KURZ™ INSTRUMENTS, INC.

Kurz™ Air Flow Meter with Model 435R1 Power Supply and Analog Linearizer Board

Calibration Manual

Document Number: 360190, Rev. C

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Section 1: Introduction

1.1 General Overview

The calibration procedures[1] reviewed in this manual pertain to the Kurz™ air flow meter which comprises of a Model 435R_1 Power Supply and Analog Linearizer Board and a Kurz™ thermal mass flow sensor (Series 450 Insertion Mass Flow Element or a Series 500 In-Line Mass Flow Element). In association with the sensor is a Model 465R_x Current-Transmitter Board serialized with a corresponding identification number.

Note: The sensor and its associated bridge circuitry on the current-transmitter board are matched by serial number. This is due to the technical aspect of the bridge circuit being set up during a part of the calibration process at the Kurz™ factory we call *temp comp*. In general, the process consists of determining the balance point of the bridge circuit in reference to the amount of power supplied to the velocity winding (R_p, for resistor, probe) to maintain a constant temperature differential or overheat, above the temperature of the passive temperature compensation winding, we call R_{tc}, for resistor, temperature compensation. Thus, in no event should a sensor be interchanged with an unmatched current-transmitter board.

The calibration procedures are only applicable with the Kurz™ Instruments' Series 400 Air Velocity Calibration Systems; i.e., the 400A, 400B and 400BL Models (vacuum devices); and the 400B-P and 400C-P Models (pressure devices).

As a prerequisite to performing the calibration procedures, you should review and perform the maintenance and trouble-shooting procedures discussed in Section 4: *Service*. It is recommended that the unit be returned to the Kurz™ factory if repairs are needed. This is usually the most cost effective and reliable means.

1 Given that "temp comp" is current (I) mode, the calibration procedure doesn't comply with Kurz™ air flow meters "temp comp" for voltage (E) mode. Though, similarities in the preliminary phases of the procedures for calibration do exist for E-mode, we recommend that you consult with the Customer Service Dept. at Kurz™ Instruments, Inc. for procedures pertaining to E-mode system configuration to simplify the calibration procedures.

1.2 Principle of Calibration — An Overview

The Kurz™ air flow meter is calibrated in a Series 400 Air Velocity Calibration System with reference to a precise, NIST-traceable laminar-flow type mass flow meter used to measure the total air flowing through the calibrator. This air flows through a well-shaped nozzle to form a free-jet of air having a very uniform, flat velocity profile, which is provided by a flow straightener and air filter. The Kurz™ thermal mass flow sensor is inserted in the center of a free-jet of air (the free-jet is external with the Model 400B-P and C-P calibrators)[2]. Turbine-type vacuum supplies are used to "pull" the air flow through the test section except for a Model 400B-P and C-P calibrators where the air flow is "pushed". By varying the voltage to the motor(s) by means of a variable autotransformer, the velocity of the free-jet of air impinging on the sensor may be adjusted over the full range. A precise, inclined water manometer is used to measure the differential pressure (ΔP) across the pressure taps in the mass flow meter section of the Model 400 calibrator. This differential pressure is measured, corrected for nonstandard conditions and the air velocity is determined through the use of the calibration data supplied[3].

As for the system's technical aspect of calibration, dependent on the amount of air velocity measured by the Kurz™ thermal mass flow sensor, the current-return signal from the Model 465Rx Current-Transmitter Board (range of 100.0 mA to 600.0 mA) is drawn across a resistor (R_8) on the Model 435R1 Power Supply and Analog Linearizer Board, resulting in a current-sense voltage signal (range of 0.600 Vdc to 3.000 Vdc). This current-sense voltage signal at zero and specified maximum flow rate are then adjusted in the nonlinear circuitry of the linearizer board in association with the "zero" and "span" control-potentiometers to a nonlinear 0.000 Vdc to 5.000 Vdc signal. The nonlinear voltages for each calibration point or flow rate are recorded and then plotted on a curve; whereas, break-point voltages are plotted on the same curve and linear voltage points are selected in retrospect to the break-point voltages on the curve to be used in linearizing the nonlinear signal.

2 Center of velocity winding (R_p) should be at a point of average flow (normally at center-line of nozzle).

3 Local temperature and barometric pressure are measured, and correction factors are applied to correct to standard conditions referenced to a temperature of 77° F (25° C) and an atmospheric pressure of 29.92 inches (760 mm) of mercury (Hg).

The linearizer circuitry on the linearizer board being an analog offset type, the number of amplifier stages shift the linear voltage points up or down to a approximate a linear curve within the range of a linear 0.000 Vdc to 5.0000 Vdc signal that is in direct representation to the amount of air flow being measured by the sensor: 0.000 Vdc represents no flow conditions, 2.500 Vdc indicates a representation of flow exactly half of the maximum flow, and 5.000 Vdc represents maximum flow.

Note: There is a maximum on one current-return signal input per linearizer board; however, a maximum of two analog outputs. One output is scaled 0.000 Vdc to 5.000 Vdc for the selected velocity or mass flow calibration; whereas, the other is scaled for mass flow rate for specified duct or pipe area, flow profile factor[4], and full scale flow rate and units.

WARNING: Kurz™ Instruments, Inc. will **NOT** perform a free calibration, while the Kurz™ air flow meter is still under warranty, if you have already made adjustments to the "zero", "span" and, or other linearization controls.

End of Section 1

4 The profile factor is the ratio of the duct or pipe average velocity to the velocity value measured by the Kurz™ thermal mass flow sensor.

Section 2: Setup

2.1 Procedure

The inclined water manometer should be mounted on a wall, filled with fluid, and levelled by following the instructions enclosed with the manometer. Two tubing adapters and two sections of vinyl tubing are supplied; connect the downstream pressure tap of the mass flow meter section of the Model 400 calibrator to the "high" end of the manometer and the upstream pressure tap to the "low" end of the manometer. The Model 400 calibrator should be used in a safe working area and preferably on a laboratory bench. For connections between the motor(s) and the variable autotransformer(s), refer to the instructional manual enclosed with the Model 400 calibrator. The sensor to be calibrated is inserted through the compression fitting such that the center of the velocity winding (R_P) is in the center of the calibrator body and aligned to face directly upstream. (**Note:** Compression fittings are not required for the 400B-P and 400C-P Models since it calibrates externally; however, to achieve better results and accuracy, align the sensor three inches from the nozzle of the nozzle section.)

Note: If you are using a laminar flow element (LFE) to calibrate a Series 500 In-Line Mass Flow Element, the long end of the unsymmetrical flow body is installed in-line with and downstream from the LFE; i.e., the air flow enters through the long end of the flow body and exits through the short end. A flow control valve is connected to the shorter end of the flow body and a vacuum source is attached to the flow control valve. In most cases, unless otherwise specified, the flow body is orientated in a horizontal run with the flow transmitter enclosure or junction box extending straight up.

2.2 Equipment

Basically, the following accessories will be required for the calibration procedures:

a) A calibrated digital voltmeter (DVM) accurate to ± 0.001 Vdc.

b) A flat-bladed screwdriver with a narrow blade and preferably with a long shaft.

c) A Model 400 calibrator and supplied Meriam LFE curve.

d) A thermometer placed in such a way as to accurately determine the immediate temperature of the air flowing through the test section of the mass flow meter (NIST-traceable), and an absolute barometer to measure actual pressure in the approximate area.

e) A Kurz™ calibration work sheet for recording calibration information. (**Note:** A sample Kurz™ calibration work sheet is provided in Appendix A.)

f) A Kurz™ air flow meter and for recalibration purposes, the provided Calibration Data and Certification Sheet.

End of Section 2

Section 3: Procedures for Calibration

NOTICE: A completed Kurz™ calibration work sheet has been provided and can be found at the end of this section. The work sheet comprises of recorded data in reference to each calibration procedure in discussion. The primary objective serves to facilitate any complications (such as misinterpretation or ambiguousness of text). Please refer to this work sheet for reference purposes only.

3.1 Recording Flow Rates

If this is a recalibration, the flow rates in velocity and, or mass flow are listed on the Calibration Data and Certification Document enclosed with the Kurz™ air flow meter. Refer to the appropriate serial number on the document corresponding to the matching equipment.

The following steps describe the procedure for obtaining the flow rates for a desired flow range:

Step 1. Record the selected maximum flow rate for calibration point 11 in the "Flow Rate" column. (**Note:** You will be required to record the remaining flow rates.)

Step 2. Divide this maximum flow rate by 10. The value calculated will be used as the decremental value; e.g., if the maximum flow rate is 1500 standard feet-per-minute (SFPM), then the decremental value is 150.

Step 3. To obtain the flow rate for calibration point 10, subtract the decremental value from the maximum flow rate.

Step 4. Continue to subtract the decremental value from each preceding calibration point until you have calculated the flow rate for calibration point 2.

Step 5. After you have calculated the flow rate for calibration point 2, divide this flow rate by half to obtain the flow rate for calibration point 1.

Step 6. Zero flow rate will be a value of 0 in calibration point 0.

3.2 Recording Inches of Water

A. From the Meriam LFE curve supplied with the Model 400 calibrator, find the differential pressure (H_S) corresponding for each flow rate recorded in the "Flow Rate" column. Record each value in the "Inches of H_2O" column for calibration points 0 through 11.

Refer to Figure 3.2-1 for an example of a Meriam LFE curve in cubic-feet-per-minute (CFM).

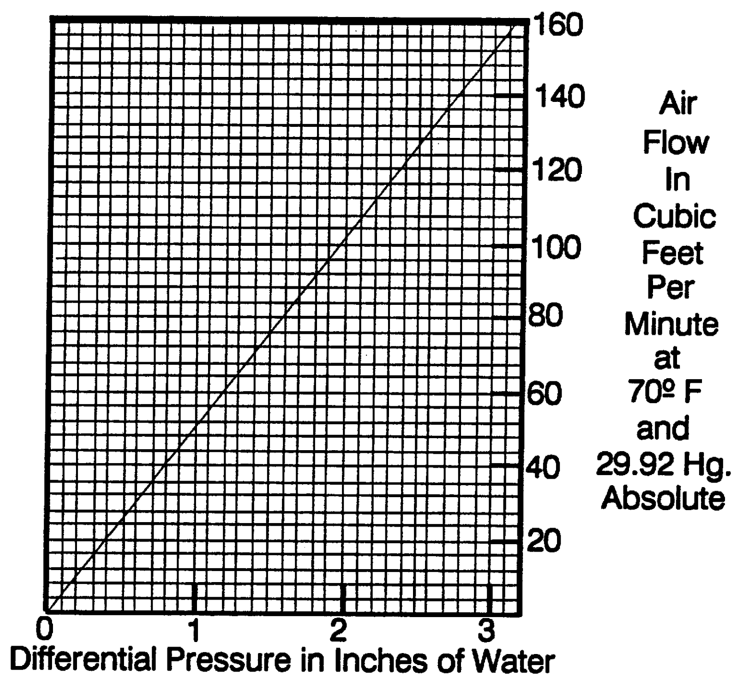
Note:

$$Velocity = \frac{SCFM}{LFE\ Area} = SFPM$$

Whereas:

$$Mass\ Flow = SFPM \times LFE\ Area = SCFM$$

Figure 3.2-1
Example of a Calibration Curve



B. The next procedure consists of adjusting the air flow through the test section of the Model 400 calibrator. The flow will be adjusted to a specific level on the manometer. The manometer reflects flow rates according to the inches of water.

Note: If not already set, adjust the manometer to read 0.0 inches of water at zero flow rate.

However, to obtain the desired flow rates in the "Flow Rate" column, you must initially determine the temperature and pressure correction factor for the mass flow meter section; in other words, the Kurz™ thermal mass flow sensor, unlike the Model 400 calibrator, is a mass flow instrument and will provide readings of a flowing gas relative to a standard temperature and pressure (STP), regardless of the actual temperature and pressure. Therefore, you will need to correct for actual temperature and pressure to STP. The temperature correction factor (T_{cf}) is shown in Chart A. The pressure correction factor (P_{cf}) is the ratio of the true absolute pressure (P_a) at the inlet to the Model 400 calibrator (normally this is the same as the barometric pressure) to the standard atmospheric pressure (P_s) of 29.92 inches of Hg. Thus:

$$P_{cf} = \frac{P_a}{P_s}$$

The external flow air velocity calibrators (400B-P and 400C-P Models), are pressure devices rather than vacuum devices resulting in an external free-jet. With this principle in mind, a conversion constant (13.6) is used in the pressure correction equation. Therefore:

$$P_{cf} = \frac{\left(\frac{H_s}{13.6}\right) + P_a}{P_s}$$

Chart A
Temperature Correction Factor (T_{cf})
Air Base Temperature 77° F (25° C)

AIR TEMPERATURE CORRECTION CHART										
°F	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
50	1.0848	1.0810	1.0773	1.0735	1.0698	1.0661	1.0625	1.0583	1.0552	1.0516
60	1.0480	1.0444	1.0409	1.0373	1.0039	1.0303	1.0269	1.0234	1.0200	1.0165
70	1.0132	1.0097	1.0064	1.0031	.9997	.9964	.9931	.9899	.9866	.9833
80	.9802	.9769	.9738	.9705	.9674	.9643	.9611	.9581	.9549	.9519
90	.9489	.9548	.9428	.9397	.9368	.9338	.9308	.9279	.9250	.9220

Note: In some cases, there is a need to correct from actual temperatures to standard temperatures referenced to 32° F (0° C) and 1 BAR pressure; for instance, European countries where nominal units are applicable. The temperature correction factor (T_{cf}) is shown in Chart B.

Chart B
Temperature Correction Factor (T_{cf})
Air Base Temperature 0° C

AIR TEMPERATURE CORRECTION CHART										
°F	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
50	.9939	.9905	.9870	.9836	.9801	.9768	.9735	.9701	.9668	.9634
60	.9602	.9568	.9536	.9503	.9472	.9439	.9408	.9376	.9345	.9313
70	.9283	.9251	.9220	.9190	.9159	.9128	.9099	.9069	.9038	.9009
80	.8980	.8950	.8921	.8892	.8863	.8834	.8805	.8778	.8749	.8721
90	.8693	.8665	.8637	.8610	.8583	.8555	.8528	.8501	.8474	.8447

If it is assumed there are a certain amount of air velocities to be set up in the Model 400 calibrator, the correct differential pressure drop (ΔP) across the flow meter section must be determined. Differential pressure (H_s) in inches of water corresponds to air velocity. Because present conditions will probably be different than the basis for the calibration (25° C and 29.92 inches Hg) the indicated differential pressure (H_{ind}) must be determined as follows using the temperature (T_{cf}) and pressure (P_{cf}) correction factors:

$$H_{ind}=\frac{H_s}{P_{cf}\,x\,T_{cf}}$$

Example: Establish the proper differential pressure to set up an air velocity of 1500 SFPM. The air temperature at the inlet to a Model 400B calibrator is 90° F and the absolute pressure is 29.00 inches of Hg. Find H_{ind}.

a) From Chart A, $T_{cf}=0.9489$

b) $P_{cf}=\frac{29.00}{29.92}=0.96925$

c) From Figure 3.2-1, $H_s=1.720\,inches\ of\ water$

d) Therefore, $H_{ind}=\frac{1.720}{0.9489\,x\,0.96925}=1.870\,inches\ of\ water$

e) Adjust the variable transformer(s) to obtain exactly 1.870 inches of water in the manometer.

C. If you wish to know the actual air velocity instead of the "standard" air velocity referenced to 29.92 inches Hg and 25° C. The following equation may be used:

$$V_a = \left(\frac{\rho_s}{\rho_a}\right) x\ V_s$$

Where,

V_a= velocity in actual feet-per-minute

V_s= standard velocity in feet-per-minute (SFPM)

ρ_s= standard air density

ρ_a= actual air density

Another way to write the above equation is:

$$V_a = \left(\frac{P_s\ x\ T_s}{P_a x\ T_s}\right) x\ V_s = 0.05578 \left(\frac{T_a}{P_a}\right) x\ V_s$$

Where,

P_s= 29.92 inches Hg pressure

P_a= actual barometric pressure (in Hg)

T_s= 25° C = 536.4° R (Rankine)

T_a= actual temperature in ° R (° R = ° F + 459.4)

3.3 Recording the Current-Sense Voltage Signals

Before initiating this procedure, you will be required to check the bridge voltage (B.V.) on the Model 465R_x Current-Transmitter Board; in addition, record the voltage measurement at zero flow rate and of the known air velocity at maximum flow rate. Therefore, refer to Section 4: *Service*, for your appropriate current-transmitter board and the test point placement for measuring B.V.

> **CAUTION:** If the B.V. is 5.000 Vdc or more (with no air flow impinging on the sensor), and the voltage does not start to alleviate below 5.000 Vdc within 10 seconds, turn power OFF, immediately. Supplying power for more than 10 seconds under these conditions may result in damage to the sensor.

Note: The Kurz™ air flow meter must be operational, and a DVM must be connected between terminal block 1, terminal screw 3 (TB1-3; GND) and terminal block 1, terminal screw 9 (TB1-9; I RET).

Step 1. Check to make sure that no air flow conditions are present; i.e., the test section of the Model 400 calibrator is at zero flow. Allow the sensor and associated circuitry to stabilize. (**Note:** For an external flow air velocity calibration, cover the protective window of the sensor to prevent any air flow to impinge on the sensor.)

Step 2. While monitoring the current-sense voltage signal at TB1-9, record the voltage measurement for calibration point 0 in the "Current-Sense DC Voltage" column for zero flow rate.

Note: You should check for current-sense voltage signal immediately due to after several minutes at zero flow in a small air volume, the heat produced by the R_p winding begins to affect the R_{tc} winding.

Step 3. For calibration points 1 through 11, starting with the maximum flow rate, execute Steps 1 through 5 in Subsection 3.2, Part B. Remember to record the current-sense voltage signal for each calibration point in the "Current-Sense DC Voltage" column.

3.4 Adjustments to the Nonlinear Circuitry

3.4.1 Calculating Resistant Values for R_{17} and R_{23}

This procedure consists of calculating resistant values for resistors R_{17} and R_{23} in the nonlinear section: R_{17} is for the "zero" control-potentiometer; whereas, R_{23} is for the "span" control-potentiometer. Both R_{17} and R_{23} are located below the "zero" and "span" control-potentiometers, as shown in Figure 3.4-1.

Formula to obtain the resistant value for R_{17}:

$$R_{17}=\frac{50}{X}-1=Value\ in\ K\Omega$$

Formula to obtain the resistant value for R_{23}:

$$R_{23}=\frac{1}{(Y-X)}x\ 45.45-1=Value\ in\ K\Omega$$

Where,

X= Current-sense voltage signal at zero flow rate

Y= Current-sense voltage signal at maximum flow rate

After calculating for correct resistance and solder R_{17} and R_{23} on the linearizer board.

Refer to Figure 3.4-1 for the resistor placements.

