1071-4841-124

MONARCH INSTRUMENT

Instruction Manual

ACT-2A, ACT-3A, ACT-3

Panel / Bench / Portable
Tachometers / Totalizers / Ratemeters

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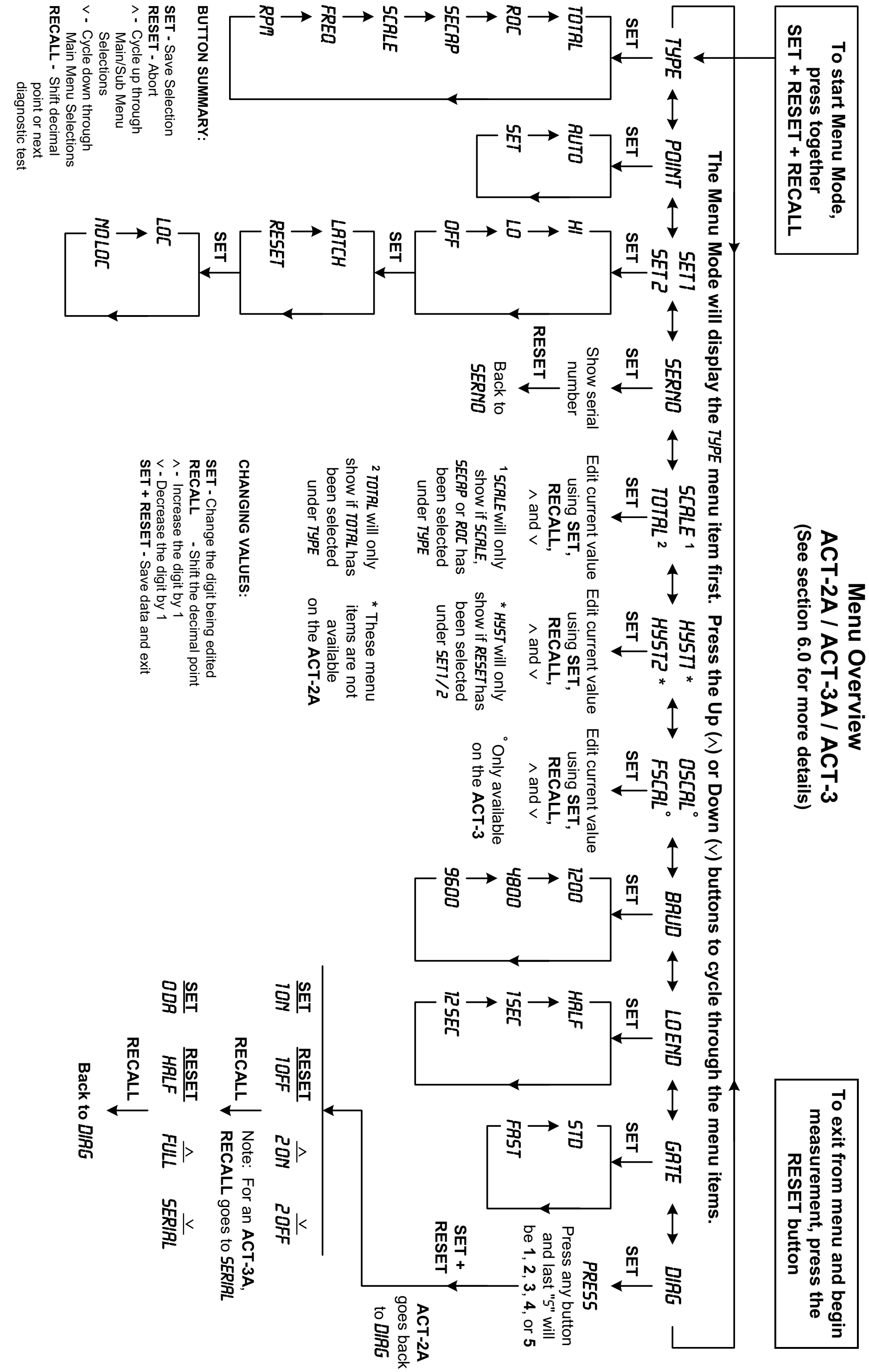
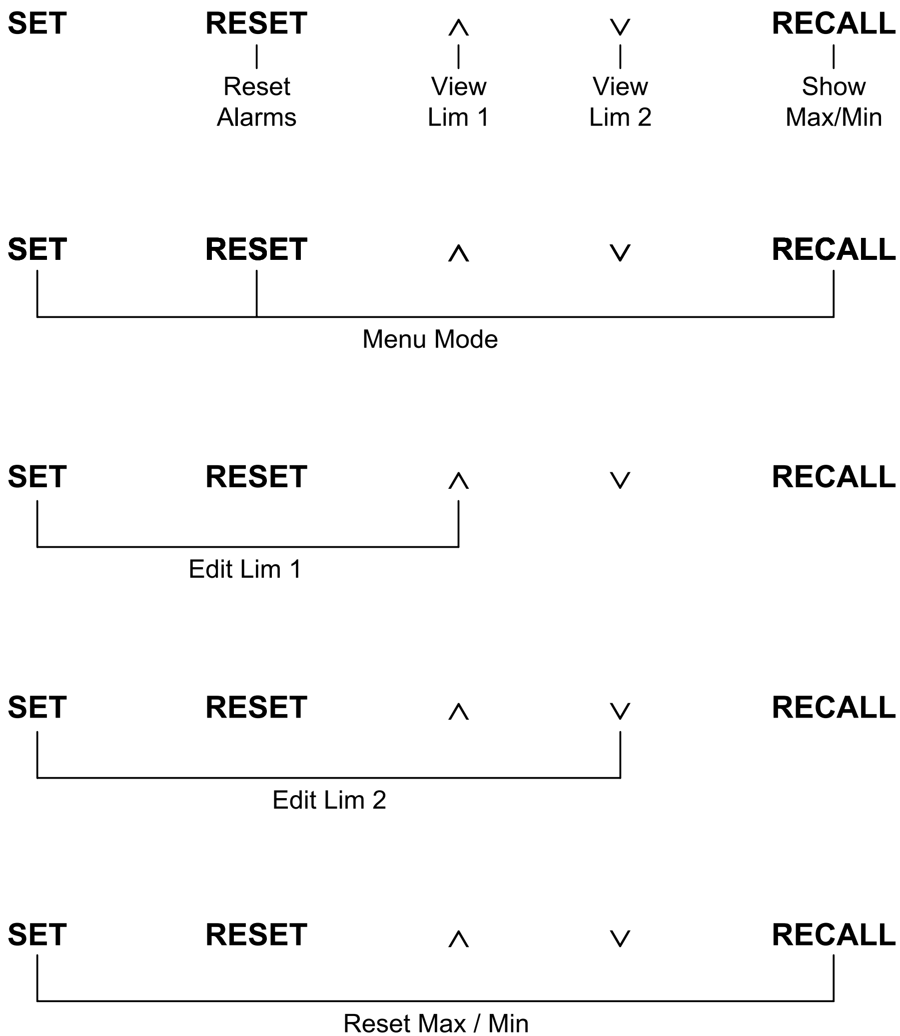
SPECIFICATIONS

