INSTRUCTION MANUAL

SLIMLINE III
TACHOMETER
ATK 4654

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DESCRIPTION OF METER

Introduction

Slimline III Tachometers count low frequency input pulses and calculate RPM. By setting different scale factors, other units of rotational rate can be displayed (revolutions per second, revolutions per hour, etc.) as well as any units of rate or frequency. These units also have limit outputs capable of automatically switching relays. All functions related to rate calculation and set point are operator programmable in these microprocessor-based instruments. The Slimline III model described in this manual is designed for input frequencies between less than 1 cycle per hour to 4 kHz.

If your Series III instruments are built to special specifications (indicated by an "SP" after the model number), some procedures described in this manual may not apply.

Specifications

INPUTS:
- **Power:** +5 VDC @ 850 mA (absolute minimum is 4.8 V, absolute maximum is 5.5 V).
- **Signal:** Positive voltage pulses, variable from 250 mV to 50 V depending on threshold range switch settings. Maximum countable frequency varies from 40 Hz to 4 kHz depending on noise filtering switch settings and threshold adjustment. Minimum countable frequency is less than 1 cycle per hour.

OUTPUTS:
- **Set Points:** Three open collector transistor switches that switch to ground when the appropriate relationship between display and programmed set points exists. Set point outputs will switch up to 40 V at 100 mA resistive with a maximum dissipation of 350 mwatts.

CONTROLS:
- **Under Access Door:** Dip switches to select run or two different program modes, threshold ranges, noise filtering; pushbutton switches to advance program step and set program.

ADJUSTMENTS:
- **Under Access Door:** Potentiometer to adjust threshold voltage.

DISPLAY: LED, .9" (23 mm) PH*, .56" (14 mm) objective height, 7 segment arrays, average viewing distance 30 feet. 999999 maximum counts.

INDICATORS:
- **Program Mode:** Display indicates step number and programmed function.
- **Run Mode:** Overranged unit displays E and the decimal point shifted two places to the right of the original location.

ACCURACY: Time base accuracy is ± .0037% within operating temperature range.

TEMPERATURE STABILITY: Typically ±5 counts per million over 0-50°C temperature range.

ENVIRONMENTAL:
- **Storage Temperature:** −45°C to +85°C.
- **Operating Temperature:** 0°C to +50°C.
- **Humidity:** 0 to 95% RH non-condensing.
- **Altitude:** 1000' (.3 km) below sea level to 15,000' (4.6 km) above sea level.

PHYSICAL (MECHANICAL):
- **Size:** 4.55"W x 3.55"H x 0.72"D (115.5mm x 89.9mm x 18.2mm).
- **Net Weight:** Approximately 8 oz.
- **Shipping Weight:** Approximately 23 oz.
- **Finish:** Satin black sides, raised brushed aluminum front surface, anti-glare display area
- **Input Connections.** .025" (.64 mm) pins on 0.1" centers for various 50-pin connectors (e.g. Amp, Ansley, Berg, 3M Scotchflex, etc.).

ACCESSORIES FURNISHED: A selection of various assorted non-glare adhesive-backed labels.

*Phantasm Height

INSIDE THE METER

Raising And Lowering Access Panel

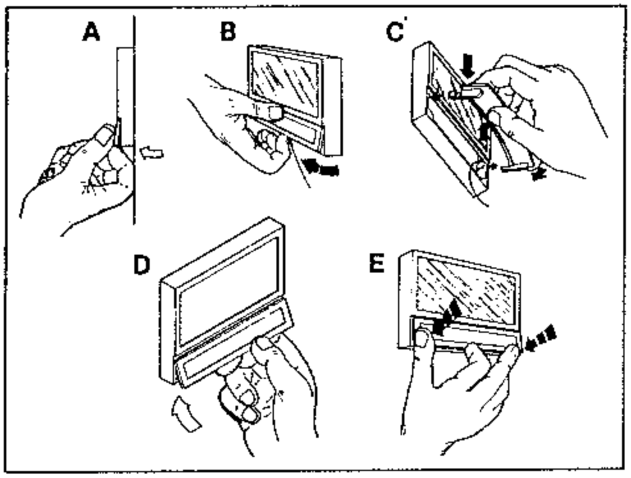


Figure 1. Raising and lowering the access panel.

The front access panel is raised most easily by fitting a fingernail under the lip at the center of the panel, then prying up and out (Figure 1, A and B). The door can be removed by bending down at the ends and up in the middle while pulling away from the meter. It may be necessary to angle the right side of the door out first. This same method of bending the door should be used when replacing it (Figure 1, C). To close the access panel, simply push both ends of the door directly toward the meter. A slight upwards pressure may be necessary (Figure 1, D and E).

When removing and replacing the access panel, care should be taken not to snag the hinges on internal components of the meter.

Controls

Slimline Series III meters have controls for programming and controls for regulating the input signal. These controls are shown in Figure 2.

