P/N 1071-4841-001
Rev 2.0 November 1999

MONARCH INSTRUMENT

Operations Manual

ACT 2A, 3A, 3

TACHOMETER
RATEMETER
TOTALIZER

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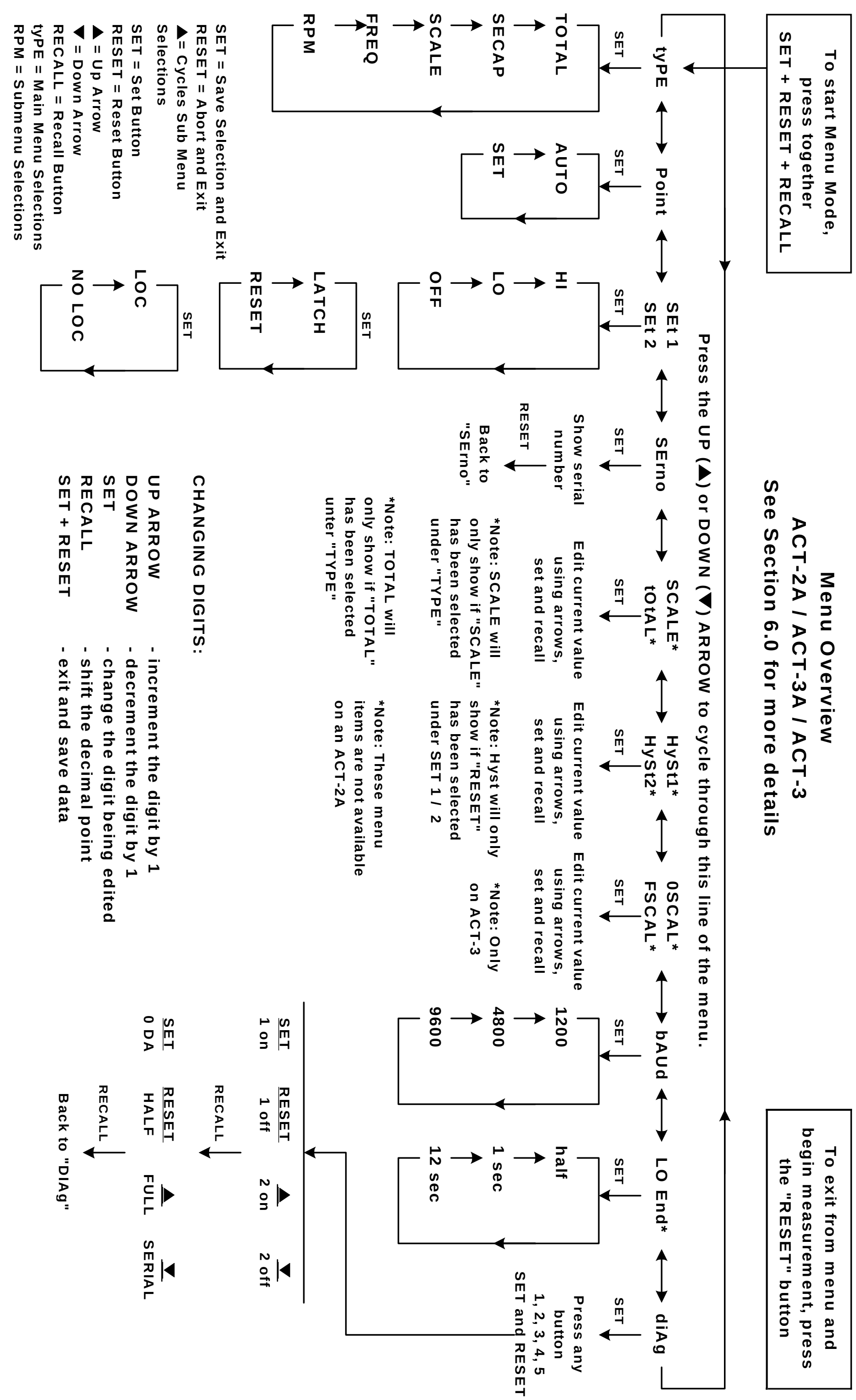
SPECIFICATIONS

