DNI NEVADA

Operating Manual

454A

Electrosurgical Analyzer

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Operating Manual

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DNI NEVADA
INCORPORATED

To order this manual, use Part Number 9508-0229.

Revision History		
Revision	Description	Date
A	Initial Release	12/93
B	Manual Update	3/94
C	Specifications Change/Update	3/98
D	Correction page 3-5	4/98
E	Programmable Autosequences	3/02

Copyright

Standard Terms and Conditions

Refunds & Credits

Please note that only serialized products (products labeled with a distinct serial number) and accessories are eligible for partial refund and/or credit. Nonserialized parts and accessory items (cables, carrying cases, auxiliary modules, etc.) are not eligible for return or refund. In order to receive a partial refund/credit of a product purchase price on a serialized product, the product must not have been damaged by the customer or by the common carrier chosen by the customer to return the goods, and the product must be returned complete (meaning all manuals, cables, accessories, etc.) within 90 days of original purchase and in "as new" and resellable condition. The *Return Procedure* must be followed to assure prompt refund/credit.

Restocking Charges

Only products returned within 90 days from the date of original purchase are eligible for refund/credit. Products returned within 30 days of original purchase are subject to a minimum restocking fee of 15%. Products returned in excess of 30 days after purchase, but prior to 90 days, are subject to a minimum restocking fee of 20%. Additional charges for damage and/or missing parts and accessories will be applied to all returns. Products not returned within 90 days of purchase, or products which are not in "as new" and resellable condition, are not eligible for credit return and will be returned to the customer.

Return Procedure

Every product returned for refund/credit must be accompanied by a Return Material Authorization (RMA) number, to be obtained from our Order Processing Department. All items being returned must be sent freight prepaid to our factory location.

Certification

This instrument was thoroughly tested and inspected and found to meet DNI Nevada's manufacturing specifications when it was shipped from the factory. Calibration measurements are traceable to the National Institute of Standards and Technology (NIST). Devices for which there are no NIST calibration standards are measured against in-house performance standards using accepted test procedures.

Warranty

Warranty and Product Support

This instrument is warranted by DNI Nevada against defects in materials and workmanship for one full year from the date of original purchase. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you return the product, shipping prepaid, to DNI Nevada, Inc. This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by other than DNI Nevada. IN NO EVENT SHALL DNI NEVADA BE LIABLE FOR CONSEQUENTIAL DAMAGES.

Only serialized products and their accessory items (those items bearing a distinct serial number tag) are covered under this one–year warranty. PHYSICAL DAMAGE CAUSED BY MISUSE OR PHYSICAL ABUSE IS NOT COVERED UNDER THE WARRANTY. Items such as cables and nonserialized modules are not covered under this warranty.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state, province to province, or country to country. This warranty is limited to repairing the instrument to DNI Nevada's specifications.

When you return an instrument to DNI Nevada, Inc., for service, repair, or calibration, we recommend using United Parcel Service, Federal Express, or Air Parcel Post. We also recommend that you insure your shipment for its actual replacement cost. DNI Nevada will not be responsible for lost shipments or instruments that are received in damaged condition due to improper packaging or handling. All warranty claim shipments must be made on a freight prepaid basis. Also, in order to expedite your claim, please include a properly completed copy of the Service Return Form. Recalibration of instruments, which have a recommended semiannual calibration frequency, is not covered under the warranty.

Warranty Disclaimer

Should you elect to have your instrument serviced and/or calibrated by someone other than DNI Nevada, please be advised that the original warranty covering your product becomes void when the tamper-resistant Quality Seal is removed or broken without proper factory authorization. We strongly recommend, therefore, that you send your instrument to DNI Nevada for factory service and calibration, especially during the original warranty period.

In all cases, breaking the tamper-resistant Quality Seal should be avoided at all cost, as this seal is the key to your original instrument warranty. In the event that the seal must be broken to gain internal access to the instrument (e.g., in the case of a customer-installed firmware upgrade), you must first contact DNI Nevada's technical support department at 775-883-3400. You will be required to provide us with the serial number for your instrument as well as a valid reason for breaking the Quality Seal. You should break this seal only after you have received factory authorization. Do not break the Quality Seal before you have contacted us! Following these steps will help ensure that you will retain the original warranty on your instrument without interruption.

WARNING

Unauthorized user modifications or application beyond the published specifications may result in electrical shock hazards or improper operation. DNI Nevada will not be responsible for any injuries sustained due to unauthorized equipment modifications.

Table of Contents

1 General Information

2 Installation

3 Operation

4 Performance Test

5 Modules

Illustrations

1 General Information

2 Installation

3 Operation

5 Modules

Abbreviations

NOTE: This column is alphabetized.

A	ampere
c	centi– (10^{-2})
cm	centimeter
dB	decibel
°C	degrees Celsius (centigrade)
°F	degrees Fahrenheit
EEPROM	electrically erasable PROM
EUT	equipment under test
Hz	hertz
″	inch
in	inch
k	kilo- (10^{3})
kg	kilogram
kHz	kilohertz
kΩ	kilohm
kV	kilovolt
M	meg(a)- (10^{6})
MHz	megahertz
µ	micro- (10^{-6})
m	milli- (10^{-3})
mA	milliampere
Ω	ohm
p-p	peak-to-peak
lb	pound
V	volt
w	watt

Chapter 1

General Information

In this chapter—

- *Safety Considerations*
- *Important Safety Information*
- *Overview*
- *Instrument Familiarity*
- *Instrument Specifications*
- *Accessories*

Safety Considerations

General

This instrument and related documentation must be reviewed for familiarization with safety markings and instructions before you operate the instrument.

Safety Symbols

This is the Operating Manual symbol. When you see this symbol on the instrument, refer to the Operating Manual.

This symbol indicates that a terminal is connected to the chassis when such a connection is not apparent.

Alternating current.

Direct current.

Earth ground

WARNING!

The ***WARNING!*** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a ***WARNING!*** sign until the indicated conditions are fully understood and met.

CAUTION

The ***CAUTION*** sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the instrument. Do not proceed beyond a ***CAUTION*** sign until the indicated conditions are fully understood and met.

Important Safety Information

The Model 454A Electrosurgical Analyzer is designed and manufactured to be a safe product. Your instrument should be calibrated and inspected every six months according to DNI Nevada specifications and after any components have been replaced to assure your instrument is functioning to factory specifications.

Hardware or calibration failure is unlikely. However, in the event of such an occurrence, refer to the *454A Service Manual* for further instruction. It is always important to **contact DNI Nevada for service upon observation of any visual indicator**.

Below is an illustration of what the display looks like when showing a visual indicator.

```
SYSTEM CALIBRATION FAULT
Service Recommended

Press any key to continue.
```

A visual indicator appears in the event of

1. Change in calibration of system.
2. Model 454A system hardware failure.

The Model 454A Electrosurgical Analyzer has been designed to minimize the possibility of such an event. Therefore, for problem recognition, a self–test feature is embedded into the firmware that verifies proper system–level hardware operation. **A malfunction will cause a visual indicator to appear on the Model 454 display upon system power–up.**

During system initialization, data error detection software is used to verify that calibration data has not been corrupted. Absence of the visual indicator upon system power–up indicates the integrity of the calibration data. In addition, a hardware "lock" designed into the system prevents inadvertent writes to system EEPROM (where calibration data is stored) in the unlikely event of a system "crash."

The RF measurement inputs for generator output and the current loop input are isolated from ground. Additionally, the oscilloscope output is also isolated from ground. The RF leakage measurement is referenced to ground. You must follow good technician's safety practices while testing these potentially dangerous high–frequency RF generators. Ensure that interconnecting test leads and other cabling insulation is not cracked or otherwise deteriorated.

Refer to the actual ESU device manufacturer's operating and service manual for additional information regarding test protocols, test limits, user safety, and precautions.

CAUTION

To avoid burns do not touch either electrode while an ESU is under test.

Overview

The manual is written for the BMET or clinical engineer involved in testing electrosurgical equipment for safety and performance. The purpose of this manual is to explain the intended operation of the basic Model 454A Electrosurgical Analyzer.

The Model 454A Electrosurgical Analyzer is an instrument that analyzes the performance of an electrosurgical unit (ESU). It has been designed to test ESUs in use by a physician in his office or at the hospital. The purpose of this instrument is to measure and report specific ESU safety and performance parameters.

The Model 454A is specifically intended to measure output parameters of an ESU. It is a microprocessor–based instrument utilizing a precision thermal converter to make true RMS current measurements. In addition, it has peak detection circuitry. This circuitry provides a method to determine peak–to–peak voltage and crest factors in electrosurgical instruments.

Instrument Familiarity

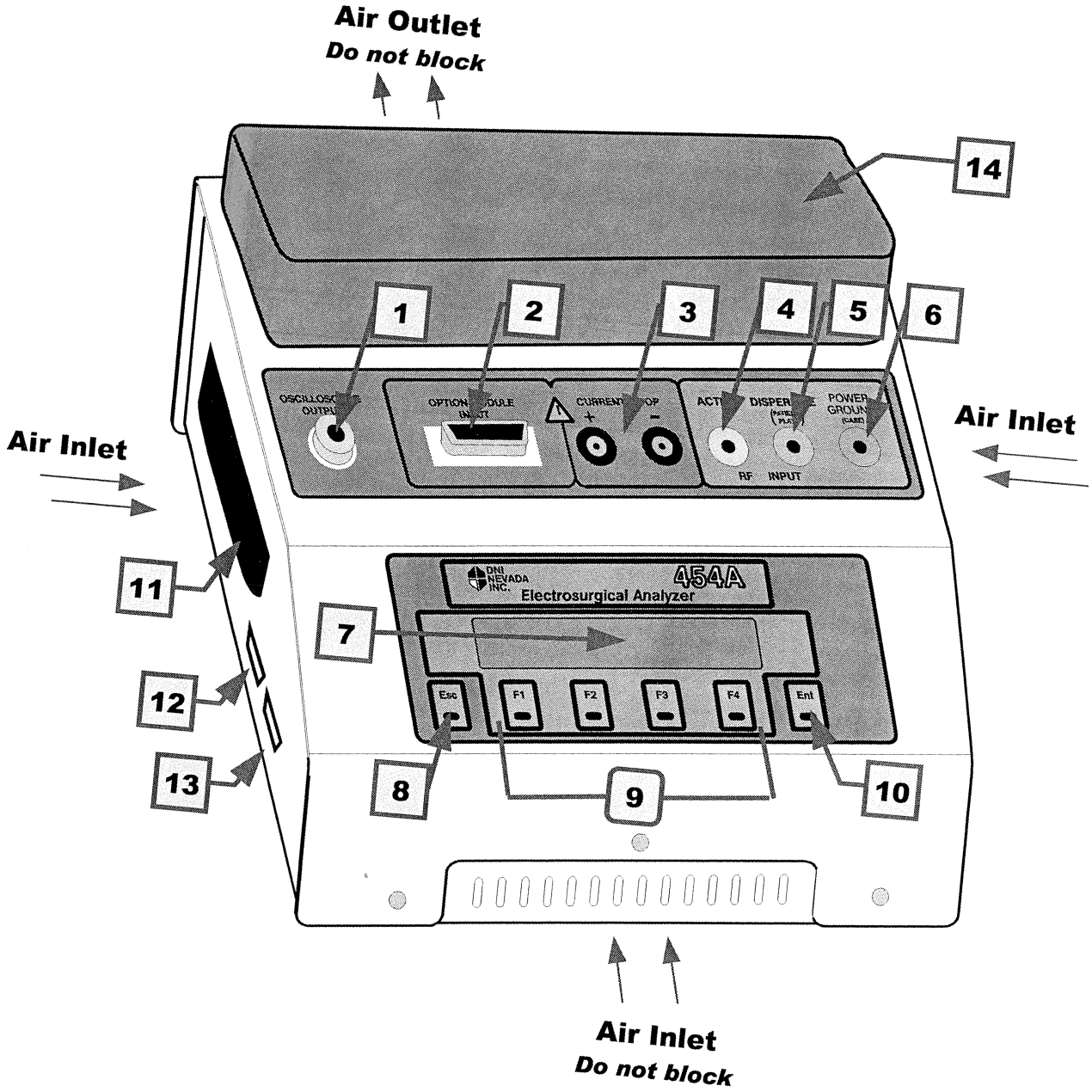


Figure 1-1. *The controls and indicators located in the above drawing are identified on the next page.*

Legend

1 **Oscilloscope Output**

2 **Option Module Control Connector**

3 **Current Loop (zero impedance current sensor)**

4 **Active Electrode Input**

5 **Dispersive Electrode Input**

6 **Power Ground (case)**

7 **Display**

8 **Escape Key (Esc)**
Exits menus without saving data or aborts function

9 **Preprogrammed function keys (F1 – F4)**
Execute function displayed above key

10 **Enter Key (Ent)**
Selects highlighted menu or executes function

11 **Handle**

12 **Printer Port** — Printer cable plugs in here
(refer to *Connecting the Printer* in Chapter 2)

13 **RS–232 Port**
Serial data link for remote control

14 **Soft vinyl accessory pouch**

Instrument Specifications

Parameter	Specification/Accuracy
RMS Current	±5.0% of reading (100–2000 mA) ±5.0% of reading (30–100 mA) for Crest Factor <16.0
RMS Power	±10% of range (watts)
Peak–to–Peak Voltage	±10% of reading (0–10 kV)
Crest Factor	±10% of reading (1.4≥CF≤15.9)
Bandwidth	-3 dB (30 Hz–7 MHz)
Load Resistance	50–1550 Ω (50–Ω steps) ±3.0% of selected load (@ dc)
Oscilloscope Output	≈2.5 volt/amp (uncalibrated)
Temperature Range	Operating: 15° to 35°C Storage: 0° to 50°C
Power Requirements	≤0.75 amps, 115 VAC 50/60 Hz 240 VAC 50/60 Hz
Display	4 lines × 42 characters 32 × 256 pixel matrix 0.5″ H × 0.5″ W numeric font
Case	Aluminum frame with polycarbonate front panel
Weight	7.71 kg (17 lb)
Dimensions	46.36 cm L × 31.75 cm W × 15.24 cm H (18.25″ L × 12.50″ W × 6.00″ H)

Accessories

Standard	DNI Part #
454A Operating Manual	9508–0229
Test Lead Set (3)	9502–0002
Vinyl Accessory Pouch	9530–0030
Power Cord Assembly	3010–0055
Dispersive Electrode Test Lead	3010–0436

Optional	
454A Service Manual	9508–0282
Hard-Sided Protective Carrying Case	9530–0047
RS–232 Null Modem Cable	3010–0250
454A Auxiliary Test Modules:	
REM/ARM & Return Fault Monitor	9513–0173
REM/ARM Module	9513–0177
10–Ohm Test Load Module	9513–0189
25–Ohm Test Load Module	9513–0175
35–Ohm Test Load Module	9513–0190
50–Ohm Test Load Module	9513–0191
75–Ohm Test Load Module	9513–0192
125–Ohm Test Load Module	9513–0193
330–Ohm Test Load Module	9513–0194
2000–Ohm Test Load Module	9513–0176
5000–Ohm Test Load Module	9513–0195

Note

For information on test modules see the *Modules* chapter of this manual. In addition, refer to the current DNI Price List for availability, part number information, and price.

