SYSTEM CALIBRATION TECHNOLOGY

BLH

MODEL 625
Weigh System Calibrator
Operator's Manual

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SECTION 1. General Information

1.1 GENERAL INFORMATION

1.1.1 Model 625.

The BLH Model 625 Calibrator (Figure 1-1) is a compact, high accuracy, portable, resistance network specifically designed to simulate the output of full bridge strain gage type transducers. Through the use of a highly stable resistance network the calibrator provides an accurate method of simulating 120-ohm or 350-ohm transducers. This circuitry provides 55 precision mV/V output signals in 5 ranges of 11 settings each. When powered by a known, regulated voltage other than the indicator excitation voltage supply, the calibrator can be used to check the linearity, sensitivity, and for general troubleshooting of an indicator, recorder, any millivolt instrument, or a complete load or force measuring system.

1.1.2 Model 624.

The BLH Model 624 Vernier, Figure 1-1, is a compact, portable, specially designed test circuit which, when used in conjunction with the Model 625, eliminates the need to apply force to transducers in order to obtain a desired indicator readout. This combination provides both precision test signals and a finely variable millivoltage useful for testing and adjusting set point controllers, signal conditioning units and indicators. It is particularly suitable for checking Electronic•Zero, circuits, Frontset and Backset controls and response of all millivolt instruments to varying input signals. Set point controllers can be adjusted to within the accuracy allowed by the controller, typically ±1 count.

1.2 DESCRIPTION

1.2.1 Model 625.

The Model 625 components include two rotary switches labeled RANGE and STEP to provide the five ranges of mV/V output with 11 settings for each range, see Table 1-1; a two-position toggle switch to select either 120-ohm or 350-ohm operation, and 10 color-coded binding posts for interconnecting the 625 with the instruments being tested.

All components are mounted on the front panel which is housed in a finished mahogany case. The 625 is also available in a larger case designed to hold both the 625 and the 624.

1.2.2 Model 624.

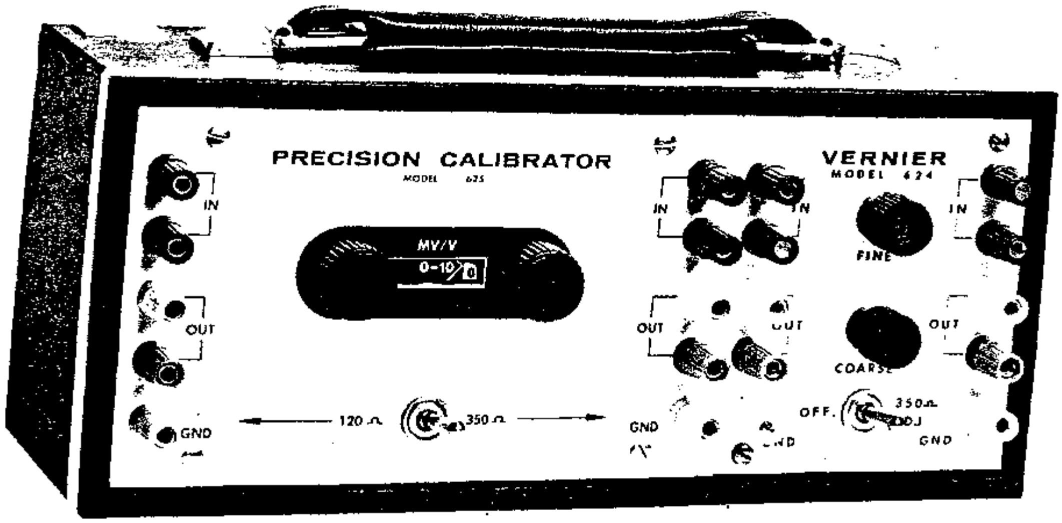
The Model 624 operates as a voltage divider to provide a small, continuously variable millivoltage (0-1 mV/V) output useful for checking and adjusting many BLH plug-in options. The components of the 624 include two potentiometers labeled COARSE and FINE for varying the millivolt output; one two-position (OFF/350 OHM ADJ.) toggle switch for connecting and removing the 624 from the circuit, and two groups of color-coded binding posts for interface with the 625 and connections to the instrument to be tested. All are mounted on a narrow panel and housed in a finished mahogany case, dimensioned to house both the 624 and the 625.

1.3 SPECIFICATIONS.

Specifications for both the 625 and the 624 are shown in Table 1-2.

Table 1-1. 625 Calibrator Output Settings

OUTPUT RANGE"	GRADUATED IN	
0-0,5 mV/V	10 steps of 0.05	mV/V each
0-1 mV/V	10 steps of 0.1	mV/V each
0 - 2 m V / V	10 steps of 0.2	mV/V each
0-5 mV/V	10 stops of 0.5	mV/V each
0-10 mV/V	10 steps of 1.0	mV/V each



Combination Model 624 /625

Model 625 Calibrator

Figure 1-1. Model 625 Precision Calibrator and Combination Model 625/ Model 624 Vernier

Table 1-2. Specifications.

MODEL 625	
OUTPUT ACCURACY:	Each point is accurate to 0.05% of reading, or 0.02% of range, or 0.003 millivolts per volt, or ±2 microvolts, whichever is greater.
ZERO STABILITY:	Less than 2 microvolts.
CALIBRATION STABILITY:	Less than 0.02%.
BRIDGE RESISTANCE SELECTOR:	120 ohms and 350 ohms.
INPUT VOLTAGE LEVELS:	120 ohms - 0-12 350 ohms - 0-25
OPERATING TEMPERATURE:	0 to 120°F (-17.8°C to +49°C).
SIZE:	8" x 5" x 4" approx .With Model 624 - 12" x 5" x 4" approx
WEIGHT:	3-3/4 lbs. approx.
MODEL 624	
BRIDGE IMPEDANCE:	350 Ohms
RANGE:	0 to 1. mV/V
SIZE:	12" x 5" x 4" approx.
WEIGHT (with Model 625):	4-1/4 lbs. approx.

SECTION 2. Installation

2.1 INTRODUCTION

This section contains information on unpacking, inspection, installation, and repacking for shipment, if necessary.

2.2 INITIAL INSPECTION

2.2.1 Mechanical Inspection

If external damage to the shipping carton is evident, ask the carrier's agent to be present when the instrument is unpacked. Check the unit for external damage such as broken controls or connectors, and dents or scratches on the panel surface. If damage is found, refer to Section 2.3 for recommended claim procedure and repacking in-formation. If shipping carton is not damaged, check the cushioning material and note any signs of severe stress as an indication of rough handling in transit. Retain the packing material for possible future use.

2.2.2 Electrical Check

Check the electrical performance of the equipment as soon as possible after receipt. The normal operation process should provide a valid indication of satisfactory performance.

2.3 CLAIMS AND REPACKING

2.3.1 Claims for Damage

If physical damage is evident or if the instrument does not meet specifications when received, notify the carrier and the nearest BLH Sales/Service Office. The Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

2.3.2 Repacking for Shipment or Storage.

If the instrument is to be shipped to a BLH Sales/ Service Office, or to the factory, attach a tag showing owner with address, instrument model and serial number and the repair required. The original shipping carton and packaging material may be reusable. The BLH Sales/Service Office will also provide information and recommendations on materials to be used if the original packaging material is not available or not reusable. Materials should include, (1) a double-walled carton (check with a freight carrier for test strength required.), (2) polyfoam, heavy paper, or sheets of cardboard, to protect all instrument surfaces: use extra material around projecting parts of the instrument, (3) at least four inches of tightly-packed, shock absorbing material surrounding the instrument. Close the package securely with heavy paper tape.

2.4 INSTALLATION

2.4.1 General

The BLH Model 625 and combination Model 625 and 624 are portable units and require no special installation procedures.

2.4.2 Location

The instruments will operate satisfactorily between 0°F and 120°F in most environments. They should be stored in an area free from unusual temperature extremes, high humidity, and vibration.

2.4.3 Line Losses.

The Model 625 should be placed within three feet of the point of connection to the instrument or system to be tested. It has been calibrated with four lengths of #20 gage wire, each three feet long. For most applications, three feet of cable will be sufficient. When longer lead lengths are required, the additional lead wire resistance will reduce the output voltage in proportion to the ratio of the additional lead resistance to the bridge resistance. This can be compensated for by using a larger diameter lead wire or applying a correction factor to the indicated output voltage. For example, each additional foot of #20 gage wire (.01 ohm/ ft.) will add 02 ohms of lead wire resistance for two wires. This means that the 350 ohm output will be reduced by 02/350 = .006% for each additional foot of cable. A useful formula for deriving the percent of 'error of the output voltage is:

$$\left[\frac{R_B + 0.06}{R_B + 2L\left(\frac{ohms}{ft}\right)} - 1\right] 100 = \%\, of\ error$$

where L is the length (in feet) of cable used, RB is the bridge resistance, and ohms/ft, is the resistance of wire per foot.

2.5 ELECTRICAL CONNECTIONS.

2.5.1 Power Requirements.

Power for both the 625 and the 624 is provided by the instrument under test from the excitation voltage power supply (black and green terminals).

CAUTION: DC voltage is applied to the black and green or excitation voltage terminals of the instrument under test. Be careful not to short these together or serious damage to the power supply could result

2.5.2 Model 625.

Connections to the 625 are made at the 10 color-coded binding posts on the aides of the front panel (see fig. 2-1). Connections for 120-ohm operation are made to the posts on the left side and for 350-ohm operation, to the right side. Check that all connections are tight.

NOTE: A 5-conductor cable of #20 gage stranded wire, 3 feet in length, should be used for hookup of the Model 625 Calibrator to the system being tested.

Disconnect the transducer for which the Model 625 is substituting before calibrating or testing. If the equipment to be tested is manufactured by BLH and is provided with color-coded terminals, a direct color-to-color• connection can be made. Otherwise connect the 625 as follows:

BLACK - Excitation Voltage

GREEN+ Excitation Voltage

WHITE + Signal Out

RED - Signal Out

YELLOW GROUND

Examples of the Model 625 connected to various BLH equipment are shown in Figure 2-2.

NOTE: The Model 625 is wired for compression transducer substitution. If the 625 is used to substitute for tension transducers reverse the WHITE and RED leads at the point of connection to the system under test.

When longer transducer leads are required or several transducers are combined for a single input, connect the 625 at the junction or extension box where the cables or transducers are connected (see fig. 2-3).

NOTE: For the most accurate calibration or the most efficient troubleshooting technique, ALWAYS connect the 625 at, or as close to the transducer as possible.