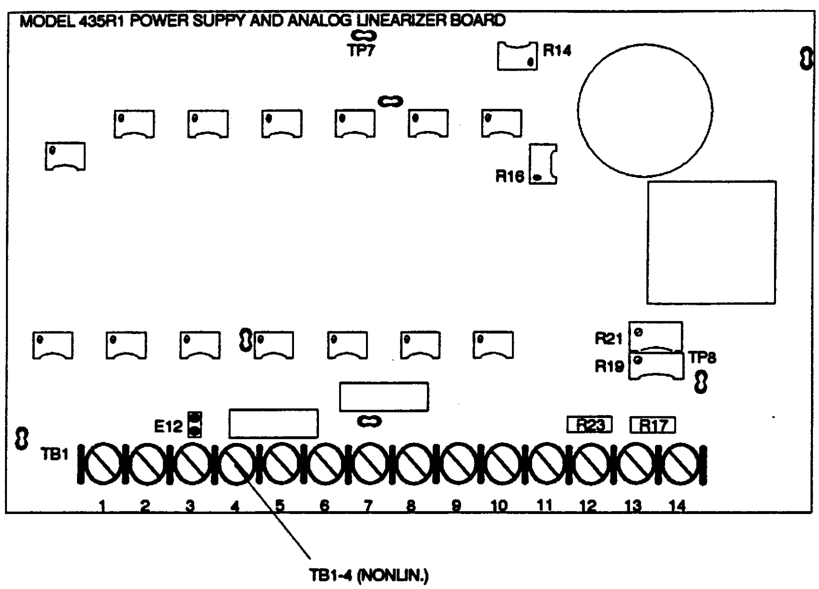
3.4.2 Calibrating the Nonlinear Circuitry

The next procedure is to adjust the current-sense voltage signals at zero flow rate and maximum flow rate to a nonlinear voltage signal; i.e., adjust the "zero" control-potentiometer (R_{19}) at zero flow rate to a nonlinear 0.000 Vdc signal and adjust the "span" control-potentiometer (R_{21}) while monitoring the known air velocity at specified maximum flow rate to a nonlinear 5.000 Vdc signal.

Refer to Figure 3.4-1 for the control-potentiometer placements and test point locations on the linearizer board.

Figure 3.4-1

Model 435R_1 Power Supply and Analog Linearizer Board



Step 1. Immediately after powering up the Kurz™ air flow meter, check the internal 2.490 Vdc reference voltage. Measure the voltage between terminal block 1, terminal screw 3 (TB1-3; GND) and test point 7 (TP7). The voltage measured should be 2.490 Vdc ± 5.0%. If necessary, adjust the contol-potentiometer (R_{14}) up or down until you get a reading of 2.490 Vdc.

Step 2. Next, check the internal -5.000 Vdc reference voltage. Measure the voltage between TB1-3 (GND) and test point 8 (TP8). The voltage measured should be -5.000 Vdc ± 5.0%. If necessary, adjust the contol-potentiometer (R_{16}) up or down until you get a reading of -5.000 Vdc.

Step 3. Check to make sure that no air flow conditions are present; i.e., the test section of the Model 400 calibrator is at zero flow. Allow the sensor and associated circuitry to stabilize. (**Note:** For an external flow air velocity calibration, cover the protective window of the sensor to prevent any air flow to impinge on the sensor.)

Step 4. Check the nonlinear voltage between terminal block 1, terminal screw 4 (TB1-4; NONLIN.) and TB1-3 (GND), adjust R_{19} up or down until you get a reading of 0.000 Vdc. (**Note:** Record this value for calibration point 0 in the "Actual Nonlin. Vdc" column.

Note: You should check for 0.000 Vdc immediately due to after several minutes at zero flow in a small air volume, the heat produced by the R_p winding begins to affect the R_{tc} winding.

Step 5. Starting with the maximum flow rate, execute Steps 1 through 5 in Subsection 3.2, Part B.

Step 6. While still measuring the nonlinear voltage at TB1-4, adjust the R_{21} up or down until you get a reading of 5.000 Vdc at specified maximum flow rate. (**Note:** Record this value for calibration point 11 in the "Actual Nonlin. Vdc" column.

Step 7. For calibration points 1 through 10, repeat step 5. Remember to record the value for each calibration point in the "Actual Nonlin. Vdc" column.

3.4.3 Verifying the Nonlinear Voltages

The nonlinear circuitry, if the "zero" and "span" control-potentiometers are adjusted properly in reference to the current-sense voltage signals at zero and specified maximum flow rate, should yield a nonlinear voltage reading approximate to those recorded in the "Actual Nonlin. Vdc" column.

Formula for calculating the nonlinear voltages, given the following:

X= Current-sense voltage signal at zero flow rate

Y= Current-sense voltage signal at maximum flow rate

Z= Specific current-sense voltage signal of a calibration point for calculating the nonlinear voltage

Whereas:

$$\text{Factor Constant} = \frac{Y-X}{5}$$

Thus:

$$\text{Nonlin. Vdc} = \frac{Z-X}{\text{Factor Constant}}$$

Example: Given the proper differential pressures to set up air velocities of 0 SFPM, 750 SFPM, and 1500 SFPM. The current-sense voltage signal measured between TB1-3 (GND) and TB1-9 (I RET) are the following: 0 SFPM is 0.900 Vdc, representing a zero flow rate; 1500 SFPM is 1.500 Vdc, representing a maximum flow rate; and 750 SFPM is 1.384 Vdc, indicating a representation of flow of exactly half of the maximum flow rate. Calculate the nonlinear voltage for the calibration point at 750 SFPM.

a) Given: $X = 0.900Vdc$; $Y = 1.500Vdc$; and $Z = 1.384Vdc$

b) $\text{Factor Constant} = \frac{1.500 - 0.900}{5} = 0.12$

c) Therefore, $\text{Nonlin. Vdc} = \frac{1.384 - 0.900}{0.12} = 4.033Vdc$

3.5 Graphing Data Points

3.5.1 Plotting the Nonlinear Voltages on a Graph

This procedure illustrates the graphic technique used to plot the nonlinear voltages recorded in the "Actual Nonlin. Vdc" column against the ideal voltages in the "Desired Lin. Vdc" column. The ideal voltages are plotted on the x-axis and the nonlinear voltages are plotted on the y-axis.

Example: Provided data representing the values of the variable quantities on the y-axis vs. the values of the constant quantities on the x-axis. The ideal voltages, across the horizontal axis, correspond to a linear 0.000 Vdc to 5.000 Vdc output, with the vertical axis corresponding to nonlinear 0.000 Vdc to 5.000 Vdc input.

Figure 3.5-1 shows this data plotted on a graph. Figure 3.5-2 shows a curve through the data points with one continual slope, avoiding a straight point-to-point connection of data points.

X-Axis (Ideal Voltages)	Y-Axis (Nonlinear Voltages)
0.000 Vdc	0.000 Vdc
0.250 Vdc	1.460 Vdc
0.500 Vdc	2.140 Vdc
1.000 Vdc	2.923 Vdc
1.500 Vdc	3.410 Vdc
2.000 Vdc	3.740 Vdc
2.500 Vdc	4.037 Vdc
3.000 Vdc	4.270 Vdc
3.500 Vdc	4.490 Vdc
4.000 Vdc	4.664 Vdc
4.500 Vdc	4.855 Vdc
5.000 Vdc	5.000 Vdc

Figure 3.5-1

Graph of Plotted Nonlinear Voltages vs. Ideal Voltages

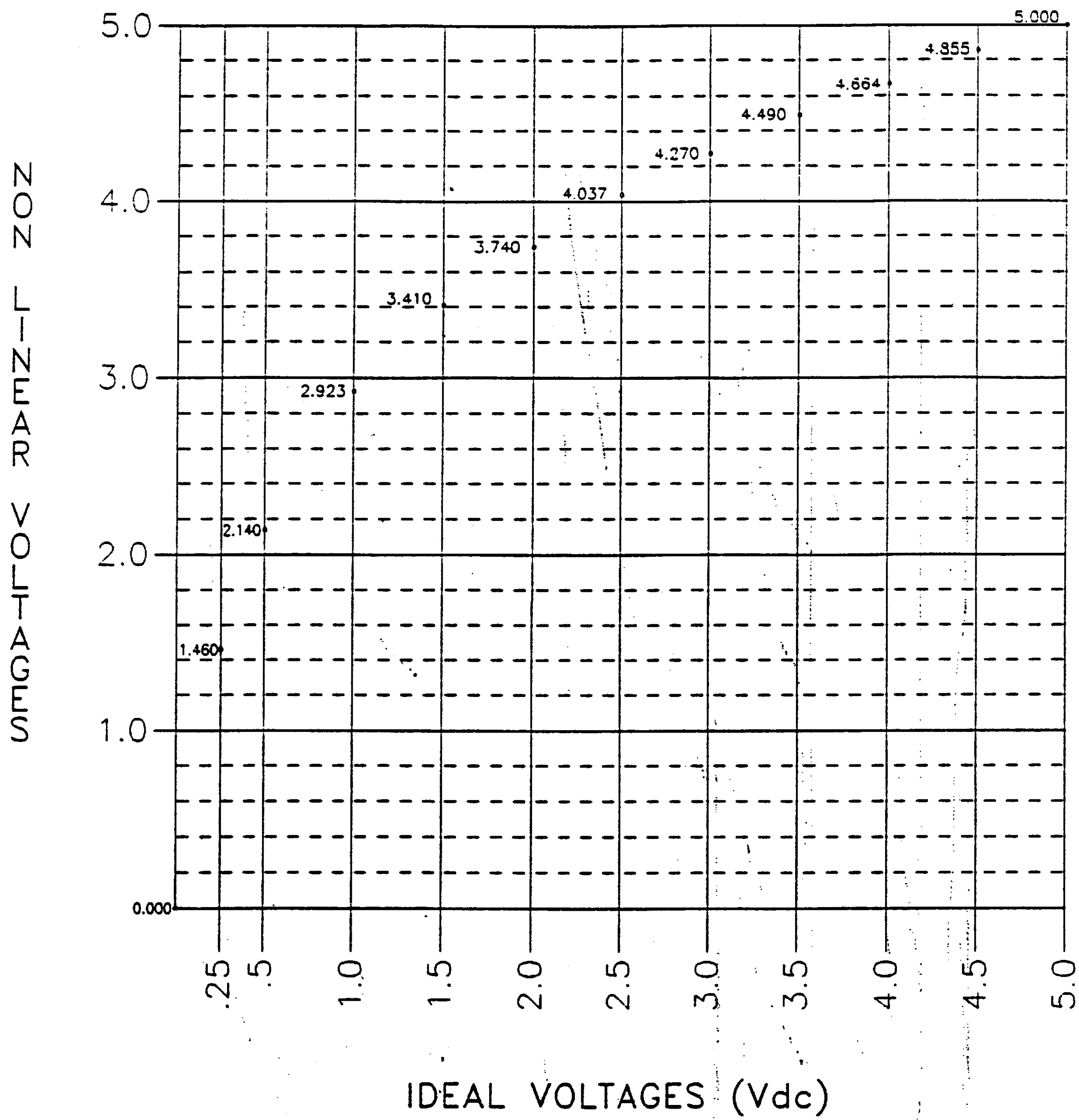
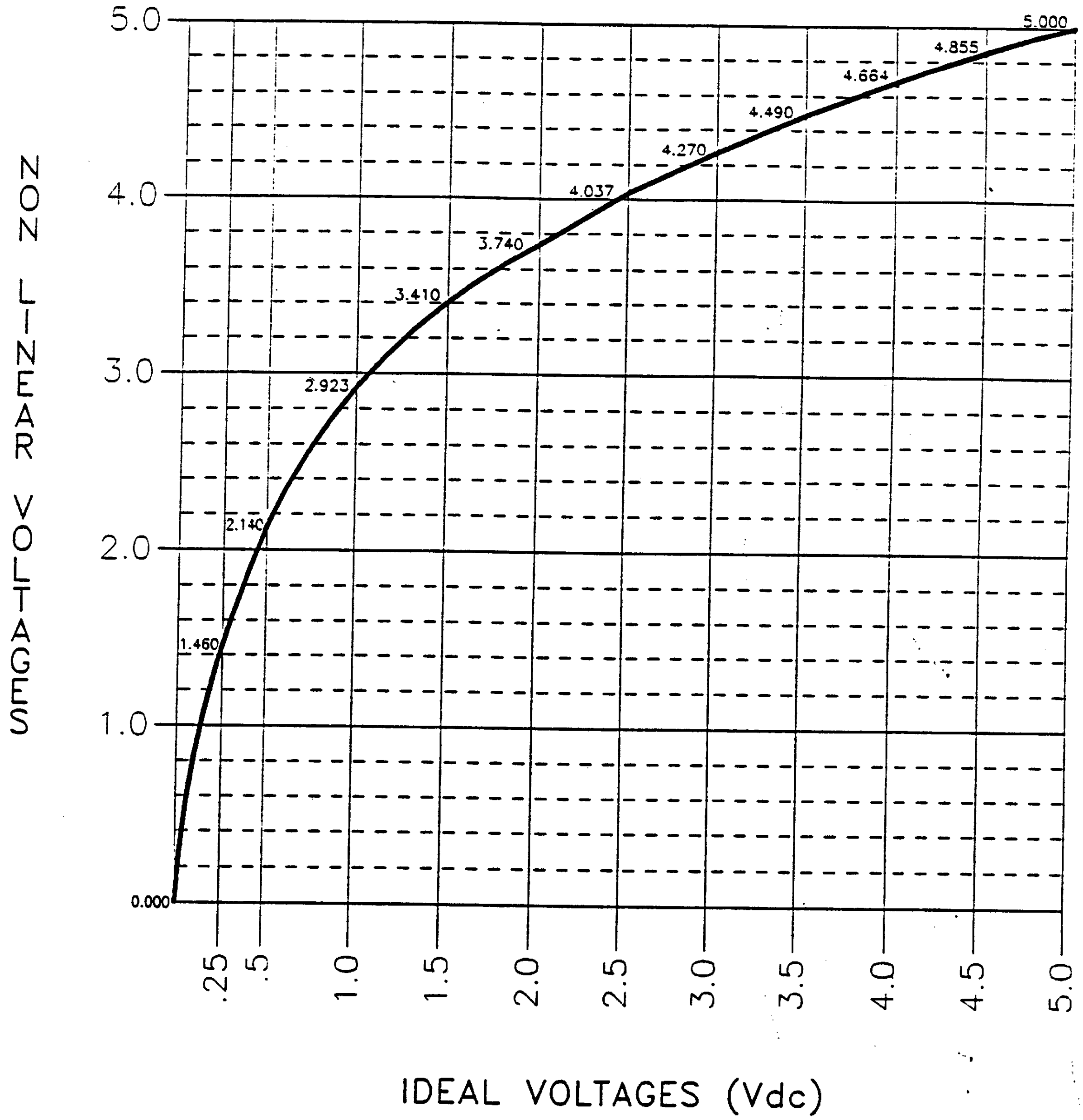


Figure 3.5-2
Curve for Plotted Nonlinear Voltages vs. Ideal Voltages



3.5.2 Plotting Break-Point Voltages on the Curve

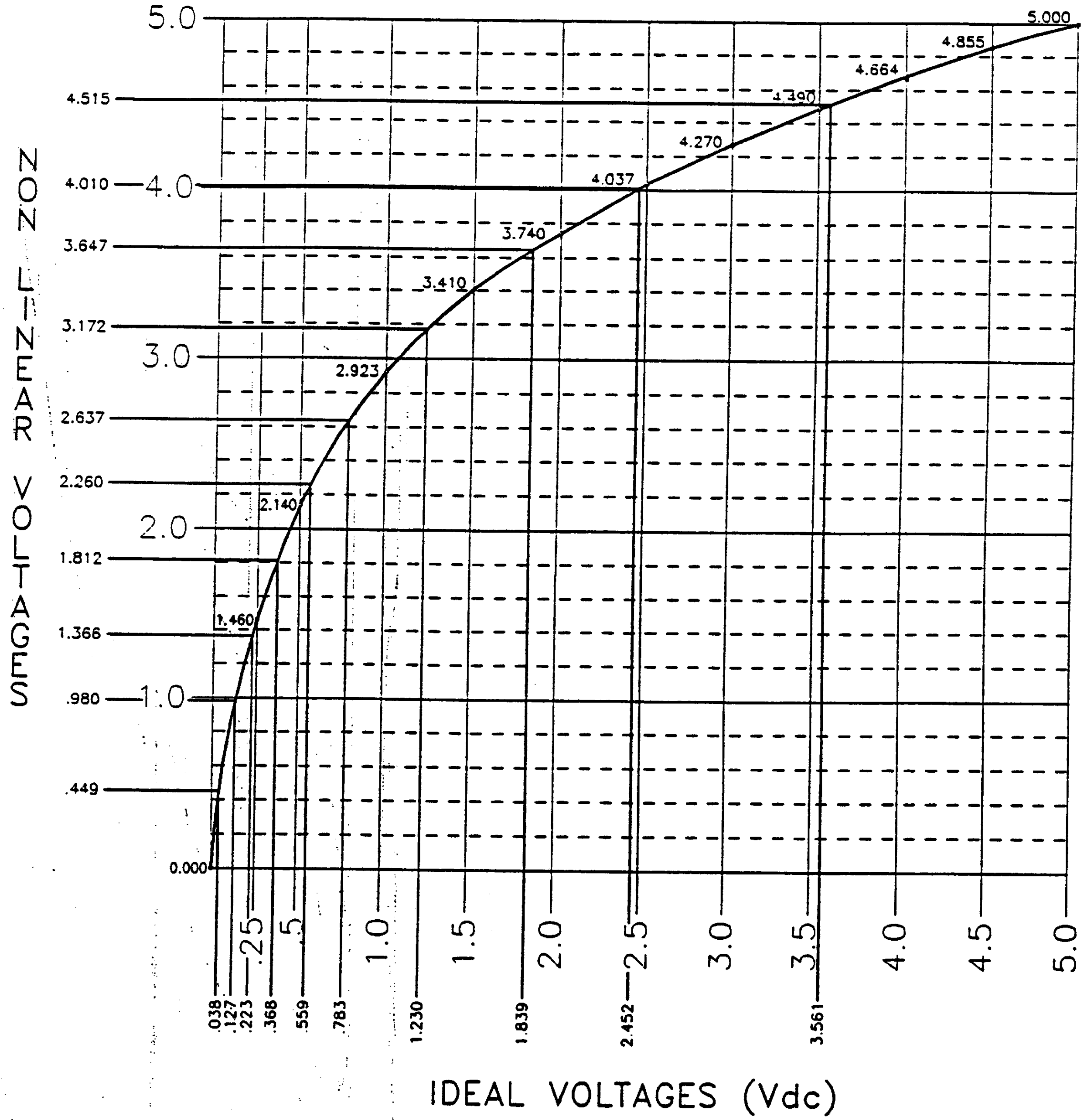
Step 1. Identify on the curve the break-point voltages listed in the "Break-Points" column.

Step 2. Draw a horizontal line from each break-point voltage on the curve to the base line of the y-axis. From each break-point voltage on the same curve, draw a vertical line down to the base line of the x-axis.

Step 3. The data extracted from the x-axis represents data points that will used in linearizing the nonlinear 0.000 Vdc to 5.000 Vdc input signal to a linear 0.000 Vdc to 5.000 Vdc output signal. Record the obtained data for calibration points 0 to 11 in the "Linear Vdc Points" column.

For example, the curve now have the linearized "ideal voltages" from each of the break-point voltages as shown in Figures 3.5-3.

Figure 3.5-3
Linear Voltage Points on the Curve



3.6 Adjustments to the Linear Circuitry

3.6.1 Calibrating the Linear Circuitry

This procedure primarily consists of inputting each break-point voltage listed in the "Break-Points" column to the linear circuitry of the linearizer board, and adjusting the appropriate control-potentiometer for each data point recorded in the "Lin. Vdc Points" column, respectively.

