

KURZ™ INSTRUMENTS, INC.

**Series 440
Air Velocity Meters
User's Guide**

Customer Name:

P.O. Number:

Date of Order:

Complete Model Number:

Kurz™ Order Number:

Serial Number:

Document Number: 360123, Rev. A

TABLE OF CONTENTS

		Pages
SECTION 1	Description	1
SECTION 2	Principle of Operation	1
SECTION 3	Operation Instructions	1
SECTION 4	Applications	6
	A. Air Velocities in Open Spaces	
	B. Ventilation Openings	
	C. Velocities and Flow Rates in Ducts	
	D. Static Pressure Measurements	
	E. Temperature Measurements	
	F. Recorder Output	
SECTION 5	Specifications	2
SECTION 6	Maintenance	1
SECTION 7	Calibration Procedure	2
APPENDIX	Reference documents	
	Schematic diagram	
	Component assembly layout and parts list	
	Bill of material	

A440350Q1 Rev. A (July, 1986)

By: _____

Date: _____

Checked by: _____

Date: _____

Approved by: _____

Date: _____

SECTION 1

Description

The KURZ Series 440 Portable Air Velocity Meters are easy-to-use, battery powered, highly accurate instruments for measuring air velocity, static pressure and temperature in heating, ventilation, air-conditioning (HVAC), industrial hygiene, occupational safety and health and research applications.

The Series 440 provide accurate measurements of extremely low velocities with exceptional sensitivity and readability (down to +5 sfpm). KURZ solid-state "DuraFlo"TM velocity sensing element is extremely rugged, and its large size renders it immune to particulate contamination. KURZ Portable Air Velocity Meters have unsurpassed accuracy and repeatability: + 2% accuracy for each full scale range and +0.25% of full scale reproducibility over the wide temperature range of -20°C to +55°C.

Weighing less than 6 pounds, the rugged, shock-resistant 440, with its attractive carrying case, can be carried and used anywhere. Self-contained, rechargeable nickel-cadium batteries provide many hours of continued operation, although 115 or 230 VAC operation is available for continuous use applications (Models 442 and 440AC). The Series 440 are designed to be easy to use, with a single probe and a minimum of knobs.

KURZ Portable Air Velocity Meters conveniently and accurately provide direct reading of air velocity through supply-and-return grills and in ducts. The 440 Series also gives static pressure and pressure drops across air filters -- without the tedious use of multiple probes and cumbersome hoses. It is used by consultants, contractors, governmental and OSHA personnel and air pollution officials for developing, testing, and balancing HVAC systems.

All Series 440s come complete with a 13-inch-long "DuraFlo" velocity probe that is marked in increments of one inch; a retractable, removable shield; a readout meter; a static pressure attachment; an 8-foot probe cable; 115/230 VAC battery charger; rugged carrying case; and a complete operating manual. A unique feature of the probe shield is that it can be reversed and positioned down the probe cable to yield a total probe length of up to 20 inches.

SECTION 2

Principle of Operation

The basic sensing element of the Series 440 Portable Air Velocity Meter is the KURZ "DuraFlo" probe. This probe consists of two integral sensors: a velocity sensor and a temperature sensor. The velocity sensor is a constant-temperature thermal anemometer which measures "standard" velocity (mass flow referenced to 25°C and 760 mm Hg) by sensing the cooling effect of the moving flowstream as it passes over the heated sensor. The velocity sensor is heated electrically by the control circuitry in the electronics package. The velocity sensor is rugged and large -- it is not a fragile hot-wire and therefore is resistant to breakage and insensitive to particulate contamination. The temperature sensor accurately compensates for temperature variations over a wide range. The maximum temperature of the velocity sensor is only 75°F above ambient temperature.

The probe is used directly to measure air velocity in open spaces, ducts and supply & return openings. Static pressure measurements are obtained through the use of the pressure attachment (stock no. PRT0670). The pressure attachment has a small orifice which is used to direct air to the velocity sensor of the probe. The air flow generated by the static pressure is proportional to the static pressure proper. Either positive or negative static pressures can be measured.

It should be noted that the velocity readings of all KURZ Air Velocity Meters are referenced to standard conditions of 25°C and 760 mm Hg pressure, and therefore directly measure the local mass velocity of the air. In order to obtain the actual velocity a simple density correction may be used as follows:

$$V_{act} = V_{ind} \times \rho_s / \rho_a, \text{ where}$$

$$\rho_s = \text{air density at standard conditions of } 25^{\circ}\text{C} \\ \text{and } 760 \text{ mm Hg}$$

$$\rho_a = \text{actual air density at local temperature} \\ \text{and barometric pressure}$$

$$V_{act} = \text{actual air velocity in feet-per minute, and}$$

$$V_{ind} = \text{indicated velocity on Kurz Air Velocity Meters}$$

Normally this correction is small and may be neglected. Also, in most applications it is the mass velocity which is needed and no density calculation is required.

