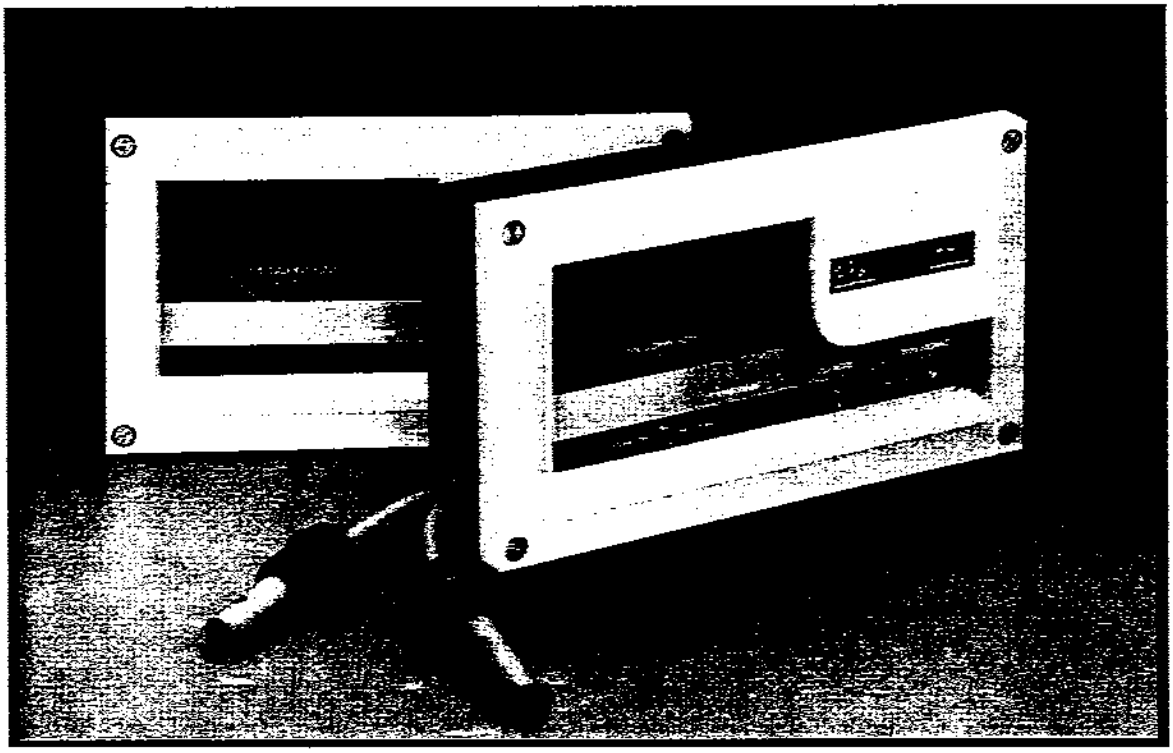
INSTRUCTION MANUAL

822 Analog & 832 Digital
Indicator / Controllers



thornton

WARRANTY

This warranty is a statement by Thornton Associates, Inc. that any of the following Thornton products, if found to be defective in materials or workmanship, will be replaced at no cost, if returned to Thornton by the original user within a period of 12 months from the date of purchase.

Products which are returned to and repaired by Thornton Associates, Inc., if found to be defective in materials or workmanship for the items stated as replaced or repaired, will be repaired or replaced at no cost, if returned to Thornton within a period of 3 months from the date of repair.

Thornton Associates, Inc. is not responsible for any products which fail, due to improper installation or any error, whether through negligence or otherwise, in their handling or operation. Thornton assumes no responsibility for the functioning of its products under any condition other than normal conditions. Thornton's liability under the foregoing warranty is limited to making the described repairs, and in no event shall Thornton be liable for special or consequential damages.

The foregoing warranty is the only warranty made by Thornton Associates, Inc., and is in lieu of all other warranties expressed or implied (including without limitation, implied warranties of merchantability and fitness for a particular purpose).

Note: Substitution of cables voids all warranties.

CONTENTS

1.1 SPECIFICATIONS

Ranges:	3 ranges—0 to 200 kilohms, 0 to 2 megohm, 0 to 20 megohm-cm.
Calibration:	Internal pots set power supply voltage and full scale, adjusted at factory.
Cells:	Use with Thornton Type 211-1 Cell
Cell Inputs:	1 of 2 selected from front panel switch—standard
Temperature Compensation:	Thornton dual automatic compensation, referenced to 25°C
Controller:	Single Set point
Relay:	2PDT (2 form C) 3 Amp resistive rating at 115 VAC
Power:	47-63 Hz, jumper selectable for 115 or 230 VAC inputs (5W max.)
Weight:	4 lb. (1.8 Kg)
Output Voltage:	0–10 VDC at 5 mA, max.
Voltage to Current Converter:	Plug-in card option available for 4–20 mA or 10–50 mA outputs.

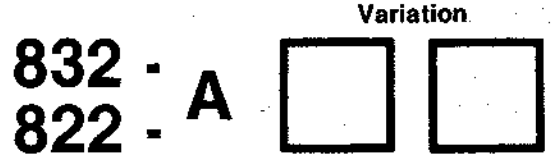
TYPE 832

Temperature Range:	−5°C to +55°C Operating −40°C to +60°C Storage
Readout:	½ in. high LCD liquid crystal display

TYPE 822

Temperature Range:	Operating: −30°C to +60°C Storage: −40°C to +70°C
Readout:	4½ in. analog meter (±2% tracking accuracy)

1.2 HOW TO ORDER



832 = Digital LCD Display, Resistivity, Indicator/Controller

822 = Analog Meter, Resistivity, Indicator/Controller

A = 0-20 Mohm-cm, 3 Range (0-20 Mohm-cm, 0-2 Mohm-cm, 0-200K ohm-cm).

Variation 01 = 115VAC Supply, Relay energized when reading is below set point, and Red LED indicator is illuminated

02 = 230VAC Supply, Relay energized when reading is below set point, and Red LED indicator is illuminated

1.3 DESCRIPTION

1.3.1. Measurement Technique — The electronic circuitry supplies a clipped 60 Hz AC current to the cell electrodes causing current to flow through the solution by virtue of the ions in the solution. The AC voltage between the electrodes is proportional to the cell resistance and hence, for a given cell constant, is proportional to cell resistivity. In order to display the temperature compensated resistivity it is necessary to sense solution temperature. For the 822 and 832 two thermistor temperature sensors are used, one having a resistance vs temperature characteristic which approximates that of pure water, and one which approximates that of impure water. The resistances of the cell and two thermistors are used in an analog computer circuit to create a voltage proportional to what the solution resistivity would be if it were at 25° C. The computation assumes that the common impurity is NaCl but most other impurities have a similar temperature dependence.

The 822 uses a 4-1/2 inch meter for display white the 832 uses a 3-1/2 digit LCD display. Both units have a full scale reading which can be set according to the intended application. An analog output signal is also provided with 10 volts corresponding to full scale. For control purposes this analog output is compared with a reference signal derived from a front panel "set point" control. A multipole relay is actuated if the analog output is below (or above) the set point and a red or green light indicates the relay state. The choice between actuation below or above set point is determined by jumper connections on the circuit board, as is the color of the indicator light.

This system features:

- dual thermistor automatic temperature compensation
- three ranges: 0-20 megohm-cm, 0-2 megohm-cm and 0-200 kilohm-cm.
- single set point controller/alarm
- 2 Form "C" relay (alarm) outputs
- selectable input from 1 of 2 sensors

1.3.2 Electrical Circuit (FIG. 1) A simplified functional schematic shows the essential elements of the 800 series meter which consists of:

A rear circuit board for the:
1) power supply
2) square wave a-c generator
3) controller/relay alarm
4) cell inputs

A front panel assembly including the:
1) amplifier circuitry
2) set point control
3) range switch
4) meter output
5) calibration adjust

More detailed schematics, component layouts and wiring diagrams are available in other sections.

1.3.3. Cells (or sensors) — The cell recommended for use with the Thornton 800 Series (822 and 832) controllers is the Thornton Type 211 (FIG. 2 - Appendix). The cell constant* is 0.01/cm. and incorporates two thermistors (FIG. 3).