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	1 - 99,999 Counts		
Input Configuration Input Voltage Range	Universal inputs: 1 up to 9,999 pulses per revolution. Front panel push button programmable TTL input and 200 mV to 50V ac signals		
Recommended sensor	Remote Optical ROS-5W Proximity PS-11 Magnetic M-190W Infrared IRS-5W Laser RLS-5W Mag/Amp MT-190W		
Accuracy	0.001% of reading		
Resolution	Fixed Range Mode 1 RPM (5-99,999 RPM) 10 RPM (100,000-999,990 RPM) Auto Range Mode Up to 0.0001 RPM		
	0.56 inch high red seven segment LED		
Display Update	0.5 second above 120 RPM		
Pulse Repeater Output	N/A	Pulse Repeater Output, 0-5 V TTL compatible (0.5 millisecond width typical). Pulses out per revolution equal pulses in per revolution.	
RS232C Interface	N/A	Bi-directional RS232C Interface	
Analog Outputs	N/A		Simultaneous Analog Output Voltage (0-5 Vdc @5 mA max load) and Current (4-20mA). Front panel pushbutton programmable for common full scale and offset RPM ranges.
Alarm Capability	N/A		Two alarm setpoints, each front panel programmable as either high or Low, latching or non-latching. Accuracy ±0.1% of setpoint. Hysteresis and low limit lockout are programmable.
Alarm Outputs	N/A		Form C relay contacts, rated 1A at 115 Vac
Alarm Reset	N/A		Automatic or manual reset, programmable from front panel pushbuttons
Scaling Computation	Programmable scaling 0.0001 to 9999.9 Programmable from front panel pushbuttons		
Decimal Point	Fixed or auto ranging, programmable from front panel		
Memory	Maximum and minimum recall from front panel pushbuttons		
Dimensions	1/8 DIN by 7" (178) deepPanel Cut Out 1.74" (44) H X 3.58" (91) W		
Input Power	Must specify 115 V or 220/230/240 V, 50/60 Hz, or 12 Vdc		

CONTENTS



Menu Overview
ACT-2A / ACT-3A / ACT-3
See Section 6.0 for more details
To start Menu Mode, press together SET + RESET + RECALL
To exit from menu and begin measurement, press the "RESET" button
Press the UP (▲) or DOWN (▼) ARROW to cycle through this line of the menu.
typE
Point
SEt 1
SEt 2
SErno
SCALE*
tOtAL*
HySt1*
HySt2*
0SCAL*
FSCAL*
bAUd
LO End*
diAg
SET
TOTAL
SECAP
SCALE
FREQ
RPM
AUTO
SET
HI
LO
OFF
LATCH
RESET
LOC
NO LOC
Show serial number
RESET
Back to "SErno"
Edit current value using arrows, set and recall
*Note: SCALE will only show if "SCALE" has been selected under "TYPE"
*Note: TOTAL will only show if "TOTAL" has been selected unter "TYPE"
*Note: Hyst will only show if "RESET" has been selected under SET 1 / 2
*Note: These menu items are not available on an ACT-2A
*Note: Only on ACT-3
1200
4800
9600
half
1 sec
12 sec
Press any button 1, 2, 3, 4, 5 SET and RESET
SET 1 on
RESET 1 off
▲ 2 on
▼ 2 off
RECALL
SET 0 DA
RESET HALF
▲ FULL
▼ SERIAL
RECALL
Back to "DIAg"
SET = Save Selection and Exit
RESET = Abort and Exit
▲= Cycles Sub Menu Selections
SET = Set Button
RESET = Reset Button
▲ = Up Arrow
▼ = Down Arrow
RECALL = Recall Button
tyPE = Main Menu Selections
RPM = Submenu Selections
CHANGING DIGITS:
UP ARROW - increment the digit by 1
DOWN ARROW - decrement the digit by 1
SET - change the digit being edited
RECALL - shift the decimal point
SET + RESET - exit and save data

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.

1.0 GENERAL OVERVIEW

The ACT2A / ACT3A / ACT3 digital panel meters are extremely versatile instruments. The user has complete control over the way in which the unit operates. Some of the features discussed below are options on the ACT2A and may not be fitted. These are marked with an asterisk (*). The analog output option is not available on the ACT3A.

When the instrument is turned on for the first time, it displays all 8s, then rEvx.x, where x.x is the software revision level, before entering the normal mode of operation.

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. See section 6.0 for details on changing modes.

1.1.1 RPM Mode

In the RPM mode the unit behaves like a tachometer displaying 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 **SCALE** mode (see below) MUST be used to display RPM in applications where there are more than one pulse per revolution.

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 Scaling Mode (Ratemeter)

In the SCALING 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, 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

This is just like the SCALE mode except only one reading is made. The user will press the **RESET** button 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 32mS has passed so it can give an accurate reading. The Single Event Capture mode sacrifices accuracy as measurements get shorter than 32mS, but it is the only way to measure Single (non-repeating) Events. See **Appendix C— Using the Single Event Capture Mode**.

