

Installation & Operation Manual

Quantim[®] QMC Series **Mass Flow Controllers & Meters**

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.

⚠ WARNING: Prior to installation ensure this instrument has the required approval ratings to meet local and national codes. Failure to heed this warning can result in serious personal injury and / or damage to the equipment.

- 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.
- Products described in this manual are in compliance with EN directive 2014/34/EU.
- All Brooks Instrument Flowmeters fall under fluid group 1.
- Products larger than 25mm or 1" (inch) are in compliance with PED category I, II or III.
- Products 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 2014/30/EU).

Special attention however is required when selecting the signal cable to be used with CE marked equipment.

Grounding Signal Wire & Power Lines

- 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.
- For twisted pair connection (e.g. RJ45), to avoid electrical interference and to meet the Electro Magnetic Compatibility (EMC directive) requirements, use individually shielded twisted pair cable, either in single pair or multi-pair varieties.
- For pin configuration : Please refer to the enclosed Instruction Manual.

Grounding the Device

- Ground the device to earth using a low-impedance conductive connection path, such as a grounded substrate or the pipeline plumbing (if the joints are ground-bonded). Improper grounding can cause measurement error or damage to the device.

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

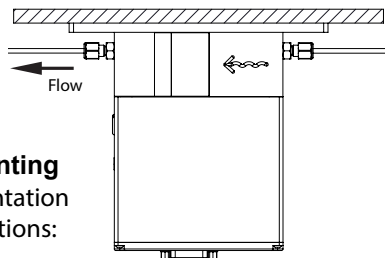
This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these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

Step 1: Location/Orientation

The instrument may be located anywhere in the process line, as long as the following conditions are met:

- Before operation, you must be able to stop flow through the meter. During the zeroing procedure, flow must be stopped completely, and the flow meter sensor tube must be full of process fluid to achieve an accurate zero.
- During operation, the flow sensor tube must be full of process fluid.
- Ambient temperature must remain between 0° and 60°C (32°F and 140°F).
- The instrument (cable connections, wiring compartments and/or conduit openings) should be accessible for service.

1-1

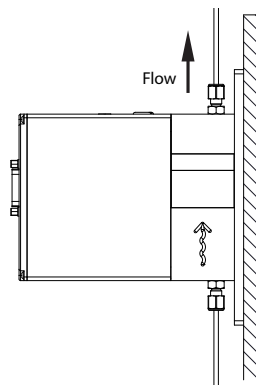


Horizontal Down Mounting

Preferred mounting orientation for most **LIQUID** applications:

- Sensor tube **DOWN**
- Horizontal pipeline

1-2

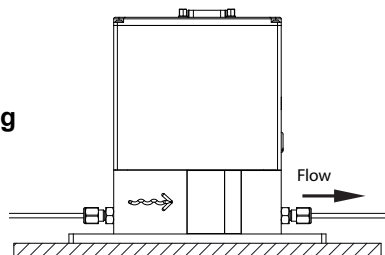


Vertical Mounting

Orientation for **LIQUID** applications where entrapped gas may occur:

- Flag mount
- Vertical pipeline

1-3



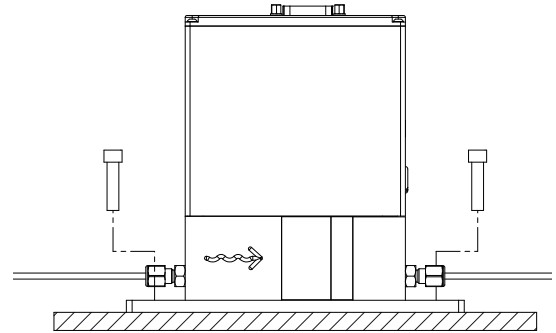
Horizontal Up Mounting

Preferred mounting for most **GAS** applications:

- Sensor tube **UP**
- Horizontal pipeline

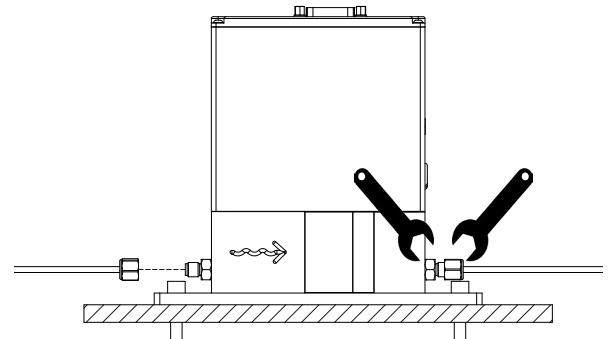
Step 2: Mounting the Quantim

2-1



Mount the device in the proper orientation and location for your process.

2-2



After mounting the device connect the process lines. Carefully tighten the process lines, using two (2) wrenches to prevent rotation of the inlet/outlet fitting.

⚠ WARNING

Any rotation of the inlet or outlet fitting during installation of a metal seal device may result in a leak. Always use two wrenches when attaching process line to prevent rotation.

Step 3: Electrical Connections

NEMA 1 / IP40 Meter/Controller

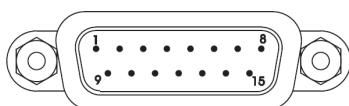
D-Connector Functions Legends:

- = Feature Available
- N/A = Not Available

NOTE: Chassis ground is available through the D-Connector back shell.

3-A1

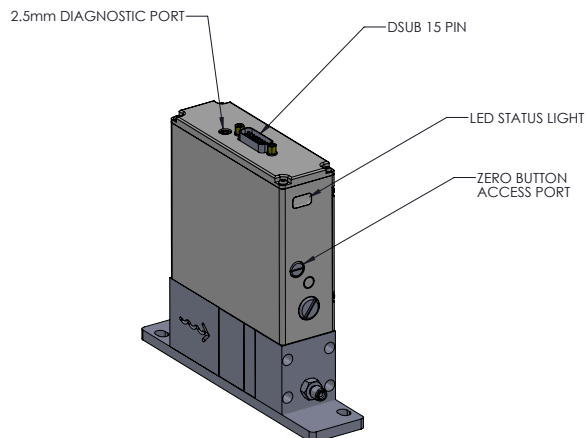
D-Connector for QmC NEMA 1 / IP40
Pin Out Connections



D-CONNECTOR PINOUTS

Pin	Function	Controller	Meter
1	Setpoint Common	*	N/A
2	0-5(10) Volt Flow Output	*	*
3	(TTL) Open Collector Alarm Output	*	*
4	(0)4-20 mA Flow Output	*	*
5	Power Supply (14-27 V)	*	*
6	Not Connected	N/A	N/A
7	(0)4-20 mA Setpoint Input	*	N/A
8	0-5(10) Volt Setpoint Input	*	N/A
9	Power Common	*	*
10	Signal Out Common	*	*
11	Not Connected	N/A	N/A
12	Valve Override Input	*	N/A
13	Density or Temperature output, Current or Voltage	*	*
14	RS-485, B(-) Input/Output	*	*
15	RS-485, A(+) Input/Output	*	*

3-A2



Step 4: Zeroing Procedure

To assure measurement accuracy, the instrument must be zeroed to the operational installation conditions:

- Apply power to instrument for approximately 45 minutes to reach a stable thermal condition prior to applying flow.
- Flow the process fluid into the instrument and allow sufficient time for the sensor to reach normal operating temperature.
- Close the shutoff valve downstream to eliminate any pressure differential across the instrument.
- After confirming a NO flow condition, press the zeroing button for at least 3 seconds
 - Zeroing button is located on the side of the instrument's housing.
- The zeroing process takes approximately 60 seconds. Status light will flash red.
- A solid Green LED means a successful zero.
- A solid Red LED means an unsuccessful zero.

Note: If solid Red LED is indicated, recycle power and repeat zeroing procedure or contact Technical Services at Brooks Instrument

Step 5: Operation

After the flowmeter or flow controller has been installed in the system it is ready for operation.

Meter: The meter will provide a flow signal proportional to the full scale flow of the device as indicated on the device label.

Controller: You must provide a setpoint/command signal to the controller. The controller will read the setpoint signal and will automatically adjust the valve to the appropriate position to achieve the desired flow and will provide a flow signal proportional to the full scale flow of the device as indicated on the device label.

