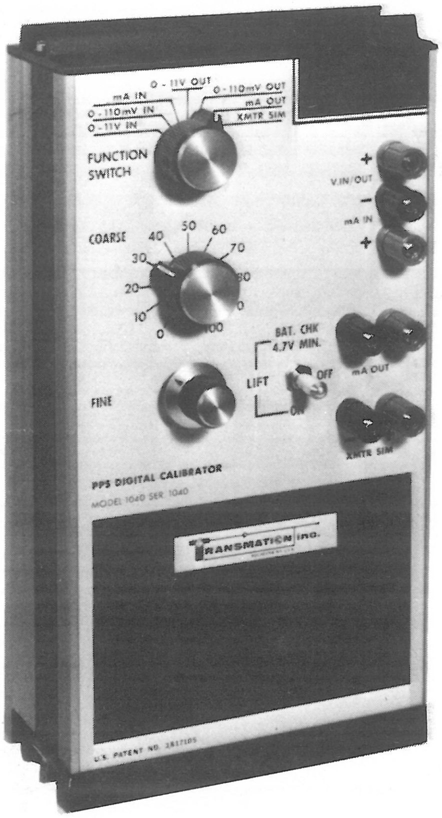
INSTRUCTION THAT SETS THE TREND

TRANSMATION inc.
ROCHESTER, N.Y. U.S.A.

INSTRUCTION BOOK

1040



1040 PPS DIGITAL POTENTIOMETER
(PART NO. 100724-000)

I.S. NO.: 100724-900

DATE: OCTOBER 1974

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FILE: TESTER

CUSTOMER P. O. NO.:

TRANSMATION REF. NO.:

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INTERFACE INSTRUMENTATION - DIGITAL/ANALOG

Analysis • Specifications • Design • Production

TRANSMATION inc.
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TELEX 97-8314 □ TELEPHONE 716 254-9000

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SECTION I

1040 GENERAL DESCRIPTION

1.1 DESCRIPTION:

The Transmation® Precision Pocket Source (PPS) Digital Potentiometer is a pocket sized, high accuracy portable test instrument in an anodized case intended for field use. It will directly measure unknown voltages and currents with a 4-1/2 digit digital voltmeter.

The PPS Digital Potentiometer also provides high accuracy test signals of 0 to 11 V, 0 to 110 MV, 0 to 22 MA, and 0 to 54 MA, for use in calibration of electronic equipment.

Simulation of two-wire transmitters for 0 to 22 MA and 0 to 54 MA output is standard. The tester is battery powered and uses rechargeable nickel-cadmium batteries with built-in recharger.

The Model 1040 is protected against misconnection by the use of fuses and internal protective circuits. The anodized case has a watersealed switch and gasketing provided so that the instrument may be used in light rain or mist. The rotary switches have rolled gold contacts instead of the more common gold flashed contacts for increased resistance to corrosive atmospheres, reliability and accuracy. The instrument case is rugged anodized aluminum with a padded vinyl case for carrying or handing from a pipe. Industrialized silicon solid state electronics and integrated circuits assure long term reliability in industrial environments.

SECTION II

1040 DIGITAL POTENTIOMETER

SPECIFICATIONS

(Part No. 100724-000)

2.1 INPUT: BY MEANS OF 5-WAY COLOR CODED BINDING POSTS

0-11 VOLTS DC WITH 10 MEGOHMS MIN. INPUT IMPEDANCE, CONSTANT INPUT BIAS CURRENT OF 70 NA MAX.
0-110 MV DC WITH 2 MEGOHM MIN. INPUT IMPEDANCE, CONSTANT INPUT BIAS CURRENT OF 50 NA MAX. EQUIVALENT TO 1°F ERROR WITH 1000 FEET OF 20 GAUGE J THERMOCOUPLE WIRE
0-22 MA DC WITH 100 OHMS INPUT IMPEDANCE
0-54 MA DC WITH 100 OHMS INPUT IMPEDANCE

2.2 MEASUREMENT CALIBRATED ACCURACY:

0-11V:	±0.04% OF RANGE ±0.03% OF READING MAX.
0-110 MV:	±0.06% OF RANGE ±0.06% OF READING MAX.
0-22 MA:	±0.12% OF RANGE ±0.06% OF READING MAX.
0-54 MA:	±0.06% OF RANGE ±0.06% OF READING MAX.

2.3 MEASUREMENT METHOD: 4-1/2 DIGIT INTEGRATING DIGITAL VOLTMETER WITH 5 DIGIT LED DISPLAY TO 11,000 COUNTS MAX.

2.4 OUTPUT: BY MEANS OF 5-WAY COLOR CODED BINDING POSTS

0-11 V DC:	5 OHM OUTPUT IMPEDANCE MAX.
0-110 MV DC:	25 OHM OUTPUT IMPEDANCE MAX.
0-22 MA:	0 TO 1300 OHMS LOAD
0-52 MA:	0 TO 500 OHMS LOAD
0-22 MA:	TWO WIRE TRANSMITTER SIMULATOR. EXCEEDS ALL POWER AND LOAD REQUIREMENTS OF
0-54 MA:	ISA SP-50 WITH 100V MAXIMUM DC SUPPLY VOLTAGE

2.5 OUTPUT CALIBRATED ACCURACY:

0-11 V:	±0.04% OF RANGE ±0.03% OF READING MAX.
0-110 MV:	±0.06% OF RANGE ±0.06% OF READING MAX.
0-22 MA:	±0.12% OF RANGE ±0.06% OF READING MAX.
0-54 MA:	±0.06% OF RANGE ±0.06% OF READING MAX.
XMTR SIM:	SAME AS 0-22 MA AND 0-54 MA

2.6 REFERENCE: STABILIZED ZENER DIODE

2.7 RECOMMENDED OPERATING TEMPERATURE RANGE: 0 TO +110°F, -18 TO +45°C

STORAGE TEMP: -40 TO +120°F, -40 TO +50°C

2.8 TEMPERATURE EFFECT: ±4 uv/°F TYP., ±6 uv/°F MAX. MV IN: .0015%/°F ALL OTHER RANGES

2.9 SENSITIVITY: 0-11V IN/OUT, 0-110MV IN/OUT: .01% F.S.
0-22 MA IN/OUT: .05% F.S.
0-54 MA IN/OUT: .02% F.S.

2.10 REPEATABILITY: 0.02% OF RANGE

2.11 POWER REQUIREMENTS: BUILT-IN RECHARGEABLE NICKEL CADMIUM BATTERIES - BUILT-IN CHARGER OPERATES FROM 115VAC 50/60 HZ. SUPPLY

2.12 BATTERY LIFE: 1.9 HOURS - 50 MA CONTINUOUS OUTPUT *gemeten 1 uur + 35 min*
2.7 HOURS - 20 MA CONTINUOUS OUTPUT
3.1 HOURS - V, MV CONTINIOUS IN/OUTPUT

2.13 WARMUP TIME TO RATED ACCURACY: 30 SEC MV IN; 5 SEC MAX. ALL OTHER RANGES

2.14 AREA CLASSIFICATION: DESIGNED FOR CLASS I, GROUP D, DIV. 2 SERVICE EXCEPT FOR RECHARGING

2.15 PROTECTION: ZENER DIODE AND FUSE PROTECTED ON ALL RANGES AGAINST MISCONNECTION AND OVERVOLTAGE UP TO 110 VOLTS

2.16 WEIGHT: 3 LBS. INCLUDING BATTERY (1.4KG)

2.17 SIZE: 8.25" HIGH X 2.67" DEEP X 4.5" WIDE

2.18 RANGE SELECTION: MANUAL WITH DECIMAL POINT SWITCHING AND LEADING ZERO BLANKING BUILT-IN

2.19 BATTERY CHECK: BUILT INTO ON-OFF SWITCH. DISPLAY INDICATES BATTERY VOLTAGE DIRECTLY

2.20 POWER SUPPLY EFFECT: LESS THAN ±2 COUNTS SHIFT FROM 5.3-4.7V BATTERY VOLTAGE

2.21 NORMAL MODE REJECTION: 70 DB 0-11V IN, 101 DB 0-110MV IN

2.22 COMMON MODE REJECTION: NO EFFECT UP TO 140 VAC 60 HZ

2.23 READING RATE: 700MS/READING

SECTION III

OPERATION

3.1 DESCRIPTION OF OPERATING CONTROLS (Refer to Figure 1 Page 13)

A. Function Switch "A"

This switch selects the desired mode and range of operation. There are seven positions.

1. 0-11V in: In this position an unknown DC voltage in the range of 0-11V may be measured.
2. 0-110 MV in: In this position an unknown DC voltage in the range of 0-110 MV may be measured.
3. MA in: In this position, an unknown DC current in the range of 0-54 MA may be measured.
4. 0-11 V out: In this position, the instrument provides a DC voltage output in the range of 0-11 volts.
5. 0-110 MV out: In this position, the instrument provides a DC voltage output in the range of 0-110 MV.
6. MA out: In this position, the instrument provides a DC current output in the range of 0-22 MA, and 0-54 MA out.

7. XMTR SIM: In this position, the instrument simulates a two-wire transmitter and may be inserted in a DC loop with a supply of 22 to 100V DC meeting the requirements of ISA SP-50. The instrument will provide an output of 0-54 MA in this function.

B. Coarse Decade Adjustment: "B"

This switch in conjunction with the fine adjustment control "C", determines the output signal. The dial is calibrated from 0-100 with each position representing the following:

0-11V in:	1.00 volt per step
0-110 MV in:	10.00 MV per step
MA in or XMTR SIM:	10.00 MA per step

This control is not used in the measurement mode.