SPECS↓ MODEL→	ACT-2A	ACT-3A	ACT-3
Speed Range	5 RPM to 999,990 RPM		
Input Frequency Range	0.083 Hz to 250 KHz		
Totalizer / Counter	Display Range: 0.0001 to 99,999 Maximum count of 16,777,216 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		
Accuracy	±0.0015% of reading or ±½ displayed resolution		
Resolution	Fixed Range Mode 1 RPM (5 to 99,999 RPM) 10 RPM (100,000 to 999,990 RPM)		Auto Range Mode Up to 0.0001 RPM
Display	0.56 inch high red seven segment LED		
Display Update	0.5 second above 120 RPM		
Max Measurement Rate	Up to 31 times per second or up to 244 with Fast Gate mode		
Scaling Computation	Programmable scaling 0.0001 to 9999.9 Front panel push button programmable		
Decimal Point	Fixed or Auto ranging, front panel push button programmable		
Memory	Maximum and minimum recall from front panel push buttons		
Dimensions	1/8 DIN by 7” [178 mm] deep Panel cut out: 1.74” H x 3/58” W [44 mm x 91 mm]		
Input Power	Standard 115 Vac ±10% or 230 Vac ±10% (50/60 Hz) Optional 12 Vdc		
Recommended Sensors	Optical – ROS-5W Proximity – P5-11 Magnetic – M-190W Gas Engine - GE-200		Infrared – IRS-5W Laser – RLS-5W Mag/Amp – MT-190W
Sensor Power Output	5 Vdc to 8 Vdc to sensor		
Pulse Repeater Output	N/A	0 to 5 V TTL compatible, one pulse out for each pulse in, 0.5 millisecond width typical	
RS232C Interface	N/A	Bi-directional RS232C Interface	
Analog Outputs	N/A		Simultaneous Analog Output Voltage: 0 to 5 Vdc, 5 mA max load Current: 4 to 20 mA 12 bit resolution Front panel push button programmable for common full scale and offset RPM ranges
Alarm Capability	N/A	Two alarm set points: High or Low Limits Latching or Non-latching Front panel push button programmable Accuracy ±0.1% of set point Hysteresis and low limit lockout are programmable	
Alarm Outputs	N/A	Form C relay contacts, rated 1A at 115 Vac or 230 Vac	
Alarm Reset	N/A	Automatic or manual reset Front panel push button programmable	

Our Limited Warranty is available at www.monarchinstrument.com.



Measurement Mode Button Overview



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.**

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APPENDIX D - ACT3 RS232C INTERFACE CONNECTIONS

The ACT-3 has a DB9S connector configured as Data Communication Equipment (DCE). The following connection details are for use with IBM™ PC compatible computers. Connections are given for both 9 pin and 25 pin connectors. Note that some computers have the 25-pin connector configured as DTE while others have it connected as DCE. The information given here is for a DTE configuration which is the more common. On a standard PC, a NULL Modem cable will work fine.

ACT 9 Pin	Description	PC 9 Pin	PC 25 Pin
2	Transmit Data	3	2
3	Receive Data	2	3
5	Common	5	7
7	Clear to Sent	8	5
8	Request to Send	7	4
-	Link	4 & 6	6 & 20

Communications are at the preset Baud Rate, 8 bits, No Parity and 1 stop bit.

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.