1.1.5 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 in position or may be floating (auto ranging).

Accuracy Specification
Measuring only one rotation (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

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, 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.

scale factor =

$$\frac{1\ \text{Pulse}}{\text{Second}} \times \frac{1\ \text{Inch}}{\text{Pulse}} \times \frac{3600\ \text{Seconds}}{\text{Hour}} \times \frac{1\ \text{Foot}}{2\ \text{Inches}} \times \frac{1\ \text{Mile}}{5280\ \text{Feet}} \times \frac{0.05681818\ \text{Miles}}{\text{Hour}}$$

There will be an error because our scale factors can only have five digits in them. Scale factor is 0.0568.

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

The internal clock inside the tachometer runs at 2Mhz. All measurements are synchronized to this internal clock giving a ± 0.5 microsecond uncertainty. As RPM, MPH, etc increases the measurement time decreases. As the measurement time decreases, our 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.) That is equal to about 874 clock cycles for a 2Mhz internal reference clock.

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

Therefore we have an error of ± 0.148765 MPH just from the clock resolution at 130 MPH. If this resolution is not good enough, the sensors must be placed further apart.

1.2.1 Auto Ranging

If the instrument is set to Auto range, 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 that in order to display values in excess of 99,999 with only 5 digits, the instrument lights all the decimal points 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

In this mode the decimal point is effectively fixed on the extreme right hand side of the display. Note that 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". The resolution is always ±1. 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 that 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 ±1.

1.3 Limits (Alarms)*

The unit has two independent alarm setpoints, referred to as **LIMIT 1** and **LIMIT 2 (Set 1** and **Set 2** on the menu)**.** These limits are fully programmable by the user (unless the write protect option has been set). The limits may be set as high or low with an option of low limit lockout, latching or non-latching at any value from 10 to 999,990. The limits are accurate to better than ±0.1% of the setpoint value. Refer to the section on throughput for the limit response time. The hysteresis is also programmable at any value from 1 to 99% of the setpoint value. The actual output from these alarms are a set of form C, potential free relay contacts, accessible via barrier strip screw terminals on the rear panel. These contacts are capable of switching **1A at 250 VAC**. When the unit is making measurements, the limits can be viewed by pressing the **UP ARROW** button for **LIMIT 1** or the **DOWN ARROW** button for **LIMIT 2.** The display will return to normal after a few seconds. See Section 5.0 to set limit setpoints.

1.3.1 Latching vs. Non-Latching Limits

A latching limit is one which, when the alarm trips, remains in this condition reguardless of what the input may do. This tripped limit needs to be manually reset by the operator to restore it back to its rest position. A non-latching limit on the other hand will automatically reset itself when the input no longer exceeds the setpoint, either high or low. The user can program each limit to be latching or non-latching. See section 6.0

APPENDIX B - SOME USEFUL CONVERSIONS:

Multiply	**By**	**To get**
Centimeters	0.2381	Feet
Centimeters	0.3937	Inches
Feet	30.48	Centimeters
Feet	0.3048	Meters
Furlong	66	Feet
Inches	2.54	Centimeters
Knots	6080	Feet / Hour
Knots	1.152	Miles / Hour
Meters	39.37	Inches
Meters	6.214 x 10	Miles
Miles	1.609 x 10	Centimeters
Miles	5280	Feet
Miles	1.609	Kilometers
Yards	0.914402	Meters

Press and release the **UP ARROW** 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 ARROW** and **DOWN ARROW** 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.

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** 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.

1.3.2 Hysteresis

Hysteresis is only applicable to non-latching limits. Hysteresis is a value that is added to the setpoint, in the case of a low limit, or subtracted from the setpoint, in the case of a high limit so that this new value, setpoint + 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 setpoint. Hysteresis is generally expressed as a percentage of the setpoint. Whenever the user sets or changes a setpoint, the instrument automatically calculates a 5% hysteresis value. Thus suppose you had set a high limit at 100, the hysteresis would be 5% of 100 or 5. This value is then subtracted from the setpoint (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. Consider the case of no hysteresis with the input oscillating from 99 to 101, and you will understand the importance of hysteresis. The user can set the hysteresis to any value from 1 to 99% of the setpoint. See section 6.0.

Note: The instrument recalculates the hysteresis at 5% each time you alter the setpoint, 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 setpoint. This feature enables a motor that has a low speed cut out (low alarm) to be started from rest, without having to short out the relay contacts externally. This feature may be enabled or disabled by the user. See section 6.0.