2.5.3 SWITCHING AND BALANCING UNITS

When using the Model 625 in a system which includes one or more Switching and Balancing Units, connect the 625 at the Switching and Balancing Unit (see Figure 2-4) or in the case where a junction box is used, connect the 625 to the junction box with the Switching and Balancing Unit in the circuit.-

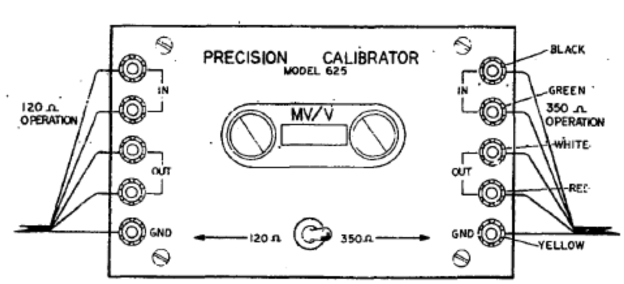


Figure 2-1. Model 625 Connections.

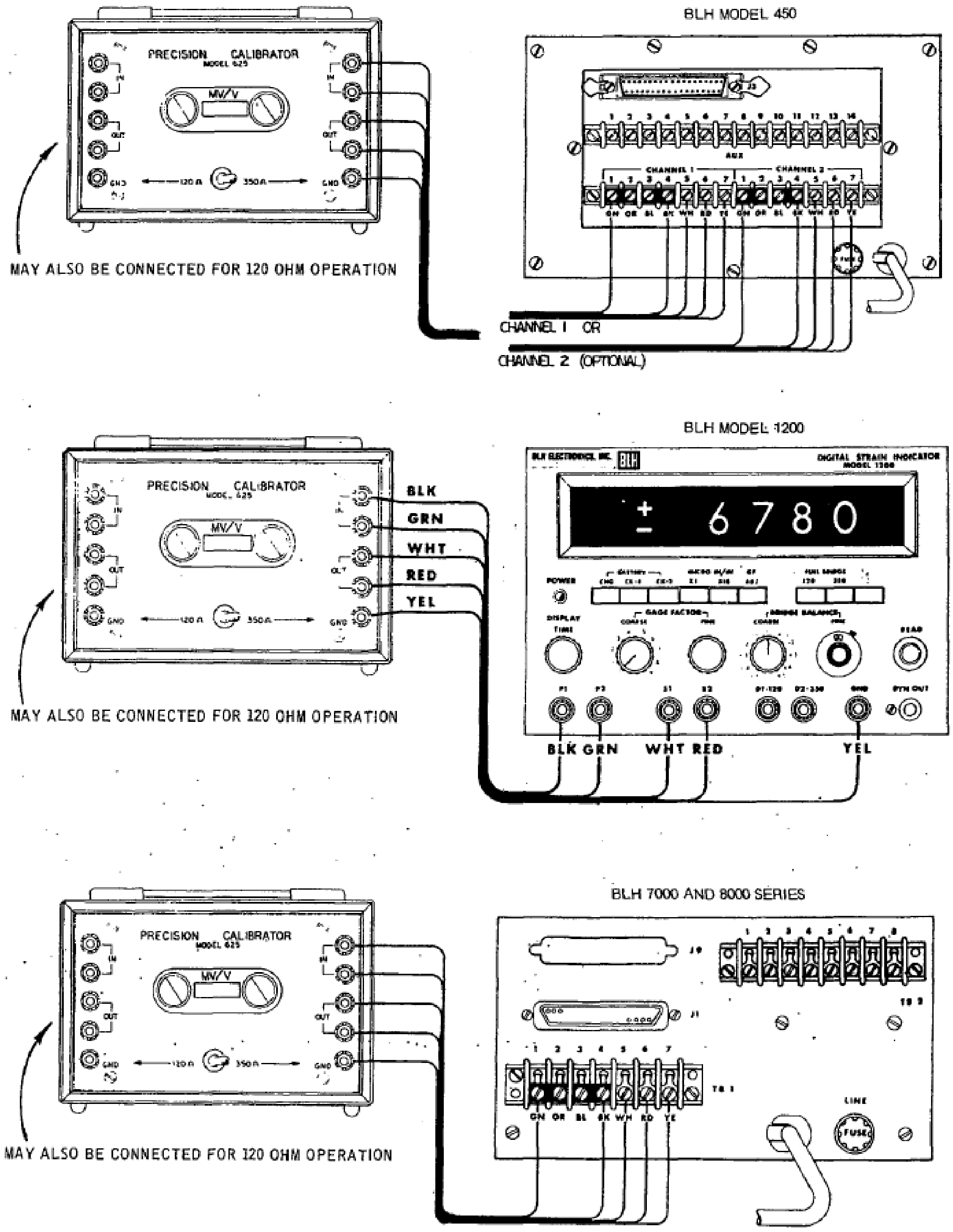


Figure 2-2. Typical Connections to Various BLH Equipment

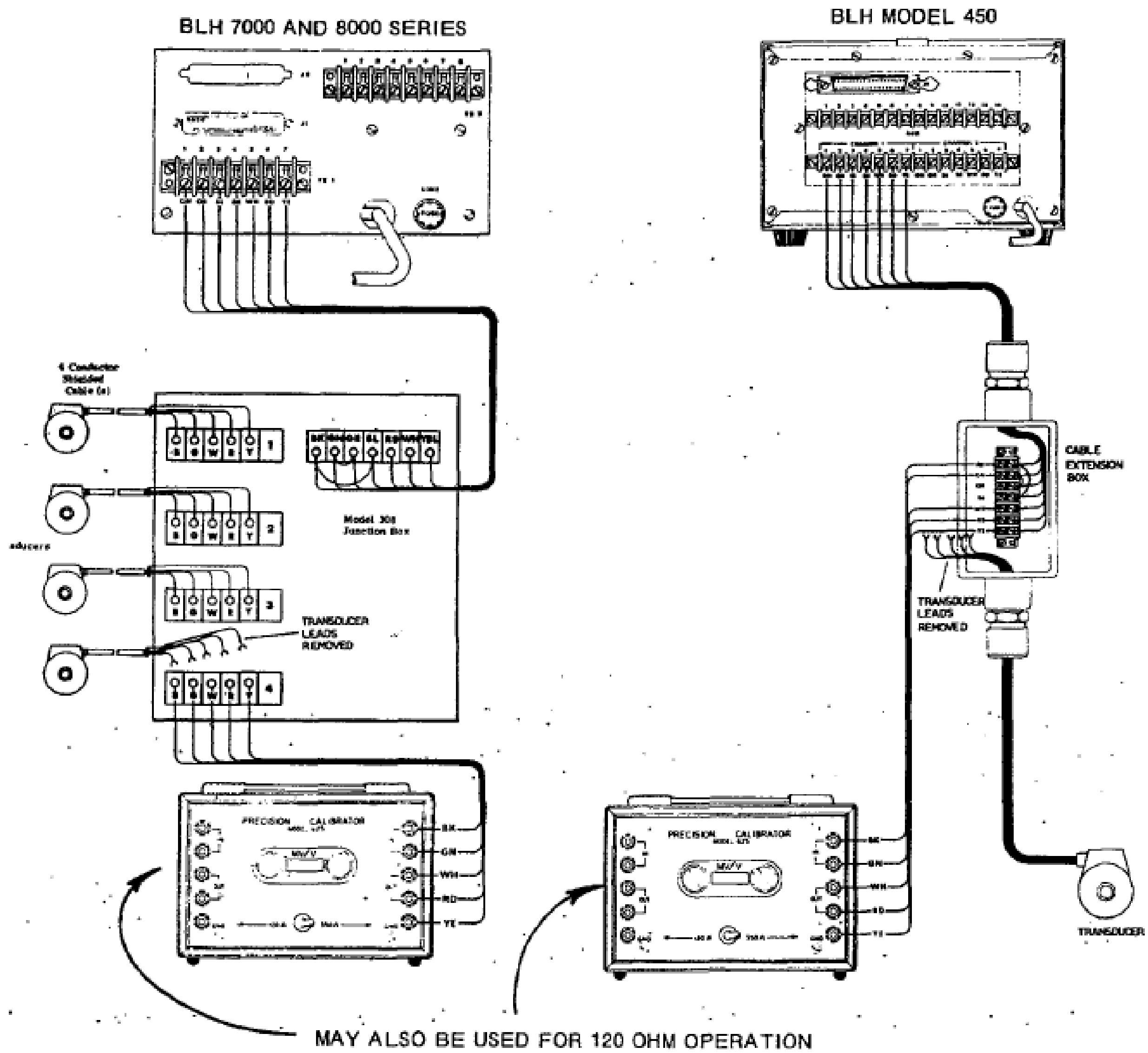


Figure 2-3. 625 Connections to J-Box and Extension Box

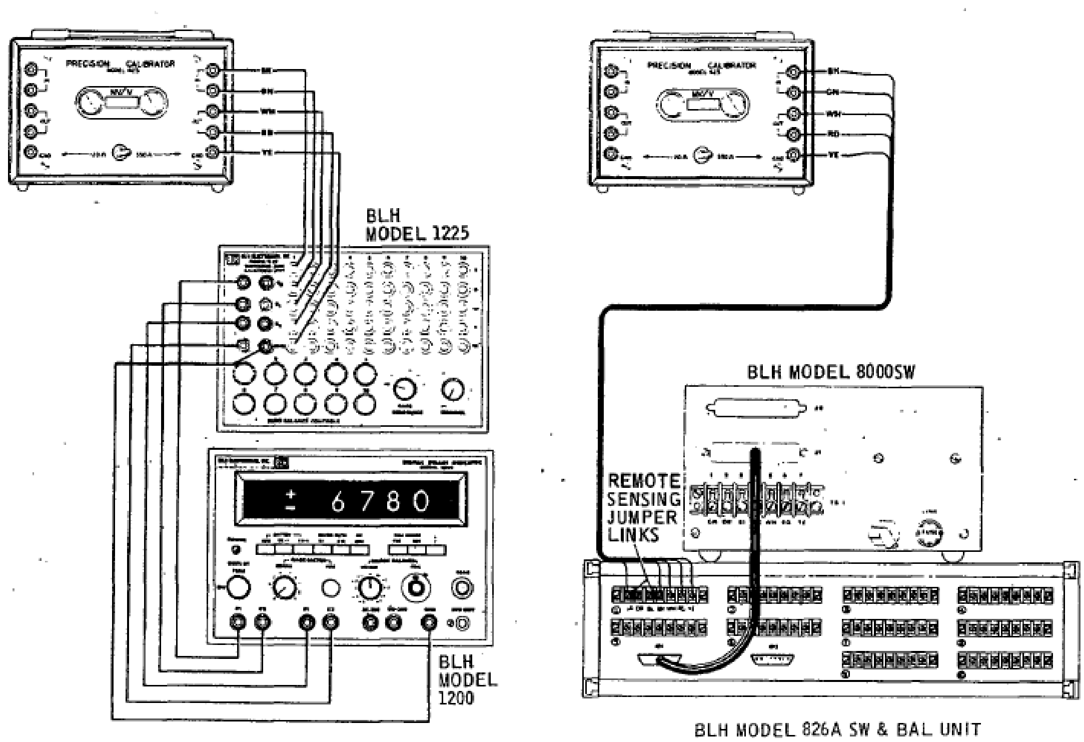


Figure 2-4. 625 Used with Switching and Balancing Units

2.5.4 REMOTE SENSING.

Special attention must be paid to systems using remote sensing. Remote sensing is a bridge excitation technique, which cornpensates for the change in bridge excitation voltage caused by ambient temperature variations in systems where the transducers are placed a considerable distance from the instrumentation. Ambient temperature variations .tend to raise or lower the resistance of the cable which in turn reduces or increases the applied bridge voltage in proportion to the change. To compensate for this effect-, two additional leads are connected from the instrumentation to the power input leads of the transducer at, or as close to the transducer as possible, typically at the cable extension or junction box. Internal circuitry is then able to sense and regulate the excitation voltage,