The TYPE 211 has cell electrodes which are two concentric titanium cylinders constructed so as to allow the solution to flow through the gap between the cylinders. Two thermistor temperature sensors, mounted inside the inner electrode, and the cell electrodes are connected to a short 4 conductor cable terminated in a connector. The Type 800 Controllers measure the AC resistances of the

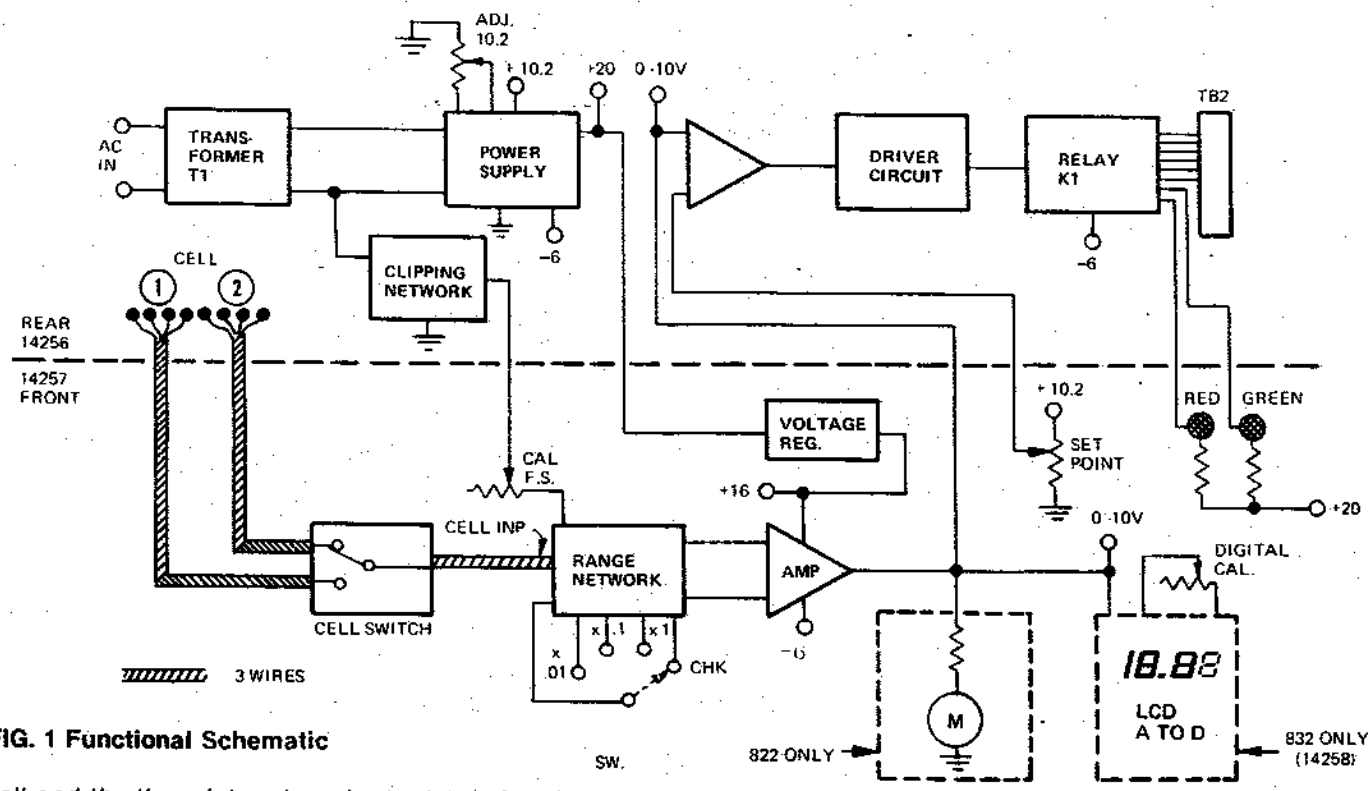


FIG. 1 Functional Schematic

cell and the thermistors in order to determine the temperature compensated resistivity. The resistance of the solution in the cell and the thermistor resistances will vary with temperature with typical values given below, assuming a solution of perfectly pure water.

T(°C)	R_{CELL}(KΩ)	R_{t1}(KΩ)	R_{t2}(KΩ)
0	833.0	653.0	17.6
10	444.0	380.0	14.0
25	183.0	180.0	10.0
50	55.5	59.7	6.1
70	28.5	27.0	4.3
100	12.8	9.6	2.7

The cell constant of the Type 211 is 0.01 cm^{-1}, so the resistivity of pure water is deduced to be 18.3 Mohm-cm if the cell resistance is 183 Kohm at 25 °C. The cell constant represents a geometry factor which can be visualized simply as in FIG. 4. Assuming the conducting solution exists in the space between the electrodes, the cell constant is the ratio of the spacing between the electrodes to the electrode area.

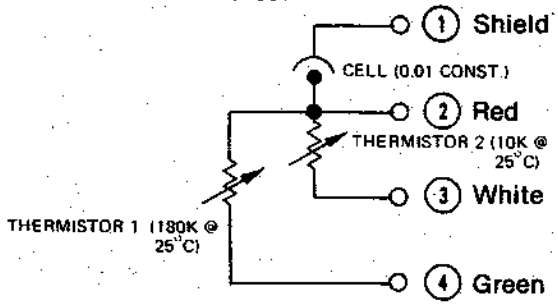


FIG. 3 Type 211 Cell Wire Connections

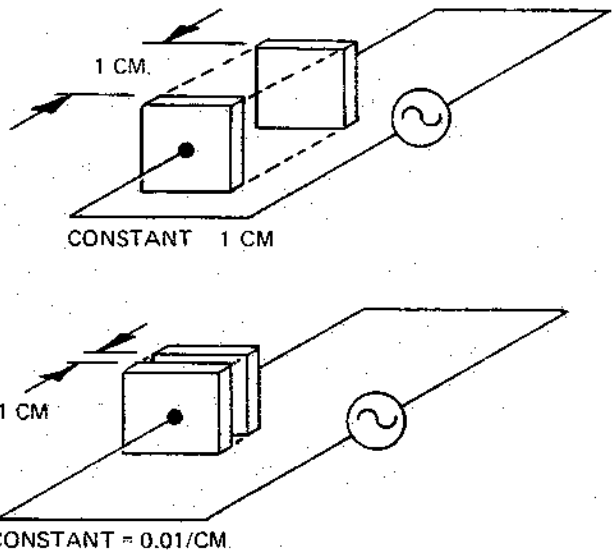


FIG. 4 Cell Geometry Equivalents (or Constants) Plate Areas both 1cm x 1 cm

2.0 INSTALLATION

2.1 MECHANICAL ATTACHMENT

The unique design of the rear case assembly allows all Series 800 controllers to have uniform attachment provisions. (FIG. 8 - Appendix). The case may be wall or panel (flush) mounted and fits cutouts of some other manufacturers as well.

Surface Mount: When the rear of the control panel or wall is accessible, the 800 Series case may be attached by two ¼-20 machine screws. (In a vertical alignment - 3.75-in. apart). The ¼-20 screw should be ⅜-in. longer than the panel is thick.

Panel Mount: The flanges of the rear case will accept 2 flat head No. 6 screws into tapped holes in the control panel or through slots for tinnerman nuts.