Accuracy Specification

Measuring only one rotation or linear motion measurement (just a start pulse and a stop pulse)

RPM	SECS	2Mhz CLOCKS	± %	± RPM	± RPM Displayed
5	12	24,000,000	8.333e-6	4.1665e- 7	0.0001
50	1.2	2,400,000	8.333e-5	4.1665e-5	0.001
500	1.2e-1	240,000	8.333e-4	4.1665e-3	0.01
5,000	1.2e-2	24,000	8.333e-3	4.1665e-1	0.5
50,000	1.2e-32	2,400	8.333e-2	41.665	42
100,000	6e-4	1,200	1.6e-1	160	160
500,000	1.2e-4	240	8.33e-1	4166	4166

1.0 GENERAL OVERVIEW

The **ACT-2A** / **ACT-3A** / **ACT-3** digital panel meters are extremely versatile instruments. The user has complete control of the unit configuration. Power may be either 115 Vac or 230 Vac (50/60 Hz), or optionally, 12 Vdc to 15 Vdc. Input signals are accepted from optical, proximity, magnetic, infrared or laser sensors, or direct TTL or external AC sources. All models are suitable for panel mounting or bench top, with convenient screw terminal connections on the rear panel of the instrument.

When the instrument is turned on, it displays all 8s, then rEvx.x, where x.x is the software revision level, before entering the normal mode of operation. The display will show "——— " when a measurement is over range.

1.1 Modes of Operation

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. Refer to Section 6.0 for details on changing modes.

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

1.1.1 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.

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

1.1.2 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.

1.1.3 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.

1.1.4 SECAP (Single Event Capture) Mode

The **SECAP (Single Event Capture) Mode** is just like the Scaling 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. Refer to **Appendix C - Using the Single Event Capture Mode**.

1.1.5 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

APPENDIX B - SOME 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	6.214×10^{-4}	Miles
Miles	160900.0000	Centimeters
Miles	5280.0000	Feet
Furlong	66.0000	Feet
Knots	6080.0000	Feet/Hour
Knots	1.1520	Miles/Hour

Once you have the correct scale factor entered, press and hold the **SET** button and press the **RESET** button once. The display will show **donE** and the **SCALE**. Release the buttons and then press the **RESET** button once to return the unit to normal operations.

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.

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.

The SCALE menu selection is used to set the scale factor. Without any scaling (Scale = 1), the tachometer measures in pulses per second per second. This is the rate of change of the number of pulses per second over a second. To get a readout in RPMPM in a system with **P** pulses per revolution set the scale factor to 3600/**P**.

$$\frac{\text{Pulses}}{\text{Second}^2} * \frac{\text{Revolution}}{\mathbf{P}\ \text{Pulses}} * \frac{60\ \text{second}}{\text{Minute}} * \frac{60\ \text{second}}{\text{Minute}} = \frac{3600}{\mathbf{P}} * \frac{\text{Revolutions}}{\text{Minute}^2}$$

Which is Revolutions per minute per minute.

For example, the scale factor to display in RPMPM for a 68 tooth gear would be 3600/ 68 = 52.941.

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 about 2 times a second.

Press the **SET** and **RESET** buttons together to temporarily show the last RPM (Input frequency * 60) measured.

The display will show a positive number when the frequency is increasing and a negative number when the frequency is decreasing.

Otherwise this mode behaves like the SCALE mode.

In order to support negative numbers when editing set points, zero scale and full-scale values, press the **SET** and ∨ buttons together to toggle a minus sign in the left most position on the display.

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.

1.1.6 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.

1.2 Decimal Point

The decimal point on the display may be fixed (set) in position or floating (auto-ranging).

1.2.1 Auto Ranging

If the instrument is set to **auto range** (**AUTO**), it will always display data to the maximum resolution, utilizing all five digits in the display. The display is always left justified, that is the data always begins in the left most digit position and the decimal point moves to the right with each increasing decade. The value 100 is thus indicated as "100.00". The resolution then varies from 0.0001 below 10 to 10 above 100,000.

NOTE: In order to display values in excess of 99,999 with only 5 digits, all the decimal points light for values between 100,000 and 999,990, effectively indicating that the displayed value needs to be multiplied by 10 to get the correct reading.

In the Auto ranging mode the decimal point is always visible, and zero is indicated as "0.0".

1.2.2 Fixed Decimal Point

If the instrument is set to have a fixed decimal point (**SET**), the decimal point is effectively fixed on the extreme right hand side of the display. The decimal point it is not actually visible in this position. In fact, the decimal point is not visible at all for readings less than 100,000. In this case the display is always right justified with unused digits to the left being blanked. The value 100 is thus displayed as "100" with a resolution of ±½. For values above 99,999 all the decimal points light as in the auto ranging mode and the resolution of the display is 10.

NOTE: The display is always rounded to the nearest whole number. A value of 100.3 is displayed as 100 while a value of 100.7 would be displayed as 101, maintaining the accuracy, as well as the resolution to ±½.

1.3 Limits (Alarms)

The **ACT-3** and **ACT-3A** have 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 3.0 for the limit response time. The 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. Refer to Section 5.0 to set limit set points.

1.3.1 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. 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 6.0.

1.3.2 Hysteresis

Hysteresis is only applicable to ***non-latching limits***. Hysteresis 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 + hysteresis) 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. Hysteresis is generally expressed as a percentage of the set point. Whenever the user sets or changes a set point, the instrument automatically calculates a 5% hysteresis value. Suppose you had set a high limit at 100, the

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 and hold in the **SET** and **RESET** buttons and then press the **RECALL** button once. Release all buttons and the display should show **tyPE**. Press the **SET** button once and the unit will display its current mode of operation. Press and release the **UP (∧)** button until the display shows **SCALE**, the press the **SET** button once. The display will show **donE** and the **tyPE**.