Equipment Receipt and Return Procedures

Receipt of Equipment

When the equipment 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 his liability. A report should be submitted to the nearest Brooks Instrument location listed on the Global Service Network page on our website: brooksinstrument.com/service-support. Remove the envelope containing the packing list. Carefully remove the instrument from the packing case. Make sure spare parts are not discarded with the packing materials. Inspect for damaged or missing parts.

Return Shipment

Prior to returning any instrument to the factory for any reason, visit our website for instructions on how to obtain a Return Materials Authorization Number (RMA #) and complete a Decontamination Statement to accompany it: brooksinstrument.com/service-support. All instruments returned to Brooks also require a Material Safety Data Sheet (MSDS) for the fluid(s) used in the instrument. Failure to provide this information will delay processing of the instrument. Instrument must have been purged in accordance with the following:

⚠ WARNING

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

⚠ WARNING

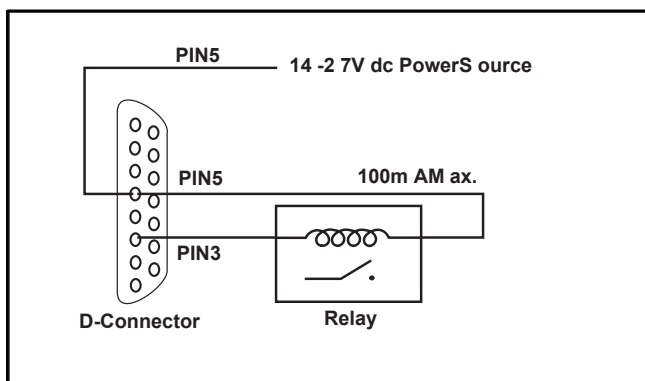
- Read all instructions prior to installing, operating and servicing this product.
- Follow all warnings, cautions and instructions marked on and supplied with this product.
- Install your equipment as specified in the installation instructions in the appropriate instruction manual and per local and national codes. Connect all products to the proper electrical and pressure sources.
- 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.
- Do not operate this instrument in excess of the specifications marked on and supplied with this product. Failure to heed this warning can result in serious personal injury and/or damage to the equipment.
- Before operating the device, ensure all electrical connections have been properly terminated.
- If it becomes necessary to remove the device from the system, power to the device must be disconnected.
- If it becomes necessary to remove the device from the system after exposure to toxic, pyrophoric, flammable or corrosive gas, purge the device thoroughly with a dry inert gas such as nitrogen before disconnecting the gas connections. Failure to correctly purge the device could result in fire, explosion or death. Corrosion or contamination of the device upon exposure to air may also occur.

⚠ CAUTION

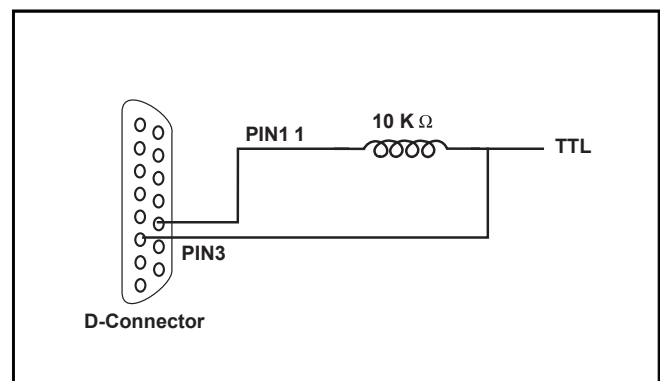
- Incorrect voltage will cause flowmeter damage or failure.
- QUANTIM is an input sinking device. Do not use a current sinking PLC output card.
- QUANTIM sources its own 4-20mA output signal. Do not source this output with an external supply.

Quick Start Instructions for Connecting Alarm Output

Alarm Output Option 1 - Relay



Alarm Output Option 2 - TTL



Quick Start Instructions

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Quick Start Instructions Electrical Connections, Zeroing and OperationQS-2

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How to Use This Manual

It is recommended to read this manual before installing, operating or troubleshooting your Quantim® QMC Series Mass Flow Meter or Controller.

This manual is organized into the following sections:

Section 1.	Introduction
Section 2.	Installation
Section 3.	Operation
Section 4.	Maintenance & Troubleshooting
Back Cover	Warranty, Local Sales/Service Contact Information

The Quality System at Brooks Instrument conforms to the quality standards set forth in ISO 9001.

This instruction manual is intended to provide the user with all the information necessary to install, operate and maintain the Quantim® QMC Series Mass Flow Meters and Controllers.

Description

Quantim® QMC Series Mass Flow Meters and Controllers for gases and liquids are used to provide accurate measurements of fluid flow, fluid density and temperature. The heart of these instruments is the Coriolis mass flow sensor, which produces an electrical output signal directly proportional to mass flow rate and density. Quantim® Mass Flow Controllers couple the Coriolis sensor with a control valve. Additionally, Quantim® Mass Flow Controllers possess digital signal processing (DSP) electronics and PID control electronics to provide measurement and control in one complete package.

Quantim® is available for a wide range of gas and liquid flows.

(See specifications, Section 1 for details).

Performance Specifications

Figure 1-1 Product Specifications

Figure 1-1 Product Specifications	QMCC (Controller)			QMCM (Meter)		
Performance						
Tube Size:	2	3	4	2	3	4
Nominal Flow Range ¹ :						
Liquid (kg/hr):	0.15	0.78	7.97	0.19	1.30	13.50
Gas (kg/hr):	0.076	0.214	1.796	0.103	0.53	3.840
Gas (sccm) ² :	1051	2955	24787	1432	7207	53116
Minimum Measurable Flow Liquid (kg/hr):	0.001	0.010	0.100	0.001	0.010	0.100
Zero Stability Stainless Steel Sensor (kg/hr):	0.00013	0.0010	0.0040	0.00013	0.0010	0.0040
Repeatability & Reproducibility:	+0.05% or +[0.5 x (zero stability/flowrate) x 100]% of rate whichever is greater					
Response Time (Settling Time): 2% F.S. of final value, (per SEMI Guideline E17-91)	<2 seconds			<0.5 seconds		
Flow Accuracy ^{3,4} :	Standard Flow Accuracy or [(zero stability/flow rate) x 100]% of rate, whichever is greater					
Standard Flow Accuracy:	Liquid: 0.2% Gas: 0.5% of rate					
Ratings						
Operating Temperature Range ⁵ :	0 to 65°C					
Temperature Accuracy (Device):	± 0.5°C					
Differential Pressure Range:	Liquid: 10 to 200 psi Gas: 10 to 150 psi					
Maximum Operating Pressure:	Standard: 500 psi Optional: 1500 psi					
Density Range:	0 to 2.0 g/cc					
Density Accuracy ⁶ :	± 0.005 g/cc					
Leak Integrity (External):	Elastomer: Outboard 1 x 10 ⁻⁹ atm. cc/sec., helium (max) Metal Seal: 1 x 10 ⁻¹⁰ atm. cc/sec., helium (max)					
Mechanical						
Materials of Construction (Process Wetted):	316L, 316L VAR, High alloy ferritic stainless and 17-7PH					
Materials of Construction (Process Seals):	Elastomer Seal: Viton® fluoroelastomers, Buna, Kalrez® or EPDM Metal Seal: stainless steel and nickel					
Housing:	IP40: polyurethane painted aluminum					
In-Line Filter ⁷ :	Tube size 2 controller: 1 micron or 10 micron filter recommended Tube size 3 or 4: 10, 20, 30 & 40 micron filters available					
Weight:	2.4 kg (5.4 lbs.)					
Moisture Content:	Purged to exhaust dew point less than -40°C (-40°F) prior to shipment to remove calibration liquid, to prevent process contamination. Then vacuum bagged at ambient room conditions.					
Process Fitting Options:	Elastomer Seal: 1/16", 1/8", 1/4" or 6mm tube compression, 1/8" or 1/4" NPT(F), 1/8" or 1/4" VCR, 1/4" VCO Metal Seal: 1/8" VCR, 1/4" VCR, 3.2 mm UPG					
Electrical Connections:	15 pin D-Type connector (See Figure 2).					
Dimensions:	(See Figures 1 through 3)					
Vibration:	Tested per: IEC 60068-2-64 Ed 2.1, Table A.3, Category 1, per ETSI EN 300 019-2-3, T 3.2., 30 min / axis, 1.1m/s2 (0.1g), 5 to 100Hz IEC 60068-2-6, Table A.1, 75min / axis, Peak Acceleration of 9.8m/s2 (1g), 5 to 2,000Hz, 5 Sweeps					

Figure 1-1 Product Specifications (Contin.)