2.2 ELECTRICAL WIRING (FIG. 5)

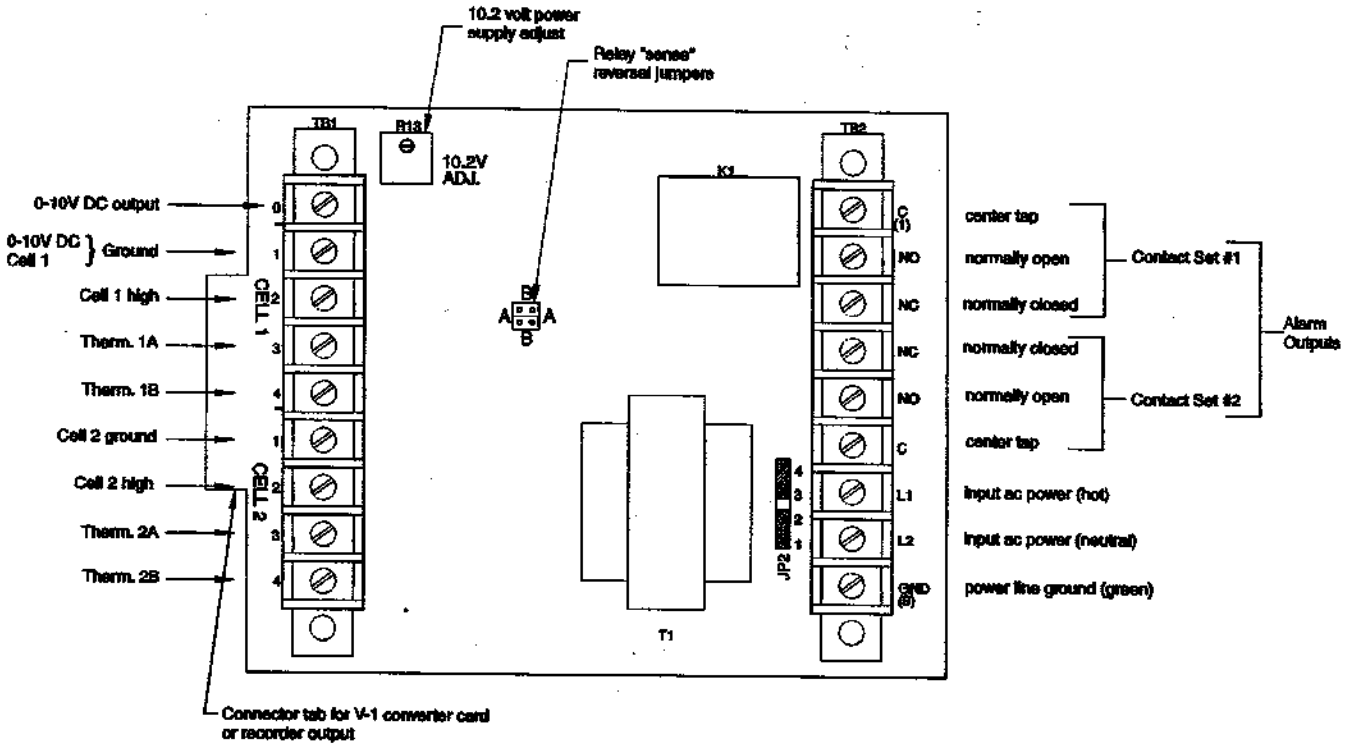


FIG. 5 Cell and Power Wiring

All electrical wiring should be done after mechanical installation of the rear case. No connections are made to the front panel — thus all reference below is to connections on the rear PC board.

The cell, power, alarm and output signal wires should be in accordance with all local electrical codes. In general, the 4 conduit holes may be used for the 4 types of signal used (Fig. 7). Viewed from the front of the controller, the left port would be for the cell, next port, 0-10V or current recorder output, next for power input and final for alarm output. IT IS USUALLY NOT ADVISABLE TO RUN POWER AND LOW LEVEL SIGNAL (cell and 0-10V output) WIRES IN THE SAME CONDUIT. Because the terminal strips both have built-in washer assemblies on each terminal, either stripped wires or spade lugs may be used.

2.2.1. Cell Wiring (FIG. 3) — The cell wires are always shielded with the shield connecting to the outer electrode of the cell. Two sets of cell wires may be connected to the left hand terminal strip (TB1) on the rear PC board. A factory purchased cell patch cord will be numbered on the end terminals 1-4 corresponding to 1-4 of TB1. Be sure 1-4 of cell 1 are separated from 1-4 of cell 2.

NOTE: If only one cell is used, it may be helpful to jumper cell 1 and cell 2 (corresponding pin numbers) together so the cell will be in the circuit regardless of the position of the front panel selector switch.

Should a different patch cord be used, Belden 9155 or equal cable should be used. Two critical components of the cell cable are:

(1) Shielding the cell input lead
(2) Low inter-wire capacitance

If the cell cable is not properly shielded, a small amount of electrical pickup can cause a large error in the output signal. If the cable capacitance is high it will also cause an error. Using Thornton supplied cable (or Belden 9155) will allow cell cable runs up to 100 feet (30 meters) without a significant error.

2.2.2 Power Wiring – The Series 800 is normally supplied with jumpers set for 100-130VAC (47-63Hz) power input. For operation at 230VAC (200-260VAC, 47-63Hz) the two jumpers must be removed and a single jumper installed. (FIG. 6).

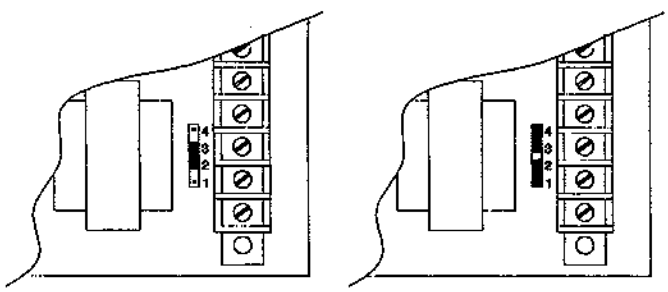


FIG. 6 Power Input Voltage Selection

The ac power input wires are attached to TB1 at pins 8 and 9 (L1 and L2) - Hot and Neutral respectively. PROVISION FOR FUSING OR CIRCUIT BREAKERS MUST BE MADE BY THE CUSTOMER — EXTERNAL TO THE SERIES 800 CASE.

2.2.3. Alarm Wiring — The alarm wiring is made to TB2 pins 1-6. These connections are wired via the pc board to a relay with two independent Form "C" contacts. These contacts will switch 3A resistive loads at 120VAC. Care should be taker with inductive loads not to overload the contacts.

Normally an 800 series unit will be wired to operate as follows:

(When the solution resistivity is)	Relay is	Light "ON"
Below the set point	energized	red
Above the set point	de-energized	green

This operation may be reversed by removing the pc jumpers at positions "A" and placing them into positions "B". (Table 1) pc board 14256.

2.2.4. Output Signal — Terminals 0 and 1 on TB1 provide a 0-10 volt dc output which is proportional to the span or meter reading. Connections made to this may be used to operate remote meters, recorders or as a computer interface. The output load should be such that **no more than 5mA** is drawn. Be sure the ground is connected to pin 1. (FIG. 5). The card edge tab on the left edge of 14256 also has connections for a voltage-to-current card or other remote recording devices. The 0-10 volt output as well as the ac line voltage is available from the card edge tab.

NOTE: Caution — all connections must be made before power input is connected. Hazardous voltages may appear on the terminal strip and precautions must be taken to avoid bare wires within the case. Wiring should be made before attaching the front panel, or applying power. Inspect to assure all wiring is correct and connections are tight. Complete the installation by connecting the polarized Flat cable into the Front Panel assembly.

TABLE 1 ALARM CONTROL WIRING

The following Table is set up to check the wiring desired for your system. It assumes a condition where the solution resistivity is higher than the set point.* (Solution Resistivity = 18 Megohms: Set Point = 10 Megohms.)

Measurement	Type	14256 Rear PCB Relay Sense Jumpers		Relay E = energized D = de-energized	14257 Front PCB LED Indicator Jumpers (14257)	Red LED	Green LED
Resistivity	822/832						
		A ⁞⁞ A		D	═	OFF	ON
		A ⁞⁞ A		D	✕	ON	OFF
		B ═ B		E	═	ON	OFF
		B ═ B		E	✕	OFF	ON

3.0 OPERATION

3.1 INITIAL OPERATION CHECK

1. Apply ac power to the system.
2. Switch the range knob to "Check" (CHK)
3. The check or calibrate span adjust is set by a screwdriver adjust on the pc board 14257 (labeled **R29**).
4. For the TYPE 822, adjust **R29** so the meter reads 20 (full scale).
   For the TYPE 832, adjust **R29** so the LCD display reads 10.0.
5. A check of the set point adjust may now be made to see that the relay changes state and the lights operate (per Table 1) when the set point control is rotated to positions above and below the meter "check" position.
6. Other calibrations available are factory adjustments or should be left to qualified service personnel.
   a) 10.2 volt power supply adjust (on rear pc board)
   b) DVM calibration (A to D converter board 14258) (set to make LCD reading = 2 times 0-10V output reading).

NOTE: No further calibration is necessary for most applications. All three ranges are matched with fixed resistors so they need not be adjusted. It is important for the cell shield (outer electrode) to be attached to earth ground. This is usually accomplished when the cell is threaded into a metal pipe.

It **may be** necessary to connect a ground wire internally between earth (case) ground (Pin 9, TB2) and pin 1 of TB1 (cell ground = signal ground) to avoid ground pickup problems which would primarily occur on the ×1 range (0-20MΩ -cm).

7. A check of the controller operation, exclusive of the cell may be made with fixed resistors used as simulators of cell and thermistor resistances. A test fixture may also be purchased from Thornton for that purpose.

3.3 USE

The Thornton 800 Series controllers and 200 Series cells are designed with high quality components and reflect design experience of over 15 years in conductivity experience. When used properly, the system will provide years of trouble-free operation.

The 800 Series controller and 200 Series cells may be used to test aqueous solutions in the general resistivity range of 1000 ohm-cm to 20 megohm-cm.

Because of variations in compensation requirements, the application may require special factory adjustments for very high accuracy. You may be assured of prompt response to requests for applications help by calling the factory.

Thornton **does not recommend** user servicing. Improper use or service of the equipment may void the warranty. The information contained within this manual is offered to aid in the application only.

4.1 CALIBRATION

The TYPES 822 and 832 are calibrated and individually tested and this field calibration should not be required. If the calibration controls have been changed, follow the steps below, **in the sequence listed** to recalibrate.

Note: For proper calibration use a mid scale simulator, part #1801-A with a patch cord. If this is not available, three precision resistors (±1%) can be used for a 10MΩ simulation on the 1x range. (Fig. 7), page 13. The steps below assume a 10MΩ simulated value at 25°C.