If the Remote Sensing technique is used, it will be connected as shown in Figure 2-5. When standard transducer cable lengths are used (approx. 10 ft, or less), the remote sensing terminals must be jumpered as shown in Figure 2-6, These situations have no effect on calibration when properly installed.

NOTE: When it is desired to connect the 625 or the 624 directly at the instrument for any system with Remote Sensing capabilities, these terminals must be jumpered at the instrument.

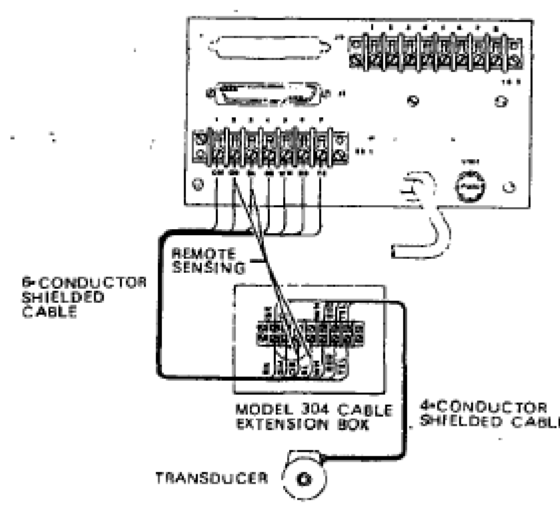


Figure 2-5, Remote Sensing Connections.

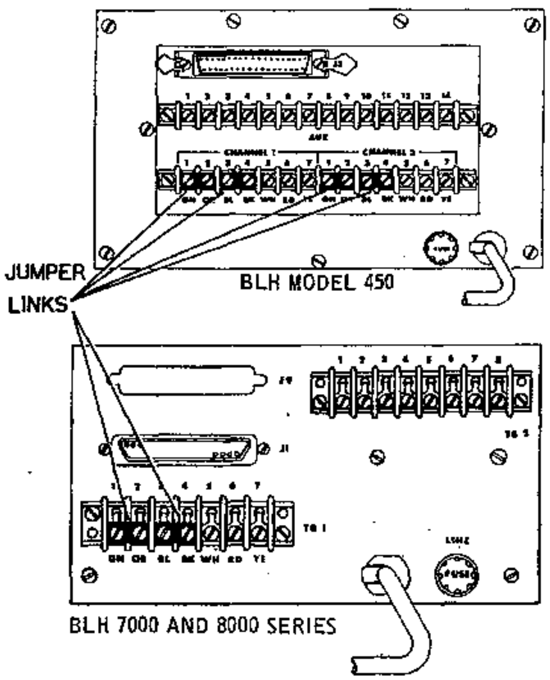


Figure 2-6. Jumper Links Installed.

If the system includes a Switching and Balancing Unit and Remote Sensing, Calibration must be made with the Remote Sensing terminals or connector pins jumpered at the Switching and Balancing Unit for accuracy.

MODEL 625/624

When the Model 625 is combined with the Model 624, it will be buss-wired to the 624 by means of the adjoining binding posts in the center of the front panel of the combination model (see fig. 2-7). All connections to the 625 will then be made at the right side terminals of the Model 624.

MODEL 624.

Connections to the Model 624 are made at the ten color-coded binding posts on the sides of the front panel (see Fig 2-7). The terminals on the left side are used only for connecting the Model 624 with the Model 625. The right side binding posts are used for all connections to the equip-ment to be tested. Remote Sensing jumper links must be installed (if the indicator is equipped with Remote Sensing) on the indicator before applying power to the indicator after the transducer leads have been disconnected.

NOTE: When using the combination Model 624/625, ALL connections for the use .of either device will be made at the right side binding posts of the 624. When using just the 625, the OFF/350 ohm switch MUST be in the OFF position.

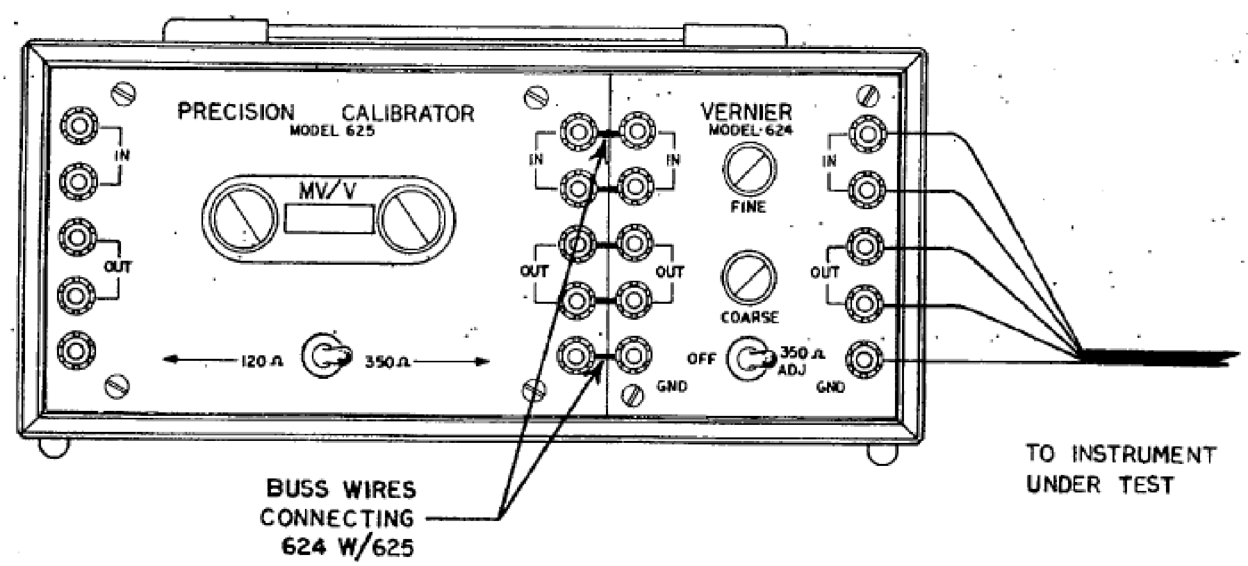


Figure 2-7. Combination Model 624/625 Connections

The Model 624 does not provide a calibration signal and therefore requires no special cable length. But when using the 625 without the 624, refer to Sections 2.4.3 and 2.5. The connection arrangement is the same as the 625, i.e., when testing BLII equipment with color-coded terminals a color-to-color connection can be made, otherwise connect the 624 as follows:

BLACK - Excitation Voltage

GREEN + Excitation Voltage

WHITE + Signal Voltage

RED - Signal Voltage

YELLOW GROUND

The Model 624 will be connected as described in the previous sections for all of the applications described in this section. Examples of connecting the 624 for adjustment or troubleshooting of Peak and Hold circuitry, Frontset and Backset Controls, Current Out- • put Amplifiers, and Electronic Zero circuitry are shown in Figure 2-8.

2.6 CONTROLS

2.6.1 Model 625

Controls consist of the front panel mounted RANGE and STEP switches, the 120-ohm/350-ohm BRIDGE RE¬SISTANCE SELECTOR switch, and ten color-coded binding posts for all connections. Refer to Figure 2-9. Operation of these controls is covered in Section III of this manual.

2.6.2 Model 624

Controls consist of the front panel mounted FINE and COARSE controls, the OFF/350 ohm (effectively off/on) switch, and ten color-coded binding posts for all connections. Refer to Figure 2-9. Operation of these controls is covered in Section III of this manual.

