USER GUIDE

KURZ SERIES 7500 MASS FLOW CONTROL SYSTEMS

Written By: Tom Ramey

Release 1.20
June 18,1984

2411 Garden Road
Monterey, CA 93940
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Section 1 - SYSTEM OVERVIEW

The KURZ Series 7500 Mass Flow Control Systems are state of the art mass flow controllers for use in the most demanding process requirements. KURZ Mass Flow Controllers are composed of three basic subsystems. First, a fast response linear thermal mass flow meter provides a 0-5 Vdc signal linearly proportional to flow. This is commonly a Kurz Series 505 flowmeter. Secondly, a Kurz Series 710 Electric Valve P.I.D. Controller takes the abovementioned 0-5 Vdc input signal, compares it to setpoint and sends an error signal that either opens or closes the control valve until the setpoint is reached. The third major component, or subsystem, is the Kurz 730 Electric Rotary Ramp Metering Valve. This valve has been designed for use in flow control. The Series 7500 name is used to refer to an integrated KURZ Mass Flow Control System in general. In fact, both in specifying and in ordering , a KURZ Mass Flow Control System is assembled by specifying model numbers for each of the three major subsystems, i.e. a 505 Series flowmeter, a 710 Series controller and a 730 Series valve. similarly, the cost of a complete mass flow control system is found by adding up the cost of each individual subsystem along with any options selected. A brief description of each subsystem follows:

SERIES 505 LINEAR FAST RESPONSE MASS FLOW METERS

The Series 505 are rugged, industrial grade extended life solid state flowmeters which feature type 304 stainless steel construction standard . Series 505 flowmeters allow cable runs to over 1,000 ft. by virtue of their two-wire current mode transmitters. Accuracy is 2% of reading + 1/2% at full scale. Repeatability is 0.25%. All models feature a linear 0-5Vdc output signal. NBS(National Bureau of Standards) Traceable calibration is standard and is included in the price for Air at <50 psig.Calibration data and Certificate are provided. Flow bodies include male National Pipe Thread fittings. All KURZ thermal mass flowmeters feature very low pressure drops, typically only a few inches of water column pressure a full scale flow. Additionally, KURZ mass flowmeters automatically correct for changes in gas temperature and density, thus readings are automatically referenced to standard conditions without any tedious manual calculations. Thus flow is usually scaled in SCFM or SLPM or (our preference) lbs/hr.

SERIES 710 ELECTRIC VALVE P.I.D. CONTROLLER

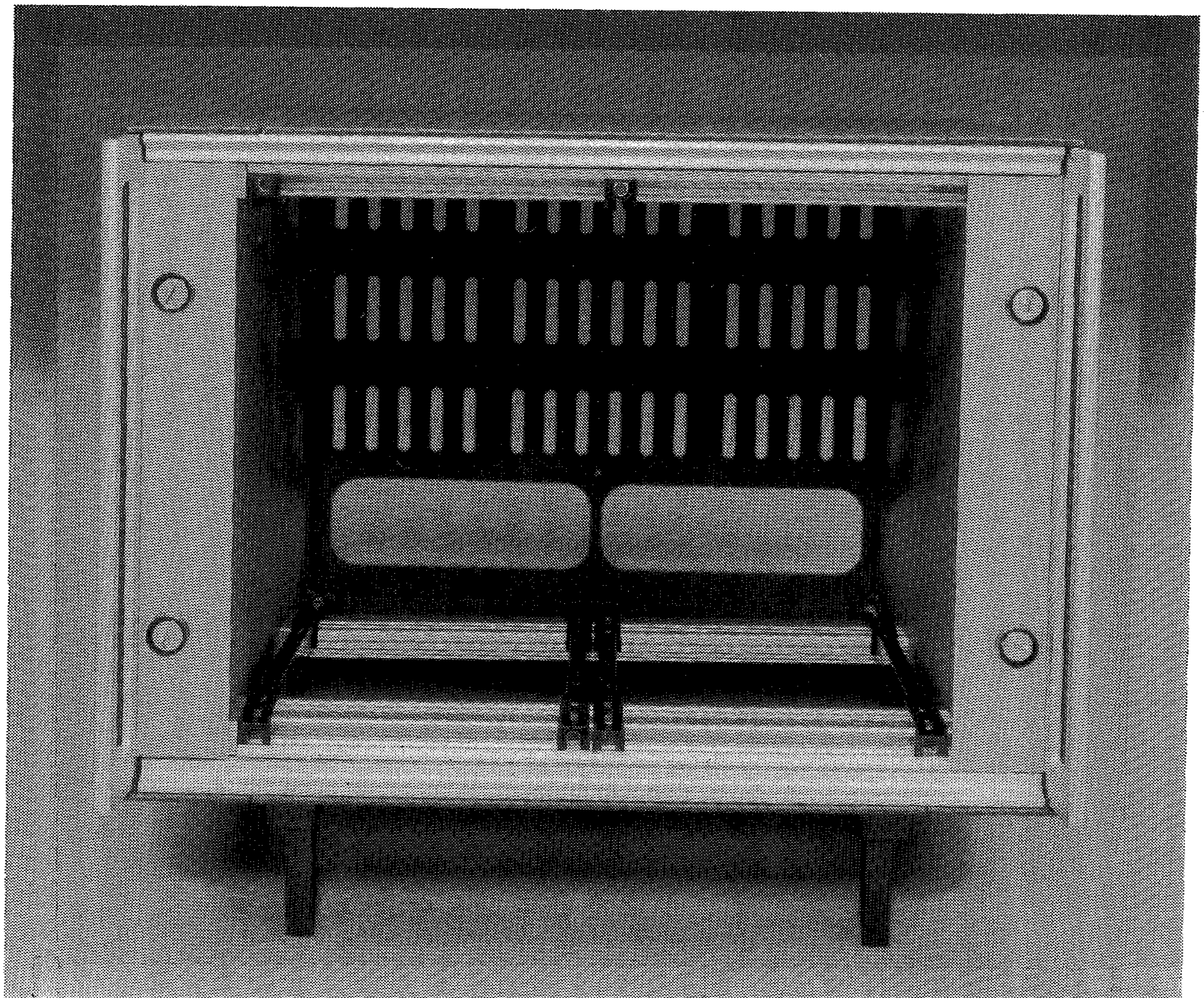
The KURZ Series 710 is an electric P.I.D. (Proportional Integral plus Derivative) Controller designed for use with KURZ valve products or any other electric valve using a DC error signal DC motor driven flow control valve. Versions of the Series 710 are available to accept input signals of 0-5 Vdc,0-2Vdc,1-5 Vdc and 4 -20 ma. The 710 Controller is commonly paired with a Kurz Series 505 mass flow meter and a Kurz Series 730 or 731 electric valve to make a complete mass flow control system. The Series 710 Controllers can accept common process variable inputs from a variety of sensors and control such things as pressure, temperature and humidity. See Specification sheets for further details on the Series 710 Controllers. Further details are also included in this manual.

SERIES 730 ELECTRIC ROTARY RAMP METERING VALVES

The Series 730 Electric Rotary Ramp Metering Valves represent a new concept in electrically actuated metering valves. Unlike competitive electrical metering valves, the Series 730 combines the electric drive motor, the valve body and limit switches into a well designed integrated package. The flow coefficient (Cv) is linear over a wide range due to its nearly 300 degree rotation between shutoff and full open. A remarkable feature of the 730 is that it incorporates a complete flow shutoff feature not found in other fine metering valves. In addition, the orifice size is unaffected by changes in system pressure and the valve remains in its last position during constant flow or during power shutoff. The standard valve incorporates a high torque DC gear motor designed to be operated by error signals from the Series 710 Controller. Series 730 valves may also be ordered with reversible 24 VAC or a 115 VAC/60 Hz drive motor. Each valve is constructed of type 304 stainless steel and includes an O-Ring sealed motor cover with a 1/2" FNPT conduit fitting. Only two wires are required to operate the standard Series 730 valve for ease of installation. The standard full open to full close time is 30 seconds, but other valve speeds can be specified. The Series 730 valves may be used with most fluids, including steam and liquids. Special materials of construction may be specified for hostile fluids or environments.

This photo shows a typical 7500 System with the system electronics in a 1/2 rack bench enclosure. This package is popular with users who plan on using their 7500 System in a lab or test bench type setting.

This photo shows the 1/2 rack bench enclosure without any electronic modules installed. Note that the bench enclosure includes the 1/2 rack chassis with guides for the slide-in rack modules preinstalled. Also note the cutouts on the back of the bench enclosure for feedthru of power, signal and valve control lines.

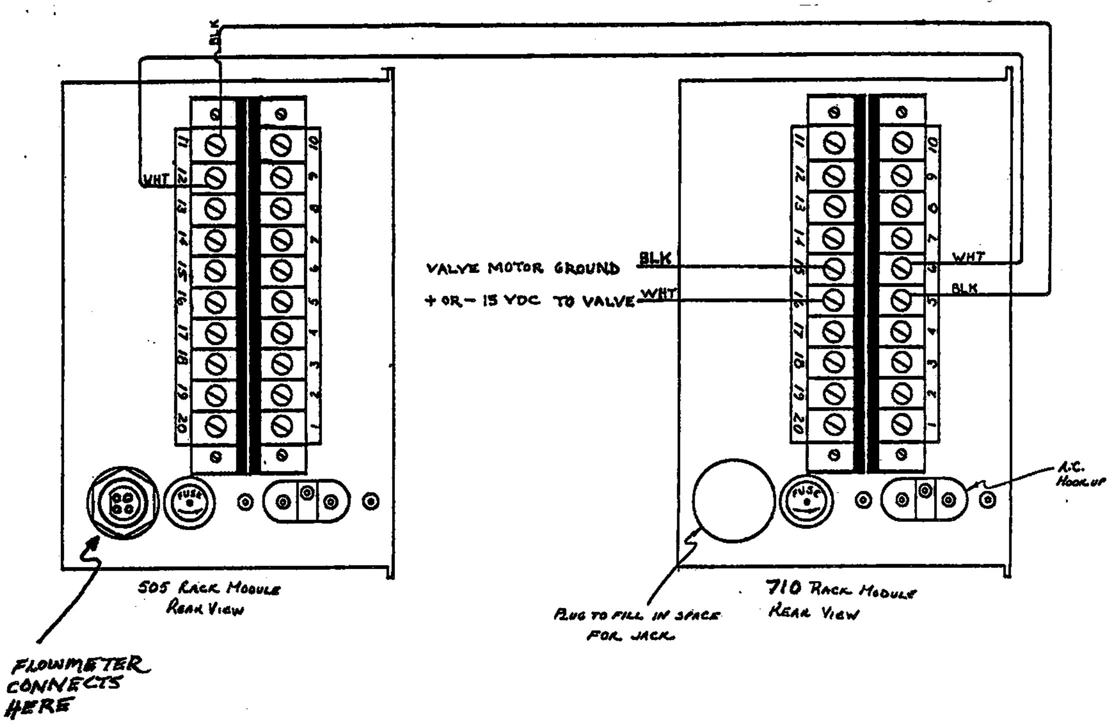


Normally no special precautions need to be observed during unpacking of your flow control system. Of course, any external damage to the package should be reported to the carrier. Usually, the mass flow meter and the flow control valve are shipped already mated or piped together. Depending upon the number of systems or components, the Series 710 Electric Valve P.I.D. Controller may or may not be shipped in the same physical box as the mass flowmeter and the flow control valve. Indeed, for larger flowmeters the mass flow meter and the flow control valve may be separately boxed. Really the only delicate component that might sustain damage in shipping would be the liquid crystal display (LCD) on the Series 710 Controller. We recommend plugging in the Series 710 Controller immediately after unpacking, turning the unit on, and verifying that some indication is present on the digital display. The Series 710 Controller may be turned on and used for this purpose without any connections being made to the mass flow meter or the flow control valve. If no indication is present be sure the display is at something approaching room temperature. As anyone who has ever owned a LCD digital display wristwatch knows, liquid crystal displays will not work when too cold or too hot. If no indications are present report damage to your freight carrier. By the way, all displays are tested prior to shipping to be sure all segments work.

Further details concerning hookup and installation are covered in following sections of this manual. Briefly though, the flowmeter is installed upstream of the flow control valve. If the flowmeter is boxed separately, the longer section of pipe represents the upstream side of the sensor. The mounting orientation (vertical, horizontal,etc.) is immaterial.

Section 3 - QUICK GUIDE TO HOW TO HOOKUP YOUR FLOW CONTROL SYSTEM

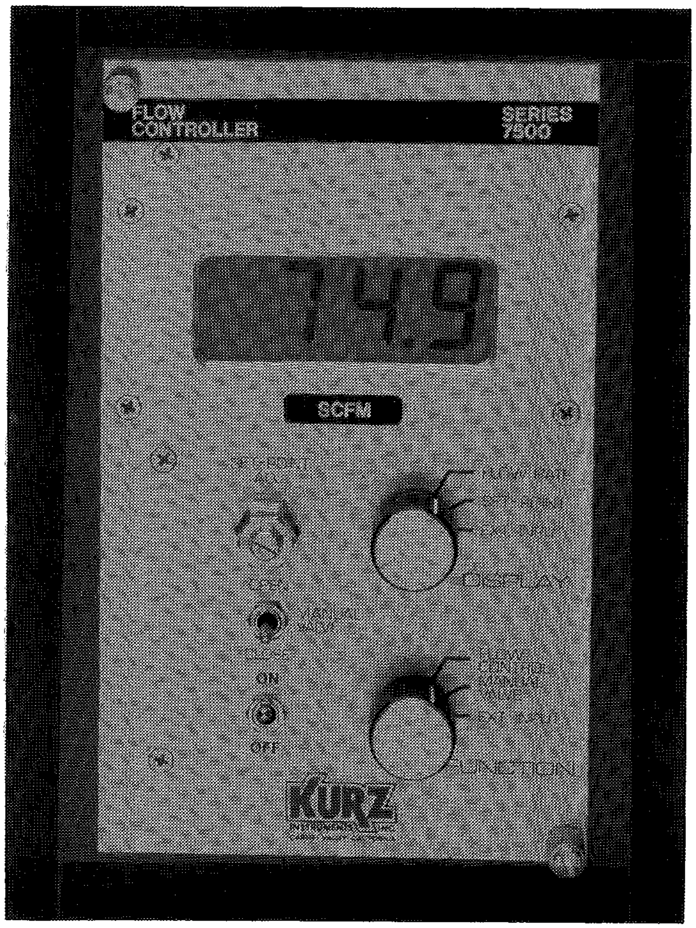
Normally Kurz flow control systems are shipped already hooked up and ready to plug in and operate, with the exception of hooking up the flowmeter and the valve via their own 2-wire cables (customer supplied). The drawing below illustrates flowmeter and valve 2-wire connection points on the rear of the 505 and 7500 Controller rack modules, and also shows inter-module connection points.



Kurz Drawing No. 750030-022

Section 4 - OPERATION — GETTING STARTED

The simplest way to explain operation is to explain the functions of the control switches. Typically the Series 505 flowmeter rack module will have an ON/OFF switch only. All controls for the Series 7500 Mass Flow Control System will therefore be found on the 710-00-RMD (typical) Electric Valve P.I.D. Controller Rack Module.



Typical 710-00-RMD Module Showing Operator Switches

LIST OF OPERATOR SWITCHES:

ON/OFF	Self-Explanatory
DISPLAY SELECT	Selects Flow Rate,Setpoint or External Input
FUNCTION SELECT	Selects Flow Control,Manual Valve or External Input
MANUAL VALVE	Momentary Toggle Open or Close
SETPOINT ADJUST	Locking Potentiometer

DESCRIPTION OF OPERATION SWITCHES

ON/OFF:

Self Explanatory Toggle Switch

DISPLAY SELECT:

Flow Rate:

This is the position the switch will normally be on when operating the flow control system. The reading displayed will be in engineering units and will be displaying the signal from the mass flowmeter. Because the flowmeter is directly upstream of the flow control valve the reading displayed is equivalent, or actually is the current rate of flow control.

Setpoint:

In this position the display provides a reading derived from the setpoint reference voltage as set by the front-panel mounted Setpoint Adjust locking potentiometer. The reading will be in your particular control systems engineering units (typically a unit of flow or lbs.) This switch position is the one you will use when setting up or changing the flow control setpoint of your system via the front panel mounted locking Setpoint Adjust potentiometer.

External Input:

When sending a 0-5 Vdc or other flow setpoint signal from an external source (such as a computer) this switch position is selected to display locally on your Kurz flow controller a reading in engineering units of the external setpoint signal.

FUNCTION SELECT:

Flow Control:

This is the position the FUNCTION SELECT switch would normally be set on to operate the flow controller. The KURZ flow control system makes use of its own internal setpoint signal as set via the front panel mounted setpoint adjustment potentiometer. The setpoint adjustment potentiometer provides a voltage reference signal that is inverted by the controller circuitry and fed into a comparator along with the flow signal from the mass flowmeter. The comparator then generates a voltage error signal which it sends to the flow control valve to change its position (either open or close it as needed any amount needed). The comparator generates the error signal to drive the valve based on the imbalance between the flow signal and the setpoint signal. Normally, the error signal sent to the valve drives the valve motor to open the valve if it is a positive 15 Vdc signal and drives the motor to close the valve if it is a minus 15 Vdc signal. The valve stays in its last position until it receives an error system, and only moves while an error signal is present.

Manual Valve:

When this switch position is selected the controller allows the operator to manually operate the MANUAL VALVE switch. This switch allows the operator to manually open or close the valve at will. The switch is a momentarily closed toggle switch. Since the valve starts moving and keeps moving either toward open or toward close only when a plus or minus 15 Vdc voltage is applied to its motor, the operator must hold down the switch in the desired position to create opening motion or closing motion in the valve. When released the MANUAL VALVE switch automatically springs back to the non-active center position. If the operator desired to see the effect on flow of manually opening or closing the valve the DISPLAY SELECT switch should be set on Flow Rate.

External Input:

When this switch position is selected the 710-00-RMD Electric Valve P.I.D. controller allows the flow controller to come under the control of an external 0-5 Vdc setpoint signal. Thus other process variables may be used to vary the setpoint. This also allows computer control of process. Further, one flow control system may be slaved to another to create a blending system for example.

MANUAL VALVE:

This is a momentary closed center off switch which allows the operator to manually open or close the flow control valve to a degree proportional to how long the operator holds the switch down. Valve motor speed is typically 30 seconds from full open to full close although other speeds are often specified. Thus, the operator would have to hold the switch down a full 30 seconds to move from full closed to full open, or 15 seconds to move from full closed to half open, etc. The FUNCTION SELECT switch must have Manual Valve selected in order for the operator to use the MANUAL VALVE Open/Close toggle switch. Further, the DISPLAY SELECT switch is normally set on Flow Rate to allow the operator to verify that flow is indeed changing as the valve is manually opened or closed.

SETPOINT ADJUST:

This is the front panel mounted locking potentiometer to provide setpoint adjustment when the KURZ mass flow control system is relying on an onboard rather than an external setpoint signal. This front-panel mounted locking potentiometer has a simple potentiometric effect on a supplied voltage which it trims to between 0 and 5 Vdc to supply the setpoint signal to the controller comparator. This potentiometer is a 10-turn potentiometer.

SECTION 5 - Subsystem A - The Mass Flowmeter

INTRODUCTION:

The Kurz Series 505 Linear Two-Wire Mass Flow Meter is a rugged industrial grade mass flow meter with several outstanding features. Pressure drops are extremely low, typically 2" of water or about 1/15th of 1 psi, resulting in a very energy efficient design. The Kurz sensor described below responds to true mass flow. Previously complex measurements are now simple. There is no need for separate flow, temperature, and pressure sensors, or for the complicated flow computers required to integrate their signals.The Series 505 flow meters provide 11 breakpoint linearization of the sensed flow to provide an accuracy of + or - 2% of reading over a 10 to 1 range plus an additional +1/2% at full scale. Response time of the linearizer is 20Khz.

PACKAGING:

Kurz Series 505 Linear Mass Flow Meters are sold in several standard packages, and of course from time to time in non-standard packages to meet specific customer requirements.

The standard packages are:

1. Nema 1 type steel enclosures with a green hammertone enamel paint finish. Nominal dimensions are 3.5" high x 6" wide x 8" length.

2. Slide-in rack modules, 1/4th Rack. These are 4.2" wide x 7" tall x 10.25" deep. These fit standard 19" rack chassis's.

3. Slide-in rack modules, 1/6th Rack. These units are 2.8" wide x 7" tall x 10.25" deep. These also fit standard 19" rack chassis's.

4. Slide-in rack modules, 1/4th Rack with Digital Display. These units are the same size as the 1/4th rack module (#2 above) and include a 3 1/2 digit LCD display with .7" high characters.

Terminal descriptions and wiring diagrams are provided which cover all of these packaging options.

DESCRIPTION:

In order to understand the technology of Kurz mass flow meters a brief explanation of our sensor and how it works is in order. Each probe is constructed of reference grade Platinum 385 wound on a ceramic mandrel and then glass,epoxy or teflon coated. There are two platinum windings. These serve as platinum resistance temperature detectors and consequently exhibit the exceptional stability and linear resistance change vs. temperature that Platinum RTD´s are so well known for. One winding serves as an ambient temperature detector, the other winding is heated to a constant temperature above that of the ambient or surrounding gas. A measure of the power required to maintain this differential overheat is a measure of the heat transfer from the heated flow sensor winding. This heat transfer off a well defined heat element is a measure of the gas flow moving past the sensor. The sensor circuitry is designed to measure the conditions at the center of the heated velocity winding, therefore the Kurz sensor makes a point measurement of mass flow rate per unit area at the location of the probe. Within a Kurz mass flow meter a uniform flow is ensured thru use of 10 pipe diameters upstream pipe length and thru acceleration of the flow thru a nozzle.

Because our sensor always operates at a constant temperature above that of the surrounding gas it may be thought of as temperature compensating. This is one of the requirements for measuring mass flow. Secondly, because a measure of heat transfer capacity is a direct measure of mass, heat carried away from our sensor is a direct indication of the amount of mass (true number of molecules) that has flowed past our heated sensor. Thus our sensor measures mass flow. The effect of density is automatically incorporated during sensing.

Calibration is accomplished thru use of Meriam laminar flow standards that are + or - 1/2 % accurate and directly traceable to NBS equipment. Calibration systems are available from Kurz Instruments for larger users. Specialty gas calibrations are done at an outside facility equiped for safe handling of various toxic and corrosive gases. Normally, calibration is accomplished with NBS traceable bell provers.

LINEARIZATION:

While the resistance of our Platinum RTD sensors is linear with respect to temperature change, heat transfer vs. flow is a non-linear function. Thus to provide the convenience of a linear output signal we provide an onboard linearizer with the Series 505 Mass Flow Meters.

Because flow pulsations and large scale turbulence may occur at rapid rates, the Kurz linearizer was designed to be a fast response device. Response is 20Khz. The linearizer is an analog voltage offset type. During calibration the linearizer is adjusted by the calibration technician to yield 10 to 11 straight line segments that approxiamate a linear curve. The Kurz linearizer is highly accurate, repeatable, easy to set up and relatively inexpensive compared to other techniques. Linearity is typically 1% or better. The linearizer circuit includes features to closely follow the inflection point near zero flow. This means that under all conditions we produce a zero output voltage at zero flow. Calibration data including a graph of actual non-linear voltage output is included with each Kurz flow meter.