SECTION 3

Operating Instructions

All KURZ portable meters are shipped with the battery in a "low-charge" condition. Plug the charger into the front panel receptacle labeled "CHARGER". Plug the other end of the charger into a 115V wall socket. Charge the unit for a period of at least one hour before operating. A charge of 12-16 hours is recommended to obtain a full-charge condition. Whenever possible, leave the charger connected when operating the meter. This procedure will not damage the battery and will increase the time between charges. A 220 VAC charger is optionally available with the Series 440 (Designated: "-X" option). When not operating the unit, always charge with the range switch in the "OFF" position.

To check the battery voltage, turn the single, centrally located knob to "BATTERY". For proper operation the meter needle should be displaced to the right of the "BATT. OK" symbol on the meter scale. When plugging the probe connector into the "PROBE" receptacle, be sure the range switch is in the "OFF" position.

Next, turn the range switch to the highest air velocity range position, allowing the needle to return to the zero position. Loosen the knurled nut on the probe shield and slide the shield toward the cable, exposing the sensor. Tighten the knurled nut to secure the probe shield. The air velocity meter is now operating and will respond to the slightest air movement. Use lower ranges to obtain increased accuracy at low velocities.

Remember to turn the range switch to "OFF" when putting the system back into the carrying case. To save battery time, it is also recommended that users turn the meter off if there are long periods between measurements.

Always slide the retractable probe shield over the sensor when the system is not in use to avoid possible breakage.

If a longer reach is needed for your measurement, remove the probe shield and put it on the probe in the reversed position and slide it down the cable. Lock the shield in this position to produce an effective probe length of up to 20 inches.

To make static pressure measurement, place the pressure attachment on the probe, aligning the scribe lines on the probe with the corresponding lines of the attachment. Secure the attachment with the locking screw. The range switch should then be turned to the "inches of water" scale.

SECTION 4

Applications

A. Air Velocities in Open Spaces or Single-point Measurement

The 440 Series Air Velocity Meters are easily used to measure local air velocities in a wide variety of applications. Simply retract the probe shield and place the probe perpendicular to the air flow expected. The window in the probe tip should be rotated such that the flow passes directly through it. You will notice that the output is not affected greatly by angular rotation of the probe until a change of about $\pm 15^\circ$ to the flow direction is implemented.

For extremely low velocities, it is recommended that the probe be firmly attached to a tripod, wall, beam or other structure in order to eliminate movement of the probe.

In situations where the air temperature is changing, let the probe come to thermal equilibrium, thus allowing time for the temperature-compensation features of the air velocity meter to respond.

B. Ventilation Openings

The 440 Series Air Velocity Meters can be conveniently used to obtain the velocity and total flow of supply and return openings or suction openings. In either case, place the probe close to and parallel to the surface of the opening, allowing the air to flow perpendicularly through the window at the probe tip.

When it is necessary to obtain the total flow (SCFM) of a supply or return opening having no grill, use the equation:

$$Q = A \bar{V}, \text{ where}$$

Q = quantity of air in standard cubic feet per minute (SCFM)

A = area of the opening in square feet, and

\bar{V} = the area-weighted average air velocity in standard feet per minute (SFPM)

To determine the average air velocity, divide the opening into a number of equal areas. Take a velocity reading at the center of each area and numerically average the results. If the velocity profile is relatively flat, only a few areas need be taken; if the profile is non-uniform, several areas should be used. Generally, it is a good idea to make a rapid traverse across the duct in two dimensions to determine the uniformity of the air velocity. If the velocity is not constant at one measuring point, use the mean velocity between the upper and

lower readings. Generally, the velocity profile is more uniform on suction openings than on supply openings.

If a supply opening is covered by a grill, it is suggested that the probe be placed about one inch in front of the grill to obtain the average velocity reading, as above. The Area, "A," used in the above equation is the core area of the grill.

If information is given on the coefficient of discharge for a specific grill, the probe should be placed against the grill and centered over the open areas in the grill. Choose several grill openings to obtain an average air velocity. In this case the total flow is given by:

$$Q = K A \bar{V}, \text{ where}$$

K = the given coefficient of discharge, and

A = area of the grill as specified by the manufacturer

For openings covered by diffusers, please refer to the manufacturer's instructions for the particular type of diffuser. This information is normally readily available.

If a return or suction opening is covered by a grill and it is necessary to compute the total flow into the opening, the correct procedure is to take a number of readings at the center of equal areas, as in the case of having no grill, and determining the average velocity. The probe should be placed in the plane of the opening, close to the grill. The flow rate can be computed fairly accurately by the following:

$$Q = F A \bar{V}, \text{ where}$$

Q = flow rate in standard cubic feet per minute

F = application factor (see following table)

A = designated area in square feet, and

\bar{V} = average velocity in standard feet per minute

<u>Grill Type</u>	<u>Application Factors (F)</u>	<u>Designated Area</u>
No Grill	1.00	Full Duct Area
Square Punch Grill	0.88	Free(daylite) area
Bar Grill	0.78	Core Area
Steel Strip Grill	0.73	Core Area

C. Velocities and Flow Rates Inside Ducts

Since air velocities are rarely uniform (or even symmetric) across a duct, it is usually necessary to obtain the average velocity within the duct. Whenever possible, choose a measurement location at least 10 duct diameters downstream from the nearest elbow, tee, bend, valve or other flow obstruction.

