DAYTRONIC

MODEL
3230
Manuals 3130 + 3200
with C, G & P options

LVDT CONDITIONER

INSTRUCTION MANUAL

3000
Instrument Series

NOTE

The 110 vac primary power fuse for the Model 3130 is now rated at 0.5 amp, and its part number is now "29049."

Model 3130 Instruction Manual, v. SB.5
Pub. No. 3130M.5, Issued 10/96
Part No. 91120

DAYTRONIC

MODEL
3130
LVDT CONDITIONER

INSTRUCTION MANUAL

Daytronic Corporation

Dayton, OH • Tel (800) 668-4745
www.daytronic.com

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

PLEASE NOTE: Sections 6 and 7, Figures 9 and 10, and Table 4 have been removed from this manual.

If you need information regarding specific 3130 components and circuitry, please contact the Daytronic Service Department at (937) 293-2566.

Daytronic Corporation

INSTRUCTION MANUAL
MODEL 3130 LVDT CONDITIONER

1. DESCRIPTION

The Model 3130 is a conditioner-amplifier for use with 3-wire variable reluctance transducers or 5- and 7-wire linear variable differential transformer (lvdt) transducers that are wired series opposed. A 3-kHz excitation voltage that is amplitude regulated is supplied to the transducer by the instrument. The resultant signal is demodulated by a phase-sensitive (synchronous) amplifier/demodulator circuit so that both direction and displacement of the core are determined. The Model 3130 is shown in Figure 1 and the specifications are given in Table 1.

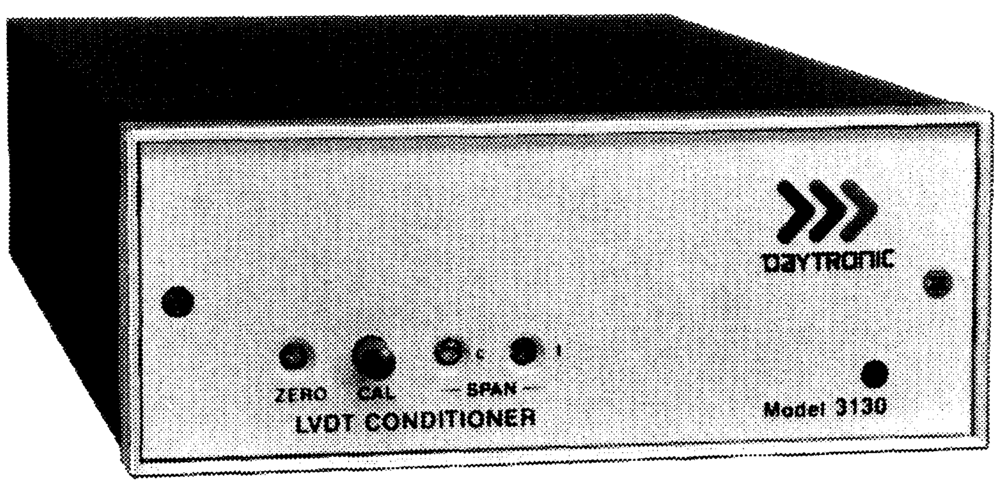


Figure 1. Model 3130 LVDT Conditioner

Table 1. Specifications

Transducers: 3-wire variable reluctance, 5-wire (series opposed), and 7-wire lvdt types suitable for operation with 3-kHz excitation frequency and having primary impedance greater than 80 ohms, including all Daytronic lvdt transducers.

Excitation: 3-kHz with optional remote sensing for long cables.

Span Adjustment: 12-turn *Coarse* and *Fine* controls plus 5 internal *Range* multiplier switches. Nominal maximum sensitivity is 10 millivolts (in-phase component) for full-scale output.

Analog Outputs: Two analog outputs available; 0 to ± 5 volts with 50% overrange, 5 milliamperes maximum. Bandpass is dc-to-2 Hz or dc-to-400 Hz, depending on output used. Active low-pass filters provide for rolloff of 60 dB per decade above cutoff frequency. Full-scale slew time is 1.4/f seconds, where f is the cutoff frequency.

Output Ripple and Noise: 0.15% of full scale (rms) maximum for 400-Hz output; 0.02% of full scale (rms) for 2-Hz output.

Dimensions: 1.7 H x 4.41 W x 8.5 D (inches)

Operating Temperature Range: 0 to + 130 degrees F.

Power Requirements: 105 to 135 volts ac, 50 to 400 Hz at 5 watts maximum.

The instrument contains the necessary ZERO, SPAN, AND CAL(ibration) controls for zeroing and calibrating the analog output. An internal calibration reference is provided that can be used, following initial calibration by transducer displacement, to quickly verify calibration at any time or to recalibrate the instrument with a known calibration factor. A front-panel button applies the calibration signal to the signal conditioner (and disconnects the transducer input). Calibration can also be checked remotely through *Remote Cal* terminals on the instrument I/O connector.

Internal *Range* switches provide a wide sensitivity selection, allowing full-scale output for input displacements as small as ±0.001 inch (±0.0254 mm) or as large as several inches, using suitably selected lvdt elements. The range of the ZERO control can also be increased through the use of an internal switch. Increased ZERO control is desirable when a transducer with a l-inch stroke or longer is used.

When the instrument is to be used over the full range of the transducer, internal linearization controls can be activated (through an internal switch) to compensate for lvdt's whose output tend to flatten near full-scale displacement.

The 3130 also contains a unique phase *control* circuit that provides for automatic synchronous demodulation of the transducer output. No internal phase selection is generally required.

Active low-pass filtering after carrier demodulation allows the averaging or smoothing of signals containing noise or other unwanted characteristics that are periodic in nature. Filtering removes these dynamic components so that stable digital indication and precise *jitter-free* control action can be obtained. Two analog outputs are provided, with one having a bandpass from dc to 2 Hz and the other a bandpass from dc to 400 Hz. The full-scale output is the standard Five-Volt Data Signal Level of the *3000 Instruments.*

The 3130 LVDT Conditioner is also available in two additional forms. The Model 3230 includes the addition of a Digital Indicator to view the analog output of the conditioner. The Model 3330 includes a Limit section (in addition to a Digital Indicator) which provides HI/LO/OK indications and outputs. The Digital Indicator and Limit options are standard to all *3000 Instruments* and are covered in separate instruction manuals.

2. INSTALLATION AND CABLING

The following paragraphs provide the instructions for module installation and cabling.

MOUNTING. The *3000 Series* instruments can be operated as bench-top instruments or they can be rack- or panel-mounted. Clearance dimensions for a bench-mounted instrument are given in Figure 2. Panel cut-out dimensions for panel mounting are also shown in Figure 2. Up to four *3000 Series* Instruments can be mounted in a 19-inch rack using the 1-3/4 inch high Model 3004 Rack Adaptor. Rack-mounting dimensions are also given in Figure 2. To panel mount an instrument, proceed as follows. Refer to Figure 3.

IMPORTANT: The unit is shipped with two spacer washers on the securing screws of the rear-panel I/O Connector. When panel-mounting the unit, you MUST REMOVE THESE WASHERS, so that the printed-circuit board may move forward about 1/8" during Step (f).

(a) Remove the front panel by removing the two 2-56 x 3/8 flat-head screws.

(b) Remove the front bezel by removing the four 6-32 x 5/8 fillister-head screws.

(c) Make the panel cutout and drill the screw clearance holes indicated in Figure 2. The front bezel can be used as a template to define the rectangular cutout and locate the clearance holes.

(d) Hold the instrument enclosure behind the panel and reattach the front bezel to the enclosure from the front of the panel with the four remaining screws.

(e) Reinstall the front panel.

(f) Tighten the two securing screws of the rear-panel I/O connector to ensure that the connector is seated and that the conditioner printed-circuit board is pushed fully forward so that the front-panel screwdriver adjustments and buttons are accessible. These screws give approximately 1/8-inch of adjustment; consequently, this is the maximum panel thickness which should be used.

CAUTION

Do not overtighten the connector securing screws or resultant damage may occur to the printed-circuit board.

AC POWER CONNECTION. To protect operating personnel, the *3000 Series* Instruments are equipped with a three-conductor power cord. When the cord is plugged into the appropriate receptacle, the instrument is grounded. The offset pin on the power cord is ground. To maintain the safety ground when operating the unit from a two-contact outlet, use a three-prong to two-prong adaptor and connect the green pigtail on the adaptor to ground.

To prepare the instrument for operation, connect the power cable to a 105-135 volt ac, 50-400 Hz power source. The instrument can use up to 5 watts of power.

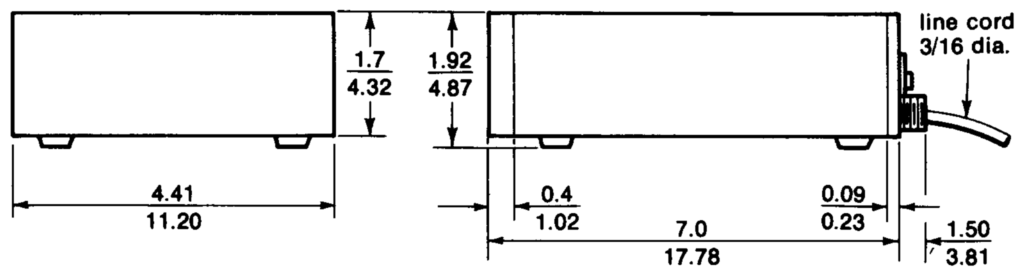
TRANSDUCER CABLING. Cabling to the transducer is accomplished via the supplied instrument I/O connector. The I/O connector pin numbers and functions are given in Figure 4. When Daytronic transducers are used, factory wired cables are available as shown in Figure 4. The Daytronic 83S Cable is for use with DS100A, DS200A, DS80, DS190, and DS400 The 84S Cable is for use with DS500 and DS2000 transducers.

When user-fabricated transducer cabling is used, it should take the form of either the 5- or 7- wire configurations shown in Figure 4. The 5-wire configuration can be used when the cable length is to be less than 100 feet. The 7-wire configuration should be used with cable lengths 100 feet or longer. A generalized 7-wire cable drawing is provided in Figure 4 for use when Daytronic transducers are not supplied.

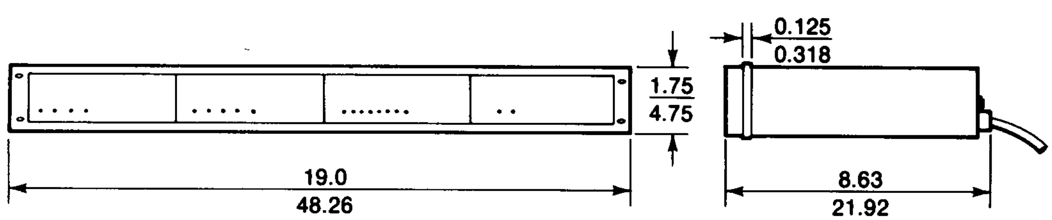
The 3130 can also be used with 3-wire variable reluctance transducers. A generalized cabling diagram for connection to this type of transducer is also given in Figure 4.

It is also possible, when a Daytronic transducer is not used, that the selected transducer is not provided with a center tap between the two series-opposed secondary windings. In this case, *pins 4 and 5 of the I/O connector must be tied* (see Fig. 4), 4-or 6-wire cables must be fabricated, and the *automatic phase control* feature of the 3130 cannot be used. Refer to the following paragraph entitled *Phase Control.*

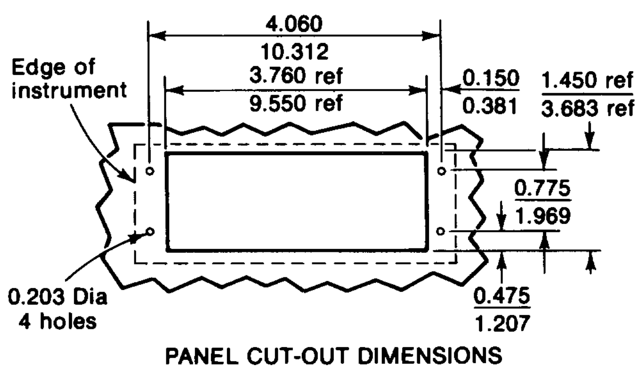
PHASE CONTROL. When a center-tap lead is provided on the selected transducer and the transducer is properly cabled to the 3130 via a 5- or 7-wire cable, the instrument has an *automatic phase-lock* feature for synchronous demodulation. Other than cabling the transducer to the instrument, no other operator action is required. If, however, a secondary center-tap lead is not provided with the transducer, the *automatic phase-lock* feature cannot be used and an internal wiring change must be made.



A. Bench Mounting



B. Rack Mounting



C. Panel Mounting

Figure 2. Instrument Mounting Dimensions

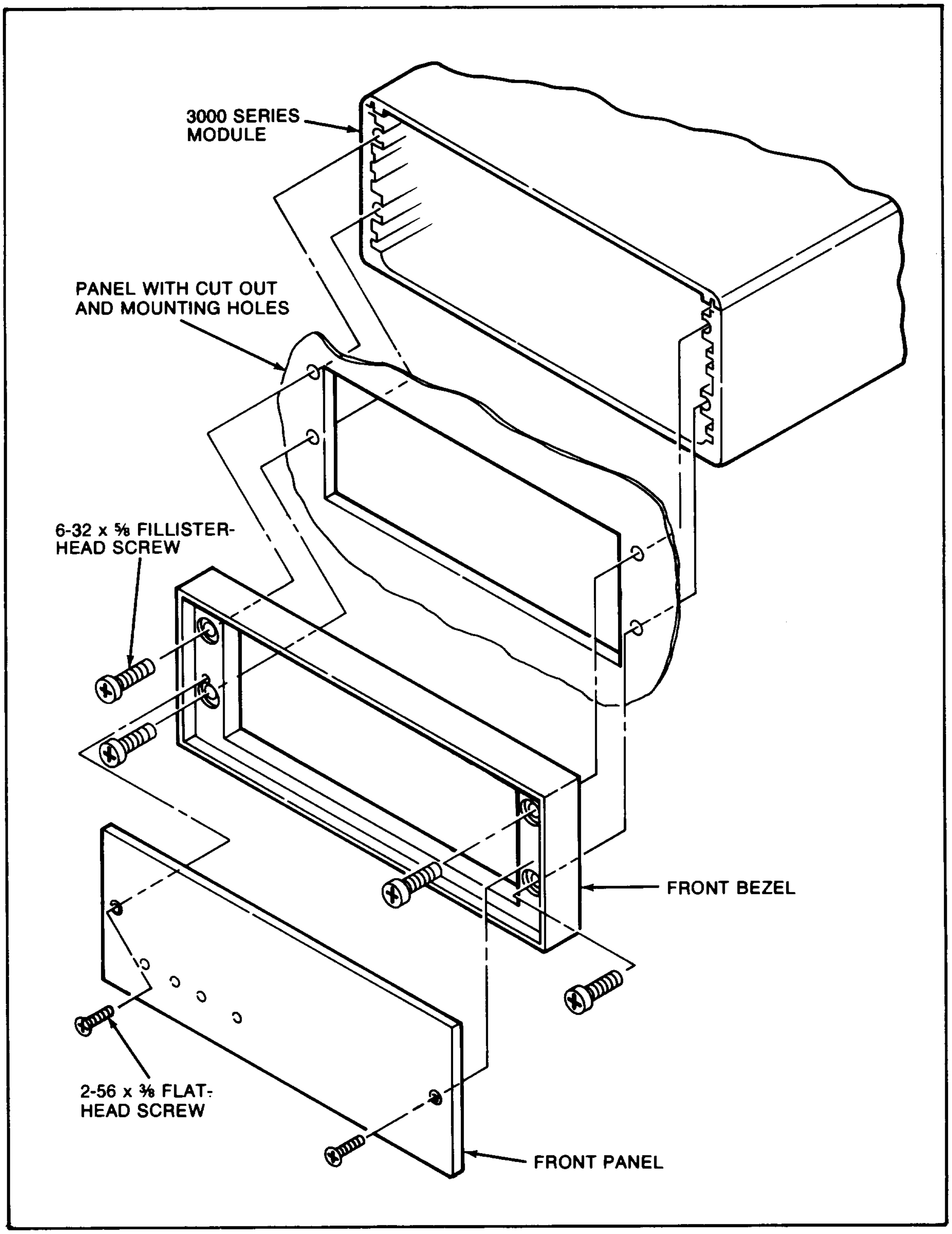


Figure 3. Instrument Panel Mounting

In the event the center-tap lead is not provided, remove the main circuit board from the instrument housing and locate the solder-drop terminals indicated in Figure 5. Remove the solder-drop connection between the center pad and the pad marked *A.* Make a new connection between the center pad and the pad marked *B.* The instrument demodulation circuit will now be synchronized with the primary excitation signal which does not include the primary-to-secondary phase shift. Reinstall the main circuit board.

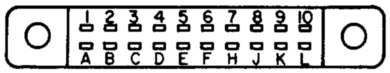
INTERNAL CONTROLS. A bank of ten miniature switches and two *Linearizing* adjustments are located at the front of the main circuit board, immediately behind the front panel (see Figure 6). The switches can be set at this time (prior to calibration). The two adjustments are used when the *Linearizing* function (described in a following paragraph) is to be used in calibration. The following paragraphs describe the switch functions so that the user can now determine which functions to activate or select. For access to the switches and controls, remove the front panel by removing the two #2-56 flat-head screws.