TWO-WIRE SIGNAL TRANSMISSION:

KURZ Series 505 Mass Flow Meters include two-wire transmission circuitry that allows the probe/flow transducer to be over 1,000 ft. from the signal conditioning and power supply electronics. No additional power supply is needed at the physical location of the flow transducer.

First however, let's consider how we get the signal from our sensor to the signal conditioning electronics in our non-two-wire systems, such as a portable battery powered instrument for example. The two Platinum RTD windings in the sensor are two legs of a Wheatstone bridge. Therefore the sensor or probe cable is an integral part of the sensor circuit. Since cables have their own resistance values, the temperature compensation and the calibration are therefore dependent on an exact known cable length. If the cable is cut or changed a calibration error is introduced and re-calibration is required. Since the probe cable has a voltage signal on it from the sensor normally the cable cannot be over 50 ft. long or voltage drops too much due to cable resistance.

In Kurz systems having two-wire signal transmission features, such as the Series 505 mass flow meters, the entire bridge circuit is contained in the explosion-proof conduit junction box mounted to the Series 505 flow transducer. A current mode circuit is also included in the junction housing. This allows transmission of the signal over a simple 2 wires. It should be noted that the current output from the flow transducer is not the industry standard 4-20ma but is our own current that is based on calibration of the instrument.

To summarize some of the advantages of the two-wire signal transmission method:

(1) The output and power leads are the same—no other power is needed to the sensor.

(2) Current is drawn from a remotely located power supply in proportion to the sensor signal changes.

(3) The current mode has a very high line noise immunity allowing use of a simple twisted pair of wires.

The 2-wire cable is connected between the transducer printed circuit board in the flow transducer junction box (or ball) and terminals on the main Series 505 signal conditioning and power supply board. See following pages for hookup instructions. Total loop resistance of the two conductors should be 4 ohms or less. A wire resistance table follows immediately below for your convenience in selecting two-wire hookup cable.

DETERMINATION OF 2-WIRE CABLE LENGTH
(Series 505—Maximum Loop Resistance of 4 Ohms)

Approximate Resistance of Stranded Copper Wire at +65 Degrees C

AWG Size	Ohms/Ft.
4	.0003
6	.0005
8	.0008
10	.0012
12	.002
14	.003
16	.005
18	.008
20	.012
22	.019
24	.030
28	.077

OPERATION:

Operation of Kurz Series 505 flow meters is very straightforward. Install the flow transducer in-line. Mounting altitude is unimportant. Connect the transducer to the signal conditioning/power supply module via your two-wire hook-up cable. Rack module units include a power ON/OFF switch. Units in Nema-type housing have no power switch.

WARNING

Always make certain that the power cord is removed from your power outlet when connections are made to avoid an electrical shock hazard and possible damage to the electronics or sensor.

Your mass flow meter is now ready to operate.

MAINTENANCE:

Although the relatively large size of the mass flow sensor renders it resistant to particulate contamination in most applications, continuous use in dirty flows may necessitate periodic cleaning of the sensor and internal parts of the flow body. For small flow bodies we recommend the use of a small camel's hair brush and water followed by an alcohol rinse. In the case of the larger transducer, the insertion probe can be removed for cleaning as described above. Be very careful not to damage the exposed element on removal or insertion. Always seal the end of the transducer when not in service.

CALIBRATION:

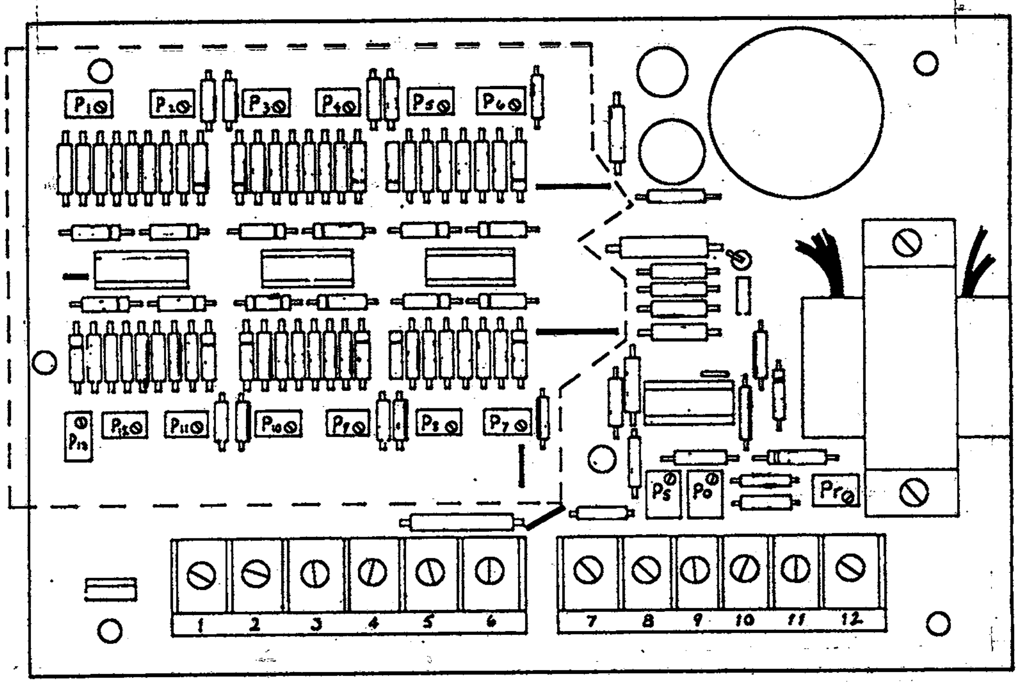
All Kurz products are calibrated at the factory, with the exception of specialty gases mentioned earlier.A separate manual covering calibration and set-up of the linearizer is available at a nominal charge. Consult the factory.

PROBE INTERCHANGEABILITY:

Probes are not interchangeable. They should be used only with the matching signal conditioning/power supply unit with which they were delivered. Temperature compensation resistors matched for your individual sensor and linearizer calibration for your individual sensor preclude sensor interchangeability.

CALIBRATION POTENTIOMETERS:

There are a number of potentiometers that are adjusted and fixed by a Kurz technician during calibration of the 505. The potentiometers directly effect calibration of the instrument and should only be adjusted upon recalibration of the instrument. Nevertheless, a description of the potentiometers is included here for reference. All of the potentiometers or "pots" are marked on the component layout drawing below, and then further described.



NONLINEAR SECTION:

Po:

This potentiometer on the 505 board is the zero adjust pot for the mass flow sensor or "bridge" circuit. A Kurz calibration technician adjusts this pot so that output of the sensor circuit is zero volts when the sensor is in zero flow. This is an adjustment of the zero before the signal enters the linearizer section.

A dab of paint is put on the pot to seal the screw and indicate that this pot should not be adjusted by the user. Any adjustment to this pot will place the 505 out of calibration.

A SPECIAL NOTE ON ZERO:

Smaller 505's with 1/4" male fitting on both ends must have some pipe section connected in order to see zero flow. Simply plugging the inlet and outlet with a stopper or cork or with tape will result in too small a volume of air being around the sensor. This small volume of air will allow a condition to develop in which the sensor becomes self heating. Normally, the thermal flow sensor is heated to about 70 degrees Fahrenheit above that of the surrounding air. The ambient air temperature is detected by the "temp comp" winding around the base of the sensor. In small air volumes the warm flow sensor heats the air which, in turn, the ambient temperature sensor then detects and subsequently "tells" the flow sensor to heat up even more in order to maintain the 70 deg. overheat. The end result, in any event, is an erroneous zero signal. Again, this applies only to the smallest 505's.

Ps:

This is the full span adjustment potentiometer for the mass flow sensor circuit. A Kurz calibration technician pipes the 505 inline with a laminar flow element that is an NBS secondary standard, sets up flow conditions equal to the intended full scale range of the 505, and then adjusts this pot, Ps, so that the circuit (nonlinear section) gives a +5Vdc output during full scale flow conditions. The calibration technician corrects the reading to standard conditions. This pot should not be adjusted by the user, since to do so would ruin the calibration of the instrument.

Pr:

This is a -5Vdc reference voltage adjustment pot. This pot is adjusted by the Kurz calibration technician to yield a -5Vdc signal out. This -5Vdc signal is used by the amplifier on the mass flow sensor or "bridge" circuit. This pot also should not be field adjusted.

LINEARIZER SECTION:

P1 thru P11:

These potentiometers are adjusted by the calibration technician to break the nonlinear 0 - 5Vdc output curve into 11 straight line segments. Basically, there are 11 amplifiers. The nonlinear voltage is fed into these amplifiers. Each amplifier will begin supplying voltage to a final summing amplifier at predetermined points. These predetermined points are set up by fixed resistors. Potentiometers P1 thru P12 are individually adjusted for their respective amplifier. Each pot adjusts the gain of it's amplifier. The outputs of the 11 individual amplifiers feed into a summing amplifier. The output of the final summing amplifier then approximates a linear 0 - 5Vdc output. Users should not change these potentiometer adjustments. To do so would ruin the instruments calibration.

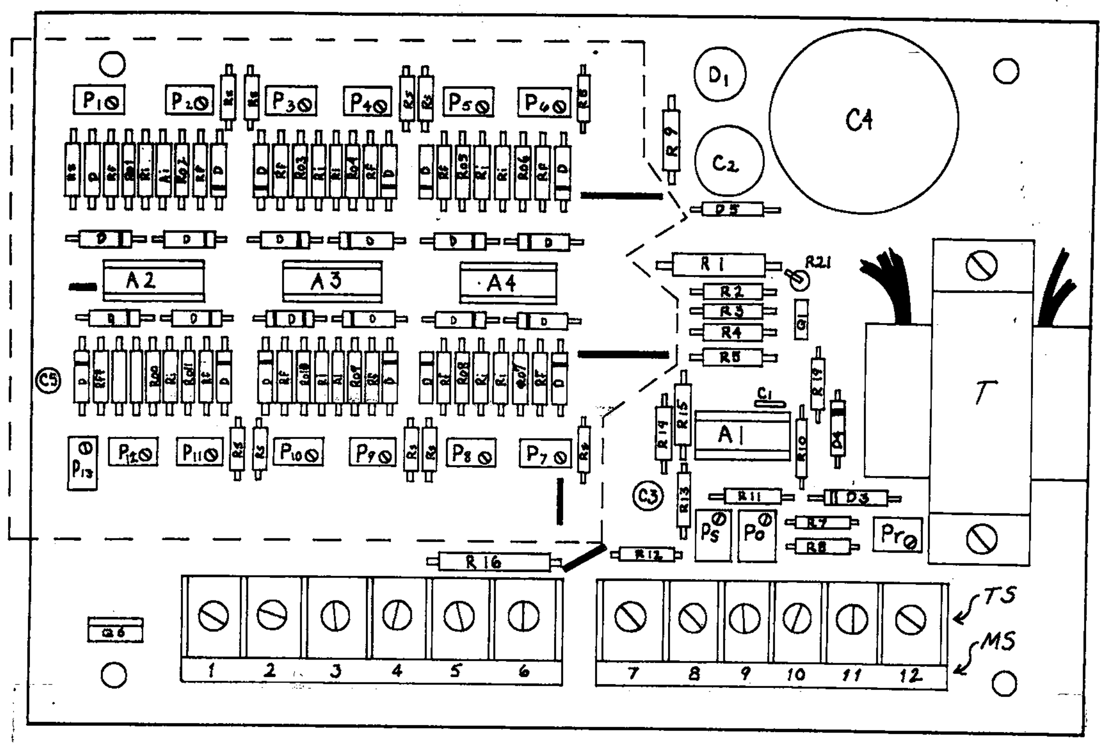
P12:

This is the zero adjust pot for the linearizer section. At first glance you might assume the output of the linearizer section is zero Vdc when there is zero Vdc nonlinear signal being fed in. This is not the case however because the first amplifier stage has some gain that results in voltage out of the linearizer even when there is zero signal into the linearizer. This output is seldom scarcely more than 10 mv, but nevertheless the P12 potentiometer is included on the board and is adjusted by the calibration technician to trim the linearizer to zero.

P13:

This is the linearizer span adjust potentiometer. The linearizer works by having each stage feed into a final summing amplifier. P13 allows the calibration technician to trim the linearizer to output exactly 5Vdc at full scale flow rate conditions. One way of saying it is that P1 thru P11 control the shape of the output curve (they straighten it up or make it linear) while P12 allows positioning the bottom end of the curve and P13 allows positioning the top end of the curve.

COMPONENT LAYOUT, SERIES 505 MASS FLOWMETER
Linearizer Section Shown Within Dotted Lines



NOTE:

C3 and C5 are feedback capacitors that slow the output response to 1 second. C3 is not normally installed on standard units. The 35 millisecond fast response option may be attained by removing C5 and C3 (if it is present) from the circuit. Simply clip the capacitors out and replace with simple wire jumpers.

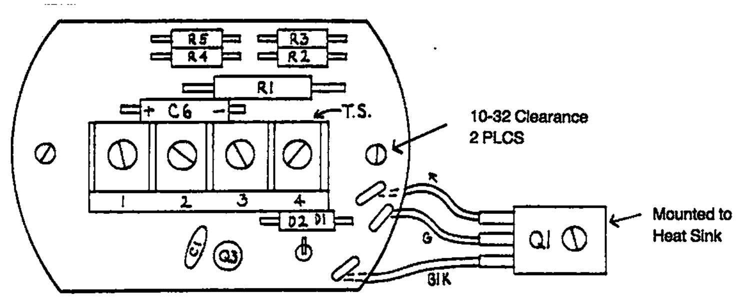
SERIES 505 MAIN PRINTED CIRCUIT BOARD PARTS LIST

A1	(Quad) Amplifier (Q2,Q3,Q4,Q5)
A2	(Quad) Amplifier (Stage 1,2,11,& sum)
A3	(Quad) Amplifier (Stage 3,4,9,& 10)
A4	(Quad) Amplifier (Stage 5,6,7,& 8)
B	Printed Circuit Board
C1	Capacitor, Mylar
C2	Capacitor, Electrolytic, 220 mfd, 25Vdc
C3	Capacitor, Electrolytic
C4	Capacitor, Electrolytic, 3300 mfd, 25Vdc
C5	Capacitor, Electrolytic
D	Diode (22 ea)
D1	Bridge Rectifier
D3	Reference Zener Regulator LM336Z, 2.5 Volt
D4	Zener Diode, +12Vdc
D5	Zener Diode, -12Vdc
MS	Terminal Marker Strip, Numbers 1 thru 12
P1-P11	Potentiometer, Linearizer Span
P12	Potentiometer, Linearizer Zero (Optional)
P13	Potentiometer, Linearizer Sum (Optional)
R6-R14	Resistor, 1% LTC, 1/4 watt
Ps	Potentiometer, analog span control
Po	Potentiometer, analog zero control
Pr	Potentiometer, negative reference control
Rf	Resistor, 5% (Jumper)
Ri	Resistor, Input, 1% LTC
Rs	Resistor, Summing 1% LTC
RO1-RO11	Resistor, Breakpoint, 1% LTC
Rff	Resistor, Summing Feedback, 1% LTC
ROO	Resistor, Linearizer Zero, 1% LTC
T	Transformer
Ts	Terminal Strip, Numbered 1 thru 12
Q1	Transistor

SERIES 505 CIRCUIT BOARD ELECTRICAL TERMINAL DESCRIPTION

TERMINAL NUMBER	DESCRIPTION (Standard 2-Wire Units)	DESCRIPTION (Voltage Mode Units)
1	Unregulated Supply Voltage (+16Vdc) White Transducer Wire	Unregulated Supply Voltage
2	Linear Output	Linear Output
3	Ground	Ground
4	Input to Linearizer	Input to Linearizer
5	Nonlinear Output, 0-5Vdc	Nonlinear Output, 0-5Vdc
6	Bridge Voltage Black Wire Return from Transducer	Bridge Voltage
7	No Connection	Red Wire to Transducer
8	No Connection	Black Wire to Transducer
9	Ground, No Connection	Ground, Shield and White Wire to Transducer
10	AC Input \	AC Input \
11	Ground > Power Cord	Ground > Power Cord
12	AC Input /	AC Input /

SERIES 505 TRANSDUCER PCB COMPONENT LAYOUT



SERIES 505 TRANSDUCER PCB TERMINAL DESCRIPTION

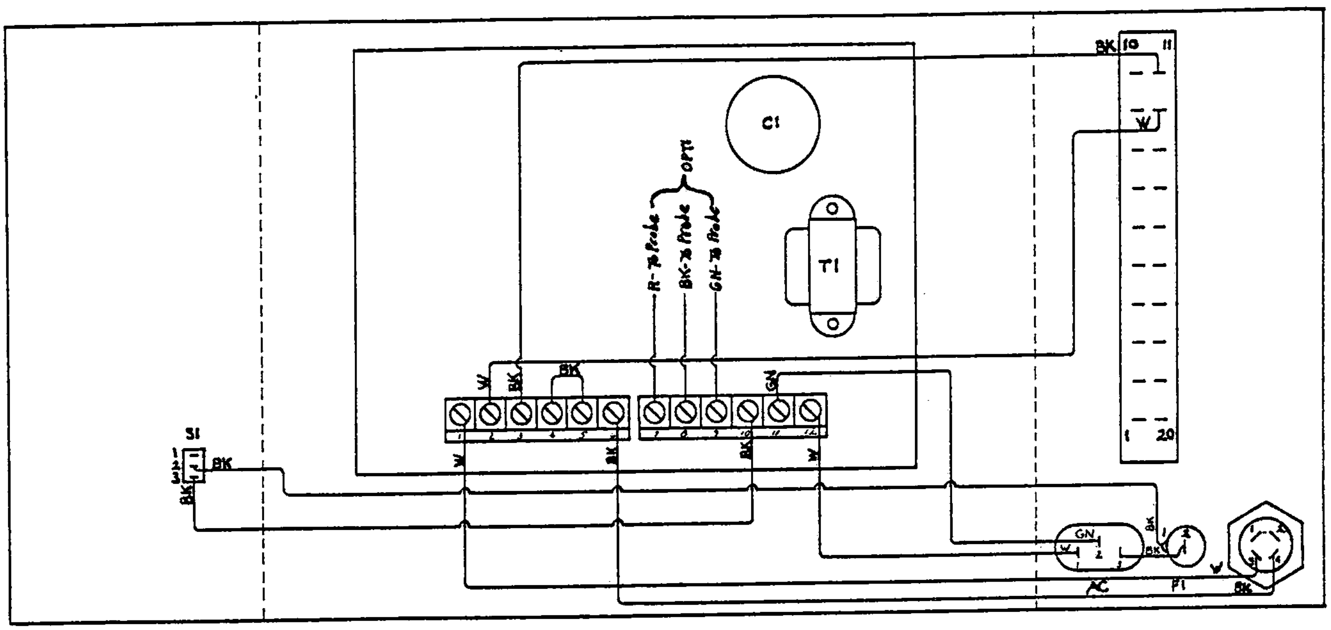
TERMINAL NUMBER	DESCRIPTION
4	+DC Volt input from terminal #1 on Main Printed Circuit Board (white wire).
3	-DC Volt return line to terminal #6 on Main Printed Circuit Board (black wire). Common for sensor wires.
2	Mass Flow Sensor Terminal (normally a red wire).
1	Temperature Compensation Sensor Terminal (normally a black wire).

SERIES 505 TRANSDUCER PCB PARTS LIST

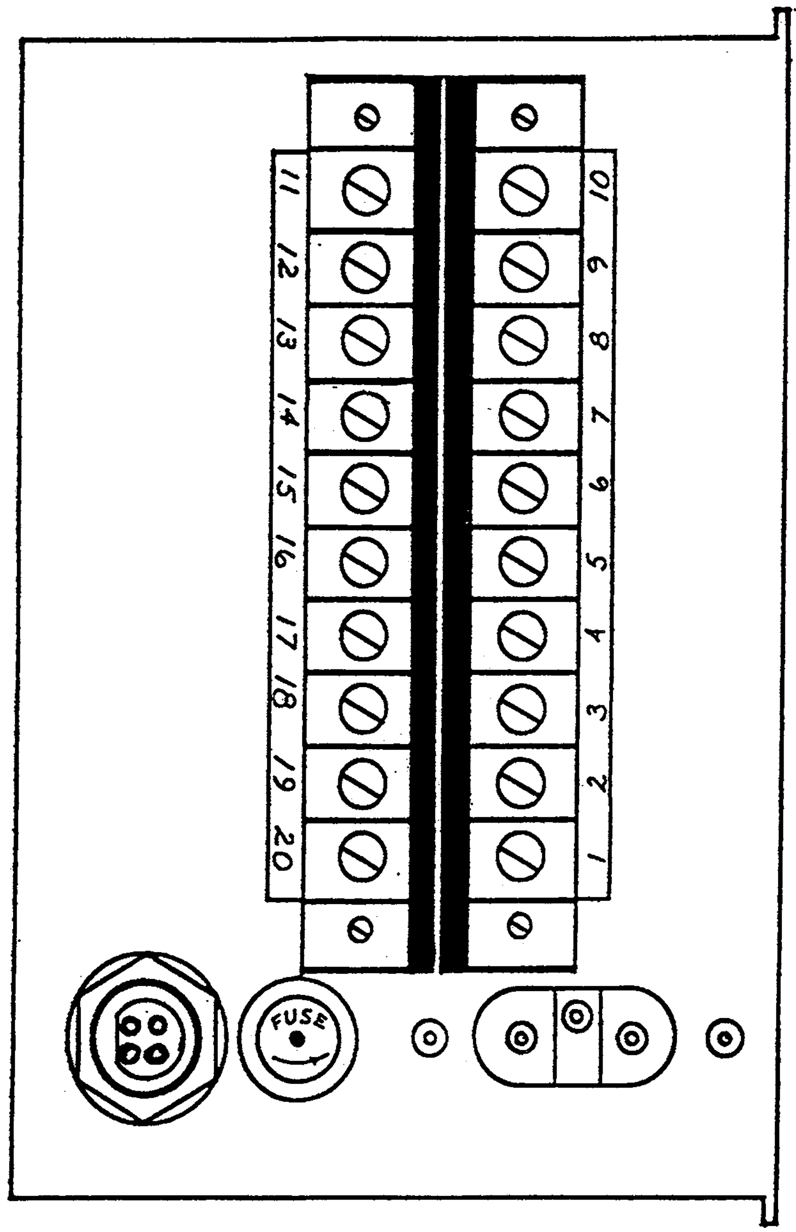
REFERENCE	DESCRIPTION
R1	Resistor, low temp. comp., 1% , 3 watt
R2-R5	Resistor, low temp. comp., 1% , 1/2 watt
D2	Diode 1N4001
C1	Capacitor, .02 microfarad, 50 Volt
Q1	Transistor, MJE 520 (NPN)
Q3	Operational Amplifier 741 & 8 Pin IC Socket
TS	Terminal Strip, 4 screw barrier