1.4 Analog Output

The instrument is unique in that it has both voltage out, 0 to 5 Volts DC, and a current sink, 4 to 20 mA, both of which may be used together. The voltage and current outputs track one another, that is at 0 volts out the current is 4 mA and at 5 Volts out, the current is 20mA. 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 that value at which the analog outputs are a maximum, 5 Volts 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 volts (20mA) 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:

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

$$\text{Resolution} = \frac{(2000 - 1000)}{4096} = .2441 \text{ RPM}$$

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

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 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 that for more than one pulse per rev simply divide the scale factor you get for one pulse by the number of actual pulses per rev.

Scale Factor of	Comment	Scales Display To
(π x d”)	circumference of wheel	inches per second
(π x d”) ÷ (5280x12)	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 ARROW** button until the display shows **SCALE**, the press the **SET** button once. The display will show **done** and the **tYPE**.

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 rev so:

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

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

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 knowns	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.

1.5 Maximum and Minimum

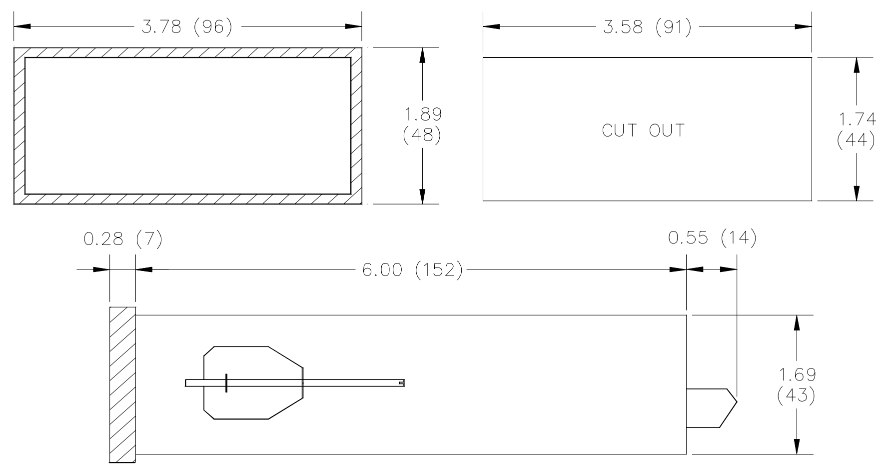
The unit tracks and saves the maximum and minimum values. These values are continuously updated and can be viewed at any time by pressing the **RECALL** button on the front panel. The first time this button is pressed the MAXIMUM is shown, indicated by the MAX light to the right of the display. Pressing the **RECALL** button a second time shows the MINIMUM. 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

Note: The instrument is programmed from the factory in the “RPM” mode for one pulse per revolution.

The ACT2A, ACT3A and ACT3 instruments are housed in a one eighth DIN enclosure and require a 3.58 inch wide by 1.74 inch high mounting hole. (91x44mm). You will require a depth of approximately 7 inches (178mm) behind the panel. Refer to Fig 1.0.



DIMENSIONS IN INCHES AND (MILLIMETERS)

FIGURE 1.0

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, then tighten the mounting screws against the front panel.

DO NOT OVER TIGHTEN THE MOUNTING SCREWS

Power is supplied to the unit via the 3-way screw terminal block, marked **POWER** on the rear panel.

If the unit is AC powered, 115 or 240 VAC, connect a power cable to the terminal marked L for Live (Hot) and N for Neutral (Return). The earth is connected to the GND or Ground terminal. Note: The ground connection is not required, as the unit is fully isolated from the mains. Normal line cord connections are as follows:

Black - to L (Line or Live)
White - to N (Neutral)

If the unit is DC powered, connect the dc supply Positive to the "**+**" terminal and the dc supply Negative or Common to the "**-**" terminal. The ground connection not required. Ensure the DC voltage does not exceed the rating on the unit.

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.

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 you have adequately suppressed all sources of spikes or noise from the environment.

APPENDIX A - SCALING THE ACT FOR ENGINEERING DISPLAYS

<u>The **SCALE** mode (in the **"TYPE"** sub menu) MUST be used to display RPM in applications where there are more than one pulse per revolution.</u> 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**
Pulses		1 Rev		60 Seconds		Revs
--------	x	--------	x	---------------	=	----------
Second		1 Pulse		Minute		Minute

In an application with multiple pulses per rev:

Input		**Conversions (Scale Factor)**				**Scales Display To**
Pulses		1 Rev		60 Seconds		Revs
--------	x	----------	x	---------------	=	-------
Second		N pulses		Minute		Minute

Therefore to read out in RPM the scale factor in 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 rev, 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 (Tables are available).

