MODEL 432 D

DIGITAL SAFETY ANALYZER

OPERATING and SERVICE

MANUAL

DYNATECH NEVADA
INCORPORATED

Formerly NEURODYNE-DEMPSEY

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WARRANTY

The terms and conditions of warranties made by Dynatech Nevada Inc. with respect to its products are as set forth in its Standard Terms and Conditions of Sale which are included herein by reference. Persuant to those provisions, Dynatech Nevada Inc. warrants that all products are to be free from defects in workmanship and materials for a period of one year, unless a different period is specified, after delivery to the customer. If the notice of defect is timely given, Dynatech Nevada Inc. will either modify the product or part to correct defect, replace the product or part with either new or factory reconditioned complying products or parts, or refund the amount paid for the defective part. The Standard Terms and Conditions of Sale are printed on the reverse side of the company's invoice and acknowledges of customer's order forms and additional copies thereof may also be obtained from the company's offices.

CERTIFICATION

This instrument was thoroughly tested and inspected and found to meet our manufacturing specifications as published when it was shipped from the factory.

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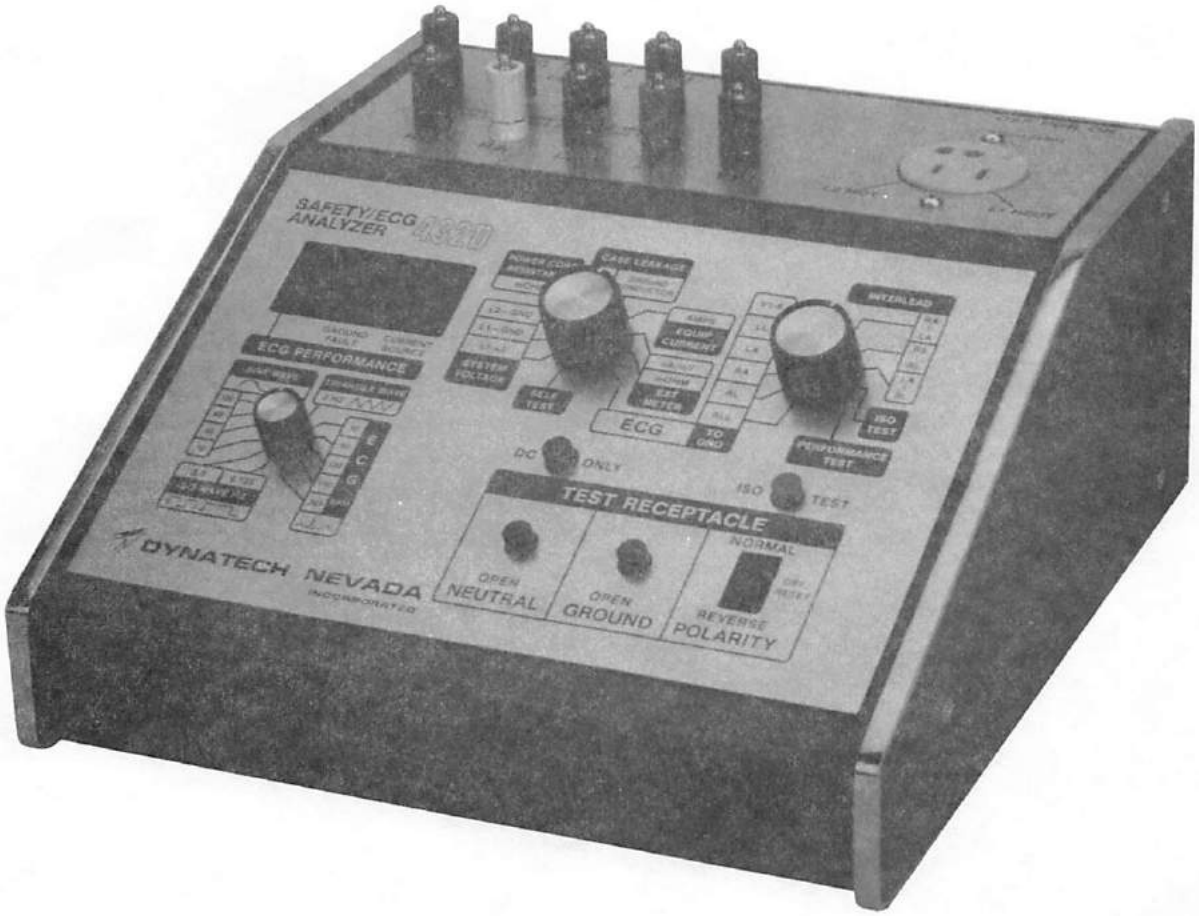
SAFETY/ECG ANALYZER
ECG PERFORMANCE
ECG
DC ONLY
ISO TEST
TEST RECEPTACLE
OPEN NEUTRAL
OPEN GROUND
NORMAL
REVERSE POLARITY
DYNATECH NEVADA
INCORPORATED

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SECTION 1

SYSTEM FAMILIARIZATION

INTRODUCTION

The Model 432D safety analyzer is a precision voltage, current and resistance meter designed expressly for testing the level of safety of the patient environment and of the associated electrically operated equipment. These environmental tests include the measurement of power system voltages(V), voltage gradient/ grounding differential (mV), and intergrounding resistances (mOhm). Additionally, the Model 432D, when connected to the specified power source and electrocardiograph, is capable of making each of the following measurements by activating appropriate switches and without changing terminal connections:

1. Line voltage of AC power line at test receptacle three ways: neutral to hot,neutral to ground and hot to ground.

2. Operating line current of the device connected to the TEST RECEPTACLE.

3. Leakage current from the chassis of an electrocardiograph to ground; from each patient electrode individually to ground; and from all patient electrodes in common to ground with the electrical power supply to the electrocardiograph. These measurements may be made in a normal, a reversed, a grounded and an ungrounded configuration.

4. Leakage current between the right arm and left arm; right arm and right leg; and between left arm and right leg.

5. Leakage current through all patient electrodes, in common to ground, when 120 VAC is applied to the electrodes.

A ground fault interrupter (GFI) has been incorporated in the 432D to protect the unit under test, the 432D and the user. The GFI circuit is always active.

SPECIFICATIONS

METER

Measurements are displayed on a 3 1/2 digit LED display. Overrange is indicated by a flashing 1999. The appropriate range is selected automatically with the units of measure shown on the FRONT DATA PANEL. During resistance measurements, a separate LED illuminates when the current source has been activated.

CURRENT

There are two current ranges: 0-199.9 uAmps and 200-1999 uAmps. Measurements are made through an AAMI LOAD. Accuracy is 1% of range. Measurements are RMS and can be AC+DC. With the DC ONLY switch depressed, only the DC component of the signal is measured.

EQUIPMENT CURRENT

There is one range: 0.1-15 Amps. Accuracy is 5% of range.

RESISTANCE

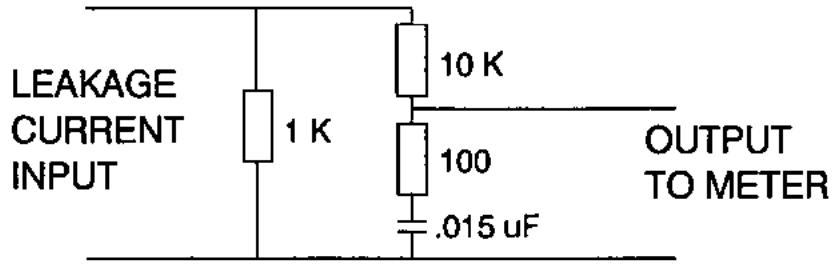
There is one resistance range: 0-1999 mOhm. Accuracy is 1% of range. Resistance is measured by monitoring the voltage across the unit under test when a DC current is passed through it. The four terminal resistance measurement method is used. The POWER CORD RESISTANCE measurement includes the resistance of the TEST RECEPTACLE ground contact, typically <2mOhm.

VOLTAGE

There are four voltage ranges: 0-199.9 mV, 200-1999 mV, 0-199.9 V and 200-500 V. Readings are RMS AC+DC or DC only. Accuracy is 1% of range. The AAMI LOAD is used for these tests. Both mVolts and Volts are autoranging. Only the mVolt ranges are available on the EXT METER jacks.

AAMI LOAD

The simulated patient load of the 432D is as recommended by the Association for the Advancement of Medical Instrumentation, Safe Current Limits Standard (ANSI/AAMI ES1-1985) (revision of ANSI/AAMI SCL-12/78). Below is a



The result is a frequency response which is flat to 1KHz then rolls off at 20dB per decade and levels off at 1MHz attenuated by 40 dB, which describes an ideal filter. The actual filter is rolled off at 3.2 dB at 1KHz. The measurement circuit adds an additional roll off of approximately 3 dB at 1MHz. Measurement accuracy is 1% of range from 40Hz to 1000Hz, 2.5% of range from 1KHz to 100KHz and 5% of range from 100KHz to 1MHz.

TEST RECEPTACLE

The test receptacle supplies power to the unit under test, 115 VAC at 15 Amps maximum or 230 VAC at 7.5 Amps maximum. Front panel push button switches select power on/off, normal/ reverse polarity and open/closed ground to the unit under test.

GROUND FAULT INTERRUPTER

The GFI circuit built into the 432D detects a TEST RECEPTACLE ground fault of >10mA +-20%. When a fault is detected, the hot and neutral lines to the TEST RECEPTACLE are disconnected. The circuit is reset by setting the POLARITY switch temporarily to the centre position.

TEST LEAD JACKS

The test lead jacks are standard banana jacks. Two are for the meter input and two are for the current source. These jacks are arranged to allow a set of Kelvin cables to be connected to the four terminals and left in for all tests, without damaging the analyzer. The current source is only connected for resistance measurements, so it will not interfere with leakage measurements, even though the cables are connected to the current source jacks. Protection against the accidental application of line voltage is provided internally.

ECG JACKS

The ECG posts are ten universal binding posts which accept 3.2mm or 4mm pins or disposable snap electrocardiograph electrodes.

POWER REQUIREMENTS

Power requirement for the 432D is 115 VAC at 15 Amps or 230 VAC at 7.5 Amps 50-60 Hz. A detachable hospital grade power cord is supplied. The analyzer by itself uses very little power (100mA), the 15 and 7.5 Amp rating is for "equipment under test" plugged into the test receptacle and powered up.

PHYSICAL CHARACTERISTICS

Instrument size: 9.2" (234mm) wide
5.3" (135mm) high
10.2" (259mm) deep

Instrument weight : 7.5 lbs.

Construction: State of the art electronic circuitry enclosed in a sturdy die cast side plate and vinyl covered aluminum housing.

STANDARD ACCESSORIES

Power cord : The supplied power cord is 14 guage 3 conductor wire rated at 15 Amps. Do not use a smaller size cord.

Kelvin cable test leads: 2 each provided

Ground pin adapter: 2 each provided

Manual: operating and maintenance 1 provided

TEMPERATURE RANGE

Operating : 59 deg to 95 deg F (15 deg to 35 deg C)
Storage : 32 deg to 122 deg F (0 deg to 50 deg C)

STORAGE

Store the 432D in a dry area within storage temperature limits. There are no other storage requirements.
No periodic inspection or maintenance is required during storage.

PERIODIC MAINTENANCE

It is recommended that the unit be calibrated at six month intervals.

SECTION 2

RECEIVING AND SHIPPING

INTRODUCTION

This section contains information for making a visual and performance check of the instrument, processing a claim, repackaging for shipment and preparation for use.

UNPACKING AND INCOMING INSPECTION

Standard receiving practices should have been followed upon delivery of the instrument; i.e. the shipping carton should have been checked for damage and if damage was found, the carrier's agent should have been asked to be present while the instrument was unpacked. There are no special unpacking instructions but care should be taken not to damage the analyzer while removing from the shipping carton. Inspect the analyzer for external physical damage, dents or scratches.

CLAIMS

If physical damage is found or operation is not within specifications when the instrument is received, notify the carrier immediately. Please read the sheet on damage and shortage in the back of this manual. If Dynatech Nevada or a factory representative is notified, arrangements will be made for repair or replacement of the instrument without waiting for settlement of carrier's claim, however, a new purchase order must be issued to cover this work.

WARRANTY REPAIR

The warranty statement for all Dynatech Nevada products is printed on the back side of the title page of this manual.The warranty does not cover the cost of transportation. No C.O.D. shipments will be accepted without prior authorization. All transportation and phone charges will be billed to the customer.

It is recommended that United Parcel Service or Air Parcel Post be used to return the instrument to the factory. Please follow the guidelines that follow when packaging the instrument to avoid delay or damage.

REPACKAGING FOR SHIPMENT

When shipping an instrument to Dynatech Nevada, attach a tag to the instrument describing the required services and include the model number, serial number and return address.

Use the original carton and packaging material for shipment. If they are no longer available, use the following guide for repackaging:

a) Use a double walled carton of sufficient strength for the weight of the unit to be shipped.

b) Use heavy paper of cardboard to protect all instrument surfaces. Use a non-abrasive material arround all projecting parts.

c) Use at least four inches of tightly packed industrial approved shock-absorbant material around the instrument.

