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944i Dielectric Analyzer



Operating & Maintenance Manual

Vitrek Corporation

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Introduction

The Vitrek 944i Dielectric Analyzer combines the four basic dielectric tests into one compact, easy to use, feature-rich instrument. The 944i's standard multi-function capabilities include - AC and DC Dielectric strength testing, Insulation Resistance (IR) measurement to 100 gigaohms and Earth Continuity measurement down to 10 milliohms. All of these tests can be run in either manual or automatic mode, as well as, via remote control using the optional IEEE-488.2 (GPIB), RS-232C or parallel communication ports.

Vitrek has taken advantage of advanced microprocessor and ASIC technologies in order to reduce the size and complexity of the 944i while increasing reliability and functionality when compared to traditional hi-pot testers. Operating the 944i is easier than ever due to extensive menu prompting on the unit's brilliant 40 character back-lit LCD. Built-in test procedure storage and edit capability increases test throughput and reduces test development time. Internal diagnostics ensure that the 944i is properly functioning at all times while the automatic calibration capability maintains highest possible systems accuracy.

Read the Vitrek 944i manual carefully before operating the instrument. Should you have any questions, Please contact your local Vitrek Service Center or Vitrek Customer Satisfaction Department at 9880A Via Pasar, San Diego, CA 92126 phone (858)689-2755 fax (858)689-2760.

Certification

Vitrek Corporation certifies that this instrument was thoroughly tested and inspected and found to meet published specifications when shipped from the factory. Vitrek Corporation further certifies that the calibration of this instrument is traceable to the National Institute of Standards and Technology to the extent allowed by NIST's calibration facility.

Limited Warranty

The warranty period for this instrument is stated on your invoice and packing list. Please refer to these documents to determine appropriate warranty dates. Vitrek warrants to the original purchaser that this product will be free from defects in material and workmanship under normal use throughout the warranty period. Vitrek Corporation's liability under this warranty is limited solely to the repair or replacement of this instrument during the warranty period, provided it is returned to the factory freight prepaid with return authorization number. And provided that such defects are not determined by Vitrek to have been caused by abuse, misuse, alteration, improper installation, neglect or environmental conditions. No other warranty is expressed or implied. Vitrek Corporation is not liable for incidental, consequential, direct or indirect damages or for costs, losses or expenses of any kind. A return authorization number must be obtained directly from the factory for warranty repairs. No liability will be accepted if returned without factory authorization number.

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Safety Precautions

The following general safety precautions must be observed during all phases of operation, service and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture and intended use of the instrument. Vitrek Corporation assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument must be connected to an electrical ground. This should be accomplished through the earth ground pin of the instrument's power connector and power cord.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Operation of any electrical instrument in the presence of flammable gases, fumes or particles constitutes a definite safety hazard.

DO NOT REMOVE COVERS

Operating personnel must not attempt component replacement or internal adjustment. Dangerous voltages may exist internally even when the power is switched off. Because of the dangers of introducing additional hazards, do not install substitute parts or perform any unauthorized modifications to the instrument. Refer the unit to qualified maintenance personnel or to your nearest Vitrek service center.

DO NOT OPERATE ALONE

Do not attempt to operate the instrument at high voltages unless another person, capable of rendering first aid and resuscitation, is present.

DANGER! HIGH VOLTAGE

Use extreme caution when working with high voltages. Never remove or insert test leads from the 944i while high voltage is present. Only use test lead materials which have adequate high voltage ratings. Inspect test leads regularly for signs of wear and abrasion.

READ AND UNDERSTAND THE MANUAL

Prior to operating this instrument, the user must be familiar with the operating procedures, controls and precautions.

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Unpacking

If the shipping carton is damaged, request that the carrier's agent be present when the instrument is unpacked. If the instrument appears damaged, notify the carrier's agent for repair authorization before returning the instrument to Vitrek.

It is also necessary to notify Vitrek and receive a RETURN MATERIALS AUTHORIZATION number before returning the instrument.

Even if the instrument appears undamaged, it may have suffered internal damage in transit that may not be evident until operated or tested to verify performance. If the instrument fails to operate, notify the carrier's agent and Vitrek or your local Vitrek Service Center. Retain the shipping carton for the carrier's inspection.

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Initial Adjustments

The only adjustments required prior to operation of the 944i are selection of the local power source voltage and verification that the correct fuse for this voltage is fitted. The supply voltages and fuses are listed below:

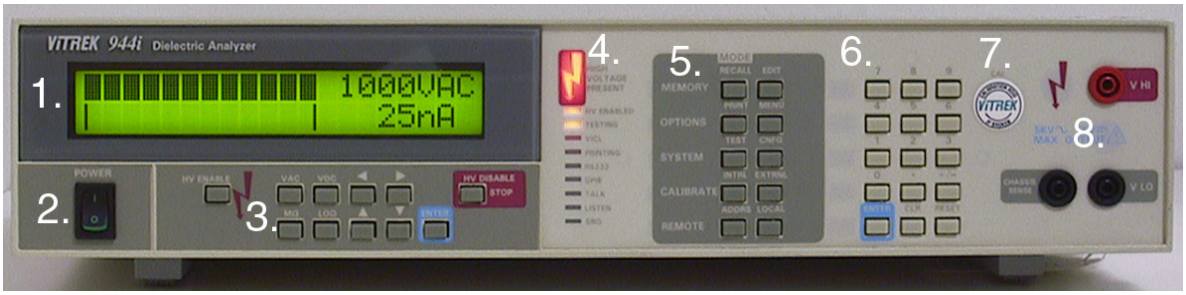
105 to 128VAC 50/60Hz	5 Amp slow blow fuse
210 to 256 VAC 50/60Hz	2.5 or 3 Amp slow blow fuse

Unless specifically requested, all units shipped to North American locations are factory set for 115VAC. Check the rear panel mounted selector switch to ensure that the proper line voltage is selected prior to applying power to the 944i.

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Front Panel Layout



1. Main Display
2. Power Switch
3. Function Keys
4. L.E.D. Indicators
5. Mode Keys
6. Numeric Entry Keys
7. Calibration Enable Switch
8. Measurement Terminals

Main Display - The 944i utilizes a 2 row by 20 Character, alphanumeric, backlit LCD.

Power Switch - The 944i features an ergonomic, rocker style power switch.

Function Keys - The keypad grouping immediately below the main display contains 11 function keys. The functions are (from left to right, top row first): High Voltage Enable, VAC (AC Dielectric), VDC (DC Dielectric), Left Arrow, Right Arrow, High Voltage Disable, Megaohms (Insulation resistance), Low-ohms (Continuity), Up Arrow, Down Arrow and Enter. The High Voltage Disable key is highlighted in bright red for easy identification. This key may be used at any time to disable the high voltage output and return the instrument to a safe operating state.

L.E.D. Indicators - The 944i is equipped with 10 front panel L.E.D. status indicators. They are (from top to bottom): High Voltage Present, High Voltage Enabled, Testing, VICL Port Active, Printing, RS232 Active, GPIB Remote, Talk, Listen and SRQ (remote service request).

Mode Keys - The two columns of keys to the right of the status indicators are the mode keys. A listing of the 10 mode keys (from left to right, top row to bottom row) is as follows: Recall Test Program, Edit Test Program, Print, Menu, System Test, System Configuration, Internal Calibration, External Calibration, GPIB Address and Local.

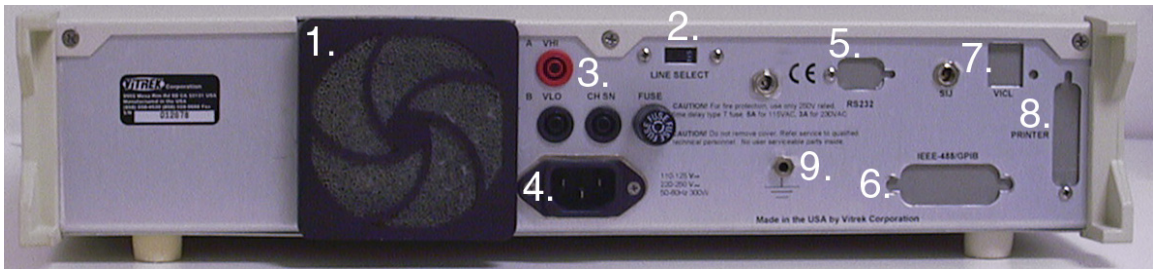
Numeric Entry Keys - The numeric entry keys are located to the right of the mode keys. They consist of 0 through 9, +/-, Decimal Point (.), Enter, Clear and Reset.

Calibration Enable Switch - The calibration enable switch is recessed behind the front panel and is located to the right of the numeric entry keys. The calibration enable switch may be secured by a calibration sticker which must be broken in order to engage the switch.

Measurement Terminals - The 944i is designed with three safety sheathed banana plug receptacles for stimulus and measurement. Warning! Terminals provide dangerous and potentially lethal voltages. Read and understand all safety precautions before connecting to these measurement terminals.

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Rear Panel Layout



1. Fan Filter Assembly
2. Line Voltage Selector
3. Rear Panel Terminals
4. Line power Receptacle
5. RS232 Port
6. IEEE-488 Port
7. VICL/ SIJ Ports
8. Parallel Printer Port
9. Chassis Ground Terminal

Fan Filter Assembly - The 944i uses a removable fan filter to clean the air used for cooling. Refer to the maintenance section of this manual for instructions on periodic removal and cleaning.

Line Voltage Selector - To select between 115 and 230 VAC line voltage operation, the 944i provides a built-in line voltage selector switch. Refer to the initial settings instructions, located earlier in this section of the manual, prior to changing switch positions.

RPO Rear Panel Output Terminals - The 944i may be optionally equipped with rear output terminals for applications (such as rack mounting) where this feature is desirable and convenient.

Line Power Receptacle - Power is provided to the 944i through a three-prong internal type power receptacle. A power cord, which mates with this receptacle, is also provided.

RS232 Port - The 944i uses a 9-pin male "D" sub connector for serial communications when the option IF-4 interface package is ordered.

IEEE-488 Port - Access to the optional IEEE-488/ GPIB interface is accomplished through this connector.

VICL/SIJ Ports - The 944i is configured with a proprietary serial control ports when the IF-4 interface package is ordered. This serial port is provided to communicate with auxiliary instruments such as the 930i Ground Integrity Tester. The SIJ port is optionally available for connection to safety interlock devices (i.e. palm switches or micro-switches).

Parallel Printer Port - To output data to an Epson FX-80 compatible parallel printer, the 944i utilizes a standard 25 pin "D" sub connector. The parallel printer capability is part of the IF-4 interface package.

Chassis Ground Terminal. This binding post provides convenient access to the 944i's chassis ground. The chassis ground terminal is used in the process of calibrating the 944i.

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Instructions for Bench Use

The 944i is delivered ready for bench operation. The unit is equipped with front tilt feet to adjust viewing angle. The 944i is also equipped with side handles to assist in carrying the unit. Use caution when lifting, the 944i is surprisingly heavy. Hold handles toward the rear of the unit for best balance. Always verify that the power cord is equipped with a three terminal connector before applying power to the 944i.

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Instructions for Rack Mounting

Optional rack mounting brackets are available for mounting the 944i in a standard 19" equipment rack. The size and weight of the 944i require that the unit should be supported on both sides along its entire length by the use of trays or slides. If it is to be transported while mounted in a rack, it must be supported to prevent upward or downward movement.

To install the RM-1 rack mount kit, remove the two forward flathead screws on each side of the 944i. Position the rack ears in place and install with the provided 5/8 inch 8-32 flathead screws. CAUTION! Longer screws may damage the unit. The specifications for the 944i become degraded at high temperatures, therefore it is recommended sufficient room be allowed for airflow around the 944i. This may be achieved by placing at east 1.75" high blank panels above and below the 944i in the rack. Under no circumstances should the ambient air temperature surrounding the 944i be allowed to exceed 50° C while in operation or 70° C while not in operation.

Earth Ground Connection

The power connector should be a three-contact device meeting the safety requirements of the area in which the 944i is to be used and should only be mated with a three-contact connector where the third contact provides ground connection. If the power is provided through an extension cable then the ground connection must be continuous throughout this cable to the 944i.

FAILURE TO PROVIDE A CONTINUOUS GROUND CONNECTION TO THE 944i MAY RENDER THE UNIT UNSAFE FOR USE.

Current Detection Circuitry

The 944i is equipped with three separate circuits for the monitoring and measurement of the output current. For precision measurement, the 944i utilizes an RMS measurement circuit based on a 12 bit ADC. When load failures are detected using the RMS circuit, a typical failure message would be "failed-max I" or "failed-min I".

For high-speed detection of load breakdown, the 944i utilizes a peak current comparator circuit which is set to trip at approximately 50 mA peak. When sudden breakdown occurs, the peak detection circuit will generally trigger before the slower, precision RMS measurement circuit. The failure message for the over current circuit is "Failed-OVR Current".