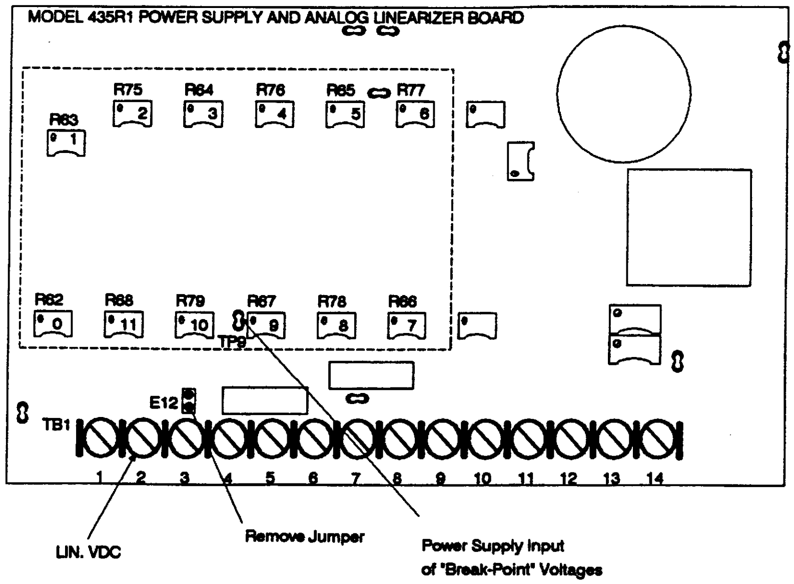
Note: The DVM must be connected between terminal block 1, terminal screw 2 (TB1-2; LIN. OUT) and terminal block 1, terminal screw 3 (TB1-3; GND), and a variable power supply capable of up to 5.000 Vdc connected to test point 9 (TP9) and TB1-3 (GND).

Step 1. As a precaution, before supplying input power to the linearizer board, we recommend the two-wire conductor cable be disconnected from the linearizer board to prevent any damages that may may be incurred to the sensor and its associated circuitry during this calibration procedure.

Step 2. Pull out jumper E_{12} from the linearizer board. Removing jumper E_{12} isolates the actual nonlinear signal that would be transmitted to the linear section in normal operations when the Kurz™ air flow meter is operational. (**Note:** You will be adjusting the control-potentiometers shown within the dotted lines; i.e., by working clockwise starting from R_{62}, R_{63}, R_{75}...R_{68}.)

Refer to Figure 3.6-1 for a simplified component diagram of the linearizer board.

Figure 3.6-1
Simplified Component Diagram of the Linearizer Board



Step 3. With an input of 0.000 Vdc at TP9, adjust R_{62} for a measurement of 0.000 Vdc output at TB1-2.

Step 4. Supply an input of 0.449 Vdc at TP9. While monitoring the linear voltage output at TB1-2, adjust R_{63} for a voltage measurement of the equivalence recorded for calibration point 1 in the "Lin. Vdc Points" column.

Step 5. Supply an input of 0.980 Vdc at TP9. While monitoring the linear voltage ouptut at TB1-2, adjust R_{75} for a voltage measurement of the equivalence recorded for calibration point 2 in the "Lin. Vdc Points" column.

Step 6. Supply an input of 1.366 Vdc at TP9. While monitoring the linear voltage ouptut at TB1-2, adjust R_{64} for a voltage measurement of the equivalence recorded for calibration point 3 in the "Lin. Vdc Points" column.

Step 7. Supply an input of 1.812 Vdc at TP9. While monitoring the linear voltage ouptut at TB1-2, adjust R_{76} for a voltage measurement of the equivalence recorded for calibration point 4 in the "Lin. Vdc Points" column.

Step 8. Supply an input of 2.260 Vdc at TP9. While monitoring the linear voltage ouptut at TB1-2, adjust R_{65} for a voltage measurement of the equivalence recorded for calibration point 5 in the "Lin. Vdc Points" column.

Step 9. Supply an input of 2.637 Vdc at TP9. While monitoring the linear voltage ouptut at TB1-2, adjust R_{77} for a voltage measurement of the equivalence recorded calibration point 6 in the "Lin. Vdc Points" column.

Step 10. Supply an input of 3.172 Vdc at TP9. While monitoring the linear voltage ouptut at TB1-2, adjust R_{66} for a voltage measurement of the equivalence recorded for calibration point 7 in the "Lin. Vdc Points" column.

Step 11. Supply an input of 3.647 Vdc at TP9. While monitoring the linear voltage ouptut at TB1-2, adjust R_{78} for a voltage measurement of the equivalence recorded for calibration point 8 in the "Lin. Vdc Points" column.

Step 12. Supply an input of 4.010 Vdc at TP9. While monitoring the linear voltage ouptut at TB1-2, adjust R_{67} for a voltage measurement of the equivalence recorded for calibration point 9 in the "Lin. Vdc Points" column.

Step 13. Supply an input of 4.515 Vdc at TP9. While monitoring the linear Vdc ouptut at TB1-2, adjust R_{79} for a voltage measurement of the equivalence recorded for calibration point 10 in the "Lin. Vdc Points" column.

Step 14. Supply an input of 5.000 Vdc at TP9. While monitoring the linear voltage ouptut at TB1-2, adjust R_{68} for a voltage measurement of the equivalence recorded for calibration point 11 in the "Lin. Vdc Points" column.

3.6.2 Verifying the Linear Voltages

The linear circuitry, if the procedures for calibration have been performed properly, should yield ± 2.0% of reading plus 0.5% of full scale.

Formula for calculating the maximum value for the specified ideal voltage, given the following ± 2.0% of reading plus 0.5% of full scale:

$$MPE_{lin.\ vdc} = (E \times 1.020) + 0.025$$

Formula for calculating the minumum value for the specified ideal voltage, given the following ± 2.0% of reading plus 0.5% of full scale:

$$MPE_{lin.\ vdc} = (E \times 0.980) - 0.025$$

where,

$MPE_{lin.\ vdc}$= the maximum percentage of error for the actual linear voltage to be in range

E= the ideal voltage in the "Desired Lin. Vdc" column

1.020= maximum for 2.0% of reading

0.970= minimum for 2.0% of reading

± 0.025 = 0.5% of full scale @ 5.000 Vdc

The procedure for checking the accuracy of the linear circuitry is similar to the preceeding calibration procedure; except, instead of inputting the break-point voltages at TP9, you will be simulating each nonlinear voltage recorded in the "Actual Nonlin. Vdc" column. Nonetheless, you will still monitor the linear voltage outputs at TB1-2 with a DVM and record the voltage measurements in the "Actual Lin. Vdc" column for each simulated nonlinear voltage input.

Step 1. With an input of 0.000 Vdc at TP9, monitor the linear voltage output at TB1-2. Record the voltage measurement for calibration point 0 in the "Actual Lin. Vdc" column. The voltage should be no more than 0.025 Vdc.

Step 2. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 1 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 1 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 0.250 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 0.280 Vdc or less than 0.220 Vdc.

Step 3. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 2 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 2 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 0.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 0.535 Vdc or less than 0.465 Vdc.

Step 4. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 3 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 3 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 1.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 1.045 Vdc or less than 0.955 Vdc.

Step 5. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 4 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 4 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 1.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 1.555 Vdc or less than 1.455 Vdc.

Step 6. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 5 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 5 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 2.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 2.065 Vdc or less than 1.935 Vdc.

Step 7. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 6 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 6 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 2.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 2.575 Vdc or less than 2.425 Vdc.

Step 8. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 7 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 7 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 3.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 3.085 Vdc or less than 2.915 Vdc.

Step 9: Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 8 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 8 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 3.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 3.595 Vdc or less than 3.405 Vdc.

Step 10: Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 9 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 9 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 4.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 4.105 Vdc or less than 3.895 Vdc.

Step 11: Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 10 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 10 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 4.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 4.615 Vdc or less than 4.385 Vdc.

Step 12: Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 11 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 11 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 5.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 5.125 Vdc or less than 4.875 Vdc.

Step 13. Install jumper E_{12}. Hookup the two-wire conductor cable to terminal block 1, terminal screw 9 (TB1-9; I RET) and terminal screw 10 (TB1-10; 24.000 Vdc; RTC).

Note: If the linear voltage outputs are in specifications (± 2.0% of reading plus 0.5% of full scale), no further adjustments are needed, and the Kurz™ air flow meter is ready for process applications. If the linear voltages outputs are not within the specifications, then erroneous data exists in flow setup or graphing and the procedures for calibration should be reviewed.

3.6.3 Adjustments to the Optional Signal Output

The linearizer board can also provide a second linear 0.000Vdc to 5.000 Vdc analog output located at terminal block 1, terminal screw 1 (TB1-1; ENG. UNIT SIG. OUT) or when external devices are used, we call terminal block 3, terminal screw 1 (TB3-1).

This procedure simply consists of inputting 5.000 Vdc representing a selected velocity calibration range at TP9 and adjusting R99 (control-potentiometer) to read 5.000 Vdc at TB1-1. In some cases, you will need to simulate a specified scaled voltage representing mass flow rate for a specified duct or pipe area.

Note: The DVM must be connected between TB1-1 and TB1-3 (GND) and a variable power supply capable of up to 5.000 Vdc connected to TP9 and TB1-3 (GND).

KURZ CALIBRATION WORK SHEET

KURZ MODEL: 450-08-AT-LD-6" **CUSTOMER CODE:** AIR-FLO

	FLOW RATE VELOCITY POINT	FLOW RATE MASS POINT	IDEAL LIN. VDC	ACTUAL LIN. VDC	ACTUAL mA OUT	ACTUAL NONLIN. VDC	INCHES OF H20	CURRENT SENSE D.C. VDC		BREAK POINTS	LIN. VDC POINTS
0	0		0.000	0.000		0.000	0	0.900	0	0.000	0.000
1	75		0.250	0.255		1.460	0.093	1.075	1	0.449	0.038
2	150		0.500	0.507		2.140	0.185	1.157	2	0.980	0.127
3	300		1.000	1.003		2.923	0.310	1.251	3	1.366	0.223
4	450		1.500	1.529		3.410	0.470	1.309	4	1.812	0.368
5	600		2.000	2.005		3.740	0.650	1.349	5	2.260	0.559
6	750		2.500	2.523		4.037	0.780	1.384	6	2.637	0.783
7	900		3.000	3.041		4.270	1.045	1.412	7	3.172	1.230
8	1050		3.500	3.534		4.490	1.180	1.439	8	3.647	1.839
9	1200		4.000	4.000		4.664	1.250	1.460	9	4.010	2.452
10	1350		4.500	4.562		4.855	1.530	1.483	10	4.515	3.561
11	1500		5.000	5.000		5.000	1.720	1.500	11	5.000	5.000

LFE S/N: **104180-T4-R5** Due Date: **01 JUL 92** Range: **0 - 1500 SFPM**

LFE Area: **0.057609501 FT^2**

Model No.: **400B** Input: **115** Vac **60** Hz

DVM S/N: **2092** Due Date: **05 MAR 92** ____ Vdc

Temp. S/N: **13001** Due Date: **28 MAR 92** I-Mode: Yes **X** No ____

Bar. S/N: **11508 Y1** Due Date: **NA** Absolute Pressure: **29.00** "Hg

Pipe Size: **NA** Actual Temperature: **90** °F

Pipe Area: **NA** Calculated Nonlin. Resistors:

R_{17} **54.55 KΩ** R_{23} **74.55 KΩ**

COMMENTS:

BRIDGE VOLTAGE

Zero Flow: **2.919 Vdc**

Max. Flow: **8.452 Vdc**

For Intrinsic Safety Circuit:

Zener Diode: **NA**

Ballast Resistor: **NA**

CURRENT-SENSE VOLTAGE

Zero Flow: **0.900 Vdc**

Max. Flow: **1.500 Vdc**

Section 4: Service

This section describes the routine maintenance and trouble-shooting procedures pertaining to the Kurz™ air flow meters. Nonetheless, it is recommended that a unit be returned to the Kurz™ factory if repairs and, or recalibration are needed. This is usually the most cost effective and reliable means.

4.1 Routine Maintenance

The Kurz™ air flow meters are virtually maintenance free. Though, when required, we recommend the following:

- Electronics maintenance
- Mechanical maintenance

CAUTION: When dismantling the unit for repair, recalibration and, or cleaning make sure that power is off.

4.1.1 Electronics Maintenance

The electronic components on the current-transmitter board and linearizer board essentially require no maintenance; however, should be periodically inspected and cleaned.

The factory calibration of the unit remains stable over a duration of up to several years. However, in order to sustain NIST-traceability, annual recalibrations are recommended.

Note: If the unit requires recalibration while still under warranty, contact Kurz™ Instruments, Inc. at (800) 424-7356 and ask for Customer Service.

4.1.2 Mechanical Maintenance

Mechanical maintenance comprises of inspecting the sensor's flow path and checking the sensor for proper functioning.

The Kurz™ thermal mass flow sensor render it resistant to particulate contamination in most applications; nevertheless, performs best when it is kept relatively free of contamination. You should, therefore, check the sensor at regular intervals, cleaning it if necessary. Be careful not to damage the sensor during removal or reinsertion. A bent sensor may develop a short and would need to be replaced.

a) For a Kurz™ MetalClad™ sensor, use a fine wire brush, crocus cloth or fine grit emery cloth to remove build-up contamination from the sensor.

Note: Some sensors may have small specks of excess metal adhering to their sheaths. This is normal and in no way degrades the performance of the sensors. Do **NOT** attempt to remove such specks. Doing so may change the unit's calibration.

b) For a Kurz™ DuraFlo™ sensor, use a small camel's hair brush and water, followed by an alcohol rinse.

4.2 Trouble-Shooting

This procedure to help locate the section of the electronics assembly at fault. It is not intended to be an all inclusive repair manual. Nonetheless, the corrective actions to be taken usually recommend electronic components or wiring connections to be corrected, replaced or repaired by a certified eletrical technician, familiar with electronic test equipment and measurements. In most major repairs, the unit should be returned to the Kurz™ factory for service. Kurz™ Instruments, Inc. will provide technical assistance over the phone to qualified repair personnel. Please call Customer Service Department (800) 424-7356.

Once installed, the operation of the Kurz™ air flow meter is primarily a matter of maintaining power to the system. The system will continue to operate for prolonged periods without intervention. However, when it is suspected that the unit is not operating correctly, the following test procedures that can be performed before dismantling for repair:

- Power-on voltage test for the Model 435R1 Power Supply and Analog Linearizer Board

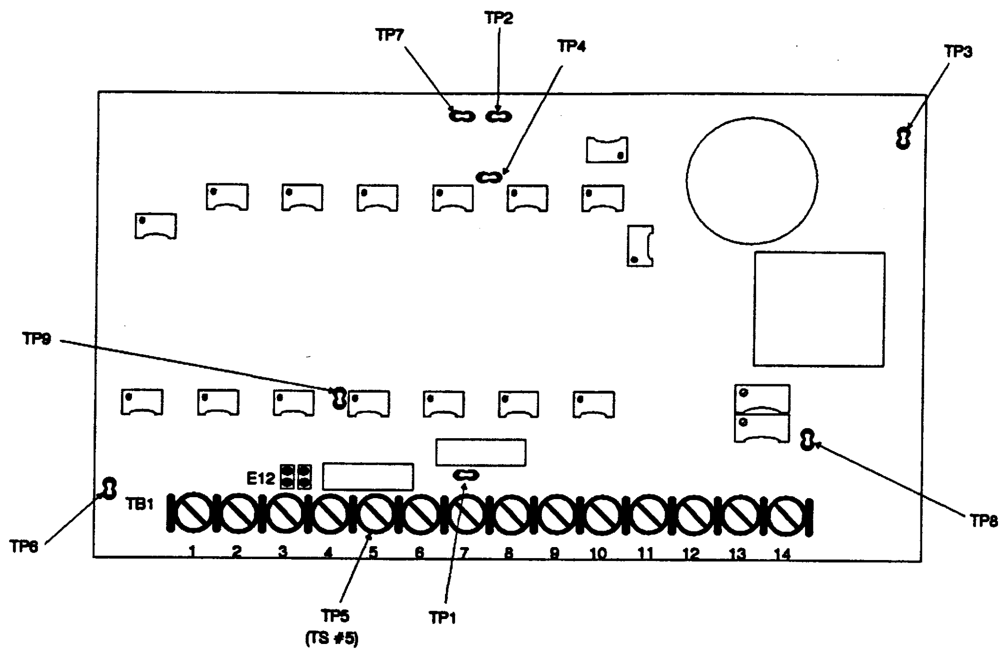
- Power-on voltage test for the Model 465Rx Current-Transmitter Board

> **WARNING:** Any warranty service to be performed at the customer's site must have written authorization by Kurz™ Instruments Inc. Nonwarranty service should be performed only by a certified electrical technician.

4.2.1 Test Procedure for the Model 435R1 Power Supply and Analog Linearizer Board

The test procedure for the linearizer board consists of verifying voltages between terminal block 1, terminal screw 3 (TB1-3; GND) and each of the nine test points given. Refer to Figure 4.2-1 for the location of the test points on the linearizer board. You will need a digital voltmeter (DVM) accurate to within ± 0.001 Vdc.

Figure 4.2-1.
Test Points on the Linearizer Board



Note: All test verifications with the exception of test points 1 and 9 can be checked with the two-wire loop operation disconnected from the linearizer board. This allows the removal of the linearizer board from the system enclosure for bench-test purposes. However, a power source must be connected to the A.C. terminals on terminal block 1, terminal screws 12 (TB1-12; AC GND), 13 (TB1-13; ACC) and 14 (TB1-14; AC).

The power-on voltage test for the linearizer board are as follows:

Test point 1 (TP1) — is for the current-sense voltage (flow meter must be operational) of 0.600 Vdc, ± 0.015 Vdc at zero flow rate to 3.000 Vdc, ± 0.075 Vdc at specified maximum flow rate (this voltage is nominal, refer to the appropriate Calibration Data and Certification Document for exact rated voltage).

Test point 2 (TP2) — is for the unregulated supply voltage of 24.000 Vdc, ± 5.000 Vdc.

Test point 3 (TP3) — is for the unregulated, negative supply voltage of -24.000 Vdc, ± 5.000 Vdc.

Test point 4 (TP4) — is for the regulated supply voltage of 15.000 Vdc, ± 0.450 Vdc.

Test point 5 (TP5) or TB1-5 — is for the regulated, negative supply voltage of -12.000 Vdc, ± 0.360 Vdc.

Test point 6 (TP6) — is for the regulated supply voltage of 5.000 Vdc, ± 0.150 Vdc.

Test point 7 (TP7) — is for the reference voltage of 2.490 Vdc, ± 0.001 Vdc.

Test point 8 (TP8) — is for the negative reference voltage of -5.000 Vdc, ± 0.001 Vdc.

Test point 9 (TP9) — is for the nonlinear voltage signal to the linearizing circuitry (flow meter must be operational): 0.000 Vdc, 0.025 Vdc at zero flow rate and 5.000 Vdc, ± 0.125 Vdc at specified maximum flow rate.

Note: Refer to Appendix B: *Trouble-Shooting Guide*, for more indepth information pertaining to the symptoms and probable causes for electronics malfunction on the linearizer board.

4.2.2 Testing the Model $465R_x$ Current-Transmitter Board

This test procedure allows you to verify the operation of the Model $465R_6$ and $465R_7$ Current-Transmitter Boards. You will need a digital voltmeter (DVM) accurate to within ± 0.001 Vdc.

Before you perform the test, check to make sure that the following conditions are met:

a) The two-wire conductor cable is properly connected to terminal block 1 (TB1) on both the current-transmitter board and linearizer board.

b) The four-wire or five-wire cable from the sensor is properly connected to the appropriate terminal screws on terminal block 2 (TB2) on the current-transmitter board. (**Note:** For a probe assembly with a "TS" electronic configuration, make sure the wiring from the terminal board in the junction box are properly connected to TB2 on the current-transmitter board.)

c) If possible, set the flow to zero flow rate.

Note: All test point are accessible on the current-transmitter board after the cover of the flow transmitter enclosure has been removed.

Refer to Figures 4.2-2 and 4.2-3, respectively, for the test point locations where the voltages and current can be measured.