Range Selection. Five Range switches, designated *.3, 1, 3, 10,* and *30*, are provided for selecting the proper amplifier sensitivity. The *x.3* range is the least sensitive range, and the *x30* range is the most sensitive. Only one of the five switches should be turned ON. Table 2 gives the nominal range selections which should be made for Daytronic transducers. If more sensitive scaling of the transducer is desired, a larger *Range* term can be selected. For example, a DS200A transducer can be spanned to give a ±5 volt output for ±0.100 inch of displacement on the *x1 Range*. If 0.010 inch is the desired full-scale displacement, choose the *x10 Range* and adjust the SPAN controls accordingly for the ±5 volt analog output. Range selection for transducers other than those supplied by Daytronic can be determined by trial and error when calibrating the instrument.

Cal Level Selection. An internal reference signal is applied to the Signal Conditioner when the front-panel CAL button is pressed. After initial calibration by transducer displacement, the number displayed when the CAL button is pressed can be recorded for use in future calibrations or for calibration verification. However, this internal reference must have a value less than the full-scale calibration value. Three *Cal Level* switches (*A*, *B,* and *C*) are provided so that the proper calibration signal level can be selected. Except for the DS80, all Daytronic transducers use *Cal Level B* for the range selections given in Table 2. When other *Ranges* or transducers are used, *Cal Level* selection can be determined by trial and error when calibrating the instrument.

DAYTRONIC 3X30 INSTRUMENT I/O CONNECTOR W/PIN DESIGNATIONS

(X=1,2,or 3, e.g. 3130, 3230,3330)



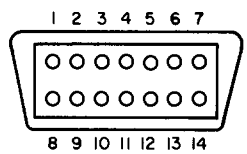
AMPHENOL 225-21021-103 REARVIEW

Fig. 4 I/O Wiring Data

A

PIN		PIN	
1	+EXCITATION	A	+SENSE
2	−EXCITATION	B	−SENSE
3	SECONDARY 1	C	NC
4	SECONDARY 2	D	OSC. DISABLE
5	SIGNAL COMMON	E	AUXILIARY SIGNAL COMMON
6	OSC. INPUT	F	OSC. OUTPUT
7	NC	H	ANALOG OUTPUT, ±5V-DC TO 2HZ
8	REMOTE CAL.	J	ANALOG OUTPUT, ±5V-DC TO 400HZ
9	SHIELD	K	BRIDGE COMPLETION RESISTOR
10	OUTPUT SIGNAL COMMON	L	BRIDGE COMPLETION RESISTOR

DAYTRONIC DC20, DS100, DS200A TRANSDUCER CONNECTOR

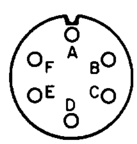


AMPHENOL 57-60140 REARVIEW

B

PIN		PIN	
1	+EXCITATION	8	+SENSE
2	NC	9	NC
3	−EXCITATION	10	−SENSE
4	NC	11	NC
5	SECONDARY 2	12	SIGNAL COMMON
6	NC	13	NC
7	SECONDARY 1	14	SIGNAL COMMON

DAYTRONIC DS500, DS2000, DS4000 TRANSDUCER CONNECTOR



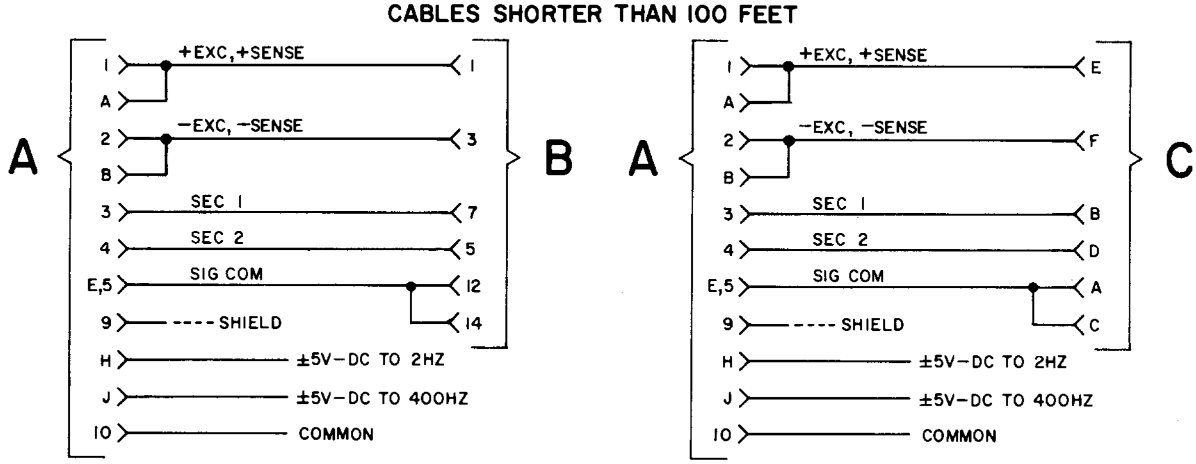
AMPHENOL 97-3106A-14S-6S, AN3057-6 REARVIEW

C

PIN		PIN	
A	SIGNAL COMMON	D	SECONDARY 2
B	SECONDARY 1	E	+EXCITATION, +SENSE
C	SIGNAL COMMON	F	−EXCITATION, −SENSE

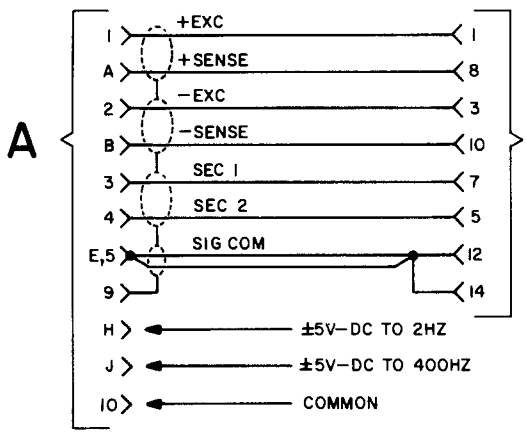
SHIELDING PRACTICE FOR ALL CONFIGURATIONS: SHIELD SIGNAL WIRES FROM PINS 3, 4, AND 5 OF "A" SEPARATELY FROM EXCITATION AND SENSE WIRES. ATTACH SHIELDS TO PIN 9 OF "A" AND AT NO OTHER POINT.

5 WIRE CONFIGURATION FOR CABLES SHORTER THAN 100 FEET

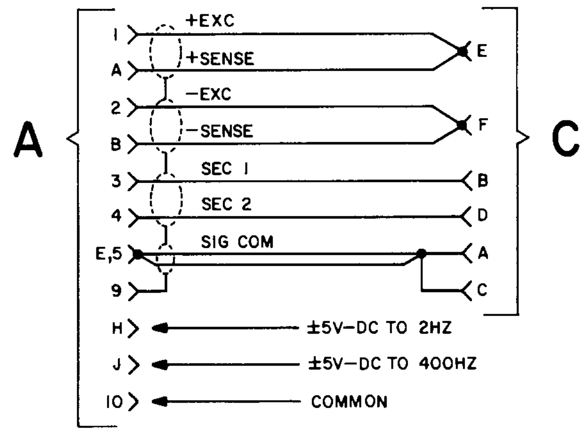


DAYTRONIC FACTORY WIRED CABLE
7 WIRE CONFIGURATION FOR
CABLES LONGER THAN 100 FEET

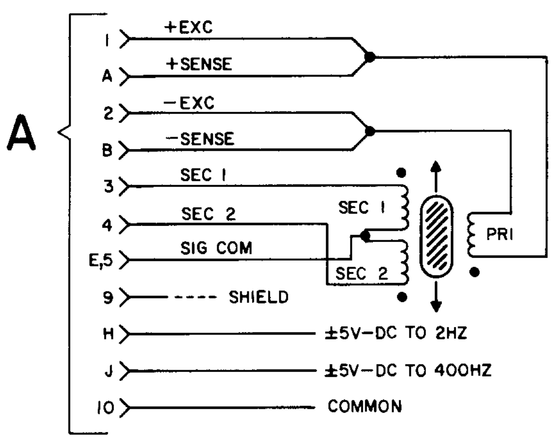
83S



84S

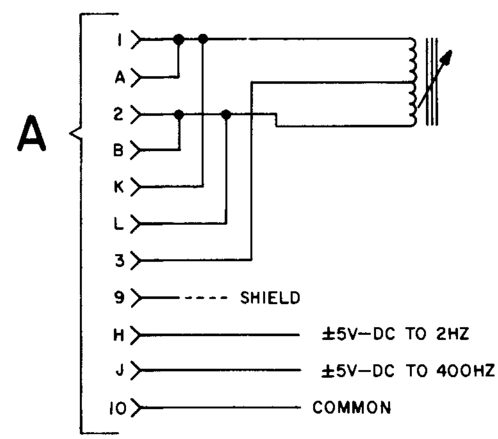


DAYTRONIC 3X30 INSTRUMENT
TO GENERALIZED TRANSDUCER



NOTE: FOR TRANSDUCERS WITHOUT CENTER TAP CONNECT PINS 4 AND 5 TOGETHER. ALSO USE PHASE CONTROL CONNECTION B.

RELUCTANCE TRANSDUCER CONNECTION



REMOTE CALIBRATION CONNECTIONS

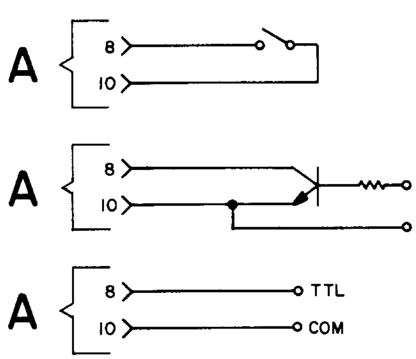


Fig. 4 (cont'd)

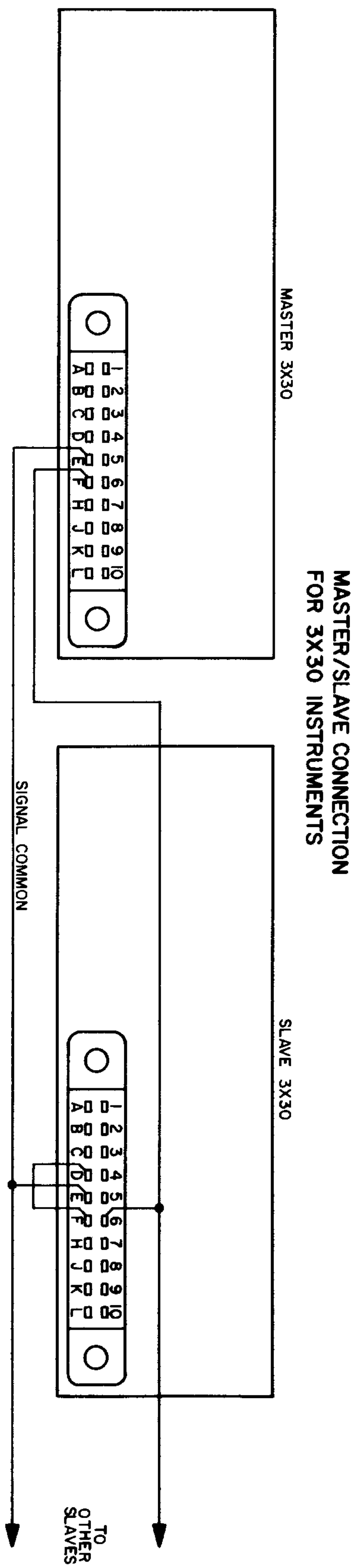

MASTER/SLAVE CONNECTION
FOR 3X30 INSTRUMENTS
MASTER 3X30
SLAVE 3X30
SIGNAL COMMON
TO OTHER SLAVES
1 2 3 4 5 6 7 8 9 10
A B C D E F H J K L

Fig. 4 (cont'd)

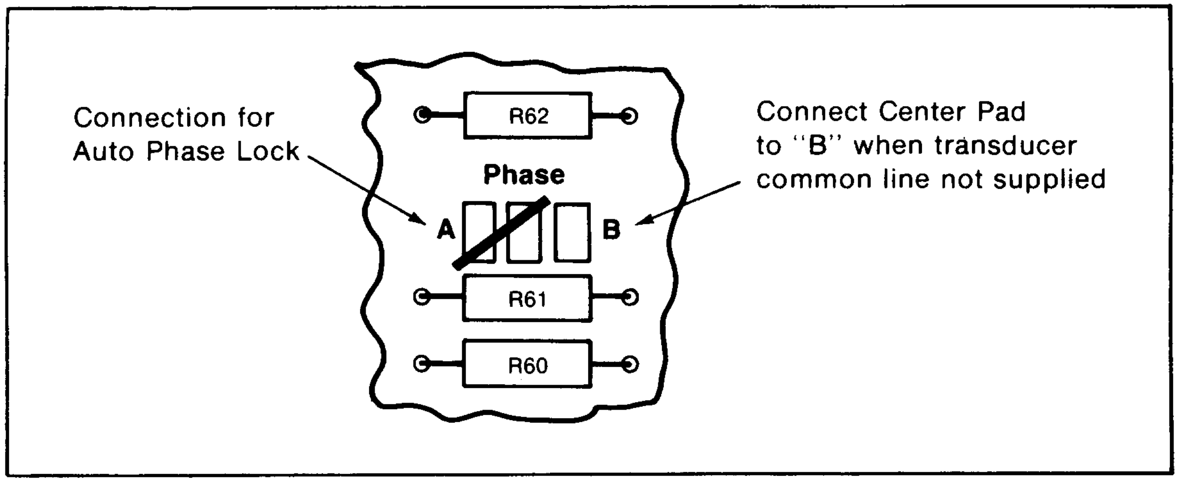


Figure 5. Phase Control Select Terminals

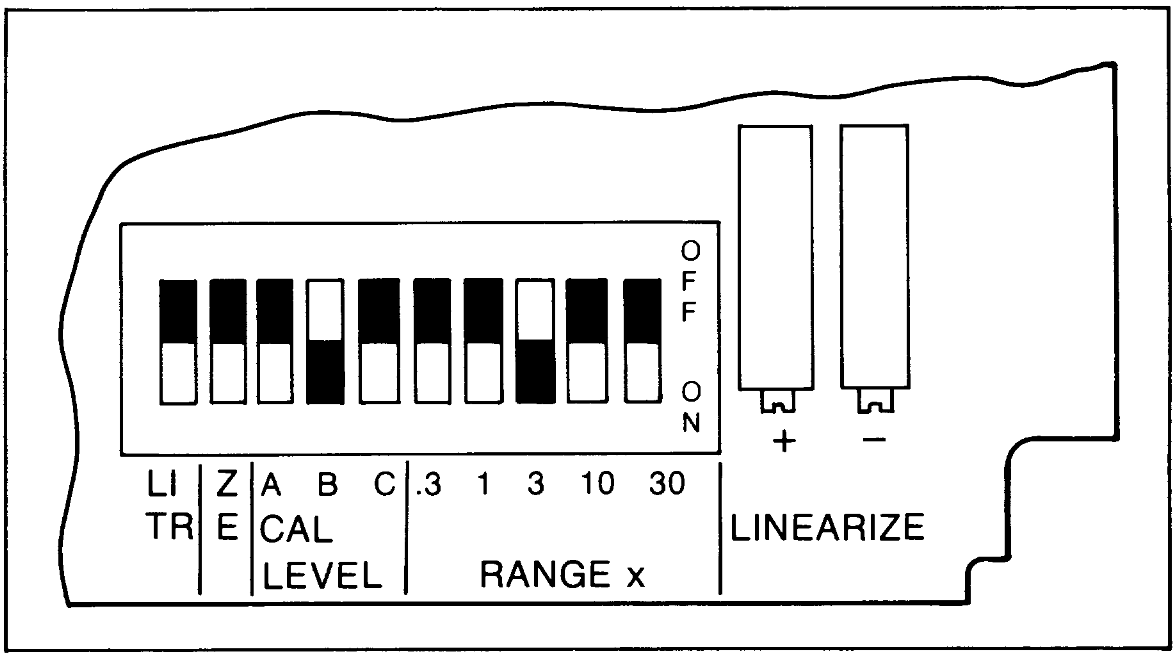


Figure 6. Internal Operating Controls

Table 2. Operational Settings For Daytronic Transducers

Transducer	Displacement (inches)	Cal Level	Range
DS100A	±0.050	B	x 3
DS200A	±0.100	B	x 1
DS500	±0.250	B	x 1
DS2000	±1.000	B	x.3
DS80	±0.04 (1mm)	C	x 1
DS190	±0.10 (2.5mm)	B	x 1
DS400	±0.20 (5mm)	B	x 1

Zero Expansion. The *Zero Expansion* switch (marked ZE) expands the authority of the front-panel ZERO control when ON. In general, the *Zero Expansion* switch should be turned ON when the transducer has a stroke greater than one inch. For transducers with a stroke less than one inch, the switch should be OFF.

