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Technology for Productivity

Flow Measurement & Control

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πMFC

MODEL PFC-50 AND PFC-60

Features & Benefits

Increases Throughput and Performance

- Insensitive to upstream and downstream pressure disturbances
  - — Accurate flow control without the need for additional dedicated line pressure regulators
- Enables better chamber matching through increased MFC accuracy of any process gas
- Increases tool uptime through reduction of “No Problem Found” MFC replacements
  - —Includes embedded diagnostics software that allows users to check MFC functionality without removing the MFC
  - —E-diagnostics through embedded Ethernet interface

Reduces Overall Costs

- Reduces MFC inventory through multi-gas, multi-range availability
- Enables reduction in number of gas stick components needed, such as pressure regulators, filters, and pressure transducers
- Minimizes overall footprint of gas delivery module

Easy to Integrate and Operate

- Straightforward configuration and diagnostics through Ethernet interface
  - —Uses standard web browser – no special software required
  - —Includes remote PC application
- Easy viewing of line pressure, flow rate, gas type, full scale flow range and Ethernet address with bright LED display

Description

The next generation MKS πMFC (mass flow controller) includes technology improvements in functionality and performance to help users in semiconductor and high purity thin-film applications increase tool throughput and reduce overall system costs. Real-time accurate flow control that is insensitive to upstream and downstream pressure disturbances is provided through advanced digital algorithms. Enabling real-time control of process gas flow, accuracy and repeatability is significantly improved over conventional PID based digital MFCs, resulting in better chamber matching.

Cost savings to users are seen through several innovative enhancements. To reduce the number of MFCs in inventory, users can access specific MFC gas calibrations and flow ranges from up to 31 stored gas tables, configuring the πMFC right off the shelf. The integrated pressure sensor and local LED display help to reduce the number of components required in a gas stick. A web based browser interface allows for setup and troubleshooting of MFCs in-situ, thereby reducing the number of “No Problem Found” MFC replacements and the need to break the process gas line.

The πMFC represents MKS’ ongoing dedication to helping customers increase productivity while reducing system costs.

πMFC with Integrated Display —
Ethernet e-diagnostics interface and DNET control option

Description (cont'd)

As a technology leader in MFCs, the πMFC represents the latest in cost effective technology and innovation to meet production needs.

The performance of the πMFC is quickly apparent where short process steps are required. The ability to provide accurate and real-time control of high molecular weight gas applications differentiates πMFC from other market brands. This results in precise etch rates and controlled deposition for most critical semiconductor processes.

To enable ease of integration into next generation or existing process tools, a variety of mechanical configurations exist, including surface mount and VCR®. Coupled with its compact size, the πMFC provides an ideal way to migrate from existing analog MFCs where reducing MFC inventory and improving process repeatability are important.

To ensure that customers can easily use the πMFC, the gas selection and full-scale range can be easily selected by the customer to meet specific application requirements (PFC-50). For DeviceNet™ configurations, this is performed through the DeviceNet protocols or Ethernet interface. For analog I/O users, setup is achieved via Ethernet on or off the tool. Users can configure the πMFC directly through the separate embedded Ethernet port using a standard web browser – no special software is required.

The embedded Ethernet port also offers e-diagnostics capability for maintenance and troubleshooting – without interrupting πMFC operation. Password protected, the configuration mode provides access to all device functions, live updates, and real-time plotting of pressure and flow conditions.

Our award winning manufacturing facility is well versed in producing high quality MFCs to meet the demands of critical ultra-high purity applications. πMFCs are manufactured in our Class 100 cleanroom, in accordance with ISO 9001 procedures. With short lead times to allow you to meet your ever changing delivery schedules, the πMFC meets your business requirements as well as your technical specifications.

Designed with production requirements in mind, the πMFC offers process reliability and device flexibility for all your gas delivery applications.