Diagnostics	
Status Lights:	Status and Alarm LEDs
Alarms:	Mass Flow, Density, Volumetric Flow, Temperature, Slug Flow, Diagnostic Failure, Setpoint Deviation, Valve Drive
Electrical	
Output Signal:	Digital: RS485 S-Protocol (See RS485 Supplemental Manual – QMC for additional details) Analog: Primary: 0-20 mA, 4-20 mA, 0-5 Vdc, or 0-10 Vdc active output represents mass flow or volume flow(3) Secondary: 0-20 mA, 4-20 mA 0-5 Vdc or 0-10 Vdc active output represents density or temperature. Alarm output, max. voltage 30 Vdc, max. current 100 mA
Input Signal:	Digital: RS485 S-Protocol (See RS485 Supplemental Manual – QMC for additional details) Analog: Command (setpoint): 0-20 mA, 4-20 mA, 0-5 Vdc or 0-10 Vdc input signals Valve Override (VOR) Function: Left floating/unconnected - instrument controls flow at setpoint Connected to signal at or above 5.0 volts - valve is forced open Connected to signal at or below 0.0 volts - valve is closed
Power Requirements:	Voltage: +14 to 27 Vdc
Nominal Current:	Controller: 300 mA to 400 mA Meter: 100 mA to 150 mA
Max Current	Controller: 715 @ 14 Vdc Meter: 470 mA @ 14 Vdc
Max Power	Controller: 10.0 W Meter: 6.6 W
Additional Functions & Outputs	
Damping:	Factory set time constant from 0 to 10 seconds
LED's:	'STAT' solid green: system operative 'AL' solid red: system fault
Pushbutton:	'ZERO' setting pushbutton
Certifications and Compliance	
Environmental Compliance:	EMC Directive 2014/30/EU per EN 61326-1: 2013 ROHS Directive 2011/65/EU and 2015/863
Pressure Effects Compliance:	Pressure Equipment Directive 2014/34/EU "Sound Engineering Practice"
Additional Certifications (Optional)	Material 2.1 EN10204, Material 3.1B EN10204, Calibration Traceability, Oxygen Clean, Certificate of Conformance

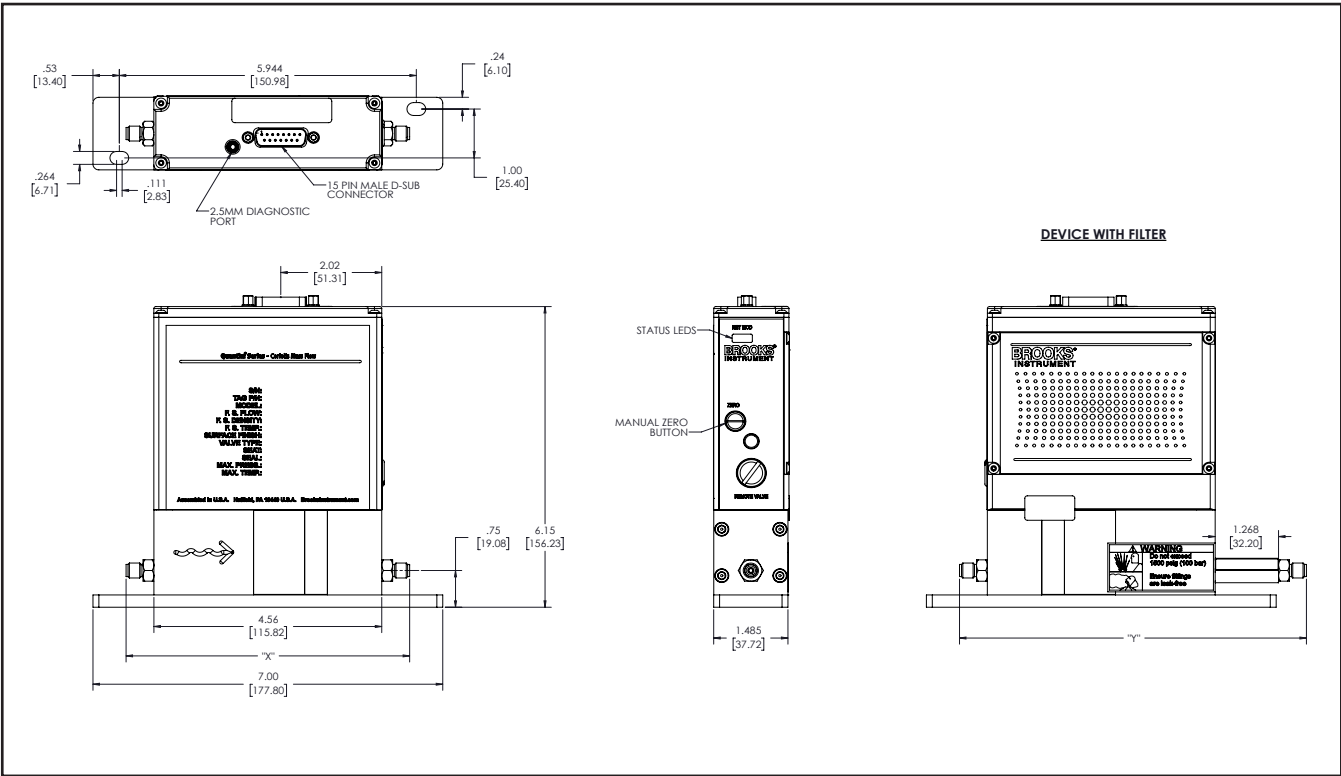
Notes

- ¹ The nominal flow rate is the flow rate at which water at reference conditions causes approximately 1 bar of pressure drop or the laminar to turbulent transition flow whichever is lower. Maximum flow rate is higher than the nominal flow rate and is dependent upon process fluid and process conditions.
- ² Standard volumetric conditions are 14.696 psia and 70°F.
- ³ Actual volumetric flow is a function of the mass flow and the density measurements; therefore the accuracy of actual volumetric flow is a function of the mass flow and density accuracy.
- ⁴ Accuracy includes combined repeatability, linearity, hysteresis and calibration system uncertainty. Specifications are based on reference test conditions of water/nitrogen at 68 to 77°F (20 to 25°C) and 15 to 30 psig (1 to 2 bar).
- ⁵ A temperature rise of up to 20°C (68°F) from internal heating can occur in an open environment where ambient temperature is 23°C (73°F). The device temperature is affected by the ambient and process temperature as well as warming when the device is powered. The device should be maintained in the specified temperature range at all times.
- ⁶ The density measurement at temperatures other than 21°C (70°F) has an additional error of approximately 0.0005 grams/cc per °C.
- ⁷ Additional upstream filtration is always recommended to remove any particulate from the process fluid before it flows through these devices. In most applications, Brooks in-line filters are recommended as a secondary filter in addition to other upstream filtering methods. The use of Brooks in-line filters are not recommended in moisture sensitive applications.

⚠ 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.

Dimensions



FITTING	"X" DIMENSION (NO FILTER)	"Y" DIMENSION (FILTER)
1/8" VCR	5.92 [150.37]	7.19 [182.57]
1/4" VCR	6.64 [168.66]	7.91 [200.86]
1/16" TUBE COMPRESSION	5.68 [144.27]	6.95 [176.47]
1/8" TUBE COMPRESSION	5.68 [144.27]	6.95 [176.47]
1/4" TUBE COMPRESSION	5.92 [150.37]	7.19 [182.57]
6mm TUBE COMPRESSION	5.93 [150.62]	7.2 [182.82]
1/8" NPT	5.81 [147.57]	7.08 [179.77]
1/4" NPT	6.19 [157.23]	7.46 [189.43]
1/4" VCO	6.14 [155.96]	7.41 [188.16]
3.2MM UPG	5.92 [150.3]	N/A

Figure 1-2 Lay-In Dimensions Integral Valve

General

WARNING

Operating Procedure: Do not operate this instrument outside the specifications listed in Section 1. Before bringing the unit into operation, make sure that all fluid connections have been correctly tightened and that all necessary electrical connections have been made.