SERIES 505 RACK MODULE INTERNAL WIRING DIAGRAM

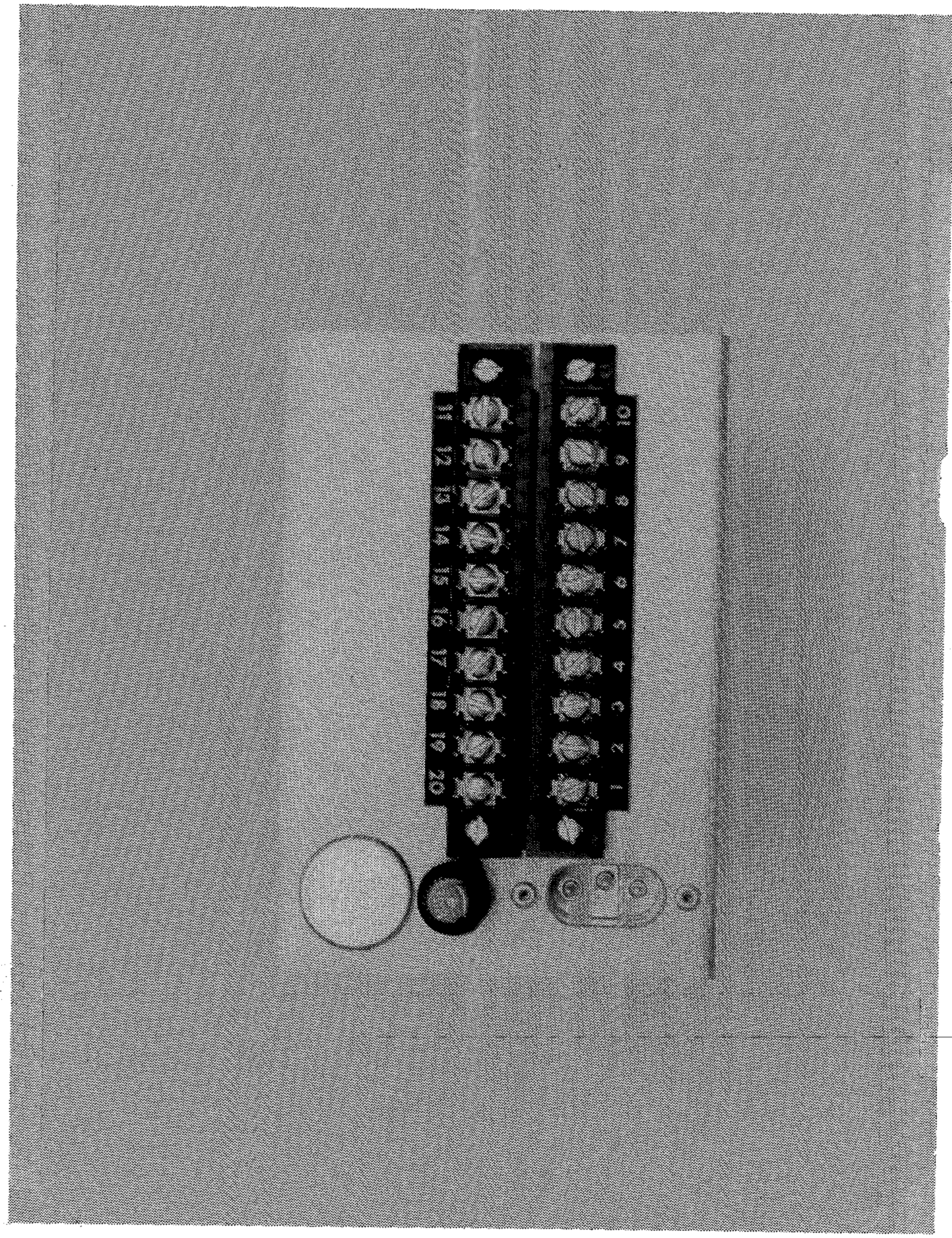
This view is looking down on the 505 rack module housing from the open side of the module. The front and back of the module have been drawn flattened out for ease of wiring representation. Note that the linear 0 - 5Vdc output is found on the module terminal strip terminal #12, with terminal #11 being signal ground.



SERIES 505 RACK MODULE REAR VIEW



SERIES 505 RACK MODULE REAR VIEW PHOTOGRAPH



SERIES 505 RACK MODULE REAR-MOUNTED TERMINAL STRIP

TERMINAL DESCRIPTION

Terminal Number	Polarity	Pair	Kurz Standard (Reserved For:)	Description
1		A	Intermodule Power	+24Vac
2				Ground
3		B	Intermodule Power	-18Vdc
4				n/c
5	(-)	C	Input Signal X	n/c
6	(+)			n/c
7	(-)	D	Input Signal Y	n/c
8	(+)			n/c
9	(-)	E	Input Signal Z	n/c
10	(+)			n/c
11	(-)	F	0-5Vdc Signal Out	Signal Ground
12	(+)			0-5Vdc Linear
13	(-)	G	4-20Ma Signal Out	n/c
14	(+)			n/c
15	(-)	H	Output Signal X	n/c
16	(+)			n/c
17	(-)	I	Output Signal Y	n/c
18	(+)			n/c
19	(-)	J	Output Signal Z	n/c
20	(+)			n/c

PROBE CONNECTOR TERMINAL DESCRIPTION
[Switchcraft (tm) connector]

1		A	2-Wire Transmitter	Negative
2				Positive
3		B		n/c
4				n/c

Section 6 - Subsystem B - ELECTRIC VALVE P.I.D. CONTROLLER AND DIGITAL DISPLAY

INTRODUCTION:

The Kurz Series 710 Electric Valve P.I.D. Controller's basic job is to input an external process variable signal, compare it to a setpoint, and signal a valve or some other control device to change its state.

DESCRIPTION:

The Series 710 Controller consists of a single printed circuit board and is typically housed with accompanying function switches and a digital display. The 710 controller board itself is fairly simple and straightforward. It consists of a power supply providing regulated +5 Vdc,+15 Vdc, and -15 Vdc; a comparator circuit to compare the process and setpoint signals and generate an error signal; and power transistors to drive the flow control valve DC motor. Although the 710 controller board has its own terminal strip, it is usually jumpered to the rack module's rear mounted terminal strip. The user should have no occasion to utilize the 710 controller's board mounted terminal strip.

OPERATION:

The operation of the 710 controller and descriptions of its functions are covered in the OPERATION - GETTING STARTED section of this manual.

CALIBRATION:

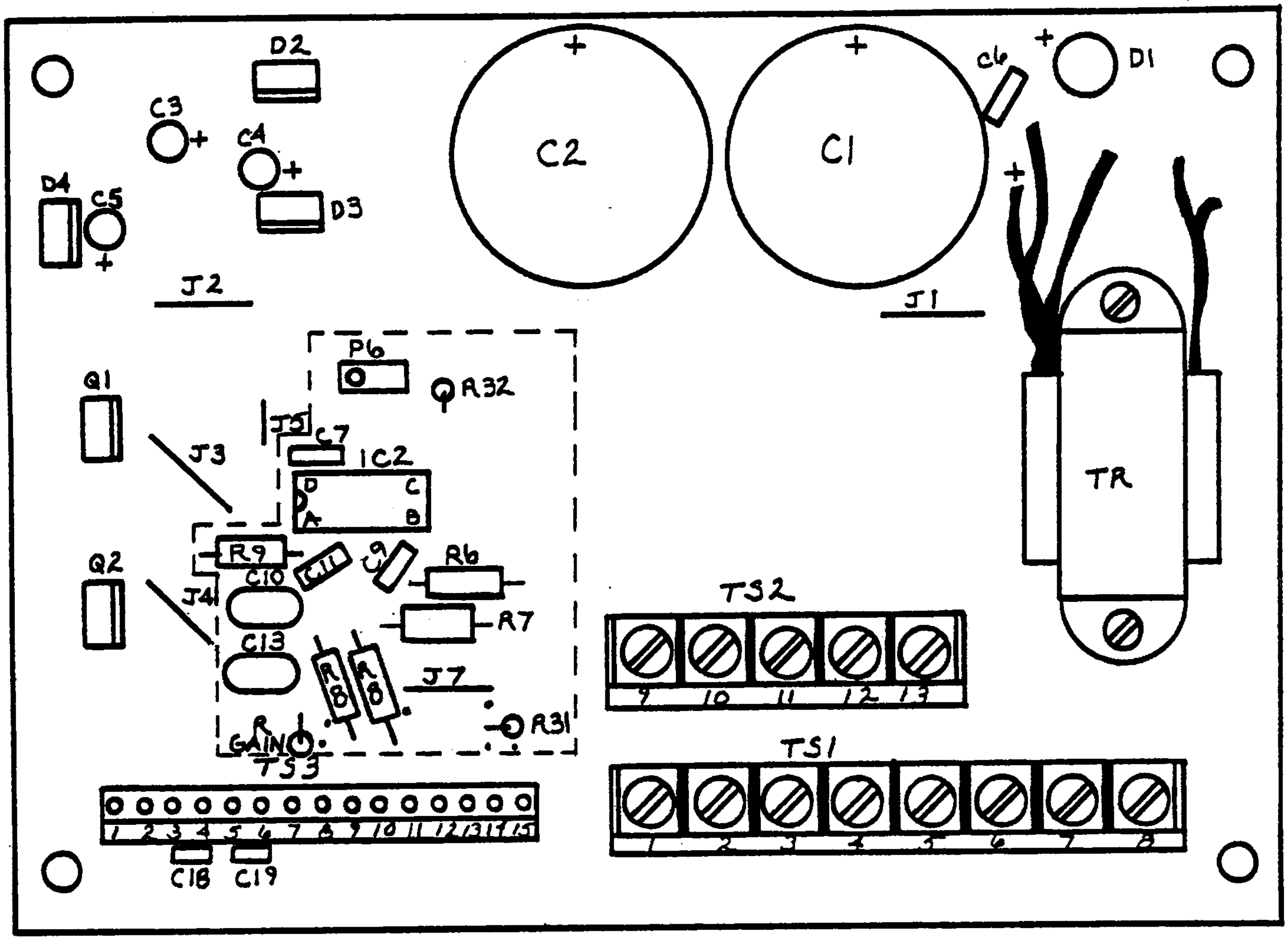
There are two board mounted potentiometers on the 710 controller board. These are normally factory set and do not require adjustment.

DIGITAL DISPLAY:

The 3 1/2 digit LCD liquid crystal display mounted in the Series 710 controller module functions as a standalone digital voltmeter module. A 10-turn 20K potentiometer mounted to the rear or foil side of the digital display's printed circuit board functions as a scaling potentiometer. The display module utilizes the Intersil 7106 A/D to 3 1/2 Digit LCD single chip voltmeter. Consult the Intersil data book for more information on the functions and specifications of this chip.

The Kurz digital display is a standalone module and is usually simply swapped out with a new working module in the event of malfunction.

SERIES 710 PCB COMPONENT LAYOUT



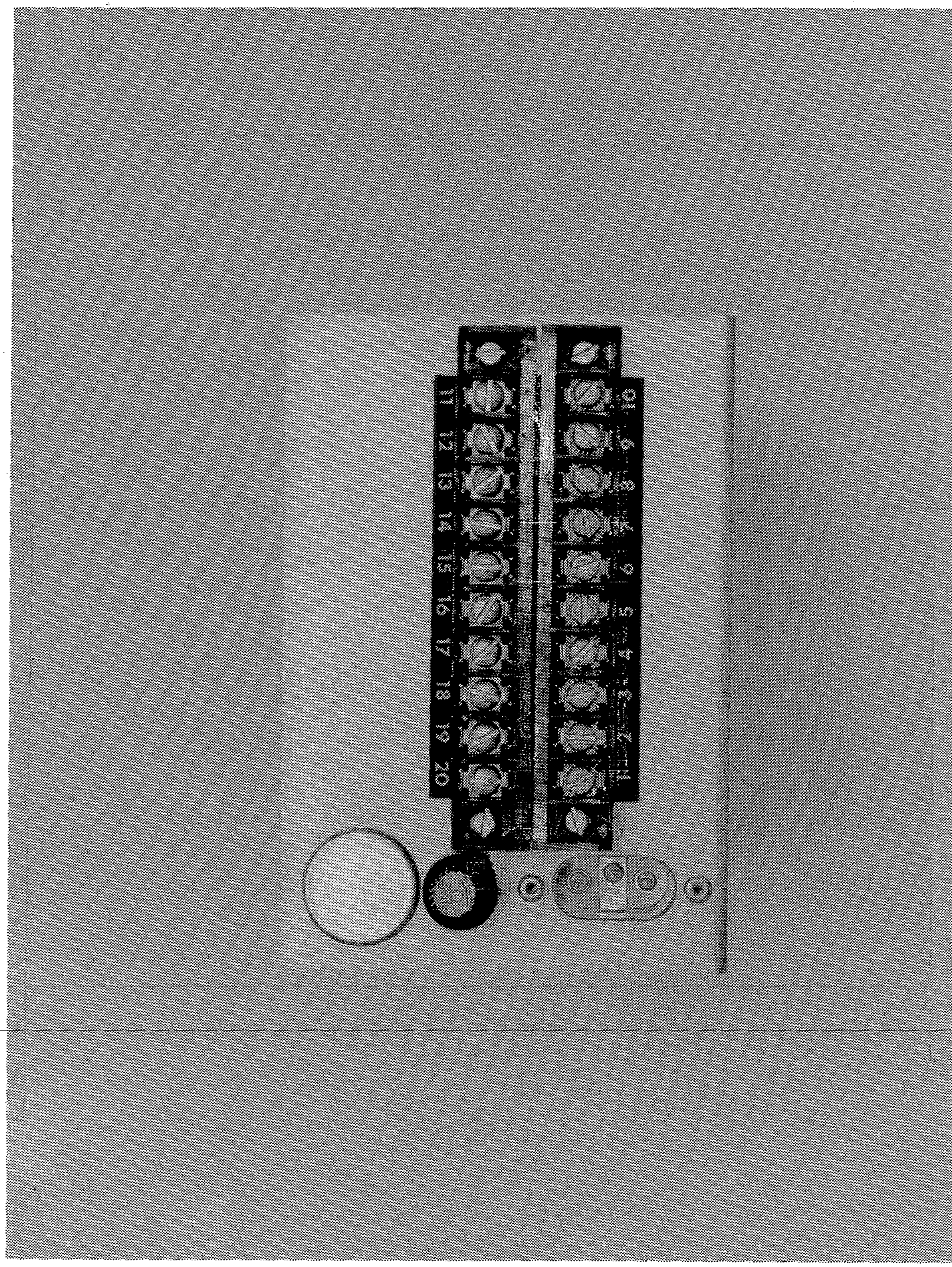
SERIES 710 CONTROLLER PCB PARTS LIST

REFERENCE DESIGNATION	QTY.	DESCRIPTION
D1	1	Bridge Rectifier
D2	1	7815 +15V Regulator
D3	1	7915 -15V Regulator
D4	1	7805 +5V Regulator
D5	1	LM336Z 2.5V
D6,D7	2	1N914 Diode
D8	1	9VDC Zener Diode
Q1	1	Transistor, 2N6388 NPN
Q2	1	Transistor, 2N6668 PNP
Q3	1	Transistor, MJE520
C1,C2	2	Capacitor, 3300 microfarad, 25V
C3-C5	3	Capacitor, 10 microfarad, 25V
C6,C7,C9,C11, C12,C15-C19	10	Capacitor, .02 microfarad, 50V
C10,C13	2	Capacitor, .1 microfarad, 100V
P4-P6	3	Potentiometer, 2K
Pr, V Pot.	2	Potentiometer, 20K
R30	1	Resistor, 13.3K
R24,R26,R28, R29,R31	5	Resistors, 10K
R6,R27	2	Resistors, 9.09K
R32	1	Resistor, 8.06K
R7	1	Resistor, 6.04K
R8	2	2ea Shunt Resistors, Shunt Values = R9
R9	1	Resistor, 4.99K
R19-R21	3	Resistors, Calculate for Bridge
R25	1	Resistor, Calculate
R15	1	Resistor, 25 Ohm, 2W, (Dale)
R-GAIN	1	Resistor, Nominally 300K (Changeable)
R11	1	Resistor, 200K
TS1	1	Terminal Strip, 8 Screw, Barrier Type
TS2	1	Terminal Strip, 5 Screw, Barrier Type
TS3	1	Terminal Strip, 15 Pin Male, Molex Type Connector
TR	1	Power Transformer, 115VAC Primary, 24VAC Secondary 8435A-60

NOTE:

All components above may or may not be included on your specific version of the 710 Controller Board.

SERIES 710 RACK MODULE REAR VIEW PHOTOGRAPH



SERIES 710 RACK MODULE REAR-MOUNTED TERMINAL STRIP

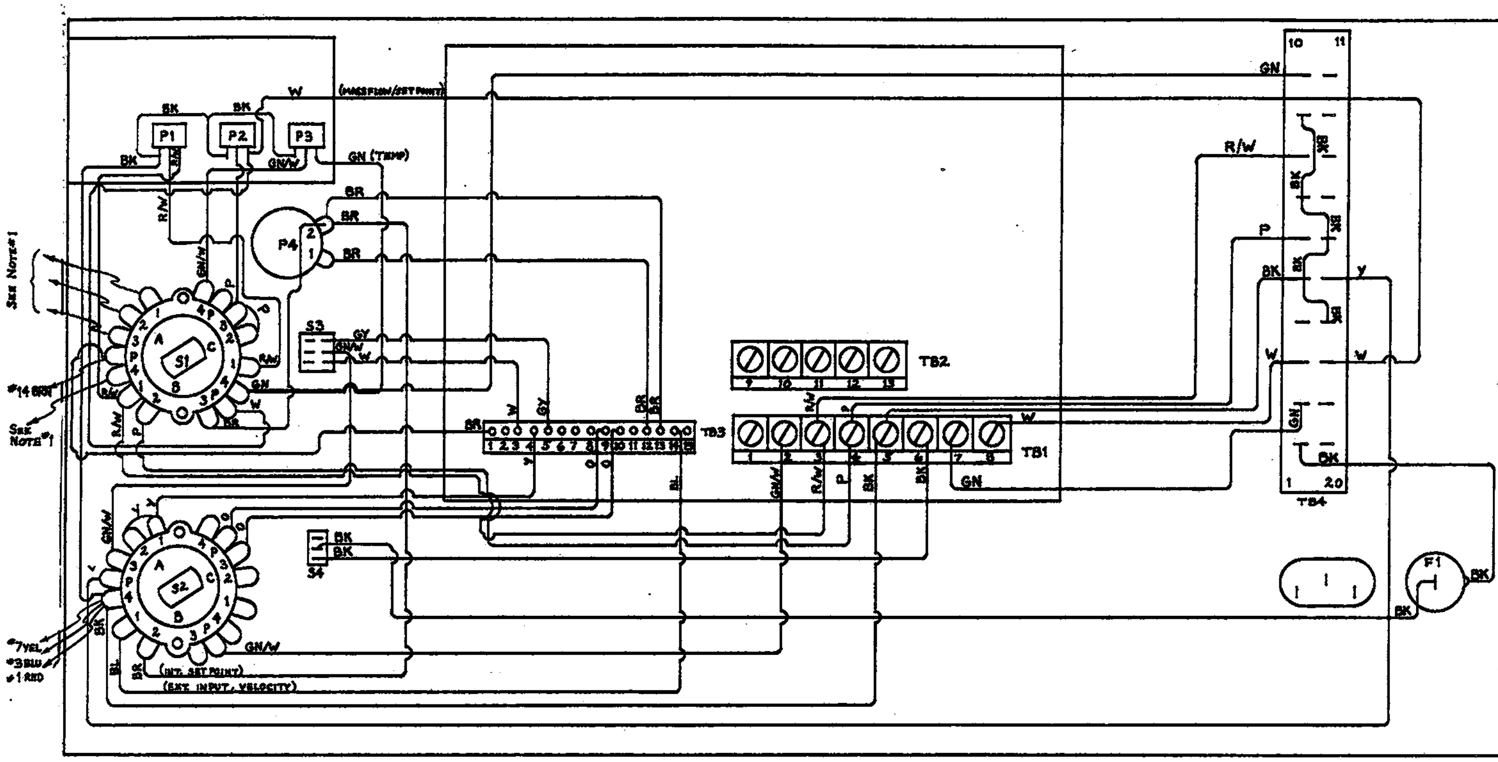
TERMINAL DESCRIPTION

Terminal Number	Polarity	Pair	Kurz Standard (Reserved For:)	Description
1		A	Power In	+24Vac
2				Ground
3		B	Power In	-18Vdc
4				n/c
5	(-)	C	Input Signal X	Signal Ground
6	(+)			0-5Vdc From Flowmeter
7	(-)	D	Input Signal Y	Ground
8	(+)			0-5Vdc External Setpoint Input
9	(-)	E	Input Signal Z	n/c
10	(+)			n/c
11	(-)	F	Linear 0-5Vdc Flow Signal Output	n/c
12	(+)			n/c
13	(-)	G	4-20 Ma Output	n/c
14	(+)			n/c
15	(-)	H	Output Signal X	Valve Motor Ground
16	(+ or -)			+ or - 15Vdc To Valve
17	(-)	I	Output Signal Y	n/c
18	(+)			n/c
19	(-)	J	Output Signal Z	n/c
20	(+)			n/c

Kurz Drawing No. 71030-020

SERIES 710 RACK MODULE INTERNAL WIRING DIAGRAM

This view is looking down on the 710 rack module from the open side of the module. The front and back of the module have been drawn flattened out for ease of wiring representation.