Press and release the **UP (∧)** button until the word **SCALE** appears in the display, then press the **SET** button once. The display will show the current scale factor value with the right-most digit flashing. The **UP (∧)** and **DOWN (∨)** buttons will change the flashing digit, the **SET** button moves the flashing digit and the **RECALL** button changes the decimal point. Using these buttons, alter the display to indicate the scale factor you want.

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, 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**

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

hysteresis would be 5% of 100 or 5. This value is then subtracted from the set point (it would be added for a low limit) so that the absolute value is 95. Thus, the alarms will trip for any input value greater or equal to 100, but will only reset when the input drops below 95. Without the hysteresis feature, the alarm relays would chatter on and off it the input varied from 99 to 101, which is undesirable. The user can set the hysteresis to any value from 0.0001 to 99.999% of the set point. Refer to Section 6.0.

NOTE: The instrument recalculates the hysteresis at 5% each time you alter the set point or change the limit type (e.g. from high to low).

1.3.3 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 6.0.

1.4 Current (IO) and Analog (AO) Output

The **ACT-3** is unique because it allows simultaneous current sink (4 to 20 mA) and voltage (0 to 5 Vdc) outputs. The current and voltage outputs track one another so that when the current is 4 mA, the voltage is 0 Vdc, and when the current is 20 mA, the voltage is 5 Vdc. The output is linear to within 0.5%.

The analog outputs are derived from a 12-bit digital to analog converter. This means that the output voltage (or current) changes in steps. The standard analog output has 4096 steps from zero to full scale. This implies that each step size is 1/4096 of the full-scale value or about 0.0244% of full scale. The user can set the actual full scale value anywhere from 10 to 999,990. This full-scale value is the value at which the analog outputs are at a maximum, 20 mA or 5 Vdc.

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:

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

$$\text{Resolution} = \frac{(2000 - 1000)}{4096} = 0.2441 \text{ RPM}$$

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.

1.5 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.

2.0 INSTALLATION and POWER

The ACT2A, ACT3A and ACT3 instruments have a 1/8 DIN enclosure requiring a 3.58” wide by 1.74” high (91x44 mm) mounting hole. Approximately 7” (178 mm) will be required behind the panel. Refer to Figure 1 below.

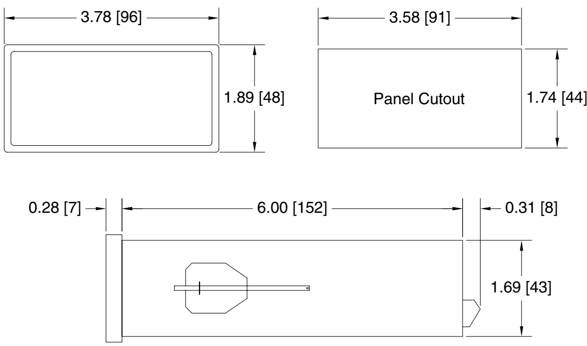

Figure 1 Dimensions in Inches [Millimeters]

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.

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 below.

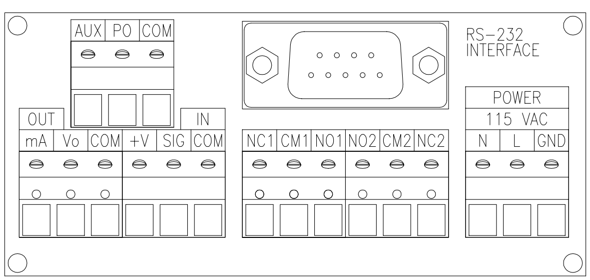

Figure 2 ACT Rear Panel (AC powered unit)

If the unit is **ac powered** (115 Vac or 230 Vac), connect the Live (Hot) wire to the terminal marked **L** and the Neutral (Return) wire to the terminal marked **N**. Connect the Ground (Earth) wire to the terminal marked **GND**.

NOTE: The ground connection is not required as the unit is fully isolated from the mains.

9.0 OPTIONS and ACCESSORIES / SENSORS

CAL-N.I.S.T.	N.I.S.T. Traceable Certificate of Calibration (standard on **ACT-3**)
T-5	Reflective Tape - 5 foot (1.5 m) roll, 0.5 inch (10 mm) wide
ROS-W	Remote Optical Sensor with 8-foot cable length
ROS-P-25	Remote Optical Sensor with 25-foot cable length
SLS	Smart Laser Sensor
IRS-W	Infrared Sensor
M-190W	Magnetic Sensor
MT-190W	Magnetic Sensor with Amplifier Module
P5-11	Proximity Sensor
GE-200	Gasoline Engine Spark Inductive Sensor

For Longer Cable Lengths for Sensors:

Bulk Wire 3-wire shielded Sensor Cable, bulk lengths for any sensor

Remove any plug (P) to create a tinned wire (W) sensor.

NOTE: W = 3 tinned wire termination, P = 3.5 mm phone plug termination.

