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Martel LC-110H Loop Calibrator and HART Communications/Diagnostics

Abstract

This white paper describes the basic functions of HART communications and the diagnostic capability of the Martel LC-110H mA (loop) calibrator.

Exactly what is HART Communication?

In layman's terms, the HART Communication Protocol is a digital signal that rides on top of the traditional 4-20mA analog signal. The digital signal consists of two frequencies that represent bits 1 and 0. The frequency is superimposed on the analog signal to provide simultaneous analog and digital communications.

What are the different commands?

There are three basic levels of HART commands Universal Commands, Common Practice Commands and Device Specific Commands, all described in more detail below.

1.) Universal Commands (All HART devices must recognize and support)

Universal commands are mainly read commands that let the user read the main device parameter: Some examples are:

- Poll HART devices for unique identifiers
- Read primary variables (PV) and units
- Read AO value and % of range
- Read transmitter range, units, and damping
- Read serial number and limits
- Read or write tag numbers and messages

2.) Common Practice Commands (Implemented by many manufacturers)

Common practice commands are a combination of read and write commands which are widely used in many HART devices. Some examples are:

- Read selection of up to four dynamic variables
- Write device range values (LRV, URV)
- Set fixed current output current
- Perform self-test
- Trim PV zero
- Trim DAC zero and gain
- Write sensor serial number
- Read or write dynamic variables
- Diagnostic functions

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3.) Device Specific Commands (Unique to the manufacturer Device Descriptor - DD)

These commands allow the user to drill down into the detailed operating parameters and functions of a specific HART device. Some examples are:

- Full calibration
- Read or write a density calibration factor
- Choose PV (mass, flow, or density)
- Sensor Trim Calibration
- Write PID Set Point and PID Enable
- Valve characterization
- Valve set point and travel limits
- Local display information
- Many, Many more commands depending on the complexity of the device.

So, what can the LC-110H do to facilitate the maintenance HART devices and loop calibration?

Traditionally a technician would normally use a loop calibrator to troubleshoot or calibrate an analog 4 to 20mA loop device. A loop calibrator can source current (4 to 20mA) into a SCADA system or local display to test the system and calibrate the loop (i.e. set 4mA to a “minimum” reading and 20mA to a “full scale” reading for a given loop). This is still the most common use for a loop calibrator today. However, over the years many of the devices that operate on a 4 to 20mA loop are now HART smart devices so in order to do a full loop test, or troubleshoot the loop, you need to carry an expensive (and somewhat complex) HART communicator as well as a loop calibrator.

This is the need that the LC-110H addresses. For the first time there is product that is as simple to use as a loop calibrator yet combines the communication functions needed to troubleshoot, do basic setup and trim the 4 to 20mA output of a HART transmitter. This powerful combination of functions allows the technician to do the following tasks:

- Calibrate a 4 to 20mA loop. The LC-110H can source and read 4 to 20mA as well as provide 24V power to a transmitter under test.
- Use advanced functions like auto-step/ramp, valve test to facilitate testing of specialized devices
- Download device configurations from the HART device and data log (record) the loop
- Communicate with HART devices by performing the most frequently used universal and common practice commands. Some of the commands include:
 - Trim DAC output (4 to 20mA)
 - Set fixed current output

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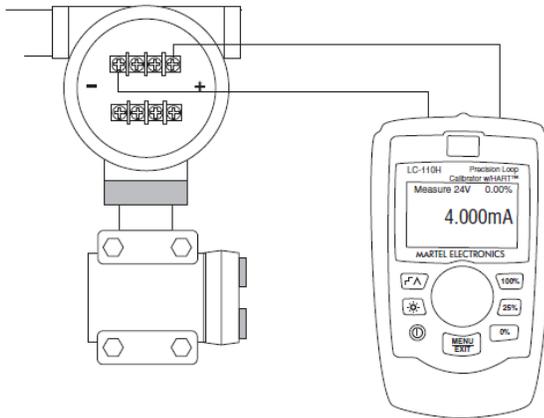
- Set LRV and URV
- Run self-diagnostic tests
- Zero the PV on pressure transmitters
- Read all device setup information
- *Write Short and Long Tag*
- *Write Descriptor and Message*
- *Select PV Unit*

New features added in firmware version 1.01 (Sept. 2013).

The LC-110H offers several simple and flexible connection options, including being able to troubleshoot and test HART devices used in Ex areas from the “safe” or control room side of the plant.

Figure 1 (Powering a transmitter while reading the mA)

In the mA Measure with 24V mode, the calibrator outputs 24VDC while displaying the loop current. The mode is useful for powering a transmitter without the need for a separate power supply.



