Allen-Bradley

Enwatch

Installation Guide

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.ab.com/manuals/gi) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc. is prohibited.

Throughout this manual we use notes to make you aware of safety considerations.

WARNING

Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid a hazard
- recognize the consequence

SHOCK HAZARD

Labels may be located on or inside the drive to alert people that dangerous voltage may be present.

BURN HAZARD

Labels may be located on or inside the drive to alert people that surfaces may be dangerous temperatures.

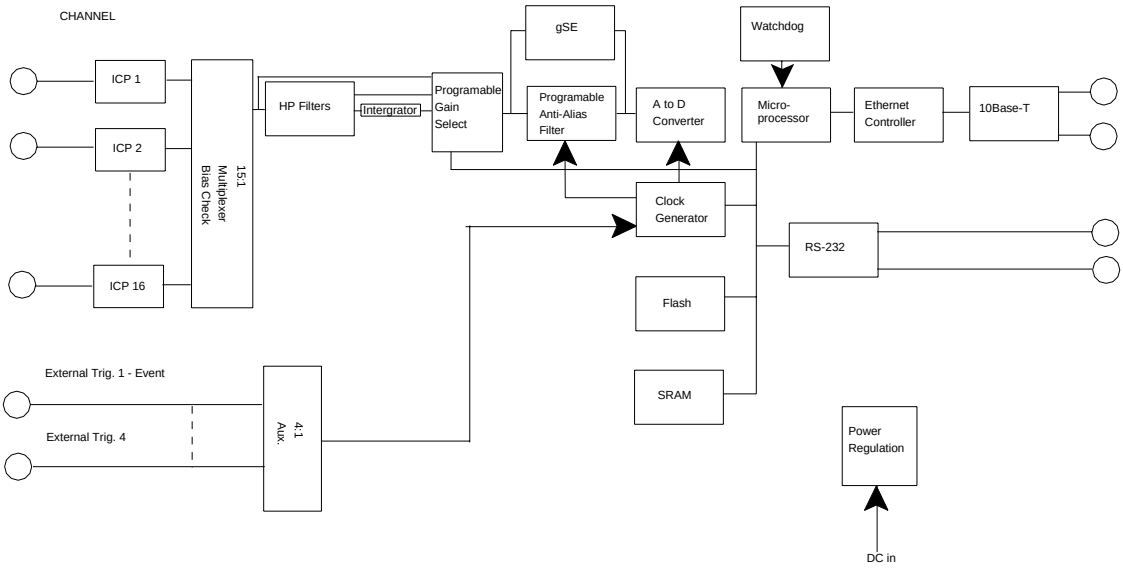
Installing the Enwatch

This manual introduces you to the Allen Bradley Enwatch® unit. The manual is intended for anyone who installs, tests, or configures the Enwatch hardware. It does not cover using the Enwatch unit to collect data. For information on collecting data with the Enwatch unit, refer to the *Online Applications Guide* provided with your Emonitor® online system.

Introduction

Enwatch is a distributed network system providing 16 channels of analog inputs together with 4 trigger channels. The unit includes signal conditioning and analog to digital conversion. It allows you to connect 16 two-wire ICP or other sensors into your Emonitor Online system. Each Enwatch unit is a microprocessor-based system, complete with network controller that carries out data acquisition tasks as directed by an Emonitor unload station. A typical diagram for an Enwatch unit is shown in Figure 1.1, below.

Figure 1.1 Enwatch diagram



The Enwatch unit responds to all relevant network data exchanges as defined by the Ethernet protocol using the UDP/IP standard. In addition, there is a comprehensive on-board monitor program that can exercise all functions via the on-board serial RS232 port.

Installation

The Enwatch unit is easy to install. The enclosure is mounted using four screws. Cables are terminated on removable screw terminal blocks, making installation and service simple. Network cables are terminated on the board using a a standard RJ-45 connector.

Each Enwatch board has four status LEDs to monitor system activity. In the unlikely event of a system problem, a portable PC can be used to diagnose the problem using the RS-232 serial interface on each Enwatch board.

Prior to installation, the only set-up required is to assign an IP address, Subnet Mask, and Gateway IP address (if available) to the node. This must be a unique address on the network. You assign the IP address by connecting a terminal (or PC in terminal mode) to the on-board RS-232 port and using the on-board monitor program. See "Setting Up an Enwatch Unit" on page 11 for more information.

Electrical

The circuit board is a completely self-contained 16-channel analog input to Ethernet interface, including power regulation and local communication facilities. A block diagram of the board is shown in Figure 1.1 on page 1. Each block of the diagram is described below.

- **ICP interface -** Each of the 16 channels has its own ICP interface that is capable of powering a typical two-wire ICP transducer. The nominal voltage is 24 V with a constant current of 3.6 mA. A typical transducer has a bias voltage value of around 11 V, so that the system can accommodate a full ±10V input range. The ICP interface can be disabled for AC and DC coupling of voltage signals.
- **Multiplexer -** The multiplexer circuit selects one of the 16 input channels under software control. All inputs are over-voltage and ESD protected.
- **High pass filters -** Four software-programmable high-pass filters (0.36 Hz, 2.67 Hz, 5.3 Hz, and 23.8 Hz) are available to remove unwanted low frequency signals.
- **Integrator -** An on-board hardware integrator is available for getting a velocity measurement from an accelerometer, as well as displacement from a velocity sensor. The host software can perform a second level of integration if required.
- **Spike Energy™ function (gSE™) -** gSE provides a conditioned signal suitable for measurement of bearing condition.
- **Anti-aliasing filter -** This filter removes high-frequency components from the incoming analog signal that might alias back into the sampled signal, resulting in incorrect data in the spectrum. The filter has a very high roll-off and removes all alias effects in standard sampling/spectral analysis applications.

- **Analog-to-digital converter (ADC) -** The ADC samples up to 51.2 kHz and has 16-bit resolution, providing a theoretical dynamic range of 96 dB.
- **Clock generator -** The timer varies the sampling rate under microprocessor control. Sampling can be synchronized to one of 4 external triggers (typically a once-per-rev TTL signal from a rotating shaft). This system can also take a preprogrammed number of samples per revolution. The external trigger acts as a tachometer to determine shaft speed. Pre and post-trigger functions are available.
- **Gain amplifier -** The Enwatch unit automatically sets the input gain in auto-range mode as each channel is selected by the multiplexer.
- **Microprocessor subsystem -** This comprises the microprocessor, flash memory, and SRAM memory. The microprocessor controls the Enwatch unit under instructions stored in the flash memory. The SRAM memory acts as a temporary data storage area if buffering is required before data is transferred over the network.
- **Watchdog -** The microprocessor subsystem incorporates a watchdog facility that, if a power glitch or other external effect interrupts the system, automatically resets without the need for user intervention.
- **Ethernet controller/buffer memory/10Base-T -** These functions control data transfer over the Ethernet network. The system uses the UDP/IP standard protocol and implements 10 Base-T as the physical network layer.
- **Power regulation** - Input DC power is derived from an AC to DC converter (not shown in Figure 1.1) and the Power Regulation function provides the secondary DC voltages as required.

Mechanical

The Enwatch unit is comprised of a single circuit board housed in a sealed (IP 66) enclosure. Each system has its own self-contained power supply, and terminals for the input, power, tachometer, and network cables.