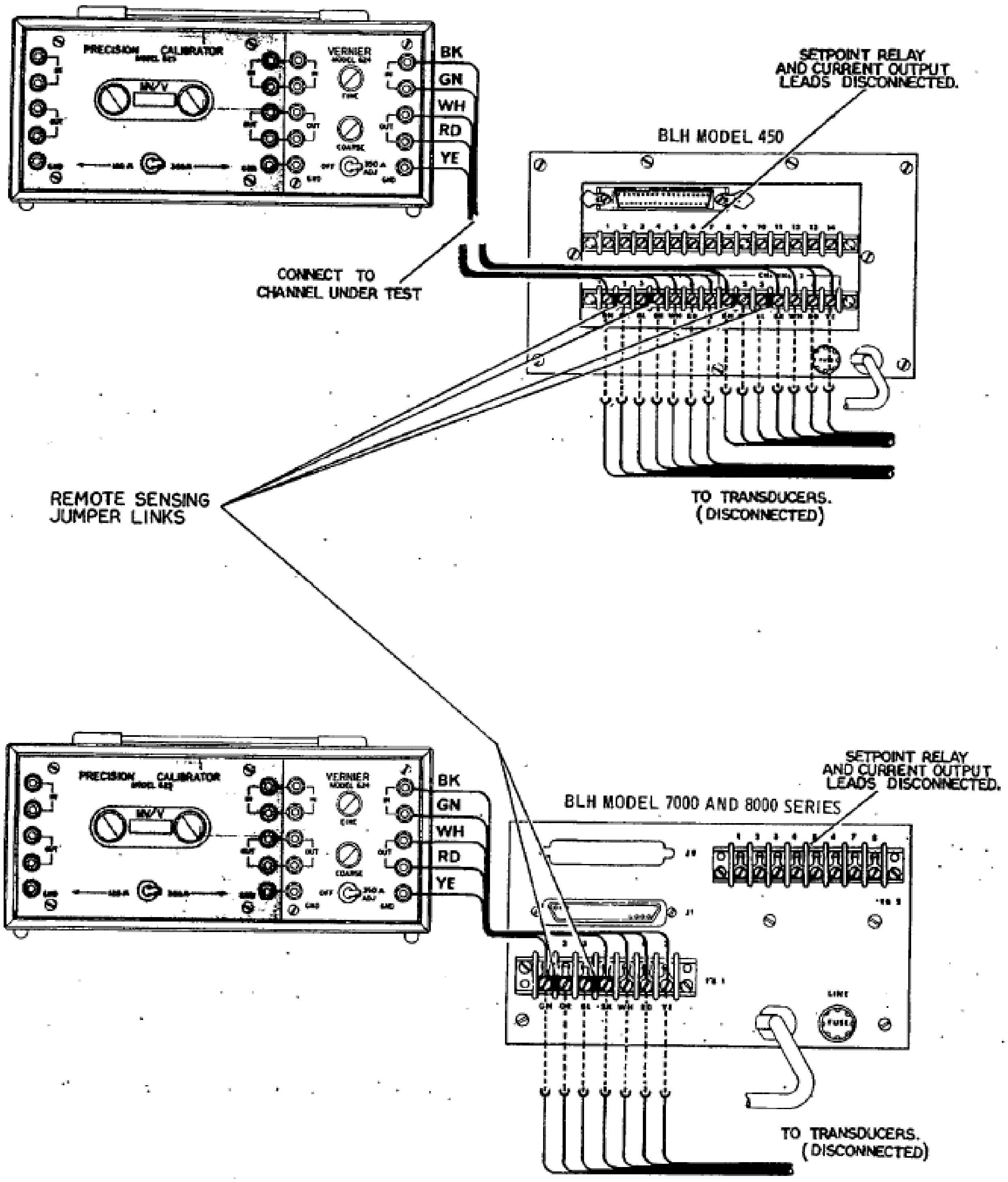
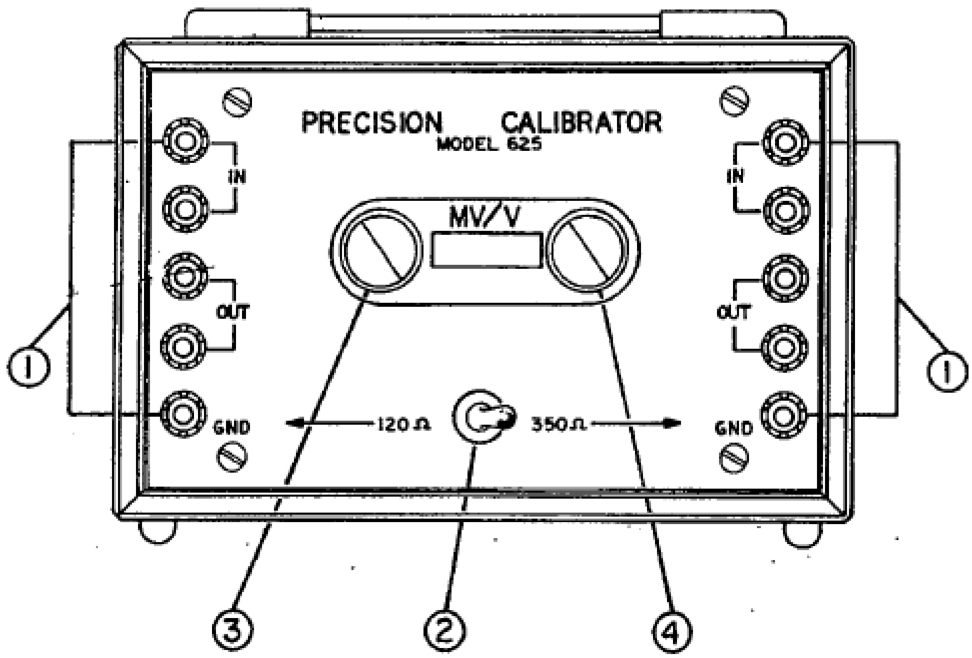


Figure 2-8. Typical 624 Connections to BLH Equipment



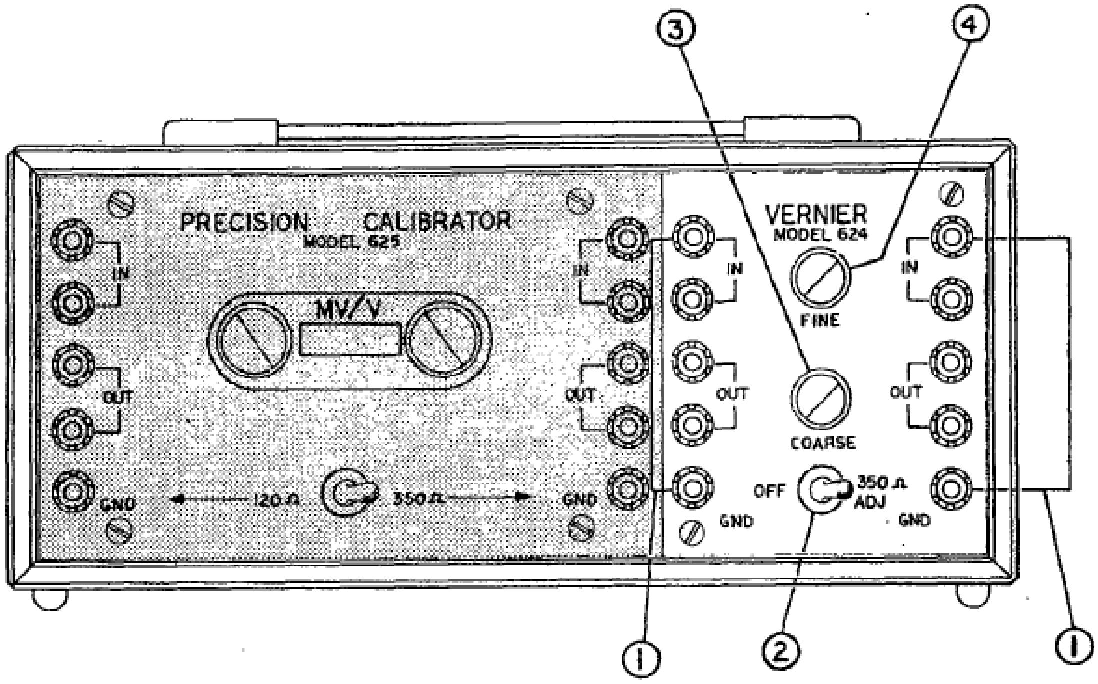
1. Color-coded Binding Posts. Right side posts are used for 350Ω connections; left side posts for 120Ω connections.

2. Bridge Resistance Selector switch. Toggle switch used for selecting either 120Ω or 350Ω operation.

3. Range switch. Rotary switch used for selecting the appropriate mV/V output range.

4. Step switch. Rotary switch used for selecting the mV/V increments within the selected range.

Figure 2-9. Model 625 and Model 624 Control Data



1. Color-coded Binding Posts. Right side posts are used for all interconnections with the equipment to be tested; left side posts are used for connecting the 624 with the 625.

2. OFF/350Ω ADJ switch. Effectively an on/off switch used for disconnecting or connecting the 624 to the test circuit.

> **IMPORTANT**
>
> THE OFF / 350 OHM ADJ SWITCH ON THE MODEL 624 MUST BE IN THE OFF POSITION WHEN USING THE MODEL 625 FOR CALIBRATION IF SUPPLIED IN THE COMBINATION MODEL 624 / 625 UNIT.

3. COARSE adjustment control. Used for rough adjustments over a small range of millivoltage.

4. FINE adjustment control. Used for precise adjustments over a smaller range of millivoltage.

Figure 2-9. Model 625 and Model 624 Control Data (Cont'd)

SECTION 3. Operation

3.1 MODEL 625 OPERATION

3.1.1 General

The general procedure for calibrating an instrument or instrument/transducer combination (system) is to apply a known input signal and adjust the instrument SPAN control until the readout indicates the correct reading (+indicator accuracy). The calibration of most BLH instruments is in millivolts per volt and is imprinted on a data plate installed on the instrument, e. g. 2 mV/V = 50,000 lbs.

Strain indicators are normally calibrated in micro-inches per inch (microstrain) which must be converted to mV/V when using the Model 625 as the calibration source. Microinch per inch to mV/V conversions are listed in Table 3-1.

The precision millivoltage output of the 625 can be used to simulate the output of one or more transducers when calibrating a weighing system thus eliminating the need-for applying force to the transducers. •

Procedures for connecting the 625 with the unit under test and initial control settings are described in Figure 3-1.

3.1.2 DC System Calibration

3-8. Transducers in a multiple transducer de weighing system are connected in parallel and the calibration of the system is stated as the output of one transducer at full scale, i.e. with the greatest load the system would normally be required to weigh. For example, a four transducer system with a calibration of 1 mV/V = 60,000 lbs means that each cell is supporting 15,000 lbs of live load and has an output of 1 mV/V when the indicator or readout is displaying 60,000 lbs.

In addition to the live (net) weight, the weight of the vessel, Scale, platform, etc. (tare), supported by the transducers, 'usually represents a substantial part of the gross weight. In a properly designed system, the transducer capacity is sufficient to handle the maximum anticipated gross weight with allowances for overload conditions. In the example above, assume a vessel weight (tare weight) of 60,000 lbs. The transducers in this case would have a minimum capacity of 30,000 lbs each. If 2 mV/V load cells were used, the output of each cell at full scale load would be 2 mV/V, 1 mV/V for tare and 1 mV/V for live load. Tare weight in excess of approximately 5% of full scale is normally cancelled by internal adjustment of the indicating instrument. In this example, mV/V, representing the tare portion of the signal, would be suppressed within the indicator, leaving a live load signal of 1 mV/V per cell at full scale. Calibration under these conditions would remain at 1 mV/V = 60,000 lbs.