@S1 Set Limit 1 mode Enter a single character followed by a <CR>. The following are acceptable:

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

@L1 Set Limit 1 Setpoint	Enter a maximum of 6 digits, no decimal point. Recommended values are 0 to 999999 followed by a <CR>.
@H1 Set Limit 1 Hysteresis	Enter a maximum of 2 digits, no decimal point. Values can be from 1 to 99 only, followed by a carriage return.
@S2 Set Limit 2 mode	As per @S1.
@L2 Set Limit 2 Setpoint	As per @L1.
@H2 Set Limit 2 Hysteresis	As per @H1.
@P0 Set Analog Out	Enter a maximum of 6 digits. Recommended Zero Scale values are 0.0 to 999999 followed by a <CR>.
@P1 Set Analog Out	Enter a maximum of 6 digits. Recommended Full Scale values are 10 to 999999 followed by a <CR>.
@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 and the decimal point or period. If the command is successfully executed, the instrument will again send the OK message.

2.2 Adjustments

There are no adjustments since the instruments are crystal controlled. You will have to set up any of the programmable parameters you may be using, such as scaling, limits, analog out and so on using the menu.

2.3 Sensor Connections

These instruments have three input terminals on the rear panel. Refer to Fig 2.0.

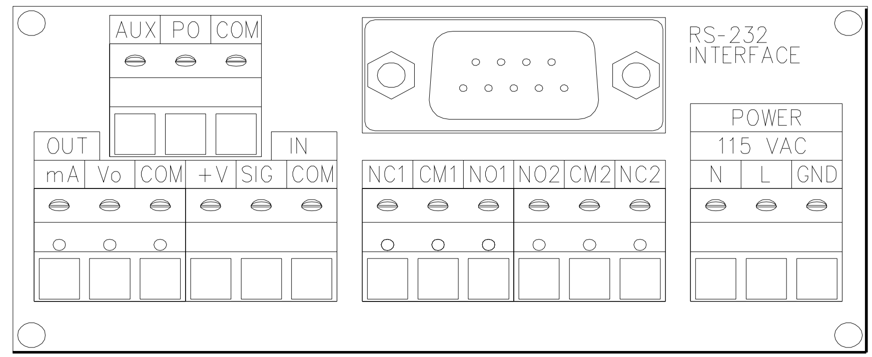


FIG 2.0

Three terminals are marked +V, SIG and COM. They function as follows:

+V -	Positive Supply Output. Used to power the sensors. The voltage out at this pin varies between +8VDC and +5VDC depending on load. Maximum load is 60 mA DC. This output has internal current sensing for use with two wire sensors. Maximum load for proper operation with two wire sensors is 5mA.
SIG -	Signal Input. This is the input for most ac signals, both Unipolar and Bipolar, from 5mV to 50V. It is also TTL compatible. Connect the signal wire from three wire sensors or the positive side of two wire magnetic sensors to this terminal. Typical Impedance is 10KW.
COM -	Common or Negative Terminal. This is the common for both signal and power on most sensors.

Refer to Figs 3.1 to 3.4 for connection of Monarch standard Sensors. The connections are typical for these types of sensors.

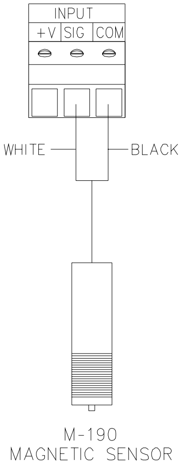


FIG 3.1

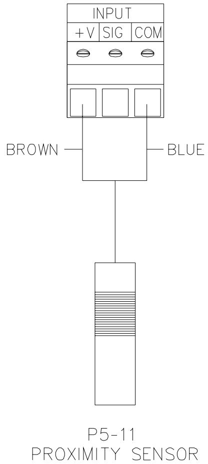


FIG 3.2

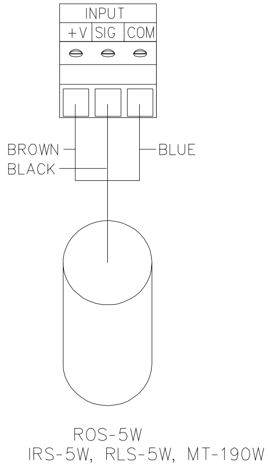


FIG 3.3

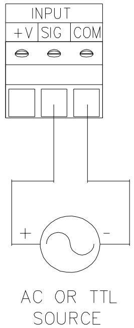


FIG 3.4

2.4 Other Connections

Depending on how your unit is configured you may have relay output connections or analog output connections on the rear panel. Connection details for these are given in figs 4.1, 4.2 and 4.3.

