Eldridge Products, Inc.

Master-Touch™

Thermal Gas Mass Flow Meters

CFG9B (DC)

MPNH-INTEGRAL

Series 8600MPNH–8800MPNH

Series 9700MPNH–9800MPNH

Approved for use in Ordinary (Non-Hazardous) locations

CSA/CUS

Installation, Wiring and Dimensions

80203101-CFG9B (Rev. 0)

CE

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Section A Introduction and Installation

Introduction

Your Master-Touch™ flow meter includes a flow sensing element, temperature sensing element, analog bridge board, digital controller board and a transmitter enclosure. The flow sensor is mounted in an insertion probe support / averaging tube or an inline flow section. Depending upon your requirements, all of these components may be integrated into one flow transmitter assembly or you may have a flow transmitter and a second, remote electronics enclosure. In either configuration, the digital controller converts the nonlinear input signal received from the flow sensor to linear 0–5 VDC & 4–20 mA output signals. RS485 Modbus RTU communications are embedded in the firmware. HART and Profibus DP-compatible modules are optionally available.

Unpacking Your Instrument

Your Master-Touch™ thermal mass flow meter is a precision piece of electronic flow instrumentation. Although these instruments are rugged, they should be inspected upon delivery to assure that no damage has taken place during transit. *If upon inspection it is found that damage has occurred, notify the carrier immediately and place a claim for damaged goods*. The shipping container or crate should be handled with care and carefully opened to avoid possible damage to the contents. After the container is opened the contents should be carefully removed and the individual pieces checked against the packing list. Please note that the packing list will show all of the options that were ordered for your instrument. Many, if not all, of those options will be incorporated into the flow meter itself and will not be separate components. The last verification is to check that the equipment and calibration range as shown on the documentation match your purchase order specifications. *If you discover a discrepancy or have any questions about what you have received, contact EPI immediately*.

Power Requirements

Power requirements for Master-Touch™ flow meters with the "-DC24" option are user-supplied 18 to 24 Volts DC @ 250 mA.

Power requirements for Master-Touch™ flow averaging tubes with the "-AC115" option are 115 VAC 50/60 Hz standard, or 220 VAC 50/60 Hz with the "-AC230" option. If conduit is used to enclose the power input line, it should be suitable for the application, electrically conductive, and connected within the enclosure to the earth ground. Our recommendation on wire size is 18 Ga. stranded for all AC wiring.

If the flow meter includes a remote electronics assembly, then the flow transmitter power is provided by the connection to the remote assembly (see the wiring instructions in Section G which correspond to your configuration). Ten feet of four or six wire connection cable is provided with the remote assembly (depending on signal requirements). If more cable is required, the 10' length should be replaced with a four- or six-wire, twisted pair shielded cable. The transmitter is independent of cable length and won't suffer any signal degradation with length changes. The 4–20mA analog output wire should be sized for no more than 5 Ohms resistance across the loop and not less than 22 AWG.

All wiring and conduits shall be installed per the local requirements as appropriate for the application and conditions.

Signal Interface

All Master-Touch™ flow meters provide both 0-5 Volts DC and 4-20 mA flow output signals and Modbus RTU communications. Additional communications protocols such as HART, Profibus DP etc. are available as options. Voltage signals should not be sent over long distances due to small currents causing voltage drops across the wire pair. If the voltage is to be sent over a distance (for example 50 feet), the wire AWG should be sized to reduce the voltage drop to acceptable levels. Knowing your load impedance is the only way this calculation may be achieved. Our 4-20 mA signal is provided to prevent this sort of signal loss. Current loops are normally not susceptible to noise and are not affected by voltage drops around the loop. However, it is important when using a current loop not to exceed the level of load resistance that the current loop may drive.