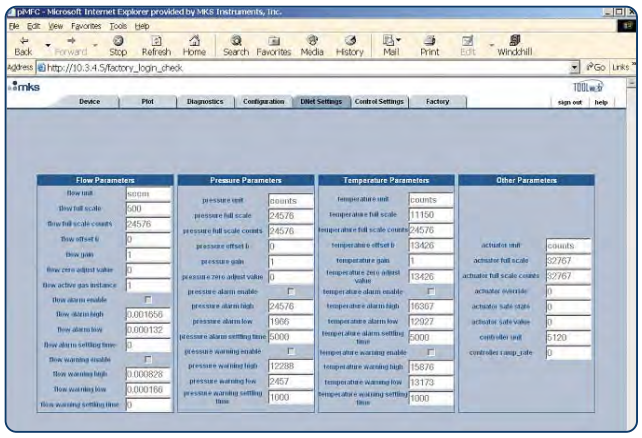


Figure 1 —

πMFC User Interface Screen illustrating DeviceNet™ parameters

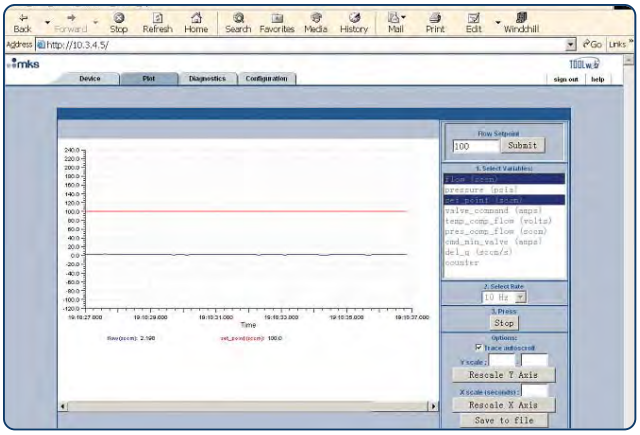


Figure 2 —

πMFC User Interface Screen demonstrating real-time charting of pressure and flow rate.

Performance

Full Scale Flow Ranges *(N_2 equivalent)*	5 - 50000 sccm (consult factory for available flow ranges)
Maximum Inlet Pressure	150 psig (can not exceed pressure differential requirement across MFC)
Normal Operating Pressure Differential	10 to 5000 sccm; 10 to 40 psid
(with atmospheric pressure at the MFC outlet)	10000 to 30000 sccm; 15 to 40 psid
Proof Pressure	1000 psig
Burst Pressure	1500 psig
Control Range	2% to 100% of F.S.
Typical Accuracy	± 1% of setpoint for > 20 to 100% F.S.
	± 0.2% of F.S. for 2 to 20% F.S.
Repeatability	± 0.3% of Reading
Resolution	0.1% of Reading
Temperature Coefficients	
Zero	< 0.05% of F.S./°C
Span	< 0.08% of Rdg./°C
Inlet Pressure Coefficient	< 0.02% of Rdg./psi
Typical Controller Settling Time	< 1.5 sec typical above 5% F.S.
(per SEMI Guideline E-17-0600)	
Warm-up Time	< 30 min
(to within 0.2% of F.S. of steady state performance)	
Normal Operating Temperature Range	10°C to 50°C
Storage Humidity	0 to 95% Relative Humidity, non-condensing
Storage Temperature	-20° to 65°C (-4° to 149° F)
Pressure Display	0 to 100 psia
Pressure Readout Units	psia, kPA
Pressure Accuracy	1% of Reading
Pressure Resolution	0.1 psia
Temperature Display	0 to 100°C
Temperature Readout Units	°C
Temperature Accuracy	± 2°C
Temperature Resolution	0.1°C

Mechanical

Fittings *(compatible with)*	Swagelok® 4 VCR®, 1-1/8" surface mount (C-seal, W-seal)
Display	4 digits for value, 4 characters for unit
Leak Integrity	
External (scc/sec He)	< 1 x 10^{-10}
Through closed valve	< 1.0% of F.S. at 25 psig inlet to atmosphere
	(To assure no flow-through, a separate positive shut-off valve is required.)
Wetted Materials	
Standard	316L S.S. VAR (equivalent to 316 S.S. SCQ for semiconductor quality), 316 S.S., Elgiloy, KM-45, Inconel®, 825 Incoloy®
Optional (Valve Seat)	PTFE (Teflon) or Sapphire (Metal)
Surface Finish	5µ inch average Ra
Weight	less than 3 lbs (1.4kg)

