2505
VIBRATION SENSOR INTERFACE MODULE
INSTALLATION AND OPERATION GUIDE
Version 1.4

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REVISION HISTORY

Version 1.0	12/5/03	Original Release
Version 1.1	8/12/04	Incorporated SPQ393 (velocity probe leakage current) and SPQ396 (displacement probe used as tach source) into Board Rev D.
Version 1.2	12/1/05	
Version 1.3	8/15/16	Added notes on LED functionality (Sect 1.3.4 and Sect 3.8)
Version 1.4	4/1/2020	Updated format, date, removed Part# resaved in pdf

PREFACE

This ***Installation and Operation Guide*** provides installation and operation instructions for the CTI 2505 4-Channel Vibration Sensor Interface Module for Simatic® 505 programmable controllers. We assume you are familiar with the operation of Simatic® 505 programmable controllers. Refer to the appropriate user documentation for specific information on the Simatic® 505 programmable controllers and I/O modules.

This ***Installation and Operation Guide*** is organized as follows:

Chapter 1 provides a description of the module.
Chapter 2 covers hardware configuration.
Chapter 3 looks at software configuration.
Chapter 4 is a guide to troubleshooting.
Appendix A provides a jumper/dip settings log sheet.
Appendix B gives sample ladder logic for programming purposes.
Appendix C shows the configuration of status and timing for command/acknowledge

The 2505 4-Channel Vibration Sensor Interface Module

USAGE CONVENTIONS

NOTE:
Notes alert the user to special features or procedures.

CAUTION:
Cautions alert the user to procedures that could damage equipment.

WARNING:
Warnings alert the user to procedures that could damage equipment and endanger the user.

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CHAPTER 1. OVERVIEW

1.0. Product Summary

The CTI 2505 Four Channel Vibration Sensor Interface Module is a member of Control Technology's family of I/O modules compatible with Simatic® 505 programmable controllers. The 2505 is designed to translate millivolt-level analog signals from velocity, accelerometer, and/or proximity sensors into digital words for a Simatic® 505 programmable controller (PLC).

1.1. Operation

The 2505 Vibration Sensor Interface Module is a double-wide module. It logs in as 18WX and 22WY words. In operation the 2505 converts the signal coming from a vibration sensor into three pieces of information: the overall RMS vibration, the maximum reading (True Peak-to-Peak), and the DC bias of the probe circuit. There are four vibration input channels which are individually configurable for either an accelerometer, velocity sensor, or displacement probe. An additional input channel interfaces to a speed sensor; this can be either single or multiple-pulses per revolution.

The first step in using the 2505 is to configure the hardware. Several jumpers and switches must be set for each channel to select the type of probe, the gain, the high-pass filter setting, and whether the hardware integration will be enabled. Jumpers must also be set to select the type of electrical interface for the tachometer circuitry.

The next step is software configuration. The WY output words contain the parameters for each channel's configuration. These are downloaded to the 2505 module one channel at a time using handshake bits to select the channel. Care should be taken to ensure the software parameters agree with the hardware settings; the module can check syntax on several of these. Parameters that can be specified include probe sensitivity, input and output scale factors, Alert and Danger setpoints and time delays, and the low-pass filter setting. All of these parameters are downloaded from the controller to the module via the WY output words.

Once the 2505 hardware and software has been configured, the WX input words can be monitored for RMS, Peak-to-Peak, and DC bias on each vibration channel, and the speed from the tachometer (tach). Status bits offer quick identification of alarm levels (Alert, Danger, Probe Circuit status), tach status, Analog-Digital Converter (ADC) over-range conditions, and out-of-range for reported values.

Note: Throughout this manual WX and WY are referenced as starting at a PLC log-in value of address 1; this is portrayed as WX(1) where the parentheses are used to indicate this is for reference only. These addresses must be changed to agree with the actual I/O addressing for each installation.

1.2. User-Configurable Options

The following is a summary of user-configurable options:
Probe type - accelerometer, velocity, or displacement
Gain - interacts with maximum expected signal (full-scale reading) and probe sensitivity; sets resolution for channel
Integration - accelerometer reports ips, or velocity reports mils
Tachometer - single or multiple pulses per revolution, wide range of electrical pickups
High-pass filter - seven steps between 1Hz to 100Hz
Low-pass filter - sixteen steps between 1.5Hz to 50kHz; interacts with Number of Samples (lines of resolution) to determine how long it takes to sample the input channels
I.S. barrier factor - compensates for attenuation introduced by external Intrinsic Safety barrier
Units of measurement - either English or Metric
Input and Output Scale factor - multipliers to achieve higher resolution
Report mode - either mV or engineering units (g, ips, mils)
Trip Multiply value - factor to multiply alarm levels
Alert and Danger alarms - setpoints and time delays
Bias alarms - upper and lower setpoints on the probe's DC bias
Displacement response curve - specification enables module to report displacement in mils or mV
Port options - serial or parallel ports to access raw waveform data for analysis

1.3. Front Panel Description

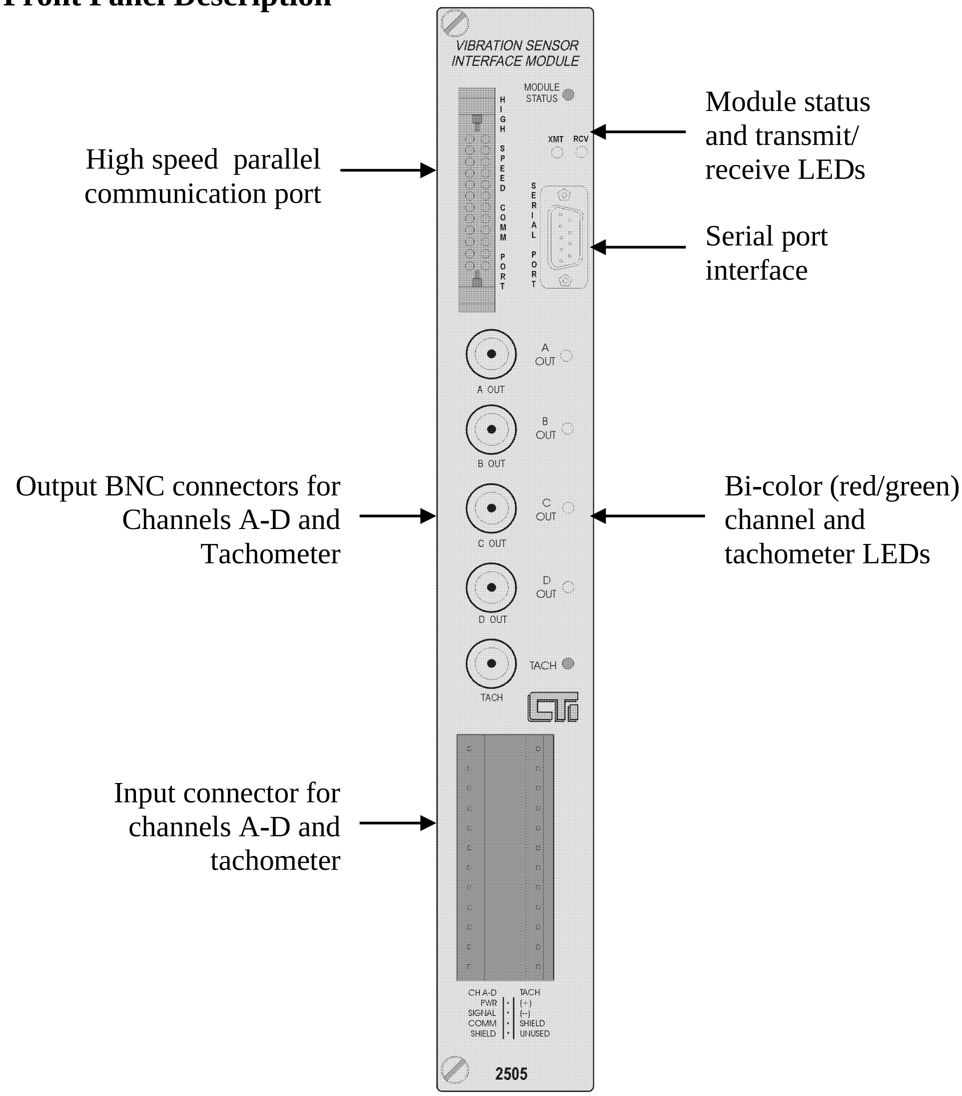


Figure 1.1. CTI 2505 Front Panel

1.3.1. Module Status LED

The green Module Status LED will be illuminated when the module is functioning normally. If the Status LED is not lit, the module has not completed power up diagnostics, it is not powered, or a serious problem exists with the module. Refer to Chapter 4 for troubleshooting.

1.3.2. Analysis Data Ports

The 9-pin serial port interfaces with a software program available from CTI / MAARS which takes "snapshot" data from the module and provides the time-domain waveforms and frequency-domain spectrum on a PC. This port requires significant attention from the on-board microprocessor (e.g. 10 seconds to download maximum data from all four channels) so is not recommended for frequent usage, especially in a critical application.

The parallel port is provided for future use with a high-speed data interface. This port is much faster than the serial port and will not interfere with the normal scanning of the inputs.

1.3.3. Output BNC Connectors for Channels A-D and Tachometer

Five individual BNC connectors for channels A-D and the tachometer signal are available for use with external analysis equipment. These are buffered but the signal output is not filtered.

1.3.4. Tachometer and Channel Sensor LEDs

The bi-color (green and red) channel LEDs show the following operating modes:
Solid green = channel configured and operating within limits
Not lit = channel not configured *or* bad configuration
Flashing green = Alert setpoint and time delay exceeded
Flashing red = Danger setpoint and time delay exceeded
Solid red = probe circuit fault (takes precedence over Alert or Danger indications)
Note: These LEDs function even if the 2505 is not calculating alarms (WY19.5 = 1).

The single color (green) tachometer LED flashes in relation to speed of input signal.

1.3.5. Input Connector for Channels A-D and Tachometer

This connector provides wiring terminals for channels A-D and for a tachometer signal. The wiring connector accepts 14-26 AWG wire.

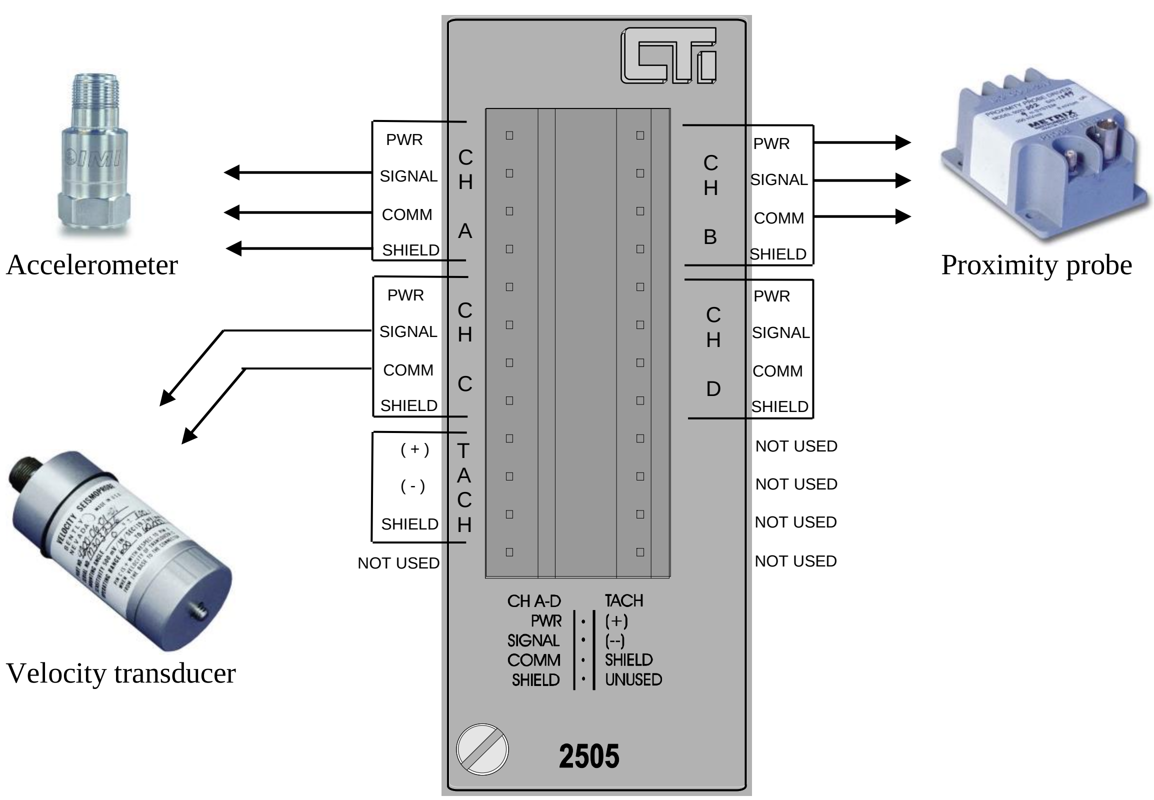


Figure 1.1.a. CTI 2505 Wiring Connector

1.4. Asynchronous Operation

The module operates asynchronously with respect to the PLC so that a scan of the PLC and a module output scan cycle do not occur at the same time. Note also that how an output signal change is dependent on the update time of the module. The following figure illustrates this relationship:

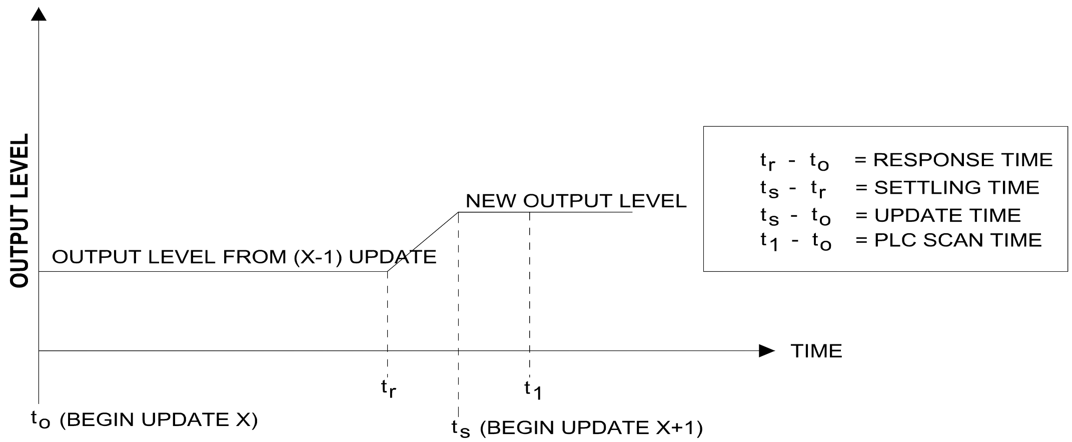


Figure 1.2. Relation of Update Time Change in Signal Input

1.5. Product Selections

On-board switch/jumpers selections include:

Address selection switch - choose address 1 through E (not used except with parallel port).

