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I. Introduction

Description: The model 7530 Strain Indicator is an extremely versatile instrument which can be tailored with a variety of options and fill the needs of numerous applications. Basic readout options include a circular bar-scan readout which combines the advantages of both analog and digital readout and a highly visible gas discharge digital display. Other options include a dual (2 set point) limit with relay output and a horsepower/R.P.M. unit.

With either readout, polarity selection is automatic. The bar-scan option uses a front panel indicator lamp to show negative polarity. The digital unit has a minus sign in readout. Separate plus and minus push button calibrate switches are located on the front panel as well.

Ten turn precision potentiometers equipped with knob locks are located on the front panel for zero and span adjustments. On digital readout units a second set of screwdriver adjust trim pots are used for course zero and span. The ten turn pots then become fine controls.

The span adjustment has sufficient range to accommodate transducers with full scale outputs of 0.85 to greater than 7 mv/v while the zero adjustment provides more than ±100% of full scale assuming a transducer with an output of 2 mv/v. Bridge resistances of 85 to 1000 ohms are acceptable. Maximum bridge current is 120 MA.

A bi-polar, 1 to 5 volt adjustable analog output signal and provisions for a calibrate resistor are available on the rear barrier strip. The power input connector used includes a line filter, line cord disconnect, fuse, and 120/240 volt line voltage selector in a single assembly. This unit meets both North American and European standards.

The display response is controlled by an internal slide switch. 2 Hz and 0.2 Hz filter settings are available. The analog output response is also selectable. It is either 1k Hz or else the same as the display response.

SPECIFICATIONS

Input connector: Bendix PTO2E-12-10S
Transducer: 85 to 1000 ohms, full bridge
Excitation: Selectable (120 MA max. current)
5 VDC
10VDC
20VDC

Input impedance: Greater than 10 Megohms
Common Mode Rejection: D.C. - greater than 120 db
60 Hz - greater than 97 db
Display: Three options: Bar-scan (1x2),
Polarity:

Non-linearity:

Filtering:

Temperature Effects:

Power Requirements:

Net weight:

Size:

Operating temperature:

Bridge balance:

Span Adjust:

Symmetry:

Analog output:

low resolution digital (1x5), and high resolution digital (1x4)
Automatic indication with red LED indicator when used with Bar-scan display. Minus polarity sign displayed with digital displays.
Maximum of 0.005% of full scale.
Active, sharp cut-off five pole Bessel phase linear type.
Internal 1 db down at 2 hz or 0.2 hz. Excitation: + 0.0003%°F at 10 volts Span: 0.015%/°F of reading
Zero: 0.015%/°F of full scale
115/230 VAC, 50/60 hz, 12 watts, integral line filter and fuse.
8 pounds
8 1/4"x3 1/2x3 3/8 overall. 4" high including bail bar assembly.
+40°C to 130°C, 5 to 95% R.H.
± 100% of full scale at 2 mv/v span setting, 10 volts excitation.
10 turn pot with knob and lock.
On digital models, coarse-22 turn screw driver adjust, fine-10 turn with knob and lock.
0.85 mv/v to 7 mv/v input for full scale indication. 10 turn pot with knob and lock. On digital models, coarse-22 turn screw driver adjust, fine-10 turn with knob and lock.
Internally adjustable +3% of span.
Adjustable from 1 VDC to 5 VDC for full scale display indication. 2 ma maximum. Selectable response: 1k hz, 2.0 hz, or 0.2 hz. Short circuit protected, maximum non-linearity 0.05%, noise and spurious response at least 50 db below full scale output.
APPLICATIONS: The Model 7530 Strain Indicator can be used with virtually any strain gage bridge capable of being operated with 5, 10, or 20 volts excitation. Instrument sensitivity is such that it will accommodate full scale outputs from slightly less than 0.5 mv/v for full scale indication to greater than 7 mv/v. In addition, zero offsets of 100% or more can be effectively suppressed with front panel controls. Strain gage resistances of 85 to 1,000 ohms are readily accepted.

The Model 7530 is based on a DC excitation system and offers a number of advantages including excellent frequency response, low cost and overall simplicity of operation. However, there are some precautions which must be observed in order to assure dependable instrument readings with any DC system.

Effects which can influence instrument readings to varying degrees include thermocouple voltages, galvanic voltages, homopolar voltages, I/f noise and various stray AC pick up voltages. Care must be exercised in initial installation in many systems to minimize effects from the above.

