HART Communication with GF868, XGM868, XGS868, and XMT868 Flowmeters

Panametrics Model GF868, XGM868, XGS868, and XMT868 ultrasonic flowmeters may be modified to permit two-way communication with a HART communication device. This requires the installation of a HART option card in the flowmeter. The option card generates a 4-20 mA analog output signal that can be read by the HART device. Proceed to the appropriate section for detailed instructions on installing and/or using the HART option card.

Installing the HART Option Card

To install a HART option card in your flowmeter, complete the following steps:

!WARNING!
This procedure should be performed only by qualified service personnel.

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1. Disconnect the main power from the flowmeter.

!WARNING!
Failure to disconnect the power before proceeding may result in serious injury.

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2. Refer to your *User's Manual* for step-by-step instructions, and install the HART option card in **Slot 6** for a GF868 flowmeter or in **Slot 2** for an XGM868, XGS868, or XMT868 flowmeter.

IMPORTANT: *If a MODBUS option card is installed in Slot 5 of a GF868 flowmeter, the HART option card in Slot 6 will be ignored.*

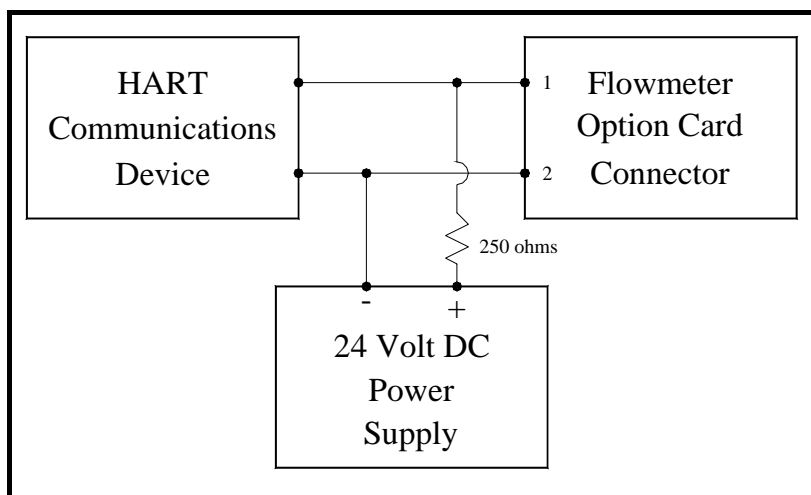**3.** Interconnect the HART option card and the HART device as shown in Figure 1 below.

Figure 1: Option Card Wiring

Installing the HART Option Card (cont.)

For a GF868 flowmeter, the option card connector is mounted on the card, and the HART device leads should go to pins 1 and 2 of this connector. As for other option cards installed in the same meter as the HART option card, the HART device will not recognize any option card installed in Slots 3-5 and it will only recognize option cards installed in Slots 1-2 if they are Analog Input, Analog Output, or RTD option cards.

For XGM868, XGS868, and XMT868 flowmeters, the HART device connections must be made to pins 1 and 2 of 12-pin terminal block J2 on the terminal board. Therefore, you must make sure that any option card installed in Slot 1 does not use these terminals.

Note: *Refer to your* User's Manual *for a complete description of the available Slot 1 option cards and their terminal usage.*

Flowmeter Software Setup

Panametrics flowmeters that are shipped with a factory-installed HART option card require no special setup procedures by the user. The meter automatically configures itself for HART communication on startup. However, for field-installation of a HART option card, the card must be configured in the factory test menu before it will be recognized by the meter. Thereafter, the initialization will be automatic on startup. Consult Panametrics for specific instructions.

In addition to setting up the HART option card so that it is recognized by the meter, the analog output of the option card may be configured using any of the following methods (if available):

- the flowmeter keypad (GF868 only)

- Instrument Data Manager (IDM) software

- Remote Control Communications Unit (RCCU)

- the HART device

To configure your HART option card analog output using any of the first three methods, follow the instructions in your flowmeter *User's Manual*. During configuration, the choice of parameter must be limited to those listed in Table 1 on page 3. To use the HART device for configuration of the analog output, refer to the instructions that came with that device.

