FISHER

HART INTERFACE PROGRAMS

User Manual

Form A4650
March 1999

Part Number D301069X012

Revision Tracking Sheet
March 1999

This manual may be revised periodically to incorporate new or updated information. The revision date of each page is indicated at the bottom of the page opposite the page number. A major change in the content of the manual also changes the date that appears on the front cover. Listed below is the revision date of each page.

Page	Revision
All	3/99

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SECTION 1 — INTRODUCTION

The Remote Operations Controllers (ROCs) and FloBoss units use standard Highway Addressable Remote Transducer (HART®) Protocol commands to request and write parameters to a HART Slave device. The HART Protocol relies on the Bell 202 Frequency Shift Keying (FSK) standard to superimpose digital signals at a low level on top of the 4 to 20mA. The low-level FSK sine-wave signal transmits digitally. The HART Protocol allows both analog and digital communication signals to be transmitted simultaneously on the same wiring allowing two-way field communications from the Host to the HART device. Process Variable and control signal information may be transmitted using the 4 to 20mA while additional measurements, device configuration, parameters, and calibration travel over the digital channel.

1.1 ORGANIZATION OF MANUAL

This manual is organized into the following major sections:

- Table of Contents
- Section 1 — Introduction
- Section 2 — Hardware Installation
- Section 3 — Downloading the HART User Program
- Section 4 — Configuring the HART Points
- Section 5 — Configuring the HART Device
- Section 6 — HART Host Operation
- Section 7 — Using HART Parameters
- Appendix A — Soft Point Mapping
- Appendix B — HART Parameters
- Topical Index

Table of Contents — Lists each section and information contained in that section of the document.

Section 1 — Introduction describes this manual and mentions related manuals. This section also provides a summary of the HART user program, hardware overview, and lists the HART user programs.

Section 2 — Hardware Installation provides information concerning installation and wiring of the HART Card and HART Modules. This section also includes testing information.

Section 3 — Downloading the HART User Program describes how to view available memory, how to select and how to download the correct HART User Program to the ROC or FloBoss.

Section 4 — Configuring the HART Points provides information detailing how to configure the HART Points.

Section 5 — Configuring the HART Device provides information detailing how to configure the HART slave device.

Section 6 — HART Host Operation provides information detailing how to perform a full update, polling methods, writing parameters to the HART device, and clearing the configuration change bit.

Section 7 — Using HART Parameters provides information on how the HART parameters are referenced in the ROC/FloBoss, accessed using opcodes, and used in conjunction with Modbus.

Appendix A — Soft Point Mapping provides information detailing how the HART parameters can be mapped to the ROC soft points.

Appendix B — HART Parameters lists the ROC point types associated with the HART User Program.

Topical Index — Lists alphabetically the items contained in this manual, including the section and page number.

NOTE

"ROC" may occasionally be used in this manual to stand for both the ROC and FloBoss products. The FloBoss is essentially a specialized Remote Operations Controller (ROC).

1.2 SECTION 1 – CONTENTS

This section includes:

1.3 HART INTERFACE CARDS AND HART INTERFACE MODULES

The ROC or FloBoss and HART devices create a Host/Slave network. The ROC or FloBoss is the Host and each HART device is a Slave. There are two ways to send and receive HART messages between a ROC and HART devices, depending on the type of ROC/FloBoss and HART interface being used.

HART Interface Card — The way first uses one HART Interface Card installed in a:

- ROC306 or ROC312 with a ROCPAC, firmware version 1.10.
- ROC306 or ROC312 with a FlashPAC, firmware version 2.0 or 2.1.

HART Interface Modules — The second way uses one or more HART Interface Modules (sometimes called HART I/O Modules or HART Modules) installed in a:

- ROC312 with a ROCPAC, firmware version 1.10.
- ROC364 with a ROCPAC, firmware version 1.70.
- ROC312 or ROC364 with a FlashPAC, firmware version 2.0 or 2.1.
- FloBoss 407 with firmware version 1.04 or 1.06.

NOTE

In the case of the ROC312, it is not possible to use both a HART Interface Card and HART Interface Modules. One or the other must be chosen. Either option requires the correct HART user program to be loaded into the ROC.

NOTE

ROCLINK Configuration Software is required when using a ROC with a FlashPAC, or a FloBoss 407 with firmware version 1.06. For ROCs with a ROCPAC or a FloBoss 407 with firmware version 1.04, either the GV101 or the ROCLINK Configuration Software may be used.

NOTE

In most cases, the FloBoss 407 and ROC300-series units are identical in operation. Unless otherwise noted, the descriptions and procedures in this manual apply to all FloBoss and ROC types. In areas where the operation differs, the differences are described.

1.4 ADDITIONAL INFORMATION

This document is intended to be used in conjunction with the following manuals and Web sites to assist in downloading and configuration. The physical (hardware) aspects of the FloBoss and ROC units are contained in their respective instruction manuals.

- *Type RL101 ROCLINK Configuration Software User Manual (Form A6051)* – Part Number D301101X12
- *GV101 Configuration Software User Manual (Form A4194)* – Part Number D301058X012
- *Type ROC306/312 Remote Operations Controller Instruction Manual (Form A4630)* – Part Number D301059X12
- *Type ROC364 Remote Operations Controller Instruction Manual (Form A4193)* – Part Number D301060X12
- *FloBoss 407 Flow Manager Instruction Manual (Form A6013)* – Part Number D301080X12
- *ROC Protocol User Manual (Form A4199)* – Part Number D301053X12
- www.ccsi.com/hart
- www.fieldbus.com/hart

1.5 OVERVIEW

ROC and FloBoss units use the standard HART protocol commands to request and write parameters to a HART device. HART travels over low signal frequencies (1200 and 2200Hz) which restricts transmissions to 1200 baud rate. When data is transmitted, 1200Hz represents a "1" state and 2200Hz represents a "0" state. Each message passed between a field device (Slave) and the Host includes the ROC Address and the destination Slave Address of the HART device, Device Status, and series of bytes representing the Commands sent by the Host. HART Host Commands are detailed in Section 6. The Host transmits a voltage signal and the Slave responds with a current signal.

Each response message received from the HART Slave device contains information used to indicate problems with the device or communication errors. The Command Response or Response Code reports communication problems or problems with the HART Command the Slave received. The Device Status field displays the specific condition of the HART field device.

When loaded into RAM, a HART program can use the following configuration software for configuring and monitoring HART points and devices.

- ROCLINK Configuration Software version 2.0 or 2.1.
- GV101 Configuration Software version 1.63.

NOTE

ROCLINK Configuration Software is required when using the HART program in a ROC with a FlashPAC, or in a FloBoss 407 with firmware version 1.06. For ROCs with a ROCPAC or a FloBoss 407 with firmware version 1.04, either the GV101 or the ROCLINK Configuration Software may be used.

The HART parameters are referenced in the ROC the same as standard point type parameters by **Type**, **Logical number**, and **Parameter** (TLP). Each input and output has a unique Point Number to identify the input or output. Each I/O Point Type must be individually configured. This allows parameters such as a HART Primary Variable to be assigned as an input to an AGA Flow Calculation, a Process Variable or Process Value for a PID loop, a variable to display on a Local Display Panel, or a variable for any other ROC function.

Two point types are added to the ROC protocol by a HART program:

- Point Type 30 – HART Point Configuration Parameters
- Point Type 31 – HART Device Configuration Parameters

Refer to Appendix B for a complete list of the parameters associated with these HART point types.

1.6 HART INTERFACE CARD PROGRAM

The HART Interface Card Program allows a ROC306 or ROC312 with an installed HART Interface Card to communicate with HART devices. Using HART digital communications, up to four measurements (Dynamic Variables) can be communicated in a single message. Other HART device specific transmitter variables may also be read. The HART Card allows both digital and analog signals through the ROC analog inputs.

Each of the three built-in analog inputs (AIs) on the ROC306/ROC312 can be configured as a HART Point. Once a built-in analog input is configured as a HART Point, it can communicate either in the point-to-point mode or in the multi-drop mode to HART devices.

In **point-to-point mode**, digital communications are superimposed on the 4 to 20 milliamp analog signals (which can still measure the Process Variable) through a built-in analog input. This mode allows communications with one HART device per built-in analog input point and maximizes polling speed. In point-to-point mode, all HART field devices have an address of 0.

In **multi-drop mode**, several HART devices are connected to a single communications line. As many as five HART devices (limited by the total current consumption of the devices) can be connected in parallel to a single built-in analog input. Like the point-to-point mode, digital communications are superimposed on the current signals; however, the analog signal is used only to measure the current consumed by all HART devices in the multi-drop loop. Communications are restricted to digital transmissions as the loop current is fixed at a minimum value and no longer has meaning relative to the process. The digital transmissions contain the values read from the HART device. Multiple field devices may be physically connected (in parallel) to the same pair of wires when installed. When all three built-in analog input channels are used in multi-drop mode and five HART devices are wired to each input channel, a ROC306/ROC312 with a Hart Card can support a maximum of 15 HART devices.

In multi-drop mode, HART field devices have an address of 1 through 15, and each device sets its output current to a fixed value (typically 4 mA). The ROC HART application sends a message to all multi-dropped devices, telling the HART device with a certain tag name to respond. Therefore, the Address of that HART device must match the Device Tag as defined in the Config HART Point screen. If the Device Tag of the HART device (typically set by a handheld communicator) does not match the Device Tag set in the Config Hart Point screen, the HART device will not respond.

1.7 HART INTERFACE MODULE PROGRAM

The HART Interface Module Program allows a ROC312, ROC364, or a FloBoss 407 unit with one or more installed HART Interface Modules to communicate with HART devices. The 4mA to 20mA analog signal is ignored when using a HART Module and communications are limited to digital signals only.

When using a HART module, the HART module polls the HART device and temporarily stores the data in the HART module. The HART User Program polls the HART module and stores the data into the user defined point types. If the HART User Program fails to collect the data from the HART module, the next time the HART module polls the HART device, the data is overwritten in the HART module.

Each HART module contains two channels configured as HART Points. Each HART module channel or point may be configured for point-to-point mode or multi-drop mode.

In **point-to-point mode**, one HART device is connected to a HART module channel, for a total of two HART devices per HART module. In this mode, the speed of polling a HART device is maximized.

In **multi-drop mode**, as many as five HART devices (limited by the total current consumption of the devices) can be connected in parallel to a single HART module channel. Since each HART module has two channels, one module can support as many as ten HART devices.

The maximum number of HART points/devices allowed by the HART module program is 32. Depending on the mode, this may be accomplished with as few as four or as many as six HART modules. Therefore, although the ROC364 can physically hold more than six HART modules, the program limits it to using six HART modules.

1.8 PROGRAM FILES SUPPLIED

The HART program files, supplied on a single 1.4 Mbyte disk, are listed in Table 1-1.

Table 1-1. HART User Programs

	HART Card in:		Hart Interface Module in:		
User Program	**ROC306/312 ROCPAC**	**ROC306/312 FlashPAC**	**FloBoss 407**	**ROC300 ROCPAC**	**ROC300 FlashPAC**
HART_B4.H00	X				
HART_C0.H00	X				
HART_D0.H00	X				
HART2_B8.H00	X				
HART2_D0.H00	X				
FP_HCARD.H00		X			
FP2HCARD.H00		X			
FBHI7060.H00			X		
FBHIA07C.H00			X		
FBHIB07C.H00			X		
FBHIC07C.H00			X		
FBCLR_A0.H00*			X		
FBCLR_B0.H00*			X		
FBCLR_C0.H00*			X		
HIO_7060.H00				X	
HIO_B8A8.H00				X	
HIO_C0C8.H00				X	
HIO_D0D8.H00				X	
FPHID0B0.H00					X

* Not required when using ROCLINK Configuration Software.

SECTION 2 — HARDWARE INSTALLATION

2.1 SECTION CONTENTS

As listed below, this section provides instructions for installing, wiring, and testing the HART Interface Card and the HART Interface Module.

2.2 RAM BACKUP AND RESTORATION PROCEDURES

Before removing power to the ROC, perform one of the following procedures to avoid losing the ROC configuration and other data stored in RAM (in the event that backup power is not working). Refer to:

- RAM Backup with GV101 Configuration Software on page 2-2.
- RAM Backup Procedure using ROCLINK Software on page 2-5.
- After Installing Components Using GV101 on page 2-6.
- After Installing Components using ROCLINK on page 2-8.

2.2.1 RAM Backup with GV101 Configuration Software

This procedure assumes you are using Revision 1.62 or later of the GV101 Configuration Software, or Revision 1.0 or later of the Industry Canada GV101. User programs cannot be saved to disk from the ROC; if these are lost or corrupted, they need to be reloaded from their original disk files as instructed in Section 3, Downloading Procedures.

The RAM Backup with GV101 Configuration Software processes include:

- Saving ROC Configuration to Memory using GV101 on page 2-2.
- Saving the ROC Configuration to a Disk File using GV101 on page 2-3.
- Saving Historical Configurations to a Disk File using GV101 on page 2-3.
- Saving the Event and Alarm Logs to Disk Files using GV101 on page 2-4.
- Saving FSTs to a Disk File using GV101 on page 2-4.

NOTE

You may not require all of the RAM Backup procedures if you do not desire to save certain configuration data.

2.2.1.1 Saving ROC Configuration to Memory using GV101

This procedure saves the current ROC configuration to permanent memory so it is restored after you remove power when you install a HART Card or HART Module.

1. Press **F4**, Configure, from the GV101 Main Menu.
2. Select **8**, ROC System Flags, from the Configuration menu and press **Enter**.
3. Move your cursor to the **Write to EEPROM** field, type **1**, and press **Enter**.

4. Press **(F8)Save** and press **Enter** to confirm your actions. This action saves most of the ROC configuration (but not logs or FST programs) into the permanent memory accessed when a cold start is performed.
5. Press **Esc**.

2.2.1.2 Saving the ROC Configuration to a Disk File using GV101

This procedure saves the current ROC configuration to a disk file so it is restored after you remove power when you install a HART Card or HART Module.

1. Press **F4**, Configure, from the GV101 Main Menu.
2. Type **3**, Save ROC Configuration to Disk File, to save the configuration data (except for FSTs) of a connected ROC to a disk file and press **Enter**.
3. Enter the **name** of the file where the configuration data is to be saved by typing the name of the drive, subdirectory (if needed), and file name, and press **Enter**. This file will have the `.dcf` extension.
4. When the save process is complete, press **Enter**. The Configuration Menu is displays.
5. Press **Esc** to return to the Main Menu.

2.2.1.3 Saving Historical Configurations to a Disk File using GV101

This procedure saves the Historical configurations to a disk file. This information cannot be restored to the ROC but it can be viewed or printed.

1. Type **6**, Historical Database Functions, from the Main Menu and press **Enter**.
2. Type **6**, Save Historical Database to Disk File, and press **Enter**.
3. Enter the **name** of the file where the configuration data is to be saved by typing the name of the drive, subdirectory (if needed), and file name, and press **Enter**. This file will have the `.pdb` extension.
4. Press **Enter** to selected the desired options and press **F2**.
5. Type the **number of logs** you desire to save and press **Enter**.
6. Type **5**, Save Minute Database to Disk File, and press **Enter**.
7. Enter the **name** of the file where the configuration data is to be saved by typing the name of the drive, subdirectory (if needed), and file name, and press **Enter**. This file will have the `.mdb` extension.
8. Press **Enter** to selected the desired options and press **F2**.
9. Type **7**, Save Daily Database to Disk File, and press **Enter**.

10. Enter the **name** of the file where the configuration data is to be saved by typing the name of the drive, subdirectory (if needed), and file name, and press **Enter**. This file will have the `.day` extension.
11. Press **Enter** to selected the desired options and press **F2**.
12. Type the **number of logs** you desire to save and press **Enter**.
13. Press **Esc**.

2.2.1.4 Saving the Event and Alarm Logs to Disk Files using GV101

This procedure saves the current Event Log and Alarm Log to a disk file so it is viewed or printed after you remove power when you install a HART Card or HART Module. This file cannot be restored to the ROC after removing power.

1. Type **7**, Event Log, Alarm Log Functions, from the Main Menu and press **Enter**.
2. Type **3**, Save Event Log to Disk File, and press **Enter**.
3. Enter the **name** of the file where the configuration data is to be saved by typing the name of the drive, subdirectory (if needed), and file name, and press **Enter**.
4. Type **4**, Save Alarm Log to Disk File, and press **Enter**.
5. Enter the **name** of the file where the configuration data is to be saved by typing the name of the drive, subdirectory (if needed), and file name, and press **Enter**.
6. Press **Esc**.

2.2.1.5 Saving FSTs to a Disk File using GV101

This procedure saves the current FST configurations to a disk file so it is restored after you remove power when you install a HART Card or HART Module.

1. Type **8**, Utilities, from the GV101 Main Menu and press **Enter**.
2. Type **1**, FST Editor, from the Utilities Menu and press **Enter**.
3. Type **1**, Setup Information from ROC, and press **Enter**.
4. Press /.
5. Select **FST** and press **Enter**.
6. Select **Write FST** and press **Enter**.
7. Type a file name in the **Enter File name** field and press **Enter**. This saves the current workspace contents to a disk file (saves one FST at a time). Use a different name for each of the four FSTs.
8. Press /.
9. Select **Quit** and press **Enter**.

10. Select **Yes** and press **Enter** to return to GV101.
11. Repeat for each of the four FSTs.

2.2.2 RAM Backup Procedure using ROCLINK Software

To back up the ROC configuration, perform the following steps. User programs cannot be saved to disk from the ROC; if these are lost or corrupted, they need to be reloaded from their original disk files as instructed in Section 3, Downloading HART using ROCLINK.

NOTE

You may not require all of the RAM Backup procedures if you do not desire to save certain configuration data.

1. Select **Flags** from the System Menu.
2. Set the **Write to Internal Config Memory** or **Write to EEPROM** to display **Yes**.
3. Press **(F8)Save**.
4. Select **Download** from the File menu in ROCLINK.
5. Select **ROC Config. to Disk**. The Save File dialog box appears.
6. Type the **File Name** of the backup file or use the default name, which is based on the Group and Address of the device.
7. Press **OK**. A file with a `.DCF` or `.FCF` extension is created in the default ROCLINK directory. The default ROCLINK directory is the directory from which you launched the ROCLINK program.
8. Press **Enter** when complete.
9. Select **Collect ROC Data** from the File menu.
10. Select **All** and press **Enter**.
11. Enter a **File Name** and press **OK**.
12. Select **FST** under the Data menu.
13. Select **Editor**.
14. Type **1**, Setup Information from ROC, and press **Enter**.
15. Press /.
16. Select **FST** and press **Enter**.
17. Select **Write FST** and press **Enter**.
18. Type a file name in the **Enter File name** field and press **Enter**. This saves the current workspace contents to a disk file (saves one FST at a time). Use a different file name for each of the four FSTs.
19. Repeat steps 17 and 18 for each FST. Use a different file name for each of the four FSTs.

20. Press /.
21. Select **Quit** and press **Enter**.
22. Select **Yes** and press **Enter** to return to ROCLINK.

2.2.3 After Installing Components Using GV101

After removing power to the ROC and installing components as needed, perform the following steps to start your ROC and reconfigure your data.

The After Installing Component Using GV101 processes include:

- Restoring the ROC Configuration from a Disk File using GV101 on page 2-6.
- Restoring FSTs from a Disk File using GV101 on page 2-7.

NOTE

You may not require all of the all procedures if you do not desire to reload certain configuration data.

2.2.3.1 Restoring the ROC Configuration from a Disk File using GV101

After restoring power to the ROC, the configuration data stored in memory may be corrupt. To restore the ROC to the ROCs last known operating state, use this procedure to load the disk configuration you created in Section 2.2.1.1, Saving ROC Configuration to Memory using GV101, on page 2-2.

1. Press **F4**, Configure, from the GV101 Main Menu.
2. Type **4**, Load Configuration from Disk File to ROC, to reinstall the configuration data (except for FSTs) of a connected ROC to a disk file and press **Enter**.
3. Select **Configure ROC300 Series** or **Configure ROC400** Series and press **Enter**.
4. Select the **File Name** of the file you created in step 3 of Section 2.2.1.2, Saving the ROC Configuration to a Disk File using GV101, on page 2-3 and press **Enter**. This file will have the `.dcf` extension.
5. Press **F2**.
6. Press **Enter** to continue.
7. Press **Enter** to verify the download. You are returned to the Configuration Menu.
8. Press **Esc** to return to the Main Menu.