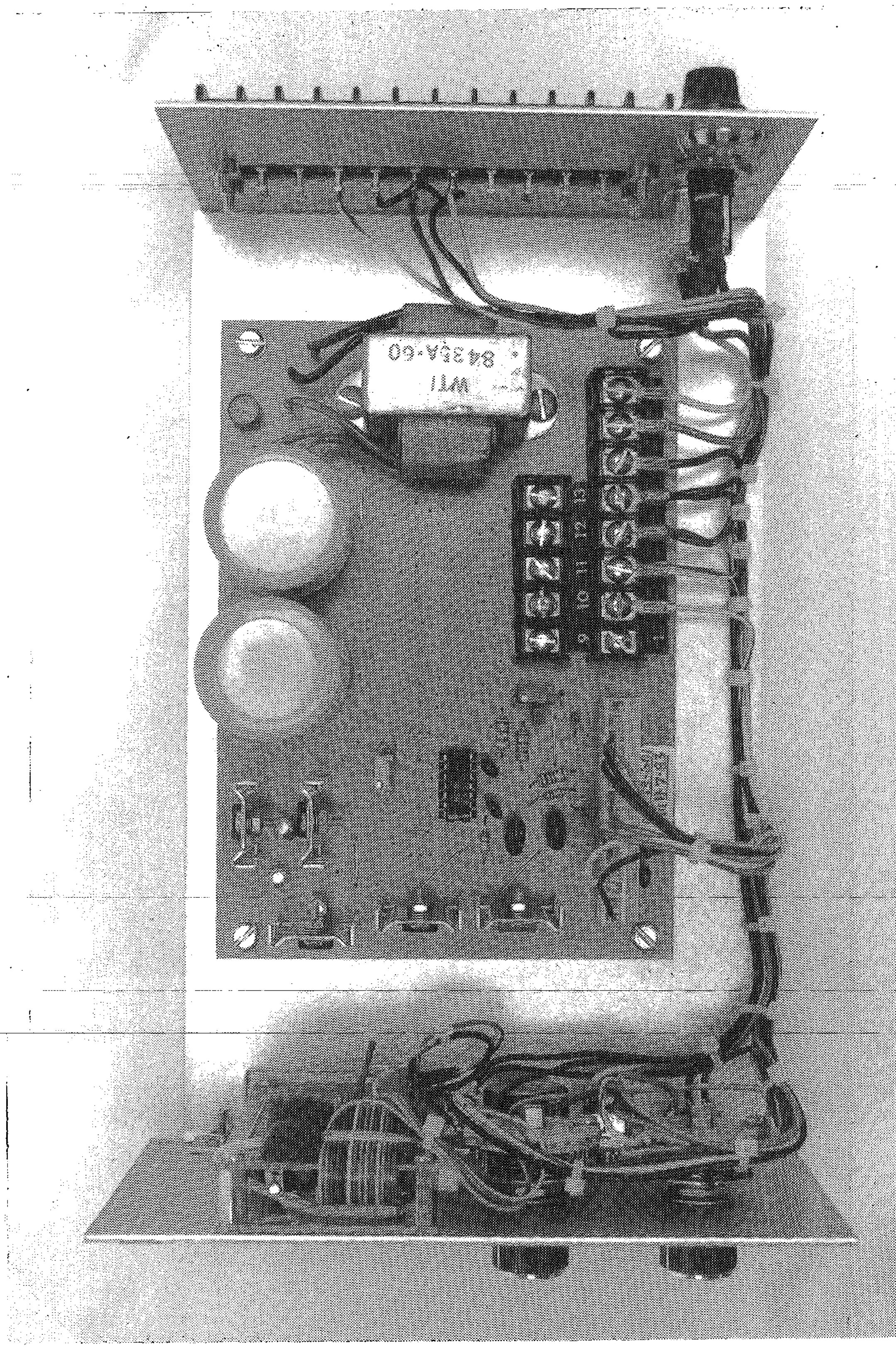
NOTES:

1. Connect to either #9 Brown, #11 Purple, or #12 Green of ribbon cable to obtain correct decimal point reading.

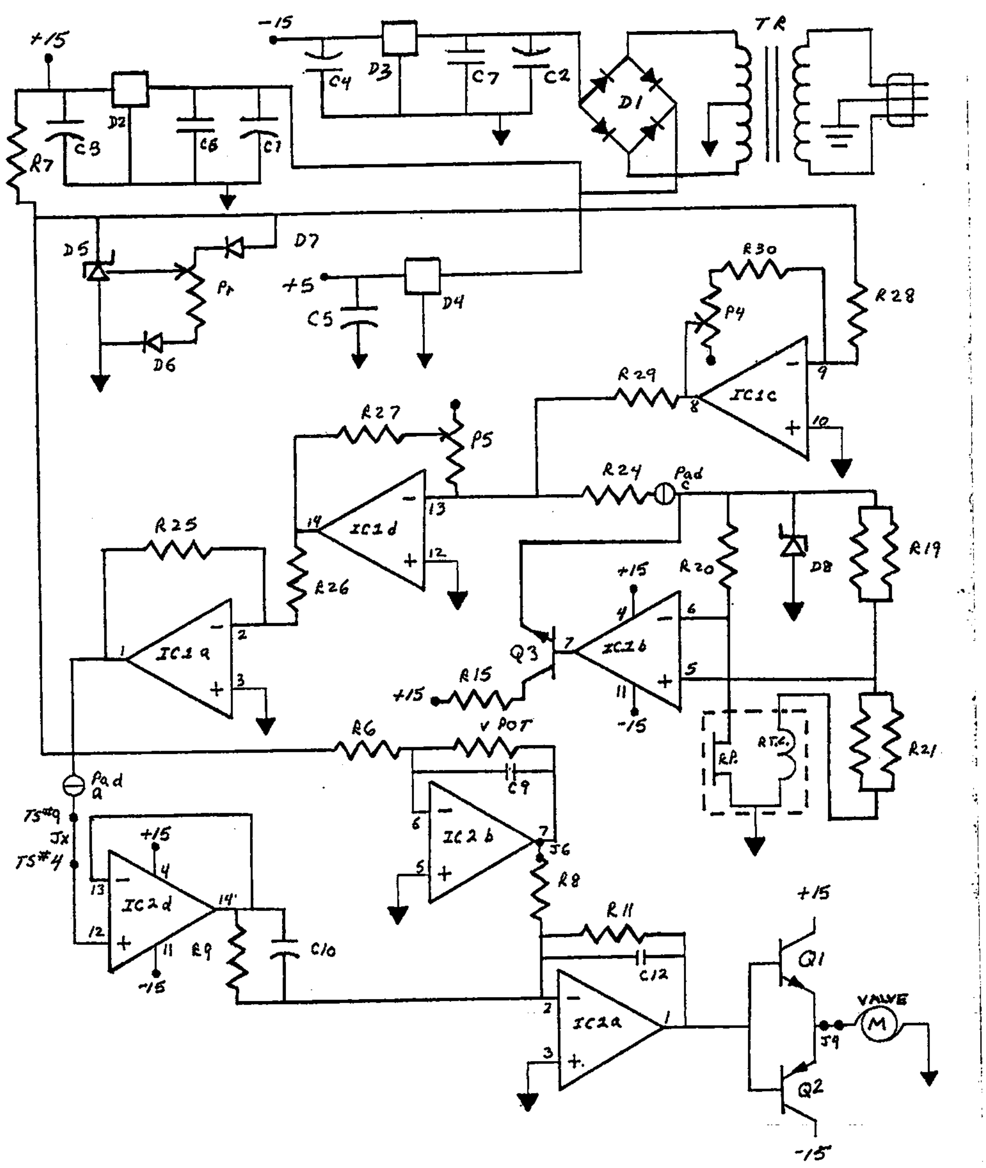
2. Ribbon Cable - Tie #4 Grey to #5 Black, cut remaining wires unless connecting to S1 & R1.

Kurz Drawing No. 71030-019

SERIES 710 RACK MODULE INTERIOR VIEW PHOTOGRAPH



SERIES 710 SCHEMATIC DIAGRAM

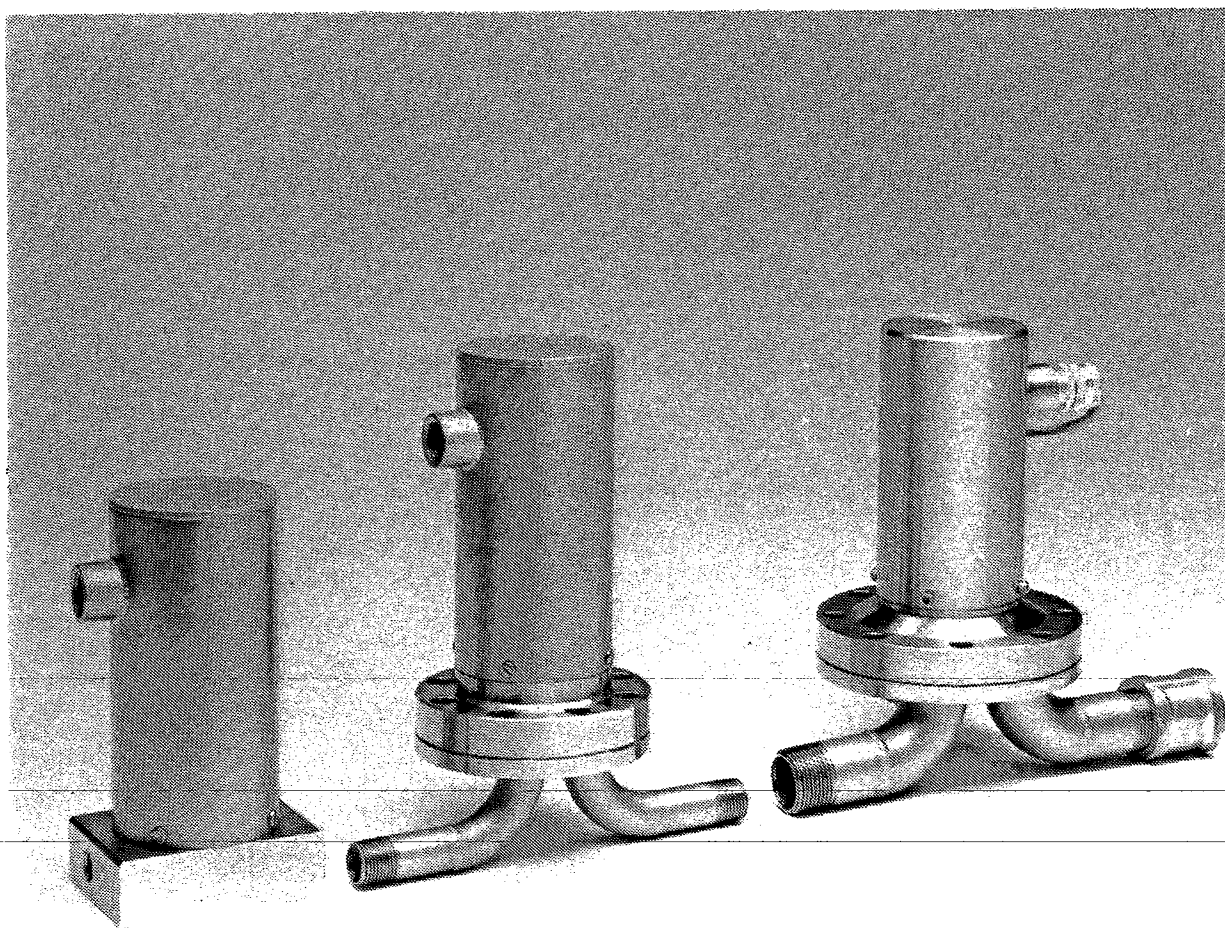


Section 7 - Subsystem C - ELECTRIC ROTARY RAMP METERING VALVE

INTRODUCTION:

The Kurz Series 730 Electric Rotary Ramp Valve provides the metering required for both isokinetic and constant flow control operations. These exclusive valves were designed by and are manufactured solely by Kurz Instruments Inc. The description of the Series 730 valves found in the SYSTEM OVERVIEW should be referred to for highlights of this valve design, as well as the specification sheet available separately.

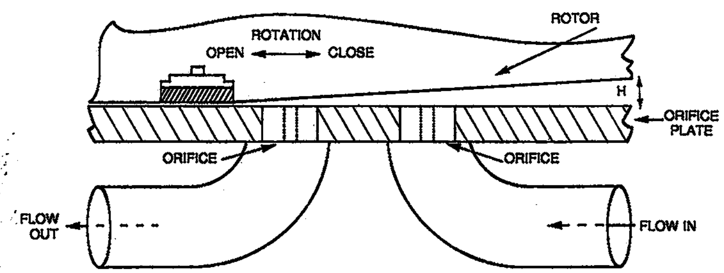
Several typical 730 Series valves are pictured below.



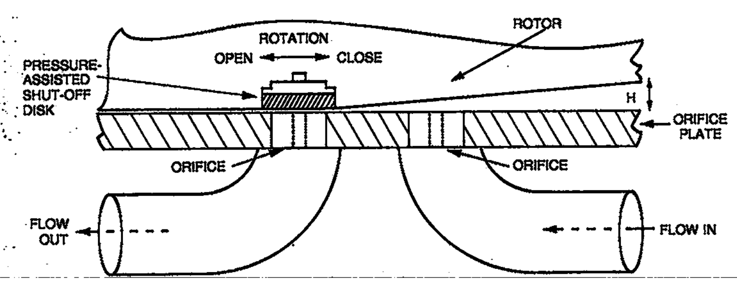
DESCRIPTION:

The Series 730 valves utilize a rotating disc with a precision helix machined onto the face. This disc rotates over an orifice to meter flow. The motor used to rotate the disc is typically a Pittman DC gear motor. Limit switches stop the motor when the valve is full open or full close. The motor is used only when the valve must move to a new position during flow control, thus the motor operates only for brief periods and is usually idle. Thus the motor should enjoy an extremely long life in this application. No motor maintenance requirements, such as brush replacement, are anticipated due to the light duty intermittent use of the motor in this application.

Drawings illustrating valve positions follow immediately below.



CROSS SECTION OF VALVE SHOWING SLIGHTLY OPENED POSITION



CROSS SECTION OF VALVE SHOWING SHUT-OFF POSITION

Cv:

Cv is the coefficient of flow of a flow control valve. Kurz Series 730 valves are available in Cv's ranging from .001 to 10.0 . Cv may be derived as follows:

$$C_v = .044\ \dot{m}\sqrt{\frac{460 + T}{P_i \times \Delta P}}$$

Where C_v = Flow coefficient
$\dot{m}$ = Full scale mass flow rate (SCFM)
P_i = Absolute pressure upstream of valve (PSIA)
ΔP = Maximum allowable pressure drop through valve at full scale mass flow rate. (PSIA)
T = Temperature (°F)

HOUSING:

The Series 730 valves are contained in either a heavy duty stainless steel or aluminum motor cover housing with a 1/2" conduit fitting. The cover may be removed for valve servicing or hookup by removing the 4 socket cap screws circumferentially mounted to the base of the valve motor cover housing.

MOTOR:

As described above the valve motor is used to rotate the rotary ramp disc that does the actual flow metering. This is typically a Pittman DC gearmotor. This motor drives the valve towards open when a +15 Vdc signal is applied to it and towards closed when a -15 Vdc signal is applied. The + or - 15 Vdc goes to the motor over the same two wires. The black wire is ground, the white wire see's the + or - voltage. The motor shaft has a machined thru hole which mounts a shear pin. The shaft is then loosely fitted to the rotary disc motor coupling. The motor may be removed by unscrewing 3 socket cap screws that mount the motor mounting base plate to the valve body. If by some chance the flow control valve does not seem to operating, checking the condition of this shear pin might be indicated. Note that the motor would turn freely if the shear pin was sheared away. If the shear pin condition is good and still the valve rotary disc does not seem to be turning and doing its job, remove the motor and check for stripped gears in the motor itself. Check that the motor shaft cannot be held stationary while the motor is turning. If it can, either you've overpowered the torque rating of the motor (unlikely on a gearmotor) or the gear train contains one or more stripped gears.

LIMIT SWITCHES:

Limit switches mentioned above stop the valve motor when it reaches either full open or full close. A small pin on the rotary disc actuates the limit switches. The switches break the voltage supply (the white wire motor lead) to the motor. Diodes wired across the poles on the switches allow reverse current flow to move the valve motor in the opposite direction and off the limit switch.

MAINTENANCE AND VALVE DISASSEMBLY:

It is conceivable that your valve might require disassembly at some time to allow for cleaning , primarily the orifices. Smaller valves with smaller orifices would be expected to require cleaning sooner than larger valves. Likewise, gas flows with some contamination would be expected to create a valve cleaning requirement sooner than a clean pure gas.

To disassemble the valve remove the motor cover housing as described above. Remove the motor lead wires. Next remove the motor by removing the base plate the motor is mounted to as described above. Finally remove the 4 or more socket cap screws that hold the motor coupling / limit switch / bearing block and rotary ramp disc assembly. Be careful not to lose the pressure assisted shutoff plug that fits into a machined opening in the face of the rotary ramp disc. The valve orifices may be cleaned with any solvent indicated for use with the contaminant. Assembly is the reverse of the above. The valve may be tested with the MANUAL VALVE function of the flow controller.

Larger Series 730 Valves can be disassembled by removing the socket head cap screws that are circumferentially positioned around the largest diameter of the valve. This allows the valve rotor housing halves to be separated. With these type valves this should normally be all the disassembly required to allow access for maintenance and cleaning. If your Series 730 valve does not have an alignment mark or internal alignment pin be sure to mark the position before disassembly in order that the valve rotor housing halves may be properly realigned upon reassembly.

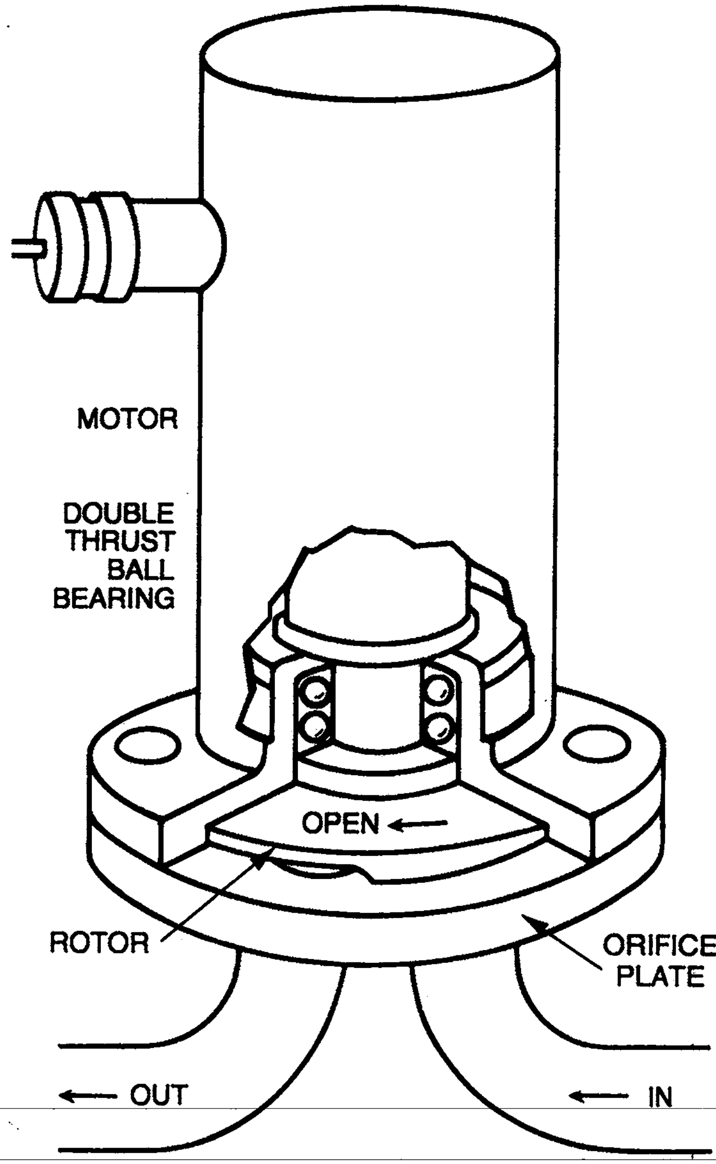
SEALS:

The valve is sealed with an O-Ring on the rotary ramp disc rotor. The O-Ring is placed in order to minimize its size on the rotary ramp disc rotor (shaft). See the valve cutaway drawing to view O-Ring and bearing positions.

LEAKAGE:

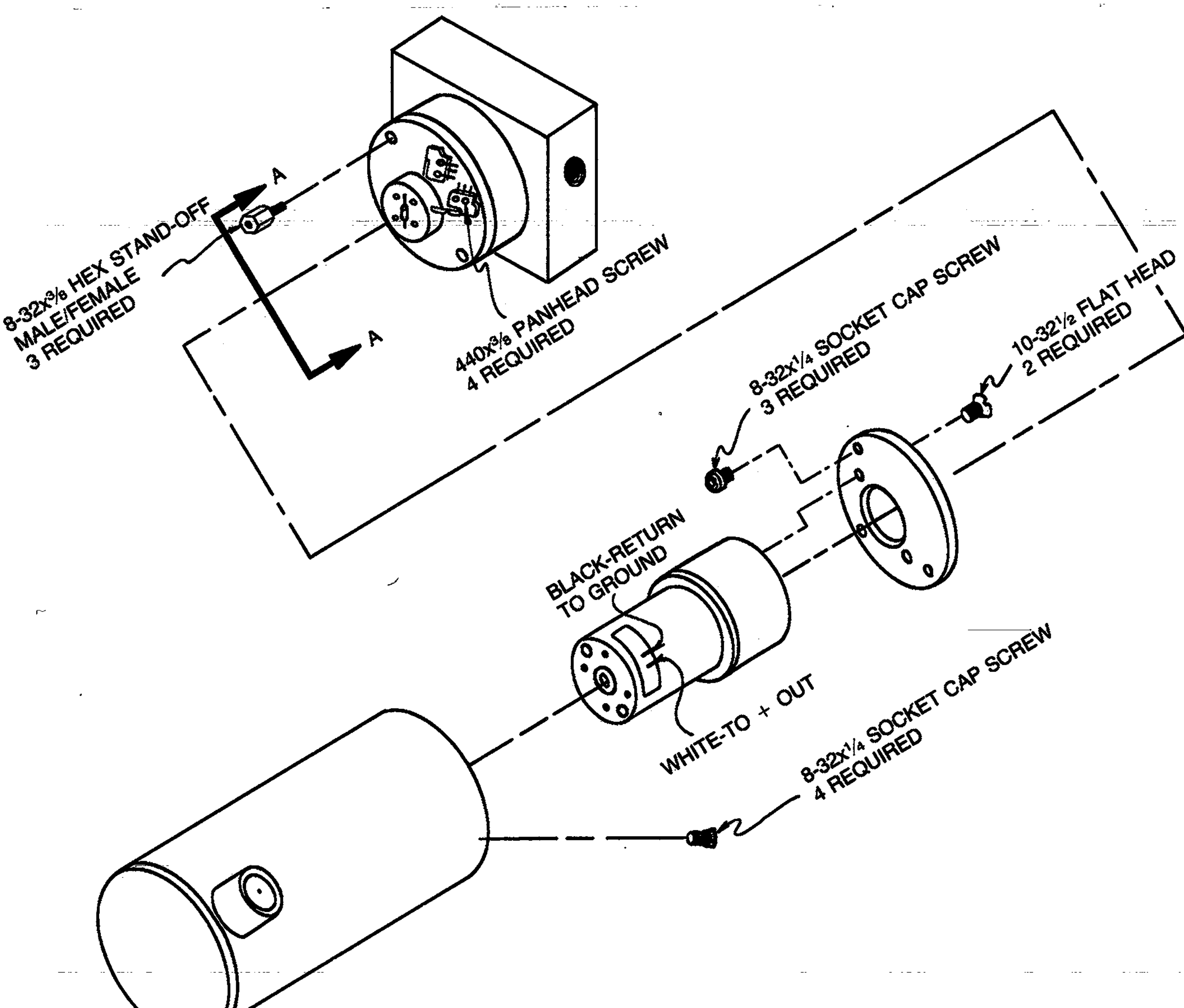
There are several situations that can cause leakage or the failure of the valve to obtain complete shutoff. Leakage is a factor only regarding complete shutoff, and would not interfere with the otherwise normal operation of the valve. Dirt can interfere with the seating of the shutoff plug on the orifice. Thus the first course of action to remedy shutoff leakage will be to disassemble and clean the valve. Secondly, although the dimensional tolerances are a close as can reasonably and economically be machined, an imperfect fit can occur between the shutoff plug and the orifice. This type of leakage can occur during shutoff even if the valve is well within tolerances. Further, this type of leakage is aggravated by high pressures. At several hundred pounds of pressure a 1/1000" misfit can cause significant leakage. For users who require absolute shutoff and are operating at an elevated pressure we recommend the installation of a simple open/close solenoid valve downstream of the Kurz 730 Series flow control valve. Be sure to obtain a solenoid valve which guarantees no leakage at the pressure rating you require. A normally closed solenoid valve can be operated by the shutoff limit microswitch that is closed when the 730 valve rotor is in the shutoff position. Wire your solenoid valve so that power is applied to it when the Kurz 730 valve closed position limit switch is closed. If your solenoid valve uses substantial current, it may be necessary to use a relay to avoid exceeding the power rating of the microswitch. See the limit switch layout on the Series 730 Valve Assembly Drawing that follows.

