Section 5
OPERATOR & FIELD MAINTENANCE

5.1 GENERAL

Series 2000 Digital Multimeters use solid state components and integrated circuits (except for display tubes), and are designed for reliable long-life operation. Except for calibration verification, no operator maintenance should be required, and there should be no normal requirement for opening the DMM case. Should any malfunction require corrective action within the warranty period, arrangements should be made to obtain factory assistance.

CAUTION

Data Precision provides this Maintenance Information primarily for users of Series 2000 Digital Multimeters in need of repair after the expiration of the Warranty period. The information is intended for users who are qualified and competent to effect any needed repairs. The equipment may be returned for repairs at a nominal fee if the user should elect to have the factory make repairs.

Should the qualified user attempt to troubleshoot and repair the DMM, he will find that Series 2000 DMM contains a number of features especially designed for simplified unambiguous troubleshooting and fault indication. Among these are:

a. Full and complete design and parts data in this Instruction Manual;

b. A positive troubleshooting procedure intended for effective use by competent technical personnel in isolating and correcting all but the most subtle and intricate problem sources;

c. Mechanical parts layout and identification for logical and easy location.

5.2 PARTS GROUPING AND THE TEST STAND-OFF GRID

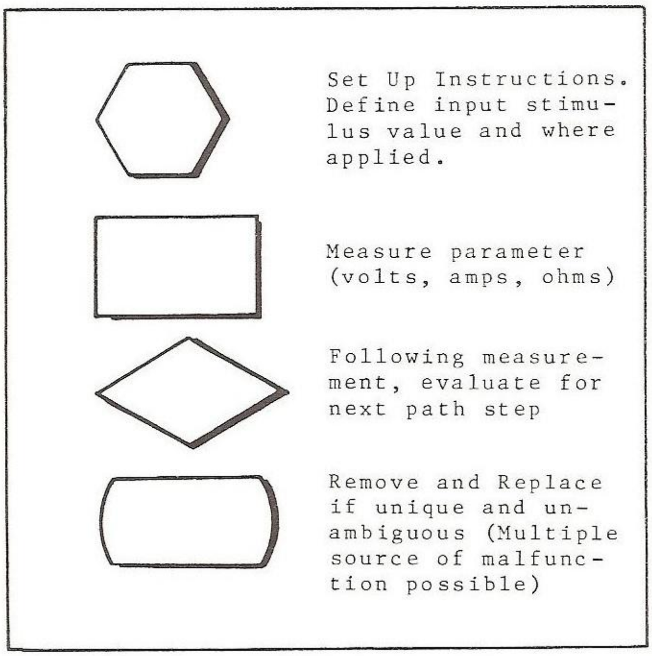
The printed circuit board is etched to show the grouping into major functions of the components (Figure 5-1). These correspond, generally, to the schematics in Section 6. The separate groups are individually named, the designations appearing along the edge of the board. When the Guard is removed, the floating Analog power supply and the analog portion of the A/D Converter and Signal Conditioner are revealed. The two amplifiers of the A/D Converter and the CLAMP/UNCLAMP switching module are separate modular components. They are mounted on the base PC board as integral component assemblies.

Verifying signal values throughout the circuit is considerably simplified mechanically by strategically positioned stand-offs, connected to circuit components for easy access to points where performance may be monitored. Each installed stand-off is identified by an E-number on the schematics, and etched on the PC board. Access to every major critical portion of the circuit has been assured.

5.3 THE TROUBLESHOOTING FLOW CHART

Figure 5-2 is a coded plan for troubleshooting Series 2000 DMM. The chart presents the logical sequence for performing tests so that an interpretation of test results will isolate the circuit components that are functioning properly. The complete sequence then leads the technician to the only components that may be the source of trouble. Signal tracing the isolated faulty circuit group and reference to the schematic for correct values normally will uncover the faulty component.