Write Protect Switch - when set, the module will accept only one download of configuration parameters for each channel from the PLC. Changing parameters again will require power cycling of the module.

Tach section
Tachometer Input mode – Open Collector *or* Normal
Tach Signal Type – Positive, Negative, *or* Bipolar
Tach Master switch – select which module has the Tach signal input which will be sent to other 2505 modules across the high-speed bus.
Tach Input – local *or* bussed master

Analog input section (four channels)
Gain - jumper select one of: 1, 1.25, 2.5, 5, 10, 25
Hardware Integration - jumper select to enable *or* disable
High-pass filter value - jumper select one of: 1, 2, 5, 10, 20, 50, *or* 100 Hz
Probe type selection - switch select of : Proximity Probe or Accelerometer/Velocity Probes and/or Probe bias

CHAPTER 2. HARDWARE CONFIGURATION

The installation of the Vibration Sensor Interface Module involves the following steps:

1. Planning the installation
2. Unpacking the module
3. Configuring the module
4. Wiring the module
5. Checking module operation

The steps listed above are explained in detail in the following pages.

2.1. Planning the Installation

Planning is the first step in the installation of the module. This involves calculating the I/O base power budget and routing the input signal wiring to minimize noise. The following sections discuss these important considerations.

2.1.1. Calculating the I/O Base Power Budget

The 2505 requires 14 watts of +5 VDC power from the I/O base. Before inserting the module into the I/O base, ensure that the I/O base power supply capacity is not exceeded. The power supply should be a single voltage, 20-28 VDC nominal 2.0 amp, UL Class 2 device. The drive voltage and current are specified at 24 VDC.

2.1.2. Wiring Consideration

Power, communication, and signal wiring must be separated to prevent noise in the signal wiring. Input signal wiring must be shielded, twisted-pair cable, with 14 to 26 gauge stranded conductors. The cable shield should always be terminated to earth ground at the I/O base. It should not be terminated at the output connector. Use the following guidelines when wiring the module:

- Always use the shortest possible cables
- Avoid placing power supply wires and signal wires near sources of high energy
- Avoid placing low voltage wire parallel to high energy wire (if the two wires must meet, cross them at a right angle)
- Avoid bending the wires into sharp angles
- Use wireways for wire routing
- Be sure to provide a proper earth ground for the cable shield at the I/O base
- Avoid placing wires on any vibrating surfaces

2.2. Unpacking the Module

Open the shipping carton and remove the special anti-static bag which contains the module.

CAUTION:
HANDLING STATIC SENSITIVE DEVICES
The components on the 2505 module printed circuit card can be damaged by static electricity discharge. To prevent this damage, the module is shipped in a special anti-static bag. Static control precautions should be followed when removing the module from the bag, when opening the module, and when handling the printed circuit card during configuration.

After discharging any static build-up, remove the module from the static bag**. Do not discard the static bag. Always use this bag for protection against static damage when the module is not inserted into the I/O backplane.**

WARNING:
Ensure that the power supply is turned OFF before connecting the wires to the I/O base.

2.3. Configuring the Module for Operation

The 2505 must be configured for a high-pass filter setting, gain range and value, sensor configuration, integration and transducer type, input mode, tachometer input and status, signal type, port type, module address, and write configuration before inserting the module into the I/O base. As shipped, all input channels are configured for 1Hz high pass filter, a gain range and value of 1.0, accelerometer with (+) bias, integration disabled, tachometer input from local source and 'is master' disabled, bipolar signal type, serial port type, module address of 0001, write configuration enabled, and normal input mode.

Configuring the 2505 for operation consists of the following steps. Following this list are sections which describe these selections in detail.

1. High-pass frequency input.
2. Gain range and value.
3. Sensor configuration.
4. Integration and transducer type.
5. Tachometer: input mode.
6. Tachometer source.
7. Signal type.
8. Port type.
9. Module address.
10. Write configuration.
11. Dip switches to match the hardware settings.

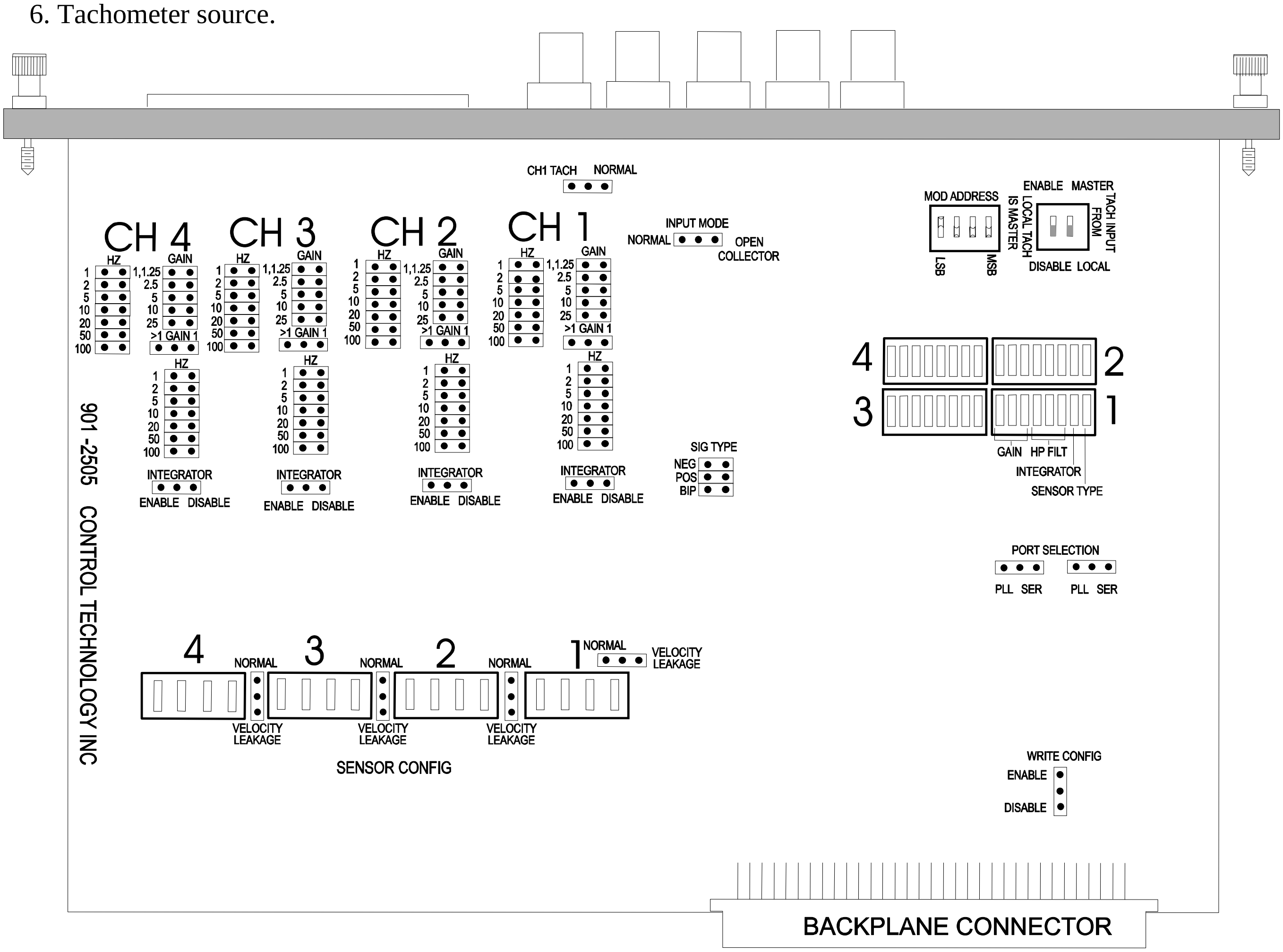
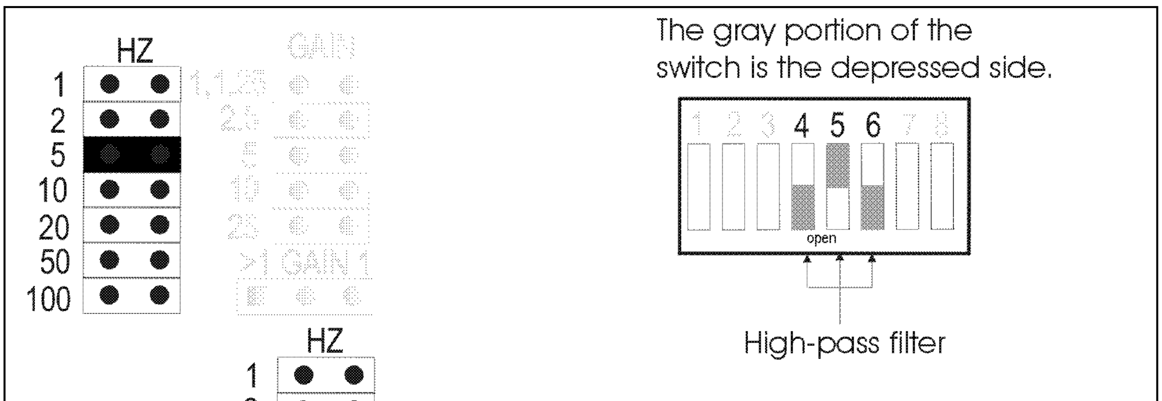


Figure 2.1. Jumper and Switch locations

2.3.1. Selecting High-pass Filter Value

The 2505 allows high-pass filter values to be set for each of the four channels. This value must match the WY configuration in the PLC. For each channel, the high-pass filter must be set in three places: two hardware jumpers and a switch bank. The jumpers are on the field side of the circuitry and the switch bank is on the digital logic side of the isolation barrier. As shipped, the 1 Hz filter value is selected. Refer to the diagram below for the correct settings for a 5Hz example.

			High-pass Filter	
WY(20)	Transducer Type & Integration	Gain	**0, 1, 2, 3, 4, 5, 6**	Not Defined
	nibble 1	nibble 2	nibble 3	nibble 4



High-pass Filter	WY(20) nibble 3	Switch 4	Switch 5	Switch 6
1	0	off	off	off
2	1	on	off	off
5	2	off	on	off
10	3	on	on	off
20	4	off	off	on
50	5	on	off	on
100	6	off	on	on

Figure 2.3. Selecting High-Pass Filter Value

2.3.2. Selecting the Gain Range and Value

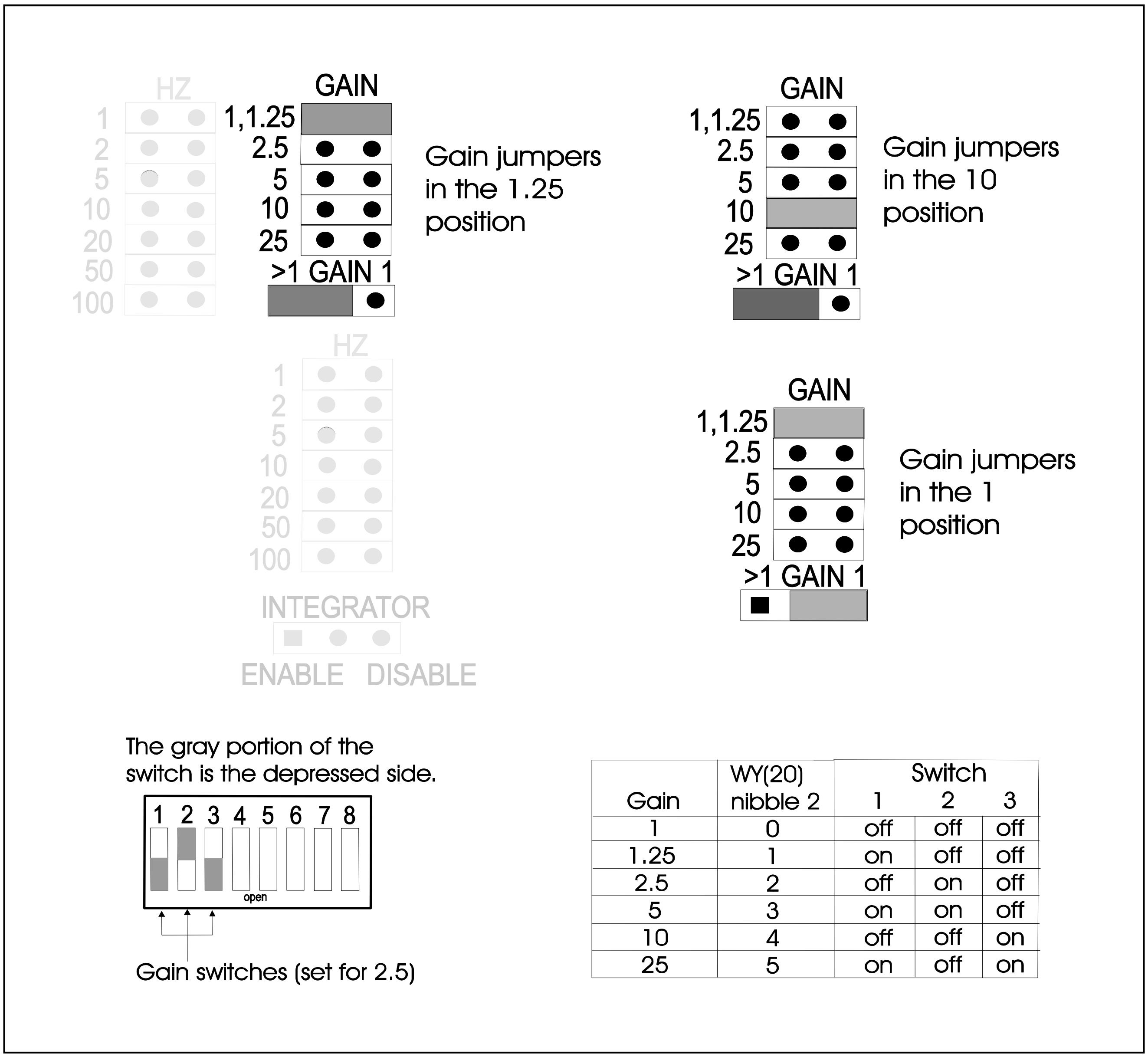
The Gain settings of ‘Range’ and ‘Value’ must be set in three places for each channel of the module: two jumpers and a switch bank. The corresponding value must also be entered in the WY(20) nibble 2 configuration word. Use the table below to correlate these two values and choose a gain setting for the channel.

When the module is operating, status bits WX(15.13) through WX(15.16) can be monitored to check for an Analog-Digital Converter (ADC) over-range condition. If the bit is ON, that indicates the gain setting is set too high for that channel, i.e. the ADC is getting too much voltage from the vibration sensor. A graphical picture would show the input signal clipping. Move the gain to a lower setting if this occurs.