2.2.3.2 Restoring FSTs from a Disk File using GV101

This procedure restores the FST configurations from a disk file after you remove power when you install a HART Card or HART Module.

1. Type **8**, Utilities, from the GV101 Main Menu and press **Enter**.
2. Type **1**, FST Editor, from the Utilities Menu and press **Enter**.
3. Type **1**, Setup Information from ROC, and press **Enter**.
4. Press /.
5. Select **FST** and press **Enter**.
6. Select **Read FST** and press **Enter**.
7. Select **Disk File** and press **Enter**.
8. Select the **File Name** of the file you created in step 7 of Section 2.2.1.5, Saving FSTs to a Disk File using GV101, on page 2-4 and press **Enter**.
9. Press **F2**.
10. Press /.
11. Select **Quit** and press **Enter**.
12. Select **Yes** and press **Enter** to return to GV101.
13. Press **F4**, Configure, from the GV101 Main Menu.
14. Select **8**, ROC System Flags, from the Configuration menu and press **Enter**.
15. Set the **Write to EEPROM** to display **1**. This action saves most of the ROC configuration (but not logs or FST programs) into the permanent memory accessed when a cold start is performed.
16. Press **(F8)Save**.
17. Press **Enter** to confirm your actions.
18. Press **Esc**.

2.2.4 After Installing Components using ROCLINK

To restore the ROC to the ROCs last known operating state before removing power, use this procedure to load the disk configuration you created in Section 2.2.2, RAM Backup Procedure using ROCLINK Software, on page 2-5.

NOTE

You may not require all of the RAM Backup procedures if you do not desire to save certain configuration data.

CAUTION

Ensure all input devices, output devices, and processes remain in a safe state upon restoring power.

1. Select **Download** from the File menu in ROCLINK.
2. Select **Disk Config. To ROC**.
3. Select the **File Name** of the backup file you created in step 10 of Section 2.2.2, RAM Backup Procedure using ROCLINK Software, on page 2-5.
4. Press **OK**.
5. Select the **Download Configuration** components you desire to re-install and press **F8**.
6. Select **FST** under the Data menu.
7. Select **Editor**.
8. Type **1**, Setup Information from ROC, and press **Enter**.
9. Press /.
10. Select **FST** and press **Enter**.
11. Select **Read FST** and press **Enter**.
12. Select **Disk File** and press **Enter**.
13. Select the **File Name** of the file you created in step 18 of Section 2.2.2, RAM Backup Procedure using ROCLINK Software, on page 2-5.
14. Press **F2**.
15. Press /.
16. Select **Quit** and press **Enter**.
17. Select **Yes** and press **Enter** to return to ROCLINK.
18. Select **Flags** from the System Menu.
19. Set the **Write to Internal Config Memory** or **Write to EEPROM** to display **Yes**.
20. Press **(F8)Save**.

2.3 HART INTERFACE MODULE

The HART Interface Module provides communications between a ROC and other devices using the HART protocol. The module has its own microprocessor and mounts in the I/O module sockets of a ROC.

The HART Interface Module communicates digitally to HART devices through the I/O termination blocks associated with the module position. Each HART module contains two separate channels. Each channel polls all HART devices connected to it before the other channel is polled. Each channel can be configured to operate in either the point-to-point mode or the multi-drop mode. In the point-to-point mode, each module channel supports one HART device.

In the multi-drop mode, each channel can support up to five HART devices for a total of ten devices for each module. By using the multi-drop mode with multiple HART modules, up to 32 HART devices (limited by the software) can be supported by a single ROC. Refer to Figure 2-1.

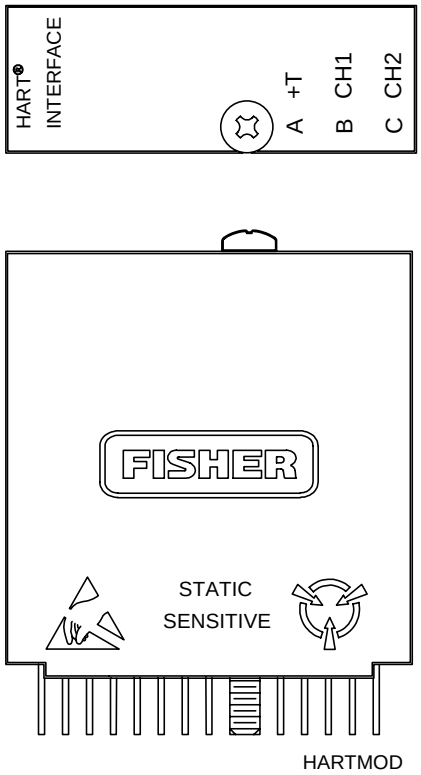

Figure 2-1. HART Interface Module

2.3.1 Installing a HART Interface Module

The HART Interface Module package includes one HART Interface Module and a mounting screw. Requirements for using the HART Module are:

- GV101 Configuration Software version 1.63, or ROCLINK Configuration Software version 2.0 or 2.1.
- ROC312 with ROCPAC version 1.10, or with a FlashPAC version 2.0 or 2.1 (used with ROCLINK only).
- ROC364 with a ROCPAC version 1.70, or with a FlashPAC version 2.0 or 2.1 (used with ROCLINK only).
- FloBoss 407 with firmware version 1.04 or 1.06.
- HART Interface User Program loaded into ROC memory.

Each HART module installs in the ROC or FloBoss in the same manner. A HART module can be installed into any I/O module socket.

CAUTION

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

CAUTION

When preparing a unit for installation into a hazardous area, change, or install components in an area known to be non-hazardous.

CAUTION

Units used for Canadian custody transfer (Industry Canada approved) must not employ I/O modules to supply flow measurement inputs.

CAUTION

Ensure all input devices, output devices, and processes remain in a safe state upon restoring power.

1. Perform the RAM Backup Procedure. Refer to Section 2.2, RAM Backup and Restoration Procedures, on page 2-2.
2. Remove Power from the ROC.
3. Install I/O module by aligning the pins with the desired I/O module socket and pressing gently, but firmly straight down.
4. Tighten the module retaining screw.

5. Make sure a field wiring terminal block is installed in the socket adjacent to where the HART module was installed.
6. Enable Power to the ROC.
7. Reload the ROC configuration. Refer to Section 2.2.3, After Installing Components Using GV101 on page 2-6 or Section 2.2.4, After Installing Components using ROCLINK, on page 2-8.

NOTE

The FloBoss 407 requires a minimum of 12.5 volts to start up. This is due to a cutout feature designed to avoid draining down the power supply battery.

8. Install all user programs from their original disks including the HART User Program. Refer to Section 3, Downloading.
9. Configure the HART Points and HART Device using the HART User Program software. Refer to Section 4 and Section 5.
10. Select **Flags** from the System Menu.
11. Set the **Write to Internal Config Memory** or **Write to EEPROM** to display **Yes**.
12. Press **(F8)Save**.

NOTE

It is not recommended that a HART device be used for inputs to PID controls or AGA calculations unless it is a slow-acting process.

2.3.2 HART Interface Module Wiring

The HART Interface Module allows the ROC to interface with up to ten HART devices per I/O slot. The HART Interface Module communicates digitally to HART devices through the I/O termination blocks associated with the module position. The HART module provides “loop source” power (+T) on terminal A and two channels for communications on terminals B and C. The +T power is regulated by a current limit. If the power required by all connected HART devices exceeds 40 milliamps (more than an average of 4 milliamps each), the total number of HART devices must be reduced.

Channel 1 is wired to terminals A and B. Channel 2 is wired to terminals A and C. The HART module polls one channel at a time. If more than one device is connected to a channel in a multi-drop configuration, the module polls all devices on that channel before it polls the second channel. The HART protocol allows one second per poll for each device, so with five devices per channel the entire poll time for the module would be ten seconds.

In a point-to-point configuration, only one HART device is wired to each HART module channel. In a multi-drop configuration, two to five HART devices are connected to a channel. In either case,

terminal A (+T) is wired in parallel to the positive (+) terminal on all of the HART devices, regardless of the channel to which they are connected.

Channel 1 (terminal B) is wired to the negative (-) terminal of a single HART device, or in parallel to the negative terminals of two to five devices. Likewise, channel 2 (terminal C) is wired to the negative (-) terminal of a single HART device, or in parallel to the negative terminals of a second group of two to five devices. Refer to Figure 2-2 and Figure 2-3.

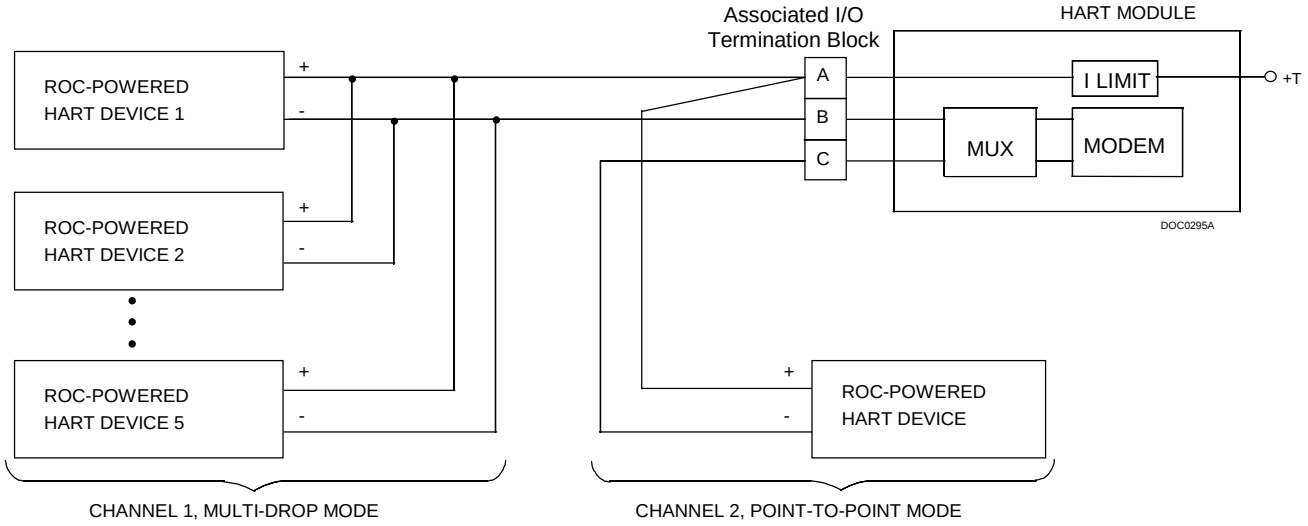

Figure 2-2. Field Wiring using ROC-Powered HART Devices

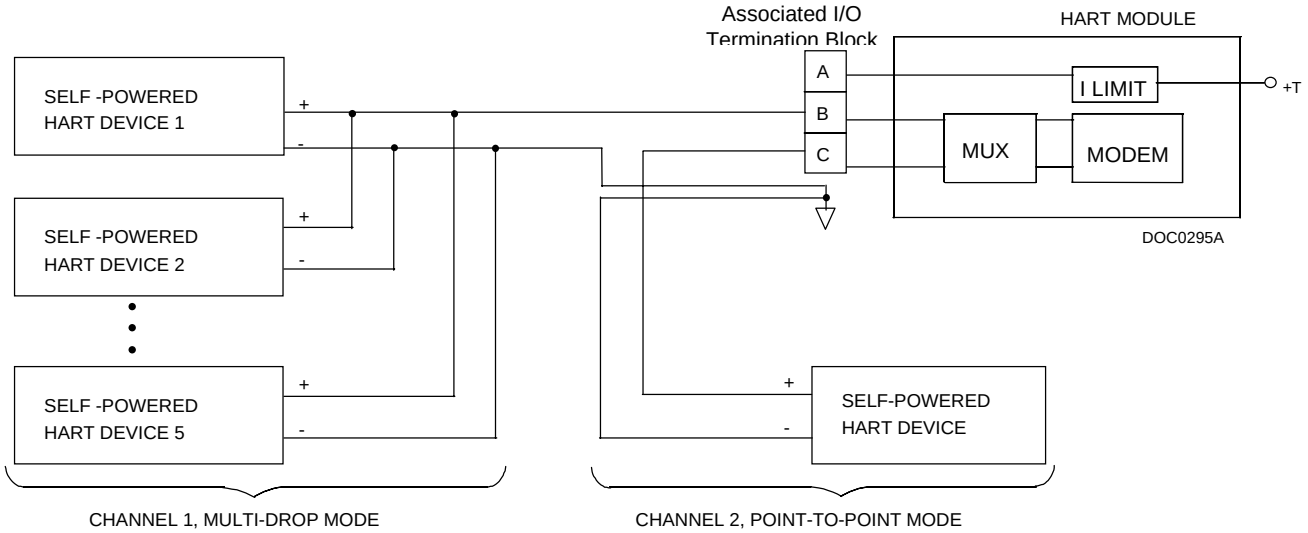

Figure 2-3. Field Wiring using Self-Powered HART Devices

2.3.3 Testing the HART Interface Module

The HART Interface Module provides the source for the HART devices and uses two test procedures to verify correct operation. Use the first procedure to check the integrity of the loop power and the second to verify communications.

2.3.3.1 Verify Integrity of Loop Power Supplied by ROC

Equipment Required: Multimeter

1. Measure voltage between terminals A and B to verify channel 1.
2. Measure voltage between terminals A and C to verify channel 2.

The voltage read in both measurements should reflect the value of +T less the voltage drop of the HART devices. 24 volts indicates an open circuit in the I/O wiring, a defective HART device, or a defective module.

2.3.3.2 Verify Communications

Equipment Required: Dual-trace Oscilloscope

In this test, the HART module and the ROC act as the Host and transmit a polling request to each HART device. When polled, the HART device responds. In this test, use the oscilloscope to observe the activity on the two HART communication channels. Note that there is normally one second from the start of one request to the start of the next request.

1. Attach one input probe to terminal B of the HART module and examine the signal for a polling request and response for each HART device connected to this channel.
2. Attach the other input probe to terminal C and examine the signal for a polling request and response for each HART device connected.
3. Compare the two traces; signal bursts should not appear on both channels simultaneously.

Keep in mind that each device on one channel is polled before the devices on the other channel are polled. If a channel indicates no response, this could be caused by faulty I/O wiring or a faulty HART device. If the HART module tries to poll both channels simultaneously, this could be caused by a defective module, in which case the module must be replaced.

2.4 HART INTERFACE CARD

The HART Interface Card plugs “piggy-back” on top of a ROC communications card. Refer to Figure 2-4 and Figure 2-5. The HART Card communicates to HART devices through one or more of the three built-in analog input channels on the ROC. Each of these input channels can be configured to operate in either the point-to-point mode or the multi-drop mode.

NOTE

It is not recommended that a HART device be used for inputs to PID controls or AGA calculations unless the input is a slow acting process.

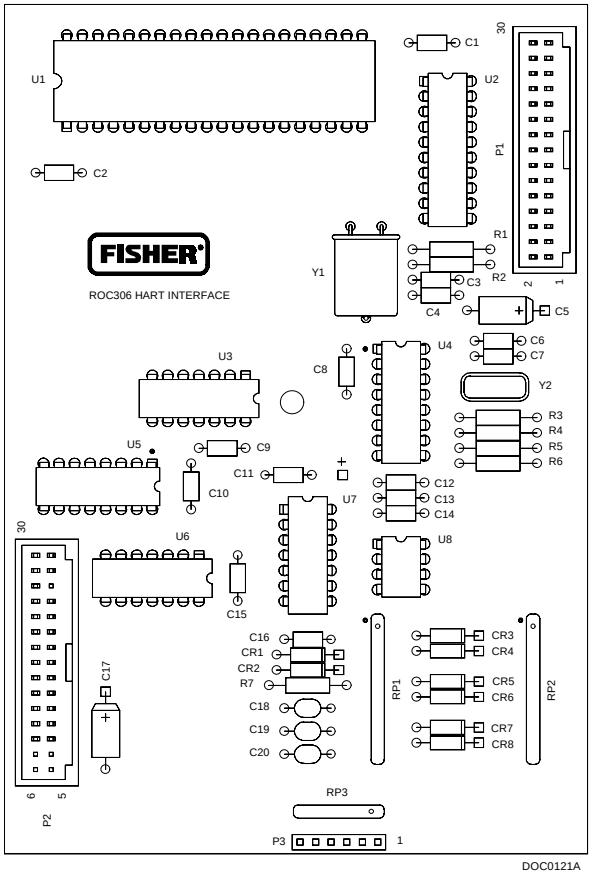

Figure 2-4. HART Interface Card

In the point-to-point mode, digital communications is superimposed on the 4 to 20 milliamp analog signal (which can still measure the process variable) through a built-in analog input. This mode allows communications with one HART device per fixed analog input point.

In the multi-drop mode, as many as five HART devices can be connected in parallel to a single built-in analog input. Like the point-to-point mode, digital communications are superimposed on the fixed signal (typically 4 mA); however, the analog signal is used only to measure the current consumed by the multi-drop loop. With all three built-in analog input points in the multi-drop mode and five HART devices wired in parallel, the ROC306/312 can support a maximum of fifteen HART devices.

2.4.1 Installing a HART Interface Card

The HART Interface Card package includes one HART Interface Card, one 6-pin header, and a mounting screw. The following items are also required to support the HART Interface Card:

- GV101 Configuration Software version 1.63, or ROCLINK Configuration Software version 2.0 or 2.1.
- ROC306 or ROC312 main board with part number W48032X0012 revision A or greater.
- ROC306/312 with ROCPAC version 1.10, or with FlashPAC version 2.0 or 2.1 (used with ROCLINK only).
- HART Interface User Program, loaded into ROC memory.
- A ROC communications card installed and functioning.

To allow a HART Interface Card to be installed, a communications card of any type must already be installed. Perform the following steps to install the HART Interface Card. Refer to Figure 2-5 during the procedure.

CAUTION

Install HART Interface Cards only in areas known to be non-hazardous.

CAUTION

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

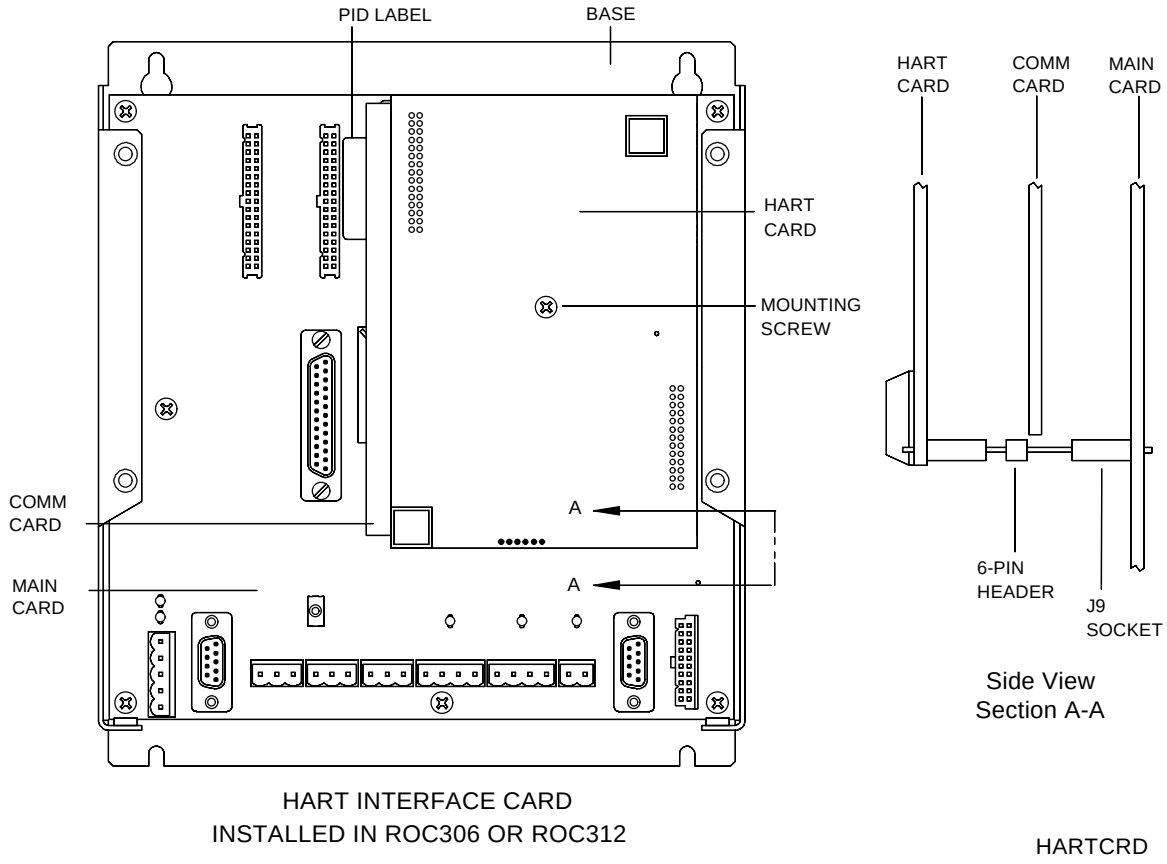

Figure 2-5. HART Interface Card Installation

1. Perform the RAM Backup Procedure. Refer to Section 2.2, RAM Backup and Restoration Procedure, on page 2-2.
2. Remove Power from the ROC.
3. Remove the screws that hold the upper cover in place, and lift off the cover. Note that on a ROC312, some resistance may be encountered because of the connector that mates the I/O module board in the cover to the main circuit board.
4. Ensure that a communications card is installed on the main circuit board. If not, install a communications card as detailed in your ROC user manual.
5. Take the 6-pin header connector supplied with the HART card and plug it into socket J9 on the main board just below the bottom edge of the communications card. See Figure 2-5 (Side View). If the J9 socket is not present, then the ROC is not HART-compatible.
6. Align the HART card with the 6-pin header and the two connectors on the communications card. Gently press on the card until the connectors firmly seat.
7. Install the mounting screw to secure the HART card. Refer to Figure 2-5.

