TECHNICAL MANUAL

for

FUEL QUANTITY TEST SET

P/N 101-00420

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OPERATION AND MAINTENANCE

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INTRODUCTION

SCOPE OF MANUAL

This manual provides a complete description of the subject test set and all the necessary operating and maintenance procedures necessary for its use and support.

REVISIONS

Any subsequent changes which occur after the original printing of this technical manual will be noted in the Revision column of the List of Effective Pages at the beginning of this manual.

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APPLICABILITY

This manual applies to test sets up through modification status "C" as indicated by the letters punched on the nameplate on the outside carrying case.

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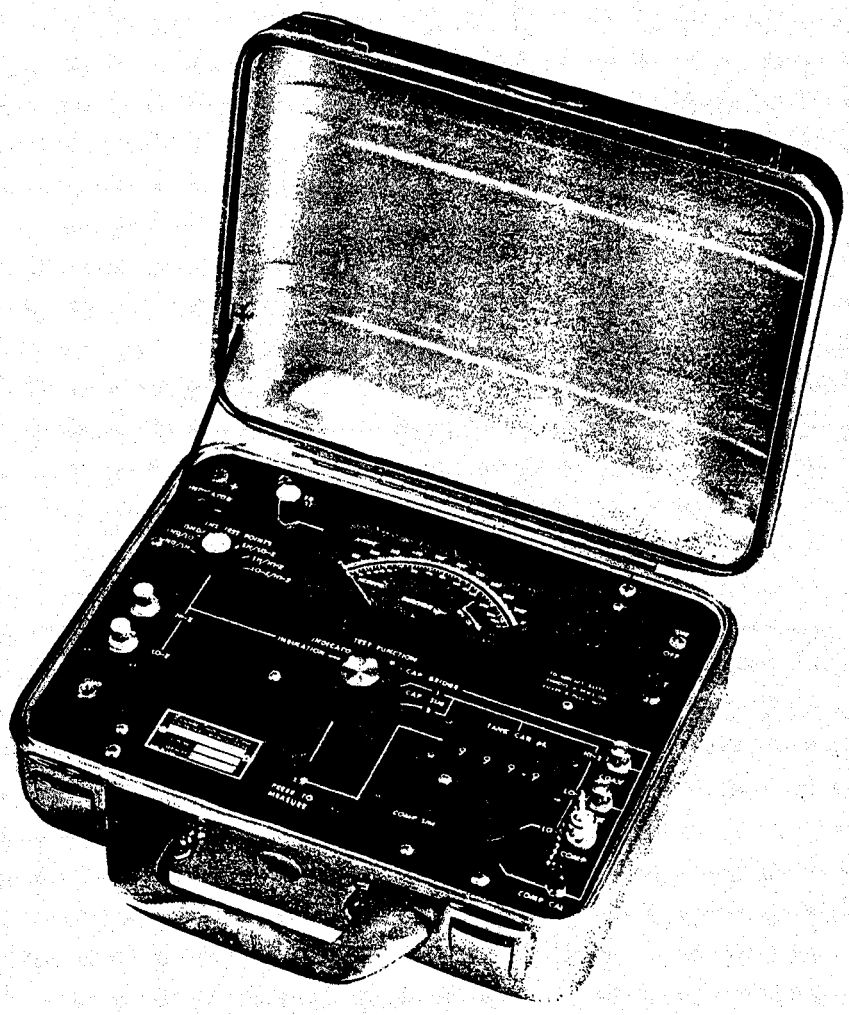

BARFIELD 2548H (MOD C)
FUEL QUANTITY TEST SET
FIGURE 1

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GENERAL INFORMATION

1.1 PURPOSE

The Barfield Fuel Quantity Test Set (T/S) is specifically designed to meet the need for servicing guarded capacitance type aircraft fuel and oil quantity measuring systems. Accuracy and reliability have been optimized together with portability and convenience.

The T/S provides means for maintenance testing, trouble-shooting, and calibration of 3-wire guarded systems. The accuracy of the T/S ensures meeting manufacturer's measurement and calibration requirements, and the potentials and currents introduced are limited to meet all safety specifications.

1.2 DESCRIPTION

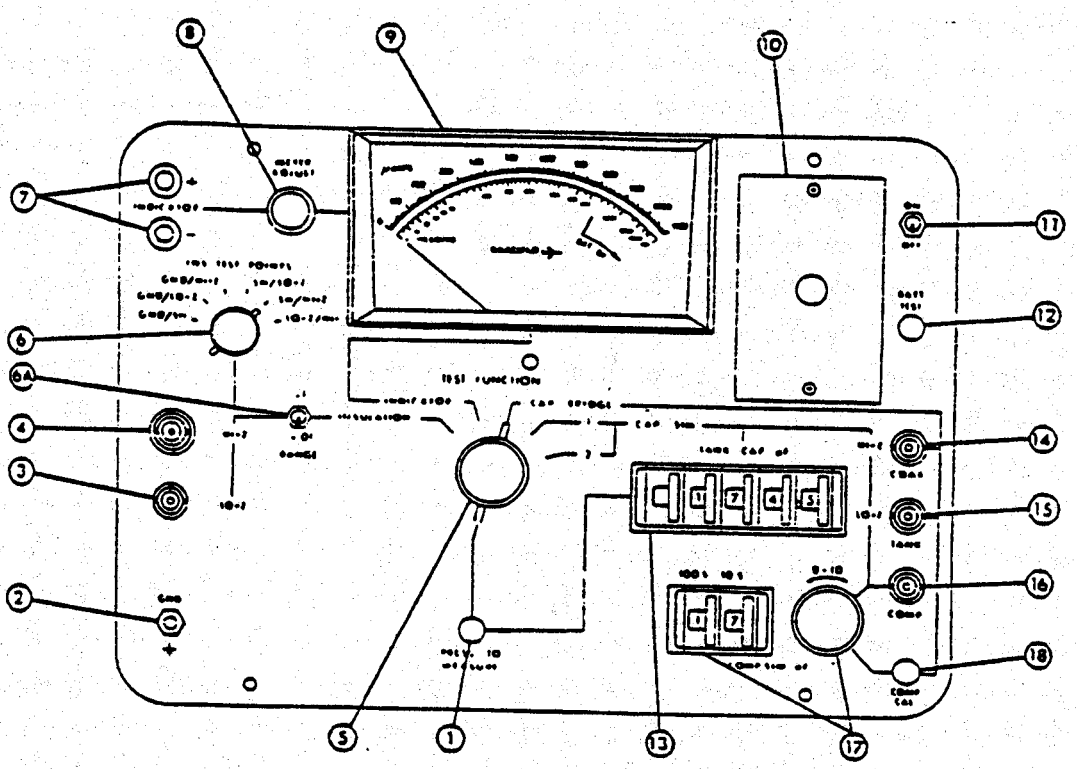
1.2.1 Leading Particulars - See Figure 1 for illustration and Figure 2 for leading particulars.

DIMENSIONS	In.	Cm
Length (max)	12.2	31.0
Width (max)	10.4	26.4
Height (lid closed max)	5.3	13.5
	Lbs	**Kg**
WEIGHT	7.0	3.2
POWER REQUIREMENTS	Four 9V NEDA 1604A Self contained alkaline batteries	
OPTIONAL POWER	Either 115V or 230V 50 to 400 Hz	

LEADING PARTICULARS
FIGURE 2

1.2.2 General - Three measurement and two capacitance simulator functions are provided through a function selector switch. With the exception of adapter leads, fittings, and harnesses, the T/S contains everything necessary for test and calibration of the aircraft system and its individual components.

1.2.3 Panel Components - See Figure 3 for panel illustration and reference numbers and see Figure 4 for description of all panel components.



Figures enclosed in parentheses in text refer to circled figures in illustration above.

REF. NO.	PANEL DESIGNATION	DESCRIPTION	FUNCTION
1	PRESS TO MEASURE	Pushbutton	Engages bridge VCC supply and switches bridge for external use
2	GND	Banana Jack	External connection to case ground
3	LO-Z	BNC Receptacle polarized	Insulation Test LO-Z
4	HI-Z	BNC Receptacle	Insulation Test HI-Z
5	TEST FUNCTION	5-position rotary switch	Selects one of five test functions
6	INS TEST POINTS	6-position rotary switch	Selects one of six pairs of test points
6A	RANGE	2-position toggle switch	Selects X1 or X.01 Megohms scale insulation range
7	INDICATOR	Two Banana jacks	Input connections for 0-1100 uA meter testing or substitution
8	METER ADJUST	Linear Potentiometer	Controls 0-1100 uA test current or adjusts megohmmeter for infinity setting
9	—	Taut-band panel meter	Provides 0-1100 uA current scale, 0-5000 megohm scale, and battery condition scale
10	BATTERY COMPARTMENT	Battery or AC power supply	Contains batteries or optional AC power supply
11	ON, OFF	2-position toggle switch	Controls battery or output of AC supply
12	BATT TEST	Pushbutton	Connects panel meter as 0-33.1 V meter across battery supply (BAT OK line is 24.8 V)
13	TANK CAP pF	Five section digital select switch	Selects capacitance simulator value between HI-Z COAX and LO-Z TANK jacks or bridge value
14	HI-Z COAX	BNC Receptacle	HI-Z connection for bridge and simulators
15	LO-Z TANK	BNC Receptacle Polarized	LO-Z connection for bridge and tank simulators
16	LO-Z COMP	BNC Receptacle Polarized	LO-Z connection for the compensator simulator
17	COMP SIM	Decade selectable and a variable capacitor	Compensator simulator capacitance between HI-Z COAX and LO-Z COMP
18	COMP CAL	Pushbutton	Connects compensator simulator to capacitance bridge

1.3 CAPABILITIES AND SPECIFICATIONS

1.3.1 Capabilities - When connected through appropriate adapter cables, the following functions may be performed:

a. Measure capacitance of individual or interconnected tank sensor probes or probe simulators.

b. Measure the insulation resistance of system wiring, probes, or other discrete components.

c. Test the performance of indicators and signal conditioners or bridge amplifiers.

d. Simulate capacitances representative of empty or full probes or systems, or the added capacitance effect of the fuel between empty and full.

e. Substitute T/S meter for DC meter-movement type gages, and provide adjustable metered current to test these gages.

1.3.2 Specifications - See Figure 5 for listing.

INSULATION	
Range:	0 to infinity in two scales, 5 to 5000 megohms and 50K ohms to 50 megohms.
Accuracy:	± 5% of reading nominal, but not in excess of ± 2% of scale length throughout range.
Applied Voltage:	10 VDC nominal.
Current:	50 nA maximum
INDICATOR	
Range:	0-1100 uA in 10 uA increments.
Accuracy:	± 1% of full scale.
CAPACITANCE BRIDGE	
Range:	0 to 999.9 pF in 0.1 pF increments.
Accuracy:	± (0.1% of reading + 0.1 pF)
Signal:	400 Hz at 5.7V r.m.s. nominal.
CAPACITANCE SIMULATORS	
Tank Range:	0 to 999.9 pF in 0.1 pF increments.
Accuracy:	Same as Capacitance Bridge.
Comp. Range:	10-400 pF continuously adjustable
Accuracy:	Set with Capacitance Bridge
Max. Input:	75V r.m.s., 220V p-p (above 3 KHz, Tank Simulator limit decreases proportionately to 10V r.m.s. at 25 KHz.

1.4 SHIPPING

It is recommended that the original shipping container be saved for future shipment. However, a minimum of 1½ inches of packing type foam rubber should be used between all six sides of the T/S case and a sturdy pasteboard carton. All of the space between the case and carton must be filled with the packing material,

CAUTION: DO NOT PACK ANY LOOSE CABLES OR OTHER ACCESSORIES INSIDE THE TEST CASE.

All accessories should be contained within separate packing material and preferably not stored within the T/S carrying case.

The batteries should be removed from the test set before shipping. Make certain that all T/S panel screws and panel components are securely fastened.

1.5 STORAGE

Remove all batteries for prolonged storage, and store in a cool, dry place. If T/S should become exposed to water or very high humidity, dry completely as soon as possible. Removing from case and temporarily storing in a dehumidified area is recommended.

1.6 ACCESSORIES

The Barfield 2548H Fuel Quantity Test Set includes a standard lead package P/N 101-00401. Refer to Chapter 6 for a list of components.

1.7 OPTIONS

1.7.1 AC Power Supply - A 101-00700 115V or 101-00701 230V AC power supply is available as an option.

1.7.2 Three Terminal Megohmmeter - A two terminal megohmmeter is standard, but a three terminal megohmmeter is available as an option or modification.

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PRINCIPLES OF OPERATION

2.1 INTRODUCTION

2.1.1 General - In addition to the schematics included in this chapter, refer also to Chapter 5.

2.2 POWER SUPPLY

2.2.1 Batteries - Four 9 V batteries, B1 through B4, are connected to provide a bipolar 18 VDC supply which is switched through an ON-OFF switch, S1.

2.2.2 AC Power - An optional 115 VAC or 230 VAC power supply assembly is directly interchangable with the battery supply assembly. The AC supplies use potted modular assemblies which are short-circuit protected and warranted by the manufacturer.

2.3 METERING

2.3.1 General - The panel meter, M1, is a 0-1000 DC taut-band microammeter with an internal resistance of approximately 14 ohms. R6 and P1 on the meter PC board form an adjustable shunt for all test functions to set full scale at 1100 uA.

2.3.2 Battery Test - BATT TEST pushbutton, S4, connects M1 as a 33.1 V full-scale voltmeter across the four batteries in series through R44. The BAT OK radial on meter dial represents 24.8 V.

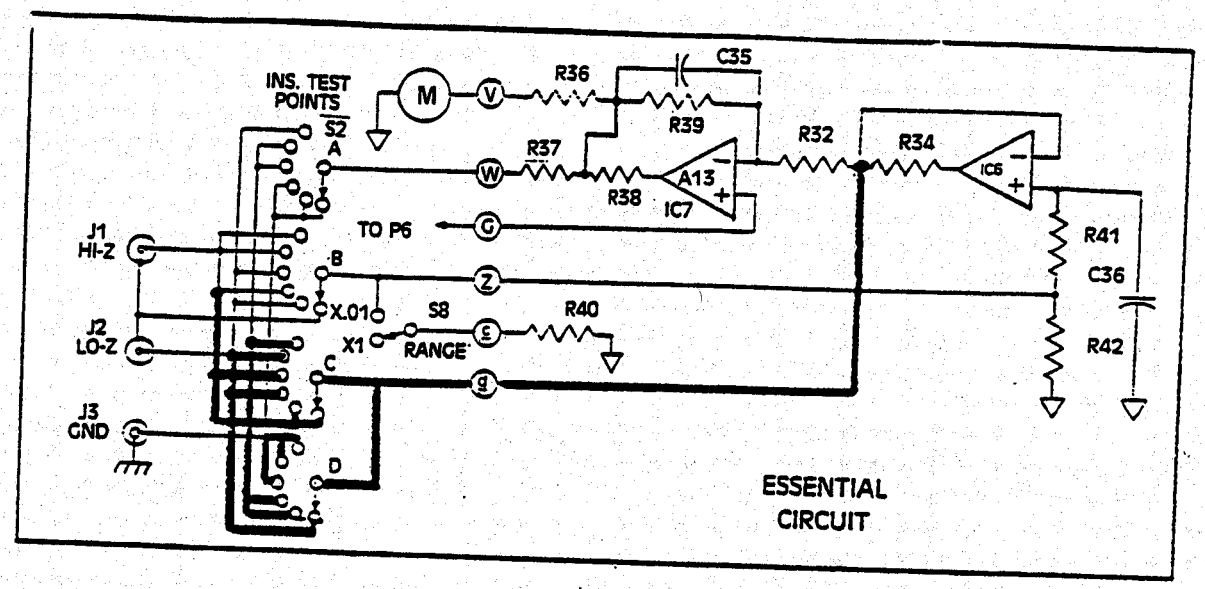
2.4 INDICATOR FUNCTION

When the "INDICATOR" function is selected, METER ADJ, P6, provides an adjustable current through M1 to the indicator jacks, J6 and J7.