Receipt of Equipment

When the equipment 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 Brooks Instrument. Visit the Brooks Instrument website at www.brooksinstrument.com/en/service-support

Remove the envelope containing the packing list. Carefully remove the instrument from the packing case. Make sure spare parts, accessories and documentation are not discarded with the packing materials. Inspect for damaged or missing parts.

Recommended Storage Practice

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

- a. In the original vacuum bag and shipping container.
- b. In a sheltered area with the following conditions: Ambient temperature 70°C (160°F) maximum and 0°C (32°F) minimum.
- c. Relative humidity 45% nominal, 60% maximum, 25% minimum. Upon removal from storage a visual inspection should be conducted to verify the condition of equipment is "as received".

Return Shipment

Prior to returning any instrument to the factory for any reason, visit our website for instructions on how to obtain a Return Materials Authorization Number (RMA #) and complete a Decontamination Statement to accompany it: www.brooksinstrument.com/en/service-support. All instruments returned to Brooks also require a Material Safety Data Sheet (MSDS) for the fluid(s) used in the instrument. Failure to provide this information will delay processing of the instrument.

Instrument must have been purged in accordance with the following:

WARNING

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

Transit Precautions

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

Fluid Connections**General Mounting Practices**

Use good piping practices to minimize transmitting any torque or bending loads onto the process connections on Quantim®. Always verify there are no leaks prior to starting Quantim® on process fluid. The instrument is delivered from the factory with a rigid surface mounting plate. For optimum performance, this mounting plate should be used to mount Quantim® to a rigid surface. If panel mounting is required, the bottom of the instrument is provided with two M4 and M6 (see dimensional drawings, Section A) mounting holes to properly install the instrument on a rigid flat plate. Panel mounting is not recommended for Quantim® flow controllers with remote valve configuration.

⚠ WARNING

Any rotation of the inlet or outlet fitting during installation of a metal seal device may result in a leak. Always use two (2) wrenches when attaching gas lines to prevent rotation.

Mechanical Installation

Prior to installation:

- a. Verify that tube fittings match the fitting type and size supplied with your Quantim® instrument.
- b. Make certain that all piping and fittings are clean and free of obstructions for the instrument and filter.
- c. Assure that the final installation permits easy access to the instrument.

(For Dimensional Drawings see Section 1-4 Dimensions)

⚠ CAUTION

When installing the Mass Flow device, care should be taken to prevent foreign materials from entering the instrument's inlet or outlet. Internal passages are very small. It is recommended that an inlet filter be used to limit the chance of clogging. Do not remove the protective end-caps until the actual moment of installation. When used with reactive fluids (some of which may be toxic), contamination or corrosion may occur as a result of plumbing leaks or improper purging. Plumbing should be checked carefully for leaks.

Recommended installation procedures:

- a. All models should be mounted to a stable surface that is relatively free from mechanical shocks and mechanical vibration using the supplied mounting plate.
- b. Leave sufficient room for access to the electrical connections.
- c. Install in a manner that allows the instrument to be easily removed.
- d. Install the instrument with an appropriate filter on the fluid inlet side.
- e. It is recommended that a positive shutoff valve be installed downstream of the Quantim® to allow for proper zeroing after installation.

⚠ CAUTION

The control valve of the Quantim Mass Flow Controller provides precision control and is not designed for positive shutoff. If positive shutoff is required, it is recommended that a separate shut-off valve be installed in-line, downstream from the Quantim Mass Flow Controller.

⚠ CAUTION

If the power supply to the Quantim Mass Flow Controller is interrupted, a NORMALLY CLOSED valve will be fully closed. However, a shutoff valve is recommended if the process architecture requires it as the Quantim control valve may not provide positive shutoff.

Process Mounting

Quantim® will function in any orientation if the Coriolis sensor and the control valve remain filled with process fluid. Entrapped gas in a liquid application and entrapped liquid in a gas application should be prevented as it may disturb the Coriolis sensor and the control valve. Install Quantim® in the direction of the FLOW arrow. The arrow indicating proper flow direction is engraved on the front of the instrument between the process fittings. (See Figure 2-1 below.)

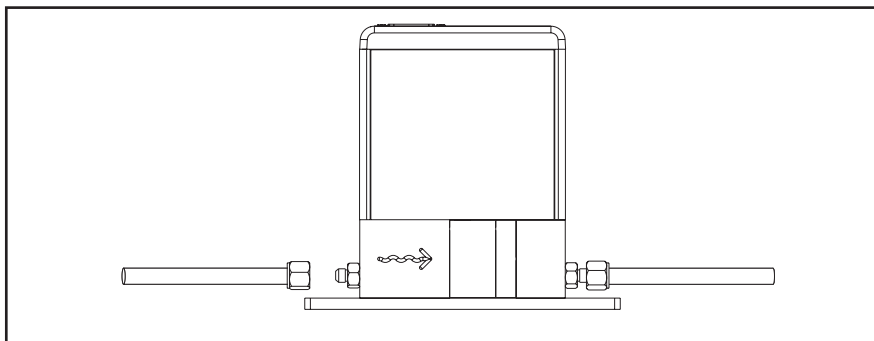


Figure 2-1 Flow Direction Through the Quantim, as Indicated by the Arrow Engraved on the Meter/Controller Body.

Horizontal Mounting

If installing Quantim® in a horizontal orientation, liquids should flow in the direction of the flow arrow. Situations of entrapped gas in the liquid process should be avoided. In liquid flow applications, it is recommended to mount Quantim® in an inverted attitude on the underside of the pipe to limit the possibility of entrapped gas collecting in the sensor, which can cause errors (See Figure 2-2).

For use in gas flow measurement, Quantim® should be mounted on the topside of the pipe to limit the possibility of entrapped fluid collecting in the sensor, which can cause errors. (See Figure 2-3).

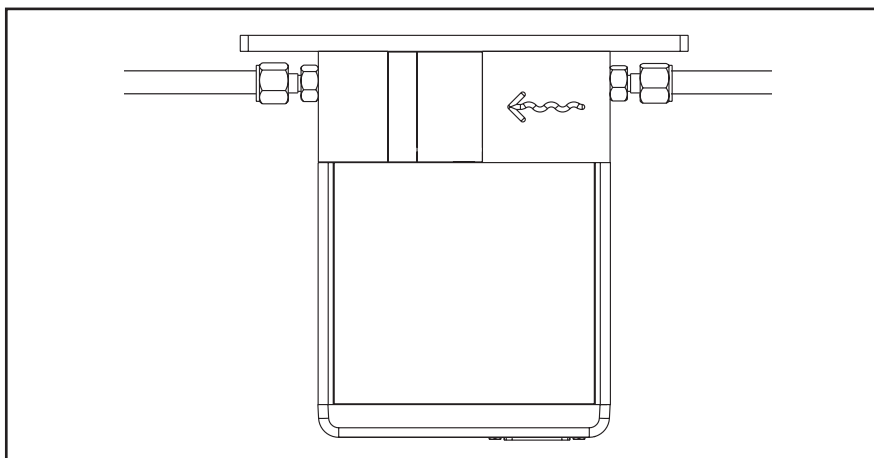


Figure 2-2 Horizontal Inverted Installation

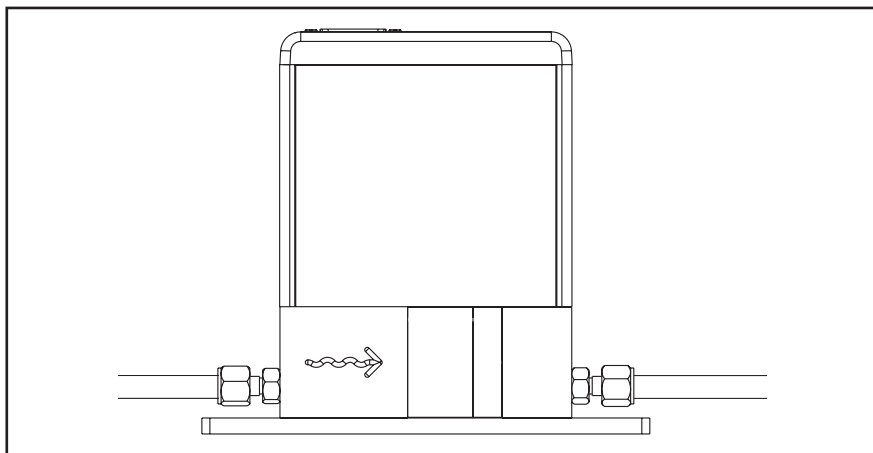


Figure 2-3 Horizontal Right Side Up Installation

Vertical Mounting

If Quantim® is installed in a vertical orientation, for use in a liquid application, liquid should flow upwards through the instrument to help minimize errors due to entrapped gas (See Figure 2-4). For gas flow vertical orientation, flow up or down is acceptable.