For short runs (20' or less), and where the temperature is reasonably constant, a four wire cable system can be used with good results. For longer cable runs and/or where substantial temperature variations occur, a six wire cable system is recommended. However, where optimum results are required, a full seven wire cabling system is recommended. This system is essentially independent of cable length and temperature, and more important in systems that depend upon shunt calibration, is free of shunt calibration errors caused by IR drops across the cable.

Relative to the above, bear in mind that if the instrument was supplied as a calibrated system, with a transducer and shunt calibration resistor and it is necessary to remove and reinstall the system with a different length cable, the seven wire system must be used to assure a valid transfer of calibration data.

The table in Section II is helpful in minimizing temperature effects caused by cabling.

Customer application assistance is always available from Lebow Associates. Contacting either the factory or your area representative will bring a prompt response (list of representatives appears at rear of this manual).

OPTIONS: Options for use with the Model 7530 are as follows:
* Dual limit (two set point)
* Torque, speed, H.P. readout
* Rack mount adapter (19")
* Bar-scan readout
* 10,000 digital panel meter readout
* calibrated zero and/or span knobs.

II. Installation

Locating and Mounting: The Model 7530 is half rack size and can be adapted to a variety of mounting configurations such as:

1. As a bench top instrument. The standard unit is equipped with a swing away bail bar which holds the instrument at a convenient operating angle.

2. As a dual bench top unit when paired with another. In this configuration, when factory ordered, it is equipped with a full length swing away bail bar.

3. As a dual unit and when equipped with rack mounting plates, it may be installed in a standard 19" rack panel.

4. It may be combined with another half rack size instrument to form a full width suitable for rack mounting.

The rack mounting plates may be easily installed by removing the normal side plates. Hardware is captive to simplify this change. In addition, the mounting feet may be easily removed for installation in a rack panel.

See instrument outline drawing at end of this section.

NOTE: RACK MOUNTED INSTRUMENTS WILL WITHSTAND NORMAL SHOCK AND VIBRATION INCIDENT TO SUCH USE, BUT RACK MOUNT INSTRUMENT SHOULD NEVER BE SHIPPED INSTALLED IN A RACK UNLESS BRACING IS PROVIDED TO SUPPORT THE INSTRUMENT CHASSIS.

ENVIRONMENTAL CONSIDERATIONS: The instrument must be located in an indoor location and, ideally, where temperature extremes will not be encountered. Other conditions to avoid, include extreme humidity, corrosive atmospheres, and restricted ventilation. Exposure to corrosive atmospheres and continuous high humidity will almost certainly cause permanent damage to the instrument.

The instrument may be operated satisfactorily at any temperature within the specifications noted previously. However, temperature changes during its operation will cause some shift in reading. For example, a 25°F. shift in temperature will cause a 0.04% readout error. Of course, if the instrument is adjusted prior to
the reading, the error will be eliminated. Therefore, if the
instrument is operated in a reasonable temperature controlled
environment, further adjustments are unnecessary and instrument
operation is simplified.

POWER AND GROUND CONSIDERATIONS: Either 120 or 240 VAC 50/60 Hz
is required to operate the Model 7530 Indicator. As shipped from
the factory, it is set up for 120 volt operation.

To change to 240 volts operation, proceed as follows:

1. Remove the line cord from power socket at rear of in-
   strument.
2. Slide clear plastic cover to the left.
3. Remove the fuse by pulling the fuse puller out and to left.
4. Using a pointed instrument, such as a ball point pen, re-
   move the voltage program printed circuit card by engaging
   the hole in the center and prying outward.
5. Reverse the voltage program circuit card and reinsert so
   that the 240 volt marking is visible when reinserted in
   the socket.
6. Replace fuse, slide plastic cover to right and install
   line cord.

A high quality earth ground, of course, is ideal for operation of
the Model 7530 instrument. Many obscure problems in equipment of
this type can be traced to poor or inadequate grounds. Fortunately,
the instrument will function reliably with only a modest ground
connection such as provided by most wall receptacles. A power
line filter is included with the instrument which can effectively
suppress most types of transients which are likely to cause inter-
ference. Some precautions to observe are:

1. The ground pin on the power plug must be terminated. If
   the wall plug does not have a ground provision and a three
   wire to two wire adapter is used, the ground wire usually
   included must be slipped under a convenient screw at the
   wall plug and carefully secured.

2. Avoid using power receptacles which have high inductive
   loads connected to them. Transients generated by this
   type of load can cause unstable readings in the instrument.