The final circuit which the 944i contains for catching load failures is a user programmable arc detector. The arc detector checks for small current pulses using a DIDT comparator circuit. The user selectable arc detection modes of "fast", "medium", and "slow" equates to arc pulse width of approximately 3, 10 and 30 micro seconds. The failure message of the arc detector is "Failed-Arc".

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Operating the Vitrek 944i in direct mode permits the user to manually control the output up or down while monitoring the leakage current being drawn by the load. When operating in the direct mode the user is in full control of the measurement process - ramp rate and dwell time are a function of how fast the user changes the output voltage and how long the user chooses to stay at that setting. Voltage and current limits are set by the user to prevent accidental excursion beyond those preset points.

DC Dielectric Strength Function

In evaluating the ability of materials to insulate against the flow of electricity, the DC Dielectric Strength Test is extremely valuable. The DC test function specifically analyzes the ability of a material to resist the flow of direct current in the presence of a high voltage. Other common names for the DC Dielectric strength test include: DC Hipot, DC Voltage Breakdown and DC Voltage Withstand.

To gain access to the DC Dielectric test mode, simply press the VDC button located under the display window. Upon pressing the VDC button, the following display prompt will appear:

DC DIELECTRIC TEST
DIRECT AUTOMATIC

This message confirms that the DC function has been selected and offers two different operating modes. By using the left/right cursor arrows, one can alternatively highlight either Direct mode or Automatic mode.
Direct mode permits manual operation and is highlighted when the Direct/Automatic menu pops-up. To select Direct mode, simply press enter. The following prompt will appear:

ENTER MAX VOLTAGE
1000 VOLTS

This prompt allows the operator to set a maximum test voltage. This limit prevents the user from inadvertently exceeding the intended range of output voltage. The 1000 VDC shown is the default limit. To enter another limit, simply press the number keys for the desired value. The range of limits for the VDC function may be as low as 100 VDC or as high as 5000 VDC. Once the desired voltage limit is displayed, press enter to advance to the next step.

The last setup prompt in VDC direct mode is the current limit prompt as shown below:

ENTER MAX CURRENT
10.0 mA

This value sets the maximum amount of leakage current, which the 944i will source without shutting down the test. Any current, which exceeds this limit, will cause the unit to automatically stop the test. The default value is 10.0 mA. However, any value between 100 nA and 35 mA may be used. To change the value of the current limit, use the number keypad. To change the units from m (milli) to u (micro) or n (nano), use the up/down cursor arrows. Once the desired maximum current limit is displayed, press enter to complete the test set-up for VDC Direct mode.

For safety purposes, the 944i requires a two-step key press sequence prior to initiating high voltage testing. Before beginning this sequence, it is important to ensure that the device under test is properly connected to the 944i test terminals. Please refer to the "Test Connections" section of the operating manual before proceeding.

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WARNING!: failure to observe test connection precautions may result in severe injury or death to the operator. The display will prompt the user to press the HV enable key as follows:

HIGH VOLTAGE ENABLE
REQUIRED

Once the test connections have been verified, press the HV enable button. After pressing the high voltage enable key the final prompt is:

PRESS ENTER TO
START TEST

Upon pressing the enter key the 944i will sound a number of warning beeps while flashing the HV enable indicator. If the user has enabled the auto-ground test feature of the 944i, the unit will automatically check the chassis of the DUT for earth ground continuity before applying high voltage to the DUT.

Whenever any voltage greater than 80 volts is applied to the output terminals, the high voltage present indicator will automatically illuminate. The starting point for all direct high voltage tests is at 100V. The test display is arranged with the top row indicating the output voltage in both digital read-out and bar graph formats. The multi-segment bar graph represents the proportion of output voltage relative to the preset voltage limit. For example, if the output setting was 500 volts and the preset voltage limit was 2500 volts approximately 20% of the bar graph segments will be illuminated.

Adjacent to the bar graph is a digital display of the output voltage setting. The display is a four-digit display with a resolution of one volt. The digit that is blinking is the digit that is presently subject to modification by the up/down cursors. To increase the output voltage, press the up arrow. To decrease the output, press the down arrow. To move the blinking digit to the left or right, use the left/right cursors.

If at any time during direct output control the preset maximum current limit is exceeded, the test is automatically aborted and a maximum current exceeded message will be displayed. When the user has completed direct mode testing, press the High Voltage Disable/Stop key to remove the high voltage output. **ALWAYS** verify that the high voltage present indicator has extinguished prior to handling the test leads.

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AC Dielectric Strength Function

AC dielectric strength testing is performed to evaluate a materials ability to resist the flow of alternating current in the presence of high voltage. The AC dielectric strength test is also commonly referred to as: AC Hipot, AC Voltage Breakdown and AC Voltage Withstand.

To begin an AC dielectric test press VAC. The 944i will respond with the following message:

AC DIELECTRIC TEST
DIRECT AUTOMATIC

This message confirms that the AC function has been selected and offers two different operating modes. By using the left/right cursor arrows, one can alternatively highlight either Direct mode or Automatic mode.

Direct mode permits manual operation and is highlighted when the Direct/Automatic menu pops up. To select DIRECT mode, simply press enter. The following prompt will appear:

ENTER MAX VOLTAGE
1000 VOLTS

This prompt allows the operator to set a maximum test voltage. This limit prevents the user from inadvertently exceeding the intended range of output voltage. The 1000 VAC shown is the default limit. To enter another limit, simply press the number keys for the desired value. The range of limits for the VAC function may be as low as 100 VAC or as high as 5000 VAC. Once the desired voltage limit is displayed, press enter to advance to the next step.

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After the voltage limit has been set the 944i will prompt for a test frequency. This advanced feature, which enables the user to test AC dielectric strength over a wide range of test frequencies, is unique to the Vitrek 944i. The frequency prompt is as follows:

SELECT TEST FREQUENCY
60 HZ 50 HZ _ _ _ HZ

Should the user desire a test frequency of 60 Hz, press enter. If 50 Hz is the desired test frequency, use the right cursor to highlight the 50 Hz option and then press enter. When an alternate test frequency is required, use the cursors to highlight the _ _ _ Hz option and then use the number keys to fill in the frequency of interest and then press enter.

Following frequency selection, the current sense selection menu will appear as shown below:

SELECT CURRENT SENSE
REAL APPARENT **TOTAL**

The Vitrek 944i uses internal phase angle circuitry to determine if the leakage current being measured is a result of a resistive load (real), reactive load (apparent) or both (total). In most applications total current is the desired sense mode and is highlighted when the current sense prompt pops-up. To select "total" press the enter key.

In many applications involving devices with EMI filters, the current being drawn by the filter capacitor is of no interest to the user. To ignore the current flow caused by the reactive component, select the "real" current sense mode. To determine the amount of current flow caused by the reactive component, select "apparent" current sense.

Due to the nature of phase measurement, it is difficult to accurately determine the phase of low amplitude signals. To prevent erroneous phase measurement under low amplitude conditions, the 944i will automatically default to "total" current sense when phase signals are below the minimum threshold.

Once the current sense mode has been selected, the 944i will prompt the user to set a current limit with the following message:

ENTER MAX CURRENT
10.0 mA

This value sets the maximum amount of leakage current which the 944i will source prior to shutting down the test. Any current which exceeds this limit will cause the unit to automatically stop the test. The default value is 10.0 mA. However, any value between 1nA and 35 mA may be used. To change the value of the current limit, use the number keypad. To change the units from m (milli) to u (micro) or n (nano), use the up/down cursor arrows. Once the desired maximum current limit is displayed, press enter to complete the test set-up for VAC Direct mode.

For safety purposes, the 944i requires a two step key press sequence prior to initiating high voltage testing. Before beginning this sequence, it is important to ensure that the device under test is properly connected to the 944i test terminals. Please refer to the "Test Connections" section of the operating manual before proceeding. **WARNING!, failure to observe safety precautions may result in severe injury or death to the operator.** The display will prompt the user to press the HV enable key as follows:

HIGH VOLTAGE ENABLE
REQUIRED

Once the test connections have been verified, press the HV enable key. After pressing the high voltage enable key the final prompt is:

PRESS ENTER TO
START TEST

Upon pressing the enter key the 944i will sound a number of warning beeps while flashing the HV enable indicator. If the user has enabled the auto-ground test feature of the 944i, the unit will automatically check the chassis of the DUT for earth ground continuity before applying high voltage to the DUT.

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Insulation Resistance (Megaohm) Function

In addition to having AC and DC dielectric strength functions, the Vitrek 944i also offers the convenience of high resistance measurement. To call the insulation resistance (megaohm) function, press the megaohm key. The following prompt will appear:

MEG OHM TEST
DIRECT AUTOMATIC

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For direct (manual control) mode, press enter, as the direct mode is highlighted when the menu pops-up. The next prompt is as follows:

ENTER MAX VOLTAGE
1000 VOLTS

This prompt allows the operator to set a maximum test voltage. This limit prevents the user from inadvertently exceeding the intended range of output voltage. The 1000 VDC shown is the default limit. To enter another limit, simply press the number keys for the desired value. The range of test voltages for the Megaohm function is from a low of 100 VDC to a maximum of 2500 VDC. Once the desired voltage limit has been entered, press enter to advance to the next step.

ENTER MIN RESISTANCE
1.000 MEGOHMS

The minimum resistance value is a built-in safety feature. Should the load resistance drop below this value the 944i will automatically stop the test. The default value is 1 megaohm. The lowest allowable minimum resistance value is 100 KΩ. Should the user care to use a different value, just enter the new value and press the enter key. To change the units from M (mega) to G (giga) or K (kilo) use the up down cursor arrows.

As in AC and DC, the Megaohm function of the 944i requires a two-step key press sequence that the device under test is properly connected to the 944i test terminals. Please refer to the "Test Connections" section of the operating manual before proceeding.

WARNING!, failure to observe safety precautions may result in severe injury or death to the operator. Before beginning this sequence, it is important to ensure that the device under test is properly connected to the 944i test terminals.

The display will prompt the user to press the HV enable key as follows:

HIGH VOLTAGE ENABLE
REQUIRED

Once the test connections have been verified, press the HV enable key. After pressing the high voltage enable key the final prompt is:

PRESS ENTER TO
START TEST

Upon pressing the enter key the 944i will sound a number of warning beeps while flashing the HV enable indicator. If the auto-ground test feature is enabled, the unit will automatically check the chassis of the DUT for earth ground continuity before applying high voltage to the DUT.

The starting test voltage for high resistance measurement is 100 VDC. The test display is arranged with the top row indicating the output voltage in both digital read-out and bar graph formats. The multi-segment bar graph represents the proportion of output voltage relative to the preset voltage limit. For example, if the output setting was 500 volts and the preset voltage limit was 1000 volts approximately 50% of the bar graph segments will be illuminated.

Adjacent to the bar graph is a digital display of the output voltage setting. The display is a four digit display with a resolution of one volt. The digit that is blinking is the digit that is presently subject to modification by the up/down cursors. To increase the output voltage, press the up arrow. To decrease the output voltage, press the down arrow. To move the blinking digit to the left or right use the left/right cursor controls.

When the user has completed direct mode testing, press the High Voltage Disable/Stop key to remove the high voltage output. **ALWAYS** verify that the high voltage present indicator has extinguished prior to handling the test leads.

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Low Resistance (Continuity) Function

The Vitrek 944i Dielectric Analyzer is a true multi-function tester. In addition to high voltage testing, the 944i has built-in low resistance measurement capability. The 944i can measure resistance from 0.001 ohm to 8.5 ohms, with the option LO-500 this range can be extended up to 500 ohms. The measurement is made with a 50mA test current. For regulatory compliance testing of

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earth ground continuity the Vitrek 930i Ground Integrity Analyzer is recommended.

To start low resistance testing, press the low ohms key. The low ohm prompt will appear as follows:

LOW OHM TEST
DIRECT AUTOMATIC

To conduct manual low resistance measurements, select the direct option. The 944i uses a 2-wire measurement technique. Proper zeroing of test lead resistance is essential to obtaining reliable results. To facilitate the canceling of lead wire resistance the 944i will provide a brief message as follows:

PRESS 0 TO NULL
LEAD RESISTANCE

It is recommended that the user "null" the lead set periodically to obtain the most accurate results. Always do a "null" when a new or different set of test leads are used with the unit. If you wish to null the test leads press the zero (0) key. When the "0" is pressed the following prompt will appear:

SHORT V LO & CHASSIS
SENSE LEADS (ENTER)

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The low resistance measurement is made between the V LO and Chassis Sense terminals. Apply a short to the end of the leads and press enter. The 944i will measure the lead resistance and store the value in non-volatile memory. Until a new value is stored the 944i will use this value to offset the lead resistance each time a low ohms test is done. In the event that the lead resistance is too high or a poor contact is made, the 944i will advise the user to check leads.