Rockwell Automation Support

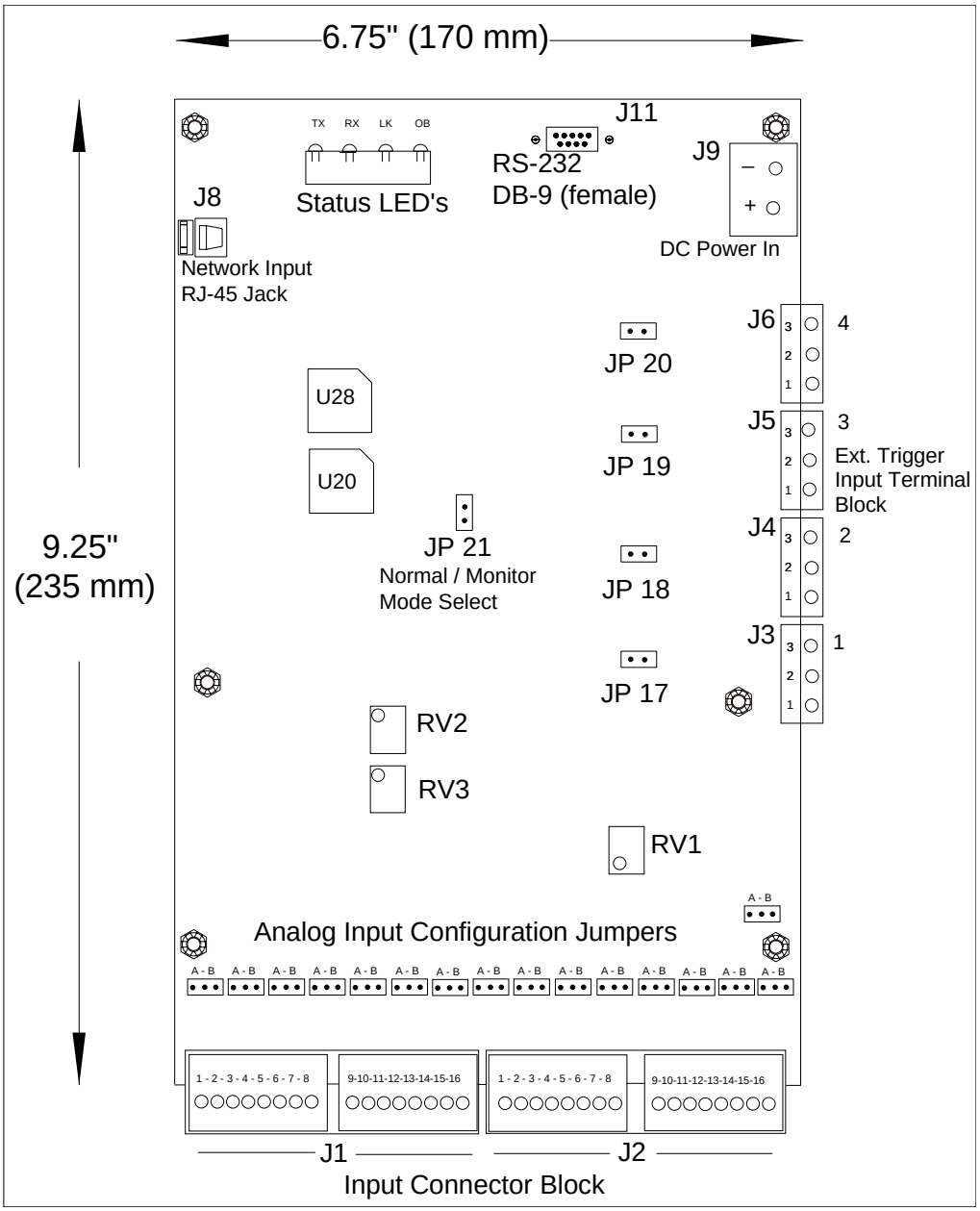
Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://support.rockwellautomation.com.

Electrical Connections

This section describes the electrical connections on the Enwatch board, shown in Figure 1.2, below.

Figure 1.2 Enwatch electrical connections



Connectors

The Enwatch unit has 11 connectors labeled J1 to J11 as shown in Table 1.1.

Table 1.1 Enwatch connectors

Connector	No. of Pins	Function
J1	16	Analog input channels 1–8
J2	16	Analog input channels 9–16
J3	3	External trigger 1 / event 1
J4	3	External trigger 2 / event 2
J5	3	External trigger 3
J6	3	External trigger 4
J7	5	Test points (service use only)
J8	8	Ethernet interface
J9	2	Supply voltage
J10	2	Spare
J11	9	Serial port (RS-232)

The location of the connectors is shown in Figure 1.2 on page 4. The pin outputs are listed in the following tables.

Table 1.2 J1 and J2 pin outputs

J1: Analog Inputs 1-8		J2: Analog Inputs 9-16	
Signal	**Pin No**	**Signal**	**Pin No.**
CH 1 input CH 1 ground	1 2	CH 9 input CH 9 ground	1 2
CH 2 input CH 2 ground	3 4	CH 10 input CH 10 ground	3 4
CH 3 input CH 3 ground	5 6	CH 11 input CH 11 ground	5 6
CH 4 input CH 4 ground	7 8	CH 12 input CH 12 ground	7 8
CH 5 input CH 5 ground	9 10	CH 13 input CH 13 ground	9 10
CH 6 input CH 6 ground	11 12	CH 14 input CH 14 ground	11 12
CH 7 input CH 7 ground	13 14	CH 15 input CH 15 ground	13 14
CH 8 input CH 8 ground	15 16	CH 16 input CH 16 ground	15 16

Table 1.3 J3 External trigger pin outputs

Signal	Pin No.	Notes
Power supply	1	See note 1 on page 7.
Input	2	See note 2 on page 7.
Ground	3	

Table 1.4 J4 External trigger pin outputs

Signal	Pin No.	Notes
Power supply	1	See note 1 on page 7.
Input	2	See note 2 on page 7.
Ground	3	

Table 1.5 J5 External trigger pin outs

Signal	Pin No.	Notes
Power supply	1	See note 1 on page 7.
Input	2	See note 2 on page 7.
Ground	3	

Table 1.6 J6 External trigger pin outputs

Signal	Pin No.	Notes
Power supply	1	See note 1 on page 7.
Input	2	See note 2 on page 7.
Ground	3	

Table 1.7 J8 Ethernet connection pin outputs

Common	RJ-45

Table 1.8 J9 Supply voltage pin outputs

Signal	Pin No.
Positive supply voltage	+
Common	-

Table 1.9 J10 pin outputs

Not user accessible

Table 1.10 J11 Serial port (RS-232) pin outputs

Signal	Pin No.	Notes
TXD	1	To connect to a host computer, use a null modem 9-pin female to 9-pin female cable.
RXD	2	
Ground	3	

Notes:

1. A supply voltage is available on pin 1 of the connector to power an external trigger device. The voltage is equal to the voltage of the incoming power supply to the board (on connector J9).

2. The external trigger is compatible with a CMOS/TTL logic level (5 V logic). Alternatively, any voltage input in the range 5 to 24 V can be accommodated. The trigger can be isolated or non-isolated.

Analog Input Configuration

The 16 analog inputs provide you three options for signal coupling using a 3-way configurable jumper. The three positions are described in Table 1.11.

Table 1.11 Analog input options

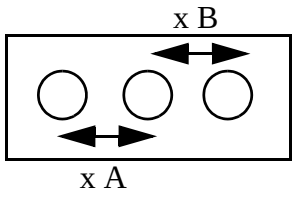
Position	Description
ICP	Interface (nominal 24 V supply at 3.6 mA constant current for transducer powering)
DC	DC coupled
AC	AC coupled

Each channel (16 total) has a 3-way header associated with it. These are labeled with the channel number and "A" or "B." The three jumper options are:

- Fitted to position xA
- Fitted to position xB
- Not fitted

where x is the channel number 1-16.

Position	Coupling
x A	ICP
x B	DC Coupled
Not Fitted	AC Coupled



IMPORTANT The -3dB point of the high-pass coupling for the ICP interface and AC Coupled configuration is 0.07 Hz.

LEDs

Four LEDs, as shown in Figure 1.2 on page 4, indicate the status of the Ethernet communication. These illuminate as described in Table 1.12.

Table 1.12 LEDs

LED	Description
OB	The Enwatch unit is accessing LAN controller
LK	Communication link is established between Enwatch unit and network
RX	Data is being received
TX	Data is being transmitted

Trigger Isolation Jumpers

Four jumpers, JP17 to JP20, are sited on the board to enable the four trigger inputs to be isolated or non-isolated. Non-isolated means the common of the trigger input can be connected to the common of the Enwatch unit. With a jumper removed, the trigger is isolated. Table 1.13 summarizes the jumper positions.

Table 1.13 Jumper positions

Mode	Jumper
External trigger 1 isolated	JP17 Out
External trigger 1 non-isolated	JP 17 In
External trigger 2 isolated	JP18 Out
External trigger 2 non-isolated	JP18 In
External trigger 3 isolated	JP19 Out
External trigger 3 non-isolated	JP19 In
External trigger 4 isolated	JP20 Out
External trigger 4 non-isolated	JP20 In

IMPORTANT If an external sensor is to be used that is powered from pin 1 of J3, J4, J5 or J6, then the jumper corresponding to the trigger channel must be inserted to provide a ground return path for the sensor power.

Normal Operation versus Monitor Mode

The Enwatch unit incorporates an on-board monitor program for checking the unit and modifying the system's IP address. Inserting a jumper in JP21 enters into monitor mode.

Table 1.14 Normal vs. monitor mode

Mode	Jumper J21
Normal	Out
Monitor	In

Serial Port (RS-232)

An RS-232 compatible serial port is available on connector J11 for providing local communication with the board (independent of the Ethernet network). Only RXD and TXD lines are supported, and so a null modem cable must be used. An on-board software monitor is provided to communicate through the serial port.

If you do not use a 9-pin female to female null modem cable, the recommended cable connection to a PC is shown in Table 1.15.

Table 1.15 J11 cable connections

J11	9-Pin D-Shell Connector
1	2
2	3
3	5

Supply Voltage

Incoming supply voltage to the power supply is 80 to 240 VAC / 50 or 60 Hz. The power supply should be rated for a minimum of 1 A. If you have an ISSUE F board, set the AC to DC power supply output voltage to 9 VDC. All ISSUE G boards and higher, require a 24 VDC power supply. The power supply that comes with the ISSUE G boards is pre set to 24 VDC and should not be adjusted.

