DESIGN FEATURES

- ✓ Rigid metallic construction.
- ✓ Maximum pressure of 1000 psig (70 bars) for GM1, GM3, GM4 models. 500 psig for GM5, GM6 and GM7.
- ✓ Leak integrity 1 x 10^{-9} of helium.
- ✓ NIST traceable certification.
- ✓ Built-in tiltable LCD readout.
- ✓ 0-5 Vdc and 4-20 mA signals.
- ✓ Circuit protection.
- ✓ Can be used as a portable device.
- ✓ Engineering units or 0 to 100% displays.
- ✓ Totalizer option.

MASS FLOW METERS

A low cost solution to thermal mass flow metering for gases is presented by Dakota's mass flow meter line.

The mass flow meter design combines the convenience and accuracy of conventional mass flow devices with low costs previously unattainable.

Each of these meters incorporate an advanced straight tube sensor in conjunction with flow passage elements constructed of aluminum and brass for non-corrosive gases or 316 stainless steel for corrosive applications.

GENERAL DESCRIPTION

Compact, self contained Mass Flow Meters are designed to read flow rates of gases. The rugged design coupled with instrumentation grade accuracy provides versatile and economical means of flow control.

Aluminum or stainless steel models with readout options of either engineering units (standard) or 0 to 100 percent displays are available.

The mechanical layout of the design includes an LCD readout built into the top of the transducer. This read-out module is tiltable over 90 degrees to provide optimal reading comfort. It is connected to the transducer by a standard modular plug, and is also readily removable for remote reading installations. Transducers without LCD readout are offered for OEM applications.

Mass flow meters are available with flow ranges from 10 sccm to 1000 sL/min N_2. Gases are connected by means of 1/4", 3/8", 1/2" compression fittings and 3/4" FNPT fittings. Optional fittings are available. These controllers may be used as bench top units or mounted by means of screws in the base.

SPECIFICATIONS

ACCURACY: **GM 1, 3 and 4:** ±1.0% of full scale.
GM 5, 6 and 7: ±1.5% of full scale.
OPTIONAL ENHANCED ACCURACY: ±1.0% of full scale.

CALIBRATIONS: Performed at standard conditions [14.7 psia (101.4 kPa) and 70 °F (21.1 °C)] unless otherwise requested.

REPEATABILITY: ±0.25% of full scale.

RESPONSE TIME: Generally 2 seconds to within ±2% of actual flow rate over 25 to 100% of full scale.

TEMPERATURE COEFFICIENT:
0.15% of full scale / °C.

PRESSURE COEFFICIENT:
0.01% of full scale / psi (0.07 bar).

MAXIMUM PRESSURE DROP:
See Table 3.

GAS AND AMBIENT TEMP.:
Gas: 32 °F to 122 °F (0 °C to 50 °C).
Ambient: 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only.

OUTPUT SIGNALS: Linear 0-5 Vdc. 1000 ohms min.load impedance and 4-20 mA 0-500 Ohms loop resistance.

TRANSDUCER INPUT POWER:
Universal +12 to +26 VDC, 200 mA maximum.

TIME CONSTANT: 800 ms.

GAS PRESSURE: 1000 psig (70 bars) maximum GM 1, 3, 4. 20 psig (1.4 bars) optimum. 500 psig (34.5 bars) GM 5, 6, 7. 20 psig (1.4 bars) optimum.

MATERIALS IN FLUID CONTACT:
a. Aluminum models GM Series: anodized aluminum, 316 stainless steel, brass and Fkm O-rings.
b. Stainless steel models GM1S, 3S,4S, 5S, 67S and 7S: 316 stainless steel and Fkm O-rings. Optional O-rings: Buna®, EPR and FFKM.

ATTITUDE SENSITIVITY:
No greater than +15 degree rotation from horizontal to vertical; standard calibration is in horizontal position.