Linearization Selection. The 3130 contains *Linearization* circuits which provide for electronically linearizing lvdt transducers since these types of transducers are generally nonlinear in the 50 to 100 percent displacement range. Both + and – *Linearization* adjustments are provided since lvdt's also exhibit unsymmetrical characteristics. If the selected transducer can be calibrated at full displacement so that the full analog output of the 3130 is obtained (±5 volts output is provided at the full displacement of the transducer), the *Linearization Trim* switch (marked *LI TR* should be turned ON. Table 3 is a listing of the Daytronic transducers which can be calibrated using the *Linearization* circuits. Table 3 also gives the Digital indicator scaling which must be selected when calibration is accomplished using a 3230 or 3330 instrument. The procedures for calibration using the *Linearization* circuits are given in Section 3. Refer to the *Digital Indicator Instruction Manual* for the procedures for selecting the scaling given in Table 3.

REMOTE CALIBRATION CHECK. The instrument can be placed in the calibration mode by shorting pins 5 (*Signal Common*) and 8 (*Remote Cal*) of the rear-panel I/O connector. Figure 4 indicates three methods of remotely entering the calibration mode (external switch. transistor, or TTL source). The *Remote Cal* function provides a convenient method of periodically monitoring calibration of the instrument.

Table 3. Linearization Scaling For Daytronic Transducers

Transducer	Full-Scale Displacement (inches)	Digital Indicator Scaling	3130 Full-Scale Output	Units
DS100A	±0.050	50.00	±5 volts	milliinches
DS200A	±0.100	100.00	±5 volts	milliinches
DS2000	±1.000	1.0000	±5 volts	inches
DS80	±0.04 (1mm)	50.00	±5 volts	milliinches
DS190	±0.10 (2.5mm)	100.00	±5 volts	milliinches
DS400	±0.20 (5mm)	200.00	±5 volts	milliinches

MASTER/SLAVE CONNECTIONS. When more than one 3130 (or a combination of 3130 or 3178 Strain Gage Conditioners) is being used in a measurement setup (instruments are contiguously mounted or the transducer cabling is in a common conduit or raceway), beat frequencies may be produced from the 3-kHz oscillators used in the instruments to develop the excitation. To prevent beat frequencies from occurring, one unit can be designated the master, and the remaining units can be driven from the oscillator contained in the *master* unit. The remaining units are designated as slave instruments. To perform *master/slave* wiring, refer to Figure 4.

ANALOG OUTPUTS. Two analog outputs are available at the instrument I/O connector, with each output having a different passband: dc to 2 Hz and dc to 400 Hz. The cutoff frequencies are achieved with active low-pass filters. When the dc-to-2 Hz output is used, a trade off is made between noise elimination and increased time-to-answer or slew time. Each output has a 60-dB rolloff a decade from the cutoff frequency. The filter characteristics are given by the following equations:

$$A_{out} \ @ \ f_0 = 0.7 \ A_{in}$$
$$A_{out} \ @ \ 10f_0 = 0.001 \ A_{in}$$
$$T = 1.4/f_0$$

where A_{out} = output amplitude
A_{in} = input amplitude
f_0 = selected cutoff frequency
T = time-to-answer in seconds (output of filter within 0.1% of final value after step function is applied).

3. CALIBRATION

This section contains the instructions for calibrating the 3130. Included is a functional description of the instrument panel (see Figure 7). To perform calibration proceed as follows.

(a) Turn power ON by placing the rear-panel slide switch in the ON position. The front-panel indicator should light to indicate the application of ac power. Allow 5 minutes of warmup for stabilization of transducer characteristics.

(b) Set the ZERO and *Coarse* SPAN controls to mid-position. These are twelve-turn controls and should be set six turns from either end.

(c) Position the transducer stem for an output reading as near 0.000 volts dc as possible. If the unit is supplied with the optional Digital Indicator (3230/3330), position the stem for a front-panel indication of all zeroes.

(d) Using the front-panel ZERO control, set the output to 0.000 volts dc or a front-panel indication of all zeroes (3230/3330).

(e) Determine whether the *Linearizing* function is to be used. If the full ±5 volt analog output (full-scale indication on 3230/3330) is to be produced for the full-rated displacement of the transducer, the *Linearizing Trim* switch (located behind the front panel) should be ON. When only a portion of the rated displacement of the transducer is to produce a ±5 volt analog output, or an output other than ±5 volts is to be produced for the full-rated displacement of the transducer, the switch should be OFF. Refer to Table 3 for a listing of Daytronic transducers which can be used with the *Linearizing* function and the corresponding digital scaling used when a 3230/3330 instrument is supplied.

(f) Proceed to step (j) if the *Linearizing* function is to be used. If this function is not to be used, proceed to step (g).

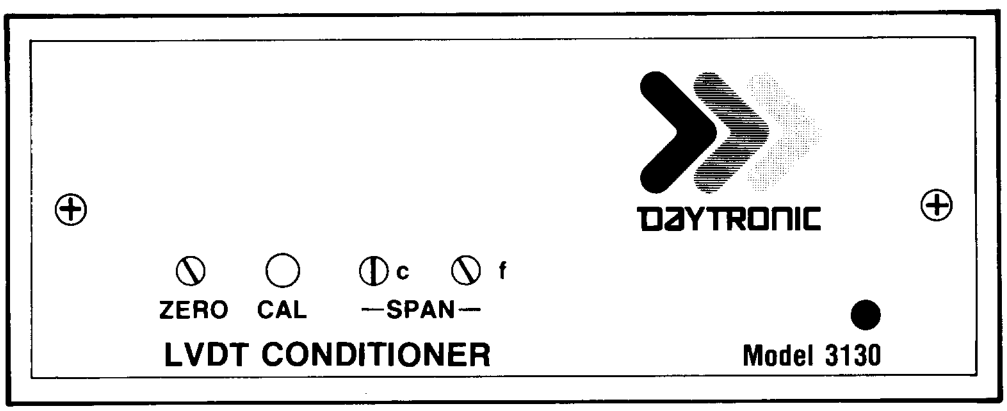
(g) Using a gage block or other convenient standard, displace the transducer stem to the desired full-scale value.

(h) Adjust the *Fine* and *Coarse* SPAN controls for the desired output reading. If the desired output reading cannot be reached, it may be necessary to select another internal *Range* switch. Refer to section 2, Installation.

(i) Proceed to step (p).

(j) Steps (j) thru (o) are to be performed only when the *Linearizing* function is used. Using a gage block or other convenient standard, displace the transducer stem to 50 percent of its positive full-scale value.

(k) Adjust the *Coarse* and *Fine* SPAN controls for an analog output reading



ZERO Control: The ZERO control sets the output to zero with zero transducer displacement.

SPAN Controls: The ***Coarse*** (c) and ***Fine*** (f) SPAN controls are used to adjust the analog output voltage to a value precisely proportional to the displacement of the transducer stem.

CAL Pushbutton: When pressed, the CAL pushbutton causes the internal ***Excitation*** sensing lines to be substituted for the signal input from the transducer, supplying an ***Equivalent Displacement*** value for the adjustment of the SPAN controls.

Figure 7. Front-Panel Description

of +2.5 volts (half-scale indication on the 3230/3330). If this indication cannot be reached, it may be necessary to select another internal *Range* switch. Refer to Section 2, Installation.

(l) Displace the transducer to 100 percent of its positive full-scale range.

(m) Adjust the + *Linearize* adjustment (see Figure 6) for an analog output of +5.000 volts dc or a full-scale indication if the 3230 or 3330 is supplied.

(n) Displace the transducer to its negative full-scale value.

(o) Adjust the – *Linearize* control for an analog output of -5.000 volts dc or a minus full-scale indication if the 3230/3330 is supplied.

(p) Steps (p) thru (r) describe the procedure to determine a *calibration number* for a given transducer. Press the CAL button.

(q) Observe the analog output voltage produced when the CAL button is pressed (or the 3230/3330 indication). The resulting number is the *calibration number.* It should be recorded and used for subsequent calibration checks or for instrument recalibration without using a gage block or other calibration standard when setting the SPAN controls.

(r) The internal *Cal Level* switches described in Section 2, Installation. are used to select the proper signal level for the internal calibration reference. If the *calibration number* is an off-scale value, or is a number less than half of the instrument full-scale output, another *Cal Level* switch may have to be selected. When the proper *Cal Level* switch is selected, the *calibration number* will be the greatest output value that can be obtained that is less than the full-scale output of the instrument.

4. BLOCK DIAGRAM DESCRIPTION

The purpose of this section is to explain how the Model 3130 works by using a simplified block diagram. This section is not intended to provide a detailed explanation of electronic circuits for personnel untrained in electronic technology. However, it provides an adequate overview of operation for those familiar with basic electronic circuit operation. Throughout the following, refer to Figure 8.

POWER SUPPLIES. Primary power (115 volts ac, 50-400 Hz) is applied to the instrument by means of a rear-panel ac connection point and the supplied 3-conductor power cord. A rear-panel slide switch is used to turn ON primary power. Overload protection is provided by a 0.50 ampere fuse mounted near the ac connection point. When the slide switch in ON, primary power is applied to the transformer which provides the necessary power-line isolation and the low ac voltages required to develop the regulated dc voltages used in the 3130. The secondary of the power transformer has a grounded center tap, and a diode bridge functions as two full-wave rectifiers to produce ± 9 volts regulated dc. Two three-terminal integrated-circuit *Regulators* are used to develop these regulated voltages. The reference terminal of each *Regulator* is biased with one or two diodes to make certain that a minimum regulated voltage of 9 volts is achieved. The proper diode biasing is accomplished at factory check out.

A dc reference voltage of +2.5 volts dc is further developed from regulated +9 volts by use of a third three-terminal *Regulator.* This precision dc reference is used to control the amplitude of the ac excitation and is further discussed in a following paragraph.

The – 9 volts regulated is used to light the front-panel indicator (LED) which indicates the application of ac power to the instrument.

The + unregulated voltage from the diode bridge is routed to the Digital Indicator and HI/LO Limits circuit boards when these items are supplied (Models 3230 and 3330). It is used to develop + 5 volts regulated for the TTL logic employed in these circuits. Refer to the *Digital Indicator* and *HI/LO Limits Instruction Manuals*.

The secondary of the power transformer also supplies 5 volts ac to the Digital Indicator circuit board when the Model 3230/3330 is supplied. This ac voltage is used to develop unregulated +6 volts. Refer to the *Digital Indicator Instruction Manual*.

AC EXCITATION. The 3-kHz ac excitation is produced with a *Wein Bridge Oscillator.* The oscillator output is applied to a full-wave rectifier to obtain a dc voltage proportional to the ac amplitude of the oscillator output. The rectifier output is applied to the inverting input of an *Integrating Amplifier.* The noninverting input of the amplifier is connected to the precision Reference voltage (+2.5 volts dc). If the amplitude of the oscillator varies, the output of the *Integrating Amplifier* changes the resistance of an *Automatic Gain Control* element (FET) to return the oscillator amplitude to its nominal value of 2 volts ac. The *Integrating Amplifier* thus serves as an error amplifier, and the integrating element (capacitor) deletes 6-kHz ripple from the rectified oscillator output.

The 3-kHz oscillator output is applied to an excitation buffer amplifier. Both plus and minus *Sense* lines are returned to the excitation buffer to sense and regulate the excitation voltage at the transducer (Figure 8 shows the 3130 connected to the transducer via a 7-wire cable. Refer to Figure 4). A *Power Driver* circuit is used to provide the drive current required by the transducer.

When more than one 3130 (or a combination of 3130 or 3178 Strain Gage Conditioners) is being used in a measurement setup, beat frequencies may be produced from the 3-kHz oscillators contained in each instrument. To prevent beat frequencies from occurring, one unit can be designated the *master*, and the remaining units can be driven from the oscillator contained in the *master* unit. The remaining units are designated as *slave* instruments. The *Oscillator In* terminal of each *slave* unit (at the instrument I/O connector) provides a connection point to the *Oscillator Out* terminal of the *master* unit. The *Oscillator Out* and *Oscillator Disable* terminals of the *slave* units are jumpered to disable the oscillator internal to these units.

CALIBRATION CIRCUIT. The *Calibration* circuit provides a means of inserting an internal reference in place of the transducer output signal, yielding an arbitrary output value that allows the amplifier gain to be checked or adjusted without repeating the initial transducer setup (calibration through transducer stem displacement). When the CAL button is pressed, the plus and minus *Sense* lines are substituted for the plus and minus *Signal* lines as the input to the Signal Conditioner circuits. This action occurs when the negative input of a *Comparator* is grounded through the CAL switch. The output of the *Comparator* actuates an analog switch (DPDT) that selects the input source of the Signal Conditioner.

The *Cal Level* switches (three switches termed *A*, *B*, and *C*) are provided as a means of scaling the calibration signal to a level that is less than the full-scale output of the instrument. When the CAL button is pressed, the *Comparator* output actuates a second analog switch (SPDT) that selects the appropriate calibration level.

Zero offset voltages that are introduced by the *Zero Amplifier* circuit are eliminated when the CAL button is pressed. The +2.5 volt *Reference* is removed from the ZERO control by means of an FET switch controlled by the output of the *Comparator.*

Calibration can also be remotely checked. When the *Remote Cal* input at the 3130 I/O connector is brought to a zero-volt (ground) level through the action of an external switch, transistor driver, etc. the same action occurs as when the CAL button is pressed.

SIGNAL CONDITIONER. The + *Signal* and – *Signal* inputs from the transducer are applied to a *Differential Amplifier* with excellent common-mode rejection. The output of the *Differential Amplifier* is applied across a divider network with five tap offs that are terminated at corresponding *Range* switches. These switches provide coarse scaling of the amplifier output.

The *Synchronous Demodulator* receives the scaled output of the *Differential Amplifier* and a Phase *Control* signal and provides a dc output that is proportional to the magnitude of the transducer core displacement and of the proper polarity. The *Phase Control* signal normally is developed by a divider network (two equal resistors) across + *Signal* and – *Signal* inputs. This constant amplitude signal, which includes the phase shift between the primary and secondary windings of the transducer, is applied to an *Amplifier* and *Squarer*, then to the demodulator. It guarantees *automatic phase lock* for synchronous demodulation.

A solder-drop matrix, comprised of three solder pads, is provided for use when the above described *Phase Control* signal cannot be used. The center pad is the input line to the *Amplifier/Squarer* circuit. The pad labeled *A* is connected to the previously described divider junction. A solder-drop connection is made between the center pad and the pad marked *A* when the selected transducer is supplied with a lead from the common connection point of the secondary windings. The pad labeled *B* is connected to the + *Excitation.* A solder-drop connection is made between the center pad and the pad marked *B* when the selected transducer is supplied without the aforementioned center-tap lead. All Daytronic transducers are supplied with the center-tap lead: thus, all 3130 instruments are shipped with the solder-drop connection made between the center pad and pad *A*.

The Zero circuit provides a means of introducing a dc offset on the output of the *Synchronous Demodulator* for electronically zeroing the instrument when the transducer stem is near its zero position. The +2.5 volt *Reference* is applied across the ZERO control. The wiper of the control is connected to the input of an *Amplifier/Buffer* circuit. The authority of the ZERO control is determined by the *Zero Expansion* switch. In general, the *Zero Expansion* switch should be OFF (open) for transducers with a stroke less than one inch. The switch should be ON (closed) for transducers with a stroke greater than one inch.

The dc output of the *Synchronous Demodulator* is buffered by an output amplifier circuit. The *Coarse* and *Fine* SPAN controls are contained in the circuit, and provide a gain adjustment for instrument calibration.

The amplified analog signal is applied to two active low-pass filters, each of which provide an output at the instrument I/O connector. The filters are in series and provide passband outputs of dc-to-2 Hz and dc-to-400 Hz. Output selection is a tradeoff between eliminating unwanted signals caused by vibration, etc, or increasing the time-to-answer (slew rate) of the conditioner. The rolloff of each output is 60 dB within a decade of the cutoff frequency.

A *Linearizing* circuit is provided to improve the output characteristics of lvdt transducers since these types of transducers are generally nonlinear in the 50 to 100 percent displacement range. Both + and – *Linearization* adjustments are provided since lvdt's also exhibit unsymmetrical characteristics. The *Linearizing* circuit can be disconnected from operation by means of the *Linearizing Trim* switch. If the selected transducer can be calibrated at the full analog output of the 3130 and the transducer is to be used at 100 percent displacement, the *Linearization* circuits should be used to calibrate the instrument. If the preceding does not hold true, the switch should be turned OFF and the instrument should be calibrated using only the SPAN controls.

5. VERIFICATION OF NORMAL OPERATION

It is the purpose of this section to aid the user in determining, in the event of a malfunction to which the Model 3130 is suspected of contributing, whether the instrument is functioning normally or whether it is the source of the observed trouble. In the event the module requires repair, a complete parts list, schematic diagram, and component location drawing are included in this manual. The user may also contact the factory Service Department or the local Daytronic Representative for assistance.

