# Audio Monitor for HART® Communications, for HART Communicating FIELDVUE™ Instruments

The frequencies used for HART communications are in the audible range—you can hear them! The 1200 and 2200 Hz waveforms sound similar to the sounds you hear from a FAX machine's phone modem. This document outlines how to assemble a device to monitor these audible waveforms and a few suggestions on how to use it for troubleshooting. The audio monitor is shown in figure 1. The cable can also be used as an input to a cassette recorder if recordings of the HART messages are desired.

Figure 1. Audio Monitor for HART Communications
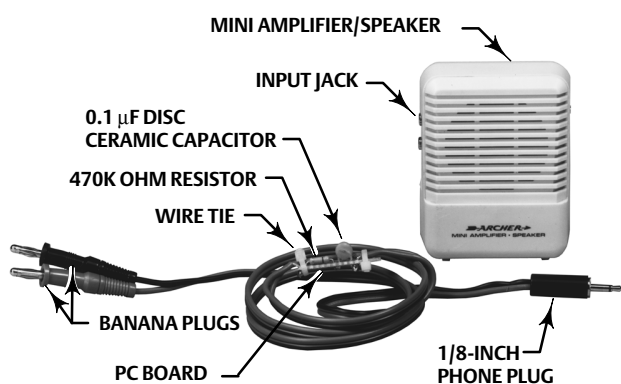
HART Protocol—A Little Background

The HART communication protocol has a "question-answer" format; the HART master asks a question and the HART slave answers back. The slave will not communicate unless a master first asks a question. With the audio monitor powered up and attached to a FIELDVUE instrument which is communicating with a 475/375 Field Communicator or a PC running ValveLink software or AMS Suite: Intelligent Device Manager, a series of "squawks" are heard. Often the pattern heard is "dot dot dash ...dot dot dash...dot dot dash..." that occur at intervals of about once a second with a slight pause in between. The first "dot" is the master asking the question and the remaining "dot dash" is the instrument's response.

It is possible to have two HART masters communicating simultaneously with one HART slave. This is done by having one master be "primary" and the second master be "secondary". The HART protocol provides time for each master to alternate making "question-answer" exchanges with the slave. The pattern heard would then be "dot dot dash dot dot dash dot dot dash dot dot dash" with no pauses in between exchanges. Assuming the communications are within HART waveform specifications, no communication errors should normally occur.

Some analog output circuits used to generate the 4 to 20 milliamp control signal are adversely affected by the HART communications waveforms. The usual result is that the impedance of the output circuit is substantially reduced

during communications. Good HART communications depend on the master device creating the waveform in a circuit where the load from the FIELDVUE instrument and the current source are roughly equal such that the signal is uniform throughout the loop. If the output circuit's impedance drops, the HART waveform is unevenly split (as in a voltage divider) and the signal received by the FIELDVUE instrument is reduced. The HART filter blocks the HART waveform from being detected by the analog output circuitry and prevents the source impedance from dropping.

Another thing to understand is the Field Communicator has a broadcasting mode called the "shout" mode. If it doesn't receive an answer to its initial "question", it will ask again with a larger signal strength. Demonstrate this by connecting the audio monitor to the Field Communicator without a FIELDVUE digital valve controller attached. Power on the Field Communicator and listen to the HART messages. The pattern will be something like this: "dot...dot...DOT...DOT...DOT" where the capitalization indicates the louder attempt.

# Troubleshooting Communications Problems with the Audio Monitor

Several HART communication problems can be identified with use of the audio monitor, a little knowledge of the HART protocol, and a little experience by the user in hearing differences between normal HART communications and faulty ones.

1. **No response by slave device**—Polling by a master device that is not answered by a slave device would sound like " dot...dot...dot..." and would continue for only a few times before the master device would display a message stating that no device was found. Corrective action would be to determine why slave is not communicating.

2. **Two masters of the same gender**—If two masters set to the same "gender" (primary or secondary) were trying to communicate with the same slave device, both would try to share their "half" of the bandwidth. The basic pattern would still be "dot dot dash ... dot dot dash..." as if there were only one master but there might be some distortion or extra characters as the messages overlap. The pause in the middle would still be present. The master device might suffer communications errors or stop updating its readback values while in conflict. Corrective action would be to have only one primary and/or one secondary HART master communicating at a time.

3. **Current loop might need a FIELDVUE HART filter**—To determine if a current loop needs a HART filter, configure ValveLink software as "primary" master and connect both it, a Field Communicator, and the audio monitor to a FIELDVUE instrument powered by the current loop in question. Start both masters communicating to the FIELDVUE instrument (something that keeps asking for information, such as displaying the status of the instrument condition information). Listen to the waveforms on the audio monitor. If there are no "Communication Errors" displayed on the masters and the pattern sounds like "dot dot dash dot dot dash dot dot dash dot dot dash", things are probably OK without a filter. If the pattern sounds like "dot dot dash DOT DOT DASH dot dot dash DOT DOT DASH" where one series is noticeably louder than the other or like "DOT DOT DASH...DOT DOT DASH..." where it sounds as if there is only one master, a HART filter should be tried and the test repeated. The louder sound or presence of only one master's messages where two should be present indicates that the Field Communicator is operating in the "shout" mode to overcome a poor HART circuit.