The procedure is to divide the flow areas into several equal areas and take a velocity reading at the center of each area. The number of such areas will increase as the velocity profile becomes more non-uniform. These readings are then averaged arithmetically to obtain the average velocity. The total flow rate is then given by:

$$Q = \bar{V} A, \text{ where}$$

Q = flow rate in standard cubic feet per minute

\bar{V} = average velocity in standard feet per minute

A = area of duct in square feet

A common procedure is to traverse the probe once horizontally and once vertically to obtain the proper velocity readings. Figure 4-1 shows non-dimensional, probe traverse locations for equal-area readings in round and square ducts. To obtain faster results, less points can be used with a corresponding sacrifice in accuracy. Please note that the locations designated #1 in Figure 4-1 have areas equivalent to four times the areas of the other locations and are accounted for in the example which follows:

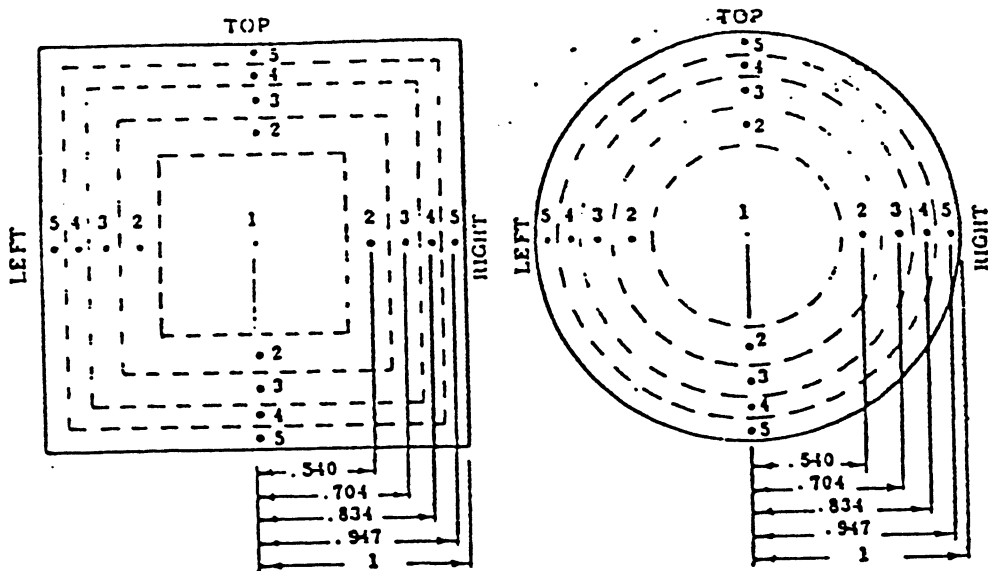


Figure 4-1: Equal-Area Traverses for Square and Round Ducts

To make the traverse, drill two $17/64$ -inch-diameter holes in the side of the duct, oriented 90° with respect to each other. Be careful not to create a jagged hole which may disturb the measurements. Note that the probe is marked in one-inch increments starting from the center of the velocity sensor. The first mark, therefore, is one inch from the sensor, and the mark closest to the probe cable is 12 inches from the velocity sensor. For ducts having a diameter greater than about six inches, the probe shield must be removed. Use a ruler to position the probe at the appropriate location, using the marks on the ruler for reference. The probe is also scribed axially from one end to the other to allow the operator to align the probe window with the flow. Since the window in the probe is about $15/16$ inches long, it is not normally possible to obtain accurate velocity measurements near the traverse hole in the duct because of a possible leakage path through the window to the outside of the duct. Such a leakage may affect the velocity reading of the sensor. If the probe is inserted into the duct past the window in the probe, accurate measurements are obtained. It is therefore suggested that the edge measurements near the two traverse holes be ignored and that the average velocity measurements taken at the opposite wall be substituted. This procedure involves very little error in the overall measurement. After the measurements are complete, be sure to seal the traverse holes.

A numerical example illustrating the averaging process is given on the next page for a six-inch square duct:

LOCATION

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>Sum</u>	<u>Average</u>
Left	1200	1150	1100	1000	700	5150	1030
Right	1200	1140	1115	1020	700	5175	1035
Top	1200	1200	1175	1100	800	5475	1095
Bottom	1200	1175	1150	1050	800	5375	1075
Sum	4800	4665	4540	4170	3000	21,175	4235
Average	1200	1166	1135	1043	750	5294	1059

Thus the average velocity is 1059 standard feet per minute (SFPM). The total flow is given by:

$$Q = A V = 0.5 \text{ ft.} \times 0.5 \text{ ft} \times 1059 \text{ SFPM, or}$$

$$Q = 264.75 \text{ SCFM}$$

D. Static Pressure Measurements

The static pressure (either positive or negative) within a duct system, filter or other pressurized or evacuated body can be easily measured by using the pressure attachment for the probe.