PREPARATION FOR USE

The Model 432D is a portable instrument designed for use on three wire 115/230 VAC 50-60 Hz power.

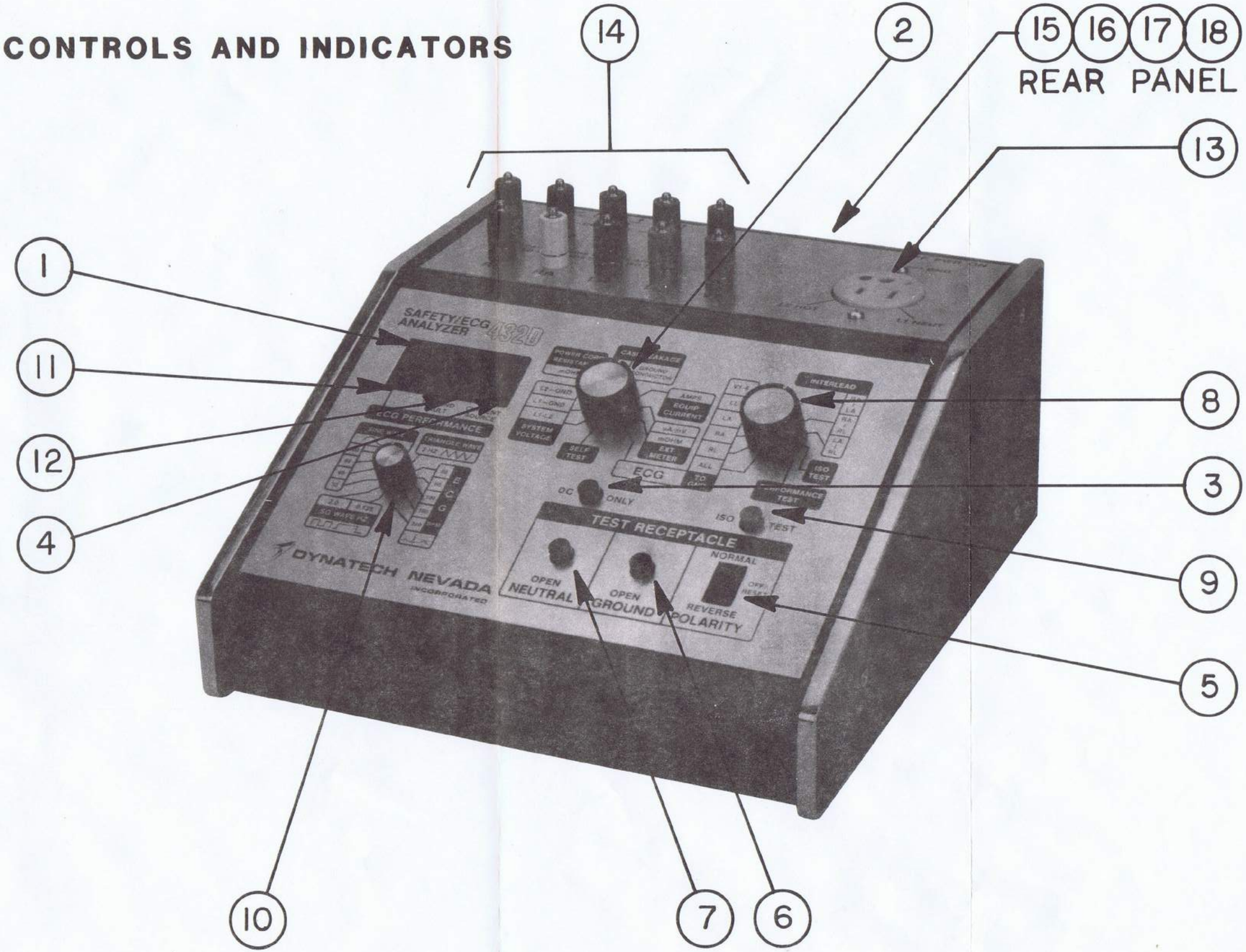
The standard Model 432D is shipped with the U.S. style 15 Amp / 115VAC hospital grade test receptacle. The Model 432D may be optionally specified with export IEC test receptacles. Contact Dynatech Nevada for availability.

No cables or wires other than those supplied need be used. No cables need to be fabricated.

SECTION 3

OPERATION

432D CONTROLS AND INDICATORS



FRONT PANEL CONTROLS AND INDICATORS (figure 3.1)

(1) DISPLAY: a 3 1/2 digit LED display that indicates the results of the measurement being made. Decimal points are placed automatically and the units of measure are shown on the front data panel.

(2) MODE SWITCH: sets the type of measurement to be made. The fully clockwise position enables the ECG selector switch on the 432D.

(3) DC ONLY SWITCH: Changes the measurement mode from AC + DC to DC only.

(4) CURRENT SOURCE ACTIVE LED: lights up in resistance tests to indicate when the current source is connected properly.

(5) POLARITY SWITCH: three position switch that selects normal or reverse polarity of the hot and neutral lines connected to the test receptacle. The center position shuts off power to the test receptacle and resets the ground fault circuitry.

(6) GROUND SWITCH: momentarily opens the ground connection to the test receptacle.

(7) NEUTRAL SWITCH: momentarily opens the neutral line connection to the test receptacle.

(8) ECG SELECTOR SWITCH: sets the ECG lead tests to be made. The MODE switch must be in the ECG position to activate this mode.

(9) ISO TEST: connects the ECG isolation voltage to the ECG terminals.

CAUTION: TEST VOLTAGE IS 115 VAC AND EVEN THOUGH ONLY 1mAMP IS POTENTIALLY LETHAL

SINCE THE ISO TEST INJECTS POTENTIALLY HAZARDOUS CURRENT LEVELS INTO THE ELECTROCARDIOGRAPH AND THE RELATED POWER SYSTEM, DO NOT CONDUCT TESTS IN AN OCCUPIED PATIENT LOCATION OR WHILE THE PATIENT IS CONNECTED TO A RELATED POWER SYSTEM BRANCH CIRCUIT.(reference: ANSI/AAMI SCL ESI 1978 A3.4 and A3.3.2).

⑩ ECG PERFORMANCE SWITCH: Selects the ECG performance waveform to be applied to the ECG POSTS. The MODE switch must be in the ECG position and the ECG switch must be in the performance position to enable this mode.

⑪ ECG PERFORMANCE INDICATOR LAMP: Lights up and the display blanks in the performance waveform mode.

⑫ GROUND FAULT LAMP: Lights up when a ground fault has been detected.

TOP PANEL CONNECTIONS

⑬ TEST RECEPTACLE: Power receptacle for the unit under test.

⑭ ECG BINDING POSTS: Accepts all styles of electrocardiograph connectors: disposable snaps, 3.2mm pins and 4mm pins.

REAR PANEL CONNECTORS AND CONTROLS

⑮ POWER SWITCH: Turns on the instrument and connects power to the test receptacle.

⑯ POWER CORD RECEPTACLE: The 432D power cord plugs into this receptacle.

⑰ FUSE HOLDERS: The 15 Amp / 7.5 Amp 3AG slow blow fuse protects the unit under test and the .50 Amp / .25 Amp 3AG fuse protects the analyzer.

⑱ EXTERNAL PROBE CONNECTIONS:

CURRENT SOURCE: The current source for measuring resistance is internally connected here when the MODE switch is in the mOhm measuring positions.

EXTERNAL METER: The metering circuit is internally connected here when the MODE switch is in any position requiring external connections.

Both Kelvin cables may be left connected for all measurements because the MODE switch only connects the current source to the rear panel jacks in the resistance measuring positions. Only one Kelvin cable is needed for all equipment leakage and ground resistance measurements.

TESTING PROCEDURES

The following is a description of the general types of tests that may be performed with the model 432D. It is not intended to be a complete list of possible tests nor does it represent a list of what tests should be made on any particular type of equipment.

- - - WARNING - - -

THE GROUND FAULT INTERRUPTER WILL PROTECT THE UNIT UNDER TEST FROM DAMAGE IN THE EVENT OF A GROUND FAULT OF GREATER THAN 10mA. UNDER MOST CONDITIONS THIS WILL PROTECT THE OPERATOR FROM ELECTRICAL SHOCK, HOWEVER A CURRENT OF 10mA CAN BE FATAL.

THE OPERATOR IS ADVISED TO USE THE SAME PRECAUTIONS AS IF THERE WERE NO GROUND FAULT PROTECTION.

CAUTION:

IF ANY OF THE FIRST FOUR TESTS FAIL, DO NOT CONTINUE. STOP IMMEDIATELY AND REPAIR THE PROBLEM BEFORE CONTINUING, OTHERWISE THE OPERATOR IS IN DANGER OF RECEIVING A LETHAL ELECTRICAL SHOCK.

AVOID CONTACTING THE UNIT UNDER TEST (UUT) DURING ANY TESTS.

START UP AND SELF TEST

Before plugging the analyzer in or turning the power on, ensure that no equipment is plugged into the TEST RECEPTACLE and that the polarity switch is set to OFF (center position).

Before using the analyzer to test any other equipment, it is recommended that the following self test be made. Plug the analyzer in, turn it on and set the MODE switch to SELF TEST. The display should read 1000 +/-20 and the CURRENT SOURCE ACTIVE lamp should be lit. If this is not the case, the unit is not functioning properly and should be repaired before using. This test is not intended to be a complete checkout of the analyzer but just a quick method of determining if it is operational. See section 5 for a complete performance check.

> CAUTION:
>
> IF THE ANALYZER FAILS THIS TEST, STOP AND REPAIR THE PROBLEM. CONTINUING TO TEST MAY RESULT IN THE OPERATOR RECEIVING A LETHAL ELECTRICAL SHOCK.

SYSTEM VOLTAGE

Set the MODE switch to L1-L2. The display should now read line voltage within 10%.

Set MODE switch to L1-GND. The display should read no more than 5% of the L1-L2 (line voltage) on a grounded power system. For a properly balanced isolated system, the reading at this point should be about the same as the L2-GND reading.

Set the MODE switch to L2-GND. This should read about the same as the L1-L2 reading for a grounded system. For an isolated system, it should read about the same as the L1-GND reading.

If the wall receptacle is wired backwards (reverse polarity), L1-GND instead of L2-GND will be about equal to L1-L2. If the ground is open, L1-GND and L2-GND will both read 0 volts.

> CAUTION:
>
> IF THE ANALYZER FAILS THIS TEST, STOP AND REPAIR THE PROBLEM. CONTINUING TO TEST MAY RESULT IN THE OPERATOR RECEIVING A LETHAL ELECTRICAL SHOCK.

NOTE: To measure leakage current properly , use a grounded power system for line voltage source. (reference: ANSI/AAMI ES1-1985 4.2.1.2)

POWER CORD RESISTANCE

See figure 3-2. Set the MODE switch to POWER CORD RESISTANCE. Set the TEST RECEPTACLE POLARITY switch to the center position (OFF). Plug the unit under test into the test receptacle on top of the Model 432D. Connect the dual banana plug end of a Kelvin cable into the two RED rear panel jacks. Connect the clip end of the Kelvin cable to a grounded point on the case of the unit under test. The CURRENT SOURCE ACTIVE lamp lights up to indicate that the connection is made. The display reads resistance (mohms) from the case of the unit under test to the test receptacle ground contact of the Model 432D

This is a four terminal resistance measurement. The Kelvin cable connects one end of the current source and the positive input of the measuring circuit through separate wires; thus, the voltage drop in the current source leads does not effect the meter reading. The same scheme is used inside the model 432D at the receptacle ground contact so the resistance of the wiring in the unit does not effect the reading. The resistance of the test receptacle will add to the reading (<2mohm).

CAUTION:

IF THE UUT FAILS THIS TEST, STOP AND REPAIR THE PROBLEM. CONTINUING TO TEST MAY RESULT IN THE OPERATOR RECEIVING A LETHAL ELECTRICAL SHOCK. EXCEPTION: Devices with double power circuit insulation and a three prong power plug with ground pin connected to the electrostatic shield (i.e. Cambridge VSIV electrocardiograph).

CASE LEAKAGE, EXTERNAL LEAD

See figure 3-2. Set the MODE switch to CASE LEAKAGE,EXT. LEAD. Connect a Kelvin cable to the RED rear panel jacks. The current source is only connected to the rear panel jacks for resistance measurements, so the cable may be left connected to them for both resistance and leakage tests. (An alternate approach is to use a single test lead connected to RED EXT only). Connect the other end of the cable to the case of the unit under test. Case leakage measurements may now be made for various line conditions: power on, power off, normal polarity, reverse polarity, closed or open ground and closed or open neutral. If a ground fault is detected when the polarity switch is placed in either the NORMAL or REVERSE position, the TEST RECEPTACLE will be automatically shut off again. To reset it, return the polarity switch to OFF/RESET then back again.

> CAUTION:
>
> IF THE ANALYZER FAILS THIS TEST, STOP AND REPAIR THE PROBLEM. CONTINUING TO TEST MAY RESULT IN THE OPERATOR RECEIVING A LETHAL ELECTRICAL SHOCK.