CONNECTIONS:
GM 1: 1/4" compression fittings.
Optional: 6mm, 3/8" and 1/8" compression fittings or 1/4" VCR® .
GM 3: 1/4" compression fittings.
Optional: 6mm and 3/8" compression fittings or 1/4" VCR®
GM 4: 3/8" compression fittings.
GM 5: 3/8" compression fittings.
GM 6: 1/2" compression fittings.
GM 7: 3/4" FNPT fittings or 3/4" compression fittings.

LEAK INTEGRITY: 1 x 10^{-9} smL/sec of helium maximum to the outside environment.

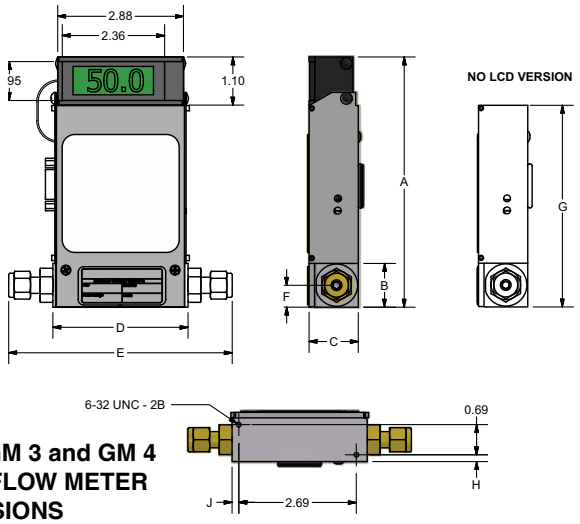
CE COMPLIANT: EN 55011 class 1, class B; EN50082-1.

⚠ *The selection of materials of construction, is the is the responsibility of the customer. The company accepts no liability.*

***DIMENSIONS** (not including fittings)

GM1:	Models up to 15 sL/min: 3" W x 5 1/2" H x 1" D
GM3 /GM4:	30 to 100 sL/min models: 3 5/8" W x 6" H x 1 1/4" D
GM5:	200 sL/min models: 12" W x 9" H x 2 1/2" D
GM6:	500 sL/min models: 12" W X 10" H X 3 1/2" D
GM7:	1000 sL/min models: 12" W x 11 1/2" H x 5" D