C. Fine Adjustment: "C"

This control in conjunction with the coarse decade control "B" determines the output signal. The control is a ten-turn potentiometer with the full range of the control equal to one step of the coarse control. One turn of control "C" is equal to the following:

0-11V	100 MV
0-110 MV	100 UV
MA	1 MA
XMTR SIM	1 MA

This control is not used in the measurement mode.

D. Power Switch: "D"

This switch is a special locking type to prevent accidental power application. It has three positions. When the switch is in the center position, the instrument is off. To apply power to the instrument, pull the switch handle straight up and move it to the lower position, labeled "ON". To turn the instrument off, reverse the procedure. To test the batteries, pull the switch handle straight up and move it to the upper position, labeled "BAT.CHK.". This position is a momentary spring return position, so the handle will have to be held in place while checking batteries. When the switch is in the "BAT.CHK." position, the display "L" will indicate the battery voltage.

E,F. Xmtr Sim Output: "E" and "F"

These binding posts are used to connect the instrument into a control loop to substitute for a two wire transmitter.

G,H. MA Out Output: "G" and "H"

These binding posts are used to connect the instrument for current output.

I,J. MA In Input: "I" and "J"

These binding posts are used to apply a current input to the instrument.

J,K. Vin/Out: "J" and "K"

These binding posts are used for voltage and millivolt input and output.

3.2 USE OF FIVE WAY BINDING POSTS

All connections to the PPS "Digital Potentiometer" are made with 5-way binding posts. These posts allow almost any type of wire or test lead to be connected to the post. A miniature banana jack may be inserted into the top of the post. A wire may be connected by turning the plastic top of the post, counter clockwise, and inserting the wire in the exposed hole or wrapping the wire around the post and tightening down the post. A spade lug or the end of a test prod may be connected in the same manner as the wire. An alligator clip may be clipped to the top of the post.

3.3 USE OF PPS "DIGITAL POTENTIOMETER"

3.3.1 GENERAL OPERATION: (Refer to Figure 1 Page 13)

The PPS "Digital Potentiometer" is designed to give years of trouble free operation with little or no maintenance. The instrument is protected against false connection and wrong switch positions by internal protective circuitry and fuses, so that damage will not occur to the instrument, if a wrong connection is made.

It is a good practice to position function switch "A" to its proper position before any connections are made to the instrument. When changing functions, it is recommended that all wires going to the instrument are disconnected first. Then the function switch is set to its new position and the wire connected to the proper terminal.

Since the instrument has instantaneous warmup to calibrated accuracy, the power does not have to be left on. In order to obtain maximum life from the batteries, it is recommended that power switch "D" is kept on only during actual use. Set up the measurement, make it, and then turn the switch off. The electronics of the PPS "Digital Potentiometer" are separated from the battery compartment to prevent any leakage from the batteries from damaging sensitive components.

3.3.2 BATTERY CHECKING:

The PPS "Digital Potentiometer" has a built-in provision for checking batteries. The batteries should be checked each time the instrument is used.

To check the batteries, throw switch "D" upward to its "BAT.CHK." position. This switch has a spring return so that it will have to be held in position. If the display "L" reads greater than 4.700, the batteries are good. If the display does not light or lights briefly and then goes out, or reads less than 4.700, the batteries are weak and should be recharged. See recharging instructions Section 3.4.

When the battery voltage drops below 4.7 volts, the display will begin to flash as a warning of the low battery condition. After the display starts flashing the instrument will operate for approximately 15 minutes before the battery has exhausted below the point where operation is possible. The batteries should be recharged immediately after the display begins to flash.

WARNING: To prolong battery life and avoid damage, avoid completely discharging the batteries. The batteries should be recharged when the "BAT.CHK." reads 4.700 or lower.

3.3.3 USING THE PPS "DIGITAL POTENTIOMETER" AS A SOURCE OF SIGNALS:

The output of the source may be set at any level within the range selected by the use of the coarse and fine adjustment control "B" and "C".

3.3.3.1 VOLTAGE OUTPUT: (Refer to Figure 2 Page 14)

In this mode, the instrument will provide an output voltage of 0-11V DC.

1. Put the function switch "A" in the 0-11V out position.
2. Connect the input of the device under test to the Vin/Out binding posts.
3. Set the coarse and fine controls "B" and "C" to the desired voltage. The coarse control has a sensitivity of 1 volt per step and the fine control has a sensitivity of 0.1 volt per turn. The output voltage is read directly off the display "L".

3.3.3.2 MILLIVOLT OUTPUT: (Refer to Figure 2 Page 14)

In this mode the instrument will provide an output millivoltage in the range of 0-110 MV DC.

1. Put the function switch "A" in the 0-110 MV out position.
2. Connect the input of the device under test to the Vin/Out binding posts.
3. Set the coarse and fine controls "B" and "C" to the desired MV output. The coarse control has a sensitivity of 10 MV per step and the fine control has a sensitivity of 1 MV per turn. The output millivoltage is read directly off the display "L".

3.3.3.3 CURRENT OUTPUT: (Refer to Figure 2 Page 14)

In this mode the instrument will provide an output current in the range of 0-22 MA DC or 0-54 MA DC.

1. Put function switch "A" in the MA out position.

2. Connect the input of the device under test to the MA out binding posts.
3. Set the coarse and fine controls "B" and "C" to the desired current. The coarse control has a sensitivity of 10 MA per step, and the fine control has a sensitivity of 1 MA per turn. The output current is read directly off the display "L".

3.3.3.4 TWO-WIRE TRANSMITTER SIMULATOR OUTPUT: (Refer to Figure 2 Page 14)

In this mode, the instrument will simulate the output from a two-wire transmitter when connected in a loop having a supply voltage of between 22 and 100 volts.

1. Put function switch "A" in the xmtr sim position.
2. Disconnect the two-wire transmitter from the loop.
3. Connect the digital potentiometer in the loop with the xmtr sim binding posts.
4. Set the coarse and fine controls "B" and "C" to the desired current. The coarse control has a sensitivity of 10 MA per position and the fine control has a sensitivity of 1 MA per turn. The output current is read directly off the display "L".

3.3.4 USING THE PPS "DIGITAL POTENTIOMETER" TO MEASURE UNKNOWN SIGNALS:

The PPS "Digital Potentiometer" may be used to measure unknown signals within the range of the instrument. The unknown signal is read directly on display "L".

3.3.4.1 MEASUREMENT OF UNKNOWN VOLTAGE: (Refer to Figure 3 Page 14)

In this mode, the instrument will measure an unknown voltage in the range of 0-11 volts.

1. Put function switch "A" in the 0-11 volts in position.
2. Connect the unknown voltage to the Vin/Out terminals. Turn power switch "D" on. If display "L" reads 0.00, reverse the input leads (negative polarity signal).
3. Read the unknown voltage directly off display "L".

3.3.4.2 MILLIVOLTS IN: (Refer to Figure 3 Page 14)

In this mode, the PPS "Digital Potentiometer" source may be used to measure an unknown signal in the range of 0-110 MV DC.

1. Turn function switch "A" to the 0-110 MV in position.
2. Connect the unknown voltage to the Vin/Out terminals. Turn the power switch "D" on. Reverse the input leads (negative polarity input), if display "L" reads 0.00.
3. Read the unknown voltage directly from display "L".

3.3.4.3 THERMOCOUPLE INPUT: (Refer to Figure 3 Page 14)

In this mode, the PPS "Digital Potentiometer" may be used to measure unknown temperature from a thermocouple.

1. Turn function switch "A" to the 0-110 MV in position.
2. Connect the thermocouple to Vin/Out terminals. See connection diagram (Figure). The red thermocouple wire goes to the negative (black) binding post. Turn power switch "D" on. If display "L" reads 0.00, reverse the input leads, (negative polarity input).
3. Obtain a reading from the display "L".
4. Using an instrument thermometer determine the ambient temperature of the input terminals.
5. Using the thermocouple tables in the pouch, determine the output signal in millivolts from the thermocouple type in use at the measured ambient temperature of the terminals.
6. Add this value found in Step 5 to the signal found in Step 3.
7. On the thermocouple tables opposite the value found in Step 6, read the unknown temperature.
8. Example: A type "J" thermocouple is connected and the unknown voltage is measured as 7.94 MV. The ambient temperature near the terminals is measured as 80°F. In the thermocouple tables for type "J", 80°F is found to be 1.36 MV. Adding 1.36 MV to the measured voltage of 7.94 MV gives 9.30 MV. In the table, 9.30 MV is 344°F. Therefore, the unknown temperature is 344°F.

3.3.4.4 THERMOCOUPLE INPUT WITH REFERENCE: (Refer to Figure 5 Page 15)

If a Transmation Model 1010 Reference Cell of the proper type set to 32°F or 0°C is available, the computation in the previous section for temperature can be considerable simplified.

1. Turn function switch "A" to the <u>0-110 MV in</u> position.
2. Connect the thermocouple and PPS Reference Cell to the Model 1040 as shown in connection diagram (Figure). The wire from the Reference Cell to the 1040 should be positive thermocouple wire of the proper type. Turn power switch "D" on. If the display "L" reads 0.00, reverse the input leads (negative polarity signal).
3. Obtain a reading from display "L".
4. Using the thermocouple tables on the rear of the instrument, for the proper thermocouple type, determine the temperature for the unknown signal found in Step 3. This is the unknown temperature.
5. <u>Example</u>: A type "J" thermocouple and reference cell are connected and the unknown voltage is measured as 7.94 MV. From the type "J" thermocouple tables, the unknown temperature is read as 300°F.