SERIES 730 VALVE CUTAWAY ILLUSTRATION

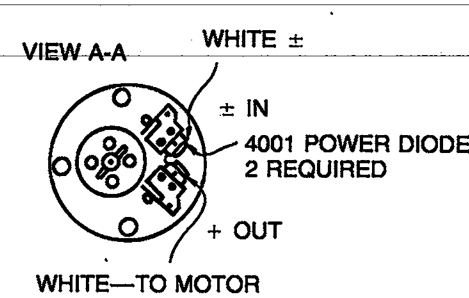


Typical (Reference Only)

SERIES 730 VALVE ASSEMBLY DRAWING



TYPICAL (REFERENCE ONLY)

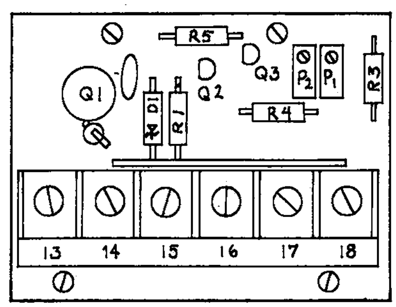


Typical (Reference Only)

APPENDIX A: DESCRIPTION OF 4-20 ma CURRENT OUTPUT BOARDS

4-20ma outputs are optional on all Kurz products and are not included in the price of the standard product. Currently, a 4-20ma output board is designated by adding a -131 to the Kurz product model number. 4-20ma boards are either piggybacked onto a larger circuit board or are alternatively available in 1.4" wide slide in rack modules. The 4-20ma board accepts the 0-5Vdc linear output signal and converts it to a 4-20ma output signal.

4-20 Ma OUTPUT CIRCUIT BOARD COMPONENT LAYOUT



ELECTRICAL TERMINAL DESCRIPTION

Terminal Number	Description
13	Ground (pre-connected to main PCB, terminal 3)
14	4-20 ma current return, Negative Supply (pre-connected to Main Board, solder connection)
15	Plus Supply (pre-connected to main PCB, solder connection)
16	0 - 5Vdc Input (pre-connected to main PCB,terminal 2)
17	4-20 ma Current Output
18	No Connection

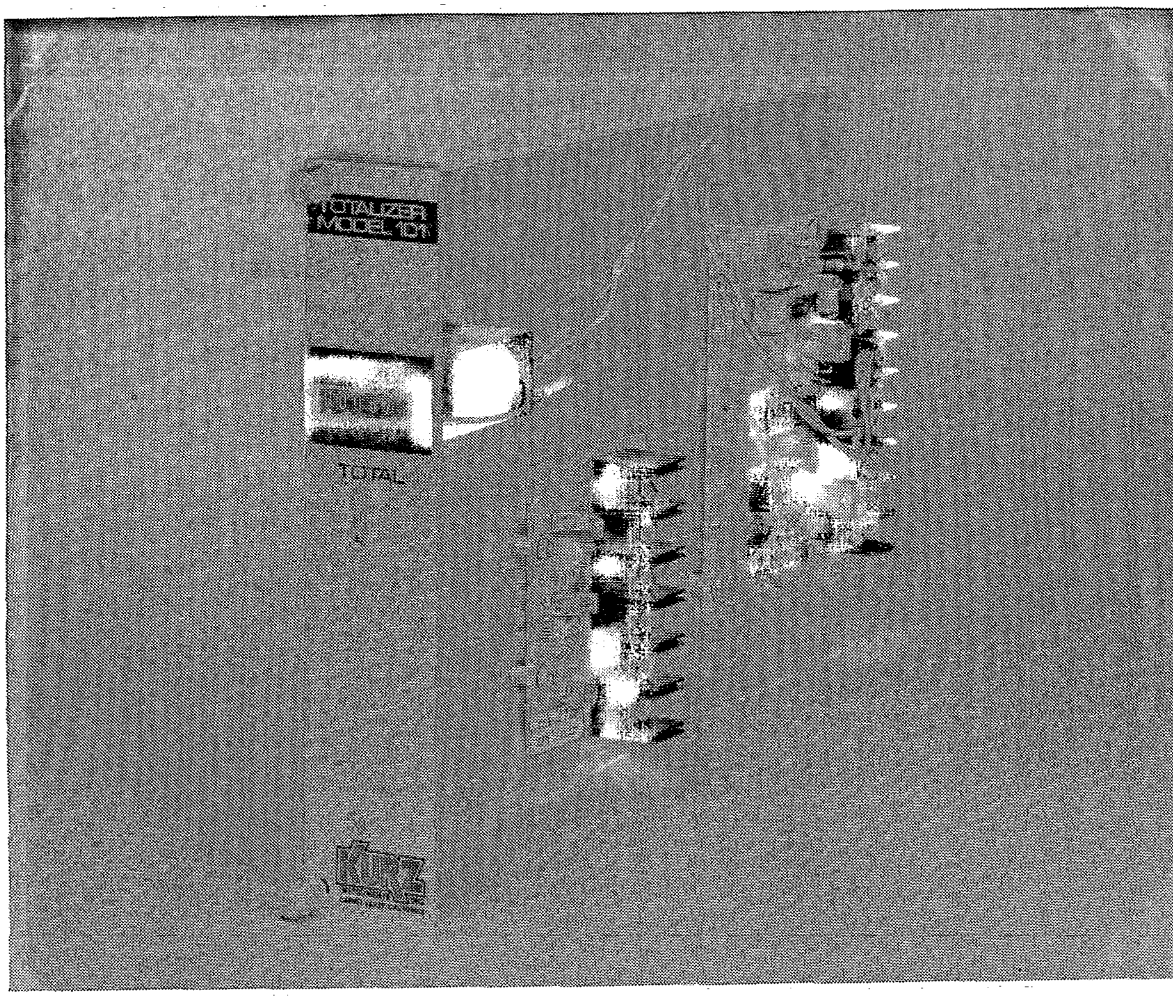
NOTES

#1 Connect your circuit between terminal 17 and terminal 14; plus current flows from terminal 17 to terminal 14. We suggest 100 ohm load resistor. Maximum useable resistance is 500 ohm.

#2 Output current of 4 ma corresponds to zero flow, conversely 20 ma output corresponds to full scale flow.

APPENDIX B: MODEL 101RM SIGNAL TOTALIZER MODULE

The Kurz 101RM Signal Totalizer Module is a popular option for use with 7500 Mass Flow Control Systems. The totalizer is a voltage to frequency converter with a factory set divider circuit that increments a mechanical counter. The Kurz Model 101RM Rack Module Totalizer is pictured below.



The Model 101RM Signal Totalizers may be specified with resettable or non-resettable 6-digit counters. The totalizer circuit may also be utilized as a frequency or pulse output unit for users desiring such an output. The Model 101RM Totalizer is described in detail in the following pages.

PACKAGING:

The Kurz Model 101RM Totalizer is built into a slide-in rack module package 1.4" wide x 7" tall. This is a 1/12 rack module, or in other words you could mount 12 units in a 19" rack chassis. Note that the optional resettable totalizer requires a 2.8" wide or 1/6 rack module.

TOTALIZER CIRCUIT DESCRIPTION

POWER SUPPLY:

The Totalizer uses an external +24Vdc to generate the +12Vdc to drive counters, and +5Vdc to operate circuits. The +24Vdc must be capable of supplying approximately 200 ma to maintain regulation at the switching point of the counter. The average current requirement, using both counters at maximum counting rate is approximately# 150 ma. The +5Vdc requirement is approximately# 10 ma. -5Vdc is derived from the -18Vdc input via a LM336 reference diode. For -12Vdc input change 2.2K to 1.5K. Temperature compensation may be added as shown on the power supply schematic. The -5Vdc circuit requirement is approximately 5 ma.

Note that mechanical counters requiring 24Vdc for operation require replacing the +12Vdc regulator with a jumper.

Totalizer power is normally supplied from an adjacent rack module.

0 - 5Vdc and 4 - 20ma INPUT CIRCUITS:

Input circuits utilize jumpers or component omission to select voltage or current input signals. The 0 - 5Vdc input develops an input current for the voltage-to-frequency convertor across a 430K and a 500K pot. The 500K pot provides a 2 to 1 frequency range adjustment to eliminate any gaps in the output spectrum.

The 4 - 20ma circuit develops a voltage across the 255 ohm input resistor. A -5Vdc bias current is summed to produce 0 into the voltage-to-frequency at 4ma. Again the 500K pot in conjunction with a 270K input resistor provides a 2 to 1 frequency range.

Note that 1% metal film resistors are used.

VOLTAGE TO FREQUENCY CONVERTOR:

A Datel VFQ-1 is used with 200pf as the frequency determining element. With 200pf the frequency at 10ua input current will be 10Khz at pin 8. In this application, an exact output frequency is less important than the ability to span the range of ppm or pph at the totalizer output. To do this the 500K pot must be able to reduce the voltage-to-frequency output to half, that is at on end (500K) the output frequency must be less than half of what it is at the other end (0 ohms). Note that Kurz uses accurate and temperature stable components (the 200pf capacitor and resistors) in the zero set circuit.

FREQUENCY DIVIDER:

Two CMOS C4040 counters are used to divide the frequency to drive the totalizing counters. The first device divides by 256 and produces a clock to drive the second. The output of the second C4040 is selectable by jumper. One jumper is used to provide inputs to the one-shot circuits. Jumper selection is discussed in CALIBRATING THE TOTALIZER. Note that the first counter output after initialization may not be accurate because no initial conditions are established.

ONE-SHOT & COUNTER DRIVE:

A 74C221 provides two one-shot circuits to drive two totalizing counters through a high-gain (must be a minimum of 300) 2N6388 transistor stage. The one-shots are set to provide a 50 ms pulse with .2uf and 220K timing components. One is set to trigger on the positive transistion, and the other on the negative transistion of the common clock signal.

CALIBRATING THE TOTALIZER:

There are two variables that determine the output rate: the jumper selection of the C4040 output divider and the frequency setting of the voltage-to-frequency convertor. A third adjustment, the zero set of the voltage-to-frequency convertor is also required.

SELECTING THE JUMPER:

Jumper selection determines the range of the totalizer output. Select the appropriate jumper by looking up the range into which the desired output falls from the table below.

JUMPER SELECTION TABLE

N	U/SEC	U/MIN	U/HR	PIN #
2	5.078125	304.6875	18281.25	9
2	10.15625	609.375	36562.5	9
4	2.539063	152.3438	9140.625	7
4	5.078125	304.6875	18281.25	7
8	1.269531	76.17188	4570.313	6
8	2.539063	152.3438	9140.625	6
16	.6347656	38.08594	2285.156	5
16	1.269531	76.17188	4570.313	5
32	.3173828	19.04297	1142.578	3
32	.6347656	38.08594	2285.156	3
64	.1586914	9.521484	571.2891	2
64	.3173828	19.04297	1142.578	2
128	.0793457	4.760742	285.6445	4
128	.1586914	9.521484	571.2891	4
256	.0396729	2.380371	142.8223	13
256	.0793457	4.760742	285.6445	13

SETTING THE VOLTAGE-TO-FREQUENCY FULL SCALE FREQUENCY:

The following formulas are used to determine what the full scale voltage-to-frequency setting should be:

If the Totalizer output is desired in Units/Hr, then:
[(Units/Hr)/3600] x 256 x N = Frequency

If the Totalizer output is desired in Units/Min., then:
[(Units/Min.)/60] x 256 x N = Frequency

Note that the term N used above is from the JUMPER SELECTION TABLE

Note that the resulting frequency should always be between 2600Hz and 5200Hz.

Once the frequency is determined it is set by applying an accurate 5Vdc or 20ma signal to the input of the Totalizer and adjusting the 500K pot on the voltage-to-frequency input circuit to produce the frequency on pin 10 of the voltage-to-frequency convertor.

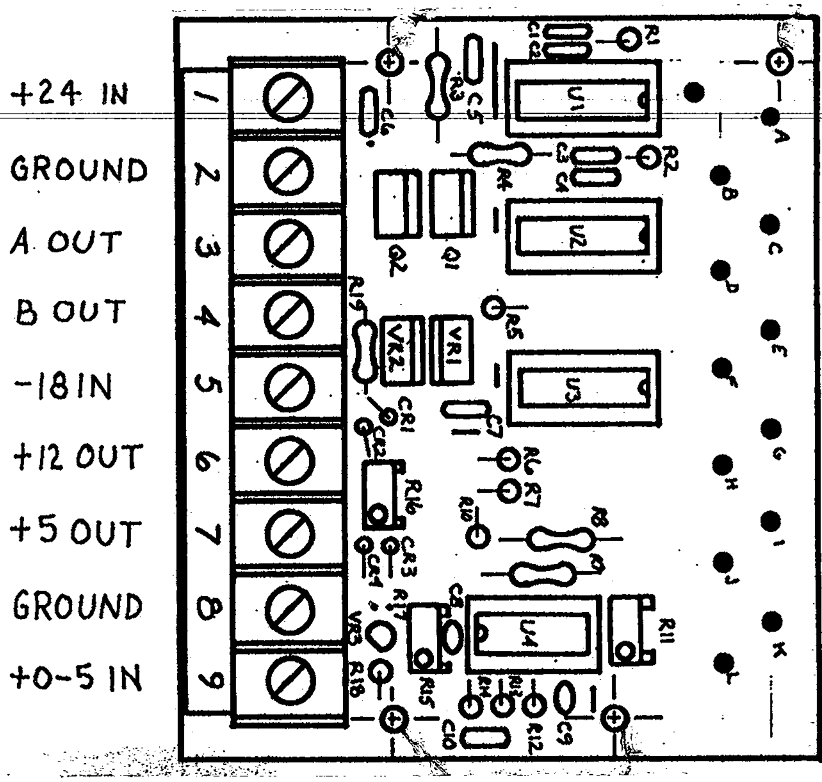
SETTING THE VOLTAGE-TO-FREQUENCY ZERO ADJUSTMENT:

Apply an accurate 50mv or 4.16ma signal to the input of the Totalizer and adjust the zero set pot (50K) to a frequency that is 1% of the full scale set in the previous step. Note that Full Scale and Zero Settings should be rechecked and adjusted as necessary.

AN EXAMPLE:

To set the Totalizer to produce 2500 pph (representing 2500 SCFH or standard cubic feet per hour, let's say) we would look at the JUMPER SELECTION TABLE and see that 2500 falls between 2285 and 4570 U/HR. The jumper that connects the C4040 counter output (pin 5) to the one-shot inputs would be used. N would be 16 for purposes of calculations. Using the Units/Hr. formula would produce 2844 Hz as the full-scale frequency setting. We adjust the 500K pot to get it on pin 10 of the voltage-to-frequency converter with an accurate 5Vdc input. Then with an accurate 50mv input we set the Zero Set pot to get 28.4 Hz.

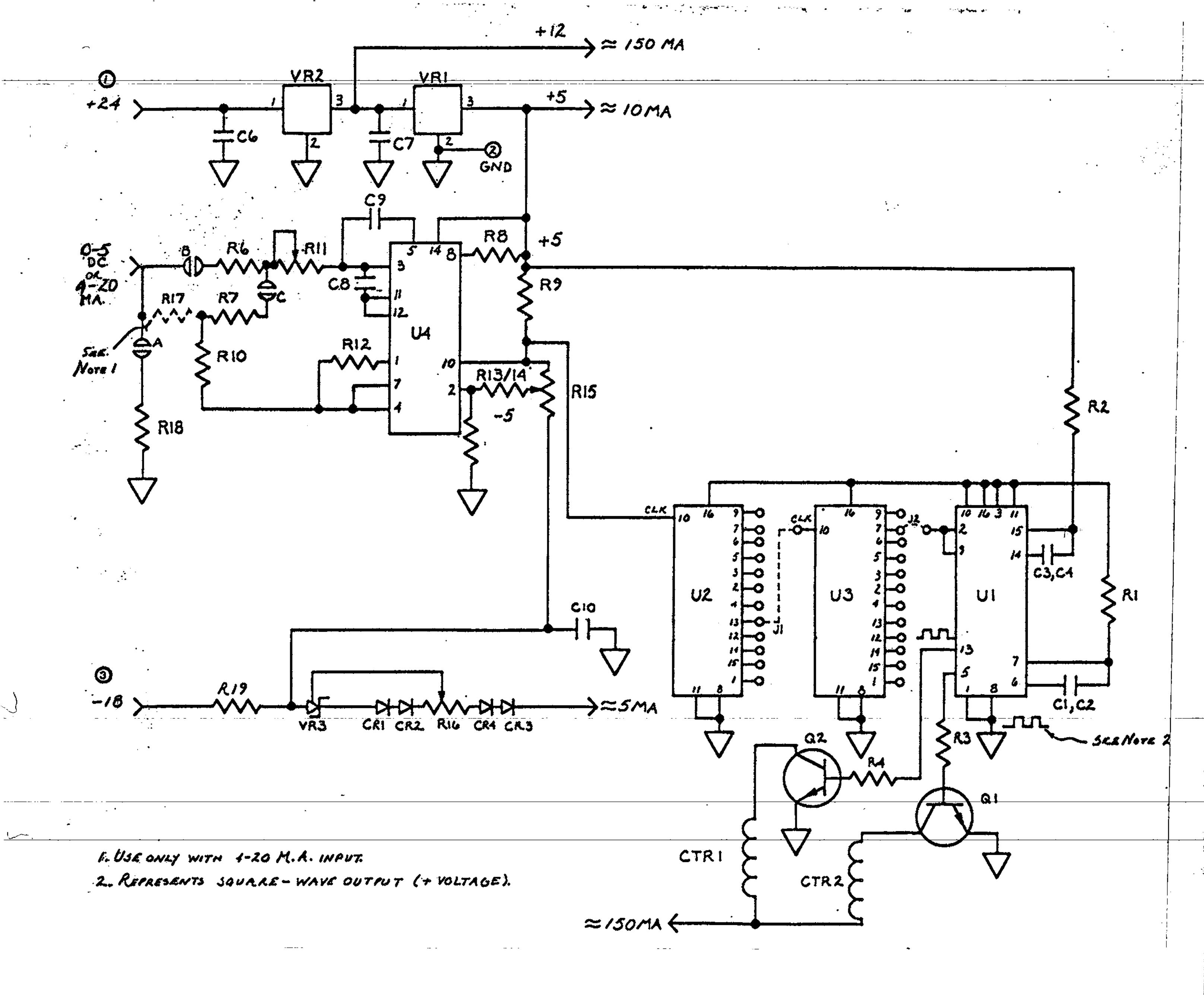
MODEL 101RM TOTALIZER COMPONENT LAYOUT DRAWING



MODEL 101RM TOTALIZER PARTS LIST

Designation	Description
R1	220K Resistor
R2	220K Resistor
R3	10K Resistor
R4	10K Resistor
R5	.5 Ohm Resistor
R6	392K Resistor
R7	249K Resistor
R8	10K Resistor
R9	10K Resistor
R10	49.9K Resistor
R11	500K Potentiometer
R12	100K Resistor
R13	10K Resistor
R14	499K Resistor
R15	50K Potentiometer
R16	10K Resistor
R17	10K Resistor
R18	255K Resistor
R19	2.2K Resistor
U1	74C221 IC
U2	C4040 IC
U3	C4040 IC
U4	Datel VFQ-1 IC
C1-C7,C10	.1 microfarad Capacitors
C8	1000 picofarad Capacitor
C9	200 picofarad Capacitor
VR1	LM340T 5V Voltage Regulator
VR2	LM340T 12V Voltage Regulator
VR3	LM336Z 2.5V Voltage Regulator
Q1,Q2	2N6388 Transistors
CR1-CR4	IN4148 Diodes

MODEL 101RM TOTALIZER SCHEMATIC DIAGRAM



1. Use only with 4-20 M.A. input.

2. Represents square-wave output (+ voltage).

WARRANTY STATEMENT

All products from Kurz Instruments Inc. are warranted against defective materials or workmanship to the original purchaser for a period of one year from the original purchase date, under normal use and service.

Defective parts will be repaired, adjusted, and/or replaced at no charge when the instrument is returned prepaid to Kurz Instruments Inc. Please call for a Return Authorization Number.

The warranty is VOID if the instrument has been visibly damaged by accident, misuse, or has been serviced or modified by any person other than Kurz Instruments Inc.

This warranty contains the entire obligation of Kurz Instruments Inc. and no other warranties expressed, implied, or statutory are given.

REQUESTS FOR READER´S COMMENTS

Kurz Instruments Inc. attempts to provide instruction manuals which meet the needs of all Kurz instrumentation users. This response form allows you to participate directly in our documentation process.

Certainly, we will appreciate your comments and carefully consider your suggestions.

Many Kurz products become non-standard when they are slightly modified, usually in packaging, to accommodate special requests or requirements by you— the customer. Clearly, it is not possible to produce a manual that accurately covers these small modifications, unless documentation charges are being paid above and beyond the price of the equipment. Thus, bear in mind you are reading an attempt to describe typical features of standard products.

Consider commenting on useability, accuracy, readability, organization and completeness.