Note: Resistance loop - is the wire loop (resistance) out to and back from customer control panel, plus the series resistance (typically 250 Ohm) at customer control panel. The 250 ohm series resistor is placed across the signal input terminals, at the customer control panel, to produce a 1-5 VDC signal input, from the 4-20 mA DC current loop signal. The maximum resistance less this 250 Ohms is available for the wire loop resistance and wire gage (AWG) sizing. We recommend using an AWG size to allow a minimum margin of 10% less than the loop maximum resistance.

Examples:	DC Voltage Input		Coefficient		Resistance Loop Ohms Max.
*24 VDC Powered EPI Flowmeter Power Input Supply:	24	x	32.708	=	785
115/230 VAC Powered EPI Flowmeter Power Input Supply:	20	x	32.708	=	654
Isolated - Customer Powered 4-20 mA Current Loop:	24	x	34.167	=	820
*Isolated - Customer Powered 4-20 mA Current Loop:	20	x	34.167	=	683

*Same formula applies for less than 24 VDC input, substitute lesser value in equation.

In our standard configuration, our flow meters are not loop-powered devices. However, this option is available upon request. If a flow meter must be changed from the standard configuration to loop-powered in the field, contact the factory for assistance.

General Installation and Mounting Guidelines

The Master-Touch™ thermal dispersion sensor must be exposed to the flowing gas the process pipe at a location that provides a uniform and consistent flow profile across the pipe diameter. Anomalies in the actual flow profile or installations in non-circular ducts may require adjustments for the best accuracy. Although changes to the process gas composition, gas temperature, line pressure, etc. can affect the overall accuracy of the flow readings, these effects are often minimal with compared to their effect on other flow measurement technologies.

The Master-Touch™ firmware supports three methods of in situ flow signal adjustments for superior accuracy: C-Factor, Point-Wise, or Secondary Coefficient adjustments to the factory linearization for the most accurate flow readings:

- The C-Factor (Menu 811) adjusts the linearized microprocessor output by a uniform percentage of the readings. This adjustment is applied before the others.
- Point-Wise adjustments (Menu 750 PW-Curve Fit) provide greater flexibility by allowing adjustments in increments of 5% of the Full Scale, i.e., 10–15% or 65–70%.

Please see the *Master-Touch™ Display/Keypad Menu System Manual* for complete description of these menus and their functions, or consult the factory for additional information.

The temperature parameters for the transmitter are listed in the specification section of this manual. Acceptable limits for the gas temperature and the environmental temperature limits to which the transmitter electronics may be subjected are also provided.

We recommend installing the flow meter at a location where the gas is dry or above the dew point temperature. Installations which allow large droplets of water to condense out and to come in contact with the sensing element must be avoided. The design of the flow averaging tubes minimizes this risk, but it does not eliminate it. Applications with large quantities of gas-borne particulates should also be avoided as the sensor may become dirty which could affect the heat loss to the flowing gas and therefore have a negative impact on the overall accuracy of the flow readings. Gas purge options are available, if necessary. Consult the factory for options.

Optimum installation requires sufficient straight run to allow a uniform, non-swirling, fully-developed flow profile within the flow conduit. The illustration below is provided as a general guideline for minimum straight run requirements. Depending upon the specific location details, more or less straight run may be required to produce a satisfactory flow profile. It is best to avoid installations which are immediately downstream of bends, abrupt cross-sectional area increases or decreases, fans, louvers, or other equipment installed in the line. These situations can cause non-uniform flow profiles and swirl which can result in signal errors. Problematic flow profiles require flow conditioning to improve meter performance.

Some of EPI inline flow meters come with flow conditioning plates that can assist with shorter upstream conditions. Consult the factory for additional information concerning options to reduce the required straight run. (Note: 10x below represents 10 ID lengths and 15x represents 15 ID lengths and so forth)

Our inline style flow meters are calibrated with the sensors in a fixed position within the provided flow section. Our insertion flow meters are calibrated near the ANSI Point-of-Average-Flow (.243r) positioning in the process line with a fully-developed flow profile. You may need to make minor adjustments in the sensor position for best results in your process line. With either style of flow meter, you may also need to utilize the C-Factor adjustments of the Master-Touch™ software for the most accurate flow readings due to a non-uniform flow profile in your process line.