WARNING

Never attempt to connect the ISSUE F board to a 24V power supply as doing this will damage the board. Always ensure you have the proper power supply for the board ISSUE you are using. The 24VDC power supply for ISSUE G and higher boards has a yellow label that is marked 24VDC. The 12VDC power supply for ISSUE F boards has a blue label that is marked 12VDC.

TIP

The ISSUE letter is located on the board. ISSUE F is located at the bottom edge of the board near the J2 connector. See Figure 1.2 on page 4.

The ISSUE letter for ISSUE G and higher boards is located in the upper left corner of the board, near the J8 connector.

Flash Memory

If it is necessary to change the firmware, the flash memory is located in position U20 and U28 (see Figure 1.2 on page 4). This flash memory is socket mounted to allow you to change the EPROM. Make sure that the orientation of the chip is correct when installing.

On Board Monitor

When you insert a jumper into JP21, the Enwatch unit operates in its internal monitor mode. This enables you to change the IP address as well as modify other options. To invoke monitor mode, connect a terminal (or PC computer in terminal mode) to the serial port and insert a jumper at position JP21. Remove the power and then reconnect the power to reset the unit. A sign-on message appears on the terminal together with a list of options (described in "Setting Up an Enwatch Unit", below).

To exit monitor mode, simply remove the jumper at position JP21, then remove and reconnect the power to reset the unit.

Setting Up an Enwatch Unit

Before installation, make sure you have plant specific IP network addresses available for each Enwatch unit. For convenience write them down here.

IP Address 1: _____ IP Address 6: _____

IP Address 2: _____ IP Address 7: _____

IP Address 3: _____ IP Address 8: _____

IP Address 4: _____ IP Address 9: _____

IP Address 5: _____ IP Address 10: _____

You should also know the Subnet Mask and Gateway IP address (if available) for each Enwatch unit.

1. Attach the Enwatch unit to the test computer via the RS-232 (serial) port using a null modem cable.

2. Make sure the jumper in the middle of the Enwatch unit board is inserted (JP21).

3. Start up any terminal program (Winterm, QVT/Term, Procomm, etc.…) and set it up to communicate through the serial port at 9600 Baud, No parity, 8 data bits, and 1 stop bit.

4. Turn on the Enwatch unit. It should display its configuration, then a configuration menu in the terminal window.

```
---------- Start monitor com port: COM1  9600   N81
Intelligent Transducer Adapter Type 1) V 1.2
Copyright Icon Research Ltd 1998/99
Main Menu:
1 - Exercise Hardware Control
2 - Exercise Memory Devices
3 - Exercise Ethernet Controller
4 - Exercise Combined Sub-Systems
5 - Configure Adapter Settings
6 - Enter Download Mode
Make your selection (1-6) : 5
```

5. Select **5- Configure Adapter Settings**.

```
Intelligent Transducer Adapter Type 1) V 1.2
Copyright Icon Research Ltd 1998/99
Configure Adapter Menu:
1   - Default Settings
2   - Assign Host MAC
3   - Assign Host IP
4   - Assign Host UDP Port
5   - Assign Subnet Mask
6   - Assign Gateway IP
7   - Assign Name
8   - Assign Network Option
9   - Assign Debug Level
ESC - Back to Main Menu
```

6. Select **2 - Assign Host MAC**, and set it to the MAC address from the board by pressing **ESC**.

```
Intelligent Transducer Adapter Type 1) V 1.2
Copyright Icon Research Ltd 1998/99
Configure Adapter Menu:
1   - Default Settings
2   - Assign Host MAC
3   - Assign Host IP
4   - Assign Host UDP Port
5   - Assign Subnet Mask
6   - Assign Gateway IP
7   - Assign Name
8   - Assign Network Option
9   - Assign Debug Level
ESC - Back to Main Menu
Make your selection (1-9) : 2
Assigning Host MAC
Current Host MAC : 00-50-C2-02-00-01
Enter New Address or ESC to abandon :
Aborted Input - Host MAC unchanged
```

7. Select **3 - Assign Host IP**, and set your Enwatch unit to one of your plant specific IP addresses.

```
Intelligent Transducer Adapter Type 1) V 1.2
Copyright Icon Research Ltd 1998/99
Configure Adapter Menu:
1   - Default Settings
2   - Assign Host MAC
3   - Assign Host IP
4   - Assign Host UDP Port
5   - Assign Subnet Mask
6   - Assign Gateway IP
7   - Assign Name
8   - Assign Network Option
9   - Assign Debug Level
ESC - Back to Main Menu
Make your selection (1-9) : 3
Assigning Host IP
Current Host IP : 200.100.200.100
Enter New Address or ESC to abandon :
```

8. Select **4 - Assign Host UDP Port**, and set it to 4242. This is the default port number and cannot be any other number.

```
Intelligent Transducer Adapter Type 1) V 1.2
Copyright Icon Research Ltd 1998/99
Configure Adapter Menu:
1   - Default Settings
2   - Assign Host MAC
3   - Assign Host IP
4   - Assign Host UDP Port
5   - Assign Subnet Mask
6   - Assign Gateway IP
7   - Assign Name
8   - Assign Network Option
9   - Assign Debug Level
ESC - Back to Main Menu
Make your selection (1-9) : 4
Assigning Host UDP Port
Current Host UDP Port           : 4242
Enter New Port or ESC to abandon :
```

9. Select **5 - Assign Subnet Mask**, and set it to the number obtained from the IT department. Normally it is 255.255.255.000

```
Intelligent Transducer Adapter Type 1) V 1.2
Copyright Icon Research Ltd 1998/99
Configure Adapter Menu:
1   - Default Settings
2   - Assign Host MAC
3   - Assign Host IP
4   - Assign Host UDP Port
5   - Assign Subnet Mask
6   - Assign Gateway IP
7   - Assign Name
8   - Assign Network Option
9   - Assign Debug Level
ESC - Back to Main Menu
Make your selection (1-9) : 5
Assigning Subnet Mask
Current Subnet Mask                 : 255.255.255.000
Enter New Address or ESC to abandon :
```

10. Select **6 - Assign Gateway IP**, and set it to the number obtained from the IT department.

```
Intelligent Transducer Adapter Type 1) V 1.2
Copyright Icon Research Ltd 1998/99
Configure Adapter Menu:
1   - Default Settings
2   - Assign Host MAC
3   - Assign Host IP
4   - Assign Host UDP Port
5   - Assign Subnet Mask
6   - Assign Gateway IP
7   - Assign Name
8   - Assign Network Option
9   - Assign Debug Level
ESC - Back to Main Menu
Make your selection (1-9) : 6
Assigning Gateway IP
Current Gateway IP                  : 255.255.255.255
Enter New Address or ESC to abandon :
```

11. Select **8 - Assign Network Option**, and set it to the 10 Base T Port.

```
Intelligent Transducer Adapter Type 1) V 1.2
Copyright Icon Research Ltd 1998/99
Configure Adapter Menu:
1   - Default Settings
2   - Assign Host MAC
3   - Assign Host IP
4   - Assign Host UDP Port
5   - Assign Subnet Mask
6   - Assign Gateway IP
7   - Assign Name
8   - Assign Network Option
9   - Assign Debug Level
ESC - Back to Main Menu
Make your selection (1-9) : 8
Assigning Network Option
Currently using Ethernet 10 Base T Port
Network Options Available:
1 : Ethernet 10 Base T
2 : Ethernet 10 Base 2
Enter New Network or ESC to abandon :
```

12. Select **9 - Assign Debug Level**, and set it to OFF unless you want to see the debug messages from the Enwatch unit.

```
Intelligent Transducer Adapter Type 1) V 1.2
Copyright Icon Research Ltd 1998/99
Configure Adapter Menu:
1   - Default Settings
2   - Assign Host MAC
3   - Assign Host IP
4   - Assign Host UDP Port
5   - Assign Subnet Mask
6   - Assign Gateway IP
7   - Assign Name
8   - Assign Network Option
9   - Assign Debug Level
ESC - Back to Main Menu
Make your selection (1-9) : 9
Assigning Debug Level
Debug Options Available:
0 : Off
1 : Basic System Sampling & Message Processing
2 : (1) + Full Rx & Tx Message Display
3 : (2) + Interrupt Firing Notifications
Debug Level 1 Currently Set
Enter New Debug Level or ESC to abandon :
```

13. Shut down the Enwatch unit by removing the AC power, and turn it back on. Look at the configuration settings and make sure the MAC and IP address are correct.

14. Shut down the Enwatch unit by removing the AC power, then remove the jumper in the center of the board (JP21) and connect the board to an active Ethernet connection. You do not have to disconnect the RS-232 port.