3.3.4.5 CURRENT INPUT: (See Connection Diagram, Figure 3 Page 14)

In this mode, the PPS "Digital Potentiometer" will measure an unknown current in the range from 0-54 MA DC.

1. Turn function switch "A" to the <u>MA in</u> position.
2. Connect the unknown current to the <u>MA in</u> terminals. Turn the power switch "D" to on. If display "L" reads 0.00, reverse the input leads (negative polarity input).
3. Read the unknown current from display "L".

3.3.5 CURRENT LIMIT:

On some older transmitters of various manufacture, current limiting of the output signal was not provided. As a result, a transmitter that would normally send a signal in the range of 10 to 50 MA could provide an initial surge current in excess of 100 MA. This surge current, unless dissipated or limited, will cause the input fuse to blow, protecting the instrument. To prevent this occurence, attach a series limiting resistor, approximate value 100 to 200 ohms, to limit the surge current.

Newer transmitters produced with an intrinsically safe design do not have this problem. This is due to the fact that intrinsically safe requirements, limit the surge current to a safe level.

3.4 RECHARGING OF BATTERIES:

If the battery check test described in Section 3.3.2 indicates the batteries need recharging, they may be recharged in the following manner.

3.4.1 Remove instrument from its vinyl case.

3.4.2 Plug the charger cord into the receptacle on the bottom of the instrument.

3.4.3 Plug the other end of the cord into a 117V A.C. outlet, $\pm$10%, 50/60 HZ. A complete charge takes 12 hours.

WARNING: <u>DO NOT CHARGE IN HAZARDOUS AREAS</u>

3.5 Because of the slight differences in capacity between cells, one or more cells may run out of energy before the other cells in a multicell battery and reach zero voltage causing reverse charging of the lowest capacity cells. Cell reversal will not occur if the instrument is recharged when the battery test function indicates that recharging is necessary. A cell reversal could occur however, if the power switch is inadvertently left on for long periods of time.

3.5.1 DETECTING CELL REVERSAL:

If it is suspected that a cell reversal has occurred, the following procedure may be used to detect this condition. Verify that the one amp fuse in the battery circuit is good. Remove the battery assembly from the battery compartment and with an A.C. voltmeter measure the voltage across the secondary of the charging transformer, (across the yellow wires of the transformer). If the voltage across the secondary is between 8 and 15 volts A.C. with the charger plugged in, the charger circuit is working correctly. If this voltage is not present, the charger circuit is defective and is more than likely to cause the problem. If everything checks out O.K. plug the instrument in and allow it to charge for 24 hours. At the end of this time measure the D.C. voltage across the entire battery stack with a D.C. voltmeter and tester power switch off. If this voltage is less than 3.5 volts a cell reversal has probably occurred. A cell reversal cannot be corrected with the standard charging circuit.

3.5.2 CORRECTION OF CELL REVERSAL:

There are two basic ways that a cell reversal problem can be fixed. The first and the most obvious is to replace the defective cell. However, it is possible to restore a cell which has undergone reversal. The following procedure is recommended:

Remove the cells from the instrument. Connect them all in series to a current limited D.C. power supply capable of supplying 8 volts D.C. at 2 amps. Connect the batteries to the power supply and turn the current limit to a minimum. While monitoring the voltage across the cells with a voltmeter, increase the current limit to approximately 2 amps. After a few minutes, the voltage across the cell should suddenly start to rise. When it reaches approximately 4 1/2 to 5 volts reduce the current limit point to 200 milliamps. Allow the cells to charge at the 200 milliamp current level for 24 hours. This procedure should cure a cell reversal probelm. At the end of the 24 hours the open circuit voltage of the cells should be approximately 5.2 to 5.5 volts. If this is the case, these cells may be returned to service. If this procedure does not cure the reversal problem, these cells must be replaced.

3.5.3 PREVENTION OF CELL REVERSAL:

Cell reversal may be prevented by not allowing complete discharge of the batteries. When using the equipment always make sure that the power switch is off after making the measurement. Use the battery check function before each reading to assure that the batteries are not in need of charge. As soon as the battery test function indicates that the batteries need recharging, IMMEDIATELY recharge the batteries. Do not operate the instrument below the point where the battery test function indicates recharging is necessary.

3.6 REPLACING BATTERIES:

To replace the batteries, remove the lower cover plate. Pull the battery holder assembly out. Unsolder the leads from the batteries and solder in the new batteries. Connect two batteries in series, then connect the red lead to (+) and the black lead to (-). Place the batteries in the holder and replace the holder in the case.

SECTION IV

TROUBLE SHOOTING GUIDE

4.1 PREFACE:

Because of the extremely dense packaging and large number of precision components used in the Model 1040, it is recommended that any repairs or calibration other than replacing the batteries and fuses should be done by returning the instrument to the factory for repair or replacement. Accomplishing repairs in this manner minimizes instrument down-time and enables the user to achieve the maximum benefit of Transmation's factory repair service. However, for experienced electronic technicians who desire to repair their own unit, a careful reading of the description of OPERATION - SECTION VI and their own electronics knowledge should enable repairs to be accomplished. When a large number of instruments are in use, it is strongly recommended that a spare instrument should be purchased as per the Recommended Spare Parts List in SECTION VIII.

4.2 TROUBLE SHOOTING GUIDE:

DIFFICULTY	CAUSE OF TROUBLE	SOLUTION
Display dim, reads below 4.700 on BAT.CHK., Display flashes	Weak Batteries	Recharge Batteries
Unit completely inoperative, no function works. BAT.CHK. does not work.	Power switch turned off Batteries weak or dead F3 Blown	 Replace or recharge Batteries Replace F3
Unit completely inoperative, BAT.CHK. works. Display reads correctly on Vout and MV out.	Fuse F1 and/or F2 * Blown	Replace Fuse(s) *

* If fuses blow, read Paragraph 3.3.5 fully regarding surge currents and how to limit surges with a series resistor in the test leads.

DIFFICULTY	CAUSE OF TROUBLE	SOLUTION
MV IN/OUT, VIN/OUT, MA IN, XMTR SIM does not work, MA OUT works.	Fuse F1 Blown *	Replace F1 *
MA OUT does not work, all other functions working correctly.	Fuse F2 Blown *	Replace F2 *

* If fuses blow, read Paragraph 3.3.5 fully regarding surge currents and how to limit surges with a series resistor in the test leads.

4.3 REPLACING FUSES: (Refer to Figure 12 Page 20)

The instrument is protected against most electrical overloads by two fuses located in the instrument. To replace these fuses, remove the upper cover plate. The blown fuse should be replaced with a 1/10 amp fuse Littelfuse number 273.100 or equivalent for F1 and F2 and a 1 amp fuse Littelfuse number 273001 for F3. Refer to paragraph 3.3.5 for additional information on fuse blowing.

SECTION V

FACTORY SERVICE AND WARRANTY

5.1 FACTORY SERVICE:

Should service become necessary and field repair is inconvenient or undesirable, the instrument may be returned to the factory for repair or replacement as necessary. Please assist our Service Department by providing as complete a description of faulty operation as possible. Instruments should be shipped via AIR PARCEL POST: SPECIAL HANDLING, or other means as the urgency of services require, prepaid to:

FACTORY SERVICE DEPARTMENT
TRANSMATION, INCORPORATED

"CHECK YOUR LOCAL REPRESENTATIVE
FOR NEAREST REPAIR FACILITY."

5.2 WARRANTY:

Transmation, Inc. hereinafter referred to as the Company, warrants all equipment manufactured by it and bearing its nameplate, and all repairs made by it, to be free from defects in material or workmanship under normal use and service. If any part of the equipment herein described, and sold by the Company, proves to be defective in workmanship or material and if such part is, within twelve months from date of shipment from the Company's factory, returned to such factory, transportation charges prepaid, and if the same is found by the Company to be defective in workmanship or material, it will be replaced or repaired, free of charge, F.O.B. the Company's factory. The Company assumes no liability for the consequence of its use or misuse by the purchaser, his employees or others. A defect, in the meaning of this warranty, in any part of said equipment shall not, when such part is capable of being renewed, repaired or replaced, operate to condemn such equipment. This warranty is expressly in lieu of all other warranties, guarantees, obligations or liabilities, expressed or implied by the Company or its representatives. All statutory or implied warranties other than title, are hereby expressly negated and excluded. This warranty excludes expendable parts such as batteries, fuses and test leads.

5.3 ORDERING INFORMATION:

Please specify, when ordering spare parts or replacement parts for an instrument, the following:

1. Series number - Model 1040
2. Options

SECTION VI

THEORY OF OPERATION

The 1040 is composed of two printed circuit boards. One printed circuit board has the input, output, reference, switching and control functions while the other board houses a 4-1/2 digit DVM.

6.1 INPUT BOARD OPERATION: (Refer to Figure 7 Page 16 and Figure 8 Page 17)

In the voltage input mode, the input voltage is conditioned and switched directly to the input of the DVM. In the millivolt input mode, the millivolt signal is first conditioned and amplified by a millivolt amplifier A2. This amplifier brings the millivolt signal level up to a level high enough to operate the DVM. For milliamp inputs, the input current must first pass through scale factor resistor R40 which acts as a current shunt resistor to convert the current into a voltage which then drives the DVM.