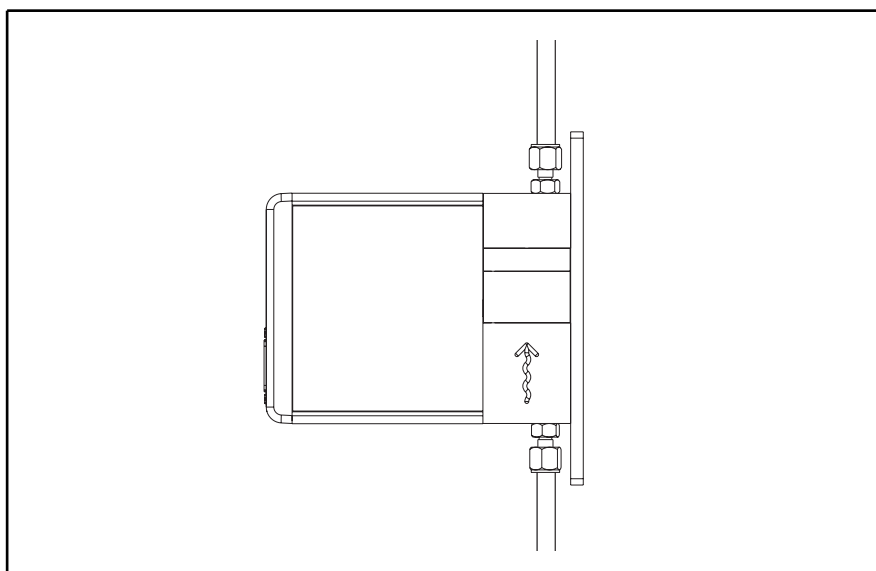


Figure 2-4 Vertical Flow Up Installation

Electrical Interfacing

Meter and Controller

Flow Output (Pins 2, 4 and 10)

Flow Output configuration is a factory selected option.

Each Quantim® instrument is calibrated as either 0-5 (10) Vdc or (0) 4-20 mA at the factory as specified when ordering. Pin 2 indicates the flow rate, represented by a 0-5 (10) Vdc signal proportional to flow, if so configured. Recommended load on Pin 2 is >1K ohm. Pin 4 indicates the flow rate, represented by a (0) 4-20 mA signal current proportional to flow, if so configured. Maximum series resistance on Pin 4 is 500 ohms. Do not apply power to Pin 4. The current and voltage signals are returned via Pin10.

Analog Setpoint Input (Pins 7, 8 and 1; Controller models only)

Signal Input configuration is a factory selected option.

The Mass Flow Controller can be used either with a current or voltage set point as configured when ordered. If configured for current (4-20 mA or 0-20 mA) setpoint, connect the setpoint signal to Pin 7 and the setpoint return signal to Pin 1. Input impedance on Pin 7 is 250 ohms. Do not apply power to Pin 7. If configured for voltage (0-5 Vdc or 0-10 Vdc) setpoint, connect the setpoint signal to Pin 8 and the setpoint return to Pin 1. Input impedance to Pin 8 is 200K ohms.

Power Supply (Pin 5 and Pin 9)

Both Mass Flow Meter and Controller models are connected via Pins 5 (+14 to +27 Vdc) and 9 (power supply common) on the customer connector. See Section 1, Performance Specifications for current requirement.

EMC note: The DC Input Port of the device is not intended to be connected to a DC Distribution Network; therefore the DC Input Leads were tested as I/O signal / control ports.

WARNING

With regard to power supply connections, the user must ensure that the minimum required voltage and current is available at the mass flow device taking into consideration any losses in the interconnecting cable.

Valve Override (Pin 12; Controller models only)

To open or close the control valve independently of the setpoint signal (e.g. for process reasons), Pin 12 is available to carry a valve override signal. Leave floating (i.e. not connected) to allow for normal control operation. Input impedance on Pin 12 is >50K ohms.

>5 Vdc @ Valve Open

0 Vdc @ Valve Closed

Secondary Output, Density or Temperature (Pin 13 and Pin 10)

Pin 13 indicates the density or temperature, represented by a (0) 4-20 mA or 0-5 (10) Vdc signal, proportional to density or temperature. The current and voltage signals are returned via Pin 10. Maximum series resistance on Pin 3 is 500 ohms when configured for (0) 4-20 mA. Recommended load on Pin 13 is >100K ohms when configured for 0-5 (10) Vdc. Do not apply power to Pin 13.

Alarm Output (Pin 3 and Pin 9)

Pin 3 indicates an alarm condition as an open drain FET configuration. Maximum voltage is 30 Vdc, maximum current is 100 mA. (See Figure 2-6 on page 2-8.)

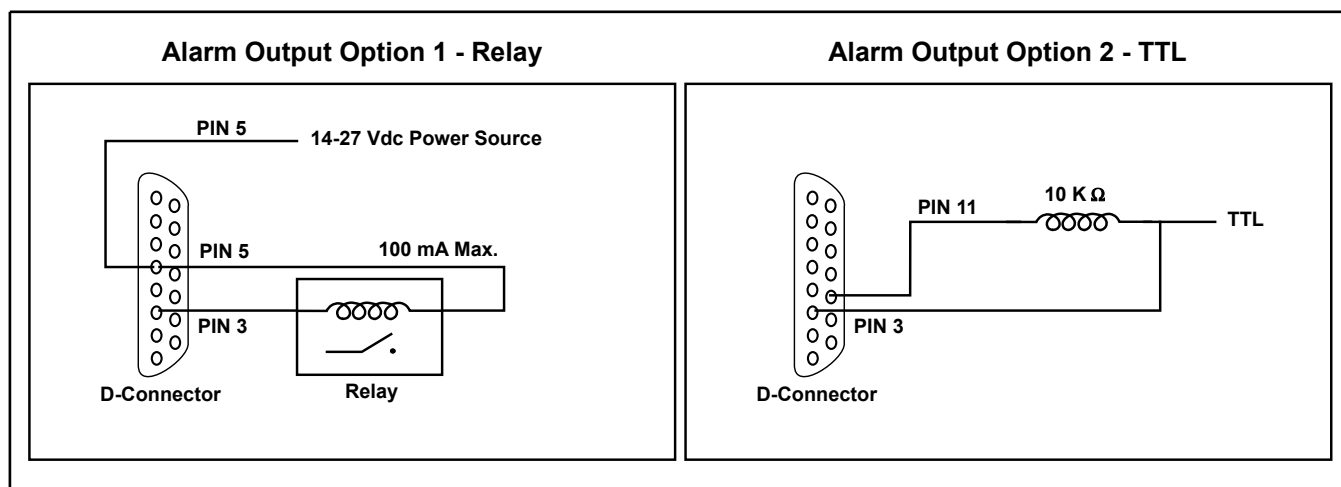


Figure 2-5 Alarm Output Wiring Options

Table 2-1 Electrical Interfacing for Quantim

Pin	Function	Controller	Meter
1	Setpoint Common	*	N/A
2	0-5(10) Volt Flow Output	*	*
3	(TTL) Open Collector Alarm Output	*	*
4	(0)4-20 mA Flow Output	*	*
5	Power Supply (14-27 V)	*	*
6	Not Connected	N/A	N/A
7	(0)4-20 mA Setpoint Input	*	N/A
8	0-5(10) Volt Setpoint Input	*	N/A
9	Power Common	*	*
10	Signal Out Common	*	*
11	Not Connected	N/A	N/A
12	Valve Override Input	*	N/A
13	Density or Tempertaure output, Current or Voltage	*	*
14	RS-485, B(-) Input/Output	*	*
15	RS-485, A(+) Input/Output	*	*

* Do not apply power to these Pins.