Installation of Inline Flow Meters

The inline style flow meter assembly includes the flow sensing element, temperature sensing element, bridge amplifier/signal output board, microprocessor circuit board, transmitter enclosure, and flow section. Depending on the flow section size and/or other requirements, the flow section may include flow conditioning plates. The flow section is typically specified to match the user's flow conduit and is plumbed directly in the flow line. This design has the sensing elements mounted directly in the flow section for exposure to the process gas. Inline mounting styles are available through EPI for line sizes 1/4" pipe and larger. Consult our factory for flow section end mounting options.

Inline flow meters are calibrated with the flow sensing element mounted in place within the flow section. The sensor should not be removed as the accuracy of the flow signal will be affected. Should ever it become necessary to remove the sensing element for any reason, the element should be replaced in the same alignment as it was originally positioned. Consult the factory before disassembling.

Installation of Insertion Flow Meters

The insertion style flow meters include the flow sensing element, temperature sensing element, bridge amplifier/signal output board, microprocessor circuit board, transmitter enclosure, and the probe assembly which supports the sensing elements. This design requires the probe assembly to be inserted into the process gas flow conduit.

Insertion styles are available with 1/2", 3/4" or 1" OD probes. Insertion style flow meters may be installed with properly sized bored-through tube fittings to mount them in place. Tube fittings, with or without mounting flange, are available from the factory as an option. Installing the tube fitting consists of preparing the flow conduit to accept the fitting by first drilling a clearance hole for the transmitter probe assembly, welding it in place, or threading it into the proper size half coupling which has been welded to the flow conduit. The tube length will be determined by EPI based upon the installation specifications.

Optional ball valve assemblies are available through EPI which allow the removal of the insertion style averaging tubes for service, calibration, cleaning, etc. The valve provides a means to seal off leaks of the process gas at the point of insertion after the probe assembly has been removed. Installation requires fitting the flow section to which the insertion probe assembly will be inserted with a threaded half coupling of the proper size to accommodate the ball valve retractor. In some instances, this requires direct threading together (or with a reducing bushing) of the retractor assembly. In other cases, it requires welding the half coupling in place and drilling a clearance hole through for the probe assembly. If the flow section is under pressure, a hot tap drill rig (not available through EPI) may be required.

The maximum pressure for insertion style flow meters is stated in the General Specifications section of this manual. To reduce the possibility of personal injury when servicing the flow meter, each size is rated such that the maximum force applied to the transmitter is approximately 25 pounds. Caution should be exercised if considering applying higher pressures, and AT HIGHER PRESSURES, A HOLDING DEVICE MAY BE REQUIRED TO PREVENT THE TRANSMITTER FROM BEING PROJECTED OUT OF THE PROCESS LINE WHEN REMOVING OR REPLACING THE TRANSMITTER ASSEMBLY. ***EPI manufactures a custom high pressure retractor that can be seen in the image above where extraction is controlled using a threaded bolt. Contact the factory for more information on this high pressure retractor.***

Please note that the proper installation of insertion style Flow Averaging Tubes™ requires the unobstructed flow of the process gas through the return port to the process line. Therefore the clearance hole in the process pipe must be sized to return port, not the flow inlet tube. Also, FAT™ probe assemblies longer than 24" require support at the pipe or duct wall opposite the insertion point to avoid the potential of damage to the assembly.

Single Point Probe Insertion Depth Guidelines

For probe insertion depth, see the below table to determine the depth of the probe from the outside pipe wall to the end of the probe, then add the insertion fitting height to that value. This resulting value will be the total length of probe insertion and should be marked on the probe accordingly. The probe is then inserted into the fitting until the mark reaches the top of the fitting. Any potential blockage effect created by inserting the probe assembly into the pipe to the depth listed has been accommodated by EPI as part of the calibration for the pipe size specified for the initial factory calibration.

The information in the table below assumes a well-developed flow profile in the process line.