The output voltage from the voltage reference is coupled into the operational amplifier A1. The gain of this amplifier is controlled by coarse switch S2 and 10 turn potentiometer R21. From A1, the reference voltage is coupled into operational amplifier A3. This amplifier, in conjunction with transistor Q2, serves as the output amplifier for the source. The function of A3 and Q4 depends upon the setting of function switch S1. In the voltage out position, the amplifier acts as a buffer amplifier coupling the signal from amplifier A1 to the output terminals. In the millivolt output mode, the amplifier again functions as a buffer amplifier. The voltage signal must pass thru a precision voltage divider consisting of R38 and R39 so that the signal level is reduced to a millivolt level.

In the current output mode A3 and Q2 form a voltage to current converter with the output taken from the collector of Q2. The scale factor for the voltage to current converter is determined by the scale factor resistor R40. In the transmitter simulator mode, the voltage supply of the collector of Q2 is replaced by the voltage from the controller in the field and may be anywhere from 22 to 100 volts. Operation other than this is identical to the milliamp output range. In all output modes, the output of amplifier A3 and transistor Q2 is monitored by the DVM so that the output is displayed.

The battery check function applies voltage from the batteries to the input of the DVM. The DVM then reads the battery voltage directly. Satisfactory operation will occur above battery voltages of 4.7 volts. Zener diodes, VR3, VR4, VR5, VR6, diode CR1, and fuses F1 and F2 serve to protect the instrument against accidental misconnection or overload which might otherwise damage the instrument.

6.2 DVM OPERATION: (Refer to Figure 9 Page18 and Figure 9 Page 19)

The DVM is basically a voltage to frequency converter whose output pulse repetition rate is proportional to the input voltage. These pulses are counted by a counter and displayed on a display. The input signal is first applied to the input buffer amplifier A1. This amplifier conditions the input signal and scales it to the proper magnitude to operate the rest of the DVM circuitry.

The output of the input buffer amplifier feeds the comparator A2. If the plus input of A2 is higher than the minus input, the comparator output is high. If the plus input is lower than the minus input, the output is low. The output from the comparator is used to gate a flip-flop A4. When A2 is high, the flip-flop is enabled and clock pulses are allowed to pass thru to the output. When A2 is low, the flip-flop is disables and no pulses can be present at the output. The output of the flip-flop feeds a precision pulse shaper network. This precision pulse shaper network generates a pulse of precise amplitude and width. One pulse is generated each time the flip-flop toggles.

The output from this pulse shaper is integrated by resistor R56 and capacitor C10 and applied to the negative input of comparator A2. If the input voltage to comparator A2 is more positive than the feedback voltage on the minus input, the output of comparator is high, the flip-flop is enabled and pulses from the precision pulse shaper pass to the integrator network. This causes the voltage on the integrating network to rise. When this voltage reaches the value of the input voltage, the comparator goes negative, the flip-flop is disabled and the precision pulse shaper stops. Thus, this feedback network adjusts the pulse repetition rate until the average on the integration capacitor is equal to the input voltage. For larger input voltages, a greater repetition rate is required. Therefore, the pulse repetition rate at the output of flip-flop A4 is directly proportional to input voltage.

These pulses are coupled into counter A7 where they are accumulated. The clock output also drives a divider chain consisting of A6. This divider chain divides the clock pulse by approximately 12,000. When this count is reached, the divider chain sends a transfer pulse in the counter, which transfers the accumulated count into the display. Immediately following the transfer pulse, a reset pulse also occurs which resets the counter and the divider chain to zero. Thus, the amount of counts accumulated in the counter is directly proportional to the input voltage.

A7 also contains decoding circuitry to drive the LED display A9. Over-range and decimal point switching are also handled by A7 and A8.

The DVM board also contains a D.C. to D.C. converter which supplies the necessary +40 volts, +15 volts and -15 volts from the 5 volt rechargeable nickel cadmium batteries. This converter runs at approximately 14K HZ. This board also contains the battery charging circuitry that allows recharging of the nickel cadmium batteries with no external components.

SECTION VII

CALIBRATION PROCEDURE

This instrument has been carefully calibrated at the factory and recalibration should not be attempted in the field unless equipment of sufficient accuracy is available to correctly adjust the instrument.

7.1 CALIBRATION OF DVM: (Refer to Figure 11 Page 20)

The calibration controls for the DVM are located on the DVM board.

MATERIAL REQUIRED: Precision voltage source capable of producing 10 volts with an accuracy of 1/2 millivolt or better. (Electronic Development Corporation Model MV100N or equivalent)

7.1.1 Remove the bottom cover from the instrument and carefully lift out the battery assembly. The DVM board is the lower of the two P.C. boards in the case.

7.1.2 Set function switch "A" to the <u>0-11V in</u> position. Connect the voltage source to the <u>Vin/out</u> terminals.

7.1.3 Set the source to 0.010 volts. Turn on the 1040 and note the reading on the display. If the reading is between 0.007 and 0.013, the DVM zero control is in adjustment and need not be calibrated.

7.1.4 If the DVM reads out of tolerance, adjust potentiometer R9 on the DVM board for a reading of 0.010.

7.1.5 Set the voltage source to exactly 10 volts. Note the reading on the display. If the reading is between 9.993 and 10.007 the DVM is in calibration and need not be adjusted. If outside of these limits, adjust potentiometer R17 to read exactly 10.000.

7.1.6 Repeat Steps 7.1.3 thru 7.1.5 until no further improvement is obtained.

7.1.7 This completes calibration of the DVM. Potentiometer R18 should not be adjusted.

7.2 CALIBRATION OF V OUT, MA OUT, MV OUT, AND XMTR SIM.:

MATERIAL REQUIRED: Precision voltmeter capable of measuring 10 volts to an accuracy of 1 MV. (Hewlett-Packard 740B or equivalent.)

7.2.1 Set function switch "A" to <u>0-11V out</u> position. Connect the voltmeter to the <u>Vin/out</u> terminals.

7.2.2 Set the coarse and fine controls fully counter clockwise.

7.2.3 Turn on the source and read the output on the voltmeter. If the voltmeter reads 0 volts ± 3 MV, the instrument is in specification and should not be adjusted. If the instrument does not read within specifications, adjust potentiometer R8 on the input board until the output is exactly 0 volts.

7.2.4 Turn the coarse dial to 100.

7.2.5 If the voltmeter reads 10.00 volts ±5 MV, the instrument is in specification and should not be adjusted. If the instrument does not read within specification, adjust potentiometer R11 on the input board until the output reads exactly 10.000 volts.

7.2.6 Repeat Steps 7.2.2 thru 7.2.5 until no further improvement can be obtained.

7.2.7 This completes calibration of the reference amplifier. Unless the MV in function is to be calibrated, return the battery assembly to the case.

7.3 CALIBRATION OF MV IN:

MATERIAL REQUIRED: Precision millivolt source capable of supplying 0-110 MV to an accuracy of ±5 UV. (Leeds & Northrup 7554 Type K4 or equivalent.)

7.3.1 Calibrate the V out range and DVM as described in the preceding sections.

7.3.2 Set the function switch to 0-110 MV in. Connect the millivolt source to the Vin/out binding post. Turn on the instrument.

7.3.3 Set the MV source to 100.00 MV.

7.3.4 Carefully adjust the potentiometer R28 on the input board until the readout reads 100.00 MV ±0.12 MV.

7.3.5 Set the MV source to 0.010 MV.

7.3.6 Adjust potentiometer R45 until the readout reads 0.010 MV ±.006 MV.

7.3.7 Repeat Steps 7.3.3 to 7.3.6 until no further improvement is obtained.

7.3.8 This completes calibration of the instrument. Disconnect the equipment and replace the battery assembly and cover.

7.4 CHECK OF CURRENT OUTPUT:

MATERIAL REQUIRED: Precision voltmeter capable of reading 5 volts to an accuracy of 1 MV or better. (HP 740B or equivalent.) Precision 100 ohm resistor .001% accuracy or better.

7.4.1 Calibrate the V out range and DVM as described in Section 7.1 and 7.2.

7.4.2 Set the function switch "A" to MA out. Connect the DVM to the MA out terminals. Connect the 100 ohm shunt resistor across the input to the DVM.

7.4.3 Set the coarse control to 20 and the fine control fully counter clockwise.

7.4.4 Turn on the power switch. The DVM should read 2 volts ±3.6 MV. If the reading is not within the specification, the instrument should be returned to the factory for repair.

7.5 CHECK OF CURRENT INPUT:

MATERIAL REQUIRED: Current source and current measuring potentiometer capable of measuring 20 MA to an accuracy of 2 UA. (L & N Type 7554 Type K4 with 4385 Shunt Box or equivalent.)

7.5.1 Calibrate the V out range and DVM described in Section 7.1 and 7.2.

7.5.2 Set the function switch "A" to MA in. Connect the current source in series with the potentiometer to the MA in binding posts. Turn on the instrument.

7.5.3 Set the output of the current source to exactly 20.000 MA. The DVM on the 1040 should indicate a reading of 20 MA ±.04 MA. If the instrument is not within specifications, it must be returned to the factory for repair.