4.1.1. **Power Supply** — (pc board 14256) The regulated +10.2 volt dc power supply for all 800 Series units may be adjusted on the rear pc board with a small screwdriver on the single turn potentiometer R13. (Pg. 7, Component Layout 800 Rear). A 3½ digit DVM connected between pin 1 of the IC (U1) and ground (Pin 1, TB1) will monitor the voltage. Set R13 so that the 10.2 volt supply is 10.20 volts ±0.01 volts.

4.1.2. **Analog Circuit** (pc board 14257) — The full scale output of the analog portion of both the 822 and 832 is calibrated with the 1 Kilohm potentiometer R1. (Pg. 8 top, 822/832 Front PC). Adjusting this pot changes the full amplitude of the square wave ac signal to the front pc board. To accurately adjust R1, attach a DVM to pins 0 and 1 of TB1, a 10MΩ simulator and patchcord to cell 1, pins 1 through 4, and calibrate to 5.00 volts. This represents ½ scale. The analog meter will then read ±2% of full scale.

4.1.3. **Digital Circuit** (pc board 14258) TYPE 832 ONLY — Following the calibration per section 4.1.2., the TYPE 832 digital board may be calibrated so that the 10MΩ simulated input causes a 10.0MΩ reading on the LCD display. This is accomplished by varying R1 (5k pot) on pc board 14258. (Pg. 8 bottom, 832 Front PC).

4.1.4. **Check** — Adjust R29 (pg. 8 top, 822/832 Front PC) on pc board 14257 when range knob is turned to check position. For TYPE 822 adjust R29 so meter reads 20 (full scale) or DVM reads 10.0 VDC when the DVM is attached to pins 0 and 1 of TB1. For the TYPE 832, adjust R29 so the LCD reads 10.0 (½ scale) or the DVM reads 5.0 VDC (½ scale).

4.2 TROUBLESHOOTING (Tables 2 & 3)

The 800 Series system is designed with high quality semiconductor and passive components which are not likely to fail. Electromechanical components such as switches, relays, potentiometers etc. are more likely to be items which will require maintenance or replacement after extended use.

Repairs should be accomplished by "board level" replacement of assemblies. If component parts are replaced, such operation must be done by qualified personnel. In general, most repair or replacement work should be done by Thornton at its factory.

HINTS:

1) Try to isolate the problem as confined to the cell or the controller.
2) If the problem is not in the cell, check the front assembly separate from the rear.*
3) Look for obvious problems such as broken or loose cables, or damaged components.

TABLE 2 TROUBLESHOOTING CELL

Use a digital ohmmeter and check the following resistances between cell wires and the electrodes. The cell must be clean, dry and at 25°C.

From	To	Resistance (ohms)
Pin 1	Outer electrode	0
Pin 2	Inner electrode	0
Pin 1	Pin 2	∞ (> 50 Megohms)
Pin 2	Pin 3	10K ± 5% 25°C
Pin 2	Pin 4	180K ± 5% 25°C

*If you have more than one Series 800 unit, you can interchange fronts and rears to determine which part is faulty.

TABLE 3 Troubleshooting the Controller

Symptom	Check
No meter movement, No lights No relay action	Input power wiring Transformer T1 (open) Faulty cable interconnect
Lights ok Relay ok No meter	Open meter coil Faulty cable Open resistor R26 Open pot R1
Meter reads ok in CHK Meter reads off scale all ranges	Open cell, shorted thermistor Bad range switch Faulty component
Meter cannot be calibrated	Shorted pot R1 Component failure
dc output (0-10V) does not agree with meter	Faulty meter R26 out of tolerance
No lights Relay switches Meter reads	Faulty LED Faulty cable

4.3 REPLACEMENT SUB-ASSEMBLY (Board Level)

The 3 pc boards for the 822 and 832 are available for replacement as sub assembly parts. They may be ordered below by Thornton assembly number and pc part number. BE SURE TO SPECIFY CURRENT REVISION!

The 832 digital pc assembly will include the jumper wire set.

THORNTON Part No.	Assembly No.	DESCRIPTION
14257	08029	Analog Board Assembly
14257	08031*	Analog Board Assembly
14258	08020*	Digital Board Assembly
14256	08010	115V Power Supply Assembly
14256	08011	230V Power Supply Assembly

*832-A only

4.4 REPLACEMENT PARTS

4.4.1 PARTS LIST

KIT LIST 08076 - REAR CKT BD

	PART	DESCRIPTION	QTY.	COMMENT		PART	DESCRIPTION	QTY.	COMMENT
1	14256	CIRCUIT BOARD, REAR	1		16	501-2K2	RESISTOR, CARBON, 1/	1	R10
2	22108	TERMINAL, FORKED, SW	8		17	501-39K	RESISTOR, CARBON, 1/	2	R8,9
3	22170	TERMINAL STRIP 9 PI	2	TB1,TB2	18	501-8K2	RESISTOR, CARBON, 1/	1	R11
4	32087	POT CERMET, 2K, PC M	1	R13	19	503-2K2	RESISTOR, CARBON, 1/	1	R12
5	34006	RELAY, 24V, 3A, PC M	1	K1	20	55-10K0	RESISTOR, MET-FL, RN	1	R7
6	36078	XFORM DUAL PRI, 14 V	1	T1	21	55-1K91	RESISTOR, MET-FL, RN	1	R2
7	41015	DIODE, SILICON 600V	3	D1,4,5	22	55-5K76	RESISTOR, MET-FL, RN	1	R1
8	41038	DIODE ZENER 6.4V 0.	1	D2	23	62048	CAP CERAMIC .01 MF 2	2	C1,2
9	41039	DIODE ZENER 6.2V 5%	1	D3	24	63049	CAP LYTIC 500 MFD, A	2	C3,4
10	42032	XISTOR NPN, 2N2222A	3	Q2,4,6	25	71100	WIRE, #22 AWG SOLID	.031	J1
11	42526	XISTOR PNP HIGH BETA	3	Q1,3,5	26	71100	WIRE, #22 AWG SOLID	.031	J2
12	43071	MINI-DIP, DUAL OP AM	1	U1	27	71100	WIRE, #22 AWG SOLID	.031	J3
13	47007	LED, RED, FLV-117	1	D6	28	71100	WIRE, #22 AWG SOLID	.031	J4
14	501-10K	RESISTOR, CARBON, 1/	3	R3,4,6	29	92077	CABLE ASSY., 900 SER	1	P1
15	501-1M5	RESISTOR, CARBON, 1/	1	R5					

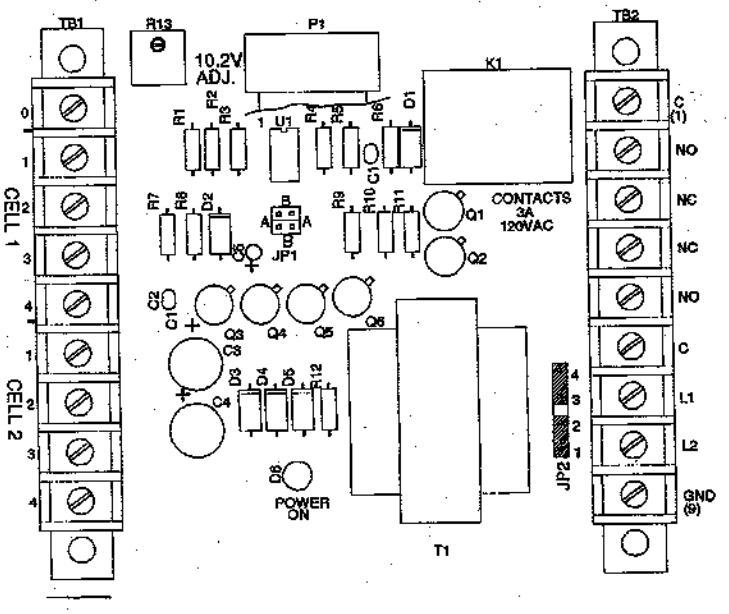
ANALOG CIRCUIT BD.