3. In situations where use of a receptacle, described in 2,
   above, is necessary, an isolation transformer can be used
   between the power receptacle and the instrument. This
   transformer should have a one to one primary to secondary
   turns ratio. Time constants in such transformers will
   normally provide sufficient suppression of transients to
   assure stable operation. In particularly stubborn cases,
   it may be necessary to use a transformer with a static
shield between windings. In some cases, an additional line filter interfaced between the instrument and the power receptacle will cure transient problems. These are available at most electronic distributors. A one ampere rating is suggested. Careful ground is important in this instance also.

**TRANSDUCER CONNECTIONS:** Various cable options are discussed below. The transducer connection drawing at the end of this section should be studied thoroughly. Whichever wiring scheme is selected, all connections must very carefully soldered and then inspected for possible adjacent pin shorts. The jumper connections shown must be completed on the rear of the connector terminating in the instrument. Use of shielded wire is essential for optimum results. Shield drain wires should be twisted together and connected as shown.

Recommended cable types are as follows:

<table>
<thead>
<tr>
<th>Connection Type</th>
<th>Belden Part #</th>
<th>Lebow Part #</th>
<th>Alpha Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four wire</td>
<td>8723</td>
<td>597-002</td>
<td>6010</td>
</tr>
<tr>
<td>Six wire</td>
<td>8725*</td>
<td>597-019</td>
<td>6010</td>
</tr>
<tr>
<td>Seven wire</td>
<td>8725**</td>
<td>597-019</td>
<td>6012</td>
</tr>
</tbody>
</table>

* Green/White and Yellow/White pair not used.
** Yellow/White wire not used.

The Alpha cable shown does not have a color code system compatible with the transducer wiring drawing. If this cable is used, customer must devise suitable color code. Wires should be paired as follows: Pair 1, + excitation and - excitation; pair 2, + signal and - signal; pair 3, + sense and -sense, pair 4, calibrate (+signal) with other wire unused.

The cable captions are as follows. The user should review the three possibilities and decide which is most appropriate for his installation:

**FULL BRIDGE, 4-WIRE:** For cable lengths of 20' or less, under reasonable controlled temperature environment, the 4-wire cable configuration will be satisfactory for use, unless the special accuracy considerations discussed below are pertinent. Note, however, that assurance of optimum accuracy requires the full 7-wire cable system and that all performance specifications are based on the use of the 7-wire cable system.

**FULL BRIDGE, 6-WIRE:** This system includes a pair of noncurrent-carrying remote sensing leads which allow determination of the precise excitation voltage at the bridge. The instrument is a ratio measuring device and in order to make a precise determination of bridge output (mv/v), it must sense both the signal (mv) and the excitation (v) with great accuracy. Using only a 4-wire system, the excitation sensing must be done through the current-carrying excitation leads. With long cable lengths, the lead resistance can be appreciable and a significant voltage drop can occur. If the cable resistance changes (because of temperature change), or if the current changes
due to changes in bridge resistance (because of temperature or strain changes), a variation in excitation voltage is created, of which the instrument can have no knowledge, and erroneous readings result. The effect is small but, in the context of the accuracy capabilities of the instrument, it can become the limiting factor in system accuracy.

FULL BRIDGE, 7-WIRE: This system adds an additional wire which is used for the purpose of shunting one arm of the bridge with the calibration resistor, without having to make use of a signal lead. Using the 4-wire or 6-wire system, the current drawn by the stunt calibration resistor, located at the instrument, must flow through one of the signal leads creating an additional voltage drop which is additive to the signal and, hence, creates an error in reading during the calibration procedure. Although the effects are small, when it is considered that the instrument is resolving a few microvolts-per-digit, it can be seen that the error can be considerably larger than the combined effects of all other instrument errors, particularly if the cable length is relatively significant. The effect of the error causes the equivalent input value of a particular calibration resistor to become a function of the cable length or cable resistance. It is important to note that the effect is one of the calibration only, and not of measurement during normal operation. If the system is calibrated (and the calibration resistor determined) with the particular cables in place, and if it is acceptable to associate the calibration resistor with the particular transducer and cable, then the seventh wire is not necessary. However, if the transducer was calibrated (and the calibration resistor determined) at another location, using a 7-wire system (or a 4-wire or 6-wire system of essentially zero length), and it is necessary to make a valid transfer of that calibration to the new installation, irrespective of cable length or resistance, then the seventh wire must be included.

ANALOG OUTPUT: The analog output voltage is available on the rear barrier strip of the instrument. The terminals are marked "analog". The terminal marked "C" is connected to circuit common.

The analog output is internally adjustable from 1 to 5 volts for full scale on the display. Maximum current is 2 ma.