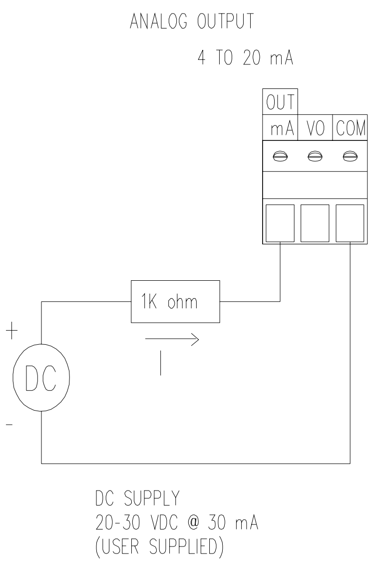


FIG 4.1

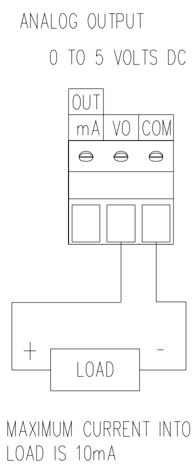


FIG 4.2

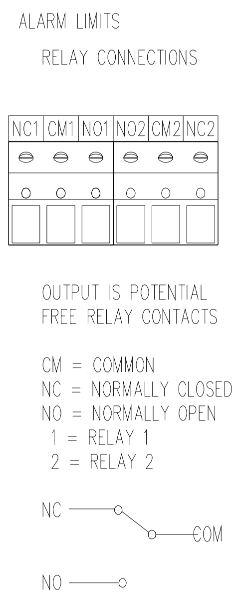


FIG 4.3

8.4 Control Commands

These commands will **STOP** the instrument, as they require further input and basically alter the operating parameters of the unit. On completion of the commands, the instrument will continue. This may cause any currently set limits to be reset or to set. **USE CONTROL COMMANDS WITH RESPECT**. It is possible to set values into the unit with the control commands, that could not be set from the front panel, however the user is cautioned to read the **MENU** section for realistic limitations to the values to be entered.

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. All end with <CR>.

Command	Action	Follow Up Action By User
@T1	Set operating mode	Enter a single character followed by a <CR>. 1 Set mode = RPM (x60) 2 Set mode = FREQUENCY (x1) 3 Set mode = SCALING 4 Set mode = SECAP 5 Set mode = TOTALIZING
@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. Recommended values are 0.0001 to 9999.9 followed by a <CR>.
@T4	Set TOTALIZE	Enter a maximum of 6 digits with or withoutScale Factor a decimal point. Recommended values are 0.0001 to 9999.9 followed by a <CR>.

If the user sends a Send display Data (@D1) command, the front panel display value is transmitted at the display update rate (See 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 @ and end with a carriage return <CR>, and consists of two characters, the first is an Alphabetic, the second is a Numeric. 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, CONTROL commands, require further information from the operator. <u>CONTROL COMMANDS SUSPEND OPERATION OF THE INSTRUMENT until completed</u>.

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. All end with <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 value	Unit sends current Reading value once.
@D1	Send display data	Unit sends display data until @D2 command.
@D2	Stop sending display data	Unit stops sending display.
@M1	Send Maximum value	Unit sends Maximum once.
@M2	Send Minimum value	Unit sends Minimum once.
@M3	Reset Max and Min	No Response

3.0 THROUGHPUT

Throughput is a measure of how fast the instrument processes data. Typically the update rate of the display is twice per second, however the rate at which the instrument acquires data is a function of the input. The instrument is in fact measuring the time between successive input pulses at its input. At faster inputs, the acquisition time is shorter than at slower inputs. When the input is faster then about 31 Hz, the instrument takes a number of samples to be able to display to the required accuracy. Typically for inputs faster than 50 pulses per second, the instrument acquires the data and updates the max/min and analog output about 25 times per second.

3.1 Display Update Rate

Although the instrument can sample at 25 times a second, to display the data at this rate would result in a totally erratic display. The instrument therefore 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, below this input, the update rate is equal to the period of the input frequency. The limiting factor is the point at which the instrument has to make the decision that the input is zero, because theoretically it could wait forever for the next pulse. This time is programmable. It can be 12, 1 or 0.5 seconds before the unit will display the value 0. See the section 6.13 for details.

