coupling nut (B)	5-pin M8 with threaded coupling nut/ 2 x RJ45
Analog I/O	0-5 V, 0-10 V, 0-20 mA, 4-20 mA	0-5 V, 0-20 mA, 4-20 mA		0-5 V
GF80 Power Max./Purge	From +12 Vdc to +24 Vdc: 7 Watt/8 Watt	From +13.5 Vdc to +27 Vdc: 7 Watt/8 Watt	From +11 Vdc to +25 Vdc: 13.6 Watt/15.0Watt	From +13.5 Vdc to +27 Vdc: 7 Watt/8 Watt
GF81 Power Max./Purge	From +12 Vdc to +24 Vdc: 3.3 Watt/10.2 Watt	From +13.5 Vdc to +27 Vdc: 3.3 Watt/10.2 Watt	From +11 Vdc to +25 Vdc: 3.3 Watt/10.2 Watt	N/A
Voltage Set Point Input Specification				
Nominal Range	0-5 Vdc or 0-10 Vdc	0-5 Vdc	N/A	N/A
Full Range	0-11 Vdc	0-5.5 Vdc	N/A	N/A
Absolute Max.	25 V (without damage)		N/A	N/A
Input Impedence	192 kOhms		N/A	N/A
Required Max. Sink Current	0.002 mA		N/A	N/A
Current Set Point				
Nominal Range	4-20 mA or 0-20 mA		N/A	N/A
Full Range	0-22 mA		N/A	N/A
Absolute Max.	25 mA (without damage)		N/A	N/A
Input Impedence	250 Ohms	125 Ohms	N/A	N/A
Flow Output (Voltage) Specifications				
Nominal Range	0-5 Vdc or 0-10 Vdc	0-5 Vdc	N/A	0-5 Vdc
Full Range	(-0.5)-11 Vdc	0-5.5 Vdc	-	(-0.5)-5.5 Vdc
Min Load Resistance	1 kOhms	1 kOhms	-	0.5 kOhms
Flow Output (Current) Specifications				
Nominal Range	0-20 mA or 4-20 mA		N/A	N/A
Full Range	0-22 mA (@ 0-20 mA); 3.8-22 mA (@ 4-20 mA)		N/A	N/A
Max. Load	400 Ohms (for supply voltage: 12-24 Vdc		N/A	N/A
Analog I/O Alarm Ouput**				
Type	Open Collector		N/A	N/A
Max. Closed (On) Current	25 mA		N/A	N/A
Max. Open (Off) Leakage	1µA		N/A	N/A
Max. Open (Off) Voltage	30 Vdc		N/A	N/A
Analog I/O Valve Override Signal Specifications***				
Floating/Unconnected	Instrument controls valve to command set point		N/A	N/A
VOR < 1.40 Vdc	Valve Closed		N/A	N/A
1.70 Vdc < VOR < 2.90 Vdc	Valve Normal		N/A	N/A
VOR > 3.20 Vdc	Valve Open		N/A	N/A
Input Impedence	800 kOhms		N/A	N/A
Absolute Max. Input	(-25 Vdc) < VOR < 25 Vdc (without damage)		N/A	N/A

*There are three (3) RS485 Protocols:
S-Protocol is a RS485 communication based on HART® command set.
L-Protocol is a RS485 communication compatible with legacy Unit® and Celerity® devices.
A-Protocol is a RS485 communication compatible with Aera® mass flow devices.

**The Alarm Output is an open collector or "contact type" that is CLOSED (on) whenever an alarm is active. The Alarm Output may be set to indicate any one of various alarm conditions.

*** The Valve Override Signal (VOR) is implemented as an analog input which measures the voltage at the input and controls the valve based upon the measured reading as shown in this section.



	Dim "A" in [mm]
Analog / RS485	5.16 [131.1]
Profibus	5.11 [129.8]
DeviceNet	5.00 [127]
EtherCat	5.41 [137.4]

Figure 1-2 Dimensions - GF80 Series

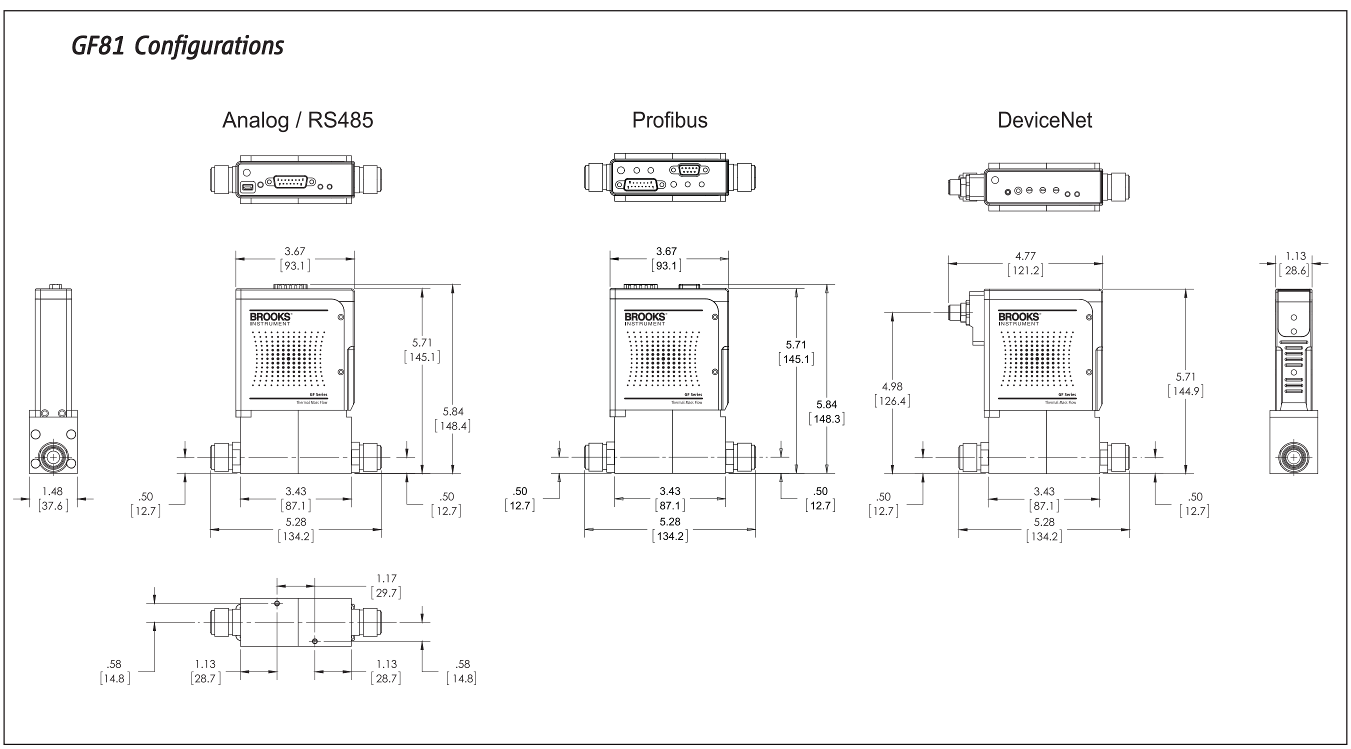


Figure 1-3 Dimensions - GF81 Series

2-1 General

This section provides installation instructions for the Brooks GF80/GF81 Series Thermal Mass Flow Devices. The installation process consists of purging the gas supply line prior to installation, unpacking and inspecting the device, connecting the device to the gas supply line and testing for leaks.

2-2 Receipt of Equipment

When the instrument is received, the outside packing case should be checked for damage incurred during shipment. If the packing case is damaged, the local carrier should be notified at once regarding their liability. A report should be submitted to your nearest Product Service Department.

Americas:

Brooks Instrument
407 W. Vine Street
P.O. Box 903
Hatfield, PA 19440 USA
Toll Free (888) 554 FLOW (3569)
Tel (215) 362 3700
Fax (215) 362 3745
E-mail: BrooksAm@BrooksInstrument.com
www.BrooksInstrument.com

Europe, Middle East, Africa:

Brooks Instrument B.V.
Neonstraat 3, P.O. Box 428
6710 BX Ede
Netherlands
Tel +31 (0) 318 549292 or
+31 (0) 318 549291
E-mail: service.coordinator@Brooks Instrument.com

Brooks Instrument GmbH
Zur Wetterwarte 50 Haus 377/B,
01109 Dresden
Germany
Tel +49 (0) 351 215 20 442
E-mail: service.coordinatorDD@Brooks Instrument.com

Asia, Japan:

Brooks Instrument
1-4-4 Kitsuna, Koto-ku
Tokyo 136-0073
Japan
Tel 81 (3) 5633-7104

Brooks Instrument Korea, Ltd.
D-406 Bundang Techno Park 151
Sungnam, Kyungki-do, 463-070
Korea
Tel +82 31 708 2522

Brooks Instrument (Shanghai) Co. LTD
RM 203, Bldg 6
NO 1888 Xin Jin Qiao Rd
Jinqiao E.P.Z. Pudong
Shanghai 201206
China
Tel 86-21-3895-4788

In case you need technical assistance:

USA	☎ 888 275 8946	Korea	☎ +82 31 708 2521
Netherlands	☎ +31 (0) 318 549290	Taiwan	☎ +886 3 5590 988
Germany	☎ +49 351 215 2040	China	☎ +86 21 5079 8828
Japan	☎ +81 3 5633 7100	Singapore	☎ +6297 9741

Remove the envelope containing the packing list. Outside of your clean area, carefully remove the equipment from the packing case. Make sure spare parts are not discarded with the packing material. Inspect the contents for damaged or missing parts.

2-3 Recommended Storage Practice

If intermediate or long-term storage of the device is required, it is recommended that it be stored in accordance with the following conditions:

- Within the original shipping container.
- Ambient temperature 21°C (70°F) nominal, 32°C (90°F) maximum, 7°C (45°F) minimum.
- Relative humidity 45% nominal, 60% maximum, 25% minimum.

2-4 Return Shipment

Prior to returning any device to the factory, visit the Brooks web site (www.BrooksInstrument.com) for a Return Materials Authorization Number (RMA#), or contact one of the locations provided on p. 2-1.

Prior to returning the device, it must be purged in accordance with the following:

⚠ WARNING

Before returning the device purge thoroughly with a dry inert gas such as Nitrogen before disconnecting gas connections. Failure to correctly purge the instrument could result in fire, explosion or death. Corrosion or contamination may occur upon exposure to air.

All flow devices returned to Brooks require completion of Form RPR003-2, Brooks Instrument Decontamination Statement, along with a Material Safety Data Sheet (MSDS) for the fluid(s) used in the instrument. Failure to provide this information will delay processing by Brooks personnel. Copies of these forms can be downloaded from the Brooks website (www.BrooksInstrument.com) or are available from any of the Brooks Instrument locations provided on p. 2-1.

2-5 Transit Precautions

To safeguard against damage during transit, transport the device to the installation site in the same container used for transportation from the factory, if circumstances permit.

2-6 Removal from Storage

Upon removal of the device from storage, a visual inspection should be conducted to verify its "as-received" condition. If the device has been subject to storage conditions in excess of those recommended (refer to "2-3 Recommended Storage Practice" on p. 2-1), it should be subjected to a pneumatic pressure test in accordance with applicable vessel codes. To maintain a device's clean integrity, this service should be performed by the factory or one of the certified service centers.

2-7 Gas Connections

Prior to installation, ensure that all piping is clean and free from obstructions. Install piping in such a manner that permits easy access to the device if removal becomes necessary.

2-8 In-Line Filter

It is recommended that an in-line filter be installed upstream from the device to prevent the possibility of any foreign material entering the flow sensor or control valve. The filtering element should be replaced periodically or ultrasonically cleaned.

2-9 Mechanical Installation

⚠ CAUTION

When installing the Mass Flow Controller or Meter, care should be taken that no foreign materials enter the inlet or outlet of the instrument. Do not remove the protective end caps until the time of installation.

The recommended installation procedure guidelines are as follows:

- The device should be located in a clean, dry atmosphere relatively free from shock and vibration.
- Leave sufficient room for access to the user interface and MAC ID and baud rate switches (if equipped) at the top of the device.
- Install the device in such a manner that permits easy purge and removal if the device requires servicing.

⚠ CAUTION

When used with a reactive (sometimes toxic) gas, contamination or corrosion may occur as a result of plumbing leaks or improper purging. Plumbing should be checked carefully for leaks and the instrument purged with clean, dry N_2 before use.

The GF80 Series also utilizes MultiFlo® technology that allows the user to configure standard configurations or "blanks" for a variety of pure gases and mixtures. As a result, MultiFlo® technology enables the user to reduce unique inventory requirements.

2-10 Flow Controller Installation Arrangement

Typical gas supply arrangements are shown in Figure 2-1. GF80s/GF81s are often arranged inside a gas panel. Configure standard configurations or "blanks" for a variety of pure gases and mixtures. As a result, MultiFlo technology enables the user to reduce unique inventory requirements.

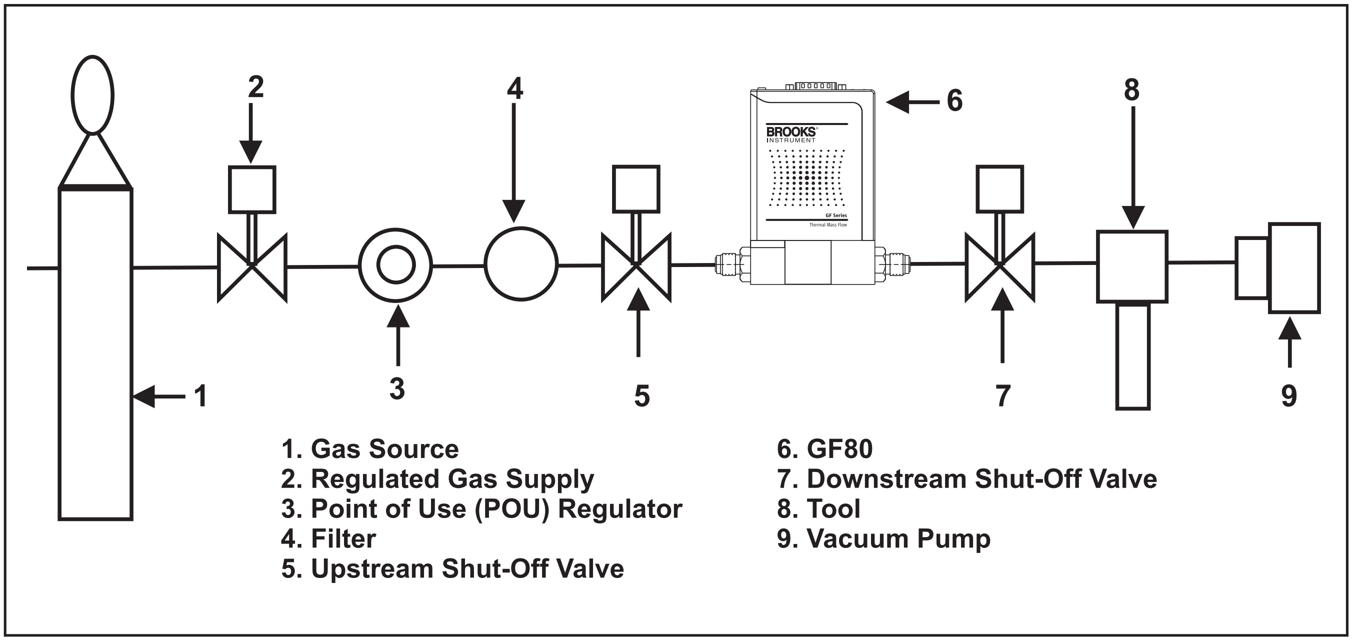


Figure 2-1 Typical Gas Supply Arrangement

2-11 Purge the Gas Supply Line Before GF80/GF81 Series Installation

CAUTION

For additional safety, it is recommended to close the two valves between the charged gas line and the GF80/GF81 Series to be installed. See Figure 2-1 for more details.

NOTICE

It is recommended to archive service and calibration documentation for the GF80/GF81 Series in order to determine the contamination state of each gas line and to assist service personnel.

CAUTION

DO NOT remove the shipping caps covering the inlet/outlet for VCR fittings before the GF80/GF81 Series is actually being installed. Failure to comply will introduce contaminants into the GF80/GF81 Series.

Before operating the GF80/GF81 Series, the gas supply line must be completely purged with nitrogen or argon to ensure the line is free from toxic or flammable gases, contaminants, moisture, and oxygen. The purge gas must be free of moisture and oxygen to less than 100 ppb. Purge the gas lines as follows or in accordance with prescribed company and safety procedures.

1. Shut off the process gas supply valve(s) upstream of the GF80/GF81 Series. If such a valve is not available, shut the valve on the gas panel. Tag the valve at this point to prevent accidental re-exposure of the process gas to the gas line.
2. Cycle purge the gas line with dry nitrogen or argon to fully flush out the process gas. Cycle purging consists of evacuating to a low pressure adequate to induce out-gassing and then purging to remove adhered moisture and oxygen. If a toxic or reactive gas is present and a clogged GF80/GF81 Series is suspected, then proceed with caution. Pump down and purge the GF80/GF81 Series from both downstream and upstream lines. If check valves are present in the gas line, both pumping down and purging are required. Pumping down without purging is inadequate. If a good vacuum source is not available, the GF80/GF81 Series can be de-contaminated by purge only.
3. Repeat the purge cycle several times within 2-4 hours to complete the cleaning. For toxic and corrosive gasses, it is recommended to use 100-120 cycles.

2-12 Position and Mount the GF80/GF81 Series

It is recommended that the MFC is re-zeroed with process gas following the recommended Brooks procedure (see zeroing bulletin FSB-001-0015 for futher information).

Secure the GF80/GF81 Series block to the gas panel with two, 8-32-UNC-2B" screws. Then connect the inlet/ outlet fittings to the gas supply line using two wrenches. Tighten the fittings to manufacturer recommendations.

2-13 Perform a Leak Test

WARNING

Before operating the flowmeter, ensure all fluid connections have been properly tightened and, where applicable, all electrical connections have been properly terminated.

It is critical to leak test the gas supply lines and GF80/GF81 Series connections before turning on the process gas supply after any new installation. Check for leaks using a helium leak detector or any other appropriate leak test method. Follow leak test specifications as defined by integrator.

2-14 Performance Checks

This section describes how to zero and sequence the GF80/GF81 Series devices for proper operation.

NOTICE

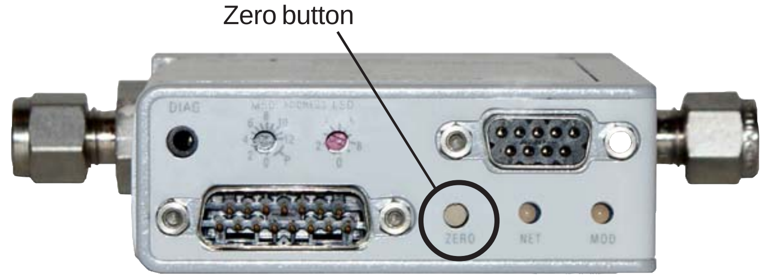
If the GF80/GF81Series has been in the purge mode for a long period of time, wait until the GF80/GF81 Series has cooled down before zeroing. The cool down period should be ~30 minutes for purges up to five minutes and at least 60 minutes after purging overnight.

- The GF80/GF81 Series must be warmed up for at least 45 minutes.
- The active gas page must be correct.

2-15 Zeroing Setup Process

The following steps are required before the GF80/GF81 Series is zeroed.

1. Place the GF80/GF81 under normal inlet operating pressure.
2. Make sure that the GF80/GF81 Series has been installed inside the equipment (panel) for at least four hours and powered up at least one hour prior to zeroing. This insures that the GF80/GF81 Series is in its "use attitude" and is operating at normal temperature. If the GF80/GF81 Series is subjected to a vacuum purge for more than one minute, turn off the GF80/GF81 Series (i.e., provide a zero setpoint) for a time period of twice the vacuum purge time.



Location of Zero button shown above on Profibus model, exact location on other models may vary.

Figure 2-2 Zero Button Accessible at Top of Device

3. Refer to Figure 2-1. Open the upstream shut-off valve (5) and close the downstream shut-off valve (7). This eliminates a pressure drop across the GF80/GF81 Series and subsequent leakage from the PID control valve inside the GF80/GF81 Series.
4. Provide a 100% setpoint to the GF80/GF81 Series for no longer than 30 seconds. This equalizes the pressure across the PID control valve.
5. Refer to Figure 2-1. Close the upstream shut-off valve (5) to prevent any pressure effects from the regulator (3).
6. Close the GF80/GF81 Series and wait two minutes.
7. Read the output signal of the GF80/GF81 Series in percent of full scale. This output signal is the initial flow. The output signal should be 0.0 (± 0.1%). If the output signal is too high, re-zero the GF80/GF81 Series as described in Section 2-16.

2-16 Zeroing the GF80/GF81 Series

⚠ NOTICE

Make sure you perform the zeroing set-up process outlined in Section 2-15 before zeroing the GF80/GF81 Series.

1. Allow time for gas pressure to equalize across the MFC's internal control valve to ensure gas movement.
2. Press and hold down the Zero button, shown in Figure 2-4, for a minimum of 5 seconds.

2-17 Auto Shut-Off

The Auto Shut-off feature closes the GF0xx valve when the set point drops below 1.5% of full scale. When the Auto Shut-off feature is NOT chosen, then the GF0xx valve will shut off when the set point drops below 0.5% of full scale.

2-18 Using the MultiFlo™ Configurator

The MutliFlo Configurator application is used to configure the gas and range of the GF80 Series devices.

The MultiFlo Configurator application allows communication to GF80 Series devices through personal computer with serial COM Port and a Windows XP or Windows 7 operating system. It's primary function is to configure gas and flow ranges within defined standard configurations. Flow ranges are configured to the Nitrogen equivalent.

Using the MultiFlo Configurator software, configure the gas and flow rate according to Table 2-1.

The MultiFlo Configurator interfaces to the GF80 Series device through RS485. There are various ways to connect the device regardless of device configuration. Devices may be connected through the diagnostic port using cables in one of the following MultiFlo Configurator Kits.

MultiFlo™ Configurator Accessory Kits:

MultiFlo kits are available in the following configurations:

778Z010ZZZ	**Basic MultiFlo Configurator Kit**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
778Z012ZZZ	**GF0xx RS485 Analog/Profibus® MultiFlo Configurator Kit w/Power Supply 24 Vdc**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
641Z117AAA	Power Supply 24 Vdc with DB-15 female
778Z013ZZZ	**GF0xx EtherCAT® MultiFlo Configurator Kit w/Power Supply 24 Vdc**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
641Z117AAA	Power Supply 24 Vdc with DB-15 female
124Z170AAA	Cable, Power, EtherCAT to DB-15 male
778Z014ZZZ	**GF0xx DeviceNet™ MultiFlo Configurator Kit w/Power Supply 24 Vdc**
A331710003	Cable Assembly 2.5mm
214F027AAA	USB-RS485 converter with DB-9 female
641Z117AAA	Power Supply 24 Vdc with DB-15 female
124Z171AAA	Cable, Power, DeviceNet to DB-15 male

Connect the MultiFlo cable adapter 2.5-mm jack to the diagnostic port on the top of the device. See Figure 2-5.

Connect the RS485 end of the converter to the 15-pin RS485 end of the MultiFlo Cable Adapter.

Connect the USB end of the converter to the Serial Port of a laptop or PC.

Table 2-1 Gas and Flow Ranges - MultiFlo Configurable - N2 Equivalent

Standard MG-MR Bin Configurations	Flow range Code	Gas Flow Range (N2 Equivalent)
SH40	010C	3-10 sccm
SH41	030C	11-30 sccm
SH42	092C	31-92 sccm
SH43	280C	93-280 sccm
SH44	860C	281-860 sccm
SH45	2.6L	861-2600 sccm
SH46	7.2L	2601-7200 sccm
SH47	015L	7201-15000 sccm
SH48	030L	15001-30000 sccm
SH49	040L	30001-40000 sccm
SH50	055L	40001-55000 sccm

The latest MutliFlo Configurator Software and Databases and MultiFlo Configurator Quick Start Guide are available on the Brooks Instrument website at: www.BrooksInstrument.com/MultiFlo. Please reference the MultiFlo Configurator Quick Start Guide for installation and operation details. Download the MultiFlo Configurator software into your computer from the Brooks Instrument website www.BrooksInstrument.com/MultiFlo. Install the MultiFlo Configurator as described in the MultiFlo Configurator Quick Start Guide and use the guide as a reference for operation details.

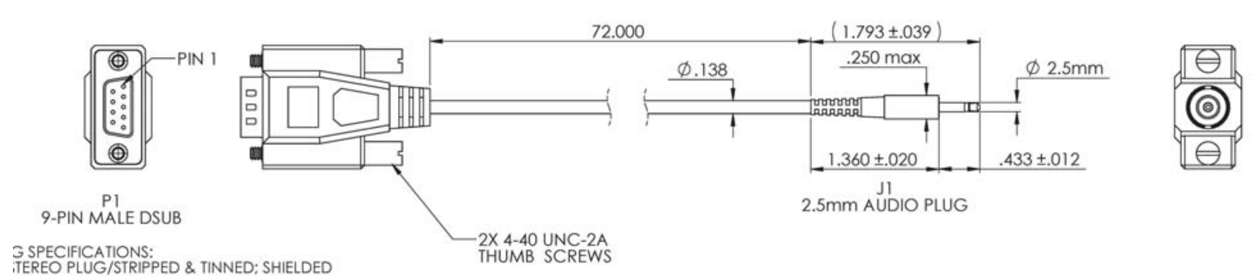
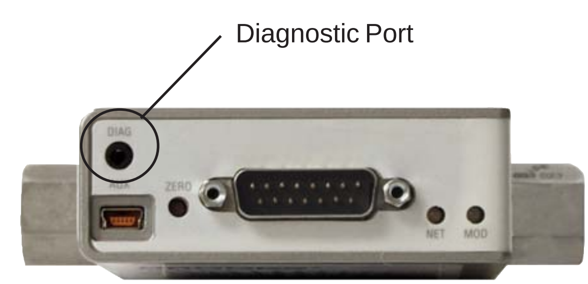


Figure 2-5 2-3 MultiFlo Cable Adaptor

Figure 2-4 USB-RS485 Converter (P/N 214F027AAA)



Location of Diagnostic Port shown above on RS485/ Analog model, exact location on other models may vary.

Figure 2-5 Diagnostic Port

2-19 Electrical Connections

⚠ CAUTION

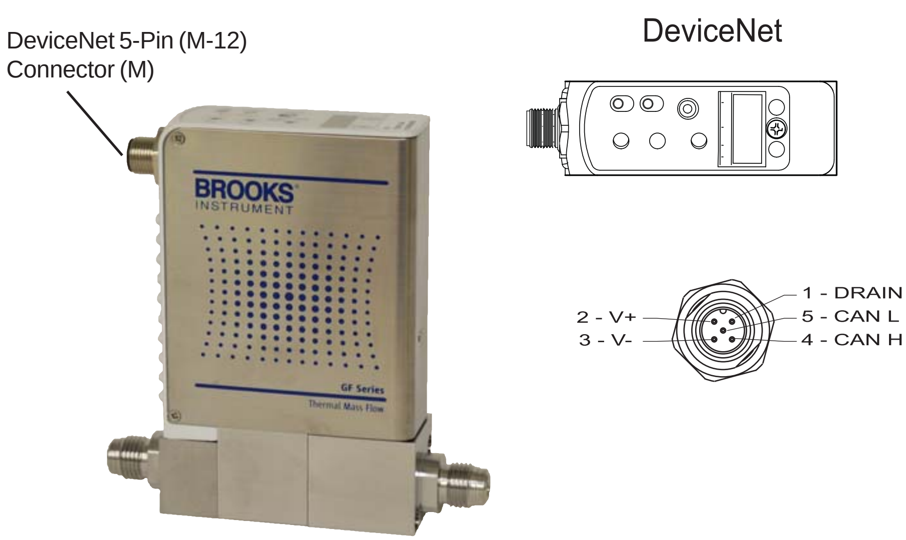
DO NOT make any connections to unlabeled connector pins. Any failure to comply could damage the GF80/GF81 Series and/or the mating electrical device. Before connecting the cable, make sure that all pin connections of the mating cable have the same pin out connections. When installing and removing cables to and from your computer, make sure the power is turned off on your computer. This will prevent damage to your computer and associated equipment.

2-19-1 DeviceNet Connections (GF80)

DeviceNet is a 5 wire local network connection that employs a command response communication protocol for communicating between a master and slave. Obtain a DeviceNet communication cable (Micro M-12) and fasten it to the 5-pin connector as shown in Figure 2-8.

⚠ CAUTION

DO NOT apply more than 10 Inch-Pounds of torque to the cable coupling when connecting the cable to the device or damage may result to the connector.



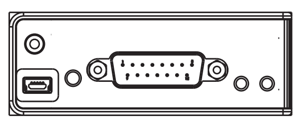
Pin No.:	Signals:
1	DRAIN
2	V+ (11-25 Vdc)
3	V-
4	CAN-H
5	CAN-L

Figure 2-6 GF80 Series DeviceNet Connection and Pinouts

2-19-2 Analog/RS485 Connections

The GF80/GF81 Series devices are available with the Analog/RS485 15-Pin D-Connector shown in Figure 2-9.

It is recommended that when using -15 Vdc & 0, the wiring hook-up should be: -15V is connected to Pin 9 (POWER COMMON) and 0 is connected to Pin 5 (POWER SUPPLY(+12 to +24 VDC)).

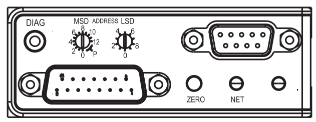


Pin No.:	Signals:
1	SETPOINT COMMON
2	FLOW OUTPUT (0-5V, 0-10V)
3	ALARM OUT
4	FLOW OUTPUT (0-20mA, 4-20mA)
5	POWER SUPPLY (+12V to +24Vdc)
6	NC
7	SETPOINT INPUT (0-20mA, 4-20mA)
8	SETPOINT INPUT (0-5V, 0-10V)
9	POWER COMMON
10	FLOW OUT COMMON
11	NC
12	VALVE OVERRIDE INPUT
13	RESERVED
14	RS485B
15	RS485A

Figure 2-7 GF80/GF81 Series with 15-Pin Analog Connector and Pinouts

2-19-3 Profibus Connections

The GF80/GF81 Series devices are available with the Profibus connections as shown in Figure 2-10.



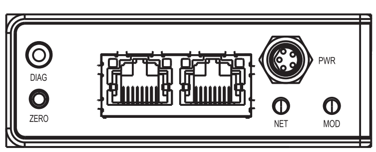
Pin No.:	Signals:
1	SETPOINT COMMON
2	FLOW OUTPUT (0-5V)
3	ALARM OUT
4	FLOW OUTPUT (0-20mA, 4-20mA)
5	POWER SUPPLY (13.5-27V)
6	NC
7	SETPOINT INPUT (0-20mA, 4-20mA)
8	SETPOINT INPUT (0-5V)
9	POWER COMMON
10	FLOW OUT COMMON
11	NC
12	VALVE OVERRIDE INPUT
13	RESERVED
14	NC
15	NC

Pin No.:	Signals:
1	NC
2	NC
3	RXD/TXD - B - red wire
4	NC
5	Ground
6	+5Vdc
7	NC
8	RXD/TXD - A - green wire
9	NC

Figure 2-8 GF80/GF81 Series Profibus Connections and Pinouts

2-19-4 EtherCAT Connections

The GF80 Series devices are available with the EtherCAT connections as shown in Figure 2-11.



Pin No.:	Signals:
1	POWER SUPPLY (13,5-27V)
2	FLOW OUT COMMON
3	POWER COMMON
4	FLOW OUTPUT (0-5V)
5	RESERVED

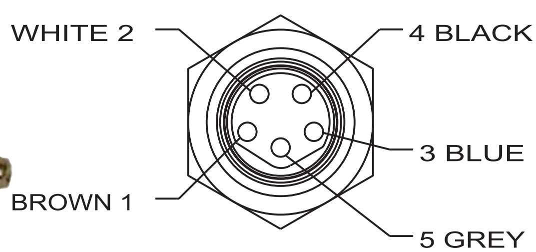


Figure 2-9 GF80 Series EtherCAT Connections and Pinouts

2-19-5 Alarm Output (Analog I/O versions only)

The Alarm Output is an open collector or "contact" type that is CLOSED (on) whenever an alarm is active. The Alarm Output may be set to indicaqte any one of various conditions.

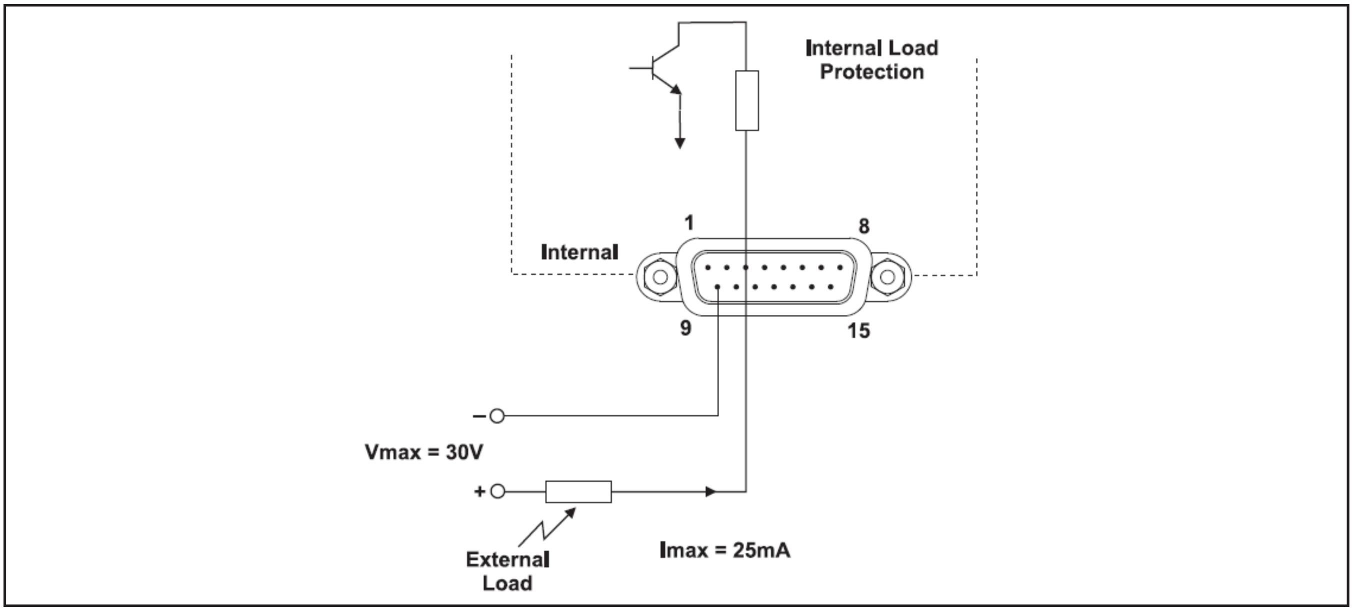


Figure 2-10 Alarm Output Schematic

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3-1 General

After the device has been properly installed in the process, it is ready for operation. When initiating flow, slowly open any upstream shutoff valve to avoid a flow surge. A bypass is helpful in bringing the flow on smoothly. Avoid starting a pump to supply the device without the use of a valve upstream of the device.

CAUTION

Any sudden change in system pressure may cause mechanical damage to elastomer materials. Damage can occur when there is a rapid expansion of fluid that has permeated elastomer materials. The user must take the necessary precautions to avoid such conditions.

WARNING

Before operating the flow controller, ensure all gas connections have been properly tightened and, where applicable, all electrical connections have been properly terminated.

3-2 Theory of Operation for Flow Measurement

The thermal mass flow measurement system consists of two components: the restrictor or bypass and the flow sensor. Figure 3-1 is a diagram of the flow stream through the device, with an enlarged view of the flow sensor. Gas flow entering the device is separated into two paths; one straight through the restrictor and the other through the flow sensor.

The separation of the flow streams is caused by the restrictor. During flow conditions, there will be a pressure differential across the restrictor that forces gas to flow in the sensor.

The pressure difference caused by the restrictor varies linearly with total flow rate. The sensor has the same linear pressure difference versus flow relationship. The ratio of sensor flow to the flow through the restrictor remains constant over the range of the device. The full scale flow rate of the device is established by selecting a restrictor with the correct pressure differential for the desired flow.

The flow sensor is a very narrow, thin-walled Hastelloy tube. This tube has upstream and downstream temperature sensing and heating elements. During no-flow conditions, the amount of heat reaching each temperature sensor is equal, so temperatures T1 and T2 (Figure 3-1) are equal. Gas flowing through the tube carries heat away from the upstream temperature sensor and toward the downstream sensor. The temperature difference, T2 – T1, is directly proportional to the gas mass flow.

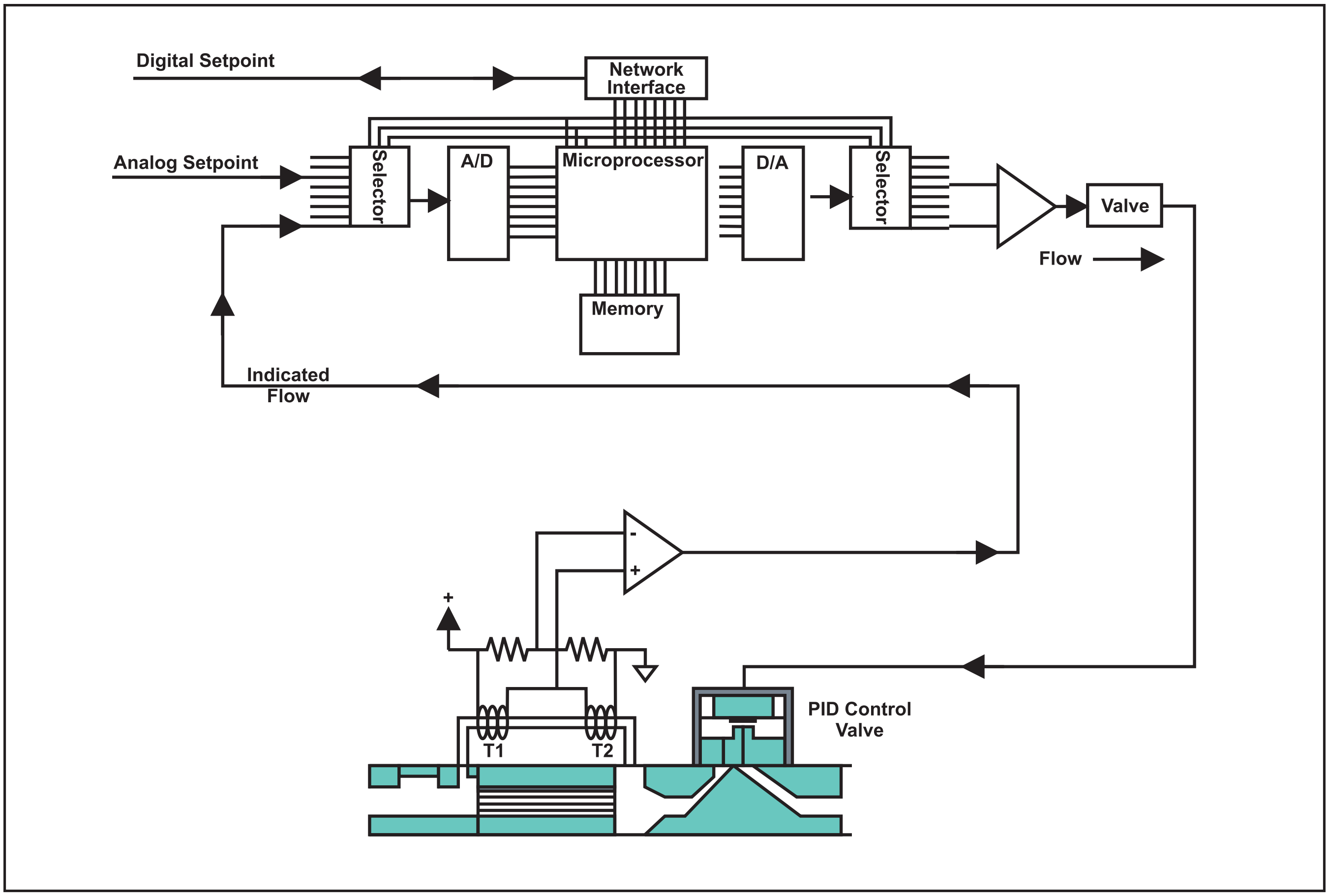

Figure 3-1 GF80/GF81 Series Operating Principles

4-1 Overview

No routine maintenance is required on the Brooks GF80/GF81 Series devices. If an in-line filter is used, the filtering elements should be periodically replaced or cleaned. Any precision unit such as a flow controller requires occasional servicing, especially if it has been operating for an extended period of time. If reactive gases are being used, it is recommended that you send the device to a Brooks Service Center for cleaning and recalibration. Please follow the instructions for removal, product packaging and product return instructions found in Section 2-Installation—Return Shipment. All active process instrumentation and equipment is subject to aging and wear from their environment. This includes temperature, mechanical stress, component tolerance shift, contaminant buildup, oxidation, and other influences. The effects are gradual, but over time the changes can affect the accuracy of even the best equipment. Therefore, it is recommended to re-zero the device at 6 month intervals. Refer to Section 2-14 Performance Checks for re-zeroing instructions.

4-2 Maintenance

⚠ WARNING

METER/CONTROLLER SEAL COMPATIBILITY

Products in this manual may contain metal or elastomeric seals, gaskets, O-rings or valve seats. It is the "user's" responsibility to select materials that are compatible with their process and process conditions. Using materials that are not compatible with the process or process conditions could result in the Meter or Controller leaking process fluid outside the pressure boundary of the device, resulting in personnel injury or death.

It is recommended that the user check the Meter or Controller on a regular schedule to ensure that it is leak free as both metal and elastomeric seals, gaskets, O-rings and valve seats may change with age, exposure to process fluid, temperature, and /or pressure.

WARNING

If it becomes necessary to remove the controller from the system after exposure to toxic, pyrophoric, flammable or corrosive gas, purge the controller thoroughly with a dry inert gas such as Nitrogen before disconnection the gas connections. Failure to correctly purge the controller could result in fire, explosion or death. Corrosion or contamination of the mass flow controller, upon exposure to air, may also occur.

WARNING

If it becomes necessary to remove the instrument from the system, power to the device must be disconnected.

CAUTION

It is important that this device only be serviced by properly trained and qualified personnel.

CAUTION

This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.

4-3 Troubleshooting

This section includes a Troubleshooting Checklist and a GF80/GF81 Series Troubleshooting Guide that identifies symptoms, possible causes, and corrective actions.

NOTICE

OEM tool problems are often caused by something other than the GF80/GF81 Series. Therefore, Brooks recommends that you review both the Troubleshooting Checklist and the GF80/GF81 Series Troubleshooting Guide before removing the GF80/GF81 Series from your system. It is also suggested to contact your Brooks Service representative before removing the GF80/GF81 Series from your system.

4-4 Troubleshooting Checklist

1. Check environmental factors that could affect changes to GF80/GF81 Series performance. The most common environmental factors are listed in Table 4-1.
2. Check supply voltage and check for a consistent ground.
3. Insure OEM tool setpoint matches the setpoint at the GF80/GF81 Series. Observe for consistency.
4. Verify isolations valves are open and the gas supply is turned on. Then verify operating pressures are within operating ranges.
5. Check GF80/GF81 Series voltage response by moving the setpoint back and forth.

   Observe for voltage changes.

Table 4-1 Environmental Factors

GF80/GF81 Series Performance	Possible Causes
Inaccurate flow.	Temperature shift (steady state or transient). Inlet pressure shift (steady state or transient). Power supply problem. Electrical interference Dirty gas chamber Changes in gas.
Control problems. Can not reach setpoint. Oscillation.	Differential pressure not within operating range Inlet pressure not stable
Zeroing problems, Indicated zero is not stable.	Temperature shift (steady state or transient). Inlet pressure shift (steady state or transient). Power supply problem. Electrical interference

4-5 GF80/GF81 Series Troubleshooting Guide

Table 4-2 GF80/GF81 Series Troubleshooting Guide

Symptoms & Possible Causes	Corrective Action
1. No gas flow.	
Is the gas supply turned on?	Check shut-off valve and pressure readout. Open the gas supply.
Is the regulator turned on at the correct operating pressure?	Turn off the regulator and reset it to the recommended pressure as described in the Data Sheet.
Are any upstream or downstream shut-off valves closed, either by the system or because of failure?	Verify that the valves are open and operating properly.
Is the MOD LED light on the GF80/GF81 Series lit solid green?	Observe the LED display panel on top of the GF80/GF81 device to verify. If the LED light is not lit, cycle power to reboot the device.
Is the commanded setpoint from tool/system at 0.00 Vdc?	Use the tool software to verify.
Has the valve been commanded off by an active “valve closed” input?	Use the tool software to verify. Confirm that pin 12 is not connected to DC common.
2. Flow out of range.	
Is the gas inlet/outlet pressure differential either too high or too low? NOTE: If the differential pressure is too high, voltage to the valve will be zero, which is abnormally low for the setpoint. If the differential is too low, voltage to the valve will be at its maximum value, which is abnormally high for the set-point.	Verify that the pressure is correct for the gas and range. If required, adjust inlet/outlet pressure to achieve proper pressure reading.
Is the MOD LED light on the GF80/GF81 Series lit solid green?	Observe the LED at the top of the GF80/GF81 device. If the LED light is not lit, cycle power the device to reboot.
Is the setpoint correct for the required gas flow?	Use the tool software to verify the analog signal.
Is the device calibrated for the particular gas?	Check the device side label. Run a flow check to verify.

Table 4-2 GF80/GF81 Series Troubleshooting Guide (Continued)

Symptoms & Possible Causes	**Corrective Action**
2. Flow out of range (Contintued).	
Is the device zero correct?	Zero the device according to zeroing procedure in Section 2-16. Verify leak check rates are OK.
3. No gas control; flow is at or above maximum.	
Is the gas pressure across the device too high?	Verify that the pressure is correct for the gas and range. If required, adjust inlet/outlet pressure to achieve proper pressure reading.
Are system valves open, or is the purge input activated?	Use tool software to verify. Confirm that pin 12 is not connected to an active voltage source.
Is the setpoint correct for the required flow?	Use tool software to verify.
4. No gas flow above some setpoint.	
NOTE: When the setpoint is increased beyond this point, the GF80/GF81 Series signal remains at some value lower than the set-point.	
Is the gas inlet/outlet differential pressure sufficient? NOTE: If the pressure is too low, the valve voltage to the GF80/GF81 Series will be at its maximum output. This condition will cause internal GF valve heating and inability to properly reach desired flow setpoints.	Verify that the pressure is correct for the gas and range. If required, adjust regulator to achieve proper pressure.
Is the GF80/GF81 Series calibrated for the gas flow?	Check GF80/GF81 Series side label. Run a flow check to verify. If flow is incorrect, replace the GF80/GF81 Series with a unit that is calibrated properly.

Table 4-2 GF80/GF81 Series Troubleshooting Guide (Continued)

Symptoms & Possible Causes	Corrective Action
5. No gas flow below some setpoint.	
NOTE: When the setpoint is decreased below this point, the GF80/GF81 Series signal remains at some value higher than the setpoint. Is the gas inlet/outlet differential pressure too high?	Verify that the pressure is correct for regulator to achieve proper pressure.
Is the GF80/GF81 Series leaking?	Check for contamination. Test the GF80/GF81 Series for leak integrity. Replace the GF80/GF81 Series if leakage is detected.
6. Gas flow oscillates.	
Is the GF80/GF81 Series calibrated for the gas flowing?	Check the GF80/GF81 Series side can label. Run a flow check to verify. If flow is incorrect, replace the GF80/GF81 Series.
Is there too much gas pressure across the GF80/GF81 Series?	Verify that the pressure is correct for this gas and range. If required, adjust regulator to achieve proper pressure reading.
Are inlet and outlet pressures stable?	If outlet pressure is unstable, check for (no oscillation or hunting) a faulty vacuum pump, or hunting at a downstream valve. Check inlet pressure on tool. A faulty pressure regulator can make the GF80/GF81 Series appear to oscillate. Adjust inlet pressure up or down by 2 psig increments until hunting disappears. Verify common gas pressure is within range. NOTE: Hunting or oscillation can be contributed to multiple GF80/GF81 Series sharing a common gas manifold. Therefore, inspect gas delivery sources to the gas box (for example; two tools sharing a common gas bottle and calling for gas at the same time). Valve leak. Unregulated gas pressure from Facilities.

Table 4-2 GF80/GF81 Series Troubleshooting Guide (Continued)

Symptoms & Possible Causes	**Corrective Action**
7. OEM tool does not read correct GF80/GF81 Series zero reading.	
Is the differential pressure across the GF80/GF81 Series really zero? Is the supply voltage within specified range? Is the GF80/GF81 Series mounted in the proper attitude? Is the flow output signal of the GF80/GF81 Series really zero?	GF80/GF81 Series valve leakage. Incorrect MFC zero.
8. Zero Drift.	
Improper zero of the GF80/GF81 Series? Excessive Valve leakage? **9. Calibration Drift.**	GF80/GF81 Series aging or sensor stabilization. Zero is not correct.
Gas box temperature too high? Is it linear offset?	Zero is not correct.
10. GF80/GF81 Series indicates Overshoot.	
If the tool is idle for an extended period of time, high inlet pressure or contamination will cause overshoot on first use.	Purge the line before operating.
11.OEM tool indicates the wrong full scale value for GF80 Series.	
Older version of Multiflo Configurator used to program GF80 Series.	Update Multiflo Configurator. Refer to Section 2-17.
12. GF80/GF81 Series dumps large volume of gas into chamber when setpoint is commanded from the tool.	
The tool is commanding a setpoint before the pneumatic valves are opened. GF80/GF81 Series and pneumatic timing may be offset. GF80/GF81 Series overshoots.	Change the tool sequence.
13. Tool display output doesn't match GF80/GF81 Series flow output.	
Cable resistance or read-out impedance causing offset in the tool's display.	Check cables and read out. Eliminate any ground loops.

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5 Product Description Code

Table 5-1 GF80 Series Product Description Code Table

Code Description		Code Option	Option Description
I.	Base Model Code	**GF080**	Metal / Range Flow (0-55 slpm)
II.	Configurability	**C**	MultiFlo Capable. Standard Bins or specific gas range may be selected
		X	Not MultiFlo Capable. Specific gas/range required
III.	Special Application	**XX**	Standard
IV.	Valve Configuration	**C**	Normally Closed Valve
		M	Meter (No Valve)
V.	Gas or SH MultiFlo Bin	**XXXX XXXX**	Specific Gas Code & Range, i.e. "0004" = Argon and "010L" = 10 slpm
		SH40 010C	Standard Configuration #40, 3-10 sccm Nitrogen Equivalent (0° C Reference)
		SH41 030C	Standard Configuration #41, 11-30 sccm Nitrogen Equivalent (0° C Reference)
		SH42 092C	Standard Configuration #42, 31-92 sccm Nitrogen Equivalent (0° C Reference)
		SH43 280C	Standard Configuration #43,93-280 sccm Nitrogen Equivalent (0° C Reference)
		SH44 860C	Standard Configuration #44, 281-860 sccm Nitrogen Equivalent (0° C Reference)
		SH45 2.6L	Standard Configuration #45, 861-2600 sccm Nitrogen Equivalent (0° C Reference)
		SH46 7.2L	Standard Configuration #46, 2601-7200 sccm Nitrogen Equivalent (0° C Reference)
		SH47 015L	Standard Configuration #47, 7201-15000 sccm Nitrogen Equivalent (0° C Reference)
		SH48 030L	Standard Configuration #48, 15001-30000 sccm Nitrogen Equivalent (0° C Reference)
		SH49 040L	Standard Configuration #49, 30001-40000 sccm Nitrogen Equivalent (0° C Reference)
		SH50 055L	Standard Configuration #50, 40001-55000 sccm Nitrogen Equivalent (0° C Reference)
VI.	Fitting	**VX**	1/4" VCR
VII.	Downstream Condition	**A**	Atmosphere
		V	Vacuum
		P	Positive Pressure
VIII.	External Seals, Valve Seat	**S**	Seal Metal / Seat Metal (316 SS)
IX.	Communications / Connector	**P5**	Profibus / Analog (Input 0-5 V; Output 0-5 V); 9-Pin Female D conn. / 15-Pin Male D conn.
		P0	Profibus / Analog (Input 0-20 mA; Output 0-20 mA); 9-Pin Female D conn. / 15-Pin Male D conn.
		P4	Profibus / Analog (Input 4-20 mA; Output 4-20 mA); 9-Pin Female D conn. / 15-Pin Male D conn.
		E5	EtherCAT™/ (Output 0-5 V); 2xRJ45 signal 2-Pin power
		S5	RS485: (S-Protocol)/Analog (Input 0-5 V; Output 0-5 V)15-Pin Male D (Brooks® Protocol)
		S1	RS485: (S-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Brooks® Protocol)
		S0	RS485 (S-Protocol)/Analog (Input 0-20 mA ; Output 0-20 mA); 15-Pin Male D (Brooks® Protocol)
		S4	RS485 (S-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Brooks® Protocol)
		L5	RS485 (L-Protocol)/Analog (Input 0-5 V; Output 0-5 V); 15-Pin Male D (Celerity®/Legacy Protocol)
		L1	RS485 (L-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Celerity®/Legacy Protocol)
		L0	RS485 (L-Protocol)/Analog (Input 0-20 mA; Output 0-20 mA); 15-Pin Male D (Celerity®/Legacy Protocol)
		L4	RS485 (L-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Celerity®/Legacy Protocol)

Code Option	DeviceNet Standard Configuration Parameters									
	I/O	Connector	Power On State	Full Scale Setting	Full Scale Setting	Full Scale Setting	Poll IO Instance Producer	Poll IO Instance Consumer	Poll IO State Transition	External Baud Rate
D0	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	2	7	Executing	500KB
D1	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	21	7	Executing	500KB
D2	DeviceNet	5 Pin Micro	Idle	SCCM	Float	7FFFh	13	19	Executing	500KB
D3	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	7	Executing	500KB
D4	DeviceNet	5 Pin Micro	Executing	Count	Integer	6000h	22	8	Executing	500KB
D5	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	6	8	Executing	500KB
D6	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	3	7	Executing	500KB
D7	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	6	8	Executing	500KB
D8	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	3	7	Executing	500KB
D9	DeviceNet	5 Pin Micro	Executing	Count	Integer	6000h	2	7	Executing	500KB
DA	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	22	7	Executing	500KB
DB	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	8	Executing	500KB
DC	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	3	7	Idle	500KB
DD	DeviceNet	5 Pin Micro	Executing	Count	Integer	7FFFh	22	8	Executing	500KB
DE	DeviceNet	5 Pin Micro	Executing	Sccm	Float	6000h	15	19	Executing	500KB
DX	DeviceNet	5 Pin Micro	To be defined by CSR							

Table continued on next page.