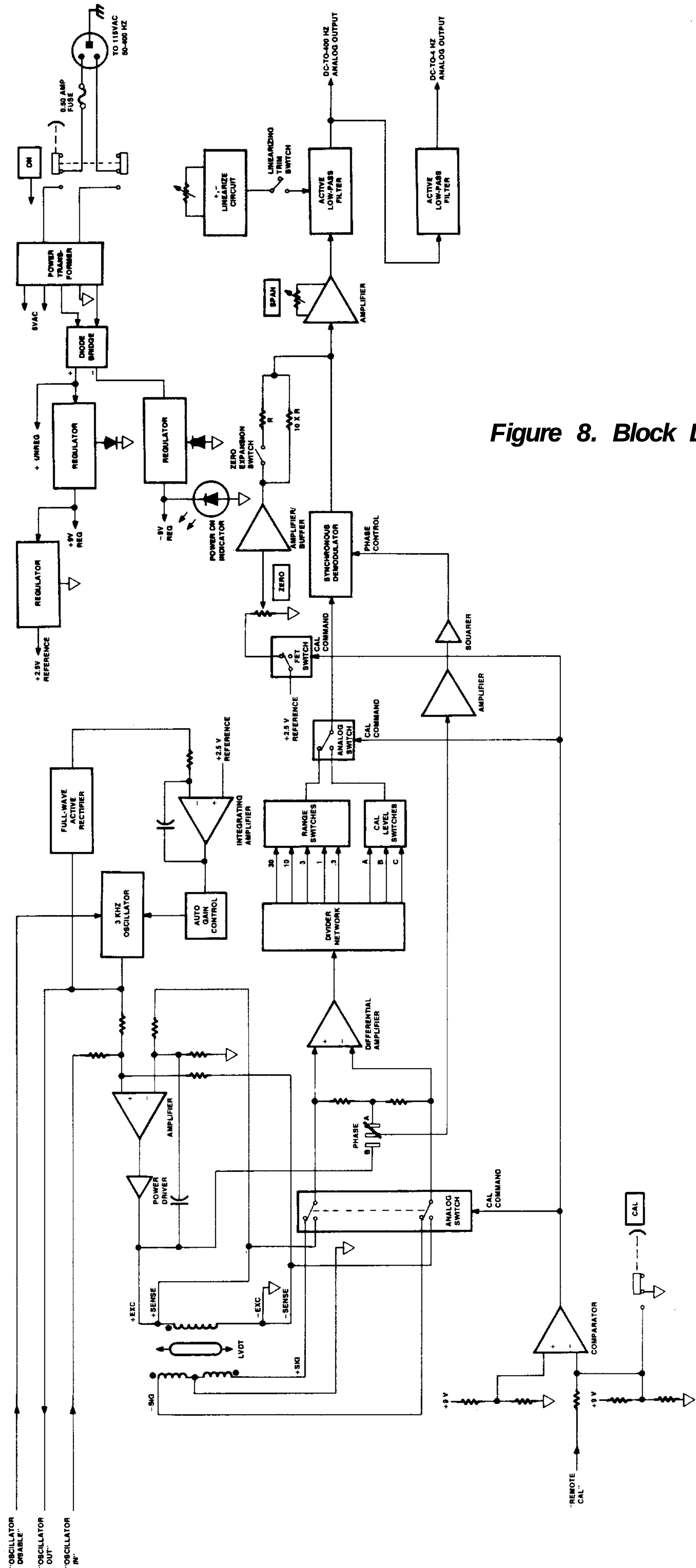


Figure 8. Block Diagram

If the instrument is suspected of faulty operation, observe the following steps.

(a) If the instrument is totally inoperational (front-panel power indicator does not light), check the primary power fuse (F1). If the fuse is blown, replace it with a 0.50 ampere fuse (see Table 4 for part number). Before reapplying power, visually inspect the power cord and the input power connections for any discrepancy which could have caused the overload.

(b) Depress the CAL pushbutton and determine whether the instrument output is stable, free of noise, and responsive to adjustment of the *Coarse* SPAN control. If the output complies with these criteria, but had previously been unstable, noisy, offscale, or unresponsive to the SPAN control, it can be assumed that the difficulty lies in the transducer and/or cable configuration due to the fact that, when the CAL pushbutton is depressed, the transducer and cable are disconnected and replaced by an internal reference signal.

(c) The inability to achieve a proper zero indication, where the instrument output reads totally off scale and the ZERO control has no authority, can very likely be the result of a damaged or defective transducer or cable. This possibility can be confirmed (or eliminated) by substituting a transducer and cable known to be in good condition or by disconnecting the transducer and cable and installing jumper wires as follows at the instrument I/O connector.

Tie pin 1 (+ Excitation) to pin A (+ Sense)
Tie pin 2 (– Excitation) to Pin B (– Sense)
Tie pin 3 (+ Signal Input) to pin 4 (– Signal Input) and pin 5 (Signal Common)

If the proper zero indication can now be achieved, the problem most likely lies in the transducer and/or cable configuration. If, however, the unit still will not zero properly, the problem lies within the instrument.

SB.5

DAYTRONIC

MODEL

3200 / 3300

DIGITAL INDICATOR

INSTRUCTION MANUAL

3000

Instrument Series

Model 3200/3300 Instruction Manual, v. SB.5
Pub. No. 3200/3300M.5, Issued 10/96
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DAYTRONIC

MODEL
3200 / 3300
DIGITAL INDICATOR

INSTRUCTION MANUAL

Daytronic Corporation

Dayton, OH • Tel (800) 668-4745
www.daytronic.com

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

PLEASE NOTE: Sections 6 and 7, Figures 6 and 7, and Table 3 have been removed from this manual.

If you need information regarding specific 3200/3300 components and circuitry, please contact the Daytronic Service Department at (937) 293-2566.

INSTRUCTION MANUAL
3200/3300 SERIES DIGITAL INDICATOR

1. DESCRIPTION

The *3000 Instrument Series* is a family of premium signal conditioning instruments that includes models to accomodate virtually all types of transducers and signal sources commonly encountered in electro-mechanical testing and control operations. The *3000 Instruments* are available in three forms: *Form 1* contains the Signal Conditioner only; *Form 2* is the Signal Conditioner with Digital Indicator; *Form 3* is the Signal Conditioner with Digital Indicator and Hi-Lo Limits. The Model numbering system used with the *3000 Series* identifies the form and the type of signal source. This numbering system is further explained in Table 1. From Table 1, it can be seen that all models having a Digital Indicator are identified by a 32XX or 33XX number, with the last two digits identifying the type of signal source (thermocouple, LVDT, etc).

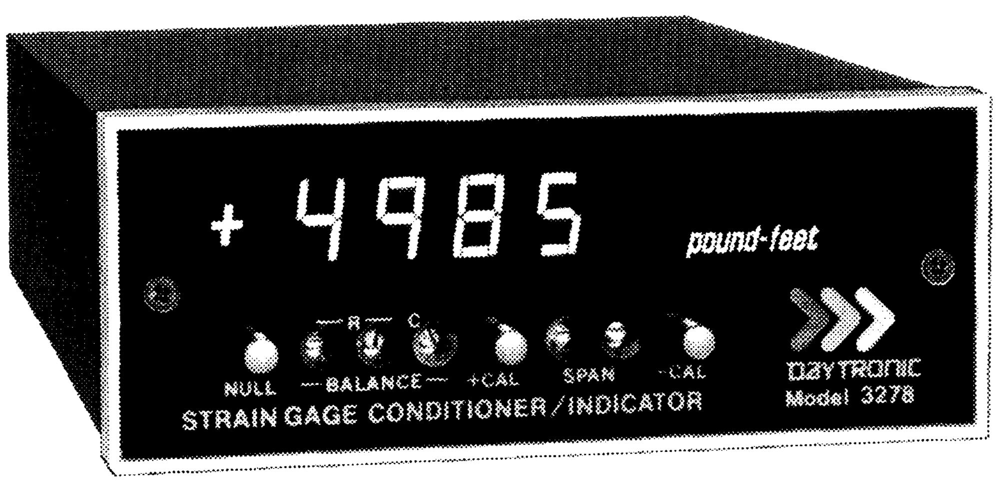


Figure 1. 3000 Series Instrument with Digital Indicator

Table 1. 3000 Series Model Numbering

Model 3 X X X

"3" is series identifier, used with all units:

Second digit identifies "form":

"1" = signal conditioner only
"2" = signal conditioner with digital indicator
"3" = signal conditioner with digital indicator and Hi-Lo limits

Third and fourth digits identify type of signal source:

"10" = Type J Thermocouple
"11" = Type K Thermocouple
"15" = Thermistors
"30" = LVDT's
"40" = Pulse Pick-up's (Frequency)
"63" = DC Volts/Millivolts/ DC-DC LVDT's/Potentiometers
"70" = Strain Gages (DC excited)
"78" = Strain Gages (AC excited)
Etc.

The *3000 Series* instruction manual system is designed to provide the user with the following documentation: (1) a separate instruction manual for each type of Signal Conditioner purchased; (2) an instruction manual covering only the Digital Indicator section of a *3000 Series* instrument, but applicable to any *Form 2* or *Form 3* instruments; and (3) an instruction manual covering only the Hi-Lo Limit section of a *3000 Series* instrument, but applicable to any *Form 3* instrument. It is the purpose of this manual to cover the Digital Indicator section of all *Form 2* and *Form 3* instruments.

The Digital Indicator section of any *Form 2* or *Form 3* instrument consists of a printed-circuit board on which are mounted the required circuit components for digitizing the analog output of the Signal Conditioner and the light-emitting-diode (LED) display. This board is mounted above the circuit board which contains the components for the Signal Conditioner. The digits which comprise the display are mounted on a small board which is affixed to the digitizer board with a right-angle printed-circuit board header. The *Form 3* instruments contain an additional printed-circuit board for the Hi-Lo Limit circuitry.

The LED display is comprised of six orange digits with polarity sign. The 0.4 inch height of the digits, combined with the inherent brilliance of an LED type of display, make the display easily discernible in normal room lighting. The display is viewed through the red plastic front panel of the instrument to provide filtering of external light and enhance the display brilliance. The front panel is opaque except for that portion through which the display is viewed. A typical *3000 Instrument* with Digital Indicator is shown in Figure 1.

The Digital Indicator scaling is selected with rear-panel pushbutton switches. Full-scale values of ±5000 counted by *1's*, ±10000 counted by *2's*, or ±20000 counted by *5's* can be selected. The most significant digit (MSD) of the display contains the polarity sign and is either unlit or lights as a *1* for displays of 10000 or greater. The least significant digit (LSD) is a dummy zero which can be turned ON or left unlit as desired. In addition, decimal-point position can be selected to give display readings as follows: 1.XXXX, lX.XXX, 1XX.XX, 1XXX.X, or 1XXXX (no decimal point). Decimal-point location and dummy zero selection are also accomplished with rear-panel switches (miniature slide-switch bank). When the 20000 scale is selected, the display is digitally limited to read a maximum number of 19995 since the MSD is either unlit or reads a "1" for displays of 10000 or greater. The 5000 and 10000 scales are analog limited to an overrange of approximately 5600 and 11200, respectively. An overrange condition on any range is indicated by a flashing display. The sampling rate of the display is 3 samples per second. The Digital Indicator specifications are summarized in Table 2.

Table 2. Specifications

Display: Orange LED's, six digits with polarity sign, 0.4 inch height. MDS is either unlit or reads a 1 and contains the polarity sign. LSD is a dummy zero which can be programmed to be lit or unlit (rear-panel switch).

Scaling: Selectable at rear panel; full-scale values of ±5000 counted by *1's*, ±10000 counted by *2's*, or ±20000 counted by *5's*.

Decimal Point: Decimal-point location can be selected with rear-panel switches as follows: 1.XXXX, 1X.XXX, 1XX.XX, 1XXX.X, or 1XXXX (no decimal point).

Sampling Rate: 3 samples per second.

Legends: Each instrument supplied with an appropriate assortment of user-installable rub-on engineering unit legends.

2. INSTALLATION

The *3000 Series* Instruments can be operated as bench-top instruments or they can be rack- or panel-mounted. Dimensions for all three types of mounting and corresponding mounting instructions are given in the accompanying Signal Conditioner *Instruction Manual*. The following paragraphs provide the instructions for legend installation, scale selection, decimal point/dummy zero selection, and ac power connection.

Legend Installation. A sheet of dry-transfer lettering is supplied with each instrument to provide the user with a means of affixing an engineering-unit legend to the front panel. The sheet contains the common engineering units encountered in making electro-mechanical measurements and additional alpha-numeric characters. Space is supplied on the front panel to affix the desired legend to the right of the display. To affix the legend to the front panel, press the dry-transfer sheet firmly against the panel with the desired legend or character situated in place. Rubbing the legend or character with a ball-point pen will cause the legend to be transferred onto the panel. The legend can be protected from scratches which may occur during calibration/operation of the instrument by lightly spraying it with Krylon #1306 Workable Fixative.

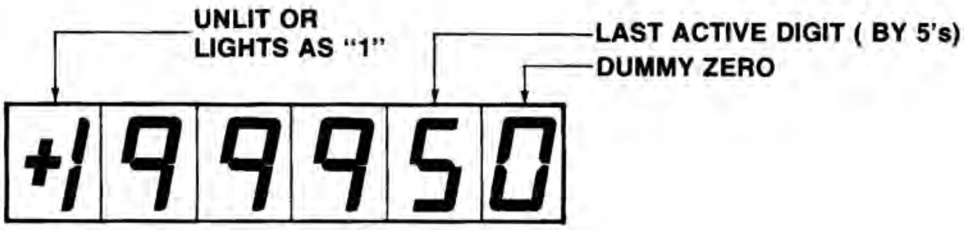
If it is desired to change a legend, remove the legend to be replaced by pressing masking tape against the legend, then pulling off the gummed tape.

Scale Selection. Figure 2 shows the full-scale display for the three selectable scales: ±5000 counted by *1's*, ±10000 counted by *2's*, and ±20000 counted by *5's*. The figure also indicates the last active digit and the dummy zero which can be lit for any scale selection. The first digit of the display contains the polarity sign and lights as *1* on the 10000 and 20000 scales for values equal to or greater than 10000. On the 20000 range, because the most significant digit is either unlit or a *1* and the count is by *5's*, the greatest number which can be displayed is 19995. Of course, this would be displayed as 199950 if the dummy zero were lit.

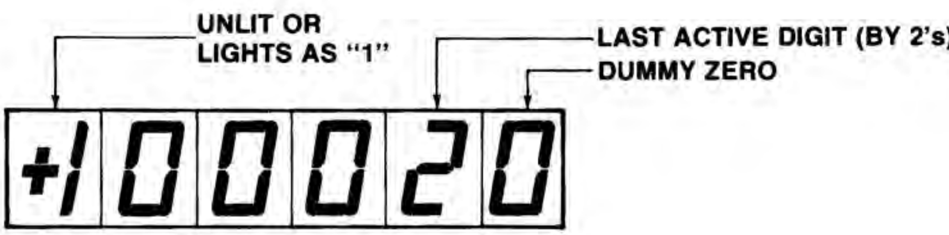
Scale selection is accomplished with the two pushbutton switches located at the rear panel. The panel is marked to indicate which switches are pushed IN or left OUT for the corresponding scale selection. The switches have a push-push action and are illustrated, with the scale selection coding, in Figure 3. With both switches OUT, the ±5000 range is selected. With the left switch OUT and the right switch IN, the ±10000 range is selected. With the left switch IN and the right switch OUT, the ±20000 range is selected.

Decimal Point/Dummy Zero Selection. Decimal-point location and dummy-zero activation are selected with a rear-panel miniature slide switch bank. The switch bank is marked on the rear panel as shown in Figure 3. The decimal-point position can be fixed at any one of the display locations indicated on Figure 3. Place any one of slide switches 1 through 4 ON to light the decimal point at the desired location. Place slide switch 5 ON if no decimal point is to be lit. To activate the dummy zero (digit to the right of last active digit will continuously light as a zero), place slide switch 6 ON.

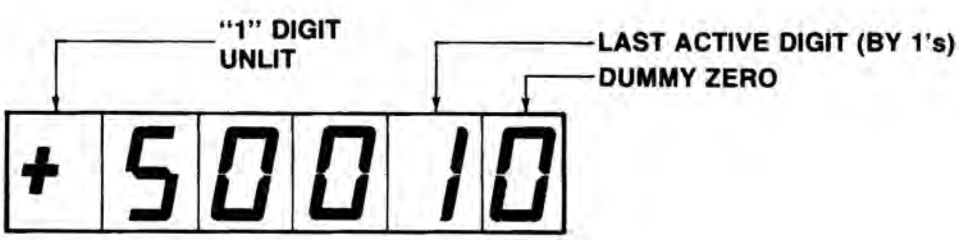
AC Power Connection. To protect operating personnel, the *3000 Series* Instruments are equipped with a three-conductor power cord. When the cord is plugged into the appropriate receptacle, the instrument is grounded. The offset pin on the



A. ±20000 Range



B. ±10000 Range



C. ±5000 Range

Figure 2. Full-Scale Displays for Three Ranges

power cord is ground. To maintain the safety ground when operating the instrument from a two-contact outlet, use a three-prong to two-prong adaptor and connect the green pigtail on the adaptor to ground.

To prepare the instrument for operation, connect the power cable to a 105-135 volt ac, 50-400 Hz power source. The instrument can use up to 5 watts of power.

3. OPERATION

The only operation required is turning ON/OFF ac power to the instrument. This is accomplished with the rear-panel slide switch (see Figure 3). The display lights immediately when ac power is ON.