First, drill a hole in the duct having a diameter greater than $17/64$ " , but less than $1/2$ ". Determine whether the duct is above ambient pressure (positive pressure) or below ambient pressure (negative pressure). This is easily done at high positive pressures, since a distinct jet of air can be felt with one's fingers. If in doubt, take a limp piece of yarn, place it near the hole, and see whether it is pulled into the duct (negative pressure) or blown away from the duct (positive).

Slip the pressure attachment onto the probe as far as it will go, rotate it until the scribe line on the pressure attachment lines up with the axial scribe lines on the probe. Lock the pressure attachment in position with the locking screw. You will note that a "+" mark is stamped into the barrel of the pressure attachment directly above the scribe line, and a corresponding "-" mark is located on the opposite side of the barrel.

The pressure attachment has identical flow nozzles opposite each other. Each nozzle is fitted with a soft sponge gasket to enable users to seal the pressure attachment against the duct in which the static pressure measurement is to be made.

To make the measurement, turn the range-selector knob to the "inches of water" scale. Firmly place the pressure attachment nozzle over the hole drilled in the duct. If the static pressure in the duct is negative, place the pressure attachment against the duct such that the "-" mark is facing the operator.

It should be realized that static pressure measurements cannot be relied on for field evaluation of air handling system performance. For various reasons, pressure readings taken in the field do not reflect the pressures associated with the fan's catalog rating.

E. Temperature Measurements

The temperature of the air within a duct can easily be measured with the use of a KURZ Model 444 Portable Air Velocity/Temperature Meter by simply rotating the switch counter clockwise to the left of the "off" position.

In this mode of operation the velocity sensor is not heated and switched out of the circuit. The temperature sensor output, which is used to temperature-compensate the velocity sensor output in the velocity mode of operation, is now used to drive the meter indicator to give you a temperature reading.

F. Use With Recorders

When the subscript "A" is added to the 440 designation (e.g. 441-A), then an analog-output signal is provided. This signal is available via specially supplied jacks on the front of the meter. The output voltage of this signal is 0-1 VDC (non-linear) corresponding to the full scale of the highest range. However, the signal is active for all ranges (see following page for data).

SECTION 5

SPECIFICATIONS

ENGLISH UNITS: MODELS AND DISPLAY RANGES														
MODEL	VELOCITY STANDARD FEET PER MINUTE (SFPM)											TEMPERATURE °F		STATIC PRESSURE INCHES WATER
	100	200	300	600	1,000	1,250	2,000	2,500	5,000	10,000	12,000	0-250	0-500	0-5
441S	■													
441S-HT														
443														
443-HT														
444														
444-HT														
490-IS														
491-IS														
493-IS														

INTERNATIONAL UNITS: MODELS AND DISPLAY RANGES													
MODEL	VELOCITY STANDARD METERS PER SECOND (SMPS)										TEMPERATURE °C		STATIC PRESSURE mm WATER
	1	1.5	3	5	6	10	30	50	60	0-125	0-200	0-120	
441M													
441M-HT													
443M													
443M-HT													
444M													
444M-HT													
490-IS-M													
491-IS-M													
493-IS-M													

PRODUCT DESCRIPTION	SERIES 440	SERIES 490-IS
POWER	1 amp-hr nicad battery	4 AA alkaline batteries
RECHARGER	115/220 VAC 50/60 Hz	—
ELECTRONIC ENCLOSURE SIZE	7.25"Hx5.19"Wx2.50"D	4.88"Hx2.38"Wx1.38"D
CARRYING CASE SIZE	12.50"Hx17"Wx3.38"D	6.75"Hx8"Wx3.13"D
SHIPPING WEIGHT	8 lbs.	3 lbs.
REPEATABILITY	0.25% F.S.	0.50% F.S.
SENSOR TYPE	DuraFlo™	Low-Power
SENSOR WETTED MATERIALS	Glass, Epoxy, Stainless Steel	Glass, Epoxy, Stainless Steel
SENSOR SUPPORT MATERIAL	316 Stainless Steel	Epoxy-Fiberglass
SENSOR SUPPORT LENGTH	13" Standard 6", 24", 36" is available	6"
PROBE CABLE LENGTH	8 feet	6'-72" (retractile)
ENCLOSURE TEMP. RANGE	-15°C to +55°C	
ENCLOSURE HUMIDITY RANGE	0-95% non-condensing	
WARRANTY	1 year (see Kurz warranty for details)	

PRODUCT SERIES	ACCURACY SPECIFICATION*
440, 440-HT	±[(3% +0.02%/°F) reading + (15 SFPM + 0.45 SFPM/°F)]
440M, 440M-HT	±[(3% +0.036%/°C) reading + (0.075 SMPS + 0.0036 SMPS/°C)]
490-IS	±[(5% +0.03%/°F) reading + (20 SFPM + 0.6 SFPM/°F)]
490-IS-M	±[(5% +0.0054%/°C) reading + (0.10 SMPS + 0.0054 SMPS/°C)]

*The temperature effect is referenced to 25°C (77°F)

PRODUCT SERIES	SENSOR PROCESS TEMPERATURE RATING
440	-40°C to + 125°C
440-HT	-40°C to + 200°C
490	-15°C to + 70°C



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DCN 367029 REV. C

IMPORTANT NOTICE: Specifications are subject to change without notice. Kurz Instruments reserves the right to make engineering changes and product improvements at any time and without prior notice.