2.5 INSULATION FUNCTION

2.5.1 Input Selector - The INS TEST POINTS switch, S2, selects a pair of input test points from J1, J2, J3, or J1 shield, and on the three terminal version simultaneously connects a guard to the two unused points.

2.5.2 Megohmmeter - Refer to Figure 1 for the essential circuit used in the "INSULATION" function. METER ADJ, P6, provides an adjustable input to IC7 of approximately 50 mV. The gain of IC7 is set at 200 by R39 and R32 so that IC7 outputs 10 VDC to the inputs selected by S2A. This output is also monitored by the panel meter so that it now reads full scale. Any leakage current from the test point selected by S2A will be returned by selector S2B through R42. The resultant voltage drop will be applied to the input of IC6. The output of IC6 supplies the inverting input of IC7, causing its output to decrease. The megohms scale on the meter is calibrated in the resistance equivalent to the leakage current between the points selected by S2A and the added circuitry for the Three terminal megohmmeter is shown by the bold lines in Figure 1. Since IC6 is a unity gain amplifier, its output exactly follows its input and provides a neutral guard point. This guard is connected to the unused input test points by S2C and S2D so that the leakage to these points is ignored.



INSULATION FUNCTION

FIGURE 1

2.5.3 Filtering - C36 and R41 form a low-pass input filter to reduce noise response and C35 increases the circuit time constant to reduce high amplitude transient response.

2.5.4 Range Switch - S8 shunts R42 with R40 to reduce the megohmmeter range by a factor of 100 when the "X.01" range is selected.

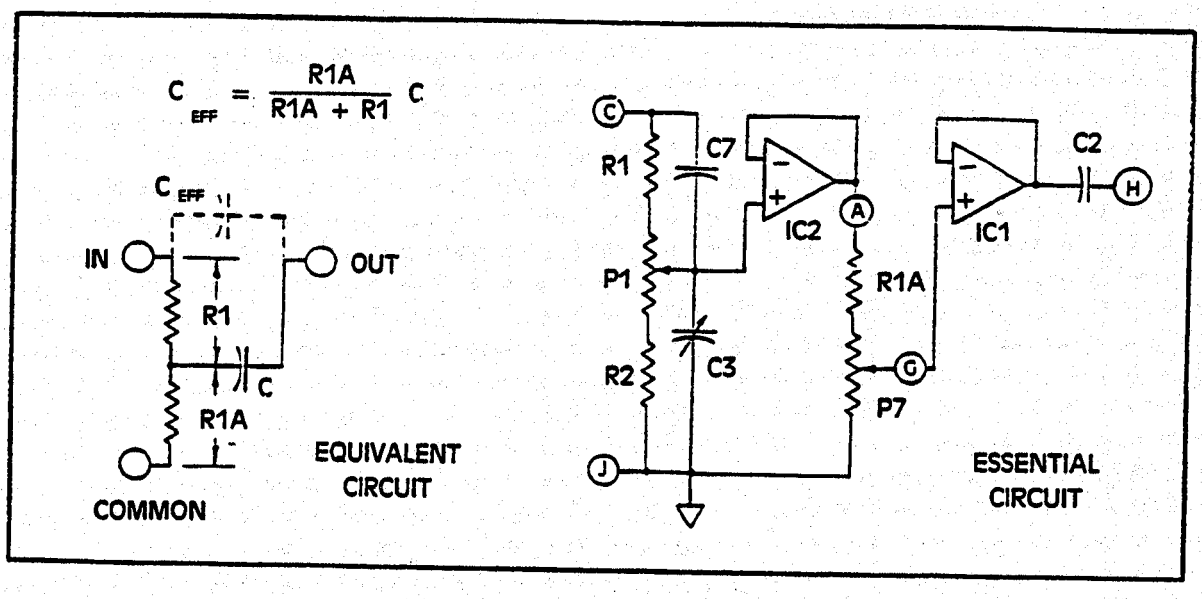
2.5.5 Current Limiting - R37 and R34 provide current limiting in the event of a catastrophic failure of IC7 or IC6.

2.6 CAP SIM FUNCTIONS

2.6.1 General - Two capacitance simulators, (TANK and COMP), have a common connection at HI-Z COAX jack, J4. The COMP SIM is an uncalibrated capacitance connected between J4 and LO-Z COMP jack, J9. The TANK CAP pF simulator consists of a fixed capacitor and ratio divider as explained in 2.6.3.

2.6.2 Compensator Simulator - The COMP SIM consists of fixed capacitors digitally selected by S9 plus a small variable capacitor, C38.
The fixed-variable combination has a range from 10 pF to over 400 pF. The "CAP BRIDGE" function must be used to set the COMP SIM to a calibrated value.

2.6.3 Tank Capacitance Simulator - If the input to a 3-wire guarded capacitor is reduced, the effect is the same as reducing the capacitance by the same factor. This principle is illustrated in the Equivalent Circuit of Figure 2. The circuitry used in the T/S is illustrated in the Essential Circuit of the same figure.



TANK CAPACITANCE SIMULATOR
FIGURE 2

A high impedance input divider consisting of R1, R2, and P1, divides the input by a ratio of approximately 8:1. C7 and C3 provide high frequency compensation to minimize phase shift that would otherwise appear as dissipation if left uncorrected.

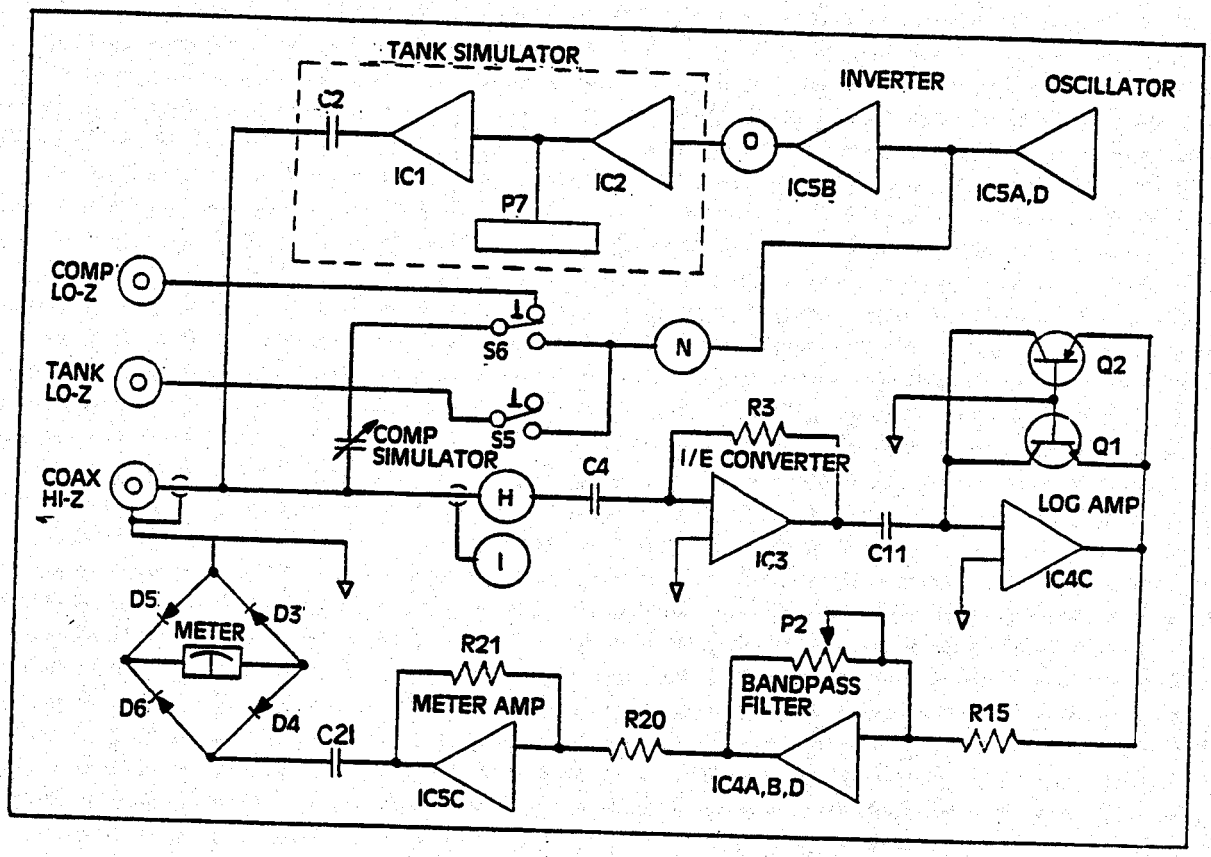
R1A is selected to further divide the input across digital Varley divider, P7, so that its settings will be an accurate equivalent capacitance ratio of reference capacitors. IC1 and IC2 are unity-gain amplifiers to isolate P7.

2.6.4 Cap Sim 2 - The connections to jacks J4 and J5 are reversed from the Functional Circuit of Figure 2. J4 remains common to both TANK and COMP simulators but now may be considered LO-Z. J5 and J9 are outputs and should be considered as HI-Z.

2.6.5 Metering in Cap Sim - In the "CAP SIM 1" and "CAP SIM 2" functions, the meter M1, connects directly between the INDICATOR jacks J6 and J7. The meter may then be conveniently substituted for a DC meter type fuel quantity indicator.

2.7 CAP BRIDGE FUNCTION

2.7.1 General - Refer to Figure 3 for the basic circuitry of the capacitance bridge, or to Chapter 5 for more detailed schematics.



CAPACITANCE BRIDGE
FIGURE 3

2.7.2 Oscillator - IC5D is a two-pole low-pass active filter which, together with integrator, IC5A, forms a low distortion sine-wave generator. Capacitors C18, C19, and C20, together with resistors R22, R30, and R23 and potentiometer P3, determine the frequency and amplitude of the oscillation.

The base-emitter junction of Q3 together with bridge connected diodes, D7 through D10, forms a bi-polar zener to regulate oscillator amplitude.

2.7.3 Inverter - IC5B inverts the oscillator output from IC5A to a precisely equal amplitude and opposite phase as adjusted by P4 and C31 repectively.

2.7.4 Bridge - The oscillator output from IC5A is connected to either; TANK LO-Z jack, through pushbutton, S5, or to the compensator simulator through pushbutton, S6. The inverted oscillator output from IC5B is connected to the input of the digital capacitance simulator.

The resultant signal from the unknown capacitance (or COMP SIM) at HI-Z jack, J4, is summed with the output of the digital simulator at the detector-amplifier input, IC3. Since the unknown capacitance and simulator are excited with equal amplitude signals, their outputs will be equally proportioned to their effective capacitances. Since their excitation signals are of opposite phase, their summed outputs will be equal to their differences in capacitance. When their effective capacitances are equal, the resultant current will be zero.

2.7.5 Detector - IC3 is a current to voltage converter. D1 and D2 provide input amplitude limiting.

2.7.6 Amplifier - Q1 and Q2, together with IC4C, form a logarithmic amplifier with the output from IC3. The logarithmic relationship between the collector current and emitter-base voltage of Q1 and Q2 results in an amplifier gain which is maximum at low levels near bridge null, and a logarithmically decreasing gain as the bridge unbalance increases.

2.7.7 Filter - IC4A, IC4B, and IC4D form a bandpass filter network with P2 providing the frequency tuning.

2.8 STRAY CAPACITANCE COMPENSATION

2.8.1 General - A certain amount of stray capacitances exists within the test set due to exposure of unshielded lead wire at connecting points, capacitance between switch contacts, and between any HI-Z to LO-Z conductors which can not be effectively shielded from one another.

These stray capacitances change from one function to another due to additions and deletions of circuitry and due to the differences in the mechanical position of movable switch contact armatures. These strays are compensated by a circuit mounted on the meter PC board.

2.8.2 Compensation Circuit - IC1 on the meter PC board is an inverting amplifier which, together with capacitor C1, acts like an inverting equivalent of the TANK CAP pF simulator. R2, together with P2, P3, and P4, form the separate dividers. These dividers can be adjusted to produce currents of equal amplitude and opposite phase to that of the strays developed in the "CAP BRIDGE", "CAP SIM 1", and "CAP SIM 2" functions. Thus, permitting the strays in each of these functions to be canceled.

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OPERATION

3.1 GENERAL

The user should first become familiar with the 2548H Fuel Quantity Test Set as described in chapter 1, General Information. The actual tests to be performed and the calibration procedures to be used are dictated by the requirements of the particular fuel quantity system. Refer to the aircraft and/or system manufacturer's maintenance manual for specific procedures and calibration values. Harness configurations vary considerably to accomodate the many fuel systems in use. Figures 2 through 4 illustrate some typical hookups.

The components of the system should be tested and their integrity proven before attempting calibration. It is always preferable to drain the fuel tanks in order that all significant tests may be made and the most accurate calibration performed. If time or facilities for tank draining is not available, limited tests and calibration may be accomplished, but the tanks should be drained and complete calibration performed at the next opportunity.

CAUTION: ALWAYS REFER TO AIRCRAFT MAINTENANCE MANUAL FOR PROPER DEFUELING AND FUELING PROCEDURES AND OBSERVE ALL SAFETY PRECAUTIONS.

3.2 PRELIMINARY

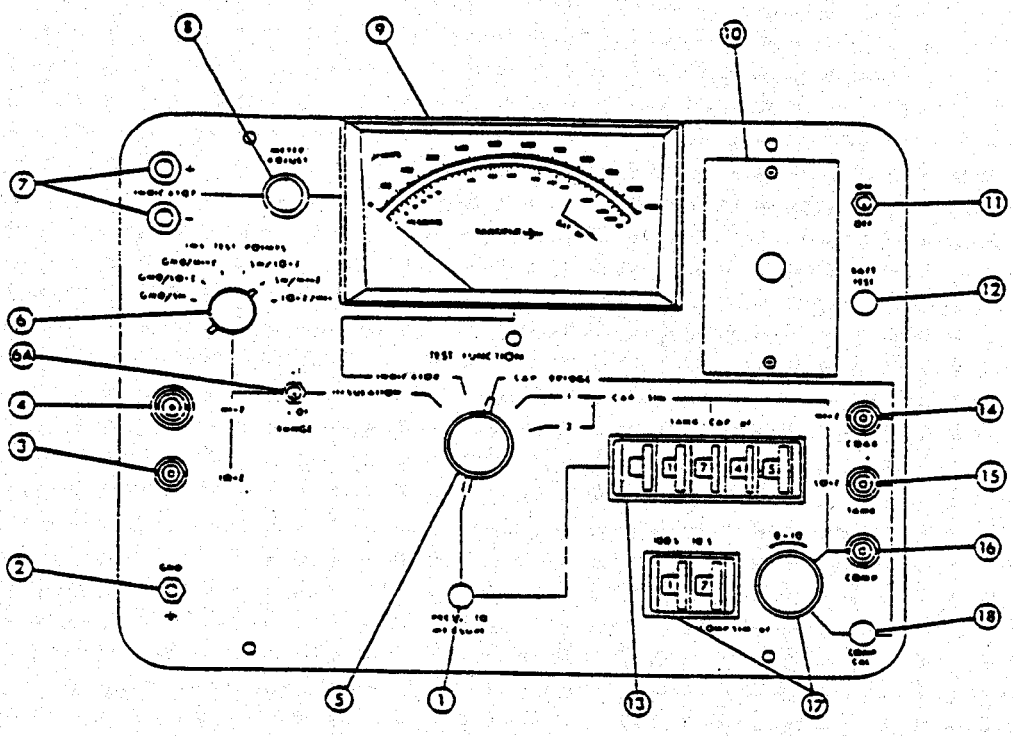
3.2.1 Precautions - For all test procedures, observe the following:

a. Make certain test set power switch is "OFF" and aircraft power to fuel quantity system is disconnected. Aircraft power should be off whenever adapter harnesses are inserted or removed.