CASE LEAKAGE, GROUND CONDUCTOR

See figure 3-3. Set the MODE switch to CASE LEAKAGE, GROUND CONDUCTOR. Without using any test leads, leakage through the ground wire of the power cord will be measured with the TEST RECEPTACLE GROUND switch open. This test configuration facilitates the measurement of leakage current for double insulated devices utilizing a three conductor power plug. If a ground fault is detected when the POLARITY switch is placed in either the NORMAL or REVERSE position, the TEST RECEPTACLE will be automatically shut off. To reset it, return the polarity switch to OFF/RESET then back again.

> CAUTION:
>
> IF THE ANALYZER FAILS THIS TEST, STOP AND REPAIR THE PROBLEM. CONTINUING TO TEST MAY RESULT IN THE OPERATOR RECEIVING A LETHAL ELECTRICAL SHOCK.

EXTERNAL METER, uA/mV

See figure 3-4. Set the MODE switch to EXT METER, uA/mV. Connect a Kelvin cable to the RED jacks on the rear panel or a single test lead to the RED EXT jack and the other cable to the BLACK jacks or BLACK EXT. A current of up to 2000uAmps or a voltage of 2000mVolts may now be measured between the cables. The AAMI load is connected which may load down voltage measurements where the impedance of the voltage source is high.

EQUIPMENT CURRENT

Set the MODE switch to AMPS/EQUIPMENT CURRENT. The 432D is now measuring the operating current of the unit under test. This measurement capability can be used to access the actual load current requirements of the UUT. Equipment current measurements in excess of specified levels could be an indicator of a defective heater, motor or inductive element in the UUT.

EXTERNAL METER, mOHMS

See figure 3-4. Set the MODE switch to EXT METER, mOHMS. In this mode, the current source and measurement circuits are both connected to the rear panel jacks. Connect one Kelvin cable to the RED jacks and the other cable to the BLACK jacks. Connect the resistance to be measured between the alligator clips. Be sure the CURRENT SOURCE ACTIVE lamp lights up after the connections are made and remains lit. This setting uses a four terminal technique to accurately measure low value resistances (i.e. less than 2 ohms). This is also the only measurement requiring two Kelvin cables.

DC ONLY

Depressing the DC ONLY button filters out the AC component of the measured signal. Thus, it is possible to get separate readings of AC+DC and DC for voltage or current.

ECG TESTS

Set the MODE switch to ECG for all the following tests. Connect the unit under test to the test receptacle. Connect the ECG leads to the posts on the top of the Model 432D. The following leakage tests can be made for normal/reverse polarity, closed/open ground and closed/open neutral.

LEAKAGE TO GROUND

See figure 3-5. Set the ECG selector switch to ALL. This measures the leakage of all leads to ground. Switching to any of the next five positions allows measurement of the leakage of an individual lead to ground. Patient lead leakage measurements may be made for various line conditions: power on/off,normal/reverse polarity, closed/open ground and closed/open neutral.

INTERLEAD LEAKAGE

See figure 3-5. Setting the ECG selector switch to RA-LA, RA-RL and LA-RL allows measurement of the leakage between the specified leads. Patient interlead leakage measurements can be made for normal/ reverse polarity, closed/open ground, closed/open neutral and power on/off.

ISOLATION

> CAUTION:
>
> THIS TEST APPLIES LINE VOLTAGE TO THE ECG POSTS LIMITED TO 1mAMP OF CURRENT.

See figure 3-5. Set the ECG switch to ISO TEST. To make the test depress the ISO TEST button. This test measures the leakage that would result if the line voltage is applied to the ECG terminals.

NOTE: During isolation test select only the properly wired test receptacle condition (normal polarity and closed ground). Additionally, place the electrocardiograph patient cable at least 20 cm from any grounded/conductive surface. (reference: ANSI/AAMI ES1-1985 4.4)

PERFORMANCE WAVEFORMS

Set the ECG switch to PERFORMANCE TESTS. The ECG PERFORMANCE switch now selects any of the waveforms listed below. All amplitudes are for lead 1.

.125 Hz SQUAREWAVE AT 1mVOLT

Used to check low end cutoff frequency of the monitor.

2 Hz SQUAREWAVE AT 1mVOLT

Used to check amplitude accuracy of monitor.

SINEWAVE AT 1mVOLT AND 10, 40, 60 OR 100 Hz

Used to check frequency response of monitor and check line frequency rejection.

TRIANGLE AT 3 Hz AND 4mVOLTS

Used for checking linearity of monitor.

ECG WAVES AT 1mVOLT AND 30, 60, 120, 180 OR 240 BPM

Used for checking monitor ecg rate indicator and rate alarm limits.

POWER DOWN PROCEDURE

At the completion of the tests, turn UUT off, set the 432D polarity switch OFF, turn the Model 432D off, disconnect the unit under test from the TEST RECEPTACLE and unplug the Model 432D.