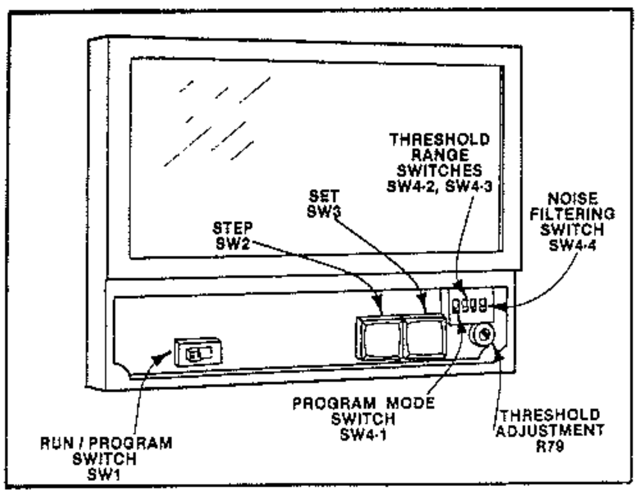


Figure 2. Front view of meter with access panel removed, showing operator controls.

SW1 is the **run/program** switch and **SW4-1** is the **program mode** switch. They are used to select between run and two program modes. Figure 3 shows switch positions and the operational modes (up = on; down = off).

SWITCH POSITION		MODE
SW1	SW4-1	
RIGHT	DOWN	PROGRAM: SET POINT
RIGHT	UP	PROGRAM: CALCULATION AND FORMATTING
LEFT	DOWN	RUN
LEFT	UP	RUN

Figure 3. Operational modes selected with program switches.

The **Set Point Mode** is a program sequence that allows you to set limits. When these limits are exceeded by the display, set point outputs (Pins 22, 24, 28 — see Figure 9) are automatically turned on or off. The **Calculation and Formatting Mode** is a separate program sequence used to select the type of calculation, scale factor, display formatting and other functions.

When the program switches select a program mode, the Slimline stops calculating and the first step of the appropriate program sequence shows up on the display. When SW1 returns the meter to a run mode, the program is stored in permanent memory registers, internal counters reset to zero and the meter begins calculating. Slimlines will retain a program **even if power is cut off.** The only way to change a program is to manually enter new values.

NOTE: The Slimline's memory has a useful life of about 10,000 reprogrammings. (If you reprogram your unit once each day, its memory should last about 30 years.) If SW1 is routinely used to reset internal counters, the life of the permanent memory could be shortened. Do not use SW1 as a reset function.

SW2 is the **Program Step** button. It works only when the Slimline is in a program mode. Each time this button is pressed, the next program step or substep is addressed. Program steps are indicated by the left most digit of the display.

SW3 is the **Program Set** button. When the meter is in a program mode, the Set button is used to set programmable functions. Values relevant to these functions are indicated on the right side of the display.

When you receive your Series III Slimlines, there will be a program in the memory. To program your own functions, switch to a program mode, use Step to advance the program steps and Set to set the desired value. All program functions are described in the Set Up section, and Figure 17 gives an abbreviated list of program steps.

The threshold range switches, threshold adjustment and noise filtering switch are described in the Set Up section.

INSTALLATION

Mounting

Slimline Series III instruments are normally mounted on the front of the panel. Figure 4 shows a mounted Slimline meter and universal mounting dimensions.

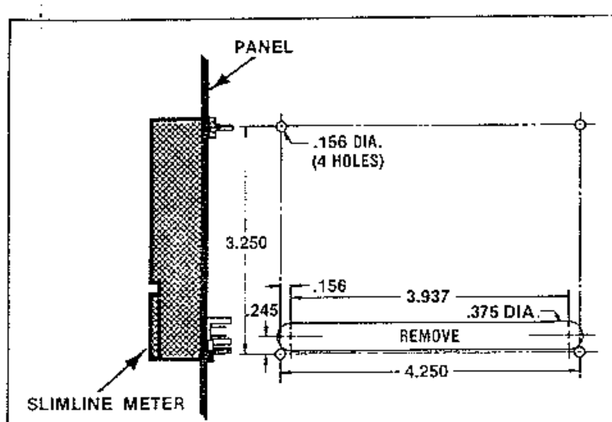


Figure 4. Mounted Slimline meter and universal mounting dimensions.

The instruments are easy to mount because four corner holes and a slot for connections are the only cutouts required.

■ ■ ■ ■ ■ ■ ■ ■
■ *CAUTION* ■
■ ■ ■ ■ ■ ■ ■ ■

Do not overtighten the nuts; excessive force will strip the studs.

Wiring

GENERAL

Slimline III Tachometers require power and signal inputs for minimal operation. All input and output connections are made by a 50-pin connector as shown in Figure 5.

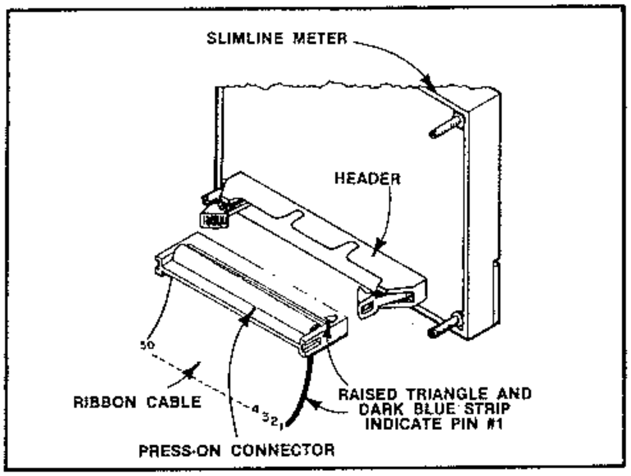


Figure 5. Rear view of meter.