CAUTION: CONNECT GROUND CLIP LEAD BETWEEN TEST SET GROUND JACK AND AIR-FRAME GROUND FOR ALL INSULATION AND CAPACITANCE MEASUREMENTS. DO NOT CONNECT GROUND LEAD FOR CAPACITANCE SIMULATION OR SYSTEM CALIBRATION.

b. Whenever a capacitance or insulation measurement is to be made, the tanks must be drained and all aircraft signal sources to the tanks must be removed.

c. Adapter harness stray capacitances should be subtracted from measured values and calibration settings for most accurate results.



Figures enclosed in parentheses in text refer to circled figures in illustration above.

3.3 INSULATION TESTS

3.3.1 Preliminary - Figures in parentheses within this text refer to circled figures in panel illustration Figure 1. Set TEST FUNCTION (5) to "INSULATION" and battery switch (11) "ON". Turn METER ADJUST (8) to set meter pointer at full scale infinity mark on MEGOHMS scale. Set range switch (6A) to "x.01" for insulation readings below 20 megohms and to "x1" for readings above 20 megohms.

3.3.2 Aircraft Connections - To test aircraft tank probes and associated aircraft wiring, disconnect aircraft wiring plug(s) from indicator (or, from bridge amplifier or signal conditioner on installations where indicator and electronics package are separate). Connect appropriate adapter harness receptacle to aircraft plug(s) only. DO NOT CONNECT PLUG(S) ON OTHER END OF ADAPTER HARNESS. See Figure 2"A" or Figure 2"B".

3.3.3 Test Set Connections - From the aircraft plug end of harness box, connect HI-Z COAX to HI-Z receptacle (4) and the corresponding LO-Z TANK harness lead to INSULATION LO-Z receptacle (3).

NOTE: Take care that harness connectors do not come in contact with airframe ground, and do not touch them while making insulation tests. To do so will provide additional leakage paths which may cause erroneous readings.

It may be necessary to set an aircraft tank selector switch to make the desired test. Refer to specific maintenance procedure for details.

3.3.4 Insulation Measurements - Test as follows:

a. Set INS. TEST POINTS switch (6) to "GND-SH" and read insulation resistance on MEGOHMS scale of test meter. Resistance must not be less than that listed for shield to aircraft ground for applicable aircraft. On certain installations this test is not specified and may be omitted.

NOTE: Meter pointer may drift rather slowly after initial movement due to capacitance charging time or presence of moisture. Wait for meter to become steady or to reach minimum acceptable reading.

b. Set INS. TEST POINTS to each of the other positions and compare results with tabulated minimums for the particular aircraft.

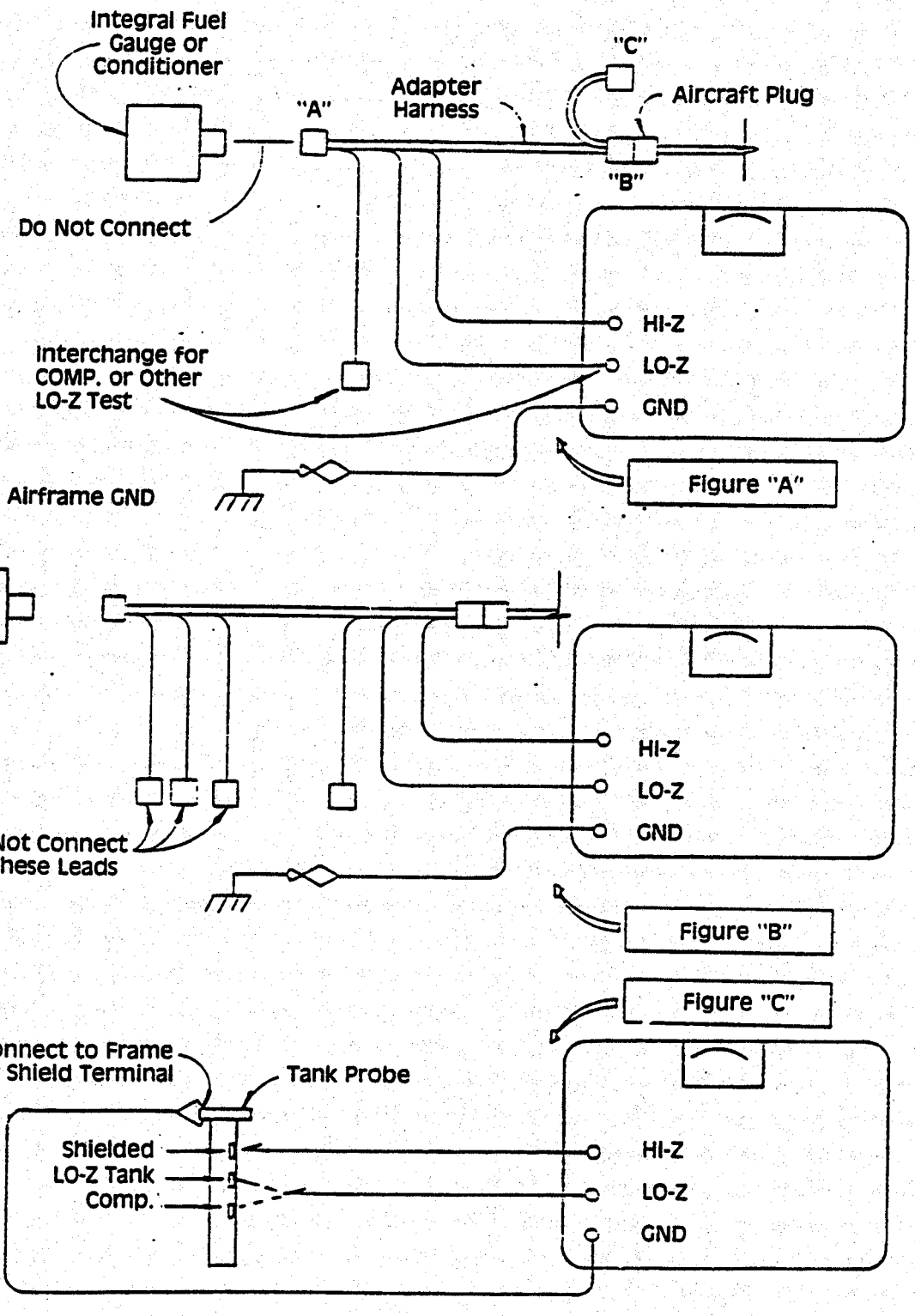
c. If there are other HI-Z and/or LO-Z leads (a reference compensator lead would be considered a LO-Z lead in this case), reconnect the panel receptacle to each other corresponding pair and repeat steps 3 through 5 until all leads have been tested.

3.3.5 Individual Component Tests - To make an insulation test on an individual probe, connect as in Figure 2"C" and test as in 3.3.4 a and b. For an individual test, connect the insulation test leads to the HI-Z and LO-Z INSULATION receptacles and set the TEST POINTS switch to "LO-Z/HI-Z". The component or circuit may then be connected with the clip leads.

3.3.6 Probe Switchbox Adapter Tests - Adapter harnesses are available for connection to certain aircraft equipped with probe system bulkhead connectors. The harness has a switch for selecting each of the individual probes for insulation and capacitance tests. This adapter harness connects directly to the test set receptacles for resistance or capacitance. See Figure 3"B".

3.4 CAPACITANCE TESTS

3.4.1 Preliminary - Set TEST FUNCTION (5) to "CAP BRIDGE".



TYPICAL INSULATION TEST HOOKUPS
FIGURE 2

3.4.2 Aircraft Connections - To test aircraft tank and compensator system capacitances, disconnect aircraft wiring plug(s) from the indicator (or, from bridge amplifier or signal conditioner on installations where indicator and electronic package are separate).

Connect appropriate adapter harness AIRCRAFT "B" receptacle(s) to aircraft plug(s) only. DO NOT CONNECT TO PLUG(S) ON THE OTHER END OF ADAPTER HARNESS. See Figure 3"A".

3.4.3 Test Set Connections - Connect harness leads or harness box receptacles to corresponding test set HI-Z COAX (14) and LO-Z TANK (15) receptacles.

NOTE: It may be necessary to set an aircraft tank selector switch to make the desired test. Consult specific maintenance procedure.

3.4.4 Isolating Measured Capacitance - Unshielded LO-Z harness leads or harness box receptacles, not involved in the particular measurement being made, must be shorted to ground with shorting caps or grounding lead connections. A reference compensator lead would be considered a LO-Z in this instance. See Figure 3"A".

3.4.5 Capacitance Measurement - Test as follows:

a. Set battery switch (11) "ON", push PRESS TO MEASURE (1), and adjust TANK CAP pF for panel meter null.

NOTE: If nominal capacitance is known, begin with dials set to this value. If unknown, set all digits to "0" and increase left hand wheel one digit at a time as long as meter decreases. When meter increases, reduce setting by one digit. Repeat with each wheel in succession toward the right until the best null is achieved.If the last one or more digits indicate "0", reduce the previous digit by one and search for a possible lower null.

b. A null of 100 uA or less can be expected. However, if the null is broadly insensitive to digit wheel settings, it may be due to poor HI-Z shielding in the aircraft. Turn all 400 Hz power off. If high null persists, there may be high resistance connections, poor insulation, or a defective probe.

c. Failure to null indicates a short circuit. A very low capacitance reading at null indicates an open circuit.

d. Repeat steps a through c for each pair of HI-Z and LO-Z connections from aircraft wiring end of harness or harness box making tank selections as applicable. A reference compensator connection would be considered a LO-Z in this instance.

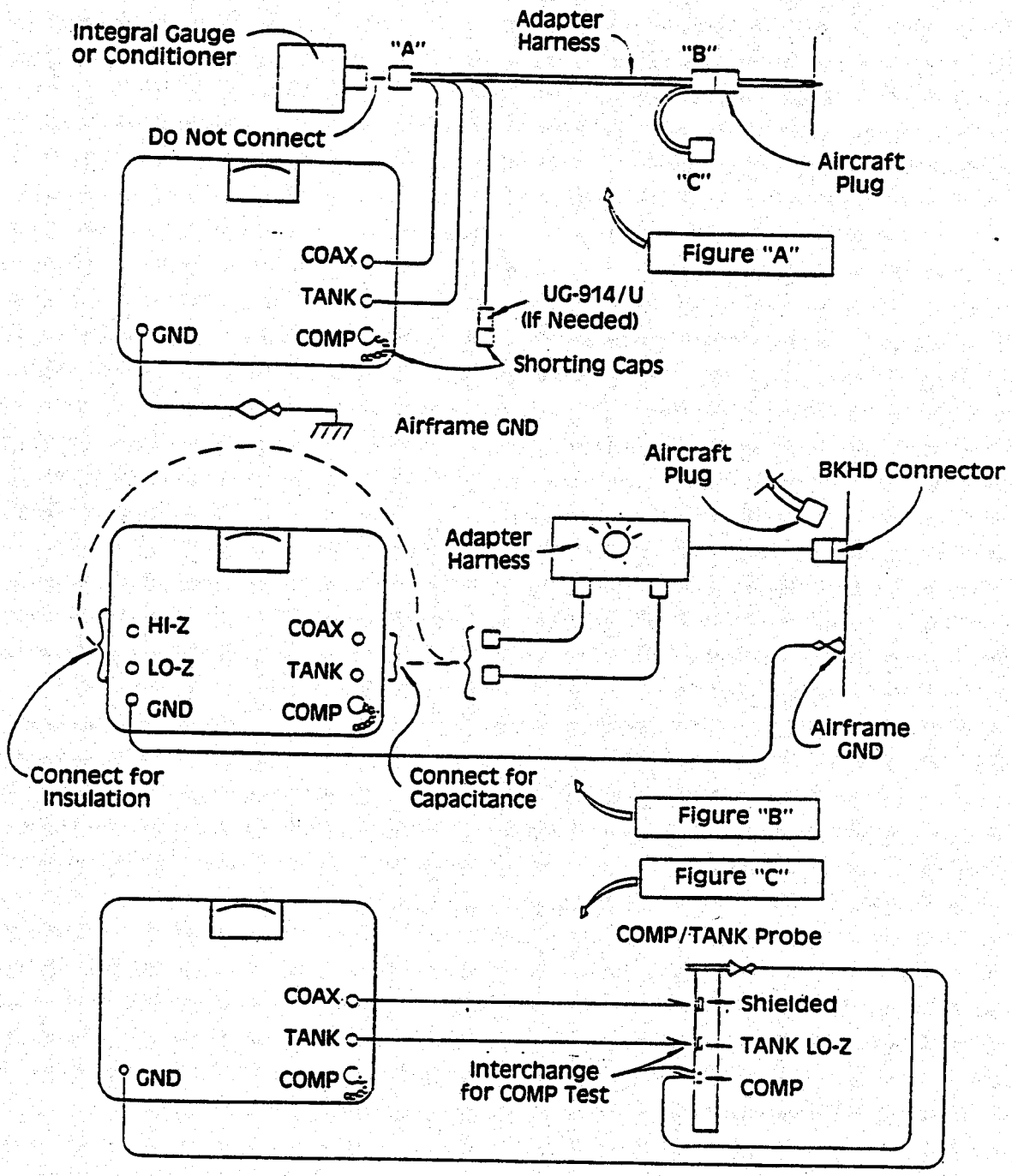
3.4.6 Probe Tests in Aircraft - Individual probes may be measured through a bulkhead connector harness as in Figure 3"B".

3.4.7 Bench Test of Probe - An individual probe removed from aircraft may be measured through shielded clip leads connected to test set (14) and (15) receptacles as in Figure 3"C".

NOTE: The ground or shield connection of the probe may be connected to the test set GND jack, and, if the probe is a combination compensator and tank probe, the unshielded tank or compensator connection not being measured must also be connected to the test set GND.

3.5 FUEL GAUGE INDICATOR TEST (DC Meter Type Only)

3.5.1 Bench Test Hookup - Connect paired indicator test lead plugs to corresponding colored test set INDICATOR jacks (7). Connect lead contact inserts to respective pins of indicator receptacle. (Refer to applicable drawing in maintenance manual.) Operate the test set as in steps 3.5.3.



TYPICAL CAPACITANCE MEASUREMENT HOOKUPS

FIGURE 3

3.5.2 Aircraft Test Hookup - Disconnect aircraft plug from the indicator and proceed as in step 3.5.1. (Some harnesses provide jacks for connection to test set through the aircraft wiring as in Figure 4"C".