15. Open a DOS prompt on a networked computer. Type `ping,` then a space, and then the first IP address.

EXAMPLE ping 200.100.200.100

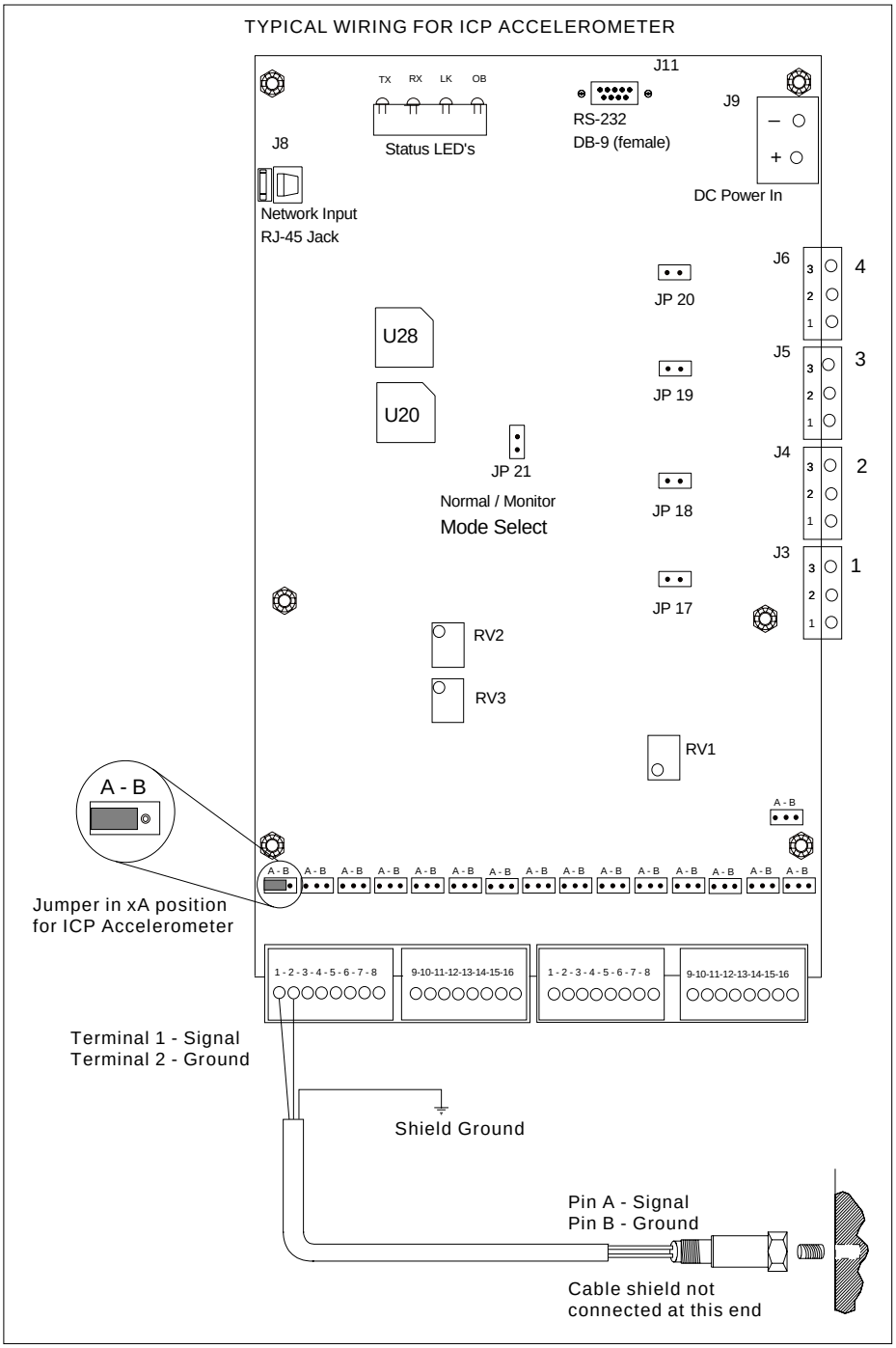
16. You should get a return response from the Enwatch unit.

Connecting Transducers

The following sections show how to connect transducers to the Enwatch terminals.

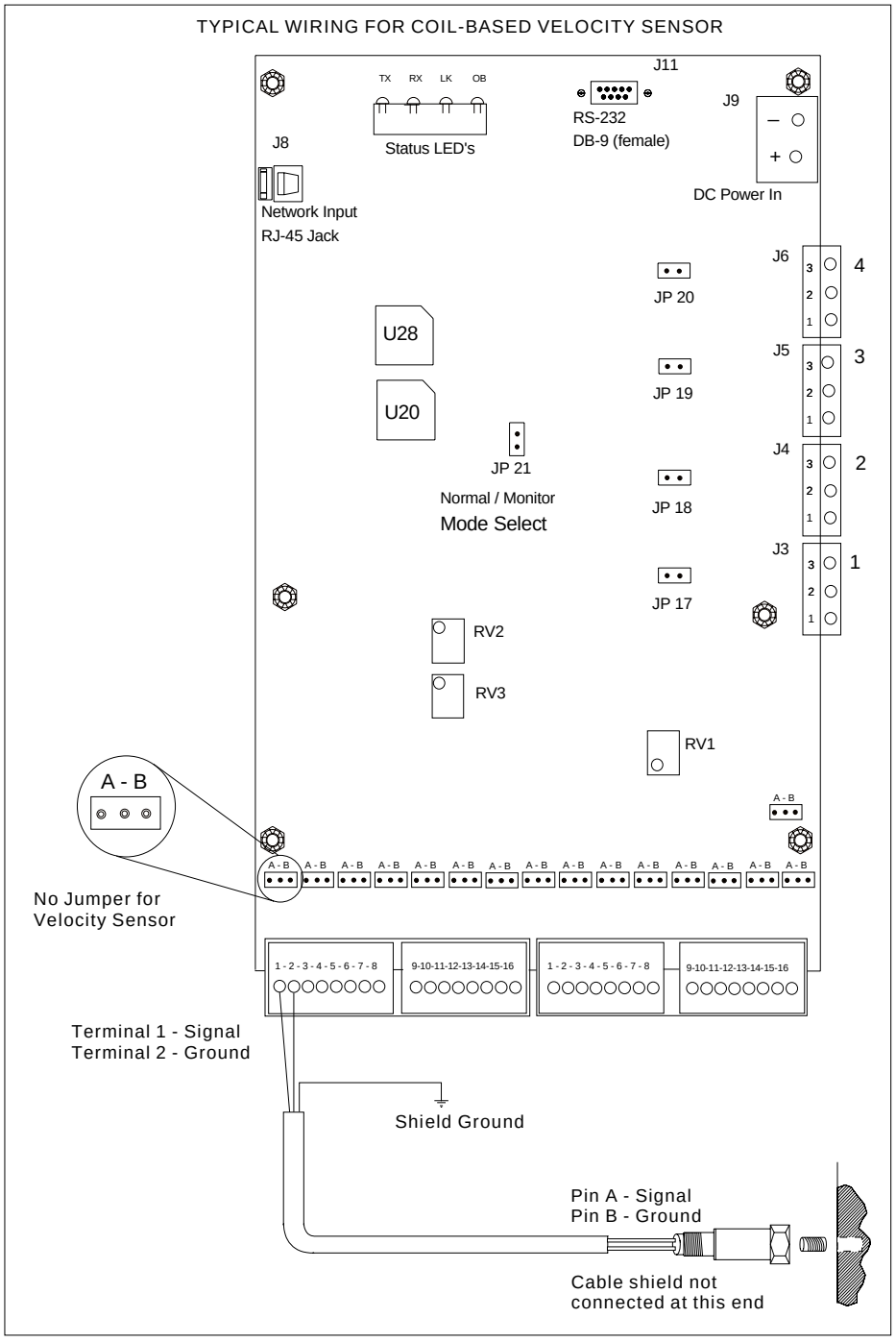
Connecting an ICP Accelerometer

The following diagram shows the wiring from an ICP accelerometer to the terminals of the Enwatch unit.



