MONARCH INSTRUMENT

Instruction Manual

ACT-3X
Panel Tachometer/Totalizer



CE NIST CALIBRATION

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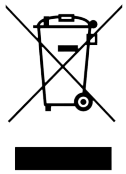
SAFEGUARDS AND PRECAUTIONS

1. Read and follow all instructions in this manual carefully, and retain this manual for future reference.
2. Do not use this instrument in any manner inconsistent with these operating instructions or under any conditions that exceed the environmental specifications stated.
3. Be sure the power supplied to this instrument matches the specification indicated on the rear panel on the instrument.
4. Be sure all power is removed before making or removing any connections to or from this instrument.
5. This instrument is not user serviceable. For technical assistance, contact the sales organization from which you purchased the product.



To comply with worldwide regulations such as the U.S. Environmental Protection Agency Resource Conservation and Recovery Act (RCRA) and EU Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), you must not discard this electrical/electronic product in domestic household waste. The electronic components in this device may contain environmentally harmful substances. DO NOT DISPOSE of this product as unsorted municipal waste. This product needs to be RECYCLED and disposed of in accordance with environmental regulations in the country of use; contact your local authorities for more information. This product may be returnable to your distributor for recycling; contact the distributor for details.

Monarch Instrument's Limited Warranty applies.
See www.monarchinstrument.com for details.

Warranty Registration and Extended Warranty Coverage information is available online at www.monarchinstrument.com.

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TABLE OF CONTENTS:

1.0 OVERVIEW 1
2.0 INSTALLATION 1
2.1 NOISY ENVIRONMENTS 3
2.2 ADJUSTMENTS 3
2.3 CONNECTIONS 3
2.3.1 Power Connections 4
2.3.2 Sensor Connections 4
2.3.3 Analog Output 5
2.3.3.1 Current Output 5
2.3.3.2 Voltage Output 6
2.3.4 Auxiliary Input (AUX-Channel 2) 6
2.3.5 Pulse Output 6
2.3.6 Alarm Relay Outputs 6
2.3.7 Serial Communications 7
3.0 FRONT PANEL 7
3.1 STATUS LEDs 8
3.1.1 LIM 1 and LIM 2 (Alarm) LEDs 8
3.1.2 Gate LED 8
3.1.3 MAX and MIN LEDs 8
3.1.4 RPM LED 8
3.2 PUSHBUTTONS 9
3.2.1 SET Button 9
3.2.2 RESET Button 9
3.2.3 UP (∧) and DOWN (∨) Buttons 10
3.2.4 RECALL Button 10
4.0 OPERATION 10
4.1 Modes of Operation – Channel 1 10
4.1.1 RPM Mode 11
4.1.2 Frequency Mode 11
4.1.3 Scale Mode (Ratemeter) 11
4.1.4 Single Event Capture (SECAP) Mode 12
4.1.5 Rate of Change (ROC) Mode 12
4.1.6 Totalizing Mode 13
4.2 MODES OF OPERATION – CHANNEL 2 13
4.2.1 Off 13
4.2.2 Inhabit 13
4.2.3 Single Event Capture 14
4.2.4 External Reset – Input Totalizer 14
4.2.5 External Reset – Alarms 14
4.3 DECIMAL POINT 14
4.4 ALARM LIMITS 14
4.4.1 Latching vs. Non-Latching Limits 15
4.4.2 Deadband (Hysteresis) 15
4.4.3 Low Limit Lockout 16
4.4.4 Fail Safe 16
4.5 ANALOG (AO) AND CURRENT (IO) OUTPUT 16
4.6 MAXIMUM AND MINIMUM 17
4.7 THROUGHPUT 18
4.7.1 Display Update Rate 18
4.7.2 Internal Update Rate – GATE 18
4.7.3 Low End 20
4.8 PULSE OUTPUT 20

5.0 USING THE MENU 20
5.1 CH_1 21
5.1.1 tYPE 21
5.1.1.1 rPn 21
5.1.1.2 FrE9 21
5.1.1.3 SCALE 22
5.1.1.4 SECAP 22
5.1.1.5 rOC 22
5.1.1.6 tOtAL 22
5.1.2 InPUt 23
5.1.3 LOEnd 23
5.1.3.1 12SEC 23
5.1.3.2 1_SEC 23
5.1.3.3 HALF 23
5.1.4 9AtE 23
5.1.4.1 Std 23
5.1.4.2 FASt 23
5.2 CH_2 24
5.2.1 tYPE 24
5.2.1.1 OFF 24
5.2.1.2 SECAP 24
5.2.1.3 InHbt 24
5.2.1.4 rStIn 24
5.2.1.5 rStAL 24
5.2.2 InPUt 24
5.3 dECPt 25
5.4 SEt_1 25
5.4.1 StYPE 25
5.4.1.1 OFF 25
5.4.1.2 LO 25
5.4.1.3 HI 25
5.4.2 LAtCH 26
5.4.3 LOC 26
5.4.4 FAILS 26
5.4.5 SEtPt 26
5.4.6 dEAdb 27
5.5 SEt_2 27
5.6 dAC_1 27
5.6.1 OSCAL 27
5.6.2 FSCAL 27
5.6.3 dIAG 27
5.7 bAUd 28
5.8 EnEt 28
5.9 OUtPUt 28
5.10 dISPr 28
5.11 SErnO 29
5.12 PASSC 29
6.0 SERIAL OUTPUT 29
6.1 Data from the Serial Interface 30
6.2 Serial Commands 30
6.2.1 Run Mode Commands 31
6.2.2 Control Commands 32
7.0 SPECIFICATIONS 36
8.0 ACCESSORIES 38
APPENDIX A: SCALING THE ACT FOR ENGINEERING DISPLAYS 40
APPENDIX B: USEFUL CONVERSIONS 43
APPENDIX C: USING THE SINGLE EVENT CAPTURE MODE 44
APPENDIX D: SETTING UP THE ETHERNET INTERFACE 45
APPENDIX E: MENU OVERVIEW 47

1.0 OVERVIEW

The ACT-3X digital panel meter is an extremely versatile instrument. The user has complete control of the unit configuration. Power may be either 115 - 230 Vac (50/60 Hz), or optionally, 12 Vdc or 24 Vdc. Input signals are accepted (on Channel 1) from optical, proximity, magnetic, infrared or laser sensors, or direct TTL or external AC sources. A second AUXiliary input (Channel 2) may be used for instrument control and remote resetting. There are several remote communication options – RS232, USB or Ethernet and the optional remote software can be used to program the unit or display data locally. The unit is suitable for panel mounting or bench top use, with convenient screw terminal connections on the rear panel of the instrument.

When the instrument is turned on, it displays all 8s, then “3 rx.x”, where 3 is the unit type (ACT3) and rx.x is the software revision level, before entering the normal mode of operation.

The display will show “- - - - -” when a measurement is over range.

2.0 INSTALLATION

The instrument is intended to operate in the following environment:

Installation Category II: per IEC 664 Pollution Degree Level II per IEC61010-1

Measurement Category I: per IEC61010-1 Altitude up to 2,000 m

Temperature: -10 °C to +50 °C operating per IEC61010-1

Humidity: Maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40 °C

AC Mains Supply: 100 - 240 Vac ~ +10% 50/60 Hz 8 VA

DC Supply (option): 12 or 24 Vdc +10% 6 W (DC option)

Indoor Use Only

CAUTION

The instrument is designed to be panel mounted and as such should be considered as fixed equipment or permanently connected. If permanently connected, disconnection from the supply must be possible via a customer supplied switch or circuit breaker rated at 120 V or 240 V (dependent on local voltage supply), 5 A minimum when connected to an ac supply or 30 V 1 A minimum when connected to a dc supply. This disconnection device must disconnect all current-carrying conductors. It must be included in the panel installation and should be clearly marked, in close proximity to the unit and easily accessible to the operator.

The ACT-3X is a 1/8 DIN enclosure requiring a 3.58" wide by 1.74" high [91 mm x 44 mm] mounting hole. Approximately 5" [127 mm] will be required behind the panel. Refer to Figure 1 below.

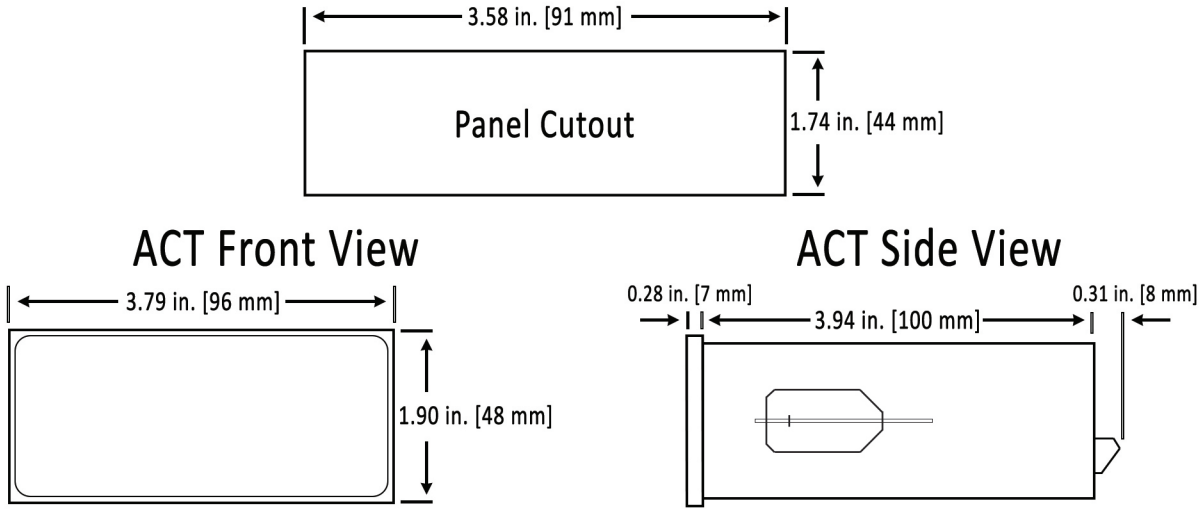


Figure 1 Dimensions in Inches [Millimeters]

Before installing, check the power supply requirements on the rear panel. Remove the mounting clips, if fitted, and install the unit into the panel from the front. From the rear of the unit, install the mounting clips into the slots on each side of the unit and tighten the mounting screws against the front panel.

WARNING

Do not over tighten the mounting screws.

Do not use this instrument in any manner inconsistent with these operating instructions or under any conditions that exceed the environmental specifications stated.