ADC max	WY(20) nibble 2	Resolution in mV	Gain	Probe Sensitivity (specified by manufacturer)			
				50mV	100mV	200mV	500mV
5V	0	2.441	1	100	50	25	10
4V	1	1.953	1.25	80	40	20	8
2V	2	0.976	2.5	40	20	10	4
1V	3	0.488	5	20	10	5	2
500mV	4	0.244	10	10	5	2.5	1
200mV	5	.0976	25	4	2	1	0.4
				Full Scale Range			

Gain

	nibble 1	nibble 2	nibble 3	nibble 4
WY(20)	Transducer Type & Integration	**0, 1, 2, 3, 4, 5**	High-pass Filter	Not Defined



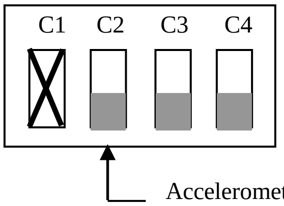
Gain	WY(20) nibble 2	Switch 1	Switch 2	Switch 3
1	0	off	off	off
1.25	1	on	off	off
2.5	2	off	on	off
5	3	on	on	off
10	4	off	off	on
25	5	on	off	on

Figure 2.4. Selecting the Gain Range and Value

2.3.3. Setting the Sensor Configuration Switchblock

The sensor configuration switchblock sets the field-side circuitry to provide the correct probe bias voltage (if necessary) and the appropriate signal sensing path. The accompanying logic-side information is provided in WY(20) nibble 1, along with the Integration option (see next section).

Settings for Accelerometers with Positive bias (typical)

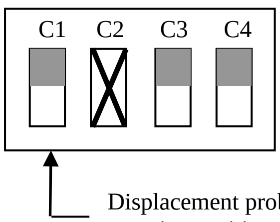


The gray portion of the switch is the depressed side.

Accelerometer bias polarity in positive position (most probes)

Note: Switch C1 is not read if an accelerometer is used. If the accelerometer requires negative bias, set C2 to the “up” position (relative to the backplane of the board). C3 and C4 must be in the “down” position.

Settings for Displacement Probes with Negative bias (typical)

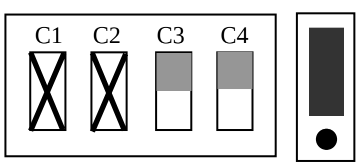


The gray portion of the switch is the depressed side.

Displacement probe bias polarity in negative position (most probes)

Note: Switch C2 is not read if a displacement probe is used. If the displacement probe requires positive bias, set C1 to the “down” position (relative to the backplane of the board). C3 and C4 must be in the “up” position.

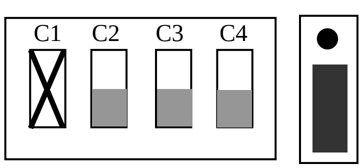
Settings for Velocity Probes (typically passive => no bias)



The jumper in the top position is NORMAL (no leakage current).

Note: Switches C1 and C2 are not read if a velocity probe is used. The internal circuitry reads the probe as a displacement probe without bias voltage. C3 and C4 must be in the “up” position.

Settings for Velocity Probes with Open Probe Detection



The jumper in the bottom position outputs 0.5mA of leakage current.

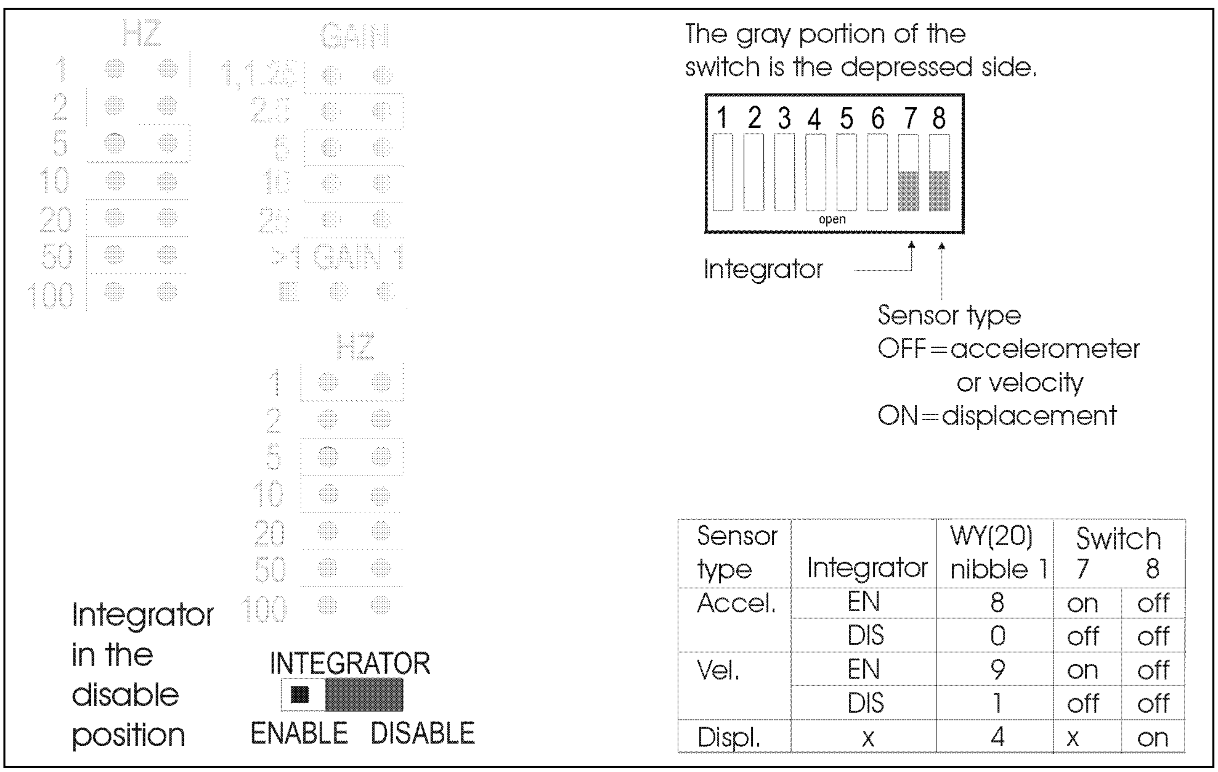
The jumper for Channel 1 is located above the switchblock; the left position is NORMAL and the right position is LEAKAGE CURRENT.

Note: For Open Probe detection, the switches must be configured as an accelerometer even though a velocity probe is being used. The “Probe Circuit Bias Voltage” word reported to the PLC will show a small voltage if the probe circuit is good. (This is the equivalent of SPO393.)

2.3.4. Selecting the Integration and Sensor Type

As shipped, the sensor type "Accelerometer" is selected. A jumper setting on the module selects whether the channel's input will be integrated. Integration is a function that can be done at the board level which allows the module to report in different units. For instance, in the case of an accelerometer the module will report the velocity measurement of 'inches per second' ("ips") instead of 'gravities' ("g"), which is the typical accelerometer measurement unit. Likewise, a velocity probe will report 'milli-inches' ("mils") instead of "ips", the common velocity measurement. See the diagram below for the jumper position and the settings for the switch banks. If integration is selected, the MSB of WY(20) nibble 1 should be set to a 1. If there is no integration, this value should be 0.

	Transducer Type & Integration			
WY(20)	**Accel = 8 or 0** **Velocity = 9 or 1** **Displacement = 4**	Gain	High-pass Filter	Not Defined
	nibble 1	nibble 2	nibble 3	nibble 4



Sensor type	Integrator	WY(20) nibble 1	Switch 7	Switch 8
Accel.	EN	8	on	off
	DIS	0	off	off
Vel.	EN	9	on	off
	DIS	1	off	off
Displ.	x	4	x	on

Figure 2.5. Selecting the Integration and Sensor Type

2.3.5. Selecting the Tachometer options: Input mode

The input signal for the 2505 tachometer circuit can come from either the input connector or from Channel 1 (Channel A on the input connector). If the tach source is from a mag pickup or other such device, the input connector should be wired directly to the device. Alternatively, the input source could be a displacement transducer which is sensing a keyslot or a drilled hole in a shaft. In this case the source will come from the Channel 1 input circuit. The advantage of using a displacement transducer is that it can be monitored for probe circuit status since it is a powered probe. A mag pickup is a passive device therefore the difference between an open circuit or a non-moving object cannot be detected; both report a 0 input.

Jumper JP95 selects whether the tach circuit will receive its signal from Channel 1 or from the input connector. If Channel 1 is selected, the input voltage threshhold is raised by an order of magnitude to remove the “noise” of the vibration signal. The actual tach pulse is a comparatively high voltage level so the gain for Channel 1 should be set to its lowest value of 1. The Channel 1 input circuit removes the DC bias from the sensor’s input signal before sending it over to the tach circuit. (Note: This was first implemented as SPQ396 which used Channel 4 for the input.)

The connector input can be a single pulse per revolution, multiple pulses per revolution such as blades on a fan or teeth on a gear, or a TTL pulse train (either + or -). The tach circuitry can sense voltages from 140mV to 50V from normal or open collector circuits, with a frequency resolution of 1Hz (maximum 65kHz). If the tach is a single pulse per revolution, this signal can be used as a synchronization mark in analyzing the vibration waveforms since all channels on a single 2505 are obtained synchronously. In addition, the tach signal can be bussed across the high speed parallel port interface between multiple 2505 modules to provide a common reference.

The type of tach input (normal or open collector) is set by jumper JP17. Normal is the default setting. Open Collector input is connected internally through a 10kΩ resistor to +15Vdc; no external pull-up resistor or power supply is needed.

The status of the tachometer circuitry is available in WX(15). Bit 2 indicates a tach overrange condition; this means the pulses are exceeding 65535 counts. This could occur if a toothed gear is used at a high speed. Bit 3 is the tach underrange status bit; this means the speed is less than 2Hz. After 10 seconds without pulses, the No Tach (bit 4) will be set.

2.3.6. Selecting the Tachometer options: Tach Source

If multiple 2505 modules are connected using the high speed parallel port interface, the tach signal can be sourced from any 2505 and bussed to the other modules. The selection of whether the tach is used locally only or as the master tach is made using switch block SW5. The options are:
Local tach only – tach source is connected to this 2505 and is not bussed to other modules
Local tach is Master – tach source is connected to this 2505 and is bussed to other modules
Use Master tach – tach source is on another 2505 and is bussed to this module

2.3.7. Selecting the Tachometer options: Signal Type

Signal type (positive, negative, or bipolar) is set by jumpers J1, J2, or J3. A negative signal type is used when devices generate a negative pulse relative to ground, a positive setting is for devices that generate a positive pulse relative to ground, and bipolar is used for devices that generate a sinusoidal or bipolar (square wave) output. A gear tooth or blade pass waveform uses the bipolar setting. See figure below for correct signal polarity.

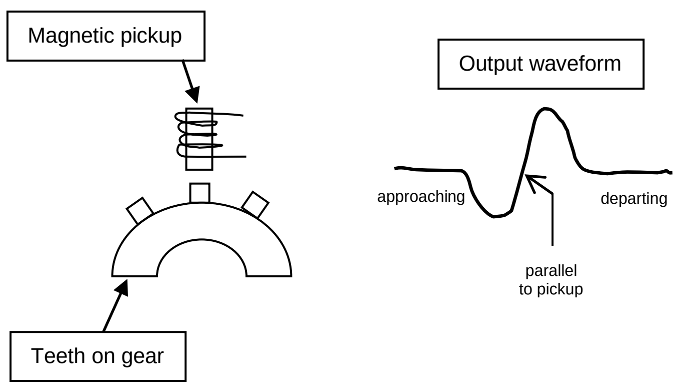
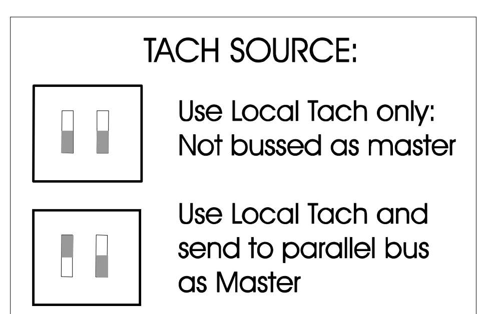


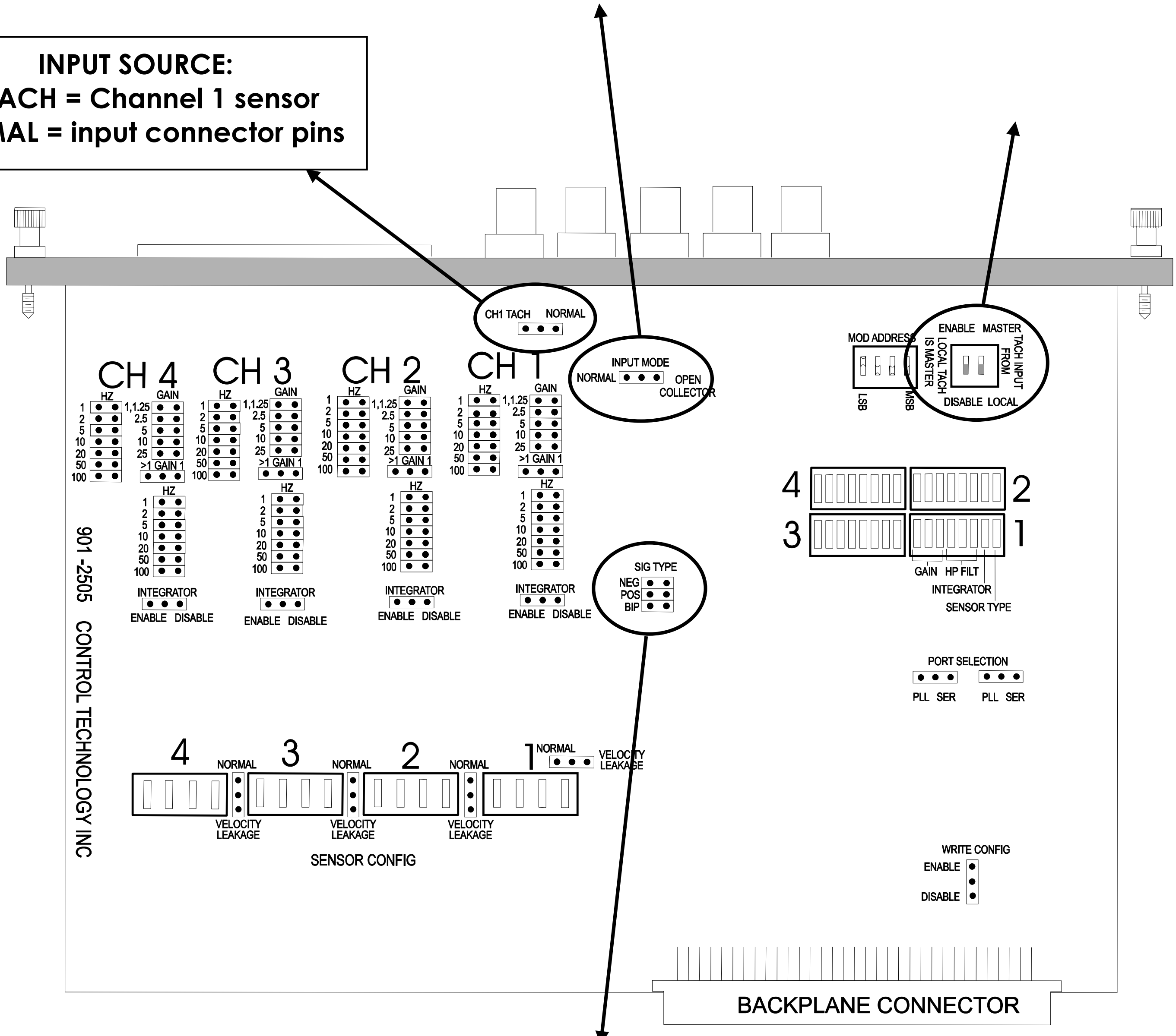
Figure 2.6. Bipolar gear tooth example

Configuration word WY(40) determines whether the tach pulses coming from the hardware circuitry are counted as once per revolution or as multiple pulses per revolution.
If WY(40) is set to 0, the speed as sensed from the tach is reported to the PLC WX(14) in Hertz; an RPM selection is not possible. If WY(40) is set to 1, that equates to a single pulse per revolution. The choice of speed reporting is made by setting WY(19.6) to 1 for Hertz or 0 for RPM. For teeth on a gear or blade passes, set WY(40) equal to the number of teeth on the gear (or vanes on the fan).