One precaution to observe deals with the possibility of ground loops when connecting foreign instruments to the 7530 Instrument. A ground loop can be generated if substantial current should flow through the shield wire as a result of uncommon grounds between the 7530 Instrument and the foreign instrument. If excessive noise appears on the analog output signal or if the 7530 Instrument display is unstable, a ground loop can be suspected. The cure is to be sure that all associated instruments are connected to a common ground point. Other possible arrangements include the lifting of all grounds except one in the instrument grouping. Experience will dictate the best arrangement.
III. SET-UP AND OPERATION

Digital display: For information on the operation of the digital display option, consult the display instruction manual.

Calibration procedure: After the load cell, torque pick-up or other transducer has been connected to the instrument, turn on the AC power switch and allow a 15-minute warm-up period.

Rotate knob lock slightly counter-clockwise and set the span and zero controls five full turns from their full counter-clockwise position (each has ten turns of total travel).

With zero mechanical input to the transducer, adjust the zero control for zero display reading and tighten knob lock.

Span setting can be accomplished in one of two ways depending upon whether the instrument was shipped as part of a precalibrated system or as an instrument only.

If the instrument has been precalibrated with a particular transducer, a calibration resistor and calibration number will usually be provided. The calibration resistor should be installed on the rear apron of the instrument at the terminals marked "CAL". With the calibration resistor in place, push the + "CAL" switch on the front panel and adjust the span control to the equivalent calibration number supplied. Lock the span control with the knob lock.

Release the + "CAL" switch and note the display reading. If it is not exactly zero, correct the reading with the zero control. Recheck the span by operating the + "CAL" switch, note the reading and make corrections as necessary. Recheck zero.

If the load cell was calibrated for both tension and compression or torque pick-up for clockwise and counter-clockwise use, two separate calibration numbers may have been supplied. Whichever is the case, depress the - "CAL" switch and note the reading. If it does not match the calibrate number supplied, it may be necessary to adjust symmetry pot P-1.

Note: When the control knob locks are operated, the display should be observed to be sure the zero and span adjustments are not disturbed.

If a calibration number is not available, a precisely known mechanical input must be applied to the transducer in order to establish calibration. If this method is chosen, proceed as below.

With zero mechanical input to transducer, set instrument zero as detailed previously. Apply a mechanical input to the transducer at or about the anticipated operating region and adjust the span control until the display indicates the input value. Recheck zero with zero mechanical input. Recheck span.

If the transducer is bidirectional, apply an opposite mechanical input to the transducer and note reading. If an exact reading is not noted, it may be necessary to adjust symmetry pot P-1.
To obtain a calibration number for future checks of the system, it is necessary to place a resistor across the "CAL" terminals on the rear of the instrument. This resistor should be a precision wire wound type or equivalent with a low temperature coefficient. The exact value is not critical but it should be such that the instrument will provide an indication of somewhere around 70% of full scale display reading upon actuating the "CAL" switch. See appendix 1 at end of this section.

The calibration resistor, then, merely simulates a mechanical input to the transducer by electrically unbalancing the strain gage bridge to produce an equivalent electrical output signal. If the calibrate resistor is determined as noted in the paragraph above, the resistor should be preferably left in place on the terminals provided or carefully preserved together with the calibration number noted.

ANALOG OUTPUT: The amplitude of the bipolar analog voltage appearing on the terminals on the rear apron of the instrument is continuously adjustable by means of a potentiometer on the main circuit card. Amplitude increases with clockwise rotation. With the control fully counterclockwise, the output level will be approximately one volt with a full scale reading on the display and will be approximately five volts at the other rotational extreme. Changing the instrument span setting will require resetting of the analog gain control in order to maintain a previously adjusted analog voltage setting. Voltage polarity will be as indicated by the display polarity sign. Refer to maintenance section for details.

If a particular application for the analog output voltage requires heavy filtering, the user may select filtered output for the analog voltage by means of a switch located on the Analog to Digital Converter printed circuit card located in the 7530 instrument. In the on position, the analog output voltage is filtered to either 2 or .2 Hertz depending upon the setting of the display switch adjacent. In the off position, the analog voltage response is 1,000 Hertz regardless of the position of the display switch.

FILTER SWITCH: A selectable filter is included in the 7530 Instrument. It is a multipole active pass type with cutoff frequencies of either 2 or .2 Hertz. The selector switch is located on the printed circuit card. If substantial low frequency variations exist in the transducer signal, it should be set to the .2 Hertz position.