2.1 NOISY ENVIRONMENTS

These instruments are highly responsive. They have input ranges up to 999,990 RPM and 250,000 Hz. They therefore have extremely fast input circuitry that may respond to spurious noise. It is important to provide a clean source of power to the units, either AC or DC, and to ensure that the input to the unit is free of spikes or any other high frequency noise. In noisy environments, it may be necessary to supply power through a filter, or alternate source. The inputs may also need to be dampened, to suppress high frequency noise. It is always a good idea to use shielded cable for input signals and ensure the shield is properly grounded.

NOTE: The common on the inputs is **NOT** a ground.

Another source of noise is spikes generated by the alarm relay contacts. It may be necessary to suppress the contacts externally. This is particularly true when the internal relays switch to other external relays that do not have spike suppression. Always ensure that all sources of spikes or noise are adequately suppressed from the environment.

2.2 ADJUSTMENTS

Since the instruments are crystal controlled, there are no user calibration adjustments. Any of the programmable parameters, such as scaling, limits, analog out, and so on must be set up using the menu options.

2.3 CONNECTIONS

All connections are via the rear panel of the instrument – power, sensors, alarms, analog output, and communication. The rear panel is shown below and may vary slightly depending on what options are in the unit.

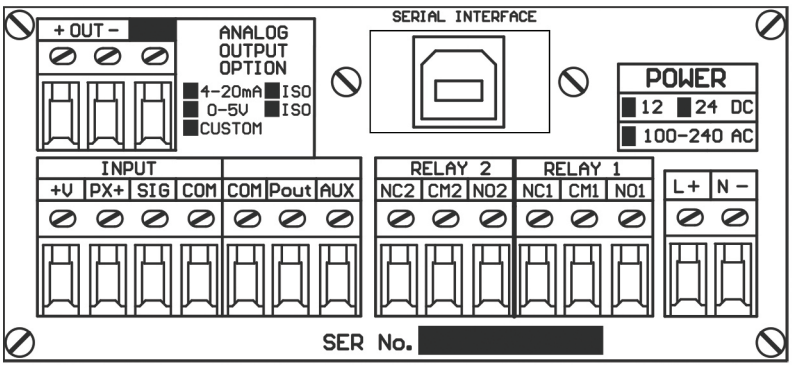


Figure 2 ACT-3X Rear panel with Analog Output and USB Option

2.3.1 Power Connections

Power to the unit is connected to the terminals under the sections labeled **POWER** on the rear panel. Be sure the power supplied matches the specification indicated on the rear panel. Refer to Figure 2.

If the unit is **ac powered** (115 - 230 Vac), connect the Live (Hot) wire to the terminal marked L and the Neutral (Return) wire to the terminal marked N. **NOTE:** The ground connection is not required as the unit is fully isolated from the mains.

If the unit is **dc powered**, connect the dc supply Positive to the terminal marked "+" and the dc supply Negative or Common to the terminal marked "-". **CAUTION:** Ensure the dc voltage does not exceed the rating on the unit (12 V ±10% or 24 V ±10% as marked).

2.3.2 Sensor Connections

A speed sensor (not included) can be connected to the terminals under the section labeled IN on the rear panel. Refer to Figure 2 and Figure 3.

Connections and their functions are as follows:

+V(A) Positive Supply Output. Used to provide power to optical, laser, infrared or amplified magnetic sensors. Voltage out is +24 Vdc, +12 Vdc or +5 Vdc (factory selected). Maximum load is 30mA from the 24 V supply or 60 mA from the 5 or 12 V supplies.

PX+ This output is for use with two wire proximity sensors. It has internal current sensing. Maximum load for proper operation with two wire sensors is 20 mA.

SIG Signal Input. Positive input signal from the speed sensor. Accepts TTL pulses or ac signals, unipolar and bipolar, from 1.1 Vac to 50 Vac. Connect the signal wire from three wire sensors or the positive side of two wire magnetic sensors to this terminal. Typical input impedance is 10 Kohms.

COM Common or Negative Terminal. Common or Negative connection for both signal and power.

Refer to Figure 3 below for connection of Monarch Instrument standard sensors. The connections are typical for these types of sensors.

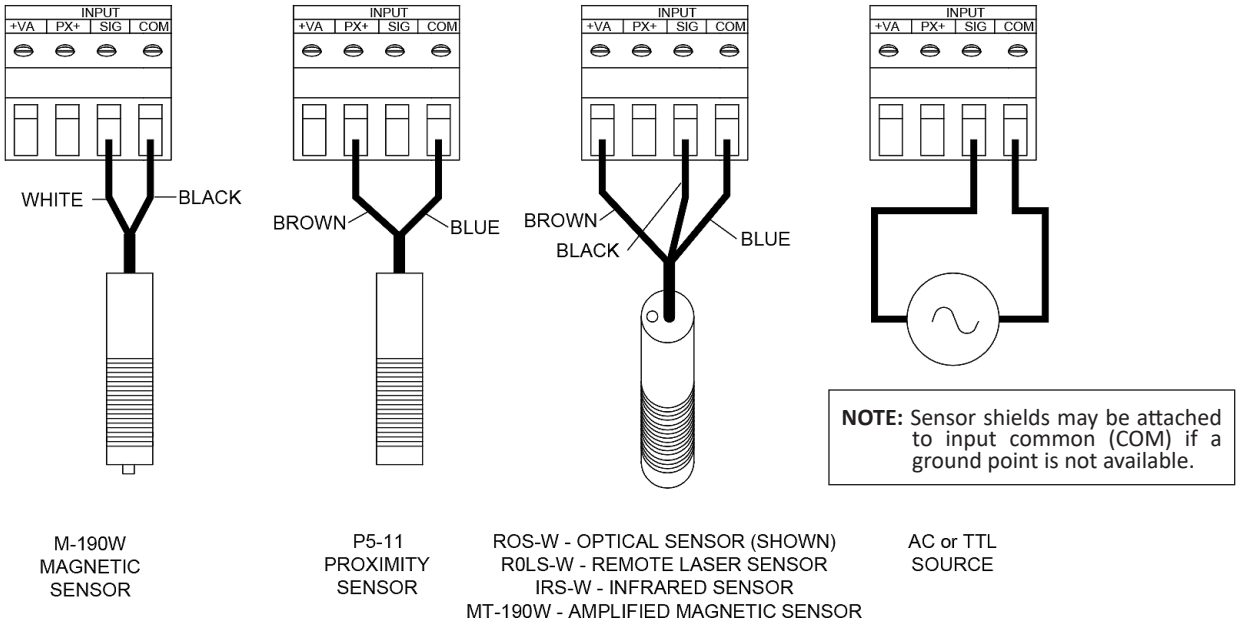


Figure 3 Sensor Connections

2.3.3 Analog Output

The Analog Output is an option. The Output option is marked on the back of the unit to the right of the connector – refer to Figure 2.

2.3.3.1 Current Output

The current output is 4 to 20 mA. This output is a current source and has a 12 Volt dc internal compliance voltage. (Optional 24 Vdc may be ordered).

Typical connection is as follows: (See Figure 4.)

Connect the Positive side of the load to the OUT terminal marked "+" and the other side of the load to the terminal marked "-". With the internal 12 Vdc compliance voltage the maximum load for the current loop is **500 Ohms**. If the optional 24 Vdc compliance option is ordered the maximum load will be **1000 Ohms**.

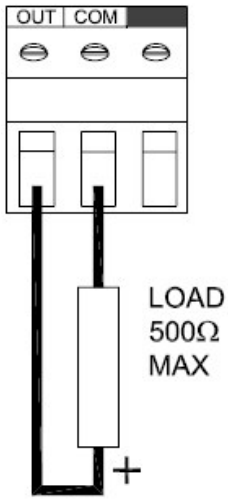


Figure 4 Analog Output Connections

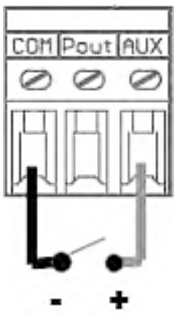
2.3.3.2 Voltage Output

The analog output is 0 to 5 Vdc @ 5mA.

Connect the Positive side of the load to the OUT terminal marked "+" and the return side of the load to the terminal marked "-". (See Figure 4.)

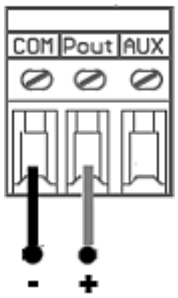
The output full scale and zero scale values are programmed via the front panel or remotely through the communication port.

2.3.4 Auxiliary Input (AUX-Channel 2)



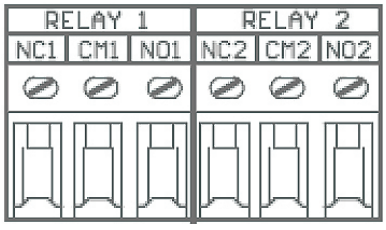
The Auxiliary Input is also referred to as Channel 2 (CH-2) and will accept a TTL input or any signal up to 12 Vdc. It has a weak pull up internally and can be used with a set of potential free contacts. The AUX input is programmed via the front panel or remotely via the communication port. Refer to Figure 2 and figure shown right. The AUX is connected to the input marked AUX (+) and COM (-).

2.3.5 Pulse Output



The Pulse Output provides a pulse out for each pulse in. It is a TTL pulse switching between +5 V and ground. Refer to Figure 2 and figure shown right. The connection is to the PO (+) terminal and the COM (-) terminal.

2.3.6 Alarm Relay Outputs



The Alarm Relay Outputs are potential free Form C contacts (Change Over) capable of carrying 1A at 250 Vac or 30 Vdc.

The contacts are marked NCx where NC is the Normally Closed Contact, x = 1 or 2 depending on which relay you are using. CM is the Common and NO is the Normally Open Contact.



CAUTION

Relay contacts may be wired to external high voltage potentials – ensure all power to the contacts is off before attempting any wiring.



CAUTION

During programming of the device, relay contacts may make or drop out intermittently.

2.3.7 Serial Communications

There are three serial communication options – Ethernet, USB and RS232. The Ethernet option will have a standard RJ45 connector, the USB option will have a type B female connector, and the RS232 option will have a male DB9 connector on the rear panel. The connections of the Ethernet and USB are generic. The connection of the RS232 DB9 is shown here:

Pin	Description	Direction
2	Receive data	In
3	Transmit Data	Out
5	Common (GND)	
7	Request to Send RTS	Out
8	Clear to Send CTS	In

All other pins are not used. Communications are at the preset Baud Rate, 8 bits, No Parity and 1 stop bit.

3.0 FRONT PANEL

Refer to the cover page for a photo of the front panel.