RECOMMENDED SPARE PARTS LIST

PART NUMBER	PART DESCRIPTION	RECOMMENDED QUANTITIES FOR 10 INSTRUMENTS
100724-000	INSTRUMENT MODEL 1040	1
759306-008	1/10 AMP FUSE	10
759306-019	1 AMP FUSE	5
759521-003	RED BINDING POST	1
759521-001	BLACK BINDING POST	1
759550-003	BATTERIES - NICKEL CADMIUM (SET OF 2) f280.=	1
100724-019	INSTRUCTION-CONVERSION CARD	1
100724-022	CONVERSION CARD	1
100724-023	J & K THERMOCOUPLE TABLES	1
100724-024	E & T THERMOCOUPLE TABLES	1
100001-006	KNOB, LARGE	1
100001-007	KNOB, SMALL	1
759995-010	CARRYING CASE	1
500143-000	TEST LEADS	5 PAIR
604000-001	THERMOMETER	1
100724-900	INSTRUCTION MANUAL	1
756023-001	POWER CORD	1
100724-003	220V 50/60 HZ ADAPTER	1
759008-004	POWER SWITCH	1

SECTION IX

FIGURES

CONTROL IDENTIFICATION

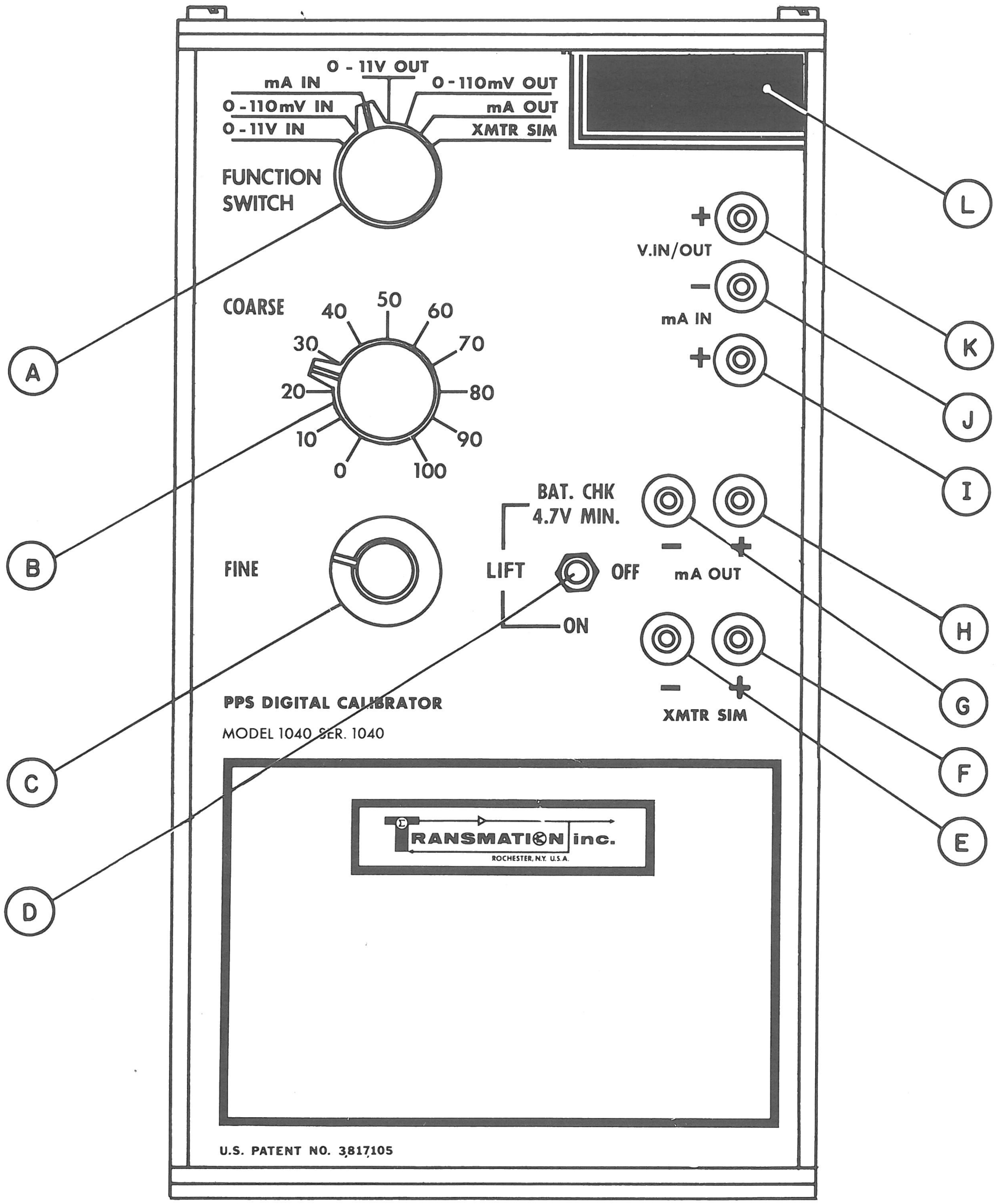


FIG. 1

CONNECTION DIAGRAM OUTPUT

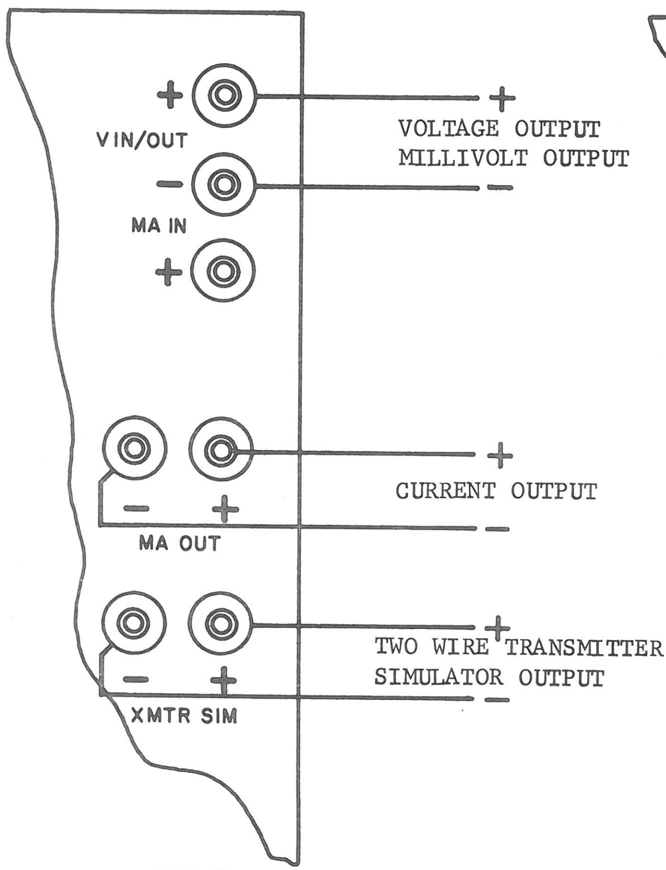


FIG 2

CONNECTION DIAGRAM INPUT

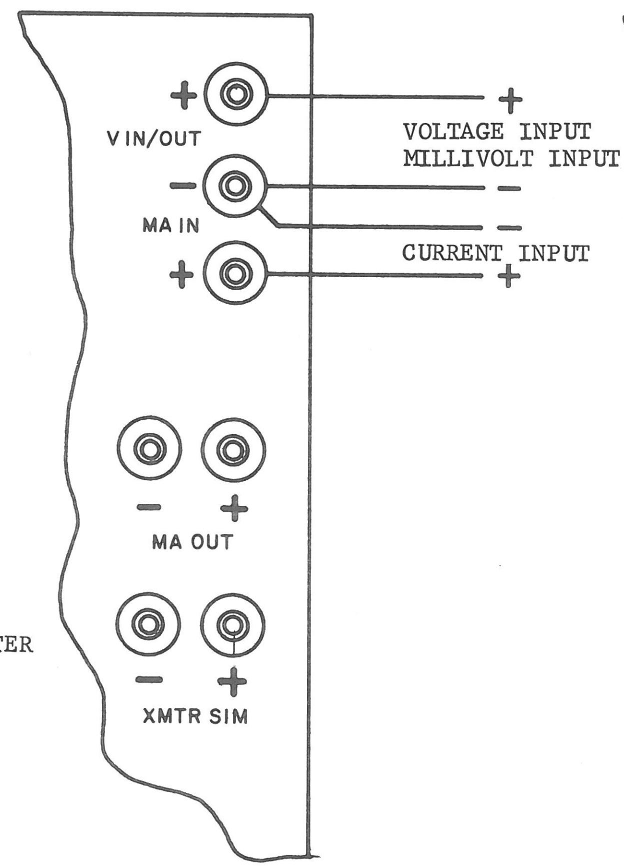


FIG 3