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Figure 2 (In series with the loop with the internal 250Ω resistor on)

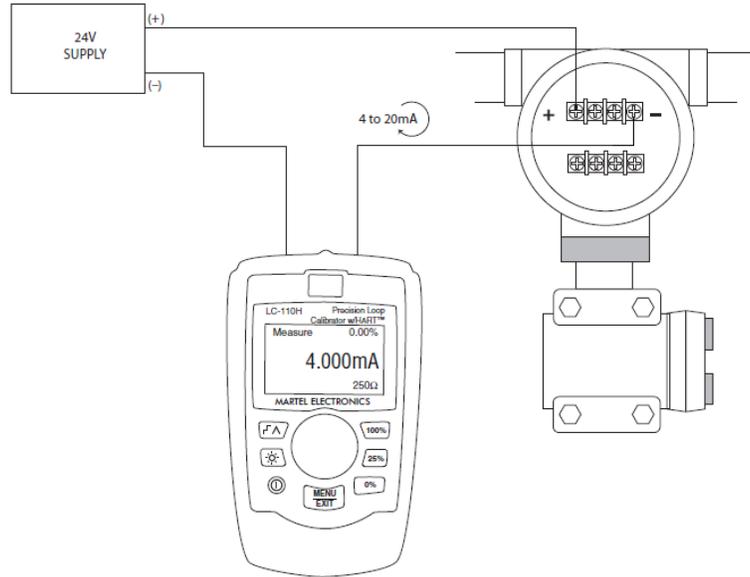
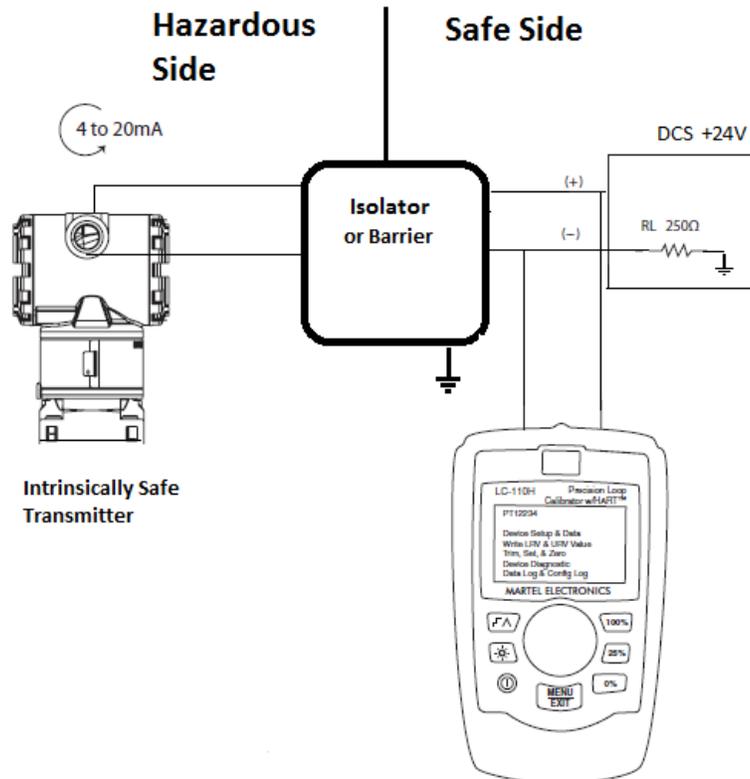


Figure 3 (HART Communicator Mode - Intrinsically Safe Barrier)



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What are the limitations of the LC-110H?

The LC-110H has the capability to perform several widely used Universal and Common Practice commands; however, it is not meant to replace a full featured HART calibrator or communicator. It does not support any of the Device Specific Commands. In order to execute device specific commands, the LC-110H would need to have a built in Device Description (DD) interpreter. These interpreters are found in the Fluke 754 or dedicated HART communicators.



LC-110H



Field Calibrator with HART Capability

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Frequently Asked Questions

- 1.) Do I need to update the firmware on my LC-110H in order to talk to newly released HART devices?

No. The LC-110H supports Universal and Common Practice commands in accordance with the HART 6 guidelines. If the device is registered to HART and follows the established guidelines, the LC-110H should always be able to establish communication.

- 2.) Do I need a separate 250Ω resistor to establish HART communications?

No. The LC-110H has a built in selectable resistor. Please make sure to follow the manual and take the proper steps to ensure safety when commissioning devices on a live loop.

- 3.) Can I use my LC-110H to download a configuration from a transmitter?

Yes. The LC-110H has the capability to download and store up to twenty transmitter configurations. Configurations then can be transferred over to the PC using the available BetaLOG HART Software and USB to Lemo cable.

- 4.) Can I use my LC-110H to clone a transmitter and upload the configuration to another unit?

No. The LC-110H currently does not have the capability to upload a configuration to a transmitter.

- 5.) Can I edit tags or select the primary variable (PV) with the LC-110H?

Yes. Firmware version 1.01 gives the user the ability to edit tags and select the PV for most HART enabled transmitters. If the manufacturer does not follow the HART guidelines or PV unit selection is handled within the DD, an error code will be displayed.

- 6.) Does the LC-110H allow me to view both the analog output and PV mA (digital reading) from the transmitter on the same screen?

Yes. In Data Log mode, the LC-110H will show you the two readings side by side on the screen. If you purchased the additional BetaLOG HART software, the data can be downloaded and saved as a .txt or .csv file. The date, time, LC-110H mA, PV mA, and four other variables will be downloaded. If the variables are not assigned in the transmitter, the default value is NONE.

J.M.D – 09/20/13

References:

HART Application Guide

HCF_LIT-039 Rev. 6.1 / September 20, 2011

Holladay, Kenneth L., "Using HART Protocol to Manage for Quality", ISA 1994 Paper