SECTION 6

MAINTENANCE

As with all rechargeable, nickel-cadmium battery systems, care should be taken to avoid extensive battery discharge. This maximizes battery life. Care should also be taken that a repetitive, consistent cycle of partial discharge/recharge is not imparted on the battery, since this will introduce a "memory effect," wherein the battery "remembers" its lowest point of discharge and does not efficiently operate below this point.

What typically happens in such an instance is the battery is consistently and repetitively recharged, over a period of time, after expending only a small portion of its capacity. This introduces the "memory" effect. Then, when the unit is discharged slightly below this point, it undergoes a precipitous, full discharge.

To avoid this "memory effect," it is recommended that batteries not be recharged according to a rigid time schedule, and that they be allowed to occasionally discharge the bulk of their capacity (Total capacity: approx. one volt per cell, for a total low voltage of eight volts).

Checking the battery charge is easily accomplished by switching the knob on the meter to the "BATTERY" position and observing the needle deflection. The batteries are always charged if the needle deflection exceeds the battery check mark ("BATT. OK") on the meter legend.

Although the relatively large diameter of the velocity sensor renders it immune to particulate contamination in typical environments, continued use in dirty environments may necessitate periodic cleaning of the sensor. Since the sensor is quite large and rugged, this can be accomplished with a small, soft brush (such as camel's hair) and clean water, followed by an alcohol rinse. The sensor should be dry before resuming operation.

Always cover the probe with the probe shield when not using the system to protect the sensor from contact with foreign objects or contamination. Store or transport the meter and probe in the convenient foam-padded carrying case to prevent damage due to shock.

Calibration should be checked periodically -- normally annually, depending on the accuracy of the data needed and frequency of use. The meter can be returned to:

Kurz Instruments Inc.
2411 Garden Rd.
Monterey, CA 93940

Be sure to call the factory for a Return Authorization Number prior to shipping your unit. Including static pressure attachment and probe, along with the name, address and phone number of user. Allow 4-6 weeks for recalibration of your portable unit.

Air velocity calibration systems can be obtained from the Kurz factory. The use of this system would allow you to check your calibration or to recalibrate most portable air velocity meters -- even those of other manufacturers. Consult our factory sales engineers or our local representative about our Model 400 Air Velocity Calibration Systems.

SECTION 7

CALIBRATION PROCEDURE (Except for 444 Series)

Kurz Air Velocity Meters are calibrated at the factory. As with any instrument, it is wise to check the calibration from time to time, preferably on a regular basis. Unless you have an accurate flow calibration facility, it may be most convenient to have this done at the factory or at an authorized service center. The use of a Kurz Model 400 Air Velocity Calibration System would allow you to conveniently calibrate your Kurz meter (or other brand meters) at your location.

The velocity calibration procedure consists of inserting the probe in a flow of known velocity and adjusting the "zero" and span controls mounted on the circuit board inside the meter. First, mechanically "zero" the meter by using the meter-zeroing screw mounted on the front panel, with the power off. Establish a "no-flow condition" in the center of a sphere three inches in diameter. Insert the probe vertically from the top until the velocity sensor is in the center of the sphere in a way that the window in the probe is perpendicular to the flow. Adjust the zero control, R_{22} , such that the meter needle reads zero on the lowest velocity range (0-300 FPM). After properly "zeroing" the instrument, the span controls (R_{11} , R_{12} , R_{13} and R_{14}), are adjusted to obtain the full-scale readings on each of the three velocity scales and the one pressure scale. The flow facility must be adjusted to give the proper full-scale values for each range adjustment. Remember to correct the calibration velocity reading to standard velocity values referenced to 25°C and 760mm Hg. "Zero" adjustments can be made using the meter zeroing screw on the front panel if small changes become necessary.

Similarly, the system can be calibrated for static pressure by exposing the probe with the pressure attachment to a source of static pressure and by suitably adjusting the pressure scale span adjustment potentiometer (R_{14}).

Document No. C44030001 in Appendix shows a component side view of the circuit board of the air velocity meters. Shown here are the five potentiometers used to zero and span the various range scales of the meter.