A standard graphic code has been used in the flow chart:



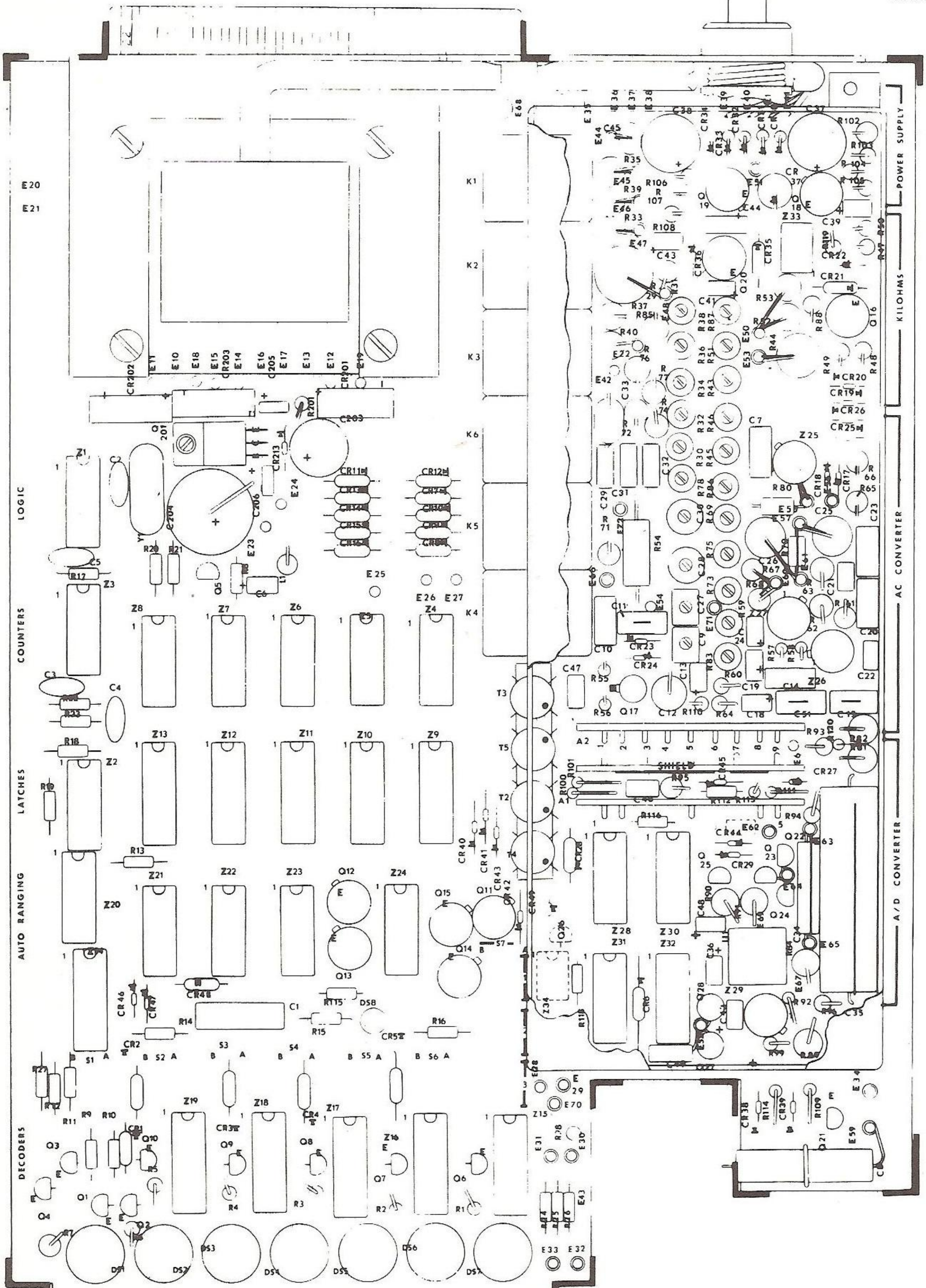


Figure 5-1. Parts and Stand-Off Layout on PC Board Assembly

The troubleshooting and maintenance procedures are intended for experienced technicians. Use of the flow chart directs the technician to the appropriate circuitry and reference schematic for subsequent detailed component fault isolation, replacement and repair.

5.4 USING THE TROUBLESHOOTING FLOW CHART

As shown in Figure 5-2, one starts by activating the POWER push button and checking to see if the POWER lamp is lit. If not, the chart directs the maintenance man to perform Test No. 1 as as defined in the integral Table of Tests. Test No. 1 calls for the measurement of a DC voltage between stand-offs E18 and E19, and checking for a nominal voltage of +140 volts. If the voltage is present, then, according to the chart, it is concluded that neon display lamp DS13 and its circuitry are in need of further isolation.