Chapter 2

Installation

In this chapter—

- *Unpacking and Inspection*
- *Claims*
- *Warranty Repair*
- *Connecting the Printer*
- *Replacing the Fuse*
- *Changing A/C Input Configuration*

Unpacking and Inspection

Follow standard receiving practices upon receipt of the instrument. Check the shipping carton for damage. If damage is found, stop unpacking the instrument. Notify the carrier and ask for an agent to be present while the instrument is unpacked. There are no special unpacking instructions, but be careful not to damage the instrument when unpacking it. Inspect the instrument for physical damage such as bent or broken parts, dents, or scratches.

Claims

Our routine method of shipment is via common carrier, FOB origin. Upon delivery, if physical damage is found, retain all packing materials in their original condition and contact the carrier immediately to file a claim.

If the instrument is delivered in good physical condition but does not operate within specifications, or if there are any other problems not caused by shipping damage, please contact DNI Nevada or your local sales representative.

Warranty Repair

The warranty statement for this product is at the front of this manual.

When shipping an instrument to DNI Nevada for repair, complete the Service Return Form and attach to the instrument. Completing this form will help to ensure timely repair of your instrument.

Use the original carton and packaging material for shipment. If they are not available, we recommend the following guide for repackaging:

- Use a double–walled carton of sufficient strength for the weight being shipped.
- Use heavy paper or cardboard to protect all instrument surfaces. Use nonabrasive material around all projecting parts.
- Use at lease four inches of tightly packed, industrial–approved shock–absorbent material around the instrument.

Connecting the Printer

You can connect any Centronics or IBM PC–compatible parallel printer to the Model 454A Electrosurgical Analyzer. It is suggested that you use a standard parallel printer cable and connect it to the port on the left side of the instrument (as you look at the instrument from the front). This port is labeled PRINTER. The connector for the parallel printer is a 25–pin (DB25) female "D" shell connector.

Replacing the Fuse

For 120–VAC Operation

1. Turn off power and unplug the power cord.
2. With a small–blade screwdriver, pry the fuse cover open from the left side.
3. Use the screwdriver to remove the fuse from the plastic holder on the rear side of the fuse cover.
4. Install one new fuse, 1ASB 250 VAC fuse (DNI part number 1005-0043), in the plastic holder.
5. Push the plastic holder into the rear panel of the Model 454A. If needed, apply extra pressure so the fuse cover sits flush to the rear panel. A white dot will be visible at the place marked 120 V on the rear panel.

For 240–VAC Operation

1. Turn off power and unplug the power cord.
2. With a small–blade screwdriver, pry the fuse cover open from the left side.
3. Use the screwdriver to remove the fuse from the plastic holder on the rear side of the fuse cover.
4. Install two new fuses, ½ ASB 250 VAC fuses (DNI part number 1005-0185), in the plastic holder.
5. Push the plastic holder into the rear panel of the Model 454A. If needed, apply extra pressure so the fuse cover sits flush to the rear panel. A white dot will be visible at the place marked 240 V on the rear panel.

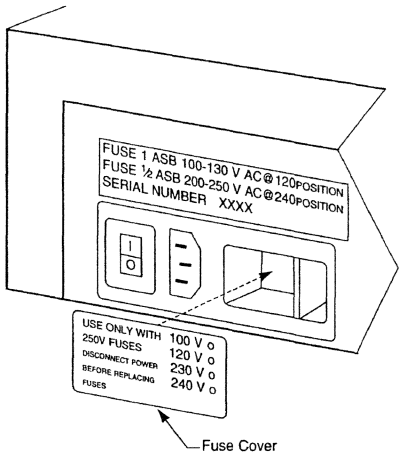


Figure 2 - 1. *This drawing shows fuse placement.*

Changing A/C Input Configuration

From 120 VAC to 240 VAC

1. Turn off power and unplug the power cord.

2. With a small-blade screwdriver, pry the fuse cover open from the left side.

3. Turn the cover over so you can see the plastic fuse holder. With a Phillips screwdriver loosen the screw to the right of the fuse. Slide the plastic fuse holder to the left and pull up to disengage.

4. Turn over the plastic fuse holder and install two ½ ASB 250 VAC fuses (DNI part number 1005-0185). Next remove the one 1ASB fuse from the other side. Reinstall the fuse holder with the two newly installed fuses facing outward. Tighten the screw.

5. Using a pair of small needle–nose pliers, remove the 1″ × 1″ printed circuit board from the receptacle.

6. Notice that there is a white plastic tab that aligns with an arrow pointing to 120. Now pull the tab away from the board. Rotate the board 180° and reorient the white plastic tab so that you can see 240.

7. Slide the printed circuit board into the receptacle. If the board does not slide in easily, check to make sure it is oriented properly. The protrusions on the tab must be pointing to the left.

8. Replace the fuse cover. A white dot will be visible at the place marked 240 V on the rear panel. Make sure you see this white dot to verify the change was made correctly.

Note

See Figure 2-2.

From 240 VAC to 120 VAC

1. Turn off power and unplug the power cord.

2. With a small-blade screwdriver, pry the fuse cover open from the left side.

3. Turn the cover over so you can see the plastic fuse holder. With a Phillips screwdriver loosen the screw to the right of the fuse. Slide the plastic fuse holder to the left and pull up to disengage.

4. Turn over the plastic fuse holder and install one 1ASB 250 VAC fuse (DNI part number 1005-0043). Next remove the two ½ ASB fuses from the other side. Reinstall the fuse holder with the one newly installed fuse facing outward. Tighten the screw.

5. Using a pair of small needle–nose pliers, remove the 1″ × 1″ printed circuit board from the receptacle.

6. Notice that there is a white plastic tab that aligns with an arrow pointing to 240. Now pull the tab away from the board. Rotate the board 180° and reorient the white plastic tab so that you can see 120.

7. Slide the printed circuit board into the receptacle. If the board does not slide in easily, check to make sure it is oriented properly. The protrusions on the tab must be pointing to the left.

8. Replace the fuse cover. A white dot will be visible at the place marked 120 V on the rear panel. Make sure you see this white dot to verify the change was made correctly.

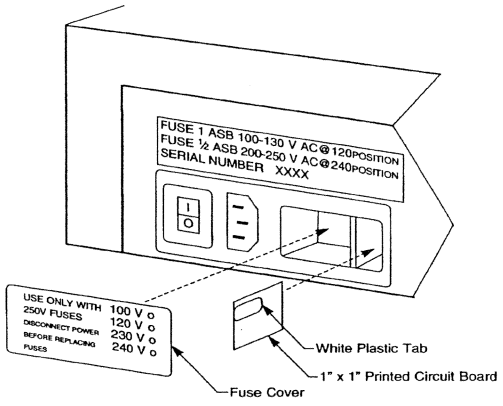


Figure 2 - 2. *Use this drawing as a reference when changing A/C input configuration.*

Chapter 3

Operation

In this chapter—

- *Power–Up Initialization*
- *Connecting the ESU to the Model 454A*
- *Operating Instructions*
- *Menu System*
- *RS–232 Communication Link*
- *Oscilloscope Output*

Power-Up Initialization

Attach the power cord supplied with the Model 454A Electrosurgical Analyzer to the power receptacle on the rear panel (see illustration of rear panel below).

Observe the right side of the fuse cover. You will see a white dot indicating the input voltage configuration. Check and confirm that the AC voltage is configured properly (either 120 V or 240 V). If you need to change the input voltage configuration because of a change in power input, refer to instructions found in the *Changing A/C Input Configuration* section of the *Installation* chapter.

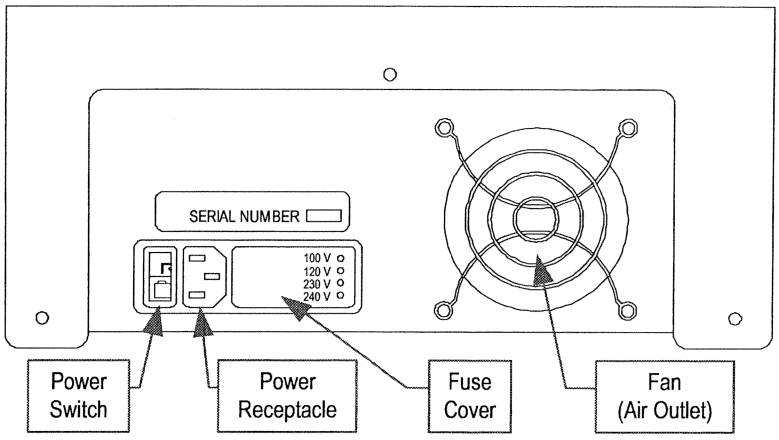


Figure 3 - 1. *The Model 454A rear panel looks like this.*

Now you are ready to plug the instrument into a properly rated outlet. After plugging in the unit, turn on the Model 454A by pushing the upper portion of the power switch on the rear panel (the upper portion of the switch is marked **I**).

The display will show

```
DNI NEVADA, INC.
ESU Analyzer
Version X.XX          Model 454A
**********************************SYSTEM INITIALIZING**********************************
```

with **********SYSTEM INITIALIZING********** blinking on and off for three seconds.

While the system is initializing, you will observe the flashing indicator. During this brief three–second initialization, the instrument performs various self–tests and load calibration data from nonvolatile memory. After initialization is complete, you will observe the MAIN MENU as shown here.

```
MAIN MENU                              01/01/93
                                       09:45:14am
Press F1-F4 to select menu item
     MANUAL          AUTO
```

In the event you do not observe the MAIN MENU but the display shows a visual indicator like this...

```
SYSTEM CALIBRATION FAULT
Service Recommended

Press any key to continue.
```

... stop and contact DNI Nevada or an authorized service center for repair or recalibration. As an alternative, in the *Calibration* section of the *454A Service Manual*, there is a procedure for calibrating the Model 454A instrument. It is important to note, however, that calibrating the Model 454A yourself will void the warranty.

Finally, it is important to make sure the air flow for the instrument is not blocked. The air outlet is located at the fan at the rear of the instrument. The air inlets are located at the front and sides of the instrument. Therefore, leave a minimum spacing of four (4) inches between any object and this instrument on all sides. Make sure the fan is functioning before proceeding any further.

Connecting the ESU to the Model 454A

Connect the ESU (electrosurgical unit) to be analyzed to an appropriate power source.

Run a cable between the active output of the ESU and the ACTIVE input of the Model 454A.

Run another cable from the dispersive electrode of this ESU to the DISPERSIVE input (PATIENT PLATE) of the Model 454A.

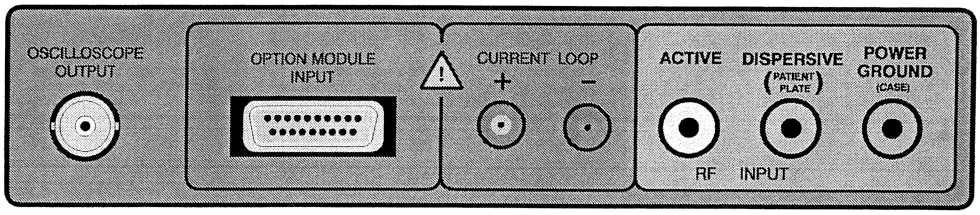


Figure 3 - 2. *This figure shows the top view of the input panel of the Model 454A.*

Note

Use the supplied Test Leads to connect the ESU under test to the Model 454A. A special purpose dispersive electrode cable is standard and supplied with the Model 454A (DNI Nevada part number 3010-0436).

Use this special purpose cable to connect ESUs such as the various Valleylab Models and the Aspen Excalibur to the Model 454A Analyzer. The patient contact monitor is defeated since the activation pin on the ESU dispersive connector is clipped. These are the only two connections required for ESU Generator Output measurement. For RF Leakage measurements the top panel power ground connection is internally referenced to the Model 454A power receptacle ground point. If desired, an additional ground cable may be connected between the top panel grounding input and the chassis of the ESU under test.

WARNING!

Make sure that both electrodes are insulated from each other and from other conductive surfaces. Surfaces such as Formica, which are normally considered to be insulators or electrostatic pads, may be inadequate at the radio frequencies being measured.

Also, never touch, connect, or disconnect leads to the ESU under test while it is in operational mode.

Operating Instructions

The Model 454A Electrosurgical Analyzer measures the output of an attached ESU when the ESU is activated. Therefore, it is important to ensure not to make contact with the ESU when it is activated. Also keep clear of both the ACTIVE and the DISPERSIVE electrodes. **Always use proper precautions when activating the ESU considering that it is a surgical tool and can be dangerous.**

There are two main modes of operation of the Model 454A directly related to testing the attached ESU. These two modes are MANUAL (F1) and AUTO (F2). There is a third mode, UTILITY (F3), that makes possible access to the utilities of the Model 454A. Pressing Esc exits any mode of operation.

Within each of the two main modes of operation is the capability to measure Generator Output and RF Leakage. The Generator Output test makes it possible to apply an isolated load value within the user–selectable range of 50 to 1550 Ω, in 50–Ω steps. The RF Leakage test provides a way to measure current through a 200-Ω leakage path to ground. The leakage path is user–selectable through either Active or Dispersive electrodes. The choice of applying a load exists. If the load is applied, it is user–selectable also within the range of 50 to 1550 Ω, in 50-Ω steps.

One other test is the AMMETER (in MANUAL mode only). The AMMETER function measures RF Current from an external test load using a simple current loop circuit.

Finally, there is an AUXILIARY mode within the MANUAL mode of operation. This mode is used to control accessory modules attached to the Model 454A. The various accessory modules provide a means to test manufacturer–specific ESU parameters. Please refer to the *Module* chapter for additional information concerning the modules.

Specific instructions regarding how to access each of the modes of operation and then initiate the test of your choice to obtain a measurement are located in the next several pages of this section.

In *Menu System*, the section following this one, are specific instructions on how to navigate through the Model 454A Menu System. Included in that section are a *Tutorial Exercise*, instructions on *Setting the Clock*, and the *Model 454A Menu Map*.

Beyond the *Menu System* section are two other sections, *RS-232 Communication Link* and *Oscilloscope Output,* explaining features of the Model 454A Electrosurgical Analyzer.

Manual Mode

This section describes how to use the four (4) different tests that are available in the MANUAL mode of operation.

From the MAIN MENU press F1 to enter MANUAL mode.

F1 GENERATOR OUTPUT

Select the isolated load (within the available range of 50 to 1550 Ω), as specified by the ESU device manufacturer, by pressing F3 (–) or F4 (+).

Next activate the ESU and take the reading.

To obtain a measurement:

1. With the ESU connected as described earlier in this section, activate the generator. Allow approximately two seconds for the Model 454A measurement to stabilize. Four parameter measurements are displayed:
   - KVpp (peak-to-peak voltage in kV-closed circuit measurement only)
   - CF (Crest Factor)
   - I (current in mA)
   - Power (watts)
2. Press the HOLD key (F1) to store the measurement.
3. Then deactivate the ESU. A PRINT prompt will appear above F2 only after the ESU output is no longer present at the Model 454A load inputs.
4. If a printer is connected, you can obtain a hardcopy print of the test results by pressing F2.
5. Finally, press the RELEASE key (F1) to release the data. Now you are ready to continue and take another measurement.
6. Press Esc to return to the MANUAL mode test menu.

F2
RF LEAKAGE

Press F1 to select the ACTIVE or DISPERSIVE electrode.

- When an open circuit is selected (F2), the load will be disconnected from the RF Leakage circuit configuration.
- When the closed circuit is selected (press F2 again), any desired load value may be selected from 50 to 1550 Ω, in 50-Ω steps.

Note: RF Leakage measurements are conducted on ESUs with isolated outputs only; *examples:* Valleylab SSE-2 series and the Aspen Labs Excalibur.