The front panel of the instrument has 5 pushbuttons, five 0.56" 7 segment light emitting displays, and six single light emitting diodes (LEDs), marked LIM 1, LIM 2, GATE, MIN, MAX and RPM. Some of these LEDs may not be visible; it depends on the mode the unit is in.

3.1 STATUS LEDS

3.1.1 LIM 1 and LIM 2 (Alarm) LEDs

The **LIM 1** and **LIM 2** (Alarm) LEDs indicate the status of the limits, particularly of the alarm output relay. When an alarm trips, the corresponding LED blinks at a rate around 1 flash per second. When the alarm resets, the LED goes out. These LEDs also go on continuously to indicate when and which limit is being set or adjusted. If the LEDs are on continuously, the value on the display is a setpoint value, not the input value.

3.1.2 Gate LED

The **GATE** LED is an indication of the instrument's input trigger signal from a sensor. It is triggered on by the falling edge of an input pulse, and goes off about 150 milliseconds later (unless there is another input pulse). It is more useful at slow speeds, as it appears to be on continuously at higher inputs. It gives an indication that a valid input trigger signal is present.

3.1.3 MAX and MIN LEDs

The **MAX** and **MIN** LEDs indicate to the user that a maximum or a minimum is being displayed. If either one of these LEDs is on, the display is a stored value, not the input value.

3.1.4 RPM LED

The **RPM** LED indicates that the RPM Mode (frequency x 60) has been selected, which can only be used when the input is ***one pulse per revolution***. The **RPM** LED is off in all other modes. In the **Scale Mode** the read outs may be in RPM, but the RPM LED will be off.

NOTE: For applications where there is more than one pulse per revolution, the Scale Mode must be used.

3.2 PUSHBUTTONS

The five pushbuttons on the front panel have multiple functions. The following sections cover the function of the buttons under normal operating conditions.

3.2.1 SET Button

The **SET** button enters the Menu and allows the user to view the current settings in the unit. Refer to 5.0 USING THE MENU.

3.2.2 RESET Button

The **RESET** button, when pressed, resets the Alarms, assuming they have tripped. It is the only way to reset a latching alarm other than via the serial interface.

NOTE: If an alarm setpoint is exceeded when the reset button is pressed, the alarm will immediately trip again on the next data acquisition cycle.

If the user holds the **RECALL** button and then presses the **RESET** button, the minimum and maximum values (and the TOTAL if the unit is in the Totalizing mode) are reset.

In the Single Event Capture (SECAP) Mode, pressing the **RESET** button signals the instrument to take a reading at the next trigger as well as its normal functions.

When in the Menu, the **RESET** button reverts back one level without saving any changes (AbOrt) or exits the Menu (dOnE). However, when entering data values in the menu such as scale factor, setpoint, Ethernet settings or passcode, the **RESET** button changes the digit being edited (blinking digit). Also when entering a data value, holding down the **RESET** button and pressing the **DOWN** (**v**) button will move the decimal place.

3.2.3 UP (∧) and DOWN (∨) Buttons

The **UP** (∧) and **DOWN** (∨) buttons can be used to view the current settings of the alarms. Press the **UP** (∧) button to view **LIMIT 1** or the **DOWN** (∨) button to view **LIMIT 2**. The display will revert back to normal after a few seconds.

When in the Menu, the **UP** (∧) and **DOWN** (∨) buttons are used to scroll through the menu options or edit data within the options.

3.2.4 RECALL Button

The **RECALL** button toggles between the maximum and minimum readings. The display will revert back to normal after a few seconds. The **RECALL** button, when used with the **RESET** button, also resets the maximum and minimum readings or total (when in Totalizing mode).

When in the Menu, the **RECALL** button reverts back one level without saving any changes (AbOrt) or exits the Menu (dOnE).

4.0 OPERATION

4.1 MODES OF OPERATION – CHANNEL 1

There are a number of different modes of operation. These modes determine what is shown on the display for any given input to the instrument. Basically, it determines what computation is performed on the input. The input signals are on Channel 1 (Signal inputs). The user can set the sense of the input, positive or negative. The AUXiliary input (Channel 2) can be used to control the signals on Channel 1. Refer to 5.0 USING THE MENU for details on changing modes.

NOTE: The instrument is programmed from the factory in the **RPM Mode** for one pulse per revolution.

4.1.1 RPM Mode

In the **RPM Mode** the unit behaves like a tachometer displaying revolutions (revs) per minute (RPM) from an input of 1 pulse per revolution. The instrument effectively multiplies the input frequency (pulses per second) by sixty to derive RPM. In this mode, the range of the unit is 5 to 999,990 RPM. The RPM LED on the bottom right of the display area illuminates to indicate the RPM mode is programmed. The AUXiliary input (Channel 2) can be used to inhibit (disable) the signal into the unit.

NOTE: For applications with more than one pulse per revolution, the **Scale Mode** (see below) must be used to display RPM or other rates.

4.1.2 Frequency Mode

In the **Frequency Mode**, the unit displays input pulses per second or more commonly, Hertz (Hz). This is the most basic mode of operation. The range of measurement in this mode is 0.0833 to 250,000 Hz. The AUXiliary input (Channel 2) can be used to inhibit (disable) the signal into the unit.

4.1.3 Scale Mode (Ratemeter)

In the **Scale Mode** of operation, the input frequency (pulses per second) is multiplied by a constant, which is set by the user, and displayed. This allows the user to scale the input to obtain a read out in any units required: RPM, inches per second, meters per hour, yards per fortnight, and so on. The scale factor may be set anywhere from 0.0001 to 99,999. The AUXiliary input (Channel 2) can be used to inhibit (disable) the signal into the unit.

4.1.4 Single Event Capture (SECAP) Mode

The **SECAP (Single Event Capture) Mode** is just like the Scale Mode except that ***only one reading is made***. The **RESET** button is pressed to start each new measurement. The unit will then use the next input pulse to start a measurement, then the next input pulse will end the measurement. In the other tachometer modes, the unit will keep acquiring pulses until 10 mS (or 1 mS) has passed so it can give an accurate reading. The **SECAP Mode** sacrifices accuracy as measurements get shorter than 32 mS (or 4mS), but it is the only way to measure single (non-repeating) events. The AUXiliary input may be used for the second pulse input if two sensors are used, the first pulse on Channel 1 will start the process and the second pulse on Channel 2 (AUX) will stop the process. Refer to APPENDIX C: Using the Single Event Capture Mode.

4.1.5 Rate of Change (ROC) Mode

In the **Rate of Change Mode**, the unit displays the rate of change of the input frequency (pulses per second). The unit measures the input frequency times the scale factor set by the user. A moment later it measures the input frequency again. The difference of these two, scaled frequencies is divided by the time interval between the two measurements. Several measurements are averaged then displayed.

The scale factor allows the user to scale the input to obtain a read out in any units required: Revolutions per Minute (RPM), inches per second per second, meters per hour per minute, yards per fortnight per second, and so on. The scale factor may be set anywhere from 0.0001 to 99,999.

In this mode:

- The display is updated up to once every two seconds with the average Rate of Change.
- The throughput of the max/min, analog outputs, and relays is up to twice a second.
- The display will show a positive number when the frequency is increasing and a negative number when the frequency is decreasing.

Remember that even a small change in RPM over a short time will cause a large Rate of Change (average acceleration) to be displayed. The gate time for each measurement is about 1/3 of a second. For instance, if you use a digital function generator to change from 3000 RPM to 3001 RPM, the change will happen all at once. You will see that it happens within 1/3 of a second. So 1 RPM change in 1/3 of a second is 180 RPM over one minute or 180 PRMPM acceleration.

4.1.6 Totalizing Mode

In the **Totalizing Mode**, each input pulse causes the display to be incremented by a constant value that is set by the user. This enables the user to scale the input to obtain a read out in any measure required: number of inches, number of bottles, number of revolutions, and so on. The scale factor may be set anywhere from 0.0001 to 99,999. The total can be reset using the **RESET** and **RECALL** buttons pressed together on the front panel. The AUX input (Channel 2) can be set to reset the totalizer and turn the unit into a batch counter or to inhibit the input signal (see Section 4.2.4).

4.2 MODES OF OPERATION – CHANNEL 2

Channel 2 is the AUXiliary input and is basically used to control the input to Channel 1, or can be used as an external reset for the input channel or the Alarms. The user can set the sense of the input, positive or negative. The input has a weak pull-up resistor internally so it can be used with potential free contact. All modes are mutually exclusive – only one mode may be active at any time. Refer to 5.0 USING THE MENU for details on changing modes.

NOTE: The instrument is programmed from the factory with the AUXiliary input disabled (OFF).

4.2.1 Off

When programmed OFF, this input has no effect.

4.2.2 Inhabit

If programmed as an inhibit pin, it will disable the signal input when asserted (high or low depending on the sense programmed). It acts as a gate preventing the input signal from updating the unit.

4.2.3 Single Event Capture

When programmed as Single Event Capture (SECAP) this input acts as the second input for the external signal – see 4.1.4 Single Event Capture (SECAP) Mode.

4.2.4 External Reset – Input Totalizer

If programmed as External Reset for Inputs (rSt In), when asserted (high or low depending on the sense programmed), it will reset the display (count) to Zero. Used in the Totalizer Mode (see 4.1.6 Totalizing Mode) to enable the unit as a batch counter.

4.2.5 External Reset – Alarms

If programmed as External Reset for Alarms (rStAL), when asserted (high or low depending on the sense programmed), it will reset any Alarms and drop out any Contact closures. **Note:** The alarms need to be set up correctly (see Section 4.4 below).

4.3 DECIMAL POINT

The decimal point on the display may be fixed from 1 to 3 places or may be set to none (only whole number displayed). As the display increases the unit will automatically drop decimals to show whole number values. Note that for values larger than 99999 all decimal points light indicating the current reading is x10.

4.4 ALARM LIMITS

The **ACT-3X** has two independent alarm setpoints, referred to as **LIMIT 1** and **LIMIT 2** (**Set 1** and **Set 2** on the menu). These limits are fully programmable by the user (unless the write protect option has been set). The limits may be set as high or low with an option of low limit lockout, latching or non-latching at any value. The limits are accurate to better than ±0.1% of the setpoint value. Refer to 4.7.2 Internal Update Rate - GATE for the limit response time. The deadband (hysteresis) is also programmable at any value from 0.0001 to 99.999% of the setpoint value. The actual output from these alarms is a set of form C, dry contacts, accessible via barrier strip screw terminals on the rear panel. These contacts are capable of switching 1 A at 250 Vac. When the unit is making measurements, the limits can be viewed by pressing the

UP (∧) button for **LIMIT 1** or the **DOWN** (∨) button for **LIMIT 2**. The display will return to normal after a few seconds. The relays may also be set to be Failsafe, which inverts the sense of the relay so that they are energized under normal condition. In the event of a power failure the contacts will drop out as they would during an alarm condition. Refer to 5.0 USING THE MENU to set limit setpoints.