INPUT MODE:
NORMAL = typical setting
OPEN COLLECTOR = input is connected thru a 10kOhm resistor to +15Vdc; no external pull-up or power source needed.



INPUT SOURCE:
CH1 TACH = Channel 1 sensor
NORMAL = input connector pins



SIG TYPE:
NEG = devices that generate a negative pulse relative to ground
POS = “ “ “ “ positive “ “ “ “
BIP = “ “ “ “ sinusoidal or bipolar (square wave)

Figure 2.7. Selecting Tachometer Options

2.3.8. Selecting the Port Type

The port type can either be parallel or serial and is selected on jumpers JP88 and JP89 (see Figure 2.8. on next page). If the 2505 is not paired with a 2506 Vibration Sensor Analysis Module (available mid-2004), then the serial port should be selected. This enables the DB9 serial port on the front of the module. A software package is available from CTI / MAARS which is capable of downloading waveform data from the serial port in a “snapshot” mode. This data can be portrayed as a time domain waveform or as a frequency domain spectrum. The historical trending and analysis features of the 2506 Vibration Sensor Analysis Module are not available in this mode. The 2505 stops processing vibration input data during this download process so it is recommended that this capability not be used frequently if the module is monitoring critical machinery for shutdown purposes.

The purpose of the parallel port interface is to connect the 2505(s) to the 2506 Vibration Sensor Analysis Module. This bus transfers waveform data at a speed which does not interfere with the ability of the 2505 to continuously monitor the vibration signals.

The status of the port activity is available in WX(15). Bit 11 indicates if the processor on the 2505 has been halted due to activity on either the serial or parallel port. Bit 12 indicates a timeout condition due to a failure of the 2506 to respond to a signal from the 2505.

2.3.9. Selecting the Module Address

The module address is set via switchblock SW10 (see Figure 2.8. on next page). It is only used when the 2506 Vibration Sensor Analysis Module (available mid-2004) is in the system. Two addresses are reserved: address 0 is always the 2506, and an address of F (hex) is used for the 2506 to broadcast to all 2505s. The 2505 can therefore be address 1 through E (hex) and is shipped with the 0001 address.

2.3.10. Selecting the Write Configuration

The Write Configuration is set via jumper JP20 (see Figure 2.8. on next page). In the Enable position, the 2505 can be dynamically configured from the PLC at any time. In this mode, changes can be made to one channel’s parameters, e.g. Alarm Delay Time, without affecting the operation of any other channel. If the application is sensitive or perhaps subject to agency regulation, the jumper can be set to Disable. In this mode, only one set of configuration parameters can be downloaded to each channel. Dynamic changes are not accepted by the 2505. To effect a change, the module must be power cycled, then another set of parameters will be accepted.

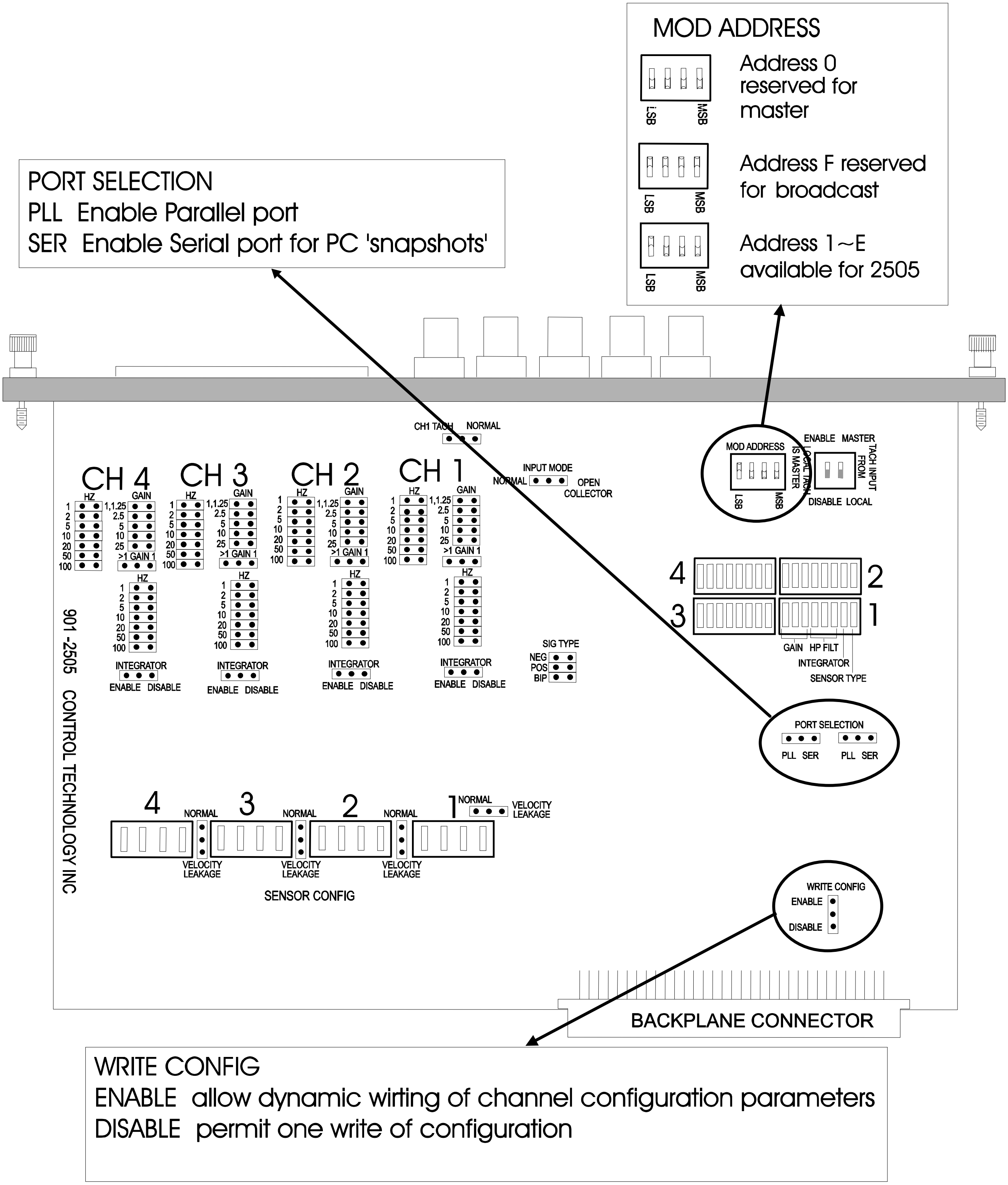


Figure 2.8. Selecting the Port Type, Module Address, and Write Configuration

2.3.11. Setting Dip switches to match the hardware settings

Once the hardware jumpers are selected this information needs to be reported to the microcomputer. The information is reported via DIP switches SW6, 7, 11, and 12. Each channel uses 8 rocker switches with a BCD code to indicate the state of the hardware jumpers. The 2505 compares the state of these switches to the configuration word WY(20) which comes from the user's program in the PLC. Because of the need to isolate the field-side circuitry from the logic-side, there is no physical check to make sure the module is configured the same as the PLC "thinks" it is. These switches are simply a step to help ensure there are no setup mis-matches.

Channel Dip Position(s)	**BCD code**	**Corresponding Value**
1-3	000	Gain = 1.0
1-3	100	Gain = 1.25
1-3	010	Gain = 2.50
1-3	110	Gain = 5
1-3	001	Gain = 10
1-3	101	Gain = 25
1-3	110	N/A
1-3	111	N/A
4-6	000	High Pass Filter = 1Hz
4-6	100	High Pass Filter = 2 Hz
4-6	010	High Pass Filter = 5 Hz
4-6	110	High Pass Filter = 10 Hz
4-6	001	High Pass Filter = 20 Hz
4-6	101	High Pass Filter = 50 Hz
4-6	011	High Pass Filter = 100 Hz
4-6	111	N/A
7	0	Integrator Value = Disabled
7	1	Integrator Value = Enabled
8	0	Sensor type = Accelerometer or Velocity Probe
8	1	Sensor type = Displacement Probe

Figure 2.9. Jumper Settings for Future Reference

See "Appendix A. Jumper Settings Log Sheet" to document individual channel settings after making copies for each of the four channels.

2.4. Inserting the Module in the I/O Base

Insert the module into the I/O base by carefully pushing the module into the slot. When the module is fully seated in the slot and backplane connector, tighten the captive screws at the top and bottom to hold the module in place. To remove the module from the I/O base loosen the captive screws then remove the module from the I/O base.

2.5. Wiring the Module

Input and output signals travel through a variety of connectors accessible on the front panel of the module: a 9-pin serial connector, a high speed 24-pin communications connector with latches, a group of five BNC connectors, and a dual row 24-pin connector. Each connector type and its function is described below.

2.5.1. Serial connector

The 9-pin D-SUB serial connector interfaces with a software program available from CTI/MAARS which takes “snapshot “ data from the module and provides the time-domain waveforms and frequency-domain spectrum on a PC. This port requires significant attention from the on-board microprocessor (e.g. 10 seconds to download maximum data from all four channels) so is not recommended for frequent usage, especially in a critical application.

2.5.2. High Speed Communications connector

The 24-pin connector acts as a high speed communication connector to transfer signals between the 2505 and a vibration data analysis program. This port is much faster than the serial port and will not interfere with the normal scanning of the inputs.

2.5.3. BNC connectors

Five individual BNC connectors for channels A-D and the tachometer signal are available for use with external analysis equipment. These are buffered but the signal output is not filtered.

2.5.4. Signal input connector

This connector provides wiring terminals for channels A-D and for a tachometer signal. The wiring connector accepts 14-26 AWG solid or stranded wire.

2.6. Checking Module Operation

First turn on the base supply power. If diagnostics detects no problems, the front panel module status indicator will light. If the indicator does not light (or goes out during operation), the base power is not available or the module has detected a different failure. For information on viewing failed module status, refer to your SIMATIC® TISOFT Programming Manual. To diagnose and correct a module failure, refer to the next section on troubleshooting.

You must also check that the module is configured in the memory of the PLC. This is important because the module will appear to be functioning regardless of whether it is communicating with the PLC. To view the PLC memory configuration chart listing all slots on the base and the inputs or outputs associated with each slot, refer to your SIMATIC® TISOFT Programming Manual. An example chart is shown in the following figure.
In this example, the 2505 Module is inserted in slot 1 in I/O base 0. For your particular module, look in the chart for the number corresponding to the slot occupied by the module. If word memory locations appear on this line, then the module is registered in the PLC memory and the module is ready for operation.

I/O Module Definition for Channel…….1 Base..…..00

		Number of Bit and Word I/O				
Slot	**I/O Address**	**X**	**Y**	**WX**	**WY**	**Special Function**
1	0001	00	00	18	22	NO
2	0000	00	00	00	00	NO
.	.	.	.	.	.	.
.	.	.	.	.	.	.
15	0000	00	00	00	00	NO
16	0000	00	00	00	00	NO

Figure 2.11. I/O Configuration Chart

If the line is blank or erroneous, re-check the module to ensure that it is firmly seated in the slots. Generate the PLC memory configuration chart again. If the line is still incorrect, contact your local distributor or CTI at 1-800-537-8398 for further assistance.

NOTE:
In the event a CTI analog module detects an onboard module failure, the module will assert the module fail line and report the module failure in the I/O Status Word, which is reported to the PLC CPU. CTI strongly recommends the user application monitor the I/O Module Status Words which are Status Words 11-26 and apply to SIMATIC® Controllers TI/545, TI/555, TI/560 & 565, and the TI/575. The I/O Module Status Word can be used to report a module failure for an I/O Module in any of theSimatic® 505 I/O slots. Please refer to Siemens® SIMATIC® TI505 Programming Reference Manual for more information. If a module failure is reported by the status word, the module should be replaced with a working unit and the failed module sent in for repair.

CHAPTER 3. SOFTWARE CONFIGURATION

In addition to the module hardware configuration settings noted in Chapter 2, a number of other items are addressed in regards to vibration monitoring. They are:

1. Intrinsic Safety Barrier Attenuation Factor
2. Output Scale Factor
3. Units of Measurement
4. Input Scale Factor
5. Reporting Mode
6. Trip Multiply Value
7. Probe Sensitivity
8. Alert / Danger Setpoints and Time Delays
9. Displacement Probe Response Curve
10. Gap Over/Under and Bias High/Low
11. Parameters that apply to All Channels
12. Analog Values and Status Bits

3.1. Intrinsic Safety Barrier Attenuation Factor

The module can automatically compensate the readings it reports to the PLC if an Intrinsic Safety barrier is present. It uses the value of WY(21) to adjust the reported reading. For instance, if an IS barrier is used which attenuates the signal 9%, set WY(21)=9. An actual input value of 91mV will be reported to the PLC as 100mV, thus compensating for the 9% decrease in sensed voltage due to the barrier. Alert and Danger Setpoints should be set to the levels that would be seen if there were no IS barrier present. A value of 0 in WY(21) means there is no attenuation compensation (i.e. no IS barrier).

WY(21)	Intrinsic Safety barrier attenuation value

3.2. Output Scale Factor

The output of a typical vibration sensor is a very low mV level. Since the PLC cannot display decimal point values (and it is inconvenient to use floating point numbers), Scaling will normally be needed. The value of WY(22) is the power of 10 by which the reported value is multiplied. If no scaling is used, this is 10^0 or multiply by 1. A value of 1 is equivalent to 10^1 or multiply by 10; an actual vibration of 0.13g RMS would be reported as 0 (no decimal values). A value of 2 (10^2 or multiply by 100) will be typical; vibration of 0.13g RMS will be reported as 13. It is possible to reduce the reading by using negative powers; these are converted into Hex as one's complement numbers. A value of –1 (10^{-1} or divide by 10) is FF in Hex.