The input/output header consists of two parallel rows of .025" pins on 0.1" centers. These pins take press-on connectors made by AMP, Ansley, 3M Scotchflex, Berg and others. Most of the connectors available use flat ribbon cable, but some use individual wires with crimped terminations inserted into a molded housing. We stock both varieties. **Note:** The numbering system on your connector may not coincide with the one we use. Refer to Figure 6 for correct pin numbers.

■ ■ ■ ■ ■ ■ ■ ■
■ *CAUTION* ■
■ ■ ■ ■ ■ ■ ■ ■

Never solder wires directly to the pins. This can cause intermittent connections inside the meter.

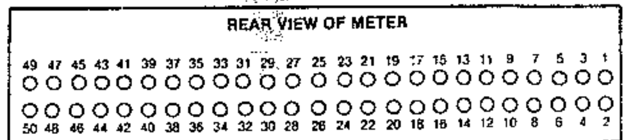
Figure 6 shows pin number and lists connections for Slimline III Tachometers.

POWER

Power requirements are listed below. The 5 V connections are doubled (Pins 1, 2 and 3, 4). This is an optional procedure which reduces wire resistance and is advised when using small gauge wire such as ribbon cable.

PIN 1, 2; (+)5 VDC — DC power input at 850 mA. Absolute minimum 4.8 V. Absolute maximum 5.5 V. Noise and ripple not to exceed 1%. These two pins are connected internally.

PIN 3,4; 5 V ground — return side of 5 VDC power input and ground reference for logic inputs and outputs. These two pins are connected to each other internally.



PIN	FUNCTION	PIN	FUNCTION
1	+5 VDC (also Pin 2)	2	+5 VDC (also Pin 1)
3	5 V Gnd (also Pin 4)	4	5 V Gnd (also Pin 3)
5	Signal Ground	6	No Function
7	Signal Ground	8	No Function
9	Signal Ground	10	No Function
11	Signal Ground	12	No Function
13	Signal Ground	14	No Function
15	Signal Ground	16	No Function
17	Signal Ground	18	No Function
19	Signal Ground	20	No Function
21	Signal Ground	22	Set Point Output 2; ≥L, < H
23	Signal Ground	24	Set Point Output 1; ≥H
25	Signal Ground	26	No Function
27	Signal Ground	28	Set Point Output 3; < L
29	Signal Ground	30	No Function
31	Signal Ground	32	No Function
33	Signal Ground	34	No Function
35	Signal Ground	36	No Function
37	Signal Ground	38	No function
39	Signal Ground	40	No Function
41	Signal Ground	42	Signal Ground
43	No Function	44	No Function
45	No Function	46	No function
47	No Function	48	No Function
49	Dry Contact Source	50	Signal Input

Figure 6. Pinout for Slimline III Tachomters.

SIGNAL

PIN 49; Dry Contact source — 220 Ω resistor to +5 V. Voltage source that can be used with any switching device to generate input pulses.

PIN 50; Signal Input — positive voltage pulses between 1 cycle per hour and 4 kHz. See Set Up section for voltages.

Positive Voltage Pulses: These Slimlines count the falling edges of positive voltage pulses. The input signal is connected to Pin 50. Input pulses can range from 250 mV to 50 V depending on threshold range switch settings. Minimum countable frequency is less than one cycle per hour. Maximum countable frequency varies from 40 Hz to 4 kHz depending on noise filtering switch settings and threshold adjustment. See threshold adjustment and noise filtering in the Set Up section.

Dry Contact Source: If the encoder you are using is a switching device with no power output, you can use the dry contact source (Pin 49) to generate input pulses.

There are two ways to do this. One is to connect Pin 49 to one side of your switching device and Pin 50 to the other (Figure 7). When the switch closes, a pulse is created. The rising edge of the pulse occurs at switch closure.

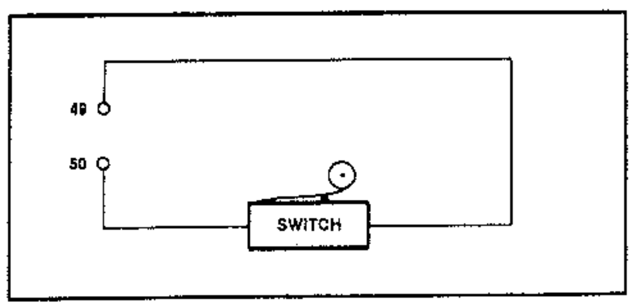


Figure 7. Input pulse occurs while switch is closed.

Another way to use the dry contact source is to wire Pins 49 and 50 together on one side of your switching device. Connect the other terminal of your switch to signal ground (Figure 8). When the switch opens, a pulse is created. The falling edge of the pulse occurs at switch closure.

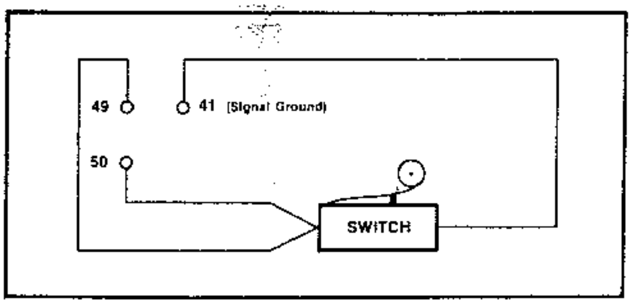


Figure 8. Input pulse occurs while switch is open.