Figure 4.2-2.
Model 465R6 Current-Transmitter Board

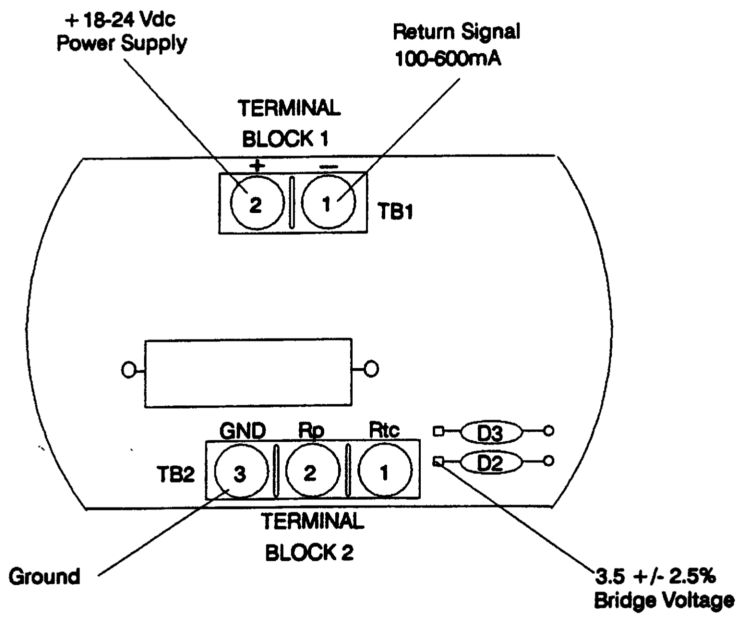
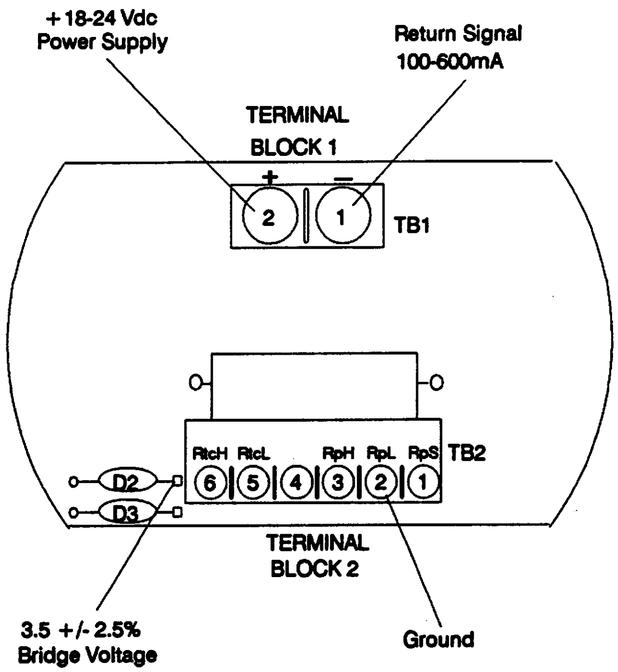


Figure 4.2-3
Model 465R7 Current-Transmitter Board



A. Power-On Voltage Test Procedure for the Model 465R6 Current-Transmitter Board

Step 1. Check the 24.000 Vdc input voltage. The two-wire conductor cable should be connected to terminal block 1, terminal screws 1 (TB1-1) and 2 (TB1-2). The 24.000 Vdc power source should be connected to terminal screw 2 and the return signal should be connected to terminal screw 1. With the power supply turned off, make sure these connections are secure.

With the power turned on, check the voltage between terminal block 2, terminal screw 3 (TB2-3; GND) and TB1-2 (24.000 Vdc).

Step 2. Check the circuit ground between TB2-3 (GND) and chassis ground. The voltage measured should be 0.000 Vdc.

Step 4. Check the bridge voltage (B.V.). The B.V. will vary with the air flow. As the velocity increases, the amount of power required to maintain the standard overheat increases. To verify the sensor and bridge circuit are operating this way, measure the voltage between TB2-3 (GND) and the leg of diode D_2 closest to TB2. This voltage should range from 3.500 Vdc to 9.000 Vdc, typically.

Step 5. Check the current-return signal. The current-return signal will also vary with the air flow. As the velocity increases, the amount of power required to maintain the standard overheat increases.

Measure the amount of current being transmitted from the current-transmitter board to the linearizer by placing an ammeter in series with TB1-1 (I RET) and the conductor cable. The current measured should be in the 100.0 mA to 600.0 mA range, dependent on the amount of air flow measured by the sensor.

B. Power-On Voltage Test Procedure for the Model 465R7 Current-Transmitter Board

Step 1. Check the 24.000 Vdc input voltage. The two-wire conductor cable should be connected to terminal block 1, terminal screws 1 (TB1-1) and 2 (TB1-2). The 24.000 Vdc power source should be connected to terminal screw 2 and the return signal should be connected to terminal screw 1. With the power supply turned off, make sure these connections are secure.

With the power turned on, check the voltage between terminal block 2, terminal screw 2 (TB2-2; GND/R_{pL}) and TB1-2 (24.000 Vdc).

Step 2. Check the circuit ground between TB2-2 (GND/R_{pL}) and chassis ground. The voltage measured should be 0.000 Vdc.

Step 3. Check the bridge voltage (B.V.). The B.V. will vary with the air flow. As the velocity increases, the amount of power required to maintain the standard overheat increases. To verify the sensor and bridge circuit are operating this way, measure the voltage between TB2-2 (GND/R_{pL}) and the leg of diode D2 closest to TB2. This voltage should range from 3.500 Vdc to 9.000 Vdc, typically.

Step 4. Check the current-return signal. The current-return signal will also vary with the air flow. As the velocity increases, the amount of power required to maintain the standard overheat increases.

Measure the amount of current being transmitted from the current-transmitter board to the linearizer board by placing an ammeter in series with TB1-1 (I RET) and the conductor cable. The current measured should be in the 100.0 mA to 600.0 mA range, dependent on the amount of air flow measured by the sensor.

C. RTD-Windings Resistance Verfication Procedure

If the sensor appears to be at fault, it can be tested and verified by measuring the ohmage of the RTD-windings[1].

With the power supply turned off, remove the sensor's four-wire or five-wire cable from the terminal screws of terminal block 2 (TB2) on the current-transmitter board.

Refer to Tables 4.2-1, 4.2-2 and 4.2-3 for the resistance values for the RTD-windings.

> **CAUTION:** Remember to reconnect the sensor's four-wire or five-wire cable to the Model 465R_x Current-Transmitter Board as wired from the Kurz™ factory.

Table 4.2-1

RESISTANCE VERIFICATION CHART			
Sensor Type	**Velocity Sensor**		**Ohmage @ Amb. Temp. 25° C**
	Four-wire	**Five-wire**	
"dual-sting"	$R_{tc}GND$ & R_{tc}	R_{tcL} & R_{tcH}	329 ohms ± 1.0%*
	R_pGND & R_p	R_{pS}, R_{pL} & R_{pH}	10 ohms ± 1.0%

* Refers to the resistance for a Kurz™ "large dual-sting" (LD) MetalClad™ sensor; whereas, the resistance for a Kurz™ "miniature dual-sting" (MD) MetalClad™ sensor is 110 ohms ± 1.0%.

Table 4.2-2

RESISTANCE VERIFICATION CHART			
Sensor Type	**Velocity Sensor**		**Ohmage @ Amb. Temp. 25° C**
	Four-wire	**Five-wire**	
"single-sting"	$R_{tc}GND$ & R_{tc}	R_{tcL} & R_{tcH}	164 ohms ± 1.0%
	R_pGND & R_p	R_{pS}, R_{pL} & R_{pH}	20 ohms ± 1.0%*

* Refers to the resistance for a Kurz™ "single-sting" DuraFlo™ sensor; whereas, the resistance for a Kurz™ "single-sting" MetalClad™ sensor is 10 ohms ± 1.0%.

1 Values obtained that are substantially different indicate a damaged sensor.

Table 4.2-3

RESISTANCE VERIFICATION CHART			
Sensor Type	Velocity Sensor	Temp. Sensor	Ohmage @ Amb. Temp. 70° F
	Four-wire	Two-wire	
"triple-sting"	$R_{tc}GND$ & R_{tc}		164 ohms ± 1.0%
	R_pGND & R_p		10 ohms ± 1.0%
		$R_{td}GND$ & R_{td}	110 ohms ± 1.0%

End of Section 4

Appendix A: Engineering Drawings

The appendix contains engineering drawings of the electronic assemblies associated with the Kurz™ air flow meter. Also, included is a blank Kurz™ calibration work sheet. You are free to copy it for calibration purposes.

Note: If you want to perform your own warranty service, you must first obtain written authorization from Kurz™ Instruments, Inc. **Unauthorized service performed during the warranty period voids your warranty.** Please read the warranty statement at the front portion of this manual before performing any services.

Table 4.2-3

RESISTANCE VERIFICATION CHART			
Sensor Type	Velocity Sensor Four-wire	Temp. Sensor Two-wire	Ohmage @ Amb. Temp. 70° F
"triple-sting"	R_{tc}GND & R_{tc}		164 ohms ± 1.0%
	R_{p}GND & R_{p}		10 ohms ± 1.0%
		R_{td}GND & R_{td}	110 ohms ± 1.0%

End of Section 4

Step 2. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 1 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 1 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 0.250 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 0.280 Vdc or less than 0.220 Vdc.

Step 3. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 2 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 2 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 0.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 0.535 Vdc or less than 0.465 Vdc.

Step 4. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 3 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 3 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 1.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 1.045 Vdc or less than 0.955 Vdc.

Step 5. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 4 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 4 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 1.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 1.555 Vdc or less than 1.455 Vdc.

Step 6. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 5 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 5 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 2.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 2.065 Vdc or less than 1.935 Vdc.

Step 7. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 6 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 6 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 2.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 2.575 Vdc or less than 2.425 Vdc.

Step 8. Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 7 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 7 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 3.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 3.085 Vdc or less than 2.915 Vdc.

Step 9: Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 8 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 8 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 3.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 3.595 Vdc or less than 3.405 Vdc.

Step 10: Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 9 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 9 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 4.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 4.105 Vdc or less than 3.895 Vdc.

Step 11: Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 10 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 10 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 4.500 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 4.615 Vdc or less than 4.385 Vdc.

Step 12: Supply an input voltage at TP9 of the equivalence to the voltage recorded for calibration point 11 in the "Actual Nonlin. Vdc" column. Monitor the linear voltage output at TB1-2 and record the voltage measurement for calibration point 11 in the "Actual Lin. Vdc" column.

In comparison to the ideal voltage of 5.000 Vdc @ ± 2.0% of reading plus 0.5% of full scale, the linear voltage output measured at TB1-2 should be no more than 5.125 Vdc or less than 4.875 Vdc.

Step 13. Install jumper E_{12}. Hookup the two-wire conductor cable to terminal block 1, terminal screw 9 (TB1-9; I RET) and terminal screw 10 (TB1-10; 24.000 Vdc; RTC).

Note: If the linear voltage outputs are in specifications (± 2.0% of reading plus 0.5% of full scale), no further adjustments are needed, and the Kurz™ air flow meter is ready for process applications. If the linear voltages outputs are not within the specifications, then erroneous data exists in flow setup or graphing and the procedures for calibration should be reviewed.

3.6.3 Adjustments to the Optional Signal Output

The linearizer board can also provide a second linear 0.000Vdc to 5.000 Vdc analog output located at terminal block 1, terminal screw 1 (TB1-1; ENG. UNIT SIG. OUT) or when external devices are used, we call terminal block 3, terminal screw 1 (TB3-1).

This procedure simply consists of inputting 5.000 Vdc representing a selected velocity calibration range at TP9 and adjusting R99 (control-potentiometer) to read 5.000 Vdc at TB1-1. In some cases, you will need to simulate a specified scaled voltage representing mass flow rate for a specified duct or pipe area.

Note: The DVM must be connected between TB1-1 and TB1-3 (GND) and a variable power supply capable of up to 5.000 Vdc connected to TP9 and TB1-3 (GND).

KURZ CALIBRATION WORK SHEET

KURZ MODEL: 450-08-AT-LD-6" **CUSTOMER CODE:** AIR-FLO

	FLOW RATE VELOCITY POINT	FLOW RATE MASS POINT	IDEAL LIN. VDC	ACTUAL LIN. VDC	ACTUAL mA OUT	ACTUAL NONLIN. VDC	INCHES OF H20	CURRENT SENSE D.C. VDC		BREAK POINTS	LIN. VDC POINTS
0	0		0.000	0.000		0.000	0	0.900	0	0.000	0.000
1	75		0.250	0.255		1.460	0.093	1.075	1	0.449	0.038
2	150		0.500	0.507		2.140	0.185	1.157	2	0.980	0.127
3	300		1.000	1.003		2.923	0.310	1.251	3	1.366	0.223
4	450		1.500	1.529		3.410	0.470	1.309	4	1.812	0.368
5	600		2.000	2.005		3.740	0.650	1.349	5	2.260	0.559
6	750		2.500	2.523		4.037	0.780	1.384	6	2.637	0.783
7	900		3.000	3.041		4.270	1.045	1.412	7	3.172	1.230
8	1050		3.500	3.534		4.490	1.180	1.439	8	3.647	1.839
9	1200		4.000	4.000		4.664	1.250	1.460	9	4.010	2.452
10	1350		4.500	4.562		4.855	1.530	1.483	10	4.515	3.561
11	1500		5.000	5.000		5.000	1.720	1.500	11	5.000	5.000

LFE S/N: 104180-T4-R5 Due Date: 01 JUL 92 Range: 0 - 1500 SFPM

LFE Area: 0.057609501 FT^2

Model No.: 400B Input: 115 Vac 60 Hz

DVM S/N: 2092 Due Date: 05 MAR 92 ____ Vdc

Temp. S/N: 13001 Due Date: 28 MAR 92 I-Mode: Yes X No ____

Bar. S/N: 11508 Y1 Due Date: NA Absolute Pressure: 29.00 "Hg

Pipe Size: NA Actual Temperature: 90 °F

Pipe Area: NA Calculated Nonlin. Resistors:

R_{17} 54.55 KΩ R_{23} 74.55 KΩ

COMMENTS:

BRIDGE VOLTAGE

Zero Flow: 2.919 Vdc

Max. Flow: 8.452 Vdc

For Intrinsic Safety Circuit:

Zener Diode: NA

Ballast Resistor: NA

CURRENT-SENSE VOLTAGE

Zero Flow: 0.900 Vdc

Max. Flow: 1.500 Vdc

Section 4: Service

This section describes the routine maintenance and trouble-shooting procedures pertaining to the Kurz™ air flow meters. Nonetheless, it is recommended that a unit be returned to the Kurz™ factory if repairs and, or recalibration are needed. This is usually the most cost effective and reliable means.

4.1 Routine Maintenance

The Kurz™ air flow meters are virtually maintenance free. Though, when required, we recommend the following:

- Electronics maintenance
- Mechanical maintenance

CAUTION: When dismantling the unit for repair, recalibration and, or cleaning make sure that power is off.

4.1.1 Electronics Maintenance

The electronic components on the current-transmitter board and linearizer board essentially require no maintenance; however, should be periodically inspected and cleaned.

The factory calibration of the unit remains stable over a duration of up to several years. However, in order to sustain NIST-traceability, annual recalibrations are recommended.

Note: If the unit requires recalibration while still under warranty, contact Kurz™ Instruments, Inc. at (800) 424-7356 and ask for Customer Service.

4.1.2 Mechanical Maintenance

Mechanical maintenance comprises of inspecting the sensor's flow path and checking the sensor for proper functioning.

The Kurz™ thermal mass flow sensor render it resistant to particulate contamination in most applications; nevertheless, performs best when it is kept relatively free of contamination. You should, therefore, check the sensor at regular intervals, cleaning it if necessary. Be careful not to damage the sensor during removal or reinsertion. A bent sensor may develop a short and would need to be replaced.

a) For a Kurz™ MetalClad™ sensor, use a fine wire brush, crocus cloth or fine grit emery cloth to remove build-up contamination from the sensor.

Note: Some sensors may have small specks of excess metal adhering to their sheaths. This is normal and in no way degrades the performance of the sensors. Do **NOT** attempt to remove such specks. Doing so may change the unit's calibration.

b) For a Kurz™ DuraFlo™ sensor, use a small camel's hair brush and water, followed by an alcohol rinse.

4.2 Trouble-Shooting

This procedure to help locate the section of the electronics assembly at fault. It is not intended to be an all inclusive repair manual. Nonetheless, the corrective actions to be taken usually recommend electronic components or wiring connections to be corrected, replaced or repaired by a certified eletrical technician, familiar with electronic test equipment and measurements. In most major repairs, the unit should be returned to the Kurz™ factory for service. Kurz™ Instruments, Inc. will provide technical assistance over the phone to qualified repair personnel. Please call Customer Service Department (800) 424-7356.

Once installed, the operation of the Kurz™ air flow meter is primarily a matter of maintaining power to the system. The system will continue to operate for prolonged periods without intervention. However, when it is suspected that the unit is not operating correctly, the following test procedures that can be performed before dismantling for repair:

- Power-on voltage test for the Model 435R1 Power Supply and Analog Linearizer Board

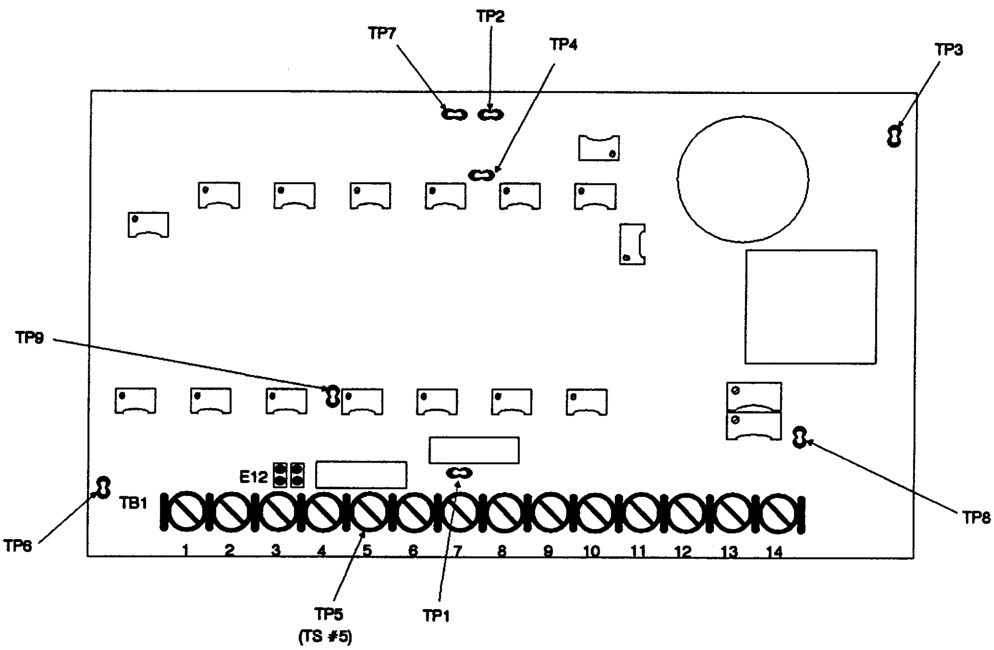
- Power-on voltage test for the Model 465Rx Current-Transmitter Board

> **WARNING:** Any warranty service to be performed at the customer's site must have written authorization by Kurz™ Instruments Inc. Nonwarranty service should be performed only by a certified electrical technician.