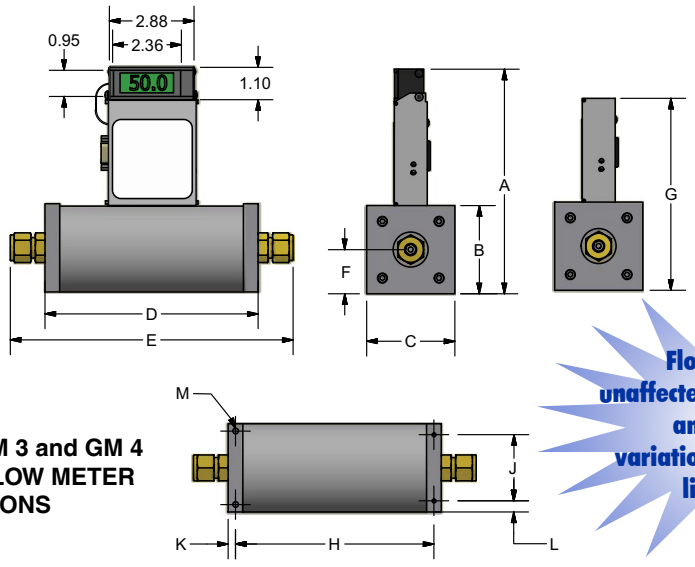
Mass Flow Meters



GM 1, GM 3 and GM 4 MASS FLOW METER DIMENSIONS

MODEL	CONNECTION COMPRESSION FITTING	DIMENSION INCH (MM)								
		LCD VERSION						NO LCD	MOUNTING HOLE	
		A	B	C	D	E	F	G	H	J
GM 1	¼" Tube O Diameter	5.72 (145.3)	1.00 (25.4)	1.13 (28.6)	3.09 (78.6)	5.10 (129.6)	0.5 (12.7)	4.61 (117.1)	0.16 (4.0)	0.16 (4.0)
GM 3	¼" Tube O Diameter	6.10 (154.9)	1.38 (34.9)	1.25 (31.8)	4.13 (104.8)	6.13 (155.8)	0.63 (15.9)	4.99 (126.7)	0.28 (7.1)	1.08 (27.3)
GM 4	¾" Tube O Diameter	6.10 (154.9)	1.38 (34.9)	1.25 (31.8)	4.13 (104.8)	6.25 (158.7)	0.63 (15.9)	4.99 (126.7)	0.28 (7.1)	1.08 (27.3)

MODEL	FLOW RATE [std liters/min]	MAXIMUM PRESSURE DROP		
		[mm H_2O]	[psid]	[mbar]
GM1	up to 10	58	0.083	5.7
GM3	20	300	0.44	30
	30	800	1.18	81
	40	1480	2.18	150
	50	2200	3.23	223
GM4	60	3100	4.56	314
	80	4422	6.5	448
	100	5500	8.08	557
GM5	200	2720	4.0	280
GM6	500	3400	5.0	340
GM7	1000	6120	9.0	620



GM 1, GM 3 and GM 4 MASS FLOW METER DIMENSIONS

Flow rates are unaffected by temperature and pressure variations within stated limitations.

MODEL	CONNECTION COMPRESSION FITTING (Except Model GM 7)	DIMENSION INCH (MM)											
		LCD VERSION						NO LCD	MOUNTING HOLE				
		A	B	C	D	E	F	G	H	J	K	L	M
GM 5	⅜" Tube O Diameter	6.73 (170.8)	2.00 (80.8)	1.75 (44.5)	6.69 (169.8)	8.81 (223.7)	0.88 (22.2)	5.62 (142.6)	4.69 (119.0)	1.39 (35.3)	1.00 (25.4)	0.18 (4.6)	10-24 x 0.25
GM 6	½" Tube O Diameter	7.64 (194.0)	3.00 (76.2)	3.00 (76.2)	7.25 (184.2)	9.65 (245.1)	1.5 (38.1)	6.53 (165.8)	6.75 (171.5)	2.25 (57.2)	0.25 (6.4)	0.38 (9.5)	1/4-20 x 0.35
GM 7	¾" NPT Female	8.66 (220.0)	4.00 (101.6)	4.00 (101.6)	7.30 (185.4)	-	2.00 (50.8)	7.55 (191.8)	6.80 (172.7)	3.00 (76.2)	0.25 (6.4)	0.50 (12.7)	1/4-20 x 0.35

PRINCIPLES OF OPERATION

Metered gases are divided into two laminar flow paths, one through the primary flow conduit, and the other through a capillary sensor tube. Both flow conduits are designed to ensure laminar flows and therefore the ratio of their flow rates is constant.

Two precision temperature sensing windings on the sensor tube are heated, and when flow takes place, gas carries heat from the upstream to the downstream windings. The resultant temperature differential is proportional to the change in resistance of the sensor windings.

Output signals of 0 to 5Vdc and 4 to 20mA are generated indicating mass molecular based flow rates of the metered gas.

Flow rates are unaffected by temperature and pressure variations within stated limitations.

www.dakotainstruments.com ✉ e-mail: info@dakotainstruments.com ☎ Toll Free in U.S.A. and Canada 1.800.879.7713
Prices are subject to change without notice.