@L1	Set Limit 1 set point	Enter a maximum of 6 digits with or without decimal point followed by **<CR>**. Recommended values are 0 to 999990.
@L2	Set Limit 2 set point	Same as **@L1** but for Limit 2.
@H1	Set Limit 1 hysteresis	Enter a maximum of 2 digits with or without decimal point followed by **<CR>**. Values can be from 1 to 99 only.
@H2	Set Limit 2 Hysteresis	Same as **@H1** but for Limit 2.
@G1	Set Gate Time	Enter either: 0 for Standard OR 1 for Fast Followed by a **<CR>**.
@G2	Set Low End	Enter a single character: 0 - 12 seconds 1 - 1 second 2 - 1/2 second Followed by a **<CR>**.
@P0	Set Analog Out	Enter a maximum of 6 digits followed by a **<CR>**. Recommended zero scale values are 0.0 to 999990.
@P1	Set Analog Out	Enter a maximum of 6 digits followed by a **<CR>**. Recommended full-scale values are 10.0 to 999990.
@C1	Send Current Settings	No further input required. The unit will send a complete listing of all current parameter settings.

If a user tries to enter too many characters, or enters illegal data, the instrument will respond with **Err** and will abort the process. The only valid characters for further data entry, not commands, are 0 to 9, the decimal point or period, and '-'. If the command is successfully executed, the instrument will again send the **OK** message.

Normal line cord connections are as follows:

Black - to **L** (Live)
White - to **N** (Neutral)

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 "**-**".

NOTE: The ground connection not required.

CAUTION: Ensure the dc voltage does not exceed the rating on the unit (12 to 15 Vdc).

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 input 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 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 Sensor Connections

A speed sensor (not included) is 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	Positive Supply Output. Used to provide power to optical, laser, infrared or amplified magnetic sensors. Voltage out varies between +8 Vdc and +5 Vdc depending on load. Maximum load is 60 mA dc. This output also has internal current sensing for use with two wire proximity sensors. Maximum load for proper operation with two wire sensors is 5 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 from most sensors.

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

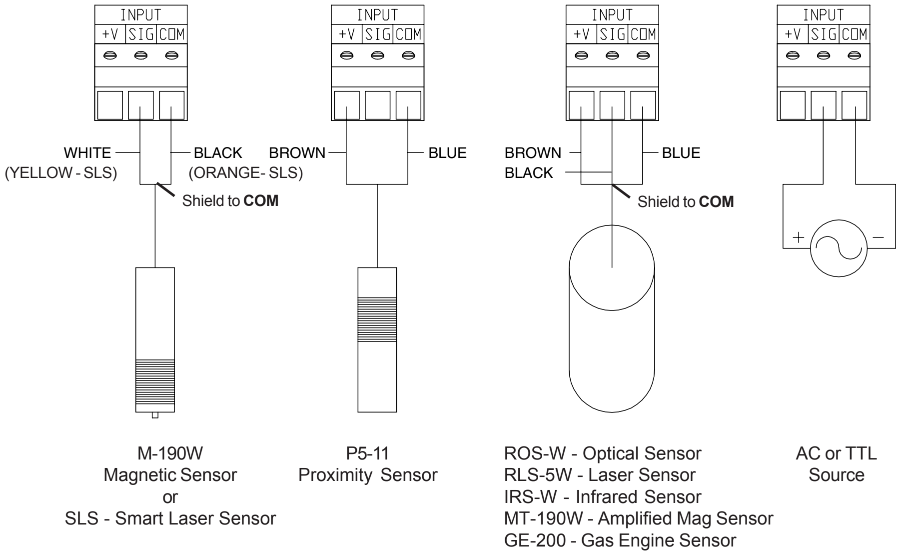

Figure 3 Sensor Connections

2.4 Other Connections

Depending on how your unit is configured you may have TTL pulses, relay output or analog output connections on the rear panel. Connection details for these options are shown in Figures 4 and 5.

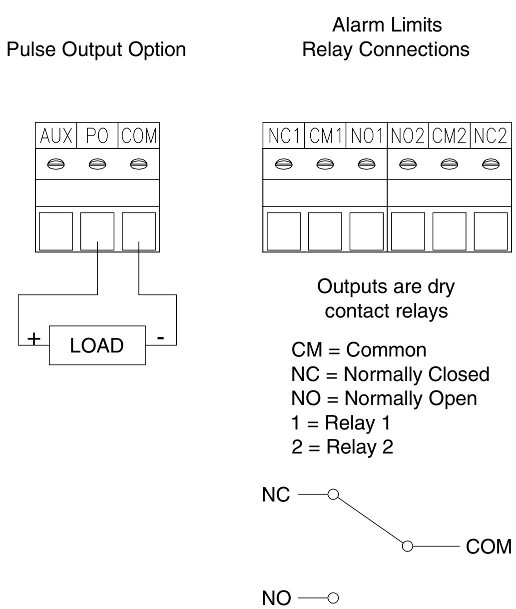

Figure 4 PO and Relay Output Connections

@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

8.4 Control Commands

Control commands will **STOP** the instrument, as they require further input and basically alter the operating parameters of the unit. Upon completion of the commands, the instrument will continue. This may cause any currently set limits to be reset or to set.

CAUTION: It is possible to set values into the unit with the Control commands that could not be set from the front panel.

Once a command has been entered and accepted, the unit will respond with **OK**. This is an indication that the instrument has stopped and is ready to accept the data. The words **Err 8** will appear on the instrument display to indicate RS232C control. The unit will remain stopped until the command is completed.

The following are valid **Control** Commands. Enter the command and **<CR>**. Then enter the follow-up command and **<CR>**.