Should one elect not to null out the leads or following the null routine the 944i goes directly into the low ohms mode. There is no "High Voltage Enable" prompt as the low ohms test is conducted with a low voltage constant current source. When measuring low resistance the reading is displayed in four digit format with a fixed decimal to the right of the most significant digit. The maximum reading is approximately 8.500 ohms. When the measurement range is exceeded, the display will show four asterisks (****). In the automatic test mode the Vitrek 944i is a powerful, high volume test system in one compact package. Whether operating from the front panel or via the GPIB interface, the 944i can quickly execute a wide variety of tests comparing each step to preset user limits. Test routines can be easily entered, stored, recalled and edited using the 944i's built-in procedure generator. When the test is completed, hard copy test results are available at the touch of a button, provided the optional IF-4 interface card is installed. The IF-4 option includes GPIB, RS232, parallel printer port and VICL port.

DC Dielectric Strength Function

The DC Dielectric test in the automatic mode is essentially the same as in direct mode, however, once the parameters for the test have been set the test is fully automatic. Unlike most testers, all test parameters are fully programmable. The 944i has no rear panel pots to adjust and no factory set test values.

To begin a new DC Dielectric test, press the VDC key located under the display window. Upon pressing the VDC button, the following display prompt will appear:

DC DIELECTRIC TEST
DIRECT AUTOMATIC

This message confirms that the DC function has been selected and offers both operating modes. Use the right cursor arrow to highlight the Automatic mode and then press enter. The following prompt will appear:

ENTER TEST VOLTAGE
1000 VOLTS

This prompt allows the operator to set the test voltage. The 1000 VDC shown is the default test voltage. To enter another test voltage, simply press the number keys for the desired value. The range of output for the VDC function may be as low as 100 VDC or as high as 5000 VDC (7000 VDC with option DC-7 or 10,000 VDC with option DC-10). Once the desired test voltage is displayed, press enter to advance to the next step.

ENTER SLEW RATE
_**100** VOLTS/SEC

The slew rate prompt allows the test developer to automatically set the ramp rate so that the output voltage linearly increases up to the test voltage. The slew rate can be set from 1 volt per second to 2000 volts per second. If 100 v/s is the desired ramp rate press enter now. If another rate is desired, use the number keys to input a new value and then press enter. The next prompt is as follows:

ENTER MAX CURRENT
10.0 mA

This value sets the maximum amount of leakage current which the 944i will source without failing the DUT and shutting down the test. Any current which exceeds this limit will cause the unit to automatically stop the test. The default value is 10.0 mA. Any value between 1nA and 35mA may be used. To change the value of the current limit, use the number keypad. To change the units from m (milli) to u (micro) or n (nano), use the up/down cursor arrows. Once the desired maximum current limit is displayed, press enter. After the maximum current limit is set the next prompt is:

ENTER MIN CURRENT
0.0_ mA

The minimum current limit is provided as a convenience to assure that the load is actually connected. Any current measured below this limit will cause the unit to automatically stop the test. The default value is 0.0 mA. When the minimum current limit

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is set to zero, the limit becomes inactive. Any value between 0 nA and 35 mA may be used as a minimum current limit. To change the value of the current limit, use the number keypad. To change the units from m (milli) to u (micro) or n (nano), use the up/down cursor arrows. Once the desired current limit is displayed, press enter. The next prompt is:

ENTER RAMP CURRENT
10.0 mA

The ramp current feature allows the user to program separate max current limits for the ramp and dwell portions of the test. The default value for the ramp current limit is the same value as the dwell current limit. The next prompt is:

ENTER TEST TIME
10.0 SECONDS

The test time is the amount of time that the 944i will hold the test voltage once it has arrived at that voltage. This period is often referred to as dwell time. During the dwell time the unit continuously monitors leakage current against both min and max current limits, while holding the output constant. If at any time during either the ramp or dwell period, a current limit is exceeded the test is stopped and the DUT is failed. If the test time elapses then the DUT has successfully passed the test without tripping a limit. Use the number keypad to overwrite the default test time with the desired time and then press enter. This completes the test parameters for automatic DC Dielectric testing. The next prompt is as follows:

SELECT MODE
RUN ADD CHANNL STORE

Run is the highlighted menu item when the select mode prompt appears. If the user chooses, another step can be added on before running the test. The cursor arrows may be used to select any of the desired mode options. Detailed instructions on the *add*, *channel* and *store* functions can be located later in this chapter. If the user is interested in repeating the test just entered, it is recommended that the test be stored. To run the test that has just been set-up, press enter while the "run" is highlighted.

As in direct mode testing, the automatic mode of the 944i requires a two step key press sequence prior to initiating high voltage testing. Before beginning this sequence, it is important to ensure that the device under test is properly connected to the 944i test terminals. Please refer to the "Test Connections" section of the operating manual before proceeding.

WARNING! Failure to observe test connection precautions may result in severe injury or death to the operator. The display will prompt the user to press the HV enable key as follows:

HIGH VOLTAGE ENABLE
REQUIRED

Once the test connections have been verified, press the HV enable button. After pressing the high voltage enable key the final prompt is:

PRESS ENTER TO
START TEST

Upon pressing the enter key the 944i will sound a number of warning beeps while flashing the HV enable indicator. If the user has enabled the auto-ground test feature of the 944i, the unit will automatically check the chassis of the DUT for earth ground continuity before applying high voltage to the DUT.

.....

AC Dielectric Strength Function

To set-up a new AC Dielectric test, press the VAC key. The familiar confirmation prompt will appear as follows:

AC DIELECTRIC TEST
DIRECT AUTOMATIC

Use the right cursor arrow to highlight the Automatic mode, then press enter. The following prompt will appear:

ENTER TEST VOLTAGE
1000 VOLTS

This prompt allows the operator to set the test voltage. The 1000 VAC shown is the default test voltage. To enter another test voltage, simply press the number keys for the desired value. The range of output for the VAC function is from 100 to 5000 VAC RMS (8000 VAC with option AC-8). When the desired test voltage is displayed, press enter to advance to the next step.

ENTER SLEW RATE
_**100** VOLTS/SEC

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The slew rate prompt allows the test developer to automatically set the ramp rate, so that the output voltage linearly increases in amplitude up to the test voltage. The slew rate can be set from 1 volt per second to 2000 volts per second. If 100 V/S is the desired ramp rate, then press enter. If another rate is desired, then use the number keys to input a new value and then press enter.

After the slew rate has been set, the 944i will prompt for a test frequency. This advanced feature, which enables the user to test AC dielectric strength over a wide range of test frequencies, is unique to the Vitrek 944i. The frequency prompt is as follows:

SELECT TEST FREQUENCY
60 HZ 50 HZ _ _ _ HZ

Should the user desire a test frequency of 60 Hz, press enter. If 50 Hz is the desired test frequency, use the right cursor to highlight the 50 Hz option and then press enter. When an alternate test frequency is required, use the cursors to highlight the _ _ _ Hz option and then use the number keys to fill in the frequency of interest and then press enter. The frequency range of the 944i is from 50 to 100 hertz.

Following frequency selection, the current sense selection menu will appear as shown below:

SELECT CURRENT SENSE
REAL APPARENT **TOTAL**

The Vitrek 944i uses internal phase angle circuitry to determine if the leakage current being measured is a result of a resistive load (real), reactive load (apparent) or both (total). In most applications total current is the desired sense mode, so "total" is highlighted when the current sense prompt pops-up. To select "total" press the enter key.

In many applications involving devices with EMI filters, the current being drawn by the filter capacitor is of no interest to the user. To ignore the current flow caused by the reactive component, select the "real" current sense mode. To determine the amount of current flow caused by the reactive component, select "apparent" current sense.
Due to the nature of phase measurement, it is difficult to accurately determine the phase of low amplitude signals. To prevent erroneous phase measurement, the 994i will default to "total" current sense when phase signals are below the minimum threshold. Once the current sense mode has been selected, the 944i will prompt the user to set a current limit with the following message:

ENTER MAX CURRENT
10.0 mA

This value sets the maximum amount of leakage current which the 944i will source without failing the DUT and shutting down the test. Any current which exceeds this limit will cause the unit to automatically stop the test. The default value is 10.0 mA. Any value between 1nA and 35mA may be used. To change the value of the current limit, use the number keypad. To change the units from m (milli) to u (micro) or n (nano), use the up/down cursor arrows. Once the desired maximum current limit is displayed, press enter. After the maximum current limit is set the next prompt is:

ENTER MIN CURRENT
0.0_ mA

The minimum current limit is provided as a convenience to assure that the load is actually connected. Any current measured below this limit will cause the unit to automatically stop the test. The default value is 0.0 mA. When the minimum current limit is set to zero, the minimum current limit becomes inactive. Any value between 0 nA and 35 mA may be used as a minimum current limit. To change the value of the current limit, use the number keypad. To change the units from m (milli) to u (micro) or n (nano), use the up/down cursor arrows. Once the desired current limit is displayed, press enter. The next prompt is:

ENTER TEST TIME
10.0 SECONDS

The test time is the amount of time that the 944i will hold the test voltage once it has arrived at that voltage. This period is often referred to as dwell time. During the dwell time the unit continuously monitors leakage current against both min and max current limits, while holding the output constant. If at any time during either the ramp or dwell period, a current limit is exceeded, the test is aborted and the DUT is failed. Use the number keypad to overwrite the default test time with the desired time and then press enter. This completes the test parameter selection for automatic AC testing. The next prompt is as follows:

SELECT MODE
RUN ADD CHANNL STORE

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Run is the highlighted menu item when the select mode prompt appears. If the user chooses, another step can be added on before running the test. The cursor arrows may be used to select any of the desired mode options. Detailed instructions on the *add*, *channel* and *store* functions can be located later in this chapter. If the user is interested in repeating the test just entered, it is recommended that the test be stored. To run the test that has just been set up, press enter while "run" is highlighted.

As in direct mode testing, the automatic mode of the 944i requires a two step key press sequence prior to initiating high voltage testing. Before beginning this sequence, it is important to insure that the device under test is properly connected to the 944i test terminals. Please refer to the "Test Connections" section of the operating manual before proceeding.

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WARNING!, failure to observe test connection precautions may result in severe injury or death to the operator. The display will prompt the user to press the HV enable key as follows:

HIGH VOLTAGE ENABLE
REQUIRED

Once the test connections have been verified, press the HV enable button. After pressing the high voltage enable key the final prompt is:

PRESS ENTER TO
START TEST

Upon pressing the enter key the 944i will sound a number of warning beeps while flashing the HV enable indicator. If the user has enabled the auto-ground test feature of the 944i, the unit will automatically check the chassis of the DUT for earth ground continuity before applying high voltage to the DUT.

.....

Insulation Resistance (Megaohm) Function

To access the insulation resistance (megaohm) function, press the megaohm key. The following prompt will appear:

MEG OHM TEST
DIRECT AUTOMATIC

For the automatic test mode, press the right cursor arrow and then enter. The next prompt is as follows:

ENTER TEST VOLTAGE
1000 VOLTS

This prompt sets the insulation resistance test voltage. The 1000 VDC shown is the default value. If this is the desired test voltage, press enter. To select another test voltage, use the number keys to input the desired value and then press enter. The range of test voltages for the Megaohm function is from a low of 100 VDC to a maximum of 5000 VDC (range is extended down to 10 volts with LVIR option). The next prompt is as follows:

ENTER SLEW RATE
100 VOLTS/SEC

The slew rate prompt allows the test developer to automatically set the ramp rate so that the output voltage linearly increases up to the test voltage. The slew rate can be set from 1 volt per second to 2000 volts per second. If 100 v/s is the desired ramp rate, then press enter. If another rate is desire, use the number keys to input a new value and then press enter. The next prompt is as follows:

ENTER MIN RESISTANCE
1.000 MEGOHMS

The minimum resistance value is a built-in safety feature. Should the load resistance drop below this value the 944i will automatically stop the test. The default value is 1 megaohm. The lowest allowable minimum resistance value is 100 KΩ. Should the user care to use a different value, just enter the new value and press the enter key. To change the units from M (mega) to G (giga) or K (kilo) use the cursor arrows.

ENTER TEST TIME
10 SECONDS

The test time is the amount of time that the 944i will hold the test voltage after it has ramped up to that voltage. Test time is also referred to as dwell time. During the dwell time the unit continuously monitors insulation resistance. If at any time during either the ramp or dwell period, the minimum limit is exceeded the test is aborted and the DUT is failed. Use the number keypad to input the desired test time and the press enter. The next prompt is as follows:

SELECT MODE
RUN ADD CHANNL STORE

The cursor arrows may be used to select any of the desired mode options. Detailed instructions on the *add*, *channel,* and *store* functions can be located in this chapter. If the user desires to run the test just entered more than one time, it is recommended that the test be stored. To run the test that has just been set up, press enter while "run" is highlighted.

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The 944i requires a two-step key press sequence prior to initiating high voltage testing. Before beginning this sequence, it is important to ensure that the device under test is properly connected to the 944i test terminals. Please refer to the "Test Connections" section of the operating manual before proceeding. WARNING!, failure to observe safety precautions may result in severe injury or death to the operator.

The display will prompt the user to press the HV enable key as follows:

HIGH VOLTAGE ENABLE
REQUIRED

Once the test connections have been verified, press the HV enable key. After pressing the high voltage enable key the final prompt is:

PRESS ENTER TO
START TEST

Upon pressing the enter key the 944i will sound a number of warning beeps while flashing the HV enable indicator. If the user has enabled the auto-ground test feature of the 944i, the unit will automatically check the chassis of the DUT for earth ground continuity before applying high voltage.