The potentiometers labeled R₁₁-R₁₄ and R₂₂ relate to the various range scales as follows:

- R₁₁ - high-velocity span adjustment
- R₁₂ - medium-velocity span adjustment
- R₁₃ - low-velocity span adjustment
- R₁₄ - static pressure span adjustment
- R₂₂ - zero adjustment for all ranges

Calibration Procedure, 444 Series

The velocity calibration procedure consists of inserting the probe in a flow of known velocity (calibrator) and adjusting the "zero" and "span" controls mounted on the circuit board inside the meter. First, with power off, mechanically zero the meter by using the meter-zeroing screw mounted on the front panel. With the probe inserted into the calibrator at zero velocity, adjust the zero control, R₂₂, such that the meter needle reads zero on the lowest velocity range (0 to 300 FPM/0-1.5 MPS). After properly zeroing the instrument, the span controls (R₁₁ and R₁₂) are adjusted to obtain the full-scale readings on each of the two velocity scales. The flow facility must be adjusted to give the proper full-scale values referenced to 25°C and 760mm Hg.

The temperature calibration must be performed after velocity is calibrated. Temp. calibration consists of inserting the probe in a calibrated temperature chamber. Adjust the temperature chamber to 0° (either farenheit or centigrade, depending on model). After allowing sufficient time for temperature stabilization, adjust R₂₆ such that the meter reads zero. Next, adjust the temperature bath to full scale temperature and adjust R₂₇ for a full-scale reading (equal to bath temperature).

The pressure calibration procedure consists of subjecting the pressure attachment (with probe inserted) to the full-scale static pressure. Adjust R₁₃ to obtain the full-scale reading.

The following potentiometers relate the indicated range scales:

- R₁₁ - High-velocity span adjustment
- R₁₂ - Low-velocity span adjustment
- R₁₃ - Static pressure span adjustment
- R₁₉ - Reference diode adjustment (factory-set)
- R₂₂ - Velocity zero adjustment
- R₂₆ - Temperature scale zero adjustment
- R₂₇ - Temperature scale span adjustment
- R₂₉ - reference diode adjustment - temp ref.
(Factory set)
- R₂₉ - Reference diode adjustment, temp. ref. (fact.-set)
- R₃₀ - Reference diode adjustment meter ref. (factory-set)

WARRANTY STATEMENT

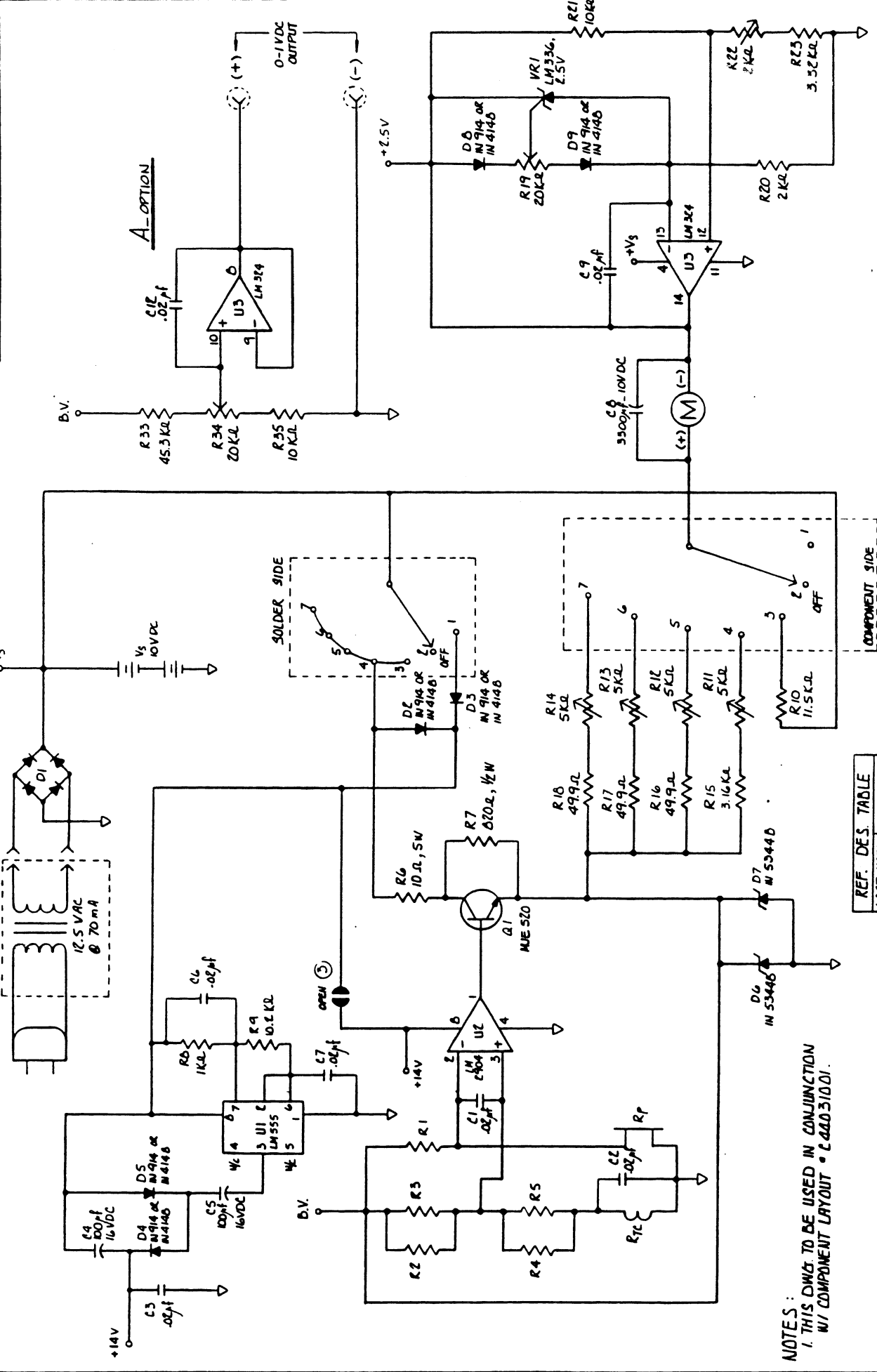
The Company's products are warranted to be free from defects in material and workmanship for one year from date of shipment from the factory. The Company's obligation is limited to repairing, or, at their option, replacing products and components which, on verification, prove to be defective at the factory in Monterey, Calif. The Company shall not be liable for installation charges, for expenses of Buyer for repairs or replacement, for damages from delay or loss of use, or other indirect or consequential damages of any kind. The Company extends this warranty only upon proper use and/or installation of the product in the application for which intended and does not cover products which have been modified without the Company's approval or which have been subjected to unusual physical or electrical stress, or upon which the original identification marks have been removed or altered.