CONNECTION DIAGRAM THERMOCOUPLE INPUT

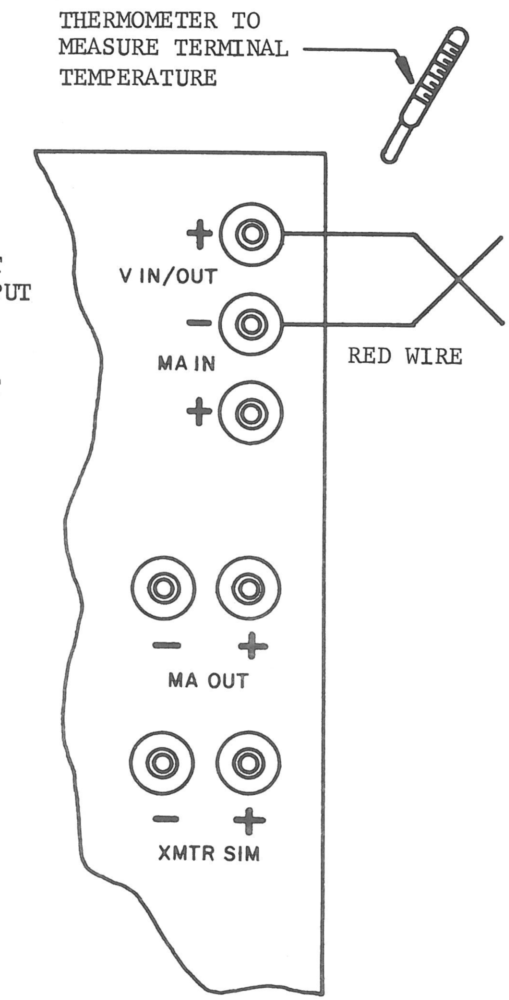


FIG 4

CONNECTION DIAGRAM THERMOCOUPLE INPUT WITH REFERENCE

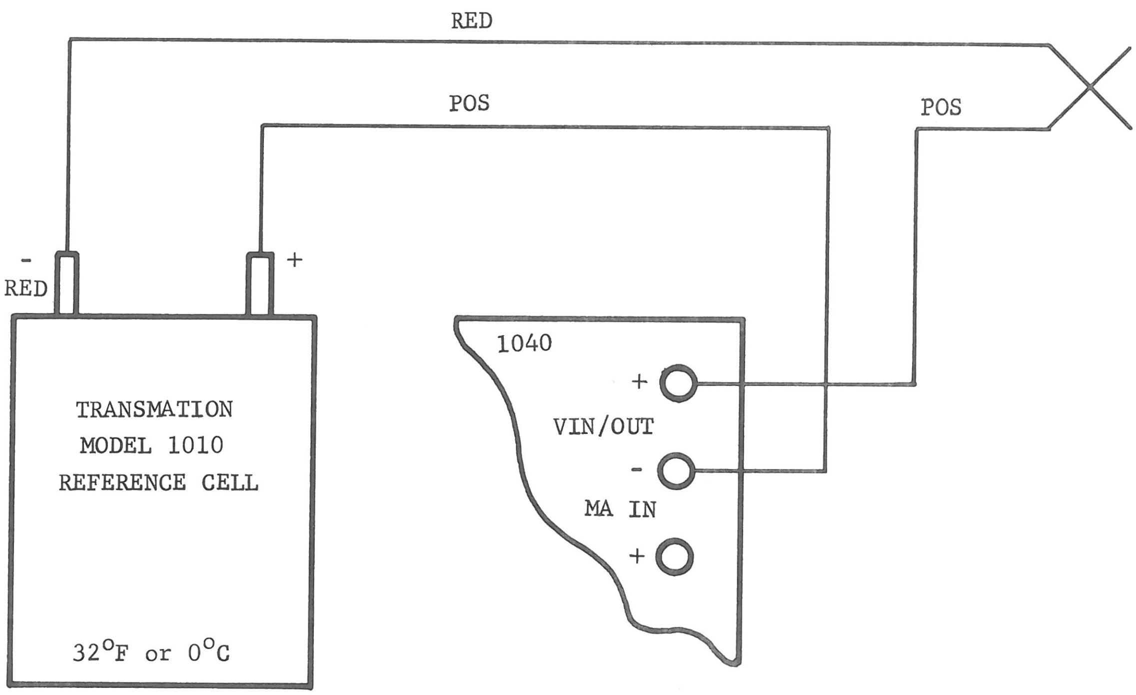


FIGURE 5

TYPICAL ICE CELL HOOK-UP THERMOCOUPLE MEASUREMENT

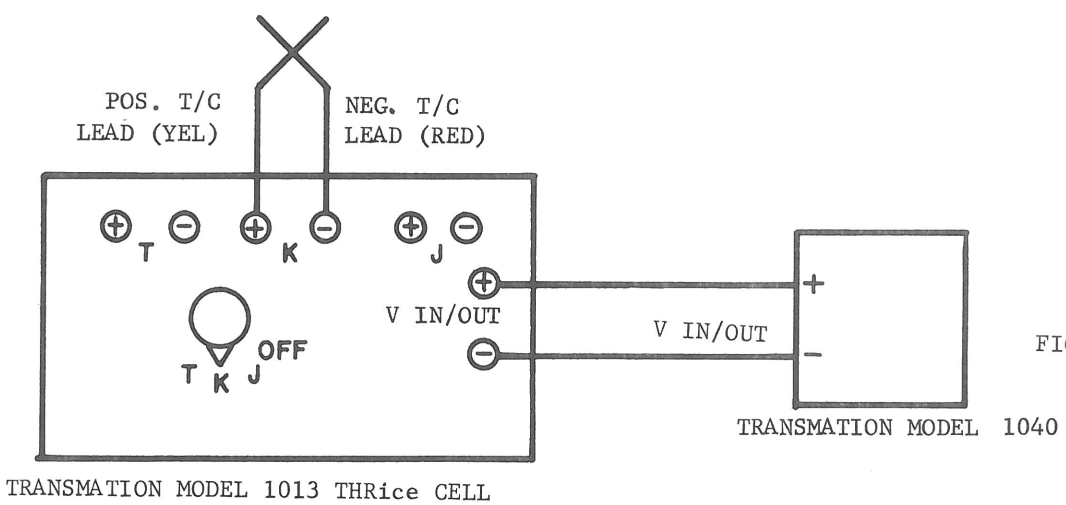


FIGURE 6

INPUT BOARD BLOCK DIAGRAM

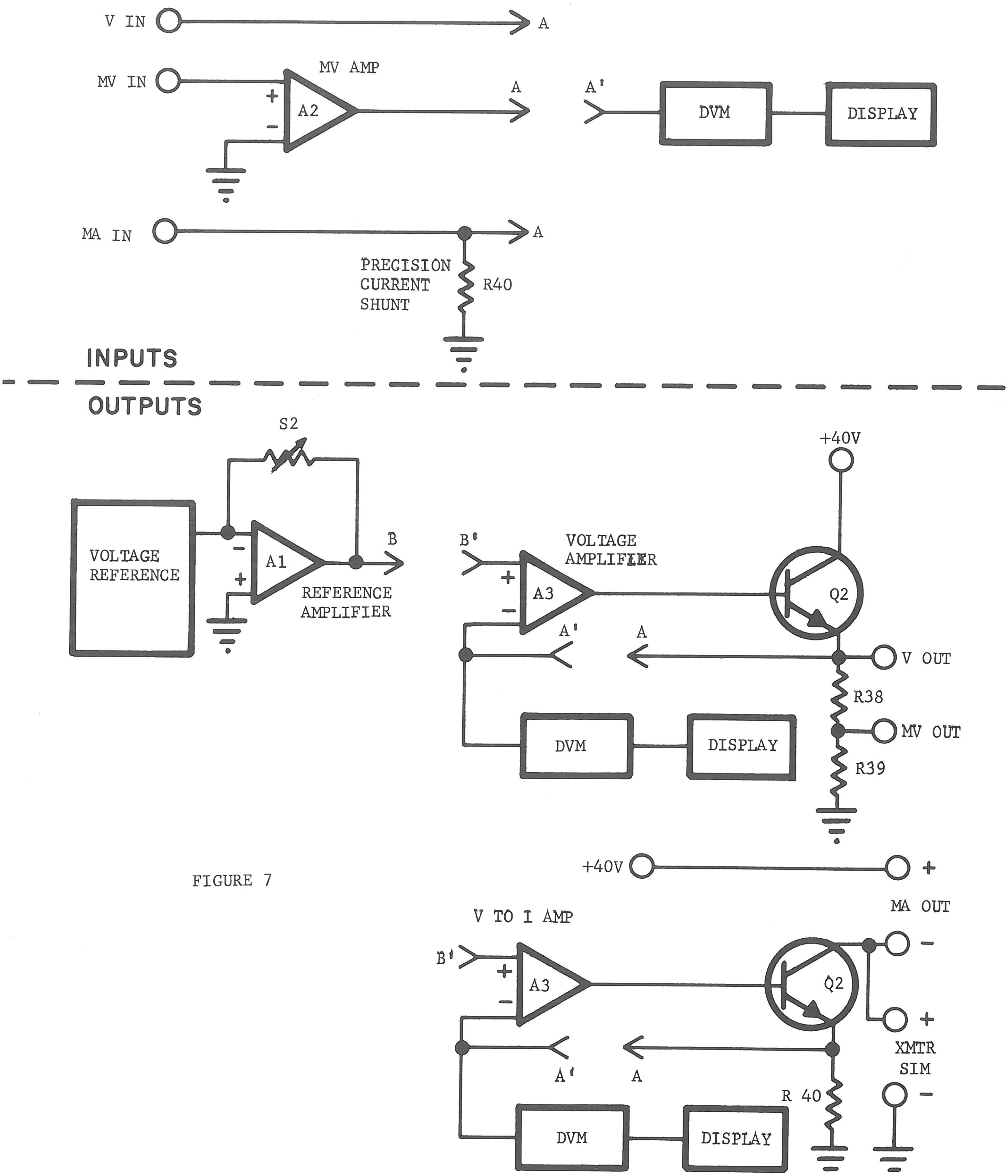


FIGURE 7

DWG. No.	REV
100724-103	A

SHEET 1 OF 1

DR R.K.B. 8 FEB., 1973

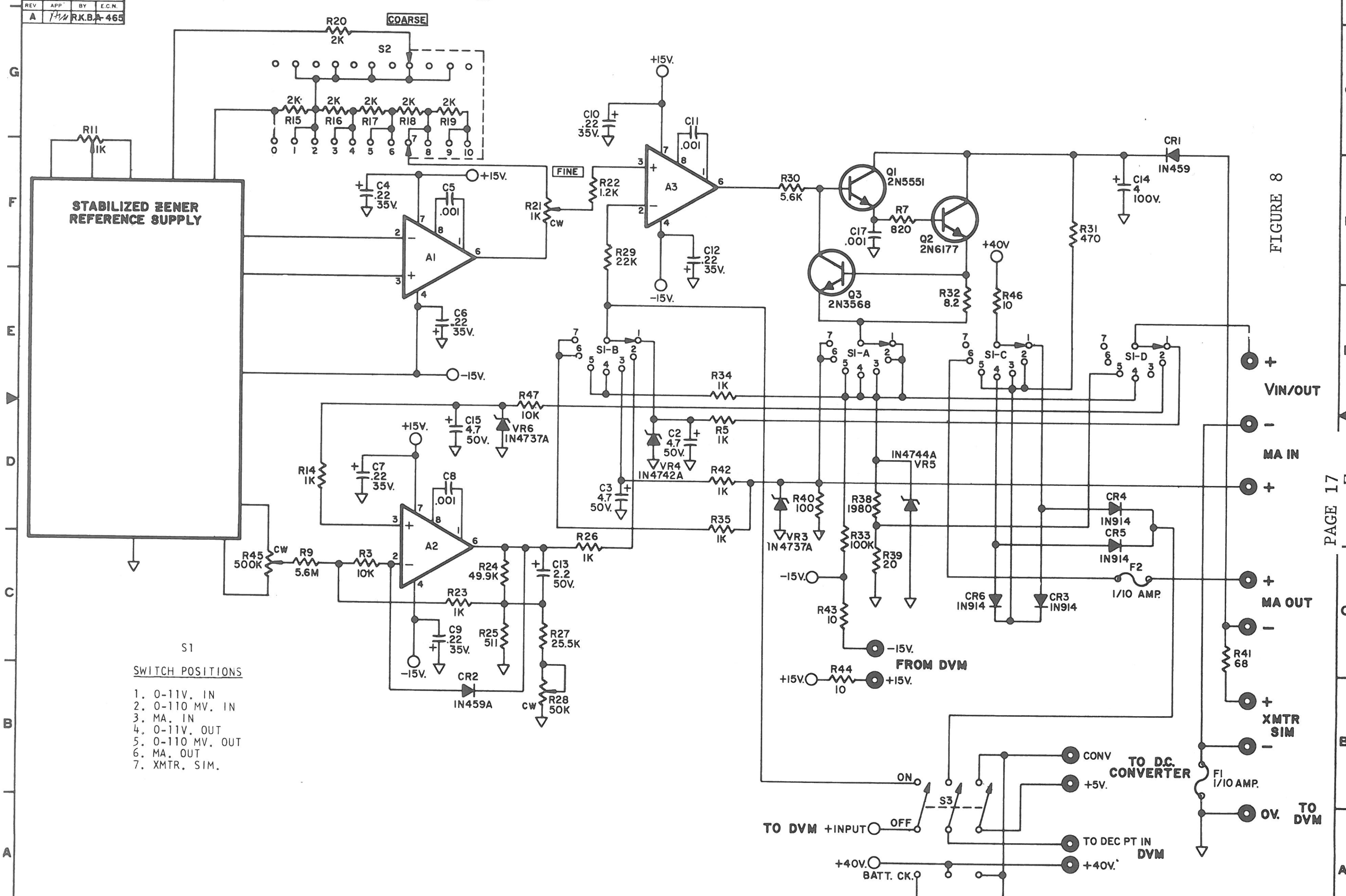
CHANGES			
REV	APP	BY	E.C.N.
A		R.K.B.	A-465

TRANSMATION Inc. ROCHESTER, N.Y. U.S.A.

SIMPLIFIED SCHEMATIC 1040 INPUT BOARD

SIZE: C

NOTES:
(1) UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS, AND ALL CAPACITOR VALUES ARE IN MFD.
(2) F1 & F2 ARE 1/10 AMP, (100 MA) FUSES, LITTELFUSE TYPE 273.100 OR EQUIVALENT.
(3) A1, A2, & A3 USE TRANSMATION PART NO. 603004-006.



S1

SWITCH POSITIONS

1. 0-11V. IN
2. 0-110 MV. IN
3. MA. IN
4. 0-11V. OUT
5. 0-110 MV. OUT
6. MA. OUT
7. XMTR. SIM.