ESUs Bovie CSV and Valleylab Force 4B are either ground–referenced or have an output balanced to ground and do not require this test to be performed.

To obtain a measurement:

1. With the ESU connected as described earlier in this section, activate the generator. Allow approximately two seconds for the Model 454A measurement to stabilize.
2. Press the HOLD key (F1) to store the measurement.
3. Then deactivate the ESU. A PRINT prompt will appear above F2 only after a signal is not present at the Model 454A load inputs.
4. If a printer is connected, you can obtain a hardcopy print of the test results by pressing F2.
5. Finally, press the RELEASE key (F1) to release the data. Now you are ready to continue and take another measurement.

F3
AMMETER

Connect an external load configuration of your choice at the CURRENT LOOP + jack and CURRENT LOOP – jack on the top panel. RMS current is measured and displayed.

Note: The ammeter function provides an easy-to-use method to measure RF Current using an external test load. This is a direct connection to the wide band current transformer. Since the impedance between the top panel + and – jacks is zero, do not connect an external RF source directly across this input without a load resistance of adequate power rating.

F4
AUXILIARY

This mode enables you to test manufacturer–specific ESU parameters through the use of an accessory module that you attach to the Model 454A. Accessory modules are controlled by the Model 454A front panel via control lines in the option module input connector at the top of the enclosure.

Note: This interconnection is neither a serial RS–232 port nor a parallel printer port. This auxiliary interface is only compatible with DNI Nevada options. Refer to the *Modules* chapter for additional information.

Auto Mode

An autosequence is a series of individual ESU performance checks or steps. They are designed to facilitate consistent and repeatable ESU performance evaluations.

Use of the AUTO mode is similar to using a programmable calculator. There are 24 autosequence programs with 49 programmable steps in each one. This gives you the capability of designing standardized testing sequences.

These autosequences are divided into the two main testing modes—GENERATOR OUTPUT and RF LEAKAGE. Most currently marketed electrosurgical units can incorporate monopolar, bipolar, and microbipolar outputs as well as several different output types (pure cut, coagulate, and blend) and a wide range of selectable power levels. These easy-to-use automated sequences simplify your ESU device inspections.

Seven of the 24 sequences have been preprogrammed with current ESU device testing protocols that can be used as a guideline for your programming:

Valleylab Force Series 1B, 2, 30, and 40;

Valleylab SSE Series 4 and 4B; and

Conmed/AspenLabs Excalibur.

Hardcopy prints of the above mentioned autosequences are located later in this section in *Preprogrammed Autosequences.*

In GENERATOR OUTPUT, you can specify the exact test format of desired output mode, output type, power setting, and expected power level. Additionally, you can specify output level test limits and your desired load. For example, you can program the following step in the autosequence:

ESU Output Mode:	MONOPOLAR
ESU Output Type:	PURE CUT
ESU Power Setting:	100
ESU Expected Power:	100 (watts)
High Limit:	+10% (110 watts)
Low Limit:	-15% (85 watts)
Load:	300 Ω

In RF LEAKAGE, you can specify the exact test format of desired output mode, output type, power setting, and desired electrode. Additionally, you can specify the output circuit to be either OPEN or CLOSED with your desired load. For example, you can program the following step in the autosequence:

ESU Output Mode:	MONOPOLAR
ESU Output Type:	COAG
ESU Power Setting:	100
Selected Electrode:	ACTIVE
Load Status:	OPEN
Load Value:	Not Applicable

Beginning at the MAIN MENU display, press F2 (AUTO). You will see the AUTOSEQUENCE UTILITY message. Press F2 (EDIT); the display shows AUTOSEQUENCE EDIT MENU. Press F2 (AUTOSEQ); you will see HIGHLIGHT AND SELECT DESIRED AUTOSEQUENCE.

Now use F1, F2, F3, or F4 to scroll through the 24 autosequence programs. Position the highlight bar at AUTO 24 and press Ent (enter). You will see the message EDITING AUTOSEQUENCE: AUTO 24. Change the name to SAMPLE by moving the highlight bar with F3 (←) and F4 (→). Then scroll through the character list using F1 (↑) and F2 (↓). Change each letter in the name using this process. When you have changed the name correspondingly, press Ent.

You will now see the message EDITING AUTOSEQUENCE: SAMPLE. Beneath this title notice the message STEP 01: and the prompt Select TEST TYPE:. By pressing F3 and F4 you can select one of the three (3) test types. Next press F2 to continue. Continue to follow the prompts and input the requested information in the same way.

Once the parameters are input for this particular test and step, the display shows AUTOSEQUENCE: SAMPLE, STEP 01 COMPLETE. By pressing F1 you can backstep through the test and change parameters. To begin another test/step sequence, press F2. To end this program press F3. Press F3 again to save the program.

The following is a sample of a printed autosequence test format:

DNI NEVADA, INC PRINT DATE: 01/05/94
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: VLF30

GENERATOR OUTPUT TESTS

Step	Load	ESU Mode	Output	Setting	ESU Power	Limits
01	300	MONOCOAG	DESICCTE	200	200(w)	170.0-230.0(w)
02	300	MONOCOAG	FLGRATE	150	150(w)	127.5-172.5(w)
03	300	MONOPOLAR	PURE CUT	300	300(w)	255.0-345.0(w)
04	300	MONOPOLAR	BLEND 1	250	250(w)	212.5-287.5(w)
09	100	BIPOLAR	STANDARD	50	50(w)	042.5-057.5(w)
10	100	BIPOLAR	PRECISE	50	50(w)	042.5-057.5(w)

RF LEAKAGE TESTS

Step	Load	ESU Mode	Output	Setting	Electrode
05	OPEN	MONOCOAG	DESICCTE	200	ACTIVE
06	OPEN	MONOCOAG	DESICCTE	200	DISPERSIVE
07	OPEN	MONOPOLAR	PURE CUT	300	ACTIVE
08	OPEN	MONOPOLAR	PURE CUT	300	DISPERSIVE

Figure 3 - 3. *This illustrates a printed autosequence test format.*

Autosequence tolerance settings show on the display as both a percentage of the value and as a deviation from the nominal watt reading. You may need to adjust the percentage to achieve the correct tolerance.

Setting	Tolerance as %	Tolerance shown as a range of watt readings
100w	15%	115 to 85 w (15% = ±15.0 w)
30w	15%	34.5 to 25.4 w (15% = ±4.5 w)
30w	17%	35.1to 24.9 w (17% = ±5.1 w)

There is the additional feature of 16 possible unnamed ESU outputs called USER LIST, which you can name and use as needed in the programs you design.

Now press Esc several times until you have returned to the MAIN MENU. Press F2 (AUTO), next press F2 (EDIT), then press F1 (USER LIST). You will see the message EDITING ESU OUTPUT LIST (user items). Press F3 or F4 to select the USER #. Next press F2 (CONTINUE) and you can now name an ESU output that corresponds to your particular situation.

Press F2 to select the AUTO MODE, then press F1 to RUN a program, press F2 to EDIT (design or change) a program or user list, press F3 to PRINT a program, and press F4 to VIEW a program sequence.

When you run a program, different prompts indicate the proper setup of the ESU. After you set the ESU accordingly, you will see the prompt activate ESU OUTPUT. As in MANUAL MODE, press F1 to hold the reading, release then deactivate the ESU. Press F2 to SAVE. The PRINT prompt appears only at the end of the autosequence.

When you finish the test sequence, press F1 to PRINT the report. The report is entitled Performance Test Record (sample is located below).

DNI NEVADA, INC PRINT DATE: 11/22/93
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: AUTO21

PERFORMANCE TEST RECORD FOR:
MANUFACTURER: _____
MODEL: _____
S/N: _____ C/N_____
LOCATION: _____

GENERATOR OUTPUT

#	Load	ESU Mode	Output	Setting	Limits (w)	P (w)	I (mA)	CF	kVpp
01	500	MONOPOLAR	BLEND 2	300	270.0-330.0	153.5#	554	3.9	1.5

RF LEAKAGE

#	Load	ESU Mode	Output	Setting	Electrode	Lkg Current
02	OPEN	MONOPOLAR	PURE CUT	300	ACTIVE	124 (mA)

Number of Tests Performed: 2
Elapsed Time: 00:02:14

COMMENTS

Figure 3 - 4. *This figure shows a Performance Test Record printed report.*

This report is a certification of the performance of the ESU output parameters. Please see *Autosequence Program Design* for more detailed instructions on designing and using autosequence programs and for samples of printed reports.

Autosequence Program Design

Designing an autosequence program is similar to using a programmable calculator. There are 24 autosequence programs with 49 programmable steps in each one. The minimum number of steps for a program is one and the maximum number of steps is 49.

The test types to select from are

- GENERATOR OUTPUT
- RF LEAKAGE
- AUXILIARY

Each of the above named test types has a set of parameters to be configured. Therefore it is recommended that the first step in this process be writing down the program, test types, and configured parameters in a step–by–step method.

To aid you in this effort here are three lists describing the available test types and the associated parameters to be configured in the order they are displayed on the Model 454A.

Generator Output

1. ESU MODE	MONOPOLAR BIPOLAR MONOCUT MONOCOAG BICUT BICOAG	
2. ESU OUTPUT	PURE CUT CUT BLEND 1 BLEND 2 BLEND 3 BLENDMAX BLENDMIN MICRO COAG STANDARD PRECISE LOWV SOFT SPRAY DESICCTE	FLGRATE TUBE CUT HEMO 1 HEMO 2 HEMO 3 MACRO PINPOINT MODE 1 MODE 2 MODE 3 MODE 4 MODE 5 COAG 1 COAG 2 USER 1 to USER16
3. ESU POWER SETTING	0–500	
4. ESU EXPECTED POWER	0–500 (w)	
5. HIGH LIMIT	1%–62% or OFF	
6. LOW LIMIT	1%–62% or OFF	
7. LOAD	0–1550 Ω, in 50–Ω increments	

RF Leakage

1. ESU MODE	MONOPOLAR BIPOLAR MONOCUT	MONOCOAG BICUT BICOAG
2. ESU OUTPUT	PURE CUT CUT BLEND 1 BLEND 2 BLEND 3 BLENDMAX BLENDMIN MICRO COAG STANDARD PRECISE LOWV SOFT SPRAY DESICCTE	FLGRATE TUBE CUT HEMO 1 HEMO 2 HEMO 3 MACRO PINPOINT MODE 1 MODE 2 MODE 3 MODE 4 MODE 5 COAG 1 COAG 2 USER 1 to USER16
3. ESU POWER SETTING	0–500	
4. SELECT ELECTRODE	0–500 (w)	
5. SELECT LOAD STATUS	1%–62% or OFF	
6. SELECT LOAD VALUE *(for closed load only)*	1%–62% or OFF	

Auxiliary

1. SELECT AUXILIARY TEST	REM TEST RES RETFLT CAP RETFLT	**2. Select POWER SETTING**
	µBIP 10 µBIP 25 µBIP 35 µBIP 50 µBIP 75 125 EXT LD 330 EXT LD 2K EXT LD 5K EXT LD	**2. Select** and proceed to **Generator Output** steps **1** through **6**.

Planning the Autosequence Program

On the two pages that follow is a form to plan your autosequence program. You may copy and use this form.

Below is an example of a filled–in autosequence program plan.

Autosequence Name: Sample **Date:** 11/22/93

Generator Output	RF Leakage	Auxiliary
ESU MODE	ESU MODE	POWER SETTING
ESU OUTPUT	ESU OUTPUT	*or*
ESU POWER SETTING	ESU POWER SETTING	ESU MODE
ESU EXPECTED POWER	SELECT ELECTRODE	ESU OUTPUT
HIGH LIMIT	SELECT LOAD STATUS	ESU POWER SETTING
LOW LIMIT	SELECT LOAD VALUE	ESU EXPECTED POWER
LOAD		HIGH LIMIT
		LOW LIMIT

	Test Type	Configured Parameters
Step #1	Generator Output	Monopolar / Pure Cut / 2 / 300w / 15% / 15% / 300Ω
Step #2	RF Leakage	Monopolar / 300 / Active / Closed / 300Ω
Step #3		
Step #4		
Step #5		
Step #6		

Figure 3 - 5. *Use this example for planning your autosequence program.*

Autosequence Name: _____ **Date:** _____

Generator Output	**RF Leakage**	**Auxiliary**
ESU MODE	ESU MODE	POWER SETTING
ESU OUTPUT	ESU OUTPUT	*or*
ESU POWER SETTING	ESU POWER SETTING	ESU MODE
ESU EXPECTED POWER	SELECT ELECTRODE	ESU OUTPUT
HIGH LIMIT	SELECT LOAD STATUS	ESU POWER SETTING
LOW LIMIT	SELECT LOAD VALUE	ESU EXPECTED POWER
LOAD		HIGH LIMIT
		LOW LIMIT

	Test Type	**Configured Parameters**
Step #1		
Step #2		
Step #3		
Step #4		
Step #5		
Step #6		
Step #7		
Step #8		
Step #9		
Step #10		
Step #11		
Step #12		
Step #13		
Step #14		
Step #15		
Step #16		
Step #17		
Step #18		
Step #19		
Step #20		
Step #21		
Step #22		
Step #23		
Step #24		
Step #25		

Autosequence Name: _____ **Date:** _____

Generator Output	RF Leakage	Auxiliary
ESU MODE	ESU MODE	POWER SETTING
ESU OUTPUT	ESU OUTPUT	*or*
ESU POWER SETTING	ESU POWER SETTING	ESU MODE
ESU EXPECTED POWER	SELECT ELECTRODE	ESU OUTPUT
HIGH LIMIT	SELECT LOAD STATUS	ESU POWER SETTING
LOW LIMIT	SELECT LOAD VALUE	ESU EXPECTED POWER
LOAD		HIGH LIMIT
		LOW LIMIT

	Test Type	Configured Parameters
Step #26		
Step #27		
Step #28		
Step #29		
Step #30		
Step #31		
Step #32		
Step #33		
Step #34		
Step #35		
Step #36		
Step #37		
Step #38		
Step #39		
Step #40		
Step #41		
Step #42		
Step #43		
Step #44		
Step #45		
Step #46		
Step #47		
Step #48		
Step #49		

Inputting the Autosequence Program Parameters

Once you have planned the autosequence program, you are ready to input the program into the Model 454A.

Beginning at the MAIN MENU display, press F2 (AUTO) and you will see the AUTOSEQUENCE UTILITY message. Press F2 (EDIT) for the AUTOSEQUENCE EDIT MENU display. Press F2 (AUTOSEQ) for the display HIGHLIGHT AND SELECT DESIRED AUTOSEQUENCE.

Now use F1, F2, F3, or F4 to scroll through the 24 autosequence programs. Position the highlight bar at AUTO 24 and press Ent. You will see the message EDITING AUTOSEQUENCE: AUTO 24. Change the name to SAMPLE by moving the highlight bar with F3 (←) and F4 (→). Then scroll through the character list using F1 (↑) and F2 (↓). Change each letter in the name using this process. When you have changed the name correspondingly, press Ent.

The message EDITING AUTOSEQUENCE: SAMPLE is now on the display. Beneath this title notice the message STEP 01: and the prompt Select TEST TYPE:. By pressing F3 and F4 you can select one of the three test types. Next press F2 to continue. Keep following the prompts and inputting the requested information in this way.

Once the parameters are input for this particular test and step, the display shows AUTOSEQUENCE: SAMPLE, STEP 01 COMPLETE. By pressing F2 you can backstep through the test and change parameters. Press F2 to begin another test/step sequence. Pressing F3 ends this program and the next prompt saves the program. To save, press F3.