Whenever the design of the equipment to be furnished or the system in which it is to be incorporated originate with the buyer, manufacturer's warranty is limited specifically to matters relating to furnishing of equipment free of defects in material and workmanship and assumes no responsibility for implied warranties of fitness for purpose or use.

Transportation charges for material shipped to the factory for warranty repair are to be paid by the shipper. The company will return items repaired or replaced under warranty prepaid. No items shall be returned for warranty repair without prior authorization from the Company.

LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECD No A-4-40-47003	6-11-68	[Signature]

REVISIONS
A-OPTION



TOLERANCES UNLESS OTHERWISE SPECIFIED	FRACCTIONS INC	DECIMALS	APPROVALS	DATE
1/2	1/2	1/2	[Signature]	5-25-68

PROJECT NO.	DATE	SCALE	DRAWING NO.
44031001	5-25-68	C	300017

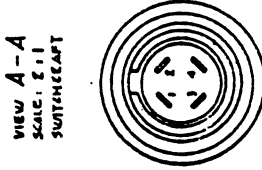
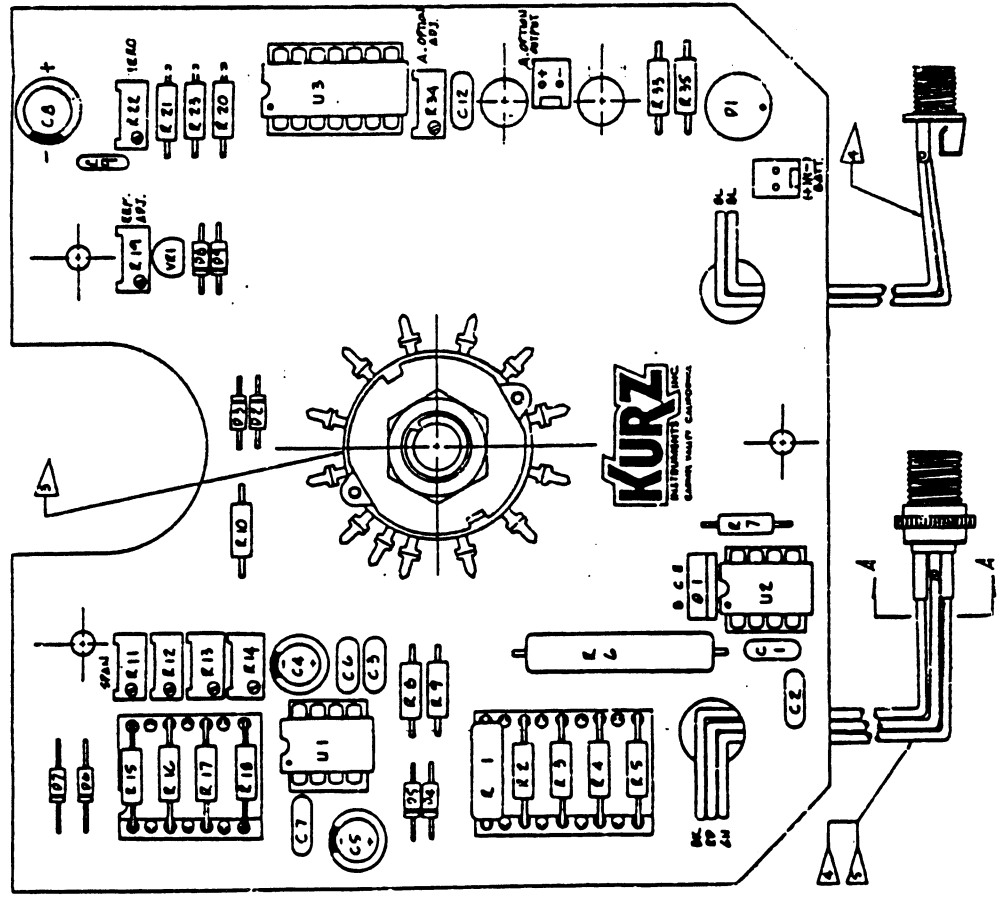
REF. DES. TABLE	LAST USED	NOT USED
U3		
VR2	VR2	
D3	D3	
C12	C10, 11	
D11	D10, 11	
R35	R24-32	