4.2.1 Test Procedure for the Model 435R1 Power Supply and Analog Linearizer Board

The test procedure for the linearizer board consists of verifying voltages between terminal block 1, terminal screw 3 (TB1-3; GND) and each of the nine test points given. Refer to Figure 4.2-1 for the location of the test points on the linearizer board. You will need a digital voltmeter (DVM) accurate to within ± 0.001 Vdc.

Figure 4.2-1.
Test Points on the Linearizer Board



Note: All test verifications with the exception of test points 1 and 9 can be checked with the two-wire loop operation disconnected from the linearizer board. This allows the removal of the linearizer board from the system enclosure for bench-test purposes . However, a power source must be connected to the A.C. terminals on terminal block 1, terminal screws 12 (TB1-12; AC GND), 13 (TB1-13; ACC) and 14 (TB1-14; AC).

The power-on voltage test for the linearizer board are as follows:

Test point 1 (TP1) — is for the current-sense voltage (flow meter must be operational) of 0.600 Vdc, ± 0.015 Vdc at zero flow rate to 3.000 Vdc, ± 0.075 Vdc at specified maximum flow rate (this voltage is nominal, refer to the appropriate Calibration Data and Certification Document for exact rated voltage).

Test point 2 (TP2) — is for the unregulated supply voltage of 24.000 Vdc, ± 5.000 Vdc.

Test point 3 (TP3) — is for the unregulated, negative supply voltage of -24.000 Vdc, ± 5.000 Vdc.

Test point 4 (TP4) — is for the regulated supply voltage of 15.000 Vdc, ± 0.450 Vdc.

Test point 5 (TP5) or TB1-5 — is for the regulated, negative supply voltage of -12.000 Vdc, ± 0.360 Vdc.

Test point 6 (TP6) — is for the regulated supply voltage of 5.000 Vdc, ± 0.150 Vdc.

Test point 7 (TP7) — is for the reference voltage of 2.490 Vdc, ± 0.001 Vdc.

Test point 8 (TP8) — is for the negative reference voltage of -5.000 Vdc, ± 0.001 Vdc.

Test point 9 (TP9) — is for the nonlinear voltage signal to the linearizing circuitry (flow meter must be operational): 0.000 Vdc, 0.025 Vdc at zero flow rate and 5.000 Vdc, ± 0.125 Vdc at specified maximum flow rate.

Note: Refer to Appendix B: *Trouble-Shooting Guide*, for more indepth information pertaining to the symptoms and probable causes for electronics malfunction on the linearizer board.

4.2.2 Testing the Model 465Rx Current-Transmitter Board

This test procedure allows you to verify the operation of the Model 465R6 and 465R7 Current-Transmitter Boards. You will need a digital voltmeter (DVM) accurate to within ± 0.001 Vdc.

Before you perform the test, check to make sure that the following conditions are met:

a) The two-wire conductor cable is properly connected to terminal block 1 (TB1) on both the current-transmitter board and linearizer board.

b) The four-wire or five-wire cable from the sensor is properly connected to the appropriate terminal screws on terminal block 2 (TB2) on the current-transmitter board. (**Note:** For a probe assembly with a "TS" electronic configuration, make sure the wiring from the terminal board in the junction box are properly connected to TB2 on the current-transmitter board.)

c) If possible, set the flow to zero flow rate.

Note: All test point are accessible on the current-transmitter board after the cover of the flow transmitter enclosure has been removed.

Refer to Figures 4.2-2 and 4.2-3, respectively, for the test point locations where the voltages and current can be measured.

Figure 4.2-2.
Model 465R6 Current-Transmitter Board

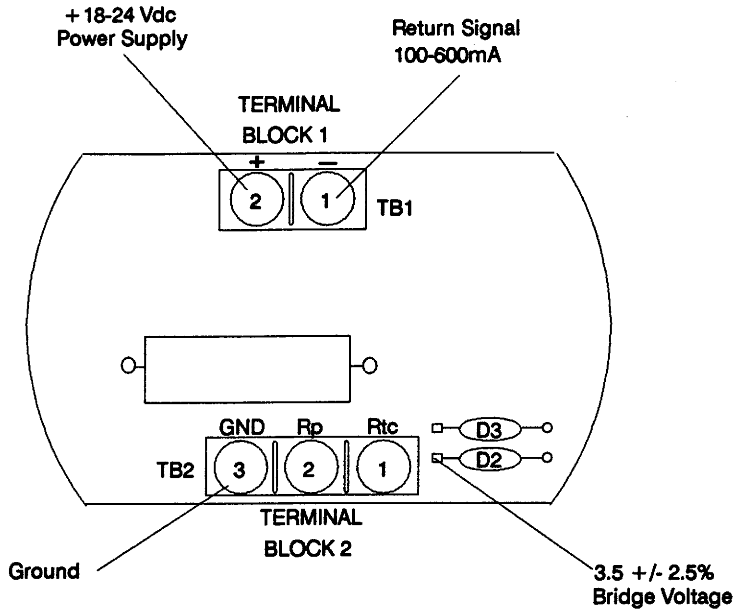
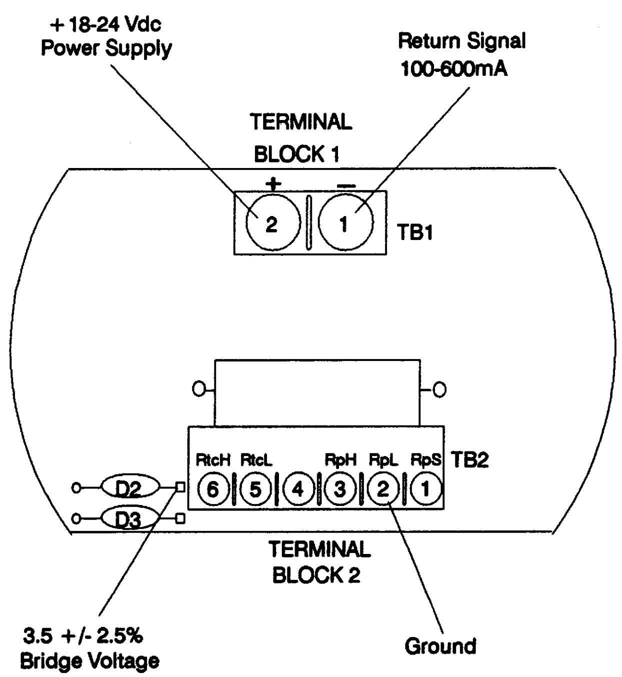


Figure 4.2-3
Model 465R7 Current-Transmitter Board



A. Power-On Voltage Test Procedure for the Model 465R6 Current-Transmitter Board

Step 1. Check the 24.000 Vdc input voltage. The two-wire conductor cable should be connected to terminal block 1, terminal screws 1 (TB1-1) and 2 (TB1-2). The 24.000 Vdc power source should be connected to terminal screw 2 and the return signal should be connected to terminal screw 1. With the power supply turned off, make sure these connections are secure.

With the power turned on, check the voltage between terminal block 2, terminal screw 3 (TB2-3; GND) and TB1-2 (24.000 Vdc).

Step 2. Check the circuit ground between TB2-3 (GND) and chassis ground. The voltage measured should be 0.000 Vdc.

Step 4. Check the bridge voltage (B.V.). The B.V. will vary with the air flow. As the velocity increases, the amount of power required to maintain the standard overheat increases. To verify the sensor and bridge circuit are operating this way, measure the voltage between TB2-3 (GND) and the leg of diode D_2 closest to TB2. This voltage should range from 3.500 Vdc to 9.000 Vdc, typically.

Step 5. Check the current-return signal. The current-return signal will also vary with the air flow. As the velocity increases, the amount of power required to maintain the standard overheat increases.

Measure the amount of current being transmitted from the current-transmitter board to the linearizer by placing an ammeter in series with TB1-1 (I RET) and the conductor cable. The current measured should be in the 100.0 mA to 600.0 mA range, dependent on the amount of air flow measured by the sensor.

B. Power-On Voltage Test Procedure for the Model 465R7 Current-Transmitter Board

Step 1. Check the 24.000 Vdc input voltage. The two-wire conductor cable should be connected to terminal block 1, terminal screws 1 (TB1-1) and 2 (TB1-2). The 24.000 Vdc power source should be connected to terminal screw 2 and the return signal should be connected to terminal screw 1. With the power supply turned off, make sure these connections are secure.

With the power turned on, check the voltage between terminal block 2, terminal screw 2 (TB2-2; GND/R_{pL}) and TB1-2 (24.000 Vdc).

Step 2. Check the circuit ground between TB2-2 (GND/R_{pL}) and chassis ground. The voltage measured should be 0.000 Vdc.

Step 3. Check the bridge voltage (B.V.). The B.V. will vary with the air flow. As the velocity increases, the amount of power required to maintain the standard overheat increases. To verify the sensor and bridge circuit are operating this way, measure the voltage between TB2-2 (GND/R_{pL}) and the leg of diode D2 closest to TB2. This voltage should range from 3.500 Vdc to 9.000 Vdc, typically.

Step 4. Check the current-return signal. The current-return signal will also vary with the air flow. As the velocity increases, the amount of power required to maintain the standard overheat increases.

Measure the amount of current being transmitted from the current-transmitter board to the linearizer board by placing an ammeter in series with TB1-1 (I RET) and the conductor cable. The current measured should be in the 100.0 mA to 600.0 mA range, dependent on the amount of air flow measured by the sensor.

C. RTD-Windings Resistance Verfication Procedure

If the sensor appears to be at fault, it can be tested and verified by measuring the ohmage of the RTD-windings[1].

With the power supply turned off, remove the sensor's four-wire or five-wire cable from the terminal screws of terminal block 2 (TB2) on the current-transmitter board.

Refer to Tables 4.2-1, 4.2-2 and 4.2-3 for the resistance values for the RTD-windings.

> **CAUTION:** Remember to reconnect the sensor's four-wire or five-wire cable to the Model 465R_x Current-Transmitter Board as wired from the Kurz™ factory.

Table 4.2-1

RESISTANCE VERIFICATION CHART			
Sensor Type	**Velocity Sensor**		**Ohmage @ Amb. Temp. 25° C**
	Four-wire	**Five-wire**	
"dual-sting"	$R_{tc}GND$ & R_{tc}	R_{tcL} & R_{tcH}	329 ohms ± 1.0%*
	R_pGND & R_p	R_{pS}, R_{pL} & R_{pH}	10 ohms ± 1.0%

* Refers to the resistance for a Kurz™ "large dual-sting" (LD) MetalClad™ sensor; whereas, the resistance for a Kurz™ "miniature dual-sting" (MD) MetalClad™ sensor is 110 ohms ± 1.0%.

Table 4.2-2

RESISTANCE VERIFICATION CHART			
Sensor Type	**Velocity Sensor**		**Ohmage @ Amb. Temp. 25° C**
	Four-wire	**Five-wire**	
"single-sting"	$R_{tc}GND$ & R_{tc}	R_{tcL} & R_{tcH}	164 ohms ± 1.0%
	R_pGND & R_p	R_{pS}, R_{pL} & R_{pH}	20 ohms ± 1.0%*

* Refers to the resistance for a Kurz™ "single-sting" DuraFlo™ sensor; whereas, the resistance for a Kurz™ "single-sting" MetalClad™ sensor is 10 ohms ± 1.0%.

1 Values obtained that are substantially different indicate a damaged sensor.

Table 4.2-3

RESISTANCE VERIFICATION CHART			
Sensor Type	**Velocity Sensor**	**Temp. Sensor**	**Ohmage @ Amb. Temp. 70° F**
	Four-wire	**Two-wire**	
"triple-sting"	$R_{tc}GND$ & R_{tc}		164 ohms ± 1.0%
	R_pGND & R_p		10 ohms ± 1.0%
		$R_{td}GND$ & R_{td}	110 ohms ± 1.0%

End of Section 4

Appendix A: Engineering Drawings

The appendix contains engineering drawings of the electronic assemblies associated with the Kurz™ air flow meter. Also, included is a blank Kurz™ calibration work sheet. You are free to copy it for calibration purposes.

Note: If you want to perform your own warranty service, you must first obtain written authorization from Kurz™ Instruments, Inc. **Unauthorized service performed during the warranty period voids your warranty.** Please read the warranty statement at the front portion of this manual before performing any services.

NOTES: UNLESS OTHERWISE SPECIFIED

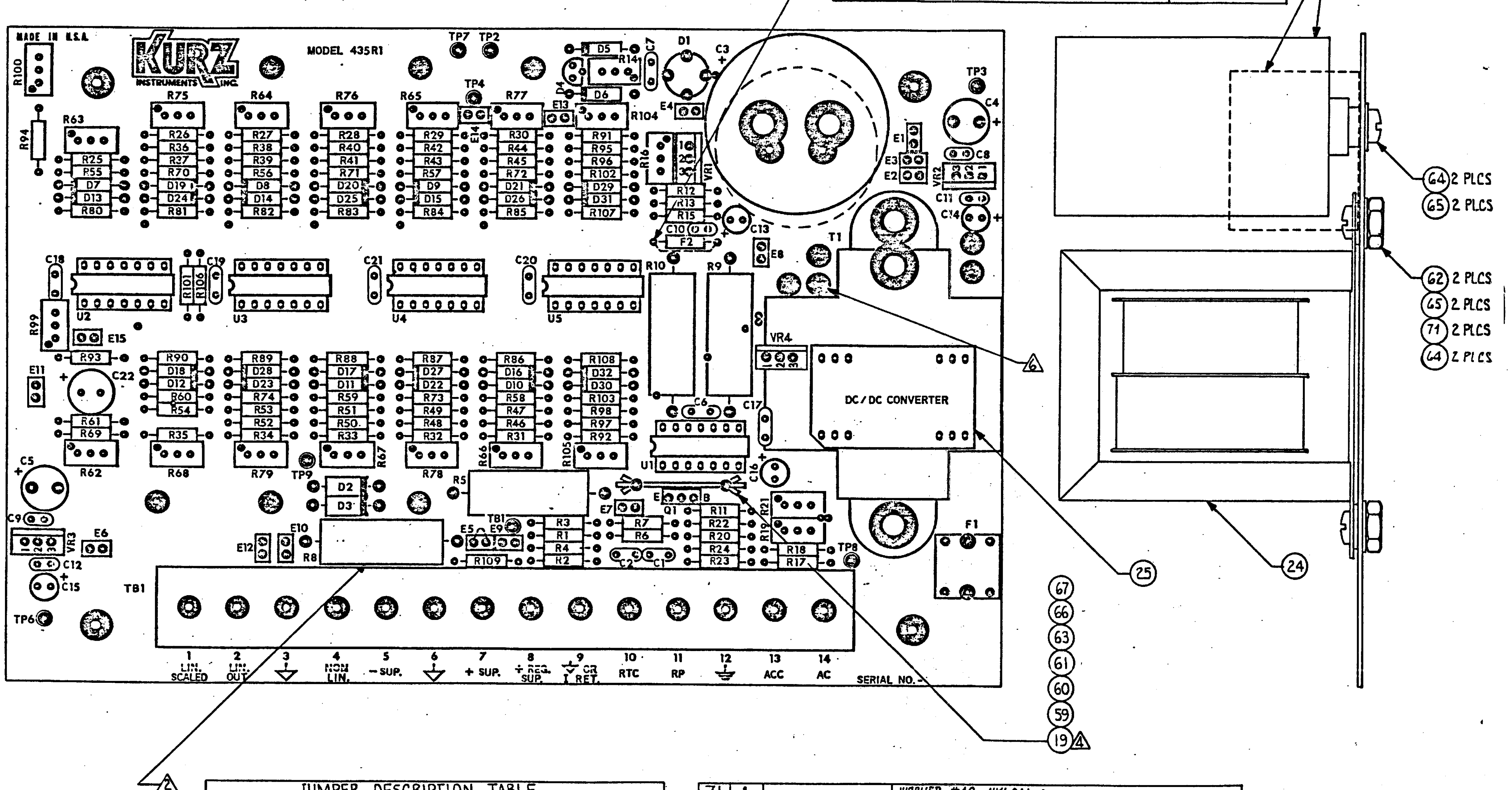
1. THIS DRAWING TO BE USED IN CONJUNCTION WITH SCHEMATIC DIAGRAM # 300013
2. R5,8-10,D1-3 TO BE ASSEMBLED WITH 1/4" CLEARANCE FROM PC BOARD.
3. FOR NON-LINEAR OPTIONS (-04, -05, -08, -09), DO NOT ASSEMBLE R25-106, D7-32, C18-22, U2-5.
4. FOR HEATSINK TO TRANSISTOR ASSEMBLY SEE DWG. NO. A70003.
5. MALLORY CAPACITOR TO BE USED FOR NUCLEAR UNITS ONLY, 3500µf, 40V.
6. T1 CENTER TAP WIRE (STRIPPED) SOLDERED TO PAD INDICATED.
7. INSTALL D2,3,R9,10 FOR SENSOR SAFETY CIRCUITS ONLY.
8. FOR CURRENT SENSE VOLTAGE, MEASURE BETWEEN TB1-3 (GND) AND TB1-9 (CURRENT RETURN).

JUMPER CONFIGURATION TABLE

PART NO.	DESCRIPTION	CLOSE JUMPER
	HEAVY DUTY, CURRENT MODE, 220V	E5,7,8,9,12
	HEAVY DUTY VOLTAGE MODE, LIN.	E10, 12
-03	HEAVY DUTY, CURRENT MODE, LIN	E5, 7, 8, 9, 12
-04	HEAVY DUTY, VOLTAGE MODE, NON-LIN.	E10
-05	HEAVY DUTY, CURRENT MODE, NON-LIN.	E5, 7, 8, 9
-	VOLTAGE MODE DC, LIN.	E2,3,4,10,12
-07	CURRENT MODE, DC, LIN.	E2,3,4,5,7,8,9,12
	VOLTAGE MODE NON-LIN. DC	E2, 3, 4, 10
	CURRENT MODE NON-LIN. DC	E2,3,4,5,7,8,9

REVISIONS

REV.	DESCRIPTION	DRAWN DATE BY	CHECK DATE BY	DESIGN DATE BY	APPROVED DATE BY
A	REVISED PER ECO'S A43547005 + A43547006. REF ECO A43547007	5-5-87	5-11-87	N/A	5-11-87
B	REVISED PER ECO A43547007	5-21-87	6-29-87	N/A	6-30-87
C	REVISED PER ECO A43547009 A43547010 AND A43547011.	2-11-88	2-11-88	NA	2-11-88
D	REVISED PER ECO # A47214	9-6-88 BSAXON		N/A	
E	REVISED PER ECO 47730	3-25-9	3/25/9	NA	3/25/91



JUMPER DESCRIPTION TABLE

JUMPER	DESCRIPTION
E1	TIES COMMON GND AND CHASSIS GND - TO REMAIN OPEN.
E2,3,4	USE A DC/DC CONVERTER. DO NOT INSTALL T1, VR2, C4, 8.
E5 7 8 9	CURRENT MODE. DO NOT INSTALL C1,2,6, D2,3, Q1, R1-7,9,10,109
E6	FOR 24 V FROM TB1-7.
E10	VOLTAGE MODE. INSTALL C1,2,6, D2,3, Q1, R1-7,9,10,109.
E11	FOR 15V FROM TB1-7.
E12	FOR LINEAR SECTION.
E13,14	OPTIONAL INVERTER OR BREAK POINT.
E15	ADJUST FOR X-5 VDC OUT.