8. Reinstall the upper cover. If the unit is a ROC312, be sure to carefully mate the I/O board connector in the cover with the connector on the main circuit board.
9. Install all user programs from their original disks including the HART User Program. Refer to Section 3, Downloading.
10. Wire the analog inputs.
11. Restore Power to the ROC.
12. Perform the procedure as detailed in Section 2.2.3, After Installing Components Using GV101 on page 2-6 or Section 2.2.4, After Installing Components using ROCLINK, on page 2-8.
13. Configure the HART Points and HART Device using the HART User Program software. Refer to Section 4 and Section 5.
14. Press **F4**, Configure, from the GV101 Main Menu.
15. Select **8**, ROC System Flags, from the Configuration menu and press **Enter**.
16. Perform a **Write to EEPROM** or a **Write to Internal Config Memory**. This action saves most of the ROC configuration into the permanent memory accessed when a cold start is performed.
17. Press **(F8)Save**.
18. Press **Esc**.

NOTE

It is not recommended that a HART device be used for inputs to PID controls or AGA calculations unless the input is used in a slow-acting process.

2.4.2 HART Interface Card Wiring

The HART Interface card provides digital, command/response communications with HART devices such as smart transmitters. The HART devices connect to the ROC via one or more of the three built-in analog inputs, and the digital communications are superimposed on the 4 to 20 milliamp current signal. Figure 2-6 shows the wiring to one of the built-in analog inputs for the multi-drop and point-to-point modes.

From one to five HART devices can be used in the **multi-drop mode**. In this mode, the fixed current (typically 4mA) is used only to measure the current consumed by the HART devices. In the **point-to-point mode**, only one HART device is connected and the same analog input terminals are used. In this mode, the 4 to 20 milliamp signal can be used for measuring the process variable.

At the analog input, the HART card provides “loop source” power (+T) and the “+” terminal is used to bring the digital signal to the HART card. The +T power is regulated by a current limit.

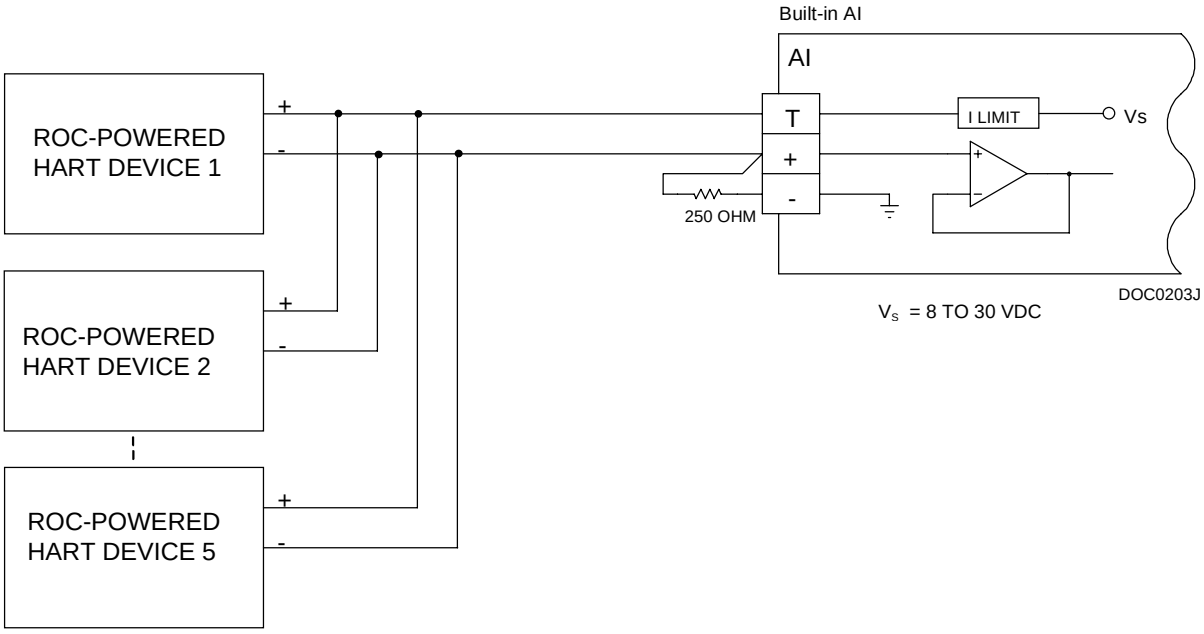

Figure 2-6. HART Interface Wiring Schematic

2.4.3 Testing the HART Interface Card

The HART Interface card provides the source for the HART devices and uses two test procedures to verify correct operation. Use the first procedure to check the integrity of the loop power and the second to verify communications.

2.4.3.1 Verify Integrity of Loop Power

Equipment Required: Multimeter

For each built-in Analog Input being used, measure the voltage between the "T" and "+" terminals. The voltage read is the voltage drop of the HART device. 24 volts indicates an open circuit in the I/O wiring, a defective HART device, or a defective supply to "T" from the ROC. Any value below the minimum value of 10.5 volts indicates that the HART device is malfunctioning. A typical value should read between the range of 15 to 17 volts.

2.4.3.2 Verify Communications

The HART card and the ROC act as the Host and transmit a polling request to each HART device. When polled, the device responds. In this test, use the oscilloscope to observe the communications between the HART devices and the HART card.

Equipment Required: Oscilloscope

1. For each Analog Input channel being used, attach the input probe of the oscilloscope to the "+" terminal.
2. Verify the channel is active by observing the oscilloscope trace for signs of communications activity. There should be a request and response message burst for each device connected, with one second of time from the start of one request to the start of the next request.

If a channel indicates no response, this may indicate faulty I/O wiring or a faulty device. If a channel shows no polling request (even after ensuring proper configuration), the HART card is defective and must be replaced.

2.5 HART INTERFACE CARD AND MODULE SPECIFICATIONS

HART Interface Module Specifications

FIELD WIRING TERMINALS	**A:** Loop Power (+T) **B:** Channel 1 (CH1) **C:** Channel 2 (CH2)
LOOP POWER	Total power supplied through module for HART devices is 20 mA per channel at 21 to 29 Vdc. Each HART device typically uses 4 mA.
CHANNELS	Two HART-compatible channels, which communicate via digital signals only. **Mode:** Half-duplex. **Data Rate:** 1200 BPS asynchronous. **Parity:** Odd. **Format:** 8 bit. **Modulation:** Phase coherent, frequency shift keyed (FSK) per Bell 202. **Carrier Frequencies:** Mark 1200 Hz, Space 2200 Hz, ± 0.1%.
HART DEVICES SUPPORTED	**Point-to-Point Mode:** Two HART devices (one per channel). **Multi-drop Mode:** Up to 10 HART devices (five per channel). 32 HART devices maximum.
POWER REQUIREMENTS	**Loop Source:** 11 to 30 Vdc, 40 mA maximum from ROC power supply or I/O converter card. **Module:** 4.9 to 5.1 Vdc, 17 mA maximum.
VIBRATION	20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F.
WEIGHT	1.7 ounces (48 grams) nominal.
MECHANICAL SHOCK	1500 Gs 0.5 mS half sine per MIL-STD-202, method 213, condition F.
CASE	Solvent-resistant thermoplastic polyester, meets UL94V-0. Dimensions 0.60 in. D by 2.00 in. H by 1.69 in. W (15 mm by 51 mm by 43 mm), not including pins.
ENVIRON-MENTAL	Meets the Environmental specifications of the ROC or FloBoss unit in which the module is installed, including Temperature and Surge specifications.
APPROVALS	Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

HART Interface Card Specifications

FIELD WIRING TERMINALS	**T:** Loop Power (+T) "**+**"**:** HART Signal Input "**-**"**:** Common	**DIMENSIONS**	1.2 in. H by 3.75 in. W by 5.55 in. L (30 mm by 95 mm by 141 mm).
CHANNELS	Three HART-compatible channels, which communicate via digital signals only (A1, A2, and A3). If sensing the HART signal, loop power is drawn from the AI channel. **Mode:** Half-duplex. **Data Rate:** 1200 BPS asynchronous. **Parity:** Odd. **Format:** 8 bit. **Modulation:** Phase coherent, frequency shift keyed (FSK) per Bell 202. **Carrier Frequencies:** Mark 1200 Hz, Space 2200 Hz, ± 0.1%.	**WEIGHT**	3 oz. (80 g) nominal.
		ENVIRON-MENTAL	Meets the Environmental specifications of the ROC or FloBoss unit in which the card is installed, including Temperature and Surge specifications.
		APPROVALS	Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.
		POWER REQUIREMENTS	4.75 to 5.25 Vdc, 0.1 W maximum (supplied by ROC or FloBoss).
HART DEVICES SUPPORTED	**Point-to-Point Mode:** Three HART devices (one per channel) (A1, A2, and A3). **Multi-drop Mode:** 5 per channel (A1, A2, and A3). Up to 15 total.		

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SECTION 3
DOWNLOADING THE HART USER PROGRAM

This section provides instructions for installing the HART Interface User Program into ROC memory. Be sure to read Section 3.1, Downloading Requirements, before proceeding to actual program installation.

This section includes:

NOTE

A PC-compatible computer must be connected to the ROC Operator Interface port (LOI) before the downloading process is started. For ROC300-series units using ROCPACs, RAM must be installed in the intended download area. For all ROC and FloBoss units, User Program memory must be available (unallocated) in the intended download memory area.

3.1 DOWNLOADING REQUIREMENTS

The HART User Program is downloaded into and run from User Program memory. For a ROC300-series unit, this user memory may be located either in a ROCPAC-with-RAM module, in a RAM module, or in a FlashPAC. For a FloBoss 407, this user memory may be located either in RAM or in Flash ROM. Refer to 3.1.4, Viewing Available Memory, on page 3-5.

After you determine the memory areas in your ROC or FloBoss available for new user programs, you may select one of the HART User Programs that require the available memory. ROC300-series units with ROCPACs, ROC300-series units with FlashPACs, and FloBoss 407 units require different HART programs.

This section details user programs available for each ROC or FloBoss and includes:

3.1.1 HART Card in a ROC306 or ROC312

- GV101 Configuration Software version 1.63, or ROCLINK version 2.0 or 2.1 (ROCLINK required if using a ROC with FlashPAC).
- A HART Interface Card must be installed (on top of a communications card of any type).
- ROC306 or ROC312 main board must be Part Number W48032X0012, Revision A or greater.
- ROC312 with ROCPAC version 1.10, or with FlashPAC version 2.0 or 2.1.
- One of the programs listed below:

NOTE

The location where the user program runs out of does not indicate where the ROC actually acquires the HART data. For example, user program HART2_D0.H00 runs out of COM2 Task in firmware; however, the information gathered from the HART device is acquired from the built-in Analog Inputs when using a HART Card.

NOTE

ROCLINK Configuration Software is required when using a FlashPAC ROC.

- **HART_B4.H00**
  256K RAM module
  Code at memory block B4000-BBFFF
  Data at memory block BC000-BFFFF
  Runs out of COM2 Task in firmware

- **HART2_B8.H00**
  256K RAM module
  Code at memory block B8000-BFFFF
  Data at memory block A8000-AFFFF
  Runs out of COM2 Task in firmware

- **HART2_D0.H00**
  ROCPAC
  Code at memory block D0000-D7FFF
  Data at memory block D8000-DBFFF
  Runs out of COM2 Task in firmware

- **HART_D0.H00**
  ROCPAC
  Code at memory block D0000-D7FFF
  Data at memory block D8000-DBFFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

- **HART_C0.H00**
  ROCPAC
  Code at memory block C0000-C7FFF
  Data at memory block C8000-CBFFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

- **FP_HCARD.H00**
  FlashPAC
  Code at memory block D0000-D7FFF
  Data at memory block B0000-B3FFF
  Runs out of Calc Task in firmware – ROCLINK

- **FP2HCARD.H00**
  FlashPAC
  Code at memory block C0000-D7FFF
  Data at memory block A0000-A3FFF
  Runs out of COM2 Task in firmware – ROCLINK

3.1.2 HART Module in a ROC312 or ROC364

- GV101 Configuration Software version 1.63, or ROCLINK version 2.0 or 2.1 (ROCLINK required if using a ROC with FlashPAC).
- ROC312 with ROCPAC version 1.10, or with FlashPAC version 2.0 or 2.1.
- ROC364 with a ROCPAC version 1.70, or with FlashPAC version 2.0 or 2.1.
- One of the programs listed below:

NOTE

The location where the user program runs out of does not indicate where the ROC actually acquires the HART data. For example, user program HIO_C0C8.H00 runs out of USER/Calc Task in firmware; however, the information gathered from the HART device is acquired from the associated I/O termination block when using a HART Module.

- **HIO_7060.H00**
  256K RAM module
  Code at memory block 70000-77FFF
  Data at memory block 60000-63FFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

- **HIO_B8A8.H00**
  256K RAM module
  Code at memory block B8000-BFFFF
  Data at memory block A8000-ABFFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

- **HIO_C0C8.H00**
  ROCPAC
  Code at memory block C0000-C7FFF
  Data at memory block C8000-CBFFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

- **HIO_D0D8.H00**
  ROCPAC
  Code at memory block D0000-D7FFF
  Data at memory block D8000-DBFFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

- **FPHID0B0.H00**
  FlashPAC
  Code at memory block D0000-D7FFF
  Data at memory block B0000-B7FFF
  Runs out of Calc Task in firmware – ROCLINK

3.1.3 HART Module in a FloBoss 407

- GV101 Configuration Software version 1.63, or ROCLINK version 2.0 or 2.1 (ROCLINK 2.1 required for firmware version 1.06).
- FloBoss 407 firmware must be version 1.04 or 1.06.
- One of the programs listed below:

NOTE

The location where the user program runs out of does not indicate where the FloBoss actually acquires the HART data. For example, user program FBHIA07C.H00 runs out of USER/Calc Task in firmware; however, the information gathered from the HART device is acquired from the associated I/O termination block when using a HART Module.

- **FBHI7060.H00**
  RAM
  Code at memory block 70000-77FFF
  Data at memory block 60000-63FFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

- **FBHIA07C.H00**
  Flash ROM
  Code at memory block A0000-A7FFF
  Data at memory block 7C000-7FFFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

- **FBHIB07C.H00**
  Flash ROM
  Code at memory block B0000-B7FFF
  Data at memory block 7C000-7FFFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

- **FBHIC07C.H00**
  Flash ROM
  Code at memory block C0000-C7FFF
  Data at memory block 7C000-7FFFF
  Runs out of USER Task in firmware – GV101
  Runs out of Calc Task in firmware – ROCLINK

3.1.4 Viewing Available Memory

For all ROC300-series and FloBoss 407 units, User Program memory must be available (unallocated) in the intended download area before installing the HART User Program. Refer to:

- Memory Segments on page 3-6.
- Viewing Memory Using ROCLINK on page 3-6.
- Viewing Memory Using GV101 on page 3-8.

Once you have determined that a block of memory is available, you may select the corresponding HART User Program detailed in Section 3.1, Downloading Requirements on page 3-2.

3.1.5 Memory Segments

Refer to Table 3-1 concerning memory blocks used in each type of ROC or FloBoss.

Table 3-1. Memory Segments

Segment	ROC300 ROCPAC	ROC300 FlashPAC	FloBoss 407
6000	Data	N/A	Data
7000	Data	N/A	Data
a000	Data	Data	Code
b000	Data	Data	Code
c000	Code	Code	Code
d000	Code	Code	N/A

NOTE

ROCLINK Configuration Software is required when using a FlashPAC.

3.1.5.1 Viewing Memory Using ROCLINK

To view the available memory using ROCLINK:

1. Select **Utilities** from the ROCLINK menu bar.
2. Select **User Programs**.

When you select User Programs, a screen appears for viewing the unused memory blocks available for the HART User Program to be loaded. Refer to Figure 3-1.

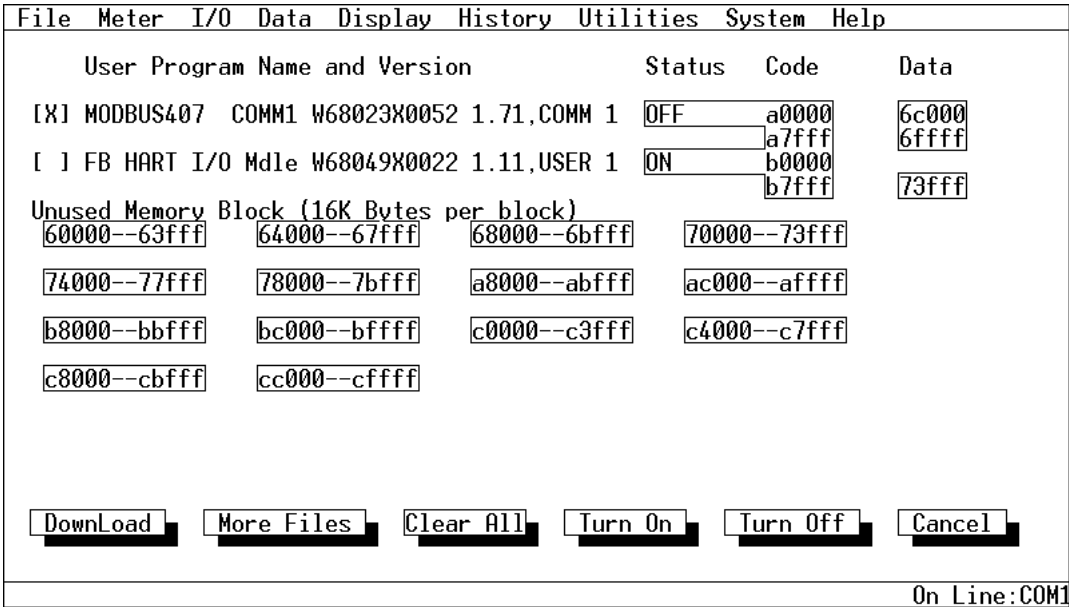


Figure 3-1. User Programs using a FloBoss 407

User Program Name and Version — Displays the name of the User Program and the version number currently installed.

Status — Displays the current status of the User Program: ON or OFF.

Code — Code displays the location of where the programs executable file resides in memory.

Data — Data displays the location of where the program data variable files reside in memory.

Unused Memory Blocks — The memory location must be available for the HART User Program to be loaded. All unallocated (available) memory blocks display under this field. User programs cannot share the same memory block. Refer to Section 3.1, Downloading Requirements, on page 3-2 to determine which available block of memory corresponds to the HART User Program.

Download — When you select Download, the Open File (Figure 3-2) display appears for selecting the program files to be loaded. After you select a user program to install, you may press Enter or press Download again to begin loading the user program. Press More File to select additional user programs for installation.