4.4.1 Latching vs. Non-Latching Limits

A Latching Limit is one which, when the alarm trips, remains in this condition regardless of what the input may do. This tripped limit needs to be manually reset by the operator to restore it back to its normal position. Reset is via the front panel **RESET** button or remotely using Channel 2 Auxiliary input if programmed. A Non-Latching Limit, on the other hand, will automatically reset itself when the input no longer exceeds the setpoint, either high or low. The user can program each limit to be Latching or Non-Latching. Refer to 5.0 USING THE MENU.

4.4.2 Deadband (Hysteresis)

Deadband is only applicable to *non-latching limits*. Deadband is a value that is added to the setpoint (in the case of a low limit) or subtracted from the setpoint (in the case of a high limit) so that this new value (setpoint ± deadband) becomes the reset point for the alarm. The primary purpose of this function is to prevent the alarm relays from chattering when the input value remains very close to the setpoint. Deadband is set in absolute engineering units. For example if the Limit is set to 200 RPM as a High limit and the deadband is set to 20 RPM, the alarm will trip when the input is greater than 200 but will not reset until the input goes below 180 PM. Without the deadband feature, the alarm relays would chatter on and off if the input varied from 199 to 201, which is undesirable. The user can set the hysteresis to any value from 0.0001 to 99,999. Refer to 5.0 USING THE MENU.

4.4.3 Low Limit Lockout

The Low Limit Lockout is a feature that prevents a low alarm from tripping when the input starts from zero. The low alarm essentially is locked out and will not operate until the input exceeds the low limit, at which time the low alarm is enabled and will trip when the input goes below the setpoint. This feature enables a motor that has a low speed cut out (low alarm) to start from rest without having to short out the normally closed relay contacts externally. This feature may be enabled or disabled by the user. Refer to 5.0 USING THE MENU.

4.4.4 Fail Safe

The Fail Safe option reverses the sense of the relays, essentially energizing them under normal conditions. When an alarm is set, the relays will drop out (become de-energized). Thus in the event of a power failure the relays will drop out by default creating the equivalent of an alarm condition.

4.5 ANALOG (AO) AND CURRENT (IO) OUTPUT*

The **ACT-3X** has options for voltage (0 to 5 Vdc) or current (4 to 20mA) outputs. The analog outputs are derived from a 15-bit digital to analog converter. This means that the output voltage (or current) changes in steps. The standard analog output has ~32,000 steps from zero to full scale. This implies that each step size is 1/32,000 of the full-scale value or about 0.003% of full scale. The user can set the actual full scale value anywhere from 1 to 999,990. This full-scale value is the value at which the analog outputs are at a maximum, 5 Vdc or 20 mA.

The zero and full-scale range is usually set to give a reasonable working range for the analog output. For example, if you are measuring the RPM of a motor that typically runs at 1700 RPM, you may want to set the zero scale (offset) for 1000 and the full-scale for the analog output at 2000. Note that the zero and full scale ranges are always set in the units you choose to display; RPM in this case. The output voltage will then be 5 Vdc (20 mA) for an input of 2000. It will be linear between 1000 (zero scale) and 2000 (full-scale). Thus, at 1700 RPM the output will be:

$$\frac{(1700 - 1000)}{(2000 - 1000)} \text{ X } 5 \text{ Vdc} = 3.5 \text{ Vdc}$$

$$\text{Resolution} = \frac{(2000 - 1000)}{32{,}000} = 0.03 \text{ RPM}$$

Note: For any input below the zero scale setting the outputs will be at 0 V dc or 4 mA. For any input above the full scale setting, the outputs will be at their maximum value, 5 Vdc or 20 mA.

***Note:** Rated accuracy reached after 10-minute warm-up period.

4.6 MAXIMUM AND MINIMUM

The unit tracks and saves the maximum and minimum values. These values are continuously updated and can be viewed at any time by pressing the **RECALL** button on the front panel. The first time this button is pressed the **MAX**imum is shown, indicated by the MAX light to the right of the display. Pressing the **RECALL** button a second time shows the **MIN**imum. The user can also reset these values by pressing and holding the **RECALL** button and then pressing the **RESET** button. The next reading will always update both values. This will keep the minimum value from showing zero unless there was a zero reading after the **RECALL** and **RESET** buttons were pressed.

Thus, if you start a motor, for example, from zero, the minimum will start recording with the first reading. Usually the user will reset the minimum once the motor is up to speed. When slowing to a stop, the minimum will naturally tend to zero, but the maximum will be retained.

4.7 THROUGHPUT

Throughput is a measure of how fast the instrument processes data. The rate at which the instrument acquires data is a function of the "Gate Time" and the input frequency. The instrument gets a start pulse then it continues to get pulses until the Gate Time elapses. The next pulse ends this measurement and starts the next. At frequencies slower than the Gate Time, the update rate is equal to the period of the input frequency. Eventually, the instrument has to make the decision that the input is zero, because theoretically it could wait forever for the next pulse. This Low-End timeout is programmable.

4.7.1 Display Update Rate

Although the instrument can update up to 244 times a second, to display the data at this rate would result in a totally erratic display. Therefore, the instrument limits the display update rate to once every ½ second. Obviously if the input pulses are spaced more than ½ second apart, the instrument will not have any new data until the next pulse comes along, and the time to update will be greater than ½ second. The point at which the update rate becomes longer than every ½ second is when the period of the input (time between pulses) is greater than ½ second, which is 2 Hz or 120 RPM. Thus, for an input greater than 2 Hz or 120 RPM, the update rate is twice a second.

For very fast inputs, the unit averages the readings between display updates so that the value displayed is an average of the total number of acquisitions since the last update.

4.7.2 Internal Update Rate – GATE

The rate at which the limits are checked, the analog output is updated, and the minimum and maximum are updated, is at the maximum rate at which the instrument acquires data. This is set by the **GATE** menu item. The Gate Time can be set to 32.786 mSecs (**STD**) or 4.096 mSecs (**FAST)**. See 5.1.3 LOEnd for more details.

The **STD** setting is slower (up to 31 readings per second) but gives more accurate readings especially for the maximum and minimum readings.

Below 31 Hz or 1860 RPM, the internal update rate is the period of the input frequency. Thus, the response of the alarms, etc can be seen to be a function of the input. Above an input of 31 Hz, the alarms respond within 66 milliseconds. Below this input they respond within (1 ÷ input frequency) seconds.

The **FAST** gate time is faster (up to 244 readings per second) but is less accurate (about 0.025% of reading worst case at high frequencies). Below 244 Hz or 14,640 RPM, the internal update rate is the period of the input frequency. Thus, the response of the alarms, etc can be seen to be a function of the input. Above an input of 244 Hz, the alarms respond within 9 milliseconds. Below this input they respond within (1 ÷ input frequency) seconds.

At input frequencies below 31 Hz or 1860 RPM there will be no difference in the two settings.

The instrument has a special feature to allow it to quickly respond to rapid deceleration and still measure down to 5 RPM with 1 pulse per revolution. (To measure to 1 RPM, 5 pulses per revolution are required). After receiving no input pulses for about 67 milliseconds for the Standard gate mode or 37 mSecs for the Fast gate mode, the instrument will calculate a reading as though an input pulse had just occurred. If this new reading is less than the last reading, the instrument uses it. Until an input pulse is detected or the Low-End timeout is reached, the instrument will "force" another reading every 33 milliseconds. These "forced" readings will update the analog output, limits, and the max/min. The last "forced" reading of every ½ second will be displayed every ½ second. The Low-End timeout can be set to 12, 1 or 0.5 seconds. Refer to 5.1.2 Input for details.

4.7.3 Low End

Low End is applicable to **RPM**, **FREQ**, **SCALE**, and **SECAP** Modes only. Low End selects how many seconds may elapse between input pulses before the unit displays the reading zero. There is a tradeoff between the lowest reading available and how quickly the unit responds when the input pulses stop and displays 0. There are three values: 12 seconds, 1 second, and 1/2 seconds. In the RPM mode, with one pulse per revolution, these settings correspond to the lowest RPM reading of 5, 60 and 120 RPM respectively.

4.8 PULSE OUTPUT

The Pulse Repeater Output provides a conditioned TTL positive going 5 V pulse out for each pulse in. The sense of the output, high pulse or low pulse, is programmable by the user. See 5.9 Output.

5.0 USING THE MENU

To enter the **MENU Mode**, press the **SET** button. The display will show the first top-level menu item, which is CH_1 for Channel 1 setup. Continuing to press the **SET** button will cycle through all options and show the current settings. At any point, press the **RECALL** button to back out (Abort) the current setting. Pressing **RECALL** again will eventually exit from the Menu.

Once in the MENU Mode, with CH_1 displayed, press the **UP** (^) or **DOWN** (v) buttons to cycle through the top-level menu options.

The top-level menu choices are:

CH_1 **Channel 1** — Set up parameters for Channel 1, the primary Input Channel

CH_2 **Channel 2** — Set up parameters for Channel 2, the Auxiliary Input Channel

dECPt **Decimal Point** — Set the number of Decimal Points displayed on the unit

SEt_1 **Setpoint 1** — Set up parameters for Alarm 1

SEt_2 **Setpoint 2** — Set up parameters for Alarm 2

dAC_1 **Digital Analog Converter 1** — Set up parameters for the Analog Output (Option)

bAUd **Baud Rate** — Set up the baud rate for the serial port (option); only seen if the option is installed

EnEt **Ethernet** — Set up the Ethernet port address, subnet mask and gateway; only seen if the option is installed

OUtPUt **Pulse Output** — Select the polarity of the pulse output

d ISPr **Display Rate** — Select the display update rate

SErnO **Serial Number** — Display the Serial Number

PASSC **Passcode** — Display or set the pass code to protect the Menu

When at the desired menu option, press the **SET** button to enter into that specific menu option.

5.1 CH_1

Channel 1 sets the mode of operation. This menu item has a number of sub items. Once selected with the **SET** button, the instrument will display its current mode. To exit back to the main menu without changing the mode, press the **RECALL** button. If you wish to change the operating mode, you can view the options using the **UP** (^) button. The available options are shown below and are described in 4.1 Modes of Operation - Channel 1. When the desired mode is displayed, press the **SET** button. The unit will return to the main menu.

5.1.1 tYPE

To set the mode **TYPE**, press the **SET** button to enter the sub menu selections shown below and use the **UP** (^) button to scroll through the options. See 4.1 Modes of Operation - Channel 1 for details on each type.