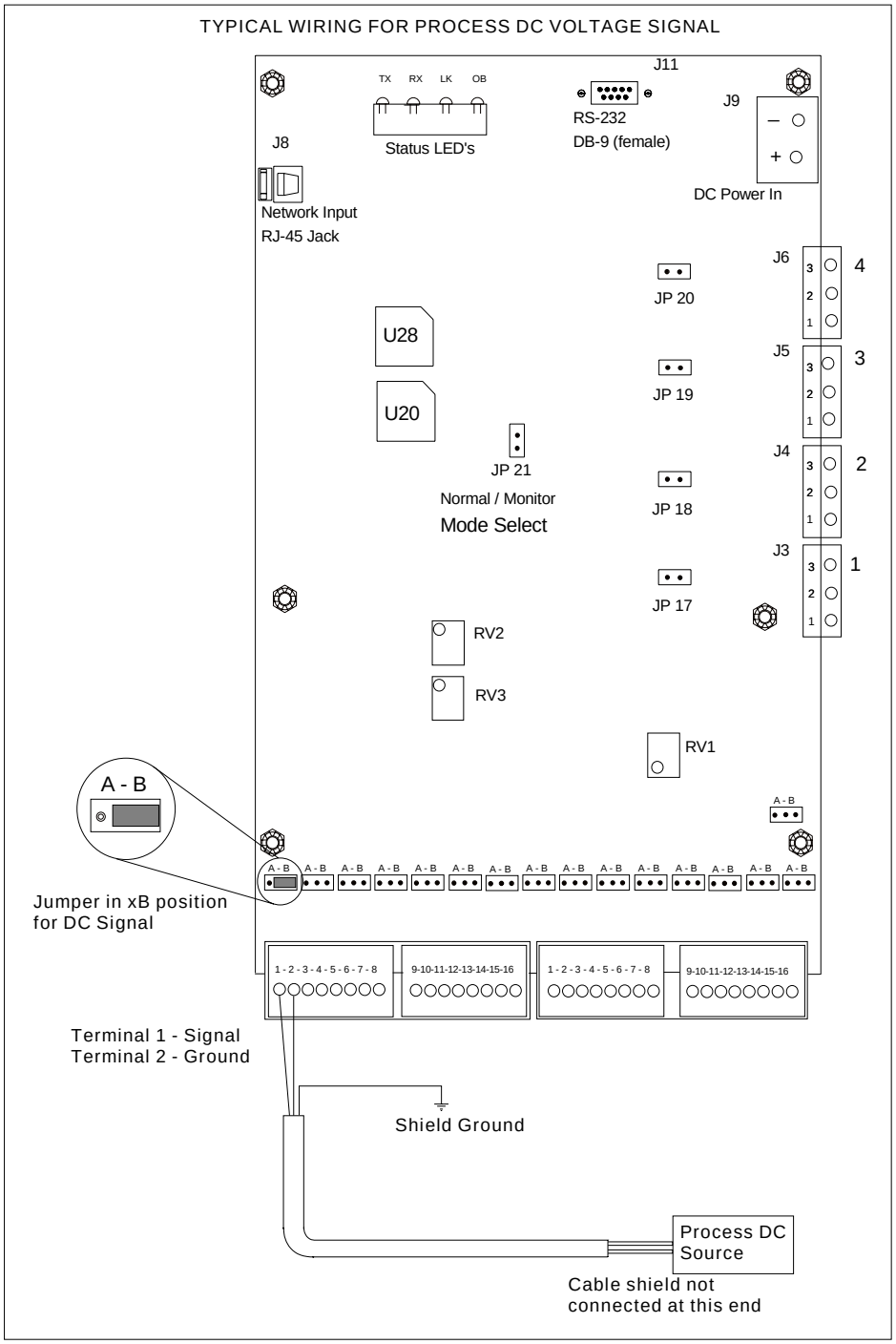
Connecting a Coil-Based Velocity Sensor

The following diagram shows the wiring from a coil-based velocity sensor to the terminals of the Enwatch unit.



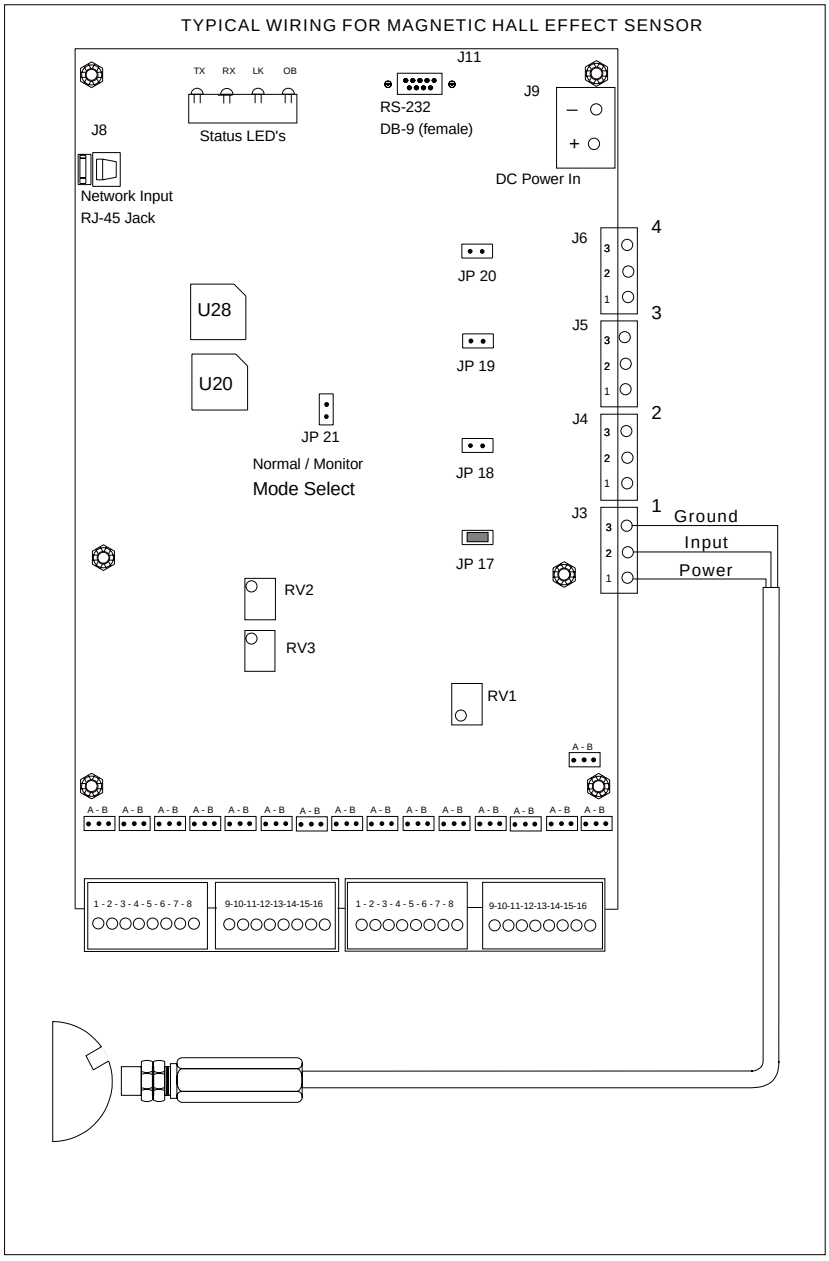
Connecting an Process DC Voltage Signal

The following diagram shows the wiring from a process DC voltage signal to the terminals of the Enwatch unit.



Connecting a Magnetic Hall Effect Sensor

The following diagram shows the external trigger wiring from a magnetic Hall effect sensor (magnetic interrupter) to the terminals of the Enwatch unit.



IMPORTANT If an external sensor is to be used that is powered from pin 1 of J3, J4, J5 or J6, then the jumper corresponding to the trigger channel must be inserted to provide a ground return path for the sensor power. See "Trigger Isolation Jumpers" on page 9.

Enwatch Measurement Capabilities

This section lists the measurement capabilities of the Enwatch unit.

Table 1.16 Enwatch measurement capabilities

Product Feature	Capability
Signal Control	Raw input signal Integrated input signal via HP filter Hp filter input signal gSE 200 Hz input signal gSE 5000 Hz input signal Bias Voltage
Combining measurements in the Enwatch driver	The Enwatch driver can combine measurements at the same location in Emonitor. The following items must to be the same to combine measurements. Signal route control (Integrate/non integrate/gSE/Raw) Tachometer on/off gSE time constant Sample rate/maximum frequency Phase lock loop Number of averages Measurement filter Number of lines
How does the Enwatch driver choose the high pass filter?	X=2 x FMAX/lines If X > 5.3 then set to 23.8 else if X > 2.67 set to 5.3 else if X > 0.36 set to 2.67 else if the Smart HP filter is on in Emonitor, then set to 2.67, otherwise set to 0.36 **Note**: The Smart HP filter in Emonitor does not use 0.36Hz HP filter.
Trigger usage	Sample on trigger (the first version of Enwatch always uses this option) Sample on post-trigger Sample on pre-trigger
Tachometer usage	Use tachometer for PLL (phase loop locked)
Autorange	Always on, maximum input ±10 V
Integrator reset control	Reset before first sampling of a measurement

Table 1.16 Enwatch measurement capabilities

<table>
<tr><th>Product Feature</th><th>Capability</th></tr>
<tr><td>Sampling rate</td><td>64 to 51200 Hz by 1

