ACT-3X
Tachometer / Totalizer / Ratemeter
User Manual and Reference Guide

Rev 1.0, 021110

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.**

4. **Be sure all AC 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 or Monarch Instrument directly.**

In order to comply with EU Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE): This product may contain material which could be hazardous to human health and the environment. DO NOT DISPOSE of this product as unsorted municipal waste. This product needs to be RECYCLED in accordance with local regulations, contact your local authorities for more information. This product may be returnable to your distributor for recycling - contact the distributor for details.

TABLE OF CONTENTS

1.0 GENERAL 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: **Indoor Use Only**

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 watts (DC Option)		

NOTE: 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 120V or 240V (dependent on local voltage supply) 5A minimum when connected to an AC supply or 30V 1A 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 ACT3X is a 1/8 DIN enclosure requiring a 3.58” wide by 1.74” high (91x44 mm) mounting hole. Approximately 5” (127 mm) will be required behind the panel. Refer to Figure 1 below.

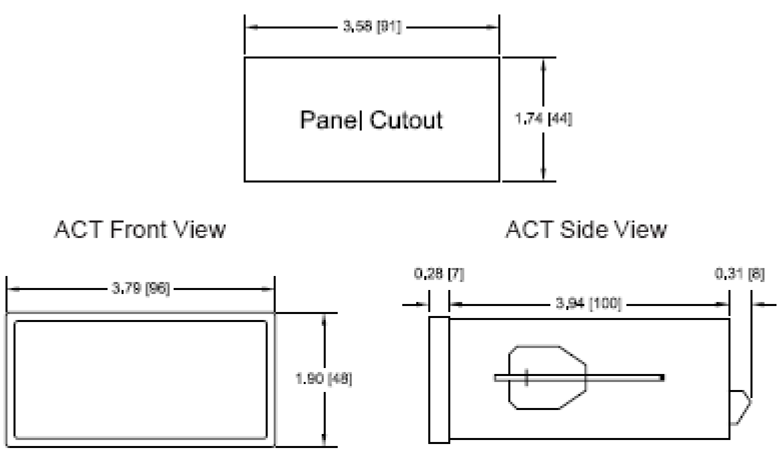


Figure 1 Dimensions in Inches [Millimeters]

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.

WARNING: 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 damped, 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 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.

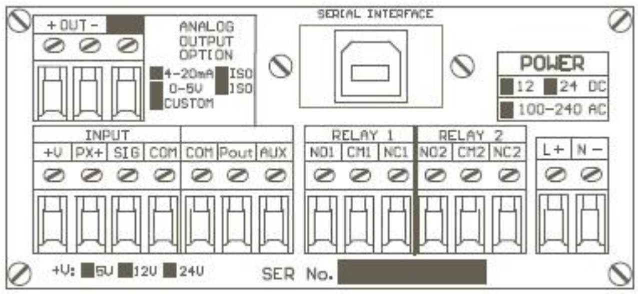


Figure 2 ACT-3X Rear panel with Analog Output and USB Option

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 above.

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 (12V ±10% or 24V ±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 Figures 2 and 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 +24Vdc, +12Vdc or +5Vdc (factory selected). Maximum load is 30mA from the 24V supply or 60mA from the 5 or 12V 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 on the following page for connection of Monarch standard sensors. The connections are typical for these types of sensors.

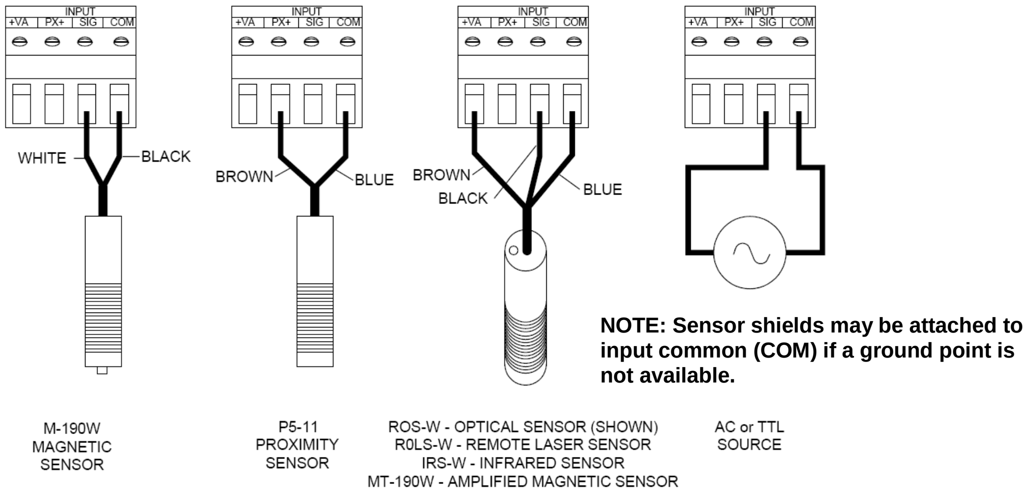


Figure 3 Sensor Connections

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**.