Table 5-1 GF40/GF80 Series Product Description Code Table (Continued)

X.	Customer Special Request	**XXXX**	Customer Special Request Number
XI.	Auto Shut-Off	**A**	Auto Shut-Off (Included)
		X	Auto Shut-Off (Not Included)
XII.	Auto Zero	**A**	Auto Zero (Included)
		X	Auto Zero (Not Included)
XIII.	Reference Temperature	**00C**	0ºC Reference
		15C	15ºC Reference
		20C	20ºC Reference
		70F	21.1ºC Reference / 70ºF Reference

Example Model Code

I	II	III	IV		V		VI	VII	VIII	IX		X	XI	XII		XIII
GF080	C	XX	C	-	0013300C	-	T2	A	V	P5	-	XXXX	X	A	-	20C

Table 5-2 GF81 Series Product Description Code Table

Code	Description	Code Option	Option Description
I.	Base Model Code	GF081	Metal/Hi-flow (51-300 slpm N_2 Eq)
II.	Configurability	X	Specific Gas & Range Required
III.	Special Application	XX	Standard
IV.	Valve Configuration	C	Normally Closed Valve
		M	Meter (No Valve)
V.	Gas or Range	XXXX XXXX	Specific Gas Code & Range, example: "0007" = Hydrogen and "200L" = 200 slpm
VI.	Fitting	V1	1 -1/2" body width, 1/2" VCR, 134.2 mm
VII.	Downstream Condition	A	Atmospheric
		V	Vacuum
		P	Positive Pressure
VIII.	External Seal/Valve Seat	S	Metal Seal/Metal Seat
IX.	Communications/ Connector	P5	Profibus/Analog (Input 0-5 V; Output 0-5 V); 9-Pin Female D conn./15-Pin Male D conn.
		P0	Profibus/Analog (Input 0-20 mA; Output 0-20 mA); 9-Pin Female D conn./15-Pin Male D conn.
		P4	Profibus/Analog (Input 4-20 mA; Output 4-20 mA); 9-Pin Female D conn./15-Pin Male D conn.
		L5	RS485 (L-Protocol)/Analog (Input 0-5 V; Output 0-5 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		L1	RS485 (L-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Pin alignment with Celerity® Power)
		L0	RS485 (L-Protocol)/Analog (Input 0-20 mA; Output 0-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		L4	RS485 (L-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		A5	RS485 (A-Protocol)/Analog (Input 0-5 V; Output 0-5 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		A1	RS485 (A-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		A0	RS485 (A-Protocol)/Analog (Input 0-20 mA; Output 0-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		A4	RS485 (A-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		S5	RS485 (S-Protocol)/Analog (Input 0-5 V; Output 0-5 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		S1	RS485 (S-Protocol)/Analog (Input 0-10 V; Output 0-10 V); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		S0	RS485 (S-Protocol)/Analog (Input 0-20 mA; Output 0-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)
		S4	RS485 (S-Protocol)/Analog (Input 4-20 mA; Output 4-20 mA); 15-Pin Male D (Pin alignment with Brooks® SLA SII)

DeviceNet Standard Configuration Parameters

Code Option	I/O	Connector	Power On State	Full Scale Setting	Full Scale Setting	Full Scale Setting	Poll IO Instance Producer	Poll IO Instance Consumer	Poll IO State Transition	External Baud Rate
D0	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	2	7	Executing	500KB
D1	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	21	7	Executing	500KB
D2	DeviceNet	5 Pin Micro	Idle	SCCM	Float	7FFFh	13	19	Executing	500KB
D3	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	7	Executing	500KB
D4	DeviceNet	5 Pin Micro	Executing	Count	Integer	6000h	22	8	Executing	500KB
D5	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	6	8	Executing	500KB
D6	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	3	7	Executing	500KB
D7	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	6	8	Executing	500KB
D8	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	3	7	Executing	500KB
D9	DeviceNet	5 Pin Micro	Executing	Count	Integer	6000h	2	7	Executing	500KB
DA	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	22	7	Executing	500KB
DB	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	8	Executing	500KB
DC	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	3	7	Idle	500KB
DD	DeviceNet	5 Pin Micro	Executing	Count	Integer	7FFFh	22	8	Executing	500KB
DE	DeviceNet	5 Pin Micro	Executing	Sccm	Float	6000h	15	19	Executing	500KB
DX	DeviceNet	5 Pin Micro	To be defined by CSR							

Code	Description	Code Option	Option Description
X.	Customer Special Request	XXXX	Customer Special Request Number
XI.	Auto Shut-Off	A	Auto Shut-Off (Included)
		X	Auto Shut-Off (Not Included)
XII.	Auto Zero-Off	A	Auto Zero (Included)
		X	Auto Zero (Not Included)
XII.	Reference Temperature	00C	0 Deg C Reference
		15C	15 Deg C Reference
		20C	20 Deg C Reference
		70F	21.1 Deg C/70 Deg F Reference

Example Model Code

I	II	III	IV		V		VI	VII	VIII	IX		X	XI	XII		XIII
GF081	X	XX	C	-	0013 100L	-	V1	A	5	P5	-	XXXX	A	A	-	00C

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A GF80 Series Gas Table

Table A-1 GF80 Series Gas Table - Codes 1-129, Bins SH40-SH44

Gas Code	Gas Symbol	Gas Name	Min inlet pressure for vac. exhaust (PSIA)				SH40		SH41		SH42		SH43		SH44	
			SH40-SH47	SH48	SH49	SH50	Low	High	Low	High	Low	High	Low	High	Low	High
1	He	Helium	19.7	24.7	29.7	29.7	5	14	15	42	43	128	129	400	401	1194
2	Ne	Neon	24.7				5	14	15	42	43	129	130	400	401	1207
4	Ar	Argon	24.7	29.7	39.7	44.7	5	14	15	42	43	130	131	400	401	1214
5	Kr	Krypton	29.7				4	11	12	32	33	100	101	300	301	930
6	Xe	Xenon	24.7				3	6	7	19	20	58	59	178	179	546
7	H2	Hydrogen	14.7	14.7	19.7	19.7	3	10	11	30	31	92	93	280	281	860
8	Air	Air	24.7	29.7	29.7	34.7	3	10	11	30	31	92	93	280	281	860
9	CO	Carbon Monoxide	24.7	29.7			3	10	11	30	31	92	93	280	281	860
10	HBr	Hydrogen Bromide	24.7				3	8	9	25	26	77	78	235	236	723
11	HCl	Hydrogen Chloride	24.7	29.7	29.7	34.7	3	10	11	30	31	92	93	280	281	860
12	HF	Hydrogen Fluoride	14.7	17.7			3	10	11	30	31	94	95	281	282	880
13	N2	Nitrogen	24.7	29.7	29.7	32.7	3	10	11	30	31	92	93	280	281	860
14	D2	Deuterium	14.7	14.7			3	10	11	30	31	94	95	280	281	880
15	O2	Oxygen	24.7	29.7	29.7	34.7	3	10	11	30	31	92	93	280	281	860
16	NO	Nitric Oxide	24.7	29.7	39.7	39.7	3	10	11	30	31	92	93	280	281	860
17	HI	Hydrogen Iodide	24.7	29.7			3	5	6	15	16	46	47	141	142	432
18	F2	Fluorine	24.7	29.7			3	9	10	27	28	83	84	254	255	780
19	Cl2	Chlorine	24.7	29.7			3	6	7	19	20	57	58	173	174	531
22	H2S	Hydrogen Sulfide	24.7	29.7			3	8	9	25	26	76	77	232	233	713
23	H2Se	Hydrogen Selenide	24.7	29.7			3	7	8	22	23	66	67	202	203	620
25	CO2	Carbon Dioxide	24.7	29.7	29.7	29.7	3	7	8	22	23	69	70	209	210	642
27	N2O	Nitrous Oxide	24.7	29.7	29.7	29.7	3	7	8	21	22	65	66	200	201	611
28	CH4	Methane	24.7	24.7	29.7		3	8	9	23	24	71	72	215	216	660
29	NH3	Ammonia	24.7	24.7	29.7	29.7	3	8	9	24	25	73	74	223	224	685
30	O3	Ozone	24.7	29.7	29.7	39.7	3	8	9	26	27	82	83	250	251	770
31	PH3	Phosphine	19.7	24.7			3	7	8	22	23	67	68	205	206	629
32	SO2	Sulfur Dioxide	19.7	24.7			3	6	7	17	18	52	53	157	158	483
33	CH3F	Methyl Fluoride	24.7	29.7			3	7	8	22	23	67	68	204	205	625
34	COS	Carbonyl Sulfide	24.7	29.7			3	7	8	20	21	60	61	183	184	562
35	AsH3	Arsine	24.7	29.7			3	6	7	18	19	55	56	170	171	510
36	CH3Cl	Methyl Chloride	24.7	29.7	29.7	34.7	3	6	7	20	21	60	61	180	181	560
37	ClCN	Cyanogen Chloride	14.7	21.7			3	5	6	15	16	46	47	142	143	435
38	C2H4	Ethylene	24.7	29.7			3	6	7	17	18	54	55	163	164	501
39	SiH4	Silane	24.7	29.7			3	6	7	18	19	56	57	170	171	523
42	C2H2	Acetylene	16.7	19.7			3	6	7	18	19	57	58	170	171	530
43	GeH4	Germane	24.7	29.7			3	6	7	17	18	53	54	161	162	495
44	CH3Br	Methyl Bromide	19.7	24.7			3	4	5	12	13	36	37	110	111	332
45	C2H4O	Ethylene Oxide	14.7	24.7			3	5	6	15	16	46	47	140	141	440
46	COF2	Carbonyl Fluoride	19.7	19.7	21.7		3	5	6	17	18	53	54	160	161	500
47	CH3SH	Methyl Mercaptan	24.7	29.7			3	5	6	15	16	45	46	132	133	410
48	BF3	Boron Trifluoride	19.7	24.7			3	5	6	16	17	50	51	150	151	457
49	CHF3	Fluoroform (Freon-23)	24.7	24.7	24.7	26.7	3	5	6	16	17	48	49	145	146	445
51	C2H3F	Vinyl Fluoride	24.7	29.7	29.7	34.7	3	6	7	18	19	55	56	170	171	520
52	CH5N	Methylamine	24.7	29.7	29.7	34.7	3	5	6	15	16	44	45	133	134	410
53	NF3	Nitrogen Trifluoride	24.7	29.7	24.7	26.7	3	5	6	15	16	46	47	140	141	430
54	C2H6	Ethane	17.7	21.7	26.7	26.7	3	5	6	16	17	50	51	153	154	469
57	CHClF2	Chlorodifluoromethane (Freon-22)	24.7	29.7			3	4	5	12	13	37	38	112	113	350
58	B2H6	Diborane	19.7	19.7			3	4	5	12	13	38	39	116	117	358
60	COCl2	Phosgene	12.7	14.7			3	3	4	11	12	35	36	106	107	325
61	C3H6-a)	Cyclopropane	24.7	29.7			3	4	5	15	16	44	45	135	136	410
62	PF3	Phosphorus Trifluoride	19.7	24.7			3	4	5	14	15	42	43	129	130	400
63	CF4	Carbon Tetrafluoride (Freon-14)	24.7	24.7	24.7	26.7	3	4	5	13	14	40	41	121	122	372
67	SiH2Cl2	Dichlorosilane	14.7	19.7			3	3	4	10	11	29	30	89	90	273
69	C3H6-b)	Propylene	19.7	19.7			3	4	5	12	13	36	37	110	111	338
70	BCl3	Boron Trichloride	11.7	14.7			3	3	4	10	11	31	32	94	95	289
72	ClO3F	Perchloryl Fluoride	14.7	20.7			3	4	5	12	13	38	39	114	115	350
73	C2H6O	Dimethylether	14.7	19.7			3	3	4	11	12	36	37	108	109	333
74	CClF3	Chlorotrifluoromethane (Freon-13)	24.7	29.7			3	4	5	13	14	39	40	120	121	360
77	ClF3	Chlorine Trifluoride	14.7	20.7			3	4	5	11	12	35	36	107	108	327
79	BBr3	Boron Tribromide	24.7	29.7	39.7	39.7	3	4	5	12	13	38	39	115	116	360
80	CBrF3	Bromotrifluoromethane (Freon-13E	24.7	29.7			3	3	4	10	11	32	33	100	101	299
84	CCl2F2	Dichlorodifluoromethane (Freon-12	24.7	29.7			3	3	4	10	11	30	31	92	93	285
85	C2H7N	Dimethylamine	9.7	14.7			3	3	4	11	12	34	35	101	102	310
88	SiF4	Silicon Tetrafluoride	19.7	24.7			3	4	5	11	12	34	35	103	104	316
89	C3H8	Propane	9.7	11.7			3	3	4	10	11	32	33	100	101	300
94	C2F4	Tetrafluoroethylene	19.7	19.7			3	3	4	10	11	31	32	100	101	300
97	Si2H6	DISILANE	19.7	19.7			3	3	4	10	11	30	31	92	93	282
98	C4H8-j)	Transbutene	19.7	19.7			3	3	4	10	11	27	28	83	84	250
99	GeF4	Germanium Tetrafluoride	20.7	24.7			3	3	4	10	11	30	31	92	93	282
100	C4H6-e)	Butadiene	19.7	19.7			3	3	4	10	11	30	31	92	93	280
102	POCl3	Phosphorus Oxychloride	9.7	9.7	14.7	14.7			3	4	5	14	15	45	46	139
104	C4H8-i)	Butene	20.7	24.7					3	5	6	17	18	52	53	160
106	C4H8-h)	Isobutylene	24.7	29.7			3	3	4	9	10	28	29	86	87	260
107	C4H8-g)	Cisbutene	24.7	29.7			3	3	4	9	10	28	29	85	86	260
108	SiCl4	Silicon Tetrachloride	8.7						3	6	7	18	19	56	57	172
109	C3H9N	Trimethylamine	6.7	8.7					3	8	9	25	26	78	79	240
110	SF6	Sulfur Hexafluoride	19.7	19.7	19.7	20.7			3	8	9	25	26	77	78	237
111	C4H10-d)	Isobutane	19.7	19.7	19.7	20.7			3	7	8	23	24	70	71	216
113	GeCl4	Germanium Tetrachloride	19.7	24.7	32.7	32.7	3	3	4	9	10	28	29	87	88	261
117	C4H10-c)	Butane	19.7	19.7	19.7	20.7			3	8	9	25	26	76	77	234
118	C2F6	Hexafluoroethane (Freon-116)	19.7	19.7					3	8	9	23	24	71	72	218
119	C2ClF5	Chloropentafluoroethane (Freon-1	24.7	29.7					3	7	8	22	23	70	71	210
121	WF6	Tungsten Hexafluoride	9.7	11.7					3	5	6	16	17	50	51	150
122	C5H12	Dimethylpropane	24.7	29.7					3	6	7	20	21	61	62	190
128	C3F8	Perfluoropropane	19.7	19.7					3	5	6	16	17	50	51	154
129	C4F8	Octafluorocyclobutane	19.7	19.7					3	5	6	16	17	50	51	154

For reference only, consult factory on the latest tables.

Table A-2 GF80 Series Gas Table - Codes 1-129, Bins SH45-SH50

Gas Code	Gas Symbol	Gas Name	Min inlet pressure for vac. exhaust (PSIA)				SH45		SH46		SH47		SH48		SH49		SH50	
			SH40-SH47	SH48	SH49	SH50	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	He	Helium	19.7	24.7	29.7	29.7	1195	3609	3610	11100	11101	23100	23101	47000	47001	#####	#####	100001
2	Ne	Neon	24.7				1208	3650	3651	10700	10701	22100						
4	Ar	Argon	24.7	29.7	39.7	44.7	1215	3671	3672	10000	10001	20200	20201	41000	41001	42000	42001	55000
5	Kr	Krypton	29.7				931	2800	2801	7160	7161	14900						
6	Xe	Xenon	24.7				547	1651	1652	4210	4211	8760						
7	H2	Hydrogen	14.7	14.7	19.7	19.7	861	2600	2601	8000	8001	16400	16401	33000	33001	73000	73001	73001
8	Air	Air	24.7	29.7	29.7	34.7	861	2600	2601	7400	7401	15000	15001	30000	30001	30001	30002	56000
9	CO	Carbon Monoxide	24.7	29.7			861	2600	2601	7300	7301	15000	15001	30000				
10	HBr	Hydrogen Bromide	24.7				724	2187	2188	5610	5611	11700						
11	HCl	Hydrogen Chloride	24.7	29.7	29.7	34.7	861	2600	2601	6900	6901	14200	14201	29000	29001	29001	29002	50000
12	HF	Hydrogen Fluoride	14.7	17.7			881	2610	2611	7400	7401	15000	15001	30000				
13	N2	Nitrogen	24.7	29.7	29.7	32.7	861	2600	2601	7200	7201	15000	15001	30000	30001	40000	40001	55000
14	D2	Deuterium	14.7	14.7			881	2600	2601	8100	8101	16500	16501	33000				
15	O2	Oxygen	24.7	29.7	29.7	34.7	861	2600	2601	7200	7201	15000	15001	30000	30001	37000	37001	55000
16	NO	Nitric Oxide	24.7	29.7	39.7	39.7	861	2600	2601	7200	7201	15000	15001	30000	30001	55000	55001	55000
17	HI	Hydrogen Iodide	24.7	29.7			433	1305	1306	3340	3341	6960	6961	13900				
18	F2	Fluorine	24.7	29.7			781	2358	2359	6700	6701	14000	14001	28000				
19	Cl2	Chlorine	24.7	29.7			532	1604	1605	4850	4851	10100	10101	20200				
22	H2S	Hydrogen Sulfide	24.7	29.7			714	2155	2156	5900	5901	12100	12101	24100				
23	H2Se	Hydrogen Selenide	24.7	29.7			621	1874	1875	4770	4771	10000	10001	20000				
25	CO2	Carbon Dioxide	24.7	29.7	29.7	29.7	643	1942	1943	5300	5301	11000	11001	22000	22001	28000	28001	39000
27	N2O	Nitrous Oxide	24.7	29.7	29.7	29.7	612	1849	1850	5100	5101	10400	10401	21000	21001	25000	25001	37000
28	CH4	Methane	24.7	24.7	29.7		661	2000	2001	5800	5801	12000	12001	24000	24001	46000		
29	NH3	Ammonia	24.7	24.7	29.7	29.7	686	2072	2073	6000	6001	12200	12201	25000	25001	46000	46001	46001
30	O3	Ozone	24.7	29.7	29.7	39.7	771	2300	2301	6000	6001	12400	12401	25000	25001	28000	28001	43000
31	PH3	Phosphine	19.7	24.7			630	1901	1902	5200	5201	10700	10701	21300				
32	SO2	Sulfur Dioxide	19.7	24.7			484	1459	1460	3800	3801	7920	7921	15800				
33	CH3F	Methyl Fluoride	24.7	29.7			626	1890	1891	5200	5201	10600	10601	21200				
34	COS	Carbonyl Sulfide	24.7	29.7			563	1700	1701	4500	4501	9400	9401	18300				
35	AsH3	Arsine	24.7	29.7			511	1550	1551	4000	4001	8500	8501	17000				
36	CH3Cl	Methyl Chloride	24.7	29.7	29.7	34.7	561	1700	1701	4400	4401	9200	9201	18100	18101	18101	18102	31000
37	ClCN	Cyanogen Chloride	14.7	21.7			436	1320	1321	3400	3401	7060	7061	14100				
38	C2H4	Ethylene	24.7	29.7			502	1516	1517	4400	4401	9300	9301	18200				
39	SiH4	Silane	24.7	29.7			524	1581	1582	4400	4401	9300	9301	18200				
42	C2H2	Acetylene	16.7	19.7			531	1600	1601	4400	4401	9300	9301	18200				
43	GeH4	Germane	24.7	29.7			496	1500	1501	4000	4001	8400	8401	16400				
44	CH3Br	Methyl Bromide	19.7	24.7			333	1000	1001	2610	2611	5500	5501	11000				
45	C2H4O	Ethylene Oxide	14.7	24.7			441	1300	1301	3500	3501	7300	7301	14500				
46	COF2	Carbonyl Fluoride	19.7	19.7	21.7		501	1500	1501	4000	4001	8400	8401	16500	16501	21000		
47	CH3SH	Methyl Mercaptan	24.7	29.7			411	1250	1251	3300	3301	6900	6901	13600				
48	BF3	Boron Trifluoride	19.7	24.7			458	1381	1382	3800	3801	7900	7901	15500				
49	CHF3	Fluoroform (Freon-23)	24.7	24.7	24.7	26.7	446	1344	1345	3600	3601	7600	7601	15000	15001	17000	17001	26000
51	C2H3F	Vinyl Fluoride	24.7	29.7	29.7	34.7	521	1540	1541	4200	4201	8700	8701	17000	17001	22000	22001	30000
52	CH5N	Methylamine	24.7	29.7	29.7	34.7	411	1250	1251	3400	3401	7100	7101	14000	14001	21000	21001	25000
53	NF3	Nitrogen Trifluoride	24.7	29.7	24.7	26.7	431	1300	1301	3600	3601	7500	7501	15000	15001	17000	17001	26000
54	C2H6	Ethane	17.7	21.7	26.7	26.7	470	1418	1419	4000	4001	8300	8301	16300	16301	28000	28001	30000
57	CHClF2	Chlorodifluoromethane (Freon-22)	24.7	29.7			351	1050	1051	2800	2801	5700	5701	11500				
58	B2H6	Diborane	19.7	19.7			359	1082	1083	3100	3101	6400	6401	12600				
60	COCl2	Phosgene	12.7	14.7			326	1000	1001	2520	2521	5250	5251	10500				
61	C3H6-a)	Cyclopropane	24.7	29.7			411	1250	1251	3300	3301	7000	7001	14000				
62	PF3	Phosphorus Trifluoride	19.7	24.7			401	1200	1201	3200	3201	6800	6801	13300				
63	CF4	Carbon Tetrafluoride (Freon-14)	24.7	24.7	24.7	26.7	373	1123	1124	3010	3011	6400	6401	12600	12601	17000	17001	22000
67	SiH2Cl2	Dichlorosilane	14.7	19.7			274	824	825	2140	2141	4450	4451	8900				
69	C3H6-b)	Propylene	19.7	19.7			339	1022	1023	2800	2801	5900	5901	11700				
70	BCl3	Boron Trichloride	11.7	14.7			290	874	875	2230	2231	4650	4651	9300				
72	ClO3F	Perchloryl Fluoride	14.7	20.7			351	1060	1061	2800	2801	5800	5801	11500				
73	C2H6O	Dimethylether	14.7	19.7			334	1006	1007	2800	2801	5800	5801	11400				
74	CClF3	Chlorotrifluoromethane (Freon-13)	24.7	29.7			361	1100	1101	2800	2801	6000	6001	12000				
77	ClF3	Chlorine Trifluoride	14.7	20.7			328	1000	1001	2560	2561	5340	5341	10700				
79	BBr3	Boron Tribromide	24.7	29.7	39.7	39.7	361	1070	1071	2800	2801	6000	6001	12000	12001	14000	14001	20000
80	CBrF3	Bromotrifluoromethane (Freon-13E	24.7	29.7			300	904	905	2320	2321	5000	5001	10000				
84	CCl2F2	Dichlorodifluoromethane (Freon-1	24.7	29.7			286	860	861	2200	2201	4600	4601	9200				
85	C2H7N	Dimethylamine	9.7	14.7			311	960	961	2530	2531	5400	5401	10600				
88	SiF4	Silicon Tetrafluoride	19.7	24.7			317	1000	1001	2600	2601	5400	5401	10600				
89	C3H8	Propane	9.7	11.7			301	910	911	2420	2421	5100	5101	10100				
94	C2F4	Tetrafluoroethylene	19.7	19.7			301	900	901	2300	2301	4900	4901	9800				
97	Si2H6	DISILANE	19.7	19.7			283	853	854	2300	2301	4900	4901	9800				
98	C4H8-j)	Transbutene	19.7	19.7			251	770	771	2030	2031	4300	4301	8700				
99	GeF4	Germanium Tetrafluoride	20.7	24.7			283	860	861	2200	2201	4700	4701	9400				
100	C4H6-e)	Butadiene	19.7	19.7			281	850	851	2300	2301	4800	4801	9600				
102	POCl3	Phosphorus Oxychloride	9.7	9.7	14.7	14.7	140	420	421	1080	1081	2250	2251	4490	4491	4491	4492	7480
104	C4H8-i)	Butene	20.7	24.7			161	480	481	1420	1421	3000	3001	6000				
106	C4H8-h)	Isobutylene	24.7	29.7			261	800	801	2110	2111	4500	4501	9000				
107	C4H8-g)	Cisbutene	24.7	29.7			261	800	801	2100	2101	4400	4401	9000				
108	SiCl4	Silicon Tetrachloride	8.7				173	520	521	1320	1321	2750						
109	C3H9N	Trimethylamine	6.7	8.7			241	720	721	1910	1911	4000	4001	8100				
110	SF6	Sulfur Hexafluoride	19.7	19.7	19.7	20.7	238	715	716	1900	1901	4000	4001	8000	8001	8200	8201	13400
111	C4H10-d)	Isobutane	19.7	19.7	19.7	20.7	217	653	654	1800	1801	3800	3801	7600	7601	8200	8201	13200
113	GeCl4	Germanium Tetrachloride	19.7	24.7	32.7	32.7	262	810	811	2200	2201	4700	4701	9400	9401	9401	9402	17000
117	C4H10-c)	Butane	19.7	19.7	19.7	20.7	235	706	707	1910	1911	4000	4001	8100	8101	8200	8201	14100
118	C2F6	Hexafluoroethane (Freon-116)	19.7	19.7			219	658	659	1750	1751	3700	3701	7400				
119	C2ClF5	Chloropentafluoroethane (Freon-1	24.7	29.7			211	640	641	1650	1651	3500	3501	7000				
121	WF6	Tungsten Hexafluoride	9.7	11.7			151	460	461	1200	1201	2500	2501	5000				
122	C5H12	Dimethylpropane	24.7	29.7			191	570	571	1500	1501	3200	3201	6400				
128	C3F8	Perfluoropropane	19.7	19.7			155	465	466	1200	1201	2500	2501	5100				
129	C4F8	Octafluorocyclobutane	19.7	19.7			155	465	466	1170	1171	2430	2431	4900				

For gases not specified for SA50, contact Brooks Product Marketing.

For reference only, consult factory on the latest tables.

Doc# 990-100-0081 Rev 021 • Ref. Temp. 0.0°C

Table A-3 GF80 Series Gas Table - Codes 138-775, Bins SH40-SH44

Gas Code	Gas Symbol	Gas Name	Min inlet pressure for vac. exhaust (PSIA)				SH40		SH41		SH42		SH43		SH44	
			SH40-SH47	SH48	SH49	SH50	Low	High	Low	High	Low	High	Low	High	Low	High
138	C3F6	Hexafluoropropylene	19.7	19.7					3	6	7	20	21	60	61	184
155	C2HF5	PENTAFLUOROETHANE (FREOI	19.7	19.7					3	8	9	25	26	77	78	235
156	C2H2F4	Tetrafluoroethane (Freon-134a)	24.7	29.7			3	3	4	9	10	28	29	86	87	260
160	CH2F2	Difluoromethane	24.7	29.7			3	6	7	19	20	57	58	174	175	533
185	CH6Si	Methylsilane (MONO)	9.7	14.7			3	4	5	12	13	37	38	111	112	340
190	(CH3)3SiH	Trimethylsilane (TMSi)	6.7						3	7	8	20	21	62	63	189
193	PCl3	Phosphorus Trichloride														
241	C4F10	Perfluorobutane	14.7	19.7					3	4	5	13	14	40	41	120
249	B2F4	Difluroborane	14.7	19.7	29.7	29.7	3	3	4	10	11	32	33	99	100	300
266	C5F8	Octafluorocyclopentene	9.7	14.7					3	5	6	14	15	44	45	134
270	C4F6	Hexafluoro-2-butyne	9.7	14.7					3	6	7	19	20	57	58	176
297	C4F6-q)	Hexafluoro Butadiene-1-3	9.7	14.7					3	6	7	17	18	52	53	160
354	C5F8O	Epoxyperfluorocyclopentene	19.7	19.7					3	4	5	13	14	40	41	122
360	CF3I	trifluoroiodo-Methane	14.7	19.7					3	7	8	22	23	66	67	201
368	Si3H9N	Trisilylamine (TSA)	6.0	7.2					3	6	7	20	21	60	61	181
371	C4H11N	Dimethylethylamine	8.0	8.0					3	6	7	20	21	63	64	190
385	C3H2F4	2,3,3,3-tetrafluoro-1-Propene	14.7	19.7					3	7	8	23	24	71	72	217
500	15%PH3/N2	15%Phosphine/Nitrogen	24.7	29.7			3	9	10	29	30	90	91	270	271	840
501	5%PH3/N2	5%Phosphine/Nitrogen	24.7	29.7			3	10	11	30	31	93	94	280	281	870
502	20%SiH4/N2	20%Silane/Nitrogen	20.7	25.7	44.7	44.7	3	9	10	27	28	83	84	250	251	780
509	10%GeH4/H2	10%Germane/Hydrogen	20.7	20.7			3	9	10	28	29	86	87	260	261	800
516	10%PH3/H2	10%Phosphine/Hydrogen	14.7	14.7			3	9	10	28	29	90	91	275	276	813
517	25%PH3/SiH4	25%Phosphine/Silane	14.7	19.7			3	6	7	19	20	60	61	180	181	560
527	10%PH3/N2	10%Phosphine/Nitrogen	19.7	24.7			3	9	10	30	31	91	92	271	272	850
528	4.5%PH3/N2	4.5%Phosphine/Nitrogen	20.7	29.7			3	10	11	30	31	94	95	280	281	880
529	20%SiH4/He	20%Silane/Helium	20.7	29.7			4	11	12	34	35	103	104	320	321	1000
532	10%H2/N2	10%Hydrogen/Nitrogen	20.7	29.7			3	10	11	30	31	94	95	281	282	880
535	4%PH3/N2	4%Phosphine/Nitrogen	20.7	29.7			3	10	11	30	31	93	94	280	281	870
536	20%O2/He	20%Oxygen/Helium	19.7	29.7			4	13	14	38	39	120	121	360	361	1102
537	1%PH3/Ar	1%Phosphine/Argon	24.7	29.7			4	14	15	43	44	130	131	400	401	1200
538	10%PH3/Ar	10%Phosphine/Argon	24.7	29.7			4	13	14	40	41	120	121	370	371	1110
542	5%H2/N2	5%Hydrogen/Nitrogen	24.7	29.7			3	10	11	30	31	92	93	280	281	860
544	2%SiH4/H2	2%Silane/Hydrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	870
546	1%PH3/He	1%Phosphine/Helium	24.7	29.7			4	14	15	42	43	130	131	400	401	1200
549	.5%B2H6/Ar	.5%Diborane/Argon	24.7	29.7			4	14	15	42	43	130	131	400	401	1200
550	.5%PH3/N2	.5%Phosphine/Nitrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	880
557	1%B2H6/H2	1%Diborane Hydrogen	24.7	29.7			3	10	11	30	31	91	92	270	271	850
559	1%BCl3/H2	1%Boron Trichloride/Hydrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	870
560	1%BCl3/N2	1%Boron Trichloride/Nitrogen	24.7	29.7			3	10	11	30	31	93	94	280	281	870
563	1%PH3/H2	1%Phosphine/Hydrogen	19.7	19.7			3	10	11	30	31	90	91	273	274	850
565	10%SiH4/Ar	10%Silane/Argon	24.7	29.7			4	12	13	38	39	115	116	350	351	1100
584	15%PH3/SiH4	15%Phosphine/Silane	19.7	19.7			3	6	7	19	20	60	61	175	176	550
589	2%SiH4/He	2%Silane/Helium	24.7	29.7			4	14	15	42	43	126	127	400	401	1200
595	3%B2H6/N2	3%Diborane/Nitrogen	20.7	29.7			3	9	10	29	30	90	91	270	271	850
597	3%H2/N2	3%Hydrogen/Nitrogen	24.7	29.7			3	10	11	30	31	92	93	280	281	860
603	30%He/O2	30%Helium/Oxygen	24.7	29.7			4	11	12	33	34	100	101	301	302	950
604	30%O2/He	30%Oxygen/Helium	19.7	24.7			4	12	13	37	38	113	114	345	346	1060
605	4%B2H6/N2	4%Diborane/Nitrogen	19.7	29.7			3	10	11	30	31	90	91	270	271	830
606	4%H2/He	4%Hydrogen/Helium	19.7	19.7			4	14	15	41	42	126	127	400	401	1200
607	4%H2/N2	4%Hydrogen/Nitrogen	24.7	29.7			3	10	11	30	31	92	93	280	281	860
615	5%B2H6/Ar	5%Diborane/Argon	24.7	29.7			4	12	13	38	39	116	117	353	354	1084
626	5%PH3/Ar	5%Phosphine/Argon	27.7	32.7			4	13	14	41	42	125	126	380	381	1170
627	5%PH3/SiH4	5%Phosphine/Silane	19.7	19.7	24.7	24.7	3	6	7	18	19	58	59	172	173	540
628	5%SiH2Cl2/Ar	5%Dichlorosilane/Argon	24.7	29.7			4	12	13	38	39	116	117	360	361	1100
632	50%PH3/SiH4	50%Phosphine/Silane	16.7	24.7			3	6	7	20	21	62	63	190	191	580
636	8%PH3/SiH4	8%Phosphine/Silane	16.7	24.7			3	6	7	19	20	58	59	175	176	540
640	2%PH3/N2	2%Phosphine/Nitrogen	22.7	27.7	49.7	49.7	3	10	11	30	31	94	95	280	281	870
649	10%O2/He	10%Oxygen/Helium	19.7	24.7			4	13	14	41	42	123	124	380	381	1150
653	2%SiH4/N2	2%SILANE/NITROGEN	19.7	24.7			3	10	11	30	31	93	94	280	281	870
654	5%B2H6/N2	5%Diborane/Nitrogen	24.7	29.7			3	9	10	28	29	86	87	262	263	804
656	.5%PH3/H2	.5%Phosphine/Hydrogen	24.7	29.7			3	10	11	31	32	95	96	282	283	880
660	.3%PH3/SiH4	.3%Phosphine/Silane	24.7	29.7			3	6	7	18	19	57	58	171	172	530
662	.8%B2H6/N2	.8%Diborane/Nitrogen	24.7	29.7			3	10	11	30	31	93	94	280	281	870
664	8%GeH4/H2	8%Germane/Hydrogen	24.7	29.7			3	10	11	30	31	90	91	270	271	840
674	10%PH3/He	10%Phosphine/Helium	14.7	19.7			4	13	14	40	41	120	121	370	371	1100
676	7.5%PH3/SiH4	7.5%Phosphine/Silane	14.7	14.7			3	6	7	19	20	58	59	175	176	540
677	20%F2/He	20%Fluorine/Helium	14.7	19.7			4	13	14	40	41	117	118	360	361	1100
693	5%PH3/He	5%Phosphine/Helium	12.7	14.7			4	13	14	41	42	125	126	380	381	1150
695	2%B2H6/N2	2%Diborane/Nitrogen	24.7	29.7			3	10	11	30	31	93	94	280	281	870
698	10%GeH4/Ar	10%Germane/Argon	24.7	29.7			4	12	13	38	39	114	115	350	351	1070
700	4%H2/Ar	4%Hydrogen/Argon	24.7	29.7			4	14	15	42	43	130	131	400	401	1200
701	10%B2H6/H2	10%Diborane/Hydrogen	14.7	14.7			3	8	9	26	27	81	82	241	242	760
710	10%CH4/Ar	10%Methane/Argon	34.7	39.7	54.7	44.7	4	13	14	40	41	120	121	370	371	1120
724	1%AsH3/H2	1%Arsine/Hydrogen	14.7	19.7			3	10	11	30	31	94	95	281	282	880
731	10%Si2H6/H2	10%Disilane/Hydrogen	19.7	19.7			3	8	9	25	26	80	81	250	251	750
762	5%H2/He	5%Hydrogen/Helium	19.7	19.7			4	14	15	41	42	125	126	400	401	1200
766	5%B2H6/He	5%Diborane/Helium	14.7	16.7			4	12	13	38	39	115	116	350	351	1100
771	.7%GeH4/H2	.7%Germane/Hydrogen	14.7	16.7			3	10	11	30	31	94	95	281	282	880
773	5%SiH4/N2	5%Silane/Nitrigen	24.7	29.7			3	10	11	30	31	91	92	272	273	850
775	1.5%GeH4/H2	1.5%Germane/Hydrogen	14.7	16.7			3	10	11	30	31	94	95	280	281	880

Table A-4 GF80 Series Gas Table - Codes 138-775, Bins SH45-SH50

Gas Code	Gas Symbol	Gas Name	Min inlet pressure for vac. exhaust (PSIA)				SH45		SH46		SH47		SH48		SH49		SH50	
			SH40-SH47	SH48	SH49	SH50	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
138	C3F6	Hexafluoropropylene	19.7	19.7			185	556	557	1470	1471	3050	3051	6110				
155	C2HF5	PENTAFLUOROETHANE (FREON	19.7	19.7			236	711	712	1900	1901	4000	4001	8000				
156	C2H2F4	Tetrafluoroethane (Freon-134a)	24.7	29.7			261	800	801	2040	2041	4300	4301	8700				
160	CH2F2	Difluoromethane	24.7	29.7			534	1612	1613	4300	4301	9000	9001	18000				
185	CH6Si	Methylsilane (MONO)	9.7	14.7			341	1050	1051	2800	2801	5900	5901	11600				
190	(CH3)3SiH	Trimethylsilane (TMSi)	6.7				190	572	573	1530	1531	3200						
193	PCl3	Phosphorus Trichloride																
241	C4F10	Perfluorobutane	14.7	19.7			121	370	371	960	961	2000	2001	4000				
249	B2F4	Difluroborane	14.7	19.7	29.7	29.7	301	920	921	2610	2611	5500	5501	11000	11001	11001	11002	21100
266	C5F8	Octafluorocyclopentene	9.7	14.7			135	406	407	1050	1051	2200	2201	4500				
270	C4F6	Hexafluoro-2-butyne	9.7	14.7			177	533	534	1400	1401	2900	2901	5900				
297	C4F6-q)	Hexafluoro Butadiene-1-3	9.7	14.7			161	500	501	1270	1271	2640	2641	5270				
354	C5F8O	Epoxyperfluorocyclopentene	19.7	19.7			123	369	370	1000	1001	2100	2101	4200				
360	CF3I	trifluoroiodo-Methane	14.7	19.7			202	609	610	1560	1561	3250	3251	6510				
368	Si3H9N	Trisilylamine (TSA)	6.0	7.2			182	560	561	1410	1411	3000	3001	6000				
371	C4H11N	Dimethylethylamine	8.0	8.0			191	580	581	1530	1531	3200	3201	6500				
385	C3H2F4	2,3,3,3-tetrafluoro-1-Propene	14.7	19.7			218	656	657	1730	1731	3700	3701	7400				
500	15%PH3/N2	15%Phosphine/Nitrogen	24.7	29.7			841	2500	2501	7000	7001	14200	14201	29000				
501	5%PH3/N2	5%Phosphine/Nitrogen	24.7	29.7			871	2600	2601	7200	7201	15000	15001	30000				
502	20%SiH4/N2	20%Silane/Nitrogen	20.7	25.7	44.7	44.7	781	2310	2311	6500	6501	13300	13301	27000	27001	50000	50001	50001
509	10%GeH4/H2	10%Germane/Hydrogen	20.7	20.7			801	2400	2401	7200	7201	15000	15001	30000				
516	10%PH3/H2	10%Phosphine/Hydrogen	14.7	14.7			814	2500	2501	7600	7601	15500	15501	31000				
517	25%PH3/SiH4	25%Phosphine/Silane	14.7	19.7			561	1700	1701	4600	4601	9600	9601	19000				
527	10%PH3/N2	10%Phosphine/Nitrogen	19.7	24.7			851	2510	2511	7100	7101	14500	14501	29000				
528	4.5%PH3/N2	4.5%Phosphine/Nitrogen	20.7	29.7			881	2600	2601	7200	7201	15000	15001	30000				
529	20%SiH4/He	20%Silane/Helium	20.7	29.7			1001	3000	3001	8800	8801	18000	18001	36000				
532	10%H2/N2	10%Hydrogen/Nitrogen	20.7	29.7			881	2610	2611	7400	7401	15200	15201	31000				
535	4%PH3/N2	4%Phosphine/Nitrogen	20.7	29.7			871	2600	2601	7200	7201	15000	15001	30000				
536	20%O2/He	20%Oxygen/Helium	19.7	29.7			1103	3331	3332	10000	10001	21000	21001	42000				
537	1%PH3/Ar	1%Phosphine/Argon	24.7	29.7			1201	3700	3701	10000	10001	20000	20001	40000				
538	10%PH3/Ar	10%Phosphine/Argon	24.7	29.7			1111	3400	3401	9100	9101	19000	19001	38000				
542	5%H2/N2	5%Hydrogen/Nitrogen	24.7	29.7			861	2600	2601	7400	7401	15100	15101	31000				
544	2%SiH4/H2	2%Silane/Hydrogen	24.7	29.7			871	2600	2601	8100	8101	17000	17001	34000				
546	1%PH3/He	1%Phosphine/Helium	24.7	29.7			1201	3700	3701	11100	11101	23100	23101	47000				
549	.5%B2H6/Ar	.5%Diborane/Argon	24.7	29.7			1201	3700	3701	10000	10001	20000	20001	40000				
550	.5%PH3/N2	.5%Phosphine/Nitrogen	24.7	29.7			881	2600	2601	7400	7401	15000	15001	30000				
557	1%B2H6/H2	1%Diborane Hydrogen	24.7	29.7			851	2510	2511	7900	7901	16100	16101	33000				
559	1%BCl3/H2	1%Boron Trichloride/Hydrogen	24.7	29.7			871	2600	2601	8100	8101	16500	16501	33000				
560	1%BCl3/N2	1%Boron Trichloride/Nitrogen	24.7	29.7			871	2600	2601	7300	7301	15000	15001	30000				
563	1%PH3/H2	1%Phosphine/Hydrogen	19.7	19.7			851	2531	2532	7800	7801	16000	16001	32000				
565	10%SiH4/Ar	10%Silane/Argon	24.7	29.7			1101	3300	3301	8800	8801	18000	18001	36000				
584	15%PH3/SiH4	15%Phosphine/Silane	19.7	19.7			551	1630	1631	4500	4501	9500	9501	19000				
589	2%SiH4/He	2%Silane/Helium	24.7	29.7			1201	3600	3601	11000	11001	23000	23001	46000				
595	3%B2H6/N2	3%Diborane/Nitrogen	20.7	29.7			851	2500	2501	7100	7101	14500	14501	29000				
597	3%H2/N2	3%Hydrogen/Nitrogen	24.7	29.7			861	2600	2601	7400	7401	15100	15101	30100				
603	30%He/O2	30%Helium/Oxygen	24.7	29.7			951	2800	2801	8100	8101	17000	17001	34000				
604	30%O2/He	30%Oxygen/Helium	19.7	24.7			1061	3203	3204	9700	9701	20000	20001	40000				
605	4%B2H6/N2	4%Diborane/Nitrogen	19.7	29.7			831	2500	2501	7000	7001	14300	14301	30000				
606	4%H2/He	4%Hydrogen/Helium	19.7	19.7			1201	3600	3601	11000	11001	23000	23001	46000				
607	4%H2/N2	4%Hydrogen/Nitrogen	24.7	29.7			861	2600	2601	7400	7401	15100	15101	30100				
615	5%B2H6/Ar	5%Diborane/Argon	24.7	29.7			1085	3278	3279	8900	8901	18200	18201	37000				
626	5%PH3/Ar	5%Phosphine/Argon	27.7	32.7			1171	3600	3601	9500	9501	19400	19401	39000				
627	5%PH3/SiH4	5%Phosphine/Silane	19.7	19.7	24.7	24.7	541	1600	1601	4500	4501	9400	9401	18300	18301	18301	18302	34000
628	5%SiH2Cl2/Ar	5%Dichlorosilane/Argon	24.7	29.7			1101	3300	3301	8800	8801	18000	18001	36000				
632	50%PH3/SiH4	50%Phosphine/Silane	16.7	24.7			581	1730	1731	4800	4801	10000	10001	20000				
636	8%PH3/SiH4	8%Phosphine/Silane	16.7	24.7			541	1610	1611	4500	4501	9400	9401	18400				
640	2%PH3/N2	2%Phosphine/Nitrogen	22.7	27.7	49.7	49.7	871	2600	2601	7300	7301	15000	15001	30000	30001	56000	56001	56001
649	10%O2/He	10%Oxygen/Helium	19.7	24.7			1151	3500	3501	10500	10501	22000	22001	44000				
653	2%SiH4/N2	2%SILANE/NITROGEN	19.7	24.7			871	2600	2601	7300	7301	15000	15001	30000				
654	5%B2H6/N2	5%Diborane/Nitrogen	24.7	29.7			805	2500	2501	7000	7001	14100	14101	28100				
656	.5%PH3/H2	.5%Phosphine/Hydrogen	24.7	29.7			881	2620	2621	8200	8201	17000	17001	34000				
660	.3%PH3/SiH4	.3%Phosphine/Silane	24.7	29.7			531	1600	1601	4400	4401	9300	9301	18200				
662	.8%B2H6/N2	.8%Diborane/Nitrogen	24.7	29.7			871	2600	2601	7300	7301	15000	15001	30000				
664	8%GeH4/H2	8%Germane/Hydrogen	24.7	29.7			841	2500	2501	7500	7501	15400	15401	31000				
674	10%PH3/He	10%Phosphine/Helium	14.7	19.7			1101	3400	3401	10000	10001	21000	21001	43000				
676	7.5%PH3/SiH4	7.5%Phosphine/Silane	14.7	14.7			541	1610	1611	4500	4501	9400	9401	18400				
677	20%F2/He	20%Fluorine/Helium	14.7	19.7			1101	3300	3301	10000	10001	21000	21001	42000				
693	5%PH3/He	5%Phosphine/Helium	12.7	14.7			1151	3500	3501	10500	10501	22000	22001	44000				
695	2%B2H6/N2	2%Diborane/Nitrogen	24.7	29.7			871	2600	2601	7200	7201	15000	15001	30000				
698	10%GeH4/Ar	10%Germane/Argon	24.7	29.7			1071	3300	3301	8700	8701	18000	18001	36000				
700	4%H2/Ar	4%Hydrogen/Argon	24.7	29.7			1201	3700	3701	10000	10001	20000	20001	40000				
701	10%B2H6/H2	10%Diborane/Hydrogen	14.7	14.7			761	2300	2301	7000	7001	14200	14201	29000				
710	10%CH4/Ar	10%Methane/Argon	34.7	39.7	54.7	44.7	1121	3400	3401	9200	9201	19000	19001	38000	38001	51000	51001	67000
724	1%AsH3/H2	1%Arsine/Hydrogen	14.7	19.7			881	2610	2611	8200	8201	17000	17001	34000				
731	10%Si2H6/H2	10%Disilane/Hydrogen	19.7	19.7			751	2200	2201	6600	6601	13500	13501	27000				
762	5%H2/He	5%Hydrogen/Helium	19.7	19.7			1201	3600	3601	11000	11001	23000	23001	46000				
766	5%B2H6/He	5%Diborane/Helium	14.7	16.7			1101	3300	3301	10000	10001	21000	21001	42000				
771	.7%GeH4/H2	.7%Germane/Hydrogen	14.7	16.7			881	2610	2611	8200	8201	17000	17001	34000				
773	5%SiH4/N2	5%Silane/Nitrigen	24.7	29.7			851	2520	2521	7100	7101	14600	14601	30000				
775	1.5%GeH4/H2	1.5%Germane/Hydrogen	14.7	16.7			881	2600	2601	8100	8101	16500	16501	33000				

For gases not specified for SA50, contact Brooks Product Marketing.
For reference only, consult factory on the latest tables.

Table A-5 GF80 Series Gas Table - Codes 780-1004, Bins SH40-SH44

Gas Code	Gas Symbol	Gas Name	Min inlet pressure for vac. exhaust (PSIA)				SH40		SH41		SH42		SH43		SH44	
			SH40-SH47	SH48	SH49	SH50	Low	High	Low	High	Low	High	Low	High	Low	High
780	5%SiH4/He	5%Silane/Helium	14.7	16.7			4	13	14	40	41	125	126	380	381	1140
784	.02%CO/N2	.02%Carbon Monoxide/Nitrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	880
786	.1%CO/N2	.1%Carbon Monoxide/Nitrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	880
805	1%B2H6/Ar	1%Diborane/Argon	24.7	29.7			4	14	15	42	43	130	131	400	401	1200
820	15%B2H6/H2	15%Diborane/Hydrogen	14.7	14.7			3	8	9	25	26	76	77	230	231	710
821	15%SiH4/Ar	15%Silane/Argon	24.7	29.7			4	12	13	36	37	110	111	330	331	1010
823	2%SiH4/Ar	2%Silane/Argon	24.7	29.7			4	14	15	42	43	126	127	400	401	1200
824	2%SO2/N2	2%Sulfur Dioxide/Nitrogen	24.7	29.7			3	10	11	30	31	93	94	280	281	870
833	3%H2/Ar	3%Hydrogen/Argon	24.7	29.7			4	14	15	42	43	130	131	400	401	1200
837	30%GeH4/Ar	30%Germane/Argon	24.7	29.7			3	10	11	30	31	93	94	280	281	860
850	50%H2/N2	50%Hydrogen/Nitrogen	19.7	24.7			3	10	11	30	31	95	96	281	282	880
863	2%O2/Ar	2%Oxygen/Argon	24.7	29.7			4	14	15	43	44	130	131	400	401	1200
865	5%CO2/5%O2/N2	5%Carbon Dioxide/5%Oxygen/Nit	24.7	29.7			3	10	11	30	31	92	93	280	281	860
866	2.5%O2/5%CO2/N2	2.5%Oxygen/5%Carbon Dioxide/N	24.7	29.7			3	10	11	30	31	93	94	280	281	860
867	.5%CO2/10%O2/N2	.5%Carbon Dioxide/10%Oxygen/N	24.7	29.7			3	10	11	30	31	92	93	280	281	860
875	20%O2/Ar	20%Oxygen/Argon	24.7	29.7			4	13	14	40	41	120	121	370	371	1120
877	30%SiHCl3/H2	30%Trichlorosilane/Hydrogen	17.7	20.7	26.7	34.7	3	6	7	19	20	60	61	180	181	550
878	3%C2H4/He	3%Ethylene/Helium	19.7	19.7			4	13	14	40	41	125	126	375	376	1150
881	10%B2H6/Ar	5%Diborane/Argon	24.7	29.7			4	11	12	35	36	105	106	320	321	1000
886	.01%PH3/Ar	.01%Phosphine/Argon	24.7	29.7			5	14	15	43	44	130	131	400	401	1210
887	.1%PH3/Ar	.1%Phosphine/Argon	24.7	29.7			5	14	15	43	44	130	131	400	401	1210
888	.1%B2H6/Ar	.1%Diborane/Argon	24.7	29.7			4	14	15	43	44	130	131	400	401	1210
895	40%GeH4/N2	40%Germane/Nitrogen	19.7	19.7			3	8	9	23	24	73	74	220	221	680
896	30%PH3/SiH4	30%Phosphine/Silane	19.7	19.7			3	6	7	20	21	60	61	180	181	560
897	2.7%C2H4/He	2.7%Ethylene/Helium	19.7	19.7			4	13	14	40	41	125	126	377	378	1158
898	1%GeH4/H2	1%Germane/Hydrogen	20.7	20.7			3	10	11	30	31	91	92	275	276	850
900	.48%NF3/N2	.48%Nitrogen Fluoride/Nitrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	880
907	10%AsH3/N2	10%Arsine/Nitrogen	24.7	29.7			3	9	10	29	30	88	89	269	270	825
908	20%B2H6/He	20%Diborane/Helium	24.7	29.7			3	10	11	30	31	90	91	270	271	840
910	.5%GeH4/H2	0.5%Germane/Hydrogen	20.7	20.7			3	10	11	30	31	92	93	280	281	860
916	2%PH3/H2	2%Phosphine/Hydrogen	21.7	21.7			3	10	11	30	31	91	92	275	276	850
917	50%C3H6-b)/N2	50%Propylene/Nitrogen	19.7	21.7			3	5	6	17	18	53	54	160	161	500
919	20%H2/20%CO/N2	20%Hydrogen/20%Carbon Monox	24.7	29.7			3	10	11	30	31	94	95	281	282	880
920	20%H2/20%CO/Ar	20%Hydrogen/20%Carbon Monox	24.7	29.7			4	12	13	37	38	112	113	340	341	1050
921	4%O2/N2	4%Oxygen/Nitrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	880
925	10%C3H6-b)/N2	10%Propylene/Nitrogen	19.7	21.7			3	8	9	26	27	82	83	243	244	760
926	3%H2S/H2	3%Hydrogen Sulfide/Hydrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	880
927	6%B2H6/N2	6%Diborane/Nitrogen	24.7	29.7			3	9	10	28	29	87	88	260	261	810
929	10%CH4/N2	10%Methane/Nitrogen	19.7	21.7			3	10	11	29	30	91	92	272	273	850
930	3.9%H2/N2	3.9%Hydrogen/Nitrogen	24.7	29.7			3	10	11	30	31	92	93	280	281	860
932	5%GeH4/H2	5%Germane/Hydrogen	19.7	19.7			3	10	11	30	31	91	92	272	273	850
936	10%He/N2	10%Helium/Nitrogen	24.7	29.7			3	10	11	31	32	100	101	300	301	910
939	10%B2H6/He	10%Diborane/Helium	19.7	19.7			4	11	12	34	35	103	104	314	315	965
941	1%O2/Ar	1%Oxygen/Atgon	24.7	29.7			4	14	15	43	44	130	131	400	401	1210
946	30%C2H4/He	30%Ethylene/Helium	19.7	24.7			3	10	11	30	31	90	91	275	276	850
947	10%HCl/Ar	10%Hydrogen Chloride/Argon	24.7	29.7			4	13	14	41	42	125	126	380	381	1160
948	20%PH3/Ar	20%Phosphine/Argon	24.7	29.7			4	12	13	36	37	109	110	332	333	1020
949	2%F2/Ne	2%Fluorine/Neon	24.7	29.7			4	14	15	42	43	130	131	400	401	1200
950	10%H2/He	10%Hydrogen/Helium	19.7	19.7			4	13	14	40	41	125	126	380	381	1200
951	7%AsH3/H2	7%Arsine/Hydrogen	24.7	29.7			3	10	11	30	31	92	93	280	281	860
953	15%H2/B2H6	15%Hydrogen/Diborane	19.7	19.7			3	4	5	14	15	42	43	130	131	400
954	14%SiH2Cl2/20%SiH4/33%HCl/N	14%Dichlorosilane/20%Silane/33%	14.7	19.7			3	7	8	23	24	71	72	212	213	670
958	17%CH4/CO2	17%Methane/Carbon Dioxide	24.7	29.7			3	7	8	23	24	70	71	210	211	650
962	20%CH6Si/H2	20%Methylsilane (MONO)/Hydrog	14.7	19.7			3	7	8	23	24	71	72	212	213	660
963	20%F2/N2	20%Fluorine/Nitrogen	24.7	29.7			3	10	11	30	31	92	93	280	281	860
965	50%CH3SiHCl2/H2	50%Dichloromethylsilane/Hydroge	11.7	13.7			3	4	5	14	15	42	43	130	131	400
976	4%CH4/Ar	4%Methane/Argon	24.7	29.7			4	13	14	41	42	125	126	390	391	1200
977	4%He/H2	4%helium/Hydrogen	14.7	19.7			3	10	11	30	31	94	95	280	281	880
978	20%GeH4/H2	20%Germane/Hydrogen	19.7	24.7			3	8	9	26	27	81	82	241	242	750
979	0.5%B2H6/He	0.5%Diborane/Helium	14.7	19.7			4	14	15	42	43	130	131	400	401	1200
980	20%F2/Ar	20%Fluorine/Argon	24.7	29.7			4	13	14	39	40	120	121	360	361	1100
982	5%HF/N2	5%Hydrogen Fluoride/Nitrogen	24.7	29.7			3	10	11	30	31	92	93	280	281	860
983	3%H2S/CO	3%Hydrogen Sulfide/Carbon Mon	24.7	29.7			3	10	11	30	31	92	93	280	281	860
984	1.4%C2H2/Ar	1.4%Acetylene/Argon	24.7	29.7			4	14	15	42	43	130	131	390	391	1200
985	2%Ge2H6/H2	2%Digermane/Hydrogen	24.7	29.7			3	10	11	30	31	92	93	280	281	860
986	38%SiCl4/O2	38%Silicon Tetrachloride/Oxygen	24.7	29.7	29.7	29.7	3	5	6	16	17	50	51	150	151	460
987	20%H2S/20%CO2/N2	20%Hydrogen Sulfide/20%Carbon	24.7	29.7			3	9	10	27	28	85	86	252	253	790
988	20%SiH2Cl2/H2	20%Dichlorosilane/Hydrogen	24.7	29.7			3	8	9	24	25	74	75	222	223	700
989	0.1%Cl2/N2	0.1%Chlorine/Nitrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	880
990	1%HCl/N2	1%Hydrogen Chloride/Nitrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	880
991	3%BCl3/N2	3%Boron Trichloride/Nitrogen	24.7	29.7			3	9	10	29	30	91	92	270	271	850
992	18%NO/N2	18%Nitric Oxide/Nitrogen	24.7	29.7			3	10	11	30	31	94	95	280	281	880
993	9%NO/41%N2/H2	9%Nitric Oxide/41%Nitrogen/H2	24.7	29.7			3	10	11	30	31	94	95	281	282	880
994	20%H2/Ar	20%Hydrogen/Argon	24.7	29.7			4	13	14	40	41	120	121	370	371	1120
996	25%H2S/Ar	25%Hydrogen Sulfide/Argon	31.7	37.7	49.7	59.7	4	12	13	37	38	111	112	340	341	1040
997	25%H2Se/Ar	25%Hydrogen Selenide/Argon	35.7	41.7	44.7	64.7	4	12	13	36	37	110	111	340	341	1030
998	50%NH3/He	50%Ammonia/Helium	14.7	19.7	34.7	34.7	3	10	11	30	31	94	95	280	281	880
999	40%CO/45%C2H4/Ar	40%Carbon Monoxide/45%Ethyle	18.7	22.7	39.7	39.7	3	8	9	24	25	75	76	230	231	700
1000	0.9%SiH4/N2	0.9%Silane/Nitrogen	24.7	29.7	39.7	39.7	3	10	11	30	31	94	95	280	281	880
1001	5%Ar/N2	5%Argon/Nitrogen	24.7	29.7	39.7	39.7	4	10	11	31	32	96	97	290	291	890
1002	25%PH3/N2	25%Phosphine/Nirtogen	24.7	29.7	34.7	34.7	3	9	10	28	29	86	87	260	261	810
1003	5%C4H6-e)/He	5%Butadiene/Helium	14.7	19.7			4	12	13	36	37	110	111	336	337	1032
1004	10%Cl2/N2	10%Chlorine/Nitrogen	24.7	29.7			3	10	11	29	30	90	91	275	276	844