NOTE

In all instances, a flashing display indicates that an overrange condition has occurred, and it is likely that the Signal Conditioner amplifiers are being overdriven. The 5000 and 10000 ranges are analog limited at approximately 5600 and 11200, and while a number may be displayed, if

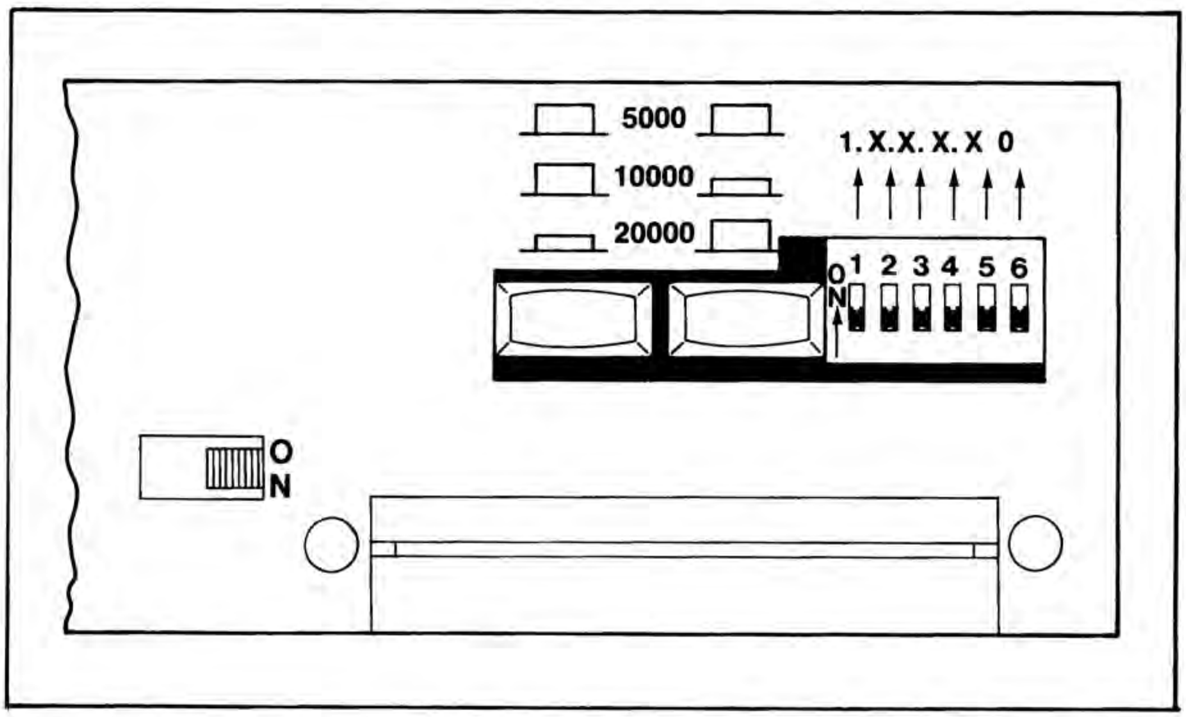


Figure 3. Scale, Decimal Point, Dummy Zero Switches

the display is flashing an overrange condition has occurred. Consequently, the displayed value may be invalid. The 20000 range is digitally limited to 19995. When an overrange occurs on this range, the display will flash all zeros.

4. BLOCK DIAGRAM DESCRIPTION

The purpose of this section is to explain how the Digital Indicator works by using a simplified block diagram. This section is not intended to provide a detailed explanation of electronic circuits for personnel untrained in electronic technology. However, it provides an adequate overview of operation for those familiar with basic electronic circuit operation. Throughout the following, refer to Figure 5.

Power Supplies. The integrated-circuit chips which comprise the A/D *Converter* and the *Overrange Comparator* are CMOS circuits which require ±9 volts regulated. These voltages are supplied from power supplies contained on the Signal Conditioner circuit board and are discussed in the Signal Conditioner *Instruction Manual*.

The digital part of the *A/D Converter, the Bit Selector,* and the various logic gates and inverters are operated from +5 volts regulated (TTL logic). The +5 volt supply consists of a three-terminal *Regulator.* The unregulated input to the Regulator is obtained from Signal Conditioner circuit board (unregulated side of +9 volt supply).

The *BCD-to-7-Segment, Decoder, Display Drivers,* and *Display LED's* operate from +6 volts unregulated. Five volts ac is supplied from the Signal Conditioner circuit board (secondary of power transformer located on board). Plus 6 volts unregulated is developed with a *Diode Bridge* and *Filter* located on the Digital Indicator board.

A +2.5 volts precision reference is supplied from a precision power supply located on the Signal Conditioner circuit board. This reference is used in the *A/D Converter* for digitizing the analog input signal.

A/D Converter. The *A/D Converter* is a dual-slope converter which digitizes the analog input signal using a ratiometric integrating technique. The analog signal input, a reference input, and a clock input are applied to the converter. The measurement cycle is divided into an *Auto-Zero* cycle, a *Signal Integrate* cycle, and a *Reference Integrate* cycle. Each cycle has a time base in which a certain amount of clock pulses occur. The clock used is a 100-kHz crystal oscillator. The *Auto-Zero* cycle is used to bring the output of the integrator to zero and lasts 10,000 counts. The next cycle is the *Signal Integrate* cycle which also lasts 10,000 counts. If the analog input is zero at the start of the *Signal Integrate* cycle, the integrator will see the same voltage that existed in the previous state. Thus, the integrator output will not change but will remain stationary during the entire *Signal Integrate* cycle. If the analog input is not equal to zero, an unbalanced condition exists compared to the *Auto-Zero* cycle and the integrator will generate a ramp whose slope is proportional to the analog input. At the end of this cycle, the sign of the ramp is determined. If the input signal was positive, a voltage which is VREF more negative than during *Auto-Zero* is applied to the integrator input. The *A/D Converter* chip generates the equivalent of a +*Reference* or –*Reference* from the single +*Reference* applied. The reference voltage returns the output of the integrator to zero. The time, or number of counts, required to do this is proportional to the input voltage. The *Reference Integrate* cycle can be a maximum of 20,000 counts. The full measurement cycle is then a maximum of 40,000 counts, with the answer to the measurement being achieved when the reference voltage returns the integrator output to zero. The full measurement cycle is shown in Figure 4.

The DIGIT DRIVES are positive-going signals that last for 200 clock pulses (see Figure 4). The scan sequence is D5 (MSD), D4, D3, D2, and D1 (last active digit). The scan is continuous unless an overrange occurs. Then all DIGIT DRIVES are blanked from the end of the first scan until the beginning of the *Reference Integrate* cycle when D5 will start the scan again. This gives a blinking or flashing display as a visual indication of overrange. Because the Digital Indicator has 5000 and 10000 ranges as well as a 20000 range, an analog *Overrange Comparator* is used as well as the inherent overrange capability of the *A/D Converter*. The *Overrange Comparator* is described in a following paragraph.

The binary-coded-decimal (BCD) outputs of the *A/D Converter* are positive logic signals that go on simultaneously with the DIGIT DRIVE. Since the DIGIT DRIVES are blanked for an overrange on the 20000 scale, the display will flash all zeros when this condition occurs on this scale.

Input Attenuators/Range Switches. The 5-volt analog signal input (full scale) and the 2.5 volt reference from the Signal Conditioner are applied to attenuator networks where 2-volt and l-volt signal and reference inputs are developed for the *A/D Converter.* Since, on the 20000 range, the *Reference Integrate* cycle can be

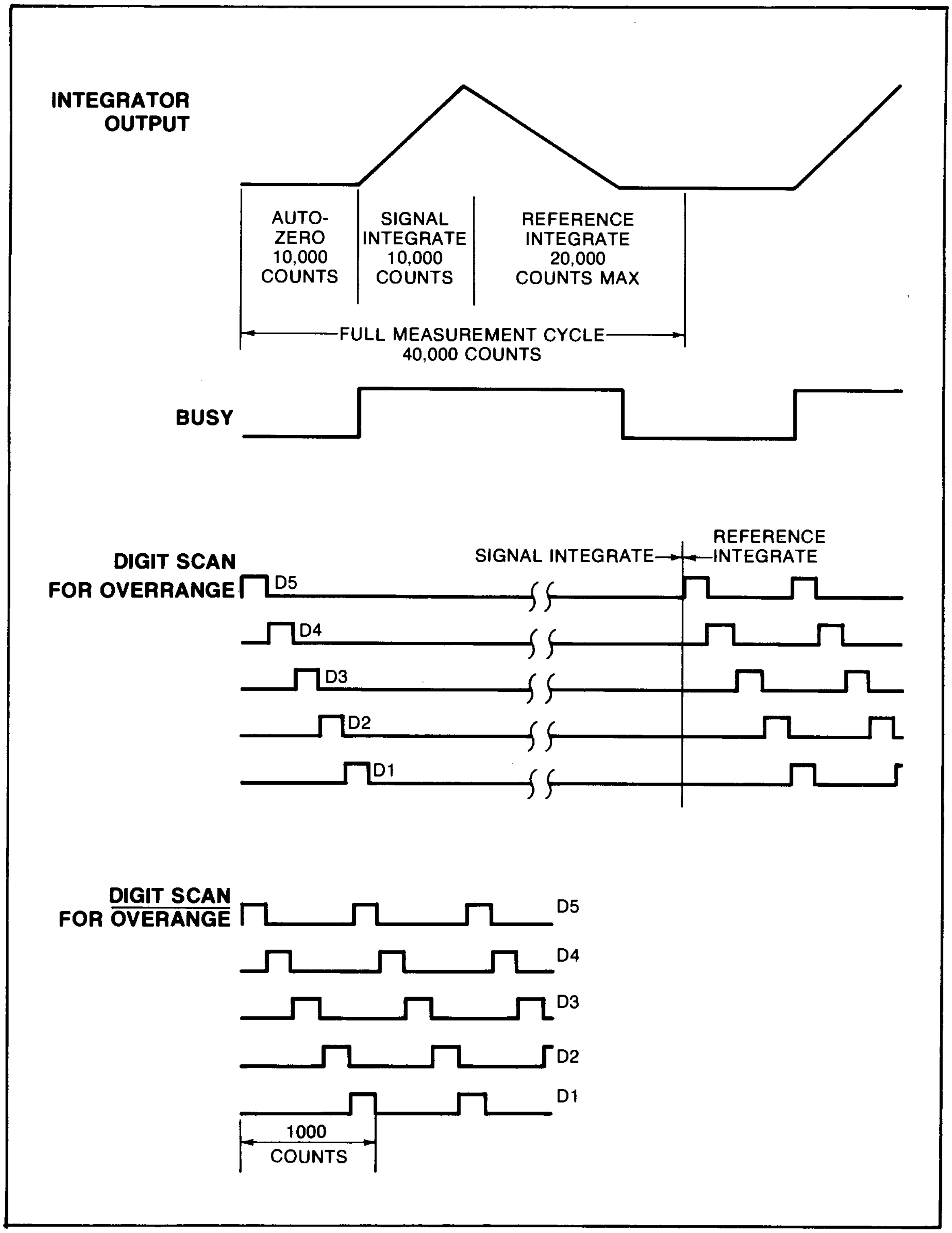


Figure 4. A/D Converter Timing Diagram

twice as long as the *Signal Integrate* cycle, the analog input voltage required to give a full-scale reading is exactly equal to 2 V_{REF}. Consequently, on the 20000 range, the V_{REF} is 1 volt and the V_{SIG} is 2 volts for full scale. On the 10000 range, the two cycles can be equal; thus, $V_{SIG} = V_{REF} = 2$ volts. On the 5000 range, the analog voltage for a full-scale reading is then equal to 1/2 V_{REF}; thus, V_{REF} must be 2 volts and V_{SIG} 1 volt. The appropriate levels are switched to the *A/D Converter* through the rear-panel *Range* switches.

Bit Selector/Decoding Logic. The Bit Selector transfers one of two sets of 4-line BCD data applied at input ports to output ports upon receiving a command at the A SELECT or B SELECT port. When the A SELECT port is high, the X input data is transferred to the Z output ports. Conversely, when the B SELECT input is high, the Y input data is transferred to the Z output ports. The Y data is obtained directly from the BCD output ports of the *A/D Converter*. The X data is comprised of specially coded bits used to count by *2's* or *5's* when the 10000 or 20000 ranges are selected, respectively. On the 5000 range, the A SELECT input is held low through the *Range* switches and the B SELECT input is high. The Y data is transferred to the output of the *Bit Selector* and the display count is by *1's*. On the 10000 range, the A SELECT input is held low except when the Dl DIGIT DRIVE is high. When D1 is high, the A SELECT is high and the B SELECT is low, transferring the X data to the Z ports of the *Bit Selector* and allowing the display to count by *2's*. Operation on the 20000 range is identical except that the bit coding is arranged to give a count by *5's* with the X data.

Display Coding/Driving. The display is a 4.5-digit LED display with polarity and a dummy zero. DS2 through DS6 are 7-segment displays with common cathodes. The *Bit Selector* output ports are connected as inputs to a *BCD-to-7-Segment Decoder*. The 7 outputs of the decoder are connected as inputs to the segments (anodes) of DS2 through DS6. The DIGIT DRIVES of the *A/D Converter* are used to sequentially turn on DS2 through DS6 through *Display Drivers* which sink current. DS1 is either unlit or lights as a *1* for displays of 10000 or greater. Unlike DS2 through DS6, DS1 is a common anode device. The DS1 segments (cathodes) are sinked via a display driver from the *1 bit* of the *A/D Converter*. The DS1 anode is then brought high by D5 through a driver comprised of an inverter and a transistor which applies +6 volts unregulated to the anode when D5 is high.

The last digit of the Display (DS6) is the dummy zero digit. When the *Dummy Zero Select* switch is ON, the DS6 cathode is sinked when D5 is high. The outputs of the *BCD-to-7-Segment Decoder* are tied to the DS6 segments. Also, when D5 is high, the B SELECT input to the *Bit Selector* is pulled low through the NOR gate connected to the port. The A SELECT input is also low since it is either held hard low through the *Range* switches on the 5000 range or it is connected to D1 through the *Range* switches on the 10000 and 20000 ranges (when D5 is high D1 must be low). With the A SELECT and B SELECT inputs both low, the Z ports of the *Bit Selector* assume the low state no matter what the X and Y input data reads. Consequently, each time D5 is high, DS6 displays a zero.

The polarity sign is also part of DS1. The minus (-) segment is always lit through 6 volts and an external resistor tied to circuit common. When the *A/D Converter* senses a positive polarity, the POLARITY port goes high. This action drives an inverter low to light the vertical portion of the polarity sign.

Decimal point position is selected with rear-panel slide switches (as is dummy zero selection). Only one of the *Decimal* slide switches is turned ON at any one time. The decimal-point LED for DS1 is hard wired to +6 volts. Turning ON the associated *Decimal* switch connects an external resistor and circuit common to the other side of the decimal-point LED. Since the remaining digits with decimal-point LED's (DS2 through DS4) are common cathodes devices, each LED is sinked when the corresponding DIGIT DRIVE is high and associated *Decimal* switch is ON, applying +6 volts to the other side of the LED through an external resistor.

Analog Overrange. Digital overrange for the 20000 range is inherent in the A/D Converter chip and has been previously described. However, for the 5000 and 10000 ranges, an analog overrange circuit is required. The *Overrange Comparator* is dc biased with equal resistors returned to the ±9 volt supplies so that its output is at approximately 4.5 volts. Both of the comparator inputs are connected through diodes to the analog input from the Signal Conditioner. When the analog input is one diode drop above or below the comparator biasing, an overrange condition exists since approximately 5.2 volts is present at the analog input (5 volts = full-scale value). The output of the *Overrange Comparator* goes low when either of the input diodes is forward biased. The comparator output and the BUSY output of the A/D Converter are gated through an OR gate. The BUSY signal is high during the Signal and Reference Integrate cycles of the A/D Converter, then it goes low. This causes the output of the OR gate to go low. The BLANK port of the BCD-to-7-Segment Decoder is normally held high through an external resistor. When the OR gate output goes low, the BLANK port is pulled low through a diode, causing DS2 through DS6 to flash. Since DS1 is not driven from the decoder, a second diode and resistor are used to pull the *A/D Converter 1-bit* output low when the overrange OR gate is low. This action causes DS1 to flash.