1. Title of the Manual your´re commenting on:

   ____

2. Release Number: ____________ 3. Publication Date: ____________

4. Specify by page any errors that you found.

Page No	Description of Error

5. Does the document cover the information you need ? If not, please explain.

   ____

6. Is it at the right level ? Should it be more simple or more detailed ?

   ____

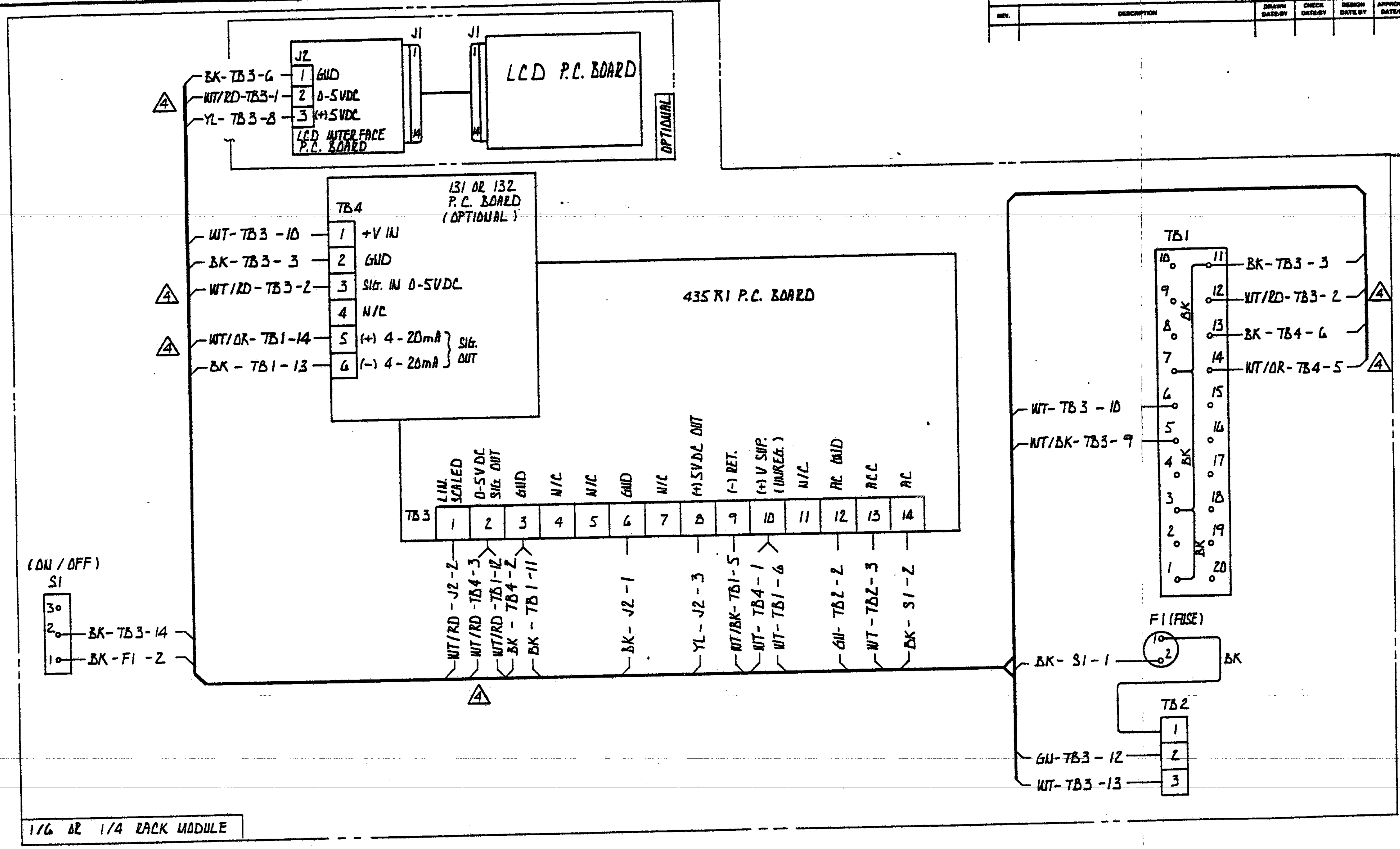
TB. 1	SIGNAL DIRECTION		DESCRIPTION	
1	OUT		CIRCUIT GROUND	GND
2	OUT		REG. (+) SUPPLY	+15 VDC
3	OUT		CIRCUIT GROUND	GND
4	OUT		REG. (-) SUPPLY	-15 VDC
5	IN		CIRCUIT GROUND	GND
6	IN		MASS FLOW SIGNAL	0-5 VDC LINEAR
7	IN		EXT.	(-) 4-20 MA
8	IN		INPUT	(+) 4-20 MA
9	IN	(OPT.)	CIRCUIT GROUND	GND
10	IN		161 TEMP. INPUT	0-5 VDC LINEAR
11	OUT		CIRCUIT GROUND	GND
			DISPLAY SWITCH	
12	OUT		SELECTED OUTPUT	± 0-5 VDC
13	OUT	(OPT.)	CURRENT LOOP	(-) 4-20 MA
14	OUT		OUTPUT	(+) 4-20 MA
15	OUT		VALVE MOTOR GROUND	GND
16	OUT		(+) OR (-) SUPPLY TO VALVE	(+) OR (-) 15 VDC
17	IN	(OPT.)	CIRCUIT GROUND	GND
18	IN		142 FLOW SIGNAL	0-5 VDC LINEAR
19	OUT	(OPT.)	UNREG. (-) SUPPLY	-24 VDC
20	OUT		UNREG. (+) SUPPLY	+24 VDC
TB. 2				
1				AC
2	IN		POWER INPUT	AC GND
3				ACC

Notes: Wire direct when supplied into Kurz enclosure (unless otherwise specified.)

APPROVALS	DATE	TITLE:
INITIATED D Trius	12-12-[illegible]	Model 7500 Flow Controller Model 710 (1/4 or 1/6 RM) rear-mounted terminal board description. (4-20 MA ext. input)
CHECKED [illegible]	[illegible]	
APPROVED E Sh[illegible]	12-17-[illegible]	
		DWG NO. 340208 · REV. 0 · SHT 1 OF 1

KURZ INSTRUMENTS INC. CARMEL VALLEY CALIFORNIA

15053



NOTES:
1. REF. DES. ARE FOR REF. ONLY AND MAY NOT APPEAR ON COMPONENTS.
2. ALL WIRES SHALL BE A MIN. OF #22 AWG.
3. THIS WIRING DIAGRAM TO BE USE FOR SERIES 151, 505, 455 AND 555 SYSTEM.
4. (△4) WIRE COLORS SHOWN ARE FOR MASS FLOW. FOR VELOCITY CHANGE: WT/RD TO WT/PR AND WT/OR TO WT/BL.

REAR MOUNTED TERMINAL BOARD DESCRIPTION

PIN	DESCRIPTION	PIN	DESCRIPTION
1	CIRC. GND } (OPT.)	11	CIRC. GND
2	(+) V SUPPLY } (OPT.)	12	0-5V DC LINEAR
3	CIRC. GND } (OPT.)	13	(-) } 4-20mA (OPT.)
4	(-) V SUPPLY } (OPT.)	14	(+) } 4-20mA (OPT.)
5	(-) RET.	15	N/C
6	(+) 24 VDC SUP.	16	N/C
7	CIRC. GND	17	N/C
8	N/C	18	N/C
9	N/C	19	N/C
10	N/C	20	N/C

N/A
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
DWG. RELEASE DATE

APPROVALS	DATE
DRAWN BY D. Vierra	8-12-87
CHECKED BY S. Fisher	8-12-87
DESIGN N/A	
APPROVED M. Elliott	8-13-87
BASELINED N/A	

REVISIONS

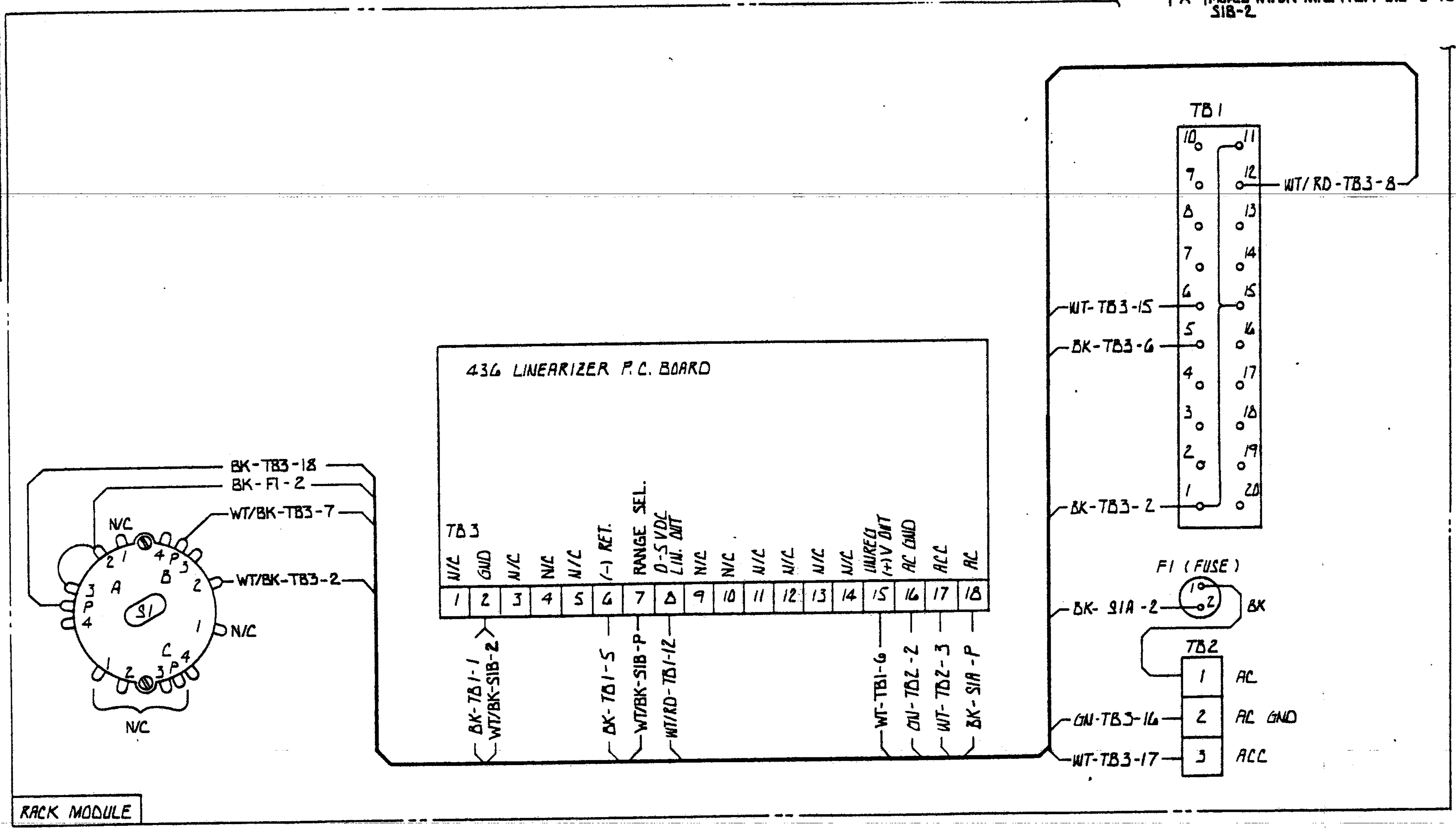
REV.	DESCRIPTION	DRAWN DATE/BY	CHECK DATE/BY	DESIGN DATE/BY	APPROVED DATE/BY

KURZ INSTRUMENTS INC.

TITLE RACK MODULE INTERNAL WIRING DIAGRAM (435R1 W/ 131 OR 132 AND DISPLAY OPTIONS)

DWG. SIZE C | DWG. NO. 340C16 | REV. 0
SCALE NONE | SHEET 1 OF 1

REV.	DESCRIPTION	DRAWN DATE/BY	CHECK DATE/BY	DESIGN DATE BY	APPROVAL DATE BY
A	MOVED WT/BK WIRE FROM S1B-3 TO S1B-2	1-13-89	1-20-89	N/A	1-24-89



NOTES: UNLESS OTHER WISE SPECIFIED.
1. REF. DES. AND TERM. NO. ARE FOR REF. ONLY AND MAY NOT APPEAR ON COMPONENTS.
2. ALL WIRES SHALL BE A MIN. OF #22 AWG.

TB1	DESCRIPTION	TB1	DESCRIPTION
10	N/C	20	N/C
9	N/C	19	N/C
8	N/C	18	N/C
7	RANGE SEL.	17	N/C
6	(+) V UNREG. OUT	16	N/C
5	(-) RET.	15	GND
4	N/C	14	N/C
3	N/C	13	N/C
2	N/C	12	(+) 0-5VDC LIN. OUT
1	GND	11	GND LIN. OUT

REAR-MOUNTED TERMINAL BOARD DESCRIPTION

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
DRAWN BY	G. Foster, 11-17-88
CHECKED BY	J.D. Young, 11.28.88
DESIGN	N/A
APPROVED	11-28-88
ORIG. RELEASE DATE	N/A

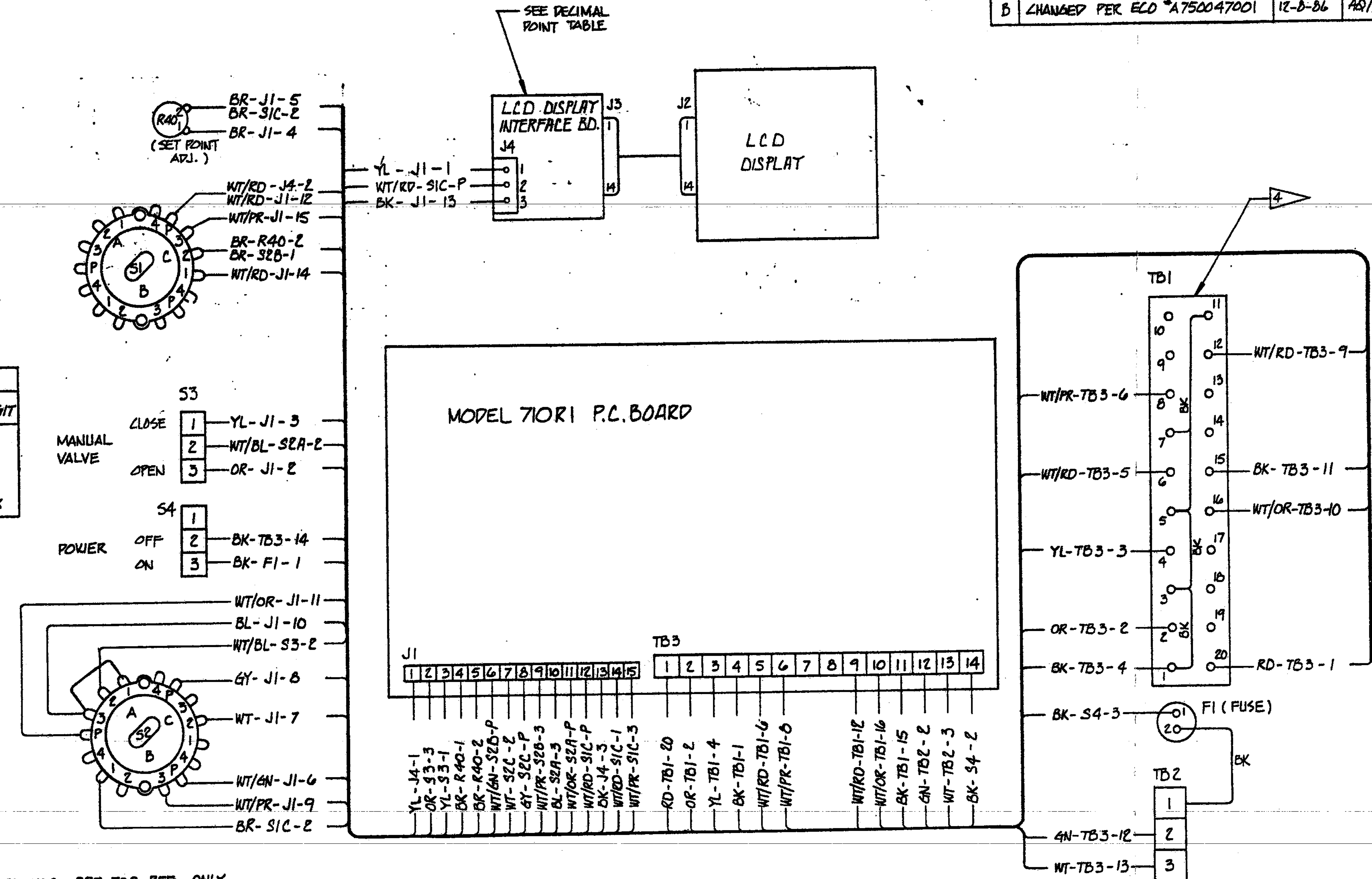
KURZ INSTRUMENTS INC.

TITLE: MODEL 505 RM (DUAL RANGE) INTERNAL WIRING DIAGRAM

DWG. SIZE	DWG. NO.	REV
C	130C3201	A

SCALE: NONE — SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED & REDRAWN	2-27-86	AQ/DT/MG
B	CHANGED PER ECO #A750047001	12-8-86	AQ/DT/MG



DECIMAL POINT SEL. TABLE		
CLOSE	4½ DIGIT	3½ DIGIT
E7	1.XXXX	1.XXX
E6	DUMMY ZERO	N/C
E5	1XX.XX	1XX.X
E4	1X.XXX	1X.XX

S1A : DECIMAL POINT
S1C : DISPLAY INPUT
S2A : VALVE CONTROL (OUTPUT)
S2B : VALVE CONTROL (INPUT)
S2C : VALVE CONTROL (SHUT-OFF)

S1 : 3 POLE – 4 POS. SWITCH
POS. 1 : FLOW RATE
2 : SET POINT
3 : EXT. INPUT

S2 : 3 POLE – 4 POS. SWITCH
POS. 1 : FLOW CONTROL
2 : MANUAL VALVE
3 : EXT. INPUT

NOTES :

1. REF. DES. AND TERMINAL NOS. ARE FOR REF. ONLY AND MAY NOT APPEAR ON COMPONENTS.
2. ALL WIRES SHALL BE A MIN. OF #22 AWG., EXCEPT RIBBON CABLE USED ON J2.

3▷ REMOVED 12-8-86

4▷ SEE DWG #340208 AND #340209 FOR REAR-MOUNTED TERM. BOARD DESCRIPTION.

5. FOR 0-5VDC EXT. INPUT USE TB1-7 AND TB1-8. FOR 4-20mA EXT. INPUT, SEE WIRING MODIFICATION TABLE.

WIRING MODIFICATION TABLE FOR 4-20mA EXT. INPUT	
REMOVE	ADD
1. WT/PR FROM TB1-8 TO TB3-6 2. JUMPER FROM TB1-5 TO TB1-7	1. JUMPER FROM TB1-5 TO TB1-11 2. BK FROM TB1-7 TO TB3-8 3. WT/BL FROM TB1-8 TO TB3-7

TOLERANCES UNLESS OTHERWISE SPECIFIED		
FRACTIONS	DEC	ANGLES
± /	± /	± /

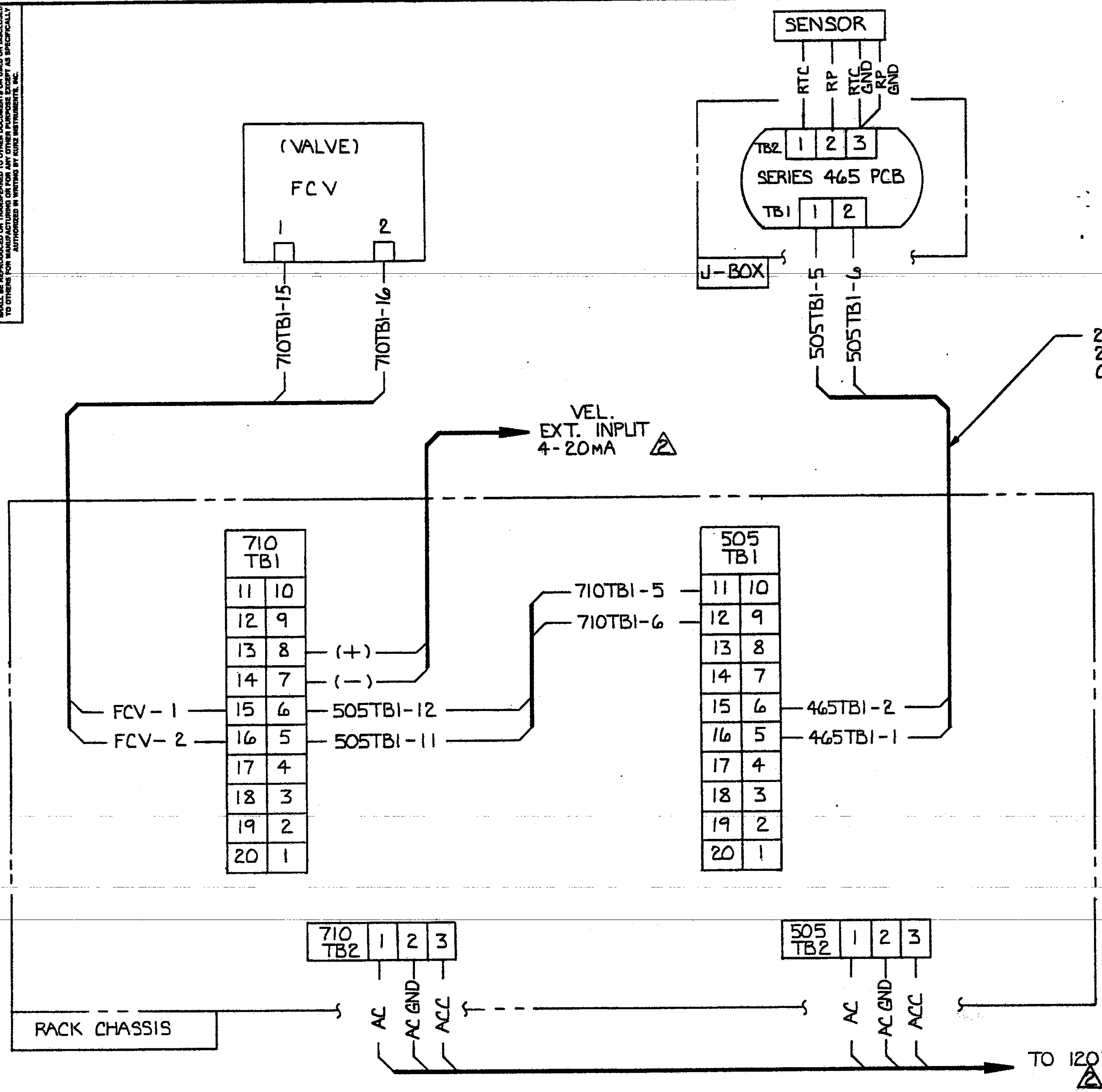
APPROVALS		DATE
DRAWN	[signature]	2-27-86
CHECKED	[signature]	3-3-86
APVD	[signature]	3-3-86

KURZ INSTRUMENTS INC.

MODEL 7500 FLOW CONTROLLER
710RMD WIRING DIAGRAM

SCALE — SIZE C DRAWING NO. 340088

DO NOT SCALE DRAWING SHEET 1 OF 1



2-WIRE TEST CABLE 15 FT. LG., 2 PLCS, SUPPLIED BY KURZ CONNECTED BY CUSTOMER

NOTES: UNLESS OTHERWISE SPECIFIED.

1) ALL REF. DES. ARE FOR REF. ONLY AND MAY NOT APPEAR ON COMPONENTS.

2) SUPPLIED AND CONNECTED BY CUSTOMER.

3) WIRING DIAGRAM SHOWS HOOK-UPS FOR ONE SYSTEM, ALL OTHER SYSTEMS (TYP.)

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

KURZ INSTRUMENTS INC.