LEGEND: If the Model 7530 Instrument is supplied with a transducer as a system, the correct legend will be supplied. Otherwise, a sheet of legends are included such as POUNDS, POINT FEET, KILOGRAMS, etc. The user may select an appropriate legend to suit his needs. With the bar-scan display, a target area is provided for the legend. When used with a digital panel meter equipped instrument, the
legend may be affixed directly above or below the digital panel meter.

**OPERATION:** After the above procedures have been completed, the instrument will operate with a particular transducer without further attention other than zero adjustments to compensate for tare loads on the transducer or substantial changes in ambient temperatures. However, it is good practice to check zero and span adjustments periodically to insure valid readings. Zero shifts can be caused by changes in tare loading on the transducer, extreme changes in ambient temperature, transducer damage and accidental changes of instrument control settings. After checking zero, operate the (+) calibrate switch and verify calibration numbers making minute adjustments as required with fine span control.

After first applying power to the instrument, zero shift errors will be introduced if readings are made immediately. As mentioned previously, a 15 minute warm-up period is recommended to allow the circuitry time to thermally stabilize.
APPENDIX I

SHUNT CALIBRATION: Shunt calibration is a method of setting and checking instrument sensitivity with a given strain gage transducer. Essentially, the process consists of shunting a value of resistance across one or two legs of a transducer bridge circuit. This simulates a mechanical input to the transducer by unbalancing the bridge and produces a proportional electrical output. The instrument used for readout thus displays this arbitrary quantity in whatever units of measurement being used such as pounds, inch-pounds, pounds per square inch, etc.

In most shunt calibrate systems the absolute value obtained is not important. Generally, the value lies in the range of 50% to 100% of the full scale output of the transducer.

The usual method of obtaining the shunt calibrate value is as follows:

1. With the transducer connected to the instrument, a full scale mechanical input is applied.

2. The instrument's span (sensitivity) control is adjusted to indicate the mechanical input quantity.

3. The mechanical input is removed and the shunt calibrate resistor placed across the bridge as described earlier.

4. The instrument display is read and noted.

5. The calibrate resistor, the number noted in 4. above and the transducer are now matched and form the basis of a transferable calibrated system.

It is possible to use this transducer with any suitable indicator as a calibrated system by first connecting the transducer to the indicator and then adjusting the span control with the calibrate resistor in place until the previously determined calibrate number is displayed. In addition, the calibrate number can be used to periodically verify system calibration.

As can be seen in the above explanation, the actual value of the calibrate number is not of significance. What is important is the relative calibrate number obtained when a particular resistor is used with a particular transducer.

A formula exists which can determine the value of the resistor required for a given electrical output. The formula is:

\[ Rs = R_b \left( \frac{1000}{4s} - 1/2 \right) \]

Where: \( Rs = \) Shunt calibrate resistor in ohms.

\( R_b = \) Strain gage resistance in ohms.

\( s = \) Bridge output in mv/v.
Example 1: A shunt calibrate resistor value is to be determined for a transducer of 350 ohms resistance and with an output of 2 mv/v full scale.

Calculation: \[ R_s = 350 \times \left( \frac{1000}{4 \times 2} \right)^{-1/2} \]

\[ R_s = 43,575 \text{ ohms} \]

The value of \( R_s \) calculated will provide a calibrate value of 100% of full scale. If a lesser calibrate number is desired, multiply the full scale mv/v (s in the above formula) by the percent of full scale desired prior to substituting in the formula. For example, assume a 70% value is desired:

\[ 2 \times \text{mv/v} \times 70\% = 1.4 \text{ mv/v} \]

\[ R_s = 350 \times \left( \frac{1000}{4 \times 1.4} \right)^{-1/2} \]

\[ R_s = 62,325 \text{ ohms} \]

Example 2. A shunt calibrate resistor with a value of 60,000 ohms is to be used with a 350 Ohms transducer. The relative output it produces can be calculated by the following:

\[ s = \frac{1000 R_b}{4 \times (R_c + R_b)} \]

\[ s = \frac{1000 \times 350}{4 \times (60,000 + 350)} \]

\[ s = 1.4541 \text{ mv/v} \]

Obviously, the results of these calculations are dependent upon the accuracy of the strain gage bridge resistance. Transducers of some manufacturers can vary in resistance as much as 1 to 2% or more. This, of course, has considerable effect on the value of the calibrate resistor calculated or the output resulting from a given shunt calibrate resistor.

Fortunately, this is of small consequence since only relative values are important in most applications as discussed earlier.