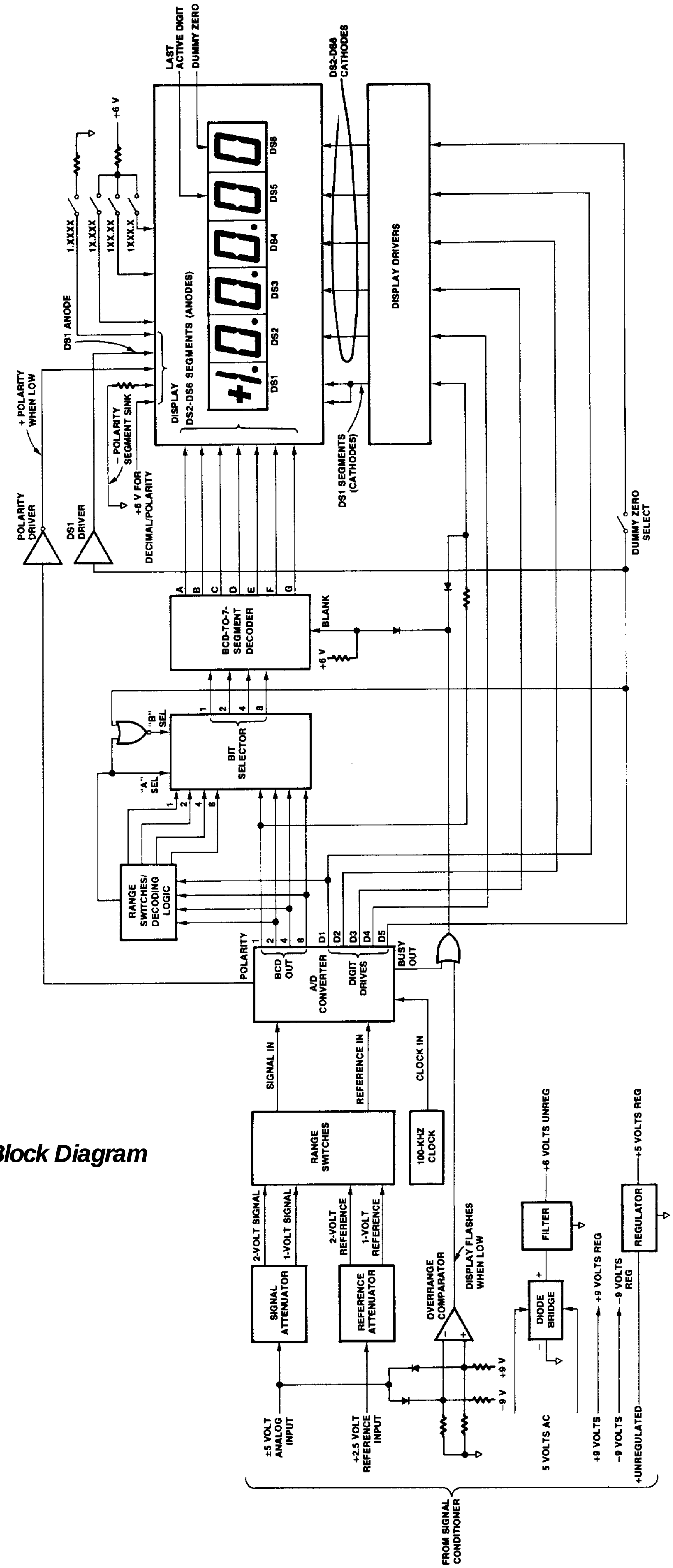


Figure 5. Block Diagram

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5. VERIFICATION OF NORMAL OPERATION

It is the purpose of this section to aid the user in rapidly determining whether the Digital Indicator is functioning normally or whether it is the source of the observed trouble. In the event a repair to the Digital Indicator is required, a complete parts list, schematic diagram, and component location drawing are included in this manual. The user may also contact the factory Service Department or the local Daytronic Representative for assistance.

One of the two techniques can be used to rapidly determine whether the Digital Indicator is malfunctioning or whether the problem is in the Signal Conditioner, transducer, or transducer cabling. If the unit is a *Form 2* instrument (no Hi-Lo Limits), attempt to zero and calibrate the Signal Conditioner while observing the Signal Conditioner analog output (use the dc-to-2Hz output) on a dc coupled oscilloscope. If the Digital Indicator is unstable or reads erratically, but the oscilloscope indicates a stable analog output from the Signal Conditioner, the problem is likely in the Digital Indicator. In the event the Signal Conditioner output is unstable or noisy, consult the Signal Conditioner *Instruction Manual* for the proper action to be taken.

If the instrument is a *Form 3* type, push one of the Limit pushbuttons and observe how the limit value is displayed on the Digital Indicator. If the display is stable with the Limit button pressed, but is unstable when the button is released, the problem is in the Signal Conditioner, transducer, or transducer cabling. If the display is unstable or erratic whether the button is pressed or released, the problem is in the Digital Indicator.

DAYTRONIC

3000 SERIES

“C” Option

4-20 mA CURRENT OUTPUT

INSTRUCTION MANUAL

Daytronic Corporation

Dayton, OH   Tel (800) 668-4745

www.daytronic.com

1. General Description

Operating in this mode, any 3000 Series instrument can transmit high-accuracy measurement data as *process signals for supervisory monitoring and control*.[1] Each “C” unit produces two kinds of analog output simultaneously: (1) its normal voltage output and (2) a current output continuously proportional to the voltage signal to within ±0.05%.

As normally shipped, this option generates a current output within the ISA standard signal range of 4 to 20 mA, corresponding to a range of 0 to +5 V. Bipolar ranges of ±16 mA and 4 to 12 to 20 mA are also available, each corresponding to -5 to +5 V. Voltage compliance is +5 V relative to Signal Common.

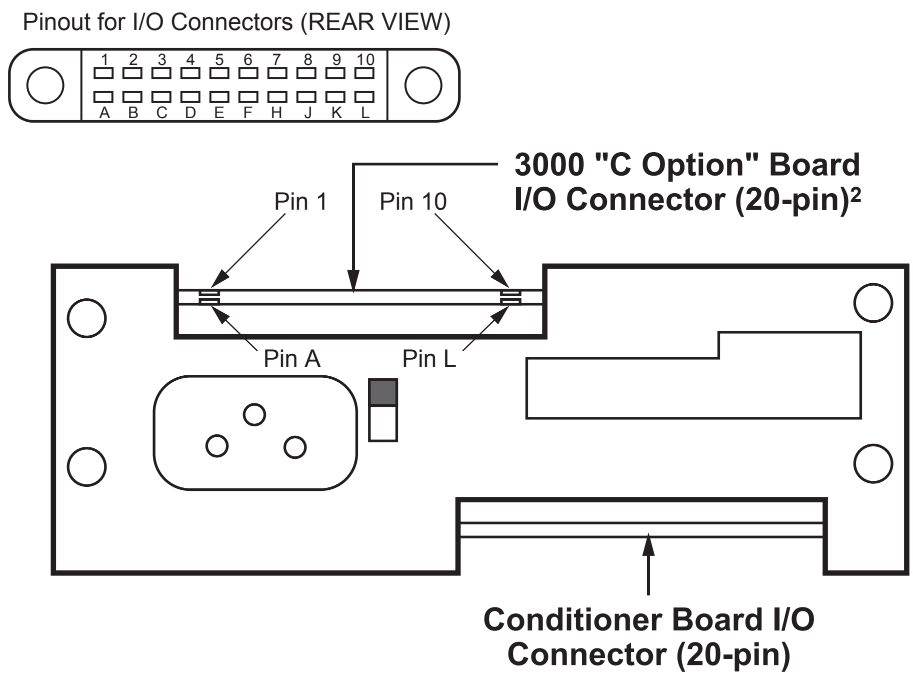


Fig. 1
Rear-Panel Location of 3000C Current Output Board

2. Connections / Output Mode Selection

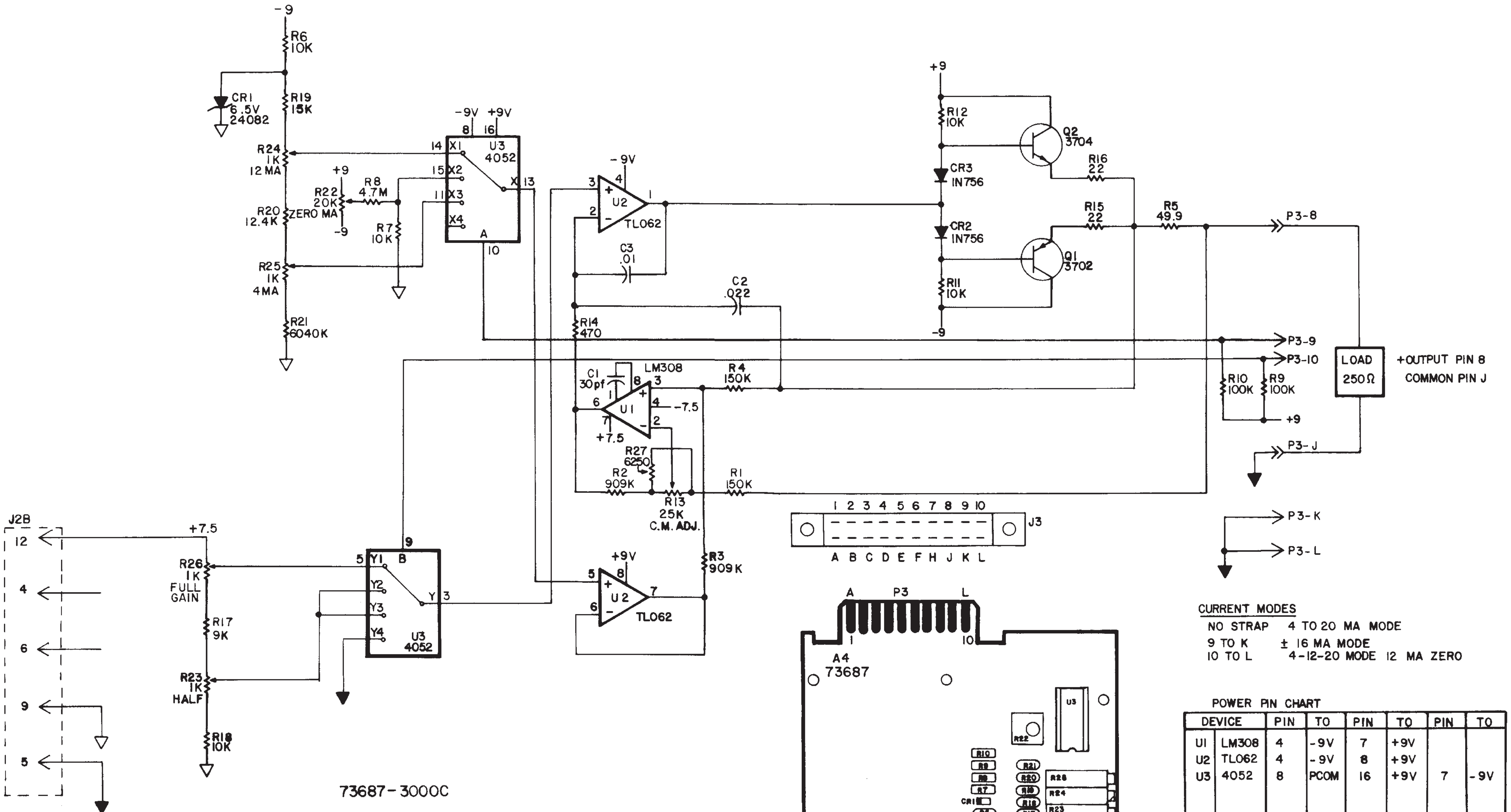
Pin assignments for the 3000C board's 20-pin I/O connector (shown in Fig. 1) are given in the following table.[3]

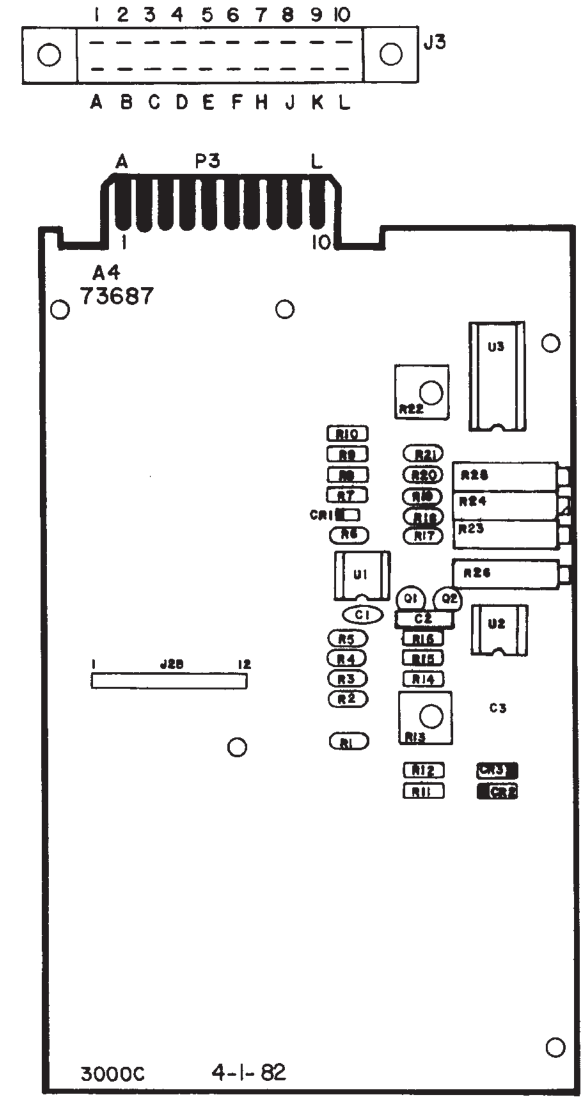
Pin Number	Function
8	**CURRENT OUTPUT SIGNAL** Range will be standard unipolar **4-20 mA** if Pins 9 and 10 are both unconnected; the output is single-ended, and should be returned to **Pin J** (COMMON)
9	**±16 mA MODE** Connecting Pin 9 to **Pin K** will set the current output range to bipolar ±16 mA
10	**4-12-20 mA MODE** Connecting Pin 10 to **Pin L** will set the current output range to bipolar 4-12-20 mA (with 12 mA as effective “zero”)
J	**COMMON**
K, L	for **OUTPUT MODE SELECTION**

[1] NOTE: The “C” Option may NOT be used in combination with the “P,” “G,” “R,” or “S” Option.

[2] In **Form 3 (“33XX”)** instruments with the “C” Option, current-output circuitry is integrated with the **3300 HI-LO Limits Board**.

[3] For all other (*limit-related*) I/O connections for **Form 3 (“33XX”)** instruments with the “C” Option, see the *Model 3300 HI-LO Limits Instruction Manual*.





CURRENT MODES

NO STRAP 4 TO 20 MA MODE
9 TO K ± 16 MA MODE
10 TO L 4-12-20 MODE 12 MA ZERO

POWER PIN CHART

DEVICE		PIN	TO	PIN	TO	PIN	TO
U1	LM308	4	-9V	7	+9V		
U2	TL062	4	-9V	8	+9V		
U3	4052	8	PCOM	16	+9V	7	-9V

NOTES:
1. ALL -9V WIRES GO TO J2B PIN 6.
2. ALL 9V WIRES GO TO J2B PIN 4.
3. ALL ▼ POW COM WIRES GO TO P3 PINS J, K, L, FROM J2B PIN 5.
4. ALL ▽ SIG COM WIRES GO TO J2B PIN 9.

ZONE	REV.	DATED	DESCRIPTION	APP.	CONTROL
CSR	C	7-1-96	WAS VERSION 003	SS	
T.T	B	2-7-91	CHG. R19 14K TO 15K, VERS. 002 TO 003	MW	
	A	10-24-90	ADDED PIN CHART, J2B, MOVED P3.	W	

DES. DHL CHK. DFT. CLM APP.

DAYTRONIC CORPORATION MIAMISBURG, OHIO

DATE: 7-12-83 REV: 7-1-96 REV. LEVEL: C

NAME: 4 TO 20 MA CURRENT OUTPUT CARD NUMBER: s3000C

3000 “G” Option Instruction Manual, v. SB.2
Pub. No. 3000GM.2, Issued 10/96
Part No. 91637

DAYTRONIC

3000 SERIES

“G” Option

DUAL GALVANIC ISOLATED OUTPUT

INSTRUCTION MANUAL

Daytronic Corporation

Dayton, OH • Tel (800) 668-4745

www.daytronic.com

1. General Description

With this optional circuit board, a **Form 1 (“31XX”)** or **Form 2 (“32XX”)** instrument can furnish two independent *galvanic outputs*, fully isolated not only from each other but also from the 3000 instrument's “common.” Each output is normally set at the factory for a full-scale range of **0-10 V-DC** (±0.2%) when the data signal from the 3000 unit's conditioner card is at its standard 5-V level. Though normally preset at “2.00,” each input's gain can be adjusted within ±5%, if desired, by means of potentiometer controls on the G-option card.

The use of galvanically isolated outputs prevents ground-loop effects in interconnections with remote data-acquisition systems or controllers. The presence of two independent outputs lets you send collected data to two different systems or devices, each with its own ground.

Load limit for each output exceeds 10 kilohms. Output bandwidth is normally 40 Hz; the “G” option can be easily modified, however, for other bandwidths up to 500 Hz (contact the factory for details).

NOTE: The only other options that may be combined with the “G” option are the “B” (battery-powered) and “F” (230 V-AC-powered) options.

2. Additional 3000(G) Specifications

Output Range: ±10 V-DC full scale (2 mA max), normal; internal controls give approximately ±5% of adjustment authority on both SPAN and ZERO

Common-Mode Range: ±500 V, max

Common-Mode Rejection Ratio: DC: -120 dB; at 60 Hz: -60 dB

Linearity: ±0.1% of full scale

Maximum Zero Drift, *After Warmup of One-Half Hour*: ±0.2% of full scale*

Maximum Span Drift, *After Warmup of One-Half Hour*: ±0.2% of full scale*

* Applies to the 3000 "G" Option only and does not include possible drift contributed by the signal conditioner board of the base 3000 instrument.