<table>
<tr><th>FMAX</th><th>Sampling Rate</th><th>FMAX</th><th>Sampling Rate</th></tr>
<tr><td>25</td><td>64</td><td>2000</td><td>5120</td></tr>
<tr><td>50</td><td>128</td><td>3200</td><td>8192</td></tr>
<tr><td>100</td><td>256</td><td>4000</td><td>10240</td></tr>
<tr><td>200</td><td>512</td><td>5000</td><td>12800</td></tr>
<tr><td>400</td><td>1024</td><td>6400</td><td>16384</td></tr>
<tr><td>500</td><td>1280</td><td>8000</td><td>20480</td></tr>
<tr><td>800</td><td>2048</td><td>10000</td><td>25600</td></tr>
<tr><td>1000</td><td>2560</td><td>16000</td><td>40960</td></tr>
<tr><td>1600</td><td>4096</td><td>20000</td><td>51200</td></tr>
</table>
</td></tr>
<tr><td>Number of synchronous time averages</td><td>1, 2, 4, 8, 32 ... 32768</td></tr>
<tr><td>Sample length</td><td>Multiple of 256 bytes, maximum sample 32768 bytes if no trigger, 16384 bytes with pre-trigger (not used in first version of Enwatch)</td></tr>
<tr><td>Filter settling time</td><td>HP 0.36 Hz 18 seconds
HP 2.67 Hz 3 seconds
HP 5.3 Hz 1.2 seconds
HP 23.8 Hz 0.3 seconds
Integrator HP 0.36 Hz 25 seconds
Integrator HP 2.67 Hz 8 seconds
Integrator HP 5.3 Hz 1.5 seconds
Integrator HP 23.8 Hz 0.8 seconds
gSE 200 Hz 88 milliseconds
gSE 5 kHz 2 milliseconds
Core 0.7 seconds
Time constant of 0.03 seconds 300 milliseconds
Time constant of 0.006 seconds 60 milliseconds
Time constant of 0.0012 seconds 12 milliseconds
Time constant of 0.00024 seconds 3 milliseconds</td></tr>
<tr><td>Trigger delay</td><td>0-32768 samples. Emonitor always uses 0.</td></tr>
<tr><td>Trigger channel</td><td>1-4 channels, TTL input 5-20 V
Maximum combined trigger current (channels 1-4), not to exceed 100mA.</td></tr>
<tr><td>Gain control</td><td>X1, X10, X100, X1000, X5, X50, X500, X5000
Download X1 always. The Enwatch unit autoranges and returns back the current gain for rescaling.</td></tr>
<tr><td>Anti-Alias filter</td><td>20 kHz, 2 kHz, 500 Hz, 100 Hz. This is read only. The Enwatch unit selects the proper filter.</td></tr>
</table>

Table 1.16 Enwatch measurement capabilities

Product Feature	Capability
gSE time constant	0.03, 0.006, 0.0012, 0.00024 seconds, the default is 0.03 seconds if FMAX > 350Hz set to 0.00024 seconds else if FMAX > 150 Hz set to 0.0012 seconds else if FMAX > 37.5 Hz set to 0.006 seconds If the measurement is overall only (no spectrum) then set to 0.03 seconds.
Integrator	One level of hardware integration The hardware has a gain factor of: 2.67/f for the 0.36 Hz and the 2.67 Hz filter ranges (INTHI = 0) 38.9/f for the 5.3 Hz and 23.7 Hz filter ranges (INTHI = 1) To convert from g->ips: Velocity (ips peak) = [integrator output (volts peak)] x [1 / (gain factor)] x [accel scale factor (g peak / mv peak)] x [61.24 / frequency]
Sample sequence allowed	4096 - one sample sequence uses one configuration table
Configuration tables	128 - one measurement point uses one table so total will be 128 points
Storage overhead	18 bytes per allocation
Flash memory lifetime	100,000 writes
Total available memory	640 Kilobytes
HOST software support (Emonitor)	Window types: Hanning, Hamming, Rectangular, Kaiser Bessel, Flattop
Number of lines	100, 200, 400, 800, 1600, 3200
Number of averages	1-99
Bias voltage reading	When you define a process measurement of DC in Emonitor, the Enwatch unit reads the transducer bias voltage. 24V means open circuit, 10V is OK.

Table 1.16 Enwatch measurement capabilities

<table>
<tr><th>Product Feature</th><th>Capability</th></tr>
<tr><td>Maximum number of averages that can be supported</td><td>Number of samples required: Lines x 2.56 + lines x 2.56(#avg -1) x (1 -%overlap)
Max number of samples per configuration: 32768
Max number of averages = ((32768 / (lines x 2.56)) - 1) / (1 -%overlap) + 1)

The following table shows the maximum number of averages versus the number of lines and percent overlap for non-trigger point.

<table>
<tr><th colspan="5">Max samples-non trigger points 32768</th></tr>
<tr><th></th><th>% overlapping</th><th>% overlapping</th><th>% overlapping</th><th>% overlapping</th></tr>
<tr><td>#lines</td><td>0</td><td>0.25</td><td>0.5</td><td>0.75</td></tr>
<tr><td>100</td><td>128</td><td>170</td><td>255</td><td>509</td></tr>
<tr><td>200</td><td>64</td><td>85</td><td>127</td><td>253</td></tr>
<tr><td>400</td><td>32</td><td>42</td><td>63</td><td>125</td></tr>
<tr><td>800</td><td>16</td><td>21</td><td>31</td><td>61</td></tr>
<tr><td>1600</td><td>8</td><td>10</td><td>15</td><td>29</td></tr>
<tr><td>3200</td><td>4</td><td>5</td><td>7</td><td>13</td></tr>
<tr><td>6400</td><td>2</td><td>2</td><td>3</td><td>5</td></tr>
<tr><td>12800</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>

The following table shows the maximum number of averages versus the number of lines and percent overlap for pre-trigger point.

<table>
<tr><th colspan="5">Max samples-trigger points 16384</th></tr>
<tr><th></th><th>% overlapping</th><th>% overlapping</th><th>% overlapping</th><th>% overlapping</th></tr>
<tr><td>#lines</td><td>0</td><td>0.25</td><td>0.5</td><td>0.75</td></tr>
<tr><td>100</td><td>64</td><td>85</td><td>127</td><td>253</td></tr>
<tr><td>200</td><td>32</td><td>42</td><td>63</td><td>125</td></tr>
<tr><td>400</td><td>16</td><td>21</td><td>31</td><td>61</td></tr>
<tr><td>800</td><td>8</td><td>10</td><td>15</td><td>29</td></tr>
<tr><td>1600</td><td>4</td><td>5</td><td>7</td><td>13</td></tr>
<tr><td>3200</td><td>2</td><td>2</td><td>3</td><td>5</td></tr>
<tr><td>6400</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>12800</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>
</td></tr>
<tr><td>Signal detection</td><td>RMS, Peak, Peak-Peak</td></tr>
<tr><td>Configuration downloading</td><td>Route mode configuration downloads to Flash memory
Live mode configuration downloads to RAM

Note: You can reduce number of average or increase percent overlap to reduce amount of memory used.</td></tr>
</table>

Setting Up Sample Measurements

This section gives examples of setting up measurement definitions in Emonitor.

DC or other Numeric measurements

Suppose you have a transducer with an output of -2 V to 2 V and a linear scale from -10° F to 100° F. How do you set up the transducer in Emonitor?

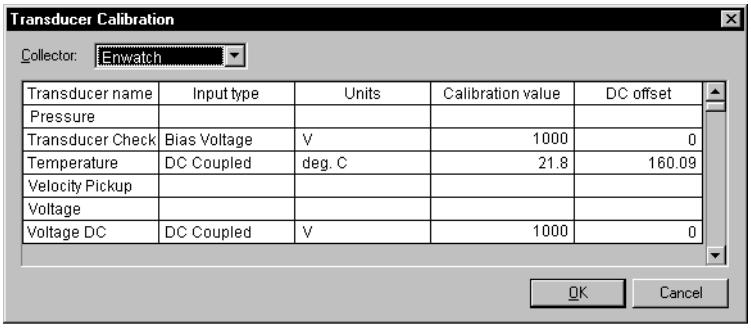
If the volts reading is R, then the data stored in Emonitor is:
(R / calibration + DC offset)

Input range volts: (X, Y)
Scale value: (A, B) volts
Data in Emonitor = (R - X) x ((B-A) / (Y-X)) + A
Calibration value in transducer setup: [(Y-X) x 1000mv / eu]/(B-A)
DC Offset in transducer setup: A - (B-A) x X / (Y-X)

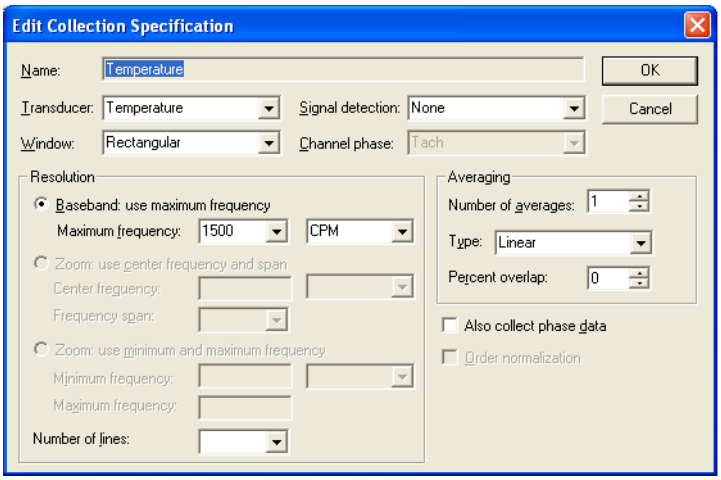
EXAMPLE

Input range: (-1.31 V, +0.87 V)
Scale value: (100° F, 200° F)
Calibration: [(0.87 - (-1.31)) x 1000] / (200 - 100) = 21.8
Offset: 100 - (200 - 100) x (-1.31) / (0.87-(-1.31)) = 160.09
Input type should be DC coupled and the jumper setting on board needs to be set as DC couple as well.