During the ramp-up period, the timer will count down until it arrives at the test voltage. Once the dwell time begins, the timer will reset and count down to the end of the test.

.....

Low Resistance (Continuity) Function

In addition to high voltage testing, the 944i has built-in low resistance measurement capability. The 944i can measure resistance form one milliohm to 8.5 ohms. The 944i uses a 50mA test current in the low ohm mode. For regulatory compliance testing of earth ground continuity at high current, the Vitrek 930i Ground Integrity Analyzer is recommended.

To start low resistance testing, press the low ohms key. The low ohm prompt will appear as follows (if unit is configured for 930i):

LOW OHM TEST
DIRECT AUTO 930i

To conduct an automatic low resistance test, press the right cursor key and enter. The 944i uses a 2-wire measurement technique (4-wire option is available). Proper zeroing of test lead resistance is essential to obtaining reliable results. The automatic low ohms test mode does not prompt for test lead calibration. It is recommended that the user "null" the lead set periodically to obtain the most accurate results. Always do a "null" when a new or different set of test leads are used with the unit. To do a lead resistance null, access the low ohms direct mode. The next prompt in the auto low ohms set-up is:

ENTER MAX RESISTANCE
2.000 OHMS

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If 2 ohms is not the desired limit, use the number keys to enter the appropriate maximum resistance limit. The next prompt is:

ENTER MIN RESISTANCE
0.000 OHMS

The minimum resistance value is typically used to verify that the load is actually in the test circuit. When the minimum limit is set to zero, the limit is not active. The next prompt is:

ENTER TEST TIME
2.00 SECONDS

Enter the desired test time and press enter. The next prompt is:

SELECT MODE
RUN ADD CHANNL STORE

Detailed instructions on the *add*, *channel* and *store* functions can be located later in this chapter. If the user desires to run the test just entered more than one time, it is recommended that the test be stored. To run the test that has just been set up, press enter while "run" is highlighted. When the "run" option is selected the 944i will go directly into the low ohms mode, unless the low ohms test has been chained to a high voltage test. If the 930i option is selected then the standard prompts of the 930i will follow and the 944i will download the test to the 930i when the test is run.

.....

Adding Test Steps

The 944i is capable of storing up to 99 test programs with a maximum of 200 test steps. The maximum number of steps in any one test is 50. When operating the 944i in the automatic mode, after each step the following prompt is provided:

SELECT MODE
RUN ADD CHANNL STORE

To chain another test step on to the one just completed use the right cursor arrow to highlight the "add" option, and press enter.

SELECT NEXT TEST
VAC VDC M-OHM LO-OHM

This prompt enables the user to select the next test step.

.....

Storing Tests

When operating the 944i in the automatic mode, after each step the following prompt is provided:

SELECT MODE
RUN ADD CHANNL STORE

In order to store the test you have just created, use either the left or right cursor arrow to highlight the "store" option and press enter. The following prompt will appear:

ENTER PROGRAM NO.
NEXT AVAILABLE 01

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Enter a program number between 0 and 40. The 944i will automatically search the test program database and display the next available program number. If the next available number is the desired test program number, press enter. After the program number has been entered the following prompt will be displayed:

ENTER PROGRAM NAME

The program name prompt is provided as a convenience so that it is easier to identify the desired test than by program number alone. To enter a program name, alpha characters can be entered using the up/down cursor arrows until the desired character is shown in the space. The left/right cursor arrows will move the digit being modified. Numbers may be entered directly with the number keypad. When the name is completed press enter to complete the process of storing.

Recalling Test Programs

To recall a test which has been stored in the test database, press the recall key. The following prompt will appear:

RECALL PROGRAM NO.

If the desired program number is known, use the number keys to enter the program number and press enter. If the program number is not known, use the up/down cursor arrows to scroll through the program database. Both the program number and program name will be shown. When the desired program name and number are displayed press enter. If the test is a low ohms only type, testing will commence immediately. Otherwise the "HIGH VOLTAGE ENABLE REQUIRED" prompt will appear.

Editing Existing Test Programs

NOTE All current firmware versions have been found to develop corrupted RAM if a test is edited. For best assured performance, delete the test you wish to change and re-enter it from scratch using the instructions below. It is recommended that you do not use the INSERT or CHANGE functions in the EDIT menu.

It is helpful to have a printout of the test database when editing a test program. To obtain a printout of the test database, press the print button. To change a step in a test program, press the edit key. The following prompt will be displayed:

ENTER PASSWORD

_ _ _ _

This feature deters unauthorized personnel from accessing the test routine database. The password is:

"TEST (test button), 1, 2, 3"

For security purposes, it may be advisable to obscure the above password and store it in an alternate location. Once the password has been successfully entered the following prompt will appear:

EDIT PROGRAM NO.

After the program number has been entered via the number keypad, press enter. The program name and number will be displayed to verify that the selected program is the program to be edited. When the up/down arrows are used to scroll through the test database, the test program name is also displayed. Press enter when the desired program is displayed in order to select that program for editing. The following prompt will appear:

SELECT EDIT TYPE
INS DEL CHANGE QUIT

To add a new step to the program, use the "ins" (insert) option. To delete a test step use the "del" option. To alter a step on the program use the "change" option. After editing is complete use the "quit" option to store the edited test program and exit the edit mode.

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To change the **Test Name**, select the "change" option in the above menu. When the "ENTER STEP NO." prompt appears enter 00 and press enter. Then use the cursor arrows to enter the new test name.

.....

Printing Test Reports

Before printing, select a compatible line termination via the front panel menu key. The CR + LF option is compatible with most modern printers. When an automatic test is successfully completed, the following menu selection will be displayed:

TEST PASSED
QUIT PRINT RETEST

If your 944i has the optional IF-4 remote interface package, then it is supplied with a built-in parallel port. For information on printer port configuration refer to section 6 - Remote Operation, Parallel Port. To obtain a listing of the test results, connect a PC compatible parallel printer to the 944i rear panel parallel port and press enter.

ENTER DUT S/N
_ _ _ _ _ _ _ _ _ _ _

Numeric entry can be done using the number keys. Alpha characters may be entered using the up down cursor arrows. Once the DUT serial number has been entered, press the enter key and the printout will commence.

To repeat the test on the existing or new device under test, select the retest option and press enter. To exit the test mode, select the quit option and press enter.

When any step in an automatic test is failed, the following typical menu will be displayed:

STEP FAILED- MAX CURRENT
QUIT RETRY CONTIN

In this menu the continue option has been added to allow for the completion of the test. When the test is terminated via one of the above options, the "test passed" or "test failed" menu provides the print option.

.....

Aborting a Test

If at any time the user desires to abort a test, press the **High Voltage Disable / Stop** key. The following menu will be displayed:

TEST FAILED-ABORTED
QUIT PRINT RETEST

Select the desired option and press enter.

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Advanced User Note

To increase throughput and reduce the number of keystrokes required to achieve the desired results, whenever multiple choices are offered in a menu selection each choice has a corresponding number. The items are numbered from left to right. For example if the "retest" option shown in the above menu is desired, a single press of the number "3" would start a new test. The number "2" would initiate the printout routine.

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Test Connection Safety Precautions

The Vitrek 944i Dielectric Analyzer is capable of generating up to 8000 VAC RMS and 10000 VDC depending on the configuration. It is extremely important that the user observe safe operating procedures to avoid contact with these **DANGEROUS VOLTAGE LEVELS**. In addition to using common sense handling techniques for high voltage operation, the following precautions should be taken into consideration whenever operating the 944i:

1. Use only high voltage rated test lead material for connection to the high voltage output terminal.
2. Inspect high voltage lead regularly for signs of wear and abrasion.
3. Avoid contact with the high voltage output (terminal, leads and DUT) at all times during high voltage testing.
4. Always ensure that the 944i is properly earth grounded before applying power.

Measurement Terminals

The stimulus/measurement terminals of the 944i are recessed and insulated to prevent operator exposure to high voltages. For connection to V hi terminal, always use an insulated (sheathed) banana plug with adequate insulation rating. Never handle the plug or test lead while high voltage is applied.

Dielectric Testing (VAC, VDC and I/R)

All dielectric tests are performed from the 944i's V HI and V LO terminals. The V HI terminal is floating, while the V LO terminal remains relatively close to chassis ground at all times.

Low Resistance Testing

All low resistance tests are conducted between the V LO terminal of the 944i and its chassis sense terminal. It is recommended that a low resistance test be conducted on earth ground devices to verify ground continuity prior to dielectric testing.

Connecting to Devices with Earth Grounds

Earth grounded devices must be isolated from earth ground when conducting dielectric strength tests with the 944i. This will insure that all leakage current flows through the 944i and is properly detected. As an added safety design, the V LO and Chassis Sense terminals of the 944i each feature dual redundant M.O.V. clamping, to keep them at a low potential (18V max).

When testing devices that are equipped with an earth ground plug, it is always recommended that the user first conduct a continuity test between the DUT's earth ground plug and any exposed conductive surfaces (chassis). The 944i is capable of conducting this test in several different modes. When a high current (3 to 40 amps) ground continuity test is required, the Vitrek 930i is recommended. The connection to the DUT for continuity testing from the 944i is as follows:

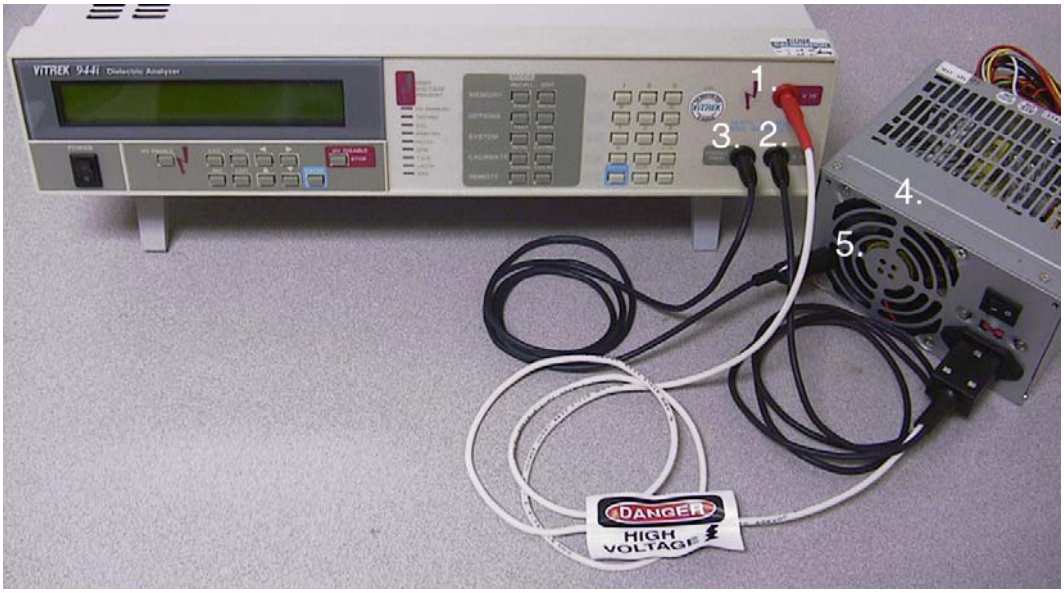
1. Connect the V LO terminal of the 944i to the DUT earth ground plug.
2. Connect the Chassis Sense terminal of the 944i to any exposed conductive surface of the DUT's chassis. Note: All continuity (low resistance) measurements on the 944i are made between the V LO terminal and the Chassis Sense terminal.
4. The V HI terminal of the 944i is normally connected to the two electrical prongs of the device under test. In this configuration the 944i will be checking for continuity between the DUT's earth ground plug and DUT chassis, as well as current flow between the DUT's electrical circuit and its' earth ground plug.

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Connecting to Non-Earth Grounded Devices

When testing devices which are not equipped with an earth grounded chassis, it is necessary to disable the automatic chassis ground test feature of the 944i. Otherwise the unit will fail the pretest auto-ground check and no further testing will commence. An alternate method is to provide a low impedance connection between the V LO terminal and the Chassis Sense terminal. **CAUTION!** Care must be taken to remove this connection after testing so that the chassis sense is not defeated when testing earth grounded chassis devices.