Now press Esc several times until you have returned to the MAIN MENU. Press F2 (AUTO), next press F2 (EDIT), then press F1 (USER LIST). At the message EDITING ESU OUTPUT LIST (user items), press F3 or F4 to select the USER #. Next press F2 (CONTINUE) and name an ESU output that corresponds to your particular situation.

Preprogrammed Autosequences

The following seven figures illustrate factory-programmed autosequences for the following ESU devices: Valleylab Force Series 1B, 2, 30, and 40; Valleylab SSE Series 4 and 4B; Conmed/AspenLabs Excalibur.

DNI NEVADA, INC PRINT DATE: 01/05/94
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: VLF1B

GENERATOR OUTPUT TESTS

Step	Load	ESU Mode	Output	Setting	ESU Power	Limits
01	300	MONOPOLAR	COAG	30	30(w)	024.9-035.1(w)
02	300	MONOPOLAR	COAG	75	75(w)	063.8-086.2(w)
03	300	MONOPOLAR	PURE CUT	200	200(w)	170.0-230.0(w)
04	300	MONOPOLAR	BLEND 1	175	175(w)	148.8-201.2(w)
05	300	MONOPOLAR	BLEND 2	150	150(w)	127.5-172.5(w)
06	300	MONOPOLAR	BLEND 3	125	125(w)	106.2-143.8(w)
11	100	BIPOLAR	MICRO	50	70(w)	042.5-057.5(w)

REM FAULT TESTS

Step	Load	ESU Mode	Output	Setting	Electrode
07	OPEN	MONOPOLAR	COAG	75	ACTIVE
08	OPEN	MONOPOLAR	COAG	75	DISPERSIVE
09	OPEN	MONOPOLAR	PURE CUT	300	ACTIVE
10	OPEN	MONOPOLAR	BLEND 1	300	DISPERSIVE

Figure 3 - 6. *This autosequence is for the Valleylab Force Series 1B.*

DNI NEVADA, INC PRINT DATE: 01/05/94
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: VLF2

GENERATOR OUTPUT TESTS

Step	Load	ESU Mode	Output	Setting	ESU Power	Limits
01	300	MONOPOLAR	COAG	30	30(w)	024.9-035.1(w)
02	300	MONOPOLAR	COAG	120	120(w)	102.0-138.0(w)
03	300	MONOCUT	BLEND 1	250	250(w)	212.5-287.5(w)
04	300	MONOCUT	BLEND 2	200	200(w)	170.0-230.0(w)
05	300	MONOCUT	BLEND 3	150	150(w)	127.5-172.5(w)
11	100	BIPOLAR	MICRO	70	70(w)	059.5-080.5(w)

RF LEAKAGE TESTS

Step	Load	ESU Mode	Output	Setting	Electrode
06	OPEN	MONOPOLAR	COAG	120	ACTIVE
07	OPEN	MONOPOLAR	COAG	120	DISPERSIVE
08	OPEN	MONOPOLAR	PURE CUT	300	ACTIVE
09	OPEN	MONOPOLAR	PURE CUT	300	DISPERSIVE

Figure 3 - 7. *This autosequence is for the Valleylab Force Series 2.*

DNI NEVADA, INC PRINT DATE: 01/05/94
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: VLSSE4

GENERATOR OUTPUT TESTS

Step	Load	ESU Mode	Output	Setting	ESU Power	Limits
01	300	MONOCOAG	SPRAY	25	25(w)	020.0-030.0(w)
02	300	MONOCOAG	SPRAY	120	120(w)	102.0-138.0(w)
03	300	MONOCOAG	SOFT	60	60(w)	051.0-069.0(w)
04	300	MONOPOLAR	PURE CUT	75	75(w)	063.8-086.2(w)
05	300	MONOPOLAR	PURE CUT	300	300(w)	255.0-345.0(w)
06	300	MONOPOLAR	BLEND 1	200	200(w)	170.0-230.0(w)
07	300	MONOPOLAR	BLEND 2	200	200(w)	170.0-230.0(w)
08	300	MONOPOLAR	BLEND 3	200	200(w)	170.0-230.0(w)
09	300	MONOPOLAR	BLEND 1	75	75(w)	063.8-086.2(w)
10	300	MONOPOLAR	BLEND 2	75	75(w)	063.8-086.2(w)
11	300	MONOPOLAR	BLEND 3	75	75(w)	063.8-086.2(w)
12	100	BICOAG	STANDARD	70	70(w)	059-5.080.5(w)
13	100	BICOAG	PRECISE	70	70(w)	059-5.080.5(w)

Figure 3 - 8. *This autosequence is for the Valleylab SSE Series 4.*

DNI NEVADA, INC PRINT DATE: 01/05/94
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: VLF4B

GENERATOR OUTPUT TESTS

Step	Load	ESU Mode	Output	Setting	ESU Power	Limits
01	300	MONOCOAG	SPRAY	50	50(w)	042.5-057.5(w)
02	300	MONOCOAG	SPRAY	120	120(w)	102.0-138.0(w)
03	300	MONOCOAG	SOFT	60	60(w)	051.0-069.0(w)
04	300	MONOCOAG	LOWV	99	99(w)	084.2-113.8(w)
05	300	MONOPOLAR	PURE CUT	50	50(w)	042.5-057.5(w)
06	300	MONOPOLAR	PURE CUT	300	300(w)	255.0-345.0(w)
07	300	MONOPOLAR	BLEND 1	250	250(w)	212.5-287.5(W)
08	300	MONOPOLAR	BLEND 2	50	50(w)	042.5-057.5(w)
09	300	MONOPOLAR	BLEND 2	200	200(w)	170.0-230.0(w)
10	300	MONOPOLAR	BLEND 3	200	200(w)	170.0-230.0(w)
11	100	BIPOLAR	STANDARD	70	70(w)	059-5.080.5(w)
12	100	BICOAG	PRECISE	70	70(w)	059-5.080.5(w)

Figure 3 - 9. *This autosequence is for the Valleylab Force Series 4B.*

DNI NEVADA, INC PRINT DATE: 01/05/94
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: VLF30

GENERATOR OUTPUT TESTS

Step	Load	ESU Mode	Output	Setting	ESU Power	Limits
01	300	MONOCOAG	DESICCTE	200	200(w)	170.0-230.0(w)
02	300	MONOCOAG	FLGRATE	150	150(w)	127.5-172.5(w)
03	300	MONOPOLAR	PURE CUT	300	300(w)	255.5-287.5(w)
04	300	MONOPOLAR	BLEND 1	250	250(w)	212.5-287.5(w)
09	100	BIPOLAR	STANDARD	50	50(w)	042.5-057.5(w)
11	100	BIPOLAR	PRECISE	50	50(w)	042.5-057.5(w)

RF LEAKAGE TESTS

Step	Load	ESU Mode	Output	Setting	Electrode
05	OPEN	MONOCOAG	DESICCTE	200	ACTIVE
06	OPEN	MONOCOAG	DESICCTE	200	DISPERSIVE
07	OPEN	MONOPOLAR	PURE CUT	300	ACTIVE
08	OPEN	MONOPOLAR	PURE CUT	300	DISPERSIVE

Figure 3 - 10. *This autosequence is for the Valleylab Force Series 30.*

DNI NEVADA, INC PRINT DATE: 01/05/94
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: VLF40

GENERATOR OUTPUT TESTS

Step	Load	ESU Mode	Output	Setting	ESU Power	Limits
01	300	MONOCOAG	SPRAY	150	150(w)	127.5-172.5(w)
02	300	MONOPOLAR	PURE CUT	300	300(w)	255.5-287.5(w)
03	300	MONOPOLAR	BLEND 1	250	250(w)	212.5-287.5(w)
04	300	MONOPOLAR	BLEND 2	200	200(w)	170.0-230.0(w)
05	300	MONOPOLAR	DESICCTE	200	200(w)	170.0-230.0(w)
06	300	MONOPOLAR	FLGRATE	150	150(w)	127.5-172.5(w)
11	100	BIPOLAR	STANDARD	50	50(w)	042.5-057.5(w)
12	100	BIPOLAR	PRECISE	50	50(w)	042.5-057.5(w)

RF LEAKAGE TESTS

Step	Load	ESU Mode	Output	Setting	Electrode
07	OPEN	MONOCOAG	DESICCTE	200	ACTIVE
08	OPEN	MONOCOAG	DESICCTE	200	DISPERSIVE
09	OPEN	MONOPOLAR	PURE CUT	300	ACTIVE
10	OPEN	MONOPOLAR	PURE CUT	300	DISPERSIVE

Figure 3 - 11. *This autosequence is for the Valleylab Force Series 40.*

DNI NEVADA, INC PRINT DATE: 01/05/94
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: ASPENX

GENERATOR OUTPUT TESTS

Step	Load	ESU Mode	Output	Setting	ESU Power	Limits
01	300	MONOPOLAR	PURE CUT	120	120(w)	108.0-132.0(w)
02	300	MONOPOLAR	PURE CUT	300	300(w)	270.0-330.0(w)
03	300	MONOPOLAR	BLEND 1	69	69(w)	062.1-075.9(w)
04	300	MONOPOLAR	BLEND 1	180	180(w)	162.0-198.0(w)
05	300	MONOCOAG	STANDARD	48	48(w)	043.2-052.8(w)
06	300	MONOCOAG	STANDARD	120	120(w)	108.0-132.0(w)
07	300	MONOCOAG	SPRAY	40	40(w)	036.0-044.0(w)
08	300	MONOCOAG	SPRAY	80	80(w)	072.0-088.0(w)
13	50	BIPOLAR	COAG	20	20(w)	017.0-023.0(w)
14	50	BIPOLAR	COAG	50	50(w)	045.0-055.0(w)
15	50	BIPOLAR	CUT	20	20(w)	017.0-023.0(w)
16	50	BIPOLAR	CUT	50	50(w)	045.0-055.5(w)

RF LEAKAGE TESTS

Step	Load	ESU Mode	Output	Setting	Electrode
09	OPEN	MONOCOAG	STANDARD	120	ACTIVE
10	OPEN	MONOCOAG	STANDARD	120	DISPERSIVE
11	OPEN	MONOPOLAR	PURE CUT	300	ACTIVE
12	OPEN	MONOPOLAR	PURE CUT	300	DISPERSIVE

Figure 3 - 12. *This autosequence is for the Conmed/AspenLabs Excalibur.*

Reports

The first two of the following figures show typical reports and the third figure is an example of how to complete an autosequence report.

DNI NEVADA, INC PRINT DATE: 11/22/93
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: TEST 1

PERFORMANCE TEST RECORD FOR:
MANUFACTURER: _____
MODEL: _____
S/N: _____ C/N: _____
LOCATION: _____

GENERATOR OUTPUT

#	Load	ESU Mode	Output	Setting	Limits (w)	P (w)	I (mA)	CF	kVpp
01	300	MONOPOLAR	PURE CUT	300	270.0-330.0	299.4	999	2.0	1.0

Number of Tests Performed: 1
Elapsed Time: 00:01:13

COMMENTS

Figure 3 - 13. *This illustrates a typical Manual Mode/Generator Output report.*

DNI NEVADA, INC PRINT DATE: 11/22/93
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: AUTO21

PERFORMANCE TEST RECORD FOR:
MANUFACTURER: _____
MODEL: _____
S/N: _____ C/N: _____
LOCATION: _____

GENERATOR OUTPUT

#	Load	ESU Mode	Output	Setting	Limits (w)	P (w)	I (mA)	CF	kVpp
01	500	MONOPOLAR	BLEND 2	300	270.0-330.0	153.5#	554	3.9	1.5

Note: Readings marked with # symbol indicate that measurement falls outside of desired limits.

RF LEAKAGE

#	Load	ESU Mode	Output	Setting	Electrode	Lkg Current
02	OPEN	MONOPOLAR	PURE CUT	300	ACTIVE	124 (mA)

Number of Tests Performed: 2
Elapsed Time: 00:02:14

COMMENTS

Figure 3 - 14. *This is a typical autosequence report.*

DNI NEVADA, INC PRINT DATE: 11/22/93
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: AUTO21

PERFORMANCE TEST RECORD FOR:
MANUFACTURER: **ESU Manufacturer**
MODEL: **ESU Model Number**
S/N: **ESU Serial Number** C/N: **Hospital's Control Number**
LOCATION: **Hospital's Location**

GENERATOR OUTPUT

#	Load	ESU Mode	Output	Setting	Limits (w)	P (w)	I (mA)	CF	kVpp
01	500	MONOPOLAR	BLEND 2	300	270.0-330.0	153.5#	554	3.9	1.5

Note: Readings marked with # symbol indicate that measurement falls outside of desired limits.

RF LEAKAGE

#	Load	ESU Mode	Output	Setting	Electrode	Lkg Current
02	OPEN	MONOPOLAR	PURE CUT	300	ACTIVE	124 (mA)

Number of Tests Performed: 2
Elapsed Time: 00:02:14

COMMENTS
Additional Comments

Figure 3 - 15. *Use this example to complete an autosequence report.*

Autosequence Samples for REM/ARM and Return Fault Testing

For your use in programming the Model 454A Electrosurgical Analyzer, following are samples of suggested autosequences including the REM/ARM and the Return Fault test formats.