In Emonitor, select **Setup>Calibration** and set up the calibration for the Temperature transducer.



Then select **Setup>Transducer** to select the "Temperature" transducer in the collection specification.



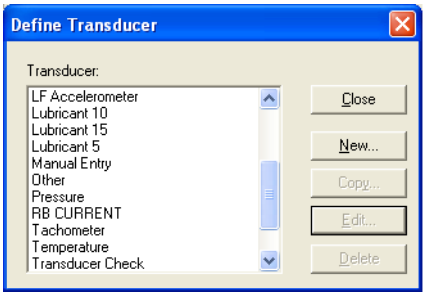
In Emonitor, define a numeric measurement definition with the temperature units and the "Temperature" collection specification.

Meas. Name	Data Type	Units	Collection	Filter	Storage	Active
None Numeric	Numeric	deg. C	Temperature	None	Always/2 Year	Yes
None Numeric1	Numeric	Vdc	Transducer Bias	None	Always/2 Year	Yes

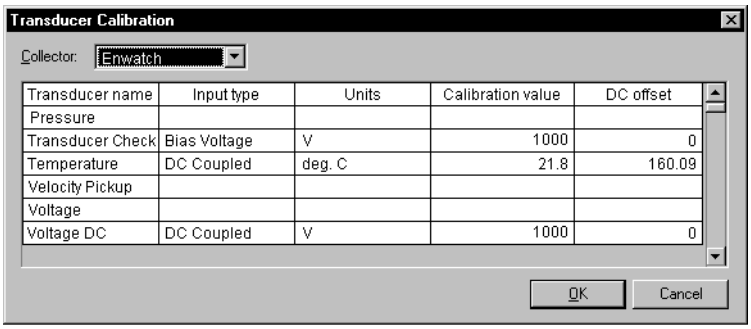
Transducer bias reading

Enwatch can take transducer bias readings; however, this is not a transducer check function that detects transducer failure before taking data. The bias reading is an independent reading with a different signal path on the Enwatch board.

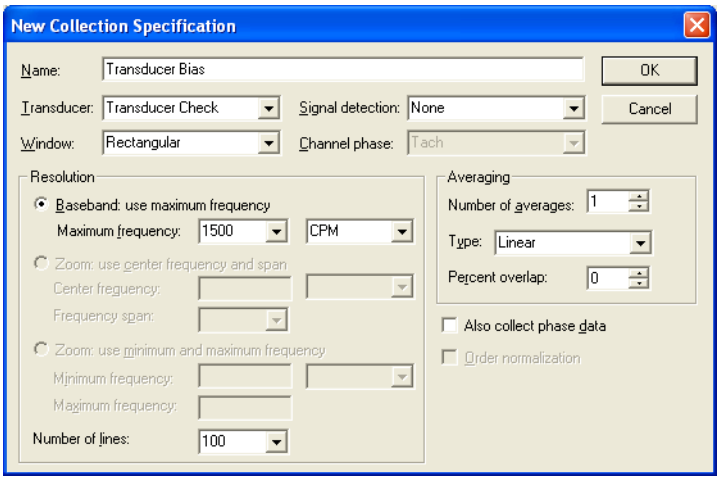
First in Emonitor, select **Setup>Transducer** to define a new transducer name, for example, "Transducer Check."



Then select **Setup>Calibration** to select "Bias Voltage" as the input type for this transducer. The calibration should set to 1000 and the offset to 0.



Then select **Setup>Collection** to define a new collection specification. Select "Transducer Check" as the transducer.

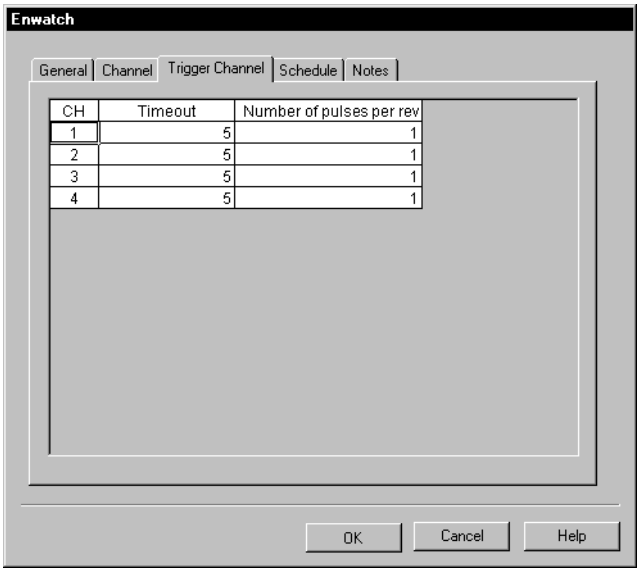


In Emonitor, define a numeric measurement definition with Vdc units and the "Transducer Bias" collection specification.

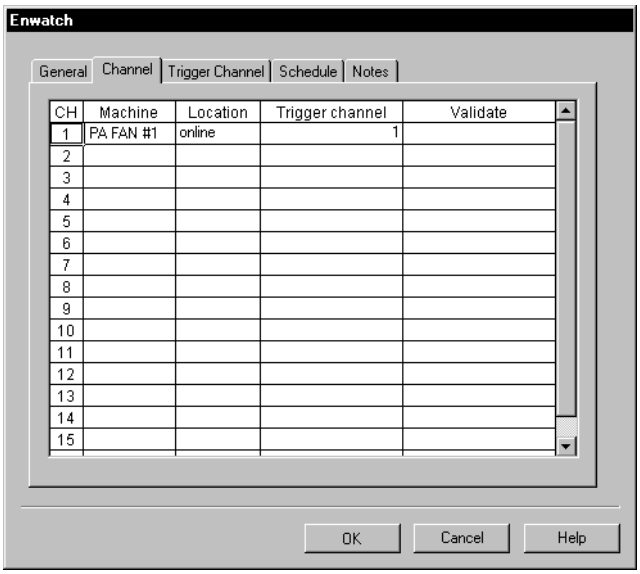
	Meas. Name	Data Type	Units	Collection	Filter	Storage	Active
	None Numeric	Numeric	deg. C	Temperature	None	Always/2 Year	Yes
▶	None Numeric1	Numeric	Vdc	Transducer Bias	None	Always/2 Year	Yes

Saving the machine speed with a spectrum

In the Hardware Setup program, when adding or editing an Enwatch unit, click the **Trigger Channel** tab.



The **Timeout** is defined in seconds (the default is 5 seconds). The **Number of pulse per rev** default is 1 pulse per revolution. Click the **Channel** tab and assign the correct **Trigger channel** to the vibration channel. This example uses trigger channel 1 for the measurement on input channel 1.



When the Enwatch unit collects data for channel 1, the unit checks trigger channel 1 to get the machine speed reading. The speed reading comes back with time waveform data and gets stored into the database with the vibration data.

Magnitude and phase reading

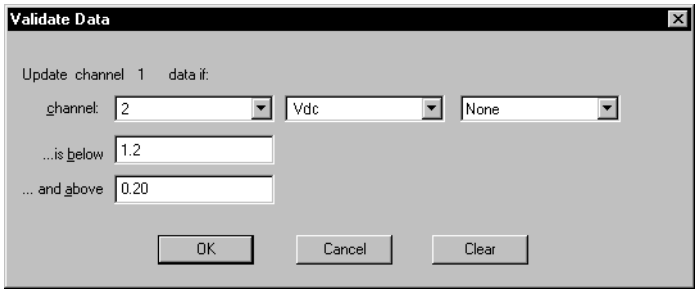
A magnitude/phase reading is similar to any other data collector in Emonitor. You set up an overall measurement, using the "Mag & Phase" collection specification. Then select "1st Order" as the measurement filter (or any other desired order).

	Meas. Name	Data Type	Units	Collection	Filter	Storage	Active
	None Numeric	Numeric	deg. C	Temperature	None	Always/2 Year	Yes
	None Numeric1	Numeric	Vdc	Transducer Bias	None	Always/2 Year	Yes
▶	None Mag	Magnitude	g's	Mag & Phase	1st Order	Always/2 Year	Yes

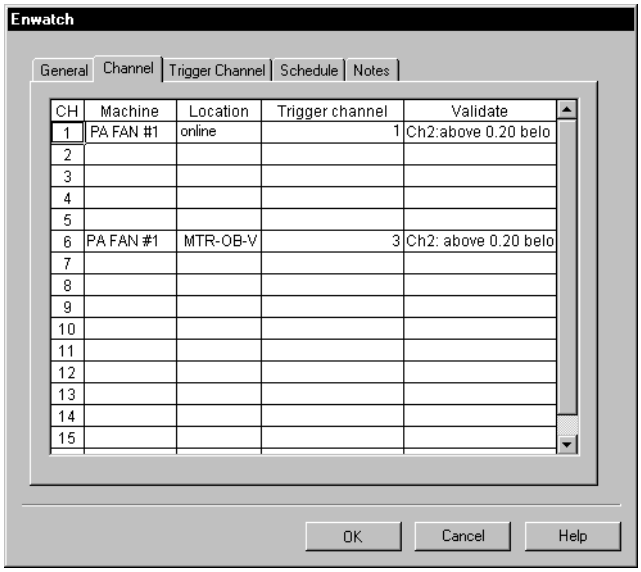
Validating Enwatch measurements

In the Hardware Setup program, when adding or editing an Enwatch unit, you can set up a validation function to allow the driver to check the channel's data before updating the database. This function can be used to filter unwanted data when the machine is not running, or when some other parameter is not within the correct bounds.