Specifications

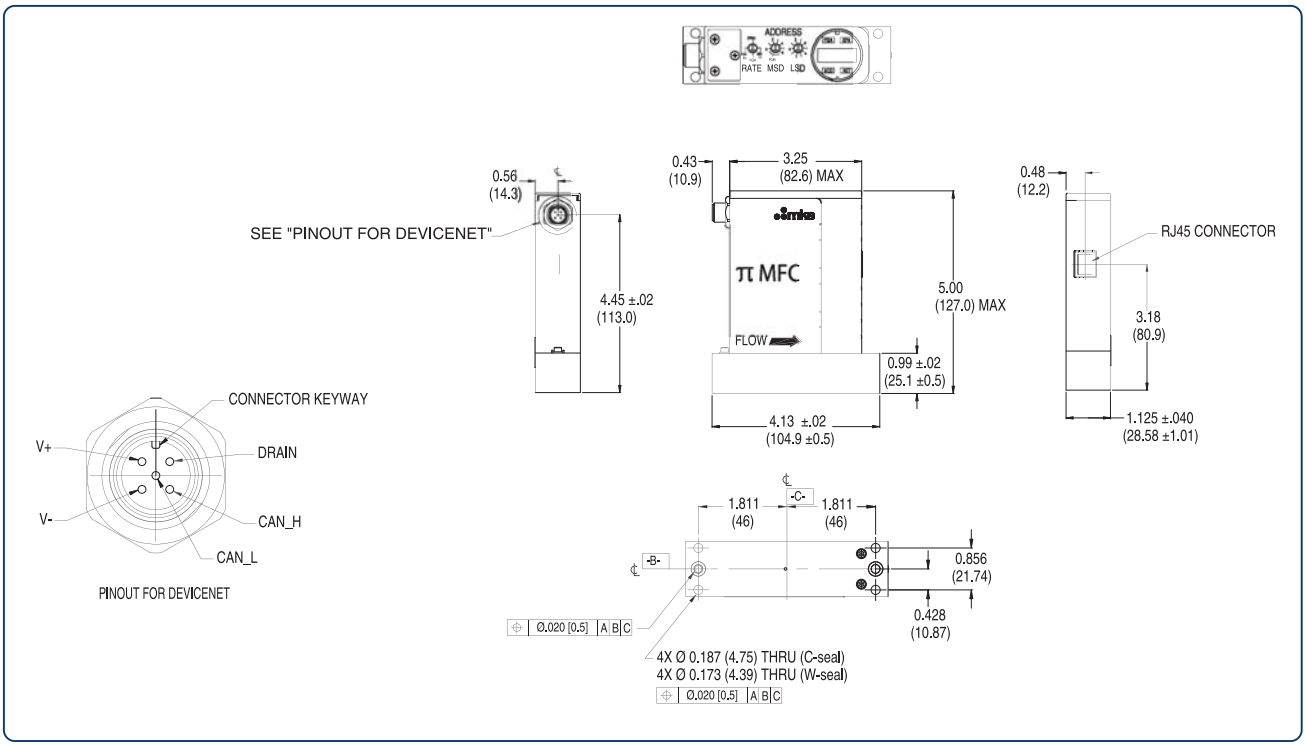
Electrical

Analog I/O

Input Voltage Required	
Max. current at start-up (first 5 sec)	+15 VDC (±5%) @ 350 mA
Typical current at steady state	+15 VDC (±5%) @ 250 mA
Set Point Command Signal	0 to 5 VDC
Flow Output Signal	0 to 5 VDC
Pressure Output	0 to 10 VDC, 0 to 5 VDC, 4-20mA
Output Impedance	< 1 Ω
Connectors	15-pin Type “D”, 9-pin Type “D”
Electromagnetic Compatibilty	CE compliant to EMC Directive 2004/108/EC when used with an overall metal braided shielded cable, properly grounded at both ends