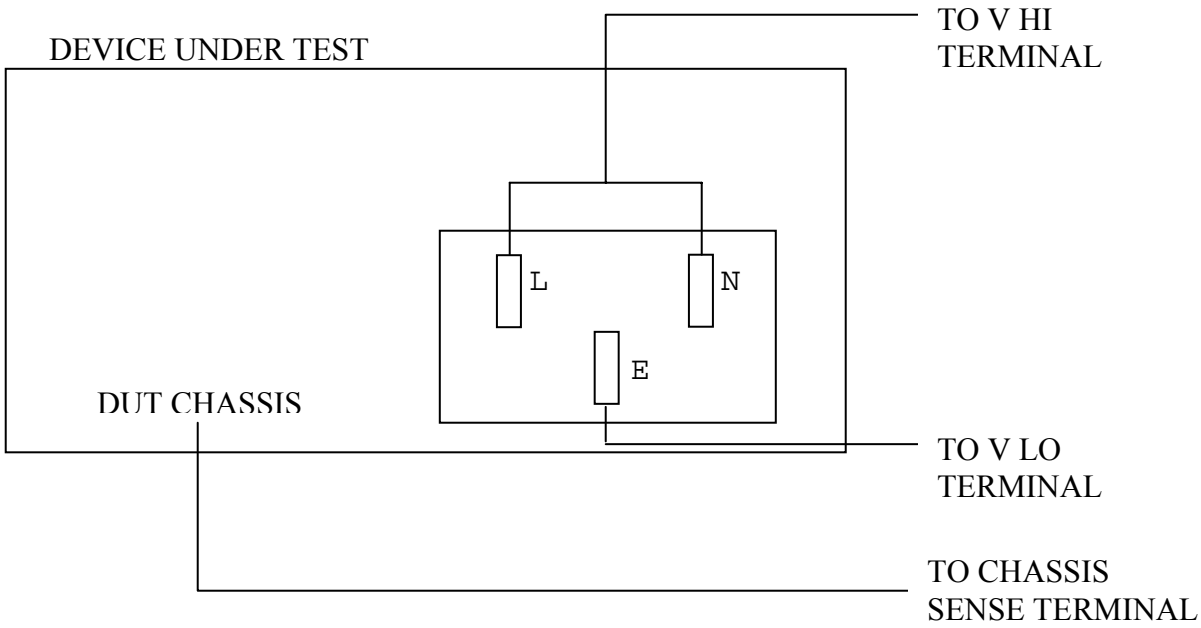
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1. **High Voltage Output Terminal**. This red HV connector labeled V Hi is the output terminal for all HV tests (ACW, DCW and IR). For typical electrical safety testing, this terminal connects to both the line and neutral power pins of the device under test (DUT). For ease of connection Vitrek offers the TL-IEC shown above, which plugs directly into an IEC 320 style power inlet. For devices using a NEMA 5-15 (North American) power plug the available TL-115-50 provides for quick and convenient connection. CAUTION: The HV terminal is capable of delivering up to 8kVAC or 10kVDC depending on installed options. Avoid contact with the terminal, test leads and the DUT when high voltage is present on this terminal.
2. **V-Lo Terminal.** The V LO terminal is the reference terminal for leakage current measurements and is also one of the two terminals used in making a continuity (low resistance) measurement. This terminal typically connects to the earth ground pin of the DUT. Inside the TL-115 and the TL-IEC this terminal is connected to the earth socket of the test adapter.
3. **Chassis Sense.** This is the other of the two terminals used in making a continuity (low resistance) measurement. The 944i always measures continuity between the "Chassis Sense" and the "V LO" terminals.
4. **Device Under Test** (DUT). A power supply shown here, represents a typical DUT. The connection to the DUT power inlet is made here by way of the optional TL-IEC.
5. **DUT Chassis.** The Chassis Sense terminal connects directly to the DUT chassis via the standard alligator test lead.

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Typical Electrical Safety Test Connection Diagram



The Vitrek 944i Dielectric Analyzer has been designed to provide maximum user safety, reliability, and test throughput. To achieve this, the 944i is equipped with built-in self test capability, and a variety of user configurable test options. This section of the manual addresses the use of the system test and configuration functions.

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Self Test Function

To execute a self test, press the test key. The following sequence of tests will be displayed:

SELF TEST
CHECKING ROM

VERSION
X.XX

SELF TEST
RAM TEST OK

If a ROM or RAM error is detected, the display will halt on a ROM or RAM "test failed message". These are fatal system errors which will prevent further operation of the unit. Should either "failed" message come up, try a reset and self test again to verify that the ROM or RAM status is accurate.

SELF TEST
CAL DATA OK

In the event of a cal data problem, the 944i will indicate that an error has been detected and that it is operating on default cal data. The unit should be referred to qualified maintenance personnel for calibration and inspection of the CMOS RAM battery, which has a five-year rating.

SELF TEST
CLOCK OK

The next two messages are provided in the self-test as a configuration status indication. For details on the other configuration options, consult the system configuration instructions in this section of the manual.

SELF TEST
ARC SENSITIVITY- MED

SELF TEST
AUTO CHASSIS GND- ON

OUTPUT SYSTEM TEST
YES NO

To conduct an output test, press enter. Select the no option if you do not desire an output system test.

The final self-test message is:

SELF TEST- OK
QUIT PRINT RETEST

If a printout of the self-test results are desired and the 944i is connected to a compatible parallel printer, highlight the print option and press the enter key.

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System Configuration

The system configuration function allows the user to: set the clock and clock format, adjust display intensity, control beeper actuation and select pretest safety checks. For other options and mode selection see "Configuration Switch Settings". To access the configuration control menu, press the "CNFG" key.

Setting Clock

To set the clock, press the "CNFG" key. The following prompt will appear:

ADJUST:
CLK SAFETY RMP LO-OHM MEG

To set the time or date or adjust the clock format, press the enter key while the "CLK" option is highlighted. The following clock adjust menu will appear with the currently programmed time and date:

01 JAN 1995
12 01 30 AM

To set the date, use the up/down arrows until the proper date is indicated. To make further adjustments highlight the month, year, hour, minute, or second and then adjust it using the up/down arrows. To select "AM", "PM" or "MIL" (24 hour format) use the up/down cursors to scroll through the three choices. When going from "PM" to "MIL" the time will automatically advance 12 hours. When all adjustments have been made, press enter to complete the clock setting procedure.

.....

Safety Control Settings

To adjust safety settings select the safety option from the main “CNFG” menu. The display will then prompt with the following items which may be adjusted**:** Beep, Arc, SS (safety lead sensing), Lo-ohm (automatic ground testing).

Controlling the HV Warning Beeper

To set the number of high volt warning beeps, select the beep option on the systems configuration menu. When the beep select menu appears, select the desired number of beeps and press enter.

.....

Arc Detection Sensitivity

To configure the arc detect sensitivity, press the "CNFG" key and select the "SAFETY" option and then the “ARC” option. The arc detection feature enables the 944i to sense the presence of arcing before catastrophic damage occurs to the DUT. The arc detection prompt will appear as follows:

SET ARC SENSITIVITY
FAST MED SLOW OFF

This menu allows the user to set the threshold for arc detection. "FAST" sensitivity means that the unit will trigger on lower amplitude, short duration spikes, while the "SLOW" sensitivity setting requires greater amplitude, longer duration spikes to trigger the arc detection circuit.

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Automatic Chassis Continuity Testing

It is always advisable to ensure that the chassis of a DUT is connected to the DUT's earth ground system. To facilitate a quick measurement of chassis continuity the 944i provides an automatic ground test when configured to do so. The "AUTO-GND" feature performs an automatic verification of DUT chassis to earth ground continuity, prior to all high voltage tests. To configure the automatic ground test, press the system configure (cnfg) button and select the “SAFETY” option and then the "AUTO-OHMS" option and select either “ON” or “OFF”. If the "ON" option is selected for "AUTO-GND", the user will be prompted to enter the maximum allowable chassis resistance.

Safety Sense

The safety sense option provides for continuous continuity monitoring between the V LO and Chassis Sense terminals (even during the HV testing). This feature can be used to monitor a safety interlock switch which when opened would shut down the HV output. To set the safety sense status press “CNFG”, select “SAFETY” then “SS”(safety sense) then select either the "ON" or "OFF" option.

.....

Ramp Down Option

A dielectric test is normally over when the end of the dwell time has been reached. In the default mode, the 944i will record the final leakage value then reduce the output voltage as rapidly as possible. Some applications require that the test voltage be ramped down at the same rate it was ramped up and that the current level is monitored during the entire descent. For this feature, press “CNFG”, select “RMP” then select “ON” or “OFF”.

Ramp Current Limit

For applications where the initial charge current is relatively high and the final leakage current is considerably smaller, the Vitrek 944i offers the ability to set different maximum current limits during the ramp-up and dwell periods. Additionally, the higher ramp current limit will apply for the specified “hold” period upon reaching the test voltage before the dwell countdown begins. To invoke this feature, press “CNFG”, “RMP”, and “RAMP-I” and select “YES”.

Configuring Meg-ohm Mode

The 944i offers three different modes of operation for high resistance measurement. In the standard **"meg-ohm"** mode, the D.U.T. must exceed the minimum resistance limit for the entire test time in order to pass the test. The test is terminated with a **fail** status immediately should the reading fall below the minimum resistance limit.

In the **"IR-MIL"** insulation resistance test mode, an allowance is made for leakage current due to dielectric absorption. In this mode, the D.U.T. is allowed to have an initial resistance value, which is below the min resistance limit and permitted the entire test period in order to reach the min resistance value. If at the end of the test time the D.U.T. has not reached the required value the test is failed. The test is terminated immediately with a **pass** status as soon as the minimum resistance limit is exceeded.

For insulation resistance measurements involving capacitive or inductive loads, the 944i features a low noise mode, which is, designated **"IR-LN"**. The low noise mode enables the unit to provide stable and accurate readings into reactive loads. The test is terminated immediately with a **pass** status as soon as the minimum resistance limit is exceeded.

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The factory default mode of operation is the "meg-ohm" mode. To select either the "IR-MIL" or "IR-LN" mode, choose the meg option at the systems configuration prompt. Use the right/left arrows to move the cursor to the desired mode and press enter.

Menu Key Options

Pressing the menu key while in the clock mode brings up the following display:

SELECT
PRINT SIJ LOCK COUNT

Printer Line Termination

The “PRINT” option allows one to select the line termination for the parallel printer port. The default mode is CR + LF, which works best with most parallel printers. Other options include - CR alone and LF alone.

Safety Interlock Jack

The “SIJ” selection provides for the set up of the optional safety interlock jack SIJ-1 which can be used to monitor the status of external palm switches or safety enclosure switches. Choices include: “OFF” (when SIJ-1 is not in use or not fitted), “MONITOR” for applications where the jack is looking for a closed circuit and will abort testing if an open circuit occurs, “RUN” mode - where the presence of a short circuit initiates the testing (once test begins an open will abort the test as in “Monitor” mode) and finally, “STEP” mode - which uses the short circuit to initiate testing then pauses and prompts the operator to interrupt the short circuit condition (allowing the operator to select a new DUT test point if desired), the 944i will automatically begin the next step of the test upon circuit closure.

Front Panel Lockout

The “LOCK” option allows one to lockout all front panel keys with the exception of the “Recall” key. When in the locked mode, operators can recall and execute tests stored in the test database only. To unlock the front panel, press “Recall” and then enter the edit password:

"TEST (test button), 1, 2, 3"

Pass/Fail Counters

The 944i is equipped with four built-in digital pass/fail test counters (VAC, VDC, Meg-ohm and low ohm). Each time an automatic test is run the resulting status increments the corresponding counter for that function. To read the counters, select the count option and desired counter. To read another counter directly from viewing and existing counter simply press “CLR” then select the desired counter. To reset or zero out all the counters select the “RST” option from the count menu.

Option IF-4 Remote Interface Card

Remote operation of the 944i is possible only if the unit has the optional interface card. The IF-4 remote interface card provides four different interface ports for control and communication with the Vitrek 944i. The interface protocols provided by the IF-4 are: IEEE-488.2 (GPIB), RS232-C, Parallel printer port, and VICL (Vitrek Instrument Control Loop).

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IEEE-488.2 (GPIB) Operation

Operation of the 944i via the GPIB interface requires a basic understanding of the IEEE-488 standard. This manual does not attempt to provide a tutorial on the General Purpose Interface Bus, but rather the specific implementation of the GPIB on the Vitrek 944i. For a detailed tutorial on the IEEE-488.1 and 488.2 interface contact your local HP sales office and order publication number 5021-1927.

Setting the GPIB Address

To view the current GPIB address, press the "ADDRS" key. If the displayed address is the desired address, press enter. To select a new address use the number keypad to enter any address between 1 and 30, then press enter. This address is stored in nonvolatile memory and will remain as set until changed.

Returning to Local Control

To take local control when the unit is operating in remote mode, press the "LOCAL" key. The GPIB indicator will go out unless the programmer has invoked the local lock-out feature of the GPIB.

Command Syntax

The GPIB command set is provided on the following pages. A description of each command, a listing of its associated arguments and a sample basic program listing are provided where appropriate. All voltage values are expressed as integers, current and resistance values may be expressed in scientific notation format.

NOTE Previous versions of the manual indicate that a 2000 V/S ramp rate can be used. The 944i will accept it, but this is for a special engineering mode where the ramp rate will be uncontrolled and the unit will not return a proper response to the "RDNG?" command. It is advised that any tests written using 2000 V/S as the ramp rate be modified to 1999 V/S.

ADD, {VAC}

This command loads a single step test into the 944i's test buffer. The added test may then be run with the RUN command.