Table A-6 GF80 Series Gas Table - Codes 780-1004, Bins SH45-SH50

Gas Code	Gas Symbol	Gas Name	Min inlet pressure for vac. exhaust (PSIA)				SH45		SH46		SH47		SH48		SH49		SH50	
			SH40-SH47	SH48	SH49	SH50	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
780	5%SiH4/He	5%Silane/Helium	14.7	16.7			1141	3500	3501	10500	10501	22000	22001	44000				
784	.02%CO/N2	.02%Carbon Monoxide/Nitrogen	24.7	29.7			881	2600	2601	7400	7401	15000	15001	30000				
786	.1%CO/N2	.1%Carbon Monoxide/Nitrogen	24.7	29.7			881	2600	2601	7400	7401	15000	15001	30000				
805	1%B2H6/Ar	1%Diborane/Argon	24.7	29.7			1201	3600	3601	9700	9701	20000	20001	40000				
820	15%B2H6/H2	15%Diborane/Hydrogen	14.7	14.7			711	2120	2121	6500	6501	13300	13301	27000				
821	15%SiH4/Ar	15%Silane/Argon	24.7	29.7			1011	3100	3101	8400	8401	17000	17001	35000				
823	2%SiH4/Ar	2%Silane/Argon	24.7	29.7			1201	3600	3601	9600	9601	20000	20001	40000				
824	2%SO2/N2	2%Sulfur Dioxide/Nitrogen	24.7	29.7			871	2600	2601	7300	7301	15000	15001	30000				
833	3%H2/Ar	3%Hydrogen/Argon	24.7	29.7			1201	3700	3701	9800	9801	20000	20001	41000				
837	30%GeH4/Ar	30%Germane/Argon	24.7	29.7			861	2600	2601	7000	7001	14100	14101	28100				
850	50%H2/N2	50%Hydrogen/Nitrogen	19.7	24.7			881	2610	2611	7800	7801	16000	16001	32000				
863	2%O2/Ar	2%Oxygen/Argon	24.7	29.7			1201	3700	3701	9800	9801	20000	20001	41000				
865	5%CO2/5%O2/N2	5%Carbon Dioxide/5%Oxygen/Nit	24.7	29.7			861	2600	2601	7200	7201	15000	15001	30000				
866	2.5%O2/5%CO2/N2	2.5%Oxygen/5%Carbon Dioxide/N	24.7	29.7			861	2600	2601	7200	7201	15000	15001	30000				
867	.5%CO2/10%O2/N2	.5%Carbon Dioxide/10%Oxygen/N	24.7	29.7			861	2600	2601	7200	7201	15000	15001	30000				
875	20%O2/Ar	20%Oxygen/Argon	24.7	29.7			1121	3400	3401	9200	9201	19000	19001	38000				
877	30%SiHCl3/H2	30%Trichlorosilane/Hydrogen	17.7	20.7	26.7	34.7	551	1640	1641	4400	4401	9300	9301	18100	18101	24000	24001	32000
878	3%C2H4/He	3%Ethylene/Helium	19.7	19.7			1151	3500	3501	10700	10701	22100	22101	45000				
881	10%B2H6/Ar	5%Diborane/Argon	24.7	29.7			1001	3000	3001	8100	8101	17000	17001	34000				
886	.01%PH3/Ar	.01%Phosphine/Argon	24.7	29.7			1211	3700	3701	10000	10001	20100	20101	41000				
887	.1%PH3/Ar	.1%Phosphine/Argon	24.7	29.7			1211	3700	3701	10000	10001	20100	20101	41000				
888	.1%B2H6/Ar	.1%Diborane/Argon	24.7	29.7			1211	3700	3701	10000	10001	20100	20101	41000				
895	40%GeH4/N2	40%Germane/Nitrogen	19.7	19.7			681	2010	2011	5500	5501	11300	11301	23000				
896	30%PH3/SiH4	30%Phosphine/Silane	19.7	19.7			561	1700	1701	4600	4601	9700	9701	19000				
897	2.7%C2H4/He	2.7%Ethylene/Helium	19.7	19.7			1159	3502	3503	10700	10701	22200	22201	45000				
898	1%GeH4/H2	1%Germane/Hydrogen	20.7	20.7			851	2530	2531	8000	8001	16200	16201	33000				
900	.48%NF3/N2	.48%Nitrogen Fluoride/Nitrogen	24.7	29.7			881	2600	2601	7300	7301	15000	15001	30000				
907	10%AsH3/N2	10%Arsine/Nitrogen	24.7	29.7			826	2495	2496	7000	7001	14300	14301	29000				
908	20%B2H6/He	20%Diborane/Helium	24.7	29.7			841	2500	2501	7500	7501	15400	15401	31000				
910	.5%GeH4/H2	0.5%Germane/Hydrogen	20.7	20.7			861	2600	2601	8000	8001	16300	16301	33000				
916	2%PH3/H2	2%Phosphine/Hydrogen	21.7	21.7			851	2530	2531	8000	8001	16200	16201	33000				
917	50%C3H6-b)/N2	50%Propylene/Nitrogen	19.7	21.7			501	1500	1501	4100	4101	8600	8601	17000				
919	20%H2/20%CO/N2	20%Hydrogen/20%Carbon Monox	24.7	29.7			881	2610	2611	7500	7501	15300	15301	31000				
920	20%H2/20%CO/Ar	20%Hydrogen/20%Carbon Monox	24.7	29.7			1051	3200	3201	8900	8901	18100	18101	37000				
921	4%O2/N2	4%Oxygen/Nitrogen	24.7	29.7			881	2600	2601	7400	7401	15000	15001	30000				
925	10%C3H6-b)/N2	10%Propylene/Nitrogen	19.7	21.7			761	2300	2301	6400	6401	13100	13101	26100				
926	3%H2S/H2	3%Hydrogen Sulfide/Hydrogen	24.7	29.7			881	2600	2601	8100	8101	17000	17001	34000				
927	6%B2H6/N2	6%Diborane/Nitrogen	24.7	29.7			811	2400	2401	6800	6801	14000	14001	28000				
929	10%CH4/N2	10%Methane/Nitrogen	19.7	21.7			851	2520	2521	7200	7201	15000	15001	30000				
930	3.9%H2/N2	3.9%Hydrogen/Nitrogen	24.7	29.7			861	2600	2601	7400	7401	15100	15101	30100				
932	5%GeH4/H2	5%Germane/Hydrogen	19.7	19.7			851	2530	2531	7800	7801	16000	16001	32000				
936	10%He/N2	10%Helium/Nitrogen	24.7	29.7			911	2700	2701	7600	7601	16000	16001	32000				
939	10%B2H6/He	10%Diborane/Helium	19.7	19.7			966	2918	2919	9000	9001	18400	18401	37000				
941	1%O2/Ar	1%Oxygen/Atgon	24.7	29.7			1211	3700	3701	10000	10001	20100	20101	41000				
946	30%C2H4/He	30%Ethylene/Helium	19.7	24.7			851	2551	2552	7800	7801	16000	16001	32000				
947	10%HCl/Ar	10%Hydrogen Chloride/Argon	24.7	29.7			1161	3600	3601	9500	9501	19300	19301	40000				
948	20%PH3/Ar	20%Phosphine/Argon	24.7	29.7			1021	3084	3085	8400	8401	17100	17101	35000				
949	2%F2/Ne	2%Fluorine/Neon	24.7	29.7			1201	3700	3701	10500	10501	22000	22001	45000				
950	10%H2/He	10%Hydrogen/Helium	19.7	19.7			1201	3500	3501	10700	10701	22200	22201	45000				
951	7%AsH3/H2	7%Arsine/Hydrogen	24.7	29.7			861	2600	2601	7800	7801	16000	16001	32000				
953	15%H2/B2H6	15%Hydrogen/Diborane	19.7	19.7			401	1200	1201	3400	3401	7100	7101	14000				
954	14%SiH2Cl2/20%SiH4/33%HCl/N2	14%Dichlorosilane/20%Silane/33%	14.7	19.7			671	2000	2001	5300	5301	11000	11001	22000				
958	17%CH4/CO2	17%Methane/Carbon Dioxide	24.7	29.7			651	2000	2001	5400	5401	11000	11001	22000				
962	20%CH6Si/H2	20%Methylsilane (MONO)/Hydrog	14.7	19.7			661	2000	2001	5900	5901	12000	12001	24000				
963	20%F2/N2	20%Fluorine/Nitrogen	24.7	29.7			861	2600	2601	7200	7201	15000	15001	30000				
965	50%CH3SiHCl2/H2	50%Dichloromethylsilane/Hydroge	11.7	13.7			401	1200	1201	3100	3101	6600	6601	13000				
976	4%CH4/Ar	4%Methane/Argon	24.7	29.7			1201	3600	3601	9600	9601	20000	20001	40000				
977	4%He/H2	4%helium/Hydrogen	14.7	19.7			881	2600	2601	8100	8101	17000	17001	34000				
978	20%GeH4/H2	20%Germane/Hydrogen	19.7	24.7			751	2240	2241	6600	6601	13500	13501	27000				
979	0.5%B2H6/He	0.5%Diborane/Helium	14.7	19.7			1201	3700	3701	11000	11001	23000	23001	47000				
980	20%F2/Ar	20%Fluorine/Argon	24.7	29.7			1101	3400	3401	9000	9001	18400	18401	37000				
982	5%HF/N2	5%Hydrogen Fluoride/Nitrogen	24.7	29.7			861	2600	2601	7200	7201	15000	15001	30000				
983	3%H2S/CO	3%Hydrogen Sulfide/Carbon Mono	24.7	29.7			861	2600	2601	7200	7201	15000	15001	30000				
984	1.4%C2H2/Ar	1.4%Acetylene/Argon	24.7	29.7			1201	3600	3601	9700	9701	20000	20001	40000				
985	2%Ge2H6/H2	2%Digermane/Hydrogen	24.7	29.7			861	2600	2601	7200	7201	15000	15001	30000				
986	38%SiCl4/O2	38%Silicon Tetrachloride/Oxygen	24.7	29.7	29.7	29.7	461	1400	1401	3600	3601	7500	7501	15000	15001	15001	15002	25000
987	20%H2S/20%CO2/N2	20%Hydrogen Sulfide/20%Carbon	24.7	29.7			791	2400	2401	6500	6501	13300	13301	27000				
988	20%SiH2Cl2/H2	20%Dichlorosilane/Hydrogen	24.7	29.7			701	2100	2101	5900	5901	12000	12001	24000				
989	0.1%Cl2/N2	0.1%Chlorine/Nitrogen	24.7	29.7			881	2600	2601	7400	7401	15000	15001	30000				
990	1%HCl/N2	1%Hydrogen Chloride/Nitrogen	24.7	29.7			881	2600	2601	7400	7401	15000	15001	30000				
991	3%BCl3/N2	3%Boron Trichloride/Nitrogen	24.7	29.7			851	2510	2511	7000	7001	14400	14401	29000				
992	18%NO/N2	18%Nitric Oxide/Nitrogen	24.7	29.7			881	2600	2601	7300	7301	15000	15001	30000				
993	9%NO/41%N2/H2	9%Nitric Oxide/41%Nitrogen/H2	24.7	29.7			881	2610	2611	7700	7701	16000	16001	32000				
994	20%H2/Ar	20%Hydrogen/Argon	24.7	29.7			1121	3400	3401	9400	9401	19200	19201	40000				
996	25%H2S/Ar	25%Hydrogen Sulfide/Argon	31.7	37.7	49.7	59.7	1041	3200	3201	8500	8501	17300	17301	35000	35001	35001	35002	61000
997	25%H2Se/Ar	25%Hydrogen Selenide/Argon	35.7	41.7	44.7	64.7	1031	3110	3111	8200	8201	17000	17001	34000	34001	34001	34002	58000
998	50%NH3/He	50%Ammonia/Helium	14.7	19.7	34.7	34.7	881	2600	2601	7700	7701	16000	16001	32000	32001	64000	64001	64001
999	40%CO/45%C2H4/Ar	40%Carbon Monoxide/45%Ethyle	18.7	22.7	39.7	39.7	701	2100	2101	6000	6001	12000	12001	24000	24001	44000	44001	44001
1000	0.9%SiH4/N2	0.9%Silane/Nitrogen	24.7	29.7	39.7	39.7	881	2600	2601	7300	7301	15000	15001	30000	30001	30001	30002	56000
1001	5%Ar/N2	5%Argon/Nitrogen	24.7	29.7	39.7	39.7	891	2700	2701	7500	7501	15200	15201	31000	31001	31001	31002	57000
1002	25%PH3/N2	25%Phosphine/Nirtogen	24.7	29.7	34.7	34.7	811	2400	2401	6700	6701	14000	14001	28000	28001	28001	28002	50000
1003	5%C4H6-e)/He	5%Butadiene/Helium	14.7	19.7			1033	3121	3122	9700	9701	20000	20001	40000				
1004	10%Cl2/N2	10%Chlorine/Nitrogen	24.7	29.7			845	2551	2552	7100	7101	14600	14601	29100				

For gases not specified for SA50, contact Brooks Product Marketing.

 For reference only, consult factory on the latest tables.

Table A-7 GF80 Series Gas Table - Codes 1005-5002, Bins SH40-SH44

Gas Code	Gas Symbol	Gas Name	Min inlet pressure for vac. exhaust (PSIA)				SH40		SH41		SH42		SH43		SH44	
			SH40-SH47	SH48	SH49	SH50	Low	High	Low	High	Low	High	Low	High	Low	High
1005	15%Xe/H2	15%Xenon/Hydrogen	24.7	29.7			4	10	11	32	33	97	98	294	295	903
5022	COS-Special	Carbonyl Sulfide (Special)	24.7	29.7			3	7	8	20	21	60	61	183	184	562

Table A-8 GF80 Series Gas Table - Codes 1005-5002, Bins SH45-SH50

Gas Code	Gas Symbol	Gas Name	Min inlet pressure for vac. exhaust (PSIA)				SH45		SH46		SH47		SH48		SH49		SH50	
			SH40-SH47	SH48	SH49	SH50	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1005	15%Xe/H2	15%Xenon/Hydrogen	24.7	29.7			904	2731	2732	8000	8001	16300	16301	33000				
5022	COS-Special	Carbonyl Sulfide (Special)	24.7	29.7			563	1700	1701	4500	4501	9400	9401	18300				

For gases not specified for SA50, contact Brooks Product Marketing.

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B GF80/GF81 Series Patents

The GF80/GF81 Series may be protected by the following US patents and their international filings.

Table B-1 GF80/GF81 Series Patents

Patent/Pub. No.	Title
6343617	System and method of operation of a digital mass flow controller
6389364	System and method for a digital mass flow controller
6425281	Pressure insensitive gas control system
6445980	System and method for a variable gain proportional-integral (PI) controller
6539792	Method and apparatus for balancing resistance
6640822	System and method of operation of a digital mass flow controller
6681787	System and method of operation of a digital mass flow controller
6714878	System and method for a digital mass flow controller
6752166	Method and apparatus for providing a determined ratio of process fluids
6826953	Flow sensor
6845659	Variable resistance sensor with common reference leg
6910381	System and method of operation of an embedded system for a digital capacitance diaphragm gauge
6941965	Method and apparatus for providing a determined ratio of process fluids
6962164	System and method for a mass flow controller
7043374	Flow sensor signal conversion
7073392	Methods and apparatus for pressure compensation in a mass flow controller
7082824	Variable resistance sensor with common reference leg
7113895	System and method for filtering output in mass flow controllers and mass flow meters
7114511	System and method for a mass flow controller
7133785	Valve control system and method
7143774	Method and apparatus for providing a determined ratio of process fluids
7150201	System and method for measuring flow
7216019	Method and system for a mass flow controller with reduced pressure sensitivity
7231931	System and method for a mass flow controller
7243035	System and method for mass flow detection device calibration
7272512	Flow sensor signal conversion
7273063	Methods and apparatus for pressure compensation in a mass flow controller
7287434	System and method for measuring flow
7360551	Method and apparatus for providing a determined ratio of process fluids
7363182	System and method for mass flow detection device calibration
7380564	System and method for a mass flow controller
7409871	Mass flow meter or controller with inclination sensor
7412986	Method and system for flow measurement and validation of a mass flow controller
7424894	Method and apparatus for providing a determined ratio of process fluids
7434477	Methods and apparatus for pressure compensation in a mass flow controller

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Bulgarian

Основни инструкции
Прочетете преди работа!

Brooks Instrument проектира, произвежда и тества продуктите си по такъв начин, че те да отговарят на многобройни национални и международни стандарти. Тези оборудвания трябва правилно да се инсталират, експлоатират и поддържат за да се гарантира, че ще могат да работят съответно на техните нормални спецификации. Следващите инструкции трябва да се спазват и трябва да се включат в програмата за безопасност на труда при инсталирането, експлоатацията и поддръжката на продуктите на Brooks Instrument.

- За да се гарантира характерната производителност, инсталирането, експлоатацията, актуализирането, програмирането и поддръжката на продукта трябва да се извършват само от квалифициран персонал.
- Прочетете всички инструкции преди инсталирането, експлоатацията и поддръжката на продукта. Ако това ръководство не е съответстващото издание, вижте на задната обложка информацията за контакт с местния търговски офис. Запазете това ръководство за по-късно информиране.

⚠ ВНИМАНИЕ: Не работете с оборудването извън диапазоните, указани в инструкцията и ръководството по експлоатация. Неизпълнението на това може да доведе до сериозни телесни повреди и / или повреждане на оборудването.

- Ако не разбирате някои инструкциите, свържете се с представителя на Brooks Instrument за изясняване на проблема.
- Спазвайте всички предупреждения, призови и инструкции означени върху оборудването или доставени заедно с него.
- Инсталирайте оборудването съответно на указанията в инструкцията за инсталиране и на действащите на местни и национални предписания. Свързвайте продуктите само към подходящи източници на електричество и налягане.
- Ход: (1) Бавно въведете системата под налягане. Бавно отворете работните клапани за да се избегнат колебанията на потока. (2) Проверете дали няма изтичане при входното и изходното съединение на разходомера. Ако няма изтичане, напълнете системата до работно налягане.
- Преди извършване на поддръжката непременно проверете дали работният тръбопровод не се намира под налягане. Ако са необходими резервни части, с определените от Brooks Instrument резервни части трябва да борави само квалифициран персонал. Неразрешените части и процедури могат да окажат влияние върху работата на продукта, и също да застрашат безопасността на експлоатацията. Заместването с неоригинални части може да доведе до пожар, опасност от токов удар или неправилна работа.
- Всички врати на оборудването непременно да бъдат затворени, а защитните покрития да бъдат на мястото си, за да се избегнат токовите удари и телесните повреди, освен ако квалифицирани специалисти извършват работи по неговото поддържане.

⚠ ВНИМАНИЕ: При оборудванията с протичащи течности, ако по някаква причина е необходимо да се затворят намиращите се до оборудването изходни и входни клапани, оборудването трябва напълно да се изпразни. Неизпълнението на това може да причини топлинно разширение на течността, което може до спука оборудването и да доведе до телесни повреди.

Европейска директива за уреди под налягане (PED)

Всички съоръжения под налягане с вътрешно налягане над 0,5 bar (g) и с размер по-голям от 25 mm или 1" (инч), попадат под действието на европейската директива за уреди под налягане (PED).

- Глава „Технически данни" на настоящото ръководство съдържа свързаните с директивата PED инструкции.
- Указаните в настоящото ръководство измерителни уреди съответстват на европейската директива 97/23/ЕО.
- Всички разходомери на Brooks Instrument се отнасят към флуиди от група 1.
- Измерителните уреди по-големи от 25 mm или 1" (инч) съответстват на I, II или III категория според PED.
- Измерителните уреди с размери 25 mm или 1" (инч), или по-малки, следват добрата инженерна практика (SEP).

Европейска директива за електромагнитна съвместимост (EMC)

Носещото знака CE (електрическо/електронно) оборудване на Brooks Instrument е изпълнило успешно тестовете за проверка на изискванията за електромагнитна съвместимост (директива EMC 2004/108/EC).
Особено внимание трябва да се обръща обаче на избирането на сигналните кабели, използвани с оборудването, носещо знака CE.
<u>Качество на сигналните кабели, кабелните салници и съединители:</u>
Brooks Insturment предлага висококачествени кабели, отговарящи на изискванията на CE сертификацията.
Ако използвате собствен сигнален кабел, трябва да изберете такъв, който е напълно защитен със 100%-ово екраниране.
Съединителите тип „D" или „кръгов" трябва да бъдат екранирани с метален щит. При необходимост за фиксирането на щита на кабела трябва да се използват метални кабелни салници.
Щитът на кабела трябва да се свърже с металното покритие или металния салник и в двата края да се екранира в 360°. Щитът трябва да бъде заземен.
Съединителите за печатни платки са стандартно неметални. Използваните кабели трябва да бъдат защитени със 100%-ово екраниране, за да отговарят на CE сертификацията.
Щитът трябва да бъде заземен.
Конфигурация на контактите: Виж приложената инструкция за експлоатация.

Електростатичен разряд (ESD)

⚠ ВНИМАНИЕ: Приборът съдържа електронни компоненти, които са чувствителни към статичното електричество и могат да се повредят от него. Трябва да се спазват съответните процедури по време на изваждане, слагане или друго боравене с вътрешните монтажни платки и устройства.

Процедура за работа:

1. Изключете оборудването.
2. Персоналът трябва да се заземи с гривна или друго безопасно и подходящо за целта средство, преди да инсталира, изважда или регулира монтажна платка или друго вътрешно устройство.
3. Печатните монтажни платки трябва да се транспортират в проводяща опаковка. Печатните платки могат да се изваждат от защитното покритие само непосредствено преди инсталирането. Отстранените печатни платки незабавно трябва да се сложат в защитна опаковка, служеща за транспортиране, складиране или връщане на производителя.

Забележки:
Не е уникално явление, че този прибор съдържа чувствителни към електростатичния заряд (ESD) компоненти. Болшинството от съвременните електронни прибори съдържат компоненти, изготвени по технология метал-окис (NMOS, SMOS и т.н.). Опитът доказва, че даже и малко количество статическо електричество може да повреди или съсипе тези прибори. Повредените компоненти даже ако привидно работят правилно, проявяват начални неизправности.

Czech

Základní instrukce
Před instalací si přečtěte následující instrukce!

Společnost Brooks Instrument konstruuje, vyrábí a testuje tento produkt tak, aby splnil mnoho národních a mezinárodních standardů. Přístroje musí být řádně nainstalovány, používány a udržovány tak, aby byl zajištěn jejich nepřetržitý provoz v rámci normálních technických specifikací. Musíte dodržovat následující pokyny a integrovat jejich obsah do svého bezpečnostního programu při instalování, používání a udržování produktů společnosti Brooks.

- Pro zajištění správné funkce zařízení mohou jeho instalaci, obsluhu, programování, údržbu a aktualizace firmwaru provádět výhradně kvalifikované osoby.
- Před instalací, provozem a údržbou produktu si prostudujte všechny pokyny. Pokud tato příručka není tou správnou příručkou pro dané zařízení, informujte se na zadní straně obálky o kontaktu na místní prodejní kancelář. Uchovejte si tuto příručku pro pozdější potřebu.

⚠ UPOZORNĚNÍ: Neprovozujte zařízení v rozsahu mimo daný rozsah v provozní příručce. Porušení tohoto upozornění může mít za následek vážné újmy na zdraví a vést k poškození zařízení.

- Pokud některým pokynům nerozumíte, kontaktujte svého prodejního zástupce společnosti Brooks a vyžádejte si objasnění.
- Dodržujte všechny výstrahy, upozornění a pokyny, uvedené a vyznačené na produktu, nebo s ním dodané.
- Namontujte zařízení specifikovaným způsobem podle správné montážní příručky a podle platných místních a národních předpisů. Připojte všechny produkty ke správným zdrojům elektrické energie a stlačených médií.
- Postup: (1) Pomalu do systému přivádějte médium. Pro zabránění vzniku rázů v systému otvírejte procesní ventily postupně. (2) Překontrolujte těsnost vstupního a výstupního připojení průtokoměru. Pokud nezjistíte žádné netěsnosti, postupně zvedejte tlak na provozní hodnotu.
- Před prováděním servisních prací zkontrolujte, zda systém není pod tlakem. V případě potřeby výměny dílů zajistěte, aby byly použity náhradní součásti specifikované společností Brooks Instrument a výměnu prováděla kvalifikovaná osoba. Použití neschválených dílů a postupů může negativně ovlivnit efektivitu a bezpečnost procesu. Použití náhrad za originální díly může způsobit požár, úraz elektrickým proudem nebo nesprávnou funkci.
- Pokud není zrovna prováděna údržba kvalifikovanou osobou, ujistěte se, že zařízení je opatřeno všemi předepsanými kryty.

⚠ UPOZORNĚNÍ: Pokud je u zařízení s průtokem kapalin nutno z jakéhokoli důvodu uzavřít vstupní a výstupní ventily, je nutné zařízení kompletně vyprázdnit. Pokud tak neučiníte, může z důvodu teplotní roztažnosti zbytků média v zařízení dojít k jeho poškození nebo k ohrožení zdraví osob.

Evropská směrnice pro tlakové zařízení (PED)

Na veškerá tlaková zařízení s vnitřním tlakem vyšším než 0,5 baru (g) a velikosti větší než 25 mm nebo 1" (palec) se vztahuje platnost směrnice o tlakovém zařízení (PED).
Kapitola „Technické údaje“ v této příručce obsahuje důležité bezpečnostní a provozní pokyny související se směrnicí PED.

- Měřicí přístroje popsané v této příručce jsou v souladu se směrnicí EN 97/23/ES.
- Všechny průtokoměry společnosti Brooks Instrument spadají do rámce Kapaliny, skupina I.
- Měřicí přístroje větší než 25 mm nebo 1" (palec) jsou v souladu se směrnicí PED, kategorii I, II nebo III
- Měřicí přístroje s velikostí 25 mm nebo 1" (palec) a menší spadají do rámce Správných technických postupů (SEP).

Evropská směrnice pro elektromagnetickou kompatibilitu (EMC)

Elektrické/elektronické zařízení Brooks Instrument nesoucí značku CE bylo úspěšně testováno dle předpisů pro elektromagnetickou kompatibilitu (směrnice EMC č. 2004/108/EC).
Výběru signálních kabelů pro použití se zařízením označeném CE je nutné věnovat zvláštní pozornost.
Kvalita signálních kabelů, kabelových průchodek a konektorů:
Brooks Instrument dodává vysoce jakostní kabely splňující požadavky kvalitativního zařazení CE. Pokud chcete použít vlastní signální kabely, zvolte typy s kvalitním stíněním všech žil a v celé délce trasy.
V případě použití konektorů kruhových nebo tvaru „D“, musí mít tyto kovové stínění. V případě jejich použití, musí kovové kabelové průchodky být propojeny se stíněním kabelu.
Stínění by mělo být připojené ke kovovému tělesu přístroje nebo krytu, na obou koncích kabelu a po celém jeho obvodu.
Stínění by mělo být uzemněno.
Přípojky vedoucí ke kartám podle norem jsou nekovová. Pro splnění požadavků předpisů CE musí být použité kabely kompletně stíněny.
Stínění by mělo být uzemněno.
Konfigurace kontaktů je uvedena v přiloženém návodu k obsluze.

Elektrostatický výboj (ESD)

⚠ UPOZORNĚNÍ: Tento přístroj obsahuje komponenty citlivé na poškození statickou elektřinou. Při montáži, demontáži či jiné manipulaci s vnitřními elektronickými obvody je potřeba dodržovat příslušné postupy.
Postup ošetřování:

1. Odpojte přístroj od napájení.
2. Osoba provádějící údržbu má být při instalaci, vyjímání či práci na desce plošných spojů nebo jiné vnitřní elektronice uzemněna zemnícím náramkem, nebo jiným vyhovujícím způsobem.
3. Desky plošných spojů je nutné přepravovat v elektricky vodivém obalu. Plošné spoje vyjímejte z vodivého obalu až bezprostředně před instalací do přístroje! Plošné spoje vyjmuté z přístroje a určené pro další využití, opět neprodleně umístěte do ochranného obalu.

Poznámky:
Existence prvků, citlivé na elektrostatické výboje (ESD) v přístrojích je častým jevem. Prvky s technologií oxidu kovů (NMOS,SMOS) jsou používány u většiny moderních elektronických zařízení. Zkušenosti dokazují, že i jen malé elektrostatické výboje mohou poškodit nebo zničit tyto zařízení. U poškozených součástek, jakkoli zdánlivě pracujících bezchybně, dochází brzy k poruše.

Dansk

Grundlæggende vejledninger
Læs disse før anvendelse!

Brooks Instruments designer, fremstiller og afprøver sine produkter således, at de tilpasser sig både de indenrigs og internationale standarder. Disse udstyr bør installeres, bruges og repareres omhyggeligt, så at de kan virke tilsvarende deres normale anvendelsesperiode. De følgende regler skal overholdes og implementeres under installeringen samt ved brug og reparation.

- For at garantere den passende kapacitet, er udstyrets installation, anvendelse, opdatering, programmering kun tilladt for kvalificeret personale. Alle vejledninger skal læses før produktets installation, anvendelse og reparation.
- Hvis denne manual ikke er den passende udgave, kontakt venligst jeres leverandør for yderligere information.
- Det anbefales at gemme denne manual for senere brug.

⚠ **OBS.: Udstyret må ikke anvendes til andet end det er angivet i brugsanvisningen. Hvis denne regel brydes, kan der forekomme alvorlige personskader eller brist på udstyret.**

Hvis vejledningerne ikke er forståelig, kontakt venligst Deres Brooks repræsentant for at afklare problemet som er opstået.

- Overhold alle regler, som er markeret eller leveret sammen med udstyret.
- Installer udstyret efter den angivne installationsvejledning og gældende lovgivning for anvendelsesområde. Udstyret må kun tilsluttes med kabler og stik som overholder kravspecifikationerne i vejledningen.
- Ibrugtagning: (1) Åbn langsomt for trykket i systemet.. Åbn langsomt for alle procesventiler for at forhindre ustabil gas flow. (2) Tjek systemet for lækage ved tilsluttet måleinstrumenter, samlinger og andet tilsluttet udstyr. Derefter øg trykket i systemet indtil arbejdstrykket er opnået.
- Før reparation tjek altid at procesledningen ikke står under tryk. Hvis der er brug for at udskifte defekte dele må kun kvalificeret personale udføre arbejdet og af sikkerhedsmæssige årsager må der kun anvendes originale Brooks reservedele. Det er ikke tilladt at anvende reservedele eller udføre arbejde der på nogen måde kan ændre produktet fra dens oprindelige specifikationer. Manglende overholdelse af de foreskrevne procedurer kan resultere i brænd, og fare for elektrisk stød eller kortslutning.
- Af sikkerhedsmæssige årsager sørg for at alle sikkerhedsforanstaltninger er overholdt. Eksempelvis at alle afskærmninger eller anden form for installationsbeskyttelse er lukket eller installeret ved normal drift.

⚠ **Advarsel.: Ved brug af udstyr som anvendes til væske skal det sikres at indgangsventilen og udgangsventilen ikke bliver lukket på samme tid i forbindelse med aftapning. Såfremt dette ikke overholdes, er der risiko for at væsken på grund af varmeudvikling ekspanderer og dette kan forårsage skade på udstyr og personer.**

Det Europæiske direktiv for trykudstyr (PED)

På alt udstyr hvis indgangstryk er større end 0,5bar (g) og større end 25 mm eller en tomme, gælder det europæiske direktiv for trykapparater. Manualens afsnit "tekniske data" indeholder anvisninger om PED direktivet.

- I manualen angives måleinstrumenter der er tilpasset direktivet 97/23/EK EU.
- Alle Brooks gennemstrømningsmålere tilhører væskegruppen nr. 1.
- Alle målinstrumenter som er større end 25 mm eller en tomme beskrives i direktivet PED´s kategorier I, II eller III.
- Alle målinstrumenter som er på 25 mm eller en tomme, eller mindre, beskrives i Sound Engineering Practice (SEP).

Det europæiske direktiv for elektromagnetisk kompatibilitet (EMC)

Alle Brooks instrumenter (elektrisk/elektronisk) som har CE markering er godkendt og testet ifølge om elektromagnetiske kompatibilitets forskrifter (EMC direktiv 2004/108/EC).
OBS: Man skal være opmærksom på hvilken type kabler der bruges til CE mærket udstyr..

<u>Om kvalitet af signalkabler, kabeltilslutninger og koblinger:</u>
Brooks tilbyder kabler af højest kvalitet, som er tilpasset CEE kvalificeringens forskrifter. Hvis man vælger at bruge egne kabler, skal man vælge et kabel som har den nødvendige afskærmning for at sikre 100 % mod udefra kommende støj.
Tilslutningerne "D" eller rundformede tilslutninger skal være afskærmet med skal af metal.
Stikket skal være afskærmet på alle sider. Al afskærmning skal jordes..
Card Edge tilslutninger er ifølge standarden ikke metalliske.. De anvendte kabler og stik skal være 100 % afskærmet for at opfylde CE kravene.. De skal ligeledes jordes.
For stik konfigurationen se vedlagte brugsvejledning.

Elektrostatisk afladning (ESD)

⚠ **OBS.: Udstyret indeholder tilbehør som kan skades ved elektrostatisk elektricitet. Alle forskrifter skal overholdes ved kontakt med alle elektriske komponenter både under drift og vedligeholdelse..**

Behandlingsproceduren:

1. Sluk for al strømtilførsel til udstyret.
2. Personer som skal i kontakt med udstyret skal være jordet eller bære anden form for elektrisk beskyttende udstyr. Manglende overholdelse af dette kan medføre skader på alle elektriske komponenter.
3. Alle elektriske komponenter skal opbevares eller transporteres i deres originale indpakning for at sikre komponenter mod statiske elektriske skader. Emballagen må ikke åbnes før komponenten skal installeres i udstyret. Ved afslutning af vedligeholdelse/reparation af udstyret, skal udstyret installeres med det samme eller pakkes forsvarligt hvis det skal på lager eller transporteres.

Bemærkninger:
Dette udstyr er ikke unik i den hensigt, at det indeholder for elektrostatisk afladning (ESD) sensitive reservedel. I de fleste elektronisk udstyr findes der metaloxyd teknologiske reservedel (NMOS, SMOS m.m.). Erfaringerne viser at selv den mindste statiske elektricitet kan skade, eller ødelægge disse instrumenter. Selv en fungerende elektrisk del kan have levetiden markant reduceret på grund af statisk elektricitet..

Dutch

Essentiële instructies

Lees ze voordat u verder gaat!

Brooks Instrument ontwerpt, produceert en test haar producten zodanig dat ze voldoen aan vele nationale en internationale normen. Deze producten moeten correct worden geïnstalleerd, bediend en onderhouden zodat ze binnen hun normale specificaties blijven werken. De volgende instructies moeten worden toegevoegd aan en geïntegreerd in uw veiligheidsprogramma als u producten van Brooks Instrument installeert, bedient en onderhoudt.

- Om de juiste prestaties te kunnen garanderen mag alleen gekwalificeerd personeel het product installeren, bedienen, updaten, programmeren en onderhouden.
- Lees alle instructies voordat u het product gaat installeren, bedienen en onderhouden. Als dit niet de juiste handleiding is, kijk dan op de achterzijde voor contactinformatie van uw vertegenwoordiger. Bewaar deze handleiding voor later.

WAARSCHUWING: gebruik dit instrument niet als niet is voldaan aan de specificaties in de handleiding. Het niet naleven van deze waarschuwing kan ernstig letsel en/of schade aan de apparatuur tot gevolg hebben.

- Als u één of meer instructies niet begrijpt, vraag dan om uitleg aan uw vertegenwoordiger van Brooks Instrument.
- Neem alle waarschuwingen, voorschriften en instructies in acht die op het product zijn aangebracht of bij het product zijn geleverd.
- Installeer uw apparatuur volgens de instructies in de bijgeleverde handleiding en in overeenstemming met de geldende lokale en nationale voorschriften. Sluit alle producten aan op de juiste elektrische voedings- en drukbronnen.
- Bediening: (1) Laat het systeem langzaam volstromen. Open de procesafsluiters langzaam om drukstoten te voorkomen. (2) Controleer op lekkages rondom de inlaat- en uitlaataansluitingen van de stromingsmeter. Als er geen lekkages zijn, kan het systeem op de bedrijfsdruk worden gebracht.
- Zorg ervoor dat de procesleiding drukvrij is gemaakt voordat u servicewerkzaamheden gaat uitvoeren. Als vervangingsonderdelen nodig zijn, zorg er dan voor dat gekwalificeerd personeel de door Brooks Instrument gespecificeerde vervangingsonderdelen gebruikt. Niet goedgekeurde onderdelen en procedures kunnen de prestaties van het product en de veilige werking van uw proces in gevaar brengen. Niet goedgekeurde vervangingsonderdelen kunnen brand, elektrische schokken of een onjuiste werking tot gevolg hebben.
- Zorg ervoor dat alle deksels van de apparatuur gesloten zijn en de afdekkingen gemonteerd zijn om elektrische schokken en lichamelijk letsel te voorkomen, behalve als gekwalificeerd personeel de onderhoudswerkzaamheden uitvoert.

WAARSCHUWING: bij vloeistofstroomapparaten waarvan de inlaat- en uitlaatkleppen om welke reden dan ook gesloten zijn, moet de vloeistof volledig worden afgetapt. Als dat wordt nagelaten, kan dit leiden tot thermische expansie van de vloeistof waardoor het apparaat kan barsten en lichamelijk letsel kan veroorzaken.

PED-richtlijn (Pressure Equipment Directive)

Alle drukapparatuur met een interne druk van meer dan 0,5 barg en een diameter van meer dan 25 mm valt onder de PED-richtlijn.

- In het hoofdstuk Specificaties van deze handleiding staan aanwijzingen die verband houden met de PED-richtlijn.
- De meters die in deze handleiding worden beschreven, voldoen aan de Europese richtlijn 97/23/EG.
- Alle stromingsmeters van Brooks Instrument vallen in groep 1.
- Meters met een diameter van meer dan 25 mm voldoen aan de categorieën I, II of III van de PED-richtlijn.
- Meters met een diameter van 25 mm of kleiner voldoen aan de regels van goed vakmanschap.

Elektromagnetische compatibiliteit (EMC)

De elektronische apparatuur van Brooks Instrument met de CE-markering is succesvol getest in overeenstemming met de EMC-voorschriften (richtlijn EMC 2004/108/EC).
De keuze van de signaalkabel voor gebruik in combinatie met apparatuur met CE-markering verdient speciale aandacht.
Kwaliteit van de signaalkabel, kabelafdichtingen en stekkers:
Brooks Instrument levert hoogwaardige kabels die voldoen aan de specificaties voor de CE-markering.
Als u zelf voor signaalkabel zorgt, moet u altijd een volledig afgeschermde kabel gebruiken.
Stekkers van het type “D” of ronde stekkers moeten zijn voorzien van een metalen afscherming. Indien nodig moeten metalen kabelafdichtingen worden gebruikt waarvan de afscherming voor het klemmen van de kabel kan worden gebruikt.
Het kabelscherm moet met het metalen omhulsel of de metalen afdichting worden verbonden en aan beide uiteinden rondom volledig worden afgeschermd.
De afscherming moet aan de aardpotentiaal worden aangesloten.
Card Edge Connectors zijn standaard niet van metaal. De gebruikte kabels moeten volledig zijn afgeschermd om te voldoen aan de CE-markering.
De afscherming moet aan de aardpotentiaal worden aangesloten.
Voor de pinconfiguratie: Raadpleeg de bijgevoegde handleiding.

Elektrostatische ontlading

VOORZICHTIG: Dit instrument bevat elektronische componenten die gevoelig zijn voor statische elektriciteit. Neem de juiste procedures in acht bij het verwijderen en installeren of bij andere werkzaamheden aan de interne printplaten of apparaten.
Procedure:

1. Schakel de voeding van de eenheid uit.
2. Het personeel moet zich met een polsbandje of ander veilig en geschikt hulpmiddel aarden voordat een printplaat of ander intern apparaat mag worden geïnstalleerd, verwijderd of aangepast.
3. Printplaten moeten in een geleidende verpakking worden vervoerd. De platen mogen pas vlak voor de eigenlijke installatie uit de beschermende verpakking worden gehaald. Verwijderde printplaten moeten onmiddellijk in de beschermende verpakking worden geplaatst om te worden getransporteerd, opgeslagen of teruggestuurd naar de fabriek.

Opmerkingen
Dit instrument is niet uniek als het gaat om componenten die gevoelig zijn voor elektrostatische ontlading. De meeste moderne elektronische apparaten bevatten componenten die gebruik maken van de metaaloxidetechnologie (NMOS, SMOS, enz.). Uit ervaring blijkt dat zelfs kleine hoeveelheden statische elektriciteit deze apparaten al dan niet onherstelbaar kunnen beschadigen. Beschadigde componenten, zelfs als ze goed lijken te functioneren, raken eerder defect.

Estonian

Olulised juhised
Enne kasutamist lugege hoolikalt läbi!

Brooks Instrument konstrueerib, valmistab ja katsetab oma tooteid selliselt, et need vastaksid paljude erinevate riiklike ja rahvusvaheliste standardite nõuetele. Ainult nõuetekohane paigaldamine, kasutamine ja hooldamine tagab toodete katkematu talitluse tavaspetsifikatsiooni raames. Brooks Instrument'i toodete paigaldamisel, kasutamisel ja hooldamisel tuleb täita alljärgnevaid juhiseid ja integreerida need asjakohasesse ohutusprogrammi.

- Nõuetekohase talitluse tagamiseks tohib toodet paigaldada, kasutada, täiustada, programmeerida ja hooldada ainult kvalifitseeritud personal.
- Enne toote paigaldamist, kasutamist ja hooldamist lugege kõik kasutusjuhised hoolikalt läbi. Kui käesolev kasutusjuhend ei vasta teie tootele, pöörduge kohaliku edasimüüja poole, kelle kontaktandmed leiate kasutusjuhendi tagakaanelt. Hoidke see kasutusjuhend edaspidiseks alles.
  HOIATUS: ärge kasutage seda instrumenti väljaspool kasutusjuhendis spetsifitseeritud piirväärtusi. Selle hoiatuse eiramine võib põhjustada tõsiseid kehavigastusi ja/või kahjustada seadet.
- Kui te saa mõne juhise mõttest aru, pöörduge selgituste saamiseks kohaliku Brooks Instrument'i edasimüüja poole.
- Järgige kõiki hoiatusi, tähelepanule manitsusi ja juhiseid, mis on tootele peale kantud või tootega kaasa antud.
- Seadme paigaldamisel järgige vastavas kasutusjuhendis toodud paigaldusjuhiseid ning asjakohaseid kohalikke ja riiklikke eeskirju. Ühendage tooted nõuetekohaste toite- ja surveallikatega.
- Talitlus: (1) Avage aeglaselt vool süsteemi. Vooluimpulsside vältimiseks avage tööventiilid aeglaselt. (2) Kontrollige, et voolukulumõõturi sisend- või väljundühenduste ümber ei ole lekkeid. Kui lekkeid ei ole, laske süsteemil saavutada töösurve.
- Enne seadme hooldamist veenduge, et kogu süsteem on surve alt vabastatud. Varuosasid tohib vahetada ainult kvalifitseeritud personal, kasutades selleks Brooks Instrument'i poolt heakskiidetud varuosi. Mitteoriginaalvaruosade kasutamine ja ebapädev toimingute tegemine võivad kahjustada toote tööomadusi ja põhjustada riski tootmistegevuse ohutuse tagamisel. Originaalvaruosadele sarnaste osade kasutamine võib põhjustada tule- või elektrilöögiohtu või seadme väärtalitlust.
- Elektrilöögi- ja vigastuseohu vältimiseks peavad seadme luugid olema alati suletud ja kaitsekatted oma kohal, va seadme hooldamisel kvalifitseeritud isikute poolt.
  HOIATUS: voolava vedelikuga seadmete kasutamisel – kui seadmega külgnevad sisend- ja väljundklapid on vaja mingil põhjusel sulgeda, tuleb seadmed vedelikust täiesti tühjaks lasta. Vastasel korral võib vedelik soojuse mõjul paisuda niivõrd, et seade puruneb. See võib põhjustada tõsiseid kehavigastusi.

Euroopa surveseadmete direktiiv (PED)

Euroopa surveseadmete direktiiv kohaldub kõikidele surveseadmetele, mille sisesurve on üle 0,5 baari (g) ja läbimõõt üle 25 mm või 1 tolli.

- Käesoleva kasutusjuhendi spetsifikatsiooniosa sisaldab surveseadmete direktiiviga seonduvaid juhiseid.
- Käesolevas kasutusjuhendis kirjeldatud mõõturid vastavad EN direktiivi 97/23/EÜ nõuetele.
- Brooks Instrument'i voolukulumõõturid kuuluvad vedelike 1. gruppi.
- Mõõturid läbimõõduga üle 25 mm või 1 tolli vastavad surveseadmete direktiivi kategooriale I, II või III.
- Mõõturitele läbimõõduga alla 25 mm või 1 tolli kohaldatakse häid inseneritavasid.

Euroopa elektromagnetilise ühilduvuse direktiiv (EMÜ)

Brooks Instrument'i (elektrilised/elektroonilised) seadmed, millele on omistatud CE-tähis, on edukalt läbinud asjakohased katsed ja vastavad elektromagnetilise ühilduvuse nõuetele (EMÜ direktiiv 2004/108/EC).
Kuid signaalkaabli valimisel on vaja pöörata suurt tähelepanu CE-tähisega seadmetele.
Signaalkaabli, läbiviigutihendite ja konnektorite kvaliteet
Brooks Instrument turustab kõrgekvaliteedilisi kaableid, mis vastavad CE-sertifikaadi nõuetele.
Olemasoleva kaabli kasutamisel jälgige, et kaabel oleks täielikult ümbritsetud varjestusega.
„D" või „Ring"-tüüpi konnektorid peavad olema varustatud metallvarjestusega. Kus kohaldatav, tuleb kasutada metallist läbiviike, mis tagavad kaabli varjestuse ühenduse.
Kaabli varjestus ühendatakse metallkesta või läbiviigutihendiga ja on mõlemast otsast kaitstud 360° ulatuses.
Varjestus peab olema maandatud.
Mikroskeemide servaühendused on üldjuhul mittemetallist. Vastavuse tagamiseks CE-sertifikaadi nõuetele peavad kasutatud kaablid olema 100% varjestatud.
Varjestus peab olema maandatud.
Klemmide konfigureerimine: vt komplekti kuuluvat kasutusjuhendit.

Elektrostaatiline laeng

TÄHELEPANU: seade sisaldab staatilise elektri suhtes tundlikke elektroonikakomponente. Seadmesse paigaldatud trükkplaatide eemaldamisel ja paigaldamisel, samuti trükkplaadi või seadmega muude toimingute teostamisel järgige nõuetekohase käsitsemise juhiseid.
Käsitsemisjuhised

1. Lahutage seade toiteallikast.
2. Enne trükkplaadi või mõne muu siseelemendi paigaldamist, eemaldamist või konfigureerimist peab personal olema maandatud läbi randmepaela või mõne muu sobiva vahendi.
3. Trükkplaate transporditakse voolujuhtivas konteineris. Võtke trükkplaat kaitsvast konteinerist välja vahetult enne selle paigaldamist. Seadmest eemaldatud trükkplaadid tuleb viivitamatult asetada kaitsvasse konteinerisse kas siis edasiseks transportimiseks, hoiustamiseks või tehasesse tagasisaatmiseks.

Kommentaarid
See seade ei ole ainus, mis sisaldab staatilise elektri suhtes tundlikke elemente. Enamik kaasaegsetest elektroonikaseadmetest sisaldavad komponente, mille valmistamiseks on kasutatud metalloksiidtehnoloogiat (NMOS, SMOS jne). Kogemused näitavad, et isegi väike kogus staatilist elektrit võib neid seadmeid kahjustada või isegi hävitada. Kuigi võib näida, et kahjustatud komponendid töötavad nõuetekohaselt, hakkavad talitlushäired ilmnema juba varakult.

Finnish

Perusohjeet
Lue ensin ohjeet huolellisesti!

Brooks Instrument suunnittelee, valmistaa ja testaa laitteensa vastaamaan useimpien kotimaisten ja kansainvälisten standardien vaatimuksia. Tuotteet tulee asentaa, käyttää ja huoltaa käyttöohjeiden mukaan jotta niiden toimivuus taataan. Brooks Instrumentin laitteiden asennuksessa, käytössä ja huollossa on noudatettava soveltuvia määräyksiä ja ohjeita, lisäksi mainitut ohjeet on huomioitava työsuojelun ohjeistuksessa.

Oikean toiminnan varmistamiseksi vain valtuutettu huoltohenkilö saa asentaa, käynnistää, päivittää, ohjelmoida ja huoltaa laitteita.
Lue kaikki käyttöohjeet koskien tuotteen asennusta, käyttöä ja huoltoa. Jos käyttöohje on puutteellinen, lisätietoja saa paikalliselta jälleenmyyjältä. Yhteystiedot löytyvät oppaan kansilehdestä. Säilytä ohjeet.

⚠ **VAROITUS!: Käyttöohjeessa ilmoitettujen standardien mukaisia ohjeita ja raja-arvoja ei saa ylittää. Rajoitusten laiminlyönti voi aiheuttaa tuotteen rikkoutumisen ja/tai vakavan henkilövahingon vaaran.**

- Jos ohjeissa on epäselvyyttä, ota yhteyttä Brooks Instrumentin edustajaan ongelman selvittämiseksi.
- Noudata kaikkia laitteessa olevia tai siihen liittyviä ohjeita, määräyksia ja varoituksia.
- Laittteen asennuksessa on noudatettava erityisiä asennusohjeita sekä voimassa olevia paikallisia ja kansainvälisiä määräyksiä. Laitteet saa yhdistää vain soveltuvaan sähkö- ja paineverkkoon.
- Asennusohjeita: (1) Päästä virtaus hitaasti järjestelmään. Avaa venttiilit hitaasti, jotta virtaus pysyy tasaisena. (2) Tarkista, ettei virtausmittarin sisään- ja ulosmenon vieressä ole vuotoa. Jos järjestelmässä ei ole vuotoa, aseta oikea käyttöpaine.
- Tarkista, että laitteeseen menevä paine on katkaistu ennen laitteen korjaamista välttääksesi äkillisen painepäästön aiheuttaman loukkaantumisriskin. Mahdollisten varaosien tulee olla Brooks Instrumentin hyväksymiä. Vain valtuutettu huoltohenkilö saa asentaa varaosat. Ei-hyväksyttyjen varaosien käyttö voi vahingoittaa tuotteen toimintaa ja aiheuttaa turvallisuusriskin. Samoin ei-hyväksyttyjen varaosien käyttö voi aiheuttaa tulipalon, sähköiskun tai virhetoiminnan riskin.
- Varmista että kaikki kaikki laitteen ovet/luukut ovat suljettuina ja tarkista että suojakannet ovat paikoillaan estääksesi mahdollisen sähköisku- ja loukkaantumisvaaran.

⚠ **VAROITUS!: Jos järjestelmässä virtaa neste ja laitteen sisään- ja ulosmenoventtiilit pitää sulkea, laite on ensin tyhjennettävä kokonaan. Tyhjentämisen laiminlyönti aiheuttaa nesteen lämpölaajenemista, joka saattaa johtaa laitteen rikkoutumiseen ja henkilövahingon vaaraan.**

Eurooppalainen painelaitedirektiivi (PED)

Painelaitteet, joidenpaine on suurempi kuin 0,5 bar ja joiden koko on suurempi kuin 25 mm tai 1 tuuma , kuuluvat eurooppalaiseen painelaitedirektiiviin (PED).

- PED direktiiviä koskevat määräykset löytyvät käyttöoppaan ’’Tekniset tiedot” -luvusta.
- Käyttöoppaassa kuvatut mittarit ovat 97/23/EC EU-direktiivin mukaisia.
- Kaikki Brooks Instrumentin virtausmittarit kuuluvat virtausryhmään 1. Laitteet jotka ovat suurempia, kuin 25 mm tai 1 tuuma, ovat PED I, II, III kategorien mukaisia.
- Mittarit joiden koko on alle 25 mm tai 1 tuuma ovat hyvän konepajakäytännön (SEP) mukaisia.

Eurooppalainen direktiivi sähkömagneettisesta yhteensopivuudesta (EMC)

Brooks Instrumentin CE-merkin saaneet (sähkö/sähköiset) laitteet täyttävät EMC direktiivin vaatimukset ja testit sähkömagneettisesta yhteensopivuudesta (2004/108/EC EMC direktiivi).
Erityistä huomioita on kiinnitettävä CE-merkittyjen laitteiden käytössä olevien kaapelien valintaan.
Kaapelien, kiinnikkeiden ja liittimien laatu:
Brooks Insturmentin kaapelit ovat korkealaatuisia ja täyttävät CE-merkintä direktiivin vaatimukset.
Muun valmistajan kaapelia käytettäessä on käytettävä 100% suojattua kaapelia.
Liittimien tulee olla häiriösuojattua tyyppiä. Tarvittaessa käytetään metallisia kiinnikkeitä kaapelin suojuksen kiinnittämiseen. Kaapelin suojakuoren pitää olla yhdistettynä metallisuojukseen tai laippaan ja sen pitää olla molemmista päistä suojattuna 360^{o} . Suojaus päättyy maadoitukseen.
Standardin mukaan korttien liittimet eivät ole metallisia. Käytettyjen kaapelien suojaus on oltava 100%, jotta se täyttäisi CE-merkinnän direktiivin vaatimukset.
Suojaus päättyy maadoitukseen.
Napojen järjestys: Katso liitteenä oleva käyttöopas.

Elektrostaattinen purkaus (ESD)

⚠ **VAROITUS!: Tuote sisältää elektroniikkakomponentteja jotka voivat vahingoittua staattisesta sähköstä. Sisäisten piirilevyjen purkamisessa,asennuksessa ja käsittelyssä tulee noudattaa kaikkia määräyksiä ja ohjeita.**

Asennusohjeet:

1. Järjestelmän sähköt katkaistaan.
2. Laitteen kanssa työskentelevä henkilö on suojattava sähköiskuilta rannehihnalla tai muulla suojavarustuksella ennen piirilevyn tai muun sisäosan asennusta, poistamista tai korjaamista.
3. Piirilevyt kuljetetaan konduktiivisessa pakkauksessa. Piirilevyt puretaan paketista juuri ennen asennusta. Poistettu piirilevy on heti pakattava soveltuvaan suojapakkaukseen kuljettamista, varastoimista tai palautusta varten.

Huomautukset:
Tuotteen herkkyys elektrostaattiselle purkaukselle (ESD) ei ole epätavallista. Suurin osa elektroniikkatuotteista sisältää komponentteja jotka hyödyntävät metallioksiditekniikkaa (NMOS, SMOS jne.) Kokemusten mukaan pienikin elektrostaattinen purkaus voi aiheuttaa laitteiden virhetoiminnan tai vahingoittumisen. Vahingoittuneet komponentit saattavat aiheuttaa laitteen ennenaikaisen rikkoutumisen vaikka laite näyttäisi toimivan normaalisti.

French

Instructions essentielles
A lire avant de commencer !

Brooks Instrument conçoit, fabrique et teste ses produits pour répondre à de nombreuses normes nationales et internationales. Ces produits doivent être correctement installés, utilisés et entretenus pour pouvoir fonctionner dans le cadre de leurs spécifications normales. Les instructions qui suivent doivent être respectées et intégrées à votre programme de sécurité lors de l'installation, l'utilisation et l'entretien des produits Brooks Instrument.

- Afin d'assurer un fonctionnement correct, faites appel à du personnel qualifié pour l'installation, l'utilisation, la mise à jour, la programmation et l'entretien du produit.
- Lisez toutes les instructions avant l'installation, l'utilisation et l'entretien du produit. Si le présent manuel d'utilisation n'est pas le bon, consultez la dernière page de la couverture pour connaître le point de vente le plus proche. Conservez ce manuel d'utilisation pour pouvoir vous y reporter par la suite.

AVERTISSEMENT : n'utilisez pas cet instrument au-delà des spécifications énumérées dans le manuel d'utilisation. Le non-respect de cet avertissement peut entraîner de graves blessures et / ou endommager l'équipement.

- Si vous ne comprenez pas l'une des instructions, prenez contact avec un représentant de Brooks Instrument pour obtenir des explications.
- Tenez compte de tous les avertissements, précautions et instructions marquées sur le produit et fournies avec celui-ci.
- Installez votre équipement de la façon indiquée dans les instructions d'installation du manuel d'utilisation et conformément à la législation en vigueur au niveau local et national. Branchez tous les produits aux sources d'électricité et de pression agréées.
- Utilisation : (1) Faites lentement entrer le débit dans le système. Ouvrez progressivement les vannes de procédé pour éviter des pics de débits. (2) Vérifiez qu'il n'y a pas de fuite au niveau des branchements d'entrée et de sortie du débitmètre. S'il n'y a pas de fuite, amenez le système à sa pression d'utilisation.
- Avant de procéder à l'entretien, assurez-vous que la conduite de procédé n'est plus sous pression. Lorsqu'il faut remplacer une pièce, assurez-vous que les pièces de rechange sont celles indiquées par Brooks Instrument et que des personnes qualifiées effectuent le remplacement. Les pièces et procédures non autorisées peuvent porter atteinte au fonctionnement du produit et mettre en péril la sécurité de votre procédé. Les remplacements par des pièces d'apparence similaire peuvent entraîner des incendies, des risques électriques ou un mauvais fonctionnement.
- Vérifiez que toutes les trappes de l'équipement sont fermées et que les couvercles de protection sont en place pour éviter les chocs électriques et les blessures, sauf lorsque l'entretien est réalisé par des personnes qualifiées.