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.)

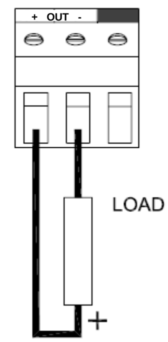
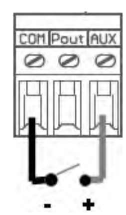


Figure 4 Analog Output Connections

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

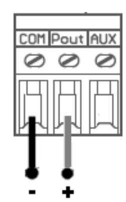
2.3.4 Auxiliary Input (AUX- Channel 2)

The Auxiliary Input is also referred to as Channel 2 (CH-2) and will accept a TTL input or any signal up to 12Vdc. 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 input is connected to the input marked AUX (+) and COM (-).

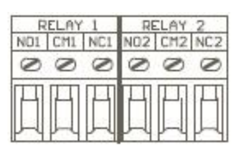


2.3.5 Pulse Output

The Pulse Output provides a pulse out for each pulse in. It is a TTL pulse switching between +5V 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 250Vac or 30Vdc.

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 are 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 first page for a photo of the front panel.

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

3.1 Status LED's

3.1.1 LIM 1 and LIM 2 (Alarm) LED's

The **LIM 1** and **LIM 2** (Alarm) LED's 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 LED's also go on continuously to indicate when and which limit is being set or adjusted. If the LED's are on continuously, the value on the display is a set point 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** LED's indicate to the user that a maximum or a minimum is being displayed. If either one of these LED's 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 Push Buttons

The five push buttons 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 Section 5.0.

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 set point 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).

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 Section 5.0 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 9999.9. 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 32 mS (or 4mS) 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: RPM per Minute (RPMPM), 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 9999.9.

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 9999.9. 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 a potential free contact. All modes are mutually exclusive – only one mode may be active at any time. Refer to Section 5.0 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 Inhibit

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 Section 4.1.4 above.

4.2.4 External Reset – Input Totalizer

If programmed as External Reset for Inputs (rStIn), when asserted (high or low depending on the sense programmed), it will reset the display (count) to Zero. Used in the Totalizer Mode (see Section 4.1.6) 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).

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 set points, 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 set point value. Refer to Section 4.7.2 for the limit response time. The dead band (hysteresis) is also programmable at any value from 0.0001 to 99.999% of the set point 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 Section 5.0 to set limit set points.

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 set point, either high or low. The user can program each limit to be Latching or Non-Latching. Refer to Section 5.0.

4.4.2 Dead band (Hysteresis)

Dead band is only applicable to ***non-latching limits***. Dead band is a value that is added to the set point (in the case of a low limit) or subtracted from the set point (in the case of a high limit) so that this new value (set point ± dead band) 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 set point. Dead band is set in absolute engineering units. For example if the Limit is set to 200 RPM as a High limit and the dead band 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 dead band feature, the alarm relays would chatter on and off it the input varied from 199 to 201, which is undesirable. The user can set the hysteresis to any value from 0.0001 to 99999. Refer to Section 5.0.

NOTE: The Dead band needs to be less than the setpoint.

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 set point. 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 Section 5.0.

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 5Vdc) 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:

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

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

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

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 Section 5.1.4 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 Section 5.1.3 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 Section 5.9.

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 **RESET** button to back out (Abort) the current setting. Pressing **RESET** again will eventually exit from the Menu.

Once in the MENU Mode, with CH_ 1 displayed, press the **UP** (∧) or **DOWN** (∨) 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	**Set point 1** - Set up parameters for Alarm 1
SEt_2	**Set point 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_ I

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 **RESET** 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 Section 4.1. When the desired mode is displayed, press the **SET** button. The unit will return to the main menu.

5.1.1 tYPE

TYPE - Press the **SET** button to enter the sub menu selections shown below and use the **UP** (∧) button to scroll through the options. See Section 4.1 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.

5.1.1.4 SECAP — **SECAP** - Sets the unit into Single Event Capture mode.

5.1.1.5 rOC — **ROC** - Sets the unit into Rate of Change mode.