5.1.1.1 rPn

RPM sets the unit into RPM mode.

5.1.1.2 FrEQ

FREQ sets the unit into Frequency (Hz) mode.

5.1.1.3 SCALE

SCALE sets the unit into Scale mode. User must then specify a scale factor from 0.0001 to 99,999. Press the **SET** button to display the current scale factor value and use the buttons to set the required scale factor. Press **RECALL** to exit up one level without making a change or press **SET** to save the change. The edit buttons function as follows:

RESET	changes the digit being edited (blinking digit)
UP (^)	increases the digit by 1
DOWN (v)	decreases the digit by 1
RESET + (v)	shifts the decimal point
RECALL	aborts the edit process
SET	saves data and exits

5.1.1.4 SECAP

SECAP sets the unit into Single Event Capture mode. User must then specify a scale factor from 0.0001 to 99,999. Press the **SET** button and use the buttons (as described in SCALE above) to set the required scale factor value. Press **RECALL** to exit up one level without making a change or press **SET** to save the change.

5.1.1.5 rOC

ROC sets the unit into Rate of Change mode. User must then specify a scale factor from 0.0001 to 99,999. Press the **SET** button and use the buttons (as described in SCALE above) to set the required scale factor value. Press **RECALL** to exit up one level without making a change or press **SET** to save the change.

5.1.1.6 tOtAL

TOTAL sets the unit into Totalizer mode. User must then specify a constant value from 0.00001 to 99,999. Press the **SET** button and use the buttons (as described in SCALE above) to set the required constant value. Press **RECALL** to exit up one level without making a change or press **SET** to save the change.

5.1.2 InPUt

This menu option changes the sense of the input trigger. Press the **SET** button to select and then use the **UP** (^) button to select POSitive or nEGative. Press the **SET** button to select the new setting or the **RECALL** button to exit without saving the settings.

5.1.3 LOEnd

This menu option determines how long the unit waits for a measurement before showing Zero as the Low End. LOEnd is only visible in the RPM, FREQ, SCALE, and SECAP modes. Press the **SET** button to enter the settings for the Low End measurement and use the **UP** (^) button to scroll through the options described below. Press the **SET** button to select the new setting or the **RECALL** button to exit without saving the settings.

5.1.3.1 12SEC

12 SEC sets the Low End to 12 Seconds, equivalent to 5 RPM.

5.1.3.2 1_SEC

1 SEC sets the Low End to 1 Second, equivalent to 60 RPM.

5.1.3.3 HALF

HALF sets the Low End to 1/2 Second, equivalent to 120 RPM.

5.1.4 GAtE

This menu option changes the internal measurement rate. Press the **SET** button to select and then use the **UP** (^) button to select Std or FASt as described below. Press the **SET** button to select the new setting or the **RECALL** button to exit without saving the settings.

5.1.4.1 Std

STD sets the gate to the Standard rate of 32.768 msec.

5.1.4.2 FASt

FAST sets the gate to the FAST rate of 4.096 msec.

5.2 CH_2

Channel 2 sets the Auxiliary input function. This menu item has a number of sub items. Once selected with the **SET** button, the instrument will display its current function. To exit back to the main menu without changing the function, press the **RECALL** button. If you wish to change the function, you can view the options using the **UP** (^) button. The available options are shown below and are described in 4.2 Modes of Operation - Channel 2. When the desired function is displayed, press the **SET** button. The unit will return to the last menu level.

5.2.1 tYPE

To set the mode **TYPE**, press the **SET** button to enter the sub menu selections shown below and use the **UP** (^) button to scroll through the options.

5.2.1.1 OFF

OFF turns OFF the Aux input so that it has no function.

5.2.1.2 SECAP

SECAP sets the Aux input to be the second input for the SECAP mode. See 4.2.3 Single Event Capture.

5.2.1.3 InHbt

INHIBIT sets the Aux input to disable the input. See 4.2.2 Inhabit.

5.2.1.4 rStIn

RESET INPUT sets the Aux input to RESET the current Display Total Value. See 4.2.4 External Reset - Input Totalizer.

5.2.1.5 rStAL

RESET ALARM sets the Aux input to be the ALARM reset. See 4.2.5 External Reset - Alarms.

5.2.2 InPUt

For **INPUT**, press the **SET** button to change the sense of the Aux input and use the **UP** (^) button to select NEGative or POSitive. Press the **SET**

button to select the new setting or the RECALL button to exit without saving the settings.

5.3 dECPt

This sets the **Decimal Point** on the displayed reading. To enter this menu item press the **SET** button. The unit will display the current decimal point setting. To select a different decimal place, press the **UP** (^) button, which will toggle between 1, 2, 3 and NONE. Press the **SET** button to change the decimal point setting to the option displayed and exit back to the menu. To exit back to the main menu without changing the mode, press the **RECALL** button.

5.4 SEt_1

Set 1 is used to set or show the **ALARM 1** SETUP parameters. This menu item has a number of sub items. Once selected with the **SET** button, the instrument will display its current setting. If you wish to change the alarm setup, you can view the options using the **UP** (^) button. The available options are shown below and are described in 4.4 ALARM LIMITS. When the desired function is displayed, press the **SET** button. The unit will return to the last menu level. To exit back to the main menu without changing the values, press the **RECALL** button.

5.4.1 StYPE

To set the **ALARM TYPE** (Set tYPE), press the **SET** button to enter the sub menu selections shown below and use the **UP** (^) button to scroll through the options. Press the **SET** button to select the new setting or the **RECALL** button to exit without saving the settings.

5.4.1.1 OFF

OFF turns the Alarms OFF so that it has no function.

5.4.1.2 LO

LOW sets the Alarm to Low type.

5.4.1.3 HI

HIGH sets the Alarm to High type.

The following options are only visible if the Alarm Type is set to Low or High:

5.4.2 LATCH

To select whether the Alarm is Latching or Non-Latching (see 4.4.1 Latching vs. Non-Latching Limits), press the **SET** button and then use the **UP** (^) button to select nO for **Non-Latching** or YES for **Latching**. Press the **SET** button to select the new setting or the **RECALL** button to exit without saving the settings.

5.4.3 LOC

To select whether the Alarm will have a low level **LOCK** out, press the **SET** button and then use the **UP** (^) button to select nO or YES. Press the **SET** button to select the new setting or the **RECALL** button to exit without saving the settings.

5.4.4 FAILS

Alarm relays can be set to be **FAILSAFE**, which inverts the sense of the relay so that they are energized under normal conditions. Press the **SET** button and then use the **UP** (^) button to select nO or YES. Press the **SET** button to select the new setting or the **RECALL** button to exit without saving the settings.

5.4.5 SETPT

Press the **SET** button to display the current **SETPOINT** value and then use the buttons to set the desired value. Press the **SET** button to save the setting or the **RECALL** button to exit without saving the setting. The edit buttons function as follows:

RESET	changes the digit being edited (blinking digit)
UP (^)	increases the digit by 1
DOWN (v)	decreases the digit by 1
RESET + (v)	shifts the decimal point
RECALL	aborts the edit process
SET	saves data and exits

5.4.6 dEAdb

DEADBAND is only applicable to non-latching limits – see 4.4.2 Deadband (Hysteresis). Press the **SET** button to display the current deadband value and then use the buttons to set the desired value. Press the **SET** button to save the setting or the **RECALL** button to exit without saving the setting. Edit the value using the buttons as described in 5.4.5 Setpoint.

5.5 SEt_2

SET 2 is the same as SEt_1 but for ALARM 2.

5.6 dAC_1

The dAC_1 menu option is used to set or show the Analog Output digital to analog converter parameters. When dAC_1 is displayed, press the **SET** button to enter the sub menu selections shown below and use the **UP** (^) button to scroll through the options. Press the **SET** button to select an option to view/change or the **RECALL** button to abort without changing the settings.

5.6.1 0SCAL

(0) ZERO SCALE sets the Zero Scale value for the Analog Output. When the **SET** button is pressed, the current value will be displayed. Edit the value using the buttons as described in section 5.4.5 Setpoint. Press **RECALL** to exit up one level without making a change or press **SET** to save the change.

5.6.2 FSCAL

FULL-SCALE sets the Full-Scale value for the Analog Output. When the **SET** button is pressed, the current value will be displayed. Edit the value using the buttons as described in section 5.4.5 Setpoint. Press **RECALL** to exit up one level without making a change or press **SET** to save the change.

5.6.3 dI AG

DIAGNOSTIC sets the Analog Output to a preset value for diagnostic purposes. Options are FULL, HALF, or 2Er0 (Zero) scale. Press **RECALL** to exit up one level without making a change or press **SET** to save the change.

5.7 bAUd

The **BAUD** menu option is used to set the baud rate for the serial communication option. When bAUd is displayed, press the SET button to display the current baud rate. Press the **UP** (^) button to scroll through the baud rate options: 115_2 = 115200, 57_6 = 57600, 38_4 = 38400, 19_2 = 19200, 9_6 = 9600, 4_8 = 4800, and 2_4 = 2400. When the desired rate is displayed, press the **SET** button to select. Press the **RECALL** button to abort without changing the baud rate.

5.8 EnEt

The **ENET** (Ethernet Network) menu option is used to set the network addresses for the Ethernet interface (Option). There are three sub items: IP = IP Address, SUb = Subnet Address, and GAt = Gateway Address. These addresses are in the format 192.168.000.100. Use the buttons as described below to edit the values as required.

RESET	changes the digit being edited to the right; will stop at the rightmost digit
RESET +v	changes the digit being edited to the left; will stop at the leftmost digit
UP (^)	increases the digit by 1
DOWN (v)	decreases the digit by 1
RECALL	aborts the edit process
SET	enters the sub menu item for editing and when pressed again, saves the data and exits

5.9 OUtPUt

The **OUTPUT** menu option is used to set the sense for the Pulse Output. When OUtPUt is displayed, press the **SET** button to display the current setting. Press the **UP** (^) button to select **NEG**ative or **POS**itive and press **SET** to save the change. Press the **RECALL** button to abort without changing the setting.

5.10 d ISPr

The **DISPLAY (Rate)** menu option is used to set the Display Update Rate. When dI SPr is displayed, press the **SET** button to display the current setting. Press the **UP** (^) button to scroll through the display rate options: HALF = ½ second, 1_SEC = 1 second, and 1_5_5 = 1.5 seconds. When the desired rate is displayed, press the **SET** button to select. Press the **RECALL** button to abort without changing the setting.

5.11 SErnO

The **SERIAL NUMBER** menu option is used to view the serial number of the unit. When SErnO is displayed, press the **SET** button and the serial number will scroll across the display. Press the **RECALL** button to return to the main menu.