More File — After selecting a user program to download using the Download pushbutton, press the More File pushbutton to select additional user programs to download.

Clear All — Press the Clear All pushbutton to clear all user programs stored in memory.

Turn On — To turn on a user program, select the check box next to the user program, and press the Turn On pushbutton. Note that the Status field displays ON or OFF indicating the status of the user program.

After turning on a user program, perform a Write to EEPROM or Write to Internal Config Memory in the ROC Flags screen. This ensures that when a Cold Start is performed, the user program automatically starts. Refer to Section 6, Writing Parameters.

Turn Off — To turn off a user program, select the check box next to the user program, and press the Turn Off pushbutton. Note that the Status field displays ON or OFF indicating the status of the user program.

Cancel — Press the Cancel pushbutton to cancel all actions and leave the User Programs dialog.

The configurable data fields for the User Program that has been loaded is located under the Data menu in User Data.

3.1.5.2 Viewing Memory Using GV101

For viewing the memory allocation in a ROC300-series or FloBoss 407 using GV101:

1. Press **F8**, Utilities, form the GV101 Main Menu.
2. Type **6** and press **Enter** to select the **User Program Routines** from the ROC Utilities menu.
3. Type **2** and press **Enter** to **Check User Memory Allocation**.

A screen appears that shows the allocation status of all user memory blocks in the upper half of the screen and a list of the User Programs and task status in the lower half. Memory blocks are 16K bytes in length and the individual User Program determines their allocation. The ROC Operating System checks each block for proper allocation and does not permit two different programs to the share same memory block. If you install a user program into memory that already contains another user program, the user program currently installed will be overwritten.

The upper half of the display appears similar to the following:

```
Block 6000 = Unalloc   Block a000 = Unalloc   Block c000 = Code 1
Block 6400 = Unalloc   Block a400 = Unalloc   Block c400 = Code 1
Block 6800 = Unalloc   Block a800 = Unalloc   Block c800 = Data 1
Block 6c00 = Unalloc   Block ac00 = Unalloc   Block cc00 = Unalloc
Block 7000 = Unalloc   Block b000 = Unalloc   Block d000 = Code 2
Block 7400 = Unalloc   Block b400 = Unalloc   Block d400 = Code 2
Block 7800 = Unalloc   Block b800 = Unalloc   Block d800 = Data 2
Block 7c00 = Unalloc   Block bc00 = Unalloc   Block dc00 = Unalloc
```

For a ROC300-series unit with a ROCPAC, blocks 6000 through bc00 correspond to various RAM modules, and blocks c000 through dc00 correspond to the RAM.

For a ROC300-series unit with a FlashPAC, blocks a000 through bc00 correspond to various RAM in the FlashPAC, and blocks c000 through dc00 correspond to the Flash memory in the FlashPAC.

For the FloBoss 407, blocks 6000 through 7c00 correspond to user RAM in the ROC; blocks a000 through cc00 correspond to Flash memory in the ROC; and blocks d000 through dc00 are reserved for factory use.

The allocation status since the last Warm Start is shown for each memory block as follows:

No RAM — No RAM is installed in this location. When viewing FloBoss 407 memory, No RAM displayed for Flash memory blocks a000 through cc00 means that the memory is unallocated.

Unalloc — No program assigned or no memory installed. The memory is available to install a User Program.

Code *x* — Code location for the User Program installed at that memory location.

Data *x* — Data location for the User Program installed at that memory location.

For more information on viewing the memory allocation of all User Programs loaded in the ROC, refer to Section 8 in the *GV101 Configuration Software User Manual.*

3.2 DOWNLOADING PROCEDURES

The following sections detail how to download the HART User Program. The downloading procedures vary depending on the software and type of memory you are using. The sections include:

3.2.1 Downloading HART Using ROCLINK

To download the HART User Program using ROCLINK:

1. Determine the memory location available for the User Program using the **Unused Memory Blocks** fields. Select the **HART User Program** that corresponds to the available block of memory and type of ROC being used. Refer to Section 3.1.4, Viewing Available Memory, on page 3-5.
2. Select **Utilities** from the ROCLINK menu bar.

3. Select **User Programs**.
4. Press **Download**. Refer to Figure 3-1 on page 3-7.
5. Select the HART User Program to install so it appears in the **File Name** field and click **OK**. Refer to Figure 3-2.

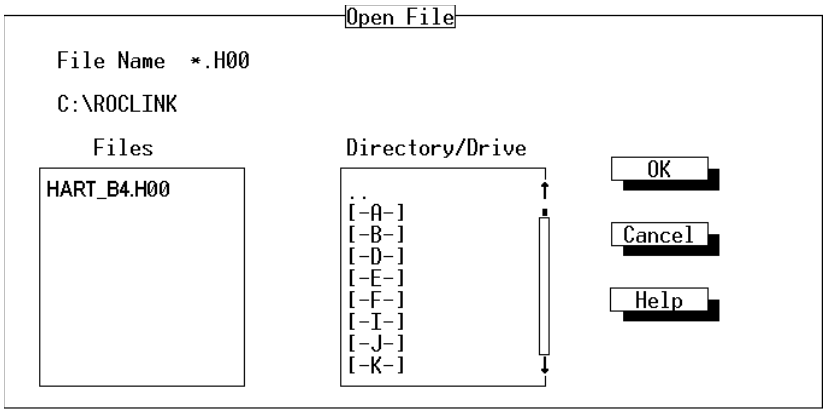


Figure 3-2. Open User Program

The **Open File** display lists the names of all the files that have the .H00 extension and are located in the default Drive and Directory. Use the Up Arrow (↑) and the Down Arrow (↓) to indicate the desired file in the Files list. You may change the location using the Directory/Drive field.

6. Press **Enter** or press **Download** again to begin loading the HART User Program. You may press the More File pushbutton to select additional User Programs for installation.

   When the HART User Program has been downloaded, the following occurs:

   - The HART User Program is automatically turned ON.
   - The correct ROC Flag is automatically enabled for the User Program.
   - A Warm Start is automatically initiated.
   - A record is created in the Event Log if Log Data is enabled in the HART Config screen.
   - The configurable data fields are located under the User Data menu.

7. After downloading the HART User Program, select **Flags** from the System menu to display the ROC Flags screen similar to the screen displayed in Figure 3-3.

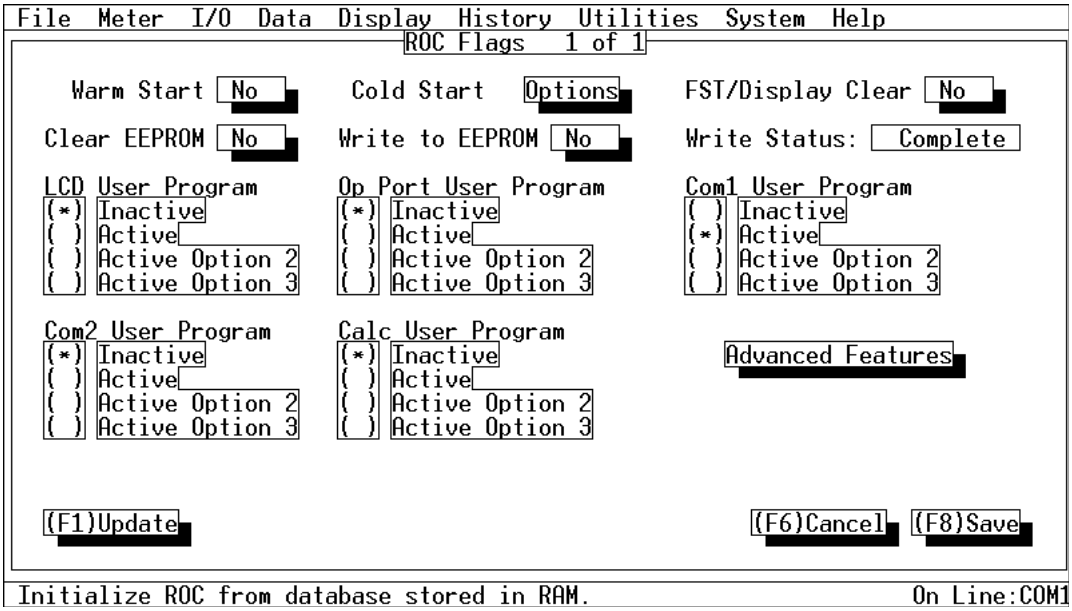


Figure 3-3. ROC Flags for a FloBoss 300-series with a FlashPAC

8. Set the **Write to EEPROM** or **Write to Internal Config Memory** flag to **Yes**. This ensures that when a Cold Start is performed, the User Program automatically starts.
9. Press **(F8)Save**.
10. Press **(F1)Update**.

3.2.2 Downloading HART to RAM Using GV101

The download procedure in this section is used with GV101 Configuration Software version 1.61 and later for a ROC300-series or a FloBoss 407 unit.

NOTE

If you are downloading a program to Flash memory in a FloBoss 407 using GV101, use the procedure given in Section 3.2.3, Downloading HART to FloBoss 407 Flash Memory Using GV101, on page 3-15.

CAUTION

If a User Program is currently installed in the same memory segment you desire to install the HART User Program, GV101 deletes the User Program currently installed in the same memory segment before installing HART.

NOTE

Programs loaded in RAM are removed with the Clear All User Memory selection under User Program Routines in the Utilities menu of GV101.

To download the HART User Program using GV101:

1. Determine the available memory location for the User Program and select the **HART User Program** that corresponds to the available block of memory and type of ROC being used. Refer to Section 3.1.4, Viewing Available Memory, on page 3-5 to view available memory.
2. Press **F8**, Utilities, form the GV101 Main Menu.
3. Type **6** and press **Enter** to select the **User Program Routines** from the ROC Utilities menu.
4. Type **3** and press **Enter** to select **Download User Programs**.
5. Select the **HART User Program** to install so the file name is highlighted. Refer to Figure 3-4.

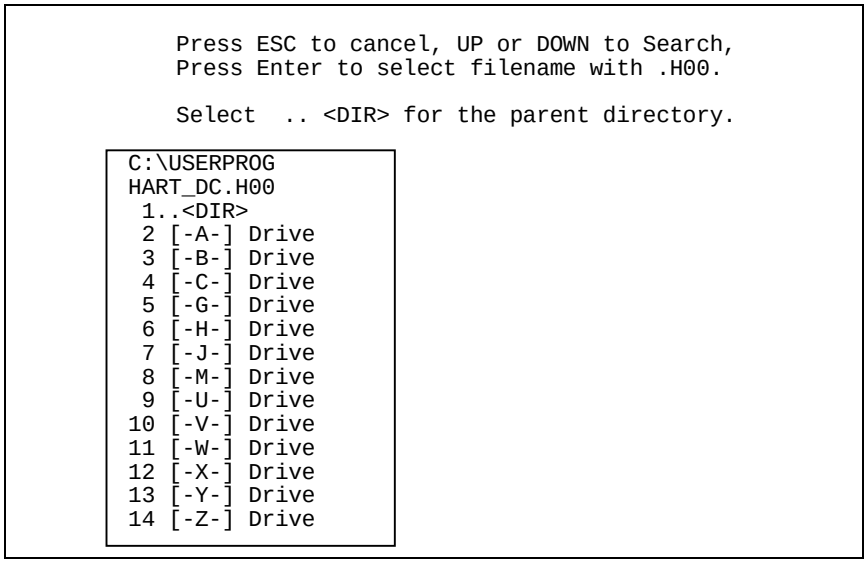


Figure 3-4. File Selection Display

When you select Download User Programs, a display appears for selecting the program files to be loaded. This display lists the names of all the files that have the .H00 extension and are located in the default drive and directory. Use the Up Arrow (↑) and the Down Arrow (↓) to indicate the desired file in the file list. If the desired file is not listed, you can instead select a drive and directory that has the file you want. Note that the current drive and directory are given at the top of the list.

6. Press **Enter** to begin loading the HART User Program.

7. Press **F2**. Refer to Figure 3-5.

```
File you selected is A:\HART_xx.H00

Is This Correct ?
Esc = cancel   F1 = Try again      F2 = OK
```

Figure 3-5. Correct File Verification Dialog

8. Press **Enter**. Refer to Figure 3-6.

```
                    Download Multiple Files

                         File to Download:

                         1 = A:\HART_DC.H00



<Esc> = Cancel  <F1> = More Files  <Enter> = Download  D = Delete
```

Figure 3-6. File Download Display

9. Type **1** (Download file) and press **Enter**. Refer to Figure 3-7.

```
 1 = Download file(s)
 2 = Cold Hard Start and Download file(s)
 3 = Exit Back to File Selection Menu
```

Figure 3-7. Downloading Options

When downloading is initiated, the software first checks to see if any User Programs are running in the same task. If so, it automatically performs a Warm Start to clear the appropriate User Enable flags. The software then begins the downloading process. Press **Esc** anytime during the download to cancel the process and return to the User Routines menu. If you install a user program into memory that already contains another user program, the user program currently installed will be overwritten.

When the file or files have been downloaded, the GV101 displays the following message:

```
Download complete, Press <Enter> to Enable
 Flags Automatically
 <Esc> to Cancel.
```

Figure 3-8. Enable Flags Dialog

10. Press **Enter** to automatically enable the appropriate User Enable flags and perform a Warm Start.
11. Press **Enter** when the Flag Enable Complete dialog displays. Refer to Figure 3-9.

```
Wait for Warm Start.......

Flag Enable Complete, press any key to Continue
```

Figure 3-9. Warm Start Dialog

12. Press **Esc** when the User Program Routines screen appears.
13. Press **F4**, Configure, from the GV101 Main Menu.
14. Select **8**, ROC System Flags, from the Configuration menu and press **Enter**.
15. Set the **Write to EEPROM** flag to **1** and press **Enter**. This ensures that when a Cold Start is performed, the User Program automatically starts. Refer to Figure 3-10.

```
                    ROC Flags 1 of 1

               CRC Check 1                    RTS Comm #2 0
        DI/PI ROC306/312 0                  Clear EEPROM 0
         User LCD Enable 0                I/O Scan Enable 1
     User OP Port Enable 0                  Aux Out #2 On 1
       FST/Display Clear 0                  Aux Out #1 On 1
        User Com1 Enable 0                Cold Hard Start 0
        User Com2 Enable 0                     Warm Start 0
        User Prog Enable 0                       Read I/O 0
           RTS Oper Port 0                Write to EEPROM 0
             RTS Comm #1 0          EEPROM Write Complete 1

0 = Disable, 1 = Enable.

1 Update 2   3   4 RD Disk 5 WR Disk 6 Quit  7   8 Save
```

Figure 3-10. ROC Flags Display

16. Press **(F8)Save**.
17. Press **Enter** to confirm your actions.
18. Press **(F1)Update** to view changes.

When the HART User Program has been downloaded, the following occurs:

- The HART User Program is automatically turned ON.
- The correct ROC Flag is automatically enabled for the User Program.
- A Warm Start is automatically initiated.
- A record is created in the Event Log if Log Data is enabled in the HART Config screen.
- The configurable data fields are located under the Configure ROC menu.

Refer to the *Type GV101 Configuration Software User Manual (Form A4194)* for detailed information concerning User Programs and ROC Flags.

3.2.3 Downloading HART to FloBoss 407 Flash Memory Using GV101

The download procedure in this section is used only to download a HART User Program to the Flash memory in a FloBoss 407. Using GV101 Configuration Software version 1.63 is recommended.

NOTE

This procedure is not required when using ROCLINK.

To download a HART program to FloBoss 407 Flash memory:

1. Determine the available memory location for the User Program and select the **HART User Program** that corresponds to the available block of Flash memory. Refer to Section 3.1.4, Viewing Available Memory, on page 3-5 to view available memory.

NOTE

Downloading the user program will overwrite any previously installed user programs. If you need to clear a program from Flash memory to make room for the HART program, refer to Section 3.2.3.1, Deleting A User Program From FloBoss 407 Flash Memory, on page 3-18.

2. Press **F8**, Utilities, form the GV101 Main Menu.
3. Type **6** and press **Enter** to select the User Program Routines from the ROC Utilities menu.
4. Type **4** and press **Enter** to select **Program Flash Memory**.

5. Select the HART User Program to install so the file name is highlighted. Refer to Figure 3-11.

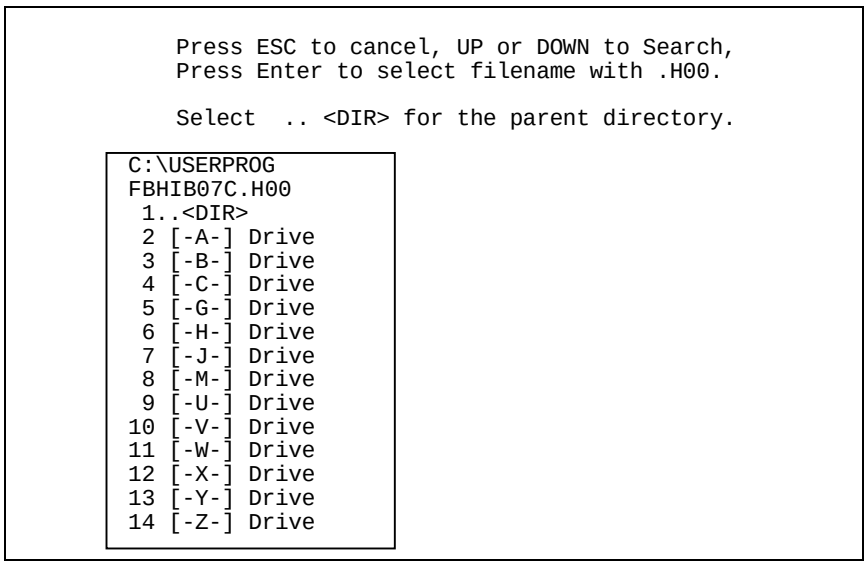


Figure 3-11. File Selection Display

When you select Program Flash Memory, a display appears for selecting the program files to be loaded. This display lists the names of all the files that have the .H00 extension and are located in the default drive and directory. Use the Up Arrow (↑) and the Down Arrow (↓) to indicate the desired file in the file list. If the desired file is not listed, you can instead select a drive and directory that has the file you want. Note that the current drive and directory are given at the top of the list.

6. Press **Enter** to begin loading the HART User Program.
7. Press **F2**. Refer to Figure 3-12.

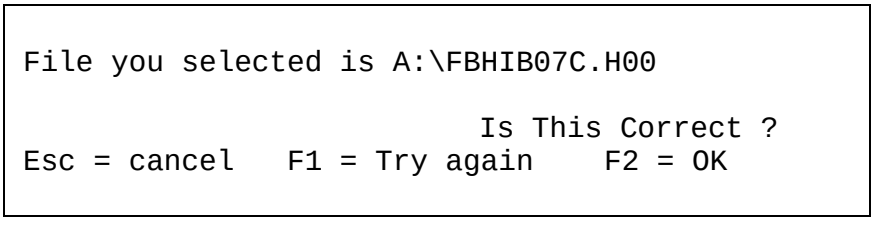


Figure 3-12. Correct File Verification Dialog

```
Downloading File A:\FBHIB07C.H00

Waiting for setting Up Flash memory...
```

Figure 3-13. Setting Up Flash Memory

When the file has been downloaded, the software displays the following message:

```
Programming the Flash memory, please wait....
```

This message automatically clears after Flash memory has been successfully programmed. You are then returned to the User Routines menu.

8. Press **Esc** in the User Routines menu.
9. Press **F4** to display the Configuration Menu.
10. Type **8** and press **Enter** to display the ROC Flags display.
11. Set the appropriate user flag based on the User Program you selected. Refer to Figure 3-14.
    - Set the **User Com1 Enable** flag to **1**, if required.
    - Set the **User Com2 Enable** flag to **1**, if required.
    - Set the **User Prog Enable** flag to **1**, if required.

```
                    ROC Flags 1 of 1

               CRC Check 1                    RTS Comm #2 0
       DI/PI ROC306/312 0                   Clear EEPROM 0
        User LCD Enable 0                 I/O Scan Enable 1
    User OP Port Enable 0                   Aux Out #2 On 1
      FST/Display Clear 0                   Aux Out #1 On 1
       User Com1 Enable 0                 Cold Hard Start 0
       User Com2 Enable 0                      Warm Start 0
       User Prog Enable 0                        Read I/O 0
          RTS Oper Port 0                Write to EEPROM 0
            RTS Comm #1 0          EEPROM Write Complete 1


 0 = Disable, 1 = Enable.

1 Update 2   3   4 RD Disk 5 WR Disk 6 Quit  7   8 Save
```

Figure 3-14. ROC Flags Display

12. Arrow down to the **Warm Start** flag. Type **1** and press **Enter**.
13. Arrow down to the **Write to EEPROM** flag. Type **1** and press **Enter**.
14. Press **(F8)Save**.