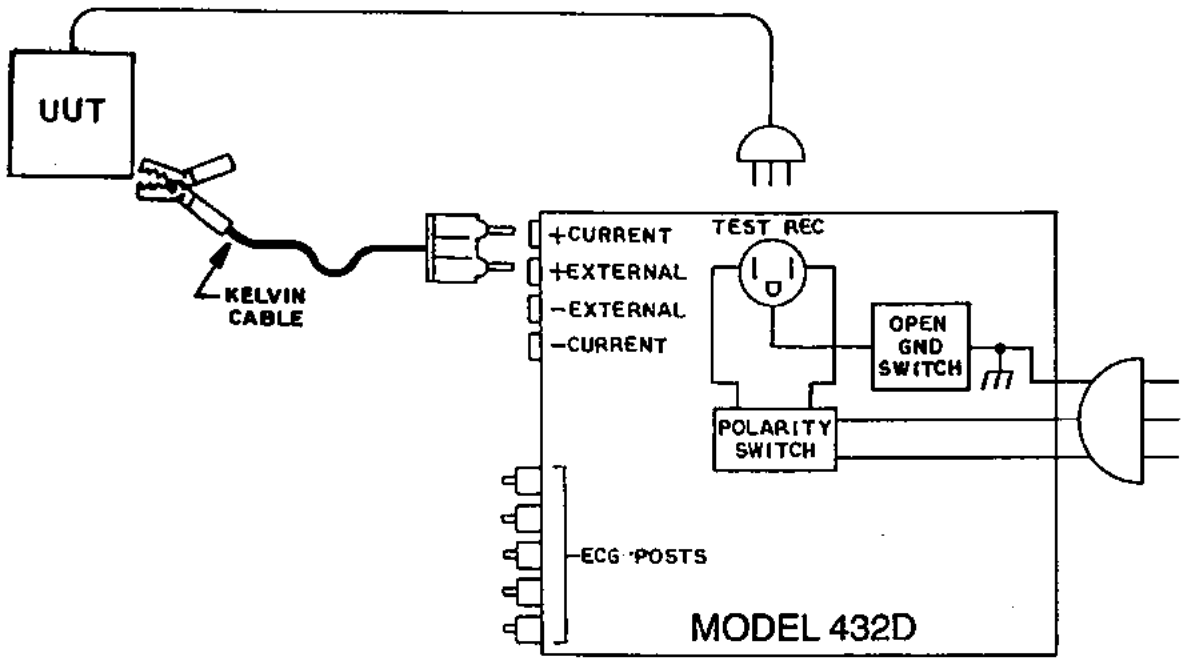


FIGURE 3 - 2
POWER CORD RESISTANCE AND
CASE LEAKAGE, EXTERNAL LOAD

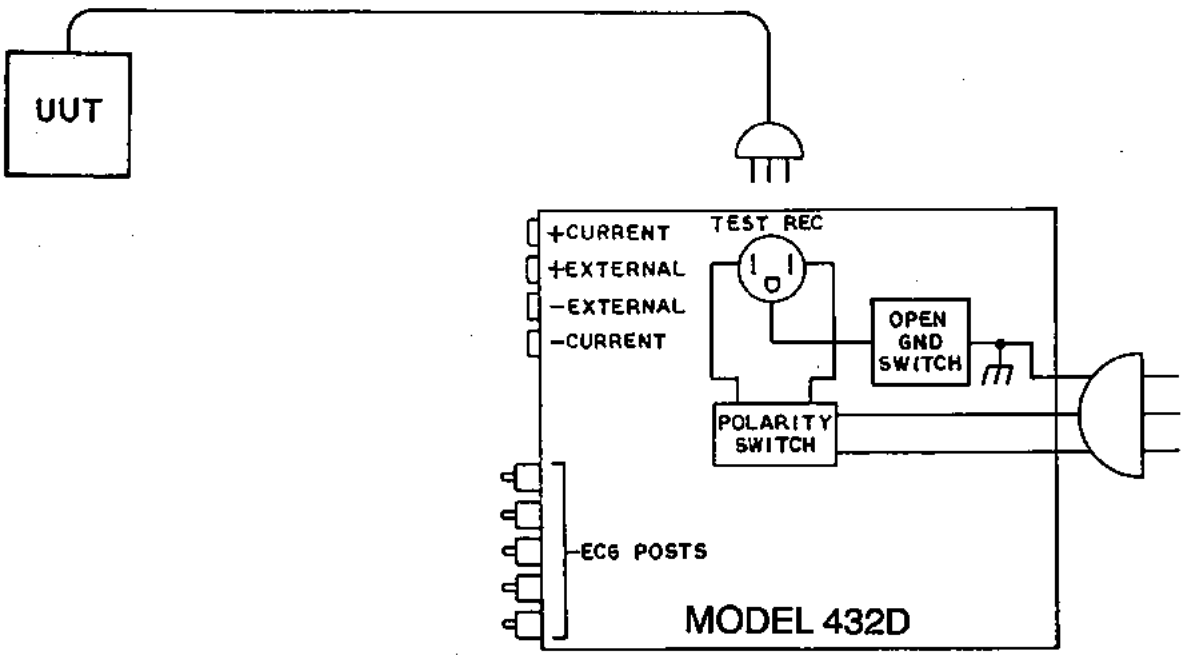


FIGURE 3 - 3
CASE LEAKAGE, GROUND CONDUCTOR

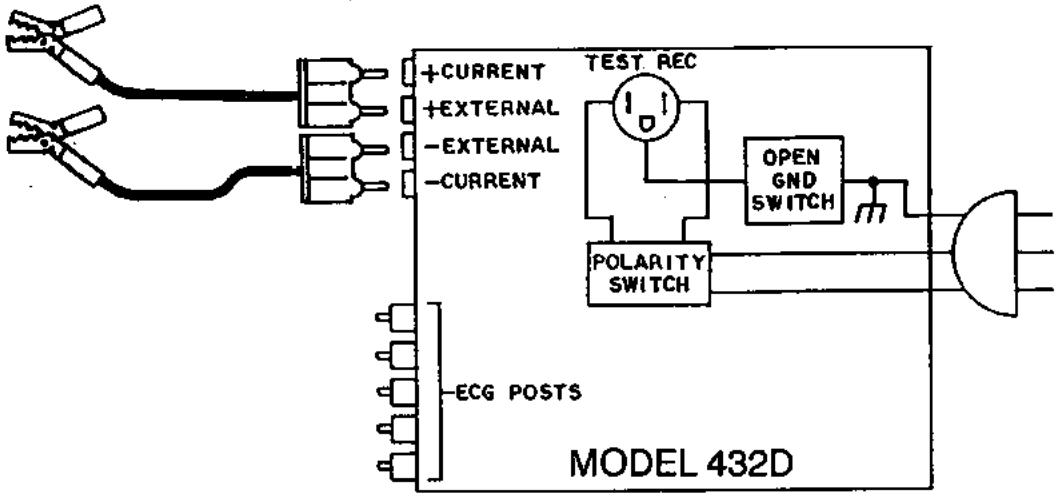


FIGURE 3 - 4
EXTERNAL METER CONNECTIONS
FOR uA, mV AND mOHM MEASUREMENTS

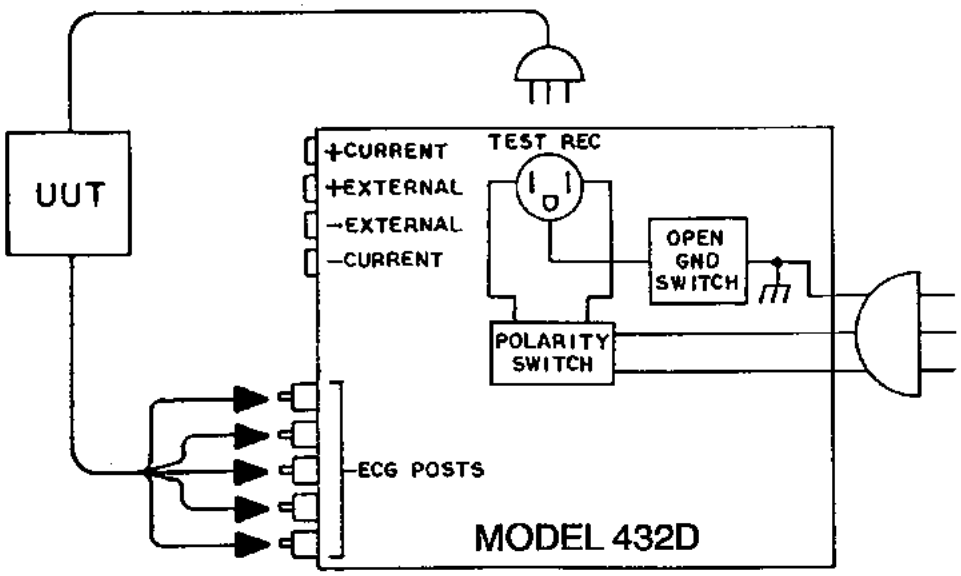
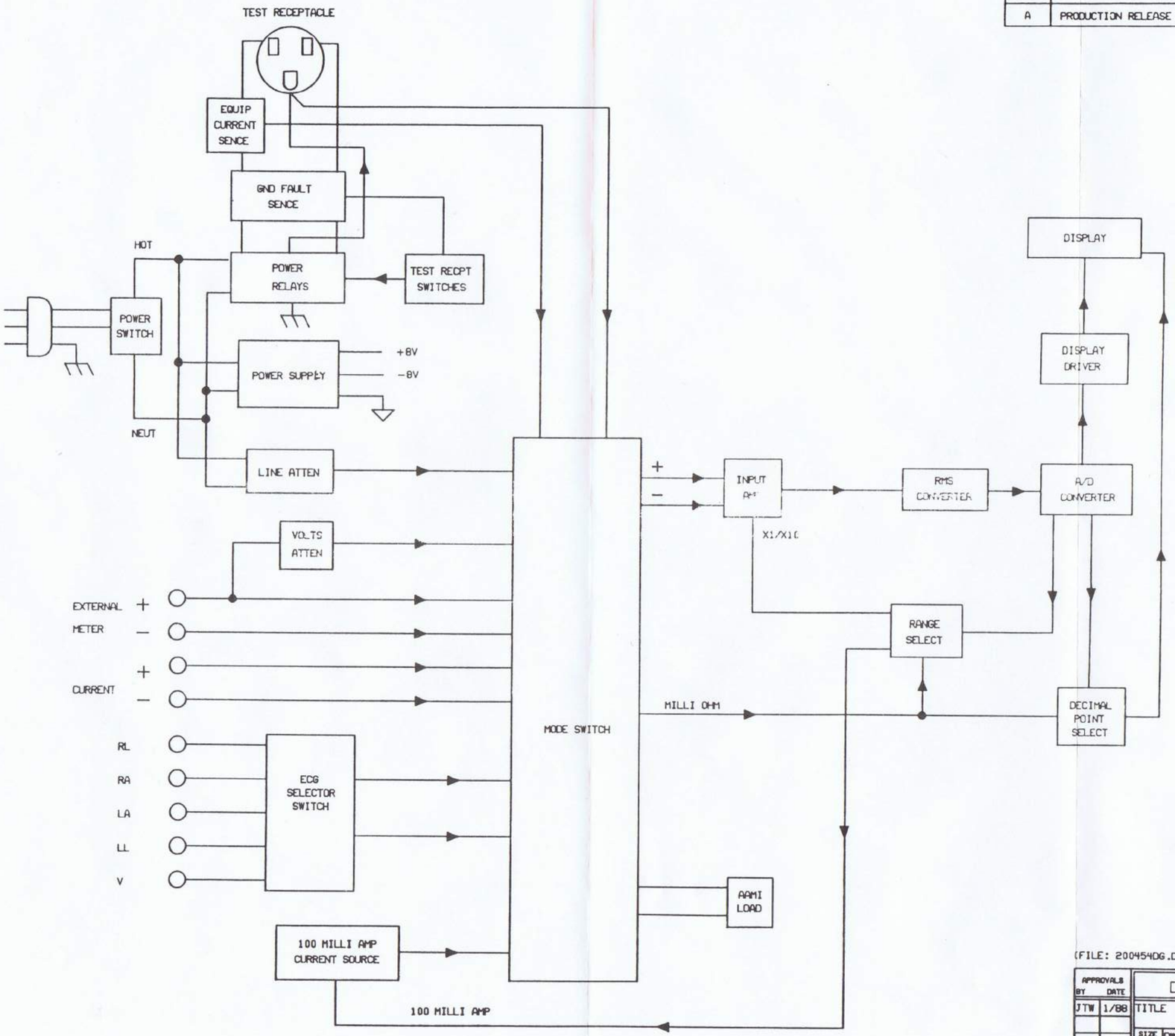


FIGURE 3 - 5
ECG LEAD TEST CONNECTIONS

SECTION 4

THEORY OF OPERATION

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	PRODUCTION RELEASE	1/88	JTW



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APPROVALS BY	DATE	DYNATECH NEVADA INC	
JTW	1/88	TITLE 432D BLOCK DIA	
		SIZE C	DWG. NO. 200454 DIA REV A
		SCALE NONE	SHEET 1 OF 1

INTRODUCTION

Following is a description of the circuitry in the Model 432D. Familiarizing yourself with this section will help in troubleshooting the 432D in case of failure.

BLOCK DIAGRAM DESCRIPTION

The Model 432D is basically a RMS voltage meter. The INPUT AMPLIFIER buffers the inputs. For signals less than 200mV, it multiplies the signal by 10. The RMS CONVERTER generates a DC voltage equal to the RMS value at its input. The A/D CONVERTER generates a three digit code from the voltage at its input and also outputs overrange and underrange information which is decoded by the DECIMAL POINT SELECT circuit to light up the appropriate decimal point. The DISPLAY DRIVER is formed of current amplifiers to drive the display. The RANGE SELECT circuit sets the gain of the INPUT AMPLIFIER.

When leakage current measurements are selected by the MODE SWITCH, the AAMI LOAD is connected in front of the INPUT AMPLIFIER, and the voltage developed across this load from the leakage current is measured.

For resistance measurements, the 100mA CURRENT SOURCE is connected to the rear panel CURRENT jacks. When the meter leads are connected to the resistance to be measured, a voltage proportional to the resistance is generated. This voltage is measured and displayed.

The TEST RECEPTACLE is connected to line voltage through relays driven by switches to select reverse/normal polarity, open/closed neutral and open/closed ground. The GROUND FAULT SENSE detects ground faults and turns off the relays. EQUIP CURRENT SENSE measures the operating current of the equipment under test, which will be displayed in the EQUIP CURRENT mode.

POWER SUPPLIES AND TEST RECEPTACLE SWITCHING (schem 4)

The Model 432D is supplied with power through transformer T1 which steps the line voltage down to 20 volts RMS. This drives the rectifier bridge D1. C1 and C2 filter the rectified voltage to generate the unregulated supply voltages for voltage regulators U1 and U2, which are are three terminal adjustable output regulators. On U1 the voltage adjustment pin is 1.2 volts less than the output voltage, this sets the current through R1. All the current through R1 goes through R2 to ground and sets the voltage across R2 to be 6.8 volts, added to the voltage across R1 gives an output voltage of 8 volts. U2 operates in a similar manner, but is a negative regulator and generates a -8 volt supply.

T2 generates the isolated line voltage for the ECG isolation test. R120 and R144 limit the current to 1mA. T2 is also generates an ISOLATION TEST compensation voltage which is used to null out AC leakage on the ECG posts wiring inside the unit. The voltage from the transformer is routed through R123 and R124 to the adjustment pot R125. This adjusts the amount and the polarity of the AC voltage to sum with the isolation measurement.

Line voltage is routed to the test receptacle relays (K4, K5, K6, K7). The POLARITY, OPEN GROUND AND OPEN NEUTRAL switches select which relays are energized. The OPEN GROUND relay is a normally closed type so ground is connected when the power is off. The TEST RECEPTACLE ground contact has two wires connected to it. One is the voltage sense wire and the other is the ground return wire.

T3 senses the difference in the current on the hot and the neutral lines. Under normal operating conditions, this will be zero; but, if any current flows to ground, there is an inbalance in the current between the hot and neutral lines. This inbalance is amplified by U21A and B. D13, D14 and C51 form a peak voltage detector. As the ground fault current increases, this voltage increases. U21C compares this voltage to a fixed voltage which is equivalent to a ground fault of 10mA. When U21C trips, its output at pin 8 goes high to turn off relay K3, which supplies power to the relay switches. Thus the relays go off and the test receptacle is off. Q5 sets a delay on power up before enabling the switches. C51 is connected to the -8 volt supply which forces the comparator to the reset state at power up. R160 limits the rate at which C51 charges to generate a 25 msec delay in the ground fault sense to make it insensitive to power line noise. When the POLARITY switch is in the center position, both D16 and D17 are off and the voltage on R156 goes low, resetting the comparator through D15.

EQUIPMENT CURRENT is sensed by T4. Its output voltage is attenuated by R154, R155 and the 1Kohm resistor in the AAMI load. The resultant voltage is 1mV per Amp and the analyzer converts the voltage for a direct readout of the UUT current.

MEASUREMENT CIRCUITRY (schem 2)

The various measurement modes are selected by the mode switch as follows:

Line voltage is routed through the LINE VOLTAGE ATTENUATOR to the AAMI LOAD and then to the INPUT AMPLIFIER.

Current to be measured is routed directly to the AAMI LOAD which is connected to the INPUT AMPLIFIER.

Resistance is measured by connecting the CURRENT SOURCE to the resistance to be measured and measuring the voltage drop with the INPUT AMPLIFIER.

Equipment current is measured by connecting the current sense coil (T4 on schem 4) to the AAMI LOAD and measuring this voltage with the INPUT AMPLIFIER.

The AAMI LOAD is formed by R39, R41, R40 and C21. R39 is selected as a 25 Watt resistor so it can withstand short overvoltage periods.

The INPUT AMPLIFIER (U10) is a high bandwidth differential amplifier with selectable gains of 1, 10 and 100. Both + and - inputs are floating allowing for true differential measurements. In the X1 gain setting, U10 simply buffers the inputs. In the X10 gain setting, relay K1 is closed causing U10 to operate at a gain of 10. The inputs are protected from overload by D5 thru D9, R40 and R54.

U11 converts the output of the INPUT AMPLIFIER to a DC voltage equal to the RMS value of the input voltage.

U6 and Q3 form a precision 100mA DC current source used for making resistance measurements. D6 is a 1.25 volt reference diode used to set the voltage drop across R38 to 1 Volt, resulting in a current of 100mA. Q3 is a high voltage power MOSFET and protects the circuit from positive overvoltage. D7 protects the circuit from negative overvoltage. The current also flows through Led DS1. When there is no path to ground for this current, the current source automatically shuts off and the LED turns off.

In the DC ONLY mode, a low pass filter made up of R44 thru R48, C18 thru C20 and C28, is switched in. This filter has >60dB of attenuation at 60Hz.

DISPLAY CIRCUITRY (schem 3)

U14 is an analog to digital converter with a 3 1/2 digit multiplexed output. Pins 20 thru 23 are the digit data in BCD code and pins 16 thru 19 are the digit select lines. U19 is a BCD to 7 segment decoder driver that drives the anodes of the display digits. U20 drives the cathodes of the display digits. DS3 and DS4 are dual 7 segment displays. U13 GENERATES the reference voltage for the A/D CONVERTER which is divided down to 2 volts and adjusted by R91.

U16B senses underrange and overrange conditions to open or close the gain setting relay in the INPUT AMPLIFIER and set the display decimal point.

The display decimal point is placed differently for the various modes described and is turned on by Q4.

U16A senses overrange and flashes the display at a rate determined by C44 and R93.

ECG CIRCUITRY (schem 1)

The ECG selector switch sets which combination of leads are to be connected to the INPUT AMPLIFIER for leakage tests. In the ISO TEST position, the selector switch connects the isolation voltage to the - input of the input amplifier and the leads to the + input. This allows the measurement of the leakage to ground through the ECG leads when they have line voltage connected to them.

SECTION 5

PERFORMANCE CHECK AND CALIBRATION

PERFORMANCE CHECK

This section describes the procedure for making a performance check of the Model 432D.

REQUIRED EQUIPMENT

DIGITAL MULTIMETER (DMM): 4 1/2 digit

DC CURRENT SOURCE: 1000uA +/-.1uA

SINE WAVE GENERATOR: 60Hz to 1MHz, 10mV to 1000mV RMS

12-15 AMP 60 Hz LOAD: portable electric heater

15A 60Hz CURRENT METER: 1% accuracy

POWER RECEPTACLE TESTER: Woodhead Model 755P or equivalent

RESISTORS: 9.31kOhm, 2W, 1%
13.0kOhm, 2W, 1%
0.1Ohm, 1/8W, .1%

PROCEDURE

1. Connect the unit to an appropriate power source and turn it on.

2. Set MODE switch to SELF TEST. The display should read 1000 +/-20 and the CURRENT SOURCE ACTIVE LED should be illuminated.