For other size pipes, use example at bottom of the table.

Sch 40 Nominal Pipe Size	Inside Diameter (I.D.) (inches)	Wall Thickness (inches)	X-modifier (Inches)	Cross-sectional Area (ft2)	Pipe OD to Probe End (inches) Depth
2"	2.067	0.154	1.19	0.0233	1.6

2.5"	2.469	0.203	1.11	0.0332	1.6
3"	3.068	0.216	1.02	0.0513	1.6
4"	4.026	0.237	0.97	0.0884	1.7
6"	6.065	0.28	0.8	0.2006	1.8
8"	7.981	0.322	0.8	0.3474	2.1
10"	10.02	0.365	0.8	0.5476	2.4
12"	12	0.375	0.8	0.7854	2.6
14"	13.25	0.375	0.8	0.9575	2.8
16"	15.25	0.375	0.8	1.2684	3
18"	17.25	0.375	0.8	1.623	3.3
20"	19.25	0.375	0.8	2.0211	3.5
24"	23.25	0.375	0.8	2.9483	4

(Table above does not apply to Flow Averaging Tubes™)

To find the insertion depth for other piping, please use the below recommended equation.

(Comparing your ID to the table above, Pick an X value that is closely related to your ID)

(Example: Your new ID = 3.5, use X-modifier value of .1)

1. (New Pipe ID / 2) * 0.243 + “new pipe wall thickness” + X-modifier = Depth (Pipe OD to probe end)
2. Depth + Fitting Height = Total depth from top of fitting to probe end.

Section B Wiring Diagrams

MPNH Series Power Input and Signal Output Wiring

Section C Dimensional Drawings

Series 8600MPNH–8700MPNH

Model Number	MNPT	Length
8636MPNH	1/4"	6"
8649MPNH	3/8"	6"
8659MPNH	1/2"	7"
8669MPNH	3/4"	7"
8689MPNH	1"	8"
8710MPNH	1 1/4"	10"
8712MPNH	1 1/2"	14"
8716MPNH	2"	14"
8720MPNH	2 1/2"	14"
8724MPNH	3" Flanged	14"
8732MPNH	4" Flanged	14"

Series 8800MPNH

Series 9700MPNH

Series 9800MPNH

Factory Calibration

The factory calibration of an Eldridge thermal gas mass flow meter is a complex process. Our first step is to perform a temperature calibration of each flow sensor to eliminate temperature effects on the flow readings within a specified gas temperature range. Once this calibration process has been performed, it need not be done again. Next, we perform a flow calibration of every flow meter. Although all flow curves are similar, they are different enough to require individual calibrations to be run for each flow meter to yield the best accuracy. Lastly, we program the flow meter's microprocessor with the linearizing coefficients, specific flow range values, etc. as required to meet the requirements for each flow meter.

Flow calibration is a process of comparing or verifying the meter under strict test conditions against a meter of better accuracy used as a calibration standard. EPI flow calibrations are traceable to NIST through traceability of the instrumentation and equipment used.

Flow readings are checked against a calibration standard at many flow points and the data is graphed. From this graph the non-linearity of the raw flow signal is determined and aligned through our signal processor to yield a linear flow output signal.

Although thermal gas mass flow meters have good, long term stability, EPI recommends a factory calibration and certification be performed as necessary to conform to most quality assurance programs. Where quality assurance programs do not require recertification, it shall be left at the users' discretion when to recertify.