5.1.1.6 tOtAL — **TOTAL** - Sets the unit into Totalizer mode.

5.1.2 I nPUt

INPUT - Press the **SET** button to change the sense of the input trigger and use the **UP** (∧) button to select NEGative or POSitive. Press **RESET** to exit up one level.

5.1.3 LOEnd

LOEND - Visible only in RPM, FREQ, SCALE and SECAP modes. Press the **SET** button to enter the settings for the **Low End** measurement (how long the unit waits for a measurement before showing Zero) selections shown below and use the **UP** (∧) button to scroll through the options. Press the **SET** button to select the new setting or the **RESET** button to exit without saving the settings.

5.1.3.1 I2SEC — **12 SEC** - Sets the Low End to 12 Seconds, equivalent to 5 RPM.

5.1.3.2 I_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

GATE - Press the **SET** button to enter the settings for the **GATE** time (internal measurement rate) selections shown below and use the **UP** (∧) button to scroll through the options. Press the **SET** button to select the new setting or the **RESET** button to exit without saving the settings.

5.1.4.1 Std — **STD** - Sets the gate to the Standard rate – 32.768 msec.

5.1.4.2 FASt — **FAST** - Sets the gate to the FAST rate – 4.096 msec.

5.2 CH_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 **RESET** 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 Section 4.2. When the desired function is displayed, press the **SET** button. The unit will return to the last menu level.

5.2.1 tYPE

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 Section 4.2.3.

5.2.1.3 InHbt **INHIBIT** - Sets the Aux input to disable the input. See Section 4.2.2.

5.2.1.4 rStIn **RESET INPUT** - Sets the Aux input to RESET the current Display Total Value. See Section 4.2.4.

5.2.1.5 rStAL **RESET ALARM** - Sets the Aux input to be the ALARM reset. See Section 4.2.5.

5.2.2 InPUt **INPUT** - Press the **SET** button to change the sense of the Aux input and use the **UP** (∧) button to select NEGative or POSitive. Press **RESET** to exit up one level.

5.3 dECPt

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 exit back to the main menu without changing the mode, press the **RESET** button. 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.

5.4 SEt_1

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. To exit back to the main menu without changing the values, press the **RESET** button. 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 Section 4.4. When the desired function is displayed, press the **SET** button. The unit will return to the last menu level.

5.4.1 StYPE **Set Type** - Select the ALARM TYPE. Press the **SET** button to enter the sub menu selections shown below and use the **UP** (∧) button to scroll through the options.

5.4.1.1 OFF **OFF** - Turns the Alarm OFF so that it has no function.

5.4.1.2 HI **HIGH** - Sets the Alarm to HIgh type.

5.4.1.3 LO **LOW** - Sets the Alarm to LOw type.

5.4.2 LAtCH **LATCH** - Press the **SET** button and use the **UP** (∧) button to select whether the Alarm is LATCHing – select **YES**, or NON-LATCHING – select **NO**. Press **RESET** to exit up one level without making a change or press **SET** to make the change.

5.4.3 LOC **LOCK** - Press the **SET** button and use the **UP** (∧) button to select whether the Alarm will LOCk out – select **YES**, or **NO**. Press **RESET** to exit up one level without making a change or press **SET** to make the change.

5.4.4 FAILS **FAIL SAFE** - Press the **SET** button and use the **UP** (∧) button to select whether the Alarm is FAIL Safe – select **YES**, or **NO**. Press **RESET** to exit up one level without making a change or press **SET** to make the change.

5.4.5 SEtPt **SET POINT** - Press the **SET** button and use the buttons to set the required SET POINT value. Press **RESET** to exit up one level without making a change or press **SET** to make the change. The edit buttons function as follows:

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

5.4.6 dEAdb **DEAD BAND** - Press the **SET** button and use the buttons to set the required DEAD BAND value. Press **RESET** to exit up one level without making a change or press **SET** to make the change. Edit the value using the buttons as shown in SEtPt above.

5.5 SEt_2

Same as SEt_1 but for **ALARM 2**.

5.6 dAC_1

Used to set or show the Analog Output (Option) parameters. This menu item has a number of sub items. Once selected with the **SET** button, the instrument will display its current setting. To exit back to the main menu without changing the function, press the **RESET** button. If you wish to change the function, you can view the options using the **UP** (∧) button. The available options are shown below. When the desired function is displayed, press the **SET** button. The unit will return to the last menu level.