3. Set the MODE switch to L1-L2. The display should read the line voltage+/-2Volts.

4. Depress the DC ONLY switch, the display should read 00.0 or 00.1.

5. Set the MODE switch to L1-GND. The display should read <5% of the measured value for L1-L2.

6. Set the MODE switch to L2-GND. The display should read the measured value of L1-L2 -0/+5%.

7. Set the MODE switch to POWER CORD RESISTANCE. The display should be flashing 1999, indicating overrange.

8. Connect a Kelvin cable to the RED EXT and RED CUR jacks. Connect the clip end to the ground contact of the test receptacle and the display should read <2.0.

9. Set the MODE switch to CASE LEAKAGE, EXT LEAD. Connect a 1000uA DC current source between the test receptacle ground contact and the Kelvin cable clip. The display should read 1000 +/-20uA.

10. Set the MODE switch to CASE LEAKAGE, GROUND CONDUCTOR. Connect a 1000uA DC current source between the test receptacle ground contact and chassis ground. Depress the OPEN GROUND switch. The display should read 1000 +/-20uA.

11. Set the MODE switch to EXTERNAL METER, uA/mV. Measure the resistance between the EXT METER jacks. The resistance should be between 995 and 1005 Ohms.

12. Connect a 1000mV, 60Hz sine wave, decoupled through a 100uF nonpolarized capacitor, to the EXT METER jacks. (Decouple the RED jack, the BLACK jack should be ground.) The display should read 1000 +/-20mV. (The AAMI load will cause a 2.4% error if the sine wave generator has a 50 Ohm output resistance and is terminated in 50 Ohms).

13. Switch the sine wave to 100mV, the display should read 100.0 +/-2.0mV.

14. Switch to 10mV, the reading should be 10.0 +/-2.0mV.

15. Set the signal generator to 1000mV at 1000Hz, the display should read 724 +/-20mV.

16. Set the signal generator to 1000mV at 10KHz, the display should read 105.0 +/-4.0mV.

17. Set the signal generator to 1000mV at 100KHz, the display should read 14.4 +/-4.0mV.

18. Set the signal generator to 1000mV at 1MHz, the display should read 9.1 +/-10mV.

19. Set the MODE switch to EXT METER, mOHM. Connect two Kelvin cables to the EXT METER and CURRENT jacks. The display should be flashing 1999, indicating overrange.

20. Short the two clip ends together and position for a minimum reading on the display of <4mOhm.

21. Connect a 0.1Ohm resistor between the clips, the display should read 0.1 +/-2mOhm.

22. Set the MODE switch to ECG. Set the ECG switch to ALL. Connect a 1000uA DC current source between any ECG post and the test receptacle ground contact. Check all ECG posts in this manner. The display should read 1000 +/-20uA.

23. Set the ECG switch to RL. Connect the current source to the RL post. The display should read 1000 +/-20uA. Repeat this procedure for RA, LA, LL and V1.

24. Set the ECG switch to RA-LA. Connect the current source to RA-LA. The display should read 1000 +/-20uA. Check that the display reads 0 for any combination of ECG post connections other than the one selected. Repeat for RA-RL and LA-RL.

25. CAUTION: Line voltage is applied to the ECG posts when the ISO TEST switch is depressed. Make sure nothing is connected to the ECG posts. Set the ECG switch to ISO TEST and depress the ISO TEST switch. The display should read <5uA.

26. Connect any ECG post to ground with the ISO TEST switch depressed and the display should read 1000 +/-100uA.

27. Set the ECG switch to PERFORMANCE TEST. The ECG PERFORMANCE LED should light and the display should be blank.

28. Connect the ECG posts to an electrocardiograph and check all waveforms.

29. Connect a Power Receptacle Tester to the test receptacle and check for proper operation of the OPEN NEUTRAL, OPEN GROUND and POLARITY switches.

30. Set the Mode switch to EQUIP CURRENT. Connect the 15A 60Hz load to the test receptacle. Monitor the current with the 15A current meter. Set the POLARITY switch to NORMAL. The display should match the current meter within 5%.

31. Connect the **13.0** KOhm resistor from HOT to GROUND of the TEST RECEPTACLE. While not touching the resistor, set the POLARITY switch to NORMAL. The GROUND FAULT LED should not light. Repeat with the **9.13** KOhm resistor and the GROUND FAULT LED should light.

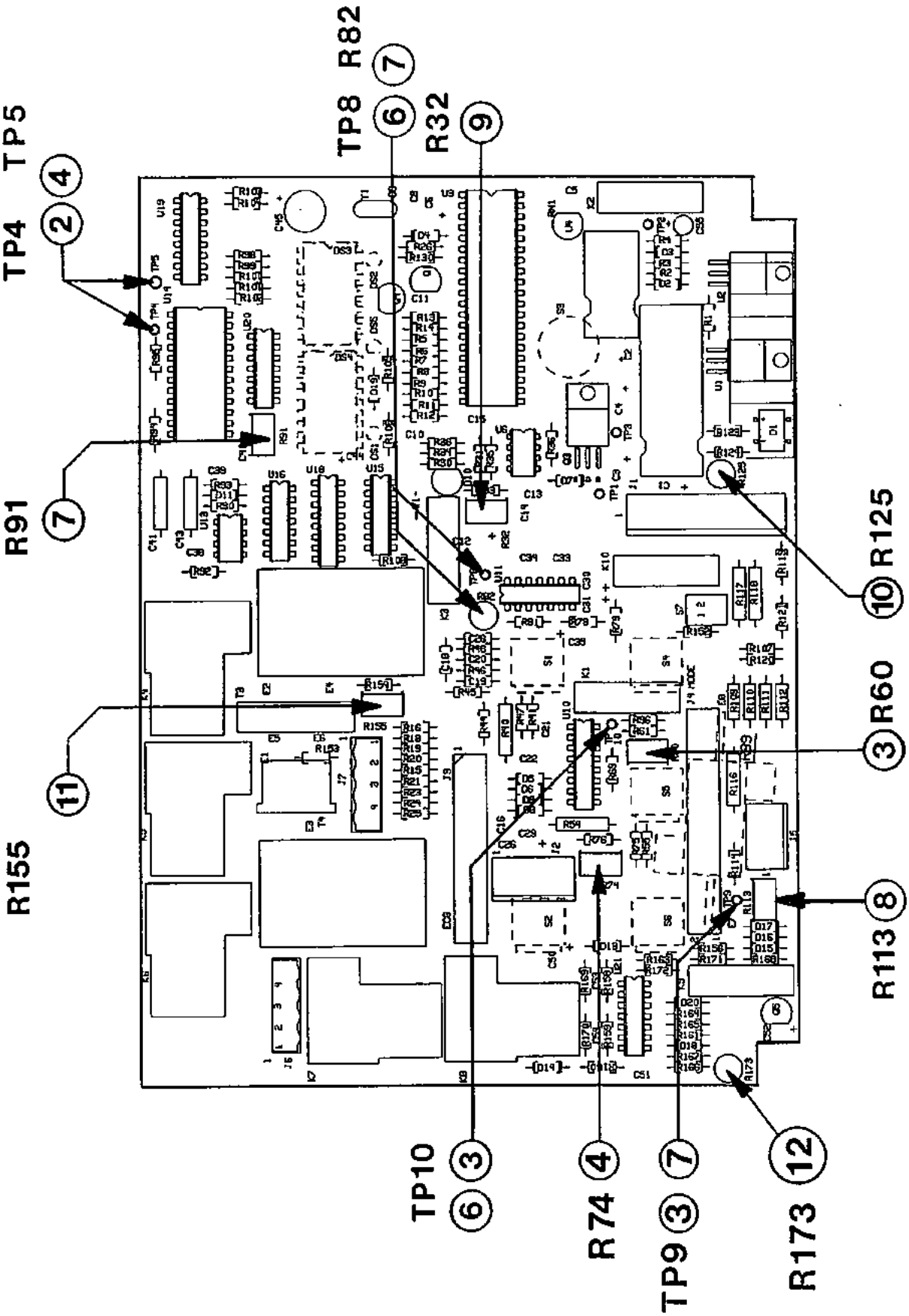

TP4
TP5
TP8
R82
R32
R91
R155
R125
R60
R113
TP10
R74
TP9
R173
2
4
6
7
9
7
11
10
3
8
6
3
4
7
3
12

FIGURE 5.1

CALIBRATION

REQUIRED EQUIPMENT

DIGITAL MULTIMETER (DMM): 4 1/2 digits
DC volts: 10uV to 1V
AC volts: 250 V
DC current: 10mA to 100mA

DC CURRENT SOURCE: 1000uA +/-.1uA

12-15 AMP 60Hz LOAD: portable electric heater

15A 60Hz CURRENT METER: 1% accuracy

SETUP

Remove the three screws in the bottom cover of the analyzer and slide the bottom cover to the rear and remove. All adjustments are accessible on the printed circuit board. Refer to figure 5.1 for the location of all adjustments and test points.

> CAUTION: LINE VOLTAGE IS EXPOSED ON THE REAR PANEL AND IN THE AREA OF THE POWER SWITCHES ON THE PCB ASSY.

Plug the analyzer into an appropriate AC power source and turn the power switch on.

PROCEDURE

1. Set the MODE switch to EXT METER, uA.

2. Connect a clip lead between TP4 and TP5 on the MAIN PCB ASSY.

3. Connect the DMM between TP9 (low) and TP10 (high). Adjust R60 for 0Volts +/-200uV.

4. Remove the clip lead. Adjust R74 for 0Volts +/-200uV.

5. Repeat the previous two steps until both conditions are within limits, <200uV.

6. Move the high DMM lead to TP8 and adjust R82 for 0Volts +/-200uV.

7. Leave the DMM leads attached. Connect the 1000uAmp current source to the rear panel EXTERNAL METER connections. Adjust R91 for a front panel display reading of 1000uAmps. Remove the current source and the Dmm leads.

8. Set the MODE switch to L1-L2. Adjust R113 for a front panel display reading of the measured line voltage.

9. Connect the DMM to the CURRENT SOURCE jacks on the rear panel of the analyzer. Set the MODE switch to EXTERNAL METER, mOhms. Adjust R32 for a display reading of 100.0mA +/-.02mA. Remove the DMM leads.

10. CAUTION: line voltage is applied to the ECG posts on the top of the unit when the ISO TEST switch is depressed. Set the MODE switch to ECG. Set the ECG switch to ISO TEST. Check that nothing is connected to the ECG posts. Depress and hold the ISO TEST button. Adjust R125 for a minimum reading on the display (typically <.8uA).

11. Connect the 15A 60Hz load to the test receptacle. Monitor the current with the 15A current meter. Adjust R155 for a display reading that matches the current meter.

REASSEMBLY

Reassemble the analyzer in the reverse order of disassembly.

CALIBRATION

1. The certificate enclosed with this manual is to certify the compliance of this unit to standards established by others.

2. As with all electronic or electromechanical devices, calibration may drift or deteriorate over time.

3. On any occasion that this unit is repaired, or if the calibration seal is found to be broken for any reason, the unit should be re-calibrated. Recalibration requires the use of certified and traceable equipment.

4. For reasons of legal liability, insurance and accreditation, all your test equipment should have a current calibration certificate not more than one year old. Calibration should only be carried out by an independent factory approved facility with factory trained staff.

5. It is recommended that the user include this unit in a regular calibration budget and calibration schedule, as a part of the user's quality assurance program.

6. In accordance with field service procedures, all Engineering Change Orders and updates that are applicable will be carried out at the time of calibration. (with your approval)

7. This unit, when sent for recalibration, should be carefully and properly packaged and sent to:-

INSET LTD.
103-3540 West 41st Avenue,
VANCOUVER, B.C. V6N 3E6

8. Calibration is recommended at 12 month intervals for Oscilloscopes, Meters, Safety Analyzers, ESU Analyzers, Laser Meters and Defibrillator Analyzers. Less critical devices such as simulators may be recalibrated at longer intervals at the discretion of the user.

