Inlink-TC™
101-0016

Transformer Coupled HART® Protocol Modem Module for OEM Applications
April 2011

General Description

InLink-TC is a complete modem for Highway Address-able Remote Transducer (HART) communications. It allows designers to easily implement a HART compliant modem - without knowledge of the HART physical layer requirements. Although InLink-TC is intended to be used as a HART master, it is possible to use InLink-TC as a slave modem also. InLink-TC requires only three controller I/O pins; transmit data (TXD), receive data (RXD), and request to send (RTS). Power requirements are low enough to allow InLink to be powered directly from a microcontroller output pin. By connecting VDD to a controller output pin the modem can be effectively turned off, consuming zero power when not being used. Slave devices should keep the modem powered on, ready to receive.

InLink-TC is a complete modem solution, including transformer galvonic isolation to eliminate grounding and polarity issues. The carrier detect (CD) output provides indication that a HART signal is being received. When RTS is low, the modulator is selected. Data to be transmitted is shifted into the TXD pin at 1200 BAUD. The modem modulates the data as it is shifted in using phase continuous frequency shift keying (FSK) at Bell 202 shift frequencies of 1200Hz and 2200Hz. The transmitted waveform is shaped to meet the slew rate requirements of the HART protocol. Received data is filtered, demodulated, and converted to serial data and then shifted out on the RXD pin at 1200 BAUD. A high logic level RTS enables the demodulator for receiving. RTS low enables the modulator for transmitting.

HART® Protocol

The HART protocol is supported by the HART Communications Foundation, 9390 Research Blvd., Austin Texas 78759, USA. HART protocol specifications are available from the HART Communications Foundation.

Visit http://www.hartcomm.org for details.

Features

- Complies with HART Protocol Physical Layer
- Transformer Isolation Eliminate Grounding Effects and Polarity Issues
- Modem Module - Reduces Time-To-Market
- Small Footprint - Simplifies Design Integration
- Rugged Encapsulated Package with Gold Plated Pins for Increased Reliability
- Through-hole or Socket mounting
- Wide Supply Range (3.0V to 5.2V)
- Industrial Temperature Range, -40°C to +85°C
- Transmit Signal Wave-Shaping Sinusoidal Output with Lowest Harmonic Distortion
- Receive Band-Pass Filter
- CMOS Compatible
- Low Power
- Evaluation Board Available

Applications

- Conversion between other communications protocols and the HART physical layer
- Remote Data Logging
- SCADA Units with HART capabilities
- Flow Computers
- Fieldbus - HART Interfaces
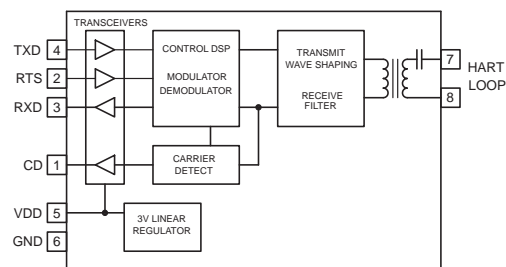- Wireless HART Interfaces
- HART Multiplexor

Block Diagram

Figure 1. InLink-TC Block Diagram

Microflex

Typical Application

The InLink application shown in Figure 2 is for an RS-232 to HART protocol interface master. The 9-pin female D connecter can be connected directly to a PC serial port and used with most HART configuration software. This is the same circuit used on the InLink evaluation board - Microflex part number 101-0003. The evaluation board uses a Sipex SP3223 RS-232 transceiver and can be used to evaluate the InLink-TC module over its full operating voltage range. Contact Microflex for additional information on the InLink evaluation board and software.
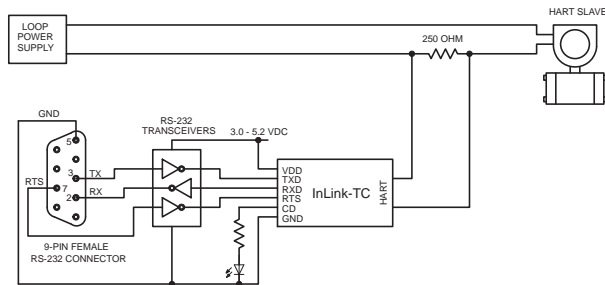

Figure 2. Typical Application RS-232 to HART Interface

Application Considerations

Power Considerations

The InLink-TC power supply, VDD, should be heavily filtered to prevent noise from interfering with the received HART data and receiver filter. VDD should have less than ±50mV P-P noise. Wait at least 10 milliseconds after power on before starting any HART transactions. InLink-TC includes an internal 3 volt linear regulator and bus transceivers for the communications and handshake control lines allowing InLink-TC to be used with a wide power supply range. Your logic levels should match the InLink VDD power supply.

Connecting to the HART Network

The HART protocol requires that a HART modem be coupled to the field device loop in a way that does not interfere with the current loop. InLink-TC includes the necessary components to simplify this. There is no need to consider polarity or ground issues between the HART network and the InLink ground. InLink provides the necessary isolation between the modem interface and the HART loop. In most cases the two HART pins can be connected directly to the HART loop in the same way that any other HART modem can be connected.

Pin Descriptions

1 - CD

Carrier Detect (CD) indicates when a valid HART signal is being received. CD is high when RTS is high (InLink in receive or demodulate mode) and four consecutive pulses of an amplitude greater than a nominal 100mV P-P are received over the HART interface. CD will stay high as long as valid pulses continue to be received in less than 2.5ms between pulses. Once CD goes inactive, it takes another 4 consecutive pulses to activate it again. Four pulses amount to 3.33 ms at 1200 Hz and 1.82 ms when receiving 2200 Hz.