15. Press **Enter** to confirm your actions.
16. Press **(F1)Update** to view changes.

Refer to the *Type GV101 Configuration Software User Manual (Form A4194)* for detailed information concerning User Programs and ROC Flags.

3.2.3.1 Deleting A User Program From FloBoss 407 Flash Memory

User Programs loaded in the Flash memory (ROM) of a FloBoss 407 are not deleted in the same way User Programs loaded in RAM would be deleted. Programs loaded in RAM are removed with the Clear All User Memory selection under User Program Routines in the Utilities menu of GV101. This routine has no effect on User Programs loaded in Flash memory.

NOTE

This procedure is not required when using ROCLINK.

To clear User Programs loaded into Flash memory, you must download a "dummy" User Program (which contains all zeros) to the targeted blocks of Flash memory. A series of programs, **FBCLR_xx.H00**, are supplied with the other HART user program files (see the listing in Table 1-1 at the end of Section 1). When downloaded, the FBCLR program clears out Code in the segment (16 Kbytes) by causing zeros to be written to the first 64 bytes. For example, to clear the A000 memory Code segment, download the FBCLR_A0.H00 program.

To download an FBCLR program using the GV101 configuration software and to clear Flash memory:

1. Determine the memory location where the User Program is currently installed and select the clear **HART User Program** that corresponds to the allocated block of memory. Refer to Section 3.1.4, Viewing Available Memory, on page 3-5 to view available memory.
2. Press **F8**, Utilities, in GV101 Main Menu.
3. Type **6** and press **Enter** to select the **User Program Routines** from the ROC Utilities menu.
4. Type **4** and press **Enter** to select **Program Flash Memory**.
5. Select the HART User Program to install so the file name is highlighted. Refer to Figure 3-15.

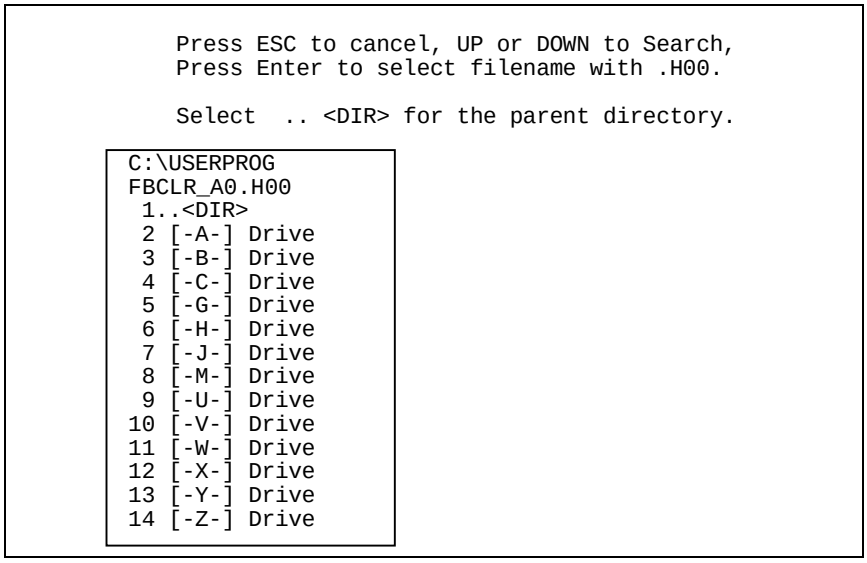


Figure 3-15. File Selection Display

When you select Program Flash Memory, a display appears for selecting the program files to be loaded. This display lists the names of all the files that have the .H00 extension and are located in the default drive and directory. Use the Up Arrow (↑) and the Down Arrow (↓) to indicate the desired file in the file list. If the desired file is not listed, you can instead select a drive and directory that has the file you want. Note that the current drive and directory are given at the top of the list.

6. Press **Enter** to begin loading the HART User Program.
7. Press **F2**. Refer to Figure 3-16.

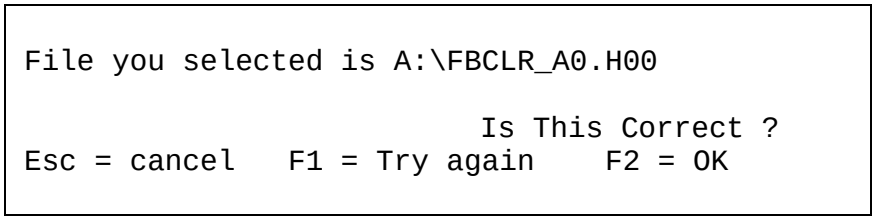


Figure 3-16. Correct File Verification Dialog

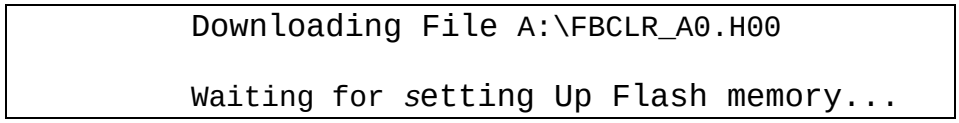


Figure 3-17. Setting Up Flash Memory

When the file has been downloaded, the software displays the following message:

```
Programming the Flash memory, please wait....
```

This message automatically clears after Flash memory has been successfully programmed. You are then returned to the User Routines menu.

8. Press **Esc** in the User Routines menu.
9. Press **F4**, Configuration, from the GV101 Main Menu.
10. Type **8** and press **Enter** to display the ROC Flags display. Refer to Figure 3-18.

```
                    ROC Flags 1 of 1

               CRC Check 1                   RTS Comm #2 0
        DI/PI ROC306/312 0                  Clear EEPROM 0
         User LCD Enable 0                I/O Scan Enable 1
     User OP Port Enable 0                  Aux Out #2 On 1
       FST/Display Clear 0                  Aux Out #1 On 1
        User Com1 Enable 0                Cold Hard Start 0
        User Com2 Enable 0                     Warm Start 0
        User Prog Enable 0                       Read I/O 0
           RTS Oper Port 0                Write to EEPROM 0
             RTS Comm #1 0          EEPROM Write Complete 1


 0 = Disable, 1 = Enable.

1 Update 2   3   4 RD Disk 5 WR Disk 6 Quit  7   8 Save
```

Figure 3-18. ROC Flags Display

11. Set the appropriate user flag based on the User Program you selected.
    - ♦ Set the **User Com1 Enable** flag to **0**, if required.
    - ♦ Set the **User Com2 Enable** flag to **0**, if required.
    - ♦ Set the **User Prog Enable** flag to **0**, if required.
12. Press **(F8)Save**.
13. Press **Enter** to confirm your actions.
14. Press **(F1)Update** to view changes.

A Warm Start is not required. Refer to Figure 3-18.

SECTION 4 — CONFIGURING HART POINTS

This section details how to configure HART Points using ROCLINK and the GV101 Configuration Software. This section includes:

4.1 CONFIGURING HART POINTS USING ROCLINK

To configure HART Points using ROCLINK:

1. Select the **I/O** menu in ROCLINK.
2. Select **HART Point**.

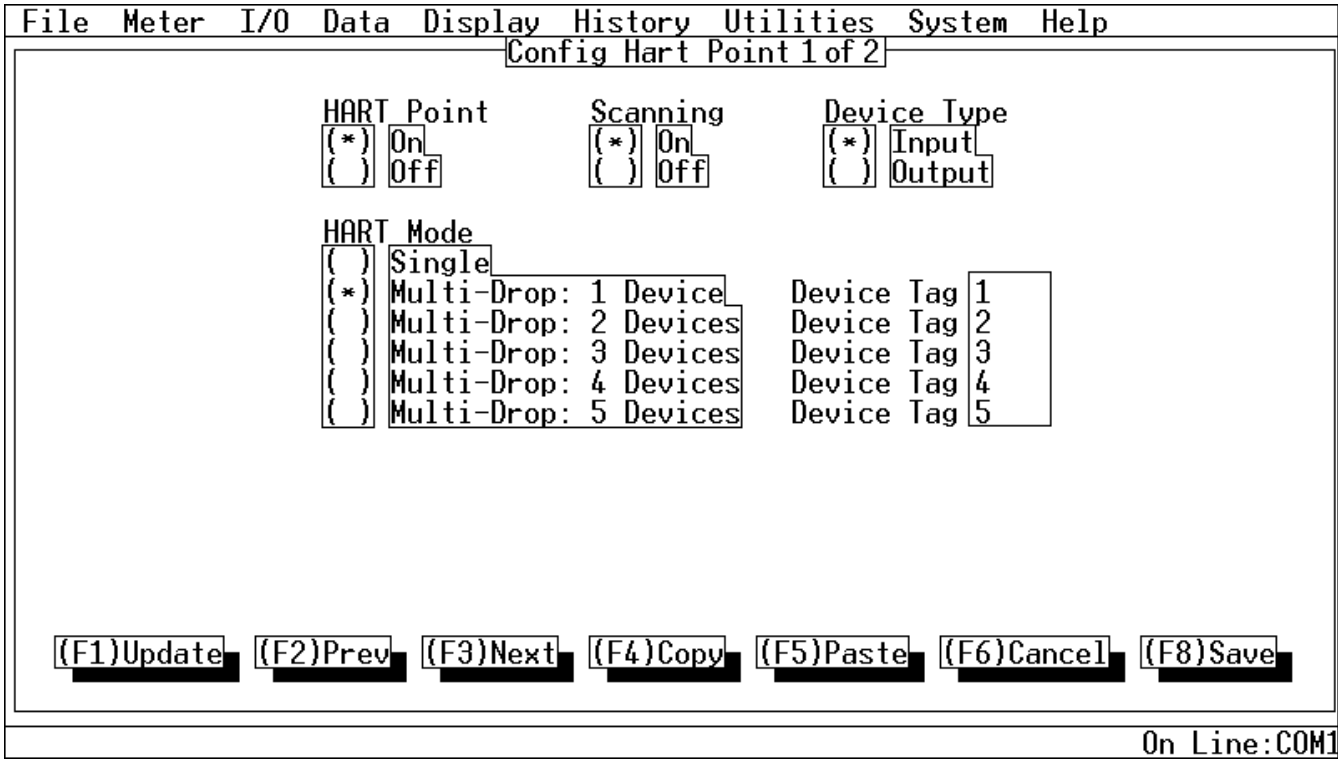


Figure 4-1. Config HART Point Using ROCLINK

When using a HART Interface **Card** program, the first line, **Config Hart Point 1 of x**, shows the current point displayed (1) and the maximum number of points (x). The value for x is fixed at 3 when using the HART Interface Card. When using a HART Interface **Card** program, the HART Points use the three built-in analog input points (for example, HART Point 1 uses Analog Input Point Number 1). If you are monitoring or controlling a fast-changing process, it is a good idea to configure the HART Point into the point-to-point mode and also configure the corresponding Analog Input point to make use of the analog signal.

When using a HART Interface **Module** program, the first line, **Config Hart Point 1 of x**, shows the current point displayed (1) and the maximum number of points (x). The value for x is the number of modules multiplied by 2. There are two points for every module installed. If you are monitoring or controlling a fast-changing process, it is a good idea to configure the HART Point into the point-to-point mode. The HART modules do not use, and are not associated with, any Analog Inputs, whether built-in or modular. The HART module can power the HART device(s), and communicate digital HART Protocol only using the I/O termination block associated with the HART Module.

HART Point — Enable or disable the corresponding built-in analog input (AI) point for HART operation. If turned **OFF**, no ROC memory is allocated for HART on the AI point. Turning this parameter **ON** causes the ROC to check memory allocation and build new HART device data templates, if required.

Scanning — Enable or disable the polling of the HART devices. Scanning should be disabled (**OFF**) if a device is being replaced or if continuous polling is done from another source such as a hand-held configuration device. Scanning must be enabled (**ON**) to use the HART device. Enabling or disabling Scanning has no effect on the ROC memory allocation of HART device data.

Device Type — This feature is currently inactive. All HART Points are inputs.

HART Mode — This field determines the operating mode of the HART Point. The operating mode may be **Single** (point-to-point) or **Multi-Drop**, with the **Device Tag** value denoting the number of devices on the drop. Changing this parameter causes the ROC to Check Memory Allocation and build new HART device data templates if required.

Device Tags 1 through *X* — The Device Tag identifies each HART device in the multi-drop mode. A unique tag must be placed in a device prior to its installation on the multi-drop point. You can modify the Device Tag by using the Config Hart device display. Refer to Section 5, Device Tag. Be sure to enter the most current Device Tag in these fields. Press (F2)Prev and (F3)Next to view each of the points.

NOTE

It is not recommended that a HART device be used for inputs to PID controls or AGA calculations unless the input is used in a slow-acting process.

4.2 CONFIGURING HART POINTS USING GV101

To configure HART Points using the GV101 Configuration Software:

1. Press **F4**, Configure, from the GV101 Main Menu.
2. Type **1** and press **Enter** to select **Configure ROC**.
3. Select **Config Hart Point**. Refer to Figure 4-2.

```
Config Hart Point 1 of x

     Point On/Off  1
     Single/Multi  3
     Scan On/Off   1
     Input/Output  0
     Device 1 Tag  DPT-1
     Device 2 Tag  PT-1
     Device 3 Tag  TT-1
     Device 4 Tag
     Device 5 Tag
```

Figure 4-2. Configure Hart Point

When using a HART Interface **Card** program, the first line, **Config Hart Point 1 of x**, shows the current point displayed (1) and the maximum number of points (x). The value for x is fixed at 3 when using the HART Interface Card. Keep in mind the HART Points use the built-in analog input points (for example, HART Point 1 uses Analog Input Point Number 1). If you are monitoring or controlling a fast-changing process, it is a good idea to configure the HART Point into the point-to-point mode and also configure its corresponding Analog Input point to make use of the analog signal.

When using a HART Interface **Module** program, the first line, **Config Hart Point 1 of x**, shows the current point displayed (1) and the maximum number of points (x). The value for x is the number of modules multiplied by 2. There are two points for every module installed. If you are monitoring or controlling a fast-changing process, it is a good idea to configure the HART Point into the point-to-point mode. The HART modules do not use, and are not associated with any Analog Inputs, whether built-in or modular. HART modules use the I/O termination block associated with the HART Module to send and receive digital signals. The HART module can power the HART device(s), and communicate digital HART Protocol only.

Point On/Off — Enable or disable the corresponding channel for HART operation. If turned OFF, no ROC memory is allocated for HART on the AI point. Turning this parameter ON causes the ROC to check memory allocation and build new HART Device Data templates, if required. The user prompt message is:

```
Point On/Off   0 = Off,  1 = On
```

Single/Multi — This field determines the operating mode of the HART Point. If a 0 is entered, the point is in the **Single** (point-to-point) mode. If a value from 1 to 5 is entered, the point is in **Multi-Drop** mode, with the value denoting the number of devices on the drop. Changing this parameter causes the ROC to check memory allocation and build new HART Device Data templates if required. The user prompt message is:

```
Single/Multi    0 = Single or Point-to-Point.
           1 to 5 = Multi-Drop, Number of Devices.
```

Scan On/Off — Enable or disable the polling of the HART devices. Scanning should be disabled (OFF) if a device is being replaced or if continuous polling is done from another source such as a hand-held configuration device. Scanning must be ON to use the HART slave device. Enabling or disabling the scanning has no effect on the ROC memory allocation of HART device data. The user prompt message is:

```
Scan On/Off    0 = Point Scan off, 1 = Point Scan On
```

Input/Output — This feature is currently inactive. All HART Points are inputs.

Device Tags 1 through 5 — The Device Tag identifies the HART device in the multi-drop mode. A unique Device Tag must be placed in a device prior to its installation on the multi-drop point. You can modify the Device Tag by using the Config Hart Device display (see Section 5), but be sure to enter the most current tag in this field. Press (F2)Prev and (F3)Next to view each of the two points. The user prompt message is:

```
Enter Tag of the Multi-Drop Device.
```

SECTION 5 — CONFIGURING THE HART DEVICE

This section details how the parameters of the HART device are configured using both ROCLINK and GV101. This section includes:

5.1 CONFIGURING THE HART DEVICE USING ROCLINK

To configure the parameters of the HART device using ROCLINK:

1. Select the **I/O** menu in ROCLINK.
2. Select **HART Device**.

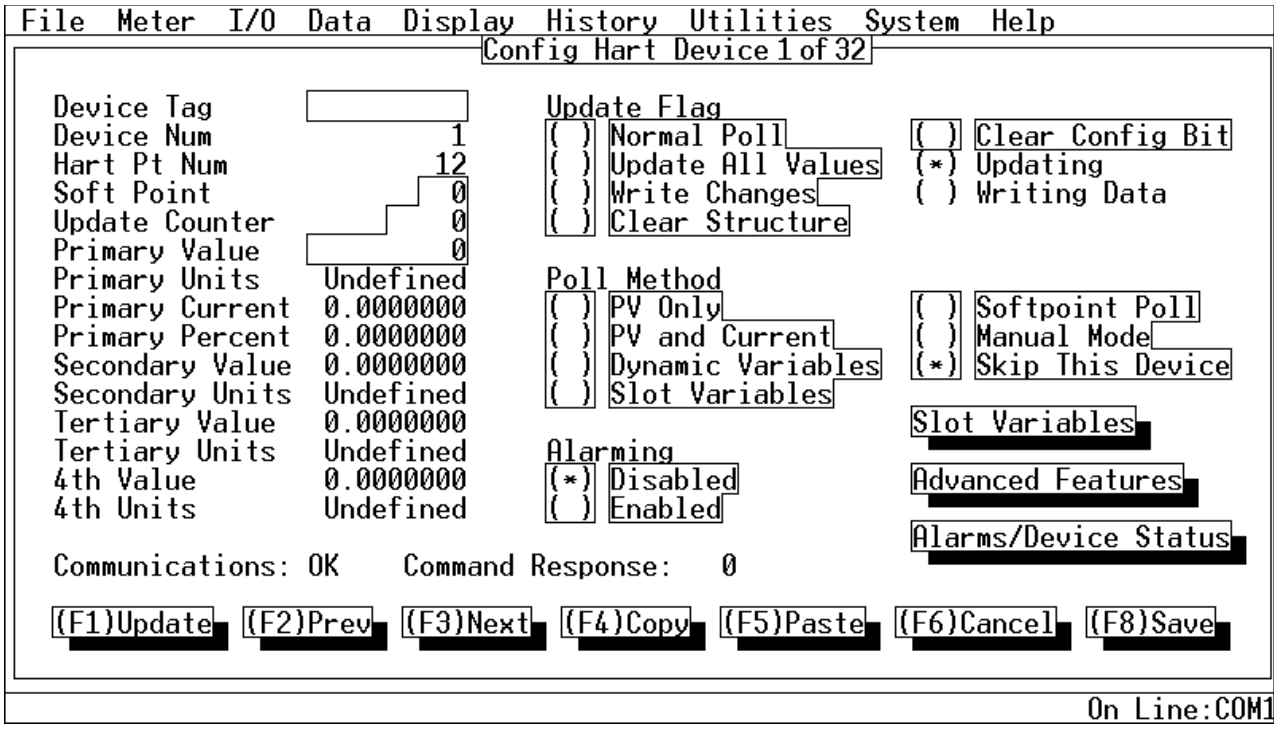


Figure 5-1. Config HART Device Using ROCLINK

Device Tag — Enter up to ten characters to identify the HART Point being defined in this screen. Any alphanumeric characters, including spaces, may be used. This field is a read/write field that displays or modifies the tag residing in the HART device. If you change the Device Tag for a multi-drop device, the new Device Tag in the Config Hart Point display is also changed.

If you change or enter a new Device Tag, you must perform a **Write Changes** update. Refer to the Update Flag parameter on page 5-4.

Device Num — Indicates the device number of the current Hart Pt Num. In the point-to-point mode, the device number is always 1. In multi-drop mode, the Device Number is a number from 1 to 5, depending on the number of HART devices configured on this channel.

Hart Pt Num — When using the HART Interface **Card** program in a ROC306 or ROC312, this field displays the built-in analog input channel (1 to 3) to which this device is connected.