TITLE: MODEL 7500 SYSTEM INTERCONNECTION WIRING DIAGRAM (4-20mA EXT. INPUT)

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	J. Foster	11-16-88
CHECKED BY	J.D. Young	11.28.88
DESIGN	N/A	
APPROVED	[signature]	11-28-88
BASELINED	N/A	

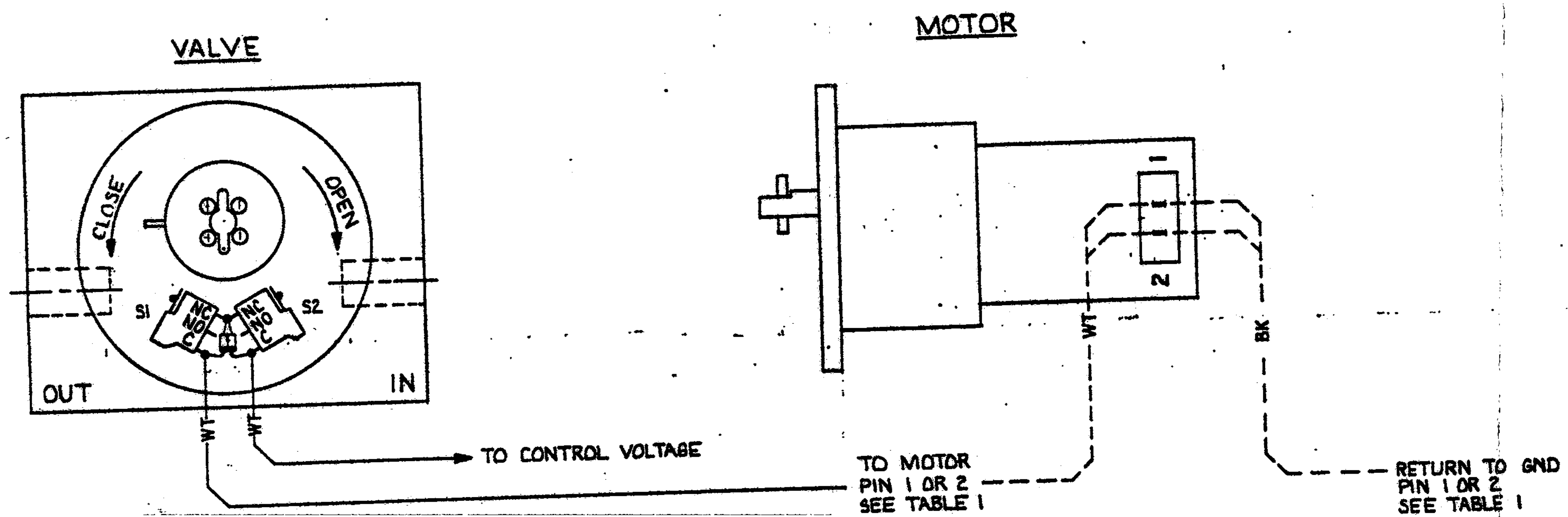
DWG. SIZE	DWG. NO.	REV.
C	1300C3202	D
	SCALE NONE	SHEET 1/1

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A36294

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

NOTES: UNLESS OTHERWISE SPECIFIED

1. WIRES SHALL BE A MINIMUM OF #22 AWG.
2. REFERANCE DESIGNATIONS ARE FOR REFERANCE ONLY AND MAY NOT APPEAR ON ACTUAL PART.



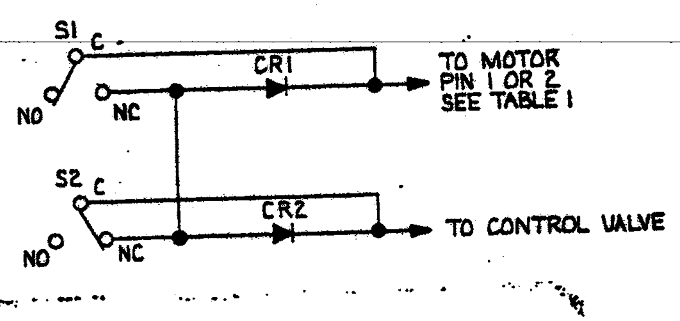
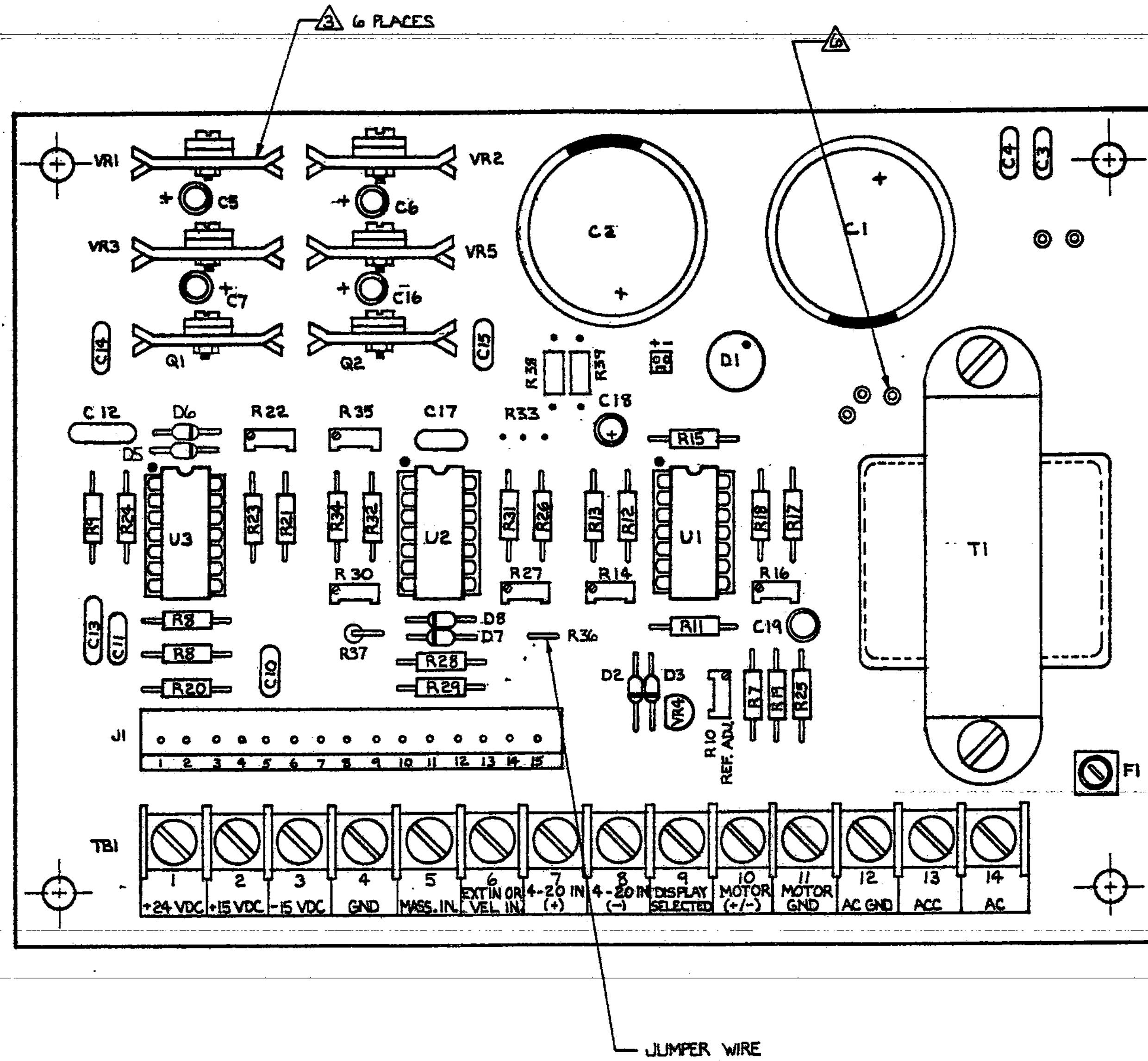


TABLE 1

VALVE		+ TO MOTOR			
OPEN	CLOSE	RATIO	ROTATION	PIN 1	PIN 2
X		5.9:1	CW	BK	WT
X		11.5:1	CW	BK	WT
X		19.7:1	CCW	WT	BK
X		38.3:1	CCW	WT	BK
X		65.5:1	CW	BK	WT
X		127.7:1	CW	BK	WT
X		218.4:1	CCW	WT	BK
X		426:1	CCW	WT	BK
X		728:1	CW	BK	WT
X		1419:1	CW	BK	WT
X		2426:1	CCW	WT	BK
X		4730:1	CCW	WT	BK

TOLERANCES UNLESS OTHERWISE SPECIFIED		KURZ INSTRUMENTS INC.
FRACTIONS ± DEC ± ANGLES ±		VALVE/MOTOR WIRING INTERCONNECTION
APPROVALS	DATE	
DRAWN J. CAREAGA	5-13-86	SCALE /
CHECKED	5-14-86	SIZE C — DRAWING NO. 340095
APP M. Eldridge	5-15-86	DO NOT SCALE DRAWING — SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADDED R36, R37, R38, R39, CHANGED C1 AND C2. ADDED NOTES 4 & 5. ADDED J1 PIN DESCRIPTION. REMOVED R33 R38 R39. CHANGE R30 TO 20K AND R36 TO 15KΩ	2/25/86	
B	CHANGED PER ECO A71047001 AND A71047002	5/7/87	



NOTES: UNLESS OTHERWISE SPECIFIED.

1. THIS DWG. TO BE USED IN CONJUNCTION W/ SCHEMATIC DIAGRAM DWG. 300019, 300020, 300022
2. LAST REF. DES. USED ARE: TB1, J1, F1, T1, U3, D8, Q3, VR5, C21, R42, S4.
3. SEE DWG.# A70003 FOR HEAT SINK ASSY.
4. D5, D6 TO BE SELECTED AND ASSEMBLED W/ 1/8" CLEARENCE FROM BOARD.
5. FOR ENVIRONMENTAL REQUIREMENT USE MALLORY CAPACITOR 3500µF - 40V
6. T1 CENTER TAP WIRE (STRIPPED) SOLDER TO PAD INDICATED.
7. T1 MOUNTING HARDWARE - #10-32 X 1/4" SCR., WASHER, NUT 2 PLACES.

REF DES.	DESCRIPTION	QTY.
R27 R10 R30	POTENTIOMETER 20K	3
R14 R16 R22 R35	POTENTIOMETER 2K	4
R25	RESISTOR 100Ω - 1% - 1W RS437	1
R24	RESISTOR 392 KΩ	1
R17, R20 R23, R34	RESISTOR 9.09 KΩ	4

PART LIST

REF DES.	DESCRIPTION	QTY.
R13	13.3 KΩ	1
R12, R18 R19, R21 R26, R28 R29, R31, R32	10 KΩ	9
R9, R37	4.99 KΩ	2
R8, R11, R15	SELECTED	3
R7	RESISTOR 6.04 KΩ	1
C18, C19	CAPACITOR SELECTED	2
C12, C13	CAPACITOR .1 µF - 100VDC	2
	22 AWG. SOLID TIN JUMPER WIRE	1
C5, C6 C7, C16	CAPACITOR 10µF - 25VDC	4
C3, C4, C10, C11, C14 C15, C17	CAPACITOR .02µF - 50VDC	7
5 C1, C2	CAPACITOR 3300µF - 35VDC - N/C NRLP332M35V (M)	2
4 D5, D6	SELECTED	2
7 T1	TRANSFORMER # 8435A-60	1
D2, D3 D7, D8	DIODE IN 914	4
D1	BRIDGE RECTIFIER CSC B20S	1
VR5	VOLTAGE REGULATOR # 7824 + HEATSINK + HARDWARE (4-40 X 3/8 RD HD SCR, NUT, WASHER)	1
VR4	VOLTAGE REGULATOR LM 336 - 2.5 V	1
VR3	VOLTAGE REGULATOR # 7915 + HEATSINK + HARDWARE (4-40 X 3/8 RD HD SCR, NUT WASHER)	1
VR2	VOLTAGE REGULATOR # 7805 + HEATSINK + HARDWARE (#4-40 X 3/8 RD HD SCR, NUT, WASHER)	1
VR1	VOLTAGE REGULATOR # 7815 HEATSINK + HARDWARE (#4-40 X 3/8 RD HD SCR, NUT WASHER)	1
Q2	TRANSISTOR # 2N6668 + HEATSINK + HARDWARE (# 4-40 X 3/8 RD HD SCR, NUT, WASHER)	1
Q1	TRANSISTOR # 2N6388 + HEAT SINK + HARDWARE (#4-40 X 3/8 RD HD SCR, NUT WASHER	1
U1 U2 U3	OP - AMP LM 324	3
	14 PIN SOCKET	3
F1	PCB MOUNTED FUSE HOLDER	1
J1	15 PIN MOLEX CONNECTOR	1
TB1	14 PIN TERMINAL BLOCK	1
	710 PCB	1

PART LIST

TOLERANCES UNLESS OTHERWISE SPECIFIED: FRACTIONS ± / DEC ± / ANGLES ± /

APPROVALS / DATE — DRAWN G. FOSTER 4/3/85; CHECKED 12/4/85; APPROVED 12/6/85

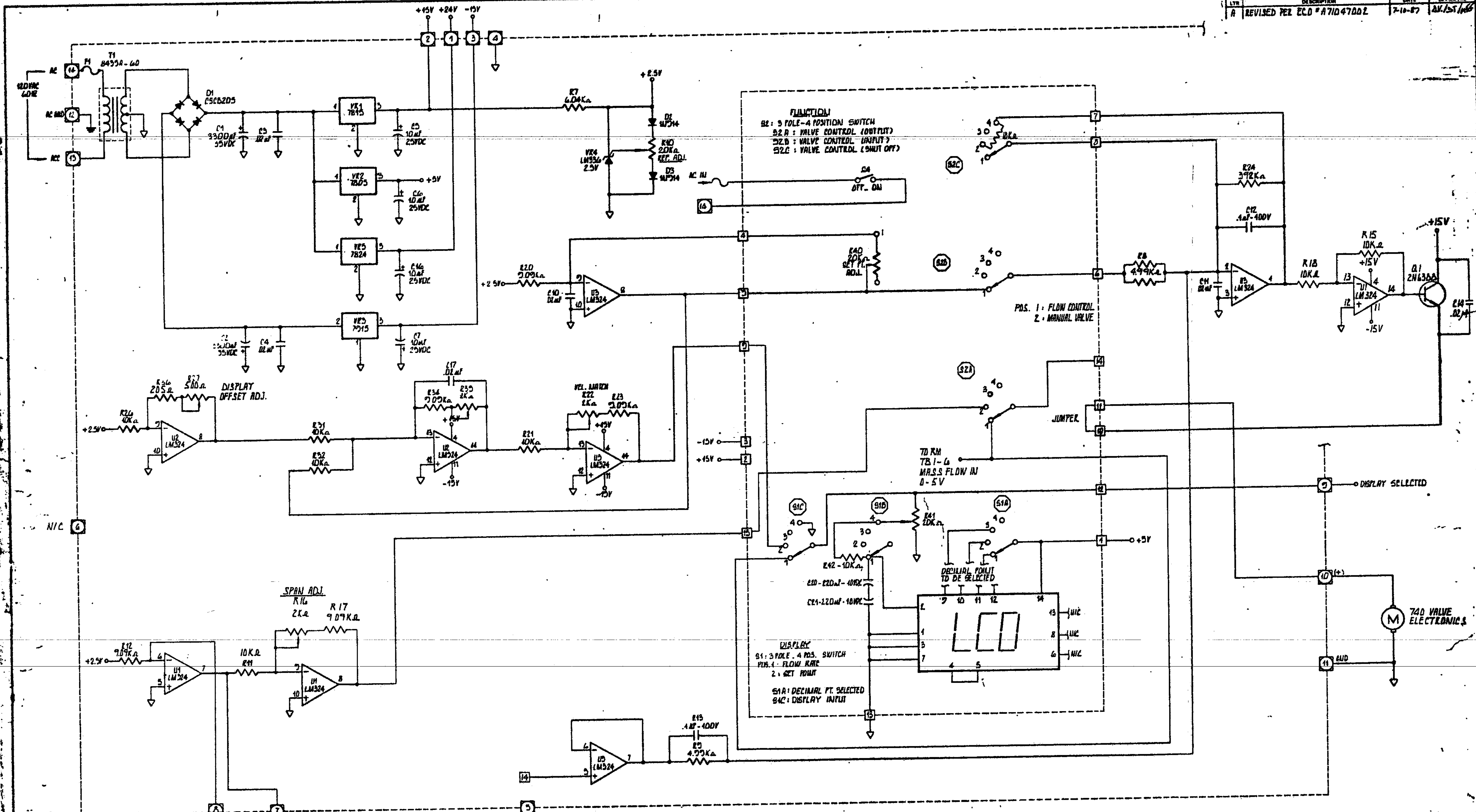
KURZ INSTRUMENTS Inc

MODEL 710 RI FLOW CONTROLLER COMPONENT LAYOUT

SCALE 2/1 — SIZE D — DRAWING NO. 420049 — L2

DO NOT SCALE DRAWING — SHEET 1 OF 1

LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO #A7ID47002	7-10-87	[illegible]



S4	
R42	R1-6, 13, 14, 19, 25, 26-30, 33, 37-39
C21	C8, 9, 15, 18, 19
D8	D4-8
VR5	
Q3	Q2-3
U3	
F1	
T1	
LAST USED	NOT USED

REF DESIGNATION TABLE

REF. DES.	IC No.	+15V	-15V	GND	UNUSED OUTPUTS
U3	LM324	4	11	3,5,10,12	
U2	LM324	4	11	5,10,12	1
U1	LM324	4	11	5,10,12	1

IC DEVICE TABLE

TOLERANCES UNLESS OTHERWISE SPECIFIED: FRACTIONS ± — DEC ± — ANGLES ± —

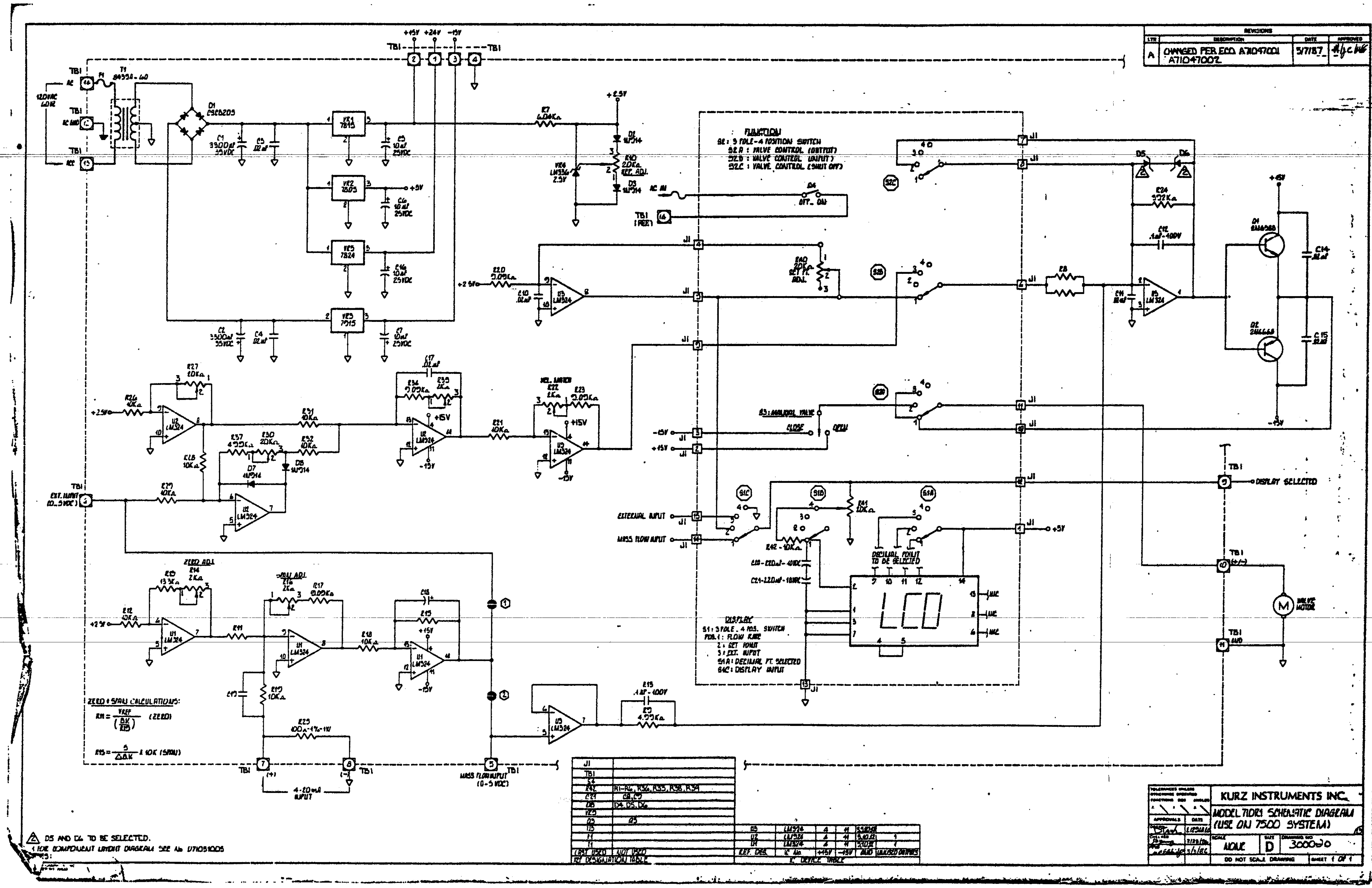
KURZ INSTRUMENTS INC.