NOTE: When using the dry contact source, both threshold range switches (SW4-2 and SW4-3) should be switched off (down). See the Set Up section.

SET POINT OUTPUTS

Pin 22, 24, 28; Set Point Outputs — open collector transistor switches which indicate the relationship between the displayed value and programmed set points. When a set point is "on", its pin is closed to ground. These outputs will switch up to 40 V at 100 mA resistive load with a maximum dissipation of 350 mwatts. Figure 9 lists set point references, pin numbers and relationships indicated.

SET POINT REFERENCE	PIN	SET POINT OUTPUT IS SWITCHED ON WHEN THE DISPLAY IS:
3	28	less than LOW
2	22	greater than or equal to LOW and less than HIGH
1	24	greater than or equal to HIGH

Figure 9. Set point outputs 1 — 3.

SET UP

Signal

Counting Input Pulses

Program Steps 1, 2 and 3 of the calculation and formatting mode tell the Slimline how it is to count input pulses. Figures 2 and 3 show how to address this program sequence.

STEP 1 is used to select one of two possible calculation modes:

Gated Counter, indicated by a display of [1 1..1]. The Series III instruments count pulses between display updates and calculate their frequency. This mode is recommended for input frequencies between 1 Hz and 4 kHz. If input pulses are received less frequently than the update rate, the meter will display 0. (See Step 2 for setting the update rate.)

Period Calculation, indicated by a display of [1 ....]. The Slimline updates its display each time an incoming pulse is received. The time elapsed since the last pulse (the period) is measured and the reciprocal calculated to arrive at the frequency. This mode is recommended for frequencies below 1 Hz. Minimum frequency is less than 1 cycle per hour. If period calculation is used for frequencies above 3 Hz, the display changes too quickly to be read.

Use the Set button to choose the calculation mode, and then press the Step button to advance to Step 2.

STEP 2 selects the update rate of the LED display. This time becomes the gate period for measuring input pulses in the meter's gated counter mode. At least two pulses must be received in an update period before the meter will calculate frequency. With higher frequency input signals (1 to 4 kHz), longer update periods stabilize the display. If you have programmed Period Calculation in Step 1, update rate will have no significance and be ignored.

Use the Set button to set one of 16 possible update rates between 0.5 and 20 seconds. The sample display above shows an update rate of 1.5 seconds. Press the Step button to call up program Step 3.

STEP 3 is used to smooth out a jumpy display caused by rapidly changing input frequencies. Up to 7 readings can be averaged for each update of the display. The sample display above shows 5 readings will be averaged (the current reading with four previous readings). If no averaging is desired, enter 1.

Use the Set button to choose the number of readings you wish to average. Use the Step button to advance to program Step 4.

SCALING

Program Steps 4, 5 and 6 of the calculation and formatting mode are used to set scale factor and display functions.

STEP 4 is used to set the scale factor. Before a rate is displayed, the frequency of input pulses (determined by either the gated counter method or period calculation in Step 1) is multiplied by any number between 1 and 59999. This allows you to display an input signal in any units of rate or frequency. A scale factor of 1 will cause the Tachometer to display frequency in cycles/second.

A simple formula can be used to determine a scale factor appropriate for any application:

$$\text{SCALE FACTOR} = \frac{\text{TIME (in seconds)}}{\text{COUNTS PER UNIT}}$$

TIME is the number of seconds in a time period. If you wish to display RPM (Revolutions Per Minute), Time would be 60 (60 seconds in a minute). If you are displaying Revolutions Per Hour, Time would be 3600. If you want to display units/shift, Time would be the number of seconds in a shift. (An 8-hour shift contains 28,800 seconds).

COUNTS PER UNIT is the number of counts representing one measured unit. In the case of RPM, this would be the number of input pulses generated by your encoder during one revolution.

EXAMPLE: A photoelectric eye is aimed at the teeth of a gear. You want to display RPM. There are 24 teeth on your gear.

$$\text{SCALE FACTOR} = \frac{\text{TIME (in seconds)}}{\text{COUNTS PER UNIT}}$$

TIME = 60 (60 seconds/minute)
COUNTS PER UNIT = 24 (24 pulses per revolution)

$$\text{SCALE FACTOR} = \frac{60}{24} = 2.5$$

The correct entry for program Step 4 would be 25. (Decimals are ignored when entering the scale factor.)

Each digit of the scale factor is set individually. When Step 4 is first called up, the far right hand digit is brighter than the other display digits (see sample display above). This far right digit is the first digit of the scale factor to be set. Press the Set button until the desired value appears in this place. (In the case of our example, the correct value would be 5.)

When this digit has been set, press the Step button. The next most significant digit of the scale factor will become brighter than the others, indicating that this digit can be set by pressing the Set button:

After each digit is set, pressing the Step button addresses the next most significant digit. Only after all 5 digits of the scale factor have been addressed will the Step button call up program Step 5.