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 updated, and the minimum and maximum updated, is the maximum rate at which the instrument acquires data. This is basically the instantaneous value acquired by the unit. The maximum rate is 25 times per second, (every 40 milliseconds). Obviously if the input is slower than this, the instrument has to wait for data. The point at which the internal update rate is less than 25 times per second is when the input is less than 50Hz or 3000 RPM.

Below 50Hz or 3000 RPM, the internal update rate is the period of the input frequency. Thus the response of the alarms can be seen to be a function of the input, above an input of 50Hz, the alarms respond within 0.04 seconds, below this input, they respond at (1 ÷ input frequency) seconds.

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 rev. To measure to 1 RPM, 5 pulses per rev is required. After receiving no input pulses for about 64 milliseconds, 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 32 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.

4.0 FRONT PANEL

Refer to the front page for a visual reference 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 (LEDs), marked LIM 1, LIM 2, GATE, MIN, MAX and RPM. Some of these LEDs may not be visible, it depends on the mode the unit is in.

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 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 following messages are sent from the instrument as each event occurs. Other information is sent on demand, and is covered in the following section. Note that no information will be sent if the Request to Send line (PIN 8) is inactive (Negative). 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 (User pushed reset button)
UM1	User has entered Menu mode from front panel
UM2	User has entered Limit Set mode from front panel

6.14 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. Press the **SET** and **RESET** buttons together to go to the next test.

This now tests the relays. Press the **SET** button to turn on relay 1. Press the **RESET** button, to turn off relay 1. Press the **UP ARROW** to turn on relay 2. Press the **DOWN ARROW** to turn off relay 2. Press the **RECALL** button to go to the next test.

This now tests the Analog Output. Press the **SET** button to test the zero scale (0 Volts or 4mA). The display will show “0 dA”. Press the **RESET** button to test the half scale (2.5 Volts or 12mA). The display will show “HALF”. Press the **UP ARROW** to test the full scale (5 Volts or 20mA). The display will show “FULL”.

Press the **DOWN ARROW** 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. Pin2 connected to Pin3, and Pin7 connected to Pin 8. The unit will respond with a “Pass” or a “Fail” message. Press the **RECALL** button to go to go back to the menu.

7.0 PULSE OUTPUT

The pulse output is not available on the ACT2A. The pulse output is basically a repeater of the input. Every pulse in gives a pulse out at the rear panel terminal marked PO. The pulse out is a 5 Volt TTL compatible signal, irrespective of the type of input into the instrument. The terminal to the right of the PO terminal, marked COM, is the common for the pulse output.

4.1 Status LEDs

4.1.1 LIM 1 and LIM 2 (Alarm) LEDs

These LEDs indicate the status of the limits, and particularly of the alarm output relay. When an alarm trips, the corresponding LED blinks at a rate around 1 flash per second. When the alarm resets, the LED goes out. These LEDs also go on continuously to indicate when and which limit is being set or adjusted. Note that if the LED is on continuously, the value on the display is a setpoint 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 MIN and MAX LEDS

Indicate to the user that a Maximum or a Minimum is being displayed. If either one of these LEDs is on, the display is a stored value, not the input value.

4.1.4 RPM LED

Indicates 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. Applications where there is more than one pulse per revolution will need to use the SCALE mode. Therefore, the RPM LED will be off even though read outs are in RPM.

4.2 PUSH BUTTONS

These buttons have multiple functions. The following covers the function of the buttons under normal operating conditions.

4.2.1 RESET BUTTON

This 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 that if an alarm setpoint is exceeded when the reset button is pressed, the alarm will immediately trip again on the next data acquisition cycle. If the user holds the **RECALL** button and then presses the **RESET** button, the minimum and maximum values are reset.

In the Single Event Capture (SECAP) mode, pressing this button tells the instrument to take a reading at the next trigger as well as its normal functions.

4.2.2 UP ARROW (▲) and DOWN ARROW (▼) BUTTONS

These buttons are used to view the current settings of the alarms. The **UP ARROW** is used to view **LIMIT 1,** the **DOWN ARROW** is used to view **LIMIT 2**. The display will revert back to normal after a few seconds.

4.2.3 RECALL BUTTON

This button is used to view the Maximum and Minimum. The first push shows the Maximum, the next shows the Minimum. Each subsequent push alternates between Maximum and Minimum. The display will revert back to normal after a few seconds. Use with **RESET** button to reset maximum and minimum. In the Totalizing mode, this button will hold the display for a few seconds so the value on the display can be easily read.

4.2.4 SET BUTTON

This button has no function on its own. Refer below.