DNI NEVADA, INC PRINT DATE: 3/27/95
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: #09:REM*

REM/FAULT TESTS

Step	ESU Mode	Output	Setting	Test ID
01	MONOPOLAR	N/A	N/A	REM TEST

Figure 3 - 16. *This is a sample of an autosequence for a REM/ARM test.*

DNI NEVADA, INC PRINT DATE: 03/27/95
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: #09:REM*

PERFORMANCE TEST RECORD FOR:
MANUFACTURER: _____
MODEL: _____
S/N: _____ C/N: _____
LOCATION: _____

REM/FAULT TESTS

#	Load	ESU Mode	Output	Setting	Test ID	Result
01	N/A	MONOPOLAR	N/A	N/A	REM TEST	PASS

Number of Tests Performed: 1
Elapsed Time: 00:00:19

COMMENTS
_____
_____
_____

Figure 3 - 17. *This is a sample of test results for a REM/ARM test.*

DNI NEVADA, INC PRINT DATE: 3/27/95
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: #17:REMRF*

REM/FAULT TESTS

Step	ESU Mode	Output	Setting	Test ID
01	MONOPOLAR	CUT	300	RES RETFLT
02	MONOPOLAR	CUT	250	RES RETFLT
03	MONOPOLAR	CUT	200	RES RETFLT
04	MONOPOLAR	CUT	200	RES RETFLT
05	MONOPOLAR	COAG	120	CAP RETFLT
06	MONOPOLAR	N/A	N/A	REM TEST

Figure 3 - 18. *This is a sample of an autosequence for a REM/ARM and Return Fault test.*

DNI NEVADA, INC PRINT DATE: 03/27/95
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: #17:REMRF*

PERFORMANCE TEST RECORD FOR:
MANUFACTURER: _____
MODEL: _____
S/N: _____ C/N:_____
LOCATION: _____

REM/FAULT TESTS

#	Load	ESU Mode	Output	Setting	Test ID	Result
01	N/A	MONOPOLAR	CUT	300	RES RETFLT	PASS
02	N/A	MONOPOLAR	CUT	250	RES RETFLT	PASS
03	N/A	MONOPOLAR	CUT	200	RES RETFLT	PASS
04	N/A	MONOPOLAR	CUT	200	RES RETFLT	PASS
05	N/A	MONOPOLAR	COAG	120	CAP RETFLT	PASS
06	N/A	MONOPOLAR	N/A	N/A	REM TEST	PASS

Number of Tests Performed: 6
Elapsed Time: 00:01:22

COMMENTS
_____
_____
_____

Figure 3 - 19. *This is a sample of test results for a REM/ARM and Return Fault test.*

DNI NEVADA, INC PRINT DATE: 03/27/95
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: #08:VLF4B*

GENERATOR OUTPUT TESTS

Step	Load	ESU Mode	Output	Setting	ESU Power	Limits
01	300	MONOCOAG	SPRAY	50	50(w)	042.5-057.5(w)
02	300	MONOCOAG	SPRAY	120	120(w)	102.0-138.0(w)
03	300	MONOCOAG	SOFT	60	60(w)	051.0-069.0(w)
04	300	MONOCOAG	LOWV	99	99(w)	084.2-113.8(w)
05	300	MONOPOLAR	PURE CUT	50	50(w)	042.5-057.5(w)
06	300	MONOPOLAR	PURE CUT	300	300(w)	255.0-345.0(w)
07	300	MONOPOLAR	BLEND 1	250	250(w)	212.5-287.5(w)
08	300	MONOPOLAR	BLEND 2	50	50(w)	042.5-057.5(w)
09	300	MONOPOLAR	BLEND 2	200	200(w)	170.0-230.0(w)
10	300	MONOPOLAR	BLEND 3	200	200(w)	170.0-230.0(w)
11	100	BIPOLAR	STANDARD	70	70(w)	059.5-080.5(w)
12	100	BIPOLAR	PRECISE	70	70(w)	059.5-080.5(w)

REM FAULT TESTS

Step	ESU Mode	Output	Setting	TEST ID
13	MONOPOLAR	CUT	300	RES RETFLT
14	MONOPOLAR	CUT	250	RES RETFLT
15	MONOPOLAR	CUT	200	RES RETFLT
16	MONOPOLAR	CUT	200	RES RETFLT
17	MONOPOLAR	COAG	120	CAP RETFLT
18	MONOPOLAR	N/A	N/A	REM TEST

Figure 3 - 20. *This is a sample of an autosequence for a normal ESU testing and REM/ARM and Return Fault test.*

DNI NEVADA, INC PRINT DATE: 03/27/95
ELECTROSURGICAL ANALYZER, MODEL 454A
AUTOSEQUENCE: #08:VLF4B*

PERFORMANCE TEST RECORD FOR:
MANUFACTURER: _____
MODEL: _____
S/N: _____ C/N: _____
LOCATION: _____

GENERATOR OUTPUT

#	Load	ESU Mode	Output	Setting	Limits (w)	P (w)	I (mA)	CF	kVpp
01	300	MONOCOAG	SPRAY	50	042.5-057.5	54.4	426	8.3	1.3
02	300	MONOCOAG	SPRAY	120	102.0-138.0	110.9	608	8.3	1.9
03	300	MONOCOAG	SOFT	60	051.0-069.0	55.0	428	10.4	1.7
04	300	MONOCOAG	LOWV	99	084.2-113.8	111.6	610	5.2	1.3
05	300	MONOPOLAR	PURE CUT	50	042.5-057.5	56.2	433	1.8	0.4
06	300	MONOPOLAR	PURE CUT	300	255.0-345.0	303.0	1005	1.8	0.9
07	300	MONOPOLAR	BLEND 1	250	212.5-287.5	249.0	911	2.6	1.1
08	300	MONOPOLAR	BLEND 2	50	042.5-057.5	57.3	437	3.2	0.7
09	300	MONOPOLAR	BLEND 2	200	170.0-230.0	202.2	821	3.2	1.2
10	300	MONOPOLAR	BLEND 3	200	170.0-230.0	212.7	842	5.2	1.8
11	100	BIPOLAR	STANDARD	70	059.5-080.5	61.8	786	4.9	0.5
12	100	BIPOLAR	PRECISE	70	059.5-080.5	67.2	820	1.8	0.2

REM/FAULT TESTS

#	Load	Mode	Output	Setting	Test ID	Result
13	N/A	MONOPOLAR	CUT	300	RES RETFLT	PASS
14	N/A	MONOPOLAR	CUT	250	RES RETFLT	PASS
15	N/A	MONOPOLAR	CUT	200	RES RETFLT	PASS
16	N/A	MONOPOLAR	CUT	200	RES RETFLT	PASS
17	N/A	MONOPOLAR	COAG	120	CAP RETFLT	PASS
18	N/A	MONOPOLAR	N/A	N/A	REM TEST	PASS

Number of Tests Performed: 18
Elapsed Time: 00:14:31

COMMENTS

_____

_____

Figure 3 - 21. *This is a sample of test results for a normal ESU testing and REM/ARM and Return Fault test.*

medCheck Samples

The following is a sample of the DNI Nevada medTester 5000B automated medCheck inspection protocol for the Valleylab Force 4B ESU. Use for programming the DNI Nevada software product Sentinel.

ACCOUNT NAME

Date: 04/21/95 — Relational Checklist Report — Page: 1

Time: 05:13 PM — Listed In Order Of Relational Procedure

Proc. Name	PM Labor Time
VALLEYLAB-F4B*	0.75

Description	Type	medTester Control
5	AUTOSEQ	medTester autosequence
INSPECT FRONT PANEL RECEPTACLES	STEP	Pass/Fail
INSPECT PATIENT/REM 2 PIN CONNECTOR	STEP	Pass/Fail
INSPECT REAR PANEL & BASE MOUNTS	STEP	Pass/Fail
INSPECT REAR PANEL CONNECTORS	STEP	Pass/Fail
CHECK REAR PANEL FUSE = 250V@1A FB	STEP	Pass/Fail
INSPECT REAR PANEL POWER CORD PLUG	STEP	Both P & I
INTERNAL CHASSIS INSPECTION	STEP	Pass/Fail
CONNECT MONOPOLAR FOOTSWITCH TO ESU	STEP	Pass/Fail
TRPN	STEP	medTester remote command
PLUG IN ESU/TURN ON (1) POWER SWITCH	STEP	Pass/Fail
CHECK ESU POWER UP SELF TEST	STEP	Both P & I
CONNECT MONOPOLAR OUTPUT TO DNI 454A	STEP	Pass/Fail
PRESS "READY" TO START OUTPUT TESTS	STEP	Pass/Fail
GOTOREMOTE	STEP	medTester remote command
SETMODE:OUTPUT	STEP	medTester remote command
SETLOAD:300	STEP	medTester remote command
OUTPUT MONOPOLAR COAG/SPRAY @ 50W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
OUTPUT MONOPOLAR COAG/SPRAY @ 120W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
OUTPUT MONOPOLAR COAG SOFT @ 60W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
PRESS ESU "READY" & "COAG POWER DWN"	STEP	Pass/Fail
OUTPUT MONOPOLAR COAG LOW V @ 99W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
OUTPUT MONOPOLAR PURE CUT @ 50W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
OUTPUT MONOPOLAR PURE CUT @ 300W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
OUTPUT MONOPOLAR BLEND 1 @ 250W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
OUTPUT MONOPOLAR BLEND 2 @ 50W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
OUTPUT MONOPOLAR BLEND 2 @ 200W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
OUTPUT MONOPOLAR BLEND 3 @ 200W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
PLACE ESU IN "STANDBY MODE"	STEP	Pass/Fail
DISCONNECT MONOPOLAR OUTPUT	STEP	Pass/Fail
SETLOAD:100	STEP	medTester remote command
CONNECT BIPOLAR OUTPUT TO DNI 454A	STEP	Pass/Fail
CONNECT BIPOLAR FOOTSWITCH TO ESU	STEP	Pass/Fail
PLACE ESU IN "READY MODE"	STEP	Pass/Fail
OUTPUT BIPOLAR STANDARD @ 70W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
OUTPUT BIPOLAR PRECISE @ 70W	STEP	Pass/Fail
RDPOWER	STEP	medTester remote command
EXITMODE	STEP	medTester remote command
GOTOLOCAL	STEP	medTester remote command
PLACE ESU IN "STANDBY MODE"	STEP	Pass/Fail
DISCONNECT BIPOLAR OUTPUT	STEP	Pass/Fail
INSTALL REM RETURN FAULT TEST MODULE	STEP	Pass/Fail
CONNECT MONOPOLAR OUTPUT TO MODULE	STEP	Pass/Fail
PLACE ESU IN "READY MODE"	STEP	Pass/Fail
SELECT "MANUAL-AUXILIARY" ON 454A	STEP	Pass/Fail
SELECT "CUT SIDE" TESTS (NO-F/FAULT)	STEP	Pass/Fail
RUN "CUT SIDE" TEST: PURE CUT @ 300W	STEP	Pass/Fail
RUN "CUT SIDE" TEST: BLEND 1 @ 250W	STEP	Pass/Fail
RUN "CUT SIDE" TEST: BLEND 2 @ 200W	STEP	Pass/Fail
RUN "CUT SIDE" TEST: BLEND 3 @ 200W	STEP	Pass/Fail
SELECT "COAG SIDE" TEST (NO-F/FAULT)	STEP	Pass/Fail
RUN "COAG SIDE" TEST: SPRAY 120W	STEP	Pass/Fail
ATTACH REM TESTLEAD: DISP ELECTRODE	STEP	Pass/Fail
RUN "REM/ARM TEST" ENTER RESISTANCE:	STEP	Pass/Fail
GTOL	STEP	medTester remote command

Figure 3 - 22. *This is a sample checklist report test.*

MERCY MEDICAL CENTER medTester REC # 1

SEQUENCE: 5 DATE: 4/22/95 TIME: 12:19:15

OP CODE: MCB

DEVICE INFORMATION
TYPE: VALLEYLAB-F4B* MANF: LOC:
MODEL: SN: CN: CN0001

PHYSICAL INSPECTION

LINE VOLTAGES

L1-L2	L1-GND	L2-GND
122.2	.9	123.9 VOLTS RMS

GROUND RESISTANCE: .142 OHMS

LEAKAGE TESTS, EQUIPMENT PWR OFF

CASE EXT LEAD	NORM POL	CLSD GND	.0 µAMPS RMS
CASE EXT LEAD	NORM POL	OPEN GND	11.5 µAMPS RMS
CASE EXT LEAD	REV POL	OPEN GND	11.9 µAMPS RMS

LEAKAGE TESTS, EQUIPMENT PWR ON

CASE EXT LEAD	REV POL	OPEN GND	18.4 µAMPS RMS
CASE EXT LEAD	NORM POL	OPEN GND	16.7 µAMPS RMS
CASE EXT LEAD	NORM POL	CLSD GND	.0 µAMPS RMS

EUT CURRENT DRAWN: .4 AMPS

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 95 SECONDS

MERCY MEDICAL CENTER medTester REC # 2

CHECKLIST: VALLEYLAB-F4B* DATE: 4/22/95 TIME: 12:20:50

OP CODE: MCB

DEVICE INFORMATION
TYPE: VALLEYLAB-F4B* MANF: LOC:
MODEL: SN: CN: CN0001

PHYSICAL INSPECTION

INSPECT FRONT PANEL RECEPTACLES	PASS
INSPECT PATIENT/REM 2 PIN CONNECTOR	PASS
INSPECT REAR PANEL & BASE MOUNTS	PASS
INSPECT REAR PANEL CONNECTORS	PASS
CHECK REAR PANEL FUSE = 250V @ 1A FB	PASS
INSPECT REAR PANEL POWER CORD/PLUG	PASS
INTERNAL CHASSIS INSPECTION	N/A
CONNECT MONOPOLAR FOOTSWITCH TO ESU	PASS
TRPN	REMOTE CMD, NO DATA
PLUG IN ESU/TURN ON (1) POWER SWITCH	PASS
CHECK ESU POWER UP SELF TEST	PASS
CONNECT MONOPOLAR OUTPUT TO DNI 454A	PASS
PRESS "READY" TO START OUTPUT TESTS	PASS
GOTOREMOTE	*
SETMODE:OUTPUT	REMOTE CMD, NO DATA
SETLOAD:300	REMOTE CMD, NO DATA
OUTPUT MONOPOLAR COAG/SPRAY @ 50W	PASS
RDPOWER	055.7 (W)
OUTPUT MONOPOLAR COAG/SPRAY @ 120W	PASS
RDPOWER	116.8 (W)
OUTPUT MONOPOLAR COAG SOFT @ 60W	PASS
RDPOWER	058.6 (W)
PRESS ESU "READY" & "COAG POWER DWN"	PASS
OUTPUT MONOPOLAR COAG LOW V @ 99W	PASS
RDPOWER	112.7 (W)
OUTPUT MONOPOLAR PURE CUT @ 50W	PASS
RDPOWER	057.0 (W)
OUTPUT MONOPOLAR PURE CUT @ 300W	PASS
RDPOWER	300.6 (W)
OUTPUT MONOPOLAR BLEND 1 @ 250W	PASS
RDPOWER	249.5 (W)
OUTPUT MONOPOLAR BLEND 2 @ 50W	PASS
RDPOWER	058.1 (W)
OUTPUT MONOPOLAR BLEND 2 @ 200W	PASS
RDPOWER	200.7 (W)
OUTPUT MONOPOLAR BLEND 3 @ 200W	PASS
RDPOWER	209.2 (W)
PLACE ESU IN "STANDBY MODE"	PASS
DISCONNECT MONOPOLAR OUTPUT	PASS
SETLOAD:100	*
CONNECT BIPOLAR OUPUT TO DNI 454A	PASS
CONNECT BIPOLAR FOOTSWITCH TO ESU	PASS
PLACE ESU IN "READY MODE"	PASS

OUTPUT BIPOLAR STANDARD @ 70W	PASS
RDPOWER	062.3 (W)
OUTPUT BIPOLAR PRECISE @ 70W	PASS
RDPOWER	067.9 (W)
EXITMODE	*
GOTOLOCAL	REMOTE CMD, NO DATA
PLACE ESU IN "STANDBY MODE"	PASS
DISCONNECT BIPOLAR OUPUT	PASS
INSTALL REM RETURN FAULT TEST MODULE	PASS
CONNECT MONOPOLAR OUTPUT TO MODULE	PASS
PLACE ESU IN "READY MODE"	PASS
SELECT "MANUAL-AUXILIARY" ON 454A	PASS
SELECT "CUT SIDE" TESTS (NO-F/FAULT)	PASS
RUN "CUT SIDE" TEST: PURE CUT @ 300W	PASS
RUN "CUT SIDE" TEST: BLEND 1 @ 250W	PASS
RUN "CUT SIDE" TEST: BLEND 2 @ 200W	PASS
RUN "CUT SIDE" TEST: BLEND 3 @ 200W	PASS
SELECT "COAG SIDE" TEST (NO-F/FAULT)	PASS
RUN "COAG SIDE" TEST: SPRAY @ 120W	PASS
ATTACH REM TESTLEAD: DISP ELECTRODE	PASS
RUN "REM/ARM" ENTER RESISTANCE:	122 OHMS
GTOL	REMOTE CMD, NO DATA

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 447 SECS

Figure 3 - 23.
This is a sample of test results for a checklist report test.

Utility Mode

There are four (4) system functions available in this mode as described.

F1
DISPLAY

Press F1 (BRIGHTER) or F2 (DIMMER) to change the brightness of the display. Once you have achieved the desired brightness, press F3 (STORE) to save the change.