It is possible to enter a scale factor of 0. However, if 0 is entered, the Slimline will automatically use 1 in its calculations. The largest possible scale factor is 59999.

STEP 5 can be used to shift a calculated value to the right in the display. For example, if a unit displays [025.000] with zero display shift, a display shift factor of 1 will produce [002.500].

The display shift factor is the number of times a calculated value will be divided by 10 before it is displayed. Each time the calculated value is divided by 10, it is shifted one place to the right in the display. A calculated value can be divided from 1 to 9 times before being displayed. If your scale factor and input frequency combine to overrange the meter, a display shift factor will allow you to shift the calculated value until it fits into the display. If no display shift is needed, enter 0.

Before deciding on the display shift factor that suits your application, you must first determine how the display will respond to your scale factor and input frequency. This is very easy to do if you keep in mind two important characteristics of all Slimline III Tachometers.

The first is that Tachometers try to display thousandths (0.000). This means that in the six digit display, there is an **implied decimal point** in the third place [000.000]. This is not to be confused with **lighted decimal point.** Program Step 6 allows you to light a decimal point after any digit on the display, but they are display functions only; they have no bearing on the meter's calculations. The **implied** decimal point is used by the meter to determine if a calculated value is too large for the display.

The second important feature to remember is that Slimline Tachometers have an **automatic decimal shift function.** Decimal shift is **not** the same as display shift. Display shift moves the displayed value to the right without moving the decimal point. The decimal shift function will automatically move a displayed value **and** the decimal point one or two places to the right so larger numbers can be displayed. Since the **implied** decimal point is in the third place [000.000], the largest calculated value that can be displayed (without a display shift factor) is [99999.9]. The implied decimal point is automatically shifted two places to the right. Any larger number would cause the meter to overrange.

Keeping these features in mind, you can easily determine what will be displayed with any combination of scale factor and input signal. This is how it is done.

1) Determine the average cycles per second your Slimline is likely to receive.
2) Multiply this number by the scale factor.
3) Mark the implied decimal point to the right of this calculated value and add three zeroes (this is the .000 the meter will try to display).
4) Mark off the six display digits, shifting the implied decimal point one or two plcaes if necessary. (Remember the meter will automatically shift to [0000.00] or [00000.0] to accommodate larger numbers.)

EXAMPLE: using the same problem described in Step 4 and assuming gear teeth will cause input pulses at a rate of about 10 per second:

1) 10 gear teeth per second = 10 pulses per second
2) Scale factor is 25. 25 x 10 = 250
3) 250,000
4) The display will indicate [250.000]. No decimal shift occurs here.

If the third decimal place is lighted (using program Step 6), the displayed value would be:

[250.000]

It should be noted that at 10 input pulses per second, the shaft on which the gear is fixed would be turning at 25 RPM. To correct the display, one could either light the fourth decimal place from the right or enter a display shift of 1. A display shift factor of 1 will produce the following display:

[025.000]

Display shift is most useful in dealing with large scale factors or high frequencies. **EXAMPLE:** Suppose you have calculated a scale factor of 2.5666666. In the interest of accuracy you wish to enter as much of this number as possible, so you enter 25666. Suppose also that you expect about 2000 cycles/second from your encoder.

To determine how the display will respond, first multiply input frequency and scale factor:

2000 x 25666 = 51332000

Indicate the implied decimal place and add the three zeroes representing thousandths:

51332000.000

It is evident that without any display shift, this value could not be displayed even after the decimal shifts two places to the right:

513[32000.0]00

OVERRANGE — IMPLIED DECIMAL, SHIFTED TWO PLACES TO THE RIGHT

If the third decimal point was lighted, the display in this case would appear as follows:

[E .]

It should also be noticed that since the number is overranged by three factors of 10, a display shift of at least 3 would be required before the display would indicate anything.

Figure 10 shows how different display shift factors would affect the display using an input of 2000 Hz and a scale factor of 25666. In all cases it is assumed that the third display decimall place is lighted.

DISPLAY SHIFT FACTOR	DISPLAY
0	E .
1	E .
2	E .
3	51332.0
4	5133.20
5	513.320
6	051.332
7	005.133
8	000.513
9	000.051

Figure 10. The Display Shift factor: input frequency of 2000 Hz; scale factor of 25666; third decimal place lighted. Notice the automatic decimal shift function.

By using display shift factors and lighting appropriate decimal points, it is possible to display any calculated value in a scale appropriate to any application.

After deciding on a display shift factor, press the Set button to enter a number between 0 and 9. Then press the Step button to address program Step 6.

STEP 6 lights the display decimal point. Pressing the Set button moves the decimal from left to right, then off the display (if you do not wish to light any decimal point), and finally returning the decimal to the left side of the display. The lighted decimal point is a display function only. It has no effect on the way these meters calculate data.

The automatic decimal shift function described in Step 5 permits a meter to display a tremendous range of values without requiring a manual change in decimal location. However, a display value calculated by the meter may force the decimal one or two places to the right of the location you select. Using the method described in Step 5, you can determine if a decimal will be shifted given your input frequency and scale factor. Figure 10 shows how different display shift factors affect the automatic decimal shift.