	Output Scale Factor
WY(22)	**FC, FD, FE, FF, 0, 1, 2, 3,**

3.3. Units of Measurement

A vibration sensor can be specified in either English or Metric units. It may be that a Metric sensor is used in an application where English output units are desired. WY(23) makes it possible to accommodate any of these cases. The first number specifies the Input spec of the sensor and the second number determines the Output mode. A value of "0" is English units, and "1" is Metric.

00 (0) = English units on Input and Output (g, ips, mils)
11 (3) = Metric units on Input and Output (m/s^2, mm/s, μm)
01 (1) = English units on Input, Metric units on Output
10 (2) = Metric units on Input, English units on Output

Most applications will have a value of "0" in this location.

	Units of Measurement
WY(23)	**0, 3, 1, 2**

3.4. Input Scale Factor

Just as the reported value output to the PLC can be scaled, the actual input reading can also be scaled. The value of WY(24) is the power of 10 by which the actual reading is multiplied. The computations are the same as used in the Output Scale Factor. It is anticipated that most applications will not require Input Scaling and therefore this value should be "0". See the paragraph on Probe Sensitivity for an example where this is useful.

	Input Scale Factor
WY(24)	**FC, FD, FE, FF, 0, 1, 2, 3,**

3.5. Reporting Mode

The module receives a mV signal input from the vibration sensor and translates this into the equivalent vibration reading based on the sensor specifications and other variables. In some cases it may be desired to know the actual voltage reading instead of the vibration value. WY(25) chooses whether the reported value is in Engineering Units or the raw mV. There is also a choice of type of output:

RMS is normally used and is an "average" of the input readings.
Peak is a computed value equal to the RMS value times 1.4.
Peak-Peak is a computed value equal to the Peak value times 2. Do not confuse this with the True Peak-to-Peak value which the module also reports.

0 = RMS raw mV	1 = RMS engineering units
2 = peak raw mV	3 = peak engineering units
4 = p-p raw mV	5 = p-p engineering units

	Reporting Mode
WY(25)	**0, 1, 2, 3, 4, 5**

It is possible to select a mode that exceeds the range of a signed integer data type (-32765 to 32767), yet have an actual vibration level that is OK. For example: Output Scale of 100 reporting in RMS engineering units gives an acceptable reading. Changing the Scale factor or the Report Mode may cause the reported value to exceed +32767. Always check the WX(15.10) Math Overflow status bit to ensure the reported value is legitimate.

3.6. Trip Multiply Value

If the module is calculating the Alarm and Danger Setpoints, then it can go into Trip Multiply mode where the setpoints are raised by the factor specified in WY(26). This Trip Multiply Value can be set on a per-channel basis and is activated when the module receives the WY(19.8) command bit from the PLC. Trip Multiply mode is maintained until the command bit is lowered. For instance, an alarm setpoint of 2 g's can be raised to 3 g's during startup or coastdown to avoid harmonic regions and spurious alarms. The value of WY(26) would be set to "1" indicating a 50% increase in setpoint. The possible values for WY(26) are:

0 = no change in Setpoint
1 = 50% increase in Setpoint
2 = 100% increase
4 = 150% increase
8 = 200% increase

WY(26)	Trip Multiply Value

3.7. Probe Sensitivity

The sensitivity of a vibration probe is specified by the manufacturer and is typically a nominal value such as 100mV/g (accelerometer) or 200mV/mil (displacement probe). The 2505 expects this parameter to be expressed in terms of RMS. This is normal for accelerometers however velocity transducers are often specified as 145mV/ips peak. This value needs to be converted to RMS (by dividing by 1.414) which yields 102.6mv/ips RMS. This can in most instances be approximated as a sensitivity of 100. The module can go a step further and accept the more accurate calibrated value if it is known. It can also accept Metric inputs with decimal values; the WY(24) Input Scale Factor is used. For example:

200mV/mil prox probe → WY(27) = 200	WY(24) = 0
7.87mV/µm prox probe → WY(27) = 787	WY(24) = FE (10^{-2})
10.2mV/m/s^2 accelerometer → WY(27) = 102	WY(24) = FF (10^{-1})
102mV/g calibrated accel → WY(27) = 102	WY(24) = 0

WY(27)	Probe Sensitivity

3.8. Alert / Danger Setpoints and Time Delays

The next four configuration words (WY(28) through WY(31)) specify the Alarm and Danger levels, and Time Delays. If the module is not calculating alarms (control bit WY(19.5) is ON) then no values need to be entered. **Note: If setpoints are not entered, then the front panel LEDs will always be in alarm (flashing).** For applications where alarm calculations are desired, refer to the following figure for assistance in determining appropriate values.

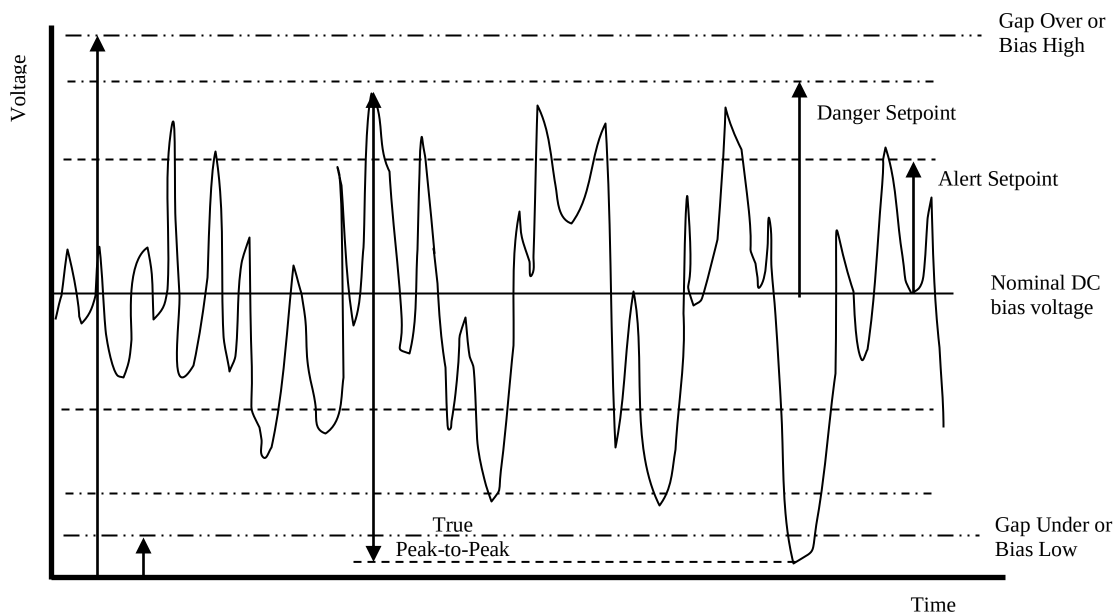


Figure 3.1. Alarm & Danger levels, Time Delay example chart

The 2505 allows several options in how vibration levels are alarmed. The first choice is whether to alarm on a level that is calculated or on the True Peak-to-Peak. As a vibration signal comes into the 2505, it is transformed by the analog-to-digital (ADC) converter into a digital representation. A math process converts the raw data points into an RMS (Root Mean Square) value. This is often called the Overall Vibration value and is very roughly analogous to the average of all the data values. Since the math process is an averaging function, the effect of a single peak on the overall value is reduced. From this RMS value, two other representations are possible: the calculated Peak (1.4 x RMS) and the calculated Peak-to-Peak (1.4 x RMS x 2). It is important to distinguish that these are calculated values. If the vibration waveform is a true sine wave, then the calculated values would correlate exactly with the actual peak and peak-to-peak measurements. Since vibration is never a perfect sine wave, these are therefore approximations based on calculated values.

The 2505 does give the option of alarming on the True Peak-to-Peak. This is demonstrated graphically in Figure 3.1, and is obtained by adding the maximum positive value out of the ADC to the absolute value of the maximum negative value. These maximum values are not necessarily caused by the same physical condition. In other words, the maximum positive value could be caused by misalignment whereas the maximum negative value is due to oil whirl. Whether or not that is possible, the point is that there may not be any correlation in the timing of the max positive peak and the max negative peak. This value is the maximum vibration (physical movement) experienced and therefore is often monitored on proximity probes. The RMS value is a more accurate representation of the overall vibration and is often used as a trend variable to detect increasing vibration levels over time.

Alert and Danger setpoints are specified in engineering units and are subject to the Output Scale Factor. Reference WY(19.13~15) for data source (calculated or true p-p), WY(25) for calculated mode (RMS, peak, p-p), and WY(25) for units (English = g, ips, mils; Metric = m/s^2, mm/s, μm). Input signals that exceed these setpoints are subject to the specified Time Delays and are reported as Status Bits, e.g. WX(1.5) and WX(1.6).

For example:
Accelerometer input, Alarm level of 0.4g RMS with Output Scale Factor of 2 ➔ WY(28)=40
Same input and Alarm level, but Output Scale Factor of 1 ➔ WY(28) = 4

Time Delays require the input to be above the Alarm / Danger Setpoint for the specified time before the Alarm or Danger status bit is triggered. If the input level dips below the Setpoint during the Time Delay, the count is reset. Time Delays are specified in seconds x 10. For a delay of 3 seconds, WY(29) = 30.

WY(28)	Alert Setpoint
WY(29)	Alert Time Delay
WY(30)	Danger Setpoint
WY(31)	Danger Time Delay

Once an alarm has been triggered, it remains on until the input signal returns to a level below the Setpoint. It is therefore possible for an alarm to be triggered for only one scan and then to reset. Logic in the PLC should be used to capture the alarms.

3.9. Displacement Probe Response Curve

The next four configuration parameters (WY(32) through WY(35)) are used only for displacement probes. They specify the slope of the response curve for the probe. Accurately filling in these values allow the module to report displacement probe vibration values in mils. Without this information, the module can only report the mV signal levels it gets from the probe. These parameters are also useful when calibrating the probe during installation (gapping the probe) on the machine to be monitored. If any of these values are zero, the module will report mV. Refer to the following figure for an example of WY(32) through WY(35) parameters.

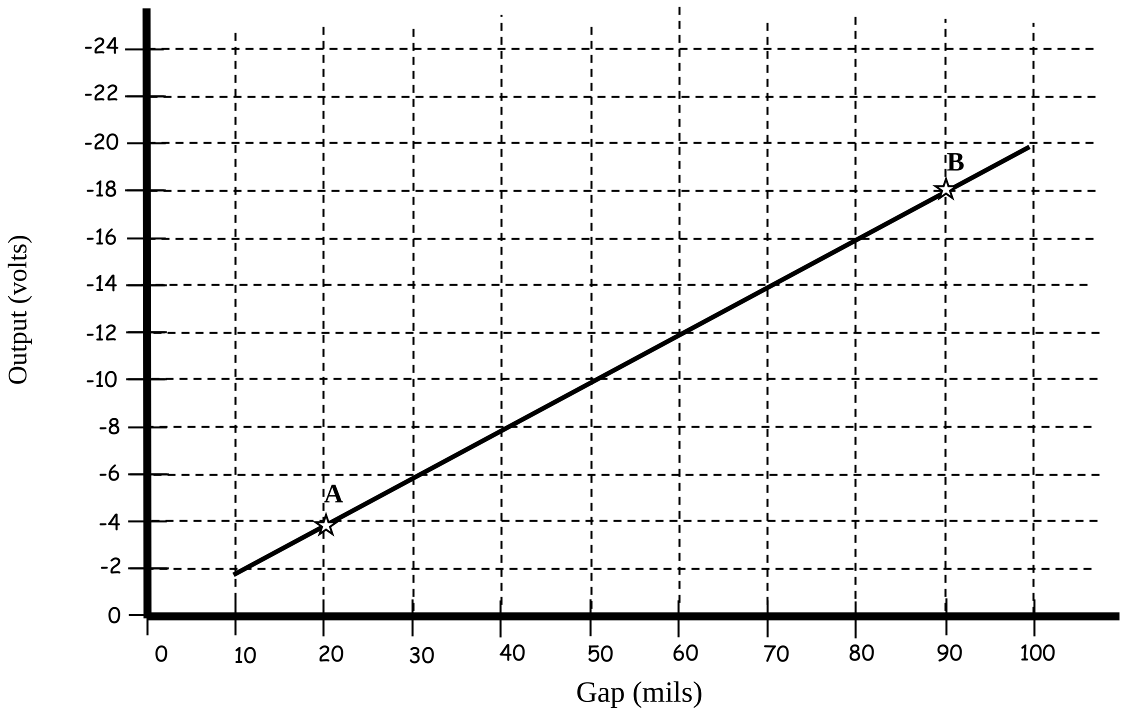


Figure 3.2. Displacement probe (200mV/mil) chart example

At point A, the DC output voltage equals –3.98V and gap distance is 20 mils.
At point B, the DC output voltage equals –18V and gap distance is 90 mils.
WY32 is the gap voltage specified as V x 100 ➔ WY(32) = -398, and WY(34) = -1800.
The gap distance values are specified in mils ➔ WY(33) = 20 and WY(35) = 90.

WY(32)	Gap Voltage at Point A
WY(33)	Gap Distance at Point A
WY(34)	Gap Voltage at Point B
WY(35)	Gap Distance at Point B

3.10. Gap Over/Under and Bias High/Low Alarm Setpoints

The last two parameters are measurements of the DC voltage component of the sensor's output. The AC voltage component is the vibration measurement which is reported in WX(2) and WX(3) for Channel A, etc. For an accelerometer this DC component is called Bias High/Low. For a displacement probe it is Gap Over/Under. A velocity transducer is typically a self-powered sensor so it does not have a bias voltage, but a small current can be run through the sensor to ascertain circuit continuity (call CTI for information on Special Product Quote 393). This DC component is an important measure of the integrity of the probe circuit and is reported separately in WX(4) for Channel A, etc. A separate status bit is also reported (WX(1.7) for Channel A, etc. if either one of these setpoints are exceeded. There are no Time Delays associated with these DC measurements. The values are specified in Volts and are scaled between 0 and ±2400. Accelerometer values are typically positive voltages and displacement sensors are negative voltages. Refer to the figure on Alarm and Danger levels for assistance in setting these parameters.

For displacement probes: if the Probe Response Curve has been specified (WY(32~35)), the value reported in WX(4) is the displacement distance not the voltage. The Gap Over/Under alarm still measures the bias voltage even though it is not being reported. Gapping the probe is normally done using voltage, but the 2505 module allows distance to be used if desired.

Important note: when dealing with negative values, the more negative value is considered to be lower than the less negative value. Format WY(36) and WY(37) as signed integers in the PLC.

For example, if the desired setpoints are –20V and -10V, then
Gap Over setpoint is –10 ➔ WY(36) = -1000, and Gap Under setpoint is –20 ➔ WY(37) = -2000. Remember these are scaled between 0 and ±2400.