5.6.1 0SCAL **ZERO SCALE** - Sets the Zero Scale value for the Analog output. Press the **SET** button and use the buttons to edit the value as per SEt_ 1 above. Press **RESET** to exit up one level without making a change or press **SET** to make the change.

5.6.2 FSCAL **FULL SCALE** - Sets the Full Scale value for the Analog output. Press the **SET** button and use the buttons to edit the value as per SEt_ 1 above. Press **RESET** to exit up one level without making a change or press **SET** to make the change.

5.6.3 dI A9 **DIAGNOSTIC** - Sets the analog output to a preset value for diagnostic purposes. Options are FULL, HALF or ZErO (Zero) scale. Press **RESET** to exit up one level without making a change or press **SET** to make the change.

5.7 bAUd

Sets the BAUD rate for serial communication (Option). Press the **SET** button to display the current baud rate. Press the **UP (∧)** button to view the baud rate options: 115.2 - 115200, 57.6 - 57600, 38.4 - 38400, 19.2 - 19200, 9.6 - 9600, 4.8 - 4800, 2.4 – 2400. When the desired mode is displayed, press the **SET** button to select or the **RESET** button to ignore. The unit will return to the menu.

5.8 EnEt

Sets the IP Address for the **Ethernet** interface (Option). There are three sub items: I P – IP Address, SUb – Sub Net Address, 9At – Gateway Address. These addresses are in the format 192.168.000.100. Use the buttons to edit the values as required.

RECALL	- changes the digit being edited to the left. Will stop at the left most digit
RECALL + (∨)	- changes the digit being edited to the right. Will stop at the right most digit
RESET	- aborts the edit process
SET	- saves data and exits
UP (∧)	- increases the digit by 1
DOWN (∨)	- decreases the digit by 1

5.9 OUtPUt

Sets the sense for the Pulse Output. Press the **SET** button to change the sense of the Pulse Output and use the **UP (∧)** button to select NEGative or POSitive. Press **RESET** to exit up one level or **SET** to change the value.

5.10 d ISPr

Sets the Display Update Rate. Press the **SET** button to change the display update rate and use the **UP (∧)** button to select **½**, **1** or **1.5** second update rate. Press **RESET** to exit up one level or **SET** to change the value.

5.11 SErnO

Used to view the Serial Number of the unit. Use the **SET** button to view the serial number and the **RESET** button to return to the main menu.

5.12 PASSC

Display or set the pass code to protect the menu. When setting or entering a pass code, the edit buttons function as follows:

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

6.0 SERIAL OUTPUT

The **ACT3X** has can have an optional USB, Ethernet or RS232C 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 Section 2.3.7 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 Section 4.7.1). 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 **@** 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	Sent current displayed value	Unit sends current displayed value 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.
@M1	Send Maximum value	Unit sends Maximum value once
@M2	Send Minimum value	Unit sends Minimum value once
@M3	Reset Max and Min	No Response

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 (eg. @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 (eg. @CH_1,TYPE,SCALE=60.0 sets the Scale Mode Scale factor to 60.0)
- Command = Argument (eg. @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 zeroes.
	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, eg. @CH1,TYPE=SCALE.
To set a scale factor use TYPE followed by the argument and the equal sign, eg. @CH1,TYPE,SCALE=60.0

Command	Category	Argument	Action
@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.
@DECPT		NONE, 1, 2, or 3	Set the maximum number of decimal places to be displayed.
@SET1			Settings for Setpoint (Alarm) 1
	STYPE	OFF, HI, LO	Select the Alarm type as High, Low 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 dead band 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
@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

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 push button 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 9999.9 Front panel push button programmable
Decimal Point	User Selectable (0-3 decimal places max) Front panel push button programmable
Memory	Maximum and minimum recall from front panel push buttons
Dimensions	1/8 DIN by 3.94” [100 mm] deep Panel cut out: 1.74” H x 3/58” W [44 mm x 91 mm]
Input Power	Standard 100 - 240 Vac (50/60 Hz) 8VA Or Optional 12 Vdc or 24Vdc isolated 6W
Recommended Sensors	Optical – ROS-W; Infrared – IRS-W Optical – ROS-HT-W-25; Laser – ROLS-W Optical – ROSM-5W; Laser – SLS-115/230 Proximity – P5-11; Mag/Amp – MT-190W Magnetic – M-190W; Gas Engine - GE-200
Sensor Power Output	12Vdc @ 60mA standard, or optional 5Vdc @ 60mA or 24Vdc @ 30mA to sensor
Pulse Repeater Output TTL	0 to 5 V TTL compatible, one pulse out for each pulse in Menu selectable polarity
Serial Interface	Bi-directional RS232C, USB or Ethernet Interface
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 12V Compliance Voltage), Isolated or Non-isolated. (1-5V with 250Ω load resistor) 15 bit resolution. Front panel push button programmable for full scale and offset RPM ranges.
Alarm Capability	Two alarm set points: High or Low Alarm Limits Latching or Non-latching Front panel push button or remotely programmable Hysteresis and low limit lockout are programmable Relays can be set as fail safe.
Alarm Outputs	Form C relay contacts, rated 1A at 115 Vac or 230 Vac
Alarm Reset	Automatic or manual reset. Front panel push button programmable Remote reset via AUXiliary input.
Remote Programming	Unit can be remotely programmed using optional Serial Interface.