RS485 (S-Protocol) Communication

Quantim® Model QMC is equipped with RS485 communication capability. Refer to Figure 2-1, D-Connector Electrical Pin Connections, that enables the device to communicate via a personal computer, PLC or DCS for process control. Baud rate selections for Quantim® with RS485 are: 1200, 2400, 4800, 9600, 19200 and 38400 baud. The device is factory set with a baud rate of 19200 and can be changed using the Brooks Expert Support Tool (BEST). The RS485 is a multidrop connection which allows a maximum of 32 devices to be connected to a personal computer or control system. Personal computers are not equipped with RS485 ports as standard. An RS232/USB to RS485 converter or RS485 interface board is therefore required to connect an RS485 network to a standard personal computer. The RS485 bus is a daisy chain network, meaning the wires are connected at the units as in Figure 2-6.

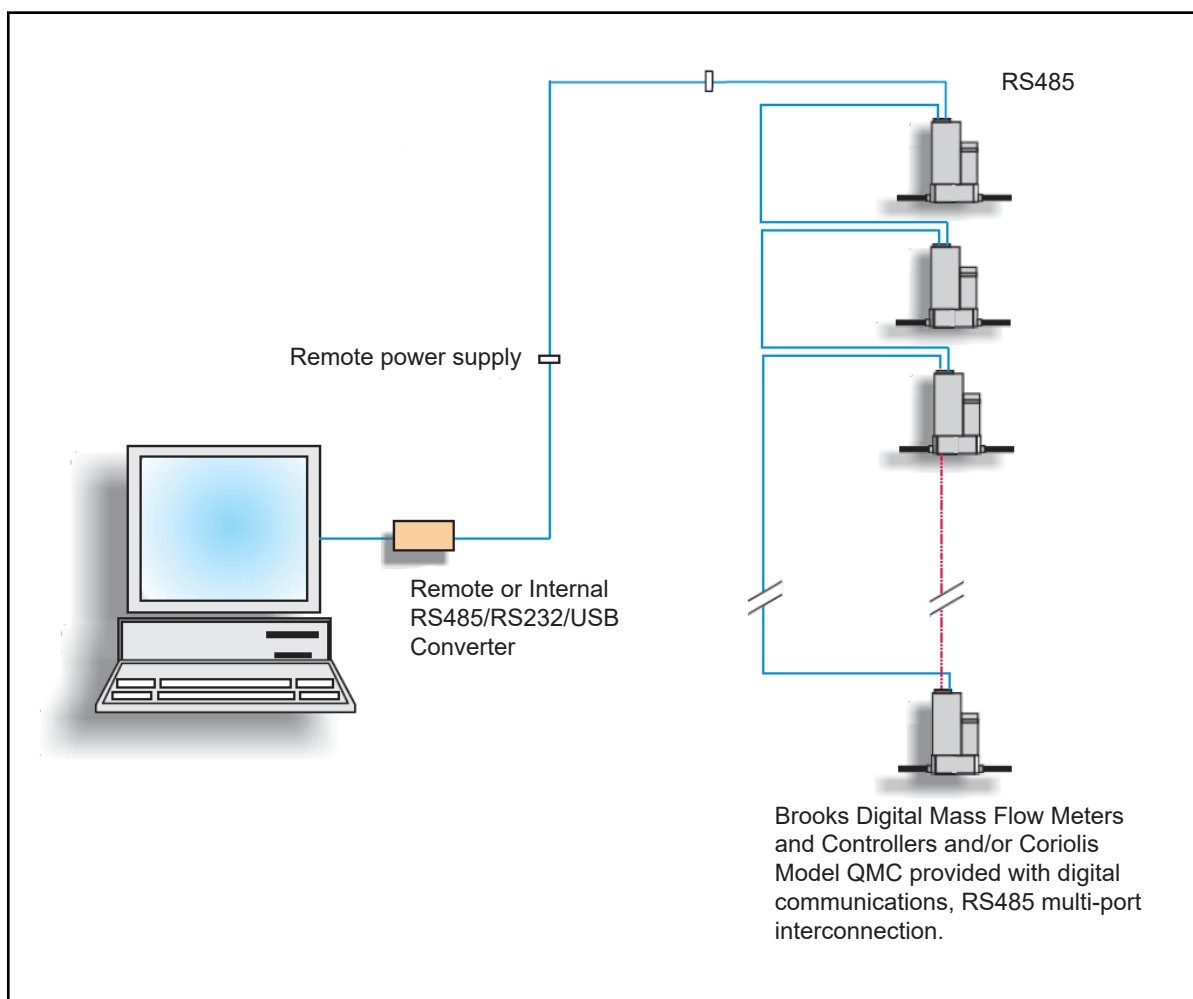


Figure 2-6 General Wiring

Interconnection with Peripheral Equipment

The following cables are available for connection of Quantim® Model QMC Meters and Controllers to the Brooks Instrument Microprocessor Control & Read-out Unit: Models # 0152, 0154, 0251 or 0254

Length: 3ft (1m);	part number	124Y054AAA
Length: 5ft (1.5m);	part number	124Y050AAA
Length: 10ft (3m);	part number	124Y051AAA
Length: 25ft (7m);	part number	124Y052AAA
Length: 50ft (15m);	part number	124Y053AAA

Or in case both Flow and Density or Temperature functions have to be made available: (for 4-20 mA secondary output only)

Length: 5ft (1.5m);	part number	124Z906ZZZ
Length: 10ft (3m);	part number	124Z907ZZZ
Length: 25ft (7m);	part number	124Z908ZZZ
Length: 50ft (15m);	part number	124Z909ZZZ

The following open frame cables are available for connection of Quantim® to any secondary electronic device.

Length: 5ft (1.5m);	part number	124Z361AAA
Length: 10ft (3m);	part number	124Z362AAA
Length: 25ft (7m);	part number	124Z363AAA
Length: 50ft (15m);	part number	124Z435AAA
Length: 75ft (22m);	part number	124Z876AAA
Length: 100ft (30m);	part number	124Z868AAA
Length: 150ft (45m);	part number	124Z757AAA
Length: 200ft (60m);	part number	124Z773AAA

(See Figure 2-7 for Wire Color Code Diagram)

Diagnostic Cable Kits

Basic BEST/MultiFlo Kit (USB to 2.5 mm Cable Assembly)
part number 778Z010ZZZ

BEST/MultiFlo Kit with Profibus/RS485 Power Supply
part number 778Z012ZZZ

Cable Shielding Earth

Cable requirements:

Compliance with EMC directive 89/336/EEC, requires that the equipment be fitted with fully screened signal cables with at least 80% shielding. The cable shielding should be connected to the D-connector's metal shell and have 360° shielding at both ends. The shielding should be connected to an earth ground.

Pin	Color	Function	Controller	Meter
1	BLK	Setpoint Common	*	N/A
2	WHT	0-5(10) Volt Flow Output	*	*
3	RED	(TTL) Open Collector Alarm Output	*	*
4	GRN	(0)4-20 mA Flow Output	*	*
5	ORG	Power Supply (14-27 V)	*	*
6	BLUE	Not Connected	N/A	N/A
7	WHT/BLK	(0)4-20 mA Setpoint Input	*	N/A
8	RED/BLK	0-5(10) Volt Setpoint Input	*	N/A
9	GRN/BLK	Power Common	*	*
10	ORG/BLK	Signal Out Common	*	*
11	BLU/BLK	Not Connected	N/A	N/A
12	BLK/WHT	Valve Override Input	*	N/A
13	RED/WHT	Density or Tempertaure output, Current or Voltage	*	*
14	GRN/WHT	RS-485, B(-) Input/Output	*	*
15	BLU/WHT	RS-485, A(+) Input/Output	*	*

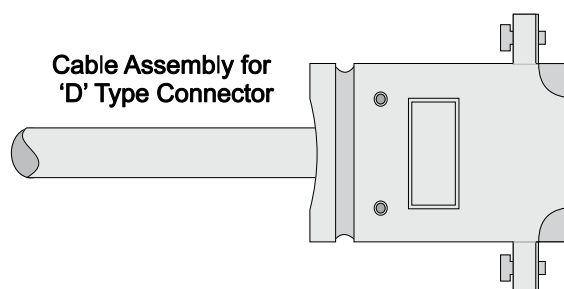


Figure 2-7 Wire Color Codes for 'D' Connector Assembly

Operating Procedure

⚠ 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.