3. Installation and Cabling

When viewing the 3000 instrument from the rear, the Galvanic Output Board is in the upper left of the rear panel (see Fig. 1). Access to the output signals is through a 20-pin edge card connector with a key slot between contact pads 4 and 5. The user must provide his own cable connection to the card, pinout for which is as follows:

Pin No. (see Fig. 1)	Function
2,B	SIGNAL 1 OUT
1,A,3,C	ISO COM 1
9,K	SIGNAL 2 OUT
8,J,10,L	ISO COM 2

Cabling of the isolated analog outputs is shown in Fig. 2. Each output is single-ended and returns to its own ISOLATED COMMON. Each output's SHIELD should be tied to the instrument chassis via one of the screws holding the rear panel.

4. Calibration

NO ADJUSTMENT OF THE G OPTION IS NECESSARY DURING NORMAL USE.** Follow the normal calibration procedure given in the respective *3000 Instrument Instruction Manual*.

** As mentioned above, separate ZERO and SPAN adjustment controls are provided on the G Option board for each isolated output, if it is desired to refine the "2.00" gain to which the output has been set prior to shipment. These controls, shown in Fig. 3, may be accessed by removing the 3000 instrument's front panel.

Fig. 1
Rear-Panel Location of 3000G Galvanic Output Board

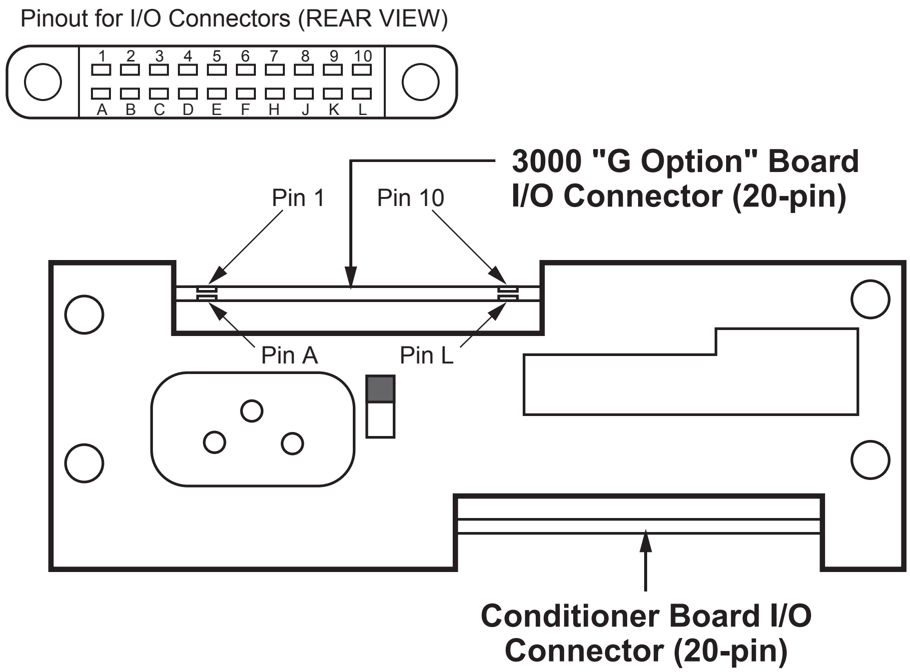


Fig. 2
Cabling of Isolated Outputs

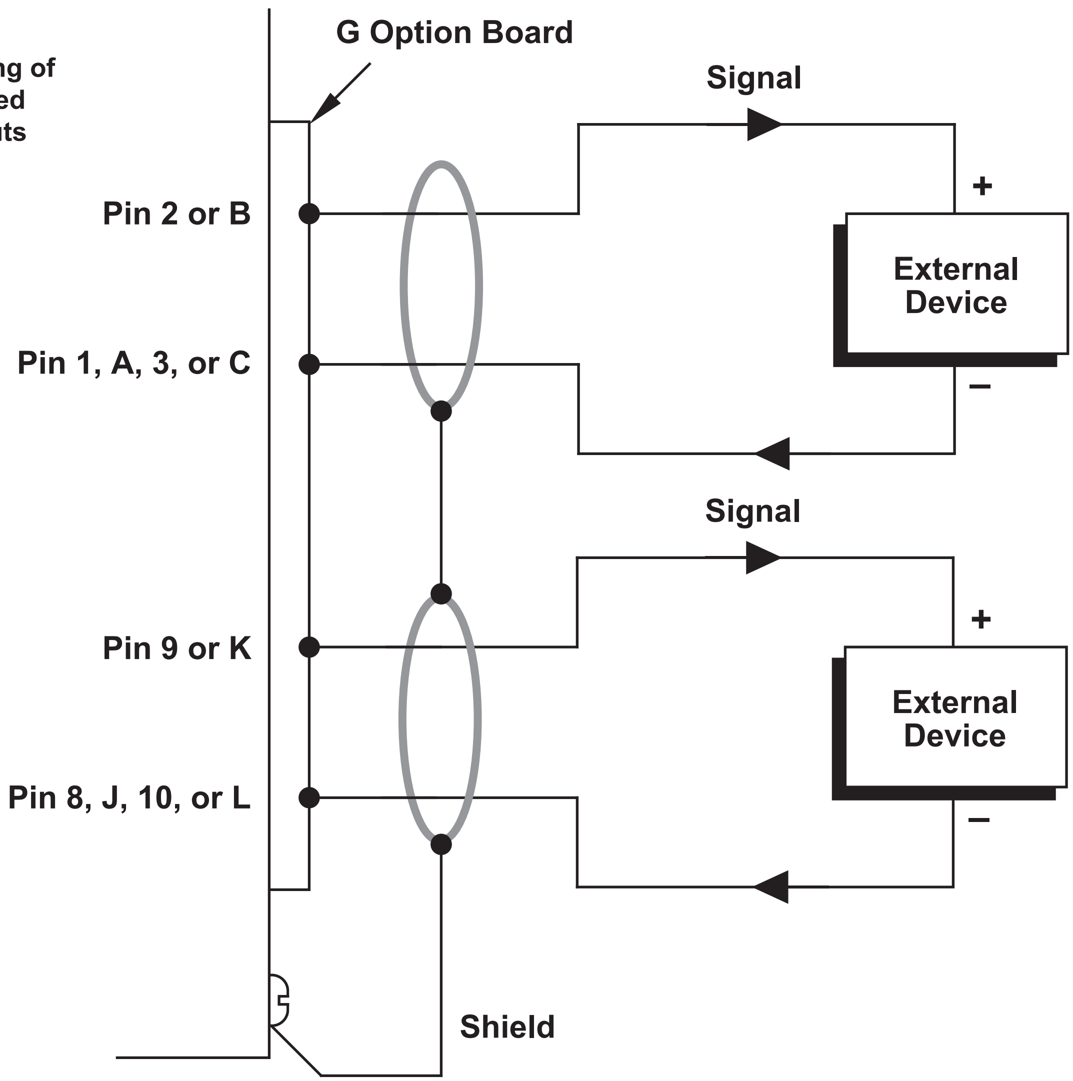
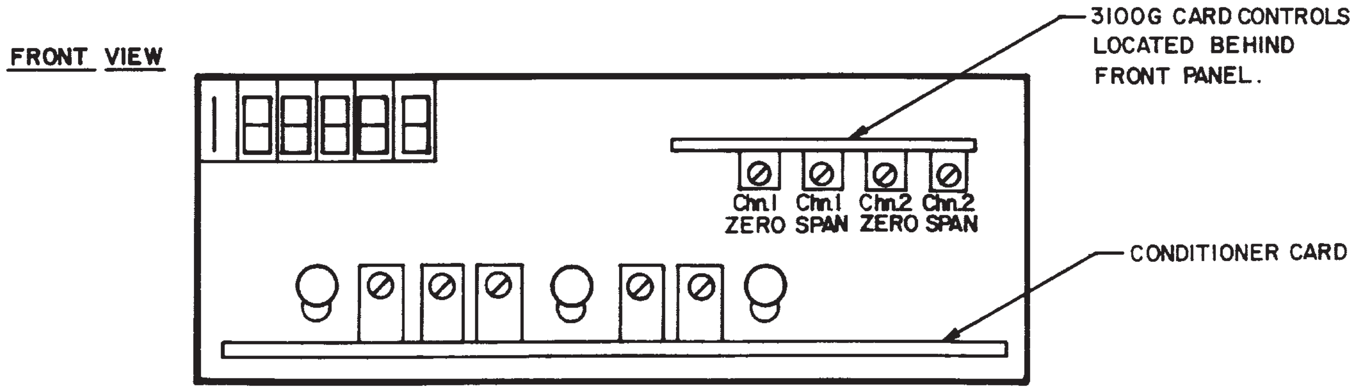
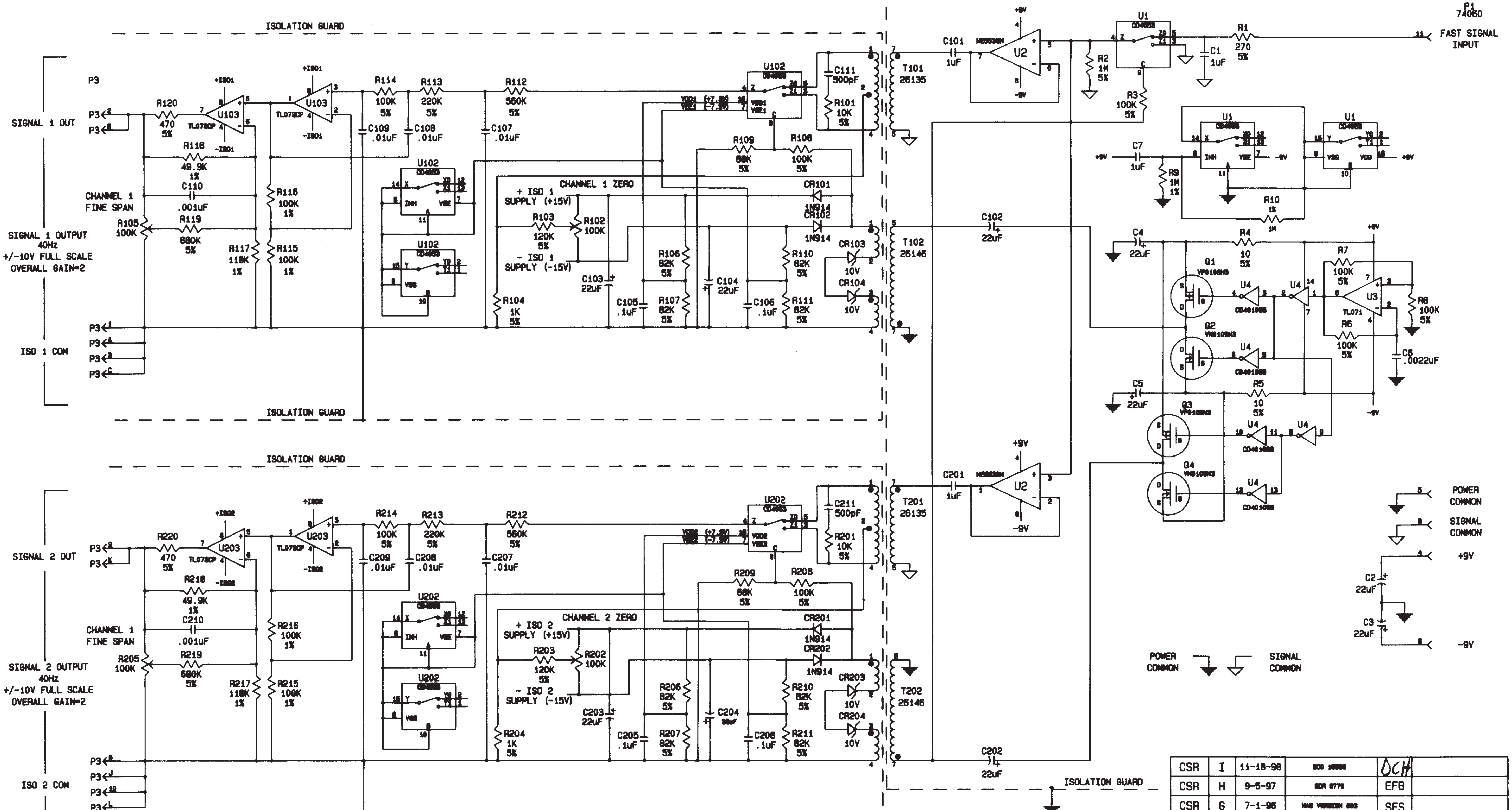
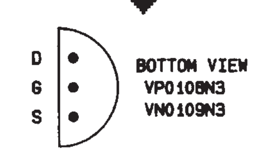
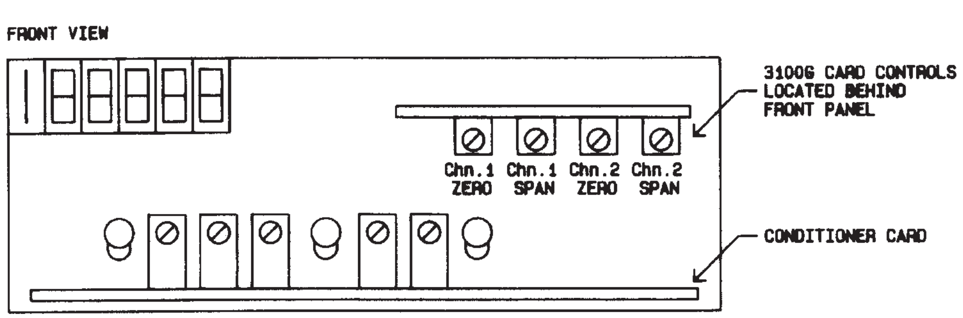


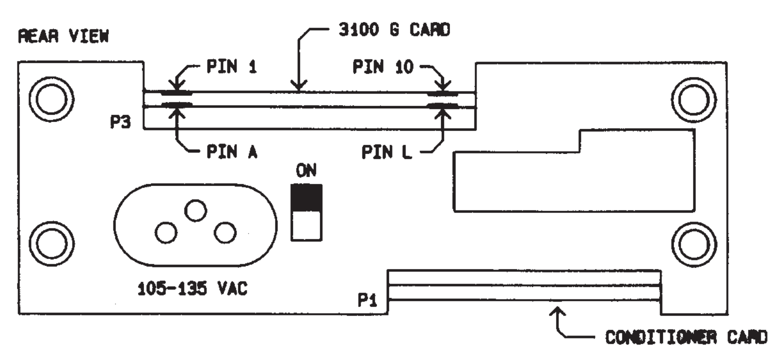
Fig. 3 Location of Internal G-Option Controls











BOARD NO.: 73871.1
BOARD DATE: 2-5-87

PROPRIETARY INFORMATION

DFT.	REV.	DATED	DESCRIPTION	APP.	CONTROL
CSR	I	11-18-98	ECO [illegible]	DCH	
CSR	H	9-5-97	ECR 8779	EFB	
CSR	G	7-1-96	MAS VERSION 003	SES	
SLS	F	3-24-94	CORRECTED T202	FW	
SLS	E	2-24-94	CHGD. FROM D TO B SIZE	FW	
CLM	D	4-8-93	SEE ECR #6480	MW	
	C	11-29-90	CHG VER. R117-R118 R217-R218 ADD C111, C211	MW	
	B	10-31-90	CHGD. FROM S3100G	MW	
	A	8-2-88	ADDED C110, C210 BOTH .001uF; CHGD. VER.#	MW	

DSA DES.	DSA CHK.	DAYTRONIC CORPORATION MIAMISBURG, OHIO
KIS DFT.	FW APP.	
DATE 1-12-87	REV 11-18-98	REV. LEVEL: I
NAME	GALVANIC ISOLATED OUPUT OPTION CARD (3100G)	NUMBER S3000G

3000 “P” Option Instruction Manual, v. SB.2
Pub. No. 3000PM.2, Issued 10/96

DAYTRONIC

3000 SERIES

“P” Option

ANALOG PEAK CAPTURE

INSTRUCTION MANUAL

Daytronic Corporation

Dayton, OH • Tel (800) 668-4745

www.daytronic.com

1. General Description

With the installation of a special "P" version of the 3000 Series HI-LO LIMITS board (shown in Figure 2, below), *real-time analog peak capture* is possible for a **Form 2 ("32XX")** or **Form 3 ("33XX")** instrument, in addition to its normal "tracking" function.[1]

Controlled either by front-panel push buttons (Fig. 1) or by a remote user-installed switch (Fig. 3), a "P" unit can "freeze" and display the last positive input-signal "peak" value to have been perceived. The analog output is held at this value until a TRACK/RESET command is applied.[2] A subsequent higher signal excursion disables the "hold," permitting the capture of subsequent higher peaks. Because it is digitally held, a displayed peak value will not decay. The maximum decay rate for a held analog output is only 0.1% of full scale per minute.

For capture of negative "peaks" (signal minima), the input lines may be inverted.

With all **Form 3** instruments, limits are automatically latched upon peak capture, and are automatically reset on return to normal TRACK mode. See the *Model 3300 HI-LO Limits Instruction Manual* for complete details regarding limit setup and operation (including mode selection, setting of limit setpoint values, and logic output connections for annunciation and control). For selection of engineering-unit digital range and resolution, see the *Model 3200/3300 Digital Indicator Instruction Manual*.