Note: *Because HART communication is unreliable at analog outputs below 4 mA, the flowmeter automatically changes a HART option card analog output configuration of 0-20 mA or OFF to a 4-20 mA configuration upon startup.*

Flowmeter Software Setup (cont.)

Some flowmeter parameters can only be read by the HART device during startup. Therefore, it is recommended that both the flowmeter and the HART device be rebooted after any reprogramming of the HART option card analog output. Failure to do so may result in erroneous information or a communication failure between the flowmeter and the HART device.

Table 1: Valid HART Parameters and Units

Parameter	English Units	Metric Units
Velocity	ft/sec	m/s
Volumetric (liquid)	gal/s, gal/m, gal/h, mgal/day, cuf/s, cuf/m, cuf/h, mcf/day, bbls/s, bbl/m, bbl/h, mbl/d, acre-inch/day	l/s, l/m, l/h, ml/d, cum/s, cum/m, cum/h, mcm/d, bbl/s, bbl/m, bbl/h, mbl/d
Volumetric (gas)	acf/m, acf/h, scf/m, scf/h	acm/h, scm/h, scm/d
+Tot, -Tot (liquid)	gal, cuf,bbl, acre-in, acre-ft	liter, cum, bbl
+Tot, -Tot (gas)	acf, scf	acm, scm
Mass Flow	lb/s, lb/m, lb/h, mlb/d, ton/m, ton/h, mton/d	kg/s, kg/h, mkg/d, tne/m, tne/h, tne/d
+Mass, -Mass	lb, ton	kg, tne
Power	kbtu/h, kw	mcal/h, kw
+Energy, -Energy	btu, kw-hr	mcal, kw-hr
Temperature	°F	°C
Pressure	psia	bar, bara
Mol Weight	none	none
NOTE: "acf" is reported as "normal cubic feet" in HART. Also, "Mega" units (i.e. mgal/day, mcf/day, etc.) are reported as standard units x 10^6 in HART. For example, 1 mgal is 1x10^6 gal in HART.		

Using the HART Interface

The HART communications option card installed in Panametrics flowmeters has been successfully tested with the **Rosemount 275 Hand-Held Communicator** and the **Rosemount AMS Computer-Based Communications Software**. Although some flowmeter functions may be performed via the HART device, many other functions (i.e. data logging, site file uploading, site file downloading, printing, etc.) must still be programmed by the methods described in the flowmeter's *User's Manual*. This is because the HART protocol was developed for use with simple transmitters and it cannot handle the multitude of sophisticated functions built into the Panametrics flowmeters.

Unit Types

Due to limitations of the HART protocol, only those unit types listed in Table 1 on page 3 are acceptable. If a meter parameter is set to any other measurement units, the HART device displays an *"Unknown Enumerator, Can not resolve"* error message and may terminate communications entirely. In some cases, both the Hart device and the flowmeter may have to be rebooted to clear the error. To address this potential problem, the flowmeter has been programmed to force all measurement units to HART compliant units if a HART option card is detected upon startup.

HART Functions

After HART communications has been properly set up, the following flowmeter functions may be accessed via the HART device:

- static temperature and static pressure

Note: *To view the static temperature or pressure for a channel via the HART device, the fixed value for that parameter must be assigned to that channel at the flowmeter. See your* User's Manual *for instructions.*

- tracking windows (XMT868 only)

- minimum and maximum soundspeed (XMT868 only)

- 2-path error handling

- velocity averaging response time

- static density

- error handling

- mA error level (if selected)

- clear totals

Note: *Refer to your* User's Manual *for a complete description of each of the above functions.*

When information is viewed through the HART device, the input variable always appears as either *Channel 1 Temperature* or *Channel 1 Pressure*. Although these inputs are not necessarily assigned to Channel 1, the HART protocol labels all inputs as channel-specific. For example, a Slot 1 analog input that is programmed at the meter as a temperature input assigned to Channel 1, Channel 2, Both, or Neither is always reported by the HART device as a *Channel 1* Temperature input.