71	2			WASHER, #10, NYLON.
70	A/R			SHUNT, 2 PIN
69	14	E2-4, 6-15		HEADER, 2 PIN
68	3	F2, E5		WIRE, 22 AWG SOLID TIN
67	1			WASHER COMPRESSED
66	1			WASHER #4 STAR
65	4			WASHER #10 STAR
64	4			SCREW #10-32 X 1/4 PHIL PAN HEAD
63	1			SCREW #4-40 X 5/16 PHIL PAN HEAD
62	2			NUT #10-32
61	1			NUT #4-40
60	1			KOOLEX PAD
59	1			HEATSINK
58				

NEXT ASSEMBLY	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
TOLERANCES ARE	
FRACTIONS	± 1/32
ANGLES	± 0°-30'
DECIMALS	
.X	± 0.1
.XX	± 0.03
.XXX	± 0.005
.XXXX	± 0.0010
ORIG. RELEASE DATE	

APPROVALS

		DATE
DRAWN BY	J. CAREAGA	6-30-86
CHECKED BY	J.D. Young	2-2-87
DESIGN	N/A	
APPROVED		2-10-87
BASELINED	N/A	

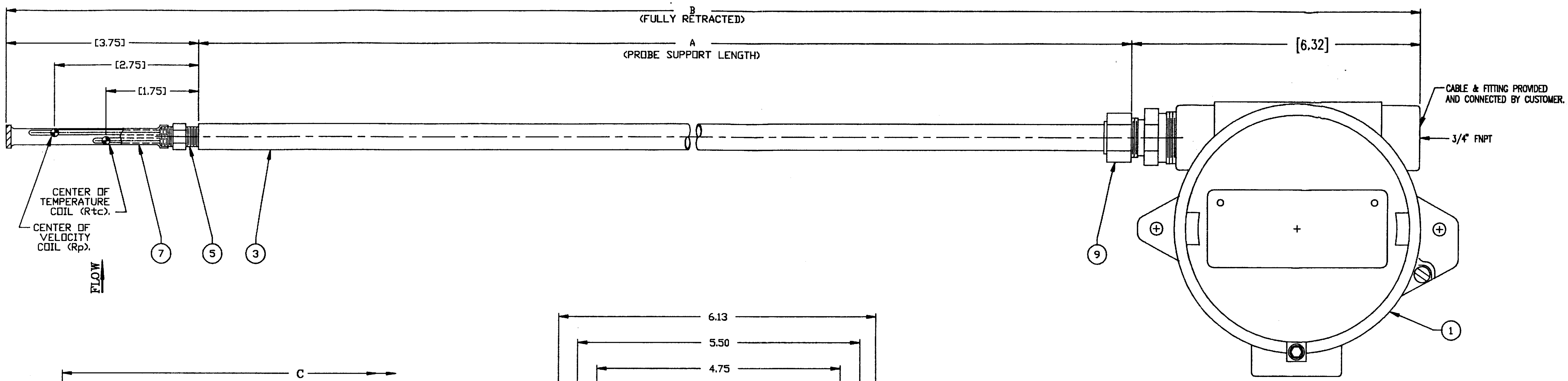
KURZ INSTRUMENTS INC.

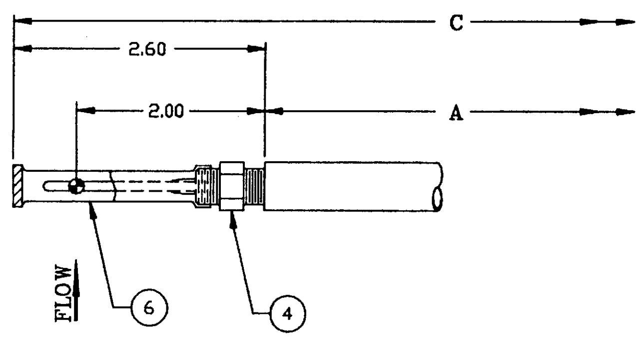
TITLE: PCB, ASSY., 435R1 (L3)

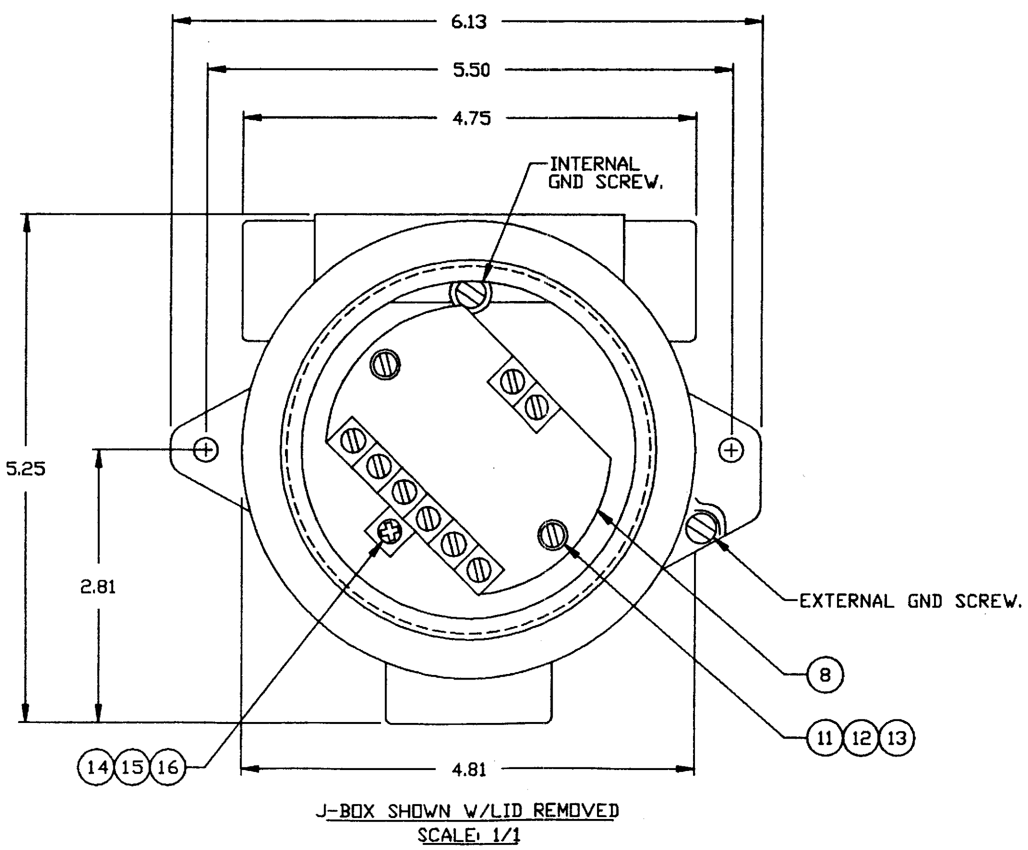
DWG. SIZE: D — DWG. NO. 420019 — REV. E

SCALE 2:1 — SHEET 1 OF 1

REV.	DESCRIPTION	DRAWN DATE/BY	CHECK DATE/BY	DESIGN DATE/BY	APPROVED DATE/BY
C	CHANGE PER ECO #47674	10/14/90 AB	GF 12/26/90	N/A	12/26/90







J-BOX SHOWN W/LID REMOVED
SCALE: 1/1

DASH NO.	DESCRIPTION
-02	450-08-AT (SINGLE STING SENSOR)
-01	450-08-HT (DUAL STING SENSOR) OR 450-08-HTT (DUAL STING SENSOR)

PART NO. ID. TABLE

ITEM	QTY. -01	QTY. -02	PART NO.	DESCRIPTION
16	1	1	580047	TRANSISTOR INSULATED PAD, .125 D HOLE
15	1	1	580044	TSTR. CUSHION WASHER, #4-1/8
14	1	1	190022	SCREW, #4-40 X .312 Lg., PHL, PH
13	2	2	190101	STANDOFF, #8-32 X .375 Lg., M/F
12	2	2	190108	LOCKWASHER, #8, INT.
11	2	2	190089	SCREW, #8-32 X .25 Lg., SLOT, PH
10				N/A
9	1	1	010310	COMPRESSION FITTING 1/2 TUBE X 3/4 MNPT S.S.
8	1	1	420160	CURRENT TRANSMITTER PCB , MODEL 465R7
7	1	—	150017	SENSOR WINDOW, 316 SS., FOR DUAL STING
6	—	1	150130	SENSOR WINDOW, 316 SS., FOR SINGLE STING
5	1	—	130029	METAL SENSOR, DUAL STING
4	—	1	130239	METAL SENSOR, SINGLE STING STUBBY
(3) 3	1	1	150013	PROBE SUPPORT, .50 O.D., SS.
2				N/A
1	1	1	110180	J-BOX, KILLARK ENCLOSURE SUB-ASSY

PARTS LIST

NOTES: UNLESS OTHERWISE SPECIFIED
1. CENTER OF VELOCITY COIL (Rp) SHOULD BE @ A POINT OF AVERAGE FLOW (NORMALLY @ CENTER OF THE PIPE/DUCT).
2. FOR TEMP. BELOW 250°C/482°F USE HI-PURITY GOOP (OR EQUIV.) FOR ALL THREAD CONNECTIONS.
(3) PROBE SUPPORT LENGTH MAY CHANGE BASED ON CUSTOMER PIPE/DUCT SIZE OR SPECIAL REQUIREMENT. (USE DIM. TABLE TO FIGURE OUT THE RIGHT LENGTH.)

DIMENSION TABLE

A = D/2 + 6"(ADJUSTABLE Lg.)
B = A + 10.07 (FOR DUAL STING SENSOR
C = A + 8.92 (FOR SINGLE STING SENSOR)

WHERE:
- A: PROBE SUPPORT LENGTH
- B: FULLY RETRACTED LENGTH (DUAL SENSOR)
- C: FULLY RETRACTED LENGTH (SINGLE SENSOR)
- D: CUSTOMER PIPE/DUCT OUTSIDE DIAMETER OR TOTAL SPANNED LENGTH

NEXT ASSEMBLY	N/A
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
TOLERANCES ARE	
FRACTIONS	± 1/32
ANGLES	± 0° 30'
DECIMALS .X	± 0.1
.XX	± 0.03
.XXX	± 0.005
.XXXX	± 0.0010
ORIG. RELEASE DATE	

APPROVALS		DATE
DRAWN BY	A CARLIN	12/18/90
CHECKED BY	G. Foster	12/26/90
DESIGN	N/A	
APPROVED		12-26-90
BASELINED	N/A	

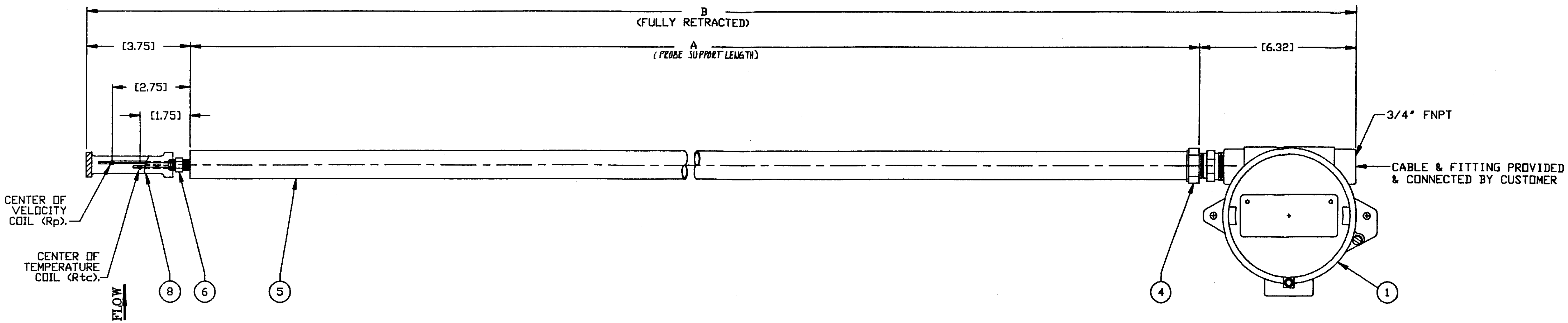
KURZ INSTRUMENTS INC.

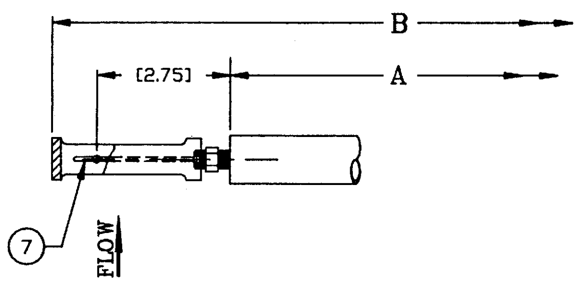
TITLE: *PROBE ASSEMBLY, 450-08*

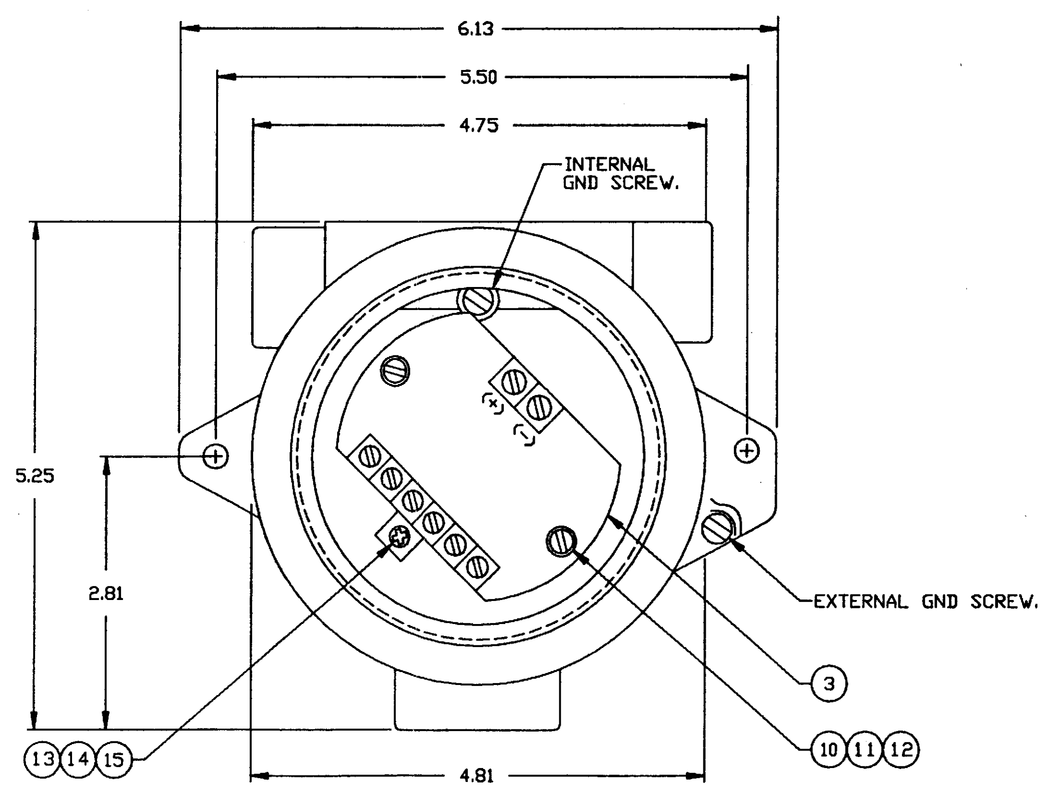
DWG. SIZE	DWG. NO.	REV.
D	700455-02	C

SCALE 1:1 SHEET 1 OF 1

REV.	DESCRIPTION	DRAWN DATE BY	CHECK DATE BY	DESIGN DATE BY	APPROVED DATE BY
C	CHANGE PER ECO #47674	12/18/90	12/26/90	N/A	12/26/90







J-BOX SHOWN W/LID REMOVED
SCALE: 1/1

DASH NO.	DESCRIPTION
-02	450-16-AT (SINGLE STING SENSOR)
-01	450-16-HT (DUAL STING SENSOR) OR 450-16-HHT (DUAL STING SENSOR)

PART LIST ID. TABLE

ITEM	QTY. -01	QTY. -02	PART NO.	DESCRIPTION
15	1	1	580047	TRANSISTOR INSULATOR PAD, .125 D HOLE
14	1	1	580044	TSTR CUSHION WASHER, #4-1/8
13	1	1	190022	SCREW, #4-40 X .312 Lg., PHL, PH
12	2	2	190101	STANDOFF, #8-32 X .375 Lg., M/F
11	2	2	190108	LOCKWASHER, #8, INT.
10	2	2	190089	SCREW, #8-32 X .25 Lg., SLOT, PH
9				N/A
8	1	1	150018	SENSOR WINDOW, 316 SS.
7		1	130149	METAL SENSOR, (SINGLE STING)
6	1		130029	METAL SENSOR, (DUAL STING)
5 (3)	1	1	150144-00	PROBE SUPPORT, 1.0 O.D., 316 SS.
4	1	1	010333	COMPRESSION FITTING, 1.0 O.D. X 1.0 MNPT WITH S.S. FERRULES (FRONT & BACK).
3	1	1	420160	CURRENT TRANSMITTER PCB, 465R7
2				N/A
1	1	1	110180	JUNCTION BOX, KILLARK

PARTS LIST

NOTES: UNLESS OTHERWISE SPECIFIED

1. CENTER OF VELOCITY COIL (Rp) SHOULD BE @ A POINT OF AVERAGE FLOW (NORMALLY @ CENTER OF THE PIPE/DUCT).
2. FOR TEMP. BELOW 250°C/482°F USE HI-PURITY GOOP (OR EQUIV.) FOR AL THREAD CONNECTIONS.
   FOR TEMP. BETWEEN 250°C/482°F & 482°C/900°F USE SILVER GOOP (OR EQUIV.) FOR ALL THREAD CONNECTIONS.
3. (3) PROBE SUPPORT LENGTH MAY CHANGE BASED ON CUSTOMER PIPE/DUCT SIZE OR SPECIAL REQUIREMENT.(USE DIM. TABLE TO FIGURE OUT THE RIGHT LENGTH).

DIMENSION TABLE

A = D/2 + 6"(ADJUSTABLE LG.)
B = A + 10.07"
WHERE:
A: PROBE SUPPORT LENGTH
B: FULLY RETRACTED LENGTH
D: CUSTOMER PIPE/DUCT OUTSIDE DIAMETER OR TOTAL SPANNED LENGTH

NEXT ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ± 1/32
ANGLES ± 0° - 30'
DECIMALS
.X ± 0.1
.XX ± 0.03
.XXX ± 0.005
.XXXX ± 0.0010
ORIG. RELEASE DATE

APPROVALS	DATE
DRAWN BY: A CARLIN	12/18/90
CHECKED BY: G. Foster	12/26/90
DESIGN: N/A	
APPROVED: [signature]	12-26-90
BASELINED: N/A	

KURZ INSTRUMENTS INC.