Fig. 1
Model 3378P Front Panel, showing push buttons for Peak / Track control

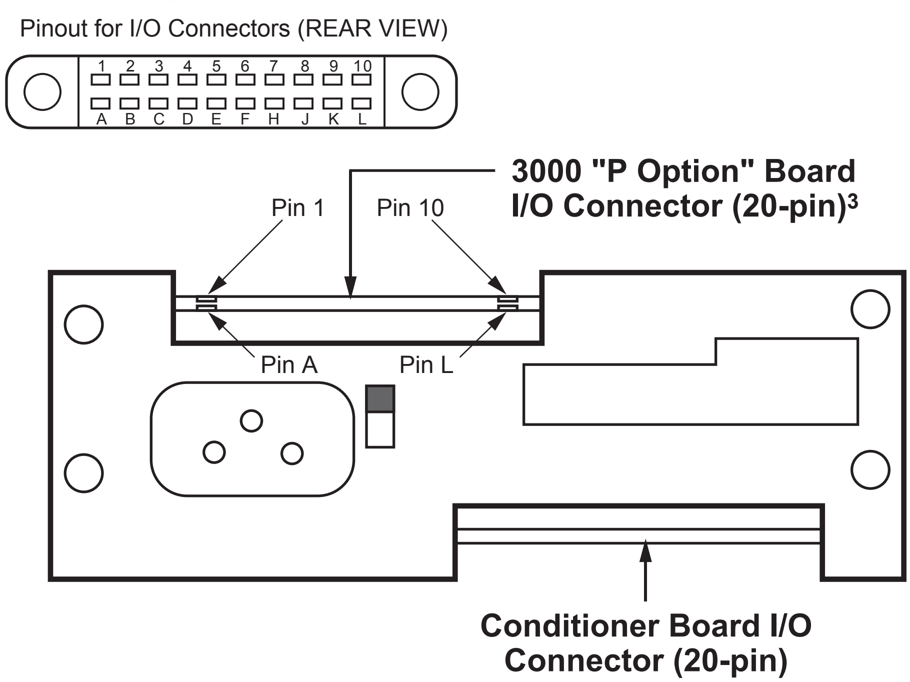


Fig. 2
Rear-Panel Location of 3000P Peak Capture Board

[1] NOTE: The "P" Option may NOT be used in combination with the "C," "G," R," or "S" Option.

[2] To prevent low-level signal noise from triggering a "peak hold," the peak capture function is automatically disabled when the input is less than 8% of full scale. If you require peak capture within the 0-8% range, contact the factory.

[3] In **Form 3 ("33XX")** instruments with the "P" Option, peak-capture circuitry is integrated with the **3300 HI-LO Limits Board**.

2. Connections

Pin assignments for the 3000P board's 20-pin I/O connector (shown in Fig. 1) are given in the following table.*

Pin Number	Function
7	**PEAK ANALOG SIGNAL** Holds peak analog input value when in PEAK mode; follows analog input continuously when in TRACK mode
8	**TRACK** Used for external *peak reset* control (see Fig. 3, below)
9	**SLOW** Tie to Pin K for *narrowband-signal* peak processing (DC to 2 Hz)
10	**FAST** Tie to Pin K for *wideband-signal* peak processing (DC to highest available low-pass filter corner frequency)
B or J**	**COMMON**
K	**PEAK RESPONSE SELECT** Tied to Pin 9 or 10 to select narrowband or wideband peak processing, respectively

As indicated in the table, *a jumper must be installed* between **PIN K** and either **PIN 9** ("SLOW") or **PIN 10** ("FAST"), depending on whether you want to capture peaks for a *narrowband* signal (DC to 2 Hz) or a *wideband* signal (DC to highest available low-pass filter corner frequency), respectively.

3. Operation

As mentioned above, PEAK/TRACK operation can be locally controlled by front-panel push buttons, while the PEAK RESET function can be remotely controlled by a logic-level command to the rear 3000P connector (when the instrument is set to PEAK mode via the front-panel buttons).

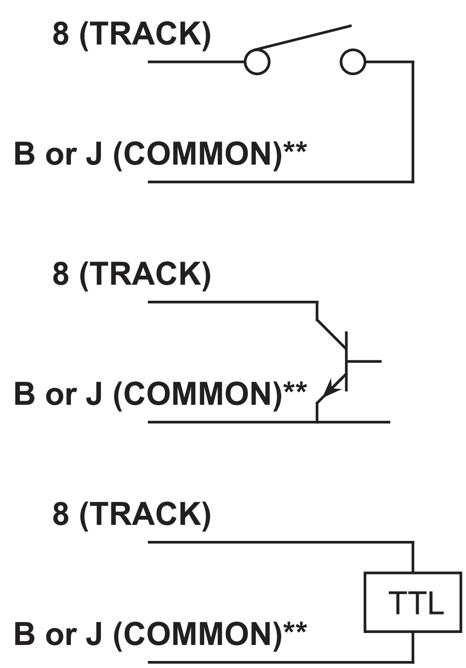
For front-panel control, you will use the two LIMIT SET buttons as follows:

BOTH BUTTONS PRESSED ("IN")
Places the unit in TRACK mode. The analog output at Pin 7 will continuously follow the analog input. This mode is used to *reset* the instrument following peak capture.

BOTH BUTTONS UNPRESSED ("OUT")
Places the unit in PEAK mode. The analog output at Pin 7 will continously represent the most positive value experienced by the analog input signal since PEAK mode was last begun.

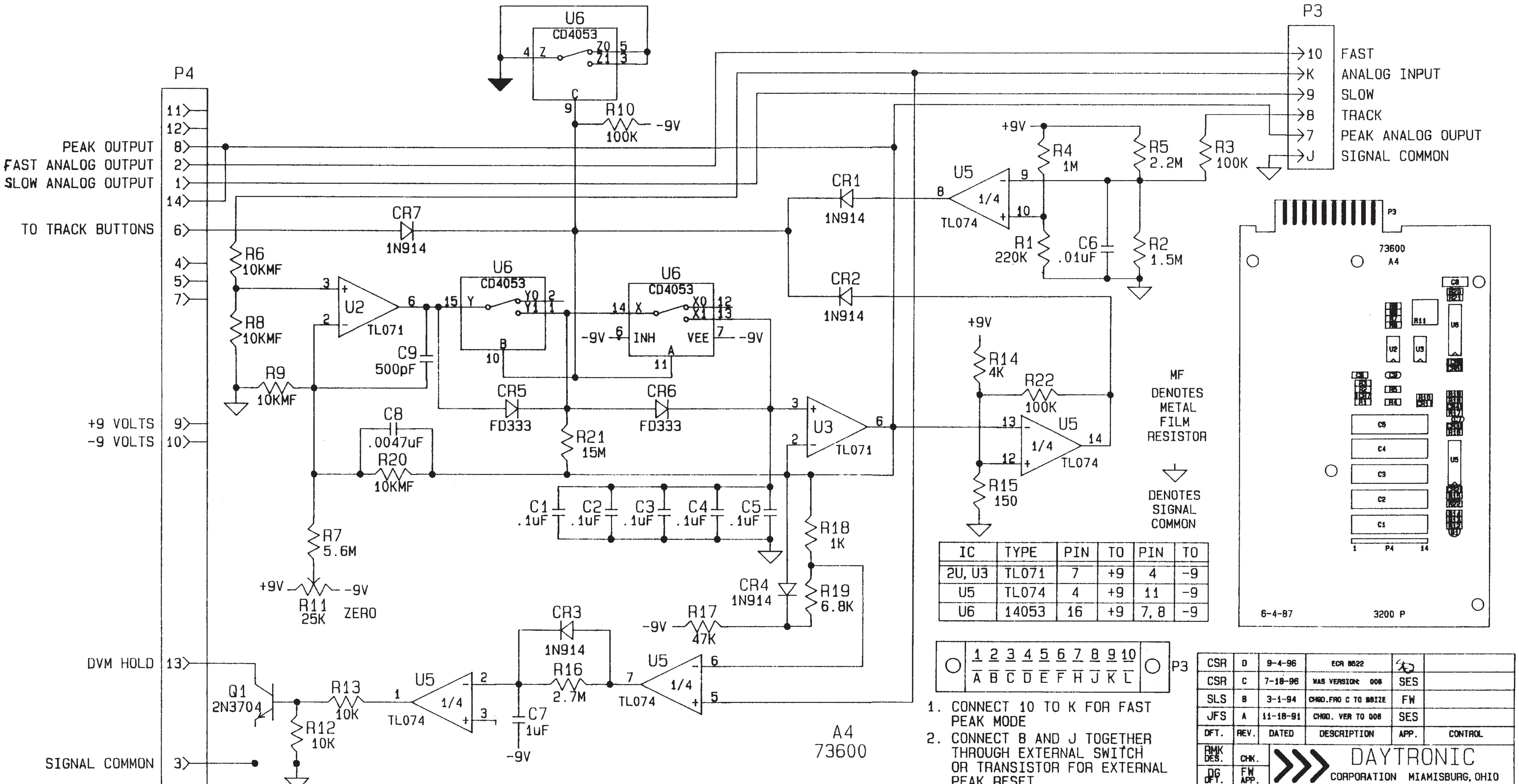
When (and only when) the instrument is set to PEAK mode via the front-panel buttons, a PEAK RESET can be externally applied by connecting **Pin 8** of the rear I/O connector with the **COMMON** line (**Pin B or J****), as shown in Fig. 3. Thus, when these pins are connected via an external contact closure (as in the top diagram of Fig. 3), CLOSING the switch will cause the output at Pin 7 to once again TRACK the analog input, while OPENING the switch will return the output to PEAK mode.

Fig. 3
Track/Reset Via External Command (Switch, Open Collector Transistor, or TTL Logic)



* For all other (*limit-related*) I/O connections for **Form 3 ("33XX")** instruments with the "P" Option, see the *Model 3300 HI-LO Limits Instruction Manual*.

** Use **Pin B** for **Form 3 ("33XX")** instruments; use **Pin J** for **Form 2 ("32XX")** instruments.



IC	TYPE	PIN	TO	PIN	TO
2U, U3	TL071	7	+9	4	-9
U5	TL074	4	+9	11	-9
U6	14053	16	+9	7, 8	-9

1. CONNECT 10 TO K FOR FAST PEAK MODE
2. CONNECT 8 AND J TOGETHER THROUGH EXTERNAL SWITCH OR TRANSISTOR FOR EXTERNAL PEAK RESET

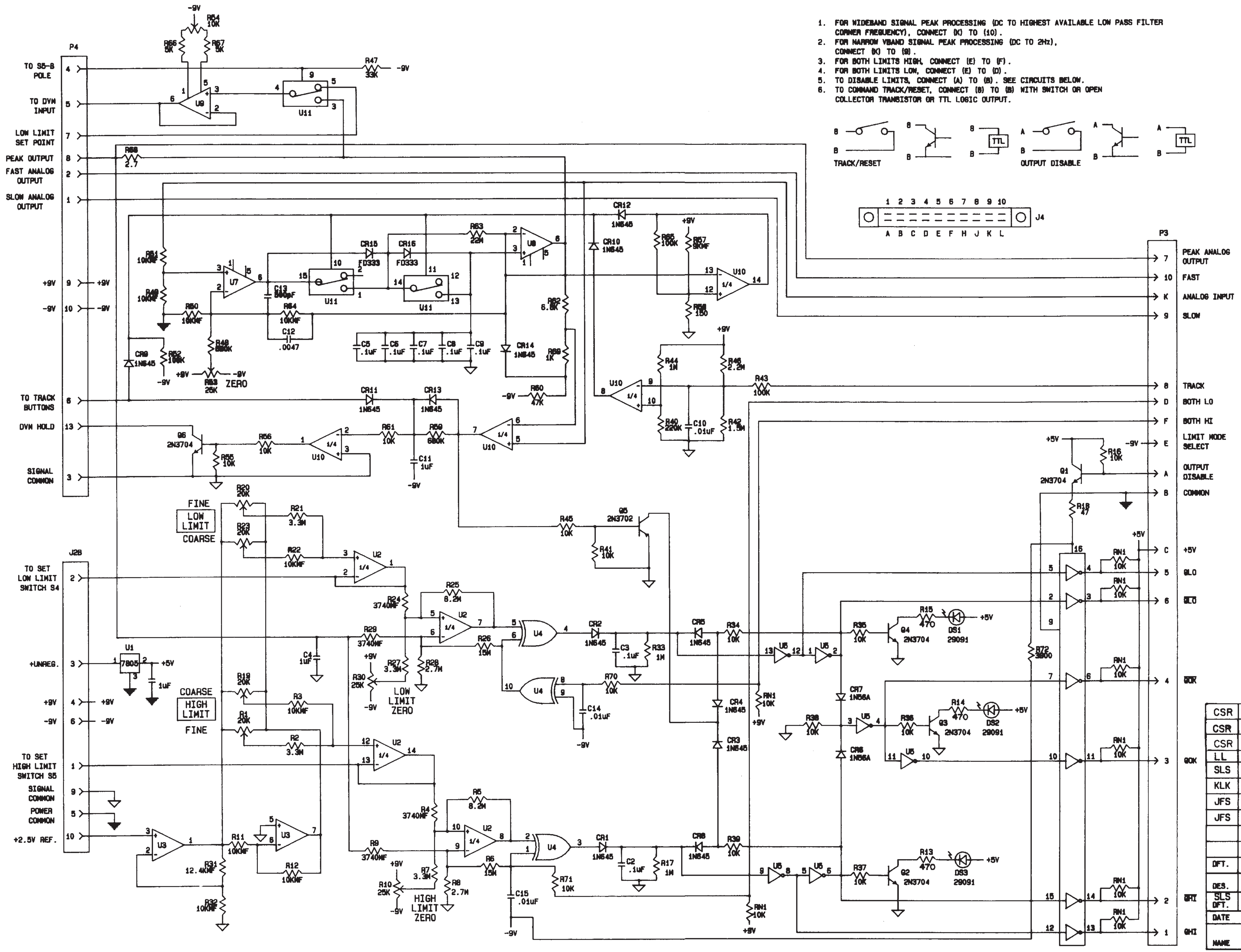
CSR	D	9-4-96	ECR 8522		
CSR	C	7-18-96	WAS VERSION 008	SES	
SLS	B	3-1-94	CHGD. FRO C TO BSIZE	FW	
JFS	A	11-18-91	CHGD. VER TO 008	SES	
DFT.	REV.	DATED	DESCRIPTION	APP.	CONTROL

RMK DES. — CHK. | DG DFT. — FW APP.

DAYTRONIC CORPORATION MIAMISBURG, OHIO

DATE 12-12-79 REV 9-4-96 REV. LEVEL: D

NAME 3000 PEAK BOARD NUMBER S3200P



1. FOR WIDEBAND SIGNAL PEAK PROCESSING (DC TO HIGHEST AVAILABLE LOW PASS FILTER CORNER FREQUENCY), CONNECT (K) TO (10).
2. FOR NARROW VBAND SIGNAL PEAK PROCESSING (DC TO 2Hz), CONNECT (K) TO (9).
3. FOR BOTH LIMITS HIGH, CONNECT (E) TO (F).
4. FOR BOTH LIMITS LOW, CONNECT (E) TO (D).
5. TO DISABLE LIMITS, CONNECT (A) TO (B). SEE CIRCUITS BELOW.
6. TO COMMAND TRACK/RESET, CONNECT (8) TO (B) WITH SWITCH OR OPEN COLLECTOR TRANSISTOR OR TTL LOGIC OUTPUT.

IC	TYPE	PIN	TO	PIN	TO
U2	TL074	4	+9	11	-9
U3	MC1458	8	+9	4	-9
U7, U8, U9	TL071	7	+9	4	-9
U11	CD4053	16	+9	6, 7, 8	-9
U4	CD4070	14	+9	7	-9
U10	TL074	4	+9	11	-9
U5	74C914	14	+5	7	P.C.
U6	75494	1	+5	8	P.C.

⏚ - DENOTES SIGNAL COMMON

⏚ - DENOTES POWER COMMON

MF - DENOTES METAL FILM RESISTOR

BD. NO. 73613.1
BD. DATE: 1-6-92

DFT.	REV.	DATED	DESCRIPTION	APP.	CONTROL
CSR	J	9-4-96	SEE ECR 8523	[illegible]	
CSR	H	7-26-96	WAS VERS. 013	[illegible]	
CSR	G	10-23-95	SEE ECR 8150	MW	
LL	F	11-8-94	SEE ECR 7091	MW	
SLS	E	5-16-94	ENTERED SCH INTO CAD	SES	
KLK	D	5-6-93	[illegible]	MW	
JFS	C	3-25-92	[illegible]	MW	
JFS	B	11-18-91	CHGD. VER. TO .007	SES	
	A	1-17-91	[illegible]	MW	
			[illegible]	MW	

DES. JCZ	CHK.	DAYTRONIC CORPORATION MIAMISBURG, OHIO
SLS DFT.	DL APP.	
DATE 4-26-80	REV: 9-4-96	REV. LEVEL: J
NAME LIMIT PEAK BOARD		NUMBER S3300P

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Daytronic Corporation

Dayton, OH • (800) 668-4745
www.daytronic.com