Note: *Inputs cannot be assigned via the HART device. Also, any input assigned as* "Special" *is always reported as a Channel 1 Temperature input by the HART device*

HART Functions (cont.)   In addition to the functions listed on the previous page, the following procedures may be performed through the HART device:

- calibration and setup of the HART option card analog output

- calibration and some programming of analog inputs, analog outputs, and RTD inputs on option cards installed in Slots 0 (all), 1 (all), and 2 (GF868 only).

- viewing some of the flowmeter's diagnostic parameters.

List of Programmable Variables   For convenient reference, all of the programmable variables for the four flowmeter models are listed in Table 2 below.

Table 2: Programmable Variables

Description	Format*	R/W/B*	XMT868	XGS868	XGM868	GF868
Channel Process Variables						
Ch1, Ch2, or Ave vel	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave vol	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave mdot	f.p.	R	Y	Y	if mass	Y
Ch1, Ch2, or Ave power	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave Temper	f.p.	R	N	Y	Y	Y
Ch1, Ch2, or Ave Pressure	f.p.	R	N	Y	Y	Y
Ch1, Ch2, or Ave Mw	f.p.	R	N	N	N	Y
Ch1, Ch2, or Ave +tot	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave -tot	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave +mass	f.p.	R	Y	Y	if mass	Y
Ch1, Ch2, or Ave -mass	f.p.	R	Y	Y	if mass	Y
Ch1, Ch2, or Ave +energy	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave -energy	f.p.	R	if energy	N	N	N
Ch1 or Ch2 Ssup	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 ssDO	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave tUP	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave tDO	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave deltaT	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 peak%	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave DeltaT(s)	f.p.	R	N	if meas	if meas	if meas
Ch1, Ch2, or Ave DeltaT(M)	f.p.	R	N	if meas	if meas	if meas
Ch1 or Ch2 qUP	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 qDOWN	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 ampUP	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 ampDOWN	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 peak#UP	f.p.	R	Y	Y	Y	Y
Ch1 or Ch2 peak#DOWN	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave t.S	f.p.	R	if energy	N	N	N

Table 2: Programmable Variables (cont.)

Description	Format*	R/W/B*	XMT868	XGS868	XGM868	GF868
Channel Process Variables (cont)						
Ch1, Ch2, or Ave t.R	f.p.	R	if energy	N	N	N
Ch1, Ch2, or Ave t.S-t.R	f.p.	R	if energy	N	N	N
Ch1 or Ch2 inco1	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 onco2	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 Rpowr	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 Rqual	f.p.	R	if transfl.	N	N	N
Ch1 or Ch2 Repp	f.p.	R	if transfl.	N	N	N
Ch1, Ch2, or Ave c3	f.p.	R	Y	Y	Y	Y
Ch1, Ch2, or Ave Temp_super	f.p.	R	N	Y	N	N
Ch1, Ch2, or Ave Rho	f.p.	R	N	Y	N	N
Ch1 or Ch2 Err code	int	R	Y	Y	Y	Y
Ch1 or Ch2 re#	f.p.	R	Y	N	N	N
Global Meter Information						
MeterType (Model)	int	R	Y	Y	Y	Y
#Channels	int	R	Y	N	N	N
2-Path?	int	B	Y	N	N	N
Resp_time	int	B	Y	Y	Y	Y
Static Density?	int	B	Y	Y	Y	Y
Static Density Value	f.p.	B	Y	Y	Y	Y
Error Mode	int	B	Y	Y	Y	Y
Aout Error Level	f.p.	B	Y	Y	Y	Y
Meter Units (Eng. or Metric)	uchar	B	Y	Y	Y	Y
EnergyMeter?	uchar	R	Y	N	N	N
Clear-totals?	int	W	Y	Y	Y	Y
CH1 Information						
Ch1 Fixed Temp	f.p.	B	N	Y	Y	Y
Ch1 Fixed Press	f.p.	B	N	Y	Y	Y
Ch1 Tracking?	int	B	Y	N	N	
Ch1 Min Sound Spd	f.p.	B	Y	N	N	N
Ch1 Max Sound Spd	f.p.	B	Y	N	N	N
CH2 Information (if applicable)						
Ch2 Fixed Temp	f.p.	B	N	Y	Y	Y
Ch2 Fixed Press	f.p.	B	N	Y	Y	Y
Ch2 Tracking?	int	B	Y	N	N	
Ch2 Min Sound Spd	f.p.	B	Y	N	N	N
Ch2 Max Sound Spd	f.p.	B	Y	N	N	N
Slot Information						
Slot 0 A or B Device	uchar	R	Y	Y	Y	Y
Slot 0 A or B Type	uchar	B	Y	Y	Y	Y
Slot 0 A or B Chan	uchar	B	if 2-Ch	if 2-Ch	if 2-Ch	if 2-Ch