8.0 OPTIONS AND ACCESSORIES / SENSORS

T-5	Reflective Tape - 5 foot (1.5 m) roll, 0.5 inch (10 mm) wide

USB Programming Cable with PM Remote Software on CD:

For use with units ordered with standard Serial Communications, phone plug. Enables the user to program the ACT-3X using a PC with USB connection. The software also allows remote monitoring of the RPM using a graphic display or an Excel™ spreadsheet.

ROLS-W	Remote Optical Laser Sensor with 8-foot cable
ROS-W	Remote Optical Sensor with 8-foot cable
ROS-P-25	Remote Optical Sensor with 25-foot cable (must cut plug off)
ROS-HT-W-25	High Temperature Remote Optical Sensor with 8-foot cable
ROSM-5W	Remote Optical Sensor, modulated
P5-11	Proximity Sensor with 6-foot cable
MT-190W	Magnetic Sensor with Amplifier Module with 8-foot cable
M-190W	Magnetic Sensor with 8-foot cable
GE-200	Gasoline Engine Sensor with 23 feet of cable
IRS-W	Infrared Sensor with 8-foot cable

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 9999.9 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**

$$\frac{\text{Pulses}}{\text{Second}} \times \frac{\text{1 Rev}}{\text{1 Pulse}} \times \frac{\text{60 Seconds}}{\text{Minute}} = \frac{\text{Revs}}{\text{Minute}}$$

In an application with multiple pulses per rev:

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

$$\frac{\text{Pulses}}{\text{Second}} \times \frac{\text{1 Rev}}{\text{N pulses}} \times \frac{\text{60 Seconds}}{\text{Minute}} = \frac{\text{Revs}}{\text{Minute}}$$

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** 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**

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

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, so:

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 **RECALL** button moves the flashing digit. 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	254.0000	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 – MENU OVERVIEW

For more detail, refer to Section 5.0.

TO ENTER THE MENU PRESS THE SET BUTTON. AT ANY TIME PRESS THE RESET or RECALL BUTTON TO EXIT UP ONE LEVEL. ▲▼ = UP and DOWN BUTTONS

▲▼	SET		Options (▲ between each)
CH_1	tYPE	SET	rPn / FrEq / SCALE (SET - ENTER DATA) / SECAP (SET - ENTER DATA) / rOC (SET - ENTER DATA) / tOtAL (SET - ENTER DATA)
	InPUt	SET	nEg / POS
	LOEnd	SET	12SEC / 1_SEC / HALF
	gAtE	SET	Std / FASt
CH_2	tYPE	SET	OFF / SECAP / InHbt / rStIn / rStAL
	InPUt	SET	nEg / POS
dECPt		SET	1 / 2 / 3 / nOnE
SEt_1	StYPE	SET	HI / LO / OFF
	LAtCH	SET	YES / nO
	LOC	SET	YES / nO
	FAILS	SET	YES / nO
	SEtPt	SET	ENTER DATA
	dEAdb	SET	ENTER DATA
SEt_2	SEE SEt_1 ABOVE		
dAC_1 (OPTION)	OSCAL	SET	ENTER DATA
	FSCAL	SET	ENTER DATA
	dIAg	SET	FULL / HALF / 2ErO
bAUd (OPTION)		SET	115_2 / 57_6 / 38_4 / 19_2 / 9_6 / 4_8 / 2_4
EnEt (OPTION)		SET	IP (SET - ENTER DATA) / SUb (SET - ENTER DATA) / gAt (SET - ENTER DATA)
OUtPt		SET	nEg / POS
dISPr		SET	HALF / 1_SEC / 1.5_S
SErnO		SET	VIEW SERIAL No.
PASSC		SET	VIEW PASS CODE

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

The edit buttons function as follows:

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