	PART	DESCRIPTION	QTY.	COMMENT		PART	DESCRIPTION	QTY.	COMMENT
1	14257	PCB FRONT W822	1		26	55-97K6	RESISTOR, MET-FL, RN55D 97.6K	1	R25
2	22108	TERMINAL, FORKED, SWAGEMOUNT	6		27	55-1K00	RESISTOR, MET-FL, RN55D 1K	1	R18
3	22544	SPACER, NYLON	2		28	55-1K15	RESISTOR, MET-FL, RN55D 1.15K	1	R12
4	25101	CONN. 16 PIN, MALE HEADER PC MT.	1	J1	29	55-21K0	RESISTOR, MET-FL, RN55D 21.0K	1	R13
5	31182	SWITCH 4 POLE, 4 POS	1	S1	30	55-2K61	RESISTOR, MET-FL, RN55D 2.61K	1	R20
6	31192	SWITCH 3P2T WIRE WRAP, SEALED	1	S2	31	55-499E	RESISTOR, MET-FL, RN55D 499 OHM	1	R3
7	32004	POT WW, 6K, PAN MT.	1	R17	32	55-42K2	RESISTOR, MET-FL, RN55D 42.2K	1	R7
8	32090	POT CERMET, 1K PC MT.	1	R1	33	55-4K53	RESISTOR, MET-FL, RN55D 4.53K	1	R23
9	32089	POT CERMET, 5K PC MT.	1	R29	34	55-562E	RESISTOR, MET-FL, RN55D 562 OHM	1	R4
10	41016	DIODE, SILICON, 1N914/4148	2	D2,D3	35	55-84K5	RESISTOR, MET-FL, RN55D 84.5K	1	R21
11	41031	DIODE, ZENER 16V, 1N4745	1	D1	36	55-9K53	RESISTOR, MET-FL, RN55D 9.53K	1	R26
12	42032	XISTOR NPN, 2N2222A	1	Q1	37	57-1M62	RESISTOR, MET-FL, RN65D 1.62M	1	R22
13	43049	DIP, QUAD OP AMP, PLASTIC, LM-324	1	U1	38	57-2M00	RESISTOR, MET-FL, RN65D 2M	1	R9
14	47009	LED RED - POINT SOURCE	1	D4	39	62048	CAP CERAMIC .01 MF 25V DISC	2	C3,C7
15	47010	LED GREEN - POINT SOURCE	1	D5	40	63036	CAP LYTIC 300 MFD, AT 6V	1	C2
16	501-180	RESISTOR, CARBON, 1/4W-10% 180 OHM	1	R16	41	63038	CAP LYTIC 47 MFD, AT 16V PC MT.	2	C1,C6
17	501-1K0	RESISTOR, CARBON, 1/4W-10% 1K	1	R14	42	63051	CAP LYTIC 10 MFD, AT 25V	2	C4,C5
18	501-3K3	RESISTOR, CARBON, 1/4W-10% 3.3K	1	R5	43	71100	WIRE, #22 AWG SOLID TINNED BUSS	.041	
19	501-47K	RESISTOR, CARBON, 1/4W-10% 47K	1	R19	44	71100	WIRE, #22 AWG SOLID TINNED BUSS	.041	
20	503-1K0	RESISTOR, CARBON, 1/2W-10% 1K	1	R8	45	71100	WIRE, #22 AWG SOLID TINNED BUSS	.041	
21	503-1K2	RESISTOR, CARBON, 1/2W-10% 1.2K	1	R6	46	77110	WIRE, #22 AWG SOLID TINNED BUSS	.041	
22	55-100K	RESISTOR, MET-FL, RN55D 100K	1	R24	47	77110	WIRE, #22 AWG SOLID TINNED BUSS	.041	
23	55-10K0	RESISTOR, MET-FL, RN55D 10K	2	R10,R15	48	78501	TUBING, #22 AWG SPAGHETTI	.060	
24	55-118K	RESISTOR, MET-FL, RN55D 118K	1	R2	49	78501	TUBING, #22 AWG SPAGHETTI	.060	
25	55-11K0	RESISTOR, MET-FL, RN55D 11.0K	1	R11	50	81070	TAPE, DBL-STICK	.083	

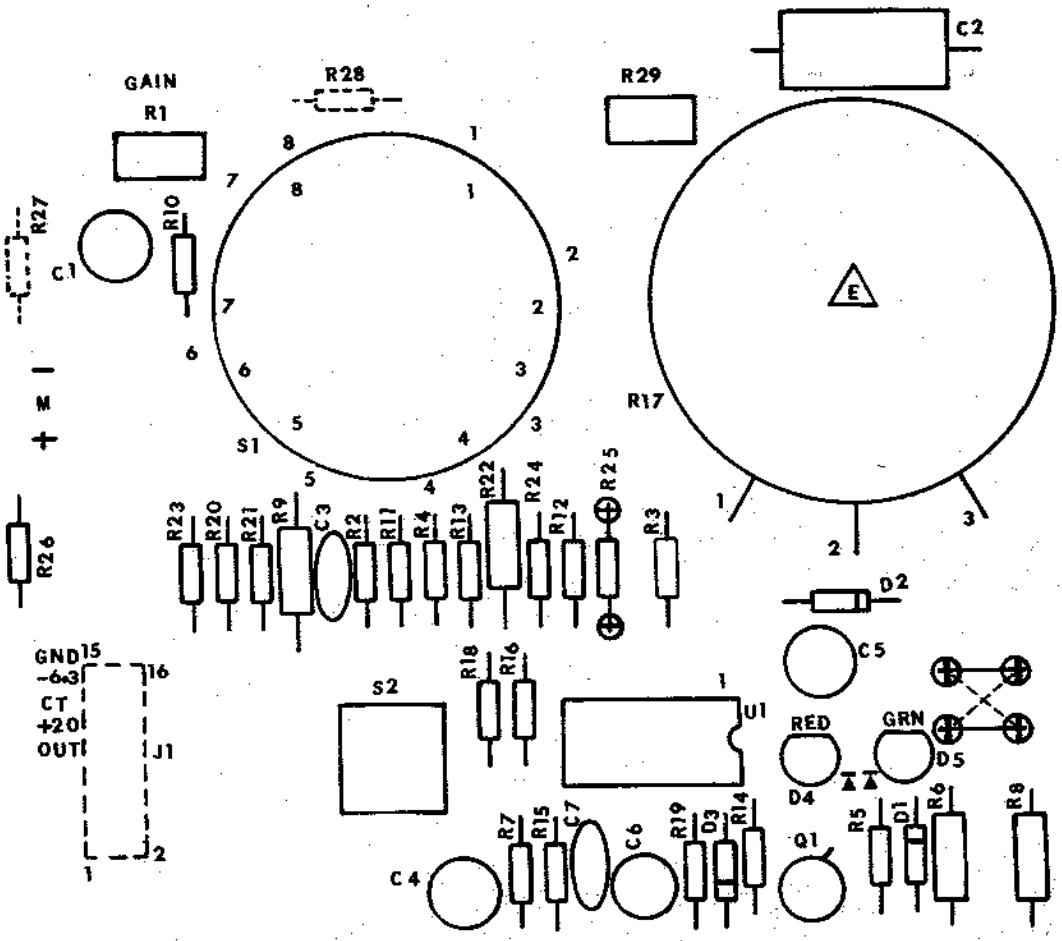
DIGITAL METER BD.

	PART	DESCRIPTION	QTY.	COMMENT
1	14258	CIRCUIT BOARD, 800	1	
2	21009	SCREW, 2-56 x ¼" PAN HD. PHIL	2	
3	21712	NUT, HEX 2-56, BVAT	2	
4	21750	L/W, NO. 2 INT	2	
5	25134	CONN, LCD ZEBRA & BEZEL	1	
6	27132	GASKET, LCD	1	
7	32089	POT CERMET, 5K PC MT.	1	R1
8	41006	DIODE, ZENER, 5.6 VOLTS, 5% IN752A	1	D1
	43045	DIP, CMOS QUAD EXCL OR GATE	1	
9		CD4030AE		U3
10	43061	DIP, HEX INVERT. BUFFER, CD4049AE	1	U1
11	43074	40 PIN, CMOS, DVM, 7106	1	U5
12	43075	DIP, CMOS QUAD 2-INPUT MULT. 4519	2	U2,U4
13	47013	LIQUID CRYSTAL DISPLAY	1	DS1
14	503-1K5	RESISTOR, CARBON, 1/2W-10% 1.5K	1	R9
15	501-M10	RESISTOR, CARBON, 1/4W-10% 100K OHM	1	R5
16	501-M47	RESISTOR, CARBON, 1/4W-10% 470K OHM	1	R4
17	55-4K75	RESISTOR, MET-FL, RN55D 4.75K	1	R3
18	55-10K0	RESISTOR, MET-FL, RN55D 10K	1	R2
19	55-100K	RESISTOR, MET-FL, RN55D 100K	1	R7
20	55-402K	RESISTOR, MET-FL, RN55D 402K	1	R8
21	61006	CAP MICA 100 PF AT 500V	1	C3
	62012	CAP MYLAR .1 MFD, AT 100V	4	C1,C2,-
22				C4,C5
23	63038	CAP LYTIC 47 MFD, AT 16V PC MT.	2	C6,C7
24	71100	WIRE, #22 AWG SOLID TINNED BUSS	.041	
25	71100	WIRE, #22 AWG SOLID TINNED BUSS	.041	
26	77110	WIRE, #22 AWG SOLID TINNED BUSS	.041	
27	77110	WIRE, #22 AWG SOLID TINNED BUSS	.041	
28	74012	JUMPER 5 COND X2"L	1	