5.12 PASSC

The menu can be locked and protected by setting a **PASSCODE**. To create a passcode, use the buttons as described below to enter a value. Set to 00000 for no passcode; otherwise, the user must enter the passcode to enter the menu.

RESET	changes the digit being edited (blinking digit)
UP (^)	increases the digit by 1
DOWN (v)	decreases the digit by 1
RECALL	aborts the edit process
SET	saves the data and exits

6.0 SERIAL OUTPUT

The ACT-3X can be ordered with an optional USB, Ethernet, or RS232 compatible serial interface. The USB connection is a Type B socket, the Ethernet is a standard RJ45 port and the RS232 interface is made via a 9-pin miniature D connector on the rear panel. See 2.3.7 Serial Communications for connection details. The instrument is not supplied with serial interface cables.

The instrument sends and receives various information out through the serial interface. Under normal operation, the status of the limits is sent as each event occurs. The user can also request the actual value of the display be sent on a continuous basis. The user can also request the minimum and maximum values be sent on demand, as well as the current set up of all parameters of the instrument and program the unit remotely. Software is available to allow programming and to show real time data, or export the real-time data to an Excel™ spreadsheet.

The instrument is fully programmable via the serial interface. The user can remotely set the modes, limits, hysteresis, scale factors and so on, as well as reset either or both the limits.

6.1 DATA FROM THE SERIAL INTERFACE

The messages below are sent from the instrument as each event occurs. Other information is sent on demand and is covered in the following section.

The messages are sent as standard ASCII and all messages end with a carriage return **<CR>**. There is no Line feed sent. However, most terminals, printers and computers have the ability to automatically add a Line feed to a carriage return.

SS1 LIMIT 1 has tripped

SS2 LIMIT 2 has tripped

SR1 LIMIT 1 has reset

SR2 LIMIT 2 has reset

SR3 Both Limits have been forced to reset (**RESET** button pressed)

If the user sends a Send display Data (**@D1**) command, the front panel display value is transmitted at the display update rate (Refer to 4.7.1 Display Update Rate). This data is sent as it is displayed on the unit.

@D1 will send data continuously

@D2 will stop data from being sent

@P1 will identify the unit

@C1 will send over the current configuration

6.2 SERIAL COMMANDS

The instrument responds to a number of commands sent to its serial port. All commands begin with @ and end with a carriage return <CR>. All illegal data is ignored.

There are basically two groups of commands. The first group are **Run Mode** commands and do not affect the operation of the unit, other than the execution of the command. The second group is **Control** commands that require further information from the operator.

Note: Control commands suspend operation of the instrument until completed.

6.2.1 Run Mode Commands

These commands do not interfere with the operation of the instrument. They result in an action only. All commands are activated after the carriage return **<CR>** or **<Enter>** is pressed. Commands entered are not echoed back to the user. However, the results, if any, are sent back to the user.

The following are valid **Run Mode** commands. Enter the command and then **<CR>**.

Command	Action	Response
@R1	Reset LIMIT 1	Unit sends LR1 when done
@R2	Reset LIMIT 2	Unit sends LR2 when done
@R3	Reset both Limits	Unit sends LR3 when done
@D0	Send current displayed value	Unit sends current displayed once
@D1	Send display data	Unit sends display data until @D2 command
@D2	Stop sending display data	Unit stops sending display data
@D3	Send last calculated reading	This value is changed as fast as the throughput of the ACT unlike the @D0 command that gives the last displayed value which only changes up to 2 times per second. In the Rate of Change (ROC) mode this command will give the last RPM measured. To get the displayed ROC value, use the @D0 or @D1 commands.
@MX	Send Maximum value	Unit sends Maximum value once
@MN	Send Minimum value	Unit sends Minimum value once
@RE 32	Reset Maximum value	Unit sends OK and R2 when done
@RE 64	Reset Minimum value	Unit sends OK and R2 when done
@RE 96	Reset Max and Min	Unit sends OK and R2 when done

6.2.2 Control Commands

Note: Control commands may affect the operation of the instrument so the user should proceed with caution if the unit is in an operational environment.



CAUTION: Relays may drop out or pull in during set up.

A COMMAND is an instruction to the unit to change one or more of its operating parameters. It consists of the @ symbol followed by the Command (,) a category (, or =) and an argument followed by a carriage return (Enter). If a command is given without an argument, the unit will return the current setting. For example: @CH_1,TYPE=RPM will change the mode to RPM and @CH_1,TYPE will return the answer RPM. In some cases the argument is followed by a numerical value. For example: @CH_1,TYPE,SCALE=60.0 will change the scale factor to 60.0. **(NOTE: The unit must be set to the Scale Mode first for the Scale factor to be recognized.)** Incomplete commands will be ignored.

The following are valid **Control** Commands:

- Command,Category (e.g. @CH_1,TYPE will return the current Type setting for Channel 1)
- Command,Category = Argument (eg. @CH_1,TYPE=ROC sets the Channel 1 Type to Rate of Change)
- Command,Category,Argument = Value (e.g. @CH_1,TYPE,SCALE=60.0 sets the Scale Mode Scale factor to 60.0)
- Command = Argument (e.g. @DECPT=NONE sets the Decimal Point to none)

Command	Category	Argument	Action
@CH_1			(Channel 1)
	TYPE		
		RPM	Sets scale to 60 so displays in RPM
		FREQ	Sets scale to 1 so displays in hertz
		SCALE	Scale mode; enter Scale factor
		SECAP	Single Event Capture; enter Scale factor
		ROC	Rate of Change; enter Scale factor
		TOTAL	Totalizer; enter Totalize Scale factor
	INPUT	POS or NEG	Select from POS or NEG edge triggering
	LOEND	12SEC, 1_SEC, HALF	Set how long with no pulses before the tachometer zeros
	GATE	STD, FAST	Select from STD (1/100 Second), or FAST (1/1000 second)

Note: To set the mode use the equal sign after TYPE, e.g. CH1,TYPE=SCALE. To set a scale factor use TYPE followed by the argument and the equal sign, e.g. @CH1,TYPE,SCALE=60.0.

@CH_2			(Channel 2 **–** AUX input)
	TYPE		
		OFF	Turn the Aux input OFF
		SECAP	Aux input is second input for SECAP
		INHBT	Aux input will enable/disable primary input (acts as a gate)
		RSTIN	Aux input will reset total
		RSTAL	Aux input will reset Alarms (drop out contacts)
	INPUT	POS or NEG	Select from POS or NEG edge triggering

Command	Category	Argument	Action
@DECPT		NONE, 1, 2, or 3	Set the maximum number of decimal places to be displayed
@SET1			Settings for Setpoint (Alarm) 1
	STYPE	OFF, LO, HI	Select the Alarm type as Low, High or Off
	LATCH	NO, YES	Select whether the Alarm is latching
	LOC	NO, YES	Select whether the Alarm has a low level lockout
	FAILS	NO, YES	Select whether the Alarm is fail safe
	SETPT	xxxxx	Enter the setpoint xxxxx = value (in same units as measurement)
	DEADB	xxxxx	Enter the deadband xxxxx = value (in same units as measurement)
@SET2			Same as SET1 but for Setpoint (Alarm) 2
@DAC1			Settings for the Digital to Analog Converter
	0SCAL	xxxxx	Set the Analog out Zero scale. xxxxx = value in measurement units
	FSCAL	xxxxx	Set the Analog out Full scale xxxxx = value in measurement units
	DIAG	ZERO, HALF, FULL	This sets the analog output to ZERO, HALF, or FULL scale
@BAUD			Will display the BAUD rate in kbyte/sec
@ENET			Will show the Ethernet Address settings. IP Address, Sub net mask and Gateway Address

Command	Category	Argument	Action
@OUTPT		POS or NEG	Select the polarity of the pulse output
@DSPLR		HALF, 1_SEC, 1.5_S	This sets the maximum display update rate to ½, 1 or 1½ second
@SERNO			View the serial number of the unit
@PASSC		xxxxx	Set this to 00000 for no passcode; otherwise the user must enter the xxxxx passcode to enter the menu

If a user tries to enter too many characters, or enters illegal data, the instrument will respond with Err and will abort the process. If the command is successfully executed, the instrument will again send the OK message.

7.0 SPECIFICATIONS

SPECIFICATIONS*	ACT-3X PANEL TACHOMETER/TOTALIZER
Speed Range	5 RPM to 999,990 RPM (speeds below 5 RPM are possible with multiple pulses per revolution)
Input Frequency Range	0.083 Hz to 250 kHz
Totalizer/Counter	Display Range: 0.001 to 99,999 100,000 – 999,990 (only top 5 digits are shown -- x10) Maximum # of counts of 16,777,216 even with a 0.001 scale
Input Configuration and Voltage Range	Universal inputs: 1 to 9,999 pulses per revolution Front panel pushbutton programmable TTL input and 1.1 V to 50 Vac signals Opt: -1 to -50 Vdc
Accuracy	±0.001% of reading or ±1 displayed resolution (Standard Gate); ±0.01% of reading or ±1 displayed resolution (Fast Gate)
Resolution	Fixed Range Mode 1 RPM (5 to 99,999 RPM) 10 RPM (100,000 to 999,990 RPM) Auto Range Mode Up to 0.001 RPM
Display	5 digits, 0.56 inch high red seven segment LED
Display Update	Menu selectable between: 0.5 second above 120 RPM, 1 Second above 60 RPM, 1.5 Second above 40 RPM
Max Measurement Rate	Up to 100 times per second (Standard Gate) or up to 1000 (Fast Gate) Dependent on input frequency; Input must be > measurement rate
Scale Mode Scaling Computation	Programmable scaling 0.0001 to 99,999; Front panel pushbutton programmable
Decimal Point	User Selectable (0-3 decimal places max); Front panel pushbutton programmable
Memory	Max/min. recall from front panel pushbuttons
Dimensions	1/8 DIN by 3.94" [100 mm] deep Panel cutout: 1.74" H x 3/58" W [44 mm x 91 mm]

SPECIFICATIONS*	ACT-3X PANEL TACHOMETER/TOTALIZER
Input Power	Standard 100 - 240 Vac (50/60 Hz) 8 VA or Optional 12 Vdc or 24 Vdc isolated 6 W
Recommended Monarch Instrument Sensors	Optical, Laser, Proximity, Magnetic, Infrared, Gas Engine (See 8.0 ACCESSORIES for more details)
Sensor Power Output	12 Vdc @ 60 mA standard, or optional 5 Vdc @ 60 mA or 24 Vdc @ 30 mA to sensor
Pulse Repeater Output TTL	0 to 5 V TTL compatible, one pulse out for each pulse in Menu selectable polarity
Serial Interface Options	Bidirectional RS232C, USB or Ethernet Interface
Alarm Capability	Two alarm setpoints: High or Low Alarm Limits Latching or Non-latching Front panel pushbutton or remotely programmable Hysteresis and low limit lockout are programmable Relays can be set as failsafe
Analog Output†	**Voltage (AO)**: 0 to 5 Vdc, 5 mA max load, Isolated or Non-isolated *or* **Current Source (IO)**: 4 to 20 mA (500Ω max load with internal 12 V Compliance Voltage), Isolated or Non-isolated (1-5V with 250Ω load resistor) 15-bit resolution; Front panel pushbutton programmable for full scale and offset RPM ranges
Alarms Outputs	Form C relay contacts, rated 1A at 115 Vac or 230 Vac
Remote Programming	Unit can be remotely programmed using Serial Interface (3.5 mm phone plug Serial Interface requires USB Programming Cable and PM Remote Software)

*Specifications are subject to change without notice.