AVERTISSEMENT : dans le cas d'appareils à écoulement liquide, si les vannes d'entrée et de sortie adjacentes aux appareils doivent être fermées pour une raison quelconque, les appareils doivent être complètement vidangés. Si cela n'est pas fait, une éventuelle dilatation thermique du fluide peut casser l'appareil et provoquer des blessures.

Directive européenne « équipements sous pression » (PED)

Tous les équipements sous pression dont la pression interne est supérieure à 0,5 bar (pression relative) et dont la taille dépasse 25 mm ou un pouce entrent dans le cadre de la directive PED.

- La section « Spécifications » de ce manuel contient les instructions relatives à la directive PED.
- Les appareils de mesure de ce manuel sont conformes à la directive EN 97/23/EC.
- Tous les débitmètres Brooks Instrument fonctionnent avec des fluides de groupe 1.
- Les appareils de mesure d'une taille supérieure à 25 mm ou un pouce entrent dans la catégorie PED I, II ou III.
- Les appareils de mesure d'une taille inférieure ou égale à 25 mm ou un pouce relèvent des « bonnes pratiques d'ingénierie » (SEP).

Compatibilité électromagnétique européenne (CEM)

L'équipement Brooks Instrument (électrique / électronique) portant le marquage CE répond à la réglementation en matière de compatibilité électromagnétique (directive CEM 2004/108/EC).
Il faut cependant prêter une grande attention au choix du câble d'interconnexion à utiliser avec l'équipement marqué CE.
<u>Qualité du câble d'interconnexion, des presse-étoupes et connecteurs :</u>
Brooks Instrument fournit un ou des câbles de qualité supérieure qui répondent aux spécifications exigées pour la certification CE.
Si vous utilisez votre propre câble d'interconnexion, ce câble doit être protégé par un blindage intégral.
Les connecteurs rectangulaires ou circulaires utilisés doivent avoir un blindage métallique. S'il y a lieu, des presse-étoupes métalliques doivent faire office de serre-écran de câble.
L'écran du câble doit être raccordé à l'enveloppe métallique ou au presse-étoupe et blindé aux deux extrémités sur 360 degrés.
Le blindage doit s'achever sur une prise de terre.
Les connecteurs de carte standards sont non métalliques. Les câbles utilisés doivent être protégés par un blindage intégral pour se conformer à la certification CE.
Le blindage doit s'achever sur une prise de terre.
En ce qui concerne la configuration des broches, veuillez vous reporter au manuel d'utilisation joint.

ESD (décharge électrostatique)

ATTENTION : cet instrument contient des composants électroniques sensibles à l'électricité statique. Des procédures de manipulation adéquates doivent être respectées pendant le retrait, l'installation ou la manipulation des cartes de circuits imprimés ou des dispositifs internes.
Procédure de manipulation :
1. L'alimentation électrique de l'appareil doit être coupée.
2. Le personnel doit être mis à la terre, au moyen d'une bande de poignet ou d'un autre moyen sûr et adéquat, avant l'installation, le retrait ou le réglage de toutes les cartes de circuits imprimés ou autres dispositifs internes.
3. Les cartes de circuits imprimés doivent être transportées dans un récipient conducteur. Les cartes ne doivent enlevées de cette enveloppe protectrice qu'au dernier moment, juste avant l'installation. Les cartes retirées doivent être immédiatement placées dans un récipient de protection pour le transport, le stockage ou le retour à l'usine.

Observations
Brooks Instrument n'est pas le seul à proposer des produits comportant des composants sensibles aux décharges électrostatiques. La plupart des produits électroniques modernes contiennent des composants qui utilisent des technologies à oxydes métalliques (NMOS, SMOS, etc.). L'expérience démontre que d'infimes quantités d'électricité statique suffisent à endommager ou détruire ces appareils. Les composants endommagés, même s'ils semblent fonctionner correctement, tombent rapidement en panne.

German

Wichtige Anweisungen
Bitte zuerst lesen!

Brooks Instrument entwickelt, produziert und testet seine Produkte derart, dass sie viele nationale und internationale Standards erfüllen. Nur bei korrektem Einbau sowie richtiger Bedienung und Wartung dieser Produkte ist ein Betrieb unter Einhaltung der Standardvorgaben sichergestellt. Die folgenden Anweisungen müssen eingehalten werden und in Ihr Sicherheitsprogramm integriert werden, wenn Sie Brooks Produkte installieren, bedienen und warten.

- Um die entsprechende Leistung zu gewährleisten, setzen Sie qualifiziertes Personal für die Installation, den Betrieb, die Aktualisierung, Programmierung und Wartung des Produkts ein.
- Lesen Sie alle Anweisungen, bevor Sie das Produkt installieren, in Betrieb nehmen und warten. Falls es sich bei diesem Handbuch nicht um das richtige Handbuch handelt, schauen Sie bitte auf der Rückseite nach den Kontaktdaten Ihres Vertriebsbüros vor Ort. Bewahren Sie dieses Handbuch auf, falls Sie später etwas nachschauen möchten.

WARNUNG: Dieses Gerät nicht außerhalb der in Bedienungsanleitung und Handbuch angegebenen Grenzen betreiben. Wird diese Warnung nicht beachtet, kann dies zu schweren Personenschäden bzw. Schäden des Gerätes führen.

- Falls Sie Anweisungen nicht verstehen, wenden Sie sich zur Klärung an Ihren Brooks Instrument Vertreter.
- Befolgen Sie alle Warnhinweise und Anweisungen, die auf dem Produkt markiert sind oder zusammen mit diesem geliefert werden.
- Installieren Sie Ihr Gerät, wie in den Installationsanweisungen des entsprechenden Handbuchs angegeben und gemäß der gültigen regionalen und nationalen Gesetze. Schließen Sie alle Produkte an eine geeignete Strom- und Druckluftversorgung an.
- Bedienung: (1) Langsam den Zufluss zum System starten. Die Ventile langsam öffnen, um einen sprunghaften Anstieg der Durchflussmenge zu verhindern. (2) Bereich der Anschlüsse (Zufluss und Ausfluss) des Durchflussmessers auf Undichtigkeiten überprüfen. Wenn das System dicht ist, auf Betriebsdruck hochfahren.
- Sicherstellen, dass der Leitungsdruck vor Wartungsarbeiten heruntergefahren wird. Wenn Ersatzteile benötigt werden, stellen Sie sicher, dass qualifizierte Personen Ersatzteile verwenden, die von Brooks Instrument vorgegeben sind. Nicht genehmigte Teile und Verfahren können die Leistungsfähigkeit des Produkts beeinträchtigen und den sicheren Betrieb Ihres Prozesses gefährden. Ähnlich aussehende Austauschteile können zu Bränden, elektrischen Gefahren oder nicht sachgerechtem Betrieb führen.
- Stellen Sie sicher, dass alle Türen der Anlage geschlossen sind und dass alle Schutzabdeckungen angebracht sind, um Stromschläge und Personenschäden zu vermeiden, es sei denn die Wartungsaufgaben werden von qualifizierten Personen durchgeführt.

WARNUNG: Werden die Ein- und Auslassventile neben Durchflussmessgeräten aus irgendwelchen Gründen geschlossen, so müssen die Geräte komplett entleert werden.
Durchflussmessgeraete muessen vor dem Schliessen von Ein- und Auslassventilen komplett entleert werden,
anderenfalls kann es zu einer thermischen Ausdehnung der Flüssigkeit und damit zum Bruch des Gerätes kommen; Personenschäden können die Folge sein.

Europäische Druckgeräterichtlinie (PED)

Alle Druckgeräte mit einem internen Druck von mehr als 0,5 bar (g) und einer Größe von mehr als 1in (1 in = 25,4 mm) unterliegen der Druckgeräterichtlinie.

- Das Kapitel zu den technischen Daten in dieser Anleitung enthält wichtige Sicherheits- und Betriebsanweisungen in Bezug auf die Druckgeräterichtlinie.
- Messgeräte, die in diesem Handbuch beschrieben sind, erfüllen die europäische Richtlinie 97/23/EG.
- Alle Durchflussmesser von Brooks Instrument fallen unter die Fluidgruppe 1.
- Messgeräte, die größer als 25 mm oder 1“ (inch) sind, erfüllen die Kategorien I, II oder III der Druckgeräterichtlinie (PED).
- Messgeräte mit einer Größe von 25 mm oder 1“ (inch) oder kleiner sind Sound Engineering Practice (SEP).

Europäische Verordnung zur elektromagnetischen Verträglichkeit (EMV)

Geräte von Brooks Instrument (elektrischer und elektronischer Art) mit CE-Zeichen haben den Test auf Einhaltung der Verordnung zur elektromagnetischen Verträglichkeit (EMV Richtlinie 2004/108/EC) erfolgreich bestanden.
Dennoch muss bei der Wahl des Signalkabels für das Gerät mit CE-Zeichen auf folgende Dinge geachtet werden.

<u>Qualität von Signalkabel, Kabeldurchführung und Anschlüsse:</u>

Brooks Instrument liefert qualitativ hochwertige Kabel, die den Anforderungen für eine CE-Zertifizierung entsprechen.
Sollten Sie eigene Kabel einsetzen, so sollte das Kabel überall mit einer 100%-Abschirmung versehen sein.
D- oder Rundstecker sollten eine Metallabschirmung aufweisen. Wenn möglich, müssen Kabeldurchführungen aus Metall mit Kabelschirmgeflechts-Klemmen verwendet werden.
Der Kabelschirm sollte an die Metallhülle oder -durchführung angeschlossen werden und an beiden Enden rundherum (360 °) abgeschirmt werden.
Die Abschirmung sollte geerdet werden.
Randstecker auf Platinen sind standardmäßig nicht aus Metall. Die verwendeten Kabel müssen mit einer 100 % Abschirmung versehen werden, um die CE-Vorgaben zu erfüllen.
Die Abschirmung sollte geerdet werden.
Klemmenbelegung: Siehe beigefügtes Handbuch.

ESD (Elektrostatische Entladung)

ACHTUNG: Dieses Gerät enthält elektronische Komponenten, die durch elektrostatische Entladungen beschädigt werden können. Ordnungsgemäße Verfahrensanweisungen müssen während des Ausbaus, der Installation oder anderer Handhabung der eingebauten Platinen oder Geräte eingehalten werden.

Verfahrensanweisung:

1. Trennen Sie das Gerät von der Stromversorgung.
2. Das Personal ist vor dem Einbau, Ausbau oder der Einstellung von Platinen oder anderen internen Komponenten durch ein entsprechendes Armband mit dem Erdpotential zu verbinden.
3. Platinen sind in speziellen Behältern mit Schutz gegen elektrostatische Spannungen zu transportieren oder zu lagern. Platinen dürfen erst kurz vor dem Einbau aus der Schutzhülle entfernt werden. Ausgebaute Platinen müssen umgehend in Schutzbehälter zum Transport, zur Lagerung oder Rücksendung an das Werk gelegt werden.

Anmerkung

Dieses Gerät ist wie viele andere elektronische Geräte auch mit Komponenten bestückt, die anfällig für elektrostatische Entladung sind. Die meisten modernen, elektronischen Geräte enthalten Komponenten, die die Metalloxidtechnologie (NMOS, SMOS etc.) verwenden. Die Erfahrung hat gezeigt, dass schon geringe Mengen elektrostatischer Energie ausreichen, um diese Geräte zu beschädigen oder zu zerstören. Beschädigte Teile fallen früh aus, obwohl sie funktionsfähig zu sein scheinen.

Greek

Βασικές οδηγίες
Διαβάστε πριν συνεχίσετε!

Η Brooks Instrument σχεδιάζει, παράγει και δοκιμάζει τα προϊόντα της σε συμμόρφωση με πλήθος εθνικών και διεθνών προτύπων. Η σωστή εγκατάσταση, χρήση και συντήρησή τους αποτελεί απαραίτητη προϋπόθεση της λειτουργίας εντός των κανονικών ορίων. Οι παρακάτω οδηγίες πρέπει να τηρούνται και πρέπει να ενσωματωθούν στο πρόγραμμα ασφάλειας της εργασίας σας κατά την εγκατάσταση, χρήση και συντήρηση προϊόντων της Brooks Instrument.

- Για σωστό αποτέλεσμα η εγκατάσταση, λειτουργία, ενημέρωση, προγραμματισμός και συντήρηση πρέπει να γίνεται από ειδικευμένο προσωπικό.
- Διαβάστε όλες τις οδηγίες πριν εγκαταστήσετε, λειτουργήσετε και συντηρήσετε το προϊόν. Εάν το παρόν εγχειρίδιο δεν είναι το σωστό εγχειρίδιο, συμβουλευθείτε το πίσω εξώφυλλο για τα στοιχεία επικοινωνίας του τοπικού αντιπροσώπου. Φυλάξτε το εγχειρίδιο αυτό για μελλοντική αναφορά.

⚠ ΠΡΟΕΙΔΟΠΟΙΗΣΗ: Μη λειτουργείτε τη συσκευή αυτή καθ' υπέρβαση των ορίων που αναγράφονται στο Εγχειρίδιο Οδηγιών και Λειτουργίας. Η μη συμμόρφωση με την προειδοποίηση αυτή μπορεί να οδηγήσει σε σοβαρό προσωπικό τραυματισμό ή/και ζημιά στον εξοπλισμό.

- Σε περίπτωση μη κατανόησης κάποιας από τις οδηγίες ζητήστε διευκρινίσεις από τον τοπικό αντιπρόσωπο της Brooks Instrument.
- Τηρείτε όλες τις προειδοποιήσεις, προφυλάξεις και οδηγίες που αναγράφονται ή συνοδεύουν το προϊόν.
- Εγκαταστήστε τη συσκευή όπως προβλέπεται στις οδηγίες εγκατάστασης του σωστού εγχειριδίου οδηγιών και στις κείμενες τοπικές και εθνικές διατάξεις. Συνδέστε τα προϊόντα στις εκάστοτε σωστές παροχές ρεύματος και πίεσης.
- Διαδικασία: (1) Αφήστε να ξεκινήσει αργά η ροή στο σύστημα. Ανοίξτε αργά τις βαλβίδες λειτουργίας για να αποφύγετε τις απότομες αυξομειώσεις ροής. (2) Ελέγξτε για διαρροές τις συνδέσεις εισόδου και εξόδου του ροόμετρου. Αν δεν υπάρχουν διαρροές, γεμίστε το σύστημα μέχρι η πίεση να φτάσει την κανονική πίεση εργασίας.
- Πριν από τη συντήρηση βεβαιωθείτε ότι γραμμή εργασίας έχει τεθεί εκτός πιέσεως. Σε περίπτωση αντικατάστασης ανταλλακτικών βεβαιωθείτε ότι το προσωπικό είναι ειδικευμένο και χρησιμοποιεί ανταλλακτικά που προβλέπει η Brooks Instrument. Μη εγκεκριμένα ανταλλακτικά και επεμβάσεις ενδέχεται να επηρεάσουν τις επιδόσεις του προϊόντος και να προκαλέσουν κίνδυνο για την ασφαλή λειτουργία. Αντικαταστάσεις με φαινομενικά όμοια ανταλλακτικά ενδέχεται να προκαλέσουν πυρκαγιά, κίνδυνο ηλεκτροπληξίας ή ανεπαρκή λειτουργία.
- Βεβαιωθείτε ότι όλα τα ανοίγματα του εξοπλισμού είναι κλειστά και τα προστατευτικά καλύμματα είναι στη θέση τους προκειμένου να αποφευχθεί ο κίνδυνος ηλεκτροπληξίας και προσωπικών τραυματισμών, εκτός εάν εκτελούνται εργασίες συντήρησης από ειδικευμένο προσωπικό.

⚠ ΠΡΟΕΙΔΟΠΟΙΗΣΗ: Προκειμένου για συσκευές με ροή ρευστού, όταν για οποιονδήποτε λόγο πρόκειται να κλείσουν οι βαλβίδες εισαγωγής και εξαγωγής κοντά στις συσκευές, οι συσκευές πρέπει να αποστραγγιστούν εντελώς. Η μη συμμόρφωση μπορεί να προκαλέσει θερμική διαστολή του υγρού που περιέχουν, με αποτέλεσμα να ραγίσει η συσκευή και να προκληθούν προσωπικοί τραυματισμοί.

Ευρωπαϊκή Οδηγία για τον εξοπλισμό υπό πίεση (PED)

Κάθε εξοπλισμός υπό πίεση με εσωτερική πίεση άνω του 0,5 bar (g) και μεγέθους μεγαλύτερου των 25 mm ή της 1 ίντσας εμπίπτει στις διατάξεις της ευρωπαϊκής Οδηγίας για τον εξοπλισμό υπό πίεση (PED).

- Το κεφάλαιο Προδιαγραφές του παρόντος εγχειριδίου περιλαμβάνει οδηγίες σχετικά με την Οδηγία PED.
- Οι μετρητές που περιγράφονται στο παρόν εγχειρίδιο συμμορφώνονται με την ευρωπαϊκή Οδηγία 97/23/ΕΚ.
- Όλα τα ροόμετρα της Brooks Instrument ανήκουν στην ομάδα ρευστών 1.
- Μετρητές μεγαλύτεροι από 25 mm ή 1 ίντσα συμμορφώνονται με τις κατηγορίες I, II και III της Οδηγίας PED.
- Μετρητές μεγέθους 25 mm ή 1 ίντσας ή και μικρότεροι κατασκευάζονται σύμφωνα με τους κανόνες της τέχνης (SEP).

Ευρωπαϊκή Οδηγία για την ηλεκτρομαγνητική συμβατότητα (EMC)

Ο (ηλεκτρικός/ηλεκτρονικός) εξοπλισμός της Brooks Instrument που φέρει το σήμα CE έχει υποστεί επιτυχώς τις δοκιμές που προβλέπουν οι διατάξεις της Οδηγίας για την ηλεκτρομαγνητική συμβατότητα (Οδηγία 2004/108/EC για την EMC).
Πάντως χρειάζεται ιδιαίτερη προσοχή στην επιλογή του καλωδίου σήματος για τον εξοπλισμό που φέρει το σήμα CE.
Ποιότητα των καλωδίων σήματος, στυπιοθλιπτών και βυσμάτων καλωδίων:
Η Brooks Instrument προσφέρει υψηλής ποιότητας καλώδια τα οποία πληρούν τις προδιαγραφές CE.
Σε περίπτωση παροχής δικού σας καλωδίου σήματος, χρησιμοποιείτε καλώδιο με πλήρη θωράκιση 100% σε όλα τα σημεία.
Βύσματα τύπου «D» ή κυκλικά πρέπει να έχουν μεταλλική θωράκιση. Να χρησιμοποιηθούν κατά προτίμηση μεταλλικοί στυπιοθλίπτες καλωδίων για τη στερέωση της θωράκισης.
Να συνδεθεί η θωράκιση του καλωδίου στο μεταλλικό κέλυφος ή στυπιοθλίπτη και να θωρακιστεί και στα δύο άκρα κατά 360 μοίρες. Η θωράκιση πρέπει να τερματίζει σε γείωση εδάφους.
Τα βύσματα άκρου της πλακέτας είναι εκ κατασκευής μη μεταλλικά. Τα χρησιμοποιούμενα καλώδια πρέπει να έχουν 100% θωράκιση για συμμόρφωση με την πιστοποίηση CE. Η θωράκιση πρέπει να τερματίζει σε γείωση εδάφους.
Για τη διάταξη των ακίδων: Συμβουλευθείτε το συνημμένο εγχειρίδιο οδηγιών.

Ηλεκτροστατική εκκένωση (ESD)

⚠ ΠΡΟΦΥΛΑΞΗ: Η συσκευή αυτή περιέχει ηλεκτρονικά εξαρτήματα τα οποία μπορούν να υποστούν εύκολα βλάβες από τον στατικό ηλεκτρισμό. Πρέπει να ακολουθούνται οι ορθές διαδικασίες χειρισμού κατά την αφαίρεση, τοποθέτηση ή άλλο χειρισμό των εσωτερικών πλακετών και διατάξεων.
Διαδικασία χειρισμού:

1. Θέστε τη συσκευή εκτός τάσεως.
2. Φροντίστε για τη γείωση του προσωπικού με περικάρπιο ή άλλο ασφαλές και κατάλληλο μέσο πριν τοποθετήσετε, αφαιρέσετε ή ρυθμίσετε κάρτες τυπωμένων κυκλωμάτων ή άλλη εσωτερική διάταξη.
3. Οι κάρτες τυπωμένων κυκλωμάτων πρέπει να μεταφέρονται σε συσκευασία από αγώγιμο υλικό. Οι κάρτες δεν πρέπει να αφαιρεθούν από το προστατευτικό περίβλημα παρά μόνο αμέσως πριν από την τοποθέτηση. Οι κάρτες που αφαιρέθηκαν πρέπει να τοποθετηθούν αμέσως σε προστατευτική συσκευασία για μεταφορά, αποθήκευση ή επιστροφή στο εργοστάσιο.

Παρατηρήσεις:
Η ύπαρξη εξαρτημάτων ευαίσθητων στα φαινόμενα ESD (ηλεκτροστατικής εκκένωσης) δεν είναι μοναδικό χαρακτηριστικό της συσκευής αυτής. Οι περισσότερες σύγχρονες ηλεκτρονικές συσκευές περιέχουν εξαρτήματα τεχνολογίας μεταλλικών οξειδίων (NMOS, SMOS κά.). Η πείρα έχει αποδείξει ότι μια μικρή ποσότητα στατικού ηλεκτρισμού αρκεί για να προκαλέσει βλάβες ή να καταστρέψει τις συσκευές αυτές. Εξαρτήματα που υπέστησαν βλάβη, ακόμη και αν μοιάζουν να λειτουργούν σωστά, κινδυνεύουν από πρώιμη αστοχία.

Hungarian

Alapvető utasítások
Először olvassa el ezeket!

A Brooks Instrument olyan módon tervezi, gyártja és teszteli termékeit, hogy azok megfeleljenek számos belföldi és nemzetközi szabványnak. Ezeket a berendezéseket megfelelően kell telepíteni, üzemeltetni és karbantartani ahhoz, hogy mindenképpen a normál működési tartományuknak megfelelően üzemelhessenek. Az alábbi utasításokat be kell tartani, és be kell építeni a munkavédelmi programba a Brooks Instrument termékeinek telepítése, üzemeltetése és karbantartása során.

A megfelelő teljesítmény garantálása érdekében kizárólag szakképzett személyzet végezze a termék telepítését, üzemeltetését, frissítését, programozását és karbantartását.

Valamennyi utasítást el kell olvasni a termék telepítése, üzemeltetése és szervizelése előtt. Amennyiben ez a kézikönyv nem a megfelelő kiadvány, a hátsó borítón keresse meg a helyi forgalmazót, és további tájékoztatásért lépjen kapcsolatba vele. Őrizze meg ezt a kézikönyvet későbbi tájékoztatásként.

⚠ **FIGYELEM: Ne működtesse a berendezést az üzemeltetési utasításban megadott üzemi tartományokon túl. Ennek megsértése súlyos személyi sérüléshez vagy a berendezés meghibásodásához vezethet.**

- Amennyiben a gépkönyv utasításai nem egyértelműek, lépjen kapcsolatba Brooks Instrument képviselőjével, hogy tisztázzák a problémát.
- Tartsa be a berendezésen feltüntetett vagy azzal együtt szállított összes figyelmeztetést, felhívást és utasítás.
- A megfelelő telepítési utasításban megadott utasítások valamint a hatályos helyi és nemzeti előírások szerint telepítse a berendezést. A termékeket kizárólag a megfelelő elektromos és nyomásellátó forrásra kösse.
- Menete: (1) Lassan helyezze nyomás alá a rendszert. Lassanként nyissa ki az üzemi szelepeket az áramlásingadozás elkerülése érdekében. (2) Ellenőrizze, nincs-e szivárgás az áramlásmérő be-, és kimeneti bekötéseinél. Ha nincs szivárgás, töltse fel a rendszert az üzemi nyomásra.
- Szervizelés előtt mindenképpen ellenőrizze, hogy az üzemi vezeték nincs-e nyomás alatt. Amennyiben cserealkatrészekre van szükség, mindenképpen szakképzett személynek kell kezelnie a Brooks Instrument által meghatározott cserealkatrészeket. A nem engedélyezett alkatrészek és tevékenységek befolyásolhatják a termék teljesítményét, illetve veszélyeztethetik a biztonságos üzemeltetést. A pusztán hasonló alkatrészekkel történő helyettesítés tüzet, áramütésveszélyt vagy elégtelen működést eredményezhet.
- A berendezés összes ajtaja mindenképpen legyen zárva, a védőburkolatok pedig legyenek a helyükön az áramütés és a személyi sérülések elkerülése érdekében, kivéve, ha szakképzett szakember végez rajta karbantartási munkákat.

⚠ **FIGYELEM: Folyadékot áramoltató berendezések esetében, ha bármilyen okból el kell zárni a berendezés melletti ki-, és belépő szelepeket, a berendezést teljesen le kell üríteni. Ennek elmulasztása a folyadék hőtágulását okozhatja, ami károsíthatja a berendezést, és személyi sérüléshez vezethet.**

Nyomástartó berendezésekre vonatkozó európai irányelv (PED)

Minden 0,5 bar-nál (g) magasabb belső nyomású és 25 mm-nél vagy 1 hüvelyknél nagyobb nyomástartó berendezés a nyomástartó berendezésekre vonatkozó európai irányelv (PED) hatálya alá tartozik.

- A gépkönyv „Műszaki adatok” fejezete tartalmaz a PED irányelvre vonatkozó utasításokat.
- A gépkönyvben megadott mérőeszközök megfelelnek a 97/23/EK EU irányelvnek.
- Minden Brooks átfolyásmérő az 1-es folyadékcsoportba tartozik.
- A 25 mm-nél vagy 1 hüvelyknél nagyobb mérőeszközök megfelelnek a PED I, II, vagy III kategóriának.
- A 25 mm-es illetve 1 hüvelykes vagy kisebb mérőeszközök az elfogadott mérnöki gyakorlatot (SEP) követik.

Elektromágneses kompatibilitásra vonatkozó európai irányelv (EMC)

A Brooks Instrument CE jelölést kiérdemelt (elektromos/elektronikus) berendezései sikeresen teljesítették az elektromágneses kompatibilitási követelményeket (2004/108/EC sz. EMC irányelv) vizsgáló teszteket.

Ugyanakkor különös figyelmet kell fordítani a CE jelölésű berendezésekhez felhasznált jelkábelek kiválasztására.

A jelkábelek, kábelösszekötők, csatlakozók minősége:

A Brooks Insturment magas minőségű kábeleket kínál, melyek megfelelnek a CE minősítés követelményeinek.

Amennyiben saját jelkábelt alkalmaznak, olyat kell választani, amely 100%-os árnyékolással, teljes mértékben szűrt.

A „D” vagy „kör alakú” csatlakozóknak fémárnyékolóval árnyékoltnak kell lennie. Szükség esetén fém kábelösszekötőket kell alkalmazni a kábelszűrő rögzítésére.

A kábelszűrőt a fém házhoz vagy hüvelyhez kell csatlakoztatni és mindkét felén 360°-ban le kell árnyékolni. Az árnyékolásnak földelésben kell végződnie.

A kártyákhoz tartozó csatlakozók szabványosan nem fémesek. Az alkalmazott kábeleknek 100%-és árnyékolással szűrteknek kell lenniük, hogy megfeleljenek a CE minősítésnek.

Az árnyékolásnak földelésben kell végződnie.

Érintkező konfiguráció: Lásd a mellékelt kezelési utasítást.

Elektrosztatikus kisülés (ESD)

⚠ **VIGYÁZAT: A készülék olyan alkatrészeket tartalmaz, melyek hajlamosak a sztatikus elektromosság okozta károsodásra. Be kell tartani a megfelelő eljárásokat a belső áramköri kártyák és eszközök eltávolítása, behelyezése vagy egyéb kezelése során.**

Kezelési eljárás:

1. A berendezést áramtalanítani kell.
2. A személyt földelni kell csuklópánttal vagy egyéb biztonságos és a célra alkalmas eszközzel, mielőtt áramköri kártyát vagy egyéb belső eszközt telepítene, venne ki, vagy állítana be.
3. A nyomtatott áramköri kártyákat vezetőképes csomagolásban kell szállítani. A kártyák kizárólag közvetlenül a behelyezés előtt vehetők ki a védőburkolatból. A kiszerelt kártyát haladéktalanul el kell helyezni a mozgatásra, raktározásra vagy a gyári visszaszállításra szolgáló védőcsomagolásba.

Megjegyzések:

Nem egyedi jelenség, hogy a készülékben elektrosztatikus kisülésre (ESD) érzékeny alkatrészek találhatók. A legtöbb korszerű elektronikus eszközben fémoxid technológiás alkatrészek (NMOS, SMOS stb.) találhatók. A tapasztalatok azt igazolják, hogy még kis mértékű sztatikus elektromosság is károsíthatja, vagy tönkreteheti ezeket az eszközöket. A károsodott alkatrészek, még ha látszólag megfelelően működnek is, kezdődő hibára utalnak.

Italian

Istruzioni fondamentali
Leggerle subito!

La Brooks Instrument progetta, fabbrica e collauda i propri prodotti in maniera tale che siano conformi ai vari standard nazionali ed internazionali. Tali apparecchiature devono essere installate, messe in esercizio e tenute in manutenzione in maniera adeguata affinché operino in conformità alle loro normali specifiche di funzionamento. Le seguenti istruzioni devono essere rispettate ed inserite nel programma di tutela sul lavoro durante l'installazione, il funzionamento e la manutenzione dei prodotti Brooks Instrument.

- Per garantire un adeguato rendimento l'installazione, il funzionamento, l'aggiornamento, la programmazione e la manutenzione del prodotto devono essere eseguiti esclusivamente da personale specializzato.
- Leggere tutte le istruzioni prima dell'installazione, utilizzo e manutenzione del prodotto. Se questo manuale non è quello relativo al Vostro prodotto, cercare sul retro della copertina il distributore locale e contattarlo per ulteriori informazioni. Conservare il presente manuale per future consultazioni.

⚠ **ATTENZIONE: Non utilizzare questo strumento in condizioni che eccedono le specifiche riportate nel Manuale d'Uso. L'inosservanza può causare gravi lesioni alle persone e/o danni all'apparecchiatura.**

- Qualora le istruzioni del manuale non siano chiare, contattare un rappresentante della Brooks Instrument per chiarire il problema.
- Rispettare tutti gli avvisi, le istruzioni e gli avvertimenti riportati sull'apparecchiatura o forniti insieme ad essa.
- Installare l'apparecchiatura in base alle istruzioni riportate nel Manuale d'Uso e alle prescrizioni locali e nazionali in vigore. Collegare i prodotti esclusivamente ad un'adeguata sorgente di pressione ed alimentazione elettrica.
- Procedimento: (1) mettere lentamente sotto pressione il sistema. Aprire lentamente le valvole di servizio per evitare l'oscillazione del flusso. (2) Controllare che non ci siano perdite nei punti di connessione in entrata e in uscita del misuratore di flusso. Se non ci sono perdite, caricare il sistema alla pressione d'esercizio.
- Prima di effettuare manutenzione controllare che la linea di processo non sia sotto pressione. Se avete bisogno di pezzi di ricambio, il personale specializzato deve usare i pezzi di ricambio definiti dalla Brooks Instrument. Attività e pezzi di ricambio non autorizzati possono influire sul rendimento del prodotto e comprometterne il funzionamento in sicurezza. La sostituzione con pezzi di ricambio non originali può causare incendi, pericolo di scosse elettriche o funzionamento improprio.
- Tutti gli sportelli dell'impianto devono essere chiusi, le cappe di protezione devono essere al loro posto per evitare scosse elettriche e lesioni personali, tranne quando il personale specializzato esegue lavori di manutenzione.

⚠ **ATTENZIONE: In caso di apparecchiature in cui scorre un liquido, se per qualsiasi motivo bisogna chiudere le valvole d'entrata e d'uscita accanto all'apparecchiatura, allora si deve svuotare completamente l'apparecchiatura. L'inosservanza può causare la dilatazione termica del liquido che può danneggiare l'apparecchiatura e provocare lesioni alle persone.**

Direttiva europea relativa alle apparecchiature a pressione (PED)

Ogni apparecchiatura a pressione con pressione interna maggiore di 0,5 bar (g) e più grande di 25 mm o di 1 pollice ricade nell'ambito della Direttiva Europea relativa alle apparecchiature a pressione (PED).

- Il capitolo „Dati tecnici" del manuale contiene le disposizioni relative alla direttiva PED.
- Gli strumenti di misura descritti nel presente manuale sono conformi alla Direttiva UE 97/23/CE.
- Ogni flussimetro Brooks appartiene al gruppo di fluidi 1.
- Gli strumenti di misura maggiori di 25 mm o di 1 pollice sono conformi alla categoria I, II o III della PED.
- Gli strumenti di misurazione minori di 25 mm o di 1 pollice rientrano nella categoria SEP (Sound Engineering Practice).

Direttiva europea relativa alla compatibilità elettromagnetica (EMC)

Le apparecchiature (elettriche/elettroniche) Brooks Instrument dispongono del marchio CE ed hanno superato positivamente i test per i requisiti di compatibilità elettromagnetica (Direttiva EMC 2004/108/EC).
In ogni caso bisogna prestare particolare attenzione alla scelta dei cavi di segnale utilizzati per le apparecchiature con marchio CE.
Qualità dei cavi di segnale, dei pressacavi e dei connettori:
La Brooks Instrument offre cavi d'alta qualità conformi ai requisiti della certificazione CE.
Qualora vengano utilizzati cavi di segnale propri, devono essere scelti con schermatura al 100% e interamente filtrati.
I connettori „D" o „rotondi" devono essere schermati con schermatura metallica. In caso di necessità bisogna utilizzare pressacavi metallici di collegamento per fissare la schermatura del cavo.
La schermatura del cavo deve far contatto col guscio metallico o col pressacavo; il cavo deve essere schermato su entrambi i lati a 360°. La schermatura deve essere effettuata con messa a terra.
I connettori Card Edge normalmente non sono di metallo. I cavi utilizzati devono essere filtrati con schermatura al 100% per essere conformi alla marcatura CE.
La schermatura deve essere effettuata con messa a terra.
Configurazione pin: Vedi Manuale d'uso allegato.

Scarica elettrostatica (ESD)

⚠ **ATTENZIONE: Il dispositivo contiene componenti elettronici che possono essere danneggiati da elettricità statica. Bisogna rispettare le adeguate procedure durante la rimozione, l'installazione o altra manovra delle schede del circuito elettrico interno.**
Procedura di manovra:

1. Togliere alimentazione elettrica all'apparecchiatura.
2. La persona deve essere collegata a terra con una cerniera o con altri strumenti di sicurezza e adeguati allo scopo prima di installare, togliere o impostare la scheda del circuito elettrico o altri dispositivi interni.
3. Le schede del circuito stampato devono essere spedite in contenitori conduttivi. Le schede devono essere tolte dal rivestimento protettivo esclusivamente prima dell'installazione. Le schede confezionate devono essere collocate immediatamente nell'imballaggio protettivo per la movimentazione, l'immagazzinamento o resa alla fabbrica.

Note:
È un fenomeno comune che nei dispositivi di questo tipo si trovino componenti sensibili alla scarica elettrostatica (ESD). Nella maggior parte degli strumenti elettronici moderni si trovano componenti tecnologici metallo-ossido (NMOS, SMOS, ecc.). Le esperienze dimostrano che l'elettrostaticità anche in piccola misura può danneggiare o rovinare gli strumenti. I componenti danneggiati, anche se all'apparenza funzionano correttamente, potrebbero manifestare il difetto rapidamente.

Latvian

Svarīga instrukcija
Pirms turpināt izlasiet!

„Brooks Instrument” projektē, ražo un pārbauda savus ražojumus atbilstoši daudziem nacionālajiem un starptautiskajiem standartiem. Lai nodrošinātu šo izstrādājumu turpmāku darbību atbilstoši noteiktajiem parametriem, tie ir pareizi jāuzstāda, jālieto un jāapkopj. Uzstādot, lietojot „Brooks Instrument” izstrādājumus un veicot to apkopi, ir jāievēro šie norādījumi un jāiekļauj tie jūsu drošības programmā.

- Lai nodrošinātu pienācīgu izstrādājuma sniegumu, izstrādājuma uzstādīšanu, lietošanu, atjaunināšanu, programmēšanu un apkopi uzticiet veikt tikai kvalificētam personālam.
- Pirms izstrādājuma uzstādīšanas, lietošanas un apkalpošanas izlasiet visus norādījumus. Ja šī instrukciju rokasgrāmata nav pareizā, izstrādājumam atbilstošā rokasgrāmata, lūdzu skat. aizmugurējo vāku, kur ir sniegta vietējā tirdzniecības biroja kontaktinformācija.
  ⚠ **BRĪDINĀJUMS! Nelietot instrumentu ārpus Instrukciju un lietošanas rokasgrāmatā norādītajiem parametriem. Šī brīdinājuma neievērošanas rezultātā var rasties traumas un / vai aprīkojuma bojājumi.**
- Ja jūs nesaprotat kādu no instrukcijām, sazinieties ar „Brooks Instrument” pārstāvi un lūdziet izskaidrot to.
- Ievērojiet visus brīdinājumus, piesardzības mērus un instrukcijas, kas norādīti uz izstrādājuma vai piegādāti kopā ar to.
- Uzstādiet aprīkojumu tā, kā tas norādīts attiecīgajā instrukciju rokasgrāmatā iekļautajā uzstādīšanas instrukcijā un atbilstoši piemērojamajām vietējām un nacionālajām normām. Pievienojiet visus izstrādājumus pareiziem elektriskajiem un spiediena avotiem.
- Lietošana: (1) Lēnām uzsāciet plūsmu sistēmā. Lai izvairītos no straujiem plūsmas kāpumiem, lēnām atveriet procesa vārstus. (2) Pārbaudiet, vai nav noplūdes ap plūsmas mērītāja ieplūdes un izplūdes savienojumiem. Ja noplūdes nav, uzstādiet sistēmā darba spiedienu.
- Pārliecinieties par to, lai pirms instrumenta tehniskās apkopes būtu likvidēts procesa līnijas spiediens. Ja ir nepieciešams veikt kādu daļu nomaiņu, nodrošiniet, lai tiktu izmantotas „Brooks Instrument” norādītās daļas un daļu nomaiņu veiktu kvalificēts personāls. Neatļautu daļu un procedūru izmantošana var ietekmēs ražojuma sniegumu un samazināt procesa drošību. Līdzīgu, bet ne identisku daļu nomaiņas lietošana var izraisīt ugunsgrēka, elektrisko traucējumu riskus un nepareizu izstrādājuma darbību.
- Nodrošiniet, lai būtu aizvērtas visas durvis un būtu pareizi uzstādīti visi aizsargpārsegumi, tādējādi novēršot elektrošoka un traumu risku. Izņēmums ir gadījumi, kad kvalificēts personāls veic ražojuma apkopi.
  ⚠ **BRĪDINĀJUMS! Ja šķidrās plūsmas ierīču tuvumā esošos ieplūdes un izplūdes vārstus kāda iemesla dēļ ir jāaizver, no ierīcēm ir jāizlaiž viss šķidrums. Pretējā gadījumā šķidrums var termiski izplesties, pārraut ierīci un radīt traumas.**

Eiropas spiedieniekārtu direktīva (PED)

Uz visām spiedieniekārtām, kuru iekšējais spriegums pārsniedz 0,5 bar (g) un ir lielākas par 25 mm jeb 1” (collu), attiecas Eiropas spiedieniekārtu direktīva (PED).

- Šīs rokasgrāmatas tehnisko parametru nodaļā ir sniegtas a PED Direktīvu saistītās instrukcijas.
- Šajā rokasgrāmatā aprakstītie mērītāji atbilst EN Direktīvas 97/23/EK prasībām.
- Visi „Brooks Instrument” plūsmas mērītāji ietilpst 1. šķidrumu grupā.
- Uz 25 mm jeb 1” (collu) maziem un mazākiem mērītājiem attiecas labas inženierijas prakse (SEP).
- 25 mm jeb 1” (collu) mazi vai mazāki mērītāji atbilst PED kategorijai I, II vai III.

Eiropas elektromagnētiskās savietojamības direktīva (EMS)

Brooks Instrument” (elektriskās / elektroniskās) iekārtas ar CE zīmi ir izturējušas pārbaudi un atzītas par atbilstošām Eiropas elektromagnētiskās savietojamības direktīvas (EMS) prasībām (EMS 2004/108/EC)

Tomēr, izvēloties signālkabeli, kas tiks lietots kopā ar CE marķējuma iekārtu, ir jāievēro īpaša uzmanība**Signālkabeļa, kabeļa blīvslēgu un savienotāju kvalitāte:**

„Brooks Instrument” piegādā augstas kvalitātes kabeļus, kas atbilst CE sertifikācijas tehniskajiem parametriem.
Ja jūs lietojat pats savu signālkabeli, tam ir jābūt pilnībā, 100% ekranizētam.
„D” un „apaļā” tipa savienotājiem ir jābūt aprīkotiem ar metāla ekranizējumu. Ja nepieciešams, ir jāizmanto metāla blīvslēgi ar kabeļa ekranizējuma skavojumu.
Kabeļa ekranizējumam ir jābūt savienotam ar metāla apvalku un abās pusēs aizsargātam 360 grādu diapazonā.
Ekranizējumam ir jābeidzas pie iezemējuma.
„Card Edge” savienotāji standarta izpildījumā ir nemetāla. Kabeļiem ir jābūt pārklātiem ar 100% ekranizējumu, lai tie atbilstu CE sertifikācijas prasībām.
Ekranizējumam ir jābeidzas pie iezemējuma.
Attiecībā uz tapu konfigurāciju: skat. pievienoto instrukciju rokasgrāmatu.

ESD (elektrostatiskā izlāde)

⚠ **IEVĒROT PIESARDZĪBU! Šis instruments satur elektriskos komponentus, kas ir jutīgi pret statisko elektrību. Izņemot un uzstādot iekšējās ķēdes plates un ierīces vai kā citādi darbojoties ar tām, ir jāievēro noteikta darba kārtība.**

Darba kārtība:

1. Iekārta jāatslēdz no barošanas.
2. Pirms jebkādas drukātas shēmas kartes vai citas iekšējās ierīces uzstādīšanas, izņemšanas vai regulēšanas personālam, kas veiks šos darbus, ir jābūt iezemētam, piem., izmantojot aproces vai citus drošus, piemērotus līdzekļus.
3. Drukātās shēmas kartes ir jātransportē vadošā iepakojumā. Plāksnes no aizsargkorpusa drīkst izņemt tikai tieši pirms uzstādīšanas. Transportējot, uzglabājot vai atgriežot rūpnīcā no izņemtās plāksnes ir nekavējoties jāievieto aizsargiepakojumā.

Komentāri

Instruments nav unikāls tajā aspektā, ka tas satur pret ESD (elektrostatisko izlādi) jutīgus komponentus. Vairums mūsdienu elektroiekārtu satur komponentus, kuru ražošanā izmantota metāla oksīdu tehnoloģijas (NMOS, SMOS u.c.). Pieredze rāda, ka pat neliels daudzums statiskās elektrības var nodarīt bojājumus šādām ierīcēm vai pilnībā sabojāt tās. Bojātie komponenti pat tad, ja tie šķietami darbojas pareizi, ir pakļauti ātrākai atteicei.

Lithuanian

Pagrindinės instrukcijos

Perskaitykite prieš tęsdami!

„Brooks Instrument“ projektuoja, gamina ir išbando savo gaminius, kad jie atitiktų įvairius nacionalinius ir tarptautinius standartus. Šie gaminiai turi būti tinkamai montuojami, eksploatuojami ir prižiūrimi, kad ir toliau veiktų pagal jiems būdingus techninius parametrus. Toliau pateiktų nurodymų reikia laikytis ir įtraukti juos į saugos programą montuojant, eksploatuojant ir prižiūrint „Brooks Instrument“ produktus.

- Siekiant užtikrinti tinkamą veikimą, montuoti, eksploatuoti, naujinti, programuoti ir prižiūrėti gaminį turi tik kvalifikuoti darbuotojai.
- Perskaitykite visus nurodymus prieš montuodami, eksploatuodami ir prižiūrėdami gaminį. Jei gavote netinkamą instrukciją, galiniame jos viršelyje žiūrėkite vietinės prekybos atstovybės kontaktinę informaciją. Išsaugokite šią instrukciją pasižiūrėjimui ateityje.

ĮSPĖJIMAS: nenaudokite šio prietaiso viršydami instrukcijoje ir eksploatacijos vadove nurodytus techninius duomenis. Nesilaikydami šio įspėjimo galite sunkiai susižeisti ir (arba) sugadinti įrangą.

- Jei nesuprantate kokių nors nurodymų, kreipkitės į „Brooks Instrument“ atstovą, kad paaiškintų.
- Paisykite visų įspėjimo, perspėjimų ir nurodymų, pažymėtų ant gaminio arba pateiktų su juo.
- Įrangą montuokite taip, kaip nurodyta atitinkamos instrukcijos montavimo nurodymuose arba taikomuose vietiniuose ar nacionaliniuose kodeksuose. Visus gaminius junkite prie tinkamų elektros ir slėgio šaltinių.
- Eksploatacija: (1) lėtai įjunkite srautą į sistemą. Lėtai atidarykite proceso vožtuvus, kad išvengtumėte srauto antplūdžių. (2) Patikrinkite, ar nėra nuotėkių aplink srauto matuoklio įleidimo ir išleidimo jungtis. Jei nuotėkių nėra, sukurkite sistemoje darbinį slėgį.
- Prieš atlikdami priežiūros darbus būtinai pašalinkite slėgį proceso linijoje. Jei reikia pakeisti dalis, užtikrinkite, kad kvalifikuoti darbuotojai naudotų „Brooks Instrument“ nurodytas pakaitines dalis. Netinkamos dalys ir procedūros gali pakenkti gaminio veikimui ir kelti pavojų saugiai jūsų proceso eksploatacijai. Tik panašiai atrodantys pakaitalai gali sąlygoti gaisrą, elektros pavojus ar netinkamą veikimą.
- Užtikrinkite, kad visos įrangos durelės būtų uždarytos, o apsauginiai dangčiai uždėti, kad išvengtumėte elektros smūgio ir sužeidimų, išskyrus kai kvalifikuoti darbuotojai atlieka priežiūros darbus.

ĮSPĖJIMAS: naudojant skysto srauto įrenginius, jei dėl kokios nors priežasties prireikia uždaryti šalia įrenginio esančius įleidimo ir išleidimo vožtuvus, iš įrenginio reikia išleisti visą skystį. To nepadarius galimas šiluminis skysčio plėtimasis, galintis sugadinti įrenginį ir sužeisti žmones.

Europos slėginės įrangos direktyva (PED)

Visa slėginė įranga, kurios vidinis slėgis didesnis nei 0,5 bar (g), o dydis didesnis nei 25 mm arba 1 colis, yra reglamentuojama slėginės įrangos direktyvos (PED).

- Šios instrukcijos dalyje „Techniniai duomenys“ pateikiami nurodymai, susiję su PED direktyva.
- Šioje instrukcijoje aprašyti matuokliai atitinka Europos Sajungos direktyvą 97/23/EB.
- Visi „Brooks Instrument“ srauto matuokliai priklauso 1 skysčių grupei.
- Didesni nei 25 mm arba 1 colis matuokliai atitinka PED I, II arba III kategoriją.
- 25 mm arba 1 colio ar mažesni matuokliai atitinka tinkamą inžinerijos praktiką (SEP).

Europoje taikomi elektromagnetinio suderinamumo (EMC) reikalavimai

CE ženklu pažymėta „Brooks Instrument“ (elektrinė / elektroninė) įranga buvo sėkmingai išbandyta pagal elektromagnetinio suderinamumo reikalavimus (EMC direktyvą 2004/108/EC).
Bet reikia ypatingo dėmesio renkantis signalizavimo kabelį, kuris bus naudojamas su CE ženklu pažymėta įranga.
Signalizavimo kabelio, kabelių riebokšlių ir jungčių kokybė:
„Brooks Instrument“ tiekia kokybiškus kabelius, kurie atitinka CE sertifikavimo specifikacijas.
Jei naudojate savo signalizavimo kabelį, jis turi būti visiškai ir visas ekranuotas 100 % ekranu.
Naudojamos „D“ arba „apskrito“ tipo jungtys turi būti ekranuotos metaliniu ekranu. Jei taikoma, reikia naudoti metalinius kabelių riebokšlius, užtikrinančius kabelio ekrano suspaudimą.
Kabelio ekraną reikia jungti prie metalinio apvalkalo ar riebokšlio ir ekranuoti abiejuose galuose 360 laipsnių.
Ekranas turi baigtis įžeminimu.
Standartinės kraštinės jungtys yra ne metalinės. Naudojami kabeliai turi būti ekranuoti 100 % ekranu, kad atitiktų CE sertifikavimą. Ekranas turi baigtis įžeminimu.
Keturių kontaktų konfigūracija: žr. pridėtą instrukciją.

ESD (elektrostatinis išlydis)

PERSPĖJIMAS: šiame prietaise yra elektroninių komponentų, kuriuos gali sugadinti statinė elektra. Išimant ar įdedant vidines spausdintines plokštes ar įrenginius, arba atliekant su jomis kitus darbus, reikia laikytis tinkamų darbo procedūrų.
Darbo procedūra:

1. Atjunkite įrenginio maitinimą.
2. Darbuotojai turi pasirūpinti įžeminimu naudodami riešo juostelę ar kitas saugias tinkamas priemones prieš įdėdami, išimdami ar reguliuodami bet kokią spausdintinės plokštės kortelę ar kitą vidinį komponentą.
3. Spausdintinės plokštės korteles reikia transportuoti laidžiame konteineryje. Neleidžiama išimti plokštės iš apsauginio dėklo, nebent prieš pat įdėjimą. Išimtas plokštes reikia nedelsiant įdėti į apsauginį konteinerį transportavimui ar saugojimui arba grąžinti į gamyklą.

Pastabos
Šis instrumentas nėra unikalus dėl jame esančių ESD (elektrostatiniam išlydžiui) jautrių komponentų. Daugelyje šiuolaikinių elektroninių gaminių yra komponentų, kuriuose naudojama metalo oksidų technologija (NMOS, SMOS ir pan.). Patirtis rodo, kad net ir mažas statinės elektros kiekis gali pakenkti tokiems gaminiams ar juos sugadinti. Sugadinti komponentai, net jei atrodo, kad jie veikia tinkamai, anksti nustoja veikti.

Polish

Zalecenia wstępne

Prosimy przeczytać przed rozpoczęciem użytkowania!

Brooks Instrument projektuje, wytwarza i testuje swoje produkty tak, aby spełniały wymagania licznych norm krajowych i międzynarodowych. Te produkty muszą być poprawnie instalowane, obsługiwane oraz konserwowane, aby zapewnić ich prawidłowe działanie zgodnie ze specyfikacją techniczną. Podczas instalowania, obsługiwania i konserwowania produktów firmy Brooks Instrument należy przestrzegać następujących zaleceń:

- Aby zapewnić właściwe działanie sprzętu, instalacja, obsługa, aktualizacje, programowanie i konserwacja powinny być wykonywane przez przeszkolony personel.
- Przed instalacją, obsługą i czynnościami serwisowymi należy zapoznać się ze wszystkimi zaleceniami producenta. Aby uzyskać instrukcję obsługi odpowiednią dla danego sprzętu należy skontaktować się z lokalnym przedstawicielem handlowym producenta. Instrukcję obsługi należy zachować do późniejszego użycia.

OSTRZEŻENIE: Nie wolno przekraczać podanych w instrukcji zakresów działania urządzenia. Nieprzestrzeganie tego zalecenia może doprowadzić do poważnego zagrożenia życia lub zdrowia personelu i / lub uszkodzenia sprzętu.

- Jeżeli jakieś zalecenia w instrukcji obsługi urządzenia są niezrozumiałe, prosimy o skontaktowanie się z przedstawicielem firmy Brooks Instrument, aby wyjaśnić problem.
- Należy postępować biorąc pod uwagę wszystkie ostrzeżenia, uwagi i zalecenia umieszczone na produkcie lub dołączone do niego.
- Instalację urządzenia należy przeprowadzić zgodnie z zaleceniami zawartymi w instrukcji instalacji oraz z obowiązującymi lokalnymi i narodowymi oznaczeniami. Wszystkie urządzenia można podłączać wyłącznie do odpowiednich źródeł energii elektrycznej oraz ciśnienia.
- Pierwsze czynności obsługowe: (1) Należy powoli włączyć przepływ w instalacji. Następnie powoli otworzyć zawory robocze tak, aby uniknąć wahań przepływu. (2) Należy teraz sprawdzić, czy nie występują nieszczelności przy podłączeniach wejściowym i wyjściowym miernika przepływu. Jeżeli nie ma żadnych nieszczelności, można zwiększyć ciśnienie w instalacji do wartości ciśnienia roboczego.
- Przed przystąpieniem do czynności serwisowych należy upewnić się, że ciśnienie robocze jest odłączone. Jeżeli konieczna jest wymiana części zamiennych, należy zawsze stosować części zamienne specyfikowane przez firmę Brooks Instrument a czynności ich wymiany powinien w każdym przypadku dokonywać przeszkolony personel. Stosowanie nieautoryzowanych części i procedur serwisowych może niekorzystnie wpłynąć na działanie produktu oraz zagrozić bezpieczeństwu instalacji. Korzystanie z podobnie wyglądających zamienników może doprowadzić do pożaru, porażenia prądem lub nieprawidłowego działania urządzenia.
- Należy upewnić się, że wszystkie otwory urządzenia są zamknięte a osłony umocowane na swoich miejscach, aby zapobiec obrażeniom ciała lub porażeniu prądem personelu. Zalecenie to nie dotyczy przeszkolonego pracownika wykonującego prace serwisowe lub konserwacyjne.

OSTRZEŻENIE: W przypadku mierników przepływu cieczy, jeżeli znajdujące się na nich zawory wejściowe i wyjściowe mają być z jakiegoś powodu zamknięte, to urządzenie musi zostać całkowicie opróżnione z ciekłego medium. Niedopełnienie tego zalecenia może doprowadzić do termicznego zwiększenia objętości cieczy, co z kolei może spowodować uszkodzenie urządzenia i obrażenia personelu.

Europejska dyrektywa dotycząca urządzeń ciśnieniowych (PED)

Wszystkie urządzenia ciśnieniowe pracujące przy ciśnieniu wewnętrznym względnym większym niż 0.5 bara i wielkości powyżej 25 mm lub 1 cala podlegają dyrektywie europejskiej dotyczącej urządzeń ciśnieniowych (PED).

- Rozdział „Specyfikacja techniczna” niniejszej instrukcji zawiera zalecenia dotyczące dyrektywy PED.
- Mierniki opisane w tej instrukcji są zgodne z dyrektywą EN 97/23/EC.
- Wszystkie mierniki przepływu firmy Brooks Instrument należą do 1-szej grupy cieczy.
- Urządzenia pomiarowe o wielkości powyżej 25 mm lub 1 cala należą do kategorii I, II lub III dyrektywy PED.
- Urządzenia pomiarowe o wielkości 25 mm lub 1 cala lub mniejsze podlegają zaleceniom „Uznanej Praktyki Inżynierskiej” (SEP).

Europejska dyrektywa dotycząca kompatybilności elektromagnetycznej (EMC)

Urządzenia elektryczne / elektroniczne firmy Brooks Instrument posiadające oznaczenie CE, przeszły pozytywnie testy pod kątem spełniania przez nich wymogów kompatybilności elektromagnetycznej (Dyrektywa EMC 2004/108/EC).
Jednakże szczególną uwagę należy poświęcić przy doborze przewodów sygnałowych, które mają być stosowane z urządzeniami ze znakiem CE.
Jakość przewodu sygnałowego, dławic oraz złączy przewodu:
Firma Brooks Instrument dostarcza wysokiej jakości przewody, które spełniają wymagania zawarte w specyfikacji dla certyfikatu CE.
Jeżeli stosuje się własne przewody sygnałowe, to powinny one być w całości w pełni ekranowane.
Złącza typu „D” lub okrągłe powinny zawierać metalowy ekran. Jeśli to możliwe, należy stosować metalowe dławice przewodu zapewniające mocowanie jego ekranu.
Ekran przewodu powinien być połączony z metalową osłoną lub dławicą zapewniając całkowite, dookólne ekranowanie na obu końcach przewodu.
Ekran przewodu powinien być uziemiony.
Złącza krawędziowe są standardowo niemetaliczne. Stosowane przewody muszą być w pełni ekranowane zgodnie z certyfikatem CE.
Ekran przewodu powinien być uziemiony.
Konfiguracja styków jest podana w niniejszej instrukcji obsługi.