NOTE: If you do not light a decimal point, you may not see a decimal shift when it occurs. **EXAMPLE:** With a scale factor of 1, zero display shift and no decimal lighted, 500 Hz would be displayed as [500000]. If this signal increased to 1000 Hz, the display would be [100000]. A decimal lighted in the third place would show [500.000] becoming [1000.00].

Step 6 is the last step in the calculating and formatting sequence. Pressing the Step button recalls program Step 1.

THRESHOLD AND NOISE FILTERING

Threshold range switches, the threshold adjustment and the noise filtering switch (see Figure 2), are used to regulate the input signal. To set these controls, we suggest you first enter a prgram for displaying cycles/second (update rate = 1.0, averaging = 1, scale factor = 00001, display shift factor = 0, third decimal place lighted).

Threshold Voltage is the voltage at which a signal pulse is registered in an internal counter (see Figure 15) in Theory of Operation). **SW4-2** and **SW4-3** are **Threshold Range** switches. They select a range of voltage in which the exact threshold voltage can occur. **R79**, the **Threshold Adjustment**, is used to fix the exact threshold voltage within that range.

The threshold range you set on these switches should correspond to the voltage output of your signal encoding device. Figure 11 lists switch positions, the lower limits of the threshold ranges (with R79 in its fully clockwise position) and the upper limits of the threshold ranges (with R79 turned fully counterclockwise). Down = off; up = on. **Note:** Actual threshold range limits are within ±5% of the values shown in Figure 11. However R79 can be adjusted with an accuracy considerably better than 5%.

SW4-2	SW4-3	LOWER LIMIT OF THRESHOLD RANGE	UPPER LIMIT OF THRESHOLD RANGE	ABSOLUTE MAXIMUM INPUT
DOWN	DOWN	250 mV	2.2 V	6.5 V
UP	DOWN	1 V	13 V	35 V
DOWN	UP	6 V	50 V	50 V
UP	UP	6.5 V	50 V	50 V

Figure 11. Threshold range switch settings.

Each time the threshold voltage is passed by the falling edge of an input pulse, that pulse is counted by an internal counter. There is however, a hysteresis built into these meters. If an input pulse increments the internal counter, then rises slightly before falling again, it must rise at least 10% above the threshold voltage in order to increment the internal counter a second time (see Figure 15 in Theory of Operation).

SW4-4 is a **Noise Filtering** switch. SW4-4 switches in a capacitor that attenuates noisy input pulses. Since noise filtering reduces the amplitude of an input signal, the threshold adjustment may have to be changed when SW4-4 is turned on. Figure 12 lists the highest countable frequencies for each position of SW4-4. Down = off; up = on.

SW4-4	MAXIMUM COUNTABLE FREQUENCY	
	STANDARD INPUT	DRY CONTACT
DOWN	4 kHz	100 Hz
UP	40 Hz	40 Hz

Figure 12. Noise Filtering switch.

NOTE: The values for the standard input column of Figure 12 were determined using a 5 V square wave. Different wave forms and amplitudes may result in slightly different maximum countable frequencies.

When setting these controls for your application, begin by determining the voltage of your input signal. Set SW4-2 and SW4-3 accordingly. (When using the dry contact source, both of these switches should be off — down). Switch SW4-4 off (down). Adjust R79 to its midpoint and begin generating pulses. If the meter displays no value at all, adjust R79 until frequency is displayed. Turning R79 counterclockwise raises the threshold voltage; turning R79 clockwise lowers the threshold voltage.

When using higher frequency input signals (between 1 and 4 kHz), R79 must be carefully set the threshold voltage (see Figure 16 and the paragraph preceding it in Theory of Operation). If your input signal is below 40 Hz but the meter displays too high a frequency, turn R79 counterclockwise to tune out noise. If noise cannot be tuned out with R79 turn on (up) SW4-4 and adjust R79 until the correct frequency is displayed.

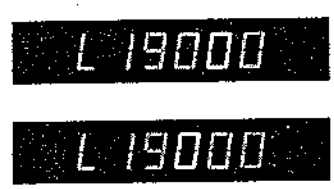
Set Points

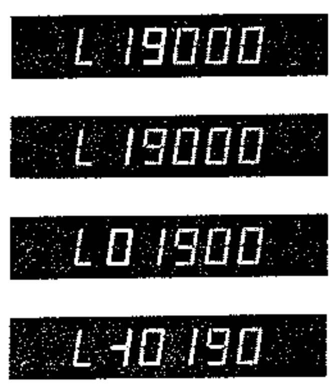
Set Points are programmed limits. Every time the display is updated, it is compared to these limits. The three set point outputs (Pins 22, 24 and 28) are then switched according to the results of this comparison. There is a low set point and a high set point. Figure 9 shows the relationships that will cause each set point output to be switched on.

When program switches select the set point mode (see Figure 3), the first step of the sequence is indicated as shown below.

Each set point is a 6 digit number with an indication of polarity. (There is no decimal point. When display comparison occurs, the display decimal point is ignored.) Each digit of each set point must be set individually. The first step of the set point sequence shows the dim letter L to the left and the far right hand digit brighter than the other digits. This means the least significant digit of the low set point is ready to be set. Press the Set button until the desired value appears in this place.