TABLE 45, MASS FLOW CONTROLLER ACCESSORIES	
MODEL NO.	**POWER SUPPLIES**
6APSGCNA-12	Power Supply 110 vac/12 Vdc (North America)
6APSGCNA-24	Power Supply 110 vac/24Vdc (North America)
6APSGCEU-12	Power Supply 230 vac/12 Vdc (Europe)
6APSGCEU-24	Power Supply 230 vac/24 Vdc (Europe)
6APSGCAU-12	Power Supply 240 vac/12 Vdc (Australia)
6APSGCAU-24	Power Supply 240 vac/24 Vdc (Australia)
6APSGCUK-12	Power Supply 240 vac/12 Vdc (United Kingdom)
6APSGCUK-24	Power Supply 240 vac/24 Vdc (United Kingdom)
CABLE ASSEMBLY	
6ACBLGCD	Shielded cable assembly, 8ft long with 15 pin D-connector
REMOTE READ OUT AND CABLE FOR REMOTE READOUT	
6ARLCDGM-3F	Remote LCD readout, with 3ft cable
6ARCBLGM-3F	Remote cable, 3ft.

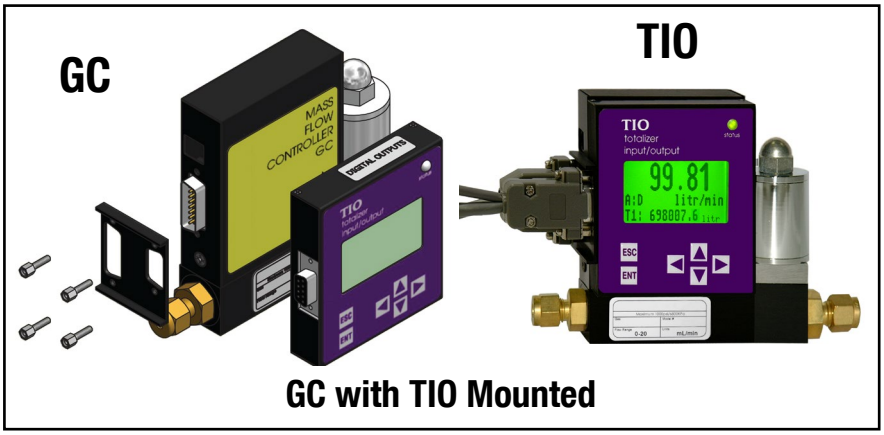
RECHARGEABLE BATTERY KIT

Mass Flow Meter with Rechargeable Battery Kit

In many applications where line voltage is either not available or desirable, the mass flow meter can be used as a portable device. This is accomplished by using an external rechargeable battery kit.

The complete kit includes a battery, recharger and a compact carrying case with shoulder strap and belt loop. With the battery kit, the meter can be used in excess of 40 hours without recharging.

TABLE 45-1, MASS FLOW METER ACCESSORIES	
MODEL NO.	**POWER SUPPLIES**
6APSGMNA-12	Power Supply 110 vac/12 Vdc (North America)
6APSGMNA-24	Power Supply 110 vac/24Vdc (North America)
6APSGMEU-12	Power Supply 230 vac/12 Vdc (Europe)
6APSGMEU-24	Power Supply 230 vac/24 Vdc (Europe)
6APSGMAU-12	Power Supply 240 vac/12 Vdc (Australia)
6APSGMAU-24	Power Supply 240 vac/24 Vdc (Australia)
6APSGMUK-12	Power Supply 240 vac/240 Vdc (United Kingdom)
6APSGMUK-24	Power Supply 240 vac/240 Vdc (United Kingdom)
BATTERY KIT WITH RECHARGER	
6ABPGMNA-12	Battery Kit, with recharger (110v)
6ABPGMEU-12	Battery Kit, with recharger (220v)
FEMALE 9 PIN D-CONNECTOR WITH CABLE	
6ACBLGM4-3F	Female 9 pin D-connector, with 3ft cable for connection to MDPC. (4-20 mA)
6ACBLGM4-6F	Female 9 pin D-connector, with 6ft cable for connection to MDPC. (4-20 mA)
6ACBLGM5-3F	Female 9 pin D-connector, with 3ft cable for connection to MDPC. (0 - 5 vdc)
6ACBLGM5-6F	Female 9 pin D-connector, with 6ft cable for connection to MDPC. (0 - 5 vdc)
REMOTE READ OUT AND CABLE FOR REMOTE READOUT	
6ARLCDGM-3F	Remote LCD readout, with 3ft cable
6ARCBLGM-3F	Remote cable, 3ft. (additional cable lengths available) Contact Dakota®.