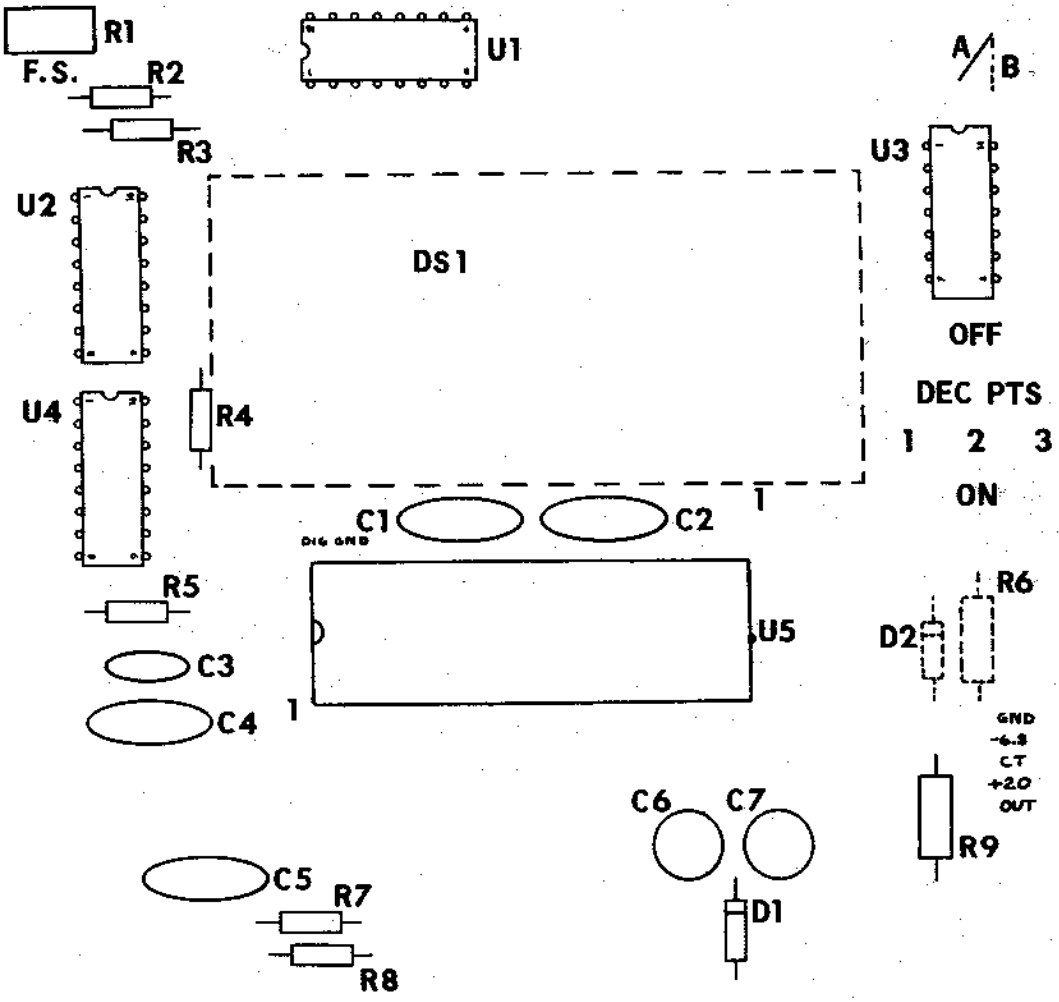
4.4.2. COMPONENT LAYOUTS



800 Series Rear PC Component Layout Power Supply-Controller

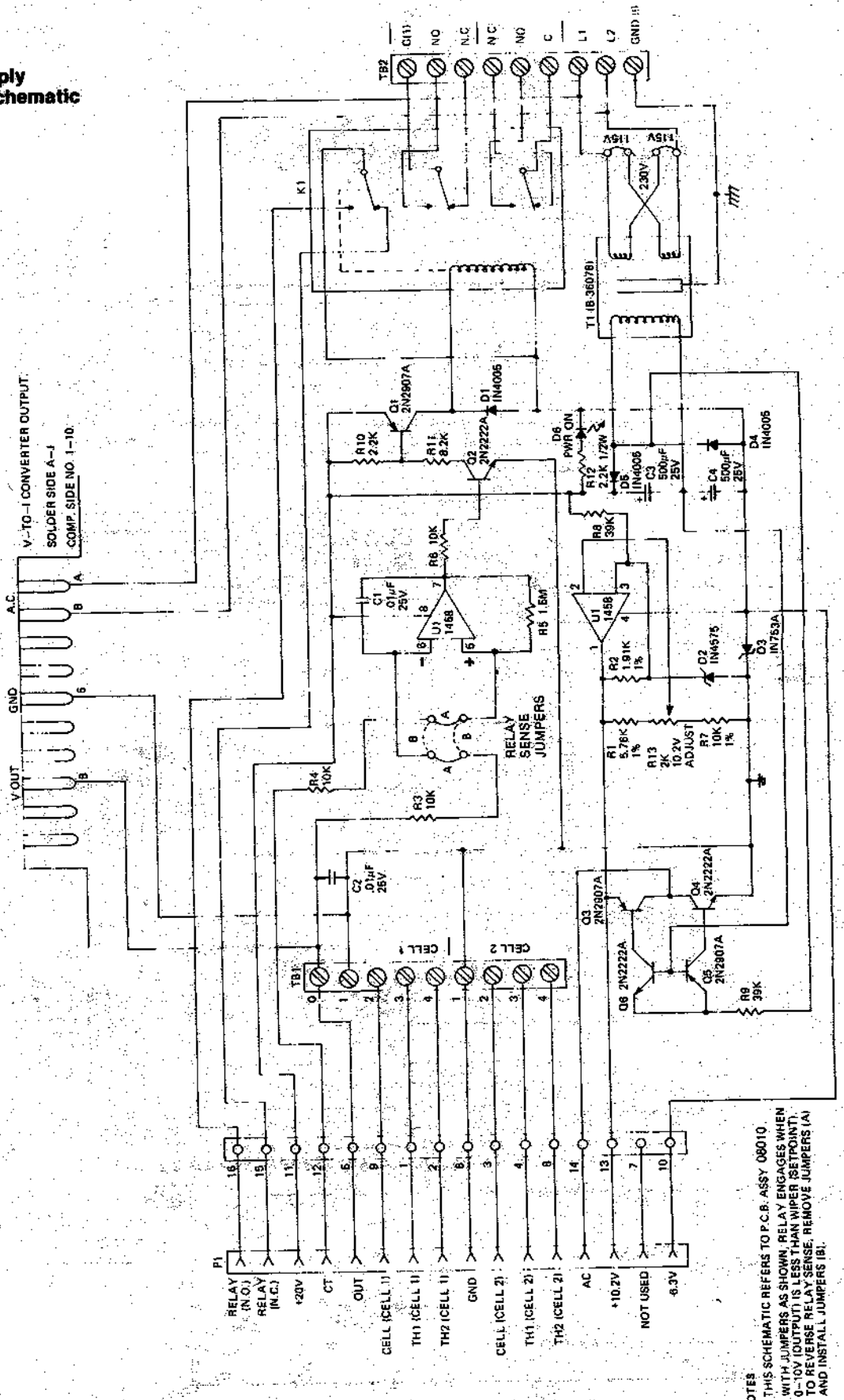


822/832 Front PC Component Layout Analog Section



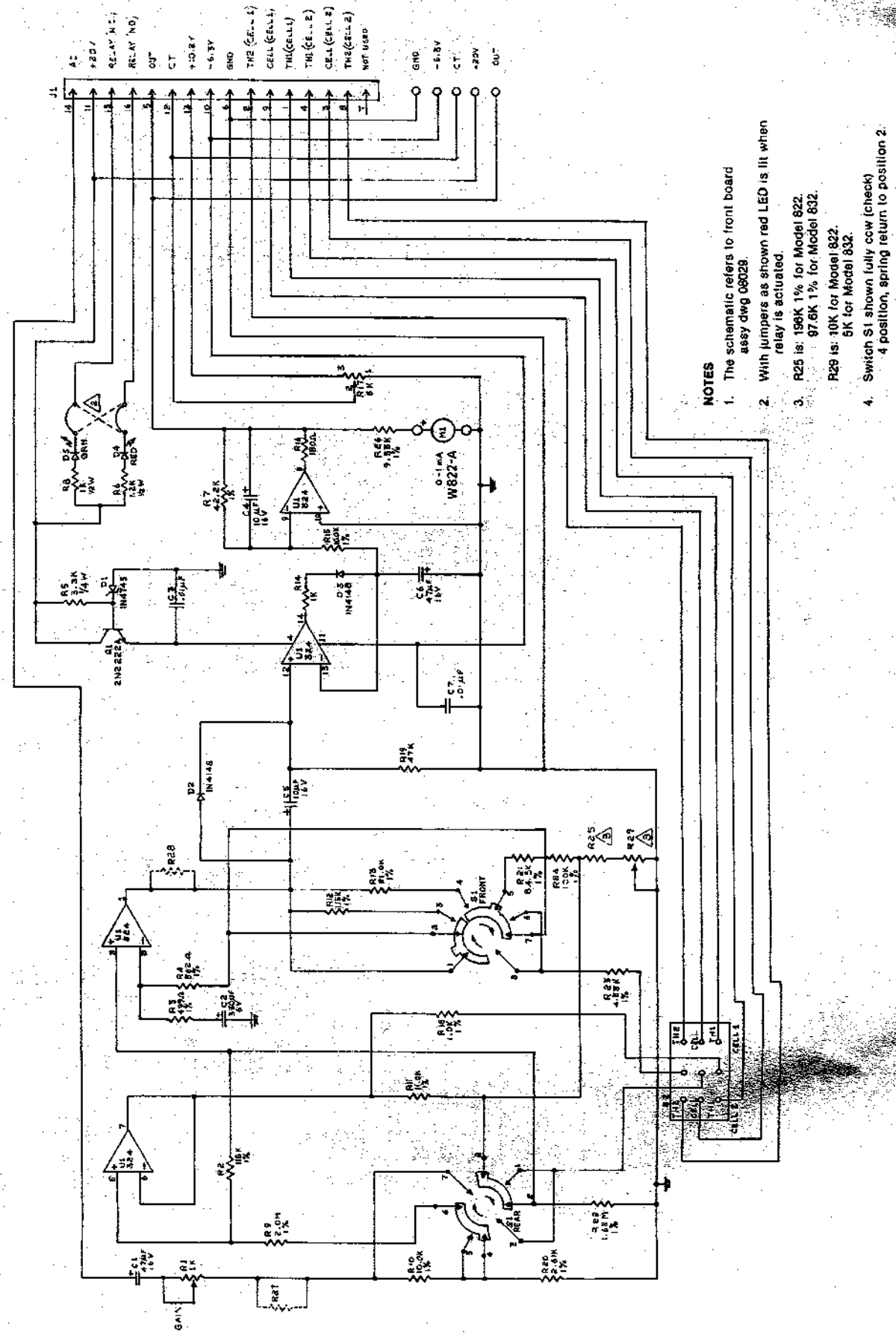
832 Front PC Component Layout Digital Section

Power Supply Rear PC Schematic (14256)

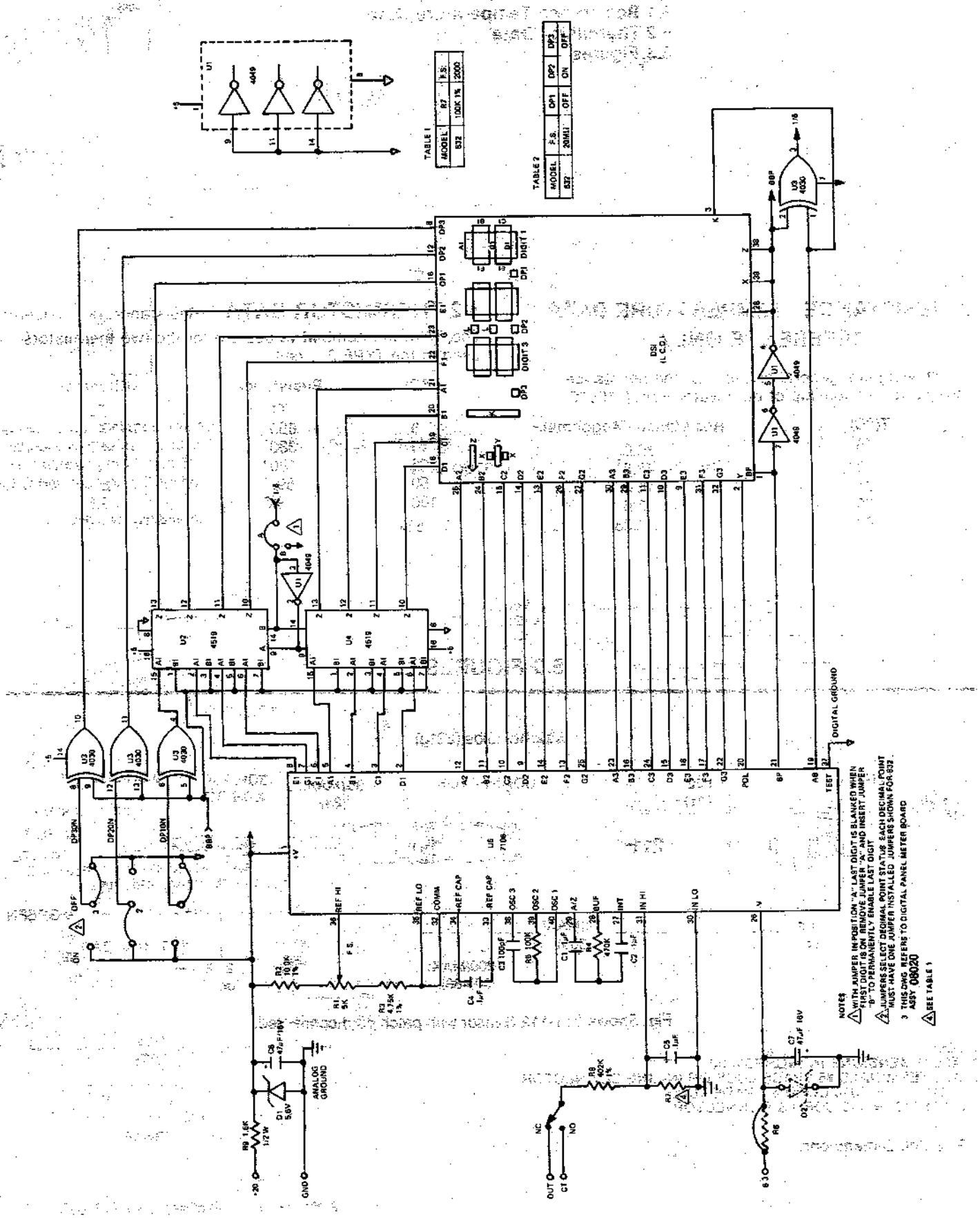


NOTES
1. THIS SCHEMATIC REFERS TO P.C.B. ASSY 08010.
2. WITH JUMPERS AS SHOWN, RELAY ENGAGES WHEN 0-10V (OUTPUT) IS LESS THAN WIPER (SETPOINT). TO REVERSE RELAY SENSE, REMOVE JUMPERS (A) AND INSTALL JUMPERS (B).

Analog
Front PC Schematic
(14257)