Command	Action	Follow Up Action By User
@T1	Set operating mode	Enter a single character: 1 - Set mode = RPM (x60) 2 - Set mode = FREQUENCY (x1) 3 - Set mode = SCALING 4 - Set mode = SECAP 5 - Set mode = ROC 6 - Set mode = TOTALIZING Followed by a **<CR>.**
@T2	Set decimal point	Enter either: 0 for fixed decimal point OR 1 for auto ranging Followed by a **<CR>.**
@T3	Set scale factor	Enter a maximum of 6 digits with or without a decimal point followed by a **<CR>**. Recommended values are 0.0001 to 9999.9.
@T4	Set totalizer scale factor	Enter a maximum of 6 digits with or without a decimal point followed by a **<CR>**. Recommended values are 0.0001 to 9999.9.
@S1	Set Limit 1 mode	Enter a single character: 0 - Limit OFF 1 - Limit High, Latching 2 - Limit High, Auto Reset 3 - Limit Low, Latching, with Lockout 4 - Limit Low, Latching, no Lockout 5 - Limit Low, Auto Reset, with Lockout 6 - Limit Low, Auto Reset, no Lockout Followed by a **<CR>**.
@S2	Set Limit 2 mode	Same as **@S1** but for Limit 2.

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.

LS1	LIMIT 1 has tripped
LS2	LIMIT 2 has tripped
LR1	LIMIT 1 has reset
LR2	LIMIT 2 has reset
LR3	Both Limits have been forced to reset (**RESET** button pressed)
UM1	User has entered Menu Mode from front panel
UM2	User has entered Limit Set Mode from front panel

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 3.1). This data always consists of seven characters including the decimal point. The value 10 will be sent as 10.0000 irrespective of the display mode of the instrument. This effectively gives a full 6 digits of resolution as opposed to the five on the display.

8.2 RS232C Commands

The instrument responds to a number of commands sent to its RS232C port. The unit will only accept data when its Clear to Send Line (Pin 7) is active (positive). All commands begin with **@**, end with a carriage return **<CR>**, and consist of two characters - the first is an alpha character, the second is a numeric character. All illegal data is ignored.

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

NOTE: **Control** commands suspend operation of the instrument until completed.

8.3 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
@R4	Reset Total (and Limits)	Unit sends LR3 when done Only works when in Total mode
@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.

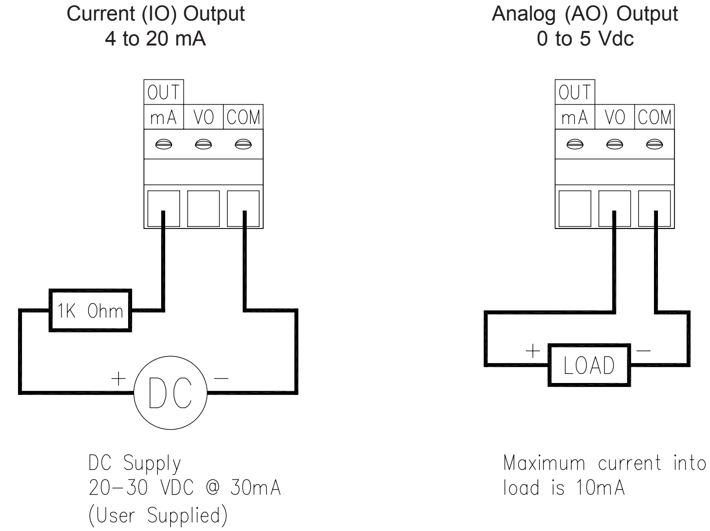

Figure 5 Current and Analog Output Connections

3.0 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.

3.1 Display Update Rate

Although the instrument can sample 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.

3.2 Internal Update Rate

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 6.14 for more details.

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

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 6.13 for details.

4.0 FRONT PANEL

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

The front panel of the instrument has a 5 button keypad, 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.

4.1 Status LED’s

4.1.1 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.

4.1.2 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.

4.1.3 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.

4.1.4 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 **Scaling Mode** the read outs may be in RPM, but the **RPM** LED will be off.

NOTE: An **ACT-2A** will return to the main menu item **DIAG** at this point.

The next test is for the relays. Press the **SET** button to turn on relay 1. The display will show **1 on**. Press the **RESET** button to turn off relay 1. The display will show **1 off**. Press the **UP (∧)** button to turn on relay 2. The display will show **2 on**. Press the **DOWN (∨)** button to turn off relay 2. The display will show **2 off**. Press the **RECALL** button to go to the next test.

NOTE: For an **ACT-3A**, pressing **RECALL** will go to the serial port test (see details below).

For an **ACT-3** the next test is for the Analog Output. Press the **SET** button to test the zero scale (0 Vdc or 4 mA). The display will show **0 dA**. Press the **RESET** button to test the half scale (2.5 Vdc or 12 mA). The display will show **HALF**. Press the **UP (∧)** button to test the full scale (5 Vdc or 20 mA). The display will show **FULL**.

For an **ACT-3** press the **DOWN (∨)** button to test the serial port, if one is present, otherwise it will do nothing. Make sure the following connections are made on the RS-232 interface connector: Pin 2 connected to Pin 3, and Pin 7 connected to Pin 8. The unit will respond with a “Pass” or a “Fail” message. For an **ACT-3** press the **RECALL** button to go back to the main menu. For an **ACT-3A** press the **SET** and **RESET** buttons to go back to the main menu.