One further point merits discussion and this concerns the actual calibrate resistor. The resistor must be of high quality. Important parameters are low temperature coefficient (under 10 parts per million per \( ^\circ \text{F} \)), good long term stability (25 parts per million per year) and adequate wattage rating.
IV. MAINTENANCE

Adjustments: A number of adjustments are provided on the main printed circuit card in the 7530 instrument. Normally these adjustments are precisely set at the factory and will not require attention for extended periods of time. Unless component changes are necessary, these adjustments should not be disturbed unless the user is certain a problem exists.

The analog output span adjust is an exception to the above. It may be necessary to re-adjust this pot to conform to the users requirements.

Refer to assembly drawing D-27399 for test point and adjusting potentiometer locations.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>TEST POINT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-1</td>
<td>Display</td>
<td>Symmetry</td>
</tr>
<tr>
<td>P-2</td>
<td>Display</td>
<td>Bar-scan symm.</td>
</tr>
<tr>
<td>P-3</td>
<td>SK</td>
<td>AP-5 zero</td>
</tr>
<tr>
<td>P-4</td>
<td>LP</td>
<td>2 Hz zero</td>
</tr>
<tr>
<td>P-5</td>
<td>PT</td>
<td>Pos. Thresh</td>
</tr>
<tr>
<td>P-6</td>
<td>NT</td>
<td>Neg. Thresh</td>
</tr>
<tr>
<td>P-7</td>
<td>+exc, -exc.</td>
<td>Exc. symm.</td>
</tr>
<tr>
<td>P-8</td>
<td>CM</td>
<td>Common Mode</td>
</tr>
<tr>
<td>P-9</td>
<td>+exc, -exc.</td>
<td>Exc. amplitude</td>
</tr>
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<td>P-10</td>
<td>AN</td>
<td>Analog zero</td>
</tr>
<tr>
<td>P-11</td>
<td>AN</td>
<td>Analog out, span</td>
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<td>P-13</td>
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<td>Not used</td>
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<td>P-14*</td>
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<td>P-15</td>
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<td>P-16</td>
<td>LP</td>
<td>.2Hz zero</td>
</tr>
<tr>
<td>P-17</td>
<td>--</td>
<td>Not used</td>
</tr>
<tr>
<td>P-18*</td>
<td>Z</td>
<td>Course zero</td>
</tr>
<tr>
<td>P-19</td>
<td>--</td>
<td>Not used</td>
</tr>
<tr>
<td>P-20</td>
<td>--</td>
<td>Not used</td>
</tr>
<tr>
<td>P-21</td>
<td>--</td>
<td>Not used</td>
</tr>
<tr>
<td>P-22*</td>
<td>Z</td>
<td>Fine zero</td>
</tr>
</tbody>
</table>

* Located on front panel

S-1 Display filter select
S-2 Analog out. Filter
S-3 Excitation select

To enable a precise calibration, the following equipment is required:

1. Digital voltmeter capable of resolving 0.1 mv.
2. Transducer simulator with steps of 0.25, 0.50, 1.0, 1.5, 2.0, 3.0 and 5 mv/v (Lebow p/n 7905-103 recommended).
To calibrate the instrument, proceed as follows:

1. Remove top cover (two screws on top and one rear)
2. Remove option boards
3. If a horsepower or limit option board was removed, solder the jumper pad behind the power switch (S3-A)
4. On digital models, remove solder from rear section of bar/sym solder jumper and solder front section. (Located in front of conn. 2)
5. Set S-1 to the 2Hz position and S-2 to the out position.
6. Set S-3 to 10 volts excitation
7. Turn on instrument and allow a 30 minute warm up period.
8. Connect the -10 DVM lead to the junction of C4 and C5 (circuit common)
9. Connect the Hi DVM lead to +EXC", and adjust P-9 for a DVM reading of \( \frac{1}{2} \) the excitation voltage selected.
10. Connect the Hi DVM lead to "+EXC" and adjust P-7 for a DVM reading of \( \frac{1}{2} \) the excitation voltage selected.
11. Re-check "+EXC" and repeat steps 9 and 10 if necessary.
12. Connect Hi DVM lead to TP-Z and adjust front panel zero pot(s) for a reading of zero.
13. Connect Hi DVM lead to TP-CM. Short the + signal and - signal terminals of the transducer simulator together.
14. Note DVM reading and then short the junction of + signal and - signal to excitation. Adjust P-3 for DVM reading equal to the reading noted above (+.1mv).
15. Remove the lead from the junction of + signal and - signal to excitation. Connect it to + excitation. The DVM reading should be equal to the readings in step 14. If not, adjust P-8 to split the difference in the readings. Remove jumpers from + and excitation leave + and signal shorted.
16. Re-adjust the front panel pots for a DVM reading of zero (+.1 mv)
17. Move the DVM Hi lead to TP-SK. Adjust P-3 for a DVM reading of zero (+.1 mv).
18. Move the DVM Hi lead to TP-LP. Adjust P-4 for a DVM reading of zero (+.1 mv).
19. Move S-1 to the .2Hz position. Adjust P-16 for a DVM reading of zero (+.1 mv).
20. Re-check the zero for the 2Hz position of S-1. Repeat steps 18 and 19 if necessary.
21. Move the Hi DVM lead to TP-AN. Adjust P-10 for a DVM reading of zero (+.1 mv).
22. Remove short between + and - signal. Adjust the front panel zero pot (s) for a DVM reading of zero (+.1mv).
23. Move the Hi DVM lead to TP-SK. Adjust the front panel span pot (s) for a DVM reading of 735.0 mv (+.1mv) with an input of +2 mv/v from the transducer simulator.
24. Move the Hi lead of the DVM to TP-AN. Adjust P-11 for 1 volt (+.1 mv). This is the standard factory setting for this voltage. However, it can be set for higher values up to 5 volts.
25. Move the Hi lead of the DVM to TP-LP. Set the transducer calibrator to zero mv/v. The voltage at TP-LP should be zero (+.1 mv). If not, adjust the front
panel zero pot.