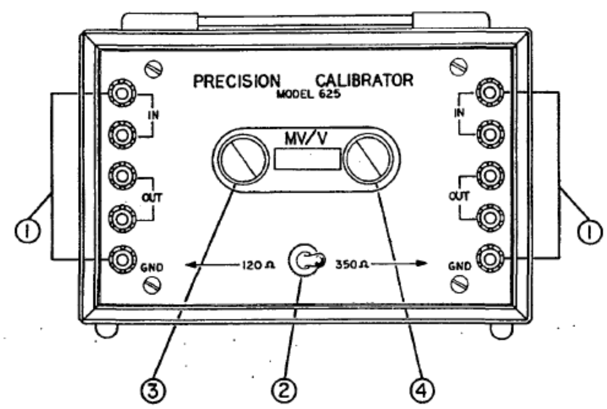
One of the most accurate methods of calibrating a multi transducer weighing system is to substitute the 625 for one of the transducers directly at the summing junction box used with these systems. Using this method, any line losses incurred in the inter-connecting cable network are compensated for while the instrument is being calibrated.

Substitution is made by disconnecting the leads of any one load cell from the terminal block inside the j-box and connecting the proper side of the 625 to the block as described in Section II of this manual. The full scale signal can then be obtained by appropriate settings of the 625 controls. One of the most accurate methods of calibrating a multi transducer weighing system is to substitute the 625 for one of the transducers directly at the summing junction box used with these systems. Using this method, any line losses incurred in the inter-connecting cable network are compensated for while the instrument is being calibrated.

Table 3-1. Conversion Table

CONVERSION TABLE - MICROINCHES PER INCH TO MILLIVOLTS PER VOLT (GAGE FACTOR =2)

p. INCHES	Mv/V	*ii* INCHES	Mv/V	*p.* INCHS	Mv/V
0	0	1400	.70	4000	2.00
100	.05	1500	.75	4500	2.25
200	.10'	1600	.80	5000	2.50
300	.15	1800	.90	5500	2.75
400	.20	2000	1.00	6000	3.00
500	.25	2200	1.10	6500	3.25
600	.30	2400	1.20	7000	3.50
700	.3,5	2500	1.25	7500	3.75
800	.40	2600	1.30	8000	4.00
900	.45	2800	1.40	8500	4.25
1000	.50	3000	1.50	9000	4.50
1200	.60	3500	1.75	9500	4.75
				10 000	5.00



1. Attach the 5-conductor cable to the correct binding posts; 120Ω on the left side, 350Ω on the right side.

2. Set the Bridge Resistance Selector switch to the correct transducer resistance; 120Ω or 350Ω. Remove the transducer leads from the terminals at the point where 625 is to be connected. Connect the 625 in place of the transducer(s) (see paragraph 2-23). Jumper the Remote Sensing terminals if necessary (see paragraphs 2-28 and 2-29).

3. Set the Range switch to the appropriate output range.

4. Set the Step switch to zero.

Refer to paragraphs 3-2 through 3-25 for calibration information and paragraph 3-30 for troubleshooting information.

Figure 3-1. Model 625 Operation

One of the most accurate methods of calibrating a multi transducer weighing system is to substitute the 625 for one of the transducers directly at the summing junction box used with these systems. Using this method, any line losses incurred in the inter-connecting cable network are compensated for while the instrument is being calibrated.

Substitution is made by disconnecting the leads of any one load cell from the terminal block inside the j-box and connecting the proper side of the 625 to the block as described in Section II of this manual. The full scale signal can then be obtained by appropriate settings of the 625 controls.

Using this calibration procedure, the remaining transducers act as a load, dissipating a proportionate amount of the 625 output. For example, in a four transducer system, each transducer remaining in the circuit will absorb one quarter of the 625 output. To compensate for this loading effect, the 625 output would have to be increased by a factor of the number of transducers in the system, in this case - four. In the earlier example, 1 mV/V = 60,000 lbs, the

625 would be set at 4 mV/V to obtain the full scale reading. See Figure 3-2.

The 625, when connected directly to the terminals of the indicator, will be set at the specified indicator calibration millivoltage, regardless of the number of transducers in the system.

CAUTION: DISCONNECT ANY EXTERNAL WIRING FROM SETPOINT RELAY CONTACT TERMINALS AND/OR CURRENT OUT¬PUT TERMINALS ON THE INDICATOR TO PREVENT OPERATION OF CON¬TROLLED EQUIPMENT DURING CALIBRATION.

The following formula can be used to deter-mine full-scale calibration when a system uses less than the maximum transducer output for full-scale calibration or when the indicator calibration data plate is lost or destroyed.

$$A \times C \times D = E \cdot$$

Where:

A = Maximum net (live) load
B = Total system capacity
C = Full output of transducers (parallel)
D = Number of transducers in system
E = Full Scale calibration

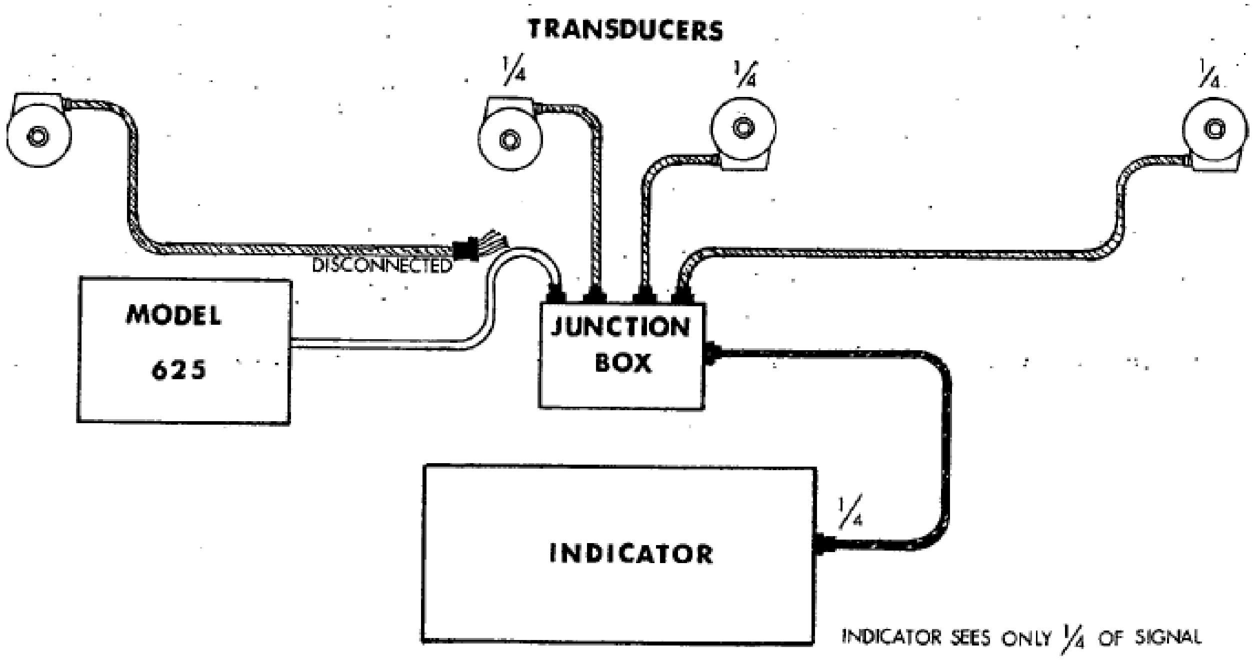


Figure 3-2. Four Transducer System Calibration.

Example: 3 transducer system, 2,000 lbs capacity each.

2 mV/V = 2,000 lbs for each transducer
Therefore, in the parallel DC system

2 mV/V = 6,000 lbs.

1,000 lbs = maximum net (live) load

A =1,000, B = 6,000, C = 2 mV/V, D = 3

$$\frac{1000}{6000} \times 2mV/V \times 3 = E$$

E = 1 mV/V

When calibration millivoltage is found to be a value not provided on the 625, e.g., 1.25 mV/V = 24,000 lbs., a proportion can be derived and the indicator can be calibrated at the nearest setting of the 625 below the rated calibration.

Example: Indicator calibration millivoltage = 1.25 mV/V=24,000 lbs. The nearest 625 setting is 1.2 mV/V.

$$\frac{1.25}{24{,}000} = \frac{1.2}{X}$$

X = 23,040

At 1.2 mV/V input the indicator must read 23,040 lbs. (indicator accuracy) in order to be calibrated at 1.25 mV/V = 24,000 lbs.

After the necessary calibration has been determined, calibrate the indicator as follows.

a. Set up the 625 as described in Figure 3-1. Set the Range switch to the proper range i.e., so that the necessary indicator calibration millivoltage falls within the range selected.
b. Apply power to the indicator and allow proper warm-up time.
c. Zero the 625 (Step switch to zero) then the indicator (ZERO control on the indicator). If the indicator cannot be zeroed with the ZERO control, refer to paragraph 3-1.7.
d. Dial in the necessary calibration with the 625.
e. Adjust the indicator SPAN control for the calibration readout.
f. Repeat steps c, d, and e until the indicator returns to zero and reads calibration without having to adjust the indicator ZERO and SPAN controls.

IMPORTANT: NO LOAD OTHER THAN TARE CAN BE PRESENT ON A SYSTEM DURING CAL-IBRATION. THE OFF/350 ohm ADJ SWITCH ON THE MODEL 624 MUST BE IN THE OFF POSITION WHEN USING THE MODEL 625 FOR CALIBRATION IF SUPPLIED IN THE COMBINATION MODEL 624/625 UNIT.

3-17. INSTRUMENT ZEROING, Occasionally, in systems that have a high tare to live weight ratio, the indicator ZERO control does not always have enough range to zero the indicator when one or all of' the transducers are removed for hookup of the 625.

To overcome this effect, the 625 can be used as a source for the tare signal as well as the calibration signal. Use the following procedure to zero the indicator.

a. Set the 625 Range switch to the lowest range.
b. Set the 625 Step switch to zero.
c. Center the instrument ZERO control (approximately)
d. Advance the Step switch until the indicator read-out is near or slightly greater than zero. If this cannot be achieved within this range, return the Step switch to zero, move the Range switch to the next higher range, and proceed with step d above.
e. Zero the indicator with the ZERO control.

Record the mV/V setting on the 625. Add this figure to the necessary calibration millivoltage. This new figure will now be the necessary calibration millivoltage.

Step c states "Zero the 625". In this case zero will be at the setting where the indicator was zeroed (step d above).

After zeroing the indicator, proceed with step d.

3.1.3 AC System Calibration.

The 625 can be used to calibrate AC systems as well as de. The main difference between the two types of systems being that the transducers in an AC system are connected in series instead of parallel. The 625 need supply only the rated indicator calibration millivoltage regardless of the number of transducers used.