3.5.3 Operation - Turn METER ADJUST (8) full counterclockwise (CCW), set TEST FUNCTION (5) to "INDICATOR", then set battery switch (11) "ON". Set METER ADJUST to compare fuel gauge readings with test set uAMP indications listed in maintenance manual. Lightly tap fuel gauge to remove slight inherent friction. Test full pointer travel of gauge to observe any possible erratic behavior. (Certain adapters may be equipped with shunt or series resistances to provide other meter scalings.)

3.6 SIGNAL CONDITIONER, BRIDGE AMPLIFIER & INTEGRAL INDICATOR TEST

Note that the testing of integral indicator bridge fuel gauges signal conditioners, or bridge amplifiers with separated gauges, is always performed in a similar manner. The device to which the aircraft probes are connected for system measurement will be referred to as the aircraft "gauge-bridge" for simplicity.

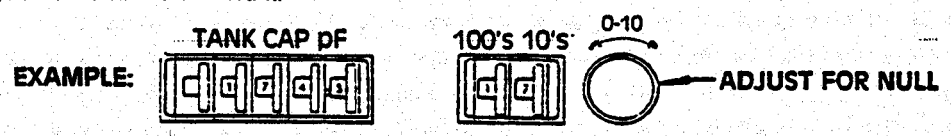
3.6.1 Preliminary - Disconnect aircraft plug(s) from gauge-bridge and connect harness between gauge-bridge and disconnected aircraft plug(s). Refer to Figure 4"A".

NOTE: The aircraft probe circuits are not used in this test and the probe connections must be removed. Connect aircraft plug to "C" receptacle on harnesses so equipped, or, to the receptacle which does not have shielded probe lead wiring. Some harnesses have probe leads wired through to both ends and the probes must be disconnected elsewhere in the aircraft. Other harnesses have probe leads from both ends of harness. Connection should be made to the leads from the gauge-bridge plug end only.

Some harnesses provide jacks for substituting the test set microammeter for the aircraft fuel gauge, or, for a series connection. Connections should be made to the INDICATOR jacks (7) on the test set. Refer to Figure 4"C".

The signal conditioner may be bench tested with an appropriate independent harness, or, with an adapter to the system calibration harness used on the aircraft.

3.6.2 Compensator Simulator Setting - If the compensator simulator (17) is to be used, set test set FUNCTION (5) to "CAP BRIDGE", set TANK CAP pF (13) to empty compensator value to be simulated and set battery switch (11) "ON". Press COMP. CAL (18) and adjust COMP. SIM. (17) for minimum meter reading. (Set 100's and 10's digits to correspond with TANK CAP setting, then adjust 0-10 knob for null.)



NOTE: The COMP. SIM. is generally used to simulate a reference compensator capacitance. If it is not required for compensator simulation, it may be used to simulate a tank probe circuit. PLACE SHORTING CAP OVER COMP RECEPTACLE (16) IF COMP. SIM. IS NOT USED.

3.6.3 Operation - Proceed as follows:

a. Set TANK CAP pF (13) to empty tank value to be simulated, and TEST FUNCTION (5) to "CAP. SIM. 1" (or "CAP. SIM. 2" for certain "ratiometric systems").

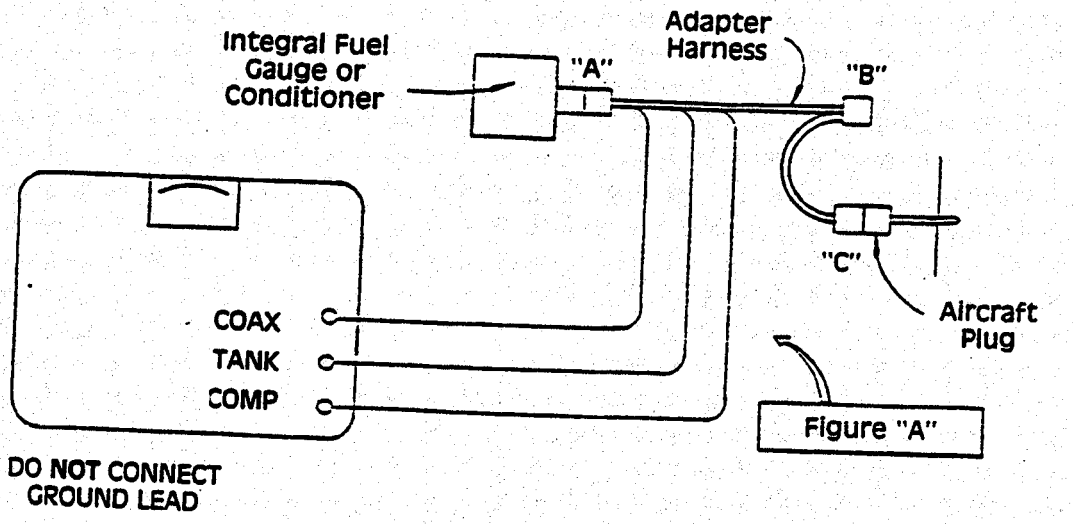


Figure "A"

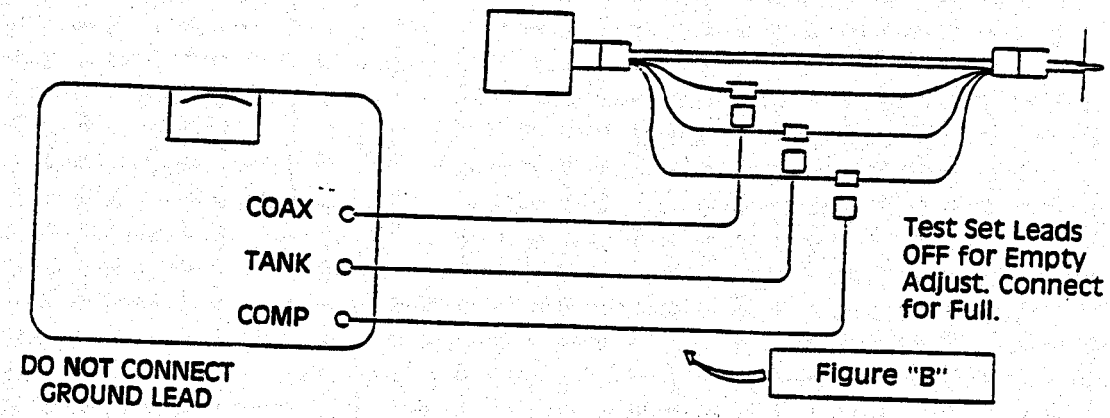
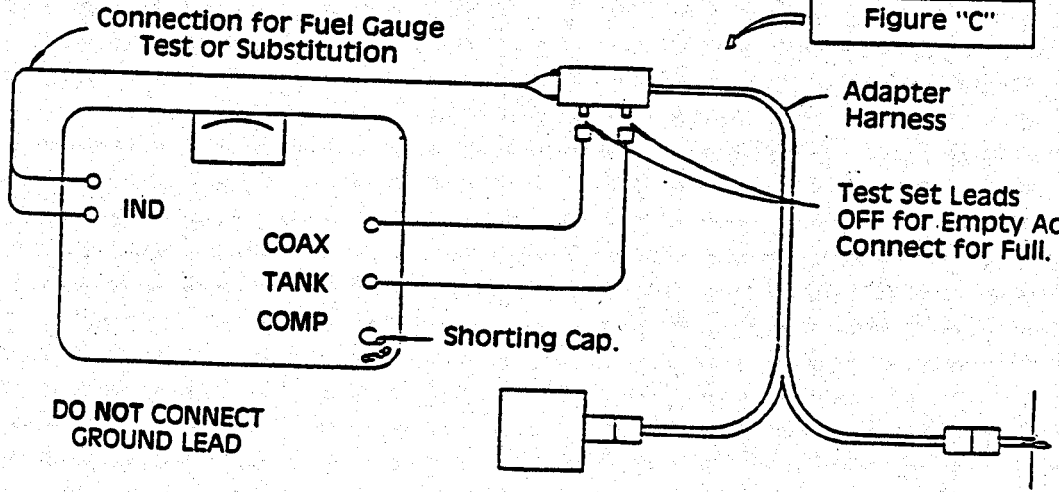


Figure "B"

Figure "C"



TYPICAL CAPACITANCE SIMULATOR HOOKUPS
FIGURE 4

NOTE: If not otherwise specified, "CAP. SIM. 1" should be used for the majority of all fuel quantity systems. Use "CAP. SIM. 2" if specified in maintenance procedure literature supplied with the test harness.

b. Connect HI-Z COAX, LO-Z TANK, and LO-Z COMP. of harness to corresponding test set receptacles (14), (15), and (16). Refer to Figure 4"A". If there is no COMP. connection, the LO-Z COMP. receptacle (16) may be used for a LO-Z TANK circuit.

c. Turn aircraft power to fuel system "ON" and test set battery switch (11) "ON". Select aircraft tank system if procedure specifies.

d. Set empty adjustment on gauge-bridge for the corresponding system.

e. Repeat step 3.6.2 for COMP. SIM. simulated full value (NOT ADDED), if different from empty and repeat set 3.6.3 for a simulated total full value (NOT ADDED).

f. Set full adjustment on gauge-bridge for the corresponding system fuel gauge reading for full.

g. Different TANK CAP. pF values may be set to represent other levels of fuel to test indicator behavior and linearity per maintenance specifications, if listed.

3.7 SYSTEM CALIBRATION, PREFERRED

Note that tanks must be drained to accomplish the preferred calibration. If tanks cannot be drained, the alternate calibration of Section 3.8 may be accomplished in certain instances.

3.7.1 **Preliminary** - Proceed as follows:

a. Maintenance procedures often specify empty adjustments to be accomplished without adapter harness or test set connected. The empty adjustments of the gauge-bridge must be accessible, so it may require dismounting of the gauge-bridge, but the aircraft wiring must remain connected. Select the tank system, if applicable, and make empty adjustments specified.

b. If empty adjustment is to be made with adapter harness connected, disconnect gauge-bridge plug(s) and connect harness between gauge-bridge and aircraft plug(s). Refer to Figure 4"B" and "C".

NOTE: The aircraft probe circuits are used in this test. Connect aircraft plug to "B" receptacle on harness so equipped, or, to the receptacle which has the shielded probe wiring. Harnesses with probe leads from each end must have their respective ends joined together. Refer to Figure 4"B".

3.7.2 **Adjustment** - Proceed as follows:

a. Select tank system, if applicable, and make empty adjustments.

NOTE: Some maintenance procedures require that additional compensator capacitance be added to represent a wetted compensator covered with fuel. This may be accomplished as in paragraph 3.6.2 except that setting is to "added compensator value". "Tee" into harness HI-Z COAX and LO-Z COMP connections to corresponding test set receptacle (14) and (16) with shielded leads. Set TEST FUNCTION (5) to "CAP. SIM. 1" (or "2", if specified), set TANK CAP. pF to "000.0", select tank system, if applicable, and make empty adjustments.

b. After empty adjustment has been made, prepare for full adjustment by connecting harness as in step 3.7.1 b, if not already connected.

c. If a new setting is required of the COMP. SIM., disconnect test leads to adapter harness, and set COMP. SIM. (17) to the value required for full, as specified in paragraph 3.6.2.

d. Reconnect test set leads to harness. Refer to Figure 4"B" and "C".

e. Set TANK CAP pF (13) to "added value for full", if it is to be used and set TEST FUNCTION (5) to "CAP SIM. 1" (or 2, if specified). (Use shorting cap on LO-Z TANK (15) if TANK CAP pF is not used.)

f. Set battery switch (11) "ON", select tank system if applicable, and make full adjustment for gauge reading specified.

g. Empty and full adjustment may interact, repeat for optimum adjustment.

3.8 SYSTEM CALIBRATION, ALTERNATE

NOTE: Tanks may have any amount of fuel whatsoever. This procedure yields a limited accuracy and should be followed by a preferred calibration per section 3.7 at the next opportune time.

Proceed as per section 3.6 using specified empty and full capacitance values. If the actual dry capacitance of the particular aircraft is known, substitute this value for empty. Add to this the "Add for Full" capacitance to substitute for full.

3.9 BATTERY TEST

3.9.1 Operational Test - Always test batteries before using the Test Set. Set TEST FUNCTION (5) to "CAP BRIDGE", battery switch (11) "ON", and press BATT TEST (12). Meter should read above the radial BAT OK line prior to any prolonged test use.

3.10 BATTERY REPLACEMENT

3.10.1 Removal - Remove the two screws from battery compartment cover and pull unit outward from panel. Disconnect battery plug from unit for better access. Lift each battery slightly and pull straight away from the contact end.

3.10.2 Individual Test - After removal, test each battery individually because one or more defective batteries mixed with good ones may produce a weak battery test.

3.10.3 Battery Type - Use alkaline NEDA 1604A batteries or equivalent batteries only. Carbon-zinc NEDA 1604 may be used for **TEMPORARY** replacement if alkaline batteries are not available.

3.10.4 Replacement - Make certain to observe polarity and to push firmly inward so that the contacts mate with a snap.

3.11 AC POWER SUPPLY

3.11.1 Use - The AC supply is intended for extended use of the test set at the bench level. Use aboard aircraft may introduce inadvertent ground loops which may invalidate test results. If used on aircraft, keep ship power off, and for safety sake, observe the following:

NOTE: ALWAYS GROUND TEST SET TO AIRFRAME GROUND BEFORE CONNECTING TEST SET POWER CORD.

3.11.2 Operation - The AC ON-OFF switch may be left ON during all testing operations and the battery switch (11) operated in the same manner as described for battery operation.

MAINTENANCE

4.1 USER MAINTENANCE

The user must ensure that only batteries of the proper type are used, and that satisfactory battery condition is maintained. The test set should be protected from excessive shock and extreme environments. User assurance of calibration may be ensured by frequent reference to a suitable standard such as the field calibration reference box, Barfield P/N 101-00510, or substitute.

4.2 RECERTIFICATION

4.2.1 Recertification Period - Recertification of the T/S should be performed at least annually. When frequent production usage occurs, or where severe environmental conditions are experienced, more frequent (6 months or less) recertification may be required.

4.2.2 Recertification Procedure - Sections 4.3 through 4.7 describes the tests and adjustments necessary to ensure test set accuracy.

4.2.3 Equipment Required - Refer to Table 4-1 for recommended test equipment. Equivalent substitutes may be used provided that they meet specified minimum tolerances.

4.3 INDICATOR FUNCTION TEST

4.3.1 Meter Calibration - Perform test as follows:

a. Set meter pointer to exactly zero with small screwdriver through panel hole below the center of the meter.

b. Connect DC current input jacks of digital voltmeter (DVM) to INDICATOR jacks and range DVM for measuring 0-1100 uADC.

c. Set T/S FUNCTION to "INDICATOR" and battery switch "ON".

d. Compare T/S meter with DVM readings when DVM is set to each 200 uA increment with METER ADJUST control. Meter tolerance is ± 11 uA at all points.

4.3.2 Meter Adjustment - If meter does not meet tolerance, set current to 1000 uA on DVM, and adjust P1 on meter PC board for a corresponding reading. Repeat 200 uA increment tests and compromise adjustment if necessary to meet tolerance at all points.

4.4 BATTERY TEST

Set TEST FUNCTION to "CAP BRIDGE", battery switch "ON" and press BATT TEST button. Meter should read at 880 uA or above for an optimum calibration. Replace with fresh alkaline batteries, if required. Refer to Battery Replacement, section 3.10.