† Rated accuracy reached after 10-minute warm-up period.

8.0 ACCESSORIES

See Accessories webpage for details.

USB Programming Cable with PM Remote Software



Download the PM Remote Software from www.monarchinstrument.com. Use the USB Programming Cable and software to change the ACT-1B settings or remotely monitor the RPM.
PN: 6180-031

Remote Optical Laser Sensors:**



ROLS-W: 3.3 to 15 V dc Power Requirement, 8-ft cable
PN: 6180-030
ROLS24-W: 24 V dc Power Requirement, 8-ft cable
PN: 6180-035
ROLS24-W-25: 24 Vdc Power Requirement, 25-ft cable
PN: 6180-035-25

Remote Optical LED Sensors:



ROS-W: 8-ft cable
PN: 6180-056
ROS-W-25: 25-ft cable
PN: 6180-056-25

Remote Optical High Temp Sensor:



ROS-HT-W-25: 25-ft cable
PN: 6180-058-25

Rugged Laser Sensors:**



RLS-W: 4 to 15 V dc Power Requirement, detachable 10-ft cable
PN: 6180-080
RLS24-W: 10 to 24 V dc Power Requirement, detachable 8-ft cable
PN: 6180-082

Proximity Sensors:

P5-11: 2-wire inductive NAMUR output with 10 ft. cable
PN: 6180-013

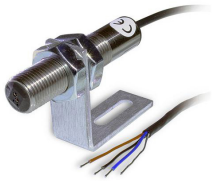


PS-12: 3-wire open collector PNP pulse output, 6-ft cable
PN: 6180-032



Infrared Sensors:

IRS-W Sensor: Infrared Sensor with 8 ft. cable
PN: 6180-021



**Pay close attention to Power Requirement when ordering! Confirm Sensor Power option of ACT configuration matches requirement. Contact Monarch Instrument with any questions.

M-190W Sensor: Magnetic Sensor with 10 ft. cable
PN: 6180-012



MT-190W Sensor: Magnetic Trigger Sensor with amplifier
PN: 6180-037



GE200 HP Sensor: Inductive Sensor with 15 ft. cable
Requires an amplifier with a wire connection
PN: 6180-014



Amplifier for GE200 HP or Magnetic Sensor
PN:4180-406



Reflective Tape

T-5 (single pack), 5 feet - PN: 6180-070
T-5 (2-pack), 5 feet each - PN: 6180-069
T-50, 50 feet - PN: 6180-072
T-5WP (waterproof), 5 feet - PN: 6180-079



APPENDIX A: SCALING THE ACT FOR ENGINEERING DISPLAYS

The **SCALE Mode** must be used to display RPM in applications where there is more than one pulse per revolution. Below describes how to use this mode and other applications that need to be scaled.

When using the scaling function of the ACT Tachometer it is possible to multiply the input signal by any value from 0.0001 to 99,999 making it possible to display the actual output in virtually any format.

The most important thing to note is that the instrument takes all tachometer measurements in pulses per second. The **RPM Mode** requires a 1 pulse per revolution input, so it simply uses a built-in scale factor of 60.

Input		**Conversions (Scale Factor)**				**Scales Display To**
$\frac{\text{Pulse}}{\text{Second}}$	x	$\frac{\text{1 Rev}}{\text{1 Pulse}}$	x	$\frac{\text{60 Seconds}}{\text{Minute}}$	=	$\frac{\text{Revs}}{\text{Minute}}$

In an application with multiple pulses per rev:

Input		**Conversions (Scale Factor)**				**Scales Display To**
$\frac{\text{Pulse}}{\text{Second}}$	x	$\frac{\text{1 Rev}}{\text{N pulses}}$	x	$\frac{\text{60 Seconds}}{\text{Minute}}$	=	$\frac{\text{Revs}}{\text{Minute}}$

Therefore, to read out in RPM, the scale factor is 60 ÷ **N**, where **N** is the number of pulses.

Thus, if the system gave out 4 pulses per revolution, the scale factor becomes 60 ÷ 4 = 15. The trivial case is the 60 toothed gearwheel used in older systems which gave out 60 pulses per revolution, reducing the scale factor to 1, or measuring frequency (cycles per second) directly.

All that is required to scale the unit is a bit of common sense, a basic knowledge of mathematics (you can of course use a calculator) and some relationships pertaining to your application (e.g. 1 yard = 36 inches, or 1 yard = 0.914402 meters). Refer to APPENDIX B: Useful Conversions for some useful conversions.

A very useful formula for this application is knowing the circumference of the shaft you are monitoring. This could also be a speed wheel, tire etc. The circumference = π x diameter (π = 3.14159).

In order to scale we need to know what we want as opposed to what we have, and some relationship between the two. For example:

1. Suppose we have a wheel turning on a roll of paper measuring its linear speed. The wheel has a diameter of d inches. Each time the wheel turns one complete revolution, π x d inches (the circumference) of paper moves under the wheel and we get one pulse into the tachometer. We want to know at what speed we are producing paper in yards per minute.

The input is measured in pulses per second. There is one pulse per revolution, so:

Input **Conversions (Scale Factor)** **Scales Display To**

$$\frac{\text{Pulses}}{\text{Second}} \times \frac{\text{1 Rev}}{\text{Pulse}} \times \frac{\pi \times d \text{ Inches}}{\text{Rev}} \times \frac{\text{Yard}}{\text{36 Inches}} \times \frac{\text{60 Seconds}}{\text{Minute}} = \frac{\text{Yards}}{\text{Minute}}$$

Scale Factor Of Comment Gives Read Outs In

(π x d"	circumference of wheel	inches per second
(π x d" ÷ 36	36 inches in a yard	yards per second
(π x d") ÷ 36) x 60	60 seconds in a minute	yards per minute
5.2360 x d”	multiplying the known	yards per minute

Say the diameter (d) is 10 inches. We get that pulses per second = 52.36 yards per minute and our scale factor is thus 52.36 for a 10 inch diameter shaft.

2. Suppose we have a shaft turning on a conveyor and we know that for each turn of the shaft, the conveyor moves X inches and we get one pulse into the tachometer. This step eliminates having to calculate the circumference. If we wanted to know speed in meters per second then review the following.

The Input is measured in pulses per second. There are X inches per pulse:

Scale Factor of	**Comment**	**Scales Display To**
X	inches per pulse	inches per second
X x 0.914402 ÷ 36	1 yard = 0.914402 meters 36 inches in a yard	meters per second
X x 0.0254	multiply out	meters per second

The scale factor is thus 0.0254 x X (where X is in inches).

3. Suppose we have wheel of d inches in diameter. This wheel turns the tire on a motor vehicle. We get one pulse into the tachometer for each revolution of the drive wheel. We want the display in miles per hour. We ignore slip.

Note: For more than one pulse per revolution, simply divide the scale factor you get for one pulse by the number of actual pulses per revolution.

Scale Factor of	**Comment**	**Scales Display To**
(π x d")	circumference of wheel	inches per second
(π x d") ÷ (5280 x 12)	1 mile = 5280 feet 12 inches = 1 foot	miles per second
(π x d") ÷ 63360	multiply out	miles per second
(π x d") ÷ 63360) x 3600	1 hour = 3600 seconds	miles per hour
0.1785 x d	multiply out	miles per hour

To enter the actual scale factor into the tachometer, do the following:

Turn the tachometer on. Assuming there is no input, the display will show 0. Press the SET button until the display shows TYPE. Press the SET button again and the unit will display its current mode of operation. Press and release the UP (∧) button until the display shows SCALE, and then press the SET button. The display will show the current scale factor value with the right-most digit flashing. The UP (∧) and DOWN (∨) buttons change the flashing digit. The RESET button moves the flashing digit and RESET + DOWN (∨) moves the decimal point. Using these buttons, alter the value to indicate the scale factor you want. Once you have the scale factor as desired, press the SET button. Press the RECALL button twice to get out of the Menu.

Note that all limits and outputs work in the absolute displayed value. Thus, if you have entered a scale factor to display in yards per minute, then the limit display and setting will be directly in yards per minute.

APPENDIX B: USEFUL CONVERSIONS

Multiply	By	To Get
Inches	2.5400	Centimeters
Centimeters	0.3937	Inches
Inches	0.0254	Meters
Meters	39.3700	Inches
Feet	30.4800	Centimeters
Centimeters	0.2381	Feet
Feet	0.3048	Meters
Meters	3.2810	Feet
Yards	0.9144	Meters
Meters	1.0940	Yards
Miles	1.6090	Kilometers
Kilometers	.6214	Miles
Miles	1609.0000	Meters
Meters	6.214 x 10-4	Miles
Miles	160900.0000	Centimeters
Miles	5280.0000	Feet
Furlong	66.0000	Feet
Knots	6080.0000	Feet/Hour
Knots	1.1520	Miles/Hour

APPENDIX C: USING THE SINGLE EVENT CAPTURE MODE

This is to how to calculate a scale factor and to show sources of measurement error. In this example, the distance between sensors is 1 inch and we want the readings displayed in Miles Per Hour (MPH). The fastest measurement we intend to make is 130 MPH.

First calculate the scale factor. With a scale of one, the tachometer will display readings in pulses per second.

The scale factor can be calculated as:

$$\frac{1\ \text{Pulse}}{\text{Second}} \times \frac{1\ \text{Inch}}{\text{Pulse}} \times \frac{3600\ \text{Seconds}}{\text{Hour}} \times \frac{1\ \text{Foot}}{12\ \text{Inches}} \times \frac{1\ \text{Mile}}{5280\ \text{Feet}} = \frac{0.05681818\ \text{Miles}}{\text{Hour}}$$

There will be an error because scale factors can only be five digits. Therefore, the scale factor is rounded to 0.0568.