Example: For an indicator rated a 2 mV/V = 30,000 lbs. , the 625 will be set for 2 mV/V in order to produce the full scale readout on the indicator, regardless of the number of transducers in the system. This procedure holds true whether the 625 is connected at a junction or extension box or at the terminals of the indicator.

The following formula can be used to determine full-scale calibration when a system uses less than the maximum transducer output for full-scale calibration or when the indicator calibration data plate has been lost or destroyed.

$\frac{A}{B} \times C = E$•

Where:

A = Maximum net (live) load
B = Total system capacity.
C = Full output of transducers (parallel)
E = Full Scale calibration

Example: 3 transducer system, 2,000 lbs capacity each.

2mV/V = 2,000 lbs for each.

Therefore, in the series AC system 6 mV/V

=6,000 lbs.

1,000 lbs maximum net (live) load.

A = 1,000 B = 6,000 C = 6 mV/y

$$\frac{1000}{6000} \text{x } 6 \text{ mV/V} = \text{E E} = 1 \text{ mV/V}$$

When the calibration millivoltage is found to be a value not provided on the 625, e.g., 1.25 mV/V = 24,000 lbs, a proportion can be derived and the indicator can be calibrated at the nearest setting of the 625 below the rated calibration.

Example: Indicator calibration millivoltage = 1.25 mV/V = 24,000 lbs. The nearest 625 setting is 1.2 mV/V.

$$\frac{1.25}{24{,}000} = \frac{1.2}{X}$$

X = 23,040

At 1.2 mV/17 input the indicator must read 23,040 lbs (± indicator accuracy) in order to be calibrated at 1.25 mV/V = 24,000 lbs.

After the necessary calibration has been determined, calibrate the indicator as follows.

a. Set up the 625 as described in Figure 3-1. Set the Range switch to the proper range I. e. so that the necessary indicator calibration millivoltage falls within the range selected.
b. Apply power to the indicator and all proper warm-up time.
c. Zero the 625 (Step switch to zero) then the indicator (ZERO control on the indicator).
d. Dial in the necessary calibration with the 625.
e. Adjust the indicator SPAN control for the calibration readout.
f. Repeat steps c, d, and e until the indicator returns to zero and reads calibration without having to adjust the indicator ZERO and SPAN controls.

IMPORTANT: NO LOAD OTHER THAN TARE CAN BE PRESENT ON A SYSTEM DURING CALIBRATION. THE OFF/350 ohm ADJ SWITCH• ON.THE MODEL 624 MUST BE IN THE 'OFF POSITION WHEN USING THE MODEL 625 FOR CALIBRATION IF SUPPLIED IN THE COMBINATION MODEL 624/625 UNIT.

3.1.4 Linearity Check.

Set up the 625 as described in Figure 3-1. The 625 should be connected directly to the indicator. The maximum output of the range selected should not exceed the calibration of the indicator.

Rotate the STEP switch one increment at a time and note the reading on the indicator each time. The reading should increase by the same amount indicator accuracy) until full scale or the last increment of the STEP switch has been reached. Conversely, rotate the STEP switch in the other direction, one decrement at a time. The reading on the indicator should decrease by the same amount (±indicator accuracy) each time until zero is reached.

If the indicator is not linear refer to the indicator instruction manual for adjustment procedure.

3.1.5 Troubleshooting with the Model 625.

NOTE: ALL CHECKS DONE IN THIS SECTION WITH THE 625, SHOULD BE PERFORMED

ONLY ON CALIBRATED EQUIPMENT TO INSURE ACCURACY.

DC SYSTEMS. The 625 can be used to isolate unknown problems within a DC system. The following procedure is typically used to check BLH indicators.

a. Disconnect the 6-wire cable from the junction or extension box at the indicator terminal strip.
b. Connect the 625 to this terminal strip (color for color - black, green, red, white, and yellow).
c. Connect jumper wires between the remote sensing terminals and the excitation voltage terminals.
d. Measure the voltage between the black and green • terminals. Voltage should be approximately .10 volts DC.
e. Set CHECK/OPERATE switch (where used) to CHECK position to open the tare compensation resistors. If there is no CHECK/OPERATE switch, dial in a mV/V input from the 625 until the instrument can be zeroed.
f. Zero the instrument.
g. Determine the indicator calibration and readjust the mV/V input from the 625.
h. If the transducers are being used in tension, the indicator does not have a reversing switch, reverse the red and white leads at the terminal strip.
i. When the proper input signal is dialed in, the indicator should read at or near full scale, depending on the length of cable removed. If the indicator operates correctly, check transducers, cabling and junction and/or extension boxes. 3-32. Transducers can be checked by directly substituting the 625 for each transducer, one at a time, using calibration procedures. If the indicator readout is correct at any time during the substitution process, the transducer being substituted for is faulty either internally or in the cable.

If none of the previous checks is conclusive, the problem probably exists in the cable, junction box, or extension box,

AC SYSTEMS. The 625 can be used to isolate unknown problems within an AC system. The following procedure is typically used to check BLH indicators.

a. Remove power from the system.
b. Remove five wires of any one transducer from the terminal strip in the junction or extension box and wire in the 625 (color for color - black, green, white, red, and yellow
c. Connect a jumper wire between the red and white terminals on each of the remaining transducer terminal strips.
d. Apply power to the indicator.
e. Measure the transducer excitation voltages at the black and green terminals on each transducer terminal strip in the junction or extension box. Voltage should be approximately 5 Vac.
f. Measure the voltage between the black and green terminals on the six-conductor terminal strip. Voltage should be approximately 2.5 Vac.
g. Measure the voltage between the orange and blue terminals. Voltage should be approximately 1 Vac. NOTE: If the voltages are incorrect or absent, the junction box transformer may be defective. Also the voltages measured in steps f and g should appear at the six point terminal strip at the indicator.
h. Set the CHECK/OPERATE switch (where. used) to CHECK. If there is no CHECK/OPERATE switch, dial in a signal from the 625 until the instrument can be zeroed.
i. Adjust the capacitive balance control on the indicator until the CAP BAL light goes out or glows at minimum brilliance.
j. Rezero the indicator.
k. Determine the indicator calibration and dial in the appropriate signal from the 625. The indicator should read full scale.

If the indicator is operating correctly check the transducers.

Transducers can be checked by directly substituting the 625 for each transducer, one at a time, using calibration procedures. If the indicator readout is correct at any time during the substitution process, the transducer being substituted for is faulty either internally or in the cable.

CAUTION: DISCONNECT ANY EXTERNAL WIRING FROM SETPOINT RELAY CONTACT TERMINALS AND/OR CURRENT OUTPUT TERMINALS ON THE INDICATOR TO PREVENT OPERATION OF CONTROLLED EQUIPMENT DURING TROUBLESHOOTING.

3.1.6 Troubleshooting Checks (Typically BLH Instruments).

PEAK and HOLD CIRCUITRY. To check Peak and-Hold circuitry, set up the 625 as described in Figure 3-1. Choose a range with a maximum output near but below the necessary indicator calibration millivoltage. Dial in a new reading higher than the one already displayed on the indicator and back off from that reading. The new maximum reading should remain displayed on the indicator. Return the Step switch to zero and press the PEAK/RESET button on the indicator. The display should return to zero. If the indicator does not operate in the preceding manner, refer to the indicator instruction manual for adjustment procedure.

CURRENT OUTPUT CIRCUITRY To check current output circuits, set up the 625 as described in Figure 3-1. Disconnect external wiring from the current output terminals of the indicator to prevent operation of controlled equipment during check. Connect a milliammeter with a range compatible with the preset current output range of the indicator, at the current output terminals. Vary the readout from zero to full scale using the Step control on the 625. The current output should rise and fall in proportion to the input throughout the entire current range. If not, refer to the indicator instruction manual for adjustment procedure.

3.2 MODEL 624 OPERATION

3.2.1 General

The 624 is a troubleshooting and adjusting device used in conjunction with the 625 to check various instrument circuitries. The remainder of this section will be devoted to the set-up and operation of the 624 in various troubleshooting and adjusting applications. Figure 3-3 of this section is used to generally describe the set-up procedure for the operation of the 624.

CAUTION: DISCONNECT ANY EXTERNAL WIRING FROM SETPOINT RELAY CONTACT TERMINALS AND/OR CURRENT OUT¬PUT TERMINALS ON THE INDICATOR TO PREVENT OPERATION OF CON¬TROLLED EQUIPMENT DURING ANY OF THE FOLLOWING CHECKS.

3.2.2 Set Point Controllers

Frontset and Backset set point controls can be adjusted or checked for accuracy of setting without applying any actual weight to the system. The system must be in calibration. The Model 624 is similar to the set point comparator test circuit described in many BLH instrument instruction manuals.

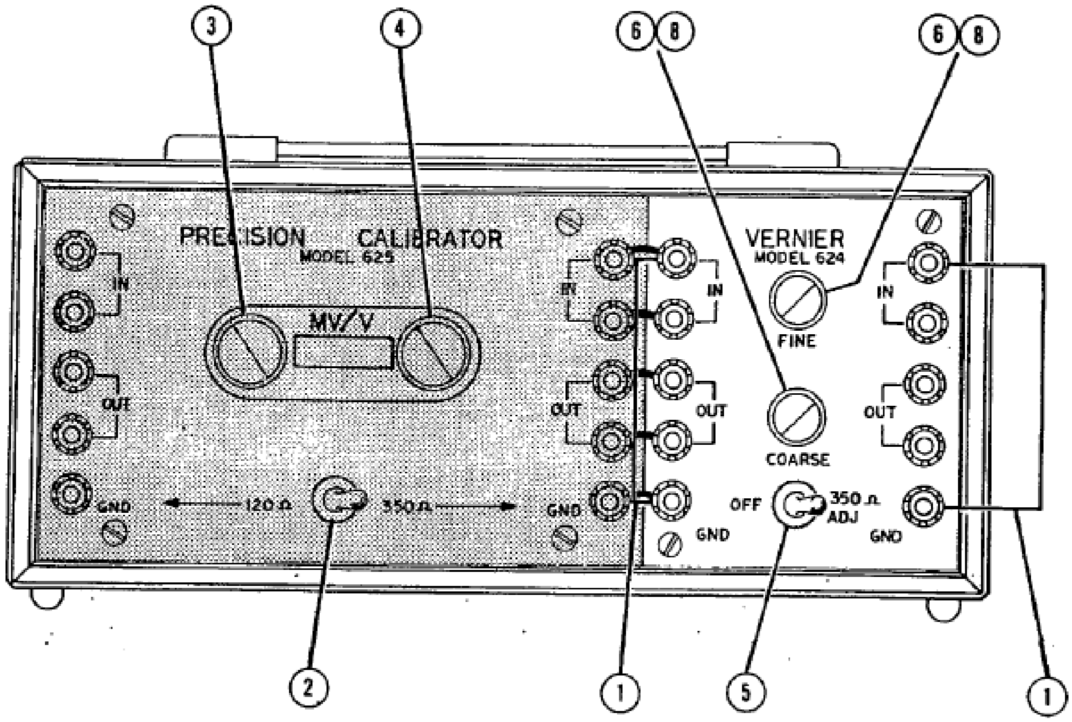
Set up the 624 as described in Figure 3-3. Set the set point controls to the reading desired before the 624 check is performed.