SECTION 6

PARTS LIST

9519-0143 200451A
432D FINAL ASSY

REF	PART NO	DESCRIPTION	QTY
A001	3010-0253	432D ECG POST C/A	1
A002	3010-0254	432D TEST RECPT C/A	1
A003	3010-0255	432D EXTERNAL METER C/A	1
A004	3010-0256	432D INPUT POWER C/A	1
A005	3010-0257	432D PCB POWER C/A	1
F001	1005-0011	FUSE 3AG 1/2A 250V	1
F002	1005-0059	FUSE 3AG 15A 250V S/B	1
J001	2719-0065	JACK, BANANA BLK	1
J002	2719-0065	JACK, BANANA BLK	1
J003	2719-0074	JACK, BANANA RED	1
J004	2719-0074	JACK, BANANA RED	1
PR001	2710-0050	POWER RECEPTACLE, INPUT	1
XF001	1006-0011	FUSE HOLDER, EUROPEAN	1
XF002	1006-0011	FUSE HOLDER, EUROPEAN	1
ZZ001	2515-0008	POWER SWITCH 2 POLE ROCKER	1
ZZ002	2710-0217	RECEPTACLE, HOSPITAL GRADE	1
ZZ003	2716-0065	SOLDER LUG #6 DBL	1
ZZ008	3012-0007	CABLE CLAMP	2
ZZ010	4704-2235	SCREW PPH 4-40x3/8	2
ZZ011	4704-0435	SCREW PPH 6-32x3/8	6
ZZ014	4711-9720	KEP-NUT 6-32	3
ZZ015	4711-9721	KEP-NUT 4-40	5
ZZ016	4902-0026	KNOB 1/4 ID	2
ZZ017	4902-0027	KNOB 1/8 ID	1
ZZ018	4902-0030	HANDLE	1
ZZ019	4902-0064	BUTTON BLK	3
ZZ020	4902-0065	BUTTON RED	1
ZZ022	4910-0107	STAND-OFF HEX 4-40 X .688	5
ZZ023	4919-0051	ECG POST INSERT	10
ZZ024	4919-0052	ECG POST BLK	1
ZZ025	4919-0053	ECG POST BRN	6
ZZ026	4919-0054	ECG POST RED	1
ZZ027	4919-0055	ECG POST GRN	1
ZZ028	4919-0056	ECG POST WHT	1
ZZ029	5001-0231	432D FRONT DATA PANEL	1
ZZ030	5001-0232	432D TOP DATA PANEL	1
ZZ031	5001-0233	432D REAR DATA PANEL	1
ZZ032	5027-0082	DISPLAY LENS 1 X 2	1
ZZ033	5215-0194	432D ENCLOSURE ASSY	1
ZZ034	5215-0195	432D BOTTOM COVER ASSY	1
ZZ035	5205-0219	232D MAIN PCB ASSY	1
ZZ036	5205-0220	231D/232D MODE SW PCB ASSY	1
ZZ037	5205-0221	232D ECG SW PCB ASSY	1
ZZ038	5205-0232	432D XFMR PCB ASSY	1
ZZ040	2716-0019	SOLDERLUG #8	10
ZZ046	4704-2433	SCREW PPH 6-32x1/4	5
ZZ047	5015-0162	TIE ROD	2
ZZ048	5215-0197	432D XFMR PCB SHIELD ASSY	1
ZZ050	5215-0031	UNIV SIDE PLT ASSY LT	1
ZZ051	5008-0004	UNIV COVER RT	1
ZZ052	5008-0005	UNIV COVER LT	1
ZZ049	5215-0030	UNIV SIDE PLT ASSY RT	1

9519-0143 200451A
432D FINAL ASSY

REF	PART NO	DESCRIPTION	QTY
A001	3010-0253	432D ECG POST C/A	1
A002	3010-0254	432D TEST RECPT C/A	1
A003	3010-0255	432D EXTERNAL METER C/A	1
A004	3010-0256	432D INPUT POWER C/A	1
A005	3010-0257	432D PCB POWER C/A	1
F001	1005-0011	FUSE 3AG 1/2A 250V	1
F002	1005-0059	FUSE 3AG 15A 250V S/B	1
J001	2719-0065	JACK, BANANA BLK	1
J002	2719-0065	JACK, BANANA BLK	1
J003	2719-0074	JACK, BANANA RED	1
J004	2719-0074	JACK, BANANA RED	1
PR001	2710-0050	POWER RECEPTACLE, INPUT	1
XF001	1006-0011	FUSE HOLDER, EUROPEAN	1
XF002	1006-0011	FUSE HOLDER, EUROPEAN	1
ZZ001	2515-0012	POWER SWITCH 2 POLE ROCKER	1
ZZ002	2710-0217	RECEPTACLE, HOSPITAL GRADE	1
ZZ003	2716-0024	SOLDER LUG #6	2
ZZ008	3012-0009	CABLE CLAMP	2
ZZ010	4704-2235	SCREW PPH 4-40x3/8	2
ZZ011	4704-2435	SCREW PPH 6-32x3/8	2
ZZ014	4711-9720	KEP-NUT 6-32	3
ZZ015	4711-9721	KEP-NUT 4-40	5
ZZ016	4902-0026	KNOB 1/4 ID	2
ZZ017	4902-0027	KNOB 1/8 ID	1
ZZ018	4902-0030	HANDLE	1
ZZ019	4902-0064	BUTTON BLK	3
ZZ020	4902-0065	BUTTON RED	1
ZZ022	4910-0107	STAND-OFF HEX 4-40 X .688	5
ZZ023	4919-0051	ECG POST INSERT	10
ZZ024	4919-0052	ECG POST BLK	1
ZZ025	4919-0053	ECG POST BRN	6
ZZ026	4919-0054	ECG POST RED	1
ZZ027	4919-0055	ECG POST GRN	1
ZZ028	4919-0056	ECG POST WHT	1
ZZ029	5001-0231	432D FRONT DATA PANEL	1
ZZ030	5001-0232	432D TOP DATA PANEL	1
ZZ031	5001-0233	432D REAR DATA PANEL	1
ZZ032	5027-0082	DISPLAY LENS 1 X 2	1
ZZ033	5215-0194	432D ENCLOSURE ASSY	1
ZZ034	5215-0195	432D BOTTOM COVER ASSY	1
ZZ035	5205-0219	232D MAIN PCB ASSY	1
ZZ036	5205-0220	231D/232D MODE SW PCB ASSY	1
ZZ037	5205-0221	232D ECG SW PCB ASSY	1
ZZ038	5205-0232	432D XFMR PCB ASSY	1
ZZ040	2716-0019	SOLDERLUG #8	10
ZZ046	4704-2433	SCREW PPH 6-32x1/4	5
ZZ047	5015-0162	TIE ROD	2
ZZ048	5215-0197	432D XFMR PCB SHIELD ASSY	1
ZZ049	5215-0030	UNIV SIDE PLT ASSY RT	1
ZZ050	5215-0031	UNIV SIDE PLT ASSY LT	1

5205-0219 200205K
232D MAIN PCB ASSY

REF	PART NO	DESCRIPTION	QTY
C001	0403-0055	CAP ALUM 2200 uF	1
C002	0403-0020	CAP ALUM 470 uF	1
C003	0403-0052	CAP ALUM 6.8 uF	1
C004	0403-0052	CAP ALUM 6.8 uF	1
C005	0418-0008	CAP CERM .1 uF	1
C006	0401-0007	CAP ALUM 1 uF	1
C008	0415-0012	CAP MICA 18 pF	1
C009	0415-0012	CAP MICA 18 pF	1
C010	0418-0008	CAP CERM .1 uF	1
C012	0403-0052	CAP ALUM 6.8uF	1
C013	0418-0008	CAP CERM .1 uF	1
C014	0418-0008	CAP CERM .1 uF	1
C015	0418-0014	CAP CERM .01 uF	1
C016	0418-0016	CAP CERM .001 uF	1
C018	0418-0009	CAP CERM 1 uF	1
C019	0418-0009	CAP CERM 1 uF	1
C020	0418-0009	CAP CERM 1 uF	1
C021	0410-0043	CAP ELEC. 500V 1% .015 uF	1
C022	0418-0014	CAP CERM .1 UF	1
C026	0401-0007	CAP ALUM 1 uF	1
C028	0418-0009	CAP CERM 1 uF	1
C029	0401-0007	CAP ALUM 1 uF	1
C030	0401-0007	CAP ALUM 1 uF	1
C031	0401-0008	CAP ALUM 2.2 uF	1
C033	0418-0008	CAP CERM .1 uF	1
C034	0418-0008	CAP CERM .1 uF	1
C035	0401-0008	CAP ALUM 2.2 uF	1
C038	0418-0008	CAP CERM .1 uF	1
C039	0418-0008	CAP CERM .1 uF	1
C040	0418-0008	CAP CERM .1 uF	1
C041	0408-0021	CAP MYLAR .1 uF	1
C043	0408-0021	CAP MYLAR .1 uF	1
C044	0403-0052	CAP ALUM 6.8 uF	1
C045	0403-0017	CAP 68 uF	1
C050	0403-0052	CAP ALUM 6.8 UF	1
C051	0418-0008	CAP CERM .1 uF	1
C052	0401-0014	CAP ALUM 22 UF	1
C053	0415-0121	CAP MICA 620 pF 300V	1
C054	0415-0121	CAP MICA 620 pF 300V	1
C055	0401-0014	CAP DIP 22 UF 16V	1
D001	2103-0005	DIODE BRIDGE VM-18	1
D002	2101-0002	DIODE 1N4001	1
D003	2101-0002	DIODE 1N4001	1
D004	2101-0010	DIODE 1N914	1
D005	2101-0008	DIODE FDH333	1
D006	2101-0008	DIODE FDH333	1
D007	2101-0005	DIODE 1N4005	1
D008	2101-0008	DIODE FDH333	1
D009	2101-0008	DIODE FDH333	1
D010	2102-0039	DIODE LM385Z-1.2	1

5205-0219 200205K
232D MAIN PCB ASSY

REF	PART NO	DESCRIPTION	QTY
D011	2101-0010	DIODE 1N914	1
D013	2101-0010	DIODE 1N914	1
D014	2101-0010	DIODE 1N914	1
D015	2101-0010	DIODE 1N914	1
D016	2101-0010	DIODE 1N914	1
D017	2101-0010	DIODE 1N914	1
D018	2101-0010	DIODE 1N914	1
D019	2101-0010	DIODE 1N914	1
D020	2101-0010	DIODE 1N914	1
DS01	2106-0009	LED	1
DS02	2106-0009	LED	1
DS03	2410-0001	7 SEG DISP MAN6640	1
DS04	2410-0001	7 SEG DISP MAN6640	1
DS05	2106-0009	LED	1
J001	2710-0013	CONN HEADER MOLEX 10 PIN	1
J002	2710-0010	CONN HEADER MOLEX 5 PIN	1
J003	2710-0094	CONN HEADER 20 PIN	1
J004	2710-0119	CONN HEADER 26 PIN	1
J005	2710-0009	CONN HEADER MOLEX 4 PIN	1
J006	2710-0216	SOCKET VERTICAL 4 PIN PCB	1
J007	2710-0216	SOCKET VERTICAL 4 PIN PCB	1
K001	2560-0003	RELAY 'BLUE BOY'	1
K002	2560-0003	RELAY 'BLUE BOY'	1
K003	2560-0003	RELAY 'BLUE BOY'	1
K004	2562-0009	RELAY PC MOUNT N/O	1
K005	2562-0009	RELAY PC MOUNT N/O	1
K006	2562-0009	RELAY PC MOUNT N/O	1
K007	2562-0009	RELAY PC MOUNT N/O	1
K008	2562-0010	RELAY PC MOUNT N/C	1
K009	2560-0003	RELAY 'BLUE BOY'	1
K010	2560-0003	RELAY 'BLUE BOY'	1
Q001	2111-0007	TRANSISTOR 2N4123	1
Q003	2114-0030	FET IRF-712	1
Q004	2112-0003	TRANSISTOR 2N4125	1
Q005	2111-0021	TRANS 2N2484	1
R001	0307-1092	RES 1/8W 1% 121	1
R002	0307-1792	RES 1/8W 1% 649	1
R003	0307-1792	RES 1/8W 1% 649	1
R004	0307-1092	RES 1/8W 1% 121	1
R005	0307-1505	RES 1/8W 1% 324K	1
R006	0307-1215	RES 1/8W 1% 162K	1
R007	0316-0207	RES 1/8W .1% 80K	1
R008	0316-0206	RES 1/8W .1% 40K	1
R009	0316-0205	RES 1/8W .1% 20K	1
R010	0316-0204	RES 1/8W .1% 10K	1
R011	0307-1693	RES 1/8W 1% 5.11K	1
R012	0307-1214	RES 1/8W 1% 16.2K	1
R013	0307-1116	RES 1/8W 1% 1.27M	1
R014	0307-1785	RES 1/8W 1% 634K	1
R015	0307-1682	RES 1/8W 1% 499	1

REF	PART NO	DESCRIPTION	QTY
R016	0307-1395	RES 1/8W 1% 249K	1
R018	0307-1682	RES 1/8W 1% 499	1
R019	0307-1105	RES 1/8W 1% 124K	1
R020	0307-1682	RES 1/8W 1% 499	1
R021	0307-1015	RES 1/8W 1% 100K	1
R023	0307-1682	RES 1/8W 1% 499	1
R024	0307-1904	RES 1/8W 1% 84.5K	1
R025	0307-1682	RES 1/8W 1% 499	1
R026	0300-1622	RES 1/4W 5% 620	1
R030	0307-1014	RES 1/8W 1% 10K	1
R031	0307-1263	RES 1/8W 1% 1.82K	1
R032	0326-0122	RES VAR 1K	1
R033	0300-1134	RES 1/4W 5% 13K	1
R034	0300-1181	RES 1/4W 5% 18	1
R035	0300-1104	RES 1/4W 5% 10K	1
R036	0300-1104	RES 1/4W 5% 10K	1
R038	0316-0202	RES 1/8W .1% 10	1
R039	0320-0020	RES 25W 1K	1
R040	0316-0203	RES 2W 5% 10K	1
R041	0307-1012	RES 1/8W 1% 100	1
R044	0300-1304	RES 1/4W 5% 30K	1
R045	0300-1304	RES 1/4W 5% 30K	1
R046	0300-1304	RES 1/4W 5% 30K	1
R047	0300-1206	RES 1/4W 5% 2M	1
R048	0300-1304	RES 1/4W 5% 30K	1
R054	0316-0203	RES 2W 5% 10K	1
R055	0300-1207	RES 1/4W 5% 20M	1
R060	0326-0114	RES VAR 100K	1
R061	0300-1625	RES 1/4W 5% 620K	1
R069	0300-1103	RES 1/4W 5% 1K	1
R074	0326-0114	RES VAR 100K	1
R075	0307-1305	RES 1/8W 1% 200K	1
R076	0307-1305	RES 1/8W 1% 200K	1
R078	0300-1244	RES 1/4W 5% 24K	1
R079	0300-1244	RES 1/4W 5% 24K	1
R081	0300-1475	RES 1/4W 5% 470K	1
R082	0326-0013	RES VAR 50K	1
R090	0307-1593	RES 1/8W 1% 4.02K	1
R091	0326-0123	RES VAR 2K	1
R092	0307-1284	RES 1/8W 1% 19.1K	1
R093	0300-1125	RES 1/4W 5% 120K	1
R094	0300-1305	RES 1/4W 5% 300K	1
R095	0300-1475	RES 1/4W 5% 470K	1
R096	0300-1122	RES 1/4W 5% 120	1
R098	0300-1222	RES 1/4W 5% 220	1
R099	0300-1222	RES 1/4W 5% 220	1
R100	0300-1222	RES 1/4W 5% 220	1
R101	0300-1222	RES 1/4W 5% 220	1
R102	0300-1222	RES 1/4W 5% 220	1
R103	0300-1222	RES 1/4W 5% 220	1