Arguments:

<VAC>,	Selects AC Volts function	
<test voltage>,	100 - 5000 V	(Integer format)
<slew rate>,	1 - 1999 V/S	(Integer format)
<frequency>,	50 - 100 Hz	(Integer format)
<current sense>,	REAL, APPARENT, TOTAL	
<max current>,	1 nA - 35 mA	(Scientific notation format)
<min current>,	0 -35 mA	(Scientific notation format)
<test time>,	0.5 - 999 S	(0 sets test time to indefinite)

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Example:

```
10    ! File: T4.IBW
20    ! This test sends a VAC command to the 944i, waits
30    ! for test completion and then returns the result
40    ! to the bus controller.
50    DIM R$[120]
60    ASSIGN @V944 TO 1410
70    ABORT 14
80    !CLEAR 14
90    REMOTE @V944
100   ! Issue test and command to run.
110   OUTPUT @V944;"ADD,VAC,1000,100,60,TOTAL,1.0E-4,0,5;RUN;"
120   ! Poll until test is complete.
130   Stb=SPOLL(@V944)
140   IF Stb<8 THEN 130
150   PRINT "Stb=",Stb
160   OUTPUT @V944;"RSLT?;"
170   ENTER @V944;R$
180   PRINT R$
181   BEEP
190   STOP
200   END
```

ADD, {VDC}

This command loads a single step test into the 944i's test buffer. The added test may then be run with the RUN command.

Arguments:

<VDC>,	Selects DC Volts function		
<test voltage>,		100 - 5000 V	(Integer format)
<slew rate>,		1 - 1999 V/S	(Integer format)
<max current>,		1 nA - 35 mA	(Scientific notation format)
<min current>,		0 - 35 mA	(Scientific notation format)
<max ramp current>,		1 nA - 35 mA	(Decimal format)
		***Only necessary when in "RAMP_I" mode	
<test time>,		.5 -999 S	(0 sets test time to indefinite)
<ramp current hold time>;	Must be <= test time. Use 0 seconds if ramp current is the same as maximum dwell current. ***Only necessary when in "RAMP_I" mode		

Example (In normal mode without "RAMP_I" enabled in CNFG menu):

```
10    ! File: T6.IBW
20    ! This test sends a VDC command to the 944i, waits
30    ! for test completion and then returns the result
40    ! to the bus controller.
50    DIM R$[120]
60    ASSIGN @V944 TO 1410
70    !ABORT 14
80    !REMOTE @V944
90    !CLEAR 14
92    CLEAR 14
100   OUTPUT @V944;"*idn?;"
101   ENTER @V944;R$
104   BEEP
```


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```
105    PRINT R$,I
120    ! Issue test and command to run.
130    ! OUTPUT @V944;"ADD,VDC,1000,100,1.234e-05,0,10;RUN;"
140    ! Poll until test is complete.
150    Stb=SPOLL(@V944)
160    IF Stb<8 THEN 150
170    PRINT "Stb=",Stb
180    OUTPUT @V944;"RSLT?;"
190    ENTER @V944;R$
200    PRINT R$
210    STOP
220    END
```

ADD, {MEG_OHM}

This command loads a single step test into the 944i's test buffer. The added test may then be run with the RUN command.

Arguments:

<MEG_OHM>, Selects MEG_OHM function
<test voltage>, 100 - 5000 V
<slew rate>, 1 - 1999 V/S
<min resistance>, 100000 Ω
<test time>; 1 - 999 S

Example:

```
10     ! File: T3.IBW
20     ! This test sends a MEG_OHM command to the 944i, waits
30     ! for test completion, and then returns the result
40     ! to the bus controller.
50     DIM Result$[120]
60     ASSIGN @V944 TO 1410
70     REMOTE @V944
80     ABORT 14
90     CLEAR 14
100    ! Issue test and command to run.
110    OUTPUT @V944;"ADD,MEG_OHM,1000,100,1.0e+6,5;RUN;"
120    ! Poll until test is complete.
130    Stb=SPOLL(@V944)
140    IF Stb<8 THEN 130
150    PRINT "Stb=",Stb
160    ! Get test results.
170    OUTPUT @V944;"RSLT?;"
180    ENTER @V944;Result$
190    PRINT Result$
200    PRINT
210    BEEP
220    STOP
230    END
```

ADD, {LO_OHM}

This command loads a single step test into the 944i's test buffer. The test may then be run with the RUN command.

Arguments for **944i** measurement:
<LO_OHM>, Selects LO_OHM function
<max resistance>, 0.001 - 8.5 Ohms (0.001 – 500 with LO-500 option)
<min resistance>, 0 - 8.5 Ohms (0 – 499.999 with LO-500 option)
<test time>; 1 - 999 S

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Arguments for **930i** measurement:

<LO_OHM>,	Selects LO_OHM function
<test current>,	3 - 30 A (40 amps with option 40A)
<frequency>,	50 - 100 Hz
<max resistance>,	1 microohm - 0.999 Ohms
<min resistance>,	0 – 0.999 ohms
<test time>;	1 - 999 S

Example:

```
10    ! File: T2.IBW
20    ! This test sends a LO_OHM command to the 944i, waits
30    ! for test completion, and then returns the results
50    DIM Result$[120]
60    ASSIGN @V944 TO 1410
70    REMOTE @V944
80    ABORT 14
90    CLEAR 14
100   ! Issue test and command to run.
110   OUTPUT @V944;"ADD,LO_OHM,2,0,5;RUN;" !For 944i
110   OUTPUT @V944;"ADD,LO_OHM,25,60,1.0E-1,0,5;RUN;" !For 930i
120   ! Poll until test is complete.
130   Stb=SPOLL(@V944)
140   IF Stb<8 THEN 130
150   PRINT "Stb=",Stb
160   ! Get test results.
170   OUTPUT @V944;"RSLT?;"
180   ENTER @V944;Result$
190   PRINT Result$
200   PRINT
210   BEEP
220   STOP
230   END
```

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CNFG

This command sets the test configuration. Once this command is sent the programmed test configuration will remain in effect until overridden by a subsequent CNFG command or the system configuration is reset in the local operating mode. If a different systems configuration is desired for local operation (i.e. high voltage warning beeps), it is recommended that the desired system configuration for local operation be sent at the conclusion of the remote program.

Arguments:

<H. V. beep>,	0 through 5 (number of beeps)
<arc response>,	0 (off), 1 (slow), 2 (med), 3 (fast)
<auto-ground>,	0 (off), .01 to 5 (max chassis resistance in ohms)
<ramp down>,	0 (sets down slew rate to max)
	1 (sets ramp down rate to same as ramp up)
<saf-sns>,	0 (off), 4 (on for all dielectric tests)
<IR-mil>,	0 (off/ normal MΩ), 1 (quick pass IR mode)

Example:

```
10    ! File: T3.IBW
20    ! This sends a CNFG command to the 944i.
60    ASSIGN @V944 TO 1410
70    REMOTE @V944
80    ABORT 14
90    CLEAR 14
110   OUTPUT @V944;"CNFG,0,2,1,0,4,0;"
220   STOP
230   END
```

ETRIG?

Argument: <none>
Function: Sends present voltage reading, in integer format, to the GPIB buffer.

ITRIG?

Argument: <none>
Function: Sends present current reading, in scientific notation, to the GPIB buffer.

TTRIG?

Argument: <none>

Function: Valid when failure occurs during the dwell period of the test. The 944i sends elapsed time into the dwell when failure occurred, in floating point format, to the GPIB buffer.

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FTRIG?

Argument: <none>
Function: Valid when failure occurs during the ramp-up period of the test. Sends output voltage at time of failure, in floating point format, to the GPIB buffer.

IMAX

Argument: <max current limit>
Function: Changes max current limit to a new value prior to or during a test. The new maximum current limit must be greater than the existing minimum current limit.

Example: IMAX,1.0E-5; (changes max current limit to 10 micro-amps)

RSLT?

Function: This query returns test Pass/Fail status with fault type if any.

Fills output register with an ASCII representation of a decimal value indicating one of the following test results. Register data remains available until cleared with a *CLS, *RST or a new test is run.

0 - TEST PASSED

Fault Codes
1 - MAX RESISTANCE EXCEEDED
2 - MIN RESISTANCE EXCEEDED
3 - OVERANGE
4 - COMPL VOLTAGE EXCEEDED
5 - AC SYSTEM FAULT
6 - HIGH RESISTANCE
7 - USER ABORTED
8 - ARC DETECTED
9 - OVER CURRENT EXCEEDED (peak detected)
10- MAX CURRENT EXCEEDED (RMS detected)
11- SYSTEM OVERVOLTAGE
12- CHASSIS GROUND EXCEEDED
13- SYSTEM OUTPUT DEMAND ERROR
14- MIN CURRENT
15- SYSTEM UNDERVOLTAGE ERROR
16- DUT SHORTED
17- SAFETY INTERLOCK OPEN
18- 930i NOT RESPONDING
19- SYSTEM ERROR

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RDNG?

Function: This query is used to retrieve the final reading of the test.
The RDNG? query returns the final reading in exponential notation (1.1020E-06). The VDC and VAC tests will respond with the final current reading. Following MEG OHM and LO OHM tests, the remote output queue will contain the final resistance reading.

ARGUMENT SEPERATOR

Use a ‘,’ as a separator for all arguments.

COMMAND TERMINATOR

Use a semicolon **<;>** (ASCII code 59) to terminate all commands through GPIB interface. Use both a semicolon <;> and a line feed character <\n> (ASCII code 10) to terminate all commands through the serial interface.

READ TERMINATOR

The 944i will terminate all commands with a line feed character <\n> via the GPIB interface. ****NOTE: There is currently no read terminator added to responses via the serial port.

RUN

Arguments: <none>
Function: Runs current test.
Example: RUN;
This command starts execution of the current test.

*CLS

Arguments: <none>
Function: Resets 944 GPIB status registers.
Example: *CLS;

This command clears all status registers.

*IDN?

Arguments: <none>
Function: Causes the 944i to put its ID information in the GPIB buffer.
Example: *IDN?;

When the 944 is read after this command is sent, the
string returned will contain the unit's ID information.

*RST

Arguments: <none>
Function: Causes an internal device reset. May be used to terminate a test and reduce output to a safe quiescent state. NOTE: This is NOT the same as pressing the RESET button on the 944i.
Example: *RST;

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*STB?

Arguments: <none>
Function: Causes 944i to respond with its status byte.
Example: *STB?;

This status byte is also available through the serial poll and the serial poll method is recommended, as it is faster and less processor intensive than the *STB? command. After this command is sent, wait 500 ms before checking status; the 944i's status byte will then be valid and available in the output buffer. The byte is provided in binary format representing 0 through 32.

0x00 0001	High Voltage Present on Output
0x00 0010	End of Test Dwell Time
0x00 0100	Test in Progress
0x00 1000	Test Result Data Ready
0x01 0000	Test Terminated with Failure
0x10 0000	Undefined
x1xx xxxx	Set if SRQ Mask Enabled
1x00 0000	Undefined

*This bit not valid until test in progress bit has been set

PRINT

Arguments: <serial number>
Function: Causes 944i to printout test results. The serial number of the DUT can be any ASCII string of up to 9 characters.
Example: PRINT,123456789;

……

RS232 (Serial) Interface

The RS232 connector on the rear panel of the 944i is a 9 pin female sub-D type. The most common type of connector found on a modern PC serial port is a 9 pin male sub-D type. The pinout of the 944i is designed to mate directly to a PC serial port using a straight through 9 pin male to 9 pin female extension type cable.

Sending Commands

Data may be exchanged with the 944i serial port using the following protocol:

Baud Rate: 9600	Stop Bits: 1
Parity: none	Handshaking: no
Word width: 8	Echo Mode: echo off

Command Set for RS232

The command set available for serial operations is the same as that for GPIB (Except for the different read terminators and command terminators noted above). You will notice that some commands are single words, but others consist of a root command followed by one or more variables, also called arguments. Arguments may be used to set-up multiple items such as voltages, currents, and test time. For commands with multiple arguments such as ADD and CNFG, the root command must be separated from the first argument by a comma, and all arguments must be separated by commas.

"Query" commands, which usually end in a question mark, always provide a response to the query. Other commands are execute-only commands that do not provide a response. It is recommended that a minimum 100ms delay be allowed following the last command before sending a new command. You should experiment with different delays until you find a safe minimum delay time between instructions.

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Parallel Printer Port

When the 944i is equipped with the optional IF-4 interface card, a centronix parallel printer port is included. The connector for

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this port is located on the rear panel and identified as the parallel port. The connector is a standard 25 pin D-Sub female. A standard PC compatible parallel cable will connect this port to a parallel printer.

Printouts of test reports are generated from the menu at the end of Automatic Mode tests. Other printouts available include: complete listings of stored programs, self-test results, and other functions as described in the operating instructions for the 944i.

In order to ensure compatibility with various types of printers, the user may change the line terminator that the 944i sends to the printer. To configure this function from the time/date screen, press the MENU key in the OPTIONS row. The following menu appears:

PRINTER SETUP
CR LF CR+LF

With most printers, selecting CR (carriage-return) or LF (line-feed) will result in a single-spaced printout. Selecting CR+LF will send both a carriage-return and a line-feed at the end of each line, and may result in double-spaced printouts.

.....

VICL (Vitrek Instrument Control Loop)

The VICL interface is provided with the option IF-4 for the express purpose of communicating with and controlling auxiliary units. This proprietary addressable serial communication link utilizes the four conductor modular telephone connector located on the rear panel. Due to the device dependent nature of this interface, detailed information on the VICL protocol may be located in the operating manual of the auxiliary unit.

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Options:

IF-4 Remote Interface Package

This option is internally installed in the 944i. It is easily identified by the numerous interface connectors located on the rear panel. This option includes the following interfaces: IEEE-488 (GPIB), RS-232C, Parallel Printer Port and a VICL port. Detailed information on the use of this option may be located in section 6 Remote Operation of this manual.

TL-115 Test Leads with 115V Outlet

For direct plug-in test convenience, this accessory provides a standard 3-prong North American power outlet in a handy compact enclosure with mating leads for the 944i.

TL-10 High Voltage Probe Set

This 10KV rated high voltage probe set allows the user to apply the test voltage to the device under test with pinpoint accuracy.

TL-20 Alligator Test Lead Set

This lead set is terminated in a booted alligator clip which enables the user to connect the high voltage test lead to a chosen point, without having to handle the lead while the test voltage is applied.

RM-1 Rack Mount Kit

The RM-1 permits the 944i to be used in a standard 19" rack. Instructions for installing the RM-1 are provided in the "Getting Started" section of this manual.

GP-1 / GP-2 GPIB Cables

The GP-1 and GP-2 are 1 and 2 meter length IEEE-488/GPIB cables.

SIJ-1 Safety Interlock Jack

Option provides a 2.5mm jack in the rear of the unit for connection to an external safety interlock which is monitored by the unit's firmware in order to disable the high voltage output when the interlock is open.

RSS-1 Remote Safety Switch

Option provides a 2.1mm jack in the rear of the unit and an external pushbutton switchbox for the purpose of starting pre-programmed tests without having to reach the front panel of the 944i. The RSS option reduces wear and tear on the front panel keypads.

RFS-1 Remote Foot Switch

Option provides a 2.1mm jack in the rear of the unit and an external foot powered switchbox for the purpose of starting pre-programmed tests without having to reach the front panel of the 944i. The RFS option reduces wear and tear on the front panel keypads.

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DC-7 7kV DC output

Increases DC output range to 7kV DC (with decreased current limits). DC-7 option does not affect AC output specs. No external boxes or circuitry are necessary.

DC-10 10kV DC output

Increases DC output range to 10kV DC (with decreased current limits). DC-10 option does not affect AC output specs. DC-10 requires an external box with circuitry inside.

AC-8 8kV AC output

Increases AC output range to 8kV DC (with decreased current limits). AC-8 option does not affect DC output specs. AC-8 requires an external box with circuitry inside.

FR-4 Fixed Range power supply mod

Option improves stability of unit's output in special cases. Current output is limited in some voltage ranges. Option may be installed by factory without being requested. The current limit specifications with the FR-4 option installed differ from a standard unit.

RPO Rear Panel Outputs

Provides V-Hi, V-Lo, and Chassis Sense outputs at the rear of the unit.

FS-1 Four Wire Fail Safe option

Provides four wire Lo-Ohms measurement capability (V-Lo and Chassis sense outputs are BNC connectors) and limits the current output in Lo-Ohms mode to 8.5mA.

PLC-2A Programmable Logic Controller interface

Option provides a 5-pin DIN connection in the rear of the unit for the purpose of controlling and monitoring automated testing with an external PLC system.

ADC Automatic Discharge option

Option provides rapid discharge of the output. No external devices necessary.

LVIR Low Voltage Insulation Resistance option

Option provides the additional ability to measure Insulation Resistance from 10 to 99 VDC in IR mode. No external devices necessary.

LO-500 Low Ohms 500 option

Option provides the additional ability to measure up to 500 ohms using the LO-OHMS mode. No external devices necessary.

Routine Inspection and Maintenance

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The 944i is equipped with a fan to cool the internal electronic circuitry. Periodically it is advisable to inspect the filter assembly located on the rear panel. In areas where there is a high level of dust or other airborne particulate matter, the inspection of this filter should be conducted more often. If the filter is allowed to become restricted, overheating can occur causing damage to the electronic components.

Should the filter require cleaning, the finger guard snaps off to provide easy access to the filter element. A thorough rinsing in a warm soap water solution should remove any build-up. Insert the filter element back into the finger guard and snap into place. Note that the finger guard has four tabs which should line up with the four indentions on the fan mounting bracket.

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Vitrek 944i Calibration Procedure No. 944CP-052902

In order to maintain the accuracy specifications of the 944i, it is necessary to verify/calibrate the unit against external standards on a periodic basis. Vitrek recommends a calibration interval of one year. A calibration seal/sticker may be placed over the cal enable hole in order to prevent unauthorized access to the external calibration routine.

Note: Allow a 60 minute, power on, warm-up period at ambient temperature (within 5°C from calibration temperature). Prior to conducting the following verification procedure, run a system test on the 944i including the output system check. Should any errors be detected, consult your Vitrek service center. In the event that the unit fails to perform within the given uncertainty levels, an external calibration to local standards may be required.

1. Calibration Verification

1.1. Voltage Output Accuracy

Connect a calibrated Vitrek 4600A Digital High Voltage Meter (or equivalent) to the V HI and V LO terminals of the 944i. Select the VDC direct mode, and record the values for the tests indicated on the proper Calibration Sheet at the end of this section.

Once completed with the VDC tests, select the VAC direct mode, and run the tests specified on the Calibration Sheet at the end of this section.

1.2. Current Measurement Accuracy

First, connect the V HI terminal to a Vitrek 4610A Precision High Voltage Resistance Standard (or equivalent), and the V LO terminal to the Common terminal. Select the VDC direct mode on the 944i and engage the output, but leave the unit running at 100 VDC. Select the proper resistor and connect it to the 944i (see table below). Edit the voltage up to 1kv, and take your readings. Then, reduce the voltage back to 100 VDC and select the next resistor. **Make sure to take the unit back down to 100 VDC when switching resistors.**

Run the four tests as specified on the 944i Calibration Sheet at the end of this section.

For your reference, this table shows which resistor is needed to create the necessary current (at 1000 volts)

Current	Resistor
1000nA	1GΩ
10µA	100 MΩ
1mA	1 MΩ
10mA	100 KΩ

The same process applies for the VAC, except that the 1000nA current test does not need to be run, leaving only the 10µA, 1mA, and 10mA tests.

1.3. Meg-ohm Mode.

The meg-ohm function of the 944i is derived using the output voltage and corresponding leakage current. No additional verification is required.

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1.4. Low Resistance.

To verify performance of the low resistance function first zero out the lead resistance of the test leads to be used (press "LO Ω", "0", short leads then "Enter"). After the leads have been "nulled out", connect the leads to a calibrated 1 Ω resistor. The 944i should display 1.000 ±0.033 Ω.