Wyładowania elektrostatyczne (ESD)

UWAGA: Urządzenie zawiera części elektroniczne podatne na uszkodzenia spowodowane ładunkami elektrostatycznymi. Przy obchodzeniu się z wewnętrznymi podzespołami i częściami elektronicznymi należy przestrzegać następujących zasad postępowania:

1. Należy odłączyć zasilanie od urządzenia.
2. Osoba wykonująca czynności musi zostać uziemiona za pomocą opaski na przegubie dłoni lub w inny, bezpieczny sposób, zanim przystąpi do instalacji, wyjęcia lub regulacji obwodów drukowanych lub innych wewnętrznych podzespołów elektronicznych urządzenia.
3. Obwody drukowane należy transportować w przewodzącym pojemniku. Płytki drukowane należy wyjmować z opakowania ochronnego bezpośrednio przed ich montażem. Wymontowane płytki należy niezwłocznie umieścić w opakowaniu ochronnym służącym do transportowania, składowania lub odsyłania do producenta.

Uwagi:
Fakt, że urządzenie zawiera części nieodporne na wyładowania elektrostatyczne (ESD) jest rzeczą normalną. Większość nowoczesnych urządzeń elektronicznych zawiera komponenty wykonane w technologii tlenków metali (NMOS, SMOS itp.). Jak pokazuje praktyka, nawet niewielkie wyładowanie elektrostatyczne może uszkodzić lub zniszczyć takie urządzenie. Uszkodzone części, nawet jeżeli na pozór działają poprawnie, szybko doprowadzają do nieprawidłowej pracy urządzenia.

Portuguese

Instruções Básicas
Ler antes de proceder!

A Brooks Instrument projecta, fabrica e testa os seus produtos de forma a satisfazer numerosas normas nacionais e internacionais. Estes equipamentos devem ser instalados, utilizados e mantidos de forma adequada, e devem funcionar dentro da sua gama de utilização. As instruções seguintes devem ser, durante a instalação, uso e/ou manutenção dos equipamentos da Brooks Instrument, apreendidas e integradas no plano de protecção e segurança no trabalho.

- Para assegurar o desempenho adequado, a instalação, exploração, actualização e/ou manutenção do equipamento deve ser realizada, exclusivamente, por pessoal qualificado.
- Antes de instalar, utilizar e/ou executar operações de manutenção devem ser lidas todas as instruções do equipamento. No caso do presente manual não ser apropriado procure, na capa traseira, o distribuidor mais próximo e contacte-o para obter informações adicionais. Guarde este manual para futura referência.

⚠ ATENÇÃO: não sujeite o equipamento a condições fora das gamas de serviços indicadas. Ao não respeitar esta advertência poderá provocar avarias no equipamento e/ou danos pessoais.

- Se as instruções deste manual não estiverem suficientemente claras, contacte o representante Brooks Instrument para esclarecer as suas dúvidas.
- Tenha sempre presente todas as advertências, apelos e instruções indicadas no equipamento e/ou fornecidas junto com o mesmo.
- A instalação do equipamento deverá ser efectuada cumprindo todas as instruções indicadas no manual assim como as normas e regulamentos locais e nacionais vigentes. Ligue o equipamento exclusivamente a fontes de energia eléctrica e/ou pneumática adequadas.
- Procedimento: (1) Pressurize lentamente o sistema. Abra lentamente as válvulas para evitar variações bruscas de caudal. (2) Verifique se há fugas nas ligações de entrada e saída do medidor de caudal. Se não detectar fugas, poderá colocar o sistema à pressão de trabalho.
- Antes de efectuar qualquer operação de manutenção verifique sempre a possibilidade do equipamento estar sob pressão. No caso de ser preciso substituir peças, estas devem ser as recomendadas pela Brooks Instrument e o trabalho de substituição deverá ser efectuado por técnicos qualificados. Procedimentos e peças não conformes poderão alterar o desempenho do equipamento, danificá-lo ou colocar em risco a sua segurança ou de outros. Substituir peças por outras não originais, meramente semelhantes, poderá originar choques eléctricos, fogo ou em funcionamento inadequado.
- Deverá manter o equipamento intacto e fechado, verificando se as coberturas de protecção estão nos seus lugares devidos, de forma a evitar choques eléctricos e/ou danos pessoais, excepto no caso de se tratar de um técnico qualificado e se estiver a executar trabalhos de manutenção.

⚠ ATENÇÃO: Se por qualquer razão for necessário fechar as válvulas a montante e jusante do equipamento, tenha em atenção que o mesmo deverá ser previamente esvaziado do fluído que o atravessa. Esta obrigação surge do facto de existir a possibilidade de ocorrer dilatação térmica do líquido, no interior do aparelho, podendo provocar danos pessoais ou materiais graves.

Directiva Europeia para equipamentos sob pressão (PED)

Todos os equipamentos sujeitos a pressão interior superior a 0,5 bar (g) e com calibre superior a 25 mm (1 polegada) estão sob a vigência da directiva europeia de equipamentos sob pressão (PED).

- O capítulo "Dados técnicos" do manual contém instruções relativas à Directiva PED.
- O caudalímetro objecto deste manual satisfaz a directiva 97/23/CE da UE.
- Os caudalímetros Brooks pertencem ao grupo 1 de fluidos.
- Os caudalímetros com calibre superior a 25 mm (1 polegada) pertencem às categorias PED I, II, ou III.
- Os caudalímetros de 25 mm (1 polegada) ou menores seguem as “Boas regras de engenharia” (SEP).

Directiva Europeia sobre Compatibilidade electromagnética (EMC)

Os equipamentos (eléctricos/electrónicos) da Brooks Instrument que têm a marcação CE passaram os testes comprovativos dos requisitos de compatibilidade electromagnética (Directiva EMC número 2004/108/EC).
Todavia, ao utilizar os aparelhos compete-lhe a escolha dos cabos de sinal adequados para os equipamentos com marcação CE.
Qualidade dos cabos de sinal, bucins e conectores:
A Brooks Instrument fornece cabos de alta qualidade que cumprem todos os requisitos da marcação CE.
No caso de utilizar os seus próprios cabos de sinal, assegure uma blindagem a 100%.
Os conectores do tipo “D” ou "circular" têm que ser blindados por uma malha metálica. Se precisar de usar bucins, estes têm que permitir a crimpagem da malha/blindagem do cabo.
A blindagem do cabo deve ser ligada ao corpo metálico ou bocal e assegurando a blindagem em 360°. A blindagem deve terminar numa ligação à terra.
Os conectores ligados a cartões serão, em geral, não-metálicos. Os cabos utilizados devem ter fita de blindagem a 100% para satisfazer a marcação CE.
A blindagem, deverá terminar numa ligação à terra.
Atribuição de pinos: Veja as instruções de operação anexas.

Descarga Electrostática (ESD)

⚠ ATENÇÃO: Alguns componentes deste equipamento são susceptíveis à acção da electricidade estática, podendo ficar danificados. Ao remover, colocar ou manipular placas de circuitos electrónicos deverá ter em atenção os seguintes procedimentos:

1. Desligar o equipamento da rede.
2. O utilizador, antes de qualquer intervenção que envolva os cartões de circuitos ou outros dispositivos internos, terá que se ligar à terra por meio duma bracelete de pulso ou outro dispositivo adequado.
3. Os circuitos impressos deverão ser transportados numa embalagem condutiva. Os cartões só deverão ser retirados da embalagem protectora imediatamente antes da sua inserção. O cartão retirado deverá ser recolocado imediatamente na embalagem protectora que servirá para o seu transporte, armazenagem ou retorno a fábrica.

Observações:
Tenha presente que este equipamento poderá não ser o único objecto capaz de ser portador de peças sensíveis a descargas electrostáticas (ESD).
Na maioria dos dispositivos electrónicos Brooks encontram-se peças de tecnologia de óxidos metálicos (NMOS, SMOS, etc.). A experiência mostra que até pequenas quantidades de electricidade estática são capazes de danificar ou destruir esses dispositivos. Os componentes danificados, embora inicialmente funcionem aparentemente bem, acabam por ter falhas prematuramente.

Romanian

Indicații de referință

Citiți-le întâi pe acestea!

Brooks Instrument își proiectează, produce și testează produsele într-un mod ce respectă un mare număr de standarde autohtone și internaționale. Aceste instalații trebuie amplasate, exploatate și întreținute corespunzător, pentru ca în toate situațiile, domeniul lor de lucru să corespundă operării normale. În ceea ce privește instalarea, operarea și întreținerea produselor Brooks Instrument, indicațiile de mai jos trebuie respectate și trebuie introduse in programul de protecția muncii.

- Pentru garantarea prestației corecte, instalarea, operarea, actualizarea, programarea și întreținerea produsului poate fi realizată doar de către personal calificat.
- Instrucțiunile de instalare ale produsului trebuie citite integral, înainte de punerea în serviciu și exploatarea sa. În măsura în care ediția acestui manual nu este cea adecvată, identificați pe ultima copertă coordonatele distribuitorului local și pentru lămuriri suplimentare adresați-vă acestuia. Păstrați acest manual pentru referințe ulterioare.

⚠ **ATENȚIE: Nu utilizați instalația în afara intervalului de funcționare indicat în instrucțiunile de operare. Nerespectarea acestui lucru se poate solda cu răniri grave de persoane sau defectarea instalației.**

- În măsura în care indicațiile cărții mașinii nu sunt suficient de lămuritoare, luați legătura cu reprezentantul Brooks Instrument pentru clarificarea problemei.
- Păstrați toate avertismentele, avizele și instrucțiunile livrate odată cu instalația sau inscripționate pe aceasta.
- Efectuați instalarea echipamentului în conformitate cu indicațiile de instalare corespunzătoare, respectiv cu respectarea prevederilor naționale. Echipamentul se conectează exclusiv la surse de energie electrică și de presiune corespunzătoare.
- Succesiune: (1) Presurizați lent instalația. Deschideți încetul cu încetul supapa de funcționare pentru evitarea fluctuațiilor de flux. (2) Controlați dacă nu sunt prelingeri la intrarea sau ieșirea debitmetrului de branșare. Dacă nu sunt scurgeri, presurizați instalația la presiunea de lucru.
- Înaintea exploatării/ întreținerii, verificați neapărat dacă conducta uzinală nu este sub presiune. În măsura în care este nevoie de piese de schimb, este neapărat necesar ca manevrarea pieselor de schimb să fie făcută de personal cu calificare profesională agreat de Brooks Instrument. Utilizarea altor piese de schimb decât cele originale și licențiate poate avea efecte asupra performanțelor instalației și asupra siguranței sale în exploatare. Utilizarea de piese asemănătoare de substituire poate avea ca rezultat pericol de incendiu și electrocutare.
- În toate cazurile toate ușile instalației trebuie să fie închise, cuștile de protecție să fie puse la locurile lor, pentru evitarea electrocutării și rănirii de persoane, exceptând situațiile când un specialist efectuează lucrări de întreținere.

⚠ **ATENȚIE: În cazul instalațiilor cu flux de fluide, dacă din orice motiv este necesară închiderea valvelor de intrare și ieșire, limitrofe instalației, instalația trebuie complet golită. Neglijarea acestui lucru poate avea ca efect dilatarea termică a fluidului, care poate defecta instalația și poate produce răniri de persoane.**

Directiva europeană pentru instalațiile sub presiune (PED)

Toate instalațiile și sistemele presurizate ce se află sub presiuni interne ce depășesc 0,5 mbar (g) și au mai mult de 25 mm sau 1 țol, cad sub incidența normei europene corespunzătoare (PED).

- La capitolul "Date tehnice" din cartea mașinii se găsesc indicațiile corespunzătoare directivei PED.
- Mijloacele de măsurare menționate în cartea mașinii corespund directivei 97/23/EK EU.
- Toate debitmetrele Brooks corespund clasei 1 de fluide.
- Mijloacele de măsurare mai mari de 25 mm sau 1 țol corespund categoriei PED I, II sau III.
- Mijloacele de măsurare mai mici de 25 mm sau 1 țol se conformează practicii inginerești acceptate (SEP).

Directiva europeană privitoare la compatibilitatea electromagnetică (EMC).

Instalațiile (electrice /electronice) ce poartă marca Brooks Instrument CE îndeplinesc cu succes cerințele testelor de verificare ale compatibilității electromagnetice (Cf. directivelor europene EMC cu nr. 2004/108/EC).
În același timp trebuie acordată o atenție deosebită la alegerea cablurilor de semnalizare utilizate pentru instalațiile ce poartă marcajul CE.
Calitatea cablurilor de semnalizare, a legăturilor prin cablu și a conectoarelor:
Brooks Instrument oferă cabluri de calitate ridicată, care corespund cerințelor calitative ale CE.
În măsura în care folosiți cabluri proprii, trebuie alese acelea care sunt 100% ecranate și prevăzute cu filtre.
Conectoarele „D" sau cele „circulare" trebuie sa dispună de ecrane metalice. În caz de nevoie trebuie folosite conectoare metalice pentru montarea filtrelor de cablu.
Filtrul de cablu trebuie conectat la carcasa metalică sau manșon și în ambele cazuri trebuie asigurată ecranarea la 360°. Ecranarea trebuie terminată cu o legare la pământ.
Conform standardului, conectoarele aparținând plăcilor electronice nu sunt metalice. Cablurile folosite trebuie să fie 100% ecranate și prevăzute cu filtre pentru a corespunde clasificării CE.
Ecranarea trebuie terminată cu o legare la pământ.
Configurație de contact: Vezi instrucțiunile de operare atașate.

Descărcare electrostatică (ESD)

⚠ **ATENȚIE: Instalația include piese care sunt predispuse la defectare sub influența electricității statice. Trebuie respectate metodele corespunzătoare de extragere, instalare sau alte manipulări ale circuitelor electronice.**
Procedură de manipulare:

1. Instalația trebuie scoasă de sub tensiune.
2. Înaintea de inserarea, scoaterea sau reglarea vreunei cartele electronice, sau a altui dispozitiv intern, persoana trebuie să se lege la pământ cu banda pentru articulația mâinii sau alte dispozitive de siguranță disponibile pentru acest scop.
3. Cartelele cu cablaje electronice imprimate trebuie transportate în ambalaje anti-electrostatice (conductoare). Cartelele se pot scoate din ambalaj, doar nemijlocit înaintea amplasării lor. Cartela demontată trebuie pusă neîntârziat în ambalajul de protecție în vederea transportării, a depozitării sau returnării la producător.

Observații:
În echipamente se găsesc adesea componente sensibile la descărcare electrostatică (ESD). Majoritatea echipamentelor moderne includ componente electronice realizate în tehnologie metal-oxid semiconductor (NMOS, SMOS, etc.) Experiența a dovedit că acestea pot fi afectate sau deteriorate chiar de energii electrostatice de slabă intensitate. Componentele defectate, cu toate că în aparență sunt funcționale, duc în timp la defecțiuni incipiente.

Slovak

Základné príkazy

Prečítať pred inštaláciou!

Brooks Instrument svoje výrobky projektuje, vyrába a testuje takým spôsobom, aby tieto vyhoveli domácim aj medzinárodným normám. Tieto zariadenia je potrebné predpísaným spôsobom inštalovať, prevádzkovať a udržiavať, na zabezpečenie ich spoľahlivej a normálnej prevádzky v celom pracovnom rozsahu. Nižšie uvedené príkazy je potrebné dodržiavať a začleniť do programu bezpečnostných predpisov v priebehu inštalácie, prevádzky a údržby výrobkov Brooks Instruments.

- V záujme zabezpečenia vyhovujúceho výkonu inštaláciu, prevádzku, programovanie, aktualizáciu a údržbu zariadení má vykonávať výlučne odborne kvalifikovaný personál.
- Pred inštaláciou, prevádzkou a servisu zariadení je potrebné prečítať všetky príkazy. Ak táto príručka nie je správna, tak na zadnej strane treba nájsť miestneho distribútora, kontaktovať ho pre ďalšie informácie. Pre neskoršie informácie uschovajte príručku.

⚠ **UPOZORNENIE: Neprevádzkovať zariadenie v rozsahu mimo rozsahu uvedenom v prevádzkovej príručke. Porušenie tohto oznámenia môže mať za následok ťažkú ujmu na zdraví a vedie k poškodeniu zariadenia.**

- Ak príkazy v návode nie sú jednoznačné, kontaktujte zástupcu Brooks Instrument na objasnenie problémov.
- Dodržujte všetky upozornenia, príkazy a usmernenia uvedené na zariadení, alebo s ním dodané.
- Zariadenia inštalujte podľa návodu uvedeného v príkaze na inštaláciu, v súlade s miestnymi a národnými predpismi. Zariadenie pripojte výlučne len na vyhovujúci elektrický a tlakový zdroj
- Postup: (1) Pomaly natlakujte systém. Prevádzkový ventil otvorte pomaly na zamedzenie kolísania prietoku. (2) Prekontrolujte tesnosť vstupného a výstupného zapojenia prietokomeru. Keď nie je presakovanie, spoje sú tesné, naplniť systém na prevádzkový tlak.
- Pred vykonávaním servisných prác kontrolovať, či systém nie je pod tlakom. V prípade, že je potrebná výmena súčiastky, výmenu dielov, určených Brooks Instrument musí vykonať kvalifikovaná osoba. Použitie nepovolených dielov a vykonávanie nepovolených aktivít ohrozujú bezpečnosť prevádzky a majú negatívny vplyv na výkon zariadenia. Nahradenie súčiastok len podobnými komponentmi môže mať za následok požiar, úraz elektrickým prúdom alebo nedostatočnú funkciu zariadenia
- Všetky ochranné kryty, dvierka zariadenia majú byť zatvorené na zabezpečenie ochrany proti úrazu elektrickým prúdom a proti poraneniam obsluhy. Výnimku tvorí vykonávanie údržby kvalifikovaným odborníkom.

⚠ **UPOZORNENIE: Pri zariadeniach s prietokom kvapalín, keď z akéhokoľvek dôvodu je nutné uzavrieť vstupné a výstupné ventily, zariadenie je potrebné úplne vyprázdniť. Zanedbanie vypúšťania má za následok poškodenie zariadenia s možnosťou zranenia obsluhy z dôvodu tepelnej rozťažnosti náplne.**

Európska smernica vzťahujúca sa na tlakové zariadenia (PED)

- Všetky zariadenia s vyšším vnútorným pretlakom ako 0,5 bar (g), a väčšieho rozmeru ako 25 mm alebo 1 anglický palec, podliehajú pod Európsku smernicu vzťahujúcu sa na tlakové nádoby (PED).
- Kapitola "Technické údaje" návodu na obsluhu obsahuje príkazy vzťahujúce sa na smernicu PED.
- Meracie prostriedky uvedené v návode na obsluhu vyhovujú smernici 97/23/ES EÚ.
- Všetky prietokomery Brooks patria do 1. skupiny kvapalín.
- Meracie prístroje presahujúce rozmery 25 mm alebo 1 " spĺňajú I., II., alebo III. kategóriu PED.
- Meracie prístroje menšie alebo rovné ako 25 mm alebo 1 " zodpovedajú zaužívanej meracej praxi (SEP).

Európska smernica vzťahujúca sa na elektromagnetickú kompatibilitu (EMC)

Elektrické / elektronické zariadenia Brooks Instrument, ktoré si zaslúžili značku CE, úspešne splnili skúšobné testy požiadaviek elektromagnetickej kompatibility (smernica EMC č. 2004/108/EC).
Pritom treba venovať zvláštnu starostlivosť na výber signálnych káblov zariadenia, s označením CE.
Kvalita signálnych káblov, káblových spojov a prípojov:
Brooks Instrument ponúka vysoko kvalitné káble, ktoré spĺňajú požiadavky kvalitatívneho zaradenia CE.
Ak použijete vlastné signálne káble, majú mať 100%-né tienenie, s plným filtrovaním.
Prípojky "kruhové" alebo tvaru "D" majú mať kovové tienenie. V prípade potreby treba použiť kovové káblové spojky k upevneniu káblového filtra.
Káblový filter treba pripojiť ku kovovému telesu alebo k puzdru, na oboch stranách zabezpečiť tienenie v kruhu 360 °. Tienenie má byť ukončené uzemnením.
Prípojky vedúce ku kartám podľa noriem sú nekovové. Použité káble, pre vyhovenie predpisom CE musia mať 100%-né filtrovanie tienením.
Tienenie má byť ukončené uzemnením.
Konfigurácia kontaktov: Viď priložený návod na obsluhu. .

Elektrostatický výboj (ESD)

⚠ **UPOZORNENIE: Prístroj obsahuje súčiastky, ktoré môžu byť poškodené od elektrostatických nábojov. Pri montáži, odstraňovaní alebo inej údržby vnútorných obvodových kariet je potrebné dodržiavať príslušné postupy.**
Postup ošetrovania:

1. Zariadenie odpojiť od napájania.
2. Osoba vykonávajúca údržbu má byť uzemnená uzemňujúcim náramkom, alebo iným, na túto prácu vyhovujúcim spôsobom pred vykonávaním inštalácie, demontáže a nastavenia obvodových kariet alebo iného vnútorného prostriedku.
3. Karty obvodov sa musia prepravovať v elektricky vodivom balení. Karty sa môžu vyberať z ochranného obalu výlučne len tesne pred montážou, zasunutím! Vybranú kartu okamžite treba umiestniť do ochranného obalu, určeného pre dopravu, skladovanie, alebo pre spätnú prepravu do výrobného závodu.

Poznámky:
Existencia prvkov, ktoré sú citlivé na elektrostatické výboje (ESD) v prístroji je častým javom. U väčšiny moderných elektronických prostriedkov sú použité prvky s technológiou oxidu kovov (NMOS, SMOS, atď.). Skúsenosti dokazujú, že aj nepatrné elektrostatické výboje poškodzujú, zničia tieto prostriedky. Poškodené súčiastky, aj keď zdanlivo pracujú bez chyby, odkazujú na vznikajúce poruchy.

Slovene

Osnovna navodila

Najprej preberite jih

Brooks Instrument tako konstruira, izdeluje in terstira svoje izdelke, da oni ustrezajo številnim domačim in mednarodnim standardom. Te naprave se morajo ustrezno instalirati, koristiti in vzdrževati, da vsekakor delajo ustrezno normalnom področju funkcioniranja. Naslednjih navodil se mora držati in potrebno je vgraditi v program varstva pri delu pri instaliranju, koriščenju in vzdržavanju izdelkov proizvajalca Brooks Instrument.

- Za jemstvo ustreznega učinka naj izključno strokovno osobje opravlja instaliranje, koriščenje, osveženje, programiranje in vzdrževanje izdelka.
- Potrebno je prebrati vsa navodila pred instaliranjem, koriščenjem in servisiranjem izdelka. V kolikor ta priročnik ni ustrezna publikacija, na zadnji strani poiščite lokalnega distributerja in za nadaljnje informacije stopite z njim v kontakt. Prihranite ta priročnik za poznejše informacije.

⚠ OPOMBA: Ne koristite napravo izven področja iz navodila za uporabo. Prekršek tega lahko privede do osebnih poškodb ali okvare naprave.

- V kolikor navodila priročnika niso enosmiselna, stopite v kontakt z zastopnikom društva Brooks Instrument, da razčistite problem.
- Držite se vseh opozoril, povabil, navodil, ki so navedena na napravi ali skupaj z njim izporočena.
- Napravo instalirajte shodno navodilom in relevantnim lokalnim in nacionalnim navodilom iz navodila za instalirenje.. Izdelek spojite izključno na ustrezni izvir elektrike in obskrbo tlaka.
- Proces: (1) Počasi položite sistem pod tlak. Počasi odpirajte pogonske ventile zaradi izogibanja nihanju pretoka. (2) Preverjajte, ima li curljanja pri povezu vstopa in izstopa merilca toka. Če ni curljanja, naplonite sistem na pogonski tlak.
- Pred servisom vsekakor preverjajte, ali je pogonski vod pod tlakom. Če je potreben rezervni del, svekakor strokovna oseba mora rokovati z rezervnimi deli odrejenimi od Brooks Instrument. Nedovoljeni rezervni deli in dejavnosti lahko vplivajo na učinek izdelka, oziroma ugrožavajo varnostni pogon. Sprememba samo z podobnimi rezervnimi deli lahko ima za posledico požar, nevarnost elektičnega šoka ali nedovoljno funkcioniranje.
- Vsa vrata naprave svekakor morajo biti zaprta, zaščitni ovitki morajo biti na svojem mestu zaradi izogibanja šoku in osebnim poškodbam, razen, če na njej strokovnjak opravlja dela vzdrževanja.

⚠ OPOMBA: V primeru naprave za tok tekočine, če je iz katera koli razloga potrebno zapreti vstopne in izstopne ventile pri napravi, naprava se mora celotno izprazniti. Zamuda tega lahko provzroči toplotno proširjenje tekočine, kar poškoduje napravo in lahko povrzoči osebno poškodbo.

Europske smernice za naprave ohranjanja pritiska (PED)

Vsaka naprava ohranjanja pritiska z notranjim pritiskom več od 0,5 bara (g) in večjim od 25 mm ali 1 palca sodi pod Europskim smernicam za ohranjanje pritiska (PED).

- Poglavje priročnika „Tehnični podatki" vsebuje navodila, ki se nanašajo na smernice PED.
- Merilni instrumenti navajani v priročniku ustrezajo smernicam EU številke 97/23/EK
- Vsaki merilec pretoka Brooks sodi v skupino tekočin številke 1.
- Merilni instrumenti večji od 25 mm ali 1 palca ustrezajo kategriji PED I, II, ali III.
- Merilni instrumenti manjši od 25 mm oziroma 1 palca ali manjši sledijo sprejeti inženjeski praksi (SEP).

Evropska smernica za Elektromagnetno kompatibilnost (EMC)

Naprave Brooks Instrument, ki so zaslužile CE označbo (električni/elektronski) so uspešno izpolnile testove zahteve o elektromangnetni kompatibilnosti (št. 2004/108/EC smernice EMC) .
Obenem mora se posebno pozornost posvetiti na izbiro signalnega kabla, ki se uporabljajo za naprave z označbo CE.
Kakaovost signalnih kablov, povezav kablov, priključkov:
Brooks Insturment nuja kabele visoke kakovosti, ki ustrezajo zahtevam kvalificiranja CE.
V kolikor se uporbalja lastni signalni kabel, treba je izbrati, ki za 100 % senco v polni meri filtriran.
Priključki „D" „olika kroga" morajo biti zasenčeni kovonskom sencom. Če bo potrebno, uporabite kovinske povezave za pritrditev filtra kabla
Filtar kabla je treba priključiti na kovinsko ohišje ali plašt in na obe polovici je treba senčiti v 360°. Senčenje mora završiti v ozemljitvi.
Priključki, ki sodijo karitcam normalno nisu kovinskik. Koriščeni kabli moraju biti filtrirani s 100 % senco, da odgovarjajo CE kvalifikaciji.
Sencanje mora imat konec v ozemljitvi.
Konfiguracija stika: Vidi priloženo navodilo za uporabo.

Elektrostatično izpražnjenje (ESD)

⚠ OPOZORILO: Naprava vsebuje take sestavne dele, ki so naklonjeni k poškodbi od statične elektrike. Treba se je držati ustreznih postopkov pri odstranjevanju, vlogu ali drugega rokovanja kartic in sredstev notranjih tokovnih krogov.
Posotpek rokovanja:

1. napravo je treba izklopiti iz električnega toka.
2. Osebo je treba ozemljiti zapestnim paščekom ali z drugim varnostnim in za ta namen primernim sredstvom preden bi instalirala, jemala, ali nastavila kartico za tokovni krog ali drugo notranjo opremo.
3. Tiskane kartice tokovnega kroga je treba izporočiti v konduktivni embalaži. Karte so odstranjive izključno neposredno pred vlogom iz zaščitne embalaže ven. Izjemljeno kartico nemudoma staviti v zaščitno embalažo za gibanje, skladiščenje ali pošiljanje nazaj.

Opombe:
Nije poseben pojav, da se v napravi nahajajo občutljivi sestavni deli na elektrostatično pražnjenje (ESD). V većem delu modernih elektronskih sredstev nahajajo se sestavni deli na kovinsko oksidno tehnologijo (NMOS, SMOS itd..). Izkustva potrjujejo, da majhna statična elektrika more poškodovati ali uničiti ta sredstva. Oškodovani rezervni deli, če na videz dobro delajo, nakažejo začetno napako.

Spanish

Instrucciones básicas
¡Léalos primero!

El Brooks Instrument proyecta, fabrica y prueba sus productos de manera que éstos respondan a numerosas normas nacionales e internacionales. Dichas instalaciones deben ser emplazadas, operadas y mantenidas adecuadamente, para que puedan marchar de todas formas en conformidad con el alcance normal de funcionamiento. Las siguientes instrucciones deben cumplirse y incorporadas en su programa de seguridad cuando instalando, operando y mantenimiento los productos Brooks Instrument.

- Para asegurar el adecuado rendimiento, para instalar, operar, actualizar, programar y mantener tiene que realizarse exclusivamente por una persona calificada.
- Antes de la instalación, operación y servicio del producto leer todas las respectivas instrucciones. Si el presente manual no es la adecuada publicación, busque al distribuidor local que figura en la contraportada y póngase en contacto con él para obtener informaciones. Guarde el presente manual para tener informaciones también en el futuro.

ATENCIÓN: No haga funcionar los equipos fuera del rango indicado en las instrucciones de funcionamiento. El incumplimiento de estas últimas puede conducir a graves daños personales o a la avería del equipo.

- Si las instrucciones del manual no son evidentes, póngase en contacto con el representante de Brooks Instrument para aclarar el problema
- Observar todas las alertas, advertencias e instrucciones indicadas en el equipo o suministradas con el mismo.
- Instale su equipo en conformidad con las recomendaciones indicadas en las respectivas instrucciones de instalación y con las pautas de las normas vigentes locales e internacionales. Conectar el producto exclusivamente a la adecuada fuente eléctrica y presión.
- Proceso: (1) Colocar lentamente flujo en el sistema. Abrir lentamente las válvulas de proceso para evitar oscilación del flujo. (2) Verificar si hay fuga alrededor de las conexiones de entrada y salida del flujómetro, Si no hay, llenar el sistema con la presión de operación.
- Antes de efectuar el servicio, verificar si hay presión o no en la tubería de la red. Si se requiere realizar un recambio de piezas, solamente el personal calificado puede manipular las piezas de repuesto determinadas por Brooks Instrument Las piezas y operaciones no autorizadas pueden afectar el rendimiento del producto o arriesgar el funcionamiento seguro. El recambio realizado con piezas sólo similares pueden traer como consecuencias incendios, choques eléctricos o funcionamiento bajo.
- Todas las puertas de la instalación deben estar cerradas, las cubiertas de protección tienen que hallarse en el debido sitio con el fin de evitar los daños personales y los choques eléctricos, salvo cuando un especialista efectúa el mantenimiento.

ADVERTENCIA: En caso de instalaciones que circulen líquido, si por cualquier razón se hubiera de cerrar las válvulas de entrada y salida situadas al lado del equipo, dichas instalaciones deberán ser completamente vaciadas. La omisión de esto último puede provocar la dilatación térmica del líquido, lo que puede dañar al equipo y conducir a daños personales.

Directriz Europea de los Equipos de Presión (PED)

Todos los equipos de presión, con una presión interna que supere a 0,5 bar (g) con tamaño mayor a 25 mm o 1 pulgada entran el ámbito de la Directriz Europea de los Equipos de Presión (PED).

- El capítulo Datos Técnicos del manual incluye las instrucciones respecto a las directivas de PED
- Los instrumentos de medición indicados en el Manual responden a las EN directivas 97/23/EC.
- Todos los flujómetros Brooks pertenecen a la categoría 1 del grupo de fluidos.
- Los instrumentos de medición más grandes que 25 mm o 1 pulgada están en conformidad con las categorías I, II o III de PED
- Los instrumentos de medición más pequeños que 25 mm o 1 pulgada siguen la Práctica Aceptada de Ingeniería (SEP).

Directriz Europea respecto a la Compatibilidad Electromagnética (EMC)

Las instalaciones de Brooks Instrument (eléctricas/electrónicas) merecedores de la categoría CE cumplieron con éxito las pruebas que verifican las exigencias de la compatibilidad electromagnética (directiva de EMC 2004/108/EC).
Al mismo tiempo se ha de prestar una especial atención en la selección de los cables de señal, utilizados con los equipos marcados con CE.
Calidad de los cables de señal, piezas de unión de cable y conectores:
El Brooks Instrument ofrece cables de alta calidad, que responden a los requerimientos de calificación CE.
Si se utiliza cable propio de la firma, se ha de elegir uno que sea completamente filtrado con blindaje de 100%.
Las piezas de unión de forma „D" o „circular" deben ser blindadas mediante blindaje metálica. Si es necesario, aplicar piezas de unión de metal para sujetar el filtro de cable.
Conectar el filtro de cable a la caja o manguito de metal blindándolo en ambas caras en 360°.
El blindaje debe terminar en tierra.
Los conectores que pertenecen a las tarjetas normalmente no son metalizados. Los cables utilizados deben ser filtrados con una blindaje de 100% para responder a la calificación CE.
El blindaje debe terminarse en tierra.
Configuración de contacto: Véase Instrucciones de operación adjuntas.

Descarga Electroestática (ESD)

PRECAUCIÓN: El aparato incluye piezas electrónicas que son susceptibles a los daños provocados por la electricidad estática. Observar los adecuados procesos para remover, instalar o manipular las tareas y medios de circuitos eléctricos internos
Proceso de operación:

1. Desconectar la fuente eléctrica de la unidad.
2. La persona debe ponerse a tierra mediante una palanca acodada o por otro medio seguro y apropiado para dicho fin antes de instalar, sacar o ajustar el circuito impreso eléctrico u otro medio interno.
3. El circuito impreso debe ser transportado en embalaje conductivo. Las tarjetas no pueden sacarse de la cubierta protectora exclusivamente directamente antes de la instalación. Las tarjetas desmontadas deben colocarse sin tardar en el embalaje protector utilizado para manipulación, almacenamiento o devolución a la fábrica.

Notas:
Esto equipo no es el único contenido de piezas susceptibles a la descarga electroestática (ESD). En la mayoría de los medios electrónicos modernos se encuentran piezas fabricadas por tecnología de óxido metálico. (NMOS, SMOS etc.). Las experiencias confirman que incluso una mínima electricidad estática puede dañar o destruir dichos medios. Las piezas averiadas, aunque funcionen aparentemente bien, indican una falla inicial.

Swedish

Väsentliga anvisningar.
Läs detta innan du fortsätter !

Brooks Instrument konstruerar, tillverkar och testar sina produkter med syfte att uppfylla alla nationella och internationella standarder. Dessa produkter måste installeras på rätt sätt, handhas och underhållas för att de skall fungera kontinuerligt enligt deras normala specifikation. De följande anvisningarna bör följas och integreras till Ert säkerhetsprogram varje gång när Brooks Instruments produkter installeras, handhas och underhålls.

- För att garantera angiven funktion, använd kvalificerad personal till att installera, handha, uppgradera, programmera och serva produkten.
- Läs alla instruktioner innan produkten installeras, startas upp och underhålls. Om du finner att denna instruktionshandbok inte är den rätta instruktionsboken, titta på i slutet av pärmen för information om hur man kan kontakta lokala representanter. Spara denna instruktions manual för senare behov.

⚠ VARNING: Kör inte detta instrument utanför dess specifikationer som är angiven i Instruktionsboken. Undvikande att ta denna varning kan leda till allvarliga personliga skador och / eller skada utrustningen.

- Om du inte förstår någon av dessa instruktioner, kontakta din representant för Brooks Instrument för klarläggande.
- Följ alla varningar och instruktioner som följer med leveransen av denna produkt.
- Installera din utrustning på sättet som anges i den gällande handbokens installationsanvisningar och enligt tillämpliga lokala och nationella föreskrifter. Koppla varje produkt till föreskriven ström- och tryckkällan.
- Igångsättning: (1) Koppla långsamt på flöde i systemet. Öppna processventiler sakta för att undvika för höga flöden. (2) Kontrollera läckor vid mätarens anslutningar för in- och utlopp. Om inget läckage förekommer, kör systemet upp till drifttrycket.
- Kontrollera att processledningens tryck är bortkopplat före service. I fall det behöves kompletteras med nya delar, se till att komponenter föreskrivna av Brooks Instrument används. Samt att kvalificerad personal utför arbetet. Ej rekommenderade komponenter och åtgärder kan påverka produktens prestanda och sätta din driftsäkerhet på spel. ”Felaktiga” ersättningar kan orsaka eld, elektriska skador samt felaktig funktion.
- Se till att anordningens kåpor och skyddslock ligger på sin plats med syfte att förebygga elektriska kontakt och personliga skador; det enda undantag gäller när underhållsarbete utförs av kvalificerad personal.

⚠ VARNING: I fall av - flödesmätare / regulatorer för vätskor: Ifall ventiler före och efter skall stängas av, måste alla ledningar tömmas på all vätska. Att ej tömma ledningar alt koppla bort trycket kan göra så att vätskans värmeutvidgning kan spräcka / skada utrustningen och orsaka personliga skador.

European Pressure Equipment Directive (PED) - (Rådets Direktiv 99/36/EG av den 29 april 1999[1] om transportabla tryckbärande anordningar)

Alla utrustning för tryck med ett tryck över 0.5 Bar(g) bar och större demensioner än 25 mm eller 1" (inch) faller under Tryck direktiv 99/36/EG av den 29 april 1999[1] om transportabla tryckbärande anordningar - PED.

- Den här Instruktionsbokens Sektion ” Specifikation” innehåller anvisningar gällande PED Direktivet.
- Mätare som beskrivs i denna Instruktionsbok är i överensstämmelse med EN Direktivet 97/23/EC.
- Brooks Instruments alla flödesmätare faller under flödesgrupp nr. I.
- Mätare som är större än 25 mm eller 1" (inch) överensstämmer med PED kategorier I, II eller III.
- Mätare på 25mm eller 1" (inch) eller mindre faller under Sound Engineering Practice (SEP) (God Teknisk Praxis).

European Electromagnetic Compatibility (EMC) - Elektromagnetisk kompatibilitet

Brooks Instrument (elektriska/elektroniska) CE-märkta anordningar har redan genomgått ett framgångsrikt prov enligt regleringar under Electromagnetic Compatibility (EMC directive 2004/108/EC). Man måstre dock ägna särskild uppmärksamhet till valet av signalkabeln som skall används för CE-märkta anordningar.

Signalkablars, packboxars och kontakdons kvalitet:

Brooks Instrument levererar högkvalitativa kablar som överensstämmer med specifikation för CE-intygade produkter.
Om man använder sin egen signalkabel, då bör man använda en kabel som är fullständigt skärmad med en 100% avskärmning.
“D” eller “Cirkelformiga” kontakdon skall vara skärmade med metalliska avskärmningar. Om det är användbart, bör metallpackboxar som ger en bra fastspänning för kabelskärmar användas.
Kabelavsärmningen måste kopplas till den metalliska skärmande anordningen eller packboxen och skärmas vid båda ändar runt omkring. Avskärmningens avspänning måste jordas.
Card Edge Kontaktdon är icke metalliska. För att överensstämma med krav på CE-intyg, skall de kablarna som används vara skärmade med 100% skärmning.
Skärmningen måste jordas.
Vad gäller stiftkonfigurationen: Se den bifogade Instruktionshandboken.

ESD (Elektrostatiska urladdningar)

⚠ OBS: Denna utrustning innehåller elektroniska komponenter som är lättpåverkade av skada orsakad av statisk elektricitet. Lämplig hanteringsprocedur måste följas när man tar bort, installerar eller på något annat sätt hanterar inre kretskort eller andra anordningar.

1. Ström till enheten måste kopplas från.
2. Personalen måste jordas med hjälp av ett armband eller något annat säkert medel innan något kretskort eller andra inre anordningar installerras, tas bort eller justeras.
3. Kretskort måste transporteras i en speciell förpackning för elektronik. Kort skall ej tas bort från deras skydsskåpa innan man skall installera dem. De borttagna korten bör omedelbart läggas i speciell förpackning för transport, lagring eller återlämnande till fabriken.

Anmärkningar:
Dessa instrument är ej unika vad gäller dess ESD **(**Elektrostatiska urladdningar) - känsliga komponenter. De flesta samtida konstruktioner innehåller komponenter som utnyttjar metalloxid teknologi (NMOS, SMOS, o.s.v.). Erfarenhet har visat att även små mängder av statisk elektricitet kan skada eller förstöra dess komponenter. Skadade komponenter - även om de annars verkar fungera ordentligt – har ofta en kortare livslängd. .

TRADEMARKS

LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller.

BROOKS SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.

For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons.

Please contact your nearest sales representative for more details.

HELP DESK

In case you need technical assistance:

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Netherlands	☎ +31 (0) 318 549290	Taiwan	☎ +886 3 5590 988
Germany	☎ +49 351 215 2040	China	☎ +86 21 5079 8828
Japan	☎ +81 3 5633 7100	Singapore	☎ +6297 9741

ISO 9001 QUALITY SYSTEM

Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

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Installation and Operation Manual
X-DPT-RS485-A-GF40-GF80-MFC-eng
Part Number: 541B176AAG
September, 2012

Supplemental Manual for Brooks® A-protocol over RS485 for GF40/GF80 Series Mass Flow Controllers and Meters

Brooks® GF40/GF80 Series
with RS485 A-protocol Communications

Brooks® GF40/GF80 A-protocol over RS485

Dear Customer,

We recommend that you read this manual in its entirety as this will enable efficient and proper use of the A-protocol over RS485 thermal mass flow controllers and meters. Should you require any additional information concerning the A-protocol over RS485 thermal mass flow controllers and meters, please feel free to contact your local Brooks Sales and Service Office; see back cover for contact information, or visit us on the web at www.BrooksInstrument.com. We appreciate this opportunity to service your fluid measurement and control requirements, and trust that we will be able to provide you with further assistance in future.

Yours sincerely,
Brooks Instrument

Contents

1.1 Introduction

The A-protocol is a digital communication protocol which provides a reliable, transaction oriented service between a master device, such as a PC, and one or more Brooks® Digital Series Mass Flow Controllers and Meters. The protocol is designed to allow a centralized controller to acquire measurement data from a Mass Flow device and, in case of Mass Flow Controllers, send setpoint values.

The Brooks RS485 on GF40/GF80 MFCs/MFMs support digital communications as defined by this manual. Communication is ASCII based and uses a command start and end byte. The physical layer supported is RS485 only.

This document is intended to give a user the means to implement the protocol structure into his own control system in order to establish communication between the control system and the RS485 based GF40/GF80 Series devices. It does not cover the non-communication functionality of these devices. For this description please refer to Installation and Operation Manual for this specific device.

The remaining sections of this document are summarized below:

- **Section 2 – Definition of Terms**
- **Section 3 – Before Starting** covers backgrounds and assumptions.
- **Section 4 – Quick Start** defines how to properly configure and wire RS485 on GF40/GF80 Series MFCs/MFMs for digital communications.
- **Section 5 – Message Protocol Structure** describes the AKT message protocol.
- **Section 6 – Communicating With Slave** describes the requirements of the Master.
- **Section 7 – ID Related Commands** describes the commands needed to retrieve the address ID of the device
- **Section 8 – Read Commands** describes the set of commands to read device attributes
- **Section 9 – Set Commands** describes the set of commands to configure device attributes.
- **Back Cover – Warranty and Contact Information**

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2.1 Definition of Terms

Abbreviation	Description
MFC/MFM	Mass Flow Controller/Meter Device
MSB	Most Significant Bit
LSB	Least Significant Bit

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3 Before Starting

3.1 Background & Assumptions

This manual is a supplement to the Brooks GF40/GF80 Series installation and operation manual. It is assumed that the owner of this RS485 GF40/GF80 MFC/MFM is thoroughly familiar with the theory and operation of this device. If not, it is recommended that the owner reads the installation and operation manual first before continuing with this supplement.

3.2 Numbers

Numeric values used throughout this manual will be clearly denoted as to the base numeric system it represents. All hexadecimal numbers (base 16) will be prefixed with a 0x, like 0xA4. All binary numbers (base 2) will be suffixed with a b, like 1001b. All other numbers not annotated this way will be assumed decimal (base 10).

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4 Quick Start

This section assumes the owner of the Digital Series device has a fully operational and trouble-free RS485 communications network with appropriate power supplies.

4.1 Supported Baud Rates

Data communication can be performed at a number of baud rates: 9600, 19.2K and 38.4K baud. The baud rate can be changed using the SBR command. The device is shipped with the baud rate set to 19.2K baud.

4.2 Character Coding

A-protocol messages are coded as a series of 8-bit characters or bytes. These are transmitted serially, using a conventional UART (Universal Asynchronous Receiver/ Transmitter). As in normal RS232 and other asynchronous communication links, a start bit, a parity bit and a stop bit are added to each byte. These allow the receiving UART to identify the start of each character and to detect bit errors due to electrical noise or other interference. An A-protocol character is built up from:

8 Databits
No parity bit
1 Stop bit

4.3 Bus and Device LEDs

The device supports a Bus and Device LED to indicate the status of network communication and the device.

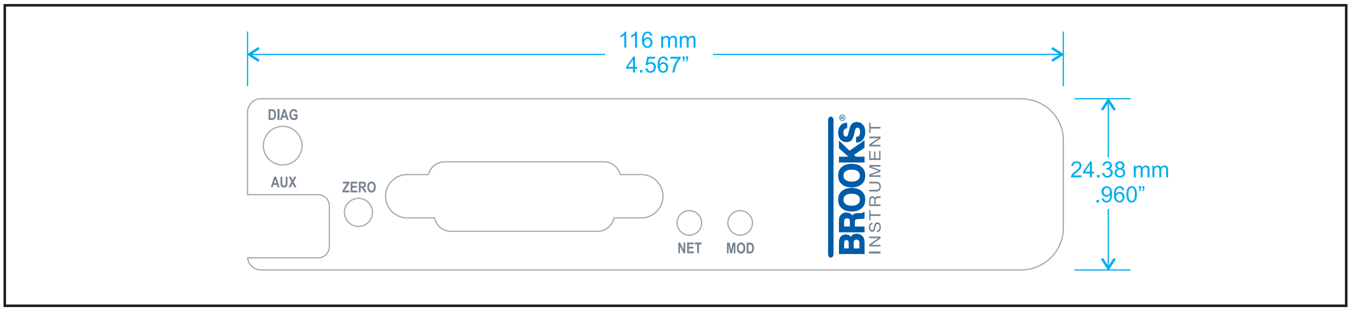

Figure 4-1 RS485 Label on Cover

The Bus LED will indicate the following:

Table 4-1 Bus LED Specification

Flash Code	Description
Off	No Network Connected
Solid Green	Communication Established at least once, resets after power cycle (no periodic check)

The Device LED will indicate the following:

Table 4-2 Device Led Specification

Flash Code	Description
Flashing Red/Green	The device is in the Self-Test/initializing mode
Solid Green	All self-tests/initialization have passed. No faults have been detected
Flashing Red	A recoverable fault has been detected. ex.: low/high flow alarm
Solid Red	An unrecoverable fault has occurred. ex.: internal power supply failure

4.4 Device Wiring

4.4.1 Electrical Connections

The RS485 on GF40/GF80 Series device has a 15-pin D-sub connector, for analog I/O, power supply and digital communication signals. See Table 4-3 for the pin-outs. For more detailed information refer to the instruction and operations manual.

Table 4 3 Pin-outs for D-Sub Connector

Pin No.	Function at Remote Connector
1	Setpoint Signal Ground
2	Flow Voltage Output
3	Alarm Output
4	Flow Current Output
5	Positive Supply Voltage
6	Not Used
7	Setpoint Current Input
8	Setpoint Voltage Input
9	Power Supply Common
10	Flow Signal Ground
11	Not Used
12	Valve Override Input
13	Auxiliary input
14	RXD/A-
15	TXD/A+

4.4.2 Multi Drop

The RS485 communications interface is a multi drop connection making it possible to connect up to 32 devices to a computer on a single multi drop line as shown Figure 4-2. Most Computers are NOT equipped with RS485 ports. In order to connect an RS485 to a computer, one will need an RS485 to RS232 converter. Figure 4-2 shows the interconnection diagram of an RS485 on GF40/GF80 MFC/MFM via an RS485 bus and an RS485 to RS232 converter to the RS232 serial port of a typical computer. The RS485 bus requires two matching resistors of 120W, one at the end of the bus and one at the beginning, near the converter. Note the control line from the PC to the converter necessary to control the data direction of the RS485 buffers. The RTS ("Request To Send") line shown in Figure 4-2 because this line is used to control data direction in many of the commercially available converters. The actual line used depends on the converter selected.

Table 4-4 D-Connector Communication Pins

D-Connector Pin Number	RS485
Pin #14	B (inverted driver side)
Pin #15	A (non-inverted driver side)

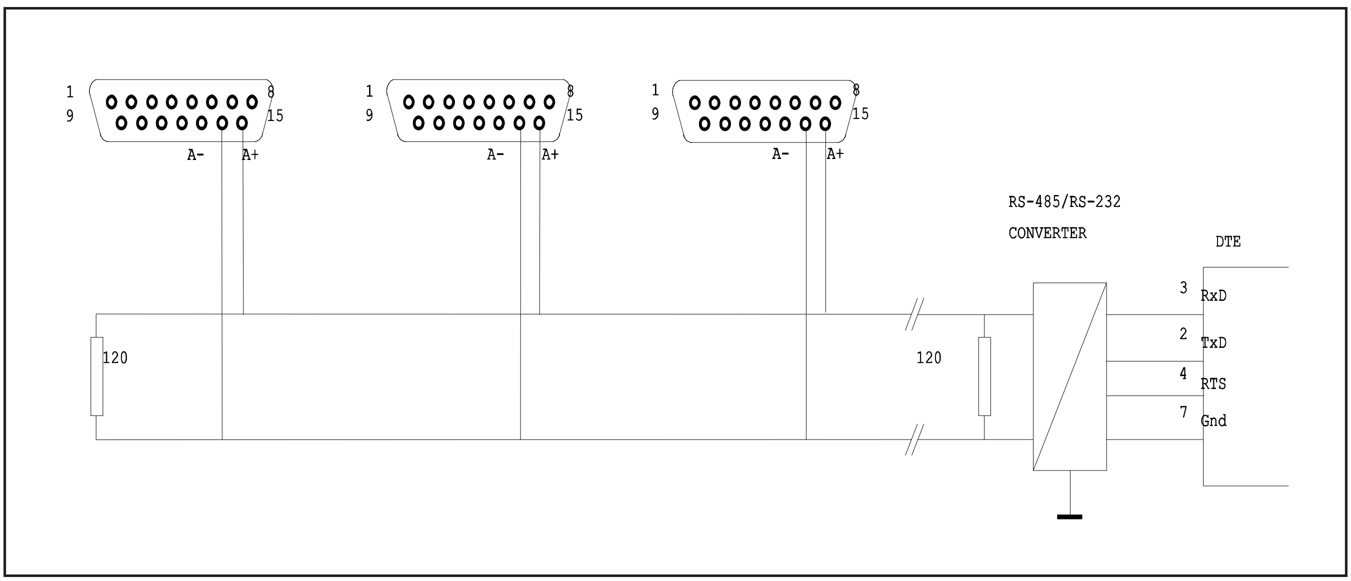

Figure 4-2 RS485 Multi Drop Interconnection DMFM/C and PC

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5 Message Protocol Structure

5.1 Introduction

The A-protocol is a “master-slave” protocol: each message transaction is originated by the master (central) station, whereas the slave (field) device only replies when it receives a command message addressed to it. The reply from the slave device will acknowledge that the command has been received and it may contain the data requested by the master.

5.2 Request Message

The request message, sent from master to slave, consists of the fields indicated in Figure 5-1, these fields will be described in the sections below.

[STX]	ID	Command	Data	[CR]

Figure 5-1 A-protocol Command Request Structure

5.2.1 Start Character

The start transmission character, [STX] 0x02, signals that a communication transaction is beginning.

5.2.2 Addressing Concept

The ID field is the unit network address set by software. The unit ID is a 2 byte ASCII field and indicates a hexadecimal number in the range 0x00-0x63 (0-100). ID 0x00 is used as a broadcast address. In case the broadcast address is used, all MFCs in the network will execute the command, but no MFCs will send a response. This doesn’t yield for commands SID and RID.

5.2.3 Command

The Command field consists of three ASCII bytes. Read commands start with R and the Set commands start with S. For more information on commands see Section 7 ID related commands, Section 8 Read commands and Section 9 Set commands.

5.2.4 Data

The Data field varies in length depending upon the command and will be empty if there is no data.

5.2.5 End Character

Carriage return is a single byte, [CR] 0x0D, which signals that the communication transaction is complete. If there is no data, [CR] immediately follows the command field.

5.3 Response Message

There are two possible responses to a transmission packet:
- a response that contains no data (an acknowledgement or negative acknowledgement)
- a response that contains data.

5.4 Response Without Data

5.4.1 OK (Acknowledgement)

O	K	[CR]

Figure 5-2 Positive Acknowledgement

If the response packet contains the 2 bytes ASCII text OK, then the transmission packet has been received and the command acknowledged.

5.4.2 NG (Negative Acknowledgement)

N	G	[CR]

Figure 5-3 Negative Acknowledgement

If the response packet contains the 2 bytes ASCII text NG, then the transmission has not been received, or the transmission ordered or requested an action or reading that is out of parameters.

5.5 Response With Data

Status	Data	[CR]

Figure 5-4 Response With Data

A data response contains both a Status field and a Data field

5.5.1 Status

The status field is a single ASCII byte, possible notations are:
N = No alarm or error
Z = Executing zero point calibration
A = Alarm exists
E = Error exists
X = Alarm(s) *and* error(s) exist
Note: The Status field is indicated as [Status] in the communication command tables starting at Section 7 ID Related Commands.

5.5.2 Data

The Data field contains the data requested by the read command.

5.6 Broadcast

It is possible to transmit the same command to all MFCs by using ID 0x00. All MFCs in the system, regardless of their network address, will execute the command, but none of the networked MFCs will send a response. The SID and RID commands are special in that they will address the device using the serial nr, passed along as data. Only the device with the specified serial number will respond, irrespective of the ID passed along with the command.

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6 Start Communicating With Slave

In order to start communicating with a slave device the first thing to do is to retrieve the IDs of the connected devices. The RID command shall be used to perform this task. It accepts a serial number (max 12 digits) as data and the broadcast ID. This serial number is derived from the serial number of the device, it will contain the last 12 (or less) numerical [0..9] digits of the device's serial number.

6.1 Examples

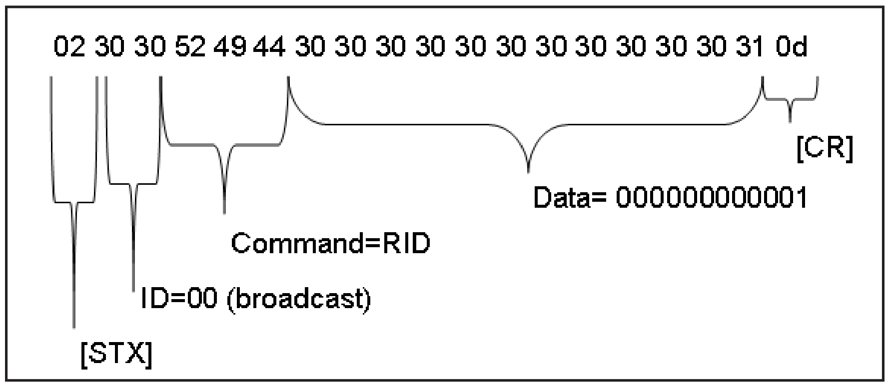

Figure 6-1 RID Command Request

Figure 6-1 RID Command Request shows the hexadecimal byte sequence of the RID command issued by a master application.

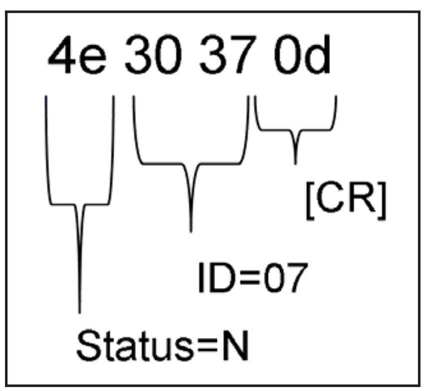

Figure 6-2 RID Command Response

Figure 6-2 RID Command Response shows the hexadecimal byte response transmitted by the slave device on the RID command request.

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7.1 ID Related Commands

Table 7-1 ID and Serial Number Commands

Command	Command Descriptions
SID set unit ID	Sets the unit ID number. The ID consists of 2 ASCII bytes indicating a hexadecimal number in the range [0x00..0x63] (0-100). To set the unit ID, you must address the command to all MFCs on the network (ID field = 00) and enter the serial number followed by the new unit ID number. Format = [STX] 00**SID** [serial number [1]] [new two-digit unit ID] [CR] Response data = OK [CR]
RID read unit ID	Reads the unit ID number. The ID consists of 2 ASCII bytes indicating a hexadecimal number in the range [0x00..0x63] (0-100). To read the unit ID, you must address the command to all MFCs on the network (ID field = 00) and enter the serial number. Format = [STX] 00**RID** [serial number[1] [CR] Response data = [Status] xx [CR]
RSR read serial number	Read the serial number. Format = [STX] id**RSR** [CR] Response data = [serial number] [CR]

[1] This serial number is derived from the serial number of the device, it will contain the last 12 (or less) numerical [0..9] digits of the device's serial number.