F2
RS232

This function is to be used to set various serial port parameters. Press F3 (←) and F4 (→) to position the highlight bar to the field to be changed. Pressing F1 (↑) and F2 (↓) changes the values in the field. Press Ent to save changes.

Five fields are displayed:

- BAUD — available rates are 300, 600, 1200, 2400, 4800, 9600
- #BITS — 5, 6, 7, 8 (data word length)
- PARITY — even, odd, none
- #STOP — 1, 2 (stop bits)
- FLOW — xon/xoff, none (software handshaking)

F3
CLOCK

Use this function to set the battery–backed real time clock and date. Press F3 (←) and F4 (→) to position the highlight bar and press F1 (↑) and F2 (↓) to change values. Press Ent to save the changes. Please refer to *Setting the Clock* in the *Menu System* section of this chapter.

F4
SYSTEM

This function verifies, by means of self–tests, the following systems:

- Keyboard
- RS–232
- Thermal Converter
- Display
- Printer
- Firmware Revision Number.

Press F1, F2, F3, or F4 to position the highlight bar then press Ent to begin the self–test.

Menu System

There are two ways to navigate around the Model 454A Menu System:

1. By use of the function keys as defined by each display.

2. By a highlight and select method. The function keys, in this case, become the means of moving the cursor for highlight purposes. Once you highlight the desired field, information may be changed in that field using the function keys as defined by the display. When the information in the field is accurate, press the Ent key to save the information.

The following step–by–step tutorial exercise illustrates the basic theory of how this menu system works.

Tutorial Exercise

With your unit powered up and initialized, as explained in the previous section of this chapter, the display should show:

```
MAIN MENU                                          01/01/93
                                                   09:45:14am
Press F1-F4 to select menu item
    MANUAL          AUTO                           UTILITY
```

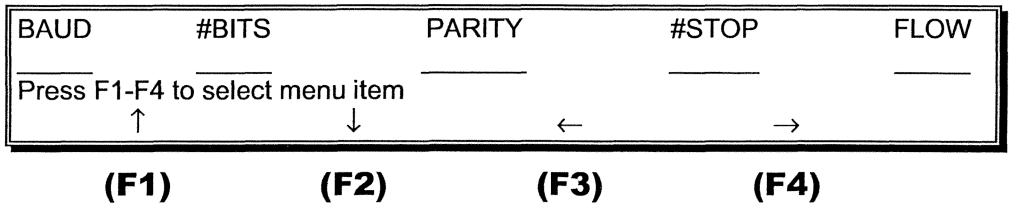
(F1) **(F2)** **(F4)**

Pressing one of the function keys (F1, F2, or F4) moves the system into that particular operating mode. For example, press F4 (UTILITY) and the display changes to:

```
454A UTILITIES                                     01/01/93
                                                   09:45:14am
Press F1-F4 to select menu item
    DISPLAY         RS232          CLOCK           SYSTEM
```

(F1) **(F2)** **(F3)** **(F4)**

Now press F2 (RS232) and the display shows:



Next press F3 (←) and notice that the highlight bar moves in a progressive fashion from right to left.

Now press F4 (→) and observe that the highlight bar moves in a progressive fashion from left to right. Highlight the FLOW field, then press F4. Notice that the BAUD field becomes highlighted.

To input some data, first highlight the BAUD field. Press F1 lightly and let go. Repeat this step a few times. Notice that the values increase up to 9600 and then the next value returns to 300. Now press F1 and hold for two (2) seconds. The values are sequenced through at high speed.

By now you have probably surmised that by pressing F2 you can sequence through the values in the reverse direction.

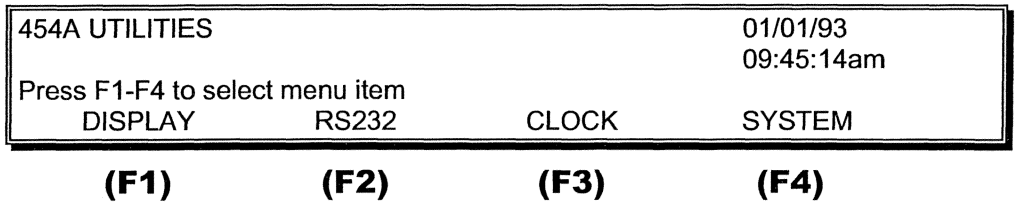
Now sequence through to the value 2400, and then press Ent. A SAVING DATA message will blink for two (2) seconds indicating the value is saved.

Press F4 and the #STOP field is highlighted. Press F1 and again the values increase. Press F2 and the values decrease. Now choose value 1 and then press Ent.

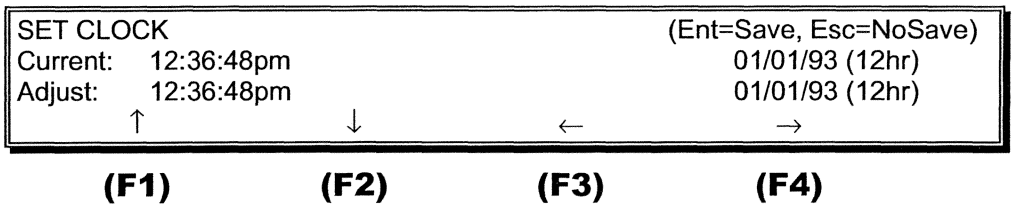
Finally, press Esc. Notice that the display is now showing the initial operating mode information that was selected at the beginning of this exercise. You have returned to the 454A UTILITIES submenu. The value for BAUD that the previous exercise said to choose (2400) and the value for STOP (1) are the DNI Nevada default values. These are the values that are needed for correct use of the serial input port when connecting to DNI Nevada's equipment.

Setting the Clock

First, return to the MAIN MENU by pressing Esc until the display shows MAIN MENU in the upper left corner. Select the UTILITY submenu by pressing F4. To confirm that you are in the UTILITY submenu look for the words 454A UTILITIES in the upper left corner of the display.



Press F3 (Clock) and the display changes to a time and date similar to what is shown below:



Press F3 (←) or F4 (→) to change the position of the highlight bar accordingly on the Adjust: line. Then press F1 (+) or F2 (–) to change the values in the highlighted field.

Start with the first set of numbers after Adjust: and highlight this field using F3 or F4. Press F1 (+) or F2 (–) to change the value to the actual hour of the day. Proceed to the next field to the right and set the minutes of the day, then seconds in the same way.

The next field to the right is for setting AM (before 12:00 noon) or PM (after 12:00 noon). If this field is not showing, it is because the 24–hr time mode is being used. To change to AM/PM mode, move the highlight bar to the far right field and press F1 so that 12hr is displayed.

Finally, press Ent and the Saving Data message blinks for one (1) second. When you look at the Current: time, it will contain the values you just saved and the seconds will be incrementing as the clock now keeps actual time.

Model 454A Menu Map

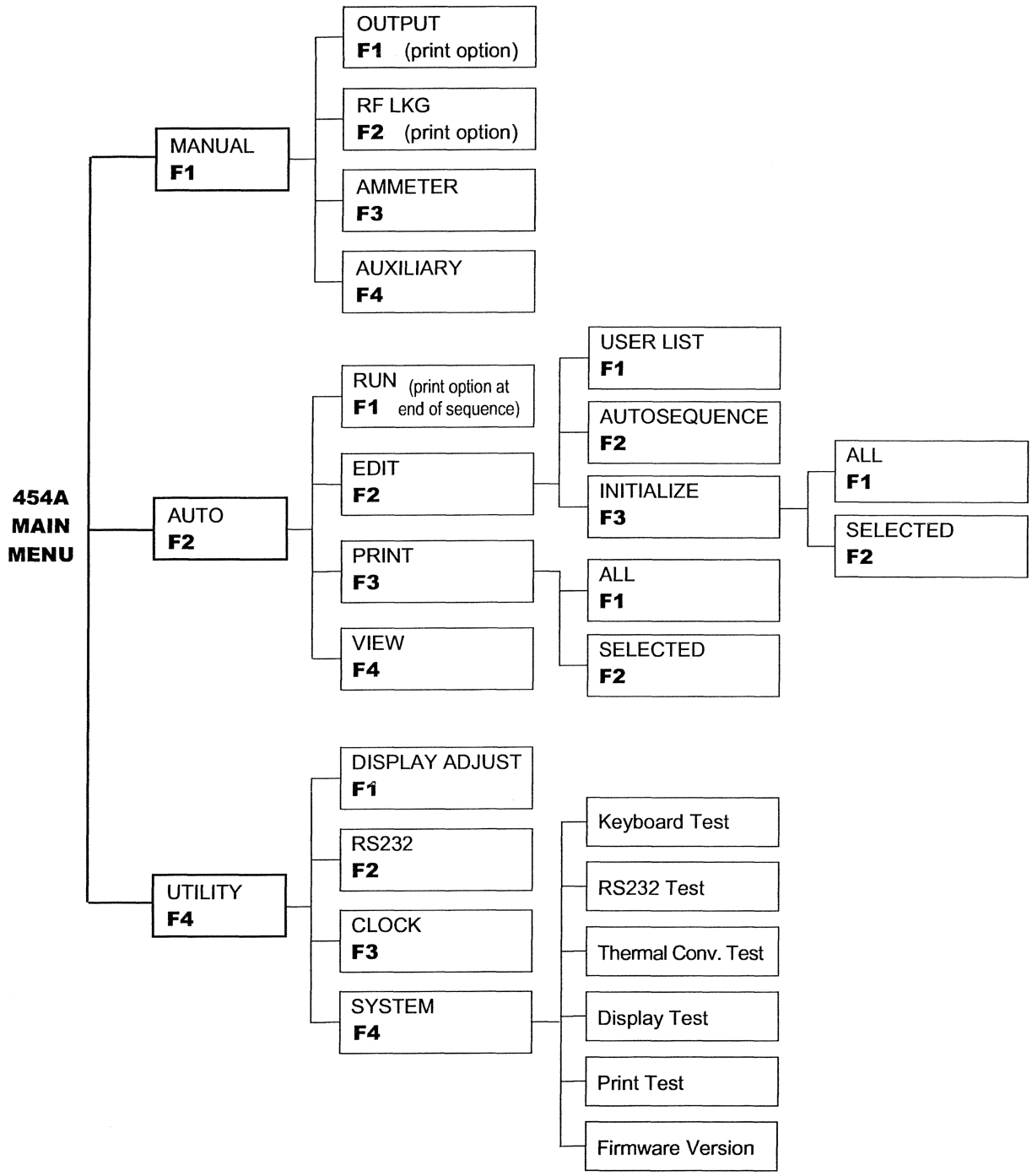


Figure 3 - 24. *Use this Menu Map to help navigate through Model 454A menu system.*

RS-232 Communication Link

The RS-232 Communication Link provides you with the capability of controlling your Model 454A remotely. This serial communications link is built into the Model 454A with the port being on the left side as you face the instrument. The controlling device must be connected using an RS-232 null modem cable (DNI part number 3010-0250).

The chart on the following page contains a list of commands that can be issued by the controlling device. The command syntax is as follows:

```
COMMAND:parm1,parm2,...,parmN<CR/LF>
```

In general, a COMMAND is issued by the controlling device followed by a colon (:) which separates the command from any required parameters. Multiple parameters, if required, must be separated by a comma.

Note

Some commands do not require any parameters in which case the colon is optional. Uppercase or lowercase characters may be used, but the Model 454A always translates lowercase to uppercase. The command must be terminated by a carriage return (CR) or line feed (LF) or both.

Upon receipt of the <CR/LF> the Model 454A decodes the command and responds as follows:

a. If the command is not recognized, the Model 454A transmits a question mark (?) followed by an error code, followed by a short text explanation. The error code can be used during runtime for software exception handling.

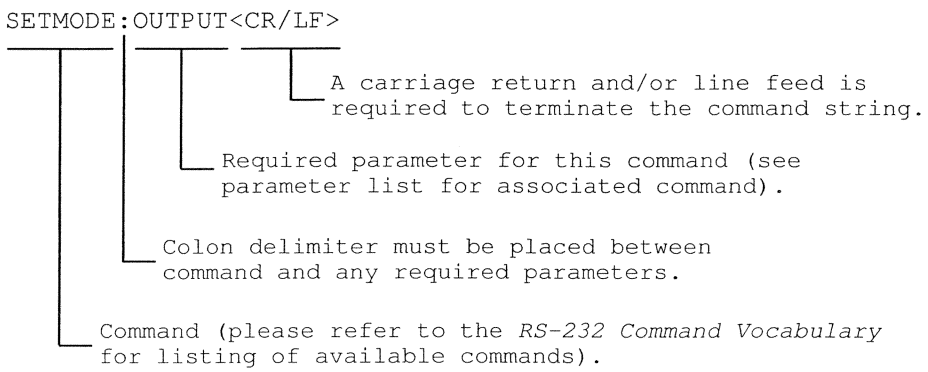
The following is a list of existing error messages:

- ? ERR=01 BAD OR MISSING PARAMETER(S)
- ? ERR=02 ILLEGAL NUMBER OF PARAMETERS
- ? ERR=03 PARAMETER OUT OF RANGE OR SYNTAX ERROR
- ? ERR=04 COMMAND NOT AVAILABLE FROM THIS MODE
- ? ERR=05 DEACTIVATE ESU BEFORE ADJUSTING
- ? ERR=06 ACCESS DENIED
- ? ERR=07 PRINTER FAULT DETECTED: CANNOT PRINT DATA

b. If the command is recognized, the Model 454A either transmits the requested data in response, or transmits an asterisk to acknowledge correct receipt of the command.

Example Command

To measure electrosurgical generator output parameters via RS-232, the Model 454A operational mode must first be set using the following command:



Upon successful receipt of the above command, the Model 454A initializes itself for generator output measurements and responds to the controlling device with an asterisk (*).