Section D General Specifications

Series 8000MP and 8000MPNH

Linear signal output	0-5 VDC & 4-20 mA (Flow and Temperature)
Relay Output	Two 1-amp @ 30 VDC, user-selectable alarm functions
Signal Interface	LCD (flow rate, flow total, gas temperature) RS232 & RS485 Modbus RTU *Optional HART or Profibus DP*
Accuracy* including linearity (Ref.: 21°C):	±(1% of Reading + 0.5% of Full Scale + GTC)
Repeatability	±0.2% of Full Scale
Sensor response time	1 second to 63% of final value
Turn down ratio	100:1 @ 1500 SFPM/7.6 NMPS minimum FS
Ambient electronics temperature range	-40° to 120°F (-40° to 50°C)
Gas temperature range	32°to 392°F (0 to 200°C) *Consult factory for extended range*
Gas temperature coefficient (GTC)	0.02% of Full Scale/°C
Gas pressure effect	Negligible over ±20% of absolute calibration pressure
Pressure rating maximum:	
Inline flow meters	500 PSI Std., >500 special
Insertion flow meters (*See note below*)	
.500" OD	125 PSI Std., >125 special
.750" OD	55 PSI Std., >55 special
1.000" OD	30 PSI Std., >30 special
Transmitter power requirements	5 Watts or less
RAM Back-up	Lithium Battery, 2.5-3.5v, >10 years
Wetted materials:	316SS, including sensor
Standard temperature & pressure (STP)	70°F & 29.92" Hg (Air .075 lb/cubic foot)
NIST traceable calibration	Standard

*** Accuracy specification applies to the instrument only. EPI is not responsible for measurement errors due to flow profile irregularities caused by installation piping configurations, corrosion on inner pipe surfaces valve placement, etc.**

Specifications are subject to change without notice. Consult factory at time of purchase.

Approvals

MP Series Flow Transmitter —	For use in hazardous area locations (See following page for specific approvals)
MP Series Remote Enclosure —	For use in Ordinary (Non-Hazardous) area locations: Type 4X, IP66 *Consult factory for optional enclosure.*
MPNH Series —	For use in Ordinary (Non-Hazardous) area locations: Type 4X, IP66

Insertion probe PSI assumes proper installation with stainless steel ferrule. Teflon ferrules are not acceptable. Above the listed pressure, flange-mounting is required to eliminate the potential of the probe being forced out of the line during installation or removal under pressure.

Series 9000MP and 9000MPNH

Linear signal output	0-5 VDC & 4-20 mA (Flow and Temperature)
Relay Output	Two 1-amp @ 30 VDC, user-selectable alarm functions
Signal Interface	LCD (flow rate, flow total, gas temperature) RS232 & RS485 Modbus RTU *Optional HART or Profibus DP*
Accuracy* including linearity (Ref.: 21˚C):	±(1% of Reading + 0.5% of Full Scale + GTC)
Repeatability	±0.2% of Full Scale
Sensor response time	1 second to 63% of final value
Turn down ratio	100:1 @ 15,000 SFPM/76 NMPS minimum FS
Ambient electronics temperature range	-40˚ to 120˚F (-40˚ to 50˚C)
Gas temperature range	40˚to 150˚F (5˚ to 65˚C)
Gas temperature coefficient (GTC)	0.05% Full Scale/˚C @ 40˚ to 100˚F (5˚ to 40˚C) 0.10% Full Scale/˚C @ 100˚ to 150˚F (40˚ to 65˚C)
Gas pressure effect	Negligible over ±20% of absolute calibration pressure
Pressure rating maximum:	
Inline flow meters	500 PSI Std., >500 special
Insertion flow meters (*See note below*)	
.500” OD	125 PSI Std., >125 special
.750” OD	55 PSI Std., >55 special
1.000” OD	30 PSI Std., >30 special
Transmitter power requirements	5 Watts or less
RAM Back-up	Lithium Battery, 2.5-3.5v, >10 years
Wetted materials:	316SS, including sensor
Standard temperature & pressure (STP)	70˚F & 29.92" Hg (Air .075 lb/cubic foot)
NIST traceable calibration	Standard

*** Accuracy specification applies to the instrument only. EPI is not responsible for measurement errors due to flow profile irregularities caused by installation piping configurations, corrosion on inner pipe surfaces valve placement, etc.**

Specifications are subject to change without notice. Consult factory at time of purchase.