NOTES:
 1. THIS DWG. TO BE USED IN CONJUNCTION W/ COMPONENT LAYOUT - C 44031001.

REV. B: REVISED PER ECO # A44047002. 7-22-87 DV/68/15/15

REV.	DESCRIPTION	REVISIONS	DATE	APPROVED
A	ELIMINATED ONE MYLAR CAP. C2 CHANGED FROM 100PF TO 3300PF-10V. NOTE Δ ADDED.		7-22-86	AG/DJ/ NIB

REV.	DESCRIPTION	REVISIONS	DATE	APPROVED
C6	CAPACITOR 3300PF-10V			
E22	POTENTIOMETER 2K.Ω			
E19	POTENTIOMETER 20K.Ω			
E11-14	POTENTIOMETER 5K.Ω			
E23	RESISTOR 332K.Ω			
E21	102K.Ω			
E20	22K.Ω			
E15,16	47.7K.Ω			
E16	47.7K.Ω			
E15	3.16K.Ω			
E10	11.5K.Ω			
E9	10.2K.Ω			
E8	1K.Ω			
E7	820.Ω, 1/4 W			
E6	2.5A, 5W METAL			
E1-5	RESISTOR SELECTED (TEMP. COMP.)			
C4,5	CAPACITOR 100PF-16VDC			
E13,14,15,16,17,18	CAPACITOR .02PF			
E17	DIODE IN 9344.0			
PE-5,10A-9	PIPER IN 1A IN 4140			
P1	BEING DESCRIBED * CSC 8105			
E1	TRANSFORMER 14:1 500			
VE1	VOLTAGE REGULATOR LM 316, 2.5V			
U3	I.C. OP-AMP LM 364			
U2	I.C. OP-AMP LM 358 OR LM 8104			
U1	I.C. 555 TIMER			
	18 PIN DIP SOCKET * IC-610-544			
	10 PIN ADAPTOR PLUG * AP-610-6-C			
	14 PIN DIP SOCKET * IC-614-6-C			
	14 PIN DIP SOCKET			
	8 PIN DIP SOCKET			
	MYLAR 2 PIN HALE DIMETER * EE-23-20E1			
	SWITCHCRAFT * 2504 PE			
	DIAGRAM JAZZ * 41			
	* WAFER * 85100-01 AHS * 85100-02			
	* ADJ. STD * 212 (1)			
	* 4-40 * 1/2" SCREW (2)			
	* NUT * WASHING * 45T1			
	* SWITCH * 85127-01 AMP MAGPAPER 1			
	ANALOG PORTABLE PCB			
REV. PNR.	DESCRIPTION			QTY.



- 1. GREEN
- 2. BLUE
- 3. BLACK

NOTES: UNLESS OTHERWISE SPECIFIED
 1. DIMENSIONS TO CENTER UNLESS INDICATED W/ DIMENSIONAL
 2. LIST FOR PARTS: U3, E1, VE1, C12, P9, E35.
 3. SEE DRAWING 857000.2 FOR PARTS LIST.
 4. THIS DRAWING IS THE PROPERTY OF KURZ INSTRUMENTS INC. AND SHOULD BE KEPT IN A SAFE PLACE.
 5. HEATSHRINK TO BE USED ON COP & SLAKE WIRE AT SWITCHCRAFT.
 6. (FOR E AND S) HOLE DIMENSION = .500 IN.
 REMOVE

E14	POTENTIOMETER 20K.Ω				
E35	RESISTOR 10K.Ω				
E33	RESISTOR 45.3K.Ω				
C12	CAPACITOR .02PF				
MYLAR	HALE DIMETER * EE-23-20E1				
SWITCHCRAFT	DESCRIPTION				QTY.

REV. PNR.	DESCRIPTION			QTY.
	FACTORY PARTS LIST			
	Kurz Instruments Inc			
	SERIES 440KI Analog Portable			
	Components Layout			
	DATE	REV.	ISSUED BY	REV.
	7/22/87	2.1	C	42002.5
	DO NOT SCALE DRAWING			SHEET 1 OF 1