Click the **Channel** tab, then double-click in the **Validate** column to set up the validation parameters.



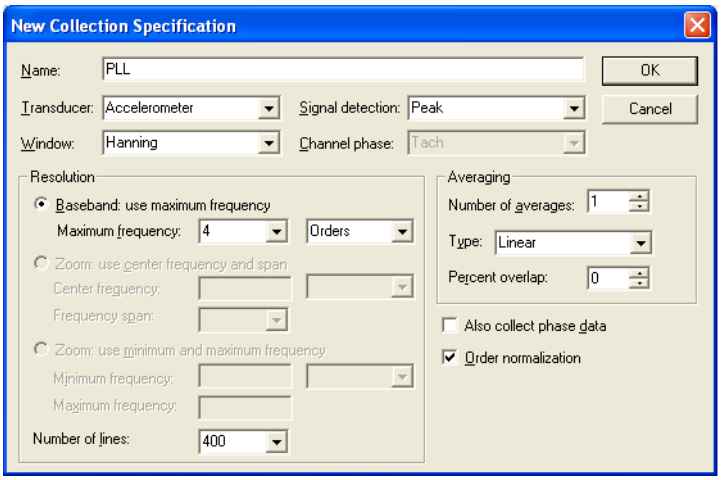
You can reference any channel and there is no order you need to follow.



Order normalized measurements

You enable order normalized measurements in the collection specification. In Emonitor, select **Setup>Collection**. Then either edit an existing collection specification or create a new one. Make sure the **Order normalization** checkbox is selected. The Enwatch unit then finds the machine speed and

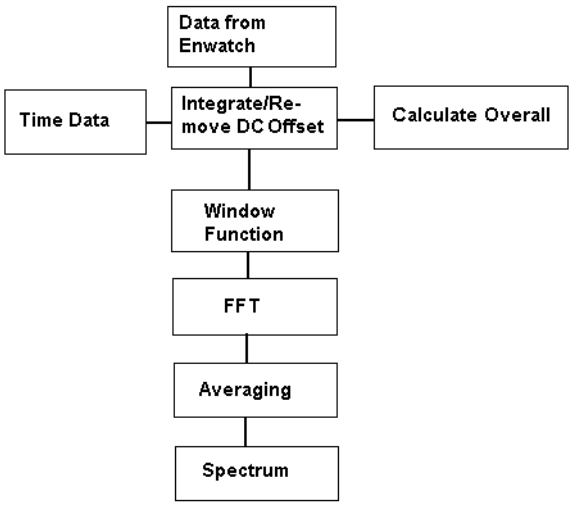
applies it to the number of orders to select the proper sampling rate before collecting data.



IMPORTANT You must also define a trigger channel for the Enwatch channel so that the Enwatch unit can find the machine speed.

How are DSP functions handled in the Enwatch driver?

The Enwatch unit only takes time domain data and returns that data to the host software. All DSP functions are done by the host driver. In this way, the firmware can focus on data collection speed. Since Enwatch does not handle calculating the average time waveform, the host driver software must tell the Enwatch unit to collect a time waveform of sufficient length in order to calculate the average.



Limitation on number of points in Enwatch

The Enwatch unit has 640 K bytes memory for data storage. If you attempt to collect data on more points than can fit in memory, the unit returns an error message. The message appears in the Unload Station Manager window (refer to the *Online Applications Guide* for more on the Unload Station Manager). The Enwatch driver can combine measurements in some cases (see "Combining measurements in the Enwatch driver" on page 21).

If a route has 5 points per channel and 400 lines, 4 averages, no overlap averaging:
Bytes required: 5 points x 16 channels x 1024 bin x 2 byte/bin x 4 averages = 655360 bytes

If a route has 2 points per channel and 800 lines, 4 averages, no overlap averaging:
Bytes required: 2 points x 16 channels x 2048 bin x 2 byte/bin x 4 averages = 524288 bytes

To best use the 640K memory, try to use overlap averaging. For examples, see "Maximum number of averages that can be supported" on page 24.

Configuration of Emonitor with Enwatch

The Enwatch unit is specially designed to operate over an Ethernet connection. Each Enwatch unit has a unique IP address that can be changed through the RS232 port inside the unit. Ideally, one Enwatch unload station can serve an unlimited number of Enwatch units. However, to improve unload speed, multiple Enwatch unload stations are suggested.

Each Enwatch unit has 16 vibration channels and 4 tachometer channels. In addition, the Allen Bradley Enlive software (live mode analysis) can be used to "lock onto" one channel at a time. During live mode analysis, regularly scheduled unload continues to unload whatever data is in the Enwatch unit buffers before entering live mode analysis. The Enlive software has a default timeout of 30 minutes to prevent an extended break in unloading scheduled data.

For more information on setting up an Enwatch unit in an Emonitor system, refer to the *Online Applications Guide* provided with your Emonitor online system.

Specifications

This chapter lists the technical specifications for the Enwatch unit.

Enwatch Technical Specifications

Product Feature		Specification
Inputs		
	Number of Channels	16 vibration and 4 tachometer (synchronizer)
	Voltage Protection	Protects against over-voltage (channel auto-switch off) 2000 V ESD protection
	Input Impedance	1 MOhm
	Ranges	±10 mV to ±10 V, 7 ranges (software selectable)
	ICP Interface	3.6 mA @ 24 VDC, configurable per channel
	Coupling	AC/DC (numeric measurements), configurable per channel DC offset removal by optional use of channel 16
	PGA Gains	Specified in Chapter 1
	Anti-Alias Filter	Compound analog filter with roll-off better than 20th order filter; cut-off frequency related to sample rate.
	High Pass Filters	4th order with corner frequencies 0.36, 2.67, 5.3, and 23.8 Hz
	Channel Cross-Talk	-80 dB
	Amplitude Accuracy	±2% typical in pass-band
	Phase Accuracy	±3%
	Harmonic Distortions	-70 dB (typical)
	Integration	One 2-stage with ideal stop-band edge at 0.36 Hz
	Acquisition Modes	Mode 1: Timed pickup Mode 2: Data Ready flag Mode 3: Data broadcast

Enwatch Technical Specifications

Product Feature		Specification
Spike Energy Measurement		
	gSE Filters	High pass at 200 Hz & 5 kHz 2nd order
Trigger		
	Types	TTL Isolated or Non-Isolated, or any voltage up to +24 V Maximum combined current for all channels, not to exceed 100mA
	Machine Speed Range	1 to 60,000 RPM
	Time to Lock	2 revolutions
	Averaging	1, 2, 4, ... 32,000 averages, programmable
	Tachometer Information	RPM using trigger input
	Trigger Delays	Post-trigger delays up to 32,768 samples Pre-trigger delays up to 16,384 samples (not used with Emonitor)
Processing		
	Time Domain ADC	16 bit
	Sampling Rate	64 Hz to 51.2 kHz
	Dynamic Range	96 dB (theoretical)
	Block Lengths	256, 512, 1024, 2048, 4096, or 8192 with averaging up to 16,384 without averaging
	Overall Units	Acceleration, velocity, or displacement (double integration in one level hardware & one level software), and Spike Energy data
Outputs		
	Status	LEDs indicate system functions
	Interface Port	RS-232C, 9600 baud for diagnostics
Storage		
	Memory Buffer	640 Kilobytes
	Power Fail Handling	Hardware checks for node power and isolates node with no power
Mechanical		
	Protection	NEMA 4, IP66
Environmental		
	Temperature	-20 to 70° C
Power		
	Power Supply	85 to 260 VAC
	Power Consumption	12 W maximum to board, using 3.6 mA ICP current sources

Enwatch Technical Specifications

Product Feature		Specification
Communications		
	Network	Ethernet
	Medium	10BASE-T
	Connectors	Weidmuller terminal blocks
	Speed	10 Mbits/sec
	Isolation	1000 Vrms

Numerics

A

B

C

D

E

Power Ratings

120mA minimum, 280mA maximum / 24Vdc

Temperature Ratings

-10C to +70C

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication GMSI10-UM031C-EN-E - July 2009
Supersedes Publication 44887 Rev. 2 - January 2009

Part Number 44887-PUB