Approvals

MP Series Flow Transmitter —	For use in hazardous area locations (See following page for specific approvals)
MP Series Remote Enclosure —	For use in Ordinary (Non-Hazardous) area locations: Type 4X, IP66 *Consult factory for optional enclosure.*
MPNH Series —	For use in Ordinary (Non-Hazardous) area locations: Type 4X, IP66

Insertion probe PSI assumes proper installation with stainless steel ferrule. Teflon ferrules are not acceptable. Above the listed pressure, flange-mounting is required to eliminate the potential of the probe being forced out of the line during installation or removal under pressure.

Specification Notice

Specifications contained herein are subject to change without notice, EPI cannot guarantee the applicability or suitability of our products in all situations since it is impossible to anticipate or control every condition under which our products and specifications may be used.

Service Work

In the event that service work is required or calibration and recertification is required, call the factory and a return materials authorization (RMA) number will be issued for each job. All units sent in for service work shall include a RMA, work instructions and be shipped prepaid. On receipt of your flow instrumentation, we will inspect the equipment and give a price quotation for service work to be performed, if not already given.

Storage

Equipment and instrumentation shall be stored in an environmentally controlled storage shelter or warehouse when not in use. All openings shall be sealed off to prevent foreign materials from entering the instrumentation.

Limited Warranty

Eldridge Products, Inc. (EPI) warrants its products to be free from defects in materials and workmanship for one year from the date of factory shipment. If there is a defect, the purchaser must notify EPI of the defect within the warranty period. Upon receipt of the defective product, EPI will either repair or replace the defective product at its sole option. EPI MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AS TO THE PRODUCTS. EPI MAKES NO WARRANTY THAT THE GOODS SOLD TO ANY PURCHASER ARE FIT FOR ANY PARTICULAR PURPOSE. FURTHERMORE, EPI MAKES NO WARRANTY OF MERCHANTABILITY WITH RESPECT TO ANY PRODUCTS SOLD TO ANY PURCHASERS. There are no other warranties that extend beyond the description on any brochure or price quote.

Limited Acceptance

Acceptance of any offer is limited to its terms. Acceptances or confirmations that state additional or differing terms from this price quote shall be operative as acceptances, but all additional or differing terms shall be deemed material alterations within the meaning of Commercial Code Section 2207(2)(b), and notice of objection to them pursuant to Commercial Code Section 2207(2)(c) is hereby given. The laws of the State of California govern this contract and venue is Monterey County. Risk of loss passes F.O.B. EPI factory. Payment due in full in US Dollars within credit terms granted from factory shipment. Additional fees shall include interest on unpaid balances that are outstanding for more than granted credit terms, plus all collection costs and attorneys' fees incurred in collecting any outstanding balance. Any and all additional or differing terms do not become part of the contract between EPI and any purchaser.

The terms of any offer are expressly limited to the terms detailed in any product brochure or price quote. Any modification to any of the terms of this offer must be in writing and must be signed by an officer of EPI.

A copy of the complete Eldridge Products, Inc. Terms and Conditions is available on our website, www.epiflow.com, or by request to the factory.

CUSTOMER SATISFACTION REPORT

Eldridge Products, Inc. is interested in your level of satisfaction with the purchase and operation of your new thermal gas mass flow meter(s) or switch(es). Please take a few moments to complete the following form and then either fax or mail it to EPI. Thank you for your cooperation.

Your Name:	Instrumentation Serial Number(s):
Company:	Date:
Fax No.:	Tel. No.:

Sales Order:

Did you receive a confirming Sales Order from Eldridge Products, Inc. for your review that was correct in its details for invoicing, order shipment, and the technical details of the required instrumentation?
Yes ___ No (Please explain):

_____
_____
_____
_____

Order Shipment:

Did you receive all instrumentation as ordered and per the Purchase Order shipping instructions?
Yes ___ No (Please explain):

_____
_____
_____
_____

Instrument Performance:

Did the instrumentation perform in accordance within factory specifications?
Yes ___ No (Please explain):

_____
_____
_____

GAS MASS FLOW MEASUREMENT & CONTROL INSTRUMENTATION
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