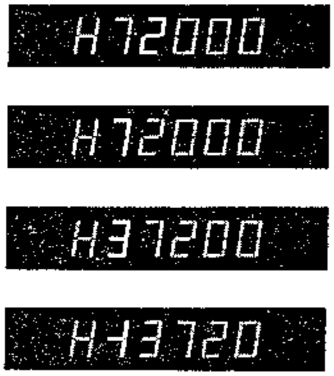
When this digit has been set, press the Step button. The next most significant digit of the low set point will become brighter than the others, indicating that this digit can be set by pressing the Set button:





After each digit is set, pressing the Step button addresses the next most significant digit. When the 5th digit has been set, pressing the Step button shifts all the digits one place to the right. This is so the most significant digit can be set (only 5 of the 6 set point digits can be seen at one time). One more press of the Step button addresses polarity by once again shifting all the digits to the right. You can set positive (+) or negative (−) polarity.

Polarity is the last element of the set point. Pressing the Step button addresses the least signficant digit of the high set point.



Each digit of the high set point is set individually as described above. When polarity of the high set point has been set, the set point program sequence is completed.

Note about polarity: Slimline Tachometers only display positive values. Negative set points are intended for use in other software packages. If you program a negative set point, the displayed value will always be greater than the set point.

OPERATION

By switching the program switches (SW1 and SW4-1) to the run Mode (see Figure 3), your Slimline should operate according to the values you have programmed. If it does not perform as expected, refer to the Operation Analysis chart (Figure 13).

THEORY OF OPERATION

Figure 14 is a Block Diagram showing relationships between the meter's major functions.

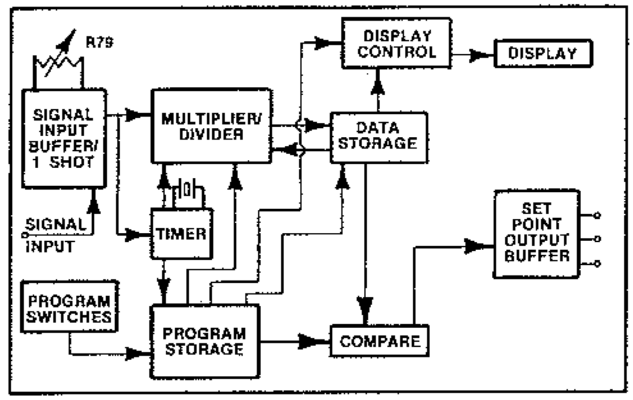


Figure 14. Block diagram for Slimline III Tachometers.

OPERATION ANALYSIS	
CHARACTERISTIC	**SUGGESTION**
The Slimline always displays zero in run mode.	1) No Input Signal. If your encoding device has no voltage output, use the Slimline's dry contact source. 2) The frequency of your input signal is above 4 kHz. 3) Threshold range switches are set too high for your input signal. See Figure 11. 4) Threshold adjustment is not correctly set. 5) In the gated counter mode, input pulses are received less frequently than the update rate. See prog. Step 2. 6) In period calculation, signal input frequency is considerably less than 1 pulse per hour.
The Slimline always displays E	1) The scale factor is too large for the input frequency: a) Increase the display shift factor. b) Remove zeroes from the least significant (right hand) end of the scale factor.
The Slimline displays all 8's in run mode.	1) This can occur when a unit is programmed for period calculation and then switched to run mode. The display will remain all 8's until an input pulse is received.
The Slimline displays an unreasonably high value in the run mode.	1) Be sure you have calculated and set the correct scale factor. 2) If the display is off by an even multiple of 10: a) Remove zeroes from the scale factor. b) Increase the display shift factor. c) Move the decimal point. 3) The Slimline may be counting noise. a) Turn the threshold adjustment counterclockwise to raise threshold voltage. b) If your input frequency is below 40 Hz, switch on the noise filtering switch and readjust the thres. adj.
The Slimline displays an unreasonably low value in the run mode.	1) Be sure you have calculated and set the correct scale factor. 2) If the display is off by an even multiple of 10: a) Add zeroes to the scale factor. b) Decrease the display shift factor. c) Move the decimal point. 3) Readjust the threshold adjustment.
The Slimline's display is unstable.	1) Increase the number of readings averaged. 2) Use a longer update period.
Set point outputs do not switch on.	1) Incorrect entry of set point. When entering set points, disregard decimal point in the display.

Figure 13. Operations Analysis Chart.

Program and pushbutton switches are used to enter set points and values for calculating the display. This information is stored in a non-volatile RAM. The non-volatile RAM is a type of Random Access Memory that will retain operator programmed values when power is turned off. The only way to change an operator program is to enter new values.

Signal pulses enter the Signal Input Buffer/One Shot. This buffer reduces signal voltage to a working level and eliminates noise from the wave form. The noise filtering switch, threshold range switches and threshold adjustment (R79) are all part of the Input Buffer/One Shot.

Each time the falling edge of an input pulse approaches ground, the Input Buffer/One Shot fires. The exact voltage at which this One Shot pulse occurs is determined by the Threshold Adjustment. By adjusting R79, threshold voltage can be set so noise is not registered as input pulses. Figure 15 shows how the Threshold Adjustment works. Two different settings of R79 are illustrated. Note the 10% hysteresis. An input signal that falls below the threshold voltage must rise 10% above this threshold before it can set off another One Shot pulse.