WY(36)	Gap Over or Bias High Alarm Setpoint
WY(37)	Gap Under or Bias Low Alarm Setpoint

3.11. Parameters that apply to All Channels

These last three words only need to be written to the module one time. In the RLL example program in Appendix B, they are written along with each channel's individual configuration parameters but the only download that matters is the last one.

F_{max} = WY(38) (Note: This value sets the low-pass filter for the module.)

Number of samples = WY(39)

Refer to figure below to correlate these two values with the amount of time the module will take to process each sample. All channels are sampled simultaneously so this value applies to the module. The "# of lines" is used in vibration analysis; it refers to the number of discrete frequency values in the spectrum. It is directly correlated to the "# of samples" in that more samples are necessary to display greater spectral detail, and enough samples must be taken to avoid aliasing (Nyquist theorem). Not all the cells contain a value because these were empirically determined; cells in the same row to the left of a specified value will be greater and cells to the right will be less. The purpose is to show the limits where the module complies with the API670 specification which states that the module must be able to sense a vibration level in excess of a threshold in less than 100ms. (The rest of the spec requires a response time of between 1 and 3 seconds.)

WY(38)	Hz f_{max}	Time to Sample (in sec)								
F	50000	4.1		1.2	0.6	0.35				
E	25000		2.05		0.6					
D	12000				0.6					
C	6000				0.6					
B	3000				0.6					
A	1500				0.8	0.4				
9	800				1.05	0.55				
8	400					0.8	0.4			
7	200					1.3	0.65	0.35		
6	100						1.15	0.60		
5	50							1.1	0.55	
4	25								1.1	0.55
# of lines		3200	1600	800	400	200	100	50	25	12.5
# of samples		8192	4096	2048	1024	512	256	128	64	32
WY(39)		**F**	**E**	**D**	**C**	**B**	**A**	**9**	**8**	**7**

Figure 3.3. Time to Sample Correlation Chart
(cells in the shaded area indicate API670-compliant region)

WY(38)	**F_{max} (0 through F)**
WY(39)	**# of samples (7 through F)**

Speed Sensing = WY(40)

If using a toothed gear, WY(40) = # of teeth (max of 255)
If sensing a single pulse per revolution, WY(40) = 1
Note: If WY(40) = 0, then speed is reported to PLC in Hz; RPM not possible.

WY(40)	**Speed sensing (0, 1, or 2-255)**

Rfer to Figure 3.4. on the next page for a detailed WX/WY summary.

I/O login			WX/WY Summary															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
WX		1	Configuration acknowledge				Channel A			Channel B			Channel C			Channel D		
			Ch A	Ch B	Ch C	Ch D	Alert	Danger	Probe	Alert	Danger	Probe	Alert	Danger	Probe	Alert	Danger	Probe
WX		2	Channel A		Calculated vibration (RMS, Peak, Peak-Peak)													
WX		3			True Peak-to-Peak vibration													
WX		4			Probe circuit bias voltage													
WX		5	Channel B		Calculated vibration (RMS, Peak, Peak-Peak)													
WX		6			True Peak-to-Peak vibration													
WX		7			Probe circuit bias voltage													
WX		8	Channel C		Calculated vibration (RMS, Peak, Peak-Peak)													
WX		9			True Peak-to-Peak vibration													
WX		10			Probe circuit bias voltage													
WX		11	Channel D		Calculated vibration (RMS, Peak, Peak-Peak)													
WX		12			True Peak-to-Peak vibration													
WX		13			Probe circuit bias voltage													
WX		14	Tachometer reading															
WX		15	Module status	Tach Over	Tach Under	No Tach	Configuration status				Not defined	Math over	Port stop	Parallel port	ADC overrange			
							Ch A	Ch B	Ch C	Ch D					Ch A	Ch B	Ch C	Ch D
WX		16	Channel A Syntax Error (in hex)								Channel B Syntax Error (in hex)							
WX		17	Channel C Syntax Error (in hex)								Channel D Syntax Error (in hex)							
WX		18	Not defined															
WY		19	Configuration command				Alarm master	Speed report	Module inhibit	Trip Multi-ply	Not defined				RMS / True P-P alarm control (0=RMS)			
			Ch A	Ch B	Ch C	Ch D	0=alarm	0=RPM	0=run						Ch A	Ch B	Ch C	Ch D
WY		20	Transducer type & integration				Gain				High-pass filter value				Not defined			
WY		21	Intrinsic safety barrier attenuation value															
WY		22	Output scale factor				(1 = 10^1, 2 = 10^2, 3 = 10^3, FF = 10^{-1}, FE = 10^{-2})											
WY		23	Units of measure				(0 = English in/out, 3 = Metric in/out, 1 = English in, Metric out, 2 = Metric in, English out)											
WY		24	Input scale factor				(1 = 10^1, 2 = 10^2, 3 = 10^3, FF = 10^{-1}, FE = 10^{-2})											
WY		25	Report Mode				(0 = mV 1 = eng units)											
WY		26	Trip Multiply value				(1 = 50% increase, 2 = 100% increase, 4 = 150% increase)											
WY		27	Probe Sensitivity															
WY		28	Alert Setpoint				(x 10^{WY22})											
WY		29	Alert Time Delay				(10 = 1 sec)											
WY		30	Danger Setpoint				(x 10^{WY22})											
WY		31	Danger Time Delay				(10 = 1 sec)											
WY		32	Gap Voltage at A				(scaled 0 to +/- 2400)											
WY		33	Gap Distance at A				(in mils)											
WY		34	Gap Voltage at B				(scaled 0 to +/- 2400)											
WY		35	Gap Distance at B				(in mils)											
WY		36	Gap Over or Bias High Alarm Setpoint						(scaled 0 to +/- 2400)									
WY		37	Gap Under or Bias Low Alarm Setpoint						(scaled 0 to +/- 2400)									
WY		38	F max				(F = 50k, E = 25k, D = 12k, C = 6k, B = 3k, A = 1.5k, 9 = 800, 8 = 400, 7 = 200)											
WY		39	Number of Samples				(F = 8192, E = 4096, D = 2048, C = 1024, B = 512, A = 256, 9 = 128, 8 = 64)											
WY		40	Number of Teeth															

Figure 3.4. WX/WY Summary Chart

CHAPTER 4. TROUBLESHOOTING

Symptom	Probable Cause	Corrective Action
Module status LED is not lit.	• Base or PLC power is off. • Module has not completed power up diagnostics. • Serious problem with module exists.	• Turn base or PLC on. • Wait for power up diagnostics to be completed. • Return module to CTI for repair.
Module XMT/RCV LEDs are not blinking	• If serial or high speed comm. Port is not populated, then module is operating properly. • Comm. problem exists between module/PC.	• N/A • Try to reseat communication cables between modules/PC.
Single channel stopped reporting	• Spike in incoming voltage exceeding fuse value.	• Replace removable SMT fuse with Littelfuse 154.062 or equivalent.
Individual channel LED not lit	• Channel not configured. • Channel has bad configuration.	• Configure channel. • Check channel configuration; change necessary values.
Continuous Red channel LED	• Probe circuit fault.	• Check probe driver (where applicable) and probe for damage/proper functioning.

Figure 4.1 Troubleshooting Matrix

When it is inconvenient to visually check the status indicator, use the TISOFT "Display Failed I/O" or "Show PLC Diagnostics" support functions. Note that if the module power supply (user supply) fails, the module will still be logged into the PLC even though it is not operating.

If after consulting the chart above and you are unable to diagnose or solve the problem, contact CTI at 1-800-537-8398 for further assistance.

SPECIFICATIONS

Input Channels:	4 input channels plus tachometer
Sensor Types:	Accelerometer, Velocity, and Proximity
Response Time:	4 mSec total module (includes settling time)
Gain settings:	1, 1.25, 2.5, 5, 10, 25
High-pass filter values:	1, 2, 5, 10, 20, 50, 100 Hz
PLC Reporting of:	Overall RMS vibration level Peak-to-Peak value DC bias voltage of probe circuit Speed (in RPM or Hz) Probe Circuit Fault status bit Alarm/Danger status bits Module status word
Reporting units:	mils, i.p.s., g's, meters, m/s, m/s^2
Isolation:	1500 VDC channel-to-PLC
Backplane Power Consumption:	up to 14.0 Watts
Module Size:	Double-wide
Module (Packed) Weight:	2.0 lbs (0.9 kg)
Operating Temperature:	0° to 60°C (32° to 140°F)
Storage Temperature:	-40° to 85°C (-40° to 185°F)
Humidity, Relative:	5% to 95% non-condensing
Agency Approvals Pending:	UL, UL-C, FM (Class 1, Div 2), CE

Specifications subject to change without notice.

APPENDIX A. CONFIGURATION LOG SHEET

These two pages are provided for an easy record of each channel's configuration setup. Make copies for each channel that is configured differently.

Channel ___

Sensor type (accelerometer velocity displacement) **Integrated** (Yes No)

Sensitivity ____________________

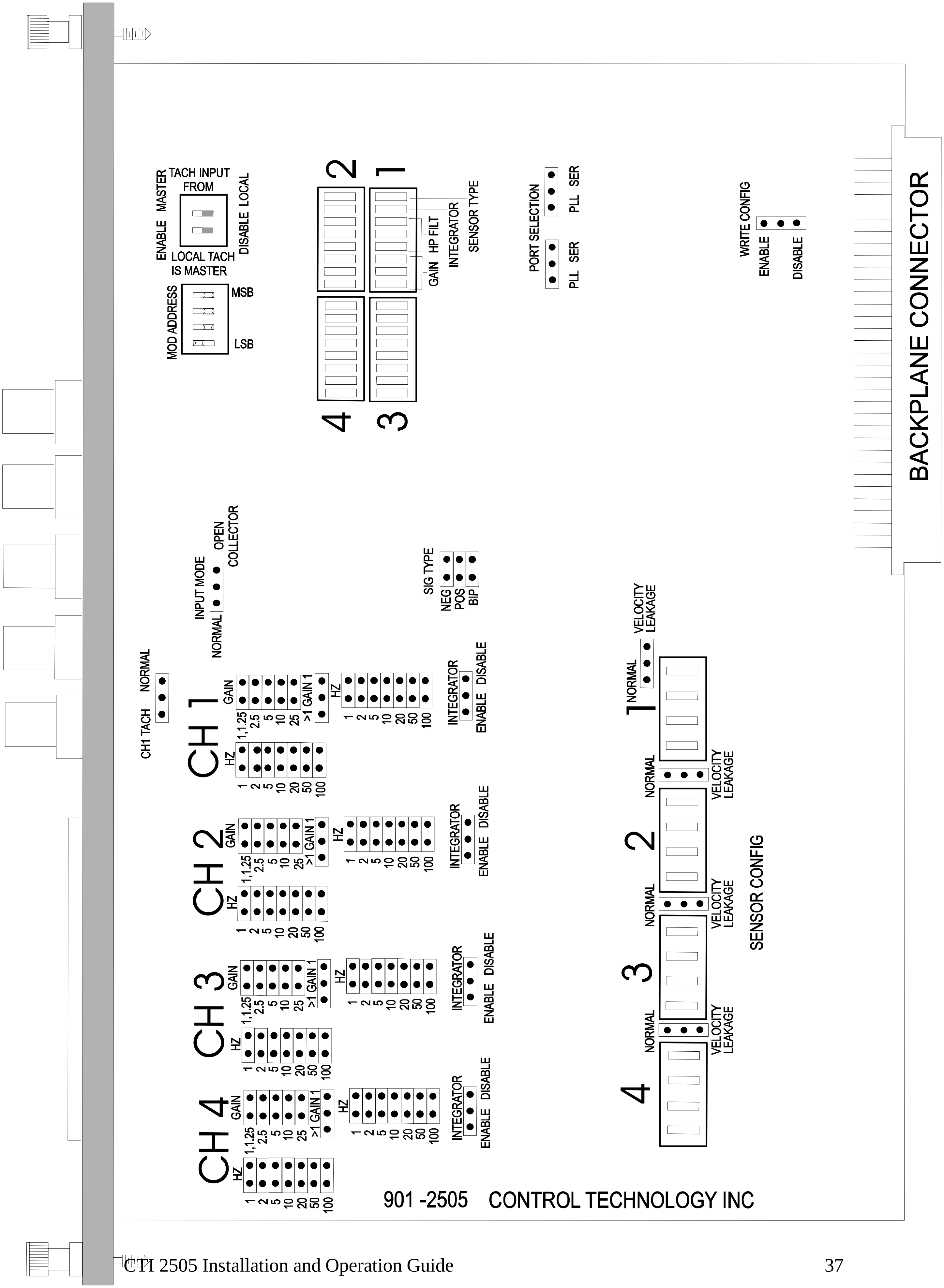
Gain (1 1.25 2 5 10 25) **High-pass filter setting** (1 2 5 10 20 50 100)

Report (RMS Peak Peak-Peak True P-P) **Alarm on** (none RMS True P-P)

Parameters stored in V-memory at V_________

Parameters stored in K-memory at K_________

WY__	Hex	____________________	Transducer Type & Integ. / Gain / HP Filter
WY__	Sint	____________________	Intrinsic Barrier Attenuation Factor
WY__	Sint	____________________	Output Scale Factor
WY__	Sint	____________________	Units of Measurement
WY__	Sint	____________________	Input Scale Factor
WY__	Sint	____________________	Reporting Mode
WY__	Sint	____________________	Trip Multiply Value
WY__	Sint	____________________	Probe Sensitivity
WY__	Sint	____________________	Alert Setpoint
WY__	Sint	____________________	Alert Time Delay
WY__	Sint	____________________	Danger Setpoint
WY__	Sint	____________________	Danger Time Delay
WY__	Sint	____________________	Gap Voltage at A
WY__	Sint	____________________	Gap Distance at A
WY__	Sint	____________________	Gap Voltage at B
WY__	Sint	____________________	Gap Distance at B
WY__	Sint	____________________	Gap Over or Bias High Alarm Setpoint
WY__	Sint	____________________	Gap Under or Bias Low Alarm Setpoint
WY__	Hex	____________________	F_{max}
WY__	Hex	____________________	# of samples
WY__	Sint	____________________	# of gear teeth