If the voltage check of Test No. 1 indicates an incorrect value of the DC voltage, then the chart directs the maintenance technician to use Reference Dwg. 35-1002 and to measure the other output voltages in accordance with Tests 2.1 and 2.2. The Table of Tests also indicates the driven circuits for each of the supply voltages. These may be the cause of incorrect voltage measurements when checking power supply levels and should be checked for excessive current drains by examining driven components and their nearby components for signs of elevated temperatures. The reference drawing includes the pin identification of the components driven by each supply.

Continue through the flow chart as directed, and the successive steps will confirm the proper operation of incremental portions of the DMM as they contribute to the performance as a whole. An incorrect reading in any step identifies the circuit components as a group within which the malfunction most probably originates.

The testing sequence represented by Figure 5-2 is concluded with a calibration to complete the maintenance process. Complete DMM function will have been verified by this process, but only those coded outputs actually tested are verified. Any pattern of missing digits may not be detected in these tests, and such a symptom is indicative of a malfunctioning counter, latch, or decoder IC.

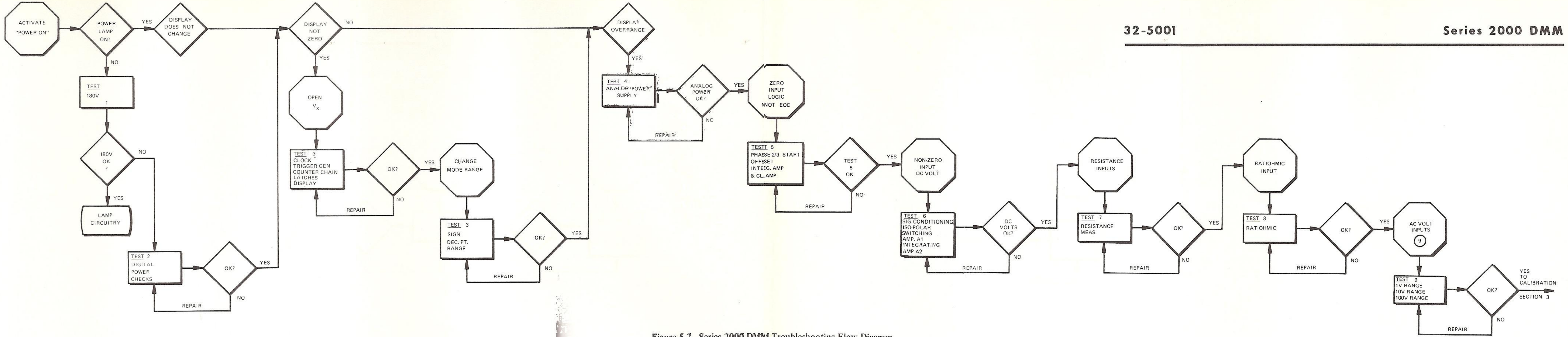


Figure 5-2. Series 2000 DMM Troubleshooting Flow Diagram

TEST NO.	SET-UP	PARAMETER	TEST POINTS	NOMINAL VALUE	LIMITS	IF N.G., CORRECTIVE ACTION REFERENCE	IF O.K., PROPERLY FUNCTIONING SUBSYSTEM
1	Activate Power ON	DC Volts	E18: E19	+140V	+125V to +155V	Power Supply Drawing 35-1002	Neon & Nixie Supply
2.1		DC Volts	E17: E19	+20V	18 to 22	Power Supply Drawing 35-1002	Relay Supply
2.2		DC Volts	E16: E19	+5V	4.5 to 5.5	Power Supply Drawing 35-1002	Digital Logic Supply
3	Open Vx Short Z1A pin 1 to GND						φ1, φ2, φ3; No EOC, 120000 Count
3.1		Frequency Count	Z2A pin 1	1 MHz	±1 kHz	Clock Circuit Drawing 35-1005	Clock
3.2		Waveform Analysis	Rear Conn Pin J	Amp >+2.5V Rep Rate ~3 pps	-0, +5 2.5-3.3	Trigger Gen Drawing 35-1005	Trigger Generator
3.3		Frequency	Z4 through Z8 and Z2 Pin 14 on each	1 MHz to 10 Hz (by 10) and 5 Hz	± 0.1%	Decade Counter Drawing 35-1005	Decade Counter Chain and Binary Counter
3.4		Logic Levels	Rear Conn DATA OUT Tabs	BCD for 120000		Latches Z9—Z13 Drawing 35-1005	Latch
3.5		Display	Front Panel	120000, Blinking "1"		Display Drawing 35-1005	Display
3.6	DC V Mode	Sign	Front Panel Display	"+"		Sign Circuit L5, Z14, etc. Drawing 35-1006	Sign Circuit