Connect the leads of a suitable test device (ohm meter, light bulb with battery, etc.).

Place the indicator hysteresis control (if equipped) in the full counterclockwise position before performing the check.

To check set points set to indicate a maximum limit, first adjust the 625, while observing the indicator readout, for a reading near but below the setting of the set point. Start on the low range

(0-0.5 mV/V) and increase the Step switch setting. If a near reading is not possible within the range, return the Step switch to zero and switch to the next highest range. Follow the same procedure until a near reading is possible.



1. Attach the 5-conductor cable to the right-side binding posts (paragraph 2-34). Left-side binding posts MUST be bussed to the Model 625.

2. Set the 625 Bridge Resistance Selector switch to the 350Ω position.

3. Set the 625 Range switch to the proper range (as defined in each application of the 624 in paragraph 3-43).

4. Set the 625 Step switch to zero.

5. Set the OFF/350Ω ADJ switch on the 624 to the 350Ω ADJ position.

6. Set the COARSE and FINE controls on the 624 to approximately midrange.

7. Connect the 624 to the instrument to be checked; refer to paragraph 2-32, Model 624 Electrical Connections, and apply power to the instrument. Allow proper instrument warm-up time.

8. Adjust the COARSE and FINE controls on the 624 for a zero reading on the indicator.

Figure 3-3. Model 624 Operation.

Set the OFF/35052 ADJ switch on the 624 to the 35011 ADJ position. Advance the COARSE control until the indicator reads nearer but below the setting of the set point. Advance the COARSE control more slowly. As the reading approaches the critical point (determined by the set points) advance the FINE control slowly so the readout is increased 1 digit or dial increment at a time. The set point relay should change state at the critical point (± indicator accuracy).

Readjust the 624 controls for a reading below this critical point. The set point relay should return to the original state at the critical point (E indicator accuracy) unless the device has a locking feature which holds the relay in the changed state. In this case, the operation of the RESET control on the indicator should then return the relay to the original state.

To check controls set to indicate a minimum limit, start at a. reading higher than the critical point and decrease the reading to the critical point. If the results are not within specifications refer to the indicator instruction manual for adjustment procedure.

Electronic Zero/Auto Tare Cancellation (BLH Model 450 and 8000 Series)

To check Electronic Zero/Auto Tare Cancellation circuitry, set up the 624 as described in Figure 3-3. Set the NORM/TARE switch on the indicator to the TARE position and press the RESET button. The indicator display should go to zero.

Dial in any low to mid-scale reading with the 625 and press the RESET button on the indicator. The reading should go to zero. •

Dial in another reading with the 624 COARSE control. The indicator display should start at zero and increase normally. If the system does not operate in this manner, refer to the indicator instruction manual for adjustment procedure.

SECTION 4. PRINCIPLES OF OPERATION

4.1 MODEL 625.

4.1.1 General.

The Model 625 consists of a highly stable crossed-arm resistance network commonly known as a star bridge. Through tin use of appropriate shunt and series precision wound resistors, the 625 produces a series of precise millivolt outputs proportional to a given input voltage. The indicator excitation voltage power supply is used for the input voltage. Refer to the 625 schematic diagram, Figure 4-1.

4.1.2 Component Description

The Range switch (Si) is a 2-pole, 5-position rotary switch which selects the proper series resistance along two arms of the bridge. These series resistors divide the output into 5 ranges.

The Step switch (S2) is a 2-pole, 11-position rotary switch which selects any one of 11 positions along the remaining two arms of the bridge. These series resistors divide the range millivoltage into 10 proportionate steps.

The 120 ohm/350 ohm Bridge Resistance Selector switch (53) is a double-pole, double-throw toggle switch. By placing appropriate shunt (parallel) resistors (R50, R51) across the step arms of the bridge, the output impedance can be switched from 350 ohms to 120 ohms.

The jumper across R7 and the potentiometer R8 are used in the initial calibration at the factory. Under no circumstances are these components to be disturbed. If doubt arises as to the state of calibration of the 625 refer to SECTION 5, MAINTENANCE or contact the nearest BLH Sales/Service Representative.

4.2 MODEL 624

4.2.1 General.

The Model 624 operates as a voltage divider, which provides a continuously variable millivoltage out-put. The indicator excitation voltage power supply provides the input voltage. Refer to the 624 schematic diagram, Figure 4-2.

4.2.2 Component Description.

4-13. The COARSE control (R1) is a 10-turn, 20K potentiometer placed across the input voltage (black and green) terminals. Resistor R2, in-series with the slider arm of R1, limits the output to a small millivoltage, highly variable by R1.

The FINE control (R4) is a 10-turn, 20K potentiometer also placed across the input voltage (black and green) terminals. Resistor R3 in series with the slider arm of R4, being 10 times the value of R2, provides a lesser millivoltage output than R2. This smaller variable millivoltage is the fine adjustment.

The OFF/350 OHM ADJ switch (Si) is a double pole, -double-throw toggle switch which disconnects or connects the millivoltage outputs of both R2 and 123 to the + signal voltage (white) terminal of the 624.

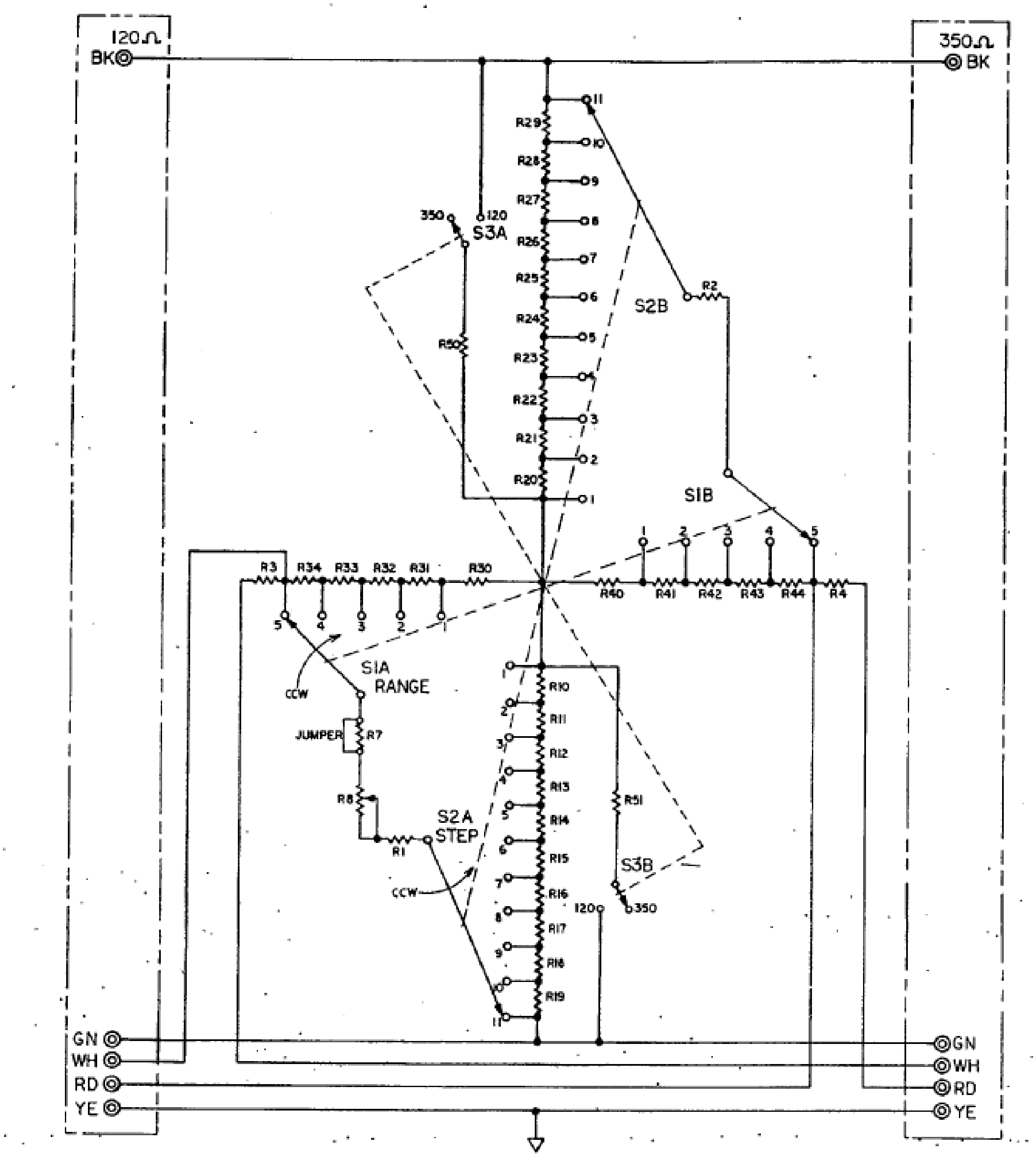


Figure 4-1. Model 625 Schematic Diagram

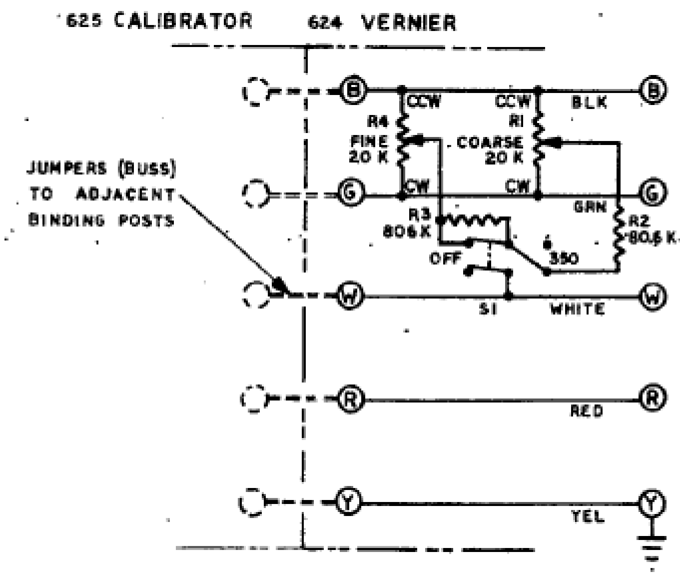


Figure 4-2. Model 624 Schematic Diagram

SECTION 5. Maintenance

5.1 MODEL 625

The Model 625 requires little customer maintenance aside from handling the device as a precision instrument. If a calibration check is desired or trouble is suspected, refer to the following sections.