7.0 PULSE OUTPUT

NOTE: The pulse output is not available on the **ACT-2A**.

The Pulse Repeater output provides a conditioned TTL positive going 5 V pulse out for each pulse in.

Connect the Positive signal wire (+5 V pulse) to the terminal marked **PO** and the Common to the terminal marked **COM** (to the right of the terminal marked **PO**). The terminal marked **AUX** is not used. See Figure 4 on page 7 for connection detail.

8.0 SERIAL OUTPUT

The **ACT-3A** and **ACT-3** have RS232C compatible serial interfaces. The interface is made via a 9 pin subminiature D connector on the rear panel. See **Appendix D** for connection details.

The Receive Data In and Transmit Data Out line are the communication lines between the instrument and the terminal or computer. The Clear to Send and Request to Send Lines establish a means for the instrument and computer to indicate when to and when not to send data. The Clear to Send line will be active (Pin 7 Positive) when the instrument is ready to accept data. Similarly, the instrument will only send data to the terminal or computer when its Request to Send line is active (Pin 8 Positive).

The instrument sends various information out through the RS232C 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.

The instrument is fully programmable via the RS232C interface. The user can remotely set the modes, limits, hysteresis, scale factors and so on, as well as reset either or both the limits.

8.1 Data from the RS232C 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.

NOTE: No information will be sent if the Request to Send line (Pin 8) is inactive (Negative).

6.9 HYST2 (Hysteresis Limit 2)

Same as **HYST1** but for **LIMIT 2**.

6.10 0SCAL (Zero Scale)

NOTE: This menu option will not be seen on an **ACT-2A** or **ACT-3A**.

Used to set the zero scale value for the analog output. Enter using the **SET** button. The current value will be displayed. To exit to the main menu without changing the value, press the **RESET** button or else change the value in the same way as the limit is set. Refer to Section 5.0.

6.11 FSCAL (Full Scale)

NOTE: This menu option will not be seen on an **ACT-2A** or **ACT-3A**.

Used to set the full-scale value for the analog output. Enter using the **SET** button. The current value will be displayed. To exit to the main menu without changing the value, press the **RESET** button or else change the value in the same way as the limit is set. Refer to Section 5.0 and 5.1. The minimum full-scale value is 10 (shown as 00010).

6.12 BAUD (Baud Rate)

This is used to set the baud rate for the serial interface. Select this item with the **SET** button. Exit back to the main menu at any time without changing the current settings by using the **RESET** button. Once selected, the display will show the current setting of the baud rate. Cycle through the choices by using the **UP (∧)** button. Press the **SET** button when the display is on the desired rate.

6.13 LOEND (Low End)

This menu item is only visible in the **RPM**, **FREQ**, **SCALE**, and **SECAP** Modes, since it only affects these modes.

Select this item with the **SET** button. Exit back to the main menu at any time without changing the current settings by using the **RESET** button. Once selected, the display will show the current setting. Select 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. Press the **UP (∧)** button to select from 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. Press the **SET** button when the desired rate is displayed.

6.14 GATE (Measurement Rates)

Sets the minimum time it takes to make a reading to **STD** (Standard 32.786 mSecs) or **FAST** (4.096 mSecs). See Sections 3.0 and 3.2 for more details.

To enter this menu item press the **SET** button. The unit will display the current Gate setting. To exit back to the main menu without changing the current settings, press the **RESET** button. To select the other Gate option, press the **UP (∧)** button, which will toggle between the two modes. Press the **SET** button to change the mode to the option displayed and exit back to the main menu.

6.15 DIAG (Self Test)

Select this item with the **SET** button. This is a set of diagnostics to test the unit. It will first display **PRESS**. The last "**S**" will change to a number depending on which button is pressed (**SET** = 1, **RESET** = 2, ∧ = 3, ∨ = 4 and **RECALL** = 5). Press the **SET** and **RESET** buttons together to go to the next test.

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

4.2 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. Refer to the **Measurement Mode Button Overview** on page 24 as a quick reference guide.

4.2.1 SET BUTTON

The **SET** button has no function on its own and must be used in conjunction with the other buttons to set functions. Refer to Section 5.0.

4.2.2 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 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.

4.2.3 UP (∧) and DOWN (∨) BUTTONS

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

4.2.4 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. In the Totalizing Mode, the **RECALL** button will hold the display for a few seconds so the value on the display can be easily read.

5.0 SETTING THE LIMITS (ALARMS)

To set the limits the user must enter the **EDIT Mode**. To enter the **EDIT Mode**, press and hold down the **SET** button and press the **UP (∧)** button to set **LIMIT 1** or the **DOWN (∨)** button to set **LIMIT 2**. The instrument will show the current limit value, and either the **LIM 1** LED will light continuously if **LIMIT 1** is being set or the **LIM 2** LED will light continuously if **LIMIT 2** is being set.

Upon entering the **EDIT Mode**, the extreme right digit will be flashing. This is the digit that is currently being edited. This digit may be incremented by pushing the **UP (∧)** button, or be decremented by pressing the **DOWN (∨)** button. The digit is incremented or decremented by 1 each time the **UP (∧)** or **DOWN (∨)** button is pressed. The digit will roll around from 9 to 0 when being incremented and from 0 to 9 when being decremented.

To change any other digit, press the **SET** button. Each time this button is pressed, the next left digit will start flashing. Each of the digits may then be incremented or decremented as above until the desired set point is set.