DESIGN FEATURES

- ✓ Displays instantaneous, total and accumulated flow rates.
- ✓ Built-in Flow Linearizer (10 point linearization of the flow curve).
- ✓ Up to 47 different volumetric and mass flow engineering units.
- ✓ Large 13mm (0.51") digits for flow rate and 5.5mm (0.21") for Total.
- ✓ Digital RS-232 or RS-485 interface (multi-drop capability of up to 64 devices.)
- ✓ Compact design for unit mount, panel mount, wall mount or field mount applications.
- ✓ User-programmable, optically-isolated pulse output.
- ✓ Two programmable, optically-isolated, digital outputs.
- ✓ Flow controllers, set point command control via local LCD or digital interface.
- ✓ Programmable set point table with ramping up/down capability up to 16 steps.
- ✓ Free Configuration and Monitoring Utility software.

Programmable Pulse Output

The programmable flow pulse output is operating independently from totalizers and based on configuration settings can provide pulse frequency proportional to instantaneous fluid flow rate.

The LCD/keypad and digital communication interface commands are provided to:

- ✓ Enable/Disable Pulse Output.
- ✓ Configure Pulse Output start flow rate (in % of full scale).
- ✓ Configure the Unit/Pulse value (in current volumetric or mass flow units).
- ✓ Configure Pulse Active On Time (10 - 6550 ms).

Applications

For flow meters and controllers with analog 0-5 (5-10) (0-10)Vdc, 4-20mA input output interface, where flow indications / control and totalizers or alarm functions are required. Also when re-transmission of the flow rate and/or totalizer functions via optically-isolated pulse output or serial communication is desired. Local or programmable set point control for flow controllers (no host PC presence required). Activation of user-supplied equipment via programmable optically-isolated digital outputs when flow alarms or totalizers events are active.

Display

The graphical LCD display has large 13mm (0.51") digits for flow rate and 5.5mm (0.21") for total and can be set by user to simultaneously show different combination of the flow parameters: flow rate, totalizers, flow alarms, and diagnostic events . All configuration parameter settings are easily accessed via a simple user-interface menu driven by a 6 button key-pad which can be password-protected.

Signal Input and Signal Output

- ✓ 0-5 Vdc (Input/Output)
- ✓ 5-10 Vdc (Output only)
- ✓ 0-10 Vdc (Input/Output)
- ✓ 4-20 mA (Input/Output)

For flow meters and / or flow controllers, TIO provides jumpers selectable for 0-5 Vdc or 4-20 mA analog set point control signals. The flow rate set point can be adjusted locally via key-pad, remotely via host PC using digital communication interface, or programmed in advance using built-in 16 steps batch table with ramping up/down support.

Digital Communication

All process data and settings can be read and modified manually via local LCD Key-pad or through the digital RS-232 or RS-485 communication interface. Proprietary ASCII software interface command set and free Communication Utility software are provided.

Programmable Totalizers

TIO provides two independent programmable flow totalizers. Both totalizers are updated every 100 ms and can be set to activate different events. Main totalizer accumulated total is backed-up in EEPROM memory every second.

The LCD/keypad and digital communication interface commands are provided to:

- ✓ Enable/Disable totalizing the flow.
- ✓ Start the totalizer at a preset flow rate (in % of full scale).
- ✓ Assign action at a preset total volume (Event Volume).
- ✓ Configure power on delay (in seconds).
- ✓ Configure Auto Reset at preset volume.
- ✓ Configure Auto Reset delay (in seconds).
- ✓ Reset the totalizer to ZERO.

Programmable Alarms

TIO provides the user with a flexible alarm/warning system that monitors the fluid flow for conditions that fall outside configurable limits as well as visual feedback for the user via the LCD or via an optically-isolated output. The flow alarm has several attributes which can be configured by the user via LCD/Keypad or digital communication interface:

- ✓ Enable/Disable flow alarm.
- ✓ Low flow alarm settings (in % of full scale).
- ✓ High flow alarm settings (in % of full scale).
- ✓ Flow alarm action delay.
- ✓ Flow alarm action latch mode.