RS–232 Command Vocabulary

Command	Description	Parameters Required	Return Value (Response)
GOTOREMOTE	Puts unit into remote control mode. Disables keyboard control. Example: GOTOREMOTE<CR/LF>	None	*
GOTOLOCAL	Exits remote control mode, enabling keyboard input. Example: GOTOLOCAL<CR/LF>	None	*
IDENT	Identifies unit model number and revision number. Example: IDENT<CR/LF>	None	Model Number and Revision Number
QBAUD	Identifies available RS–232 baud rates. Example: QBAUD<CR/LF>	None	List of available baud rates
GOTOBAUD	Allows remote control of baud rate. Example: GOTOBAUD:2400<CR/LF>	One (baud rate: 300, 600, 1200, 2400, 4800, or 9600)	*
RDCLOCK	Reads time and date from 454A real time clock. Example: RDCLOCK<CR/LF>	None	Time and date string
WRCLOCK	Sets 454A real time clock. Format of passed "time-string" is outlined below. Example: WRCLOCK:hh:mm:ssam mm/dd/yy<CR/LF>	One (time string, *see description*)	*
BATCHECK	Checks status of memory backup battery. Example: BATCHECK<CR/LF>	None	BATTERY OK or BATTERY LOW
SETMODE	Sets remote mode. Allows access to remote control ESU analyzer functions (i.e., ESU output measurement, RF Leakage, etc.). Example: SETMODE:OUTPUT<CR/LF>	One (system mode) OUTPUT, RFLKG, AMMETER, or RARF.	*
EXITMODE	Exits currently selected mode and returns control to main RS-232 menu. Example: EXITMODE<CR/LF>	None	*
RDMETER	Reads measured ESU output variables. Depends on selected mode (see SETMODE above). Example: RDMETER<CR/LF>	None	*
RDCURRENT	Reads measured current from selected mode of operation. Example: RDCURRENT<CR/LF>	None	METER READINGS Reading is returned as a single text string in human readable format.
RDPOWER	Reads measured power. Note: This command is available only from OUTPUT mode. Example: RDPOWER<CR/LF>	None	MEASURED RF CURRENT A single numeric value is returned with units tag; e.g., 30 (w)

Command	Description	Parameters Required	Return Value (Response)
RDCRESTFACTOR	Reads crest factor from OUTPUT mode. Example: RDCRESTFACTOR<CR/LF>	None	CREST FACTOR A single numeric value is returned (CF is dimensionless); e.g., 2.0
RDKVPP	Reads peak–to–peak voltage in kilovolts. Example: RDKVPP<CR/LF>	None	PEAK–TO–PEAK VOLTAGE A single numeric value is returned with units tag; e.g., 1.0 (kV)
SETLOAD	Sets 454A load to desired setting from 50 to 1550 Ω in 50–Ω steps. Example: SETLOAD:300<CR/LF>	One (load value: 50-1550) *(RFLKG only: OPEN/CLOSED)*	*
RDLOAD	Reads currently selected load value. Example: RDLOAD<CR/LF>	None	LOAD VALUE XXXX (Ω)
SETELECTRODE	Selects electrode for RF leakage measurement. *Note: This command is only available from RFLKG mode (refer to SETMODE).* Example: SETELECTRODE:DISP<CR/LF>	One (electrode) ACTIVE or DISP	*
RDELECTRODE	Reads currently selected electrode. *Note: This command is available only from RFLKG mode (refer to SETMODE).*	None	ELECTRODE ACTIVE/DISP
RDMODE	Reads currently selected 454A mode.	None	MODE=XXXX
SETAUXPORT	Parallel writes to auxiliary port relay. Parameter value is written to port.	One (value) 0-32	*
SETAUXRELAY	Sets or clears specified auxiliary port relay. Example: SETAUXRELAY:1,SET Set auxiliary relay #1 Example: SETAUXRELAY:3,CLR Clear auxiliary relay #3	Two (relay) (status) 1–5 SET/CLR	*
SETREM	Sets the RARF or RA Module to simulate resistance for the REM/ARM circuit.	None	*
SETCUT	Sets the RARF Module to the Cut Return Fault Test. The output is a capacitance that will PASS or FAIL the ESU.	Fault No Fault	*
SETCOAG	Sets the RARF Module to the Coag Return Test. The output is a capacitance that will PASS or FAIL the ESU.	Fault No Fault	*

Oscilloscope Output

Connect your oscilloscope to the Model 454A by attaching the cable to the OSCILLOSCOPE OUTPUT jack on the left side of the top panel. Adjust the oscilloscope to view a waveform. A typical waveform is shown in the following figure.

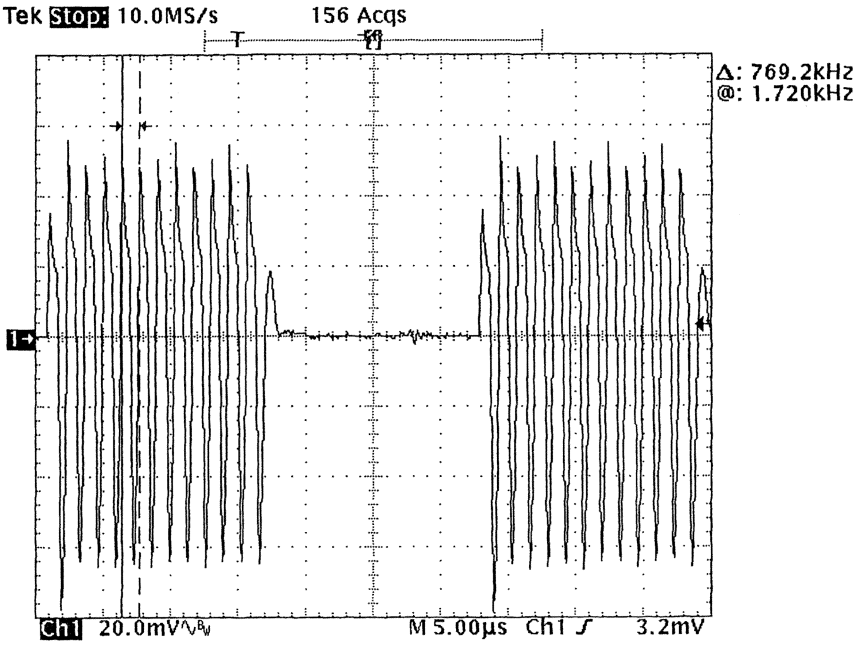


Figure 3 - 25. *This is a typical oscilloscope reading.*

Chapter 4

Performance Check

In this chapter—

- *Overview*
- *Procedure*

Overview

This check is usually performed to validate the operation of the Model 454A Electrosurgical Analyzer.

To start this check we suggest you connect the printer to the Model 454A as described in the *Connecting the Printer* section of Chapter 2, *Installation.*

Procedure

Follow the *Power–Up Initialization* procedure described in Chapter 3, *Operation.* The initialization process that is within the Model 45A checks automatically for proper performance of the measurement circuitry.

Next go to the *Menu System* (Chapter 3) and complete the *Tutorial Exercise* section.

Press F3 to enter UTILITY mode then press F4 to begin SYSTEM verification. A series of self–tests checks for proper performance of the Keyboard, RS-232, Thermal Converter, Display, Printer, and Firmware Revision Number.

Note

You must have the equipment connected to the RS-232 port and the printer port to check these data links.

Perform the tests as follows:

- **Keyboard Test**

  Highlight and select Kbd Test from the SYSTEM UTILITIES menu.

  Press each key on the keyboard (saving Esc for last) and verify that the software reads and responds to each keypress correctly.

  Press the Esc key twice to exit after completion of this test.

- **RS-232 Test**

  Highlight and select RS232 Test from the SYSTEM UTILITIES menu.

  Connect an RS-232 controller device to the 454A RS-232 port.

  Press F2 on the 454A keyboard to view the current COM port status (i.e., Baud rate, Start, Stop, Parity, etc.).

  Set your controller device to correspond to these settings.

  Test the 454A transmitter by pressing F1 to send a test message. Incoming serial data will be enumerated on the 454A display screen.

  Press Esc key when finished to return to the UTILITIES menu.

- **Thermal Converter Test**

  Highlight and select Thml Conv Test from the SYSTEM UTILITIES menu. This test will check the buffer amplifier gain at each setting and check the thermal converter offset and gain.

  A pass/fail result will be displayed.

- **Display Test**

  Highlight and select Disp Test from the SYSTEM UTILITIES menu. Each pixel of the graphics display plane will light up followed by a prompt to press any key after completion.

  Verify that all pixels light.

- **Printer Test**

  Connect a Centronics parallel printer to the 454A printer port.

  Highlight and select Print Test from the SYSTEM UTILITIES menu. A test message will be sent to the printer.

  Take printer off-line and test again.

  A message should appear prompting you for a response.

Chapter 5

Modules

In this chapter—

Return Fault Monitor

Many ground–referenced ESUs employ a return fault system that continuously compares the active electrode current to the dispersive electrode current. If the two currents differ excessively, as when an alternate ESU current path exists between the patient and ground, then a return fault condition exists. This condition is considered hazardous because it can cause burns on the patient.

An ESU that is equipped with a return fault system sounds an alarm when such a condition exists. This auxiliary module simulates a return fault condition and a borderline non-return fault condition, thereby providing a way to check the proper operation of the ESU Return Fault Monitor.

Note

The Return Fault Monitor testing capabilities of this auxiliary module are specifically designed for the Valleylab Force 4B Electrosurgical Generator.

More information concerning a REM/ARM system or a Return Fault Monitor can be found in the *Operation* chapter of this manual.

Specifications

REM/ARM Contact Resistance	0 - 200 Ω, ±5%
Resistance Measurement Accuracy	±1.5% of reading or ±1.5 Ω whichever is greater
Return Fault Circuit Parameters	
No–Fault Capacitance	50 pF, ±20% (10 kV)
Fault Capacitance	150 pF, ±20% (10 kV)
No–Fault Resistance	1.0 kΩ, ±3% (25 W)
Fault Resistance	500 Ω, ±3% (25 W)

Installation

To install the Model 454A REM/ARM & Return Fault Test Module (hereafter referred to as the Fault Module) follow these instructions:

1. Put the ESU in standby mode or turn it off.

2. Disconnect any ESU electrodes that are connected to the Model 454A.

3. Plug the Fault Module into the Model 454A top panel as shown in the illustration below. Ensure that all mating connections (banana plugs and the DB15 connector) are secure.

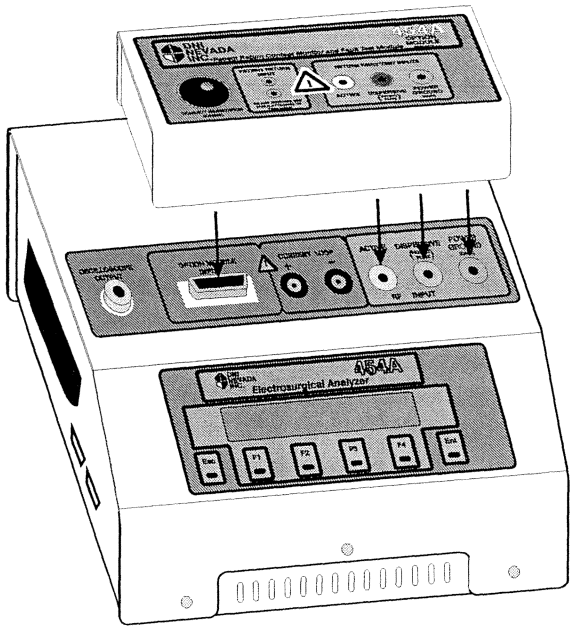


Figure 5 - 1. *Use this as a guide to module installation.*

Operating Instructions

With the Fault Module installed as shown in Figure 5-1 and the power turned on to the Model 454A, you are ready to begin testing.

The REM/ARM system test and the Return Fault Monitor tests follow.

REM/ARM System Test Procedure

1. Connect ESU to Fault Module.

Use the supplied REM test cable (DNI Part # 3010-0435) to connect the ESU under test to the Fault Module.

Connect the ESU dispersive output on the Model 454A to the PATIENT RETURN INPUT on the Fault Module. Do not connect the ESU active output on the Model 454A to the Fault Module for this test.

CAUTION

The REM/ARM system test does not require activation of the ESU generator output. Activating the ESU while it is connected to the PATIENT RETURN INPUT on the Fault Module may result in damage to the REM/ARM system test circuitry.

2. Select REM/ARM Test from the Model 454A menu.

With the 454A turned on, press Esc until the MAIN MENU is displayed.

Select MANUAL from the MAIN MENU. Then, select AUXILIARY from MANUAL mode.

You will see a prompt requesting you to select a test procedure. Press the REM/ARM function key.

Note

If the menu items do not appear as just described, check for proper installation of the Fault Module as discussed in *Installation* for this module.

3. Initialize contact resistance.

To initialize contact resistance rotate the CONTACT RESISTANCE knob on the top panel of the Fault Module to its full clockwise position.

With the knob in this position the contact resistance will equal 200 Ω. This should cause the ESU alarm to trigger.

4. Determine the upper "safe" limit.

Next, determine the upper "safe" limit by slowly rotating the knob counterclockwise to reduce the contact resistance. Rotate this knob until the REM/ARM alarm indicator lamp on the ESU turns off.

Now, press and hold the READ function key on the Model 454A to measure the contact resistance. The alarm should trigger while pressing the READ function key.

Release the READ function key when the measurement is complete.

5. Determine the lower "safe" limit.

Next, determine the lower "safe" limit by continuing to reduce the contact resistance until the ESU alarm is triggered.

Press and hold the READ function key to measure this lower limit.

Release the READ function key when the measurement is complete.

6. **Check the adaptive alarm** (for adaptive ESU REM/ARM systems only).

   a. Increase the contact resistance until the alarm light turns off.

   b. Press the READ function key to measure the contact resistance.

   c. Release the READ function key.

   d. Continue to increase the contact resistance until the ESU alarm is triggered.

   e. Measure the resistance and observe that the alarm lamp turns off after releasing the READ function key.

   f. Repeat steps **d** and **e** until the upper safe limit is reached.

Note

Steps **4** through **6** describe events that occur with a properly operating REM/ARM system. If the alarm fails to trigger or fails to turn off during this procedure, then a possible problem exists with the ESU REM/ARM system.

Note

Specific ESU manufacturers may require or specify a test protocol that differs from that just described. Refer to the ESU operator/service manual for instructions specific to the ESU under test.

Return Fault Monitor Test Procedure

There are two types of Return Fault Monitor tests available with the Fault Module:

- Resistive
- Capacitive

These tests are designed specifically for the Valleylab Force 4B Electrosurgical Generator.

Note

Other makes and models of ESUs may be tested with this unit. Consult the operator/service manual for the ESU under test for details regarding the Return Fault test procedure before proceeding further.

Both the resistive and capacitive tests can be described as PASS/FAIL or GO/NO-GO type tests.

For a PASS condition, a return fault condition is simulated that is large, but not large enough to trigger the alarm on the ESU. A low–level of capacitively–coupled RF current flows to ground in a properly operating ESU due to the use of accessory cables, etc. These PASS or NO FAULT tests ensure that the ESU does not activate nuisance alarms during use.

For a FAIL condition, the Fault Module triggers the ESU return electrode monitor alarm.

The combined PASS/FAIL tests allow the operator to test for the proper function of the ESU Return Fault alarm.

Note

For details and the specific component values used for each of these tests, please refer to the appropriate *Theory of Operation* section in the *454A Service Manual.*

1. Connect ESU to Fault Module.

Connections for the Return Fault Monitor tests differ from those required for the REM/ARM system test procedure. Connect the test leads as indicated below.

Note

Refer to the *Valleylab 4B Service Manual* for more information about calibration test values and procedures.

a. Connect the banana–plug ends of all three leads to the corresponding (color–coded) top–panel banana jacks of the module.

b. Connect the green alligator clip to the ground point on the back panel of the Valleylab Force 4B ESU.

c. Connect the non-REM 2-pin plug (clear wire) to the PATIENT return electrode receptacle used for MONOPOLAR procedures on the Valleylab Force 4B ESU front panel.

d. Connect the yellow banana plug to the banana receptacle that is located at the far left of the ACCESSORY connector within the MONOPOLAR section of the front panel.

Additional Valleylab Force 4B connections:

e. Connect the Valleylab monopolar footswitch to the rear panel receptacle. This 4-pin receptacle accepts a two-treadle footswitch connector.

f. Use the footswitch to activate the CUT and COAG functions on the ESU as required during the test sequence. Do not connect any other test leads to the ESU during these tests.

Note

The internal resistive/capacitive component values and circuit configurations have been selected to satisfy only the basic preventive maintenance (PM) requirements of the Valleylab Force 4B Electrosurgical Unit.

2. Perform CUT SIDE (resistive) Return Fault Test.

a. Press Esc repeatedly to return to the MAIN MENU.

b. Press the MANUAL function key, then the AUXILIARY key, followed by the CUT SIDE key.

c. Observe the Model 454A display. Function keys F1 and F2 provide the selection of test conditions. Pressing F1 establishes a NO-FAULT condition for the test. Pressing F2 establishes a FAULT condition for the test.

d. Activate CUT on the ESU under the NO-FAULT condition. The ESU alarm should not trigger.

e. Repeat step **d** after pressing F2 to establish a FAULT condition. The ESU alarm should trigger.