To set a value greater than 99999, press the **RECALL** button causing all the decimal points to light, indicating that the displayed value must be multiplied by 10. Thus, any value up to 999990 can be set.

NOTE: If the most significant digit (that on the extreme left) is zero, you cannot set the times ten mode.

To *escape* from the **EDIT Mode** at any time ***without updating the value***, simply press the **RESET** button.

To ***exit*** from the **EDIT Mode** and ***update the value***, press and hold down the **SET** button and then press the **RESET** button. Always ensure that the value entered is within the constraints laid down or you will get an **Err 7** message, and the value will not be updated. **Err 5** will be displayed if you try to set a limit that is not enabled. If the value is acceptable the unit will display **donE**.

NOTE: Any time the limit value is changed, the instrument will automatically recalculate the hysteresis at 5%. Refer to Sections 6.8 and 6.9.

5.1 Edit Mode Button Summary (Changing Digits)

When in the **EDIT Mode** as described above, the keypad buttons have the following functions:

SET	- changes the digit being edited
RESET	- aborts the edit process
UP (∧)	- increases the digit by 1
DOWN (∨)	- decreases the digit by 1
RECALL	- shifts the decimal point
SET + RESET	- saves data and exits
SET + DOWN (∨)	- toggles a minus sign in the left most position on the display.

6.0 USING THE MENU

To enter the **MENU Mode**, the user must use a combination of three keys. Press and hold down the **SET**, **RESET** and **RECALL** buttons. Press the **SET** button first if you do not wish to reset the limits, if they are present. The instrument will enter the **MENU Mode**, and the display will show **tyPE**.

There are a number of menu selections, some of which may not be seen depending on the option ordered, the options set, and the general status of the instrument. See page 25 for an overview of the menu options. Below is a list of the menu items with the function(s) they perform. Use the **UP (∧)** and **DOWN (∨)** buttons to step through the main menu options.

To **exit** from the **MENU Mode** press the **RESET** button.

6.1 TYPE (Mode)

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 **RPM**, **FREQ**uency, **SCALE**, **SECAP** (Single Event Capture), **ROC** (Rate of Change) and **TOTAL**izing. These functions are described in Section 1. When the desired mode is displayed, press the **SET** button. The unit will display **DONE** and return to the main menu.

6.2 Point (Decimal)

Sets the decimal point to either **AUTO** or **SET** (FIXED). 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 the other mode, press the **UP (∧)** button which will toggle between the two modes. Press the **SET** button to change the decimal point setting to the option displayed and exit back to the main menu.

6.3 SET 1 (Alarm 1)

NOTE: This menu option will not be seen on an **ACT-2A**.

Used to set the **LIMIT 1** type. This menu item has a number of sub items. **HI** or **LO** determine whether the limit is high or low, **LATCH** or **RESET** determine whether the limit will be latching or non latching, and **LOC** or **NOLOC** determine whether the lock out feature will operate for the LO limit setting.

Select this item with the **SET** button. You can exit back to the main menu at any time without changing the current settings by using the **RESET** button. Once selected, the display will show the current setting of the limit type. If no limit is set it will show **OFF**. You may cycle through the three choices (**HI**, **LO**, **OFF**) by using the **UP (∧)** button. Press the **SET** button when the desired limit type is displayed.

The unit will then display **LATCH** or **RESET** depending on how it is currently set. Again, use the **UP (∧)** button to change the type. Pressing **RESET** at this time will not alter the limit. Use the **SET** button to continue. If you set the limit to **HI**, you will return to the main menu. If you selected **LO**, you will have to choose the **LOC** or **NOLOC** option as described above.

NOTE: Setting the limit type will force a recalculation of the hysteresis to 5%.

6.4 SET 2 (Alarm 2)

Same as **SET 1** but for **LIMIT 2**.

6.5 SERNO (Serial Number

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.

6.6 SCALE (Scale Factor)

Used to set the scale factor for the **Scale Mode** of operation. This menu option will not be seen if the unit is not set in the **Scale Mode**. Enter this menu item with the **SET** button. The current scale factor will be displayed. To exit to the main menu without changing the value press the **RESET** button or else change the value in the same way that the limits are changed, as in Section 5.0. To update the scale factor, press the **SET** and **RESET** buttons. The permissible values for the scale factor are from 0.0001 to 9999.9.

6.7 TOTAL (Totalizer Scale Factor)

Used to set the scale factor for the Totalizer mode of operation. This scale factor is independent of the **SCALE** mode scale factor. It will not be seen if the unit is not set in the **TOTAL** mode, using the **TYPE** menu option. Enter this menu item with the **SET** button. The current Scale Factor will be displayed. To exit to the main menu without changing the value press the **RESET** button, else change the value in the same way that the limits are changed, as in Section 5.0 and 5.1. To update the scale factor, press the **SET** and **RESET** buttons. The permissible values for the scale factor are from 0.0001 to 9999.9.

6.8 HYST1 (Hysteresis Limit 1)

NOTE: This menu option will not be seen on an **ACT-2A** or if the limit has been set as non-latching.

Used to set the limit hysteresis as a percentage. Once selected with the **SET** button, the existing hysteresis value will be displayed. It may be changed in the same manner as setting a limit. Refer to Section 5.0 and 5.1. The permissible values for hysteresis are 0.0001 to 99.999%. The **RESET** button escapes back to the main menu, while the **SET + RESET** buttons pushed together will update the hysteresis value.