When using the HART Interface **Module** program in a ROC312, ROC364, or FloBoss 407, this field displays the HART channel number within the module. Channel numbers increment by two for every HART module installed (to a maximum of 12), starting with the first rack location. For example:

- Module 1, Channel A = HART Point 1
- Module 1, Channel B = HART Point 2
- Module 2, Channel A = HART Point 3
- Module 2, Channel B = HART Point 4

Soft Point — This enables the HART data to be mapped to one of the ROC Soft Points. A "0" entered into this field disables the writing of HART data to a Soft Point. Entering a number from 1 to 32 allows the HART data to be written to the corresponding Soft Point (1 to 32). Any number entered above 32 is invalid and will be reset to zero. See Appendix A for the mapping of HART data into a Soft Point.

Update Counter — This counter updates every time a valid response is received from the HART device connected to this point.

Primary Value — The Primary Value (process variable – PV) as read from the HART device. The PV is setup in the HART device and cannot be altered from the ROC. This is a measured quantity originating in the process such as pressure, temperature, flow, or a value derived from these like the HART Dynamic Variables.

Primary Units — The units configured in the device for the Primary Value (PV) such as InH_2O.

Primary Current — The current of the HART device loop in milliamps. In point-to-point mode, this value varies between 4 and 20mA. In the multi-drop mode, this value is fixed typically at 4mA.

Primary Percent — This field displays the HART device loop current as a percentage value.

Secondary Value — The Secondary Value as read from the device. The Secondary Value is setup in the HART device and cannot be altered from the ROC.

Secondary Units — The units configured in the HART device for the Secondary Value.

Tertiary Value — The third value as read from the device. The Tertiary Value is setup in the HART device and cannot be altered from the ROC.

Tertiary Units — The units configured in the HART device for the Tertiary Value.

4th Value — The 4th Value as read from the HART device. The 4th Value is setup in the HART device and cannot be altered from the ROC.

4th Units — The units configured in the HART device for the 4th Value.

Communications — The current status of the Communications.

- **Communication Error** – A communications error occurred during transmission.
- **L Parity Error** – The Longitudinal Parity calculated by the device did not match the Longitudinal Parity byte at the end of the message.
- **V Parity Error** – Vertical Parity error. The parity of one or more of the bytes received by the HART device was incorrect.
- **Reserved** – Reserved.
- **Overrun Error** – At least one byte of data in the receive buffer of the HART device was overwritten before it was read.
- **Buffer Overflow** – The message was too long for the receive buffer of the HART device.
- **Framing Error** – The Stop Bit of one or more bytes received by the HART device was not detected.
- **Undefined** – Unknown error.

Command Response — This read-only field indicates the current Command Response received from the Slave. Refer to the specific HART device manual for further information about the error and Command Response summaries. A brief overview of the errors that may be received is provided in Table 5-1.

Table 5-1. Command Response Errors

Command Response	
0	No Command specific error
1	Undefined
2	Invalid selection
3	Passed parameter too large

Command Response	
4	Passed parameter too small
5	Too few data bytes received
6	Device-specific Command error
7	In write-protect mode
8	Update failure Set to nearest possible value Update in progress
9	Lower range value too high Applied process too high Not in proper current mode – fixed at 4mA or 20mA
10	Multi-drop not supported – Revision 4 and earlier Lower range value too low Applied process too low
11	Upper range value too high In multi-drop mode Invalid transmitter variable code
12	Upper range value too low Invalid transmitter variable code
13	Both range values out of limits Invalid transfer function code
14	Span too small Pushed upper range value over limit
15	Multiple meanings
16	Access restricted
32	Device is busy
64	Command not implemented

Update Flag — The Update Flag allows you to demand functions on a HART device.

Normal Poll — This mode uses the polling specified in Poll Method parameters to gather information from the device.

Update All Values — This mode performs a **full update** by gathering the information from the ROC required to update all data fields in the HART Slave device. Not all HART devices contain information for all fields. Refer to Section 6 for more information.

Write Changes — Any data fields that are changed and applicable to the HART Slave device are written to the device. After the changes are written, a full update from the device is requested. Refer to Section 6 for more information.

Clear Structure — This command clears the data in the data fields, followed by a full update from the device.

Clear Config Bit — This command clears (resets) the Config bit in the HART device, which in turn clears the Configuration Change bit in the Device Status parameter. Refer to Section 6, Clearing the Configuration Change Bit.

Updating — This read-only field indicates the current state of the update.

Writing Data — This read-only field indicates if data is being written to the HART device.

Poll Method — This field determines the data or parameters that are continuously requested from the HART Slave device. Refer to Section 6, Polling Methods.

PV Only — This poll only updates the Primary Value (process variable). This is the fastest poll method.

PV and Current — This poll updates the Primary Value (PV) and the Primary Current (in milliamps).

Dynamic Variables — This poll method updates the four principal measured variables – Primary Value, Secondary Value, Tertiary Value, and 4th Value.

Slot Variables — This poll method updates the transmitter variables only. The device data updated depends upon the slot assignments. This poll method works on floating point data types only. Refer to Section 5.1.1, Slot Variables Using ROCLINK, on page 5-6.

Softpoint Poll — This poll method uses the poll method specified by the Soft Point field. This is used to control the polling method through an FST. Refer to Soft Point Mapping in Appendix A.

Manual Mode — This poll method is used by ROCLINK during calibration of the device PV. This poll method should not be used in Normal operation.

Skip this Device — This poll method will not request any information from the HART device and will pass control to the next device.

Alarming — You can either enable or disable limit Alarming for this point. If you enable Alarming, the limit alarms (four levels, Rate, and Deadband) are configured and displayed in the Alarms/Device Status dialog box, which is obtained by using the **Alarms/Device Status** pushbutton. When Enabled, alarms are logged to the Alarm Log. To optimize processor time, alarms should be Enabled only when necessary. If you disable Alarming, no limit alarms generate for this point, regardless of the Alarm configuration.

If Alarming is Enabled and there is no response from the HART device for ten consecutive

polls, a Point Fail alarm code is set in the Active Alarms field of the Alarms/Device Status dialog. In addition, if you are using the HART Interface Card program, the value of the Primary Value parameter will be set to - 9999.0. All alarms will still be recorded in the Alarm Log.

Slot Variables — See Section 5.1.1 for a description of this pushbutton.

Advanced Features — See Section 5.1.2 for a description of this pushbutton.

Alarms/Device Status — See Section 5.1.3 for a description of this pushbutton.

5.1.1 Slot Variables Using ROCLINK

Many HART devices read and store additional information besides the Dynamic Variables. These transmitter variables are device dependent but can be communicated to the ROC. Consult your HART user documentation concerning device specific transmitter variables.

To display the Slot Units and Slot Variables configured in the device, press Slot Variables in the Config HART Device dialog. Refer to Figure 5-2.

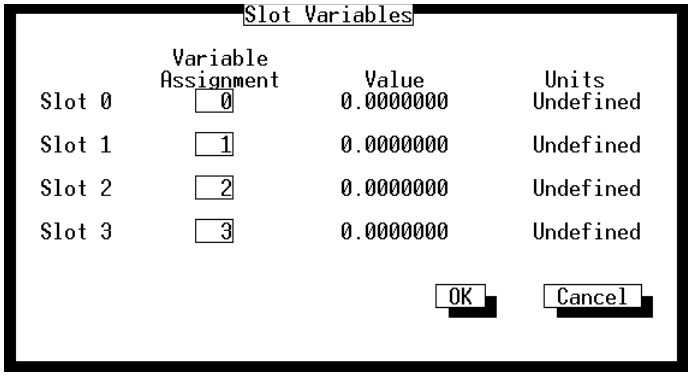


Figure 5-2. Slot Variable for ROCLINK

Slot — Slot location.

Variable Assignment — Assigns a transmitter variable to this slot such as a temperature reading. The variable must be of a floating-point data type, and it must request valid slot variables. If any of the four variables is invalid, nothing is returned and no variables are updated. See device-specific information on assignment of variables.

Slot Value — The value of the data specified by the Slot field.

Slot Units — Unit assigned by the HART device to the variable.

5.1.2 Advanced Features Using ROCLINK

To display the limits and other device information configured in the HART device, press Advanced Features in the Config HART Device dialog. Refer to Figure 5-3.

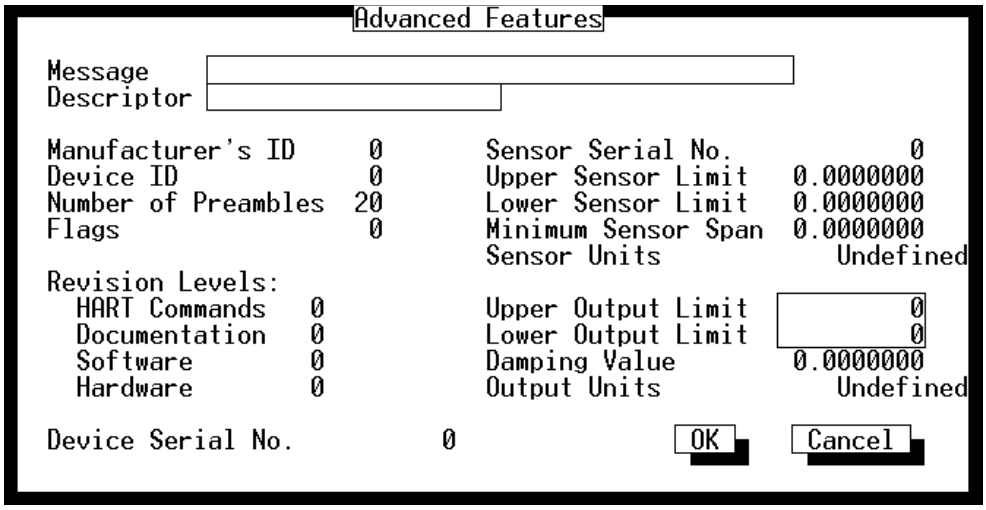


Figure 5-3. Advanced Features Using ROCLINK

Message — This field displays the message contained in the HART Slave device. If you change or enter a new Device Message, transmit the information to the HART device. Refer to the Write Changes function in the Update Flag parameter on page 5-4.

Descriptor — This is a read/write field containing a description of the HART device. If you change or enter a new Descriptor, transmit the information to the HART device. Refer to the Write Changes function in the Update Flag parameter on page 5-4.

Manufacturer's ID — The hexadecimal value that denotes the identification of the HART device manufacturer.

Device ID — The hexadecimal value denotes the type of HART device installed.

Number of Preambles — Number of preambles (FF) required for HART device communications. Preamble are HART device specific. Refer to Section 6, HART Message Frames.

Flags — Device flags. See the HART device documentation.

Revision Levels — Revision levels of HART device. All values are displayed in hexadecimal format.

HART Command — HART Commands revision level.

Documentation — HART device documentation revision level.

Software — HART device software revision level.

Hardware — HART device hardware revision level.

Device Serial No. — The serial number or identification number of the HART device. This number is also used in addressing the device.

Sensor Serial No. — Serial number of the sensor in this HART device.

Upper Sensor Limit — Upper maximum limit of the device sensor. The Upper Sensor Limit and the Lower Sensor Limit define the range over which the sensor properly works. Outside the limit range (Upper Sensor Limit through Lower Sensor Limit) the measurements are unreliable. The digital PV accurately represents the physical measurement of the limit range.

Lower Sensor Limit — Lower minimum limit of the device sensor. The Upper Sensor Limit and the Lower Sensor Limit define the range over which the sensor properly works. Outside the limit range (Upper Sensor Limit through Lower Sensor Limit) the measurements are unreliable. The digital PV accurately represents the physical measurement of the limit range.

To enable reverse analog outputs, set the Lower Sensor Limit higher than the Upper Sensor Limit.

Minimum Sensor Span — Minimum span that can be used with the sensor in this device. The span is the difference between the Upper Sensor Limit and the Lower Sensor Limit.

Sensor Units — Unit of the device sensor.

Upper Output Limit — Upper Output Limit currently assigned to this device. The Upper Output Limit and the Lower Output Limit represent the 20mA and 4mA values respectively.

Lower Output Limit — Lower Output Limit currently assigned to this device. The Upper Output Limit and the Lower Output Limit represent the 20mA and 4mA values respectively.

NOTE

The Upper Output Limit and the Lower Output Limit analog output range values should not be set outside the values set in the Upper Sensor Limit and Lower Sensor Limit fields.

- **Upper Sensor Limit ≥ Upper Output Limit.**
- **Lower Sensor Limit ≤ Lower Output Limit.**

Damping Value — Current damping value assigned to this HART device. The smoothing time constant applied to the PV before the value is made available. The Damping Value can be used to reduce "noise" from a measurement or to reduce aliasing in a Host using a slow scan cycle.

Output Units — Units assigned to the output of device.

5.1.3 Alarms/Device Status Using ROCLINK

To configure alarm limits and view the status of the device, press **Alarms/Device Status** in the Config HART Device dialog. Refer to Figure 5-4. Alarms are set to values (high and low) outside of the normal analog current value to indicate HART device malfunctions. Most HART device manufactures following measurement ranges from 3.9 mA through 20.8 mA. Typical values for alarms are:

- LoLo Alarms ≥ 3.78 mA
- Low Alarms ≥ 3.75 mA
- High Alarms ≤ 20.3 mA
- HiHi Alarms ≤ 20.9 mA

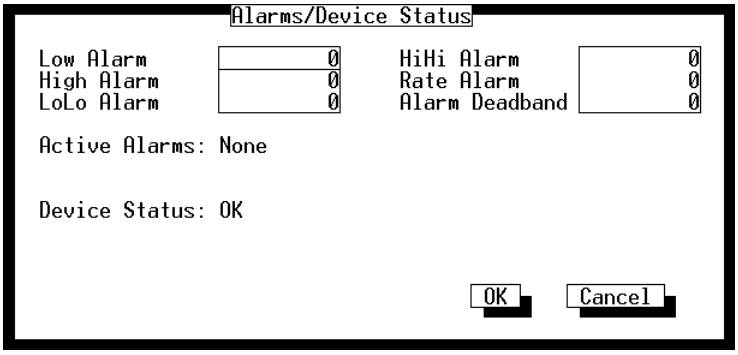


Figure 5-4. Alarms/Device Status Using ROCLINK

Low Alarm — If the Primary Value is less than this value, in engineering units, and Alarming is Enabled, a Low Alarm generates and an entry is made to the Alarm Log. This alarm clears if the Primary Value minus the Alarm Deadband value is greater than the Low Alarm. Out-of -range alarms are typically set around 3.95 mA.

High Alarm — If the Primary Value is less than this value, in engineering units, and Alarming is Enabled, a High Alarm generates, and an entry is made to the Alarm Log. This alarm clears if the Primary Value plus the Alarm Deadband value is less than the High Alarm. Threshold alarms are typically set around 20.3 mA.

LoLo Alarm — If the Primary Value is less than this value, in engineering units, and Alarming is Enabled, a Low-Low Alarm generates, and an entry is made to the Alarm Log. The value is set lower than the Low Alarm. This alarm clears if the Primary Value minus the Alarm Deadband value is greater than the LoLo Alarm. Threshold alarms are typically set around 3.78 mA.

HiHi Alarm — If the Primary Value is less than this value, in engineering units, and Alarming is Enabled, a High-High Alarm generates, and an entry is made to the Alarm Log. The value is set higher than the High Alarm. This alarm clears if the Primary Value plus the Alarm Deadband value is less than the HiHi Alarm. Out-of -range alarms are typically set around 20.9 mA.

Rate Alarm — This value denotes the amount of change required from the previous update of the Primary Value before a Rate Alarm generates and an entry is made to the Alarm Log. The value, in engineering units, that represents the maximum amount of change allowed between updates. If the change is equal to, or greater than this value, a Rate Alarm is generated.

Alarm Deadband — This is the inactive zone around the alarm values. When the Primary Value leaves this zone, the alarm clears. The value, in engineering units, is an inactive zone above the Low Alarm limits and below the High Alarm limits. The purpose of the Alarm Deadband is to prevent the alarm from being set and cleared continuously when the input value is oscillating around the alarm limits. This also prevents the Alarm Log from being over-filled with data.

Active Alarms — This field indicates any alarms that are active for this point. When Alarming is Enabled, the limit alarms (such as Low Alarm and Rate Alarm) that are active appear. Even if Alarming is Disabled, the Point Fail alarm and Manual (Scanning Disabled) indicators can still appear. If Alarming is Enabled, an alarm is generated when Scanning is Disabled.

If Alarming is Enabled and there is no response from the HART device for ten consecutive polls, a Point Fail alarm code is set in the Active Alarms field of the Alarms/Device Status dialog. In addition, if you are using the HART Interface Card program, the value of the Primary Value parameter will be set to - 9999.0. All alarms will still be recorded in the Alarm Log.

Device Status — The information pertains to the operating status of the HART device as a whole and is not associated with the completion of any command. Refer to Section 5 and Table 5-1.

The Device Status field may display the following:

- **OK** – Device is functioning correctly.
- **Device Malfunction** – Device is not functioning correctly. A failure has occurred. Measurement is not valid.
- **PV Out of Limits** – Process Variable or Primary Value measurement is outside of the Upper Sensor Limit or Lower Sensor Limit. The analog signal and digital values read by the HART Commands are unreliable.
- **Configuration Change** – The Host or local operator interface (LOI) has changed the Slave's configuration. Primary Host should recognize this bit and re-read configuration information and then transmit Command 38 to clear the configuration bit.
- **Non-PV Out of Limits** – Variable other than the Process Variable or Primary Value out of limits. The analog signal and digital values read by the HART Commands are unreliable. There is no way to identify the specific variable.
- **Cold Start** – HART device has been powered up.
- **PV Output Saturated** – Measurement is outside the linear analog output range (Lower Output Limit - 0.6% through Upper Output Limit +5%). A linear overrange band, typically – 0.63% (3.9mA) to +105% (20.8mA) is often allowed before this error occurs.
- **More Status Available** – More Status information is available than can fit into this single byte.
- **PV Output Fixed** – The device is in multi-drop mode or the Process Variable or Primary Value (PV) is currently set to a fixed value for testing. Applies to Analog Output Point Number 1 only.

After configuring a point, use **Write to Internal Config Memory** or **Write to EEPROM** in the ROC Flags display to save I/O configuration to programmable ROM in case you must perform a Cold Start. Refer to Section 6, Writing Parameters.

5.2 CONFIGURING THE HART DEVICE USING GV101

To configure the HART device parameters using GV101:

1. Press **F4**, Configure, from the GV101 Main Menu.
2. Type **1** and press **Enter** to select **Configure ROC**.
3. Select **Config Hart Device**. Refer to Figure 5-5.

```
                    Config Hart Device 1 of X

            Update Flag>0                          SV Units Undefined
            Hart Pt Num 1                 Secondary Variable .0000000
             Device Num 1                           TV Units Undefined
            Poll Method 0                  Tertiary Variable .0000000
         Update Counter 14261                      4th Units Undefined
             Soft Point 0                       4th Variable .0000000
             Device Tag DPT-1                  Slot Variables
          Response Code 00000000               Device Message
          Device Status 01000000                  Device Info
             Alarm Code 00000001            Primary Sensor Info
               PV Units InH2O               Primary Output Info
       Primary Variable .0023603                 Alarm Limits
        Primary Current .0000000


Update Flag            0 = Normal Poll             Flags
                       1 = Update All Values     Do not Enter
                       2 = Write Changes        128 = Updating
                       3 = Clear Structure      129 = Writing Data
                       4 = Clear Config Bit


1 Update  2 Prev.   3 Next    4 RD Disk 5 WR Disk 6 Quit    7         8  Save
```

Figure 5-5. Config HART Device Using GV101

When using the HART Interface **Card** program, the first line, Config Hart Device 1 of x, shows the current point displayed (1) and the maximum number of HART devices (x). The value of x is limited to 15.

When using the HART Interface **Module** program, the first line, Config Hart Device 1 of x, shows the current point displayed (1) and the maximum number of HART devices (x). The value of x is limited to 32.

Update Flag — The Update Flag provides a way to demand functions on a HART device. The user prompt message is:

```
Update Flag      0 = Normal Poll            Flags
                 1 = Update All Values      Do Not Enter
                 2 = Write Changes          128 = Updating
                 3 = Clear Structure        129 = Writing Data
                 4 = Clear Config Bit
```

0 = Normal Poll — This mode uses the polling specified in the Poll Method field to gather information from the device.