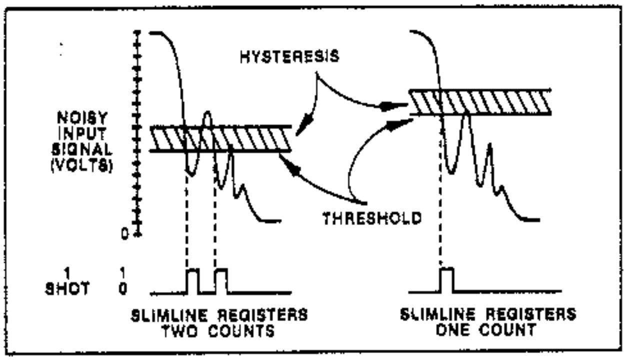


Figure 15. Effect of threshold adjustment.

When input frequencies approach the upper limit of the Slimline's operating range (for either filtered or unfiltered inputs, see Figure 12), the adjustment of threshold voltage must be very precise. Sometimes the difference between displaying zero and displaying an accurate reading of input frequency is the slightest turn of R79. This is because the difference between peaks and valleys decreases in higher frequency wave forms. Figure 16 illustrates a high frequency input and shows the threshold voltage correctly located. It can be seen that either raising or lowering the threshold, even slightly, would cause the Input Buffer/One Shot to stop firing and the meter to display zero.

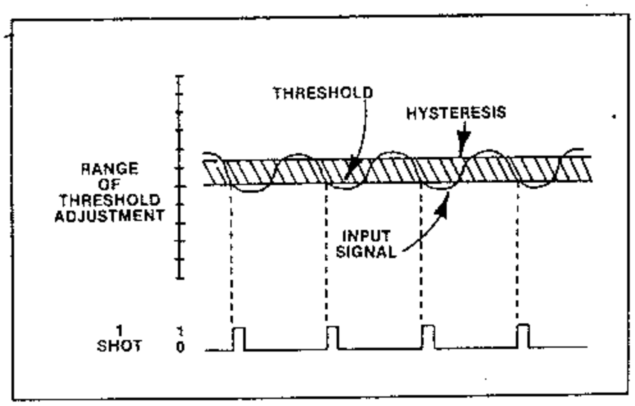


Figure 16. High frequency inputs.

One Shot pulses are counted by the Timer and the Multiplier/Divider according to information provided by Program Storage. While the Multiplier/Divider counts input pulses, the Timer measures elapsed time in μsec. At the end of each update period, there will be a total count of pulses and the time (in μsec.) between the first and last pulses of the period. The Multiplier/Divider then performs the following calculation.

$$(\text{Total Pulses} \times \text{Scale Factor}) \div \mu\text{Sec} = \text{Rate}$$

The only difference between Gated Counter calculation and Period Calculation is the determination of the update period. In Gated Counter calculation, update rate is the number of seconds set in program Step 2. In Period Calculation, the update rate is the time between consecutive pulses (total pulses always equals 1).

Each time a new rate is calculated, the value is averaged, shifted and stored in Data Storage. From there it is used to update the display and the Set Point Outputs. It is also available for ASCII transmission if a transmit command is received.

Whenever data in Data Storage is updated, it is sent to Compare where it is compared with programmed set points in Program Storage. Based on this comparison, the Set Point Output Buffers are updated and latched. New data in Data Storage is also sent to display Control Display Control scans the display digits, enabling one digit at a time. All timed functions, including those pertaining to data calculation, display scanning and message transmission, are controlled by the Timer which operates at a crystal frequency of 12 MHz.

MAINTENANCE

Normally Slimline Series III Tachometers require no calibration or maintenance. If, however, your meters are subject to shock or vibration, the Threshold Adjustment (R79), may drift slightly. This adjustment should be checked occasionally, especially if the meter displays unreasonable values.

MODE	STEP	SET	DESCRIPTION
CALCULATION AND FORMATTING SW1: Right SW4-1: Up	1	1 1..1 1	Gated counter mode. Period calculation.
	2	2 0.5 ↓ 2 20	Update rate in seconds.
	3	3 1 ↓ 3 7	Number of readings averaged.
	4	412345	Five digits of the scale factor.
	4	412345	
	4	412345	
	4	412345	
	4	412345	
	5	5 0 ↓ 5 9	Display shift factor.
	6	6 8888 6. 8888 6 .8888 6 8.888 6 88.88 6 888.8 6 8888.	Decimal point location.
SET POINT SW1: Right SW4-1 Down	L	L23456	Six digits of low set point.
	L	L23456	
	L	L23456	
	L	L23456	
	L	L23456	
	L	L12345	
	L	L +1234 L-1234	Polarity of low set point.
	H	H23456	Six digits of high set point.
	H	H23456	
	H	H23456	
	H	H23456	
	H	H23456	
	H	H12345	
	H	H +1234 H-1234	Polarity of high set point.
RUN SW1 Left	No Function		Run Mode.

Figure 17. A list of program steps. Each line in the STEP column indicates one program step or substep. NOTE: It is not necessary to go through an entire sequence every time you enter a program mode. To change part of one step only, enter the appropriate mode, press STEP until you reach the desired step or substep, change the value and then switch back to run mode. The rest of the program will remain unchanged.