26. Move the Hi lead of DVM to TP-PT. Adjust P-5 for a negative voltage on TP-PT. Next turn P-5 back slowly until the reading just swings positive. (Approximate reading +.3 volts).

27. Move the Hi lead of the DVM to TP-NT. Adjust P-6 using the same procedure as in step 26 with the exception that the voltage swings from positive to negative. (Approx. -.3 volts).

28. Move the Hi lead of the DVM to TP-AN. Set the transducer calibrator for +2 mv/v. Note the voltage AN. Apply a - 2 mv/v signal. Adjust P-1 for a negative DVM reading which is equal to the positive reading noted above.

29. Move the Hi lead of the DVM to pin 3 of connector 1. Apply +2 mv/v from the transducer simulator. Note the voltage on pin 3.

30. Apply-2 mv/v from the transducer simulator. Adjust P-2 for a DVM reading equal to the voltage in step 29.

31. This completes the calibration. If solder jumpers were changed at the beginning of the procedure, return them to their original state. Replace option boards and top cover.

See individual option manuals for calibration of options.

DIAGNOSING TROUBLE: When operated within the specifications, the Model 7530 Instrument will provide years of trouble-free use. All components were carefully selected with reliability of prime importance. If difficulty should develop, the following checklist may assist in isolating the fault. (see schematic diagram D-27400.

1. AC Power
   A. Power cord plugged tightly into rear of instrument?
   B. Line voltage selector set correctly?
   C. Power switch on?
   D. Fuse o.k.?

2. Input/Output
   A. Transducer and cabling properly connected and excitation present?
   B. Analog output voltage present in presence of transducer signal? (In absence of display indication)
   C. Instrument display operational? (in absence of analog output voltage)
   D. Shunt calibrate resistor in place and correct value?
The block diagram at the beginning of section V can be very useful in isolating problems to a section or stage of the instrument. Referring to this drawing (B-28077), it is evident that some signal paths are serial while others are parallel. For example, the instrumentation amplifier section consisting of AP-2, AP-3 and AP-4 (see schematic drawing D-27400) is common to both instrument outputs - analog voltage output and display. Thus, problems in this stage will be evident in both of these areas.

If the analog output voltage appears normal but the display is not, the problem is likely in either the low pass filter stage (AP-6,12) or absolute value amplifiers QAP-1, 1/4, 2/4. If the REV polarity indicator fails to operate with a negative input signal from the transducer, the reverse amplifier is probably the cause QAP-1,3/4 - assuming of course, that other areas are operating normally.

The basic idea of troubleshooting this instrument as well as almost any electronic circuit, is to correlate visual symptoms and identify the general areas of difficulty; use available test equipment (voltmeter, scope, etc.) to pin point the specific stage and, finally the defective component (s). By referring to the block diagram and schematic diagrams, it should be possible to quickly isolate most circuit defects.
V. THEORY OF OPERATION

See block diagram B-28077 and schematic diagram D-27400 for circuit details.

Instrument amplifier: Amplifiers AP-2 and AP-3 form the differential pair while AP-4 performs the summing function. P-8 is adjusted for maximum common mode rejection.

Amplifier AP-1 acts as a buffer stage between the front panel zero controls and the instrumentation amplifier.

Switches S3-b and S3-C together with the calibrate resistor, located on rear terminal strip form the calibrate circuit. See Appendix I at the end of Section III for details.