A-D Converter Schematic
(14258)



5.1 RESISTANCE - TEMPERATURE DATA REFERENCE ONLY

The following is a general example of the resistance-temperature relationship of pure water from 0-100 °C.

T(°C)	Resistance (Megohms)
0	80.0
10	43.2
25	18.0
50	5.5
100	1.28

5.2 THERMISTOR DATA - (Resistance vs. Temperature)

The following **nominal** values are for the two thermistors used in the TYPE 211 cell.

T(°C)	Resistance (Kilohms)	
	T1	T2
0	653	17.6
10	380	14.0
25	180*	10*
50	59.7	6.1
100	9.6	2.65

* ± 5%

5.3 FIGURES

Weight: .5lbs.(221g)

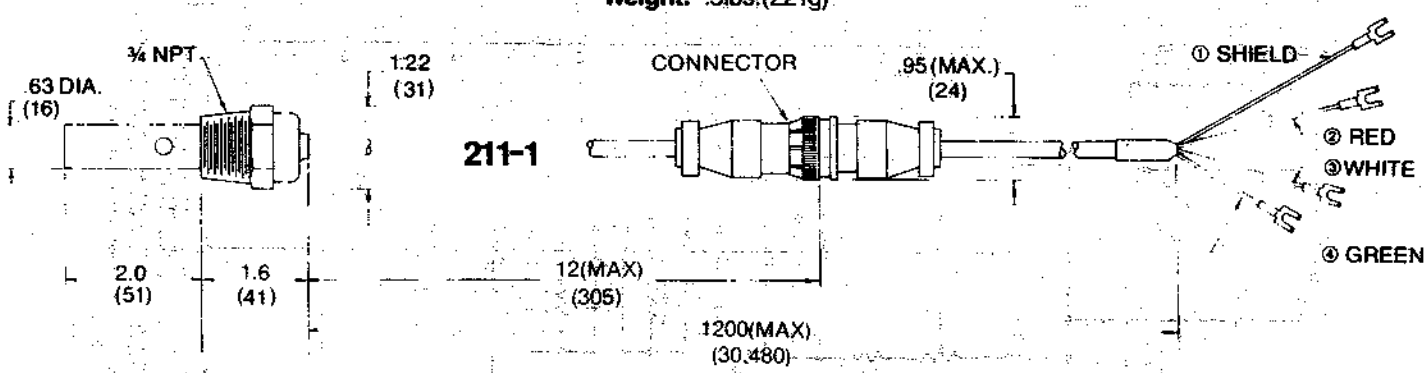


Fig. Shows 211-112 Sensor with patch cord connected.