4. **Noise on the HART circuit**—If noise is present on the HART circuit, depending on the frequency, it can sound like clicks or static, tones which last for a period of time, or a wavering of the existing HART signal. Listen both while the HART messaging is occurring and while there is no HART communication (to sense the background noise). The main thing about listening to noise is that it is most likely random in nature but may be due to system layout, construction methods, or the unshielded operation of nearby equipment. For trouble shooting purposes, use the audio monitor before and after corrective action to reduce noise as a way to detect whether the change is beneficial.

Construction

Figure 2 is the circuit diagram for the audio monitor. Parts for constructing the audio monitor are listed under Parts List.

Figure 2. HART Communications Audio Monitor Circuit Diagram
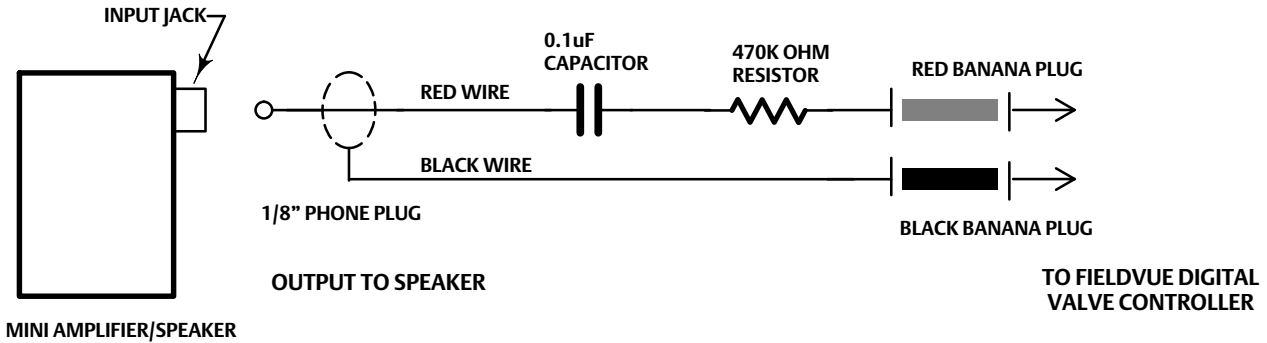
Cut the circuit board material down to approximate dimensions listed in the parts list. Solder the capacitor, resistor and input and output wires together on the circuit board. Secure the input and output wires to the circuit board with the wire ties. Cover the whole assembly with electrician's tape.

Allow about one foot of wire on the output side and attach the 1/8" phone plug (red wire to the center post, black wire to shield). On the input side allow about 3 feet of wire and attach the red banana plug to the red wire and the black banana plug to the black wire.

The 1/8" phone plug is connected to the input jack of the amplifier/speaker box. The banana plugs are either connected to the Field Communicator cable or are used with alligator clips or mini-grabber-style clips and connected to the "TALK +/-" terminals of the FIELDVUE instrument.

Parts List

Description	Quantity Required
Mini Amplifier/Speaker	1
0.1uF ceramic disc capacitor	1
470K ohm carbon resistor	1
General-purpose Component PC Board	0.5" x 1.75"

Description	Quantity Required
18AWG two-conductor stranded wire	4 feet approx
Banana plugs	1 pair
1/8" Phone Plug	1
Nylon wire ties, 4 inch long	2
Electrician's tape	as needed

Related Fisher Documents

DVC6200 and DVC6200 SIS

- DVC6200 Series Digital Valve Controller Quick Start Guide ([D103556X012](#))
- DVC6200 HW1 Digital Valve Controller Instruction Manual ([D103409X012](#))
- DVC6200 HW2 Digital Valve Controller Instruction Manual ([D103605X012](#))
- DVC6200 SIS Digital Valve Controller Instruction Manual ([D103557X012](#))

DVC6000 HW2

- DVC6005 Series Remove Mount Digital Valve Controller Quick Start Guide ([D103784X012](#))
- DVC6200 HW2 Digital Valve Controller Instruction Manual ([D103785X012](#))

DVC2000

- DVC2000 Digital Valve Controller Quick Start Guide ([D103203X012](#))
- DVC2000 Digital Valve Controller Instruction Manual ([D103176X012](#))

Miscellaneous

- HF340 Filter Instruction Manual ([D102796X012](#))
- LC340 Line Conditioner instruction manual ([D102797X012](#))

DLC3010

- DLC3010 Digital Level Controller Quick Start Guide ([D103214X012](#))
- DLC3010 Digital Level Controller Instruction Manual ([D102748X012](#))

DVC6000 and DVC6000 SIS (Supported)

- DVC6000 Digital Valve Controllers Instruction Manual ([D102794X012](#))
- DVC6000 SIS Digital Valve Controllers for Safety Instrumented System (SIS) Solutions Instruction Manual ([D103230X012](#))

Documents are available from your Emerson sales office, Local Business Partner, or at [Fisher.com](#).

Emerson Automation Solutions
Marshalltown, Iowa 50158 USA
Sorocaba, 18087 Brazil
Cernay, 68700 France
Dubai, United Arab Emirates
Singapore 128461 Singapore

www.Fisher.com

EMERSON™