You will also have an error in the placement of the sensors. The tape edges won't be exactly 1 inch apart. Assuming the edges were really 1.01 inches apart there would be 1% error. So at 130 MPH your reading would be 128.7 MPH.

The internal clock inside the tachometer runs at 2 MHz. All measurements are synchronized to this internal clock giving a ±0.5 microsecond uncertainty. As RPM, MPH, etc increase, the measurement time decreases. As the measurement time decreases, the small measurement uncertainty becomes a larger percentage of the measurement.

At 130 MPH there would be 0.00043706293706 seconds between pulses. (Seconds = scale factor / 130 MPH.) This is equal to about 874 clock cycles for a 2 MHz internal reference clock.

873 clock cycles = 130.16766 MPH
875 clock cycles = 129.87013 MPH

Therefore, we have an error of ±0.148765 MPH from the clock resolution at 130 MPH. The sensors must be placed further apart for better resolution.

APPENDIX D: SETTING UP THE ETHERNET INTERFACE

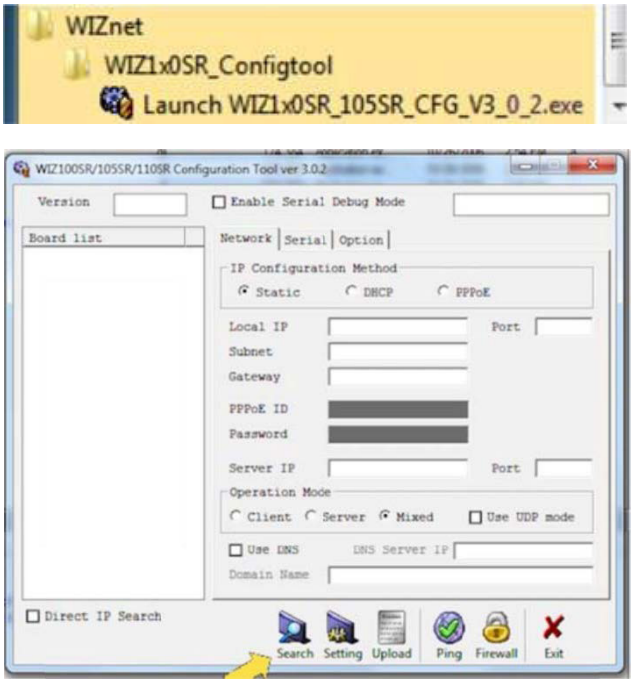
Connect an Ethernet cable from the ACT-3X device to your network. Note: The device MUST be connected to the same network as the computer on which you are going to run this setup.

You must first download the PM Remote Software package from our website.
https://monarchserver.com/Files/Software/PMRemote_Software.zip

Unzip the files and then run the program Ethernetsetup.exe in the Utilities directory. This will install the Ethernet Configuration Utility.

Ensure there is power to the device and it is connected to the Ethernet then run the program:

All Programs – Wiznet - WIZ1x0SR_Configtool - **Launch WIZ1x0SR_105SR_CFG_V3_0_2.exe**

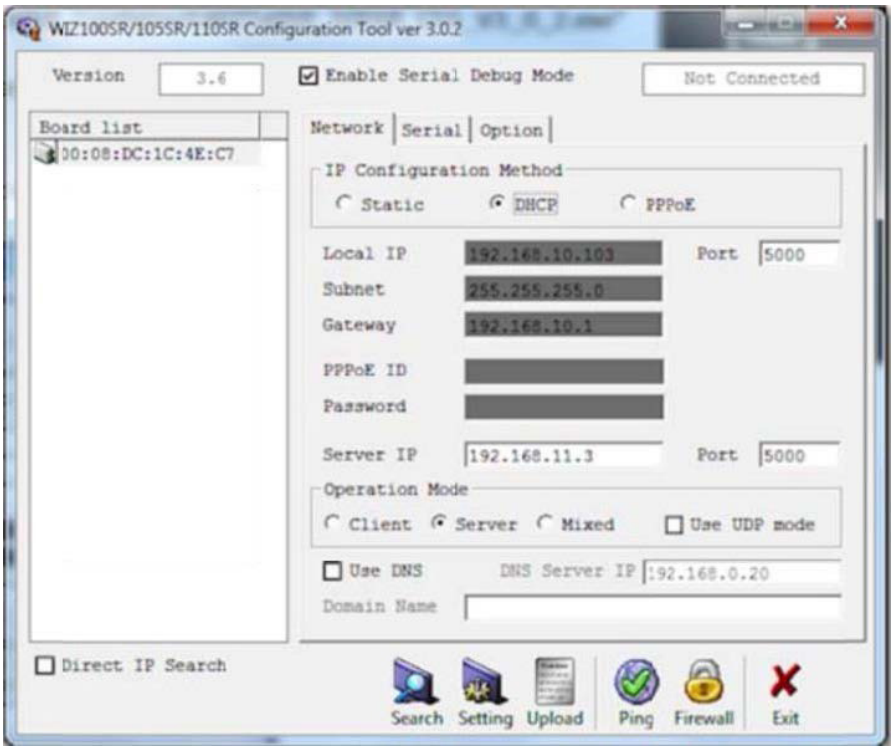


This will bring up the window on the left.

Click the **SEARCH** button at the bottom of the window and it will find all devices plugged into the Ethernet.

Note that the device is set up for DHCP by default so it will get an IP address from your local server.

Once the search is complete the window will be populated as shown next.



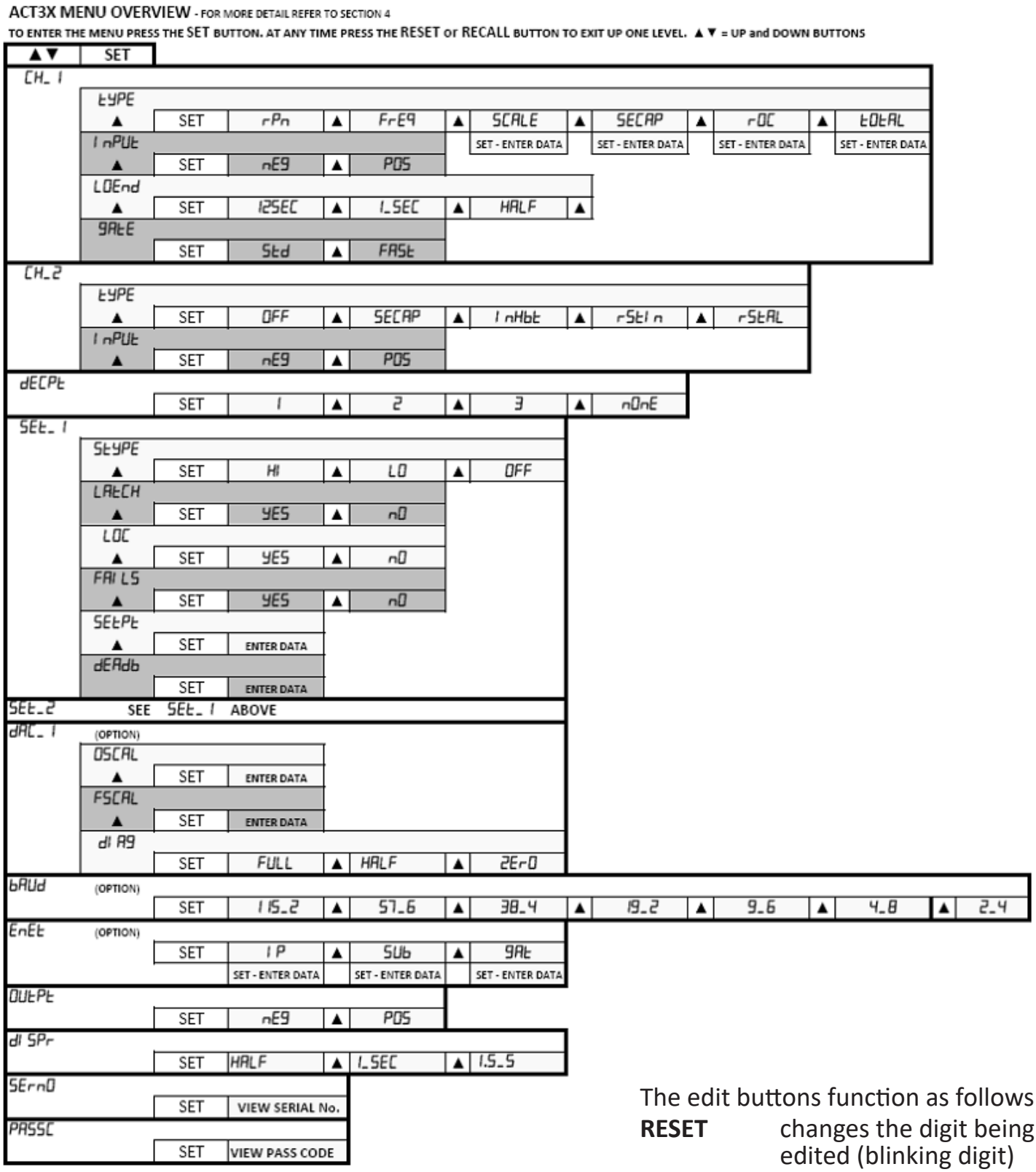
The current device setting is shown in the IP Configuration Method box. In this is example you can see the device has been set for DHCP and it shows the IP address as 192.168.10.103; of course, it will be specific to your network. The Subnet and Gateway information are also shown. If you have more than one device on your network, each will be identified by the MAC address in the Board List window. Click on the MAC address of interest to show the addressing for that device.

At this point, you can note this information for later use or you can set a static IP address by clicking the Static radio button and entering the Local IP, Subnet and Gateway information. Then click the SETTING button at the bottom of the window and this information will be sent to the device.

You need to remove power from the device for 10 seconds in order for the new information to be registered.

APPENDIX E: MENU OVERVIEW

For more information, refer to 5.0 USING THE MENU.



SET - ENTER DATA: Press the **SET** button and use the buttons to set the required value. Press **RECALL** to exit up one level without making a change or press **SET** to make the change.

The edit buttons function as follows:

RESET	changes the digit being edited (blinking digit)
UP (^)	increases the digit by 1
DOWN (v)	decreases the digit by 1
RECALL	aborts the edit process
SET	saves data and exits

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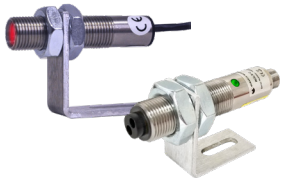

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