MODEL 710R1 SCHEMATIC DIAGRAM (USE ON 7500 SYSTEM W/ 740 VALVE)

APPROVALS	DATE
DRAWN	1-5-87
CHECKED	1-12-87
APPROVED	1/12/87

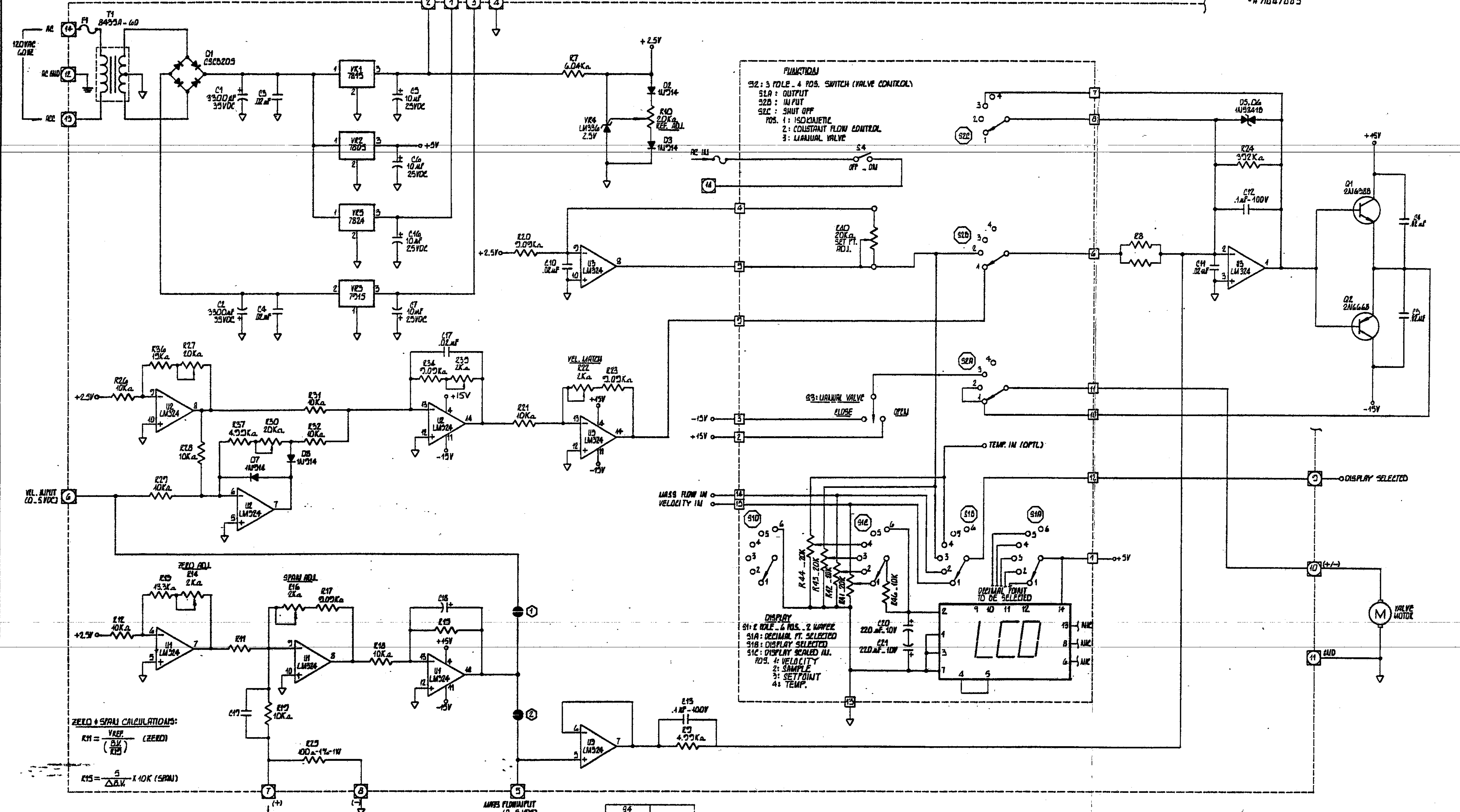
SCALE: NONE | SIZE: D | DRAWING NO.: 300021 | REV.: A

DO NOT SCALE DRAWING | SHEET 1 OF 1



REVISIONS
A CHANGED PER ECO A71047001 A71047002 5/7/87
TB1
120VAC 60HZ
T1 84334-40
D1 25CB205
VR1 7815
VR2 7805
VR3 7824
VR5 7915
+5V
+2.5V
FUNCTION
S2: 3 POLE-4 POSITION SWITCH
LCD
DISPLAY SELECTED
VALVE MOTOR
EXTERNAL INPUT
MASS FLOW INPUT
4-20mA INPUT
MASS FLOW OUTPUT (0-5 VDC)
ZERO ADJ.
SPAN ADJ.
ZERO & SPAN CALCULATIONS:
D5 AND D6 TO BE SELECTED.
KURZ INSTRUMENTS INC.
MODEL 710R1 SCHEMATIC DIAGRAM (USE ON 7500 SYSTEM)
NONE
D
DO NOT SCALE DRAWING
SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO #A71047002 AND #A71047003	7-10-87	[illegible]



$$R11 = \frac{VREF}{\left(\frac{\Delta V}{R15}\right)} \quad (ZERO)$$

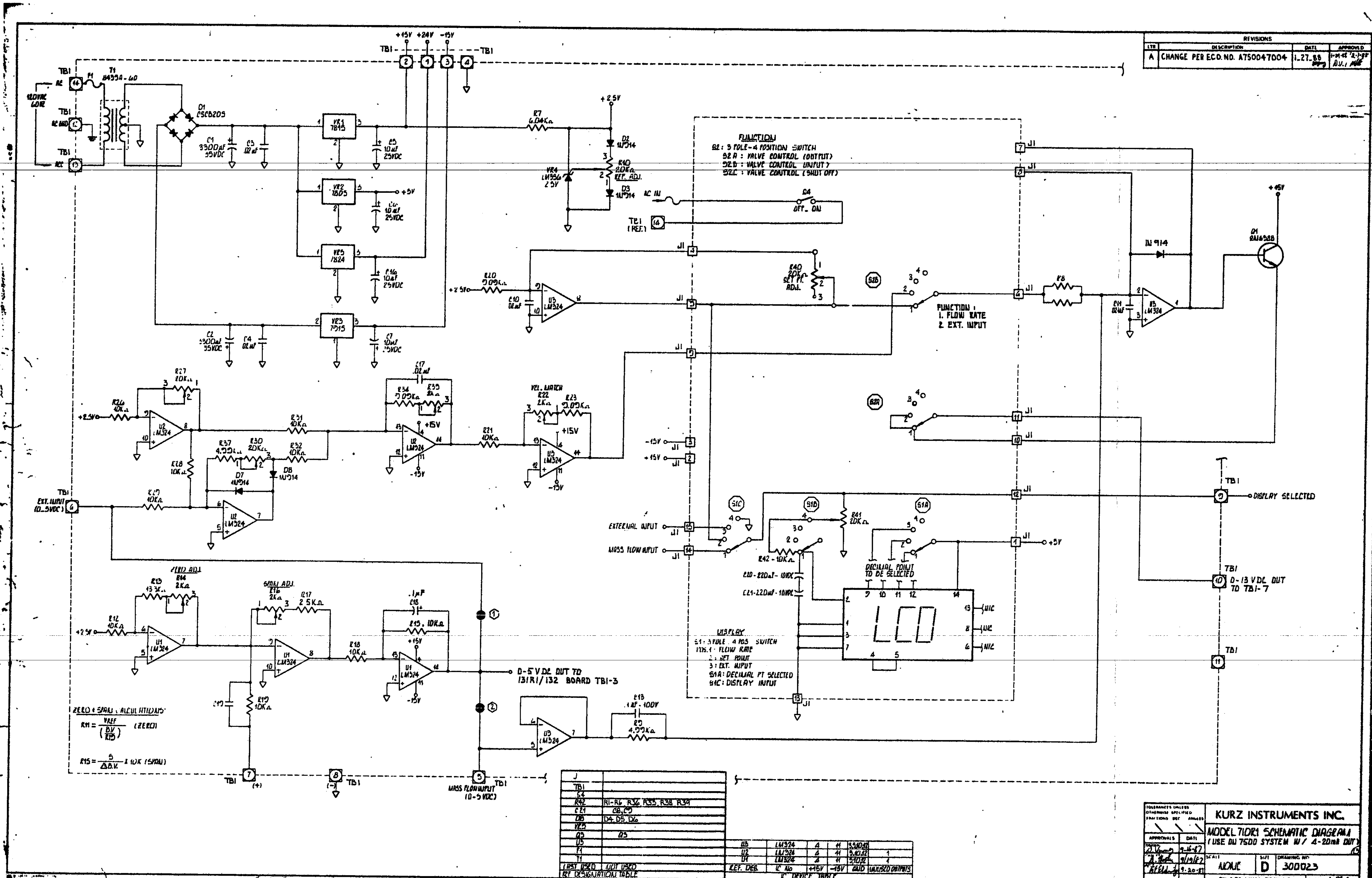
$$R15 = \frac{5}{\Delta \Delta V} \times 10K \quad (SPAN)$$

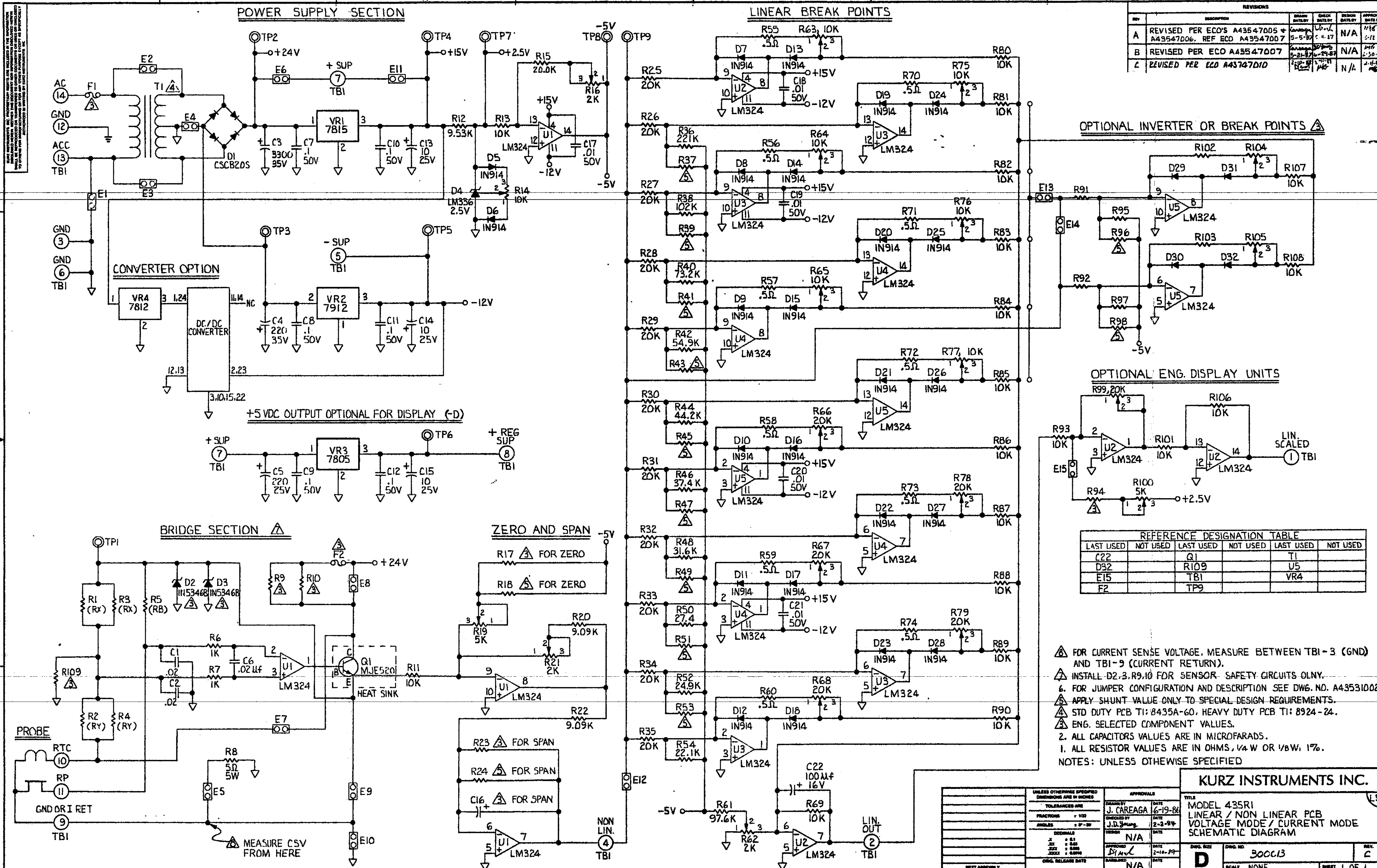
Q4	
R46	R1-6,R33,38,39
C21	C8,C9
D8	D4
VR5	
Q3	Q5
U3	
F1	
T1	
LAST USED	NOT USED
REF. DESIGNATION TABLE	

U3	LM324	4	11	3,5,10,12	
U2	LM324	4	11	5,10,12	1
U1	LM324	4	11	5,10,12	1
REF. DES.	IC No.	+15V	-15V	GND	UNUSED OUTPUTS
IC DEVICE TABLE					

NOTES:
1. FOR COMPONENT LAYOUT DIAGRAM SEE No. 071031005

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS ± DEC ± ANGLES ±		KURZ INSTRUMENTS INC.			
APPROVALS	DATE	MODEL 710R1 SCHEMATIC DIAGRAM (USE ON 4200 SYSTEM)			
DRAWN [illegible]	2/26/86				
CHECKED JD Young	2/28/86	SCALE NONE	SIZE D	DRAWING NO 300022	REV. A
APVD [illegible]	3/3/86				
		DO NOT SCALE DRAWING		SHEET 1 OF 1	


REVISIONS
A CHANGE PER ECO NO. A750047004
FUNCTION
S2: 3 POLE-4 POSITION SWITCH
S2A: VALVE CONTROL (OUTPUT)
S2B: VALVE CONTROL (INPUT)
S2C: VALVE CONTROL (SHUT OFF)
FUNCTION:
1. FLOW RATE
2. EXT. INPUT
DISPLAY SELECTED
0-13 VDC OUT TO TB1-7
D-5 VDC OUT TO 131R1/132 BOARD TB1-3
MASS FLOW INPUT (0-5 VDC)
EXTERNAL INPUT
MASS FLOW INPUT
DECIMAL POINT TO BE SELECTED
LCD
DISPLAY
S1: 3 POLE 4 POS SWITCH
POS.1: FLOW RATE
2: SET POINT
3: EXT. INPUT
S1A: DECIMAL PT SELECTED
S1C: DISPLAY INPUT
ZERO ADJ.
SPAN ADJ.
REF. ADJ.
SET PT. ADJ.
VEL. MATCH
KURZ INSTRUMENTS INC.
MODEL 710R1 SCHEMATIC DIAGRAM
(USE ON 7500 SYSTEM W/ 4-20mA OUT)
300023
DO NOT SCALE DRAWING
REF DESIGNATION TABLE
IC DEVICE TABLE



REVISIONS

REV	DESCRIPTION	DRAWN	CHECK	DESIGN	APPROVED
A	REVISED PER ECO'S A43547005 + A43547006. REF ECO A43547007			N/A	
B	REVISED PER ECO A43547007			N/A	
C	REVISED PER ECO A43747010			N/A	

REFERENCE DESIGNATION TABLE

LAST USED	NOT USED	LAST USED	NOT USED	LAST USED	NOT USED
C22		Q1		T1	
D32		R109		U5	
E15		TB1		VR4	
F2		TP9			

8. FOR CURRENT SENSE VOLTAGE, MEASURE BETWEEN TB1-3 (GND) AND TB1-9 (CURRENT RETURN).
7. INSTALL D2,3,R9,10 FOR SENSOR SAFETY CIRCUITS OLNY.
6. FOR JUMPER CONFIGURATION AND DESCRIPTION SEE DWG. NO. A43531002.
5. APPLY SHUNT VALUE ONLY TO SPECIAL DESIGN REQUIREMENTS.
4. STD DUTY PCB T1: 8435A-60, HEAVY DUTY PCB T1: 8924-24.
3. ENG. SELECTED COMPONENT VALUES.
2. ALL CAPACITORS VALUES ARE IN MICROFARADS.
1. ALL RESISTOR VALUES ARE IN OHMS, 1/4 W OR 1/8W, 1%.

NOTES: UNLESS OTHEWISE SPECIFIED

KURZ INSTRUMENTS INC.

MODEL 435RI
LINEAR / NON LINEAR PCB
VOLTAGE MODE / CURRENT MODE
SCHEMATIC DIAGRAM

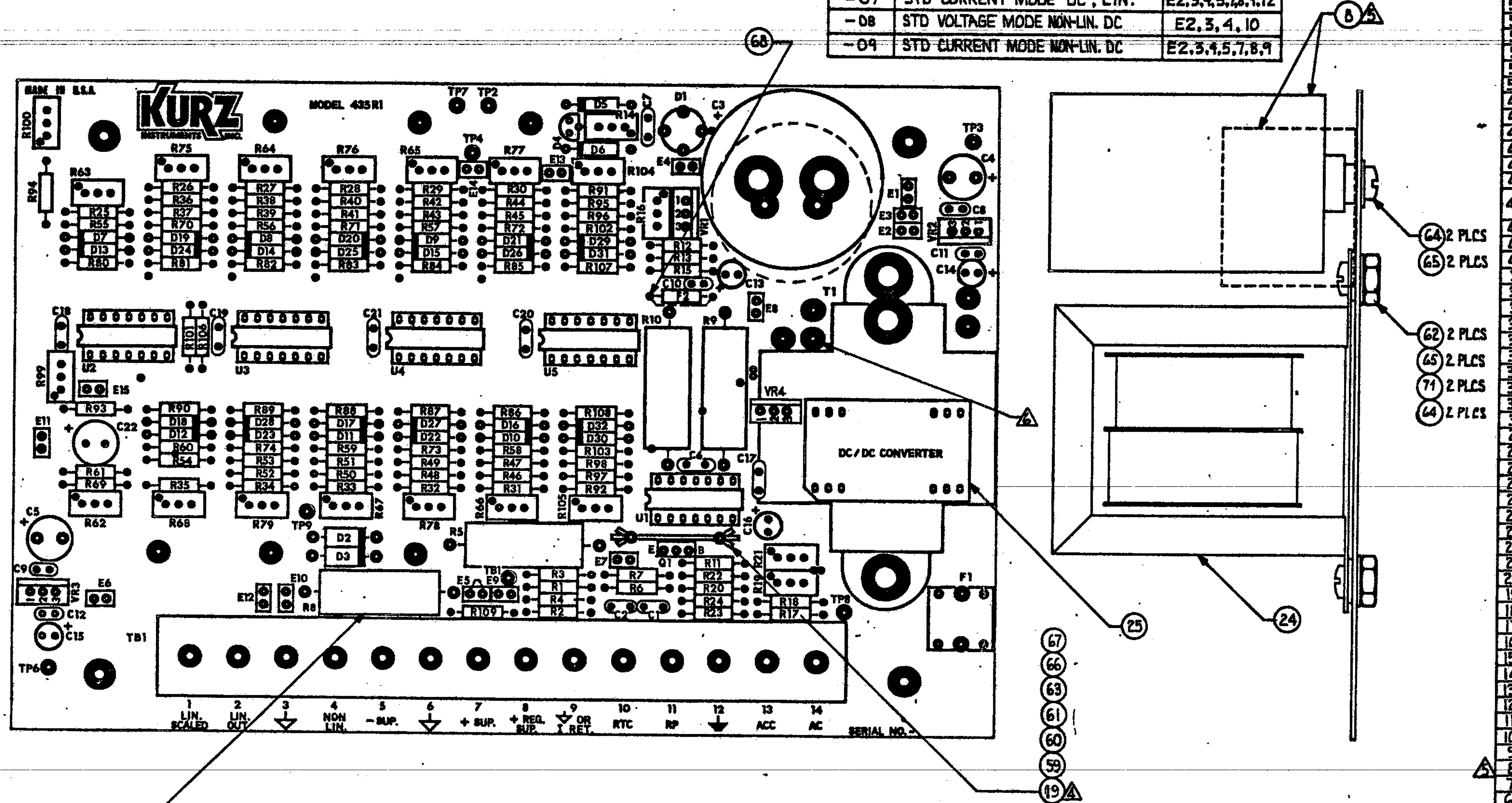
DRAWN BY: J. CAREAGA 6-19-86
CHECKED BY: J.D. Young 2-3-87
DESIGN: N/A
SIZE: D
DWG. NO. 300C13
REV. C
SCALE: NONE
SHEET 1 OF 1

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).

REV	DESCRIPTION				
A	REVISED PER ECO'S A43547005 + A43547006. REF ECO A43547007			N/A	
B	REVISED PER ECO A43547007			N/A	
C	REVISED PER ECO A43547009 A43547010 AND A43547011.			N/A	
D	REVISED PER ECO # A47214			N/A	

JUMPER CONFIGURATION TABLE

PART NO.	DESCRIPTION	CLOSE JUMPER
-01	HEAVY DUTY, CURRENT MODE, 220V	E5,7,8,9,12
-02	HEAVY DUTY VOLTAGE MODE, LIN.	E10, 12
-03	HEAVY DUTY CURRENT MODE	E5,7,8,9,12
-04	HEAVY DUTY VOLTAGE MODE NON-LIN.	E10
-05	HEAVY DUTY CURRENT MODE NON-LIN.	E5,7,8,9
-06	STD VOLTAGE MODE DC, LIN.	E2,3,4,10,12
-07	STD CURRENT MODE DC, LIN.	E2,3,4,5,7,8,9,12
-08	STD VOLTAGE MODE NON-LIN. DC	E2,3,4,10
-09	STD CURRENT MODE NON-LIN. DC	E2,3,4,5,7,8,9



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.

ITEM	QTY	REF DES	DESCRIPTION
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			
57	32	R109, R1-5,9-10,17,18,23, R24,37,39,41,43, R45,47,49,51,53,91, R92,94-98,102-105	RESISTOR, SELECTED
56	1	R36	RESISTOR 221K 1% 1/8W OR 1/4W
55	1	R38	RESISTOR 102K 1% 1/8W OR 1/4W
54	1	R61	RESISTOR 97.6K 1% 1/8W OR 1/4W
53	1	R40	RESISTOR 73.2K 1% 1/8W OR 1/4W
52	1	R42	RESISTOR 54.9K 1% 1/8W OR 1/4W
51	1	R44	RESISTOR 44.2K 1% 1/8W OR 1/4W
50	1	R46	RESISTOR 37.4K 1% 1/8W OR 1/4W
49	1	R48	RESISTOR 31.6K 1% 1/8W OR 1/4W
48	1	R50	RESISTOR 27.4K 1% 1/8W OR 1/4W
47	1	R52	RESISTOR 24.9K 1% 1/8W OR 1/4W
46	1	R54	RESISTOR 22.1K 1% 1/8W OR 1/4W
45	11	R25-35	RESISTOR 20K 1% 1/8W OR 1/4W
44	1	R15	RESISTOR 20 K 1% 1/8W OR 1/4W
43	19	R11,13,69,80-90,93, R101,106-108	RESISTOR 10K 1% 1/8W OR 1/4W
42	2	R20,22	RESISTOR 9.09K 1% 1/8W OR 1/4W
41	1	R12	RESISTOR 9.53K 1% 1/8W OR 1/4W
40	2	R6,7	RESISTOR 1K 1% 1/8W OR 1/4W
39	1	R8	RESISTOR 5Ω 1% 5W
38	11	R55-60,70-74	RESISTOR .5Ω % 1/8W OR 1/4W
37	6	R66-68,78,79,99	RESISTOR POT 20K 1%
36	7	R63-65,75-77,14	RESISTOR POT 10K 1%
35	2	R19,100	RESISTOR POT 5K 1%
34	3	R62,21,16	RESISTOR POT 2K 1%
33			
32	1	VR2	VOLTAGE REGULATOR 7912
31	1	VR1	VOLTAGE REGULATOR 7815
30	1	VR3	VOLTAGE REGULATOR 7805
29			
28	5	U1-5	SOCKET, 14 PIN
27	5	U1-5	IC LM324 OP-AMP
26			
25			DC/DC CONVERTER
24	1	T1	TRANSFORMER 8924A-24S
23			
22	8	TP1-4,6-9	TEST POINT
21	1	TB1	14 POSITION TERMINAL STRIP
20			
19	1	Q1	TRANSISTOR MJE520
18			
17	1	F1	FUSE SELECTED
16			
15	4	D29-32	DIODE SELECTED
14	1	D4	REF. VOLT. REG. LM336 2.5V
13	24	D5-28	DIODE 1N914 OR 1N4148
12	2	D2,3	DIODE 1N5346B
11	1	D1	BRIDGE RECTIFIER CSCB20S
10			
9	1	C16	CAP SELECTED
8	1	C3	CAP 3300µF, 35V
7	2	C4,5	CAP 220µF, 30V
6	1	C22	CAP 100µF, 16V
5	3	C13-15	CAP 10µF, 25V
4	6	C7-12	CAP .1µF, 50V
3	3	C1,2,6	CAP .02µF, 50V
2	5	C17-21	CAP .01µF, 50V
1	1		MODEL 435R1 PCB

KURZ INSTRUMENTS INC.

TITLE: PCB, ASSY., 435RI

DRAWN BY: J. CAREAGA DATE: 6-30-86

SIZE: D DWG. NO. 420019 REV. D

SCALE 1:1 SHEET 1 OF 1