1 = Update All Values — This mode performs a **full update** by gathering the information required to update all the data fields for the device. Not all devices contain information for all fields. Refer to Section 6 for more information.

2 = Write Changes — Any data fields that are changed and applicable to the HART device are written to the device. After the changes are written, a full update from the device is requested. Refer to Section 6 for more information.

3 = Clear Structure — This command clears the data in the data fields, followed by a full update from the device.

4 = Clear Config Bit — This command clears (resets) the Config bit in the HART device, which in turn clears the Configuration Change bit in the Device Status parameter. Refer to Section 6, Clearing the Configuration Change Bit.

Hart Pt Num — When using the HART Interface **Card** program in a ROC306 or ROC312, this field displays the built-in analog input point (1 to 3) to which this device is connected.

When using the HART Interface **Module** program in a ROC312, ROC364, or FloBoss 407, this field displays the HART module channel number. Channel numbers increment by two for every HART module installed, starting with the first rack location. The user prompt message is: `For information only.`

Device Num — The device number of the current Hart Pt Num. In the point-to-point mode, the device number is always 1. In multi-drop mode, the device number is a number from 1 to 5, depending on the number of HART devices configured on this point. The user prompt message is: `For information only.`

Poll Method — Determines the data or parameters that are continuously requested from the device. Refer to Section 6, Polling Methods. The user prompt message is:

```
Poll Method     0 = PV Only                5 = Softpoint Poll
                1 = PV, Current            6 = Manual Mode
                2 = Dynamic Variables
                3 = Slot Variables         10 = Skip this Device
```

0 = PV Only — This poll only updates the Primary (or process) Variable. This is the fastest poll method.

1 = PV, Current — This poll updates the Primary Variable (PV) and the Primary Current (in milliamps).

2 = Dynamic Variables — This poll method updates the four principal measured variables – Primary, Secondary, Tertiary, and 4th Variables.

3 = Slot Variables — This poll method updates the Slot Variables (transmitter variables) only. The device data updated depends upon the slot assignments. This poll method works on floating point data types only. Refer to Slot Variable on page 5-17.

5 = Softpoint Poll — Uses the poll method specified by the Data 1 field in the Soft Point specified by the Soft Point field. This is used to control the polling method through an FST. Refer to Appendix A for the mapping of HART data into a soft point.

6 = Manual Mode — Used by the GV101 Configuration Software during calibration of the device PV. This poll method should not be used in normal operation.

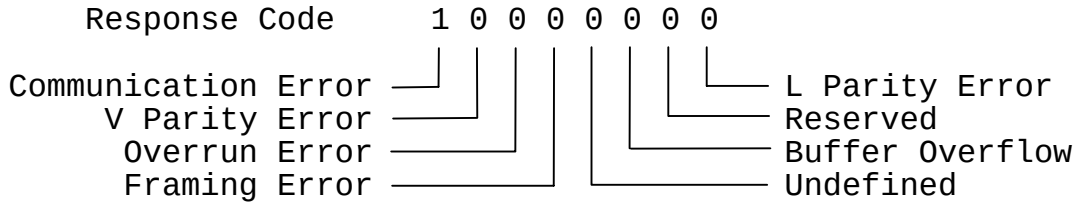
10 = Skip this Device — This poll method will not request any information from the HART device and will pass control to the next device.

Update Counter — This counter updates every time a valid response is received from the HART device connected to this point.

Soft Point — This enables the HART data to be mapped to one of the ROC Soft Points. A "0" entered into this field disables the writing of HART data to a soft point. Entering a number from 1 to 32 allows the HART data to be written to the corresponding soft point (1 to 32). Any number entered above 32 is invalid and will be reset to zero. Refer to Appendix A for the mapping of HART data into a soft point.

Device Tag — This field is a read/write field that displays or modifies the tag residing in the HART device. If you change the tag for a multi-drop device, the new tag in the Config Hart Point also updates. After changing and saving a new Device Tag to the ROC, perform a Write Changes command. Refer to the Write Changes function in the Update Flag parameter on page 5-13. The user prompt message is: `Tag that resides in device.`

Response Code — This field contains information on the Communication Error Summary when bit 7 (Communication Error) is set, and it contains information on Command Response Summary when bit 7 is cleared. Refer to the specific HART device manual for further information about the error and response summaries. The ROC sets all bits to "1" if no response is obtained from the HART device. Refer to Table 5-1 on page 5-3 concerning Command Response Codes. The user prompt message for the Communication Error Summary is:

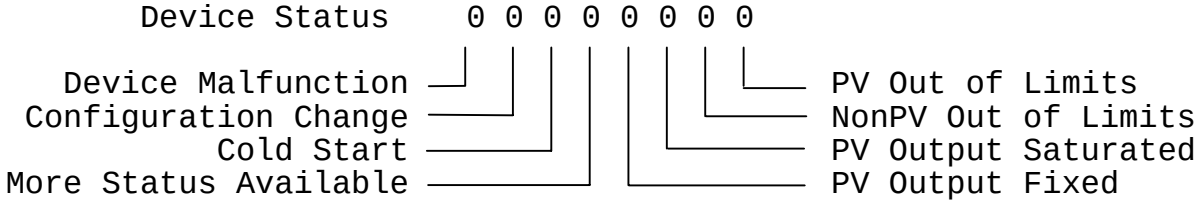


The Communications Error Summaries are as follows:

- **Communication Error** – A communications error occurred during transmission.
- **L Parity Error** – The Longitudinal Parity calculated by the device did not match the Longitudinal Parity byte at the end of the message.
- **V Parity Error** – Vertical Parity error. The parity of one or more of the bytes received by the device was incorrect.
- **Reserved** – Reserved.
- **Overrun Error** – At least one byte of data in the receive buffer of the HART device was overwritten before it was read.
- **Buffer Overflow** – The message was too long for the receive buffer of the device.
- **Framing Error** – The Stop Bit of one or more bytes received by the device was not detected.
- **Undefined** – Unknown error.

Device Status — The information in this byte pertains to the operating status of the device as a whole and is not associated with the completion of any command.

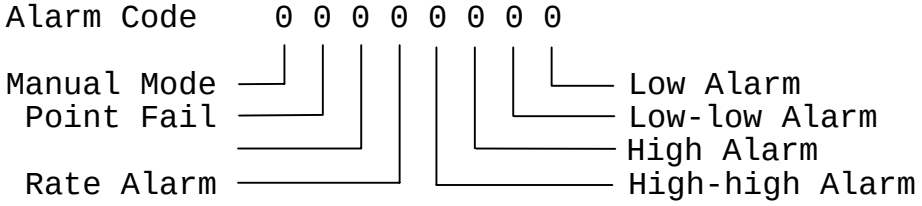
The user prompt message is:



The Device Status definitions include:

- **OK** – Device is functioning correctly.
- **Device Malfunction** – Device is not functioning correctly. A failure has occurred. Measurement is not valid.
- **PV Out of Limits** – Process Variable or Primary Value measurement is outside of the Upper Sensor Limit or Lower Sensor Limit. The analog signal and digital values read by the HART Commands are unreliable.
- **Configuration Change** – The Host or local operator interface (LOI) has changed the Slave's configuration. Primary Host should recognize this bit and re-read configuration information and then transmit Command 38 to clear the configuration bit.
- **Non-PV Out of Limits** – Variable other than the Process Variable or Primary Value out of limits. The analog signal and digital values read by the HART Commands are unreliable. There is no way to identify the specific variable.
- **Cold Start** – HART device has been powered up.
- **PV Output Saturated** – Measurement is outside the linear analog output range (Lower Output Limit - 0.6% through Upper Output Limit +5%). A linear overrange band, typically – 0.63% (3.9mA) to +105% (20.8mA) is often allowed before this error occurs.
- **More Status Available** – More Status information is available than can fit into this single byte.
- **PV Output Fixed** – The device is in multi-drop mode or the Process Variable or Primary Value (PV) is currently set to a fixed value for testing. Applies to Analog Output Point Number 1 only.

Alarm Code — The information in this byte pertains to the alarming of the Primary Variable. This information is valid only when alarms are enabled (in the Alarm Limits parameter). A "1" in the any Alarm Code bit indicates an active alarm. The user prompt message is:



PV Units — Displays the units configured in the device for the Primary Variable (PV) such as InH_2O. The user prompt message is: `For information only.`

Primary Variable — Displays the Primary Variable (primary value) as read from the device. The PV is setup in the HART device and cannot be altered from the ROC. The PV is a measured quantity originating in the process such as pressure, temperature, flow, or a value derived from these like the HART Dynamic Variables. The user prompt message is: `For information only.`

Primary Current — Displays the current of the device loop in milliamps. In the point-to-point mode, this value will vary between 4 and 20mA. In the multi-drop mode, this value is fixed typically at 4 milliamps. The user prompt message is: `For information only.`

SV Units — Displays the units configured in the device for the Secondary Variable. The user prompt message is: `For information only.`

Secondary Variable — Displays the Secondary Variable as read from the device. The Secondary Variable is setup in the HART device and cannot be altered from the ROC. The user prompt message is: `For information only.`

TV Units — Displays the units configured in the device for the Tertiary Variable. The user prompt message is: `For information only.`

Tertiary Variable — Displays the Tertiary Variable as read from the device. The Tertiary Variable is setup in the HART device and cannot be altered from the ROC. The user prompt message is: `For information only.`

4th Units — Displays the units configured in the device for the 4th Variable. The user prompt message is: `For information only.`

4th Variable — Displays the 4th Variable as read from the device. The 4th Variable is setup in the HART device and cannot be altered from the ROC. The user prompt message is: `For information only.`

Slot Variables — This field uses a pop-up dialog box to display the Slot Units and Slot Variables configured in the device. Refer to Figure 5-6.

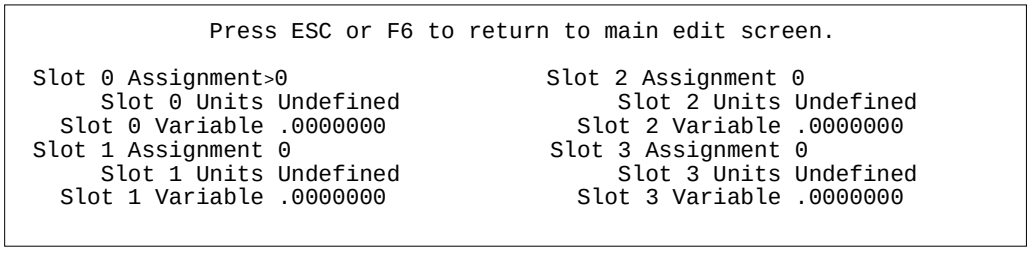


Figure 5-6. Slot Variable Using GV101

Many HART devices read and store additional information besides the Dynamic Variables. These transmitter variables are device dependent but can be communicated to the ROC. Consult your HART user documentation concerning device specific transmitter variables.

Slot *n* Assignment — Assigns a transmitter variable to this slot such as a temperature reading. The variable must be of a floating-point data type, and it must request valid slot variables. If any of the four variables is invalid, nothing is returned and no variables are updated. See device-specific information on assignment of variables.

Slot *n* Units — Unit assigned by the device to the variable.

Slot *n* Variable — The value of the data specified by the Slot Assignment.

Device Message — This is a read/write field that uses a pop-up dialog box to show the message contained in the device. If you want to change the message, save it first to the ROC and then write it to the HART device. Refer to the Write Changes function in the Update Flag parameter on page 5-13.

Device Info — This field uses a pop-up dialog box to provide information about the device. Refer to Figure 5-7.

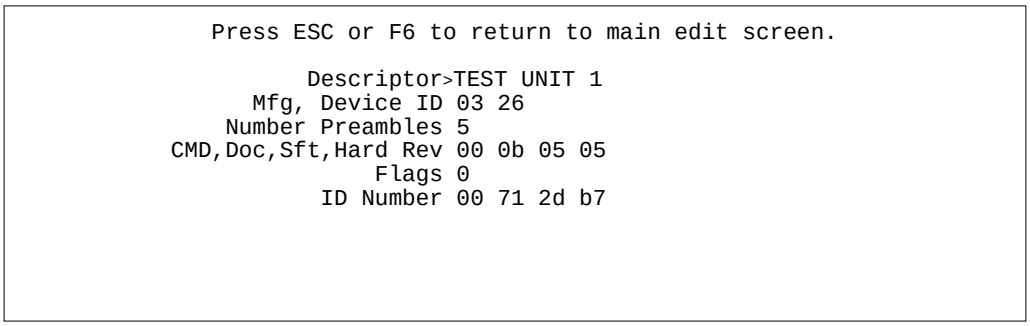


Figure 5-7. Config HART Device Using GV101

Descriptor — This is a read/write field containing a description of the HART device. If you want to change the Descriptor, save it first to the ROC and then write it to the HART device. Refer to the Write Changes function in the Update Flag parameter on page 5-13.

Mfg, Device Id — The first value in this field is a hexadecimal value that denotes the identification of the device manufacturer. The second hexadecimal value denotes the type of device installed.

Number Preambles — Number of preambles (FF) required for device communications. Preambles are HART device specific. Refer to Section 6, HART Message Frames.

CMD, Doc, Sft, Hard Rev — Revision levels of device. All values are displayed in hexadecimal format.

CMD – HART Commands revision level.

Doc – HART device documentation revision level.

Sft – HART device software revision level.

Hard Rev – HART device hardware revision level.

Flags — Device flags. See the device documentation that was supplied with your HART device.

ID Number — The serial number or identification number of the device. This number is also used in addressing the device.

Primary Sensor Info — This field uses a pop-up dialog box to show the primary sensor limits and minimum span. Refer to Figure 5-8.

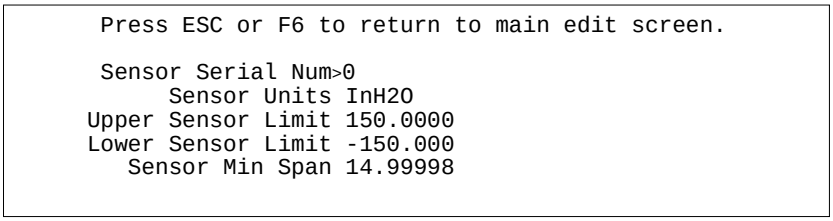


Figure 5-8. Primary Sensor Info Using GV101

Sensor Serial Num — Serial number of the sensor in this device.

Sensor Units — Unit of the device sensor.

Upper Sensor Limit — Upper maximum limit of the device sensor. The Upper Sensor Limit and the Lower Sensor Limit define the range over which the sensor properly works. Outside the limit range (Upper Sensor Limit through Lower Sensor Limit) the measurements are unreliable. The digital PV accurately represents the physical measurement of the limit range.

Lower Sensor Limit — Lower minimum limit of the device sensor. The Upper Sensor Limit and the Lower Sensor Limit define the range over which the sensor properly works. Outside the limit range (Upper Sensor Limit through Lower Sensor Limit) the measurements are unreliable. The digital PV accurately represents the physical measurement of the limit range.

If the Lower Sensor Limit is set higher than the Upper Sensor Limit enables reverse analog outputs.

Sensor Min Span — Minimum span that can be used with the sensor in this device. The span is the difference between the Upper Sensor Limit and the Lower Sensor Limit.

NOTE

The Upper Output Limit and the Lower Output Limit analog output range values should not be set outside the values set in the Upper Sensor Limit and Lower Sensor Limit fields.

- **Upper Sensor Limit ≥ Upper Output Limit.**
- **Lower Sensor Limit ≤ Lower Output Limit.**

Primary Output Info — This field uses a pop-up dialog box to show the primary output limits. Refer to Figure 5-9.

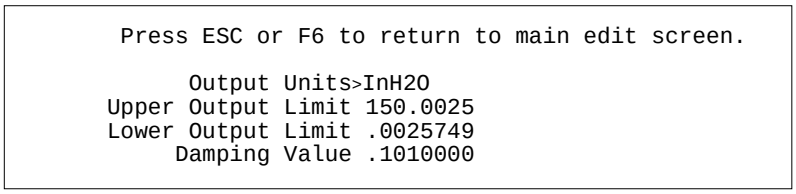


Figure 5-9. Primary Output Info Using GV101

Output Units — Units assigned to the output of device.

Upper Output Limit — Upper Output Limit currently assigned to the HART device. The Upper Output Limit and the Lower Output Limit represent the 20mA and 4mA values respectively.

Lower Output Limit — Lower Output Limit currently assigned to the HART device. The Upper Output Limit and the Lower Output Limit represent the 20mA and 4mA values respectively.

Damping Value — Current damping value assigned to the HART device. The smoothing time constant applied to the PV before the value is made available. The Damping Value can be used to reduce "noise" from a measurement or to reduce aliasing in a Host using a slow scan cycle.

Alarm Limits — This field uses a pop-up dialog box to show and allow configuration of the alarm limits of the Primary Variable. Refer to Figure 5-10. Most HART device manufactures following measurement ranges from 3.9 mA through 20.8 mA. Typical values for alarms are:

- LoLo Alarm EU ≥ 3.78 mA
- Low Alarm EU ≥ 3.75 mA
- High Alarm EU ≤ 20.3 mA
- HiHi Alarm EU ≤ 20.9 mA

```
Press ESC or F6 to return to main edit screen.

     Alarm Enable>1
     Low Alarm EU 4.000000
    High Alarm EU 100.0000
   LoLo Alarm EU -2.00000
   Hi Hi Alarm EU 110.0000
    Rate Alarm EU 30.00000
   Alarm Deadband 1.000000
```

Figure 5-10. Alarm Limits Using GV101

Alarm Enable — Setting this field to "1" enables alarming on the Primary Variable and the logging of alarms to the ROC Alarm Log. Setting the field to "0" disables the alarming function.

If Alarm Enable is set to "1" and there is no response from the HART device for ten consecutive polls, the Point Fail bit in the Alarm Code parameter will be set to "1." In addition, if you are using the HART Interface Card program, the value of the Primary Variable parameter will be set to -9999.0. All alarms will still be recorded in the Alarm Log.

Low Alarm EU — If the Primary Variable is less than this value and alarming is enabled, a Low Alarm generates, and an entry is made to the Alarm Log. This alarm clears if the Primary Variable minus the Alarm Deadband value is greater than the Low Alarm EU.

High Alarm EU — If the Primary Variable is greater than this value and alarming is enabled, a High Alarm generates, and an entry is made to the Alarm Log. This alarm clears if the Primary Variable plus the Alarm Deadband value is less than the High Alarm EU.

LoLo Alarm EU — If the Primary Variable is less than this value and alarming is enabled, a low-low alarm generates, and an entry is made to the Alarm Log. This alarm clears if the Primary Variable minus the Alarm Deadband value is greater than the LoLo Alarm EU.

HiHi Alarm EU — If the Primary Variable is greater than this value and alarming is enabled, a High-High Alarm generates, and an entry is made to the Alarm Log. This alarm clears if the Primary Variable plus the Alarm Deadband value is less than the HiHi Alarm EU.

Rate Alarm — This value denotes the amount of change required from the previous update of Primary Variable before a Rate Alarm is generated and an entry is made to the Alarm Log.

Alarm Deadband — The value, in engineering units, is an inactive zone above the Low Alarm limits and below the High Alarm limits. The purpose of the Alarm Deadband is to prevent the alarm from being set and cleared continuously when the input value is oscillating around the alarm limit. This also prevents the Alarm Log from being over-filled with data. When the Primary Variable leaves this zone, the alarm clears.

SECTION 6 — HART HOST OPERATION

This section includes the following information:

6.1 HART COMMANDS

The ROC or FloBoss is considered to be a HART Host (primary master) interface with a Class 1 Conformance classification. Most Universal and some Common Practice Commands are supported as listed in Table 6-1. The supported Universal Commands are numbered 0 through 18 and the Common Practice Commands supported are numbered 33 through 38. The supported Commands conform to Revision 5.1 of the Universal Command Specification and Revision 7.0 of the Common-Practice Command Specification (as found in the *HART - Smart Communications Protocol* document).

Because the ROC operates as a HART Host, it can request and write parameters to a HART device. Various modes of operation can be further configured with the ROC.

The Primary Variable or Process Value can be represented in engineering units (EUs) with Command 1 or Command 3 and the PV can be represented as a percent of range using Command 2. Command 3 can also represent the actual analog output current in milliamps.