EQUIPMENT DESCRIPTION	MINIMUM SPECIFICATION	TYPICAL EQUIP.	USAGE
Capacitance Bridge Measuring Assembly	3 Term., guarded, 400 or 1000 Hz, ± .025 Cap accuracy, Dissipation 0 to 0.010 at ± 1%	General Radio Type 1620	Maint
1000 pF Standard Cap. Set at 999.5 pF	A 750 to 999.5 pF capacitor with a value known to ± .05%	General Radio Type 1403-A	Maint
Coaxial Cable, 3 ft long (2 ea)	To connect T/S to bridge and standard capacitor	Barfield P/N 101-01008 or equiv.	Maint Repair
Cable, 4 ft long, Banana plugs at both ends	T/S meter jacks to digital voltmeter	Barfield P/N 612-0004 or equiv.	Maint Repair
Resistor, 1 megohm	± 1%	RN60D1004F	Maint
Resistor, 100K ohm	± 1%	RN55D1003F	Maint
Resistor, 500 megohms	200 to 500 megohm ± 2%	F43D-500M Dale	Maint
Resistor (2 each)	4K to 10K equal value ± 1%	RN55D4991F Allen Bradley	Repair
Digital Votmeter	4½ digit ± .05% nominal accuracy	Fluke 8600A	Repair
Oscilloscope	DC-1 MHz bandwidth 20 mv/cm sensitivity	Tektronix T921	Repair
Transistorized Voltmeter	10 mV F.S. sensitivity, ± 2% F.S. accuracy	Hewlett Packard 427A	Repair

EQUIPMENT REQUIRED

FIGURE 1

4.5 INSULATION FUNCTION TEST

4.5.1 Internal Leakage - Set TEST FUNCTION to "INSULATION", battery switch "ON", and RANGE to "X1". Meter pointer should remain at the infinity mark except for momentary transients when INS TEST POINTS switch is operated through all positions.

4.5.2 Insulation Calibration - Set INST TEST POINTS to "LO-Z/HI-Z" and connect standard 200 to 500 megohm resistor between insulation jacks (3) and (4). Meter should read resistor value within ± 5%. Make test using 1 megohm resistor and RANGE at "X.01". Meter should read ± 5% of 100 on Megohm scale. (Allowable tolerance is ± 2 divisions on uA scale for both tests.)

4.5.3 Three Terminal Test - Set RANGE to "X1" and connect 100K resistor from HI-Z to shield on HI-Z jack (4). Meter pointer shall indicate within ± 1 division on uA scale with resistor connected or disconnected. P5 COMMON MODE ADJ on main PC board should be adjusted, if necessary, to achieve the desired test result. (Valid for 3-terminal circuit only.)

4.5.4 Zero Resistance - Short jacks (3) and (4) together and meter shall read zero ± 1 division on uA scale.

4.6 CAPACITANCE SIMULATOR TEST

4.6.1 Preliminary - Make the following connections and settings:

a. TEST FUNCTION to "CAP SIM 1".

b. TANK CAP pF to "000.0".

c. Place BNC shorting cap on LO-Z COMP jack.

d. Connect shielded lead between T/S HI-Z COAX jack and capacitance bridge UNKNOWN L jack, and another shielded lead between T/S LO-Z TANK jack and bridge UNKNOWN H jack. (Connections are for GR bridge listed in Figure 1. For other bridges, LO-Z of T/S must be connected to excitation signal and HI-Z to null detector.)

4.6.2 Bridge Settings - Present bridge as follows:

a. Oscillator FREQUENCY to "400" and POWER "ON".

b. MAXIMUM OUTPUT to "10 V" and OUTPUT LEVEL fully CW.

c. Amplifier GAIN approximately mid-travel, METER SWITCH TO "LOG", FILTER FREQUENCY to "200 Hz - 2 KHz," and adjust FILTER TUNING for maximum bridge meter deflection.

d. Bridge D MAX to "0.1" and DISSIPATION FACTOR to "0.00050".

e. C MAX to "1000 pF" and CAPACITANCE to "000.000", MX to "0" and set Terminal Selector to "3 TERM".

4.6.3 Cap Sim Zero Adjustments - Test and adjust as follows:

a. Turn T/S battery switch "ON". If bridge does not null at 0 pF, adjust P3 on meter PC board.

b. Reverse HI-Z and LO-Z leads on bridge and select "CAP SIM 2" on T/S FUNCTION switch.

c. If bridge does not null at 0 pF, adjust P4 on meter PC board.

d. Return HI-Z and LO-Z leads to original connection on bridge and reset T/S FUNCTION to "CAP SIM 1".

4.6.4 999.9 pF Calibration - Test and adjust as follows:

a. Set T/S TANK CAP pF to "999.9" and bridge CAPACITANCE to "999.900".

b. If bridge does not null at 999.9 pF, adjust P1 on main PC board. Adjust C3 on main PC board if bridge does not null at a dissipation of 0.0005.

4.7 CAPACITANCE BRIDGE TEST

4.7.1 Meter End Scale Adjustments - Test and adjust as follows:

a. Set TEST FUNCTION to "CAP BRIDGE", TANK CAP pF to "999.9" and battery switch to "ON".

b. Push PRESS TO MEASURE and meter should read 1000 ± 100 uA at 1100 uA.

c. Set TANK CAP pF to "000.0".

d. Push PRESS TO MEASURE. Adjust P2 on meter board if meter does not zero.

4.7.2 Bridge Calibration - Test and adjust as follows:

a. Connect shielded leads between T/S HI-Z COAX and LO-Z TANK jacks to 1,000 pF (999.5) standard capacitor.

b. Push PRESS TO MEASURE and meter should null at approximately 0 uA. Adjust P4 and C31 on main PC board, if necessary, then release button.

c. Battery switch "OFF" and disconnect leads.

4.8 COMPENSATOR SIMULATOR TEST

4.8.1 Comp Sim Minimum Capacitance - Test as follows:

a. TEST FUNCTION to "CAP BRIDGE", TANK CAP pF to "010.0", and battery switch to "ON". Place BNC shorting cap on LO-Z COMP jack.

b. Set 100's to blank position representing zero, and 10's to "1".

c. Press COMP CAL button and adjust COMP SIM vernier knob for null, then release button. Null should develop smoothly and not exceed 50 uA.

4.8.2 Comp Sim Maximum Capacitance - Test as follows:

a. Set TANK CAP pF to "400.0". Set COMP SIM 100's to "3" and 10's to "9".

b. Press COMP CAL button and adjust COMP SIM 0-10 knob for null, then release.

c. Set FUNCTION switch to "CAP SIM 1", and move BNC Shorting cap from LO-Z COMP to LO-Z TANK jack.

d. Connect T/S HI-Z COAX AND LO-Z COMP jacks to bridge UNKNOWN jacks L and H respectively.

e. Set bridge C MAX to "1000" pF and adjust bridge CAPACITANCE and DISSIPATION settings for null. The capacitance reading shall be 400.0 ± 0.2 pF.

f. Battery switch "OFF" and disconnect leads.

4.9 FINAL CHECKOUT

4.9.1 Battery Condition - Test as follows:

a. FUNCTION to "CAP BRIDGE" and battery "ON".

b. Press BATT TEST button and meter should indicate in excess of 1000 uA. (Fresh batteries)

4.9.2 Bridge Minimum and Maximum - Proceed as follows:

a. Set TANK CAP to "000.0" and push PRESS TO MEASURE. Meter shall indicate — 10 to +20 uA.

b. Set TANK CAP pF to "999.9" and push PRESS TO MEASURE. Meter shall indicate 1000 ± 100 uA.

4.9.3 Cap Sim Divider - Proceed as follows:

a. With TANK CAP pF at "999.9" and PRESS TO MEASURE pushed, reduce setting of left hand digit wheel by one digit at a time to "0" while observing panel meter. Meter shall decrease with each successive step.

b. Repeat step a. with each digit in succession to the right. Meter shall fall by an increasing amount with each decrement to "000.0" when meter should read – 10 to +20 uA.

4.9.4 Auto Shut-Off - Close cover of test set with battery switch left in the "ON" position. Reopen the cover to make certain that the Auto Shut-Off bracket has returned the switch to "OFF" position.

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REPAIR

5.1 GENERAL

5.1.1 Fault Isolation - If the test set fails to perform or to calibrate to the requirements of chapter 4, check the following in the sequence listed:

a. Power supply

b. Meter and associated circuits

c. Function circuits

d. Switching, jacks and wiring

5.1.2 Equipment Required - Refer to Figure 1 for recommended test equipment. Equivalent substitutions may be used provided that they meet minimum specifications.

5.1.3 Common Circuits - All functions, with the exception of the compensator simulator, are dependant on the battery supply or alternate. Only the "CAP BRIDGE" function uses the oscillator. The meter is used in all measurement functions, and the TANK CAP pF simulator is used in the "CAP BRIDGE" as well as the "CAP SIM" functions.

5.1.4 Circuit Theory - Refer to chapter 2 for Principles of Operation and simplified circuit illustrations.

5.1.5 Tests and Adjustments - The tests and adjustments beginning with Section 5.2 may be used as an aid in troubleshooting. In case of a part replacement, these same procedures should be accomplished prior to the recertification procedure in chapter 4. All references are to the main printed circuit board (PCB).

5.2 OSCILLATOR

5.2.1 Amplitude Adjust - Make the following set-up:

a. Set oscilloscope TRIGGERING SOURCE to "INT", MODE to "AUTO", VOLTS/DIV 1X PROBE to ".2", and SEC/DIV to ".5m".

b. Connect 1X probe shield to left side of R29 and probe tip to right side of R29.

c. Select "CAP BRIDGE" function and turn battery switch "ON".

d. Push "PRESS TO MEASURE" button and adjust P3 for 1V PK-PK. Release button.

e. Connect DVM negative lead to common test point (or BW4) and positive lead to PCB terminal N.

f. Push "PRESS TO MEASURE" button. The output voltage should measure 5.2 ACV to 6.2 ACV.

5.2.2 Frequency - The oscillator frequency measured at the same points should be 400Hz ± 8Hz.

5.3 FILTER

5.3.1 Tuning Adjustment - Make the following set-up:

a. Set oscilloscope "TRIGGERING SOURCE" to "INT". "MODE" to "AUTO", "VOLTS/DIV 1X PROBE" to "2", and "SEC/DIV" to ".5m".

b. Dial in "100.0" into "TANK CAP" thumbwheels.

c. Connect 1X probe shield to common test point (or BW4) and probe tip to BW2.

d. Push "PRESS TO MEASURE" button and adjust P2 for maximum signal amplitude. Release button.

5.4 INVERTER ADJUST

5.4.1 Preliminary - Make set-up as follows:

a. Connect 1000 pF capacitor between HI-Z COAX and LO-Z TANK jacks of T/S.

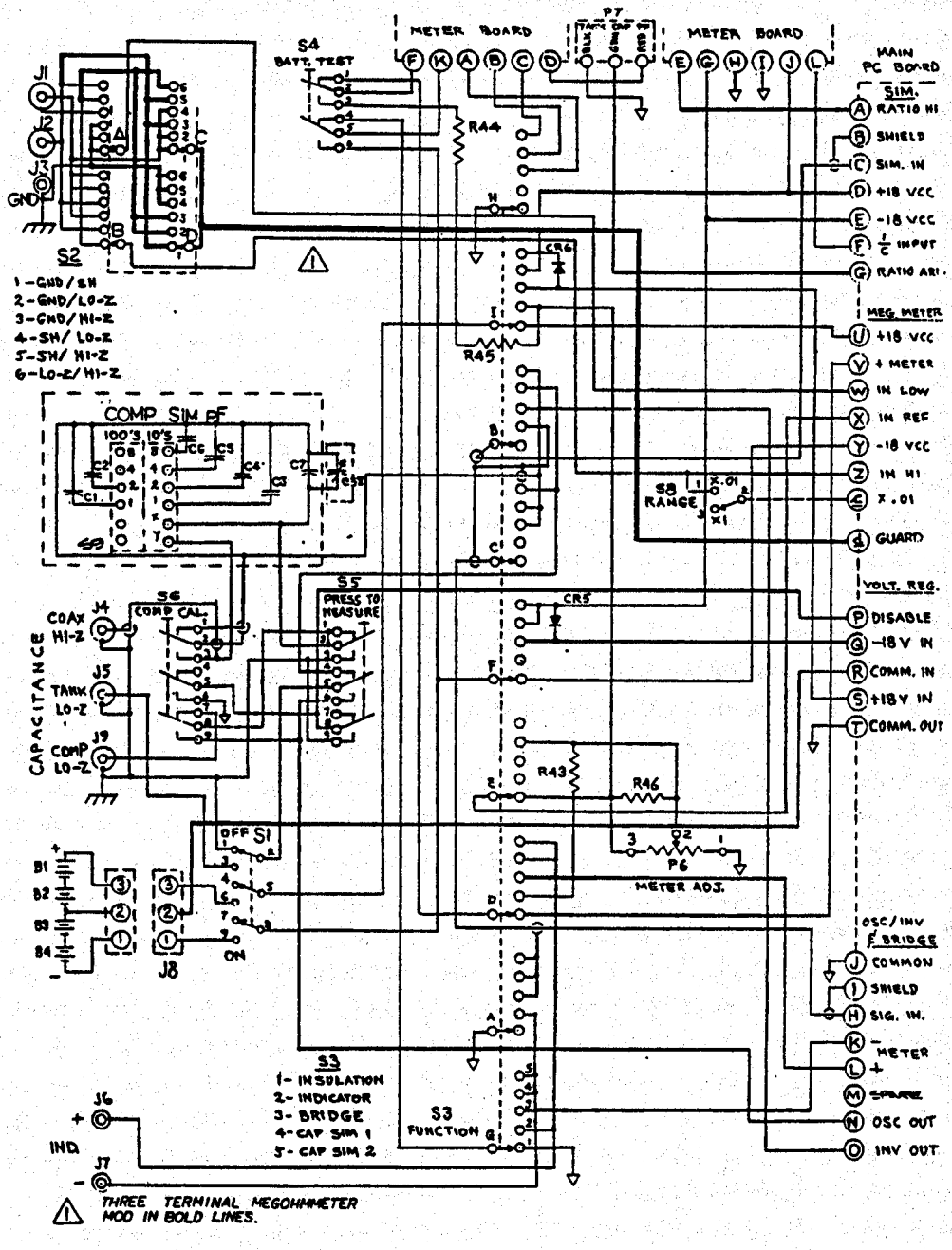
b. Connect LO input of transistorized voltmeter to common test point, and connect HI input to junction between two 1% resistors of equal value connected in series between PCB lead terminals "N" and "O".