3. Perform COAG SIDE (capacitive) Return Fault Test.

a. Use these cables to connect the ESU and limit the amount of stray capacitance. Note that stray capacitance affects the results of the PASS/FAIL or GO/NO–GO type tests.

DNI Part #	Color	Description
9501-0057	Green	Banana plug-to-alligator clip
3010-0436	Blue/Clear	Non-REM 2-pin plug-to-banana plug
9501-0058	Yellow	Banana plug-to-banana plug

b. COAG SIDE tests are performed in the same manner as CUT SIDE tests except that COAG SIDE is selected from the test procedure menu and COAG on the ESU is activated.

c. Repeatedly press Esc to return to the MAIN MENU.

d. Press the MANUAL function key, then the AUXILIARY key, followed by the COAG SIDE key.

e. Observe the Model 454A display. Function keys F1 and F2 provide the selection of test conditions. Pressing F1 establishes a NO-FAULT condition for the test. Pressing F2 establishes a FAULT condition for the test.

f. Activate COAG on the ESU under the NO-FAULT condition. The ESU alarm should not trigger.

g. Repeat step **f** after pressing F2 to establish a FAULT condition. The ESU alarm should trigger.

Note: Specific ESU manufacturers may require or specify a test protocol that differs from that described above. Refer to the operator/service manual of the ESU under test for instructions specific to that ESU.

Autosequences

Autosequences can incorporate both the REM/ARM system test and the Return Fault Monitor tests with firmware versions 2.00 or greater installed in the Model 454A Analyzer.

Note

For more information on autosequence programming, refer to the *Auto Mode* section of the *Operating Instructions,* which is found in *Operation,* Chapter 3.

Editing an Autosequence

Treat all Model 454A Auxiliary Test Modules, including the Fault Module, in the same manner when designing an autosequence.

Begin designing an autosequence by selecting AUXILIARY as the test type. After selecting AUXILIARY, choose the specific auxiliary test for your autosequence step.

- REM TEST for REM/ARM system testing.
- RES RETFLT for CUT SIDE Return Fault tests.
- CAP RETFLT for COAG SIDE Return Fault tests.

Running an Autosequence

When you run an autosequence containing REM/ARM system test or Return Fault test steps, you will see a prompt (at the time of the test) to install the Fault Module and connect the ESU. When you observe this prompt, follow the steps listed below:

1. Plug the Fault Module into the Model 454A top panel while the power is on, then press F2 to continue.

2. Connect the ESU active and dispersive electrodes as instructed on the Model 454A display.

Note

Connections differ for the REM/ARM system test and the Return Fault Monitor tests.

CAUTION

Confirm proper connection to the Fault Module.

3. Press Ent to begin the test.

4. Perform the test as described in the *Operating Instructions* for this test module. Select the REM/ARM test or one of the Return Fault tests at the prompt.

5. Press Ent when the test is complete. Write down the test result (PASS or FAIL).

6. Enter the test result when prompted by the Model 454A.

   If desired, you can repeat the autosequence step at this time.

7. Once you've entered the test result, control advances to the next autosequence step. If the next step does not require the Fault Module, the display prompts its removal. Connect the ESU active and dispersive electrodes directly to the Model 454A inputs.

Note

For *Test and Calibration, Theory of Operation, Parts Lists and Schematics,* refer to the *454A Service Manual.*

454A Auxiliary Test Module: REM/ARM

General Information

The Model 454A REM/ARM Module tests a safety feature that is incorporated into many ESUs currently used in hospitals. This safety feature is the Patient Return Contact Monitor: Valleylab has named it the Return Electrode Monitor (REM) and Aspen Labs has named it the Aspen Return Monitor (ARM).

A typical REM/ARM (Patient Return Contact Monitor) system consists of a circuit built into the ESU that monitors the contact between the dispersive electrode pad and the patient. When the patient–to–dispersive contact resistance falls outside of a specified range of safety, an audible alarm triggers on the ESU and warns the surgeon of a possible failure in the patient–to–dispersive contact. This module is a variable load that provides a way of verifying the proper operation of an ESU's REM/ARM system.

Additional information concerning the REM/ARM system is located in the operating manual of the ESU you are using.

Specifications

REM/ARM Contact Resistance	0 - 200 Ω, ±5%
Resistance Measurement Accuracy	±1.5% of reading or ±1.5 Ω whichever is greater

Installation

To install the Model 454A REM/ARM Module, follow the instructions below:

1. Put the ESU in standby mode or turn off the power.
2. Turn off the Model 454A.

Note

Leave the Model 454A power on when in the autosequence mode.

3. Disconnect any ESU electrodes that are connected to the Model 454A.
4. Plug the REM/ARM Module into the Model 454A top panel as shown in the illustration below. Ensure that all mating connections (banana plugs and the DB15 pin connector) are secure.

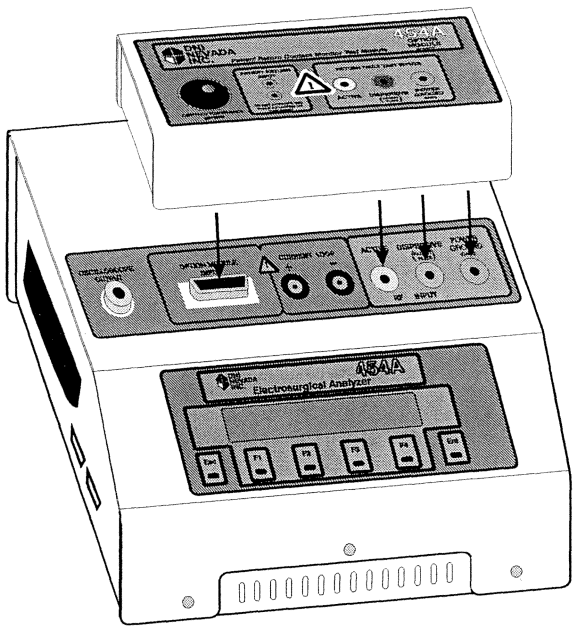


Figure 5 - 2. *Use this illustration to guide your module installation.*

Operating Instructions

With the REM/ARM Module installed as described in the *Installation* section and the power turned on to the Model 454A, you are ready to begin testing. Details of the REM/ARM system test follow:

1. Connect ESU to REM/ARM Module.

Use the supplied REM test cable (DNI Part # 3010-0435) to connect the ESU under test to the REM/ARM Module.

Connect the ESU dispersive output on the Model 454A to the PATIENT RETURN INPUT on the REM/ARM Module.

Do not connect the ESU active output on the Model 454A to the REM/ARM Module for this test.

CAUTION

The REM/ARM system test does not require activation of the ESU generator output. Activating the ESU while it is connected to the PATIENT RETURN INPUT on the REM/ARM Module may result in damage to the REM/ARM system test circuitry.

2. Select REM/ARM test from the Model 454A menu.

With the Model 454A turned on, press Esc until the MAIN MENU is displayed. Select MANUAL from the MAIN MENU. Then, select AUXILIARY from MANUAL mode. A prompt will be displayed requesting you to select a test procedure. Press the REM/ARM function key. If the menu items do not appear, as just described, check for proper installation of the REM/ARM Module as discussed in the *Installation* section for this module.

3. Initialize contact resistance.

To initialize contact resistance rotate the CONTACT RESISTANCE knob on the top panel of the REM/ARM Module to its full clockwise position. With the knob in this position, the contact resistance will equal 200 Ω. This should cause the ESU's alarm to trigger.

4. **Determine the upper "safe" limit.**

   Determine the upper "safe" limit by rotating the knob counter-clockwise, slowly, to reduce the contact resistance. Rotate this knob until the REM/ARM alarm indicator lamp on the ESU turns off.

   Press and hold the READ function key on the Model 454A to measure the contact resistance. The alarm should trigger while pressing the READ function key.

   Release the READ function key when the measurement is complete.

5. **Determine the lower "safe" limit.**

   Determine the lower "safe" limit by continuing to reduce the contact resistance until the ESU's alarm is triggered.

   Press and hold the READ function key to measure this lower limit.

   Release the READ function key when the measurement is complete.

6. **Check the adaptive alarm** (for ESUs with adaptive REM/ARM systems only).

   a. Increase the contact resistance until the alarm light turns off.

   b. Press the READ function key to measure the contact resistance.

   c. Release the READ function key.

   d. Continue to increase the contact resistance until the ESU's alarm is triggered.

   e. Measure the resistance and observe that the alarm lamp turns off after releasing the READ function key.

   f. Repeat preceding steps **d** and **e** until the upper safe limit is reached.

Note

Steps **4** through **6** describe events that occur with a properly operating REM/ARM system. If the alarm fails to trigger or fails to turn off during this procedure, then a possible problem exists with the ESU's REM/ARM system.

Some ESU manufacturers may require or specify a test protocol that differs from that described above. Therefore, we recommend that you read the operating manual of the ESU under test and follow the instructions specific to the ESU under test.

Autosequences

The Model 454A Electrosurgical Analyzer with firmware versions 2.00 or greater installed can incorporate the REM/ARM system test.

Note

For information on operating and programming autosequences, refer to the *Auto Mode* section in Chapter 3, *Operation,* of this manual.

Included in this document are specifics for this module.

Programming an Autosequence

From the MAIN MENU press F2 (AUTO), press F2 (EDIT), and then press F2 (AUTOSEQ).

Select an autosequence and edit the name for the autosequence by pressing Ent.

Next there is a prompt to Select TEST TYPE: AUXILIARY. Press F2 (CONTINUE) to program the autosequence.

In AUXILIARY use REM TEST for REM/ARM system testing.

Running an Autosequence

When running an autosequence that contains a REM/ARM system test step, a prompt is displayed (at the time of the test) to install the REM/ARM Module, and then you are to connect the ESU. Read and follow the *Installation* and *Operating Instructions* for this module.

Note

The REM test cable (DNI Part # 3010-0435) must be connected between the REM/ARM module and the ESU 2-pin dispersive electrode connector to conduct this test.

The test procedure:

1. Select and run the desired autosequence as described in the *Auto Mode* section of Chapter 3 in this manual.

2. When a REM/ARM system test is programmed for use during the autosequence, the following prompt is displayed on the Model 454A:

```
RETURN CONTACT MONITOR TEST
Install REM/RETURN FAULT module
```

   This test is skipped by pressing F1 or conducted by pressing F2.

3. After pressing F2, you are prompted to connect the REM test cable (DNI Part # 3010-0435) between the REM/ARM Module and the ESU dispersive electrode.

4. Press Ent to continue.

5. The REM/ARM system test is now active and resistance values up to 200 Ω are to be applied across the ESU 2-pin dispersive electrode connector to check this function. Please refer to the *Operating Instructions* for this REM/ARM Module.

6. Perform the REM/ARM system tests and press Ent on the Model 454A to document the test results.

The following prompt is displayed on the Model 454A:

STEP ##	AUXILIARY TEST
Enter result now	

The REM/ARM system test can be repeated by pressing F2.

Results of the REM/ARM system test are

- SKIPPED if the test is skipped as described in step **2**,
- documented as PASS by pressing F3, or
- documented as FAIL by pressing F4.

.

7. The autosequence now advances to the next preprogrammed step.

If the REM/ARM Module is not required for the next autosequence step, the operator is prompted to remove the REM/ARM Module. Connect the test leads between the Model 454A and the ESU under test as required.

454A Auxiliary Test Load Modules— 10, 25, 35, 50, 75, 125, 330, 2000, and 5000 Ohm

General Information

The Model 454A measures and displays the following ESU output parameters: power, current, crest factor, and peak–to–peak voltage.

Load modules from DNI Nevada connect to the Model 454A providing an ESU load value that is not otherwise available when using the Model 454A.

The following load modules are available for the Model 454A:

- 10–Ohm Test Load Module
- 25–Ohm Test Load Module
- 35–Ohm Test Load Module
- 50–Ohm Test Load Module
- 75–Ohm Test Load Module
- 125–Ohm Test Load Module
- 330–Ohm Test Load Module
- 2000–Ohm Test Load Module
- 5000–Ohm Test Load Module

Note

For DNI part numbers, see *Accessories, Optional* in Chapter 1, *General Information.* In addition, see the current Price List for availability, part numbers, and price.

Specifications—Load Resistance

10–Ohm Test Load Module:	10 Ω ±5%, 100 watts maximum
25–Ohm Test Load Module:	25 Ω ±5%, 100 watts maximum
35–Ohm Test Load Module:	35 Ω ±5%, 100 watts maximum
50–Ohm Test Load Module:	50 Ω ±2%, 100 watts maximum
75–Ohm Test Load Module:	75 Ω ±5%, 100 watts maximum
125–Ohm Test Load Module:	125 Ω ±5%, 300 watts maximum
330–Ohm Test Load Module:	330 Ω ±5%, 300 watts maximum
2000–Ohm Test Load Module:	2000 Ω ±5%, 300 watts maximum
5000–Ohm Test Load Module:	5000 Ω ±5%, 300 watts maximum

Installation

Follow these instructions to install any of the Model 454A Test Modules:

1. Put the ESU in standby mode or turn it off.

2. Turn power off to the Model 454A or, if in autosequence mode, leave power on.

3. Disconnect any ESU electrodes that are connected to the Model 454A.

4. Plug the load module into the Model 454A top panel as shown in the illustration below. Ensure that all mating connections (banana plugs and the DB15 connector) are secure.

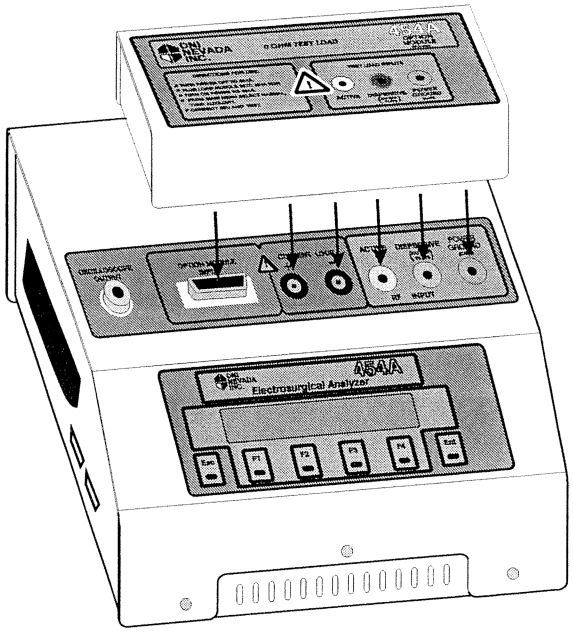


Figure 5 - 3. *This illustrates the proper load module installation.*

Operating Instructions

With the load module installed, as shown in Figure 5-3, and the power turned on to the Model 454A, you are ready to begin testing.

1. **Connect ESU to load module.**

   Connect the ESU active and dispersive outputs to the load module, just as if you were using the Model 454A without a module.

2. **Set up the Model 454A.**

   With power applied to the Model 454A, press Esc until the MAIN MENU appears.

   Select MANUAL from the MAIN MENU, then select AUXILIARY from MANUAL mode. With the load module installed, the GENERATOR OUTPUT utility appears on the display.

Note

If these menu items do not appear, ensure that the proper module is installed.

3. **ESU output measurements.**

   Select the desired ESU waveform, and set the ESU output level.

   Energize the ESU to obtain a reading.

   The Model 454A displays all measured values.