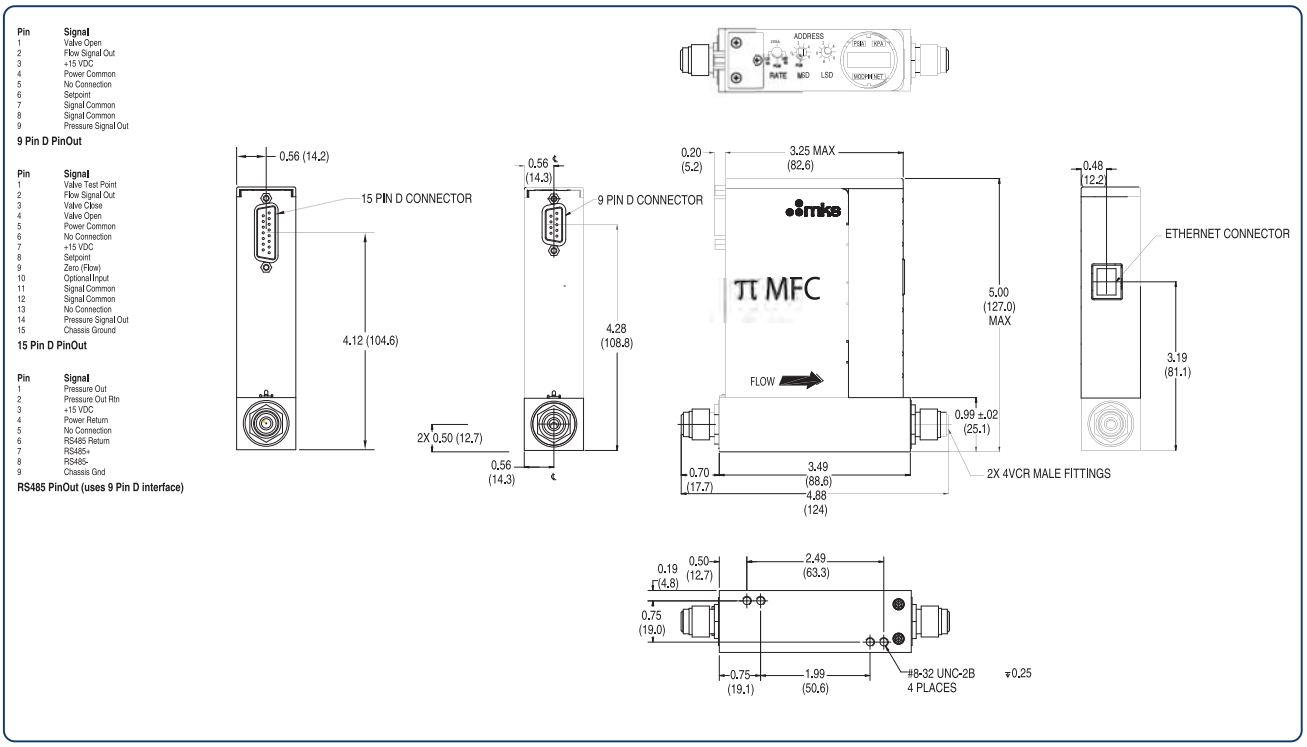
Digital I/O *(DeviceNet)*

Data Rate/Network Length	Data Rate (user selectable)
	125 Kbps, 500 m (1,640 ft.)
	250 Kbps, 250 m (820 ft.)
	500 Kbps, 100m (328 ft.)
Level of Filtering	User software adjustable
Digital Functions *(flow)*	Select units: counts, slm, sccm, % of F.S.
	Remote Zero
	Set/read flow rate
	Flow totalizer and run hours
	Valve soft start
	Monitor MFC status - valve drive level and trip points (alarm for high flow, alarm for low flow, warning for high flow, warning for low flow)
	Overrange, Underange
	Reset factory defaults
	Report run time hours
	Change user tags and device address
	Device Identification Storage includes manufacturer information, model and serial number, original factory calibration, software and hardware revision numbers.
Digital Functions *(pressure)*	Alarm enable, Warning enable
	Alarm settling time, Warning settling time
	Alarm trip point high, Warning trip point high
	Alarm trip point low, Warning trip point low
	Zero adjust
Digital Functions *(temperature)*	Alarm enable, Warning enable
	Alarm settling time, Warning settling time
	Alarm trip point high, Warning trip point high
	Alarm trip point low, Warning trip point low
	Zero adjust
Data Rate Switch	4 positions: 125, 250, 500K, PGM
	(programmable over the network)
MAC ID Switches	2 switches, 10 positions; 0,0 to 6,3 are hardware ID numbers; 7,0 to 9,9 are software ID numbers (6,4 to 6,9 are unused and, if selected will default to hardware ID number 6,3)
Input Power	11 to 25 VDC per DeviceNet specification (@ <3.5 watts)
Network Size	Up to 64 nodes
Network Topology	Linear (trunkline/dropline) power and signal on same network cable
Visual Communication Indicators	LED network status (green/red)
	LED module status (green/red)