NOTES:
1. ALL DIMENSIONS IN INCHES (MM).
2. ALL TERMINALS #6 SPADE LUGS OR IN-LINE CONNECTOR
   211-101 = 10'-0 CORD & SPADE LUGS
   211-112 = 1'-0 CORD & CONNECTOR

FIG. 2 Cell Dimensions

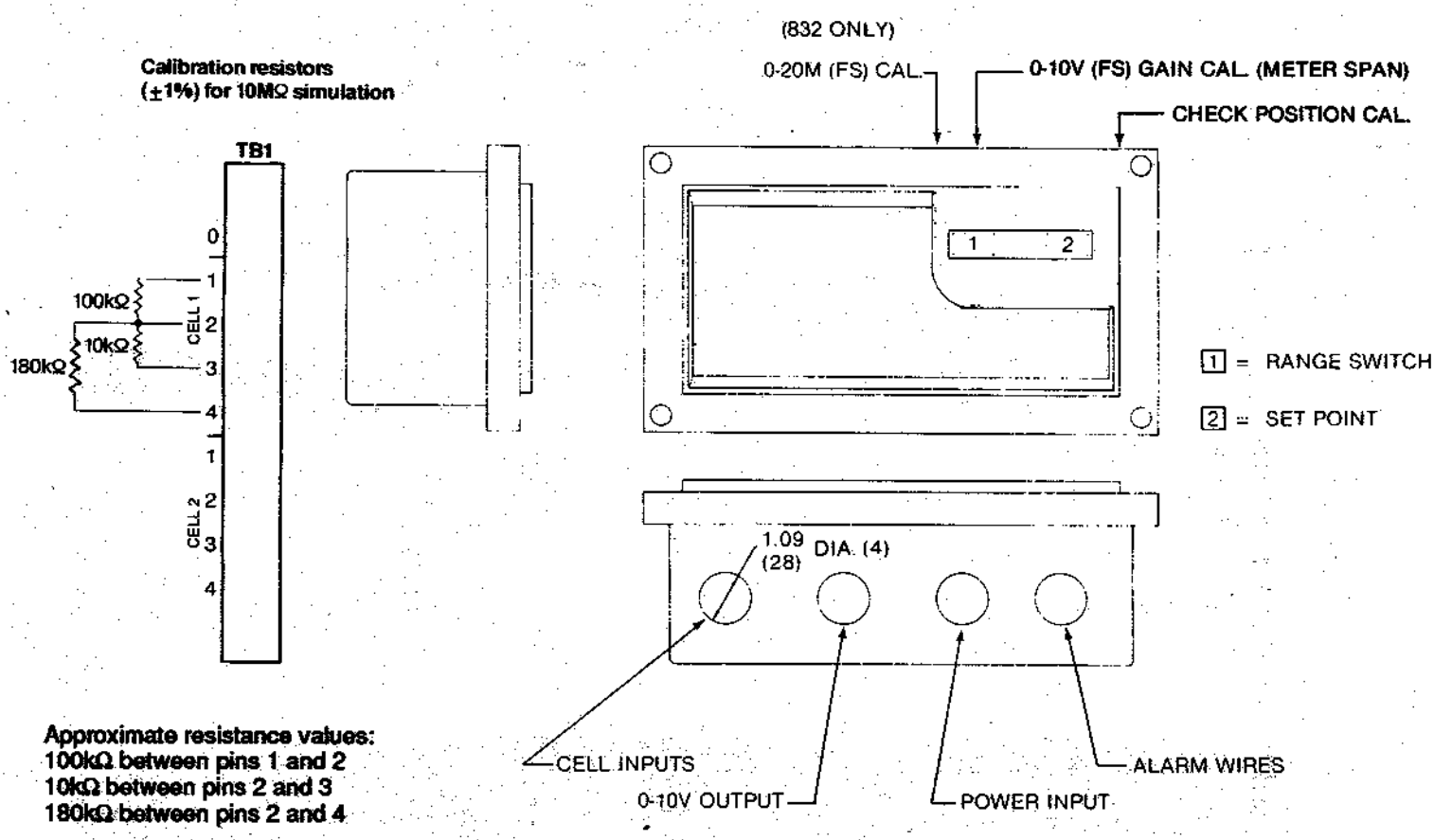


FIG. 7 Setup for Calibration

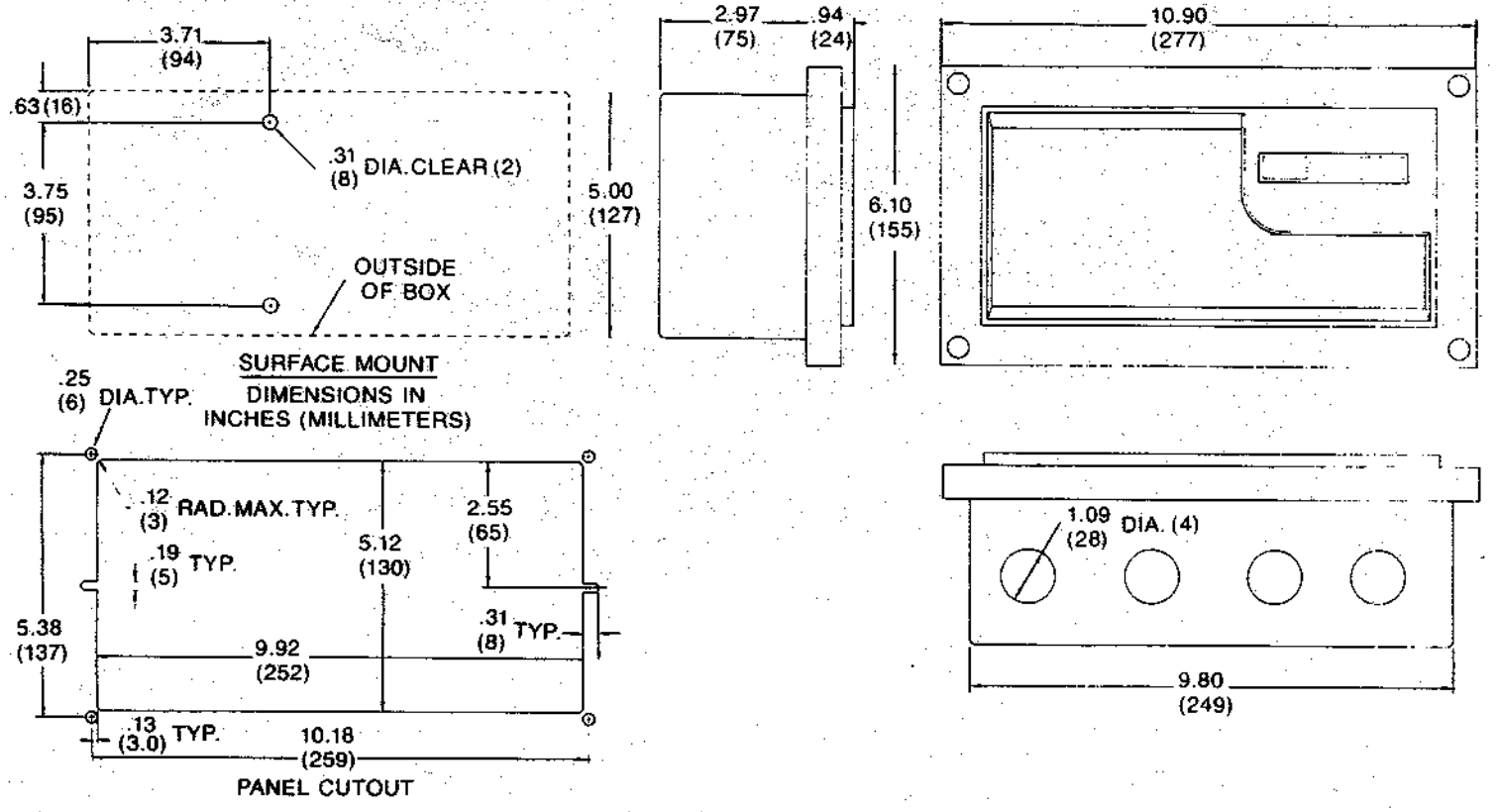


FIG. 8 800 Series Installation Dimensions