Table 2: Programmable Variables (cont.)

Description	Format*	R/W/B*	XMT868	XGS868	XGM868	GF868
Slot Information (cont.)						
Slot 0 A or B Variable	uchar	B	Y	Y	Y	Y
Slot 0 A or B Units	uchar	R	Y	Y	Y	Y
Slot 0 A or B Zero	f.p.	B	Y	Y	Y	Y
Slot 0 A or B Span	f.p.	B	Y	Y	Y	Y
Slot 1 or 2 Active	int	R	Y	Y	Y	Y
Slot 1 or 2 A, B, C, or D Device	uchar	R	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Type	uchar	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Chan	uchar	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Variable	uchar	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Units	uchar	R	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Zero	f.p.	B	if active	if active	if active	if active
Slot 1 or 2 A, B, C, or D Span	f.p.	B	if active	if active	if active	if active
HART Variables						
Universal Rev	uchar	R	Y	Y	Y	Y
Software Rev	uchar	R	Y	Y	Y	Y
Transmitter Rev	uchar	R	Y	Y	Y	Y
Hardware Rev	uchar	R	Y	Y	Y	Y
Device ID	uchar	R	Y	Y	Y	Y
PollAddress	uchar	B	Y	Y	Y	Y
Message	uchar24	B	Y	Y	Y	Y
Tag	uchar6	B	Y	Y	Y	Y
Descriptor	uchar12	B	Y	Y	Y	Y
Date	uchar3	B	Y	Y	Y	Y
Final Assy No	uchar3	B	Y	Y	Y	Y
Derial No.	uchar3	R	Y	Y	Y	Y
Pvt. Label Dist	uchar	R	Y	Y	Y	Y
Pri Var Code	uchar	R	Y	Y	Y	Y
Alarm Select	f.p.	B	Y	Y	Y	Y
Write Protect Code	uchar	B	Y	Y	Y	Y
Config Chgd Flag	uchar	B	Y	Y	Y	Y
Response Preambles	uchar	B	Y	Y	Y	Y
HART Device	uchar	R	Y	Y	Y	Y
HART Type	uchar	B	Y	Y	Y	Y
HART Channel	uchar	B	Y	Y	Y	Y
HART Variable	uchar	B	Y	Y	Y	Y
HART Units	uchar	R	Y	Y	Y	Y
HART Zero	f.p.	B	Y	Y	Y	Y
HART Span	f.p.	B	Y	Y	Y	Y
* Format - f.p. = IEEE floating point, int = integer, uchar = unsigned character ucharX = X bytes of unsigned characters. **R/W/B** - R = read only, W = write only, B = read or write via HART						