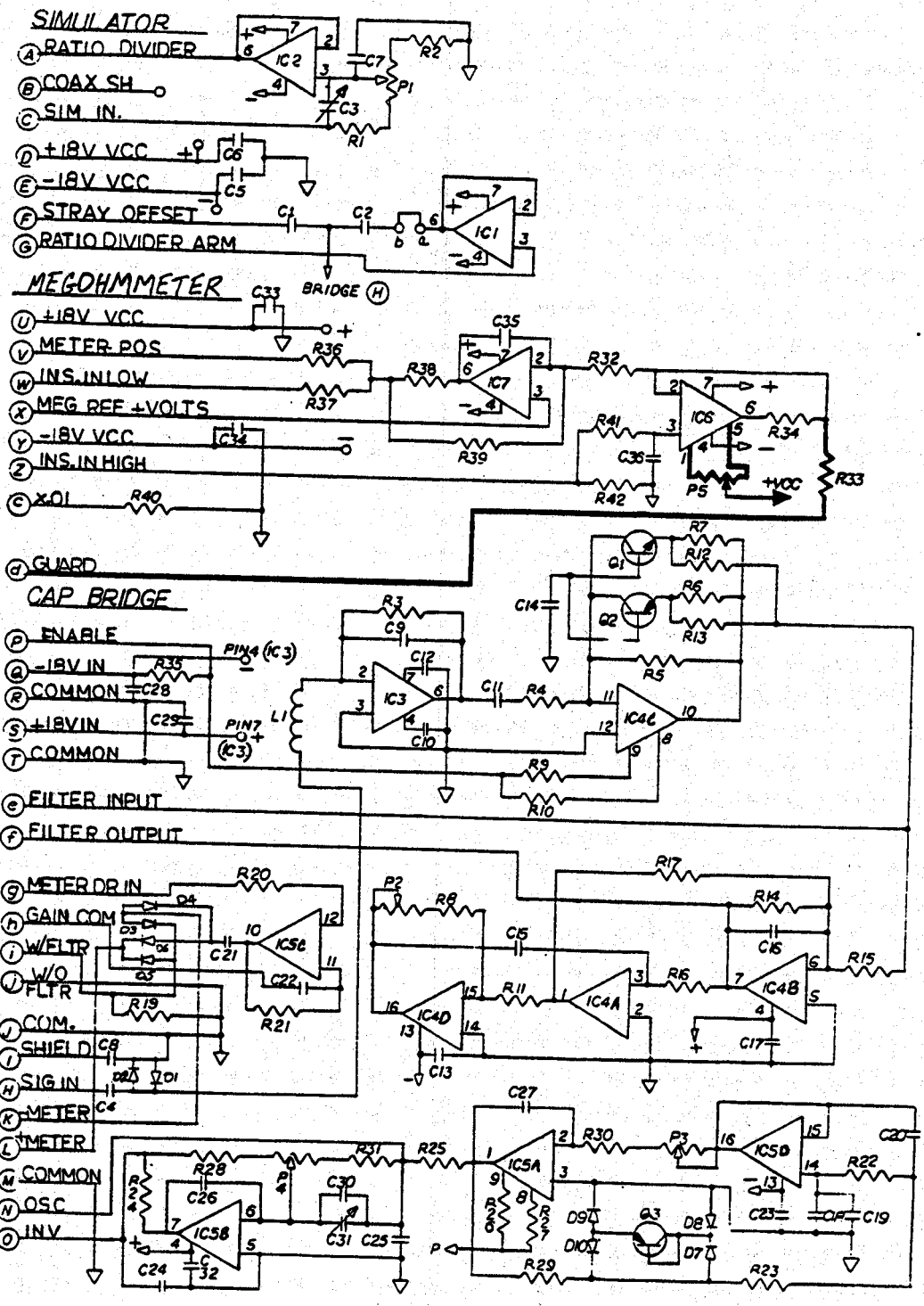
c. Set TVOM for 10 VAC range and T/S to "CAP BRIDGE" function and battery switch "ON".

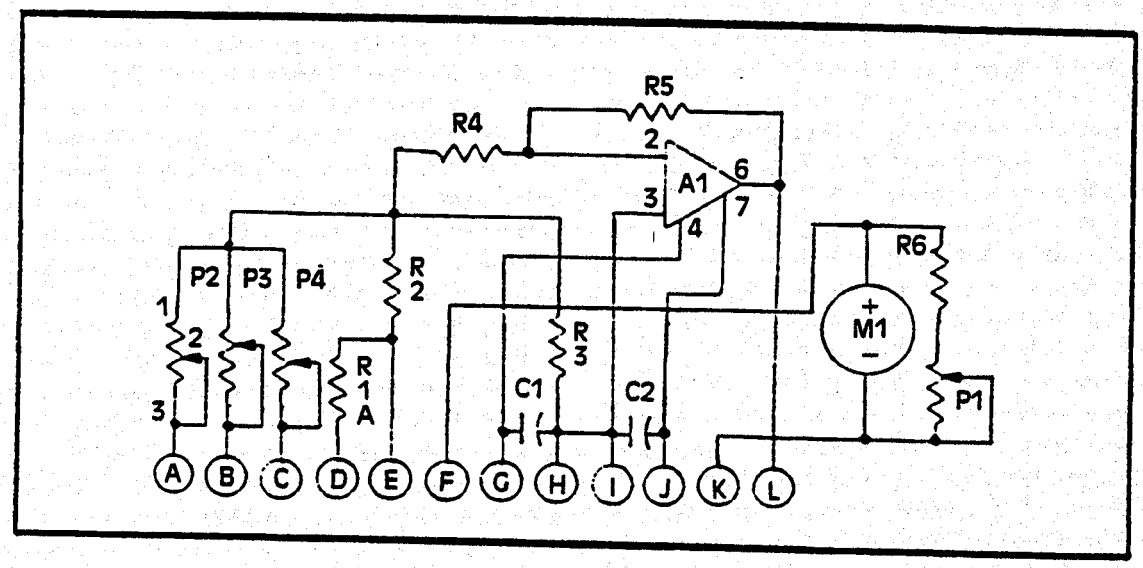
5.4.2 Adjustments - Adjust P4 and C31 alternately for TVOM null, downranging TVOM as required. A null of 1.0 mV or less should be obtainable. Disconnect test set-up and turn battery "OFF".

5.5 CALIBRATION

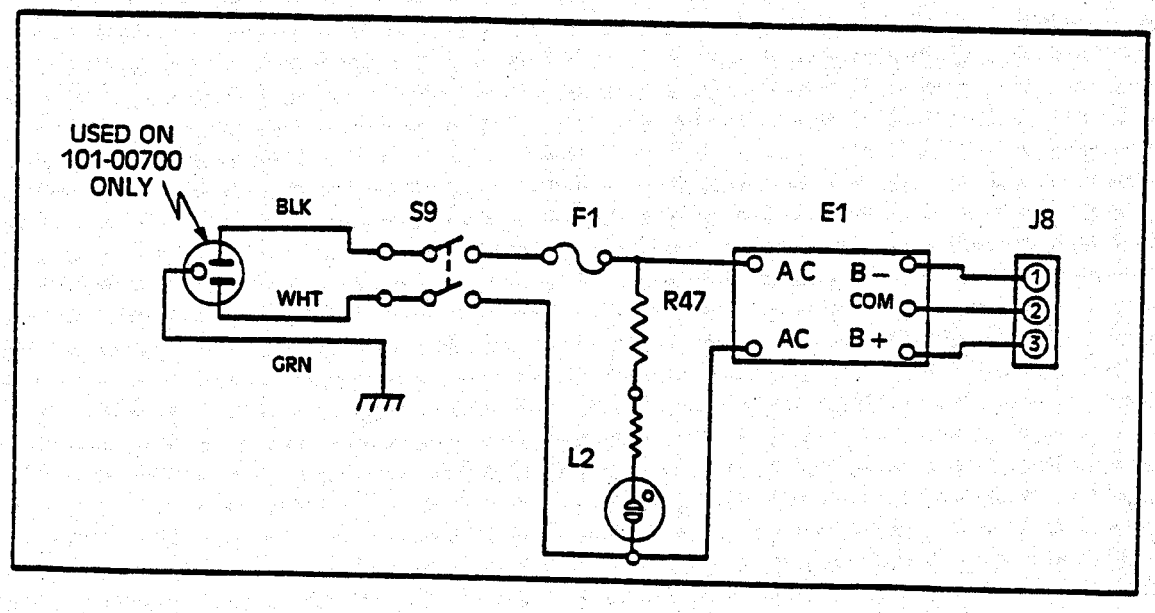
5.5.1 Procedure - Perform maintenance procedure as described in chapter 4, beginning with section 4.2 and proceeding through Final Checkout, section 4.9.


METER BOARD
METER BOARD
P7
MAIN PC BOARD
SIM.
A RATIO HI
B SHIELD
C SIM. IN
D +18 VCC
E -18 VCC
F 1/C INPUT
G RATIO ARM
MEG. METER
U +18 VCC
V + METER
W IN LOW
X IN REF
Y -18 VCC
Z IN HI
a X.01
d GUARD
VOLT. REG.
P DISABLE
Q -18 V IN
R COMM. IN
S +18 V IN
T COMM. OUT
OSC/INV
F BRIDGE
J COMMON
I SHIELD
H SIG. IN.
K - METER
L +
M SPARE
N OSC OUT
O INV OUT
S4
BATT TEST
S2
1-GND/SH
2-GND/LO-Z
3-GND/HI-Z
4-SH/LO-Z
5-SH/HI-Z
6-LO-Z/HI-Z
J1
J2
J3
GND
COMP SIM PF
100'S
10'S
R44
R45
CR6
S8
RANGE
X.01
X1
S5
PRESS TO MEASURE
S6
COMP CAL
CR5
COAX HI-Z
J4
TANK LO-Z
J5
COMP LO-Z
J9
CAPACITANCE
R43
R46
P6
METER ADJ.
OFF
S1
ON
B1
B2
B3
B4
J8
S3
1- INSULATION
2- INDICATOR
3- BRIDGE
4- CAP SIM 1
5- CAP SIM 2
S3
FUNCTION
J6
IND
J7
THREE TERMINAL MEGOHMMETER MOD IN BOLD LINES.


SIMULATOR
A RATIO DIVIDER
B COAX SH
C SIM IN.
D +18V VCC
E -18V VCC
F STRAY OFFSET
G RATIO DIVIDER ARM
BRIDGE H
MEGOHMMETER
U +18V VCC
V METER POS
W INS. IN LOW
X MEG REF +VOLTS
Y -18V VCC
Z INS. IN HIGH
c X.01
d GUARD
CAP BRIDGE
P ENABLE
Q -18V IN
R COMMON
S +18V IN
T COMMON
e FILTER INPUT
F FILTER OUTPUT
g METER DR IN
h GAIN COM
i W/FLTR
j W/O FLTR
J COM.
I SHIELD
H SIG IN
K METER
L METER
M COMMON
N OSC
O INV
IC1
IC2
IC3
IC4A
IC4B
IC4C
IC4D
IC5A
IC5B
IC5C
IC5D
IC6
IC7
IC8
+VCC
PIN4 (IC3)
PIN7 (IC3)
L1
P1
P2
P3
P4
P5



METER PCB SCHEMATIC
FIGURE 3



AC POWER SUPPLY SCHEMATIC
FIGURE 4

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ILLUSTRATED PARTS LIST

6.1 INTRODUCTION

6.1.1 General - This chapter contains information for ordering replacement parts. Each section lists parts in order of their reference designations shown in the applicable illustrations preceding the section. The manufacturer's five digit code is their Federal Supply Code for manufacturers taken from the Defense Logistics Agency microfiche. Such source of supply is shown for the part number listed. Other vendors' replacement parts may be substituted, provided they offer equal or improved specifications.

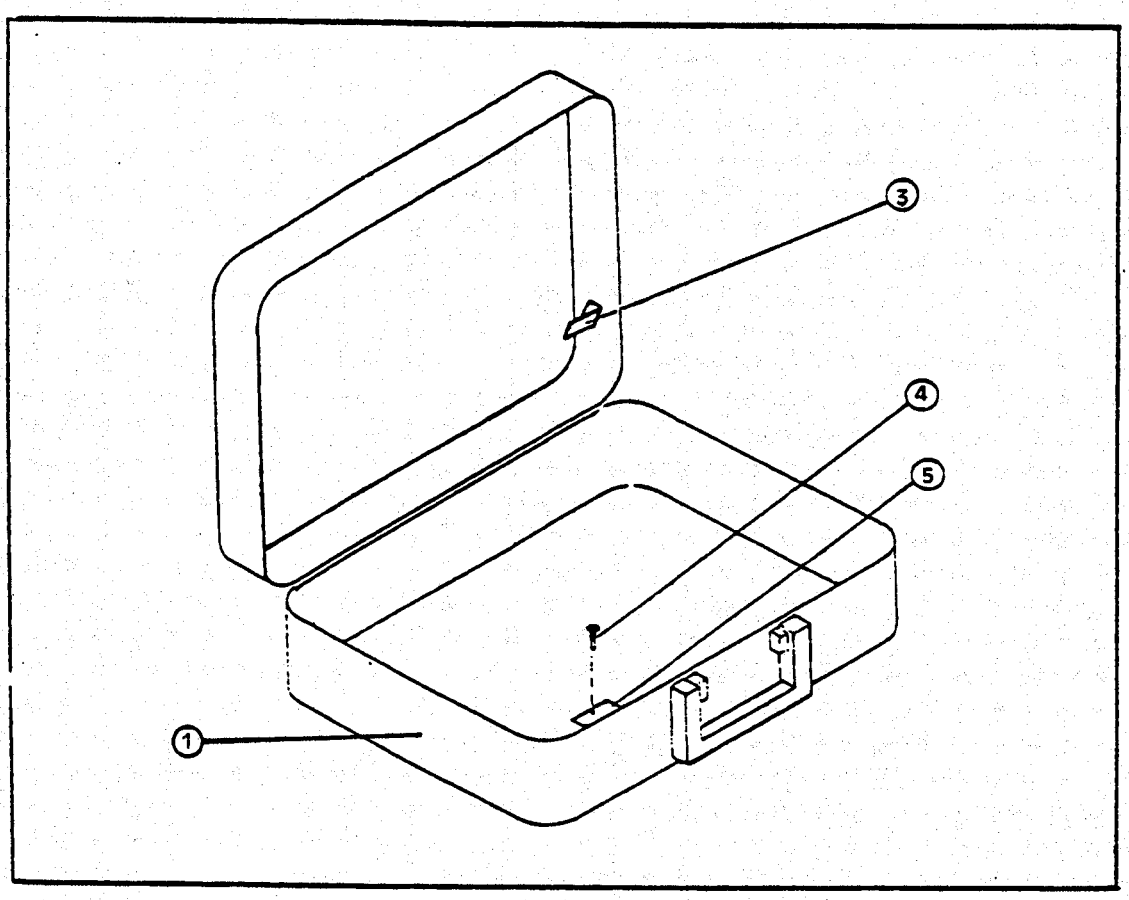
6.1.2 Replacement Parts - Address an order or inquiry to:

BARFIELD INSTRUMENT CORPORATION
P.O. BOX 420537
MIAMI, FLORIDA 33242-0537
U.S.A.

Be sure to identify test set model, part and serial number when ordering parts.

6.1.3 Non-Listed Parts - To obtain a part that is not listed, include information on model number, serial number, description of part, function and location of the part. Standard hardware, nuts, screws and washers are of standard, universal sizes and function, obtainable at any local outlet.

6.1.4 Change - Barfield Instrument Corporation reserves the right to change or substitute original manufacturer and type, subject to availability, quality and improved specifications without notice.