5205-0219 200205K
232D MAIN PCB ASSY

REF	PART NO	DESCRIPTION	QTY
R104	0300-1222	RES 1/4W 5% 220	1
R105	0300-1332	RES 1/4W 5% 330	1
R106	0300-1104	RES 1/4W 5% 10K	1
R107	0300-1207	RES 1/4W 5% 20M	1
R108	0300-1105	RES 1/4W 5% 100K	1
R109	0308-1315	RES 1/4W 1% 205K	1
R110	0308-1385	RES 1/4W 1% 243K	1
R111	0308-1385	RES 1/4W 1% 243K	1
R112	0308-1385	RES 1/4W 1% 243K	1
R113	0326-0114	RES VAR 100K	1
R114	0307-1011	RES 1/8W 1% 10	1
R116	0316-0203	RES 2W 5% 10K	1
R117	0316-0203	RES 2W 5% 10K	1
R118	0316-0203	RES 2W 5% 10K	1
R119	0300-1164	RES 1/4W 5% 16K	1
R120	0300-1105	RES 1/4W 5% 100K	1
R121	0300-1684	RES 1/4W 5% 68K	1
R123	0300-1103	RES 1/4W 5% 1K	1
R124	0300-1103	RES 1/4W 5% 1K	1
R125	0326-0010	RES VAR 10K	1
R130	0300-1105	RES 1/4W 5% 100K	1
R152	3015-0005	JUMPER .4 INSULATED	1
R153	0307-1681	RES 1/8W 1% 49.9	1
R154	0307-1283	RES 1/8W 1% 1.91K	1
R155	0326-0122	RES VAR 1K	1
R156	0300-1205	RES 1/4W 5% 200K	1
R158	0307-1395	RES 1/8W 1% 249K	1
R159	0307-1395	RES 1/8W 1% 249K	1
R160	0307-1634	RES 1/8W 1% 44.2K	1
R161	0300-1106	RES 1/4W 5% 1M	1
R163	0307-1754	RES 1/8W 1% 59.0K	1
R164	0300-1274	RES 1/4W 5% 27K	1
R165	0307-1394	RES 1/8W 1% 24.9K	1
R166	0300-1682	RES 1/4W 5% 680	1
R167	0300-1303	RES 1/4W 5% 3K	1
R168	0300-1474	RES 1/4W 5% 47K	1
R169	0300-1273	RES 1/4W 5% 2.7K	1
R170	0300-1273	RES 1/4W 5% 2.7K	1
R171	0307-1012	RES MF 1/8W 1% 100Ω	1
R172	0307-1883	RES MF 1/8W 1% 8.06K	1
R173	0326-0012	RES VAR 1/2W 10% 25K	1
RN01	0317-0027	RES NETWORK 100K X 7 SIP	1
S001	2505-0063	PB SW MODIF	1
S002	2505-0063	PB SW MODIF	1
S003	2501-0044	SW ROTARY BINARY 12 POS	1
S004	2505-0063	PB SW MODIF	1
S005	2505-0063	PB SW MODIF	1
S006	2515-0011	SW DPDT PC CNTR OFF	1
S007	2515-0003	SWITCH 2PST DIP	1
T003	5210-0153	232D G.F.I. COIL ASSY	1

5205-0219 200205K
232D MAIN PCB ASSY

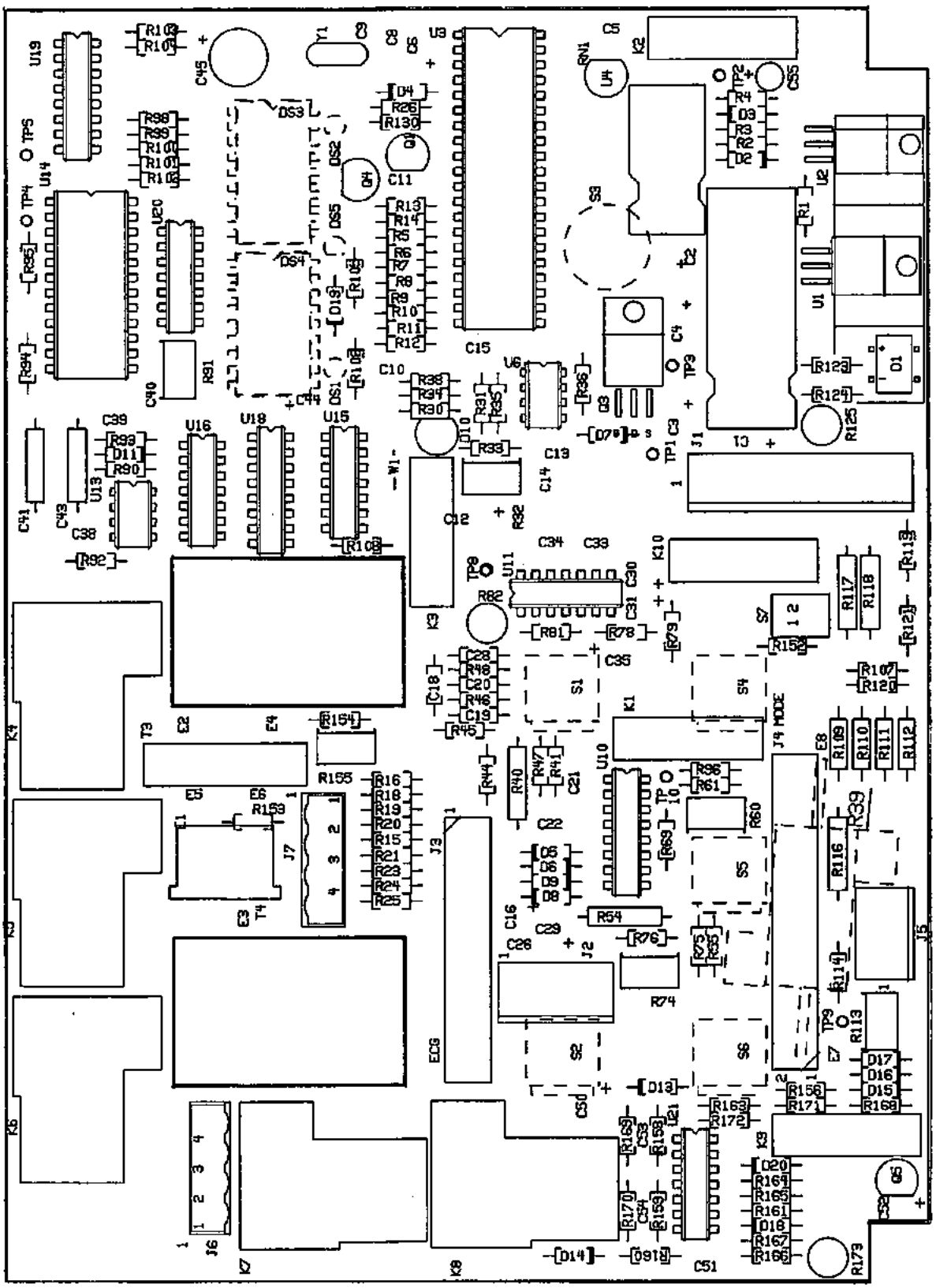
REF	PART NO	DESCRIPTION	QTY
T004	1214-0020	CURRENT SENCE COIL OC MOUNT	1
TP01	2714-0002	PCB TERM (TEST POINT)	1
TP02	2714-0002	PCB TERM (TEST POINT)	1
TP03	2714-0002	PCB TERM (TEST POINT)	1
TP04	2714-0002	PCB TERM (TEST POINT)	1
TP05	2714-0002	PCB TERM (TEST POINT)	1
TP08	2714-0002	PCB TERM (TEST POINT)	1
TP09	2714-0002	PCB TERM (TEST POINT)	1
TP10	2714-0002	PCB TERM (TEST POINT)	1
U001	2118-0050	+VOLT REG LM317	1
U002	2118-0086	-VOLT REG LM337	1
U003	2122-0073	IC PREFORMANCE GEN	1
U004	2118-0120	IC LP2950	1
U006	2118-0053	OP AMP LF356	1
U010	2118-0123	IC INA110	1
U011	2118-0118	IC AD637	1
U013	2118-0021	IC MC1403	1
U014	2122-0001	IC MC14433	1
U015	2121-0013	IC 4011	1
U016	2121-0015	IC 4013	1
U018	2121-0014	IC 4049	1
U019	2121-0016	IC 4511	1
U020	2120-0006	IC 75492	1
U021	2118-0095	IC OP AMP LF347	1
Y001	1220-0012	CRYSTAL CLOCK 4 MHz	1
ZZ01	2712-0022	IC SOCKET 40 PIN DIP	2
ZZ02	2712-0016	IC SOCKET 24 PIN DIP	1
ZZ03	2712-0018	IC SOCKET 16 PIN DIP	3
ZZ04	5201-0225	PCB 232D MAIN	1
ZZ05	4402-0018	HEAT SINK (T0-220)	1
ZZ06	4704-2405	SCREW PPH 6-32 X 3/8	2
ZZ07	4711-9720	KEP-NUT 6-32	2
ZZ08	4704-2235	SCREW PPH 4-40 X 3/8	2
ZZ09	4711-9721	KEP-NUT 4-40	2
ZZ10	2712-0003	IC SOCKET 8 PIN DIP	2
ZZ11	2712-0015	IC SOCKET 14 PIN DIP	5
ZZ12	2562-0011	RELAY DUST COVER	5
ZZ13	3012-0011	CABLE CLAMP	1

5205-0232 200473A
432D POWER XFMR PCB ASSY

REF	PART NO	DESCRIPTION	QTY
PJ001	2710-0214	SOCKET VERT PCB 7P	1
PS001	2507-0024	SWITCH PWR 4PDT	1
PT001	1201-0075	XFMR PWR 20V @300mA	1
PT002	1201-0076	XFMR ISO 120V @20mA	1
ZZ001	5201-0234	432D PWR XFMR PCB	1
ZZ002	5008-0328	L BRACKET	2
ZZ003	4704-2433	SCREW PPH 6-32x1/4"	2
ZZ004	4711-9720	NUT KEP 6-32	2