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8.1 Read Commands

Table 8-1 Read Commands

Command	READ Command Descriptions
RBR read baud rate	Reads the baud rate of the communication interface Format = [STX] id**RBR** [CR] Response data = [Status] x [CR] x=0 for baud rate is 9600 x=1 for baud rate is 19200 x=2 for baud rate is 38400
RVM read valve control mode	Reads the valve control mode (open, closed, or controlled). Format = [STX] id**RVM** [CR] Response data = [Status] x [CR] O = Valve open C = Valve closed N = Valve controlled by set point
RMD Read set point mode	Reads the set point input mode (digital or analog). Format = [STX] id**RMD** [CR] Response data = [Status] x [CR] D = Digital mode A = Analog mode
RFX read flow output	Reads flow output as a percentage of full-scale flow. Range is from 0% to 100% (in 0.01% increments). Format = [STX] id**RFX** [CR] Response = [Status] [±xxxx]x.xx [CR]
RDC read set point	Reads the flow set point as a percentage of full scale flow. Range is from 0 to 100 (in 0.01 increments). Format = [STX] id**RDC** [CR] Response data = [Status] [xxxx]x.xx [CR]
RVD read valve voltage	Reads the valve voltage as a percentage of full rated valve voltage. Range is 0% to 100% (in 1% increments). Format = [STX] id**RVD** [CR] Response = [Status] xxx [CR]
RFK read user full scale flow	Reads the user full scale flow (in sccm). Format = [STX] id**RFK** [CR] Response data = [Status] [±xxxx]x.xx [CR]
RGN read gas name	Reads the gas name. Range is from 1 to 20 characters. Format = [STX] id**RGN** [CR] Response data = [Status] [1 to 20 characters] [CR]
RGT read gas table	Sets the gas table number. Range is from 1 to 8. Format = [STX] id**RGT** [CR] Response data = [Status] [1 to 8 characters] [CR]
RFW read flow alarm range	Reads the flow alarm range as a percentage of full-scale flow. Range is 0% to 98% (in 0.01% increments). Format = [STX] id**RFW** [CR] Response data = [Status] [±xxxx]x.xx [CR]
RFT read flow alarm latch time	Reads the flow alarm latch time. Range is 0 s to 99 s (in 1s increments). Format = [STX] id**RFT** [CR] Response data = [Status] xx [CR]

Table 8-1 Read Commands (Continued)

RFT read flow alarm latch time	Reads the flow alarm latch time. Range is 0 s to 99 s (in 1s increments). Format = [STX] id**RFT** [CR] Response data = [Status] xx [CR]
RFI read flow alarm state	Reads the flow alarm enable state. Format = [STX] id**RFI** [CR] Response data = [Status] x [CR] 0 = Disabled 1 = Enabled
RVA read valve alarm set point	Reads the valve alarm set point as a percentage of full-scale flow. Range is 0% to 100% (in 1% increments). Format = [STX] id**RVA** [CR] Response data = [Status] [xx]x [CR]
RVW read valve alarm set point	Reads the valve alarm bandwidth as a percentage of full-scale flow. Range is 0% to 98% (in 1% increments). Format = [STX] id**RVW** [CR] Response data = [Status] [xx]x [CR]
RVT read valve alarm latch time	Reads the valve alarm latch time. Range is 0 s to 99 s (in 1s increments). Format = [STX] id**RVT** [CR] Response data = [Status] xx [CR]
RVI read valve alarm state	Reads the valve alarm enable state. Format = [STX] id**RVI** [CR] Response data = [Status] x [CR] 0 = Disabled 1 = Enabled
RAS read alarm status	Reads the alarm status. The response data is in a hexadecimal ASCII format representing bit flags. If a bit is set (i.e., = 1), then the corresponding condition is true. Format = [STX] id**RAS** [CR] Response data = [status] xx [CR] Bit 0 = Flow alarm high Bit 1 = Flow alarm low Bit 2 = Valve alarm high Bit 3 = Valve alarm low Bits 4 through 7 = Not used
RER Read error status	Reads the error status. The response data is in a hexa-decimal ASCII format representing bit flags. If a bit is set (that is, = 1), then the corresponding condition is true. Format = [STX] id**RER** [CR] Response data = [status] xx [CR] Bit 0 = Communication error Bit 1 = None Bit 2 = EEPROM error Bit 3 = Zero Point Correction Error 1. Zero point deviation is > ±10% of the last calibrated value. Bit 4 = Zero Point Correction Error 2. Zero point deviation is > ±10% of the default value set at shipment. Bits 5 through 7 = Not used

9.1 Set Commands

Table 9-1 Set Commands

Command	Set Command Descriptions
SBR set the baud rate	Sets the baud rate of the communication interface Format = [STX] id**SBR** x[CR] Response data = OK[CR] x=0 for baud rate is 9600 x=1 for baud rate is 19200 x=2 for baud rate is 38400
SVO open valve	Sets the control valve fully open. Format = [STX] id**SVO** [CR] Response data = OK [CR]
SVC close valve	Sets the control valve fully closed. Format = [STX] id**SVO** [CR] Response data = OK [CR]
SVN enable valve control	Enables valve control. When valve control is enabled, flow is controlled by the set point (set by command **SDC**). Format = [STX] id**SVN** [CR] Response data = OK [CR]
SDM set digital set point control	Sets digital (RS-485 input) set point control mode. Format = [STX] id**SDM** [CR] Response data = OK [CR]
SAM set analog set point control	Sets analog (analog input) set point control mode. This mode is the default mode at reset. Format = [STX] id**SAM** [CR] Response data = OK [CR]
SDC set flow set point	Sets the flow set point as a percentage of full scale flow. Range is from 0 to 100 (in 0.01 increments). Format = [STX] id**SDC** [xxxx]x.xx [CR] Response data = OK [CR]
SZP start zero point adjustment	Starts the zero point adjustment function. Format = [STX] id**SZP** [CR] Response data = OK [CR] After the initial OK response, the MFC will reply to all status commands with a specially formatted message: Zxx [CR]. When the zero calibration is complete the reply format will return to normal (Nxx [CR]).
SGN set gas name	Sets the gas name. Range is from 1 to 20 characters. Format = [STX] id**SGN** [1 to 20 characters] [CR] Response data = OK [CR]
SGT set gas table	Sets the gas table number. Range is 1 to 8. Format = [STX] id**SGT** x [CR] Response data = OK [CR]
SAF enable flow alarm	Enables the flow alarm. Format = [STX] id**SAF** [CR] Response data = OK [CR]
SFI disable flow alarm	Disables the flow alarm. Format = [STX] id**SFI** [CR] Response data = OK [CR]

Table 9-1 Set Commands (Continued)

Command	Set Command Descriptions
SFW set flow alarm range	Sets the flow alarm range as a percentage of full-scale flow. Range is 0% to 98% (in 0.01% increments). An alarm will occur when the flow is not within ±(range/2) of the alarm set point. Format = [STX] id**SRW** xx.xx [CR] Response data = OK [CR]
SFT set flow alarm latch time	Sets the flow alarm latch time. Range is 0 s to 99 s (in 1 s increments). The alarm will not occur until the flow exceeds the specified limits for the flow alarm latch time period. Format = [STX] id**SFT** xx [CR] Response data = OK [CR]
SVA set valve alarm set point	Sets the valve alarm set point as a percentage of full scale flow. Range is 0% to 100% (in 1% increments). Format = [STX] id**SVA** xxx [CR] Response data = OK [CR]
SVW set valve alarm bandwidth	Sets the valve alarm bandwidth as a percentage of full-scale flow. Range is 0% to 98% (in 1% increments). The alarm will occur when the valve voltage is not within ±(bandwidth/2) of the valve alarm value. Format = [STX] id**SVW** xxx [CR] Response data = OK [CR]
SVT set valve alarm latch time	Sets the valve alarm latch time. Range is 0 s to 99s (in 1s increments). The alarm will not occur until the flow exceeds the specified limits for the flow alarm latch time period. Format = [STX] id**SVT** xx [CR] Response data = OK [CR]
SAC Clear alarm(s)	Clears the flow alarm. Format = [STX] id**SAC** [CR] Response data = OK [CR]
SEC Clear error(s)	Clears the error status. Format = [STX] id**SEC** [CR] Response data = OK [CR]
SAV Enable valve alarm	Enables the valve alarm. Format = [STX] id**SAV** [CR] Response data = OK [CR]
SVI Disable valve alarm	Disables the valve alarm. Format = [STX] id**SVI** [CR] Response data = OK [CR]

LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller.

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.

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Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

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Installation and Operation Manual
X-DPT-RS485-L-GF40-GF80-MFC-eng
Part Number: 541B179AAG
September, 2012

Supplemental Manual for Brooks® L-protocol over RS485 for GF40/GF80 Series Mass Flow Controllers and Meters

Brooks® GF40/GF80 Series
with RS485 L-protocol Communications

BROOKS® INSTRUMENT

Brooks® GF40/GF80 L-protocol over RS485

Dear Customer,

We recommend that you read this manual in its entirety as this will enable efficient and proper use of the L-protocol over RS485 thermal mass flow controllers and meters. Should you require any additional information concerning the L-protocol over RS485 thermal mass flow controllers and meters, please feel free to contact your local Brooks Sales and Service Office; see back cover for contact information, or visit us on the web at www.BrooksInstrument.com. We appreciate this opportunity to service your fluid measurement and control requirements, and trust that we will be able to provide you with further assistance in future.

Yours sincerely,
Brooks Instrument

1.1 Introduction

The L-protocol is a digital communication protocol which provides a reliable, transaction oriented service between a master device, such as a PC, and one or more Brooks® Digital Series Mass Flow Controllers and Meters. The protocol is designed to allow a centralized controller to acquire measurement data from a Mass Flow device and, in case of Mass Flow Controllers, send setpoint values.

The Brooks RS485 on GF40/80 MFCs/MFMs support digital communications as defined by this manual. The physical layer supported is RS485 only.

This document is intended to give a user the means to implement the protocol structure into his own control system in order to establish communication between the control system and the RS485 based GF40/80 Series devices. It does not cover the non-communication functionality of these devices. For this description please refer to Installation and Operation Manual for this specific device.

The remaining sections of this document are summarized below:

- **Section 4 – Quick Start** defines how to properly configure and wire RS485 on GF40/80 Series MFCs/MFMs for digital communications.
- **Section 5 – Message Protocol Structure** describes the L-protocol message.
- **Section 6 – Generation 1 Messages** describes the set of generation 1 commands
- **Section 7 – Generation 2 Messages** describes the set of generation 2 commands
- **Back Cover – Warranty and Contact Information**

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2.1 Definition of Terms

Abbreviation	Description
MFC/MFM	Mass Flow Controller/Meter Device
MSB	Most Significant Bit
LSB	Least Significant Bit

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3 Before Starting

3.1 Background & Assumptions

This manual is a supplement to the Brooks GF40/80 Series installation and operation manual. It is assumed that the owner of this RS485 GF40/80 MFC/MFM is thoroughly familiar with the theory and operation of this device. If not, it is recommended that the owner reads the installation and operation manual first before continuing with this supplement.

3.2 Numbers

Numeric values used throughout this manual will be clearly denoted as to the base numeric system it represents. All hexadecimal numbers (base 16) will be prefixed with a 0x, like 0xA4. All binary numbers (base 2) will be suffixed with a b, like 1001b. All other numbers not annotated this way will be assumed decimal (base 10).

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4 Quick Start

This section assumes the owner of the Digital Series device has a fully operational and trouble-free RS485 communications network with appropriate power supplies.

4.1 Supported Baud Rates

Data communication can be performed at a number of baud rates: 9600, 38.4K and 115.2K baud. The baud rate can be changed using the 'Set Current Baud Rate' or 'Set Default Baud Rate'message. The device is shipped with the baud rate set to 38.4K baud. Good network wiring is important in order to achieve consistent results at a baud rate of 115.2K. Bad termination will cause random, intermittent communication failures.

4.2 Character Coding

L-protocol messages are coded as a series of 8-bit characters or bytes. These are transmitted serially, using a conventional UART (Universal Asynchronous Receiver/ Transmitter). As in normal RS-232 and other asynchronous communication links, a start bit, a parity bit and a stop bit are added to each byte. These allow the receiving UART to identify the start of each character and to detect bit errors due to electrical noise or other interference. An L-protocol character is built up from:

8 Data bits
1 start bit
No parity bit
1 stop bit
No handshake

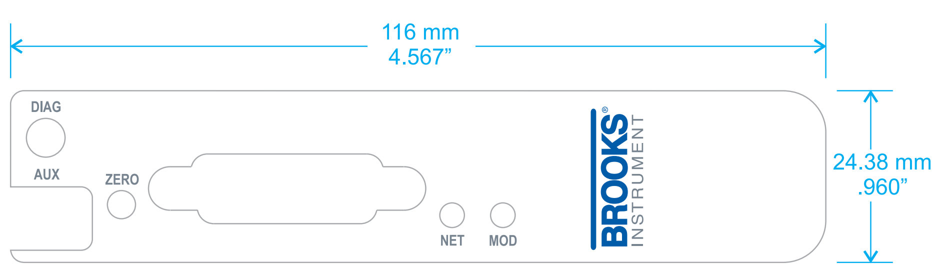

Figure 4-1 RS485 Label on Cover

4.3 Bus and Device LEDs

The device supports a Bus and Device LED to indicate the status of network communication and the device.
The Bus LED will indicate the following:

Table 4-1 Bus LED Specification

Flash Code	Description
Off	No Network Connected
Solid Green	Communication Established at least once, resets after power cycle (no periodic check)

The Device LED will indicate the following:

Table 4-2 Device Led Specification

Flash Code	Description
Flashing Red/Green	The device is in the Self-Test/initializing mode
Solid Green	All self-tests/initialization have passed. No faults have been detected
Flashing Red	A recoverable fault has been detected. ex.: low/high flow alarm
Solid Red	An unrecoverable fault has occurred. ex.: internal power supply failure

4.4 Device Wiring

4.4.1 Electrical Connections

The RS485 on GF40/GF80 Series device has a 15-pin D-sub connector, for analog I/O, power supply and digital communication signals. See Table 4-3 for the pin-outs. For more detailed information refer to the instruction and operations manual.

4.4.2 Multi Drop

The RS485 communications interface is a multi drop connection making it possible to connect up to 32 devices to a computer on a single multi drop line as shown Figure 4-2. Most Computers are NOT equipped with RS485 ports. In order to connect an RS485 to a computer, one will need an RS485 to RS232 converter. Figure 4-2 shows the interconnection diagram of an RS485 on GF40/GF80 MFC/MFM via an RS485 bus and an RS485 to RS232 converter to the RS232 serial port of a typical computer. The RS485 bus requires two matching resistors of 120Ω, one at the end of the bus and one at the beginning, near the converter. Note the control line from the PC to the converter necessary to control the data direction of the RS485 buffers. The RTS (“Request To Send”) line shown in Figure 4-2 because this line is used to control data direction in many of the commercially available converters. The actual line used depends on the converter selected.

Table 4 3 Pin-outs for D-Sub Connector

Pin No.	Function at Remote Connector
1	Setpoint Signal Ground
2	Flow Voltage Output
3	Alarm Output
4	Flow Current Output
5	Positive Supply Voltage
6	Not Used
7	Setpoint Current Input
8	Setpoint Voltage Input
9	Power Supply Common
10	Flow Signal Ground
11	Not Used
12	Valve Override Input
13	Auxiliary input
14	RXD/A-
15	TXD/A+

Table 4-4 D-Connector Communication Pins

D-Connector Pin Number	RS485
Pin #14	B (inverted driver side)
Pin #15	A (non-inverted driver side)

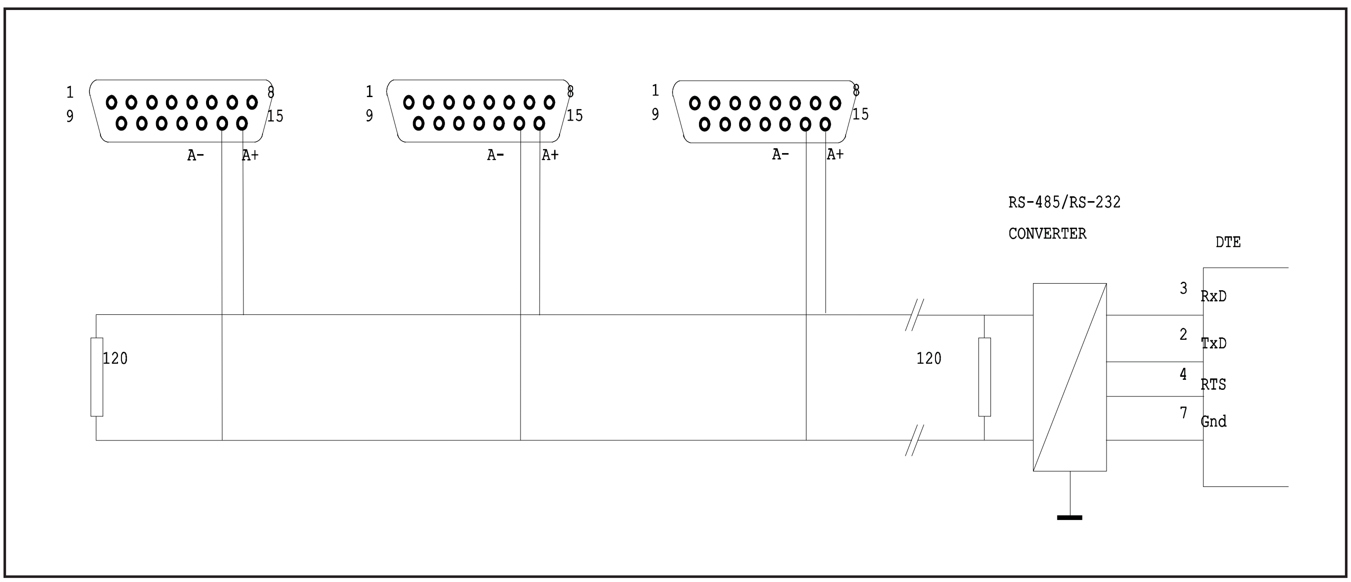

Figure 4-2 RS485 Multi Drop Interconnection MFC/MFM

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5 Message Protocol Structure

5.1 Introduction

The A-protocol is a “master-slave” protocol: each message transaction is originated by the master (central) station, whereas the slave (field) device only replies when it receives a command message addressed to it. The reply from the slave device will acknowledge that the command has been received and it may contain the data requested by the master.

5.2 Message Format

Messages on the bus are sent as packets with a fixed format, illustrated as the following diagram. Each packet begins with the target digital device controller MAC ID (address), an STX character (0x02), a service (command) code (0x80 for read and 0x81 for write), a packet length character, a variable identifier (consisting of Class ID, Instance ID, Attribute ID) and a data count between 0 to x. Each packet ends with a pad byte of 0, and a 1-byte checksum, which is the sum of all of the bytes in the packet, other than the target MAC ID, modulo 256. The checksum calculation discards the carry from the byte summation calculation.

All communication on the bus is done by service requests (from master controller to a specified Device slave controller), each addressed to a specific MAC ID, Class ID, Instance ID and Attribute ID. The RS485 protocol supports only 2 services – Read and Write (Query and Set).

Table 5-1 Fixed Format of the Message Packets

STX (0x02)
Command Code (0x80 for read, 0x81 for write)
Packet Length
Class ID
Instance ID
Attribute ID
Data (0 - x bytes)
Pad (0x00)
Checksum

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6 Generation 1 Messages

6.1 Overview

The following table summarizes the specification of Class ID, Instance ID and Attribute ID for each supported message:

Table 6-1 Summary of Messages and Specifications for Each Supported Message

Message	Class ID	Instance ID	Attribute ID
Query for MAC ID	0x03	0x01	0x01
Set MAC ID (Hardware Dependant)	0x03	0x01	0x01
Query for Current Baud Rate [1]	0x03	0x01	0x65
Set Current Baud Rate [1]	0x03	0x01	0x65
Query for Default Baud Rate [1]	0x03	0x01	0x66
Set Default Baud Rate [1]	0x03	0x01	0x66
Set Calibration Instance	0x66	0x00	0x65
Query for Calibration Instance	0x66	0x00	0x65
Query for Available # of Calibration Instances	0x66	0x00	0xA0
Set Auto Zero Enable/Disable	0x68	0x01	0xA5
Query for Sensor Current Zero	0x68	0x01	0xA9
Query for Sensor Reference Zero	0x68	0x01	0xAA
Set Sensor Reference Zero	0x68	0x01	0xAA
Set Requested Zero Enable	0x68	0x01	0xBA
Query for Requested Zero Status	0x68	0x01	0xBA
Set Digital Mode Selection*	0x69	0x01	0x03
Query for Analog/Digital Control Mode Setting	0x69	0x01	0x03
Query for Default Control Mode	0x69	0x01	0x04
Set Default Control Mode	0x69	0x01	0x04
Set Freeze Follow	0x69	0x01	0x05
Set New Set Point	0x69	0x01	0xA4
Set Ramp Time	0x6A	0x01	0xA4
Query Filtered Set Point	0x6A	0x01	0xA6
Query Indicated Flow/Pressure	0x6A	0x01	0xA9
Query Valve Drive Current	0x6A	0x01	0xB6

*Command supported but has no effect on device behavior – Recognized but not implemented
[1] These commands are optional for Gen 1 implementations.

6.2 RS485 Device NewSetpoint Conversion

The NewSetpoint request take values in the range of 0x4000 to 0xC000 which represent setpoints between 0% and 100% full scale. The linear relationship between Full Scale setpoints and the NewSetpoint is demonstrated in the following table:

Full Scale % Setpoint	New Setpoint Value (Hex)
0.0	4000
25.0	6000
50.0	8000
75.0	A000
99.0	BEB8
100.0	C000

The "NewSetpoint" value may be calculated from the full scale percent value by:

"NewSetpoint"=(327.68 * full scale %) + 16,384

or

"NewSetpoint"= ((0xC000-0x4000)/100 * full scale %) + 0x4000

Note that at the communication level all values are sent in binary format. The decimal and hexadecimal formats shown above are for convenience.

6.3 Messages

The following sections describe in detail the supported messages.

6.3.1 Query for MAC ID

Master controller will use this message to query the existence of a RS485 device controller.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	MAC ID (0- master controller)
STX(0x02)	STX(0x02)
Command Code(0x80 for read)	Command Code(0x80 for read)
Packet Length(0x03)	Packet Length(0x04)
Class ID(0x03)	Class ID(0x03)
Instance ID(0x01)	Instance ID(0x01)
Attribute ID(0x01)	Attribute ID(0x01)
Pad(0x00)	MFC MAC ID
Checksum	Pad(0x00)
	Checksum

The value of "MFC MAC ID" returned will be a hex value representing the MFC's MAC ID. If the MAC ID if the MFC is 33 the value returned in this byte should be 0x21.

6.3.2 Set MAC ID Configuration

RS485 devices can have software cnfigurable MAC ID's by sending the "Set MAC ID" command to the current RS485 device controller address.

Master controller will use this message to set the MAC ID of an RS485 device.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controll er address)	ACK
STX(0x02)	ACK
Command Code(0x81 for write)	
Packet Length(0x04)	
Class ID(0x03)	
Instance ID(0x01)	
Attribute ID(0x01)	
Data(0x21~0x(21+x))	
Pad(0x00)	
Checksum	

6.3.3 Query for Current Baud Rate

Master controller will issue this command to determine the current device BAUD rate.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	MAC ID (0-master controller)
STX(0x02)	STX(0x02)
Command Code(0x80 for read)	Command Code(0x80 for read)
Packet Length(0x03)	Packet Length(0x07)
Class ID(0x03)	Class ID(0x03)
Instance ID(0x01)	Instance ID(0x01)
Attribute ID(0x065)	Attribute ID(0x65)
Pad(0x00)	Baud Rate Byte 0 (LSB)
Checksum	Baud Rate Byte 1
	Baud Rate Byte 2
	Baud Rate Byte 3 (MSB)
	Pad(0x00)
	Checksum

6.3.4 Set Current Baud Rate

Master controller will issue this command to set the current device BAUD rate.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	ACK
STX(0x02)	ACK
Command Code(0x81 for write)	
Packet Length(0x07)	
Class ID(0x03)	
Instance ID(0x01)	
Attribute ID(0x065)	
Baud Rate Byte 0 (LSB)	
Baud Rate Byte 1	
Baud Rate Byte 2	
Baud Rate Byte 3 (MSB)	
Pad(0x00)	
Checksum	

(9600 = 0X2580. Byte 0 = 0x80; Byte 1 = 0X25; Byte 2 = 0X0; Byte 3 = 0X0.)
(38400 = 0x9600. Byte 0 = 0X0; Byte 1 = 0x96; Byte 2 = 0X0; Byte 3 = 0x0.)
(115200 = 0X1C200. Byte 0 = 0X0; Byte 1 = 0XC2; Byte 2 = 0X01; Byte 3 = 0X0.)

6.3.5 Query for Default Baud Rate

Master controller will issue this command to determine the default device BAUD rate.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	MAC ID (0-master controller)
STX(0x02)	STX(0x02)
Command Code(0x80 for read)	Command Code(0x80 for read)
Packet Length(0x03)	Packet Length(0x07)
Class ID(0x03)	Class ID(0x03)
Instance ID(0x01)	Instance ID(0x01)
Attribute ID(0x066)	Attribute ID(0x66)
Pad(0x00)	Baud Rate Byte 0 (LSB)
Checksum	Baud Rate Byte 1
	Baud Rate Byte 2
	Baud Rate Byte 3 (MSB)
	Pad(0x00)
	Checksum

6.3.6 Set Default Baud Rate

Master controller will issue this command to set the default device BAUD rate.

Query message from master controller
MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x81 for write)
Packet Length(0x07)
Class ID(0x03)
Instance ID(0x01)
Attribute ID(0x066)
Baud Rate Byte 0 (LSB)
Baud Rate Byte 1
Baud Rate Byte 2
Baud Rate Byte 3 (MSB)
Pad(0x00)
Checksum

Response message to master controller
ACK
ACK

(9600 = 0X2580. Byte 0 = 0x80; Byte 1 = 0X25; Byte 2 = 0X0; Byte 3 = 0X0.)
(38400 = 0x9600. Byte 0 = 0X0; Byte 1 = 0x96; Byte 2 = 0X0; Byte 3 = 0x0.)
(115200 = 0X1C200. Byte 0 = 0X0; Byte 1 = 0XC2; Byte 2 = 0X01; Byte 3 = 0X0.)

6.3.7 Set Calibration Instance (Process Gas) Selection

Master controller will use this message to select which calibration instance is to be used for flow metering.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	ACK
STX(0x02)	ACK
Command Code(0x81 for write)	
Packet Length(0x04)	
Class ID(0x66)	
Instance ID(0x00)	
Attribute ID(0x65)	
Calibration Instance ID(#)	
Pad(0x00)	
Checksum	

6.3.8 Query for Calibration Instance (Process Gas) Selection

Master controller will use this message to query the selected calibration instance, which is currently being used for flow metering.

Query message from master controller
MAC ID (Targeted Device controller addres s)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x66)
Instance ID(0x00)
Attribute ID(0x65)
Pad(0x00)
Checksum

Response message to master controller
MAC ID (0-master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x04)
Class ID(0x66)
Instance ID(0x00)
Attribute ID(0x65)
Calibration Instance ID(#)
Pad(0x00)
Checksum

6.3.9 Query for Available Calibration Instances (Process Gases)

Master controller will use this message to query available number of calibration instances.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	MAC ID (0-master controller)
STX(0x02)	STX(0x02)
Command Code(0x80 for read)	Command Code(0x80 for read)
Packet Length(0x03)	Packet Length(0x04)
Class ID(0x66)	Class ID(0x66)
Instance ID(0x00)	Instance ID(0x00)
Attribute ID(0xA0)	Attribute ID(0xA0)
Pad(0x00)	Available # Of Calibration Instances
Checksum	Pad(0x00)
	Checksum

6.3.10 Set Auto Zero Enable/Disable

Master controller will use this message to enable auto zero function.

Query message from master controller
MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x81 for write)
Packet Length(0x04)
Class ID(0x68)
Instance ID(0x01)
Attribute ID(0xA5)
>0 for enable, = 0 for disable
Pad(0x00)
Checksum

Response message to master controller
ACK
ACK

6.3.11 Query for Sensor Current Zero

Master controller will use this message to query the current sensor zero offset.

Query message from master controller

MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x68)
Instance ID(0x01)
Attribute ID(0xA9)
Pad(0x00)
Checksum

Response message to master controller

MAC ID (0-master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x05)
Class ID(0x68)
Instance ID(0x01)
Attribute ID(0xA9)
Data Byte #1 (LSB)
Data Byte #2(MSB)
Pad(0x00)
Checksum

6.3.12 Query for Sensor Reference Zero

Master controller will use this message to query the sensor reference zero offset.

Query message from master controller

MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x68)
Instance ID(0x01)
Attribute ID(0xAA)
Pad(0x00)
Checksum

Response message to master controller

MAC ID (0-master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x05)
Class ID(0x68)
Instance ID(0x01)
Attribute ID(0xAA)
Data Byte #1 (LSB)
Data Byte #2(MSB)
Pad(0x00)
Checksum

6.3.13 Set Sensor Reference Zero

Master controller will use this message to set sensor reference zero offset.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	ACK
STX(0x02)	ACK
Command Code(0x81 for write)	
Packet Length(0x05)	
Class ID(0x68)	
Instance ID(0x01)	
Attribute ID(0xAA)	
Data Byte #1 (LSB)	
Data Byte #1 (LSB)	
Pad(0x00)	
Checksum	

6.3.14 Set Requested Zero Enable

Master controller will use this message to enable requested function.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	ACK
STX(0x02)	ACK
Command Code(0x81 for write)	
Packet Length(0x04)	
Class ID(0x68)	
Instance ID(0x01)	
Attribute ID(0xBA)	
1 for enable	
Pad(0x00)	
Checksum	

6.3.15 Query for Requested Zero Status

Master controller will use this message to query if the requested zero function has been completed which should take no longer than 120 seconds.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	MAC ID (0-master controller)
STX(0x02)	STX(0x02)
Command Code(0x80 for read)	Command Code(0x80 for read)
Packet Length(0x03)	Packet Length(0x04)
Class ID(0x68)	Class ID(0x68)
Instance ID(0x01)	Instance ID(0x01)
Attribute ID(0xBA)	Attribute ID(0xBA)
Pad(0x00)	0: completed. 1: in progress
Checksum	Pad(0x00)
	Checksum

6.3.16 Set Digital Mode Selection

Master controller will use this message to set an RS485 device controller to digital or analog mode.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	ACK
STX(0x02)	ACK
Command Code(0x81 for write)	
Packet Length(0x04)	
Class ID(0x69)	
Instance ID(0x01)	
Attribute ID(0x03)	
Mode(1 - digital, 2 - analog)	
Pad(0x00)	
Checksum	

6.3.17 Query Present Digital/Analog Mode Setting

Master controller will use this message to query the present control mode.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	MAC ID (0-master controller)
STX(0x02)	STX(0x02)
Command Code(0x80 for read)	Command Code(0x80 for read)
Packet Length(0x03)	Packet Length(0x04)
Class ID(0x69)	Class ID(0x69)
Instance ID(0x01)	Instance ID(0x01)
Attribute ID(0x03)	Attribute ID(0x03)
Pad(0x00)	Mode(1 - digital, 2 - analog)
Checksum	Pad(0x00)
	Checksum

6.3.18 Query for Default Control Mode

Master controller will use this message to query the default control mode.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	MAC ID (0-master controller)
STX(0x02)	STX(0x02)
Command Code(0x80 for read)	Command Code(0x80 for read)
Packet Length(0x03)	Packet Length(0x04)
Class ID(0x69)	Class ID(0x69)
Instance ID(0x01)	Instance ID(0x01)
Attribute ID(0x04)	Attribute ID(0x04)
Pad(0x00)	Mode(1 - digital, 2 - analog)
Checksum	Pad(0x00)
	Checksum

6.3.19 Set Fault Control Mode

Master controller will use this message to set an RS485 device control mode when first powered up.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	ACK
STX(0x02)	ACK
Command Code(0x81 for write)	
Packet Length(0x04)	
Class ID(0x69)	
Instance ID(0x01)	
Attribute ID(0x04)	
Mode(1 - digital, 2 - analog)	
Pad(0x00)	
Checksum	

6.3.20 Set Freeze Follow

Master controller will use this message to configure an RS485 controller to act upon a new setpoint when recieved.

Query message from master controller
MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x81 for write)
Packet Length(0x04)
Class ID(0x69)
Instance ID(0x01)
Attribute ID(0x05)
FreezeFollow (1-Act on new set point immediately)
Pad(0x00)
Checksum

Response message to master controller
ACK
ACK

6.3.21 Set New Setpoint

Master controller will use this message to send a new setpoint to an RS485 device controller.

Query message from master controller
MAC ID (Targeted Device controller ad dress)
STX(0x02)
Command Code(0x81 for write)
Packet Length(0x05)
Class ID(0x69)
Instance ID(0x01)
Attribute ID(0xA4)
Data Byte #1 (LSB)
Data Byte #2 (MSB)
Pad(0x00)
Checksum

Response message to master controller
ACK
ACK

Flow/Pressure Full Scale %	Value (Hex)
0.0	4000
25.0	6000
50.0	8000
75.0	A000
99.0	BEB8
100.0	C000
125.0	E000

The flow calculation method is as defined in "6.2 RS485 Device New Setpoint Conversion".

6.3.22 Set Ramp Time

Master controller will use this message to send a a ramp time to a MFC controller. The ramp time is how long the MFC controlller should take to reach the final setpoint for the current setpoint. The unit is millisecond. A zero ramp time effectively disables the ramping.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	ACK
STX(0x02)	ACK
Command Code(0x81 for write)	
Packet Length(0x05)	
Class ID(0x6A)	
Instance ID(0x01)	
Attribute ID(0xA4)	
Data Byte #1 (LSB)	
Data Byte #2 (MSB)	
Pad(0x00)	
Checksum	

6.3.23 Query Filtered Setpoint

Master controller will use this message to get the current setpoint from an RS485 controller. This is the current setpoint after ramping has been applied.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	MAC ID (0-master controller)
STX(0x02)	STX(0x02)
Command Code(0x80 for read)	Command Code(0x80 for read)
Packet Length(0x03)	Packet Length(0x05)
Class ID(0x6A)	Class ID(0x6A)
Instance ID(0x01)	Instance ID(0x01)
Attribute ID(0xA6)	Attribute ID(0xA6)
Pad(0x00)	Data Byte #1 (LSB)
Checksum	Data Byte #2(MSB)
	Pad(0x00)
	Checksum

6.3.24 Query Indicated Flow/Pressure

Master controller will use this message to get the current flow reading from an RS485 device controller.

Query message from master controller	Response message to master controller
MAC ID (Targeted Device controller address)	MAC ID (0-master controller)
STX(0x02)	STX(0x02)
Command Code(0x80 for read)	Command Code(0x80 for read)
Packet Length(0x03)	Packet Length(0x05)
Class ID(0x6A)	Class ID(0x6A)
Instance ID(0x01)	Instance ID(0x01)
Attribute ID(0xA9)	Attribute ID(0xA9)
Pad(0x00)	Data Byte #1 (LSB)
Checksum	Data Byte #2(MSB)
	Pad(0x00)
	Checksum

Flow/Pressure Full Scale %	Value (Hex)
0.0	4000
25.0	6000
50.0	8000
75.0	A000
99.0	BEB8
100.0	C000
125.0	E000

The flow calculation method is as defined in "6.2 RS485 Device New Setpoint Conversion".

6.3.25 Query Valve Drive Current

Master controller will use this message to get the valve drive current.

Query message from master controller
MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x6A)
Instance ID(0x01)
Attribute ID(0xB6)
Pad(0x00)
Checksum

Response message to master controller
MAC ID (0-master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x05)
Class ID(0x6A)
Instance ID(0x01)
Attribute ID(0xB6)
Data Byte #1 (LSB)
Data Byte #2(MSB)
Pad(0x00)
Checksum

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7 Generation 2 Messages

7.1 Overview

GENERATION 2: Must support all of Generation 1 commands as defined – plus the following:

Message	Class ID[1]	Instance ID	Attribute ID
Query Who Are You Manufacturer ID	0x03	0x01	0xC5
Query Who Are You Firmware	0x03	0x01	0xC6
Query Who Are You Device Details	0x03	0x01	0xC7
Query Who Are You Serial Number	0x03	0x01	0xC8
Set Freeze Follow Broadcast	0x69	0x01	0x05
Set New Set Point Long	0x69	0x01	0xA6
Query Indicated Flow Long	0x6A	0x01	0xAA
Query Command Retrieval	0x6A	0x01	0xAB

[1] Commands will not be created with the following Class ID values: A0, A1, and A2. These will be considered Restricted Class ID values, for use by MFC suppliers should such suppliers require them for internal purposes
[2] These commands are supplier specific. All MFCs to whom these commands do not apply should return a reply of NSP.

7.2 Messages

7.2.1 Query Who Are You Manufacturer ID

Master controller will use this message to retrieve the RS485 device Manufacturer ID.

Message from master controller
MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x03)
Instance ID(0x01)
Attribute ID(0xC5)
Pad(0x00)
Checksum

Response message to master controller
MAC ID (0 –master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length (0xyy) Where yy is actual byte count. Max part number byte count is 14.
Class ID(0x03)
Instance ID(0x01)
Attribute ID(0xC5)
Data Byte #1(ASCII) Manufacturer ID Left most character
Data Byte #2(ASCII) Manufacturer ID
Data Byte #3(ASCII) Manufacturer ID
Data Byte #4(ASCII) Manufacturer ID Usually a hyphen “-“
Data Byte #5(ASCII) Manufacturer ID
Data Byte #6(ASCII) Manufacturer ID
Data Byte #7(ASCII) Manufacturer ID
Data Byte #8(ASCII) Manufacturer ID
Data Byte #9(ASCII) Manufacturer ID
Data Byte #10(ASCII) Manufacturer ID
Data Byte #11 (ASCII) Manufacturer ID Usually a hyphen “-“
Data Byte #12(ASCII) Manufacturer ID
Data Byte #13(ASCII) Manufacturer ID
Data Byte #14(ASCII) Manufacturer ID Right most character
Pad(0x00)
Checksum

7.2.2 Query Who Are You Firmware

Master controller will use this message to retrieve the MFC firmware version information.

Message from master controller

MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x03)
Instance ID(0x01)
Attribute ID(0xC6)
Pad(0x00)
Checksum

Response message from an RS485 device controller to master controller. Sample shows all 16 characters returned. Fewer is acceptable, as long as byte count reflects the number of characters returned.

MAC ID (0 –master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length (0xyy) Where yy is actual byte count. Max part number byte count is 16. Less is OK.
Class ID(0x03)
Instance ID(0x01)
Attribute ID(0xC6)
Data Byte #1(ASCII) Firmware Version Number (LEFT MOST CHARACTER)
Data Byte #2(ASCII) Firmware Version Number
Data Byte #3(ASCII) Firmware Version Number
Data Byte #4(ASCII) Firmware Version Number
Data Byte #5(ASCII) Firmware Version Number
Data Byte #6(ASCII) Firmware Version Number
Data Byte #7(ASCII) Firmware Version Number
Data Byte #8(ASCII) Firmware Version Number
Data Byte #9(ASCII) Firmware Version Number
Data Byte #10(ASCII) Firmware Version Number
Data Byte #11 (ASCII) Firmware Version Number
Data Byte #12(ASCII) Firmware Version Number
Data Byte #13(ASCII) Firmware Version Number
Data Byte #14(ASCII) Firmware Version Number
Data Byte #15(ASCII) Firmware Version Number
Data Byte #16(ASCII) Firmware Version Number (RIGHT MOST CHARACTER)
Pad(0x00)
Checksum

In the response to the above command, RS485 device controller will return the firmware versiion of the RS485 device. Packet length will define the number of characters actually returned.

7.2.3 Query Who Are You Device Details

Master controller will use this message to retrieve the RS485 device controller specific capability information.

Message from master controller

MAC ID (Targeted Device controll er address)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x03)
Instance ID(0x01)
Attribute ID(0xC7)
Pad(0x00)
Checksum

Response message master controller

MAC ID (0 – master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length (0x13)
Class ID(0x03)
Instance ID(0x01)
Attribute ID(0xC7)
Data Byte #1(LSB) Full scale flow size)
Data Byte #2 Full scale flow size
Data Byte #3 Full scale flow size
Data Byte #4 (MSB) Full scale flow size
Data Byte #1 (LSB) SEMI gas ID No. for this MFC
Data Byte #2 ()SEMI gas ID No. for this MFC
Data Byte #3 () SEMI gas ID No. for this MFC
Data Byte #4(MSB) SEMI gas ID No. for this MFC
Data Byte #1 (LSB) SEMI calibration gas ID number
Data Byte #2 ()SEMI calibration gas ID number
Data Byte #3 ()SEMI calibration gas ID number
Data Byte #4(MSB) SEMI calibration gas ID number
Data Byte #1 (LSB) SEMI calibration secondary gas ID number
Data Byte #2 ()SEMI calibration secondary gas ID number
Data Byte #3 ()SEMI calibration secondary gas ID number
Data Byte #4(MSB) SEMI calibration secondary gas ID number
Pad(0x00)
Checksum

In response to the above command, Digital MFC Controller will return information regarding the MFC capabilities. Request is for several pieces of information in a specific order:
1. MFC Full Scale size in tenths of a SCCM 4 byte unsigned integer format,
• To report MFC size in 10th of sccm as an integer. Take MFC size, multiple by 10, and convert to integer format.
• In tenths of a sccm – a 100 sccm device would be returned as 100*10 to convert this to 10th of sccm in integer format.
• If the MFC size were 100.5 sccm, the number they would return would be 1005.
• If the MFC size were 100.55 sccm, the number reported would be 1005 (or 1006 if you round up in your math routine).

2. SEMI Gas ID number for currently selected gas instance in 4 byte unsigned integer,
3. SEMI Gas ID number for Calibration gas used in 4 byte unsigned integer, and
4. GENERIC calibration information and may be used for SEMI Gas ID number for Secondary calibration gas used or algorithm identity or other manufacturer information useful in identifying calibration information.

Field is 4 byte unsigned integer – return zeros if not applicable.

7.2.4 Query Who Are You Serial Number

Master controller will use this message to retrieve the device serial number information.

Message from master controller

MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x03)
Instance ID(0x01)
Attribute ID(0xC8)
Pad(0x00)
Checksum

Response message master controller

MAC ID (0 – master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length (0xyy) Where yy is actual byte count. Max part number byte count is 16. Less is OK.
Class ID(0x03)
Instance ID(0x01)
Attribute ID(0xC8)
Data Byte #1(ASCII) Serial Number (LEFT MOST CHARACTER)
Data Byte #2(ASCII) Serial Number
Data Byte #3(ASCII) Serial Number
Data Byte #4(ASCII) Serial Number
Data Byte #5(ASCII) Serial Number
Data Byte #6(ASCII) Serial Number
Data Byte #7(ASCII) Serial Number
Data Byte #8(ASCII) Serial Number
Data Byte #9(ASCII) Serial Number
Data Byte #10(ASCII) Serial Number
Data Byte #11 (ASCII) Serial Number
Data Byte #12(ASCII) Serial Number
Data Byte #13(ASCII) Serial Number
Data Byte #14(ASCII) Serial Number
Data Byte #15(ASCII) Serial Number
Data Byte #16(ASCII) Serial Number (RIGHT MOST CHARACTER)
Pad(0x00)
Checksum

In response to the above command, the Digital Controller will return the Serial Number of the Device. Packet length will define the number of characters actually returned.

Response message from a digital Device controller to master controller. Sample shows all 16 characters returned. Fewer are acceptable, as long as byte count reflects the number of characters returned.

7.2.5 Set Freeze Follow Broadcast

Single Freeze Follow Broadcast Message form Master Controller.

Message from master controller
MAC ID Broadcast: (0xFE) All devices Act on this Message Devices do NOT respond
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x69)
Instance ID(0x01)
Attribute ID(0x05)
Freeze Follow Byte Value 0 = Freeze current setpoint 1 = Use new setpoint immediately. Set to 1 to Signal: Switch to previously Provided 'Next' Setpoint and Ramp Immediately
Pad(0x00)
Checksum

Response message master controller

NO RESPONSE SHOULD BE SENT

7.2.6 Set New Setpoint Long

New Setpoint Long includes Ramp and Freeze Follow.

Message from master controller
MAC ID (Targeted Device controller address) Devices do NOT respond
STX(0x02)
Command Code(0x81)
Packet Length(0x08)
Class ID(0x69)
Instance ID(0x01)
Attribute ID(0xA6)
Freeze Follow Byte Value 0 = Freeze current setpoint (don't change yet) 1 = Use new setpoint immediately. Typically set to 0, for Freeze Current Setpoint
Data Byte (LSB) 'Next" Setpoint
Data Byte #2(MSB) 'Next' Setpoint
Data Byte #1(LSB) Linear Ramp Time (milliseconds) for 'Next' Setpoint
Data Byte #2(MSB) Linear Ramp Time (milliseconds) for 'Next' Setpoint
Pad(0x00)
Checksum

Response message master controller
ACK
ACK

Master controller will use this long message to prepare for the next set point. This message will use a single data exchange to pass the Freeze Follow Flag, Ramp time to 'Next' set point and the 'Next' set point to the device. It will expect to receive the same response as it would have received from the standard New Set Point command – an ACK.

If Freeze Follow is set to 1 – use the 'Next' set point and its RAMP indicator immediately. If Freeze follow is set to 0 wait for a broadcast 'immediate' command (See previous Item). NOTE: May be overridden/cancelled by another 'set point' command. Status read commands received will be honored and will not change the settings for this new set point command.

If Ramp is set to zero, no ramp is required. If value is non-zero – always ramp. If a value is provided, this value is in milliseconds and is to be the time used for a linear ramp to next set point. RS485 device is to always set the last value for the set point to the actual set point requested at the end of the ramp. Once it reaches the set point it should stop. It is desired to avoid overshoot. If the time provided exceeds the RS485 device capability – set it to the RS485 device capability.

This message is intended to be used as an alternate to the now utilized New Set Point, Ramp time, and Original Freeze Follow individual commands and simply combines all of the commands into a single message. It is intended to be issued at the same frequency as the older set commands – potentially every 250 – 500 ms.

All set point values will be percent of full scale and are passed as fractional values in the same format as historically used, with 0x4000 corresponding to 0% of the parameter, and 0xC000 corresponding to 100% of the parameter.

7.2.7 Query Indicated Flow Long

This request will be used to obtain the current flow reading as well as other RS485 device operating status information.

Message from master controller
MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x6A)
Instance ID(0x01)
Attribute ID(0xAA)
Pad(0x00)
Checksum

Response message master controller
MAC ID (0 –master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length (0x0B)
Class ID(0x6A)
Instance ID(0x01)
Attribute ID(0xAA)
Data Byte #1 (LSB) Indicated Flow Now % full scale 4000 to C000
Data Byte #2 (MSB) Indicated Flow Now % full scale 4000 to C000
Data Byte #1 (LSB) Upstream Transducer Now
Data Byte #2(MSB) Upstream Transducer Now
Data Byte #1 (LSB) Valve Voltage/Current Now
Data Byte #2 (MSB) Valve Voltage/Current Now
Data Byte #1 (LSB) Device Internal Temperature Reading Now
Data Byte #2(MSB) Device Internal Temperature Reading Now
Pad(0x00)
Checksum

1. Current indicated flow in % of full scale (2 bytes)
0x3333 to 0x4000 = -10% to 0%
0x4000 to 0xC000 = 0% to 100%
0xC000 to 0xE000 = 100% to 125%

2. Reading from the upstream pressure transducer hundredths psi units (2 byte signed integer)
0x0000 to 0x7FFF = 0.00psi to 327.67psi
0x8000 to 0xFFFF = -327.68psi to -0.01psi

3. Valve voltage or Valve current as appropriate for the RS485 device hundredths of a % full scale (2 byte signed integer)
0x0000 to 0x7FFF = 0.00% to 100.00%
0x8000 to 0xFFFF = -100.00% to -0.01%
4. RS485 device internal temperature sensor reading hundredths of degree C (2 byte signed integer)
0x0000 to 0x7FFF = 0.00degC to 327.67degC
0x8000 to 0xFFFF = -327.68degC to -0.01degC

7.2.8 Query Command Retrieval

Master controller will use the following command to retrieve what commands the Digital RS485 device Controller believes it has been given.

Message from master controller
MAC ID (Targeted Device controller address)
STX(0x02)
Command Code(0x80 for read)
Packet Length(0x03)
Class ID(0x6A)
Instance ID(0x01)
Attribute ID(0xAB)
Pad(0x00)
Checksum

Response message master controller
MAC ID (0 –master controller)
STX(0x02)
Command Code(0x80 for read)
Packet Length (0x0A)
Class ID(0x6A)
Instance ID(0x01)
Attribute ID(0xAB)
Data Byte #1 - Current Freeze Follow Flag setting
Data Byte #1 (LSB) Current Target Flow Set Point
Data Byte #2 (MSB) Current Target Flow Set point
Data Byte #1 (LSB) Next Set point for Operation
Data Byte #2 (MSB) Next Set point for Operation
Data Byte #2 (MSB) Valve Voltage/Current Now
Data Byte #1 (LSB) Ramp time (Milliseconds) for Next Set point
Data Byte #2(MSB) Ramp time (Milliseconds) for Next Set point
Pad(0x00)
Checksum

Digital RS485 device Controller will return the following message in the order specified:
1) Current Freeze Follow Flag (1 byte)
2) Current Target Set point in % of Full Scale (not actual flow, not indicated flow, not valve position) (2 bytes 4000 to C000 as is standard)
3) Next Set point (2 bytes 4000 to C000 as is standard)
4) Ramp time for ‘Next Set point’ (2 bytes in milliseconds)

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LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller.

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.

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BROOKS® INSTRUMENT

Installation and Operation Manual
X-DPT-RS485-GF40-GF80-MFC-eng
Part Number: 541B169AAG
December, 2012

RS485 S-Protocol Communications Supplemental Manual for Brooks® GF40/GF80 Series Mass Flow Controllers and Meters

Brooks® GF40/GF80 Series
with RS485 Communications

Dear Customer,

We recommend that you read this manual in its entirety as this will enable efficient and proper use of the RS485 thermal mass flow controllers and meters. Should you require any additional information concerning the RS485 thermal mass flow controllers and meters, please feel free to contact your local Brooks Sales and Service Office; see back cover for contact information, or visit us on the web at www.BrooksInstrument.com. We appreciate this opportunity to service your fluid measurement and control requirements, and trust that we will be able to provide you with further assistance in future.

Yours sincerely,
Brooks Instrument

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1-1 Introduction

The Brooks® Digital Communication RS485 S-Protocol provides a reliable, transaction oriented service between a master device, such as a Personal Computer, and one or more Brooks® S-Protocol compatible Mass Flow Meters and Controllers. The protocol is designed to allow a centralized controller to acquire measurement data from a Mass Flow device and, in case of Mass Flow Controllers, send setpoint values.

The Brooks GF40/GF80 Series S-Protocol devices support digital communications as defined by this manual. This protocol is based on the HART® Communication Foundation (HCF) protocol. Brooks GF40/GF80 Series S-Protocol devices support all the Universal Commands and many of the Common Practice commands as defined by the HCF. However, conformance to the HCF specifications is neither claimed nor implied.

The only physical layer supported by the GF40/GF80 Series S-Protocol devices is RS-485 (see Section 2). The HART Communication Foundation FSK physical layer (Bell-202 modem) is NOT supported by the Brooks S-Protocol devices. Therefore, the commonly available HART “Hand Held Configurators” are NOT compatible with Brooks S-Protocol devices.

This document is intended to give a user the means to implement the protocol structure into his own control system in order to establish communication between the control system and the Brooks GF40/GF80 Series S-Protocol devices. It does not cover the non-communication functionality of the Brooks S-Protocol Mass Flow Meters and Controllers. For this description please refer to Installation and Operation Manual for your specific device.

The remaining sections of this document are summarized below:

- **Section 2 – Device Configuration and Wiring** defines how to properly configure and wire Brooks GF40/GF80 Series S-Protocol devices for digital communications.
- **Section 3 – Message Protocol Structure** describes the HART message protocol.
- **Section 4 – Master/Slave Communications** describes the requirements of the Master in the HART protocol.
- **Section 5 – General Transmitter Information** defines transmitter specific information such as communication response times and units conversions.
- **Section 6 – Universal Commands** defines the message formats for all supported universal commands.
- **Section 7 – Common Practice Commands** defines the message formats for all supported common practice commands.
- **Section 8 – Transmitter Specific Commands** defines the message formats for all supported transmitter specific commands.
- **Section 9 – Transmitter Specific Tables** defines the meanings of various codes utilized by individual commands.

Tables 1-1 through 1-3 provide a summary of S-Protocol commands available in the Brooks GF40/GF80 Series S-Protocol devices. This manual provides details that apply specifically to the Brooks GF40/GF80 Series S-Protocol products:

Tables 1-1 Universal Commands

Command	Description
#0	Read Unique Identifier
#1	Read Primary Variable
#2	Read Primary Variable Current and Percent Range (Supported)
#3	Read Current and all Dynamic Variables (Primary flow and secondary temperature variable supported)
#6	Write Polling Address
#11	Read Unique Identifier associated with Tag
#12	Read Message
#13	Read tag, Descriptor, Date
#14	Read Primary Variable Sensor Information
#15	Read Output Information
#16	Read Final Assembly Number
#17	Write Message
#18	Write Tag, Descriptor, Date
#19	Write Final Assembly Number

Tables 1-2 Common Practice Commands

Command	Description
#37	Set Primary Variable Lower Range Value (Zero)
#38	Reset Configuration Changed Flag
#39 E	EPROM control
#42	Perform master reset
#48	Read Additional Transmitter Status
#50	Read dynamic variable assignments
#59	Write Number of Response Preambles
#66	Enter/Exit Fixed Analog Output Mode
#67	Trim Analog Output Zero
#68	Trim Analog Output Span
#122	Write device identification number (NON-PUBLIC)
#123	Select Baud Rate

Tables 1-3 Transmitter Specific Commands

Command	Description
#128	Enter/Exit Write Protect Mode (Non-Public)
#131	Read Brooks order number (Serial Number)
#132	Read Model Number
#134 R	ead Software Rev
#150	Read Process Gas Type
#151	Read Gas Density, Flow Reference and Flow Range
#152	Read Full Scale Flow Range
#190	Read Standard Temperature and Pressure
#191	Write Standard Temperature and Pressure
#193	Read Operational Settings
#195 Se	lect Gas Calibration
#196	Select Flow Unit
#197	Select Temperature Unit
#215	Read Setpoint Settings
#216	Select Setpoint Source
#218 Se	lect Softstart
#219	Write Linear Softstart Ramp Value
#220	Read PID Controller Values
#221	Write PID Controller Values
#222	Read Valve Range and Valve Offset
#223	Write Valve Range and Valve Offset
#226	Trim Setpoint Input
#230	Get Valve Override Status
#231	Set Valve Override Status
#235	Read Setpoint in % and Selected Units
#236	Write Setpoint in % or Selected Units
#237	Read Valve Control Value
#240 R	ead Totalizer Status
#241	Set Totalizer Control
#242	Read Totalizer Value and Unit
#245	Read Alarm Enable Setting
#246	Write Alarm Enable Setting
#247	Read High/Low Flow Alarm
#248	Write High/Low Flow Alarm
#250	Change User Password

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2 Device Configuration and Wiring

2-1 Device Configuration

The RS-485 communications interface is standard on all Brooks GF40/GF80 Series S-Protocol devices. No hardware configuration is required.

All devices are shipped with the communication data rate set to 19200 baud unless otherwise specified when ordering the device.

WARNING

Before operating the device, ensure all fluid connections have been properly tightened and, where applicable, all electrical connections have been properly terminated.

2-2 Wiring

The RS-485 communications interface is a multidrop connection making it possible to connect up to 32 devices to a computer on a single multidrop line as shown Figure 2-1. Most Computers are NOT equipped with RS-485 ports. In order to connect an RS-485 to a computer, you will need an RS-485 to RS-232C converter. Figure 2-1 shows the connection of three Brooks GF40/GF80 Series S-Protocol devices via an RS-485 bus utilizing an RS-485 to RS-232C converter to the RS-232 serial port of a typical computer. The RS-485 bus requires two matching resistors of 120 Ohm, one at the end of the bus and one at the beginning, near the converter Note that a control line from the PC to the converter is necessary to control the data direction of the RS-485 buffers. The RTS (“Request To Send”) line is shown in Figure 2-1 because this line is used to control data direction in many of the commercially available converters. The actual line used depends on the converter selected.