SPECIFICATIONS

ADC/DAC RESOLUTION:	12 bit.
ANALOG INPUTS:	0-5 Vdc, 4-20 mA, 5-10 Vdc (jumper-selectable), 0-10 Vdc (special order).
ANALOG OUTPUTS:	0-5 Vdc, 4-20 mA (jumper-selectable).
LCD:	128x64 graphic LCD with instantaneous Flow reading and Total volume indication. Adjustable LCD contrast and back light.
KEY-PAD:	Local 6 tactical push buttons.
PULSE OUTPUT:	User-programmable, optically-isolated, with preset active low time interval (10 – 6550 ms).
DIGITAL OUTPUT:	Two programmable, optically-isolated, UCE @ 40Vdc, ICE @ 150 mA (Voltage Isolation: 250 Vrms).
DIGITAL INTERFACE:	RS-232 or RS-485 (multi-drop capability up to 64 devices).
PROTOCOL:	Proprietary ASCII software interface command set.
SPEED:	1200 - 2400 - 4800 - 9600 -19200 – 38400 – 57600 – 115200 baud (user selectable).
CONFIGURATION:	**Stop bit:** 1 **Data bits:** 8 **Parity:** None **Flow Control:** None
ADDRESSING:	Maximum 255 addresses (for RS-485 option only).
TYPE:	RS232 or RS485 2-wire.
POWER REQUIREMENTS:	12 – 26 Vdc (up to 60 mA maximum).
INTERFACE CONNECTORS:	Process I/O signals and Digital RS-232/RS-485 interface – miniature 9 pin female D-SUB connector. Digital optically-isolated outputs: TERM BLOCK HEADER 4POS 3.5MM Male Pins, Shrouded.
ENVIRONMENT:	Installation Level II, Pollution Degree II, (Per IEC 664).
ELECTROMAGNETIC COMPATIBILITY:	Compliant ref. 89/336/EEC as amended. Emission Standard: EN 55011:1991, Group 1, Class A Immunity Standard: EN 55082- 1:1992
OPERATING TEMPERATURE:	-10 °C to +70 °C (14°F to +158 °F).
DIMENSIONS:	86.4 x 76.2 x 19.1 mm (3.4" x 3.0" x 0.75") - W x H x D.
WEIGHT:	Appr. 125g / 0.3 lbs.