3
4
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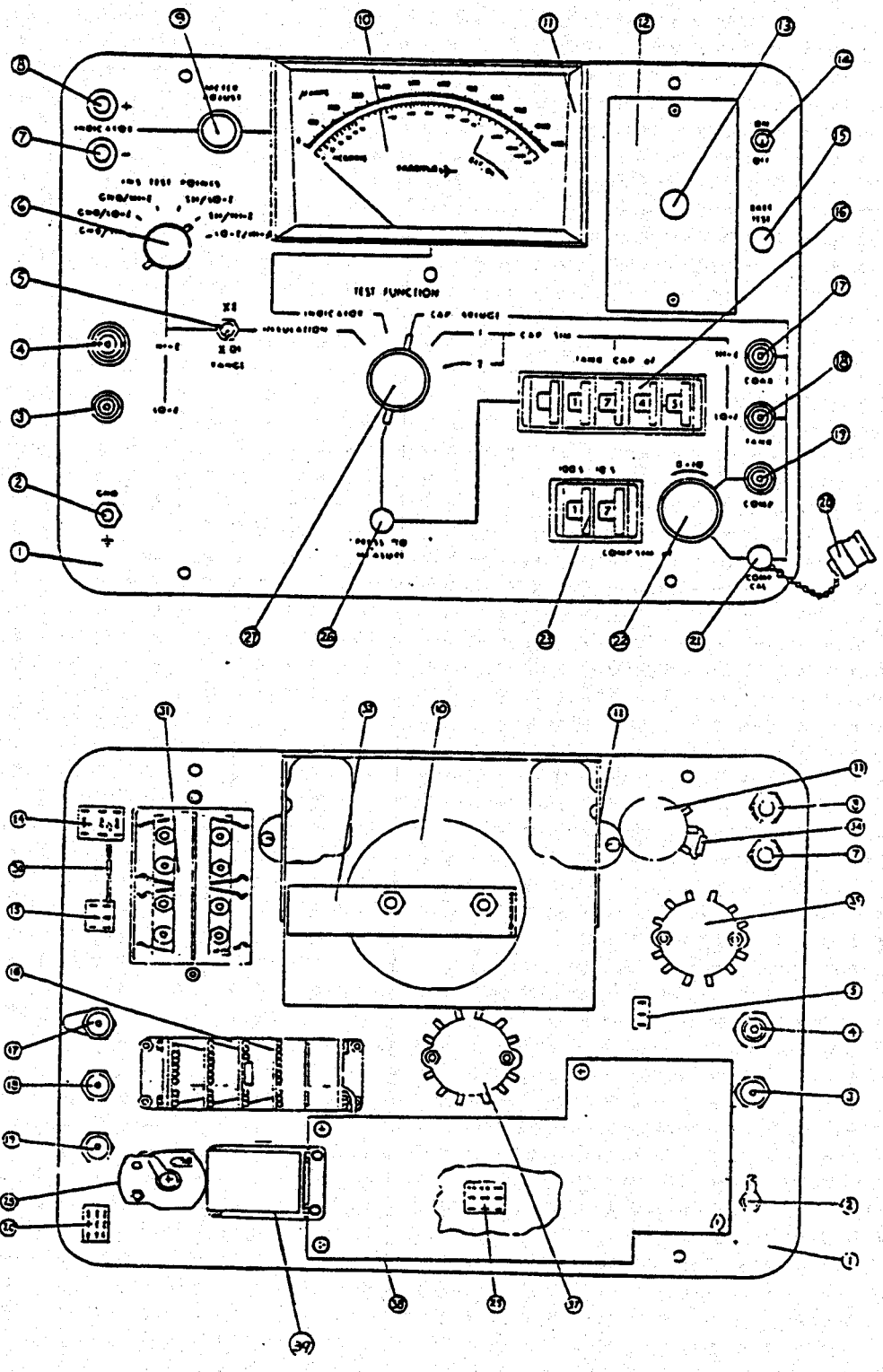
1

REF. NO.	PART NO.	DESCRIPTION	MFG CODE
See FIG 1	115-00121	Case Assembly	21844
1	194-00016	Case Assembly	21844
2	Deleted		
3	150-00010	Bracket Auto Shut Off	21844
4	MS51958-53	Screw, Machine 10-32x½ PH	
5	ZP108001	Bracket, Mounting	21844

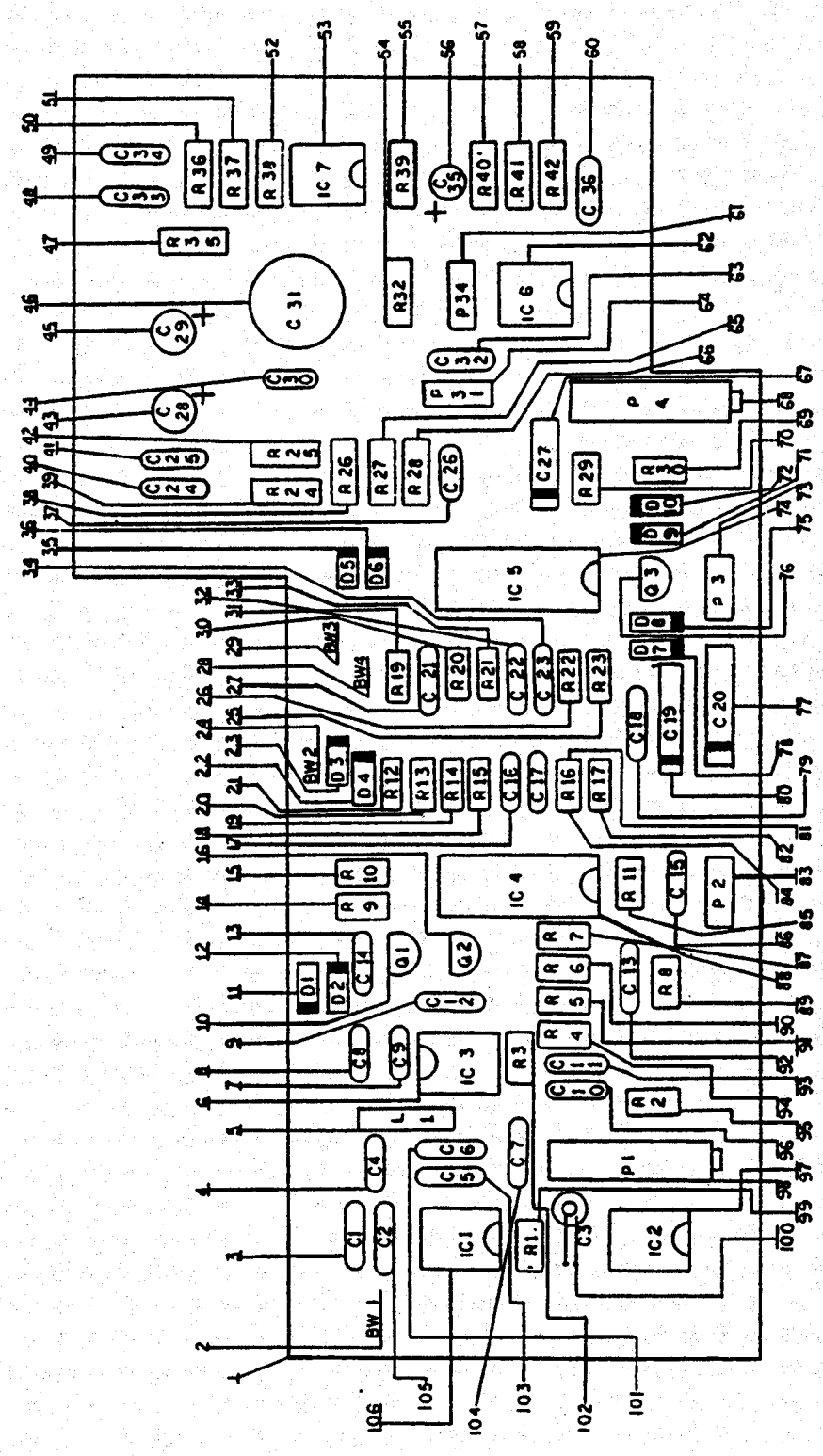

TEST FUNCTION

PARTS LIST
PANEL ASSEMBLY

REF NO.	PART NO.	SYM	DESCRIPTION	MFG CODE
See FIG 2	115-00143		Panel Assembly	21844
1	451-00029		Front Panel	21844
2	108-0740-001	J3	Jack, Plain Banana	74970
3	KC-79-67	J2	Receptacle, Insulated BNC	91836
4	KC-79-67	J1	Receptacle, Insulated BNC	91836
5	MTA-106D	S8	Switch, Toggle SPDT	95146
6	PKGP-70B-¼		Knob, Bar Pointer	95146
7	108-0903-001	J7	Jack, Black Banana	74970
8	108-0902-001	J6	Jack, Red Banana	74970
9	PKG60B-¼		Knob, Round	95146
10	407-00013	M1	Milliammeter, 0-1 mA	21844
11	01123		Bezel, Meter Mount	57466
12	115-00169		Battery Holder Assembly	21844
13	1770		Knob, Utility	72512
14	MTA-306D	S1	Switch, 3PDT Toggle	95146
15	MPA-206R	S4	Switch, DPDT P.B.	95146
16	243-00003	P7	Digivider Assy, 4 Decade	21844
17	KC-79-35	J4	Receptacle, BNC	91836
18	KC-79-35	J5	Receptacle, BNC	91836
19	KC-79-35	J9	Receptacle, BNC	21844
20	310-00002		Cap, BNC Shorting	21844

REF NO.	PART NO.	SYM	DESCRIPTION	MFG CODE
21	MPA-306F	S6	Switch, 3PDT P.B.	95146
22	PKG-100B-¼		Knob, Round Ribbed	95146
23	243-00005	S9	Switch Assy, 2 Decade	21844
24	Deleted			
25	Deleted			
26	MPA-306F	S5	Switch, 3PDT P.B.	95146
27	PKP-194B-¼		Knob, Bar Pointer	95146
28	180-00003	C38	Capacitor, Air Trim, 3.1 - 20.6 pF	21844
30	RN55D3012F	R44	Resistor, 30.1K ohms, 1%	91637
31	471-00020	B1 thru B4	Battery, 9V (4 each)	90201
32	471-00020		P.C. Board Assy Meter	21844
33	VA45R103A	P6	Pot., 10K ohms, 10¼ turns	71450
34	RCR07G512J	R42	Resistor, Comp 5.1K ohms, 5%	01121
35	PA-2003	S2	Switch Rotary	88557
35*	PA-2011	S2	Switch Rotary	88557
36	Deleted			
37	PA-2029	S3	Switch, Rotary	88557
37A	1N4001	CR5	Diode	80211
37B	1N4001	CR6	Diode	80211
37C	RCR07G185J	R41	Resistor, Comp 1.8 megohms 5%	01121
37D	RCR07G103J	R43	Resistor, Comp 10K ohms 5%	01121
38	471-00012		P.C. Board Assy, Main	21844
39	115-00232	PCB	Printed Circuit Board (CAP SIM)	

* Standard configuration uses PA-2003 Switch. PA-2011 used on three terminal megohmmeter option only.



MAIN PCB ASSEMBLY
FIGURE 3

PARTS LIST
PRINTED CIRCUIT BOARD ASSY., MAIN

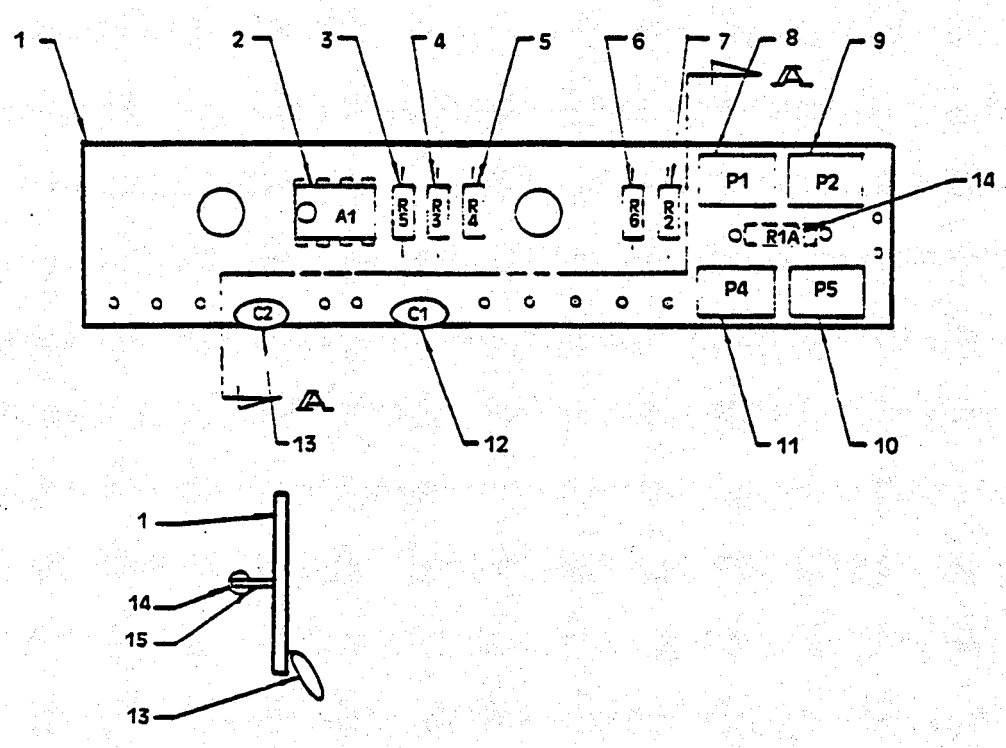
REF NO.	PART NO.	DES.	DESCRIPTION	MFG CODE
See FIG 3	471-00012		P.C. Board Assembly, Main	
1	470-00012	P.C.B.	Printed Circuit Board, Main	21844
2	8021-100	BW1	Bus Wire	
3	DM15-151J	C1	Capacitor, 150 pF	84171
4	C330C105M5U1CA	C4	Capacitor, 1.0 mF	31433
5	550-3399-25-02-00	L1	Coil	
6	LF355N	IC3	OPAMP	12040
7	8141-100-C0G0-682J	C9	Capacitor, 6800 pF	72982
8	10TS-T25	C8	Capacitor, 250 pF	56289
9	TG-S10	C12	Capacitor, .01 mF Ceramic Disc	56289
10	2N3903	Q1	Transistor	04713
11	1N4148	D1	Diode	01295
12	1N4148	D2	Diode	01295
13	TG-S10	C14	Capacitor, .01 mF Ceramic Disc	56289
14	RCR07G106J	R9	Resistor, 10 megohms 5%	01121
15	RCR07G105J	R10	Resistor, 1 megohms 5%	01121
16	2N3905	Q2	Transistor	04713
17	C330C392G1G5CA	C16	Capacitor, 3900 pF	31433
18	RCR07G514J	R15	Resistor, 510K ohms 5%	01121
19	RCR07G106J	R14	Resistor, 10 megohms 5%	01121
20	RCR07G105J	R13	Resistor, 1 megohms 5%	01121

REF NO.	PART NO.	DES.	DESCRIPTION	MFG CODE
21	RCR07G105J	R12	Resistor, 1 megohms 5%	01121
22	1N4148	D4	Diode	01295
23	1N4148	D3	Diode	01295
24	8021-100	BW2	Bus Wire	70903
25	RN55D2493F	R23	Resistor, 249K ohms 1%	01121
26	RN55D2493F	R22	Resistor, 249K ohms 1%	01121
27	C330C105M5U1CA	C21	Capacitor, 1 mF	31433
28	8021-100	BW4	Bus Wire	70903
29	8021-100	BW3	Bus Wire	70903
30	RN55D1002F	R20	Resistor, 10K ohms 1%	01121
31	RCR07G562J	R19	Resistor, 5.6K ohms 5%	01121
32	TG-S10	C22	Capacitor, .01 mF Ceramic Disc	56289
33	RCR07G226J	R21	Resistor, 22 megohms 5%	01121
34	TG-S10	C23	Capacitor, .01 mF Ceramic Disc	56289
35	1N4148	D5	Diode	01295
36	1N4148	D6	Diode	01295
37	8111A-100-C0G0-400G	C26	Capacitor, 40 pF 2%	72982
38	RCR07G105J	R26	Resistor, 1 megohms 5%	01121
39	RCR07G101J	R24	Resistor, 100 ohms 5%	01121
40	TG-S10	C24	Capacitor, .01 mF Ceramic Disc	56289
41	TG-S10	C25	Capacitor, .01 mF Ceramic Disc	56289
42	RCR07G102J	R25	Resistor, 1K ohms 5%	01121
43	503D106F035LA	C28	Capacitor, 10 mF @ 35V	56289
44	8111A-100-C0G0-400G	C30	Capacitor, 40 pF 2%	72982
45	503D106F035LA	C29	Capacitor, 10 mF @35V	56289
46	557-091A5-25	C31	Capacitor, NPO Trimmer 5-25 pF	
47	RCR07G105J	R35	Resistor, 1 megohms 5%	01121