Table 2-1 - D-Connector Communication Pins

D-Connector Pin Number	RS-485
Pin #14	B (inverted driver side)
Pin #15	A (non-inverted driver side)

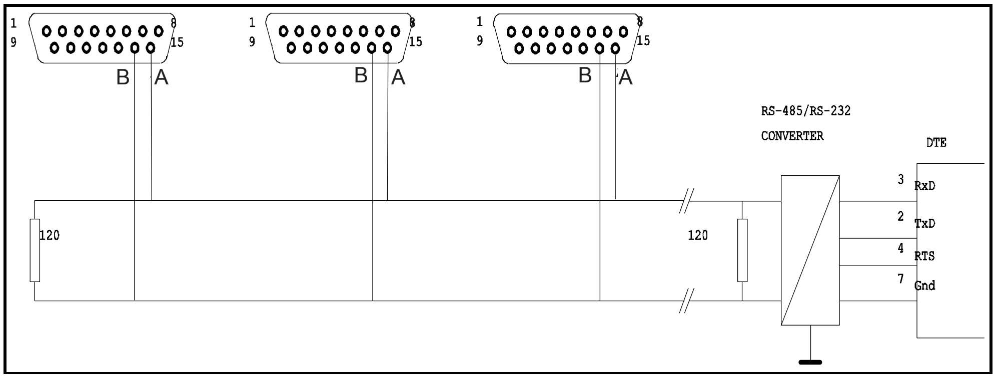

Figure 2-1 - RS-485 Multidrop Interconnection DMFM/C and PC

3-1 Message Protocol Structure

HART is a “master-slave” protocol: each message transaction is originated by the master (central) station, whereas the slave (field) device only replies when it receives a command message addressed to it. The reply from the slave device will acknowledge that the command has been received and it may contain the data requested by the master.

Brooks GF40/GF80 Series S-Protocol devices do not guarantee the timing required to support multiple masters communicating simultaneously to slave devices as defined by the HART Communications Foundation. Brooks GF40/GF80 Series S-Protocol devices do not support Burst Mode.

3-2 Addressing Concept

HART utilizes two possible addressing modes: short frame addressing and long frame addressing. The short frame addressing uses a one byte address of which the least significant nibble (four bits) is used to indicate the slave address. Because slave address 0 is reserved as a broadcast address, this provides the possibility to attach up to 15 different field devices and one master device on one multidrop bus. The long frame addressing mode uses 5 bytes (40 bits) as an address of which 38 bits are used to indicate the slave device. The slave address is built up from the manufacturer code (1 byte), the device type code (1 byte) and a device identification number (3 bytes). Details on addressing are explained in Section 3-4-4.

3-3 Character Coding

HART messages are coded as a series of 8-bit characters or bytes. These are transmitted serially, using a conventional UART (Universal Asynchronous Receiver/ Transmitter). As in normal RS-232C and other asynchronous communication links, a start bit, a parity bit and a stop bit are added to each byte. These allow the receiving UART to identify the start of each character and to detect bit errors due to electrical noise or other interference. A HART character is built up from:

1 Start bit - 0 bit
8 Databits
1 Odd parity bit
1 Stop bit - 1 bit

This sequence is summarized in Figure 3-1. Since HART is an asynchronous protocol, successive characters may be separated by idle periods (logical 1 level), but the idle period must not exceed 1 character time.

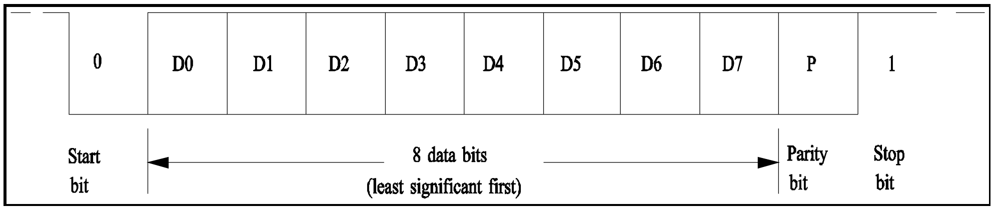

Figure 3-1 Single Character Bit Sequence

3-4 Message Format

3-4-1 Message Structure

HART specifies a message structure which is given in Figure 3-2 below.

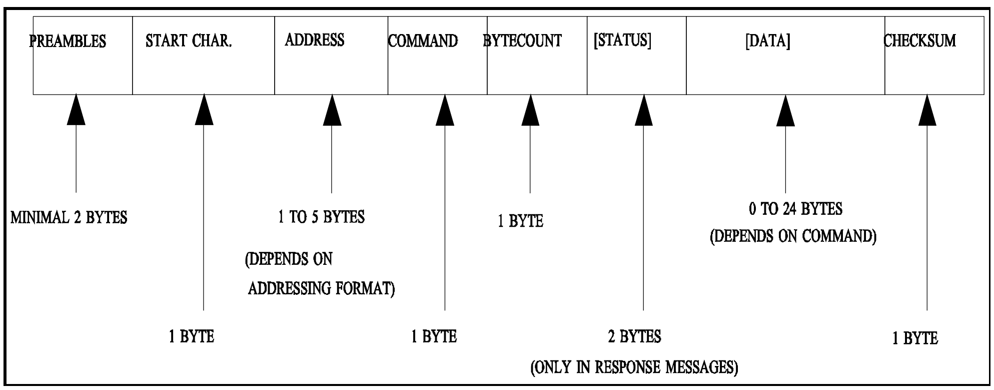

Figure 3-2 HART Message Structure

This structure is used for both the request (master to slave) and the response (slave to master) messages. The status part and the data part are shown in square brackets, because their occurrence in the message depends on the type of message (response or request message) and the command number. The individual items are explained below.

3-4-2 Preamble Characters

Every message, whether from a master or a slave device, is preceded by a specified number of hexadecimal FF characters (databyte with all 1's). These characters, called preamble characters, are used in the message-detect pattern together with the start character. The preamble characters are used to synchronize the field device. The Brooks GF40/GF80 Series S-Protocol devices require at least 2 preamble characters in order to be able to proceed in the message detection with the start of message character. Note that due to potential losses due to RS-232 to RS-485 converters, a master should send a minimum of 5 preamble characters in order to guarantee that slave device receives the required 2 preamble characters.

3-4-3 Start Character

The start character or delimiter is a one byte code used to detect the type of frame (type of message) being transmitted and the type of addressing being used. The most significant bit indicates the addressing mode used: 0 for short frame and 1 for long frame addressing, whereas the three least significant bits indicate the frame type of the message: 010 indicates a Start-Of-Text character and 110 indicates an Acknowledge character. The Start-Of-Text character is used to indicate a message from the master to a slave device whereas the Acknowledge character is used to indicate the response messages from slave devices to the master. The rest of the bits in the character are all zeros. See Figure 3-3 and Table 3-1 below.

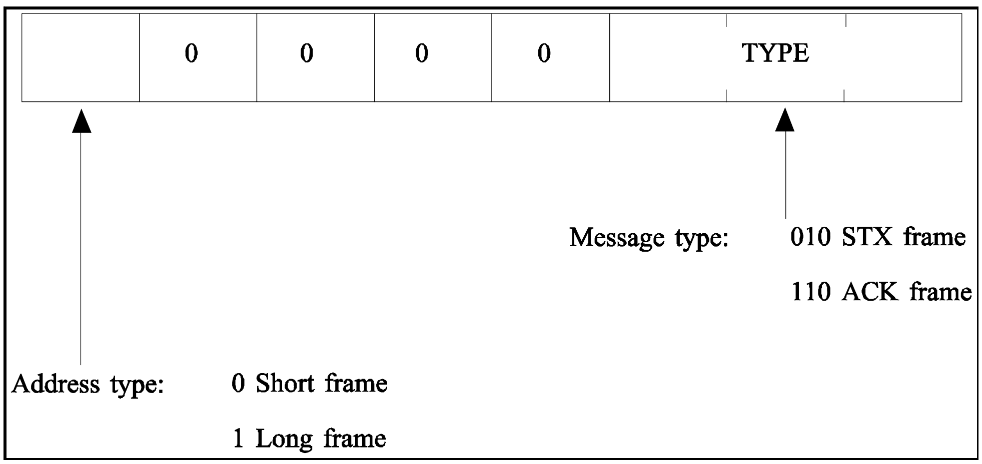

Figure 3-3 Start Character Settings

Table 3-1 Start Character Codings (Hexadecimal)

	Short frame	Long frame
Master to slave (STX)	02	82
Slave to master (ACK)	06	86
Address field length	1 byte	5 bytes

3-4-4 Address Characters

The address field contains both the master and the field device addresses for the message. These may be contained in a single byte (short frame format) or in five bytes (long frame format). In either format, the most significant bit is usually the single-bit address of the master device taking part in the message transaction (either sending a command or receiving a reply from a slave device). Since only two masters are allowed only one bit is needed for the master address. This bit will be 1 if it indicates the primary master system, and 0 if it indicates the secondary master system. The rest of the address field is determined by the frame format.

Figure 3-4 below shows the address character in the short frame format. The 4 least significant bits are the slave address, which can be used as a polling address.

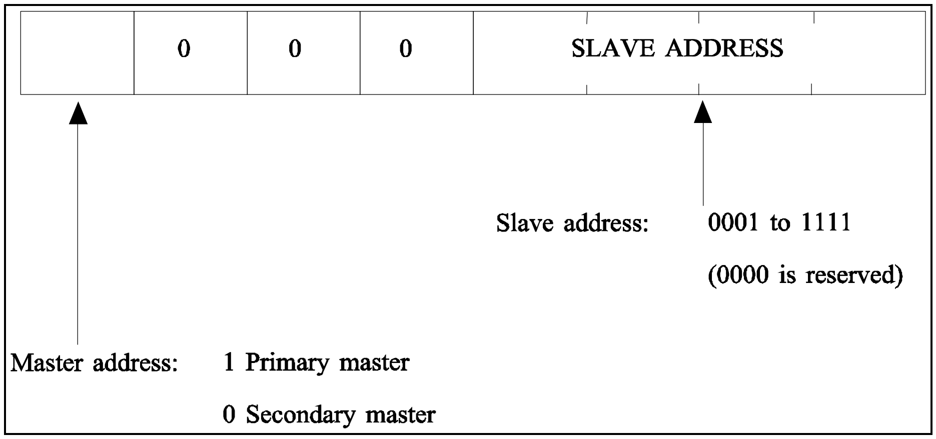

Figure 3-4 Short Frame Address Character

In the long frame format the slave device address is represented by a 38-bit number. The structure of the address is given in Figure 3-5 below.

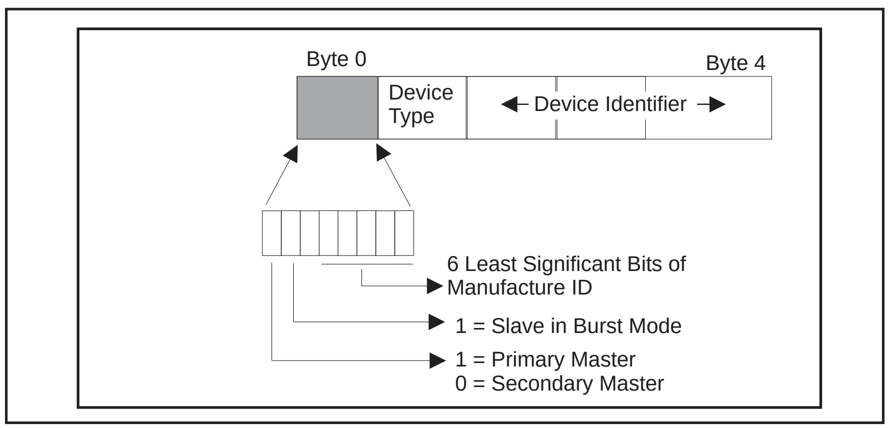

Figure 3-5 Long Frame Address Characters

In the long frame format the slave address part of the five address characters is build up from three sources: The 6 bits of the first byte of the slave address part represent the manufacturers code. In case of devices made by Brooks Instrument this is the number 10 (decimal). The manufacturer number is a number which is stored in the device by the manufacturer and which can not be changed by the user.

The second byte in the address is the device type code. This code indicates the type of the device addressed. The device type code will be 90 for all Brooks GF40/GF80 Series S-Protocol devices. The device type code is a number which is stored in the Brooks GF40/GF80 Series S-Protocol devices by the manufacturer and which can not be changed by the user.

The last three bytes form a 24-bit unique identification number. As the name implies, this value must be unique to each Brooks GF40/GF80 Series S-Protocol device on a network. For legacy products this value was derived from the serial number of the device, however for the GF40/GF80 this value is a random value. Command #122 can be used to change this value.

A special case occurs when all bits of the slave address part are set to 0. A message with this type of address, called a broadcast address, will be accepted by all slave devices attached to the bus. A slave device will always respond to a message with the broadcast address unless the message contains additional information in the data portion of the message that allows the slave device to determine that the message is not addressed to that device. Brooks GF40/GF80 Series S-Protocol devices support only one such command, Command #11. This type of addressing can be used to address devices of which the manufacturer and the device type codes and the unique identification number are not available to the host system and with which this information can still be retrieved from the unknown device. Command #11 data contains a Tag Name. Only a slave device with the specified Tag Name will respond to Command #11 even if the address in the message is the broadcast address. The Tag Name is an 8 character field which is equal to the last 8 digits of the device's serial number. See Section 4-2 for a detailed description of the use of Command #11.

3-4-5 Command Character

The command character is a 1 byte unsigned integer in the range from 0 to 255 (decimal), which indicates the action the slave device has to perform. A larger range of commands is theoretically possible by using the expansion code or 254 (decimal) followed by a second byte. This feature however is not implemented by the Brooks GF40/GF80 Series S-protocol devices. The received command is echoed back by the slave device in its reply to the master.

Three types of commands are available to the user: the ‘Universal Commands’, the ‘Common-Practice Commands’ and the ‘Transmitter-Specific Commands’. The Universal Commands are a number of commands in the range from 0 to 19, which are implemented by all field devices utilizing the HART protocol. Refer to Section 6 for descriptions of all available universal commands. The Common-Practice Commands are a number of commands in the range from 32 to 127, which can be implemented by all devices. These commands perform tasks which are often common to most devices. Refer to Section 7 for descriptions of all implemented Common-Practice Commands. The last category, Transmitter-Specific Commands are a number of commands, ranging from 128 to 250 which are specific to the type of device. Refer to Section 8 for descriptions of all available Transmitter-Specific Commands. The commands #251 to #255 are reserved.

3-4-6 Byte Count Character

The bytecount character is a 1 byte unsigned integer indicating the number of bytes which will form the remainder of the message. This number includes the two status bytes (only if the message is a response message) and the bytes in the data part. It does NOT include the checksum byte. The byte count character is used by the receiving device to identify the checksum byte and to determine when the message is finished.

3-4-7 Status Characters

Status Characters consists of two bytes, which contain bit-coded information about communications errors, command errors, and device status as defined in Table 3-2. Only response messages from the slave device to the master device will contain status characters.

Table 3-2 Status Byte Coding

	First Byte	Second Byte
Communication errors	Bit 7 1 = Communication error	Bit 7 0
	Bit 6 Parity error (hex C0) Bit 5 Overrun error (hex A0) Bit 4 Framing error (hex 90) Bit 3 Checksum error (hex 88) Bit 2 Reserved (hex 84) Bit 1 Rx Buffer Overflow (hex 82) Bit 0 Undefined	Bit 6 Bit 5 Bit 4 All 0 Bit 3 Bit 2 Bit 1 Bit 0
Command errors	Bit 7 0 = Communication error	Bit 7 Device Malfunction
	Bit 6 to 0 (not bit-mapped): 0 Non command specific error 1 Undefined 2 Invalid selection 3 Passed parameter too large 4 Passed parameter too small 5 Incorrect byte count 6 Transmitter specific command error 7 IIn write-protect mode 8-15 Command specific errors 16 Access restricted 32 Device is busy 64 Commanded not implemented	Bit 6 Configuration Changed Bit 5 Cold Start Bit 4 More Status available. Use Command # 48 to get more information Bit 3 Primary variable analog output fixed Bit 2 Primary variable analog output saturated Bit 1 Non primary variable out of range Bit 0 Primary variable out of range

If the communication failed (i.e. the slave received distorted information) the first byte indicates the receiver error(s) of the slave device. The second byte will then be 0. If communication did not fail, the first byte will give command execution information, whereas the second byte will give information on the status of the device. The command specific errors 8 - 15 are errors which can have a different meaning for different commands. Refer to the Sections 6, 7 and 8 for more information.

3-4-8 Data Characters

For the commands that contain data, the data field may contain up to a maximum of 24 8-bit data bytes. The data can appear in a number of formats described in the following sections.

3-4-8-1 8-Bit Unsigned Integer Format

This format can be used to transfer codes (e.g unit codes), indexes (e.g analog output numbers) and raw data. If a parameter, represented by an 8-bit unsigned integer in a command data part is not implemented, codes like 250, “Not Used” or 0 will be used.

3-4-8-2 24-Bit Unsigned Integer Format

This format can be used to transfer large integer data numbers (e.g. the valve values).

3-4-8-3 IEEE 754 Floating Point Format

This format is based on the IEEE 754 single precision floating point standard:

S EEEEEEE	E MMMMMMM	MMMMMMMM	MMMMMMMM
byte # 0	byte # 1	byte # 2	byte # 3

Where: S - Sign of mantissa (1 = negative)
E - Exponent; Biased by 127 in two's complement format
M - Mantissa; 23 least significant bits, fractional portion

The value of a parameter described in the above format can thus be found by:
Value = S 1.M * $2^{(E - 127)}$
This format is also used in most personal computers.
The floating point parameters not used by a device will be filled with 7F A0 00 00 (hexadecimal) or 'Not-A-Number'.

3-4-8-4 ASCII Data Format

Some of the alphanumeric data passed by the protocol is transmitted to and from the devices in the ASCII format. Refer to any ASCII Code table for the alphanumeric code assignments.

3-4-8-5 Packed-ASCII (6-bit ASCII) Data Format

Some of the alphanumeric data passed by the protocol is transmitted to and from the devices in the Packed-ASCII format. Packed-ASCII is a subset of ASCII (See Table 3-3) produced by removing the two most significant bits from each ASCII character. This allows four Packed-ASCII to be placed in the space of three ASCII characters. Typically four Packed-ASCII strings are even multiples of three bytes. Figure 3-6 illustrates the byte sequence.

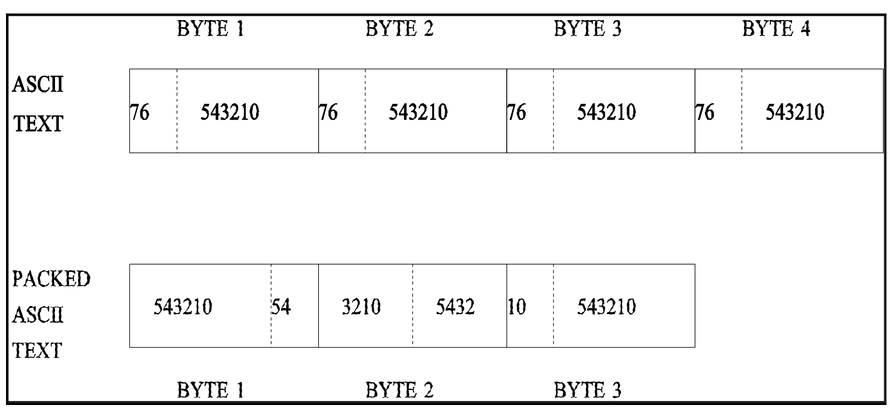

Figure 3-6 Packed-ASCII Construction

Construction of Packed-ASCII:

a. Remove bit #7 and bit #6 from each ASCII character.
b. Pack four 6-bit ASCII bytes into three bytes.

Reconstruction of ASCII characters:

a. Unpack the four 6-bit ASCII characters into four bytes.
b. Place the complement of bit #5 of each unpacked 6-bit ASCII character into bit #6.
c. Set bit #7 of each unpacked ASCII to zero.

Table 3-3 Packed-ASCII Codes

Char	Code	Char	Code	Char	Code	Char	Code
@	00	P	10	(space)	20	0	30
A	01	Q	11	!	21	1	31
B	02	R	12	“	22	2	32
C	03	S	13	#	23	3	33
D	04	T	14	$	24	4	34
E	05	U	15	%	25	5	35
F	06	V	16	&	26	6	36
G	07	W	17	‘	27	7	37
H	08	X	18	(	28	8	38
I	09	Y	19	)	29	9	39
J	0A	Z	1A	*	2A	:	3A
K	0B	[	1B	+	2B	;	3B
L	0C	\	1C	,	2C	<	3C
M	0D	]	1D	-	2D	=	3D
N	0E	^	1E	.	2E	>	3E
O	0F	_	1F	/	2F	?	3F

3-4-8-6 Checksum Characters

The checksum byte contains the ‘exclusive-or’ (‘longitudinal parity’) of all the characters preceding it in the message starting with the start character. It provides a further check on transmission integrity, beyond the one provided by the parity check on each individual byte. The exclusive-or of all the message bytes (including the start character, excluding the checksum byte) and the checksum byte itself should read exactly zero.

4-1 Master/Slave Communications

Section 3 of this manual defined the S-Protocol message structure in detail. Section 4 of this manual will describe how to utilize the S-Protocol message structure to perform master slave communications with a Brooks GF40/GF80 Series S-protocol device. This section focuses on RS-485 line handling, establishing communications with a device, error recovery, and timing. Sections 6, 7, and 8 of this manual define all S-Protocol commands available in Brooks GF40/GF80 Series S-protocol devices. This section will conclude with examples of typical communications sequences.

Master devices initiate all communications on a Master/Slave communications network. Master devices are typically a computer of some kind but other devices such as PLC's can also operate as a Master device.

Slave devices only respond to messages initiated by a Master. Brooks GF40/GF80 Series S-Protocol devices are always Slaves on the communications network.

4-1-1 RS-485 Line Handling

The physical communications layer used by Brooks GF40/GF80 Series S-Protocol devices is RS-485. On an RS-485 physical communications layer, all data is transmitted and received using differential signals on a single pair of wires. Since both the Master and the Slave devices use the same pair of wires to transmit their data, care must be taken to ensure that only one device has its transmitter enabled at any point in time.

Figure 4-1 shows a typical message exchange using RS-485. Notice that the Master's transmitter is enabled only during the Master Request message and the Slave's transmitter is enabled only during the Slave Response message. At all other times, the transmitters on the Master and all Slaves connected to the network must be in their high impedance state, leaving the network "Un-Driven."

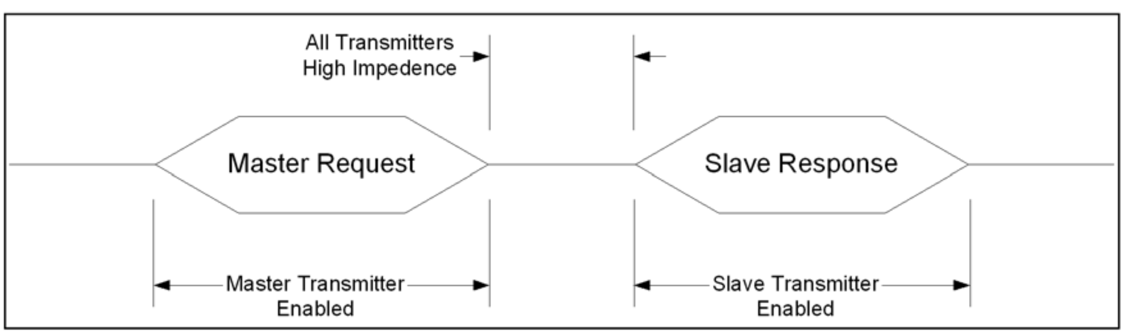

Figure 4-1 Typical Message Exchange Using RS-485 Communications

It is the user's responsibility to guarantee that the Master's transmitter is enabled only during the Master Request message. Control of the Master's transmitter is dependent upon the hardware used by the Master. If an RS-232 to RS-485 converter is used, the most common control is the RTS signal on the RS-232 interface as shown in Figure 2-1 (See Section 2-2). Refer to the user manual for your hardware to determine the proper control method required in your system.

Timing the enabling/disabling of the transmitter is very important. The transmitter must be enabled before the first bit of the first character is transmitted and must be disabled only after the last bit of the last character is transmitted. Additionally, all transmitters have some finite turn-on/turn-off delays which may be affected by the wire length and wire quality of your network. The S-Protocol message structure attempts to minimize these affects by requiring all messages to have at least 5 preamble characters while only 2 are required for the receiving device to detect a valid message (see Section 3-4-2). This allows up to 3 lost characters due to turn-on/turn-off delays.

Disabling a transmitter at the proper time is frequently a difficult task. Many UARTS/systems do not provide an indication when the last byte of a message is completely transmitted. It is more likely that an indication is provided when the last byte of a message is starting to be transmitted. Since the last byte of an S-Protocol message is the checksum byte for the message, it is critical that the transmitter remain enabled until the last byte is completely transmitted. One solution is to transmit an extra character at the end of a message (typically 0x00) and then disable the transmitter when the indication is received that the extra character is starting to be transmitted. However, the transmitter cannot be enabled too long after a message is complete. Slave devices will begin transmitting a response as soon as 5 msec after the reception of an error free request message.

High data rates increase the importance of disabling the transmitter quickly. At 19200 baud, one character time is 0.57 msec. Thus, the 3 lost character “cushion” represents only 1.72 msec. While the response of a Brooks GF40/GF80 Series S-Protocol device is always at least 5 msec regardless of the data rate, lower data rates provide a longer “cushion” and thus is a possible solution if disabling the transmitter in a timely manner proves difficult. Another solution is to increase the number of preamble characters transmitted by the Master and/or the slave.

4-2 Establishing Communications with a Device

In order for a Master to establish communications with a Brooks GF40/GF80 Series S-Protocol device, the Master must know the address of the Brooks device. The S-Protocol supports both Short Frame Addressing and Long Frame Addressing as defined in Section 3-2.

Short Frame Addressing allows a master to communicate with up to 15 devices. Each device on the network must have a unique Polling Address with a value of 1–15. Short Frame Addressing has one side effect which will be undesireable in many applications. If the Polling Address is set to a non-zero value (as required for Short Frame Addressing), the Primary Analog Output will be fixed at the low range of the output and will not respond to the applied process. If your system requires the use of the Primary Analog Ouput, then Long Frame Addressing must be used.

Long Frame Addressing allows a master to communicate with up to 16,777,215 devices on a wide area network (RS-485 has a limit of 32 devices per daisy chain). Each device is pre-programmed at the factory with a unique long address. Using the process described below, the Master can obtain the long address from the device by knowing only the device Tag Name. The Tag Name is pre-programmed at the factory and is printed on the devices's calibration sheet.

The following procedure can be performed online in order to obtain a device's long address:

1. Send Command #11 (See Section 6-6) using Long Frame Addressing and an address of 0. In the data section of Command #11, use the device's Tag Name to identify the device. Command #11 requires that the Tag Name be transmitted in Packed-ASCII format as defined in Section 3-4-8-5.
2. Extract the Manufacturer ID, Manufacturer's Device ID, and Device ID Number from the response and construct the Long Address Frame as shown in Figure 4-2.

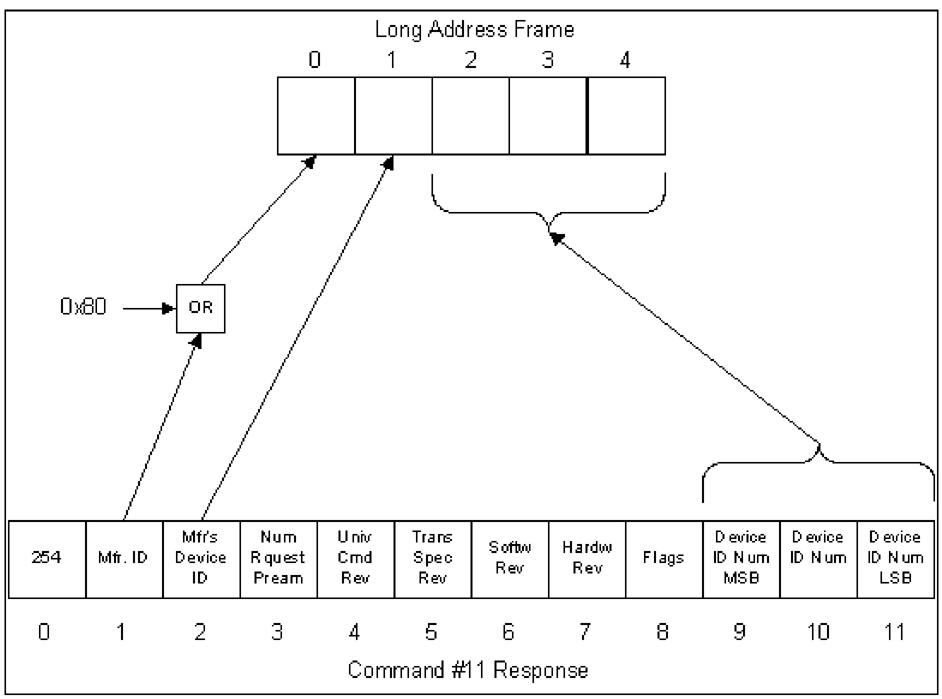

Figure 4-2 Command #11 Response to Long Frame Address

4-2-1 Example of Using Command #11

Command #11 reads the unique identifier from a device whose Tag Name is specified in the Command #11 request from the Master. Tag Names are strings of up to 8 characters which are limited to the reduced ASCII set defined in Table 3-3. A Tag Name consists of the last 8 digits of the device's serial number. Table 4-1 is an example of converting an 8 character Tag Name to 6 bytes in the Packed-ASCII format. In this example, the Tag Name of the device will be "MFC-1234".

Table 4-1 Converting Tag Name to Packed ASCII

	Representation							
Tag Name	MFC-1234							
Characters	M	F	C	-	1	2	3	4
8- bit ASCII (hex)	4D	46	43	2D	31	32	33	34
Bit 7 & 8 removed:								
6 bit ASCII (hex)	0D	06	03	2D	31	32	33	34
6 bit ASCII (binary)	001101	000110	000011	101101	110001	110010	110011	110100
Packed (binary)	00110100 0110 0000 11101101 11000111 00101100 11110100							
Packed (hex)	34 60 ED C7 2C F4							

Figure 4-3 shows the request message for Command #11 sent by the Master to the Brooks GF40/GF80 Series S-Protocol device whose Tag Name is MFC-1234.

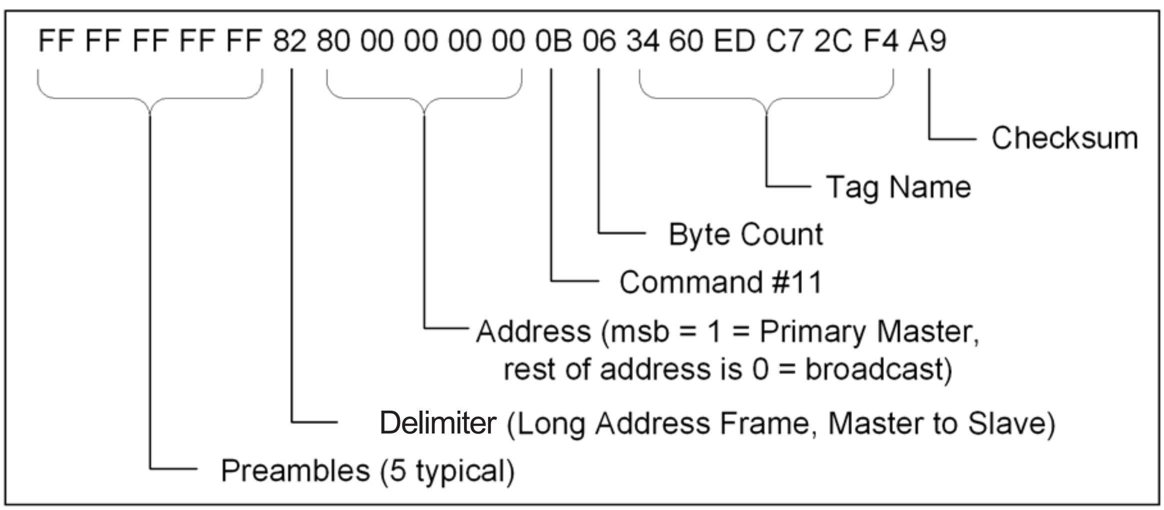

Figure 4-3 Command #11 Master Request

A possible Response Message from a Brooks GF40/GF80 Series S-Protocol device is shown in Figure 4-4.

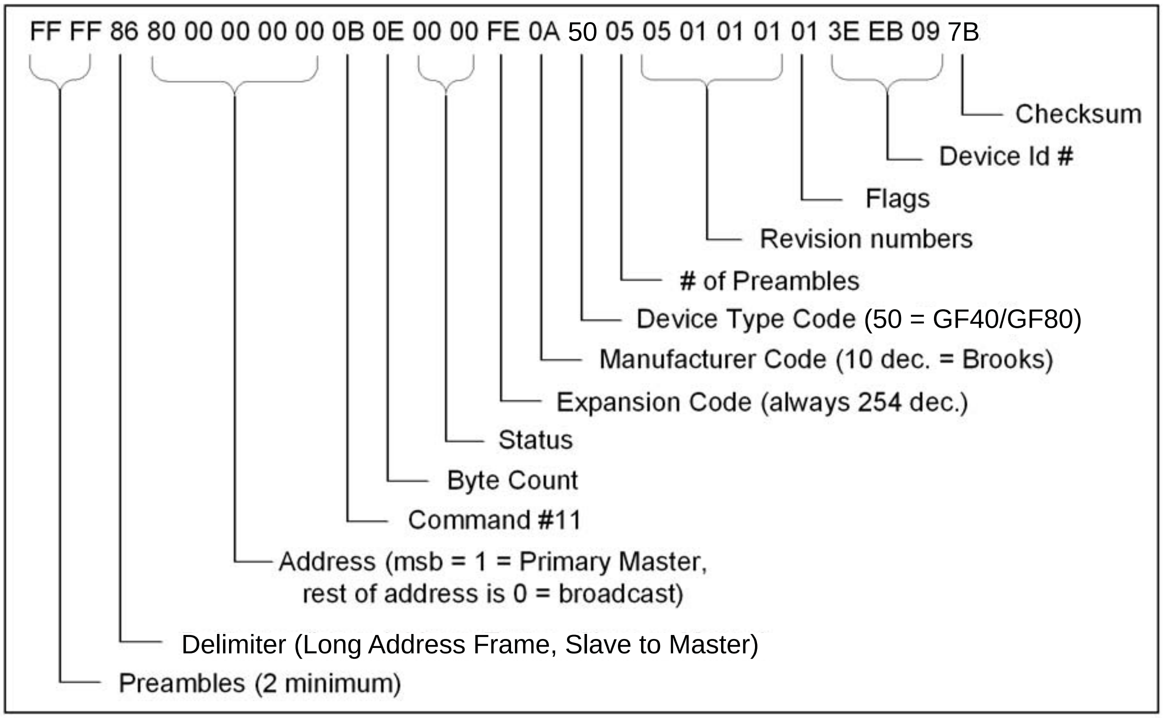

Figure 4-4 Command #11 Response Message

From the response, the long address can be extracted as shown in Figure 4-5.

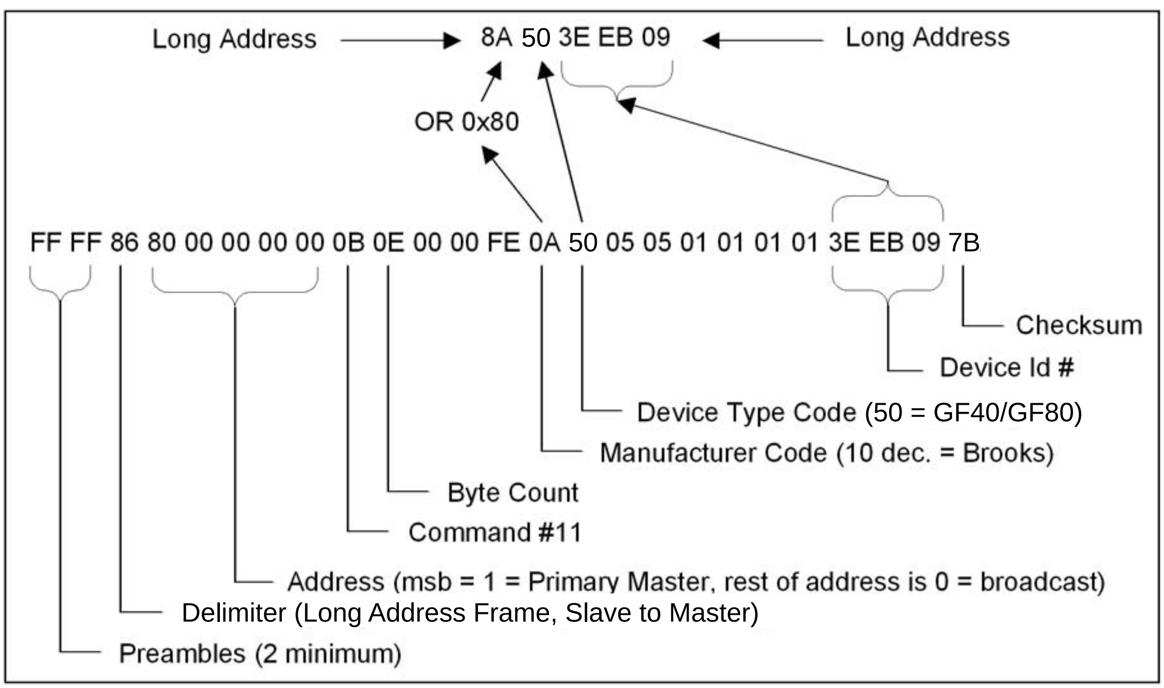

Figure 4-5 Extracting the Long Address

4-3 Alarm Configuration and Monitoring

Brooks GF40/GF80 Series S-Protocol devices monitor for various alarm conditions such as Flow Rate, Totalizer Overflow, and Diagnostics. To determine which alarms conditions have been detected, use Command #48 (See Section 7-3). However, it is not necessary to constantly poll Command #48 to determine when an alarm condition has been detected. All slave response messages contain a 2 byte status. If an alarm condition has been detected, then bit 4 of the second status byte will indicate "More Status Available". Then Command #48 can be used to determine the alarm condition(s) that has been detected.

To configure which alarm conditions are monitored and reported by the device, refer to Commands 245, 246, 247, and 248 in Section 7, also Table 9-15.

4-4 Error Handling

In all communications networks, communications errors can and will occur. Both the Master and the Slave devices must be able to properly handle errors in order to maintain a operating network. When a Brooks GF40/GF80 Series S-protocol device detects a communications error, one of two results may occur. It may respond with an error code, or it may not respond at all to the request. The result depends upon the type of error that was detected, and where in the message the error was detected. It is important that the Master handles the situation correctly.

There are two basic type of errors defined by the S-Protocol: Communications Errors and Command Response errors. The type of error can be determined by examining the Status Code returned by the slave device (See section 3-4-7). Command Response errors are typically the result of a programming error in the Master and should not normally occur in a mature system. The main focus of this section will be Communication Errors.

Communications Errors are frequently the result of external environment issues, faulty wiring, etc. In a properly designed network, Communications Errors should be rare. A Communications Error can occur in either the Master to Slave Request or the Slave to Master response. If the error occurs in a Master to Slave request, one of two results may occur. It may respond with an error code, or it may not respond at all to the request.The result depends upon the type of error that was detected, and where in the message the error was detected. It is the responsibility of the Master device to check all Slave to Master responses for errors including message frame formatting, longitudinal parity, and vertical parity.

Regardless of the type of error and when or where it was detected, the normal way to handle a Communications Error is to simply retry the message. Typically, a master would attempt to retry a message at least twice to allow any external disturbance to clear. In the event that the retries are unsuccessful, then the Master device must handle the situation in a manner consistent with the requirements of the system. Typical responses to such an error are: Taking the device off-line so that the remainder of the network is not affected; Notifying an operator; Triggering a system alarm; etc.

A Master device must allow sufficient time for a Slave to respond before attempting to retry the message. The average response time for a Brooks GF40/GF80 Series S-Protocol device is less than 1 msec, but it is possible to for the response to be as along as 10 msec. The Master should wait 4 times the maximum response time (40 msec) before retrying the message. As long as communications errors are infrequent, this retry delay time should not affect system performance.

4-5 Examples

The following 2 examples show the most typical messages used by a Master when communicating to a Brooks GF40/GF80 Series S-Protocol device: Reading Flow Rate and Sending the Setpoint. These examples will use the Long Addressing Frame with the long address established in the example in Section 4-2-1. The calibrated full scale of the device used in these examples is 1.0 liters per minute.

4-5-1 Reading Flow Rate

The flow rate of the device can be read using any of the following commands:

- Command #1 – Read Primary Variable
- Command #2 – Read Primary Variable Current and Percent of Range
- Command #3 – Read Current and All Dynamic Variables

This example will use Command #1 to read the Flow Rate of the device. This command returns the flow rate in the unit of measure as configured in the device. The units can be changed using Command #196, Select Flow Unit.
In the example shown in Figure 4-6, the device returns a flow of 0.8502 liters/min.

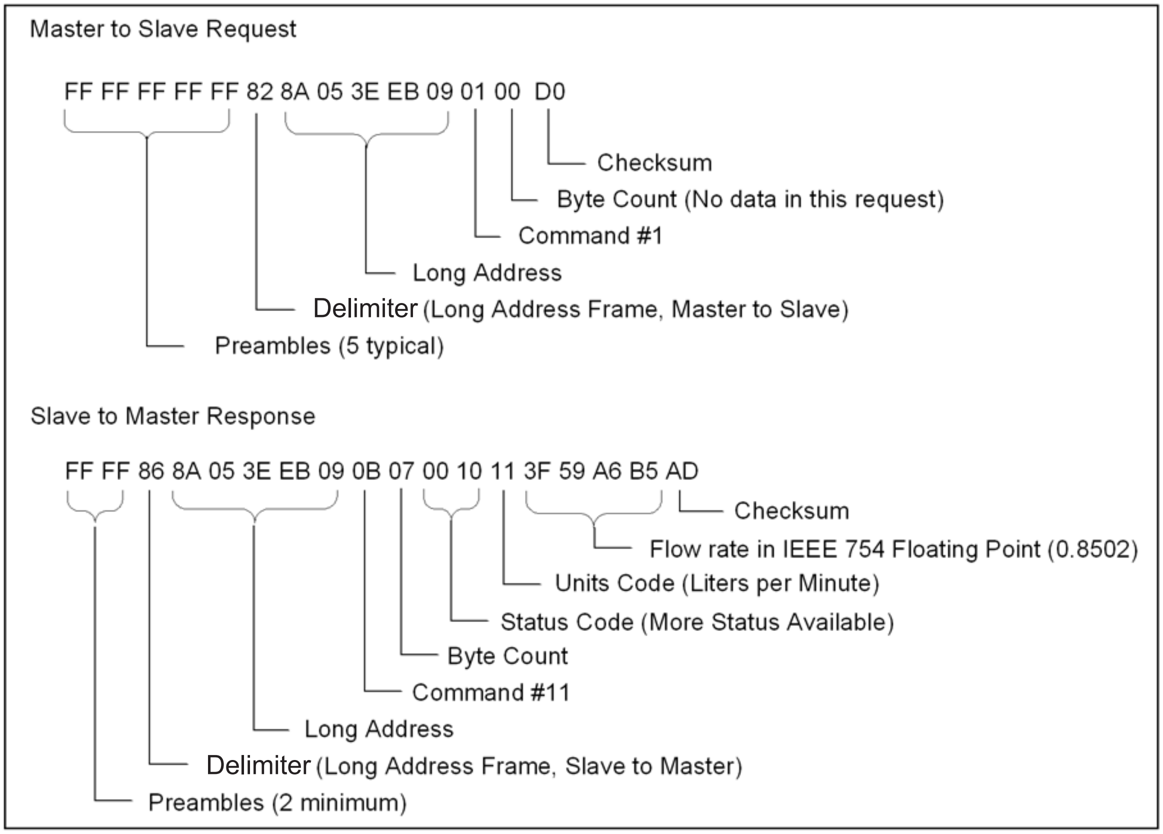

Figure 4-6 Reading Flow Rate Example

4-5-2 Sending the Setpoint

The Setpoint can be controlled via the network using Command #236. In the example shown in Figure 4-7, the setpoint is set to 85% of full scale.

If Setpoint is controlled via an analog input, then Setpoint can be read using Command #235.

When Command #236 is received by a Brooks GF40/GF80 Series S-Protocol device, the Setpoint Source is automatically changed to digital mode. Setpoint source can be changed back to analog by using Command #216 or by cycling power to the device.

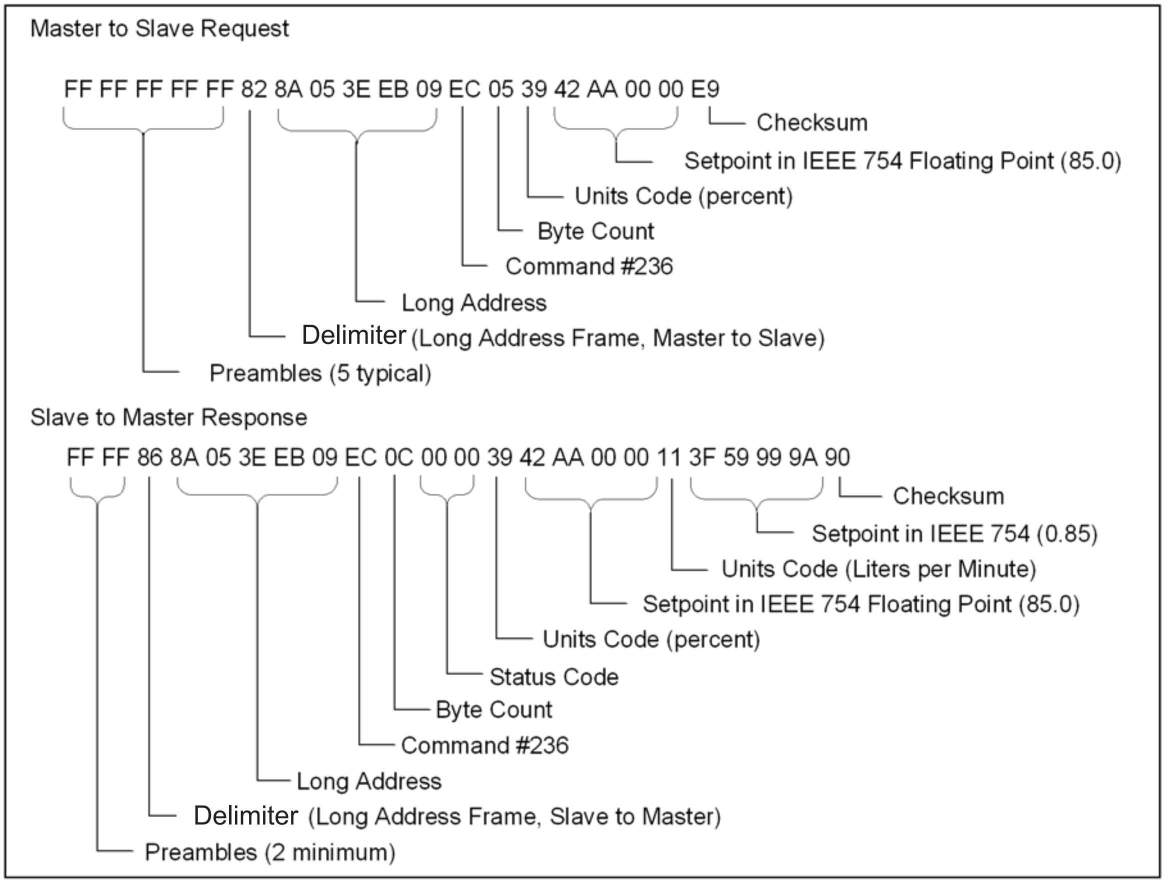

Figure 4-7 Writing Setpoint Example

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5-1 Referenced Documents

The following HART documents where referenced in order to implement the protocol:

Data Link Layer Specification Rev.	HCF_SPEC-81	Rev 7.1
Command Summary Information Rev.	HCF_SPEC-99	Rev 7.1
Command-Specific Response Code Defs. Rev.	HCF_SPEC-307	Rev 4.1
Universal Command Specification Rev.	HCF_SPEC-127	Rev 5.2
Common-Practice Command Specification Rev.	HCF_SPEC-151	Rev 7.1
Common Tables Rev.	HCF_SPEC-183	Rev 11.0

5-2 Unit Conversions

5-2-1 Flow Rate Conversions

All flow values involved in the exchange of data during communication are converted to/from the user specified flow units. A list of supported flow units is provided in Section 8-3. The user can change the flow units to be used for all flow rate conversions with Command #196.

Volume flow units are always reported at specific reference conditions. Using Command #196, the user can select reference condition type from 3 options as listed in Section 8-3.

- Normal - reference conditions of 0 ℃ and 1 atmosphere. (273.15 degrees K/ 101325 Pascals).
- Standard – user specified reference conditions. Use Brooks Service Suite software to change the user specified reference conditions.
- Calibration – reference conditions used at calibration.

Reference condition conversions are done using the Boyle-Gay-Lussac law

$$\frac{P_1 \bullet V_1}{T_1} = \frac{P_2 \bullet V_2}{T_2} = Constant \quad (1)$$

Where P is pressure, T is temperature and V is volume (per unit of time). The indexes 1 and 2 represent the two different reference conditions. This results in the reference conversion formula

$$V_2 = \frac{(P_1 \bullet T_2)}{(P_2 \bullet T_1)} * V_1 \quad (2)$$

Where applicable the conversion factors are taken from *The Handbook of Chemistry and Physics, 60th edition*, R.C. Weast (Ed.), CRC Press Inc., Cleveland, Ohio.

5-2-2 Temperature Conversions

All temperature values involved in the exchange of data during communication are converted to/from the user specified temperature units. A list of supported temperature units is provided in Section 8-5.The user can change the temperature units to be used for all temperature conversions with Command #197.

6-1 Command # 0 Read Unique Identifier

Command used to retrieve the expanded device-type codes, revision levels and the device identification number from the specified device. The device type code will always be returned in the expanded three byte format (i.e. “254”, manufacturer identification code, manufacturers device type code). The combination of the manufacturer identification code, manufacturer's device type code and device identification code make up the unique identifier for the extended frame format of the data link layer.

Request data bytes:

NONE

Response data bytes:

254	MFR. ID	MFR's DEVICE TYPE	NUMBER RQUEST PREAM	UNIV. CMD. REV.	TRANS. SPEC. REV.	SOFTW REV.	HARDW REV.	FLAGS	DEVICE ID NUM MSB	DEVICE ID NUM	DEVICE ID NUM
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Device type code for “expansion”. Contains the code “254” (decimal).
1	8-bit unsigned integer	Manufacturer identification code. (Always 10).
2	8-bit unsigned integer	Manufacturers device type code. Refer to Section 9-2, Device type codes.
3	8-bit unsigned integer	Number of response preamble characters required for the request message from the master to the slave.
4	8-bit unsigned integer	Universal command revision level implemented by this device.
5	8-bit unsigned integer	Transmitter specific command revision level implemented by this device.
6	8-bit unsigned integer	Software revision level of the device.
7	8-bit unsigned integer	Hardware revision level of the electronics in the device. Format: xxxxx.yyyB x - Device hardware revision level, 5-bit unsigned integer, level 15 is reserved. y - Physical signalling code, 3-bit unsigned integer, refer to Section 9-8, Physical signalling codes.
8	8-bit unsigned integer	Flags. Refer to Section 9-10, Flag assignments.
9 - 11	24-bit unsigned integer	Device identification number.

6-1-1 Command #0 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-2 Command #1 Read Primary Variable

Read the primary variable. The primary variable is the flow rate of the device expressed in the selected flow units at the selected flow reference conditions. See Command #196 for information on setting Flow Units, and Flow Reference conditions.

Request data bytes:
NONE

Response data bytes:

SEL. FLOW UNIT	FLOW RATE MSB	FLOW RATE	FLOW RATE	FLOW RATE LSB
#0	#1	#2	#3	#4

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Primary variable unit code. Refer to Section 9-3, Flow rate unit and reference codes.
1 - 4	32-bit floating point, IEEE 754 format	Primary variable: flow rate.

6-2-1 Command #1 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-3 Command #2 Read Primary Variable Current and Percent Range

Read the primary variable, flow rate, as current or voltage and as a percent of the primary variable range. For Brooks GF40/GF80 Series S-protocol devices, the current/voltage field reports current in mAmps or voltage in volts depending upon the configuration of the output of the device.The current/voltage always matches the analog output of the device including alarm conditions and set values. Percent of range always follows the primary variable, even if the current is in an alarm condition or set to a value. Also, the percent of range is not limited to values between 0% and 100%, but tracks the primary variable to the sensor limits.

Request data bytes:

NONE

Response data bytes:

CURRENT/ VOLTAGE MSB	CURRENT/ VOLTAGE	CURRENT/ VOLTAGE	CURRENT/ VOLTAGE LSB	PV % RANGE MSB	PV % RANGE	PV % RANGE	PV % RANGE LSB
#0	#1	#2	#3	#4	#5	#6	#7

Data Byte #	Type	Remarks
0 - 3	32-bit floating point, IEEE 754 format	Analog output current or voltage [milliamperes or volts].
4 - 7	32-bit floating Point, IEEE 754 format	Primary variable: flow rate [% of range]

6-3-1 Command #2 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-4 Command #3 Read Current and all Dynamic Variable

Read the current and the dynamic variables.The current/voltage field reports current in mAmps or voltage in volts depending upon the configuration of the output of the device.The current/voltage always matches the analog output current/voltage of the device including alarm conditions and set values. For the GF40/GF80 Series S-Protocol devices, the dynamic variable assignments are as follows:

Variable #0: Flow Rate (Primary Variable)
Variable #1: Temperature (Secondary Variable)

Request data bytes:

NONE

Response data bytes:

CURRENT/ VOLTAGE MSB	CURRENT/ VOLTAGE	CURRENT/ VOLTAGE	CURRENT/ VOLTAGE LSB	PRIMARY VAR. UNITS	PRIMARY VAR.	PRIMARY VAR.	PRIMARY VAR.
#0	#1	#2	#3	#4	#5	#6	#7

PRIMARY VAR. LSB	SECOND. VAR. UNITS	SECOND. VAR. MSB	SECOND. VAR.	SECOND. VAR.	SECOND. VAR. LSB
#8	#9	#10	#11	#12	#13

Data Byte #	Type	Remarks
0 - 3	32-bit floating point, IEEE 754 format	Analog output current/ voltage [milliamperes or volts].
4	8-bit unsigned integer code.Refer to Section	Primary variable unit 9-3, Flow rate unit and reference codes.
5 - 8	32-bit floating point, IEEE 754 format	Primary variable: flow rate.

9	8-bit unsigned integer	Secondary variable unit code.Refer to Section 9-5, Temperature unit codes.
10 - 13	32-bit floating point, IEEE 754 format	Secondary variable: temperature.

6-4-1 Command #3 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-5 Command #6 Write Polling Address

This command writes the Polling Address (Short Frame Address) to the field device.

Request data bytes:

POLLING ADDRESS
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Polling Address: 0-15 16-255 Undefined

Response data bytes:

POLLING ADDRESS
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Polling Address: 0-15 16-255 Undefined

6-5-1 Command #6 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3-4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8-15	Undefined
16	Access restricted
17 -127	Undefined

6-6 Command #11 Read Unique Identifier associated with Tag

This command returns the expanded device-type codes, revision levels and the device identification number of a device containing the requested tag. It will be executed when either the appropriate long address or the broadcast long address, “00000” is received. The address field in the response message of this command always contains the address received in the request message. This command is unique in that no response is made unless the tag matches that of the device.

Request data bytes:

TAG	TAG	TAG	TAG	TAG	TAG
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0	6(8-bit) byte packed ASCII	Device tag number

Response data bytes:

254	MFR. ID	MFR's DEVICE TYPE	NUMBER RQUEST PREAM	UNIV. CMD. REV.	TRANS. SPEC. REV.	SOFTW REV.	HARDW REV.	FLAGS	DEVICE ID NUM MSB	DEVICE ID NUM	DEVICE ID NUM
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Device type code for "expansion". Contains the code "254" (decimal).
1	8-bit unsigned integer	Manufacturer identification code. (Always 10).
2	8-bit unsigned integer	Manufacturers device type code. Refer to Section 9-2, Device type code.
3	8-bit unsigned integer	Number of response preamble characters required for the request message from the master to the slave.
4	8-bit unsigned integer	Universal command revision level implemented by this device.
5	8-bit unsigned integer	Transmitter specific command revision level implemented by this device.
6	8-bit unsigned integer	Software revision level of the device.
7	8-bit unsigned integer	Hardware revision level of the electronics in the device. Format: xxxxx.yyyB x- Device hardware revision level, 5-bit unsigned integer, level 15 is reserved. y- Physical signalling code, 3-bit unsigned integer, refer to Section 9-8, Physical signalling codes.
8	8-bit unsigned integer	Flags Refer to Section 9-10, Flag assignments.
9-11	24-bit unsigned integer	Device identification number.

6-6-1 Command #11 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-7 Command #12 Read Message

Read the 32 Character Message String contained within the device. The message string is a 32 character storage area that the user may use for any application related function desired. The message string is not used by the device.

Request data bytes:

NONE

Response data bytes:

#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11
MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE

#12	#13	#14	#15	#16	#17	#18	#19	#20	#21	#22	#23
MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE

Data Byte #	Type	Remarks
0-23	24(8-bit) byte packed ASCII	32 character message string.

6-7-1 Command #12 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-8 Command #13 Read tag, Descriptor, Date

Read the tag, descriptor and date contained within the device. The tag name is used to identify the device (See Command #11). The description and date fields can be utilized for any application specific function desired. The description and date fields are not used by the device.