5.0 SETTING THE LIMITS (ALARMS)

To set the limits the user must enter the EDIT mode. To do this press and hold down the **SET** button and also press the **UP ARROW** to set **Limit 1**, or the **DOWN ARROW** to set **Limit 2**.

6.10 0SCAL

Used to set the zero scale value for the analog output. Will not be seen on an ACT3A or an ACT2A. 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, else change the value in the same way as the limit is set. See 5.0 and 5.1 above.

6.11 FSCAL

Used to set the full scale value for the analog output. Will not be seen on an ACT3A or an ACT2A. 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, else change the value in the same way as the limit is set. See 5.0 and 5.1 above. Note that the minimum value is 0010.

6.12 bAUd

This is used to set the baud rate for the serial interface.

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 baud rate. You may cycle through the choices by using the **UP ARROW**. Press the **SET** button when the display is on the desired rate.

6.13 LoEnd

This is only visible in the RPM, FREQ, SCALE, and SECAP modes, since it only affects those modes. 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.

Select how many seconds may elapse between input pulses before the unit declares 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 ARROW** to select from three values: 12 seconds, 1 second, and HALF (0.5 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 display is on the desired rate.

6.6 Scale

Used to set the scale factor for the Scale mode of operation. Will not be seen if the unit is not set in the **SCALE** 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 5.0 and 5.1 above. Note that the **RECALL** key moves the decimal point position, unlike the other setting modes. 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

Used to set the scale factor for the Totalizer mode of operation. This scale factor is independent of the **SCALE** mode scale factor. 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 5.0 and 5.1 above. Note that the **RECALL** key moves the decimal point position, unlike the other setting modes. 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

Will not be seen on an ACT2A, 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 altered in the same manner as setting a limit. Refer to section 5.0 and 5.1 above. Note that permissible values for hysteresis are 1 to 99. The **RESET** button quits back to the main menu, while the **SET + RESET** button pushed together will update the hysteresis value.

6.9 HySt2

Hysteresis value for limit 2. Same as Limit 1.

The instrument will show the current limit value, and either the LIM 1 LED will light continuously if LIMIT 1 is being set or LIM 2 LED 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 ARROW** button, or be decremented by pressing the **DOWN ARROW** button. The digit is incremented or decremented by 1 each time the 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 setpoint is set.

To set a value greater than 99999, pressing the **RECALL** button causes 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 that if the most significant digit (that on the extreme left) is zero, you cannot set the times ten mode.

To exit from the edit mode at any time, WITHOUT UPDATING THE VALUE simply press the **RESET** button. The edit process will abort.

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: that any time the limit value is changed, the instrument will automatically recalculate the hysteresis at 5%. You may change this if you wish, see below.

5.1 Edit Key Summary

When in the EDIT mode as described above the keypad buttons have the following function.

UP ARROW(▲)	- increment the digit by 1.
DOWN ARROW(▼)	- decrement the digit by 1.
SET	- change the digit being edited.
RECALL	- shift the decimal point
RESET	- abort the edit process
SET + RESET	- exit and save data

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** and **RESET** buttons, pressing the **SET** button first if you do not wish to reset the limits, if they are present. Then while holding down these two buttons, press the **RECALL** button. 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 unit you have, the options set, and the general status of the instrument. Below is a list of the menu items, with the function they perform. The user can step through the menu using the **UP ARROW** and **DOWN ARROW** buttons.

To exit from the menu mode press the **RESET** button.

6.1 tyPE

Set 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. If you do not wish to alter it, you may return to the main menu by pressing the **RESET** button. If you wish to change the operating mode you can view the options using the **UP ARROW** button. The available options are **RPM**, **FREQ**UENCY, **SCALE**, **S**INGLE **E**VENT **CAP**TURE, **TOTAL**IZING. These functions are described in section 1 above. To select a new mode, press the **SET** button. The unit will display DONE and return to the main menu.

6.2 Point

Set the decimal point into the **AUTO** or **SET** (FIXED) mode. To enter this menu item press the **SET** button. The instrument will display its current decimal point mode. To exit back to the main menu without changing the mode, press the **RESET** button. To select the other mode, press the **UP ARROW** button. The display will alternate between the two modes. Press the **SET** button to change the mode to that of the display and exit to the main menu.

6.3 SEt 1

Will not be seen on an ACT2A. Used to set the Limit 1 type. This menu item has a number of sub items, **LO** or **HI** 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 ARROW**. Press the **SET** button when the display is on the desired limit type.

The unit will then display the **LATCH** or **RESET** message, depending on how it is currently set. Again use the **UP ARROW** to change the type. Note that 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

Same as SET 1 but for Limit 2.

6.5 SErno

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