5.1.1 Calibration Check

If the ultimate in accuracy is desired, a periodic check, by the user, manufacturer, or certified testing laboratory is recommended,

NOTE: An initial voltage reading must be made with the 625 set at zero to determine zero unbalance. This voltage must then be added or subtracted from each voltage reading taken to obtain the actual output voltage.

If the 625 proves inaccurate or if the accuracy is in doubt, contact the nearest BLH Sales/Service Representative. DO NOT attempt to recalibrate the instrument.

The user can perform this periodic check by applying a known voltage of sufficient correct capabilities to the input terminals (BLACK and GREEN) and measuring the output voltage at various settings at the output terminals (WHITE and RED) with a high impedance millivolt meter accurate to one microvolt (Fluke 885 or equiv), 10VDC with a current capability of 100 mA is a convenient source voltage (BLH 3564 Power Supply or equiv).

Refer to Figure 5-1. The output in mV/V is the measured output divided by the supply voltage. A self-regulating power supply is best for the supply voltage. If one is not available, then the source voltage must be monitored and manually regulated (if necessary) as the load is changed.

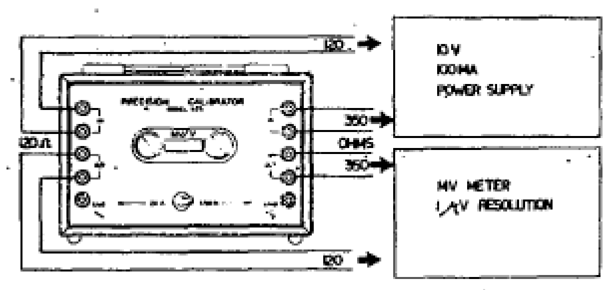


Figure 5-1. Model 625 Check

5.1.2 Troubleshooting

If rated voltages are not exceeded (see Specifications Table 1-2), the 625 should give long, trouble-free service. If the 625 is suspect, check the internal bridge resistance of the 625 with an accurate ohm-meter. Resistances between BLACK and GREEN should be 120 ohms and 350 ohms respectively. Resistances between RED and WHITE should be 117.5 ohms and 350 ohms respectively. If the 120 ohm input terminals continue to read 350 ohms or the 350 ohm input terminals continue to read 120 ohms regardless of the position of the toggle switch, the switch is faulty and must be replaced.

If the bridge resistance checks out properly and the instrument still does not function, either the RANGE or STEP switch contact arms may be faulty or corroded. To remove dirt or corrosion from switch contacts, clean with a •suitable solvent such as Contactine and then apply a thin film of Devon oil,

If the instrument continues to work improperly, contact the nearest BLH Sales/Service Representative.

5.2 Model 624,

The Model 624 requires little customer maintenance aside from handling the device as a precision instrument. Troubleshoot as follows.

The 624 should operate smoothly throughout the entire adjustment range. Check this by disconnecting the 624 from the 625, if used together, and connect a sensitive ohmmeter between the WHITE and BLACK or GREEN terminals. The OFF/350 ohm ADJ switch must be in the 350 ohm position. See Figure 5-2. The FINE and COARSE controls should be operated one at a time throughout the entire ten-turn range. There should be no rough or uneven spots or any sudden changes in resistance. If any of these conditions exist, the particular potentiometer must be replaced. The OFF/350 ohm ADJ toggle switch can be checked by operating it with the same connections made as described above. The resistance at any point should move to infinity when the switch is thrown to the OFF position. If this does not occur or if a constant infinite resistance is read in either position, the switch is defective and must be replaced. The 624 is field repairable.

Assistance on any maintenance problems can be obtained by notifying the nearest BLH Sales/Service Representative.

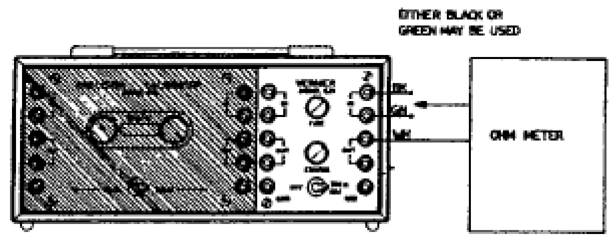


Figure 5-2. Model 624 Check

SECTION 6. REPLACEABLE PARTS

6.1 INTRODUCTION

This section contains information for identifying and ordering replacement parts. Table 6-1 lists parts in alphanumeric order by reference designator and provides the following information on each part:

a. BLIT part number (where BLH is the sole source).
b. Total quantity used in the instrument (TQ column). Quantity listed where item first appears on list.
c. Recommended spares for year application in a remote location (or 2000 hours). RS column.
d. Typical manufacturer of the part (where applicable).
e. Manufacturer's part number.

6.2 ORDERING INFORMATION

To obtain replacement parts, address order or inquiry for parts to the nearest BLH Sales/Service Office or direct to BLH. Identify parts by BLH part numbers.

To order parts not listed in Table 6-1, provide the following:

a. Model number of the instrument,
b. Serial number of the unit.
c. Description of the part including function and location.

To order a part from a manufacturer other than BLH, provide the component part description and the manufacturer's part number from Table 6-1.

Table 6-1. Replaceable Parts

Ref Design	BLH Part No.	RS	TQ	.Description '	Mfr	Mfr Part No.
End item	203797-3			Model 625 Precision Calibrator		
Al	203832-1		1	Assembly, Resistor Board		
A2	272006-2		1	Assembly, Range Switch		
A3	403664-2		1	Assembly, Step Switch		
MP 1	203381-4		1	Case, Assembled		
MP2	203013-2		1.	Panel, Front		
MP3	.203214-2		1	Bracket, 8witch		
INIP4	203164-2		1	Dial, Range		
MP5	263170-2		1	Dial, Unit		
MPG	203833-1		1	Window		
MP7	124815-8		2 •	Knob: Si, S2		
MP8	135145-8		2	Binding Post (red)		
MP9	135146-8		2	Binding Post (white)		
MP 10.	135148-8		2	Binding-Post (yellow)		
MP 11	135149-8		2	Binding Post (black)		
MP 12	135150-8		2	Binding Post (green)		
R 1	133602-8		1	R: FXD, 5800 ohms, .05%, W.W.		
R2	135151-8		1	R: FXD, 5815 ohms, .05%		
R50	133601-8		2	R: FXD, 91.3 ohms, .2%, W.W.		
R51				same as R50		

Table 6-1 con't. Replaceable Parts

Ref Design	BLH Part No.	RS	TQ	Description	Mfr	Mfr Part No.
S3	132961-8		1	Switch, Toggle		
Al	203832-1		1	Assembly, Resistor Board		
A1MP1	203831-1		1	Resistor Board		
AlR7	130318-8		1	R: FXD, 15 ohms, 1/2%, 1/4W., W. W.		
R8			1	R: Variable, 20 ohms - Bourns		3255L-1-200
A2	272006-2		1	Assembly, Range Switch		
A2R3	271721-1		2	R: FXD, 116.25 ohms, Prec. , W. W. same as R3		
R4						
R30	211716-1		2	R: FXD, 2.9096 ohms, Prec. , W.W.		
R31	271717-1		2	R: FXD, 2.9125 ohms, Prec., W. W.		
R32	271718-1		2	R: FXD, 5.8337 ohms, Prec., W.W.		
R33	271719-1		2	R: FXD, 17.5716 ohms, Prec. , W. W.		
R34	271720-1		2	R: FXD, 29.5226 ohms, Prec., W. W.		
R40				same as R30		
R41				same as R31		
R42				same as R32		
R43				same as R33		
R44				same as R34		
A2S1	271922-1		1	Switch, Range		
A3.	403644-2		1	Assembly, Step Switch		
A3R10	27.1706-1		2	R: FXD, 17.5470 ohms, Prec, W.W.		
R11	271707-1		2	R: FXD, 17.6203 ohms, Prec, W.W.		
R12	271708-1		2	R: FXD, 17.6622 ohms, Prec, W.W		
R13	271709-1.		2	R: FXD, 17.6720 ohms, Prec, W.W.		
R14	271710-1		2	R: FXD, 17.6500 ohms, Prec, W.W		
R15	271711-1		2	R: FXD, 17.5963 ohms, Prec, W. W.		
R16	271712-1		2	R: FXD, - 17.5120 ohms, Prec, W. W. • -		
R17	271713-1		2	R: FXD, 17.3979 ohms, Prec, W.W.		
R18	271714-1		2	R: FXD, 17.2556 ohms, Prec, W.W.		
R19	271715-1		2	R: FXD, 17.0867 ohms, Prec, W.W.		
A3S1	136721-8		1	Switch, Step		

Table 6-1 con’t. Replaceable Parts

Ref Design	BLH Part No.	RS	TQ	Description	Mfr	Mfr Part No.
End Item	417245-3			Model 624 Vernier		
Al	417243-2		1	Assembly, Front Panel		
MP1	417068-4		1	Case		
Al	417243-2		1	Assembly, Front Panel		
A 1MP 1	417243-2		1	Panel		
MP2	135145-8		2	Binding Post (red)		
MP3	135146-8		2	Binding Post (white)		
MP4	135148-8		2	Binding Post (yellow)		
MP5	135149-8		2	Binding Post (black)		
MP6	135150-8		2	Binding Post (green)		
MP7	124814-8		2	Knob: R1, R4		
,	128646-8		2	R: Variable, 20K		
AIR1 R2	138875-8		1	R: FXD, 80.6X, 1%, 1/8W.		
R3	136480-8		1	R:FXD, 806K, 1% same as RI		
R4						
ALS1	13296 1-8		1	Switch, DPDT		•
End Iteni	417269-3			Model 625 Precision Calibrator with Model 624 Vernier		
Al	2 03797-3		1	Assembly, Model 625 Precision Calibrator		
A2	417245-3		1	. Assembly, Model 624 .Vernier - -		-

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