TACH INPUT FROM
ENABLE MASTER
DISABLE LOCAL
LOCAL TACH IS MASTER
MOD ADDRESS
MSB
LSB
2
1
4
3
GAIN HP FILT
INTEGRATOR
SENSOR TYPE
PORT SELECTION
PLL SER
PLL SER
WRITE CONFIG
ENABLE
DISABLE
BACKPLANE CONNECTOR
INPUT MODE
NORMAL
OPEN COLLECTOR
SIG TYPE
NEG
POS
BIP
CH1 TACH
NORMAL
CH 1
CH 2
CH 3
CH 4
GAIN
1,1.25
2.5
5
10
25
>1 GAIN 1
HZ
1
2
5
10
20
50
100
INTEGRATOR
ENABLE DISABLE
NORMAL
VELOCITY LEAKAGE
SENSOR CONFIG
901 -2505
CONTROL TECHNOLOGY INC

```
| LAD Network 1  Address 1
|The configuration parameters are stored in K-memory (non-volatile)
|then moved into V-memory.  The trigger contact for this Move Word
|command is latched so any parameter changes only need to be made once
|in K-memory and are automatically moved into V-memory.
|For this sample program:
|K1-21 ==> V1-21   Channel A  (proximity probe; also used as Tach source)
|K31-51 ==> V31-51   Channel B  (velocity transducer w. Open Probe detection)
|K61-81 ==> V61-81   Channel C        (accelerometer)
|K91-111 ==> V91-111  Channel D (proximity probe in axial (thrust) orientation)
|
| MoveK_to_V   +-------------------------+               MoveK_to_V
|              | MOVE WORD               |
|      C17     |                         |                    C17
[------] [-----]                         [--------------------( / )----
|              | A:                    K1|
|              |                         |
|              |             A_Transduce|
|              |             r_Gain_HP  |
|              | B:                    V1|
|              |                         |
|              |                         |
|              | N:                   120|
|              |                         |
|              |                         |
|              +-------------------------+
|
| LAD Network 2  Address 7
|This is the test for Channel A at power-up.  ConfigStatus for all
|channels will be OFF, so Channel A will be configured first.
|
| A_ConfigSta   B_ConfigSta   C_ConfigSta   D_ConfigSta   A_InitialCo
| tus           tus           tus           tus           nfig
|    WX15.5        WX15.6        WX15.7        WX15.8          C1
[------]/[-----------]/[-----------]/[-----------]/[----------(   )----
|
|
| LAD Network 3  Address 20
|This is the Dynamic re-configuration for Channel A.  If any parameters
|have been changed in K-memory, this Command Bit will force a re-load to
|Channel A.
|
|  A_ReConfig                                             A_DynamicCo
|                                                         nfig
|      C13           5                                        C81
[------] [----------] ^ [-------------------------------------(   )----
|
```

```
|
| LAD Network 4  Address 23
|This Move Word takes configuration parameters for Channel A from
|V-memory to WY, then sets the Channel A configuration command bit (WY19.1).
|Either the initial power-up or the dynamic reconfiguration can trigger this
|command.  The Configuration Acknowledge bit (WX1.1) is tested to keep the
|command from executing more than once per download operation.
|
| A_InitialCo   A_Config_X   +-------------------------+  A_Config_Y
| nfig                       | MOVE WORD               |
|      C1           WX1.1    |             A_Transduce|     WY19.1
[------] [----+------]/[-----]             r_Gain_HP  [------(   )----
|             |              | A:                    V1|
| A_DynamicCo |              |                         |
| nfig        |              |             Transducer_|
|      C81    |              |             Gain_HP     |
[------] [----]              | B:                  WY20|
|             |              |                         |
| A_Config_Y  |              |                         |
|             |              | N:                    21|
|    WY19.1   |              |                         |
[------] [----+              |                         |
|                            +-------------------------+
|
| LAD Network 5  Address 38
|This is the test for Channel B at power-up.  ConfigStatus for Channel A
|will be ON, but Channel B, C, and D will still be OFF.
|
| A_ConfigSta   B_ConfigSta   C_ConfigSta   D_ConfigSta   B_InitialCo
| tus           tus           tus           tus           nfig
|    WX15.5        WX15.6        WX15.7        WX15.8          C2
[------] [-----------]/[-----------]/[-----------]/[----------(   )----
|
|
| LAD Network 6  Address 51
|This is the Dynamic re-configuration for Channel B.  If any parameters
|have been changed in K-memory, this Command Bit will force a re-load to
|Channel B.
|
|  B_ReConfig                                             B_DynamicCo
|                                                         nfig
|      C14           6                                        C82
[------] [----------] ^ [-----------------------------------(   )----
|
|
| LAD Network 7  Address 54
|This Move Word takes configuration parameters for Channel B from V-memory
|to WY, then sets the Channel B configuration command bit (WY19.2).  Either
|the initial power-up or the dynamic reconfiguration can trigger this command.
|The Configuration Acknowledge bit (WX1.2) is tested to keep the command
|from executing more than once per download operation.

| B_InitialCo   B_Config_X   +-------------------------+   B_Config_Y
| nfig                       | MOVE WORD               |
|      C2           WX1.2    |             B_Transduce|     WY19.2
[------] [----+------]/[-----]             r_Gain_HP  [------(   )----
|             |              | A:                   V31|
| B_DynamicCo |              |                         |
| nfig        |              |             Transducer_|
|      C82    |              |             Gain_HP     |
[------] [----]              | B:                  WY20|
|             |              |                         |
| B_Config_Y  |              |                         |
|             |              | N:                    21|
|    WY19.2   |              |                         |
[------] [----+              |                         |
|                            +-------------------------+
```

```
|
| LAD Network 8  Address 69
|This is the test for Channel C at power-up.  ConfigStatus for Channel A
|and B will be ON, but Channel D will still be OFF.
|
| A_ConfigSta   B_ConfigSta   C_ConfigSta   D_ConfigSta   C_InitialCo
| tus           tus           tus           tus           nfig
|     WX15.5        WX15.6        WX15.7        WX15.8         C3
[------] [-----------] [-----------]/[-----------]/[----------(   )----
|
|
| LAD Network 9  Address 82
|This is the Dynamic re-configuration for Channel C.  If any parameters
|have been changed in K-memory, this Command Bit will force a re-load to
|Channel C.
|
|  C_ReConfig                                              C_DynamicCo
|                                                          nfig
|      C15           7                                         C83
[------] [----------] ^ [-------------------------------------(   )----
|
|
| LAD Network 10  Address 85
|This Move Word takes configuration parameters for Channel C from V-memory to
|WY, then sets the Channel C configuration command bit (WY19.3).  Either the
|initial power-up or the dynamic reconfiguration can trigger this command.
|The Configuration Acknowledge bit (WX1.3) is tested to keep the command
|from executing more than once per download operation.
|
| C_InitialCo   C_Config_X   +-------------------------+  C_Config_Y
| nfig                       | MOVE WORD               |
|      C3           WX1.3    |              C_Transduce|     WY19.3
[------] [----+------]/[-----]              r_Gain_HP  [------(   )----
|             |              | A:                   V61|
| C_DynamicCo |              |                         |
| nfig        |              |              Transducer_|
|      C83    |              |              Gain_HP    |
[------] [----]              | B:                  WY20|
|             |              |                         |
| C_Config_Y  |              |                         |
|             |              | N:                    21|
|    WY19.3   |              |                         |
[------] [----+              |                         |
|                            +-------------------------+
|
| LAD Network 11  Address 100
|This is the test for Channel D at power-up.  ConfigStatus for all other
|channels will be ON, but Channel D will still be OFF.
|
| A_ConfigSta   B_ConfigSta   C_ConfigSta   D_ConfigSta   D_InitialCo
| tus           tus           tus           tus           nfig
|     WX15.5        WX15.6        WX15.7        WX15.8         C4
[------] [-----------] [-----------] [-----------]/[----------(   )----
|
|
| LAD Network 12  Address 113
|This is the Dynamic re-configuration for Channel D.  If any parameters
|have been changed in K-memory, this Command Bit will force a re-load to
|Channel D.
|
|  D_ReConfig                                              D_DynamicCo
|                                                          nfig
|      C16           8                                         C84
[------] [----------] ^ [-------------------------------------(   )----
|
```

```
|
| LAD Network 13  Address 116
|This Move Word takes configuration parameters for Channel D from V-memory
|to WY, then sets the Channel D configuration command bit (WY19.4).  Either
|the initial power-up or the dynamic reconfiguration can trigger this command.
|The Configuration Acknowledge bit (WX1.4) is tested to keep the command
|from executing more than once per download operation.
|
| D_InitialCo   D_Config_X   +--------------------------+   D_Config_Y
| nfig                       | MOVE WORD                |
|      C4           WX1.4    |             D_Transduce|     WY19.4
[------] [----+------]/[-----]             r_Gain_HP  [------(   )----
|             |              | A:                  V91|
| D_DynamicCo |              |                        |
| nfig        |              |             Transducer_|
|      C84    |              |             Gain_HP    |
[------] [----]              | B:                 WY20|
|             |              |                        |
| D_Config_Y  |              |                        |
|             |              | N:                   21|
|    WY19.4   |              |                        |
[------] [----+              |                        |
|                            +--------------------------+
|
| LAD Network 14  Address 131
|This AlarmMode command bit chooses whether the module performs the alarm tests.
|The default value of 0 tells the module to test the channels for alarm levels
|and set the appropriate status bits in WX1.  If AlarmControl is set to 1,
|the module ignores any alarm settings; status bits remain at 0 and the
|front panel LEDs do not indicate alarm status.
|
|  AlarmMode                                          AlarmContro
|                                                     lBit
|      C5                                               WY19.5
[------] [---------------------------------------------------(   )----
|
|
| LAD Network 15  Address 135
|SpeedReport command bit chooses whether the Tach value reported in WX14
|is in Hz or RPM.  Default of 0 is RPM; 1 chooses Hz (RPM / 60).  The
|notted contact in this sample program is indicating Hz.
|
| SpeedReport                                         TachReportM
|                                                     ode
|      C6                                               WY19.6
[------]/[---------------------------------------------------(   )----
|
|
| LAD Network 16  Address 139
|The ModuleInhibit bit (WY19.7) forces the module to cease all processing;
|WX data words will be held at last value.  This rung is conditioning the
|ModuleInhibit by Module Status, e.g. the module must be functioning to be
|inhibited.  The default of 0 is the Run condition.
|
| ModuleInhib   ModuleStatu                             Inhibit
| it            s
|      C7         WX15.1                                 WY19.7
[------] [-----------] [-------------------------------------(   )----
|
|
| LAD Network 17  Address 146
|The TripMultiply command bit from the PLC / operator tells the module
|to take each channel's alarm levels to the Trip Multiply settings
|specified in the channel's configuration parameters.  When TripMultiply
|is released (back to 0 value) then each channel reverts to normal alarm levels.
|
| TripMultipl                                         TripMultipl
| yCtrl                                               y
|      C8                                                WY19.8
[------] [---------------------------------------------------(   )----
|
```

```
|
| LAD Network 18  Address 150
|This command bit for Channel A chooses whether processing of the alarm
|values for Alert and Danger specified in the configuration parameters
|is done on the RMS value (reported in WX2) or the True Peak-Peak value
|(reported in WX3).  Default of 0 is RMS.
|
| A_PeakPeak                                           A_AlarmChoi
|                                                      ce
|      C9                                                 WY19.13
[------] [---------------------------------------------------(   )----
|
|
| LAD Network 19  Address 154
|This command bit for Channel B chooses whether processing of the alarm
|values for Alert and Danger specified in the configuration parameters
|is done on the RMS value (reported in WX5) or the True Peak-Peak value
|(reported in WX6).  Default of 0 is RMS.
|
| B_PeakPeak                                           B_AlarmChoi
|                                                      ce
|      C10                                                WY19.14
[------] [---------------------------------------------------(   )----
|
| LAD Network 20  Address 158
|This command bit for Channel C chooses whether processing of the alarm
|values for Alert and Danger specified in the configuration parameters
|is done on the RMS value (reported in WX8) or the True Peak-Peak value
|(reported in WX9).  Default of 0 is RMS.
|
| C_PeakPeak                                           C_AlarmChoi
|                                                      ce
|      C11                                                WY19.15
[------] [---------------------------------------------------(   )----
|
|
| LAD Network 21  Address 162
|This command bit for Channel D chooses whether processing of the alarm
|values for Alert and Danger specified in the configuration parameters
|is done on the RMS value (reported in WX11) or the True Peak-Peak value
|(reported in WX12).  Default of 0 is RMS.
|This example program has a proximity probe in an axial orientation to
|measure the shaft movement due to thrust.  The AC component of vibration
|is not as critical as the true movement, so the True Peak-to-Peak value
|is selected for alarming.
|
| D_PeakPeak                                           D_AlarmChoi
|                                                      ce
|      C12                                                WY19.16
[------]/[---------------------------------------------------(   )----
|
|
| LAD Network 22  Address 166
|This rung is continually testing for axial shaft movement due to thrust.
|Assume the shaft at rest was gapped to -10V with a 200mV/mil proximity probe.
|Test the DC Probe bias voltage for Channel D (WX13) for movement of 20mils
|(4V change) in positive direction and 10mils (2V change) in negative direction.
|
|             +--A > B------------------+               AxialThrust
|             |D_ProbeCirc              |               Alarm
|      C25    |uitVoltage               |                     C26
[------]/[---+-] A:    WX13    B:     -14[-+-------------------(   )----
|            | +-------------------------+ |
|            |                             |
|            | +--A < B------------------+ |
|            | |D_ProbeCirc              | |
|            | |uitVoltage               | |
|            +-] A:    WX13    B:      -8[-+
|              +-------------------------+
|
|                           +-------------+
[---------------------------+ PROGRAM END +---------------------------
|                           +-------------+
```

REGISTERS

V REGISTERS: V1 - V50120

Address	Value	Tag	Address	Value	Tag
V1	00768	A_Transducer_Gain_HP	V26	00000	
V2	00000	A_IS_Barrier	V27	00000	
V3	00000	A_OutputScaleFactor	V28	00000	
V4	00000	A_UnitsOfMeasure	V29	00000	
V5	00000	A_InputScaleFactor	V30	00000	
V6	00000	A_ReportMode	V31	00768	B_Transducer_Gain_HP
V7	00000	A_TripMultiplyValue	V32	00000	B_IS_Barrier
V8	00100	A_ProbeSensitivity	V33	00000	B_OutputScaleFactor
V9	00030	A_AlertSetpoint	V34	00000	B_UnitsOfMeasure
V10	00030	A_AlertTimeDelay	V35	00000	B_InputScaleFactor
V11	00040	A_DangerSetpoint	V36	00000	B_ReportMode
V12	00040	A_DangerTimeDelay	V37	00000	B_TripMultiplyValue
V13	00000	A_GapVoltageA	V38	00100	B_ProbeSensitivity
V14	00000	A_GapDistanceA	V39	00030	B_AlertSetpoint
V15	00000	A_GapVoltageB	V40	00030	B_AlertTimeDelay
V16	00000	A_GapDistanceB	V41	00040	B_DangerSetpoint
V17	01500	A_GapOver_BiasHigh_Ala	V42	00040	B_DangerTimeDelay
V18	00800	A_GapUnder_BiasLow_Ala	V43	00000	B_GapVoltageA
V19	00004	A_Fmax	V44	00000	B_GapDistanceA
V20	00007	A_NumberOfSamples	V45	00000	B_GapVoltageB
V21	00025	A_NumberOfTeeth	V46	00000	B_GapDistanceB
V22	00000		V47	01500	B_GapOver_BiasHigh_Ala
V23	00000		V48	00800	B_GapUnder_BiasLow_Ala
V24	00000		V49	00010	B_Fmax
V25	00000		V50	00013	B_NumberOfSamples