944i Standard Unit and 944i DC-7 Calibration Data Table

Measurement Type	Test Voltage	Test Load	Nominal Values	Incoming Readings	Dev.	Outgoing Readings	Dev.	Max. Tol.
Hi-pot Voltage	100 VDC	100 MΩ	100 VDC	VDC	-100	VDC	-100	± 7.5 VDC
Hi-pot Voltage	500 VDC	100 MΩ	500 VDC	VDC	-500	VDC	-500	± 16.8 VDC
Hi-pot Voltage	1000 VDC	100 MΩ	1000 VDC	VDC	-1000	VDC	-1000	± 23.7 VDC
Hi-pot Voltage	5000 VDC	100 MΩ	5000 VDC	VDC	-5000	VDC	-5000	± 53.0 VDC
Hi-pot Voltage	7000 VDC	100 MΩ	7000 VDC	VDC	-7000	VDC	-7000	± 62.7 VDC
Hi-pot Voltage	1000 VAC	100 MΩ	1000 VAC	VAC	-1000	VAC	-1000	± 31.6 VAC
Hi-pot Voltage	5000 VAC	100 MΩ	5000 VAC	VAC	-5000	VAC	-5000	± 70.7 VAC
Hi-pot Leakage	1000 VDC	1 GΩ	1000 nA DC	nA DC	-1000	nA DC	-1000	± 12 nA DC
Hi-pot Leakage	1000 VDC	100 MΩ	10 µA DC	µA DC	-10	µA DC	-10	± 80 nA DC
Hi-pot Leakage	1000 VDC	1 MΩ	1 mA DC	mA DC	-1.000	mA DC	-1.000	± 18 µA DC
Hi-pot Leakage	1000 VDC	100 kΩ	10 mA DC	mA DC	-10	mA DC	-10	± 130 µA DC
Hi-pot Leakage	1000 VAC	100 MΩ	10 µA AC	µA AC	-10	µA AC	-10	± 1.05 µA AC
Hi-pot Leakage	1000 VAC	1 MΩ	1 mA AC	mA AC	-1.000	mA AC	-1.000	± 35 µA AC
Hi-pot Leakage	1000 VAC	100 kΩ	10 mA AC	mA AC	-10	mA AC	-10	± 550 µA AC
Lo-Ω	Variable	1Ω	1.000 Ω	Ω	-1	Ω	-1	± 33 mΩ
Lo-Ω	Variable	5Ω	4.999 Ω	Ω	-4.999	Ω	-4.999	± 45 mΩ

944i DC-10 10kv Calibration Data Table

Measurement Type	Test Voltage	Test Load	Nominal Values	Incoming Readings	Dev.	Outgoing Readings	Dev.	Max. Tol.
Hi-pot Voltage	100 VDC	100 MΩ	100 VDC	VDC	-100	VDC	-100	± 15.0 VDC
Hi-pot Voltage	500 VDC	100 MΩ	500 VDC	VDC	-500	VDC	-500	± 33.5 VDC
Hi-pot Voltage	1000 VDC	100 MΩ	1000 VDC	VDC	-1000	VDC	-1000	± 47.4 VDC
Hi-pot Voltage	5000 VDC	100 MΩ	5000 VDC	VDC	-5000	VDC	-5000	± 106.1 VDC
Hi-pot Voltage	7000 VDC	100 MΩ	7000 VDC	VDC	-7000	VDC	-7000	± 125.5 VDC
Hi-pot Voltage	10000 VDC	100 MΩ	10000 VDC	VDC	-10000	VDC	-10000	± 150.0 VDC
Hi-pot Voltage	1000 VAC	100 MΩ	1000 VAC	VAC	-1000	VAC	-1000	± 31.6 VAC
Hi-pot Voltage	5000 VAC	100 MΩ	5000 VAC	VAC	-5000	VAC	-5000	± 70.7 VAC
Hi-pot Leakage	1000 VDC	1 GΩ	1000 nA DC	nA DC	-1000	nA DC	-1000	± 12 nA DC
Hi-pot Leakage	1000 VDC	100 MΩ	10 µA DC	µA DC	-10	µA DC	-10	± 80 nA DC
Hi-pot Leakage	1000 VDC	1 MΩ	1 mA DC	mA DC	-1.000	mA DC	-1.000	± 18 µA DC
Hi-pot Leakage	950 VDC	100 kΩ	9.5 mA DC	mA DC	-9.5	mA DC	-9.5	± 130 µA DC
Hi-pot Leakage	1000 VAC	100 MΩ	10 µA AC	µA AC	-10	µA AC	-10	± 1.05 µA AC
Hi-pot Leakage	1000 VAC	1 MΩ	1 mA AC	mA AC	-1.000	mA AC	-1.000	± 35 µA AC
Hi-pot Leakage	1000 VAC	100 kΩ	10 mA AC	mA AC	-10	mA AC	-10	± 550 µA AC
Lo-Ω	Variable	1Ω	1.000 Ω	Ω	-1	Ω	-1	± 33 mΩ
Lo-Ω	Variable	5Ω	4.999 Ω	Ω	-4.999	Ω	-4.999	± 45 mΩ

944i LVIR Option Calibration Data Table

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Measurement Type	Test Voltage	Test Load	Nominal Values	Incoming Readings		Dev.	Outgoing Readings		Dev.	Max. Tol.
LVIR Voltage	10 VDC	200 MΩ	10 VDC		VDC	-10		VDC	-10	± 3 VDC
LVIR Voltage	50 VDC	200 MΩ	50 VDC		VDC	-50		VDC	-50	± 3 VDC
LVIR Voltage	99 VDC	200 MΩ	99 VDC		VDC	-99		VDC	-99	± 3 VDC
LVIR Resistance	50 VDC	1 GΩ	1 GΩ		GΩ	-1		GΩ	-1	± 100 MΩ
LVIR Resistance	50 VDC	100 MΩ	100 MΩ		MΩ	-100		MΩ	-100	± 10 MΩ
LVIR Resistance	50 VDC	10 MΩ	10 MΩ		MΩ	-10		MΩ	-10	± 1 MΩ
LVIR Resistance	50 VDC	1 MΩ	1 MΩ		MΩ	-1		MΩ	-1	± 100 kΩ

Press the calibrate-external (EXTRNL) button. The display should respond with:

PRESS CAL ENABLE
TO CONTINUE

Use a small diameter tool to press the cal button through the hole in the front panel. The display should respond with:

CALIBRATION
VOLTS CURRENT EXIT

Place digital volt meter capable of reading up to 5000 volts on the output of the 944, with the common test lead going to V LO and the voltage input going to the V HI terminal on the 944 (If you have the DC-10 option, the voltage input goes into the V HI terminal on the DC-10, not the 944). Press enter or "1" to select the VOLTS calibration routine. The display will respond with:

HIGH VOLTAGE ENABLE
REQUIRED

Press the HV Enable push button. Three warning beeps will sound and the high voltage warning LED's will flash. CAUTION: after this point high voltage will be present on the output of the 944. The display will respond with:

ADJUST
500 VOLTS

After a few seconds the display will respond with a screen displaying two meters, the top one will be displaying the voltage that the 944i is putting out.

You will notice that the 5 in the 500VDC is flashing, this shows what digit you can make your adjustment to. You can move the flashing number to the unit column that you need to adjust using the right and left cursor keys. Using this method you can adjust the output by ether 1, 10 or 100 volts at a time using the up and down arrows.

Adjust the voltage until the meter reads exactly 500 volts. Note: The display on the 944i will reflect the adjusted value not the value shown on the meter.

When you are satisfied with the voltage reading on the meter press enter. The display will respond with:

ADJUST
1000 VOLTS

After a few seconds the display will respond with a screen displaying two meters, the top one will be displaying the voltage that the 944i is putting out.

Repeat the adjustment procedure as described above, adjusting the output voltage for 1000 volts. Press enter when you are satisfied with the meter reading. The display will respond with:

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ADJUST VOLTAGE TO
5000 VOLTS

After a few seconds the display will respond with a screen displaying two meters, the top one will be displaying the voltage that the 944i is putting out.

Repeat the adjustment procedure as described above, adjusting the output voltage for 5000 volts. Press enter when you are satisfied with the meter reading. The display will respond with:

STORING CALIBRATION
CONSTANTS

(FOLLOWED BY)

CALIBRATION COMPLETE
THANK YOU

(FOLLOWED BY)

ENTER

Press enter when ready and the calibration screen will show up again:

CALIBRATION
VOLTS CURRENT EXIT

You may exit by selecting EXIT or pressing "3" on the keypad.
You may also choose to immediately enter the CURRENT calibration routine by selecting CURRENT or pressing "2" on the keypad.
When you enter the CURRENT calibration routine, the display will show the following message:

REMOVE CONNECTIONS
THEN PRESS ENTER

Remove all connections from the 944i **except the short from V-LO to Chassis Sense**. If no adjustment of the current measurement is needed, the current calibration portion of this procedure may be skipped by pressing CLR at this prompt. To continue, press enter. The display should respond with:

APPLY 1.8µA FROM VLO
TO REAR GND (ENTER)

Connect a Valhalla Scientific 2701C (or equivalent) to a Valhalla Scientific 2500 AC-DC Current Calibrator (or equivalent) as follows:

A. Connect 2701C +V terminal to the 2500 + input terminal.
B. Connect 2701C -V terminal to the 2500 - input terminal..

Connect the 2500 to the 944i as follows:

A. Connect 2500 + output terminal to the 944i V-Lo terminal.
B. Connect 2500 - output terminal to the 944i rear chassis ground banana jack.
C. Set the 2701C range to 2 volts.
D. Dial in 1.80000 volts.
F. Set the output current range of the 2500 to 1µA.
G. Place the 2701C in the "operate" mode.

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Press enter on the 944i. The display should respond with:

APPLY 18µA FROM VLO
TO REAR GND (ENTER)

Set the output current range of the 2500 to 10µA.
Press enter on the 944i. The display should respond with:

APPLY 1.8mA FROM VLO
TO REAR GND (ENTER)

Set the current output range of the 2500 to 1mA.
Press enter on the 944i. The display should respond with:

APPLY 85mA FROM VLO
TO REAR GND (ENTER)

Dial in .85000 volts on the 2701C.
Set the current output range of the 2500 to 100mA.
Press enter on the 944i. The display should respond with:

ENTER TO PROCEED
CLEAR TO BACKUP

Press Enter to complete the calibration procedure. DO NOT use the "CLEAR TO BACKUP" feature. If you made a mistake during the calibration routine, exit the routine and start all over again. DO NOT try to back out of the routine or turn off power during the routine. When enter is pressed, the display will respond with:

STORING CALIBRATION
CONSTANTS

(FOLLOWED BY)

CALIBRATION COMPLETE
THANK YOU

(FOLLOWED BY)

ENTER

Press enter when ready and the calibration screen will show up again:

CALIBRATION
VOLTS CURRENT EXIT

You may exit by selecting EXIT or pressing "3" on the keypad.

Once the calibration n procedure is complete, another verification procedure should be run to ensure that the procedure was successful.

Vitrek 944i Lo Ohms Adjustment Procedure

1. In the direct lo ohm mode zero out the test lead resistance before attaching leads to a 1 ohm standard resistor. The uncertainty of the 944i in this mode is 1 ohm +/-0.033. Should the reading fall near or outside of this tolerance adjustment may be needed.
2. To adjust the lo ohms reading remove the screws retaining the top cover and slide the top cover back approximately two inches. Find the adjustment access hole in the clear high voltage cover located behind the front panel output

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terminals. Using an insulated adjustment tool adjust RV4 clockwise to increase reading or counter-clockwise to reduce reading. Reading should be set 15 to 20 counts high at 1 ohm in order to stay within tolerance (+/-0.045) at 5 ohms.

3. Connect a known 5 ohm resistor to the 944i. Verify that the reading is within +/- 45 counts. If necessary adjust RV4 to bring reading within tolerance (typically 30 counts low). If any adjustment is required then go back to step 2 and repeat until both points are within tolerance.

Vitrek 944i EPROM Upgrade Procedure

Caution! Use ESD workstation to prevent damage to components.
Warning! Dangerous voltages exist in this unit, even with AC power removed. Refer service to qualified personnel.

1. Disconnect AC power input. Remove the two rear plastic end caps and the top cover.

2. Remove two existing EPROMS (U101 & U102) from the main bd.

3. Install the two new EPROM's correctly in their proper sockets. Pin 1 of the EPROM should be closest to the front of the unit.

4. Install PL102 header on the main board in the setup position (PL102 is located just to the rear and left of u101).

5. Power up unit. The unit should beep three times and the display should respond with:

V I T R E K 944I
DIGITAL HIPOT TESTER

FIRST TIME POWER UP
RAM CLEARED
VERSION
3.XX

SELF TEST
CHECKING ROM

DAY MONTH YEAR
HOUR MINUTE SECOND

6. Install PL102 header on the main board in the norm position. Failure to do so will result in RAM initialization on reset or power-up causing loss of stored data.
7. The unit will now require an external calibration.

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Specifications

AC DIELECTRIC MODE

AC Voltage Output:

Voltage uncertainty is equal to the square root of the selected output.

Examples:

Output	Formula	Accuracy
100 VAC	Sqrt(100)	± 10.0 VAC
500 VAC	Sqrt(500)	± 22.4 VAC
1000 VAC	Sqrt(1000)	± 31.6 VAC
5000 VAC	Sqrt(5000)	± 70.7 VAC

Output Frequency: 50Hz to 100Hz with 1Hz resolution independent of line power frequency.

Output Waveform: Digitally synthesized, low distortion sinewave.

AC Current Sensing (AC Leakage):

Range	Resolution	Accuracy
13.00uA	10nA	0.5% of reading ± 1uA
1.300mA	1uA	0.5% of reading ± 10uA
40.0mA	100uA	0.5% of reading ± 500uA

Current Sensing: Resistive current (in-phase), reactive current (out-of-phase) or total current.

Voltage Coefficient: 100pA/V

AC Current Limits:

Range	Current Limit
100 to 5,000 VAC	35mA

AC Current Limits with option FR-4:

Range	Current Limit
100 to 500 VAC	20mA
500 to 3500 VAC	35mA
3500 to 4000 VAC	30mA
4000 to 4200 VAC	25mA
4200 to 4400 VAC	20mA
4400 to 4600 VAC	15mA
4600 to 5000 VAC	10mA

DC DIELECTRIC MODE

DC Voltage Output:

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Voltage uncertainty is equal to the square root of the selected output times 0.75

Examples:

Output	Formula	Accuracy
100 VDC	Sqrt(100) * 0.75	± 7.5 VDC
500 VDC	Sqrt(500) * 0.75	± 16.8 VDC
1000 VDC	Sqrt(1000) * 0.75	± 23.7 VDC
5000 VDC	Sqrt(5000) * 0.75	± 53.0 VDC
7000 VDC*	Sqrt(7000) * 0.75	± 62.7 VDC

* Requires option DC-7

DC Voltage Output with option DC-10:

Voltage uncertainty is equal to the square root of the selected output times 1.5

(AC Voltage specs remain the same as the standard 944 as described above)

Examples:

Output	Formula	Accuracy
100 VDC	Sqrt(100) * 1.5	± 15.0 VDC
500 VDC	Sqrt(500) * 1.5	± 33.5 VDC
1,000 VDC	Sqrt(1000) * 1.5	± 47.4 VDC
5,000 VDC	Sqrt(5000) * 1.5	± 106.1 VDC
7,000 VDC	Sqrt(7000) * 1.5	± 125.5 VDC
10,000 VDC	Sqrt(10000) * 1.5	± 150.0 VDC

DC Current Sensing (DC Leakage)

Range	Resolution	Accuracy
1.800uA	1nA	0.4% of reading ± 6nA
18.00uA	10nA	0.3% of reading ± 30nA
1.800mA	1uA	0.3% of reading ± 30uA
40.0mA	10uA	0.3% of reading ± 300uA

Voltage Coefficient: 15pA/V

DC Current Limits:

Range	Current Limit
100 to 5,000 VDC	35mA

DC Current Limits with option FR-4:

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Range	Current Limit
100 to 500 VDC	20mA
500 to 4000 VDC	35mA
4000 to 4500 VDC	30mA
4500 to 5000 VDC	25mA
5,000 to 7,000 VDC*	5mA

* Requires option DC-7

DC Current Limits with option DC-10:

Range	Current Limit
100 to 10,000 VDC	10mA

HIGH RESISTANCE MODE
(Insulation Resistance)

Resistance Range	Minimum Resistance	Test Voltage
2.6GΩ	100KΩ	100VDC
13GΩ	500KΩ	500VDC
26GΩ	1MΩ	1,000VDC
65GΩ	2.5MΩ	2,500VDC

Accuracy: Combined uncertainty of DC Voltage Output + Current Measurement Accuracy

LOW RESISTANCE MODE
(Earth Continuity)

Full Scale	8.5Ω Maximum including lead resistance.
Resolution	1mΩ
Test Current	50mA
Lead Compensation	Automatic offset circuit "nulls" out two wire lead resistance
Accuracy	0.3% of reading + 30mΩ (up to 5Ω)

General Specifications

Arc Detection Sensitivity	User selectable 3 microseconds to 30 microseconds
Display	40 character alphanumeric LCD
High Voltage Indicator	Lightning bolt illuminated by independent output voltage monitor.

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	Audible alarm sounds prior to voltage output.
Voltage Resolution	1 volt AC or DC
Dwell Time Accuracy	+2 seconds/minute, -500mS/minute
Slew Rate	10 volts/second to 1999 volts/second, user selectable
Limits	Test automatically aborts when digitally stored minimum or maximum limit is exceeded.
Remote Interface Option "IF-4"	GPIB - IEE-488.2 Subset compatible RS232C - 1200, 2400, 4800, 9600 Baud rate selectable Parallel - IBM/Centronics compatible VICL - Vitrek auxiliary unit control loop
Accuracy	Stated specifications are bipolar and apply for one year within ± 5°C from calibration temperature (20 to 25°C).
Temperature Coefficient	0.1 times stated accuracy per °C beyond calibration temperature window
Calibration	Traceable to the National Institute of Standards and Technology (NIST). Automatic "Covers on" calibration, internal or external. Calibration constants stored in non-volatile memory.
Warm up Time	No warm up time is required for units stored in ambient temperatures ranging from 64°F to 82°F (18°C to 28°C). A minimum 30 minute warm up time is recommended for units stored in temperatures outside that range. A minimum 60 minute warm up time is recommended prior to performing an external calibration procedure.
Operating Temperature	0°C to 50°C
Humidity	90% RH, 0° to 40°C
Power	115/230 VAC ± 10%, 350 VA Max
Dimensions	89mm H x 432mm W x 457mm D (3.5" H x 17" W x 18" D)
Weight	14Kg (34 lb.) Net / 18Kg (40 lb.) Shipping

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