REF NO.	PART NO.	DES.	DESCRIPTION	MFG CODE
48	TG-S10	C33	Capacitor, .01 mF Ceramic Disc	56289
49	TG-S10	C34	Capacitor, .01 mF Ceramic Disc	56289
50	RCR07G912J	R36	Resistor, 9.1K ohms 5%	01121
51	RCR07G102J	R37	Resistor, 1K ohms 5%	01121
52	RCR07G152J	R38	Resistor, 1.5K ohms 5%	01121
53	LM307N	IC7	Op-Amp	12040
54	RN55D4991F	R32	Resistor, 4.99K ohms 1%	011211
55	RN55D4991F	R39	Resistor, 1 megohms 1%	011211
56	196D105X9035HA1	C35	Capacitor, 1.0 mF @ 35V	56289
57	RN55D1022F	R40	Resistor, 10.2K ohms 1%	011211
58	RCR07G104J	R41	Resistor, 100K ohms 1%	011211
59	RN60D1004F	R42	Resistor, 1 megohms 1%	011211
60	TG-S10	C36	Capacitor; .01 mF Ceramic Disc	56289
61	RCR07G152J	R34	Resistor, 1.5K ohms 5%	01121
62	LF355N	IC6	Op-Amp	12040
63	TG-S10	C32	Capacitor, .01mF Ceramic Disc	56289
64	RN55D4022F	R31	Resistor, 40.2Kohms 1%	01121
65	RCR07G105J	R27	Resistor, 1 megohms 5%	01121
66	RN55D4022F	R28	Resistor, 40.2Kohms 1%	01121
67	SXM210	C27	Capacitor, .001 mF 160V 5%	90201
68	89XR500	P4	Potentiometer, 500 ohms 15 Turn	73138
69	RN55D2493F	R30	Resistor, 249K ohms 1%	01121
70	RN55D1001F	R29	Resistor, 1K ohms 1%	01211
71	1N4148	D9	Diode	01295
72	1N4148	D10	Diode	01295
73	72XR25K	P3	Potentiometer 25K ohms 1 Turn	73138
74	LM346N	IC5	Op-Amp Quad	12040

REF NO.	PART NO.	DES.	DESCRIPTION	MFG CODE
75	1N4148	D8	Diode	01295
76	2N3905	Q34	Transistor	04713
77	SXM222	C20	Capacitor, .0022 mF	90201
78	1N4148	D7	Diode	01295
79	DM15-151J	C18	Capacitor, 150 pF	84171
80	SXM210	C19	Capacitor	90201
81	RN55D1003	R16	Resistor, 100K ohms 1%	01121
82	RN55D1003	R17	Resistor, 100K ohms 1%	01121
83	72XR1K	P2	Potentiometer 1K ohms 1 Turn	73138
84	TG-S10	C17	Capacitor, .01 mF Ceramic Disc	56289
85	RN55D4991F	R11	Resistor, 4.99K ohms 1%	01121
86	C330C392G1G5CA	C15	Capacitor, 3900 pF	31433
87	RCR07G303J	R7	Resistor, 30K ohms 5%	01121
88	LM346N	IC4	Op-Amp Quad	12040
89	RN55D4531F	R8	Resistor 4.53K ohms 1%	01121
90	RCR07G303J	R6	Resistor, 30K ohms 5%	01121
91	RCR07G106J	R5	Resistor, 10 megohms 5%	01121
92	TG-S10	C13	Capacitor, .01 mF Ceramic Disc	56289
93	TG-S10	C11	Capacitor, .01 mF Ceramic Disc	56289
94	RCR07G303J	R4	Resistor, 30K ohms 5%	01121
95	499-00004	R2	Resistor, 1.27 meg 10 P.P.M. 1%	21844
96	TG-S10	C10	Capacitor, .01 mF Ceramic Disc	56289
97	LM310N	IC2	Op-Amp	12040
98	89XR50K	P1	Potentiometer, 50K ohms 15 Turns	73138
99	499-00005	R1	Resistor, 8.66 megohms 10 P.P.M.	21844
100	273-0001-001	C3	Capacitor .25 - 1.5 pF	
101	TG-S10	C6	Capacitor, 0.1 mF Ceramic Disc	56289

REF NO.	PART NO.	DES.	DESCRIPTION	MFG CODE
102	RCR07G105J	R3	Resistor, 1 megohms 5%	01121
103	TG-S10	C5	Capacitator, .01 mF Ceramic Disc	56289
104	10TCC-V15	C7	Capacitor, 1.5 pF N.P.O.	56289
105	6133C0G822KB100	C2	Capacitor, 8200 pF ± 5%	12040
106	LF355N	IC1	Op-Amp	12040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R5
R3
R4
R6
R2
P1
P2
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R1A
P4
P5
C2
C1
A
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12
11
10

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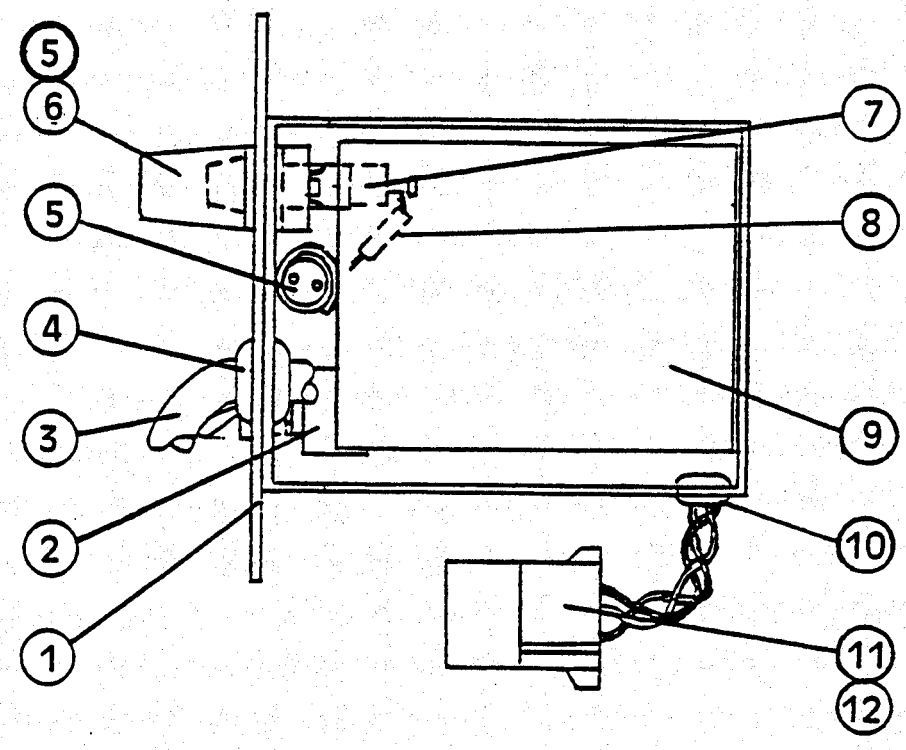
PARTS LIST
PRINTED CIRCUIT BOARD ASSEMBLY, METER

REF NO.	PART NO.	SYM.	DESCRIPTION	MFG CODE
See FIG 4	471-00020		P.C. Board Assembly, Meter	21844
1	470-00020A		Printed Circuit Board	21844
2	LF355N	A1	Amplifier, Operational	12040
3	RN55D3652F	R5	Resistor, 36.5K ohms, 1%	01121
4	RN55D1001F	R3	Resistor, 1K ohms, 1%	01121
5	RN55D1002F	R4	Resistor, 10K ohms, 1%	01121
6	Rn55D1070F	R6	Resistor, 107 ohms, 1%	01121
7	RN55D1002F	R2	Resistor, 10K ohms, 1%	01121
8	72XR100	P1	Pot., 100 ohms, 1 turn	73138
9	72XR1K	P2	Pot., 1K ohms, 1 turn	73138
10	72XR1K	P3	Pot., 1K ohms, 1 turn	73138
11	72Xr1K	P4	Pot., 1K ohms, 1 turn	73138
12	TG-S10	C1	Capacitor, 0.01 mF, 100 VDC	56289
13	TG-S10	C2	Capacitor, 0.01 mF, 100 VDC	56289
14	RN55D----F	R1A	Resistor, 1%, chosen at assy from 200 to 1210 ohms	01121
15	160-3747-01-04		Solder Terminal	71729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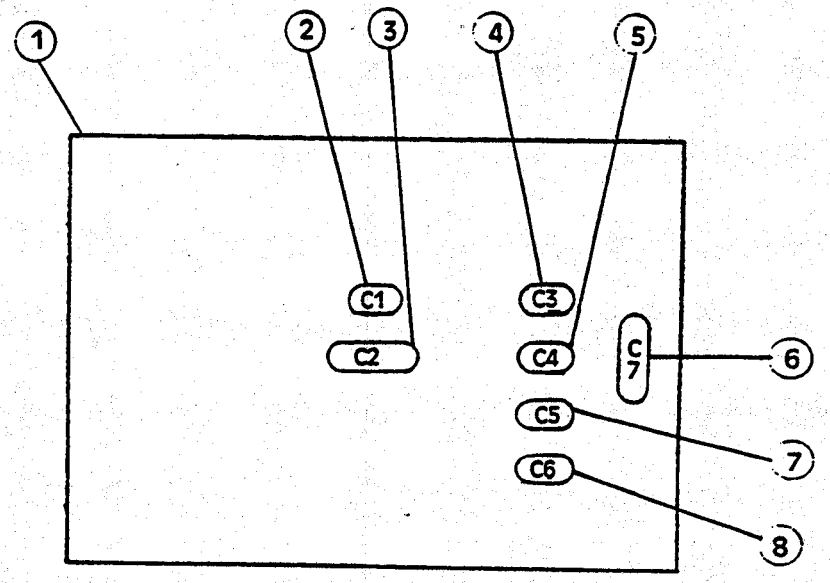
PARTS LIST
AC POWER SUPPLY

REF NO.	PART NO.	SYM.	DESCRIPTION	MFG CODE
See FIG 5	101-00700 101-00701		AC Power Supply, 115V AC Power Supply, 230V	21844 21844
1	225-00013	—	Cover, Power Supply	21844
2	MTA-206N	S9	Switch, Toggle	95146
3	20330	—	Cord, 3 Conductor	53909
4	2147	—	Grommet	11207
5	GMW-½	F1	Fuse, ½ amp, (2 ea)	03614
6	HWA-AF	—	Fuse Holder	03614
7	BNF-4R	L2	Lamp Assembly	95146
8	RCR07G333J	R47	Resistor, 33K ohm, 5% Used on 101-00701 only	01121
9	22-40	E1	Power Supply, 115V Used on 101-00700	29988
9	22-40-230	E1	Power Supply, 230V Used on 101-00701	29988
10	91114	—	Grommet	11207
11	1-48303-0	J8	Housing, Socket	00779
12	60617-4	—	Contact, Socket (3 ea)	00779

PARTS LIST
ACESSORIES

PART NO.	QTY	DESCRIPTION	MFG CODE
101-00401		Standard Lead Package	21844
101-01000	1 ea	Indicator Test Lead Pair	21844
101-01010	1 ea	Banana Lead Pair	21844
101-01007	1 ea	Ground Clip Lead	21844
101-01002	2 ea	Insulation & Capacitance	21844
101-01008	3 ea	Coaxial Cable, 3 ft	21844
112-00007	1 ea	Polarized BNC Adapter, Pin to Pin	21844
31-008	3 ea	Tee Adapter	21844
31-219	3 ea	Straight Adapter	21844
310-00004	2 ea	Shorting Plug	21844

CAP SIM PRINTED CIRCUIT BOARD
FIGURE 5



PARTS LIST
CAP SIM PRINTED CIRCUIT BOARD

REF NO.	PART NO.	DES.	DESCRIPTION	MFG CODE
FIG	115-00232		P.C.B. Assy	21844
1	470-00032	P.C.B.	Printed Circuit Board (CAP SIM)	21844
2	8121A-100-C0G0-101F	C1	Capacitor, 100 pF 1% N.P.O.	72982
3	8131A-100-C0G0-201F	C2	Capacitor, 200 pF 1% N.P.O.	72982
4	8101A-100-C0G0-100J	C3	Capacitor, 10 pF ± 5% N.P.O.	72982
5	8101A-100-C0G0-200G	C4	Capacitor, 20 pF ±2% N.P.O.	72982
6	8101-100-C0H0-569D	C7	Capacitor, 5.6 pF ± 5% N.P.O.	72982
7	8111A-100-C0G0-400G	C5	Capacitor, 40 pF ± 2% N.P.O.	72982
8	8121A-100-C0G0-800F	C6	Capacitor, 80 pF 1% N.P.O.	72982

FEDERAL SUPPLY CODE FOR MANUFACTURERS
From Defense Logistics Agency Microfiche

REF MFG CODE
IN PARTS LISTS

CODE	MANUFACTURER	CODE	MANUFACTURER
00779	AMP, Inc. Harrisburg, PA	70903	Belden Corp. Chicago, IL
01121	Allen-Bradley Co. Milwaukee, WI	71450	CTS Corporation Elkhart, IN
01295	Texas Instruments, Inc. Dallas, TX	71279	Cambridge Thermionics Corp. Cambridge, MA
01537	Motorola Franklin Park, IL	71950	Centralab Electronics Milwaukee, WI
03614	Bussman, Div McGraw-Edison St. Louis, MO	72512	Harry Davies Molding Co. Chicago, IL
11207	Herman H. Smith, Inc. Brooklyn, NY	72982	Erie Technical Products Erie, PA
12040	National Semiconductor Danbury, CT	73138	Beckman Instruments Co. Fullerton, CA
12697	Clarostat Mfg. Co. Dover, NH	74868	Amphenol Danbury, CT
18324	Signetics Corp. Sunnyvale, CA	74970	E.F. Johnson Co. Waseca, MN
19701	Mepco-Electra, Inc. Mineral Wells, TX	80211	Motorola Franklin Park, IL
21844	Barfield Instrument Corp. Miami, FL	80486	All Star Products, Inc. Defiance, OH
29988	Calex Mfr Co., Inc. Pleasant Hill, CA	84171	Arco Electronics Great Neck, NY
31433	Union Carbide, Kemet Div Greenville, SC	90201	Mallory Capacitor Co. Indianapolis, IN
49956	Raytheon Co. Lexington, MA	91637	Dale Electronics, Inc. Columbus, NB
53909	Columbia Electronic Cables New Bedford, MA	91836	King's Electronics Co., Inc. Tuckahoe, NY
56289	Sprague Electric North Adams, MA	92194	Alpha Wire Corp. Elizabeth, NJ
57466	Simpson Electric Elgin, IL	94322	Rel Labs, Inc. Londonderry, NH
65092	Weston Instruments, Inc. Newark, NJ	95146	Alco Electronic Products Lawrence, MA

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