⚠ *The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

TABLE 49, TIO ACCESSORY'S

MODEL NO.	DESCRIPTION	WHEN REQUIRED
KIT-TM-DD	GM flow meter mounting kit, shielded cable with two 9 pins D-connectors for process signals and communication branch.	GM + digital communication with Host PC or PLC.
KIT-TM-RD	GM flow meter mounting kit, 4 wire cable between GM RJ11 and TIO 9 pin D-connector.	GM (12 Vdc power option only), 5-10 Vdc input, no digital communication.
KIT-TM-FD	GM flow meter mounting kit, flat wire cable between GM and TIO 9 pin D-connectors.	GM, 0-5Vdc input no digital communication.
KIT-TC-110NA-2C	GC flow controller mounting kit, shielded cable with North America plug 110 Vac to 12 Vdc power supply, communication branch.	GC, 0-5 Vdc input, North America 12 Vdc power supply, digital communication.
KIT-TC-110NA-2N	GC flow controller mounting kit, shielded cable with North America plug 110 Vac to 12 Vdc power supply.	GC, 0-5 Vdc input, North America 12 Vdc power supply.
KIT-TC-110NA-4C	GC flow controller mounting kit, shielded cable with North America plug 110 Vac to 24 Vdc power supply, communication branch.	GC, 0-5 Vdc input, North America 12 Vdc power supply.
KIT-TC-110NA-4N	GC flow controller mounting kit, shielded cable with North America plug 110 Vac to 24 Vdc power supply.	GC, 0-5 Vdc input, North America 24 Vdc power supply.
KIT-TC-230EU-2C	GC flow controller mounting kit, shielded cable with EUROPE plug 230 Vac to 12 Vdc power supply, communication branch.	GC, 0-5 Vdc input, Europe 12 Vdc power supply, digital communication.
KIT-TC-230EU -2N	GC flow controller mounting kit, shielded cable with EUROPE plug 230 Vac to 12 Vdc power supply.	GC, 0-5 Vdc input, Europe 12 Vdc power supply.
KIT-TC-230EU -4C	GC flow controller mounting kit, shielded cable with EUROPE plug 230 Vac to 24 Vdc power supply, communication branch.	GC, 0-5 Vdc input, Europe 24 Vdc power supply, digital communication.
KIT-TC-230EU -4N	GC flow controller mounting kit, shielded cable with EUROPE plug 230 Vac to 24 Vdc power supply.	GC, 0-5 Vdc input, Europe 24 Vdc power supply.
KIT-TC-240AU-2C	GC flow controller mounting kit, shielded cable with AUSTRALIA plug 240 Vac to 12 Vdc power supply, communication branch.	GC, 0-5 Vdc input, Australia 12 Vdc power supply, digital communication.
KIT-TC-240AU-2N	GC flow controller mounting kit, shielded cable with AUSTRALIA plug 240 Vac to 12 Vdc power supply.	GC, 0-5 Vdc input, Australia 12 Vdc power supply.
KIT-TC-240AU-4C	GC flow controller mounting kit, shielded cable with AUSTRALIA plug 240 Vac to 24 Vdc power supply, communication branch.	GC, 0-5 Vdc input, Australia 24 Vdc power supply, digital communication.
KIT-TC-240AU-4N	GC flow controller mounting kit, shielded cable with AUSTRALIA plug 240 Vac to 12 Vdc power supply.	GC, 0-5 Vdc input, Australia 24 Vdc power supply.
KIT-TC-240UK-2C	GC flow controller mounting kit, shielded cable with UK plug 240 Vac to 12 Vdc power supply, communication branch.	GC, 0-5 Vdc input, UK 12 Vdc power supply, digital communication.
KIT-TC-240UK -2N	GC flow controller mounting kit, shielded cable with UK plug 240 Vac to 12 Vdc power supply.	GC, 0-5 Vdc input, UK 12 Vdc power supply.
KIT-TC-240UK -4C	GC flow controller mounting kit, shielded cable with UK plug 240 Vac to 24 Vdc power supply, communication branch.	GC, 0-5 Vdc input, UK 24 Vdc power supply, digital communication.
KIT-TC-240UK-4N	GC flow controller mounting kit, shielded cable with UK plug 240 Vac to 24 Vdc power supply.	GC, 0-5 Vdc input, UK 24 Vdc power supply.
KIT-TC-240UK-2AC	GC flow controller mounting kit, shielded cable with UK plug 240 Vac to 12 Vdc power supply, communication branch, analog 4-20 mA output branch from GC.	GC, 0-5 Vdc input, UK 12 Vdc power supply, digital communication, analog 4-20 mA output branch from GC.
KIT-TC-240UK-4AC	GC flow controller mounting kit, shielded cable with UK plug 240 Vac to 24 Vdc power supply, communication branch, analog 4-20 mA output branch from GC.	GC, 0-5 Vdc input, UK 12 Vdc power supply, digital communication, analog 4-20 mA output branch from GC.
KIT-TM	GM flow meter mounting kit, no cables.	GM, user-supplied custom cables.
KIT-TC	GC flow controller mounting kit, no cables.	GC, user-supplied custom cables.
CBL-DA9-X	9 conductor round shielded cable consisting of a 9 pin Female “D” Sub-Connector (plug) on one end, and loose wires on the other end.	For TIO stand alone option, user-supplied power supply.