After the wiring cable has been connected, power can be supplied to the instrument. During initialization, the instrument remains in start-up mode for about 5 seconds. The START-UP mode is indicated by the alternately flashing red/green status LEDs on the Meter/Controller. LEDs are on the side of the instrument in the NEMA 1/ IP40 package (See Figure 3-1).

Status LED

The Status LED, indicates the operation condition of the instrument. During start-up, the status LED blinks red/green once per second to indicate proper start-up operation of the meter/controller. Then a solid green is displayed to indicate proper function.

The status LED will be illuminated a solid green color for the meter/controller, indicating that the instrument is ready for operation.

If the status LED is illuminated a solid red color, a START-UP issue has been determined by the onboard diagnostic programs. This condition can only be cleared by cycling power to the instrument. If the issue persists, call Technical Service at Brooks Instrument.

Customer Service

Brooks Technical Service is available to assist with start-up if you experience issues you cannot solve on your own. You will be asked to provide the model code and serial number of your Brooks equipment, which will assist us in answering your questions. For telephone references, please visit our website www.brooksinstrument.com/en/service-support/contact-technical-services.

Zero Adjustment

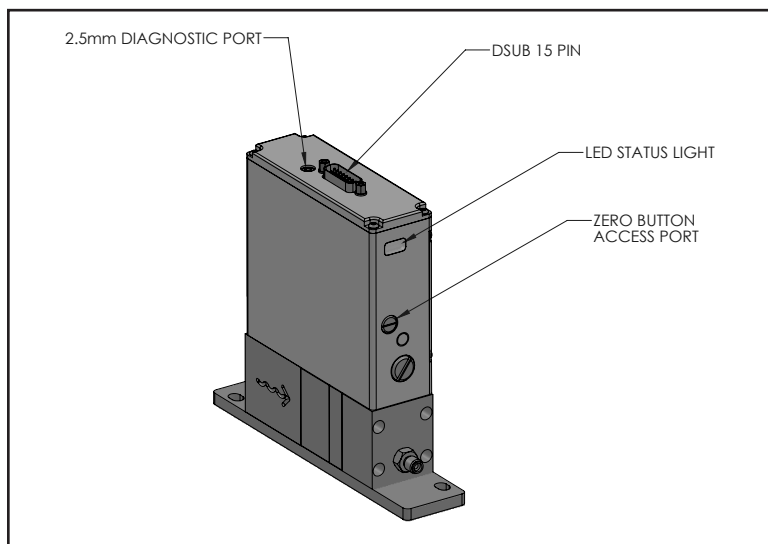


Figure 3-1 Location of the LEDs

After Quantim® has been fully installed, you must perform the zeroing procedure. This procedure ensures that the instrument responds properly to zero flow condition and sets a baseline for flow. To perform the zeroing operation on the meter/controller, use the ZERO button, which is located on top right hand side (outlet side) of the instrument. Zero button must be pressed for at least 3 seconds to initiate zeroing procedure. The status LED will flash red on and off during the zeroing procedure. (See Figure 3-1).

CAUTION

After the instrument has been installed, you must perform the re-zeroing procedure. See Section 3-2 for the re-zeroing procedure. A true zero flow condition must be present and the Coriolis sensor and control valve must both be completely full of process fluid during the re-zeroing procedure. This is done best by eliminating any pressure differential across the instrument. A shutoff valve, downstream from the instrument, is recommended to halt flow during the re-zeroing procedure.

Failure to zero the instrument after initial startup could cause measurement error.

Zero the instrument before putting the instrument in operation.

Zero Procedure

1. Prepare the instrument for zeroing:
 - a. Install the instrument according to the instructions in this manual.
 - b. Power-up sequence. Isolate device from flow pressure when applying power. Once the status indicator is illuminated green, pressure may be applied.
 - c. Apply power to the instrument and allow approximately 45 minutes to reach a stable condition.
 - d. Run the process fluid to be measured and controlled through the instrument until the temperature of the instrument approximates the normal process operating temperature. Use the Valve Override (V.O.R.) function to fully open the control valve to facilitate temperature stabilization.
5. Once the instrument has reached process temperature, close the external shutoff valve downstream from the instrument and wait for the flow to stop. Set the control function to zero and V.O.R. to normal once flow has stopped and all pressure differential across the instrument has been bled off.
6. Make sure that the instrument is completely filled with the process fluid under normal process conditions of temperature, pressure, density, etc. make sure there is no entrapped gas in the sensor tube and ensure a zero flow condition through the instrument.

⚠ CAUTION

Flow through the instrument during zeroing procedure will result in an inaccurate zero setting.

Make sure fluid flow through the instrument is completely stopped during the zeroing procedure.

4. After confirming that fluid flow through the instrument is completely stopped, actuate the zero function as previously stated.

5. The default zero sample interval is 30 seconds. A successful zero operation on the controller and meter will be indicated by a solid green color status LED. A solid red color status LED indicates a failed zero process. A non-steady flash will indicate a failed condition. A failed condition can only be cleared by a power cycle.

6. Once the status LED turns green, zero process is complete and the instrument is ready for operation.


Please note that zero command will only be accepted when the output change is less than 1% of the maximum full scale of the device. This logic prevents an accidental zero command from being initiated when flow is present, through the device.

Calibration Procedure

Quantim® calibration is not described in this manual. If your Quantim® requires calibration, please visit our website www.brooksinstrument.com/en/service-support.

General

There are no routine maintenance procedures required to keep your Quantim® instrument in good operating condition. It is however, very important to keep the fluid entering Quantim® clean, and as a result periodic replacement of the inlet guard filter is recommended at a frequency determined by the cleanliness of the fluid. At a minimum this guard filter should be replaced annually.

	⚠ WARNING METER/CONTROLLER SEAL COMPATIBILITY
<p>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 corrosion resistant and 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.</p> <p>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.</p>	

⚠ WARNING
<p>If it becomes necessary to remove the MFC/MFM from the system after exposure to toxic, pyrophoric, flammable or corrosive fluids, purge the flowmeter thoroughly before disconnecting the fluid connections. Failure to correctly purge the MFC/MFM could result in fire, explosion or death. Corrosion or contamination of the MFC/MFM upon exposure to air, may also occur.</p>

⚠ CAUTION
<p>It is important that this MFC/MFM only be serviced by properly trained and qualified personnel.</p>

Maintenance & Troubleshooting

System Checks

⚠ WARNING

Internal seals and component alignments are extremely critical within this device. Improper servicing of your Quantim can cause malfunction of the device and/or personal injury. This device **must** be serviced by factory personnel only. There are no customer serviceable components within the device. Disassembly of this device voids all warranties, explicit or implied.

Quantim® Mass Flow Meters and Controllers are typically used as a critical component in fluid systems. These systems can be complex in nature and therefore isolating a malfunction has to be done with a system perspective. An incorrectly diagnosed malfunction can cause many hours of unnecessary downtime. If possible, perform the following system checks before removing a suspect Mass Flow Meter or Controller for bench troubleshooting or return to the factory (especially if the system is new):

1. Identify a low resistance common connection and make sure that the correct power supply voltage and signals are present at the connector of the Quantim® device.
2. Verify that the process fluid connections have been made correctly, and that they have been tested for leaks.
3. If the Mass Flow Controller appears to be functioning but cannot achieve setpoint, verify that there is sufficient inlet pressure and pressure drop at the controller to provide the required flow.
4. Flow control instability can be a result of using Quantim® in a system that includes other active control elements such as pressure regulators. Depending on the tuning constants used in the Quantim® and the control dynamics of the other active elements, these devices can interfere with each other and cause flow instabilities. It is very important to take a complete system perspective when applying Quantim® to flow control applications.

