113-0002

InLink™

HART® Protocol Modem Module for OEM Applications

June 2004

General Description

InLink is a complete modem for Highway Addressable Remote Transducer (HART) communications. It allows designers to easily implement a HART compliant modem - without knowledge of the HART physical layer requirements. Although InLink is intended to be used as a HART master, it is possible to use InLink as a slave modem. InLink requires only three controller I/O pins; transmit data (TXD), receive data (RXD), and request to send (RXD). 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.

InLink is a complete modem solution, including transformer isolation and capacitor coupling, eliminating 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. NRZ data to be Transmitted is shifted into the TXD pin at 1200 BAUD. The modem modulates the data 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 NRZ data at 1200 BAUD, then shifted out on the RXD pin. A high logic level RTS enables the demodulator for receiving. RTS low enables the modulator for transmitting.

The HART protocol is supported by the HART Communications Foundation, 9390 Research Blvd., Austin Texas 78759, USA, http://www.hartcomm.org.

Features

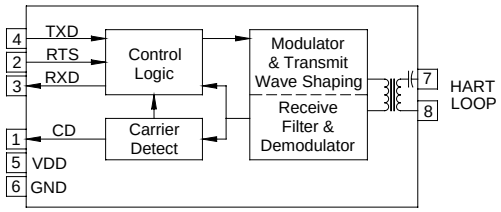
- *Complies with HART Protocol Physical Layer*
- *Transformer Isolation and Capacitor Coupling Eliminate Grounding Effects and Polarity Issues*
- *Modem Module - Reduces Time-To-Market*
- *Small Footprint - Simplifies Design Integration*
- *Rugged Encapsulated Package with Gold Plated Pins for Increased Reliability*
- *Through-hole or Socket mounting*
- *3.3V Power Supply*
- *Industrial Temperature Range, -40°C to +85°C*
- *Transmit Signal Wave-Shaping*
- *Receive Band-Pass Filter*
- *CMOS Compatible*
- *Super Low Power, 450uA at 3.3V typical*
- *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

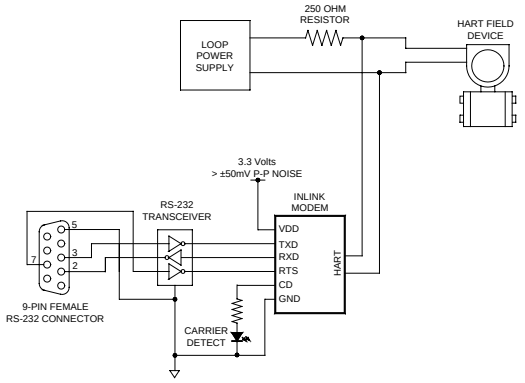
Figure 1. *InLink Block Diagram*



Typical Application

The InLink application shown in Fiqure 2 is for an RS-232 to HART protocol interface. The 9-pin female D connecter can be connected directly to a PC serial port and used with most HART configuration software. This is basically the same circuit used on the InLink evaluation board. Microflex part number 101-0003. The evaluation board uses a Sipex SP3223 RS-232 transceiver. The SP3223 has a supply range of 3.0V to 5.5V but when used with the InLink the power supply should be set to 3.3V. Contact Microflex for additional information on the InLink evaluation board and software.

Figure 2. *Typical Application*
RS-232 to HART Interface



Functional Description

Power Considerations

The InLink 3.3V power supply, VDD, should be heavily filtered to prevent noise from interfering with the received HART data. VDD should have less than ±50mV of noise. *RTS must be held high during power-on to allow Inlink to cycle through its internal power-on reset (2 milliseconds or longer).* After reset, RTS is used to switch between the modulator (RTS low) or demodulator (RTS high). Wait at least 50 milliseconds after power on before starting any HART transactions.

Connecting to the HART Network

A HART modem must be coupled to the field device loop in a way that does not interfere with the current loop. InLink 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 issolation between the modem interface and the HART loop.

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. RTS must be high during the power on reset sequence.

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 NRZ format. 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 power input. To ensure a valid power on reset VDD should rise from 0V to 2.5V in less than 1ms. VDD should be between 3V and 3.8V and have less than 50mv P-P noise. Wait at least 50ms after power on before starting a HART transaction.

6 - GND

This is the InLink ground.

HART

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

Absolute Maximum Ratings

Supply Voltage	5.5V
DC Input, Output	-0.3 Min, V_{DD} + 0.3 Max
Storage Temp. Range	-55°C to 150°C

Operating Ratings

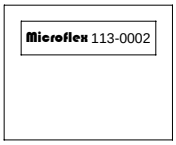
Supply Voltage	3.0V to 5.5V
Temperature Range	-40°C to 85°C

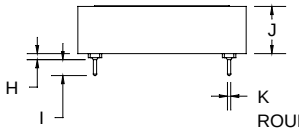
Cautions:

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.

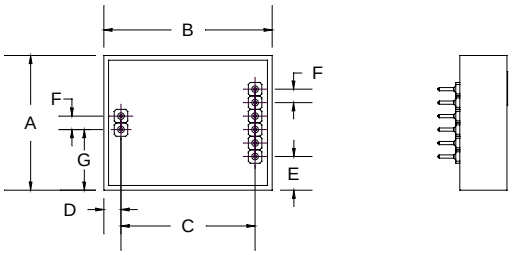
Symbol	Parameter	V_{DD}	Min.	Typ.	Max.	Units
V_{IL}	Input Voltage - Low	3.0-3.8			0.3*VDD	V
V_{IH}	Input Voltage - High	3.0-3.8	0.7*VDD			V
V_{OL}	Output Voltage - Low (IOL=0.67mA)	3.0-3.8			0.4	V
V_{OH}	Output Voltage - High (IOH=0.67mA)	3.0-3.8	2.4			V
C_{IN}	Input Capacitance			2.9		pF
$I_{IL/IH}$	Input Leakage Current				±500	nA
I_{OLL}	Output Leakage Current				±10	µA
I_{DD}	Power Supply Current	3.3		450		µA
	Demodulator Jitter			12		% of 1 bit
R_{PO}	Power On Reset			0.5	2	mS
CD_T	Carrier Detect Threshold	3.3	80	100	120	mV
	Power On Delay				50	mS

Physical Dimensions





DIM	Inches	mm	
A	1.000	25.40	
B	1.250	31.75	
C	1.000	25.40	
D	0.125	3.18	
E	0.250	6.35	
F	0.100	2.54	
G	0.450	11.43	
H	0.045	1.14	
I	0.118	3.00	
J	0.350	8.89	
K	0.024	0.61	
L	Ø.035	Ø.90	DRILL DIA.
	Ø.060	Ø.153	PAD DIA.



PCB PATTERN RECOMMENDATION