TITLE: PROBE ASSEMBLY, 450-16

DWG. SIZE: D | DWG. NO.: 700455-03 | REV.: C
SCALE: 1:1 | SHEET 1 OF 1

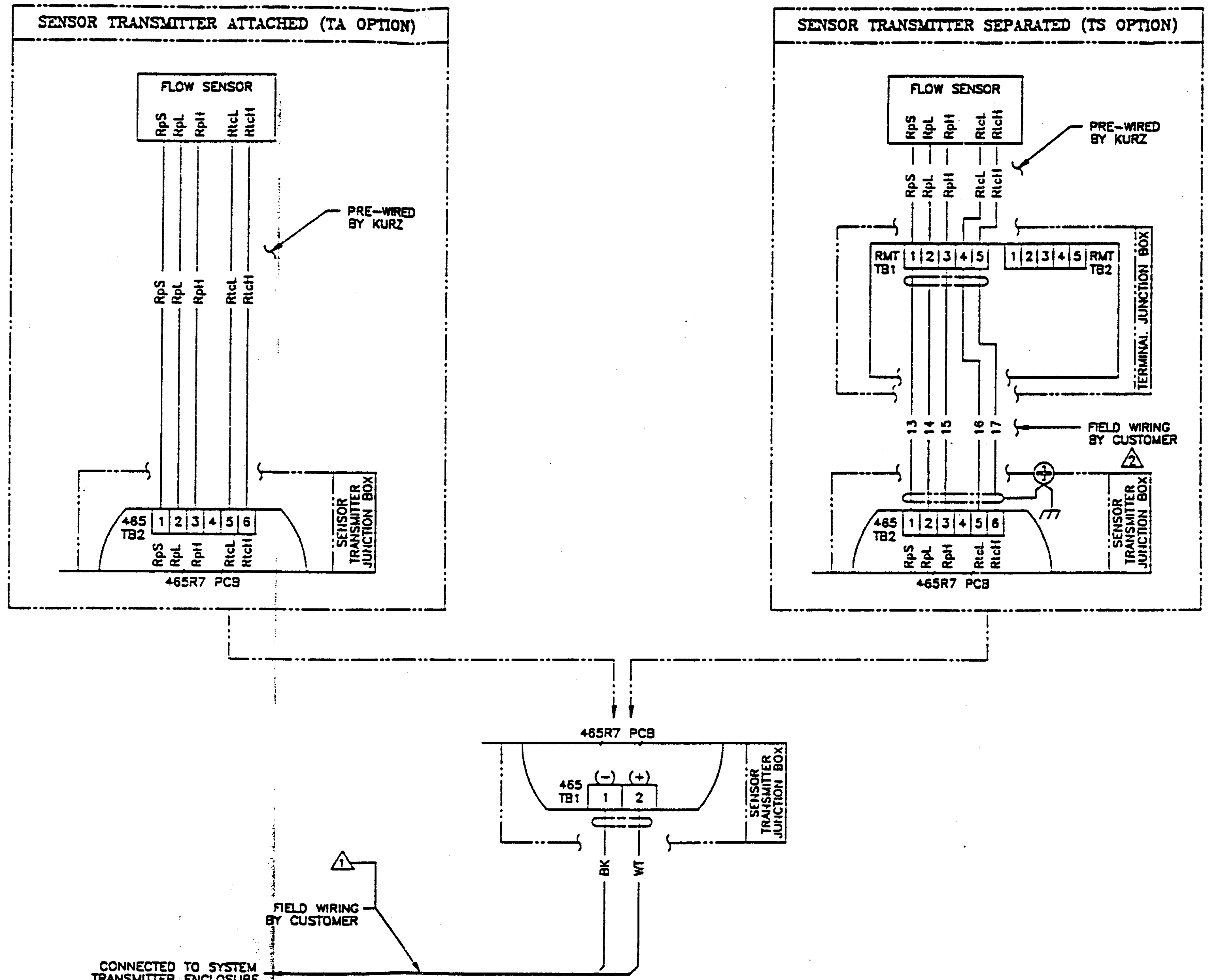
REV.	DESCRIPTION	BY	CHKD	APPVD	DATE
1	REPLACE DWG #340281,REV.0 AND RELEASE TO MANUF.	AC			

NOTES:

⚠1 CABLE RECOMMENDED FOR SENSOR TRANSMITTER CONNECTIONS
- a) TWO CONDUCTOR, SHIELDED.
- b) CONNECT THE SHIELD TO EARTH GROUND THRU SYSTEM TRANSMITTER ENCLOSURE CHASSIS OR GROUND LUG.
- c) 18 AWG IF SYSTEM TRANSMITTER ENCLOSURE IS MOUNTED WITHIN 250 FT., FOR LONGER DISTANCE FIGURE OUT WIRE GAGE FOR MAXIMUM LOOP RESISTANCE OF 4 OHMS.

⚠2 RECOMMENDATION FOR SENSOR EXTENSION CABLE: (TS OPTION ONLY)
- a) (5) CONDUCTOR, SHIELD CABLE, 18 AWG, MAX. 300 FT. LONG.
- b) CONNECT SHIELD TO EARTH GND.
- C) THE DIFFERENTIAL RESISTANCE BETWEEN CONDUCTORS MUST NOT EXCEED .02 OHM. ($\Delta R < .02\,\Omega$)

3. FOR TESTING PURPOSE, 2-WIRE HOOK UP CABLE AND 5-WIRE SENSOR EXTENSION CABLE WILL BE PROVIDED BY KURZ, CUSTOMER TO REPLACE AS REQUIRED. (GAGE: 18AWG, COLOR AS SHOWN)



	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPROVALS	
	TOLERANCES ARE	DRAWN BY CARLIN	DATE 5.7.91
	FRACTIONS ± 1/32	CHECKED BY	DATE
	ANGLES ± 0°-30'	APPROVED	DATE
	DECIMALS .X ± 0.1, .XX ± 0.01, .XXX ± 0.005, .XXXX ± 0.0010		
N/A			
NEXT ASSEMBLY	DWG. RELEASE DATE 6 1 91		

KURZ INSTRUMENTS, INC.

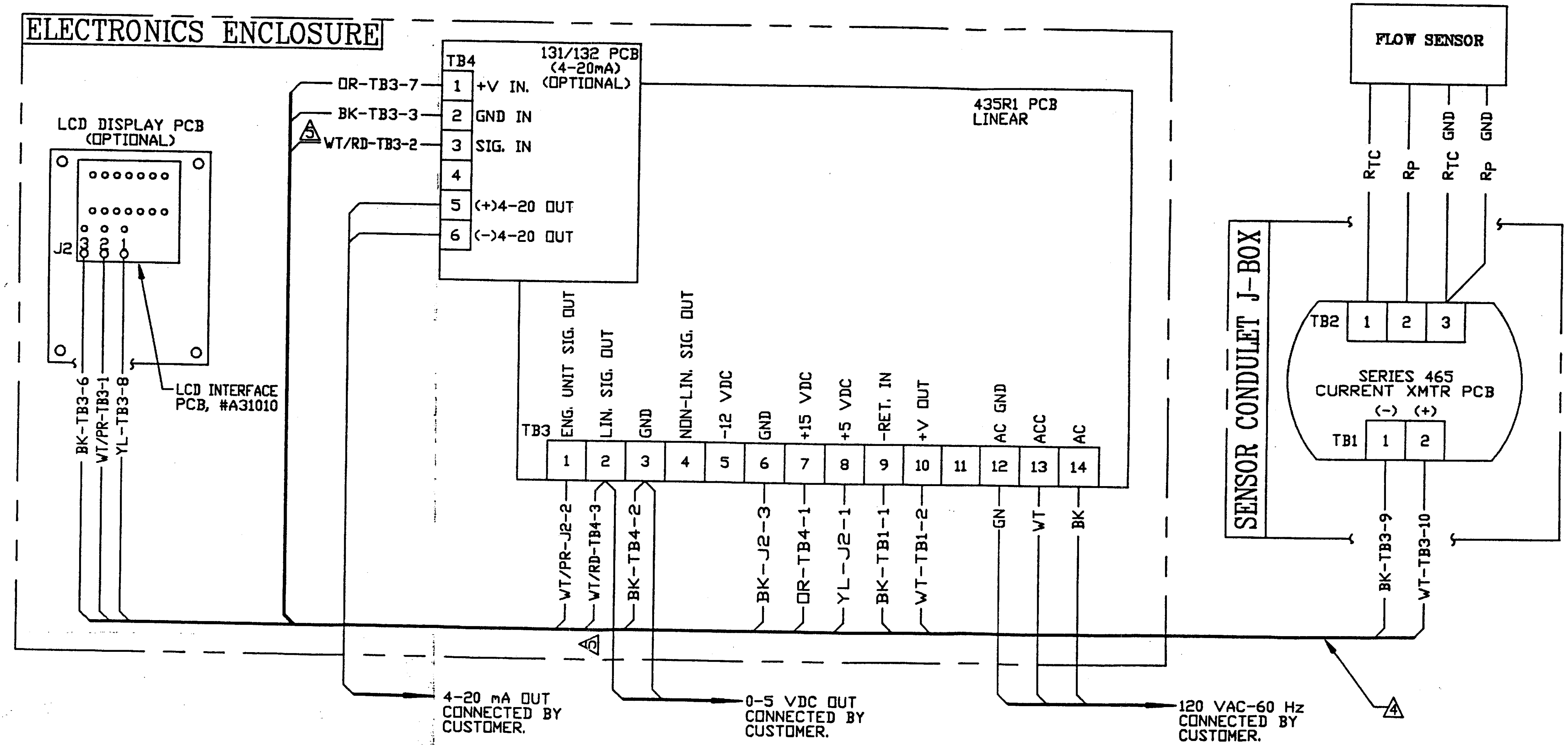
TITLE: WIRING DIAGRAM, FIELD CONNECTIONS. SERIES 450 PROBE AND SERIES 505 FLOW METER

DWG. SIZE: D | DWG. NO.: 340450-01 | REV.: 1

SCALE: NONE | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL REF. DES. ARE FOR REF. ONLY AND MAY NOT APPEAR ON COMPONENTS.
2. ALL WIRES TO BE A MIN. OF #22 AWG.
3. INSULATION SPADE LUGS TO BE USED FOR ALL CONNECTIONS.
4. (△) TWO WIRE CABLE, 15 FT. LG., PROVIDED BY KURZ, CONNECTED BY CUSTOMER.
5. (△) WIRE COLORS SHOWN ARE FOR MASS FLOW UNITS; FOR VELOCITY UNITS CHANGE COLOR FROM WT/RD TO WT/PR.
6. (△) FOR DC POWERED UNITS, +24 VDC TO TB3-14, AND -24 VDC TO TB3-13 TO AVOID GROUND-LOOP PROBLEMS, -24 VDC SUPPLY SHOULD NOT BE EARTH GROUND.

REVISIONS					
REV.	DESCRIPTION	DRAWN DATE/BY	CHECK DATE/BY	DESIGN DATE/BY	APPROVED DATE/BY
A	REVISED PER ECO No. A45547005, A47150, A55541005.	1.20.88	1-20-88 GF	NA	1-20-88
B	ADDED NOTE 6	10-5-89	10-5-89 GF	N/A	10-5-89 GF



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
TOLERANCES ARE	
FRACTIONS	± 1/32
ANGLES	± 0°-30'
DECIMALS .X	± 0.1
.XX	± 0.03
.XXX	± 0.005
.XXXX	± 0.0010
ORIG. RELEASE DATE	

NEXT ASSEMBLY: NA

APPROVALS		DATE
DRAWN BY		1.20.88
CHECKED BY		1-20-88
DESIGN	NA	
APPROVED		1-20-88
BASELINED	NA	

KURZ INSTRUMENTS INC.

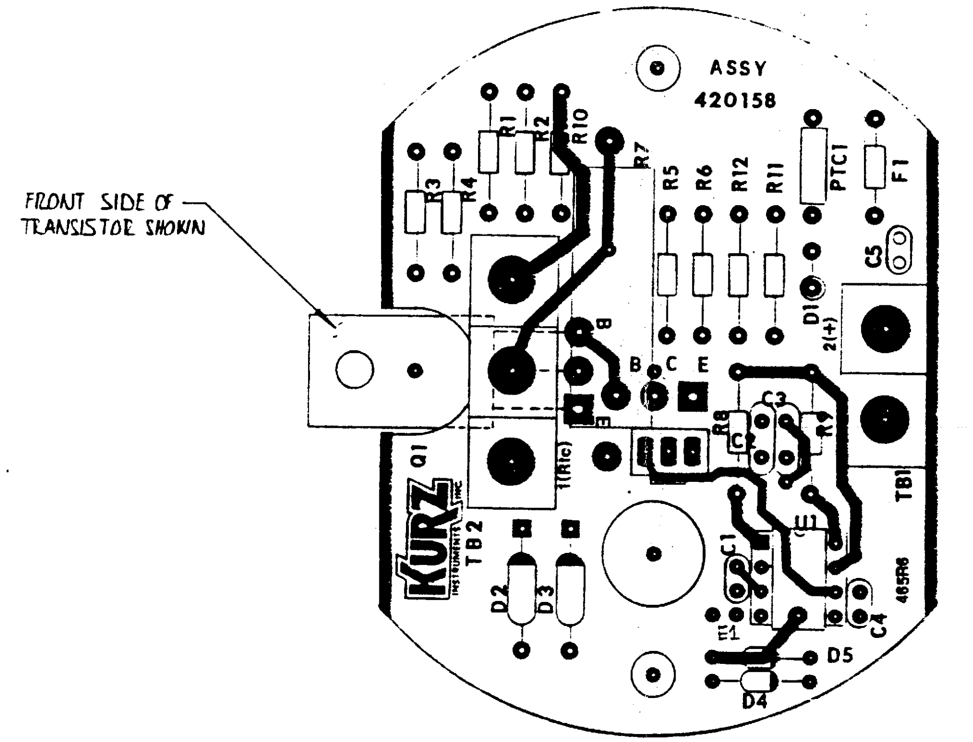
TITLE: *SERIES 455/555/505 SYSTEM WIRING DIAGRAM*

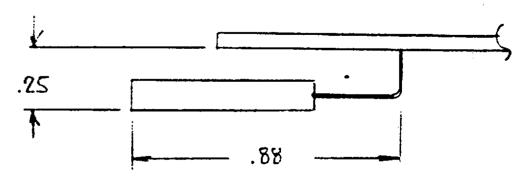
DWG. SIZE: C | DWG. NO.: 340055 | REV.: B

SCALE: NONE | SHEET 1 OF 1

REVISIONS

REV	DESCRIPTION	DRAWN DATE BY	CHECKED DATE BY	DESIGN DATE BY	APPROVED DATE BY
D	RELEASED TO PRODUCTION	[illegible]	8-10-89	N/A	[illegible]
E	CHANGE PER ECO # 47695	9/27/91	9-25-91	N/A	9-27-91





ITEM NO.	QTY.	REF.DES.	PART NO.	DESCRIPTION
18	1		420157	PCB, FAB, 465R6.
17	1	C5	510006	CAP, CER, .10 µF, 50V.
16	1	TB1	460057	CON, TERM BLOCK, 2 PIN, .375.
15	1		460007	CON, SOCKET, 8 PIN DIP.
14 △7	2	D4,5	580002	SEMI, DIODE, 1N4001 (OPT)
13 △3	2	C1,4	510006	CAP, CER, .10uF, 50V. (OPT)
12	1	PTC1	540652	RES, PTC, .5A
11 △2△3	2	C2,3		CAP, OPTIONAL
10	2	D2,D3	580025	SEMI, DIO, 1N5344B, 8.2V, 5W, ZNR
9 △5	1	D1	580002	SEMI, DIO, IN4001
8	1	U1	610022	IC, OP. AMP, AD707AQ
7 △2	2	R1,2,10		RES, SELECTED (OPTIONAL)
6	1	R8	540187	RES, METF, 20.0K OHM, .125 W
5	3	R9,R11,R12	540131	RES, METF, 10.0K OHM, .125 W
4 △2△4	6	R3-R7		RES, SELECTED (TEMP. COMP.)
3	1	F1	630033	FUSE, PICO, 1 AMP
2	1	Q1	580039	SEMI, TSTR, MJE2801
1	1	TB2	460060	CON, TERM BL, 3 PIN, .375

PARTS LIST

NOTES: UNLESS OTHERWISE SPECIFIED

1. THIS DRAWING TO BE USED IN CONJUNCTION WITH SCHEMATIC DIAGRAM 300068.
2. △ FINAL ASSY. AS REQUIRED BY KURZ.
3. △ C1-4 ARE OPTIONAL CERAMIC CAPACITORS, VALUE <= .10uF, 50V.
4. △ RESISTOR R7 IS 5 WATTS, WIREWOUND ±1% TOLERANCE LOW T.C.
5. △ D1 TO BE ASSEMBLED W/ CATHODE TO PCB.
6. R7, D2,3 TO BE ASSEMBLED W/ 1/4±1/16" FROM PCB.
7. △ D4,5 ARE OPTIONAL FOR GAS CAL ONLY, CLOSE E1 FOR ALL STD. UNITS.

NEXT ASSEMB.	N/A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TOLERANCES ARE: FRACTIONS ± 1/32; ANGLES ± 0° 30'; DECIMALS .X ± 0.1, .XX ± 0.02, .XXX ± 0.005, .XXXX ± 0.0010

ORIG. RELEASE DATE

APPROVALS		DATE
DRAWN BY	S. SAXON	1-18-89
CHECKED BY	J. D. Young	8-10-89
DESIGN	N/A	
APPROVED	[illegible]	8/10/89
BASELINED	N/A	

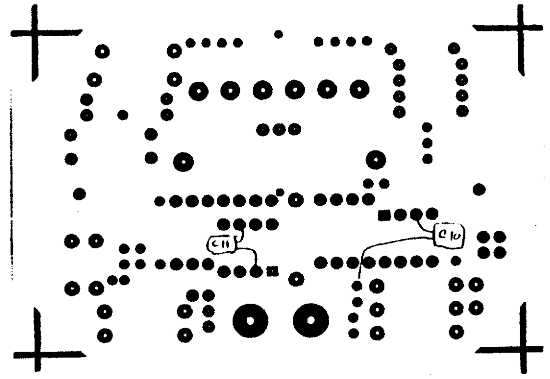
KURZ INSTRUMENTS INC.