Request data bytes:

NONE

Response data bytes:

TAG	TAG	TAG	TAG	TAG	TAG	DESCRIPT.	DESCRIPT.	DESCRIPT.	DESCRIPT.	DESCRIPT.	DESCRIPT.
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

DESCRIPT.	DESCRIPT.	DESCRIPT.	DESCRIPT.	DESCRIPT.	DESCRIPT.	DATE DAY	DATE MONTH	DATE MONTH
#12	#13	#14	#15	#16	#17	#18	#19	#20

Data Byte #	Type	Remarks
0-5	6(8-bit) byte packed ASCII	Device tag name.
6-17	12(8-bit) byte packed ASCII	Device descriptor. (16 character string)
18-20	3(8-bit) byte packed ASCII	Date.Respectively day, month, year - 1900.

6-8-1 Command #13 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-9 Command #14 Read Primary Variable Sensor Information

This command is intended to read primary variable sensor information.

Request data bytes:

NONE

Response data bytes:

SENSOR SERIAL NUM MSB	SENSOR SERIAL NUM	SENSOR SERIAL NUM LSB	LIMITS UNITS CODE	UPPER SENSOR LIMIT MSB	UPPER SENSOR LIMIT	UPPER SENSOR LIMIT	UPPER SENSOR LIMIT LSB	LOWER SENSOR LIMIT MSB	LOWER SENSOR LIMIT	LOWER SENSOR LIMIT	LOWER SENSOR LIMIT LSB
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

MIN SPAN MSB	MIN SPAN	MIN SPAN	MIN SPAN LSB
#12	#13	#14	#15

Data Byte #	**Type**	**Remarks**
0 - 2	24-bit unsigned integer	Sensor serial number.
3	8-bit unsigned integer	Sensor limits/minimum span unit code.
4 - 7	32-bit floating point, IEEE 754 format	Upper sensor limit.
8 - 11	32-bit floating point, IEEE 754 format	Lower sensor limit.
12 – 15	32-bit floating point, IEEE 754 format	Minimum span.

6-9-1 Command #14 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-10 Command #15 Read Output Information

This command is intended to read the alarm selection code, transfer function, primary variable/range unit code, upper range value, lower range value, damping value (applied to the sensor, not the output), write protect code and private label distributor

Request data bytes:

NONE

Response data bytes:

ALARM SELECT CODE	TRANSF. FUNCT. CODE	PV / RANGE UNITS CODE	UPPER RANGE MSB	UPPER RANGE	UPPER RANGE	UPPER RANGE MSB	LOWER RANGE MSB	LOWER RANGE	LOWER RANGE	LOWER VALUE MSB	DAMPING VALUE
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

DAMPING VALUE	DAMPING VALUE	DAMPING VALUE LSB	WRITE PROTECT CODE	PVT LABEL DIST
#12	#13	#14	#15	#16

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Alarm select code. Not implemented for the Brooks GF40/GF80 Series S-Protocol devices, the integer returned is a “Not-Used” or “250” (decimal).
1	8-bit unsigned integer	Transfer function code. Always returns LINEAR (0)
2	8-bit unsigned integer	Primary variable upper and lower range unit code.
3 - 6	32-bit floating point, IEEE 754 format	Upper range value.
7 - 10	32-bit floating point, IEEE 754 format	Lower range value.

Data Byte #	Type	Remarks
11 - 14	32-bit floating point, IEEE 754 format	Damping value. (Always 0.0)
15	8-bit unsigned integer	Write protect code. Not supported, returns Not Used (250 dec)
16	8-bit unsigned integer	Private label distributor. Returns Hart code for Brooks Instrument (10dec)

6-10-1 Command #15 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-11 Command #16 Read Final Assembly Number

This command is used to read the final assembly number associated with the device.

Request data bytes:

NONE

Response data bytes:

FINAL ASS. NUM MSB	FINAL ASS. NUM	FINAL ASS. NUM LSB
#0	#1	#2

Data Byte #	Type	Remarks
0 - 2	24-bit unsigned integer	Final assembly number.

6-11-1 Command Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined

6-12 Command #17 Write Message

Write a 32 Character Message String into the device. See Command #12 for more information about the message string

Request data bytes:

MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE
#12	#13	#14	#15	#16	#17	#18	#19	#20	#21	#22	#23

Data Byte #	Type	Remarks
0 - 23	24 (8-bit) byte packed ASCII	32 Character message string.

Response data bytes:

MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE	MESSAGE
#12	#13	#14	#15	#16	#17	#18	#19	#20	#21	#22	#23

Data Byte #	Type	Remarks
0 - 23	24 (8-bit) byte packed ASCII	32 Character message string.

6-12-1 Command #17 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined
7	In write protect mode
8-127	Undefined

6-13 Command #18 Write Tag, Descriptor, Date

Write the tag, descriptor and date into the device. See Command #13 for more information.

Request data bytes:

TAG	TAG	TAG	TAG	TAG	TAG	DESCR.	DESCR.	DESCR.	DESCR.	DESCR.	DESCR.
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

DESCR.	DESCR.	DESCR.	DESCR.	DESCR.	DESCR.	DATE DAY	DATE MONTH	DATE YEAR
#12	#13	#14	#15	#16	#17	#18	#19	#20

Data Byte #	Type	Remarks
0 - 5	6 (8-bit) byte packed ASCII	Device tag number.
6 - 17	12 (8-bit) byte packed ASCII	Device descriptor. (16 character string)
18 - 20	3 (8-bit) unsigned integers	Date. Respectively day, month, year - 1900.

Response data bytes:

TAG	TAG	TAG	TAG	TAG	TAG	DESCR.	DESCR.	DESCR.	DESCR.	DESCR.	DESCR.
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

DESCR.	DESCR.	DESCR.	DESCR.	DESCR.	DESCR.	DATE DAY	DATE MONTH	DATE YEAR
#12	#13	#14	#15	#16	#17	#18	#19	#20

Data Byte #	Type	Remarks
0 - 5	6 (8-bit) byte packed ASCII	Device tag number.
6 - 17	12 (8-bit) byte packed ASCII	Device descriptor. (16 character string)
18 – 20	3 (8-bit) unsigned integers	Date. Respectively day, month, year - 1900.

6-13-1 Command #18 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined
7	In write protect mode
8-127	Undefined

6-14 Command #19 Write Final Assembly Number

Write the final assembly number into the device.

Request data bytes:

FINAL ASS. NUM MSB	FINAL ASS. NUM	FINAL ASS. NUM LSB
#0	#1	#2

Data Byte #	Type	Remarks
0 - 2	24-bit unsigned integer	Final assembly number.

Response data bytes:

FINAL ASS. NUM MSB	FINAL ASS. NUM	FINAL ASS. NUM LSB
#0	#1	#2

Data Byte #	Type	Remarks
0 - 2	24-bit unsigned integer	Final assembly number.

6-14-1 Command #19 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6 - 127	Undefined
7	In write protect mode
8-127	Undefined

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7-1 Command #37 Set Primary Variable Lower Range Value

This command generates a sensor zero action, the same function as pushing the zero button on the analog device. No flow should be applied to the device.

The command will return an error response code 9, “Applied process too high,” if flow output is greater than 2% when the command is received.

Request data bytes:

NONE

Response data bytes:

NONE

7-1-1 Command #37 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8	Undefined
9	Applied pressure too high
10-127	Undefined

7-2 Command #38 Reset Configuration Changed Flag

Resets the configuration changed response code, bit #6 of the transmitter status byte. Secondary master devices, address ‘0’should not issue this command. Primary master devices, address ‘1’, should only issue this command after the configuration changed response code has been detected and acted upon.

Request data bytes:

NONE

Response data bytes:

NONE

7-2-1 Command #38 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8-15	Undefined
16	Access restricted
17-127	Undefined

7-3 Command #39 EEPROM Control

This command is supported ONLY for backwards compatibilty with Brooks 5850S devices. The GF40/GF80 device automatically saves all changes made to non-volatile attributes in flash memory. It is not necessary to use this command to save data non-volatile memory.

Request data bytes:

EEPROM CONTROL CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	EEPROM control code 0 No change 1 No change 2-249 Undefined

Response data bytes:

EEPROM CONTROL CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	EEPROM control code 0 No change 1 No change 2-249 Undefined

7-4 Command #42 Perform Master Reset

Command used to reset the device's microprocessor. The device will respond first and then perform the master reset.

Request data bytes:

NONE

Response data bytes:

NONE

Command Specific Response Codes:

0	No command-specific errors
1-15	Undefined
16	Access restricted
17-127	Undefined

7-5 Command #48 Read Additional Transmitter Status

This command is used to retrieve additional transmitter status information.

Request data bytes:

NONE

Response data bytes:

ADD. STATUS BYTE#0	ADD. STATUS BYTE#1	ADD. STATUS BYTE#2	ADD. STATUS BYTE#3
#0	#1	#2	#3

Refer to Section 9-15 for a definition of theAdditional Status Bytes.

7-5-1 Command #48 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6-127	Undefined

7-6 Command #50 Read Dynamic Variable Assignments

Read the assignment numbers for the dynamic variables. This command always returns Transmitter Variable #0 (flow rate) as the Primary Variable Transmitter Variable #1 (temperature) as the Secondary Variable, and Transmitter Variable #2 (pressure) as the Tertiary Variable. Note that the assignment of dynamic variables cannot be changed.

Transmitter variable codes **shall** be reported as defined in Section 9-9.

Request data bytes:
none

Response data bytes:

PV. XMITTER CODE	SV. XMITTER CODE	TV. XMITTER CODE	QV. XMITTER CODE
#0	#1	#2	#3

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Transmitter variable number assigned to the primary variable, flow rate
1	8-bit unsigned integer	Transmitter variable number assigned to the secondary variable, temperature
2	8-bit unsigned integer	Transmitter variable number assigned to the tertiary variable, not supported, returns Not Used (250 dec)
3	8-bit unsigned integer	Transmitter variable number assigned to the Quaternary variable, not supported, returns Not Used (250 dec)

7-6-1 Command #50 Specific Response Codes

0	No command specific errors
1 - 4	Undefined
5	Incorrect byte count
6 – 127	Undefined

7-7 Command #59 Write Number of Response Preambles

Set the minimum number of preambles to be sent by a device before the start of a response packet. This number includes the two preambles contained in the start of message. The value can vary from 2 to 15.

Request data bytes:

NUMBER RESP. PREAM.
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Number of response preambles to be sent with the response message from slave to master.

Response data bytes:

NUMBER RESP. PREAM.
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Number of response preambles to be sent with the response message from slave to master.

7-7-1 Command #59 Specific Response Codes

0	No command-specific errors
1 -2	Undefined
3	Passed parameter too large
4	Passed parameter too small
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8-15	Undefined
16	Access restricted
17	Undefined

7-8 Command #66 Enter/Exit Fixed Analog Output Mode

The device is placed in the Fixed Analog Output Mode with the analog output set to the value received. The value returned in the response data bytes is the value actually used by the device. A level of "Not-A-Number" (7F A0 00 00) with any unit code exits the fixed analog output mode. Fixed Analog Output Mode is also exited when the power is removed from the device. The Analog Output Code and the Analog Output Units must be compatible (i.e. current output and milliamps)
and the device must be configured for the type of output specified by the Analog Output Code or Response Code 12 or 15 will be returned.

Request data bytes:

ANALOG OUTPUT # CODE	ANALOG OUTPUT # UNIT	ANALOG OUT. LVL. MSB	ANALOG OUT. LVL.	ANALOG OUT. LVL.	ANALOG OUT. LVL. LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Analog output selection code. Refer to Section 9-11.
1	8-bit unsigned integer	Analog output units code. Refer to Section 9-19.
2-5	32-bit floating point, IEEE 754 format	Fixed analog output low or high level. Refer to Section 9-**1**.

Response data bytes:

ANALOG OUTPUT # CODE	ANALOG OUTPUT # UNIT	ANALOG OUT. LVL. MSB	ANALOG OUT. LVL.	ANALOG OUT. LVL.	ANALOG OUT. LVL. LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Analog output selection code. Refer to Section 9-11.
1	8-bit unsigned integer	Analog output units code. Refer to Section 9-19.
2-5	32-bit floating point, IEEE 754 format1	Fixed analog output low or high level. Refer to Section 9-**1**

7-8-1 Command #66 Specific Response Codes

0	No command-specific errors
1-2	Undefined
3	Passed parameter too large
4	Passed parameter too small
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8-11	Undefined
12	Invalid units code
13-14	Undefined
15	Invalid analog output number code
16	Access restricted
17-127	Undefined

Follow the sequence below to adjust the output:
1) Use command #66 to put the device in a fixed analog output mode with the low limit as the fixed value.
2) Use command #67 to adjust the low limit (zero offset).
3) Use command #67 to put the device in a fixed analog output mode with the high limit as the fixed value.
4) Use command #68 to adjust the high limit (span).
5) Use the command #42 to perform a master reset in order to store the new values in nonvolatile memory

7-9 Command #67 Trim Analog Output Zero

Trim the Zero of the selected analog output so that the connected meter reads the analog output lower endpoint value. The response data bytes contain the value from the request as used by the device. Command #66, Enter/Exit Fixed Analog Output Mode, should be used first to set the analog output exactly to the lower endpoint value before using this command. Response code #9, "Not in proper analog output mode" will be returned if the analog output involved has not been set to the fixed analog output mode.

Request data bytes:

ANALOG OUTPUT # CODE	ANALOG OUTPUT # UNIT	MEASURED OUT. LVL. MSB	MEASURED OUT. LVL.	MEASURED OUT. LVL.	MEASURED OUT. LVL. LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Analog output number code. Refer to Section 9-11, Analog Output Selection codes.
1	8-bit unsigned integer	Analog output units code. Refer to Section 9-19, Analog Output units codes.
2-5	32-bit floating point, IEEE 754 format	Externally measured analog output level.

Response data bytes:

ANALOG OUTPUT # CODE	ANALOG OUTPUT # UNIT	MEASURED OUT. LVL. MSB	MEASURED OUT. LVL.	MEASURED OUT. LVL.	MEASURED OUT. LVL. LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Analog output number code. Refer to Section 9-11, Analog Output Selection codes.
1	8-bit unsigned integer	Analog output units code. Refer to Section 9-19, Analog Output units codes.
2-5	32-bit floating point, IEEE 754 format1	Actual measured analog output level.

7-9-1 Command #67 Specific Response Codes

0	No command-specific errors
1-2	Undefined
3	Passed parameter too large
4	Passed parameter too small
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8	Undefined
9	Not in proper analog output mode
10-11	Undefined
12	Invalid units code
13-14	Undefined
15	Invalid analog output number code
16	Access restricted
17-127	Undefined

7-10 Command #68 Trim Analog Output Span

Trim the Span of the selected analog output so that the connected meter reads the analog output upper endpoint value. The response data bytes contain the value from the request as used by the device. Command #66, Enter/Exit Fixed Analog Output Mode, should be used first to set the analog output exactly to the upper endpoint value before using this command. Response code #9, "Not in proper analog output mode" will be returned if the analog output involved has not been set to the fixed analog output mode.

Request data bytes:

ANALOG OUTPUT # CODE	ANALOG OUTPUT # UNIT	MEASURED OUT. LVL. MSB	MEASURED OUT. LVL.	MEASURED OUT. LVL.	MEASURED OUT. LVL. LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Analog output number code. Refer to Section 9-11, Analog Output Selection codes.
1	8-bit unsigned integer	Analog output units code. Refer to Section 9-19, Analog Output units codes.
2-5	32-bit floating point, IEEE 754 format	Externally measured analog output level.

Response data bytes:

ANALOG OUTPUT # CODE	ANALOG OUTPUT # UNIT	MEASURED OUT. LVL. MSB	MEASURED OUT. LVL.	MEASURED OUT. LVL.	MEASURED OUT. LVL. LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Analog output number code. Refer to Section 9-11, Analog Output Selection codes.
1	8-bit unsigned integer	Analog output units code. Refer to Section 9-19, Analog Output units codes.
2-5	32-bit floating point, IEEE 754 format1	Actual measured analog output level.

7-10-1 Command #68 Specific Response Codes

0	No command-specific errors
1-2	Undefined
3	Passed parameter too large
4	Passed parameter too small
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8	Undefined
9	Not in proper analog output mode
10-11	Undefined
12	Invalid units code
13-14	Undefined
15	Invalid analog output number code
16	Access restricted
17-127	Undefined

7-11 Command #122 Write Device Identification Number (Non-Public)

Write the device indentification number into the device's memory. The response message will be made using the unique identifer (long frame address) as received in the request message. The devcie indentification number will not be incorporated in the unique identifer until the response message has been sent. The command is a Non-Public one, i.e. execution is protected by a three byte 'password' which has to be sent with the request message. This password should match the device's final assembly number in order to achieve a correct execution of the command. When they do not match, the "Command not implemented" response code will be returned. The coommand specific response codes will only be returned if the password and final assembly numbers have matched.

Request data bytes:

Password MSB	Password	Password LSB	Device I.D. # MSB	Device I.D. #	Device I.D. # LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0 - 2	24-bit unsigned integer	Password
3 - 5	24-bit unsigned integer	Device indentification number

Response data bytes:

Device I.D. # MSB	Device I.D. #	Device I.D. # LSB
#0	#1	#2

Data Byte #	Type	Remarks
0 - 3	24-bit unsigned integer	Device indentification number

Command specific response codes:

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8 - 15	Undefined
16	Access restricted
17 - 127	Undefined

7-12 Command #123 Select Baud Rate

Select the baud rate for S-protocol communications. The new baud rate setting will not take effect until the device is reset, (See Command #42) or power is cycled to the device.

Request data bytes:

Baud Rate
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Baud Rate 0 9600 1 19200 2 38400

Response data bytes:

Baud Rate
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Baud Rate

Command specific response codes:

0	No command-specific errors
1	Undefined
2	Invalid selection
3 - 4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8 - 127	Undefined

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8-1 Command #128 Enter/Exit Write Protect Mode (Non-Public)

This command is implemented to maintain compatibility with other Brooks Smart products, however, it is not required and has no effect. Write Protect mode is not supported by GF40/GF80 Series.

Request data bytes:

USER PASS-WORD	USER PASS-WORD	USER PASS-WORD	USER PASS-WORD	USER PASS-WORD	USER PASS-WORD	WRITE PROTECT MODE
#0	#1	#2	#3	#4	#5	#6

Data Byte #	Type	Remarks
0 - 5	6 (8-bit) byte packed ASCII	User password.
6	8-bit unsigned integer	Write protect code. Refer to Section 9-7, Write protect codes.

Response data bytes:

WRITE PROTECT MODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Write protect code. (Always returns 0). Refer to Section 9-7, Write protect codes.

8-1-1 Command #128 Specific Response Codes

0	No command-specific errors
1 - 4	Undefined
5	Incorrect bytecount
6-127	Undefined

8-2 Command #131 Read Brooks Serial Number

Read the Brooks order number from the device's memory. The Brooks order number is a 24-byte packed ASCII string (resulting in 32 total unpacked ASCII characters) indicating the serial number of the device. The number can be used for traceability purposes.

Request data bytes:
None

Response data bytes:

Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number	Brooks Serial Number
#12	#13	#14	#15	#16	#17	#18	#19	#20	#21	#22	#23

Data Byte #	Type	Remarks
0-23	24 (8-bit) packed ASCII	Brooks Serial Number

8-2-1 Command #131 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-3 Command #132 Read Model Number

Read the device Model number from the device's memory. The device Model number is a 24-byte packed ASCII string (resulting in 32 total unpacked ASCII characters).

Request data bytes:
None

Response data bytes:

Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11

Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number	Device Model Number
#12	#13	#14	#15	#16	#17	#18	#19	#20	#21	#22	#23

Data Byte #	Type	Remarks
0-23	24 (8-bit) packed ASCII	Brooks Serial Number

8-3-1 Command #132 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-4 Command #134 Read Software Revisions

Read the software revision from the device as an ASCII string of up to 8 characters. If the firmware revision string is less than 8 characters, the remaining bytes wil be 0.

Request data bytes:
None

Response data bytes:

FIRMWARE REVISION	FIRMWARE REVISION	FIRMWARE REVISION	FIRMWARE REVISION	FIRMWARE REVISION	FIRMWARE REVISION	FIRMWARE REVISION	FIRMWARE REVISION
#0	#1	#2	#3	#4	#5	#6	#7

Data Byte #	Type	Remarks
0 - 7	8 (8-bit) ASCII text	Firmware revision

8-4-1 Command #134 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-5 Command #150 Read Process Gas Type

Read the type of process gas specified by the gas selection code from the device's memory. The gas can be specified as a string of upper and lower case characters. The gases will in most cases be expressed by their chemical formula.

Request data bytes:

Gas Select Code
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Gas Selection Code (1-6)

Response data bytes:

Gas Select Code	Process Gas	Process Gas	Process Gas	Process Gas	Process Gas	Process Gas	Process Gas	Process Gas	Process Gas	Process Gas	Process Gas	Process Gas
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Gas Selection Code (1-10)
1-12	12 (8-bit) ASCII text	Process Gas Type (null terminated string)

8-5-1 Command #150 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid Selection
3-4	Undefined
5	Incorrect Bytecount
6-127	Undefined

8-6 Command #151 Read Gas Density, Flow Reference and Flow Range

Read the density of the selected gas, the operational flow range and the reference temperature and pressure for the flow range. The flow range equals the volume flow in engineering units at 100% as calibrated. The reference temperature and pressure are the conditions at which the volume flow is specified.

Request data bytes:

Gas Select Code
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Gas Selection Code (1-6)

Response data bytes:

Gas Select Code	Density Unit Code	Density MSB	Density	Density	Density LSB
#0	#1	#2	#3	#4	#5

Ref. Temp. Unit	Ref. Temp. MSB	Ref. Temp.	Ref. Temp.	Ref. Temp. LSB	Ref. Press. Unit	Ref. Press. MSB	Ref. Press.	Ref. Press.	Ref. Press. LSB
#6	#7	#8	#9	#10	#11	#12	#13	#14	#15

Flow Unit Code	Flow Range MSB	Flow Range	Flow Range	Flow Range LSB
#16	#17	#18	#19	#20

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Gas selection Code (1-10)
1	8-bit unsigned integer	Density Unit Code (See Section 9-4)
2-5	32-bit floating point, IEEE 754 format	Process Gas Density
6	8-bit unsigned integer	Reference Temperature Unit Code (See Section 9-5)
7-10	32-bit floating point, IEEE 754 format	Reference Temperature Value
11	8-bit unsigned integer	Reference Pressure Unit Code (See Section 9-6)
12-15	32-bit floating point, IEEE 754 format	Reference Pressure Value
16	8-bit unsigned integer	Reference Flow Rate Unit Code (See Section 9-3)
17-20	32-bit floating point, IEEE 754 format	Reference Flow range Value

8-6-1 Command #151 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid Selection
3-4	Undefined
5	Incorrect Byte count
6-127	Undefined

8-7 Command #152 Read Full Scale Flow Range

Read the configured full scale flow range of the specified process gas page in the selected flow units (see Command 196).

Request data bytes:

GAS SELECT CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Gas selection code. Number between 1 and 6

Response data bytes:

SEL FLOW UNIT	FLOW RATE MSB	FLOW RATE	FLOW RATE	FLOW RATE LSB
#0	#1	#2	#3	#4

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Primary variable unit code. Refer to Section 9-3, Flow rate unit and reference codes.
1-4	32-bit floating point IEEE 754 format	Primary variable: flow rate

Command specific response codes:

0	No command-specific errors
1	Unidefined
2	Invalid selection
3 - 4	Unidefined
5	Incorrect bytecount
6 - 127	Unidefined

8-8 Command #190 Read Standard Temperature and Pressure

Write the standard temperature and pressure values into the device's memory. The standard temperature and pressure are reference values which can be set by the user and which are used in the conversion of flow units as defined in Section 5-2-1.

Request data bytes:
None

Response data bytes:

Temp. Unit Code	Std. Temp MSB	Std. Temp	Std. Temp	Std. Temp LSB	Press. Unit Code	Std. Press. MSB	Std. Press.	Std. Press.	Std. Press. LSB
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Temperature Unit Code (See Section 9-5)
1-4	32-bit floating point, IEEE 754 format	Standard Temperature Value
5	8-bit unsigned integer	Pressure Unit Code (See Section 9-6)
6-9	32-bit floating point, IEEE 754 format	Standard Pressure Value

8-8-1 Command #190 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-9 Command #191 Write Standard Temperature and Pressure

Write the standard temperature and pressure values into the device's memory. The standard temperature and pressure are reference values which can be set by the user and which are used in the conversion of flow units as defined in Section 5-2-1.

Request data bytes:

Temp. Unit Code	Std. Temp MSB	Std. Temp	Std. Temp	Std. Temp LSB	Press. Unit Code	Std. Press. MSB	Std. Press.	Std. Press.	Std. Press. LSB
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Temperature Unit Code (See Section 9-5)
1-4	32-bit floating point, IEEE 754 format	Standard Temperature Value
5	8-bit unsigned integer	Pressure Unit Code (See Section 9-6)
6-9	32-bit floating point, IEEE 754 format	Standard Pressure Value

Response data bytes:

Temp. Unit Code	Std. Temp MSB	Std. Temp	Std. Temp	Std. Temp LSB	Press. Unit Code	Std. Press. MSB	Std. Press.	Std. Press.	Std. Press. LSB
#0	#1	#2	#3	#4	#5	#6	#7	#8	#9

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Temperature Unit Code (See Section 9-5)
1-4	32-bit floating point, IEEE 754 format	Standard Temperature Value
5	8-bit unsigned integer	Pressure Unit Code (See Section 9-6)
6-9	32-bit floating point, IEEE 754 format	Standard Pressure Value

8-9-1 Command #191 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid Selection
3	Passed parameter too large
4	Passed parameter too small
5	Incorrect Byte count
6	Undefined
7	In write protect mode
8-15	Undefined
16	Access restricted
17-127	Undefined

8-10 Command #193 Read Operational Settings

Read the operational settings from the device. These settings consist of the selected gas number, the selected flow reference condition, the selected flow unit and the selected temperature unit.

Request data bytes:

None

Response data bytes:

SEL GAS NUMBER	SEL FLOW REF	SEL FLOW UNIT	SEL TEMP UNIT
#0	#1	#2	#3

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Selected gas number. Number between 1 and 6.
1	8-bit unsigned integer	Selected flow reference. Refer to Section 9-3, Flow rate unit and reference codes.
2	8-bit unsigned integer	Selected flow unit. Refer to Section 9-3, Flow rate unit and reference codes.
3	8-bit unsigned integer	Selected temperature unit. Refer to Section 9-5, Temperature unit codes.

8-10-1 Command #193 Specific Response Codes

0	No command-specific errors
1 - 127	Undefined

8-11 Command #195 Select Gas Calibration

Select a gas calibration from the available calibrations. Refer to the Product/Calibration Data Sheet(s) shipped with each device to determine the proper gas calibration number for the desired gas/flow conditions.

Request data bytes:

SEL CAL NUMBER
#0

Data Byte #	**Type**	**Remarks**
0	8-bit unsigned integer	Selected calibration number. Number between 1 and 6.

Response data bytes:

SEL CAL NUMBER
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Selected calibration number. Number between 1 and 6.

8-11-1 Command #195 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3-4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8 - 127	Undefined

8-12 Command #196 Select Flow Unit

Select a flow unit. Selecting a flow unit not only consists of selecting the flow unit, but also the reference condition. The selected flow unit will be used in the conversion from flow data. Flow data will be made available to the user in the selected flow unit and reference conditions.
(See Section 5-2-1.)

Request data bytes:

SEL FLOW REF	SEL FLOW UNIT
#0	#1

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Selected flow reference. Refer to Section 9-3, Flow rate unit and reference codes.
1	8-bit unsigned integer	Selected flow unit. Refer to Section 9-3, Flow rate unit and reference codes.

Response data bytes:

SEL FLOW REF	SEL FLOW UNIT
#0	#1

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Selected flow reference. Refer to Section 9-3, Flow rate unit and reference codes.
1	8-bit unsigned integer	Selected flow unit. Refer to Section 9-3, Flow rate unit and reference codes.

8-12-1 Command #196 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3-4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8 - 127	Undefined

8-13 Command #197 Select Temperature Unit

Select a temperature unit. The selected temperature unit will be used in the conversion of temperature data. Temperature data will be made available to the user in the selected temperature unit.

Request data bytes:

SEL TEMP REF
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Selected temperature unit. Refer to Section 9-5, Temperature unit codes.

Response data bytes:

SEL TEMP REF
#0

8-13-1 Command #197 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3-4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8 - 127	Undefined

8-14 Command #215 Read Setpoint Settings

Read the setpoint related settings from the device. The settings contain the setpoint source indication, i.e. analog 0 - 5 V / 0 - 10 V / 0 - 20 mA, analog 4 - 20 mA or digital, the type of softstart and the softstart ramp.

Request data bytes:

None

Response data bytes:

SETP SOURCE CODE	SETP SPAN MSB	SETP SPAN	SETP SPAN	SETP SPAN LSB	SETP OFFSET MSB	SETP OFFSET	SETP OFFSET
#0	#1	#2	#3	#4	#5	#6	#7

SETP OFFSET LSB	SOFT START CODE	S. START RAMP MSB	S. START RAMP	S. START RAMP	S. START RAMP LSB
#8	#9	#10	#11	#12	#13

Data Byte #	Type	Remarks
0	8 bit unsigned integer	Setpoint source selection code. Refer to Section 9-12, Setpoint source selection codes.
1 - 4	32-bit floating point, IEEE 754 format	Always returns 1.0

Data Byte #	Type	Remarks
5 - 8	32-bit floating point, IEEE 754 format	Always return 0.0.
9	8 bit unsigned integer	Softstart selection code. Refer to Section 9-13, Softstart selection codes.
10 - 13	32-bit floating point, IEEE 754 format	Softstart ramp value See command #218 for an explanation of the Softstart Ramp Value.

8-14-1 Command #215 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-15 Command #216 Select Setpoint Source

Select the setpoint source to be used as setpoint input. The setpoint source can be either analog 0 - 5 V / 0 - 10 V / 0 - 20 mA, analog 4 - 20 mA or digital (i.e. through communication). This command allows the user to select between analog setpoint and digital setpoint. To change the analog input and output type configured during production, e.g. 0 - 5 V, 0 - 10 V, 0 - 20 mA, or 4 - 20 mA use the setpoint source selection values 10, 11, 20, 21 refer to Section 9-12.

Request data bytes:

SETP SOURCE CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Setpoint source selection code. Refer to Section 9-12, Setpoint source codes.

Response data bytes:

SETP SOURCE CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Setpoint source selection code. Refer to Section 9-12, Setpoint source codes.

8-15-1 Command #216 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3-4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8 - 127	Undefined

8-16 Command #218 Select Softstart

Select the softstart type to be used by the device. The softstart mode can be set to either disabled or time. When Time is selected, then the Software Ramp value (see Command #219) will be the time required to ramp to a new setpoint expressed in seconds.

Request data bytes:

SOFT START CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Softstart selection code. Refer to Section 9-13, Softstart selection codes.

Response data bytes:

SOFT START CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Softstart selection code. Refer to Section 9-13, Softstart selection codes.

8-16-1 Command #218 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3-4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8 - 127	Undefined

8-17 Command #219 Write Linear Softstart Ramp Value

Write the linear softstart ramp value into the device's memory. The definition of the softstart ramp value is dependent upon the selected softstart ramp code. See command #218 for a description of the softstart ramp value.

Request data bytes:

S.START RAMP MSB	S.START RAMP	S.START RAMP	S.START RAMP LSB
#0	#1	#2	#3

Data Byte #	**Type**	**Remarks**
0 - 3	32-bit floating point, IEEE 754 format	Softstart ramp value [seconds]

Response data bytes:

S.START RAMP MSB	S.START RAMP	S.START RAMP	S.START RAMP LSB
#0	#1	#2	#3

Data Byte #	**Type**	**Remarks**
0 - 3	32-bit floating point, IEEE 754 format	Softstart ramp value [seconds]

8-17-1 Command #219 Specific Response Codes

0	No command-specific errors
1-2	Undefined
3	Parameter too small
4	Parameter too large
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8 - 127	Undefine

8-18 Command #220 Read PID Controller Values

Read the PID controller settings from the device. The controller setting consist of three parameters: the proportional part Kp, the integral part Ki and the differential part Kd. Kd is not used and therefore is set to 0.

Request data bytes:

NONE

Response data bytes:

KP MSB	KP	KP	KP LSB	KI MSB	KI	KI	KI LSB
#0	#1	#2	#3	#4	#5	#6	#7

KD MSB	KD	KD	KD LSB
#8	#9	#10	#11

Data Byte #	Type	Remarks
0 - 3	32-bit floating point, IEEE 754 format	Kp. Proportional part of PID controller.
4 - 7	32-bit floating point, IEEE 754 format	Ki. Integral part of PID controller.
8 - 11	32-bit floating point, IEEE 754 format	Kd. Differential part of PID controller.

8-18-1 Command #220 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-19 Command #221 Write PID Controller Values

Write the PID controller settings into the device. The controller setting consist of three parameters: the proportional part Kp, the integral part Ki and the differential part Kd.

Request data bytes:

KP MSB	KP	KP	KP LSB	KI MSB	KI	KI	KI LSB
#0	#1	#2	#3	#4	#5	#6	#7

KD MSB	KD	KD	KD LSB
#8	#9	#10	#11

Data Byte #	Type	Remarks
0 - 3	32-bit floating point, IEEE 754 format	Kp. Proportional part of PID controller.
4 - 7	32-bit floating point, IEEE 754 format	Ki. Integral part of PID controller.
8 - 11	32-bit floating point, IEEE 754 format	Kd. Differential part of PID controller.

Response data bytes:

KP MSB	KP	KP	KP LSB	KI MSB	KI	KI	KI LSB
#0	#1	#2	#3	#4	#5	#6	#7

KD MSB	KD	KD	KD LSB
#8	#9	#10	#11

Data Byte #	Type	Remarks
0 - 3	32-bit floating point, IEEE 754 format	Kp. Proportional part of PID controller.
4 - 7	32-bit floating point, IEEE 754 format	Ki. Integral part of PID controller.
8 - 11	32-bit floating point,	Kd.

8-19-1 Command #221 Specific Response Codes

0	No command-specific errors
1-4	Undefined
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8-127	Undefined

8-20 Command #222 Read Valve Range and Valve Offset

Read the Valve Range and Valve Offset values from the device. The settings are 24-bit unsigned integers used to fine tune the D/A converter for the valve control. The numbers are dimensionless and sized to the range of 0 to 62500. 100% flow is achieved with the number valve offset + valve range. Also, the sum of both should not be over 62500.

Request data bytes:

NONE

Response data bytes:

VALVE RANGE MSB	VALVE RANGE	VALVE RANGE LSB	VALVE OFFSET MSB	VALVE OFFSET	VALVE OFFSET LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0 - 2	24-bit unsigned integer	Valve range - (Not used in GF40/GF80, always returns 0.) Dimensionless number in the range of 0 to 62500.
3 - 5	24-bit unsigned integer	Valve offset Dimensionless number in the range of 0 to 62500.

8-20-1 Command #222 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-21 Command #223 Write Valve Range and Valve Offset

Write the Valve Range and Valve Offset values into the device. The settings are 24-bit unsigned integers used to fine tune the D/A converter for the valve control. The numbers are dimensionless and sized to the range of 0 to 62500. 100% flow is achieved with the number valve offset + valve range. Also, the sum of both should not be over 62500.

Request data bytes:

VALVE RANGE MSB	VALVE RANGE	VALVE RANGE LSB	VALVE OFFSET MSB	VALVE OFFSET	VALVE OFFSET LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0 - 2	24-bit unsigned integer	Valve range - (Not used in GF40/GF80, always write 0.) Dimensionless number in the range of 0 to 62500.
3 - 5	24-bit unsigned integer	Valve offset Dimensionless number in the range of 0 to 62500.

Response data bytes:

VALVE RANGE MSB	VALVE RANGE	VALVE RANGE	VALVE OFFSET MSB	VALVE OFFSET	VALVE OFFSET LSB
#0	#1	#2	#3	#4	#5

Data Byte #	Type	Remarks
0 - 2	24-bit unsigned integer	Valve range (Not used in GF40/GF80; always returns 0) Dimensionless number in the range of 0 to 62500.
3 - 5	24-bit unsigned integer	Valve offset Dimensionless number in the range of 0 to 62500.

8-21-1 Command #223 Specific Response Codes

0	No command-specific errors
1-2	Undefined
3	Parameter too small
4	Parameter too large
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8-127	Undefined

8-22 Command #226 Trim Setpoint Input

This command instructs the device to perform a trim of the Setpoint Input for the condition specified in the data section. Before issuing this command, the appropriate voltage or current must be applied to the Setpoint Input. For example, to trim the Setpoint Input when the device is configured for 0 - 5 Volt input, first apply 2 Volts to the input, then send command #226 with the data value of 1. Then apply 10 Volts to the input and send command #226 with data value of 2.
The new values will be stored in non-volatile memory when a master reset is performed using command #42.

Request data bytes:

CAL POINT
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	1 = Low scale point (2 volt 0 - 5 V / 0 - 10 V; 4 mA 0 - 20 mA; 4 mA 4 - 20 mA). 2 = High scale point (10 volt 0 - 5 V / 0 - 10 V; 20 mA 0 - 20 mA; 20 mA 4 - 20 mA). 0,3 - 225 = Undefined

Response data bytes:

CAL POINT
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	1 = Min scale point (ex. 2 Volts, 4 ma). 2 = Max scale point (ex. 10 Volts, 20 ma). 0,3 -225 = Undefined

8-22-1 Command #226 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3-4	Undefined
5	Incorrect bytecount
6-127	Undefined

8-23 Command #230 Get Valve Override Status

Get the current valve override status from the device. The valve override status can be set to either OFF (No valve override), CLOSE, OPEN or MANUAL. The analog valve override input on the D-Connector of the device will take precedence over the digital command sent to the device via command #231. Therefore, the value reported with the Get Valve Override Status command may be different than the last value sent to the device using command #231.

Request data bytes:

None

.

Response data bytes:

VALVE OVERRIDE CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Valve override code. Refer to Section 9-14, Valve override codes.

8-23-1 Command Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-24 Command #231 Set Valve Override Status

Set the current valve override status. The valve override can be set to either OFF (No valve override), CLOSE or OPEN. The analog valve override input on the D-Connector of the device will take precedence over the digital command.

Request data bytes:

VALVE OVERRIDE CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Valve override code. Refer to Section 9-14, Valve override codes.

Response data bytes:

VALVE OVERRIDE CODE
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Valve override code. Refer to Section 9-14, Valve override codes.

8-24-1 Command #231 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3-127	Undefined

8-25 Command #235 Read Setpoint in % and Selected Units

Read the current setpoint value in percent of full scale and in selected flow units. The setpoint in selected flow units compared to its full scale range should be the equivalent of the setpoint in percent.

Request data bytes:

NONE

Response data bytes:

PERCENT UNIT CODE	SETP PERCENT MSB	SETP PERCENT	SETP PERCENT	SETP PERCENT LSB	SETP FLOW UNIT	SETP UNITS MSB	SETP UNITS
#0	#1	#2	#3	#4	#5	#6	#7

SETP UNITS	SETP UNITS LSB
#8	#9

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Setpoint percent unit. Unit always reads 57 (decimal), percent.
1 - 4	32-bit floating point, IEEE 754 format	Setpoint in percent of full scale.
5	8-bit unsigned integer	Selected flow unit. Refer to Section 9-3, Flow rate unit and reference codes.
6- 9	32-bit floating point, IEEE 754 format	Setpoint in selected flow unit.

8-25-1 Command #235 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-26 Command #236 Write Setpoint in % or Selected Units

Write the current setpoint value in percent of full scale or in selected flow units to the device. If the setpoint unit code is set to percent (code 57) the setpoint value is assumed to be in percent. If the setpoint unit code is set to Not Used, the setpoint value is assumed to be in the selected flow unit. The return message is the same as the one of Command #235. The setpoint in selected flow units compared to its full scale range should be the equivalent of the setpoint in percent. When this command is received, the Setpoint Source will be set to digital automatically if not already in digital mode. The Setpoint Source will remain in digital mode until the user returns the Setpoint Source to analog mode via Command #216 or until the power to the device is cycled.

Request data bytes:

SETP UNIT CODE	SETP MSB	SETP	SETP	SETP LSB
#0	#1	#2	#3	#4

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Setpoint unit. 57 (decimal), “Percent” or 250 (decimal) “Not Used”.
1 - 4	32-bit floating point, IEEE 754	Setpoint value. In either percent of full scale or in selected flow units.

Response data bytes:

PERCENT UNIT CODE	SETP PERCENT MSB	SETP PERCENT	SETP PERCENT	SETP PERCENT LSB	SETP FLOW UNIT	SETP UNITS MSB	SETP UNITS
#0	#1	#2	#3	#4	#5	#6	#7

SETP UNITS	SETP UNITS LSB
#8	#9

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Setpoint percent unit. Unit always reads 57 (decimal), percent.
1 - 4	32-bit floating point, IEEE 754 format	Setpoint in percent of full scale.
5	8-bit unsigned integer	Select flow unit. Refer to Section 9-3, Flow rate unit and reference codes.
6-9	32-bit floating point, IEEE 754 format	Setpoint in selected flow unit.

8-26-1 Command #236 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3	Parameter too small
4	Parameter too large
5	Incorrect bytecount
6	Undefined
7	In write protect mode
8 - 127	Undefined

8-27 Command #237 Read Valve Control Value

Read the current valve control value. The valve control value is a dimensionless number in the range from 0 to 62500. It represents the value sent to the D/A-converter used to control the valve.

Request data bytes:

NONE

Response data bytes:

VALVE VALUE MSB	VALVE VALUE	VALVE VALUE LSB
#0	#1	#2

Data Byte #	Type	Remarks
0-2	24-bit unsigned integer	Valve control value. Dimensionless number between 0 and 62500.

8-27-1 Command #237 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-28 Command #240 Read Totalizer Status

Read the totalizer status. Both the totalizer status and the selected totalizer unit is returned.

Request data bytes:

NONE

Response data bytes:

TOT. STATUS	SEL. TOT. UNIT
#0	#1

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Totalizer status code. Refer to 9-16
1	8-bit unsigned integer	Totalizer unit. Refer to 9-17

8-28-1 Command #240 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-29 Command #241 Set Totalizer Control

Set the totalizer state. Use this command to start, stop or reset the totalizer. Actually, the totalizer has only two states; running and stopped. A totalizer reset will not effect the totalizer state.

Request data bytes:

TOT. CMD.
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Totalizer command code. Refer to Section 9-16, Totalizer command/status codes.

Response data bytes:

TOT. STATUS
#0

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Totalizer status code. Refer to Section 9-16, Totalizer command/status codes.

8-29-1 Command #241 Specific Response Codes

0	No command-specific errors
1	Undefined
2	Invalid selection
3-4	Undefined
5	Incorrect bytecount
6- 127	Undefined

8-30 Command #242 Read Totalizer Value and Unit

Read the totalizer counter and the totalizer unit. The totalizer unit is dependent on the selected flow unit and can not be selected separately.

Request data bytes:

NONE

Response data bytes:

SEL. TOT. UNITS	TOT. COUNT. MSB	TOT. COUNT.	TOT. COUNT.	TOT. COUNT. LSB
#0	#1	#2	#3	#4

Data Byte #	Type	Remarks
0	8-bit unsigned integer	Totalizer unit code. Refer to Section 9-17, Totalizer unit codes
1-4	32-bit floating point, IEEE 754 format	Totalizer counter value.

8-30-1 Command #242 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-31 Command #245 Read Alarm Enable Setting

Read the alarm enable settings. These alarm settings can be used to mask specific alarm sources.

Request data bytes:

NONE

Response data bytes:

ALARM-ENABLE BYTE 0	ALARM-ENABLE BYTE 1	ALARM-ENABLE BYTE 2	ALARM-ENABLE BYTE 3
#0	#1	#2	#3

Data Byte #	**Type**	**Remarks**
0	8-bit bit-field	Alarm mask byte 0
1	8-bit bit-field	Alarm mask byte 1
2	8-bit bit-field	Alarm mask byte 2
3	8-bit bit-field	Alarm mask byte 3 Refer to Section 9-15, Additional device status and masking

8-31-1 Command #245 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-32 Command #246 Write Alarm Enable Setting

Set the alarm enable settings. These alarm settings can be used to mask specific alarm sources.

Request data bytes:

ALARM-ENABLE BYTE 0	ALARM-ENABLE BYTE 1	ALARM-ENABLE BYTE 2	ALARM-ENABLE BYTE 3
#0	#1	#2	#3

Data Byte #	Type	Remarks
0	8-bit bit-field	Alarm mask byte 0
1	8-bit bit-field	Alarm mask byte 1
2	8-bit bit-field	Alarm mask byte 2
3	8-bit bit-field	Alarm mask byte 3
		Refer to 9-15, Additional device status and masking

Response data bytes:

ALARM-ENABLE BYTE 0	ALARM-ENABLE BYTE 1	ALARM-ENABLE BYTE 2	ALARM-ENABLE BYTE 3
#0	#1	#2	#3

Data Byte #	Type	Remarks
0	8-bit bit-field	Alarm mask byte 0
1	8-bit bit-field	Alarm mask byte 1
2	8-bit bit-field	Alarm mask byte 2
3	8-bit bit-field	Alarm mask byte 3
		Refer to 9-15

8-32-1 Command #246 Specific Response Codes

0	No command-specific errors
1-4	Undefined
5	Too few bytes received
6-127	Undefined

8-33 Command #247 Read High/Low Flow Alarm

Read the high/low flow alarm settings as a percent of device full scale. This command can be used to read the actual flow alarm limits.

Request data bytes:

NONE

Response data bytes:

LOW-LIMIT MSB	LOW-LIMIT	LOW-LIMIT	LOW-LIMIT LSB	HIGH-LIMIT MSB	HIGH-LIMIT	HIGH-LIMIT	HIGH-LIMIT LSB
#0	#1	#2	#3	#4	#5	#6	#7

Data Byte #	Type	Remarks
0-3	32-bit floating point, IEEE 754 format	Low-flow alarm limit (Percent of FS).
4-7	32-bit floating point, IEEE 754 format	High-flow alarm limit (Percent of FS).

8-33-1 Command #247 Specific Response Codes

0	No command-specific errors
1-127	Undefined

8-34 Command #248 Write High/Low Flow Alarm

Set the high/low flow alarm settings in percent of device full scale. This command can be used to configure the flow alarm limits. NOTE: Smart *II* Digital Series devices use Flow Alarm 1 for the Low Flow Alarm and Flow Alarm 2 for the High Flow Alarm.

Request data bytes:

LOW-LIMIT MSB	LOW-LIMIT	LOW-LIMIT	LOW-LIMIT LSB	HIGH-LIMIT MSB	HIGH-LIMIT	HIGH-LIMIT	HIGH-LIMIT LSB
#0	#1	#2	#3	#4	#5	#6	#7

Data Byte #	Type	Remarks
0-3	32-bit floating point, IEEE 754 format	Low-flow alarm limit (Percent of FS).
4-7	32-bit floating point, IEEE 754 format	High-flow alarm limit (Percent of FS).

Response data bytes:

LOW-LIMIT MSB	LOW-LIMIT	LOW-LIMIT	LOW-LIMIT LSB	HIGH-LIMIT MSB	HIGH-LIMIT	HIGH-LIMIT	HIGH-LIMIT LSB
#0	#1	#2	#3	#4	#5	#6	#7

Data Byte #	Type	Remarks
0-3	32-bit floating point, IEEE 754 format	Low-flow alarm limit.
4-7	32-bit floating point, IEEE 754 format	High-flow alarm limit.

8-34-1 Command #248 Specific Response Codes

0	No command-specific errors
1-2	Undefined
3	Passed parameter too large
4	Passed parameter too small
5	Too few bytes received
6-127	Undefined

8-35 Command #250 Change User Password

This command is implemented to maintain compatibility with other Brooks Smart products, however, it is not required and has no effect. Write Protect mode is not supported by Smart *II* Digital Series and therefore the device does not require a password.

Request data bytes:

OLD PASSW.	OLD PASSW.	OLD PASSW.	OLD PASSW.	OLD PASSW.	OLD PASSW.	NEW PASSW.	NEW PASSW.
#0	#1	#2	#3	#4	#5	#6	#7

NEW PASSW.	NEW PASSW.	NEW PASSW.	NEW PASSW.
#8	#9	#10	#11

Data Byte #	Type	Remarks
0 - 5	6 (8-bit) byte packed ASCII	Current password.
6 - 11	6 (8-bit) byte packed ASCII	New password.

Response data bytes:

NONE

8-35-1 Command #250 Specific Response Codes

0	No command-specific errors
1-4	Undefined
5	Incorrect bytecount
6-127	Undefined

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9-1 Transmitter Specific Tables

This Section lists all transmitter specific codes as used by the Brooks GF40/GF80 Series S-Protocol devices. The codes are commonly 8-bit unsigned integers, ranging from 0 to 255. In a number of cases these code tables are subsets of existing “Common Tables” provided by the HART communication specification.

9-2 Device Type Codes

The Device type code for all Brooks GF40/GF80 Series S-Protocol devices is 90.

9-3 Flow Rate Unit and Reference Codes

The flow rate unit codes are covered by two tables: the table with the reference condition codes and the table with the actual unit codes.

Code	Flow rate unit
0..16	Undefined
17	Litres/minute
18	Undefined
19	Cubic meters/hour
20..23	Undefined
24	Litres/second
25..27	Undefined
28	Cubic meters/second
29..56	Undefined
57	Percent of flow range
58..130	Undefined
131	Cubic meters/minute
132..137	Undefined
138	Liters/hour
139..169	Undefined
170	Millilitres/second
171	Millilitres/minute
172	Millilitres/hour
173..249	Undefined
250..255	Reserved

Code	Reference condition
0	Normal (273.15 Kelvin/1013.33 mBar)
1	Standard (User defined through separate command)
2	Calibration (As defined at calibration)
3..249	Undefined
250..255	Reserved

9-4 Density Unit Codes

The density units are always referenced at 273.15 Kelvin and 1013.33 mBar (‘normal’ conditions).

Code	Density unit
0..90	Undefined
91	Grams/cubic centimetre
92	Kilograms/cubic meters
93	Undefined
94	Pounds/cubic feet
95	Undefined
96	Kilograms/litre
97	Grams/Litre
98..249	Undefined
250..255	Reserved

9-5 Temperature Unit Codes

Code	Temperature unit
0..31	Undefined
32	Degrees Celsius
33	Degrees Fahrenheit
34	Undefined
35	Kelvin
36..249	Undefined
250..255	Reserved

9-6 Pressure Unit and Reference Codes

All pressure values can be expressed in the pressure units as given in the table below. In case the unit refers to the inlet and outlet pressure values, the pressure reference is also given.

Code	Pressure unit
0..5	Undefined
6	Pounds/square inch
7	Bar
8	Millibar
9-10	Undefined
11	Pascals
12	Kilopascals
13	Torricelli
14	Atmosphere
15..249	Undefined
250..255	Reserved

Code	Pressure reference
0	Absolute pressure
1	Effective pressure
2..249	Undefined
250..255	Reserved

9-7 Write Protect Codes

Write Protect Codes	
Code	**Material**
0	Not write protected
2..249	Undefined
250..255	Reserved

9-8 Physical Signalling Codes

The physical signalling codes indicate the physical layer that can be used for communication.

Physical Signalling Codes	
Code	**Physical signalling code**
0	RS-485
1..249	Undefined
250..255	Reserved

9-9 Transmitter Variable Codes

Definition of the transmitter variable codes.

Transmitter Variable Codes

Code	Variable
0	Flow rate
1	Temperature
2	Pressure
3..249	Undefined
250..255	Reserved

9-10 Flag Assignments

The flag assignments indicate implementation facts of the device.

Flag Assignments

Bit	Indication
#0	Multisensor device
#1	Undefined
#2	Undefined
#3	Undefined
#4	Undefined
#5	Undefined
#6	Undefined
#7	Reserved

9-11 Analog Output Selection Codes

Definition of the analog output selection codes.

Analog Output Selection Codes

Analog Output Code	Analog Output Code Description	Factory Configured Output Type	Analog Level Low	Analog Level High
0	Current Output	0 - 20 mA[1]	4	20
		4 - 20 mA	4	20
1	Voltage Output	0 - 5 V	0	5
		0 - 10 V	0	10

[1] For output type 0 - 20 mA use command #216 to switch to 4 - 20 mA. Perform the output adjustment, master reset and use command #216 to switch back to 0 - 20 mA.

9-12 Setpoint Source Selection Codes

The codes define the possible sources for the setpoint signal.

Setpoint Source Selection Codes	
Code	**Setpoint source**
0	Undefined
1..2	Analog Input
3	Digital Communication Input
4...9	Undefined
10	Sets Analog Input and Output 0-5 V
11	Sets Analog Input and Output 0-10 V
12..19	Undefined
20	Sets Analog Input and Output 0-20 mA
21	Sets Analog Input and Output 4-20 mA
22..249	Undefined
250..255	Reserved

Read command #215 will only return setpoint source selection codes 1, 2 and 3. Command #215 returns code 1 for analog input/output type 0-5 V, 0-10 V and 0-20 mA, and code 2 for input/output type 4-20 mA. Both codes 1 and 2 can be used for command #216 to change the setpoint source to analog, this will select the analog input/output type configured during production. Next to the values 1, 2 and 3 write command #216 will also accept setpoint source selection codes 10, 11, 20 and 21 to change the configured analog input and output type to 0-5 V, 0-10 V, 0-20 mA or 4-20 mA. Only use this in case the analog input and output type, configured during production, needs to change.

9-13 Softstart Selection Codes

The codes define the possible softstart types with changing setpoints.

Softstart Selection Codes	
Code	**Softstart type**
0	Softstart disabled
1	Undefined
2	Undefined
3	Undefined
4	Linear up and down Softstart
5..249	Undefined
250..255	Reserved

9-14 Valve Override Codes

Note: These codes are all 'Undefined' for the meter models.

Valve Override Codes	
Code	**Valve override selection**
0	Valve override off (normal operation)
1	Valve override open
2	Valve override close
3	Valve override manual (Read Only)
3..249	Undefined
250..255	Reserved

9-15 Totalizer Command/Status Codes

Totalizer command/status codes	
Code	**Totalizer command / status**
0	Stop totalizer / stopped
1	Start totalizer / running
2	Reset totalizer counter / resetting

9-16 Totalizer Unit Codes

Totalizer unit codes	
Code	**Totalizer unit**
41	l (liters)
43	m^3 (cubic meters)
60	g (gram)
61	kg (kilogram)
63	lb (pound)
175	ml (milliliter)

9-17 Analog Output Unit Codes

Analog Output Unit codes	
Code	**Analog Output Unit Codes**
0..38	Undefined
39	Milliamperes
40..57	Undefined
58	Volts
59..249	Undefined
250..255	Reserved

9-18 Additional Device Status and Masking

Additional Device Status and Masking					
Byte #	**Bit #**	**Status bit description 0=no error, 1=specified error ccured):**	**Device status masking**		
			Mask bit: 0=disabled 1=enabled (*default)	**Mod LED Flash Code**	**Remarks**
0	0	Program memory corrupt	1	12	One always
	1	RAM test failure	1	12	One always
	2	Undefined	0		Zero always
	3	Non-volatile memory failure	1	12	One always
	4	Undefined	0		Zero always
	5	Internal power supply failure	1	6	One always
	6	Undefined	0		Zero always
	7	Undefined	0		Zero always
1	0	Undefined	0		Zero always
	1	Undefined	0		Zero always
	2	Undefined	0		Zero always
	3	Undefined	0		Zero always
	4	Undefined	0		Zero always
	5	Undefined	0		Zero always
	6	Setpoint deviation (controller error)	0 / 1*	8	
	7	Temperature out of limits (high/low)	0 */ 1	7	
2	0	Low flow alarm (flow alarm 1)	0* / 1	10	
	1	High flow alarm (flow alarm 2)	0* / 1	11	
	2	Totalizer overflow	0* / 1	7	
	3	Undefined	0		Zero always
	4	Undefined	0		Zero always
	5	Valve drive out of limits	0* / 1	3	
	6	Undefined	0		Zero always
	7	Device calibration due	0* / 1	2	
3	0	Device overhaul due	0* / 1	1	
	1	Undefined	0		Zero always
	2	No-flow indication	0/ 1*	9	
	3	Undefined	0		Zero always
	4	Undefined	0		Zero always
	5	Undefined	0		Zero always
	6	Undefined	0		Zero always
	7	Undefined	0		Zero always

LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller.

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller.

BROOKS SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.
For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons.

Please contact your nearest sales representative for more details.

HELP DESK

In case you need technical assistance:

USA	☎ 888 275 8946	Korea	☎ +82 31 708 2521
Netherlands	☎ +31 (0) 318 549 290	Taiwan	☎ +886 3 5590 988
Germany	☎ +49 351 215 2040	China	☎ +86 21 5079 8828
Japan	☎ +81 3 5633 7100	Singapore	☎ +6297 9741

Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

TRADEMARKS
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HART .... HART Communications Foundation

ISO 9001 QUALITY SYSTEM

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