SECTION 7

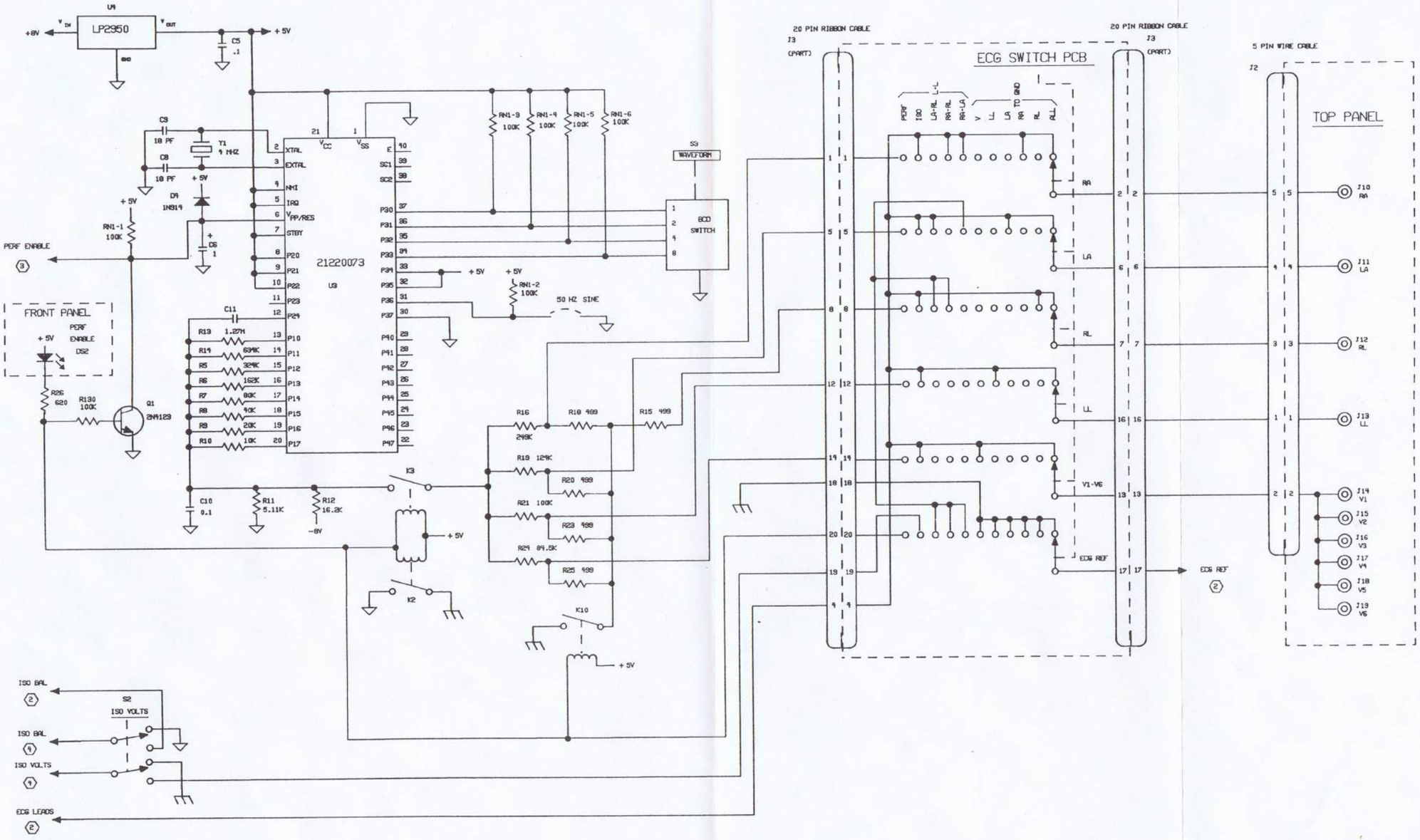
SCHEMATICS - COMPONENT LOCATOR



MAIN PCB

COMPONENT LOCATOR

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
F	INCORP ECO 388, PCB REV J	1/88	JTW
G	INCORP ECO 414, PCB REV J	3/88	JTW
H	INCORP ECO 442, 457 (PCB REV K)	7/88	



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%
2. ALL CAPACITOR VALUES ARE IN MICROFARADS

1

(FILE: 200454H1.SCH)

APPROVALS BY	DATE
JTW	1/88

DYNATECH NEVADA INC

TITLE: SCHEMATIC DIAGRAM 432D SAFTY ANALYZER

SIZE B | DWG. NO. 200454 | REV H

SCALE NONE | SHEET 1 OF 4

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
F	INCORP ECO 398, PCB REV J	1/88	JTW
G	INCORP ECO 414, PCB REV J	3/88	JTW
H	INCORP ECO 442, 457 (PCB REV K)	7/88	

(1) ISO BAL — C16 .001

S1: DC ONLY

LINE ATTEN: R107 20M; R109 205K; R110 243K; R111 243K; R112 243K; R113 100K; LINE VOLTS

R49 30K; R45 30K; R46 30K; R48 30K; R47 2M; C18 1.0; C19 1.0; C20 1.0; C28 1.0

(PART OF) AAMI LOAD: R40 10K, 2W; C21 .015; R41 100; D6 FDH333; D5 FDH333

+8V: C26 1.0; R79 100K; R75 200K; R76 200K

U10 INA110 INST AMPL: +Vcc, +IN, X10, X100, X200, X500, R_G, -IN, -Vcc, IOA, OOA, REF

K1 X10

R69 1K; TP10; TP9

R60 100K; R61 620K; C29 1.0

C35 2.2; R78 24K; C31 2.2; TP 8; (3) A/D IN

RMS GAIN: R79 24K

U11 AD637: BUF IN, CS, RMS OUT, BUF OUT, VIN, -VS, +VS, CS, NC, COM, OFST NULL, DB, CAV

C30 1; C34 .1; C33 .1; +8V; -8V

RMS OFST: R81 1M; R82 50K

R54 10K, 2W; R55 20M; D8 FDH333; D9 FDH333; C22 .01

C19 0.1; R34 10

FRONT PANEL: DS1 CURRENT ON

R38 10; Q3 IRF-712

R35 10K; R30 10K; U6 UF356; C15 .01; R36 10K; C12 6.8; D10 LM368Z-1.2; R31 1.82K; R32 1K; I ADJ; R33 13K; C13 0.1; D7 1N4005

(4) EQUIP CURR; (4) EQUIP CURR; (1) EDS REF; (4) TR SENCE; (3) RES; (1) ECG LEADS; (4) TR GND; (4) NEUT; (4) HOT

R117 10K; R118 10K; R116 10K

R39 1K 25W (PART OF) AAMI LOAD

R119 10

J4 26 COND. RIBBON CABLE

MODE SW PCB 200209

E1, E2

ECG
MILLI OHM, MICRO A — EXT
EQUIP CURRENT
INT, EXT — CASE
CORD OHM
H-G, N-G, N-H — LINE V
TEST

MODE

J5 — REAR PANEL

J22 RED — EXTERNAL METER
J23 BLK
J24 RED — CURRENT
J25 BLK

4 COND. WIRE CABLE

(FILE: 200454R2.SCH)

APPROVALS BY	DATE
JTW	1/88

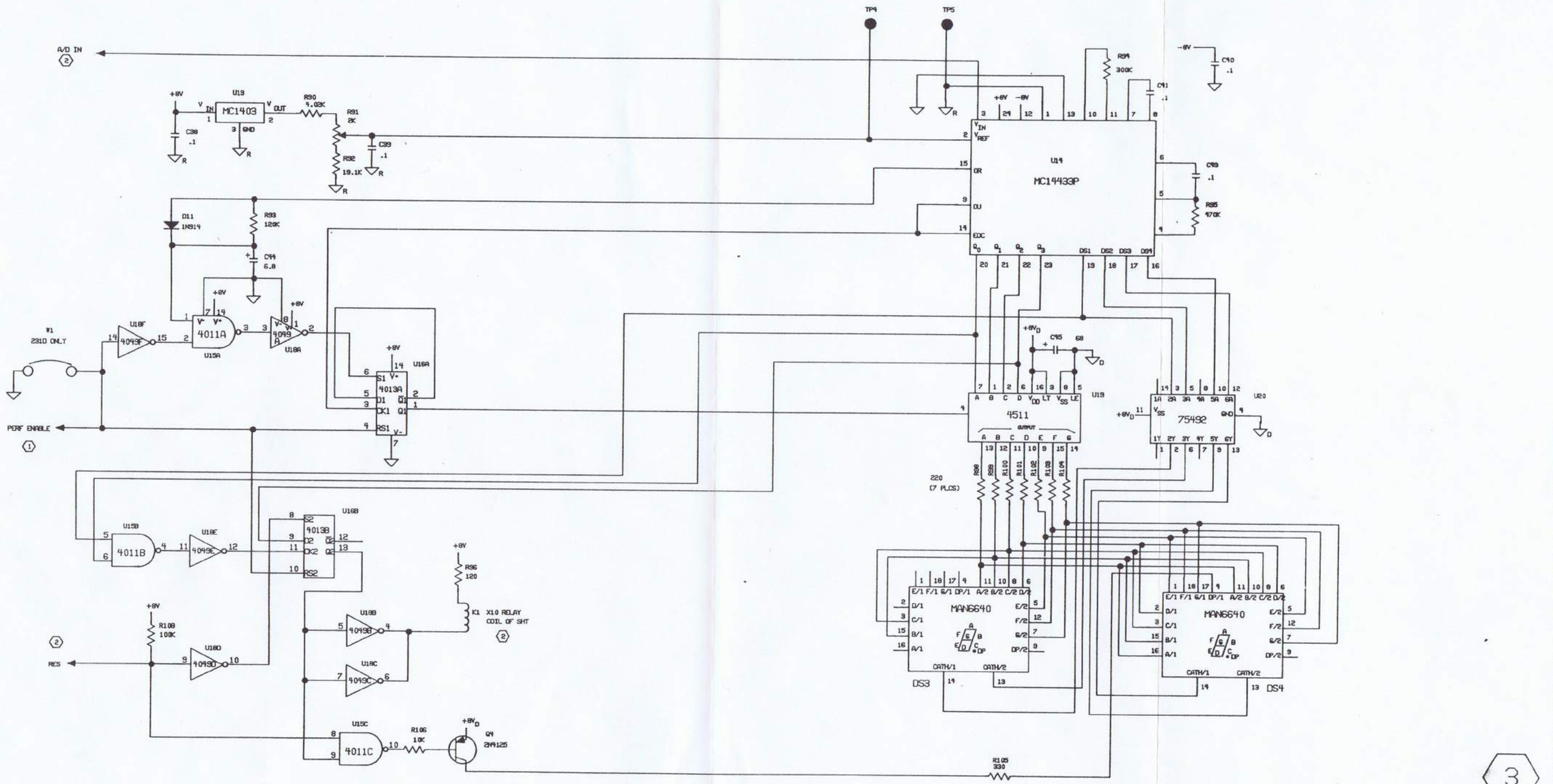
DYNATECH NEVADA INC

TITLE: SCHEMATIC DIAGRAM 432D SAFTY ANALYZER

SIZE B | DWG. NO. 200454 | REV H

SCALE NONE | SHEET 2 OF 4

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
F	INCORP ECO 388, PCB REV J	1/88	JTW
G	INCORP ECO 914, PCB REV J	3/88	JTW
H	INCORP ECO 942, 957 (PCB REV K)	7/88	



(FILE: 200454H3.SCH)

APPROVALS BY	DATE
JTW	1/88

DYNATECH NEVADA INC

TITLE SCHEMATIC DIAGRAM 432D SAFTY ANALYZER

SIZE B | DWG. NO. 200454 | REV H

SCALE NONE | SHEET 3 OF 4

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
F	INCORP ECO 388, PCB REV J	1/88	JTW
G	INCORP ECO 414, PCB REV J	3/88	JTW
H	INCORP ECO 442, 467 (PCB REV K)	7/88	

MAIN PCB ASSY 200205

ISO BAL ①

POWER CORD

FUSE 15A (115VAC) 7.5A (230VAC)

POWER

J1 (PART)

HOT

NEUT

R123 1K

R125 10K ISO BAL

R124 1K

D1 VM-18

+15V

U1 LM317 V_{IN} V_{OUT} ADJ

C1 2200

R1 121

R2 649

R3 649

D2 1N4001

C3 6.8

TP1

TP2

C2 470

C55 22UF

R9 121

U2 LM337 V_{IN} V_{OUT} ADJ

D3 1N4001

C4 6.8

TP3

-15V

HOT ②

NEUT ②

+8V$_D$

+8V

-8V

TRANSFORMER PCB ASSY 200473

PJ1 PP1

FUSE 1/2A (115VAC) 1/4A (230VAC)

PT2 ISO

115VAC

PS1 230VAC

PR4 16K

PR3 68K

PR2 100K

PR1 100K

PT1 POWER

NOTE: SWITCH PS1 SHOWN IN 115VAC POSITION

J6

K4

K5

K6

K7

K8

T3 GFI

T4 CURRENT

E1 E2 E3 E4 E5 E6

J7

HOT

NEUT

GND SENSE

GND

TOP PANEL

TEST RECEPTACLE

R154 1.91K 1%

R155 1K

R153 19.9 1%

+ EQUIP CURRENT ②

- EQUIP CURRENT ②

TR GND ②

TR SENSE ②

MAIN PCB ASSY 200205

ISO VOLTS ①

S7-1

S7-2

J1 (PART)

R120 100K

R119 16K

R121 68K

S4 OPEN NEUT

S5 OPEN GND

S6 NORM REV

PBS NC

R152 100

K9

88

C53 620PF R169 2.7K R158 249K 1%

C50 6.8UF

U21A LF347A

D13 1N914

C54 620PF R170 2.7K R159 249K 1%

U21B LF347B

D14 1N914

R160 44.2K 1%

C51 0.1UF

R161 1M

U21C LF347C

R163 59.0K 1%

R167 3K

R166 680

K9

Q5 2N2484

D18 1N914

R164 27K

C52 22UF

R168 47K

R165 29.9K

R173 25K

U21D LF347D

D20 1N914

R171 100

R172 0.09K

D16 1N914

D17 1N914

D15 1N914

R156 200K

-8V

DS5 FAULT GND FRONT PANEL

D19 1N914

4

(FILE: 200454M.SCH)

APPROVALS BY	DATE
JTW	1/88

DYNATECH NEVADA INC

TITLE SCHEMATIC DIAGRAM 432D SAFTY ANALYZER

SIZE B DWG. NO. 200454 REV H

SCALE NONE SHEET 4 OF 4