TITLE: PCB, ASSY., 465R6

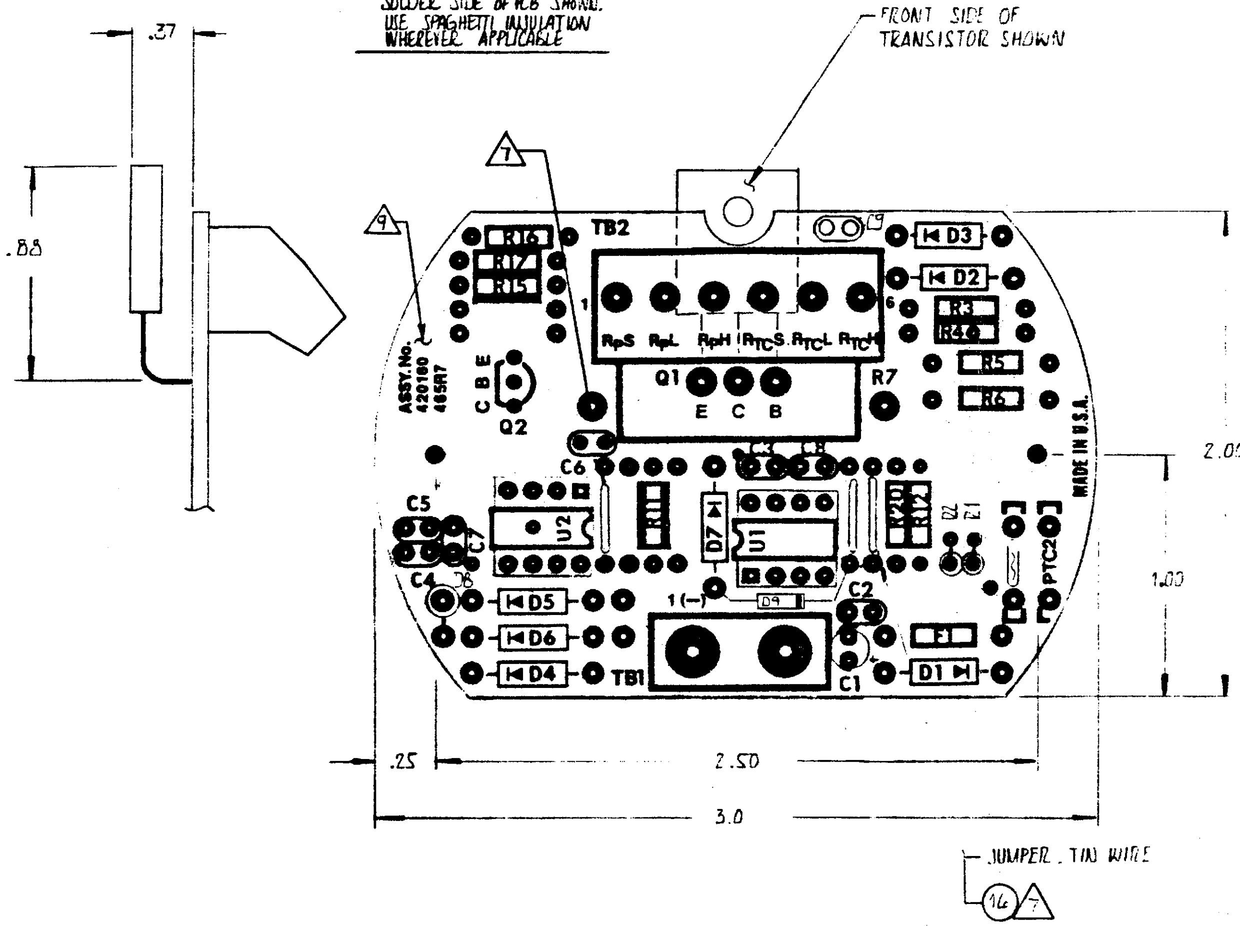
DWG. SIZE: C — DWG. NO.: 420158 — REV: E

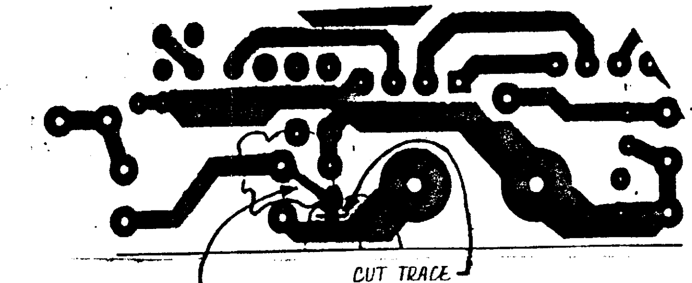
SCALE: 2:1 — SHEET 1 OF 1

REV	DESCRIPTION	DRAWN DATE BY	CHECK DATE BY	DESIGN DATE BY	APPROVAL DATE BY
A	ADDED NOTE ⚠ ADDED C9 AS PER ECO # 47315	1.9.90	RFK	N/A	RFK
B	CHANGED PER ECO # 47341	5.2.90	[illegible]	NA	[illegible]
C	CHANGED PER ECO # 473_3	9-5-90	9/11/90	N/A	[illegible]
D	CHANGED PER ECO # 47446	10.23.90	10-29	N/A	[illegible]
E	CHANGED PER ECO # 47696 & 47712	3/28/91	4/5/91	N/A	4/5/91
F	CHANGE PER ECO # 47750	4/9/91	4/11/91	N/A	4/12/91
G	CHANGE PER ECO # 47799	7/1/91	7/2/91	N/A	7-2-91



C11, 10 INSTALLATION DETAIL
SOLDER SIDE OF PCB SHOWN.
USE SPAGHETTI INSULATION
WHEREVER APPLICABLE





C1 MODIFICATION DETAIL
SHOWN FROM SOLDER SIDE

	ITEM	QTY	REF. DES.	PART. No.	DESCRIPTION
⚠10	28	1	D9	580017	DIODE, 1N5242B
	27	3	C7, 10, 11	510008	CAP, POLY, .02 uF, .50V
	26	1	C1	510040	CAP. ELECT. 22 uF. 50V.
	25	3	R11, 12, 15	540001	RES, METF, 1K OHM, .125W
	24	1	R20	540097	RES, METF, 4.99K, [illegible] W
⚠4 ⚠2	23	6	R3-7, 16		RES, SELECTED (TEMP. COMP)
⚠2	22	2	R1,2		RES, SELECTED (OPT)
	21				
	20				
⚠2	19	1	D7		DIODE, SELECTED (OPT)
⚠2	18	2	D4,6		DIODE, 1N5333B, 3.3V (OPT)
	17				
	16	4	[illegible]		JUMPER, TIN WIRE, 22 AWG.
	15				
	14				
	13	1	[illegible]	540131	RES, METF, 10.0 KΩ, .125W
	12				
	11				
	10	1	F1	630036	FUSE, PICO, 2.0 A
	9	1	Q1	580039	TRANSISTOR, MJE2801
	8	1	Q2	580035	TRANSISTOR, 2N4126
⚠3	7	3	D1,5,8	580002	DIODE, 1N4001.
	6	7	C2-6, C9, C8	510006	CAP, CER, .10 uF, 50V.
	5				
⚠8	4	2	U1,2	610022	IC, OP-AMP, AD707AQ
	3	1	TB2	460278	CON, TERM, BL., 6 PIN, RDL ANGLE.
	2	1	TB1	460057	CON, TERM, BL., 2 PIN, 3/8".
	1	1		420159	PCB, FAB, 465R7.

PARTS LIST

NOTES:
1. THIS DWG TO BE USED IN CONJUNCTION WITH SCHEMATIC DIAGRAM #300072.
⚠2 ALL OPTIONAL AND SELECTED ITEMS WILL BE FINAL ASSEMBLED BY KURZ.
⚠3 D8 TO BE ASSEMBLED WITH CATHODE TO PCB
⚠4 R7, D2, D3 TO BE ASSEMBLED WITH 1/4"±1/16" FROM PCB
⚠5 N/A
⚠7 ADD JUMPER WIRE, REMOVE R8 & R9, R21
⚠8 CUT PIN 1 AND 8 OF U1 AND U2 BEFORE SOLDERING TO PCB.
⚠9 REVISION MARKING PER PROCEDURE #38102.
⚠10 FOR HT USE 1N5244B
FOR HHT USE 1N5246B
SELECTED AND INSTALLED BY KURZ.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
TOLERANCES ARE	
FRACTIONS	± 1/32
ANGLES	± 0° - 30'
DECIMALS	
.X	± 0.1
.XX	± 0.03
.XXX	± 0.005
.XXXX	± 0.0010
ORIG. RELEASE DATE	
NEXT ASSEMBLY	

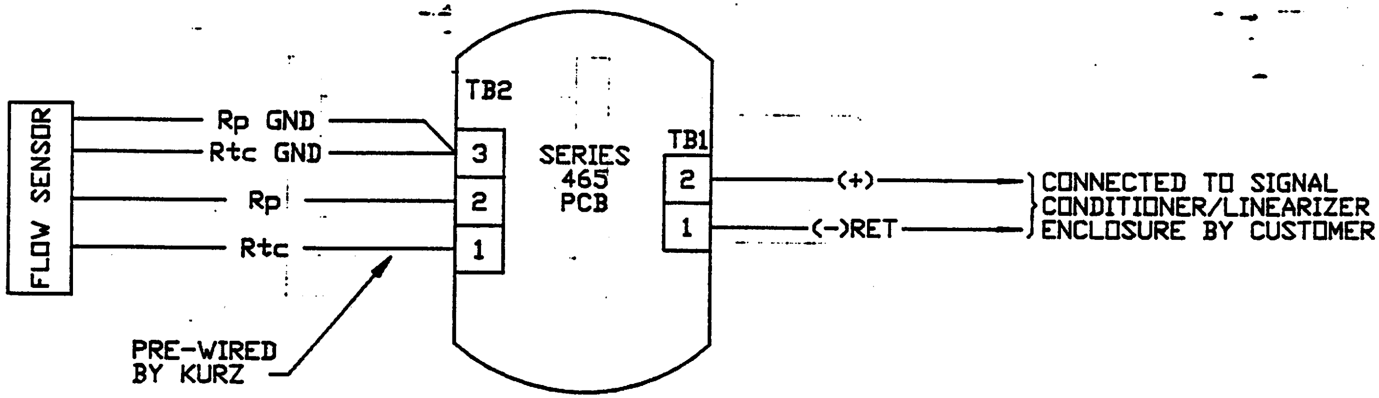
APPROVALS		DATE
DRAWN BY	[illegible]	10-6-85
CHECKED BY	J.D. Young	10-12-89
DESIGN	NA	
APPROVED	[illegible]	10-20-85
BASELINED	NA	

KURZ INSTRUMENTS INC.

TITLE: PCB, ASSY., 465R7

DWG. SIZE	DWG. NO.	REV.
C	420160	[illegible]
SCALE	2/1	SHEET 1 OF 1

BISHOP GRAPHICS / ACCUPRESS REORDER NO A36294



REV.	DESCRIPTION	DRAWN DATE/BY	CHECK DATE/BY	DESIGN DATE/BY	APPROVED DATE/BY

NOTES:

1. TWO WIRE CABLE, SHIELDED RECOMMENDED, PROVIDED AND CONNECTED BY CUSTOMER. FOR CABLE LENGTH FIGURE OUT FOR MAX. LOOP RESISTANCE OF 4 OHMS. HOWEVER, KURZ WILL PROVIDE 15 FT. OF TWO WIRE CABLE FOR TESTING PURPOSE.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TOLERANCES ARE

FRACTIONS	± 1/32
ANGLES	± 0°-30'
DECIMALS	
.X	± 0.1
.XX	± 0.03
.XXX	± 0.005
.XXXX	± 0.0010

ORIG. RELEASE DATE

NEXT ASSEMBLY

APPROVALS

	DATE
DRAWN BY [signature]	10-24-93
CHECKED BY	
DESIGN	
APPROVED	
BASELINED	

KURZ INSTRUMENTS INC.

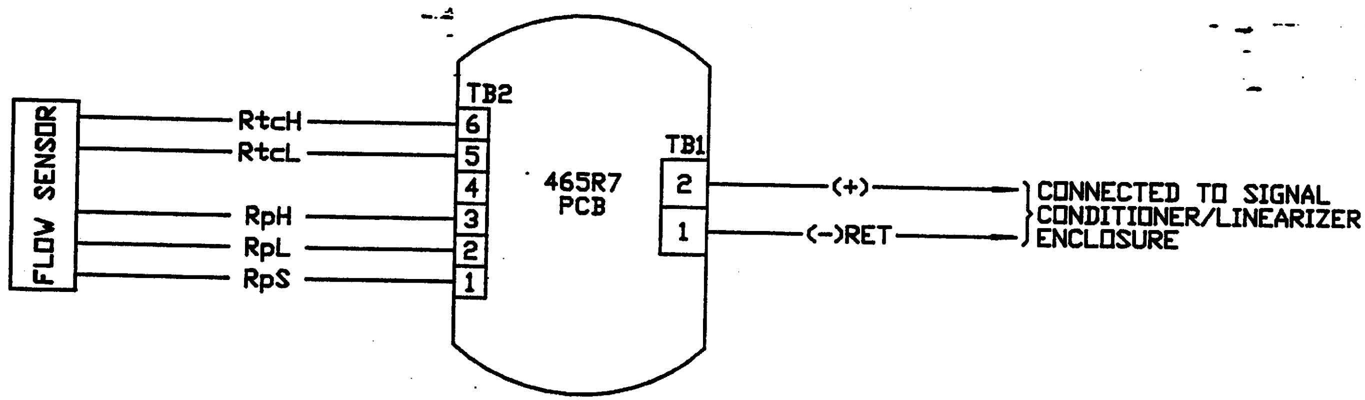
TITLE

WIRING DIAGRAM, FROM JUNCTION BOX TO ELECTRONIC ENCLOSURE

DWG. SIZE: B
DWG. NO.: 340282
REV.: 0
SCALE: NONE
SHEET 1 OF 1

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A38283

REV.	DESCRIPTION	DRAWN DATE/BY	CHECK DATE/BY	DESIGN DATE/BY	APPROVED DATE/BY



NOTES:
1. FOR 4-WIRE SENSOR, MOVE RtcL FROM TB2-5 AND CONNECTED TO TB2-4, RpS NOT USED, AND REMOVE OP-AMP U2.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
TOLERANCES ARE	
FRACTIONS	± 1/32
ANGLES	± 0°-30'
DECIMALS	
.X	± 0.1
.XX	± 0.03
.XXX	± 0.005
.XXXX	± 0.0010
ORIG. RELEASE DATE	

NEXT ASSEMBLY

APPROVALS	DATE
DRAWN BY [signature]	10-9-89
CHECKED BY [signature]	10-9-89
DESIGN	
APPROVED [signature]	10-20-89
BASELINED	

KURZ INSTRUMENTS INC.

TITLE: *WIRING DIAGRAM, 465R7 & 5-WIRE SENSOR.* L2

DWG. SIZE	DWG. NO.	REV.
B	340281	0
	SCALE NONE	SHEET 1 OF 1

KURZ CALIBRATION WORK SHEET

KURZ MODEL: ________________ **CUSTOMER CODE:** __________

	FLOW RATE		IDEAL LIN. VDC	ACTUAL LIN. VDC	ACTUAL mA OUT	ACTUAL NONLIN. VDC	INCHES OF H20	CURRENT SENSE D.C. VDC		BREAK POINTS	LIN. VDC POINTS
	VELOCITY POINT	MASS POINT									
0			0.000						0	0.000	
1			0.250						1	0.449	
2			0.500						2	0.980	
3			1.000						3	1.366	
4			1.500						4	1.812	
5			2.000						5	2.260	
6			2.500						6	2.637	
7			3.000						7	3.172	
8			3.500						8	3.647	
9			4.000						9	4.010	
10			4.500						10	4.515	
11			5.000						11	5.000	

LFE S/N: ____________ Due Date: ____________
LFE Area: ____________
Model No.: ____________
DVM S/N: ____________ Due Date: ____________
Temp. S/N: ____________ Due Date: ____________
Bar. S/N: ____________ Due Date: ____________
Pipe Size: ____________
Pipe Area: ____________

Range: ____________

Input: _____Vac _____Hz
_____Vdc
I-Mode: Yes _____ No _____
Absolute Pressure: __________"Hg
Actual Temperature: ________°F
Calculated Nonlin. Resistors:
R_{17} ________ R_{23} ________

<u>COMMENTS:</u>

<u>BRIDGE VOLTAGE</u>
Zero Flow: ____________
Max. Flow: ____________
For Intrinsic Safety Circuit:
Zener Diode: ____________
Ballast Resistor: ____________

<u>CURRENT-SENSE VOLTAGE</u>
Zero Flow: ____________
Max. Flow: ____________

Technician:________________________ **Date:**________________

Appendix B: Trouble-Shooting Guide

This appendix reviews trouble-shooting information for minor repairs should such problems occur during the calibration procedures and, or process applications. This guide is provided to help locate the section of the electronic assembly at fault. It is not intended to be an all inclusive repair manual. In most major repairs, the unit should be returned to the Kurz™ factory for service. Kurz™ Instruments, Inc. will provide technical assistance over the phone to qualified repair personnel. Please call Customer Service Department at our toll-free number 1-800-424-7356.

Do not return any equipment without a Return Material Authorization, obtainable from the Customer Service Department. Information describing the problem, corrective action or work to be accomplished at the Kurz™ factory, purchase order number the equipment was purchased under, and name of person to contact must be included with the return equipment.

Return shipping address:

KURZ™ INSTRUMENTS, INC.
2411 GARDEN ROAD
MONTEREY, CA 93940

ATTN: CUSTOMER SERVICE DEPT.
RETURN AUTHORIZATION NO.

Note: Transportation charges for equipment shipped to the Kurz™ factory for warranty repair are to be paid by the shipper. We will return the equipment under warranty prepaid.

TROUBLE-SHOOTING GUIDE

* **Symptom:** No voltage at TP1.

Probable Cause: Kurz™ thermal mass flow sensor disconnected, Q_1 (heat sink transistor) on current-transmitter board bad, no bridge voltage, no unregulated supply voltage of 24.000 Vdc getting to the current-transmitter board, faulty two-wire loop connection between current-transmitter board and linearizer board or R_8 (resistor) open.

* **Symptom:** No voltage at TP2.

Probable Cause: T_1 (transformer), D_1 (bridge rectifier), F_1 (fuse, standard $^1/_2$ ampere) or power cord bad.

* **Symptom:** No voltage at TP3.

Probable Cause: T_1 (transformer), D_1 (bridge rectifier), F_1 (fuse, standard $^1/_2$ ampere) or power cord bad.

* **Symptom:** No voltage at TP4.

Probable Cause: U1, U2, U3, U4, U5 (operational amplifiers) or VR_1 (voltage regulator) shorted or short on the circuit board. No unregulated supply voltage of 24.000 Vdc.

* **Symptom:** No voltage at TP5 or TB1-5.

Probable Cause: U1, U2, U3, U4, U5 (operational amplifiers) or VR_2 (voltage regulator) shorted or short on the circuit board. No unregulated, negative supply voltage of -24.000 Vdc.

*** Symptom:** No voltage at TP6.

Probable Cause: VR_3 (voltage regulator) shorted or short on the circuit board. No unregulated supply voltage of either 24.000 Vdc or 15.000 Vdc (depending on jumper configuration). Faulty or missing jumper.

*** Symptom:** No voltage at TP7.

Probable Cause: No unregulated supply voltage of 15.000 Vdc, R_{12} (resistor) or R_{14} (potentiometer) open, D_4 (voltage regulator), D_5 and D_6 (diodes) shorted, U1 loading down the reference voltage of 2.490 Vdc or short on circuit board.

Note: If a low or high voltage is measured at TP4, R_{14} (potentiometer) may be adjusted improperly. If necessary, adjust R_{14} up or down until the DVM reading is 2.490 Vdc.

*** Symptom:** No voltage at TP8.

Probable Cause: No reference voltage of 2.490 Vdc, U1 (operational amplifier) bad, or R_{15} (resistor) or R_{16} (potentiometer) open.

Note: If a low or high voltage is measured at TP8, R_{14} (potentiometer) or R_{16} (potentiometer) may be adjusted improperly or R_{13} (resistor) or R_{15} (resistor) are of improper values. If necessary, adjust R_{16} up or down until the DVM reading is -5.000 Vdc. You must first check to verify if the reference voltage at TP7 is 2.490 Vdc.

*** Symptom:** No voltage at TP9.

Probable Cause: Kurz™ thermal mass flow sensor disconnected, Q_1 (heat sink transistor) on current-transmitter board bad, no bridge voltage, no unregulated supply voltage of 24.000 Vdc getting to the current-transmitter board, faulty two-wire loop connection between current-transmitter board and linearizer board, E_9 (jumper) missing or faulty or U1 (operational amplifier) bad.

*** Symptom:** No bridge voltage on the current-transmitter board.

Probable Cause: Refer to the symptom of no voltage at TP9.

*** Symptom:** No nonlinear 0.000 Vdc to 5.000 Vdc corresponding to zero flow rate and specified maximum flow rate at TB1-4.

Probable Cause: No bridge voltage, U1 (operational amplifier) bad, jumper (E9) missing or faulty.

*** Symptom:** Low nonlinear 0.000 Vdc to 5.000 Vdc at TB1-4.

Probable Cause: R19 (potentiometer) or R21 (potentiometer) adjustment faulty, signal being loaded down by P.C.B, TP8 voltage drifting.

*** Symptom:** No linear output voltage.

Probable Cause: No input voltage, U2 (operational amplifier) bad, signal being loaded down.

*** Symptom:** Linear 0.000 to 5.000 Vdc reading is incorrect.

Probable Cause: Wrong flow range being used for unit, nonlinear 0.000 to 5.000 Vdc input to linear 0.000 to 5.000 Vdc output is adjusted improperly, faulty component in linear section.

*** Symptom:** Linear voltage output at TB1-2 above 10.000 Vdc continuous.

Probable Cause: Nonlinear 0.000 Vdc to 5.000 Vdc input to high and stay high (possible bad sensor), feedback resistor summing stage of linear section open, break-point amplifier railed out due to a faulty component.