3.7	AC V Mode	Sign	Display	No Sign		Sign Circuit L5, Z14, etc. Drawing 35-1006	Sign Circuit
3.8	kΩ Mode	Sign	Display	No Sign		Sign Circuit L5, Z14, etc. Drawing 35-1006	Sign Circuit
3.9	No Range Activate	Impedance	Rear Panel Range Tabs 6, 11, T, B, H	Open Ckt		Auto Range Drawing 35-1003	x 10^4 Range
3.10	All Modes a) x 1 b) x 10 c) x 100 d) x 1000 e) x 10000	Display, Relays	Display, Range Relays	Correct Decimal Point Relay per Table		Relay Table Drawing 35-1003	Decimal Point Display Relay Operation
3.11	Auto Range a) DC V b) kΩ c) Jumper Z2 Z2 pin 8 to Z3 pin 8	Decimal Point Decimal Point Value	Display	Decimal Point a) x 1000 b) x 10000 c) "0" x 1		Auto Ranging Drawing 35-1003	Auto Range
4.1		DC Volts	Z33 pin 8	+15V	±1V Ripple 1mV RMS	Power Supply Drawing 35-1002	Analog Power Supply
4.2		DC Volts	Z33 pin 4	−15V	±1V Ripple 1mV RMS	Power Supply Drawing 35-1002	Analog Power Supply
4.3		DC Volts	Z31A pin 7	−5V	±1V Noise 25 μV	Power Supply Drawing 35-1002	Analog Power Supply
5	Short E62 to E71 Jumper Z32A pin 6 to pin 7						Zero Input to A/D No EOC at End of Phase 3
5.1		Waveform	Z31A pin 5	Positive Pulses 100 msec		A/D Conv. Drawing 35-1006	Trigger & 10^5 Carry Start and End Phase 2
5.2		DC Volts	Amp A1 pin 2	200 mV	+0, −	A/D Conv. Drawing 35-1006	A1 Operation OFF SET
5.3		DC Volts	Junction R96, R99	1V	±1V	A/D Conv. Drawing 35-1006	A2 and Clamp Circuits
6	Remove Short Connect Varying Vx DCV ±11V						Supply Varying Input Voltage Values
6.1	DCV Mode Range x 10	DC Volts	E35: E6	Track Input Values (Scope Ind.)		Signal Cond. Drawing 35-1004	DCV Signal Conditioning
6.2	+10V to Vx Sync. Scope to Z31 pin 5	Waveform	Amp A1 pin 2	+8 -8 100 ms		A/D Conv. Drawing 35-1006	ISO-POLAR Switch Module, Amps A1, EOC Integrating A2
6.3	Reverse Input Vx Polarity	Waveform	Amp A1 pin 2	Reverse Polarity		A/D Conv. Drawing 35-1006	ISO-POLAR Switch Module, Amps A1, EOC Integrating A2
7	Connect for Resistance 2-Wire Connect Resistances in each Range kΩ Mode	Resistance Measurement	Display	Track Input Value Changes		Signal Cond. Drawing 35-1004	Ohms Converter Signal Conditioning
8	Apply +10V to Both Vx and Rx RATIO Mode 10V Range	Display Count	Display	10.0000	±.1000	Ratiohmic Ckt Drawing 35-1004	Ratiohmic Function
9.1	ACV Mode Range x 1 Apply 11V, 200 Hz	Waveform	Z26 pin 6 CR25, Cathode	1V RMS sin Wave Half-Wave		Signal Cond. Drawing 35-1004	ACV Signal Conditioning
9.2	x 10 Range Apply 10 VRMS 200 Hz	Display Count	Display	Approx. 10		Signal Cond. Drawing 35-1004	ACV Signal Conditioning
9.3	x 100 Range	Display Count	Display	Approx. 100		Signal Cond. Drawing 35-1004	ACV Signal Conditioning