Table 4-1 Maintenance & Troubleshooting

Observation	Cause	Resolution
Oscillating mass flow output can cause diagnostic alarm	<p>Bubbles dissolved in the liquid. High pressure push gas can cause bubbles to dissolve in fluid. Bubbles then form at the valve due to pressure drop, upsetting valve.</p> <p>Oscillating pump pressure used to move the fluid. Piston action can cause pressure oscillations, upsetting valve.</p> <p>Pressure drop or inlet pressure deviates from calibrated values.</p> <p>Valve out of adjustment.</p> <p>Unstable inlet pressure.</p> <p>Defective PC board.</p> <p>Valves are tuned digitally and mechanically for a particular ΔP.</p>	<p>Use a degasser or use Helium as a push gas with 25-50ft. of Teflon® tube. Helium is a light gas and can permeate the Teflon tube to release bubbles.</p> <p>Avoid using push gas. Use a pump or bladder tank to prevent head pressure.</p> <p>Pressure regulators on inlet and outlet of Quantim to stabilize pressure variations.</p> <p>Adjust pressure to original specifications.</p> <p>Contact Brooks Instrument.</p> <p>Check external pressure regulator.</p> <p>Contact Brooks Instrument.</p> <p>Operate Quantim at specified pressure conditions.</p>
Valve will not open or fully close	<p>Valves are tuned digitally and mechanically for a particular ΔP. Proper valve response requires just the right amount of force to be applied by the valve. With too much or too little ΔP the valve will be mis-tuned.</p> <p>Mounting attitude is different from calibration attitude; Reason, gravity effects could pull valve open or closed.</p>	<p>Operate Quantim at specified pressure conditions.</p> <p>Check valve operation with the Brooks Service Tool.</p> <p>Mount Quantim in the specified mounting attitude.</p>
No Flow or unable to achieve full flow	<p>Insufficient inlet pressure or pressure drop.</p> <p>Clogged Valve Orifice or Sensor.</p>	<p>Adjust pressures, inspect in-line filters and clean/replace as necessary.</p> <p>Back flush the device with a solvent or purge gas with valve.</p>

Table 4-1 Maintenance & Troubleshooting (continued)

Observation	Cause	Resolution
No Flow or unable to achieve full flow	Particulates in the flow stream. Agglomeration of fluid at orifice. Chemical deposits. Poor filtration of process fluid. Valve out of adjustment (applicable to Controller).	Consider a larger orifice (valve stability could suffer). Institute regular PM back flushing. Install proper filtration. Contact Brooks Instrument.
Valve out of adjustment	Valve guide spring failure (applicable to Controller). Valve override input is grounded Defective electronic board	Contact Brooks Instrument. Check the valve override input. (Pin12). Contact Brooks Instrument.
Output signal follows Setpoint at higher Setpoints but not at lower Setpoints	Control valve leaks or is stuck open.	Exercise the control valve alternating between valve override "open" and closed. If problem persists backflush the device with a solvent or purge gas with valve override "open".
Output signal stays in approx. 5.5 Vdc or 22 mA (regardless of setpoint) and there is flow through the meter/controller	Valve leaks or is stuck open (applicable to Controller). +15 Vdc applied to the valve override input (applicable to Controller). Defective PC board.	Backflush the device with a solvent or purge gas with valve override "open". Check the valve override terminal (Pin 12). Contact Brooks Instrument.
No secondary output signal	Not all models have a secondary output.	Check calibration sheet and/or other documentation to confirm if device should have a secondary output. If yes, contact Brooks Instrument.

Bench Troubleshooting**⚠ WARNING**

If it becomes necessary to remove the instrument from the system power to the device is disconnected at the power supply.

⚠ WARNING

If it becomes necessary to remove the instrument from the system after exposure to toxic, pyrophoric, flammable or corrosive chemicals, purge the instrument thoroughly with an inert fluid such as water, alcohol, nitrogen, clean dry air or some other appropriate fluid before disconnecting the fluid connections. Failure to correctly purge the instrument could result in fire, explosion or death. The Quantim Mass Flow device may also become corroded or contaminated upon exposure to air.

Quantim Bench Testing (Refer to Figure 4-1)

1. Establish the proper electrical connection to the Quantim MFC/MFM. Do not connect the device to a fluid source yet.
 - a. Connect a +14 Vdc to +27 Vdc power supply to Pin 5 and power supply common to Pin 9.
 - b. Connect a voltage output signal read-out device (4-1/2 digit voltmeter recommended) onto Pin 2 (+) and Pin 10 (common).
 - c. If applicable, connect current output signal read-out device onto Pin 4 (+) and Pin 10 (common).
 - d. Switch on power and allow the instrument to stabilize.
 - e. In case of a MFC, adjust the setpoint input to zero.
2. Observe the output signal and if necessary, perform the zero adjustment procedure as outlined in Section 3-2.
 - a. Only perform the zero operations with the Coriolis Sensor filled with either 100% fluid or 100% gas at the appropriate pressures and ensure there is no fluid flowing through the device (differential pressure = 0 psi).
 - b. Connect the Quantim to a pressurized supply of inert fluid (for example high purity water). Fill the Quantim instrument completely taking care there is no entrained gas in the sensor and perform the zero operation as described in Section 3-2.
 - c. When applying Quantim to measure a gas, fill the sensor with an inert gas (nitrogen or clean dry air) at a pressure near the process operating pressure.
 - d. If the output signal does not zero properly, please contact Brooks Instrument for technical assistance.
3. For a MFC connect a 0-5 (10) Vdc source to Pin 8 and return to Pin 1 or connect (0) 4-20 mA source to Pin 7 and return to Pin 1.
4. Provide an electrical signal to the Quantim representing a setpoint of 50% of full scale flow and adjust the inlet and outlet pressures to calibration conditions.

5. Verify that the electrical output signal reaches 100% of flow. For MFC applications vary the setpoint over the 1% to 100% range and verify that the output signal matches the setpoint. If possible, connect a flow measurement device (such as a rotometer) to the Quantim outlet to monitor the actual flow behavior.
6. If the Quantim is functioning correctly, the problem may lie elsewhere in the flow system. Re-verify the installation as well as the upstream/downstream fluid system configuration.
7. Please contact Brooks Instrument for further assistance visit our website www.brooksinstrument.com/en/service-support/contact-technical-services.

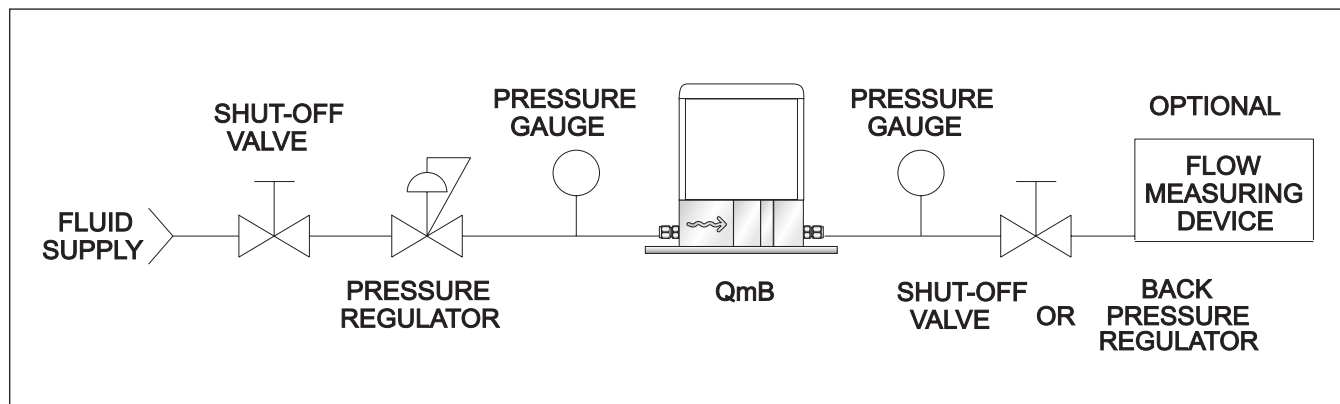


Figure 4-1 Bench Troubleshooting Circuit

LIMITED WARRANTY

Visit www.BrooksInstrument.com for the terms and conditions of our limited warranty.

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.

SEMINARS AND TRAINING

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

Please contact your nearest sales representative for more details.

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-Manual-Quantim-QMC-EN/541B234AAG/2023-11

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