REGISTERS

V REGISTERS: V51 - V100

Address	Value	Tag	Address	Value	Tag
V51	00025	B_NumberOfTeeth	V76	00090	C_GapDistanceB
V52	00000		V77	65436	C_GapOver_BiasHigh_Ala
V53	00000		V78	64036	C_GapUnder_BiasLow_Ala
V54	00000		V79	00010	C_Fmax
V55	00000		V80	00013	C_NumberOfSamples
V56	00000		V81	00025	C_NumberOfTeeth
V57	00000		V82	00000	
V58	00000		V83	00000	
V59	00000		V84	00000	
V60	00000		V85	00000	
V61	16384	C_Transducer_Gain_HP	V86	00000	
V62	00000	C_IS_Barrier	V87	00000	
V63	00000	C_OutputScaleFactor	V88	00000	
V64	00000	C_UnitsOfMeasure	V89	00000	
V65	00000	C_InputScaleFactor	V90	00000	
V66	00000	C_ReportMode	V91	16384	D_Transducer_Gain_HP
V67	00000	C_TripMultiplyValue	V92	00000	D_IS_Barrier
V68	00200	C_ProbeSensitivity	V93	00000	D_OutputScaleFactor
V69	00015	C_AlertSetpoint	V94	00000	D_UnitsOfMeasure
V70	00030	C_AlertTimeDelay	V95	00000	D_InputScaleFactor
V71	00020	C_DangerSetpoint	V96	00000	D_ReportMode
V72	00040	C_DangerTimeDelay	V97	00000	D_TripMultiplyValue
V73	65138	C_GapVoltageA	V98	00200	D_ProbeSensitivity
V74	00020	C_GapDistanceA	V99	00015	D_AlertSetpoint
V75	63736	C_GapVoltageB	V100	00030	D_AlertTimeDelay

REGISTERS

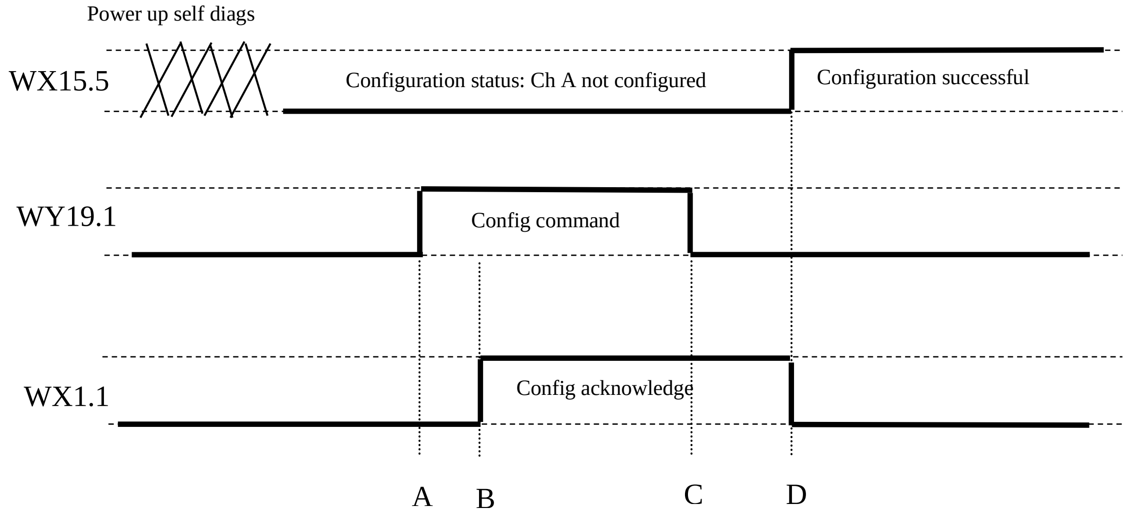
V REGISTERS: V101 - V120

Address	Value	Tag
V101	00020	D_DangerSetpoint
V102	00040	D_DangerTimeDelay
V103	65138	D_GapVoltageA
V104	00020	D_GapDistanceA
V105	63736	D_GapVoltageB
V106	00090	D_GapDistanceB
V107	65436	D_GapOver_BiasHigh_Ala
V108	64036	D_GapUnder_BiasLow_Ala
V109	00008	D_Fmax
V110	00008	D_NumberOfSamples
V111	00025	D_NumberOfTeeth
V112	00000	
V113	00000	
V114	00000	
V115	00000	
V116	00000	
V117	00000	
V118	00000	
V119	00000	
V120	00000	

Addr	Tag
C1	A_InitialConfig
C2	B_InitialConfig
C3	C_InitialConfig
C4	D_InitialConfig
C5	AlarmMode
C6	SpeedReport
C7	ModuleInhibit
C8	TripMultiplyCtrl
C9	A_PeakPeak
C10	B_PeakPeak
C11	C_PeakPeak
C12	D_PeakPeak
C13	A_ReConfig
C14	B_ReConfig
C15	C_ReConfig
C16	D_ReConfig
C17	MoveK_to_V
C26	AxialThrustAlarm
WX1	ConfigAcks_AlarmBits
WX1.1	A_Config_X
WX1.2	B_Config_X
WX1.3	C_Config_X
WX1.4	D_Config_X
WX1.5	A_Alert
WX1.6	A_Danger
WX1.7	A_ProbeFault
WX1.8	B_Alert
WX1.9	B_Danger
WX1.10	B_ProbeFault
WX1.11	C_Alert
WX1.12	C_Danger
WX1.13	C_ProbeFault
WX1.14	D_Alert
WX1.15	D_Danger
WX1.16	D_ProbeFault
WX2	A_RMS
WX3	A_TruePeak_peak
WX4	A_ProbeCircuitVoltage
WX5	B_RMS
WX6	B_TruePeak_peak
WX7	B_ProbeCircuitVoltage
WX8	C_RMS
WX9	C_TruePeak_peak
WX10	C_ProbeCircuitVoltage
WX11	D_RMS
WX12	D_TruePeak_peak
WX13	D_ProbeCircuitVoltage
WX14	TachData
WX15	Module_status_word
WX15.1	ModuleStatus
WX15.2	TachOverrange
WX15.3	TachUnderrange
WX15.4	NoTach
WX15.5	A_ConfigStatus
WX15.6	B_ConfigStatus
WX15.7	C_ConfigStatus
WX15.8	D_ConfigStatus
WX15.10	MathOverflow
WX15.11	PortStop
WX15.12	ParallelPortTimeout
WX15.13	A_ADC_Overrange
WX15.14	B_ADC_Overrange
WX15.15	C_ADC_Overrange
WX15.16	D_ADC_Overrange

Addr	Tag	Addr	Tag	Addr	Tag
WX16	A_B_SyntaxError	WY20	Transducer_Gain_HP	WY39	NumberOfSamples
WX17	C_D_SyntaxError	WY21	IS_Barrier	WY40	NumberOfTeeth
WX19.5	AlarmControl	WY22	OutputScaleFactor		
WX19.6	SpeedReportMode	WY23	UnitsOfMeasure		
WX19.7	RunMode	WY24	InputScaleFactor		
WX19.8	TripMultiplyMode	WY25	ReportMode		
WY19	ConfigCmd_ModuleControl	WY26	TripMultiplyValue		
WY19.1	A_Config_Y	WY27	ProbeSensitivity		
WY19.2	B_Config_Y	WY28	AlertSetpoint		
WY19.3	C_Config_Y	WY29	AlertTimeDelay		
WY19.4	D_Config_Y	WY30	DangerSetpoint		
WY19.5	AlarmControlBit	WY31	DangerTimeDelay		
WY19.6	TachReportMode	WY32	GapVoltageA		
WY19.7	Inhibit	WY33	GapDistanceA		
WY19.8	TripMultiply	WY34	GapVoltageB		
WY19.13	A_AlarmChoice	WY35	GapDistanceB		
WY19.14	B_AlarmChoice	WY36	GapOver_BiasHigh_Alarm		
WY19.15	C_AlarmChoice	WY37	GapUnder_BiasLow_Alarm		
WY19.16	D_AlarmChoice	WY38	F_max		

APPENDIX C. CONFIGURATION: STATUS AND TIMING FOR COMMAND/ACKNOWLEDGE



A: Power up self diagnostics passed; channel configuration status = 0 indicates no parameters loaded for that channel. PLC program sets configuration command control bit (WY19.1=1) which initiates transfer of parameters (WY20~40) to module.

B: Module responds by setting configuration acknowledge (WX1.1=1) when data has been checked for valid syntax and database successfully updated. If syntax check fails, the acknowledge bit is not set and the word that caused the error is reported in Syntax Error (WX16 high byte for Ch A).

C: PLC program resets configuration command bit (WX19.1=0).

D: Module responds by resetting configuration acknowledge bit (WX1.1=0) and setting configuration status (WX15.5=1) to indicate successful configuration. Note that the parameters can be reloaded at anytime even though configuration status is set.

WX15.5	Ch A Configuration Status
WY19.1	Configuration Command
WX1.1	Configuration Acknowledge
WX15.6	Ch B Configuration Status
WY19.2	Configuration Command
WX1.2	Configuration Acknowledge
WX15.7	Ch C Configuration Status
WY19.3	Configuration Command
WX1.3	Configuration Acknowledge
WX15.8	Ch D Configuration Status
WY19.4	Configuration Command
WX1.4	Configuration Acknowledge

Status Words

WX1	**bits 1~4**	Configuration acknowledge for Channels A~D
	bits 5~7	Alarm status bits for Channel A
	bits 8~10	Alarm status bits for Channel B
	bits 11~13	Alarm status bits for Channel C
	bits 14~16	Alarm status bits for Channel D
WX15	**bit 1**	Module status bit 1 = passed self-diags [Module LED solid Green] 0 = failed self-diags [Module LED off]
	bit 2	Tachometer Overrange 1 = tach input signal > 65535 Hz
	bit 3	Tachometer Underrange 1 = tach input < 2Hz
	bit 4	No Tach 1 = no input pulses within 10 seconds
	bit 5	Channel A configuration status bit 1 = configuration downloaded & syntax OK [Channel LED solid Green] 0 = not configured *or* configuration bad [Channel LED off]
	bit 6	Channel B
	bit 7	Channel C
	bit 8	Channel D
	bit 9	Not defined
	bit 10	Math Overflow 1 = a reported value is outside the signed integer range
	bit 11	Port Stop 1 = either Serial or Parallel port stopped the data acquisition process
	bit 12	Parallel Port Timeout 1 = 2506 failed to respond to STROBE or a BUS_BUSY signal
	bit 13	Channel A Analog-Digital Converter overrange bit 1 = set when input reading saturates ADC => Gain setting too high
	bit 14	Channel B
	bit 15	Channel C
	bit 16	Channel D
WX16	**high byte**	Channel A syntax error; displays (in hex) WY word that caused syntax error e.g. 20xx = error in WY20 … first configuration Word Note: These are referenced to WY20 even though I/O login may be different.
	low byte	Channel B syntax error
WX17	**high byte**	Channel C syntax error
	low byte	Channel D syntax error

Control Bits

WY19	**bit 1**	Channel A configuration command bit 1 = initiate download of parameters from PLC to module
	bit 2	Channel B
	bit 3	Channel C
	bit 4	Channel D
	bit 5	Alarm Master 0 = module calculates Alert / Danger; provides analog values <u>and</u> status to PLC 1 = module provides analog values <u>only</u>
	bit 6	Speed Report 1 = report speed in Hz (max of 65k) 0 = report speed in RPM
	bit 7	Module Inhibit 1 = do not process input signals & freeze outputs at current levels
	bit 8	Trip Multiply 1 = process alarms at Setpoint value x Trip Multiply value
	bit 9	Not defined
	bit 10	Not defined
	bit 11	Not defined
	bit 12	Not defined
	bit 13	Channel A RMS or True P-P alarm choice 1 = process alarms on value contained in WX3 (True Peak-to-Peak) 0 = process alarms on value contained in WX2 (Calculated RMS)
	bit 14	Channel B
	bit 15	Channel C
	bit 16	Channel D

Analog Values

WX2 Channel A calculated vibration
* in mVolts *or* eng units (dependent on value in WY25)

WX3 Channel A True Peak-to-Peak vibration
* in mVolts *or* eng units (dependent on value in WY25)

WX4 Channel A Probe circuit bias voltage
* DC voltage of probe circuit (scaled from 0 to ±2400)
* if Displacement probe *and* WY32~35 are non-zero: displacement in mils or um
(Scaled to WY22) (Note: Probe Bias Alarm still operates on bias voltage.)

WX5 ~ 7	Channel B
WX8 ~ 10	Channel C
WX11 ~ 13	Channel D
WX14	tachometer input in RPM or Hz (dependent on WY19.6)

LIMITED PRODUCT WARRANTY

CTI warrants that this CTI Industrial Product shall be free from defects in material and workmanship for a period of one (1) year after purchase from CTI or from an authorized CTI Industrial Distributor. This CTI Industrial Product will be newly manufactured from new and/or serviceable used parts which are equal to new in the Product.

Should this CTI Industrial Product fail to be free from defects in material and workmanship at any time during this (1) year warranty period, CTI will repair or replace (at its option) parts or Products found to be defective and shipped prepaid by the customer to a designated CTI service location along with proof of purchase date and associated serial number. Repair parts and replacement Product furnished under this warranty will be on an exchange basis and will be either reconditioned or new. All exchanged parts or Products become the property of CTI. Should any Product or part returned to CTI hereunder be found by CTI to be without defect, CTI will return such Product or part to the customer.

This warranty does not include repair of damage to a part or Product resulting from: failure to provide a suitable environment as specified in applicable Product specifications, or damage caused by an accident, disaster, acts of God, neglect, abuse, misuse, transportation, alterations, attachments, accessories, supplies, non-CTI parts, non-CTI repairs or activities, or to any damage whose proximate cause was utilities or utility like services, or faulty installation or maintenance done by someone other than CTI.

Control Technology Inc. reserves the right to make changes to the Product in order to improve reliability, function, or design in the pursuit of providing the best possible Product. CTI assumes no responsibility for indirect or consequential damages resulting from the use or application of this equipment.

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THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

REPAIR POLICY

In the event that the Product should fail during or after the warranty period, a Return Material Authorization (RMA) number can be requested orally or in writing from CTI main offices. Whether this equipment is in or out of warranty, a Purchase Order number provided to CTI when requesting the RMA number will aid in expediting the repair process. The RMA number that is issued and your Purchase Order number should be referenced on the returning equipment's shipping documentation. Additionally, if the product is under warranty, proof of purchase date and serial number must accompany the returned equipment. The current repair and/or exchange rates can be obtained by contacting CTI's office at 1-800-537-8398.

When returning any module to CTI, follow proper static control precautions. Keep the module away from polyethylene products, polystyrene products and all other static producing materials. Packing the module in its original conductive bag is the preferred way to control static problems during shipment. **Failure to observe static control precautions may void the warranty**. For additional information on static control precautions, contact CTI's office at 1-800-537-8398.