FIGURE 8

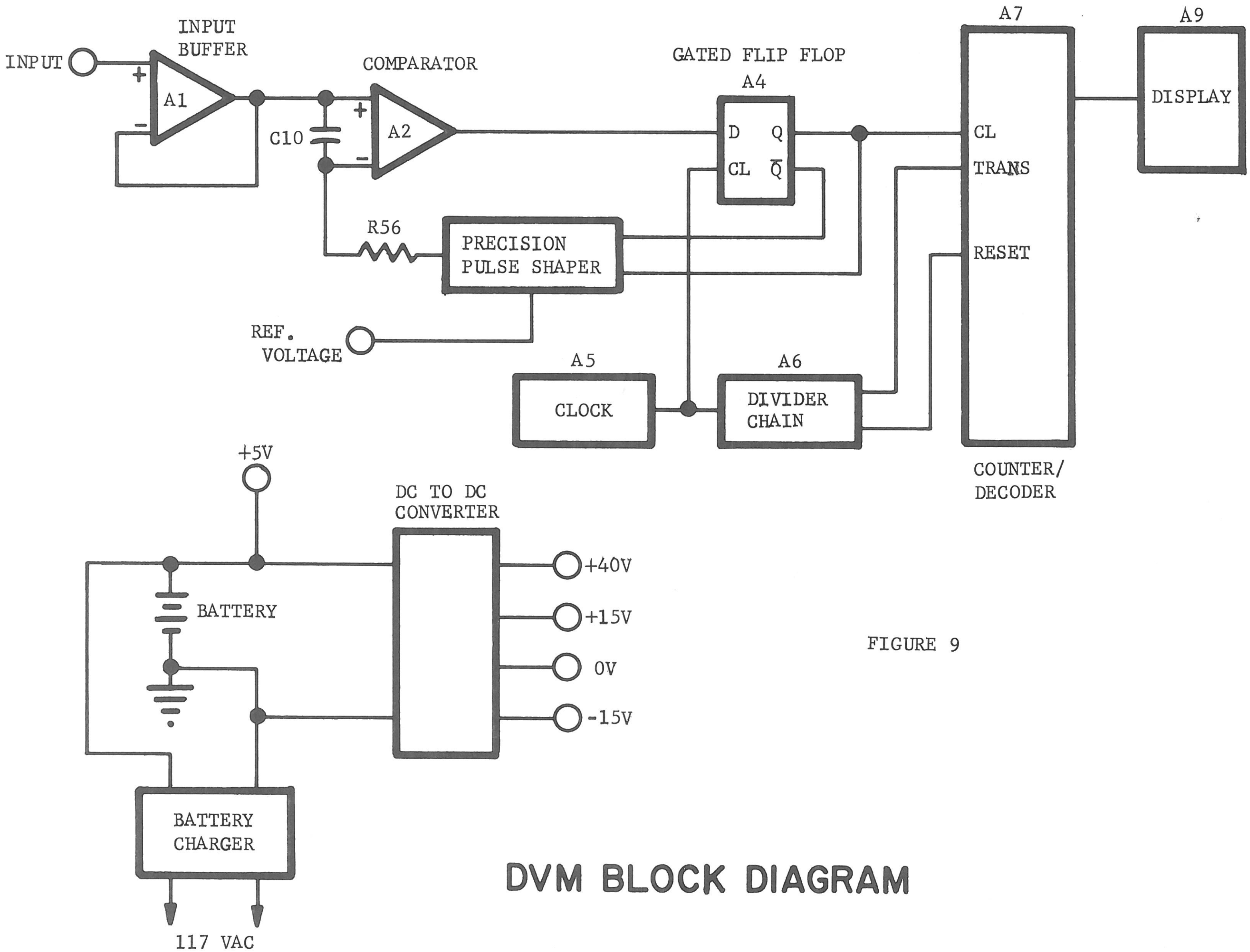


FIGURE 9

DVM BLOCK DIAGRAM

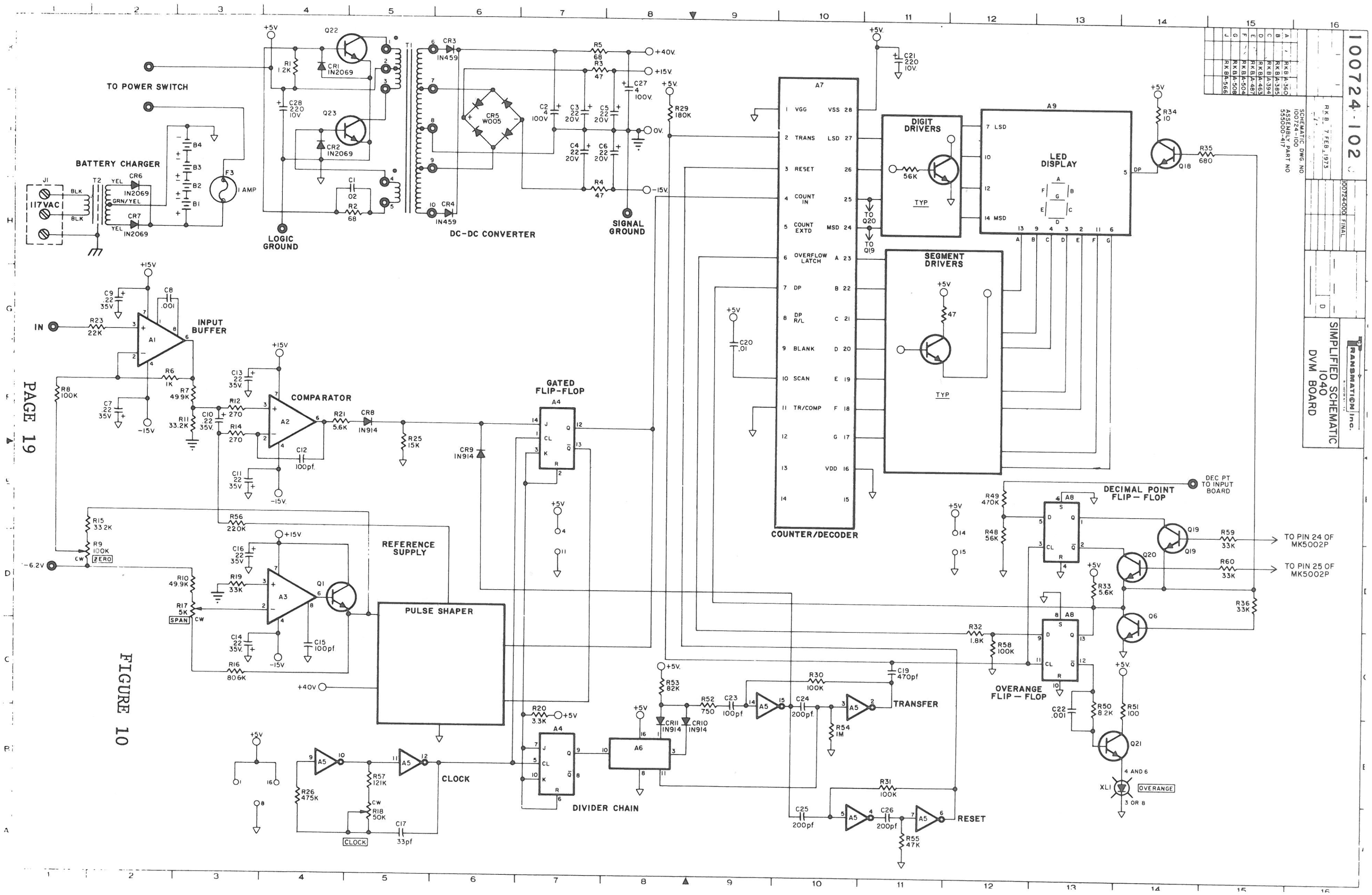


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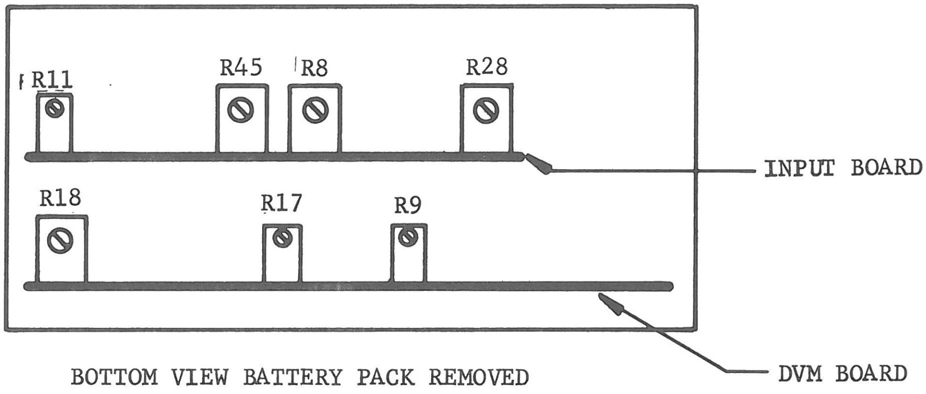
FIGURE 10

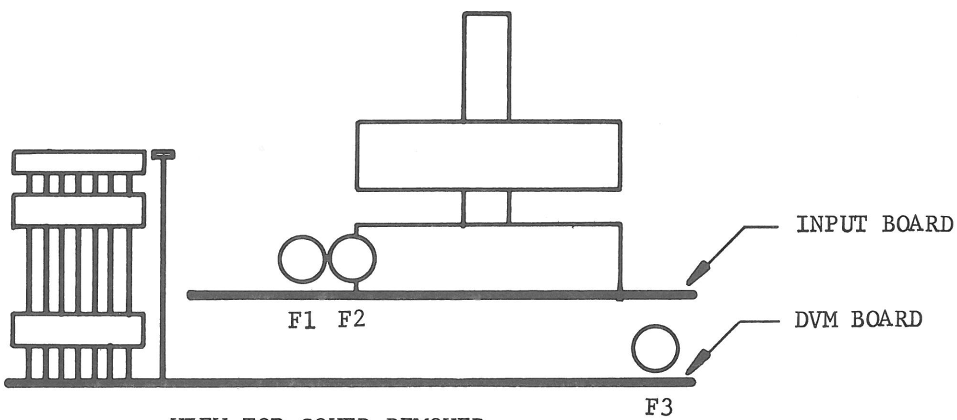
CALIBRATION CONTROL LOCATION



BOTTOM VIEW BATTERY PACK REMOVED

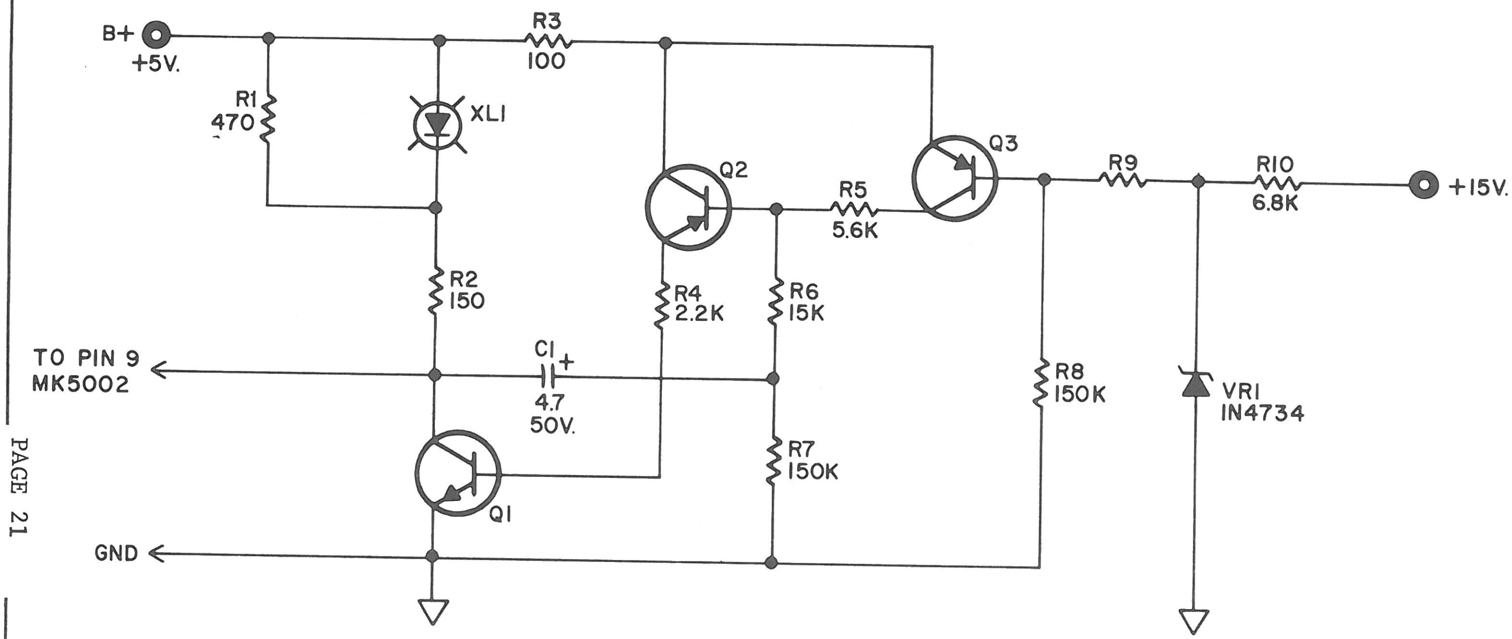
FIGURE 11

FUSE LOCATION



VIEW TOP COVER REMOVED

FIGURE 12



NOTES: (1) UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS AND ALL CAPACITOR VALUES ARE IN MFD.

(2) UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE CARBON COMPOSITION, 1/4W., ±10

(3) R9 IS A FACTORY SELECTED RESISTOR.

TRANSMATION Inc.
ROCHESTER, N.Y. U.S.A.

LOW BATTERY INDICATOR (FLASHER) — M336 SCHEMATIC

DWG. No. 100725-100 REV B

SHEET 1 OF 1

DR R.K.B. 24 APR., 1973

REF ASS'Y. PART NO. 555000-427 MATERIAL

FINISH

CHANGES

REV		BY	LCN
A		R.K.B.	A-391
B		R.K.B.	A-431

APPLICATION: NEXT ASSY. / USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON XX DEC — XXX DEC — ANGLES —

SCALE — B

FIGURE 13