Active Filter: AP5, together with C17, C25, R301, R51 and R43 form an active filter stage with a roll off of 1 db at 1KHZ. Resistor R17 sets the positive gain and resistor R76 with pot P-1 set the negative gain. D1C1 switches P 1 or P 17 to common depending on the control signal on pins 9 and 10. When the DPM option is installed, the control signal jumper is soldered in the DPM position. For all other options the jumper is soldered in the bar-scan position. P3 adjusts the offset of AP5.

Analog Output Amplifier: Amplifier AP-7 is the analog output amplifier. R-45 and R-62 set the gain of the stage. Pot P-10 is the amplifier offset adjust and P-11 sets the output voltage level. Maximum output current is 2ma. The frequency response of the analog output is determined by the position of switch S-2 and, if S-2 is in the "in" position, the position of S-1 determines the frequency response also.

Auto reverse amplifier: QAP-1 (3/4) with transistors Q1 and Q2 serves as the absolute value amplifier. QAP-1 (3/4) acts as a comparator to determine if the input of the absolute value amplifier is positive or negative. The comparator output drives transistors Q1 and Q2. Q1 turns on LED-2 when the input from the transducer is negative. Q2 pulls down the control arm D1C1 (if the bar-scan programming jumper is soldered) allowing P-1 to be used for adjusting symmetry.

Amplifier power supply: The power transformer supplies A.C. voltage to rectifier BR2. C9 and C10 are filter capacitors. Regulators Reg 3 and 4 together with R3, R 64, R68, and R69 form a dual tracking regulator circuit. C4 and C5 are output filter capacitors. Power supply output voltage is pos. and neg. 11 volts.

Digital power supplies: The power transformer supplies A.C. to rectifiers BR1 and BR3. C1 and C8 are filter capacitors. Reg. 1 supplies positive 5 volts and Reg. 2 supplies positive 12 volts. C2 and C3 are output filter capacitors.
Switchable Active Filter: Amplifiers AP-12 and AP-6 and their associated components form a 5 pole Bessel low pass active filter. Switch S-1 provides a choice of either 0.2HZ or 2HZ response. (1db down at the selected frequency). Pots P-4 and P-16 are offset pots for this filter stage.

Absolute Value Amplifier: Amplifiers QAP-1 (1/4) and (2/4) and their associated components form the absolute value amplifier circuit. This circuit is employed to effect automatic polarity selection when the instrument is used with bi-directional transducers.

The filtered signal output from AP-6 drives the inverting input terminal of QAP-1 (1/4) and the non-inverting terminal of QAP-1 (2/4). Amplifier QAP-1 (1/4) amplifies signals only in the negative regions because of the reverse clamp formed by D-5, while QAP-1 (2/4) amplifies signals only in the positive region because of the reverse clamp formed by D-7. Diodes D-4 and D-6 are steering diodes and their cathodes being common, form a summing junction. Since the positive region amplifier is non-inverting and the negative region amplifier is inverting, the output at the cathode junction is always positive regardless of input signal polarity.

P-5 precisely sets the cross-over threshold for negative inputs while P-6 performs this function for positive inputs.

P-2, the symmetry potentiometer assures uniform gain characteristics for the absolute value amplifier in both the positive and negative regions.

High voltage power supply: The power transformer supplies A.C. to rectifier BR1 (on rear circuit board). C2 is a filter capacitor and R1 is a bleed resistor. R2 is a current limit. D2 1,2, and 3 regulate the voltage to the display. Two solder jumpers are used to set the output voltage. With a bar-scan display, all zener diodes are used and the transformer solder jumper is soldered for bar scan. Supply output voltage will be approximately 235 volts. When a digital display is used, one zener diode is shorted out and the transformer solder jumper is soldered for gas-discharge. Output voltage will be approximately 170 volts.

Excitation power supply: V ref is a precision voltage reference. It feeds a series of voltage divider resistors which supply the reference voltage for the 3 switchable excitation voltages. Switch S-4 is the excitation selector and AP10 and AP11 are buffer amplifiers. AP11 supplies the reference voltage for the Digital Panel Meter Option. AP10 supplies the reference voltage to AP8 and AP9 which act as error amplifiers. The voltage from the pos. and neg. sense leads (from Recp. 1) is fed to the error amplifiers which, in turn, drive the control pins of Reg 5 and Reg. 6. BR-2 supplies the raw D.C. power to the excitation supply as well as to the amplifier power supply.

Pot P-9 sets the excitation amplitude. The excitation symmetry is set by pot P-7.