Table 6-1. HART Commands

Command Number	Description
0	Read Unique Identifier
1	Read Primary Variable or Primary Value (PV)
2	Read PV Current (milliamps) and Percent of Range
3	Read Dynamic Variables and PV Current (milliamps)
6	Write Polling Address
11	Read Unique ID Associated with Tag (Device Tag)
12	Read Message
13	Read Tag (Device Tag), Descriptor, and Date
14	Read PV Sensor Information
15	Read PV Output Information
17	Write Message
18	Write Tag (Device Tag), Descriptor, and Date
33	Read Transmitter (Slot) Variables
35	Write PV Range Values
36	Set PV Upper Range Value
37	Set PV Lower Range Value
38	Reset Configuration-changed Flag

6.1.1 HART Message Frames

Refer to Figure 6-1 concerning the structure of HART message frames.

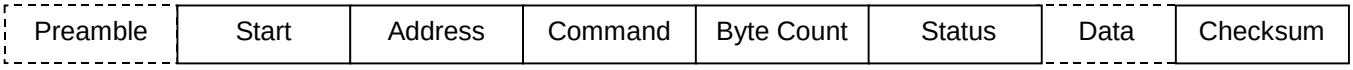


Figure 6-1. HART Message Frame

Preamble — Between 5 and 20 bytes of hexadecimal FF characters that are all 1's. HART devices use the Preamble to synchronize to the character stream.

Start — One byte in length and may include several values indicating the type of message such as: Host to Slave, Slave to Host, and address format (long or short frame).

Address — Includes both the Host address and the Slave address. The Host address is a single bit with the most significant bit (MSB) of the address field either representing the primary Host as 1 or representing the secondary Host as 0. In a short frame, the Slave address is four bits representing the polling address of 0 through 15. In a long frame, the Slave address is 38 bits containing the Device Tag and one bit indicating if the Slave is in Broadcast mode. The ROC and FloBoss units do not support Broadcast (burst) mode. Long frame formats do not use the polling address. The remaining 38 bits of the five-byte address field contain the Slave's unique identifier as an address.

Command — One byte (0 to hexadecimal FD or decimal 253) contains the HART Command message. Refer to Section 6, HART Commands. The Command code is echoed back by the Slave in the reply message.

Byte Count — The number of bytes to follow in the Status and Data bytes fields. The Slave uses the Byte Count to know when the message is complete. Byte Count functions as the end of message indicator. The Data field is limited to 25 bytes maximum so the Byte Count range is 0 to 27.

Status — Two-byte response code. Present in the response message sent from the Slave. The two bytes include information about outgoing communication errors in the return message (Command Response), the Status of the received Command (device is busy or does not recognize the Command), and the operational Device Status of the HART Slave.

Command Response codes are integers from 0 through 127 and indicate errors or warnings, which may have single or multiple meanings. Refer to Table 5-1. The Command Response code may be applicable to any transaction or have multiple meanings specific to a Universal or Common Practice Command. A Command Response code includes both fault conditions and abnormal operational modes or conditions, which do not indicate a faulty device. Communication errors are typically errors in parity, overrun, and framing errors. An overflow of the receive buffer or discrepancies between the message content and the received checksum may occur.

Data — Depending on the HART Command, the Data field may or may not be present. A maximum length of 25 bytes is recommended. The number of bytes of data and the formatted data used for each item are designated by each Command. Refer to Table 6-1, HART Commands. Data may be in the form of:

- Integers – 8, 16, 24, or 32 bits, unsigned.
- Floating point numbers – IEEE 754 single-precision floating point format.
- ASCII character strings – usually packed four characters into each three bytes.
- Enumerated items from a standard list – code as 8-bit integers.

If a Command is unsuccessful, the return Command Response message will not contain Data. A successful Command always includes the same set of variables as were contained in the Command message; however, the values in the return response message are those actually used and acquired from the Slave device's memory.

Checksum — One byte containing the longitudinal parity (exclusive-or) of all other bytes (Start through Data) with Parity bit attached to each byte. The Checksum byte is used to detect communication errors and message corruption.

The least significant byte (LSB) is always sent first.

6.2 FULL UPDATE

A full update requests data from a HART device using most of the read Commands supported (such as HART Commands 0, 11, 12, 13, 14, and 15). The full update is initiated automatically on power-up and after a major change in the configuration of a HART Point has been made. A major change is defined as a reconfiguration from point-to-point mode to multi-drop mode or vice-versa, or the addition or deletion of a device in the multi-drop mode.

A full update can also be performed on-demand either by using GV101, ROCLINK, or by using a remote host. Refer to either of the procedures below:

- Initiating a Full Update Using ROCLINK.
- Initiating a Full Update Using GV101.

6.2.1 Initiating a Full Update Using ROCLINK

To initiate a full update with ROCLINK:

1. Select **Flags** from the System Menu.
2. Set the **Write to Internal Config Memory** or **Write to EEPROM** to display **Yes**.
3. Press **(F8)Save**.
4. Select **HART Device** from the I/O menu.
5. Select the **Update All Values** parameter in the **Update Flag** field.
6. Press **(F8)Save**.
7. Press **(F1)Update** to view the changes.

6.2.2 Initiating a Full Update Using GV101

To initiate a full update with GV101:

1. Press **F4**, Configure, from the GV101 Main Menu.
2. Select **8**, ROC System Flags, from the Configuration menu and press **Enter**.
3. Set the **Write to EEPROM** to display **1**.
4. Press **(F8)Save**.
5. Press **Esc** to view the Main Menu.
6. Press **F4**, Configure, from the GV101 Main Menu.
7. Type **1** and press **Enter** to select **Configure ROC**.
8. Select **Config Hart Device**.
9. Set the **Update All Values = 1** parameter in the **Update Flag** field.
10. Press **(F8)Save**.

11. Press **Enter** to confirm your actions.
12. Press **(F1)Update** to view the changes.

6.3 POLLING METHODS

A HART data poll by the ROC is defined as the data that is continuously requested from the HART device. The ROC allows four different polling sequences or methods. The amount of time spent gathering data from a device depends upon the polling method used. Each polling method always updates the Response Code and Device Status parameters. The following table shows these polling methods.

Table 6-2. Polling the HART Device

Poll Method	HART Commands	Description
0 – PV Only	1	Read Primary Variable or Primary Value only
1 – PV and Current	1, 2	Read Primary Variable or Primary Value and Current
2 – Dynamic Variables	3	Read Dynamic Variables
3 – Slot Variables	33	Read Slot Variables

6.4 WRITING PARAMETERS

To write or change a parameter in a HART device, the parameter must first be changed and saved into ROC memory (Write to EEPROM or Write to Internal Config Memory). After the parameter is changed in ROC memory, a Command (Write Changes) must be issued to write the data to the HART device. The ROC issues a Command to the HART device to change the parameter, and then automatically follows with a full update request to update any data in ROC memory that may have been affected by the parameter change. Refer to:

- Writing Parameters Using ROCLINK on page 6-7.
- Writing Parameters Using GV101 on page 6-7.

6.4.1 Writing Parameters Using ROCLINK

To initiate a full update with ROCLINK:

1. Select **Flags** from the System Menu.
2. Set the **Write to Internal Config Memory** or **Write to EEPROM** to display **Yes**.
3. Press **(F8)Save**.
4. Select **Write Changes** under the Update Flag parameters in the Config HART Device screen.
5. Press **(F8)Save**.

6.4.2 Writing Parameters Using GV101

To initiate a full update with GV101:

1. Press **F4**, Configure, from the GV101 Main Menu.
2. Select **8**, ROC System Flags, from the Configuration menu and press **Enter**.
3. Set the **Write to EEPROM** to display **1**.
4. Press **(F8)Save**.
5. Press **Enter** to confirm your actions.
6. Enter **2**, **Write Changes**, under the Update Flag parameters in the Config HART Device screen.
7. Press **(F8)Save**.

6.5 CLEARING THE CONFIGURATION CHANGE BIT

There is a "Config" flag in the HART device set whenever the device detects a change in its configuration. Refer to:

- Clearing the Configuration Change Bit using ROCLINK on page 6-8.
- Clearing the Configuration Change Bit using GV101 on page 6-8.

6.5.1 Clearing the Configuration Change Bit using ROCLINK

When using ROCLINK, the setting of this flag is reflected in the Device Status parameter shown on the Alarms/Device Status display. To clear the Configuration Change Bit in the HART device using ROCLINK:

1. Select **HART Device** from the I/O menu.
2. Select the **Clear Config Bit** parameter in the **Update Flag** field. Refer to Section 5, Update Flag.
3. Press **(F8)Save**.
4. Press **(F1)Update** to view the changes.

6.5.2 Clearing the Configuration Change Bit using GV101

To clear the Configuration Change Bit in the HART device using GV101:

1. Press **F4**, Configure, from the GV101 Main Menu.
2. Type **1** and press **Enter** to select **Configure ROC**.
3. Select **Config Hart Device**.
4. Set the **Configuration Change = 1** parameter in the **Update Flag** field. Refer to Section 5, Update Flag.
5. Press **(F8)Save**.
6. Press **(F1)Update** to view the changes.

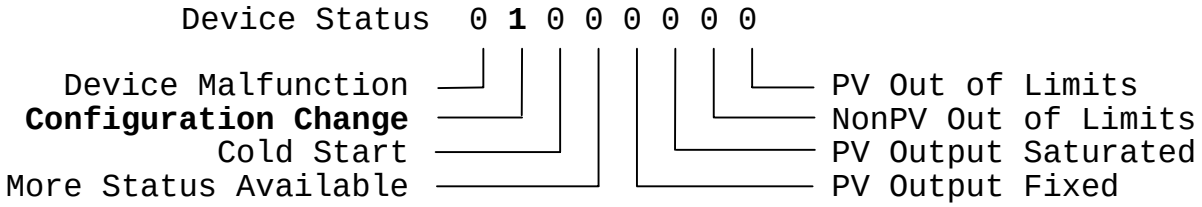


Table 6-3. HART Command and Data

Command and Function	Data In Command (Type)	Data In Reply (Type)
0 Read unique identifier	none	Byte 0 254" (expansion) Byte 1 manufacturer identification code Byte 2 manufacture's device type code Byte 3 number of preambles Byte 4 universal command revision Byte 5 transmitter-specific command revision Byte 6 software revision (H) Byte 7 hardware revision (B) Byte 8 device function flags Byte 9-11 device ID number
1 Read primary variable	none	Byte 0 PV units code (F) Byte 1-4 primary variable
2 Read current and percent of range	none	Byte 0-3 current in mA (F) Byte 4-7 percent of range (F)
3 Read current and four (predefined) dynamic variables	none	Bytes 0-3 current in mA (F) Byte 4 PV units code Byte 5-8 primary variable (F) Byte 9 SV units code Byte 10-13 second variable (F) Byte 14 TV units code Byte 15-18 third variable (F) Byte 19 FV units code Byte 20-23 fourth variable (F)
6 Write polling address.	Byte 0 polling address	as in command
11 Read unique identifier associated with tag	Byte 0-5 tag (A)	as command 0
12 Read message	none	Byte 0- 23 message (A)
13 Read tag, descriptor, date	none	Byte 0-5 tag (A) Byte 6-17 descriptor (A) Byte 18-20 date (D)
14 Read PV sensor information	none	Byte 0-2 sensor serial number Byte 3 units code for sensor limits and minimum span Byte 8-11 lower sensor limit (F) Byte 12-15 minimum span (F)

Command and Function	Data In Command (Type)	Data In Reply (Type)
15 Read output information	none	Byte 0 alarm select code Byte 1 transfer function code Byte 2 PV/range units code Byte 3-6 upper range value (F) Byte 7-10 lower range value (F) Byte 11-14 damping value (sec) (F) Byte 15 write-protect code Byte 16 private-label distributor code
17 Write message	Byte 0-23 message (A)	
18 Write tag, descriptor, date	Byte 0-5 tag (A) Byte 6-17 descriptor (A) Byte 18-20 date (D)	as in command
33 Read transmitter variables	Byte 0 transmitter variable code for Slot 0 Byte 1 transmitter variable code for Slot 1 Byte 2 transmitter variable code for Slot 2 Byte 3 transmitter variable code for Slot 3 (truncated after last requested code)	Byte 0 transmitter variable code for Slot 0 Byte 1 units code for Slot 0 Byte 2-5 data for transmitter variable Slot 0 Byte 6 transmitter variable code for Slot 1 Byte 7 units code for Slot 1 Byte 8-11 data for transmitter variable Slot 1 Byte 12 transmitter variable code for Slot 2 Byte 13 units code for Slot 2 Byte 14-17 data for transmitter variable Slot 2 Byte 18 transmitter variable code for Slot 3 Byte 19 units code for Slot 3 Byte 20-23 data for transmitter variable Slot 0
35 Write range values	Byte 0 range units code (F) Byte 1-4 upper range value (F) Byte 5-8 lower range value (unit code used does not affect PV unit code. To change PV unit code use Command 44)	as in command
36 Set upper range value (= push SPAN button)	none	none
37 Set lower range value (= push ZERO button)	none	none

Command and Function	Data In Command (Type)	Data In Reply (Type)
38 Reset configuration changed flag	none	none

Data types:

A – ASCII string (packed 4 characters per 3 bytes)
B – Bit-mapped flags (bit 0 = multisensor device; bit 1 = EEPROM control required)
D – Date (day, month, year-i 900)
F – Floating point (4 bytes IEEE 754)
H – Integers xxxxx yyy (xxxxx = hardware rev., yyy = physical signaling code)
Unmarked items are 8-, 16- or 24-bit integers

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SECTION 7 — USING HART PARAMETERS

7.1 USING HART PARAMETERS WITH THE ROC

The HART parameters are referenced by Type, Logical Number, and Parameter (TLP) in the same manner as the rest of the ROC parameters. This allows access to all the ROC functions when using the GV101 Configuration Software or ROCLINK.

For example, a HART Primary Variable or Primary Value can be assigned as an input (in a slow-acting process) to an AGA3 Flow Calculation, a process variable for a PID Loop, a Tank Level in Tank Volume Calculations, as a variable for 35 days of hourly history archival, as a variable to display on the Local Display, and as an item on the user-configured ROC Displays.

The HART parameters are also included in the ROC Event Log whenever a HART parameter is changed, showing the description, time of change, old value, new value, and who initiated the change.

7.2 USING HART WITH ROC PROTOCOL

The HART parameters can be accessed using Opcodes 166 and 167 (Block Read and Block Write), Opcodes 180 and 181 (Parameter Read and Parameter Write), and also through the Configured Opcodes by configuring a HART parameter in the Opcode parameter tables. More information can be obtained from the *ROC Protocol User Manual (Form A4199).*

7.3 USING HART WITH MODBUS PROTOCOL

Since all of the supported HART parameters also reside in the ROC memory, any parameter can be mapped to a Modbus register using the ROC Modbus Protocol. Any parameter can be read using mapping and can also be written to if the parameter has Write enabled. Accessing different data types (ASCII, Floating, Byte, Integer, Long) depends upon the Host system.

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APPENDIX A — SOFT POINT MAPPING

Table A-1. Soft Point Mapping

Soft Point	HART Device Data
Tag	Device Tag
Integer Flag	Update Flag
Data 1	Poll Method
Data 2	Update Counter
Data 3	Primary Variable / Primary Value
Data 4	Secondary Variable / Secondary Value
Data 5	Tertiary Variable / Tertiary Value
Data 6	4^{th} Variable / 4^{th} Value
Data 7	Slot 0 Variable
Data 8	Slot 1 Variable
Data 9	Slot 2 Variable
Data 10	Slot 3 Variable
Data 11	Slot 0 Assignment
Data 12	Slot 1 Assignment
Data 13	Slot 2 Assignment
Data 14	Slot 3 Assignment
Data 15	(Not used)
Data 16	(Not used)
Data 17	(Not used)
Data 18	(Not used)
Data 19	(Not used)
Data 20	(Not used)

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APPENDIX B — HART PARAMETERS

The following point types are added to the ROC Protocol when the HART program is used.

Table B-1. Point Type 30, Configure HART Point Parameters

Param Number	Read - Write	Data Type[1]	Char. Length	Description
0	R/W	UC	1	Point On/Off
1	R/W	UC	1	Single/Multiple
2	R/W	UC	1	Scan On/Off
3	R/W	UC	1	Input/Output
4	R/W	AC	10	Device Tag 1
5	R/W	AC	10	Device Tag 2
6	R/W	AC	10	Device Tag 3
7	R/W	AC	10	Device Tag 4
8	R/W	AC	10	Device Tag 5

[1]Data types are defined as follows:
AC - ASCII character
UC - Unsigned character

Table B-2. Point Type 31, Configure HART Device Parameters

Parameter Number	Read/Write	Data Type[1]	Char. Length	Description
0	R/W	UC	1	Update Flag
1	R/O	UC	1	HART Point Number
2	R/O	UC	1	Device Number
3	R/W	UC	1	Poll Method
4	R/W	UI	2	Update Counter
5	R/W	UC	1	Soft Point
6	R/W	AC	10	Device Tag
7	R/O	BN	1	Response Code / Command Response or Communications
8	R/O	BN	1	Device Status
9	R/O	BN	1	Alarm Code / Active Alarms

Parameter Number	Read/Write	Data Type[1]	Char. Length	Description
10	R/O	UC	1	Primary Variable / Primary Value Units
11	R/W	FL	4	Primary Variable / Primary Value (PV)
12	R/O	FL	4	Primary Current
13	R/O	FL	4	Polled PV in Manual Mode or PV Primary Percent
14	R/O	UC	1	Secondary Variable / Secondary Value Units
15	R/O	FL	4	Secondary Variable / Secondary Value
16	R/O	UC	1	Tertiary Variable / Tertiary Value Units
17	R/O	FL	4	Tertiary Variable / Tertiary Value
18	R/O	UC	1	4^{th} Variable / 4^{th} Value Units
19	R/O	FL	4	4^{th} Variable / 4^{th} Value
20	R/W	UC	1	Slot 0 Assignment / Variable Assignment
21	R/O	UC	1	Slot 0 Units
22	R/O	FL	4	Slot 0 Variable / Value
23	R/W	UC	1	Slot 1 Assignment / Variable Assignment
24	R/O	UC	1	Slot 1 Units
25	R/O	FL	4	Slot 1 Variable / Value
26	R/W	UC	1	Slot 2 Assignment / Variable Assignment
27	R/O	UC	1	Slot 2 Units
28	R/O	FL	4	Slot 2 Variable / Value
29	R/W	UC	1	Slot 3 Assignment / Variable Assignment
30	R/O	UC	1	Slot 3 Units
31	R/O	FL	4	Slot 3 Variable / Value
32	R/W	AC	40	Message
33	R/W	AC	20	Descriptor
34	R/O	HX2	2	Mfg / Manufacture's ID and Device ID
35	R/O	UC	1	Number Preambles
36	R/O	HX4	4	CMD,Doc,Sft,Hard Rev / Revision Levels
37	R/O	UC	1	Flags
38	R/O	UL	4	Identification Number / Device Serial No.
39	R/O	UL	4	Sensor Serial Number
40	R/O	UC	1	Sensor Units
41	R/O	FL	4	Upper Sensor Limit
42	R/O	FL	4	Lower Sensor Limit
43	R/O	FL	4	Sensor Minimum Span
44	R/O	UC	1	Output Units

Parameter Number	Read/Write	Data Type[1]	Char. Length	Description
45	R/W	FL	4	Upper Output Limit
46	R/W	FL	4	Lower Output Limit
47	R/O	FL	4	Damping Value
48	R/W	UC	1	Alarm Enable
49	R/W	FL	4	Low Alarm EU / Low Alarm
50	R/W	FL	4	High Alarm EU / High Alarm
51	R/W	FL	4	Low Low Alarm EU / LoLo Alarm
52	R/W	FL	4	High High Alarm EU / HiHi Alarm
53	R/W	FL	4	Rate Alarm EU / Rate Alarm
54	R/W	FL	4	Alarm Deadband

[1]Data types are defined as follows:

BN - Binary
AC - ASCII character
UC - Unsigned character
UI - Unsigned integer
UL - Unsigned long integer
FL - Floating point (IEEE format)
HX4 - Hex, 4 bytes
HX2 - Hex, 2 bytes

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If you have comments or questions regarding this manual, please direct them to your Fisher Representative or contact:

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