Dimensional Drawing and PinOuts—DownMount Version with DeviceNet™

Note: Unless specified, dimensions are nominal values in inches (mm referenced).



Dimensional Drawing and PinOuts—Swagelok® 4 VCR® Version with Analog 9 Pin D

Note: Unless specified, dimensions are nominal values in inches (mm referenced).

Ordering Information

Ordering Code Example: P5A013502C6T021	Code	Configuration
Type πMFC Mass Flow Controller (multigas, multi-range) PFC-50	P5A	P5A
Type πMFC Mass Flow Controller (multigas, pressure insensitive) PFC-60	P6A	
Gas *(see gas chart on page 8 for configuration)*		
For example:		013
013 = Nitrogen = N_2	013	
029 = Ammonia = NH_3	029	
110 = Sulfur Hexafluoride = SF_6	110	
Flow Range Full Scale*		502
5 sccm	500	
10 sccm	101	
20 sccm	201	
50 sccm	501	
100 sccm	102	
200 sccm	202	
500 sccm	502	
1000 sccm	103	
2000 sccm	203	
5000 sccm	503	
10000 sccm	104	
20000 sccm	204	
30000 sccm	304	
50000 sccm	504	
Fittings *(compatible with)*		
Swagelok 4 VCR	R	C
C-seal	C	
W-seal	H	
Connector		
DeviceNet	6	6
RS485	5	
15 pin D (Analog I/O)	B	
9 pin D (Analog I/O)	A	
Valve		
Normally Closed, Metal (sapphire): (10 sccm - 10 slm N_2 equivalent)	M	T
Normally Closed, Teflon®: (10 sccm - 30 slm N_2 equivalent)	T	
Reserved for MKS Future Use		
Standard	0	0
Firmware		
Unless otherwise specified, MKS will ship firmware revision current to date (DeviceNet only)	21	21

* The Full Scale Flowrate is designated by a 3 digit number. The first two digits represent the significant digits of the FS flow rate separated by a decimal point. The third digit is the exponent of the power of ten.

Example Flowrate code:
254 is 2.5 x 10^4 or 25000 sccm
153 is 1.5 x 10^3 or 1500 sccm
601 is 6.0 x 10^1 or 60 sccm