2 - RTS

RTS is used to switch the modem between modulate mode, transmitting, and demodulate mode, receiving. A low level on RTS will activate the modulator. A high level on RTS will activate the demodulator.

3 - RXD

Received data is demodulated and shifted out serially on the RXD output. RXD will be high when receiving the 1200 Hz HART carrier, and low when receiving the 2200 Hz carrier. RXD is qualified internally with CD.

4 - TXD

TXD is the input to the InLink modulator. Data is shifted into the modem in a serial format at 1200 BAUD. When TXD is low, the modulated HART frequency is 2200 Hz. When TXD is high, the modulated HART frequency is 1200 Hz.

5 - VDD

This is the InLink-TC power input. To ensure a valid power on reset VDD should rise from 0V to 3V in less than 1ms. VDD should be between 3.0V and 5.2V and have less than 50mv P-P noise. Wait at least 10ms after power on before starting a HART transaction.

6 - GND

InLink-TC ground.

HART

These two pins are the HART protocol interface to the InLink-TC modem. The interface is transformer isolated and AC coupled. Follow the same loop connection requirements outlined for all HART masters when connecting InLink-TC to a HART loop.

Absolute Maximum Ratings

Supply Voltage   6.5V

DC Input, Output   -0.5 Min, V_{DD} + 0.3 Max

Storage Temp. Range-55°C to 150°C

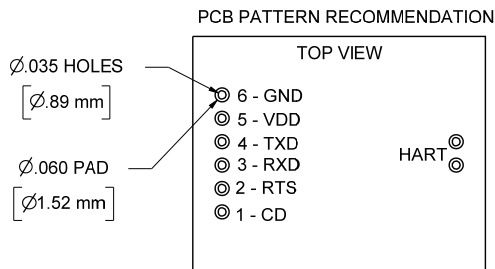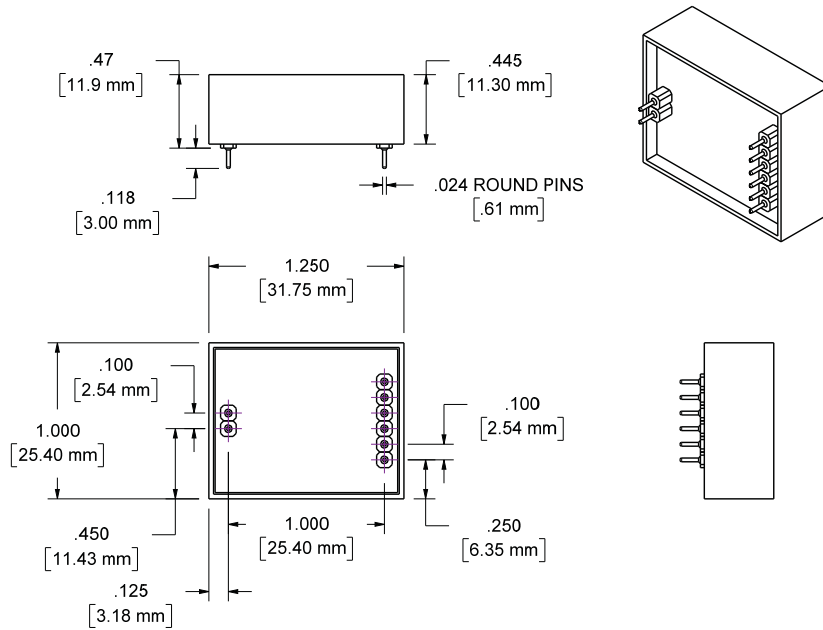## Operating Ratings

Supply Voltage   3.0V to 5.5V

Temperature Range   -40°C to 85°C

Cautions:

1. CMOS devices are damaged by high-energy electrostatic dishcarge. Modules must be stored in conductive foam or static bags.

2. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability and cause permanent damage to the module.

3. Remove power before insertion or removal of this module.

Symbol	Parameter	V_{DD}	Min.	Typ.	Max.	Units
V_{IL}	Input Voltage - Low	3.0-5.5			0.3 x VDD	V
V_{IH}	Input Voltage - High	3.0-5.5	0.7 x VDD			V
V_{OL}	Output Voltage - Low (IOL=2mA)	3.0-5.0			0.5	V
V_{OH}	Output Voltage - High (IOH=2mA)	3.3	2.4			V
V_{OH}	Output Voltage - High (IOH=2mA)	5.0	3.8			V
C_{IN}	Input Capacitance			2.9		pF
$I_{IL/IH}$	Input Leakage Current				±500	nA
I_{OLL}	Output Leakage Current				±10	µA
I_{DTX}	Power Supply Current Transmitting	3.0-5.5		1.85	2	mA
I_{DRX}	Power Supply Current Receiving	3.0-5.5		350	450	µA
	Demodulator Jitter			12		% of 1 bit
R_{PO}	Power On Reset			0.5	2	mS
CD_T	Carrier Detect Threshold	3.0-5.5	80	100	120	mV
	Power On Delay				10	mS

Physical Dimensions

.47
[11.9 mm]

.445
[11.30 mm]

.118
[3.00 mm]

.024 ROUND PINS
[.61 mm]

1.250
[31.75 mm]

.100
[2.54 mm]

1.000
[25.40 mm]

.100
[2.54 mm]

.450
[11.43 mm]

1.000
[25.40 mm]

.250
[6.35 mm]

.125
[3.18 mm]

PCB PATTERN RECOMMENDATION

∅.035 HOLES
[∅.89 mm]

∅.060 PAD
[∅1.52 mm]

TOP VIEW

6 - GND
5 - VDD
4 - TXD
3 - RXD
2 - RTS
1 - CD

HART

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