Gas Code Configuration

Gas	Code	Symbol
Acetone	184	C3H6O
Acetylene	042	C2H2
Air	008	Air
Allene	066	C3H4
Ammonia	029	NH3
Argon	004	Ar
Arsine	035	AsH3
Boron Trichloride	070	BCl3
Boron Trifluoride	048	BF3
Bromine	021	Br2
Bromine Pentafluoride	116	BrF5
Bromine Trifluoride	076	BrF3
Bromotrifluoromethane (R-13b1)	080	CBrF3
Butane	117	C4H10
Carbon Dioxide	025	CO2
Carbon Disulfide	040	CS2
Carbon Monoxide	009	CO
Carbon Tetrachloride	101	CCl4
Carbon Tetrafluoride (R-14)	063	CF4
Carbonyl Sulfide	034	COS
Chlorine	019	Cl2
Chlorine Trifluoride	077	ClF3
Chlorodifluoromethane (R-22)	057	CHClF2
Chloroform (Trichloromethane)	071	CHCl3
Chloropentafluoroethane (R-115)	119	C2ClF5
Chlorotrifluoromethane (R-13)	074	CClF3
Cyanogen	059	C2N2
Cyanogen Chloride	037	ClCN
Cyclopropane	061	C3H6
Deuterium	014	D2
Diborane	058	B2H6
Dichlorodifluoromethane (R-12)	084	CCl2F2
Dichlorofluoromethane (R-21)	065	CHCl2F
Dichlorosilane	067	SiH2Cl2
1,2-Dichlorotetrafluoroethane (R-114)	125	C2Cl2F4
Difluoroethylene (R-1132a)	064	C2H2F2
Difluoromethane	160	CH2F2
Dimethylamine	085	C2H7N
Dimethylpropane	122	C5H12
Disilane	097	Si2H6
Ethane	054	C2H6
Ethanol	136	C2H6O
Ethyl Acetylene	093	C4H6
Ethyl Chloride	075	C2H5Cl
Ethylene	038	C2H4
Ethylene Oxide	045	C2H4O
Fluorine	018	F2
Germane	043	GeH4
Germanium Tetrachloride	113	GeCl4
Helium	001	He
Hexafluoro Butadiene-1,3	297	C4F6
Hexafluoroethane (R-116)	118	C2F6
Hexafluoropropylene	138	C3F6
Hexane	127	C6H14
Hydrogen	007	H2
Hydrogen Bromide	010	HBr
Hydrogen Chloride	011	HCl
Hydrogen Cyanide	024	HCN
Hydrogen Fluoride	012	HF
Hydrogen Iodide	017	HI
Hydrogen Selenide	023	H2Se

Gas	Code	Symbol
Hydrogen Sulfide	022	H2S
Iodine Pentafluoride	115	IF5
Isobutane	111	C4H10
Isobutylene	106	C4H8
Krypton	005	Kr
Methane	028	CH4
Methanol	176	CH4O
Methyl Acetylene	068	C3H4
Methyl Bromide	044	CH3Br
Methyl Chloride	036	CH3Cl
Methyl Fluoride	033	CH3F
Methyl Mercaptan	047	CH4S
Methylamine	052	CH5N
Methyltrichlorosilane	183	CH3Cl3Si
Molybdenum Hexafluoride	124	MoF6
Neon	002	Ne
Nitric Oxide	016	NO
Nitrogen	013	N2
Nitrogen Dioxide	026	NO2
Nitrogen Trifluoride	053	NF3
Nitrosyl Chloride	141	NOCl
Nitrous Oxide	027	N2O
Octafluorocyclobutane (R-c318)	129	C4F8
Oxygen	015	O2
Oxygen Difluoride	041	OF2
Pentaborane	142	B5H9
Pentafluorethane	155	C2HF5
Perchloryl Fluoride	072	ClO3F
Perfluoropropane	128	C3F8
Phosgene	060	CCl2O
Phosphine	031	PH3
Phosphorous Oxychloride	102	POCl3
Phosphorous Pentafluoride	143	PF5
Propane	089	C3H8
Propylene	069	C3H6
Radon	003	Rn
Silane	039	SiH4
Silicon Tetrachloride	108	SiCl4
Silicon Tetrafluoride	088	SiF4
Sulfur Dioxide	032	SO2
Sulfur Hexafluoride	110	SF6
Sulfur Tetrafluoride	086	SF4
Sulfuryl Fluoride	087	SO2F2
Tetrafluoroethane (R-134a)	156	C2H2F4
Titanium Tetrachloride	114	TiCl4
Toluene	181	C7H8
Trans-Butene	098	C4H8
Trichloroethane	112	C2H3Cl3
Trichlorofluoromethane (R-11)	091	CCl3F
Trichlorosilane	147	SiHCl3
Trichlorotrifluoroethane (R-113)	126	C2Cl3F3
Trifluoromethane (Fluoroform R-23)	049	CHF3
Trimethoxyborine	131	C3H9BO3
Trimethylamine	109	C3H9N
Tungsten Hexafluoride	121	WF6
Uranium Hexafluoride	123	UF6
Vinyl Bromide	056	C2H3Br
Vinyl Chloride	055	C2H3Cl
Xenon	006	Xe

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