BC Biomedical
A UNIT OF BC GROUP INTERNATIONAL, INC.

ELECTRICAL SAFETY ANALYZER

SA-2005

SA-2005-INTL

SA-2005-AUS

USER MANUAL

BC BIOMEDICAL
SA-2005 SERIES
TABLE OF CONTENTS

This User Manual covers the following units:

- SA-2005 & SA-2005-R
- SA-2005-INTL & SA-2005-INTL-R
- SA-2005-AUS & SA-2005-AUS-R

WARNING - USE

The SA-2005 is intended for testing only and should never be used in diagnostics, treatment or any other capacity where they would come in contact with a patient.

WARNING - CONNECTIONS

All connections to patients must be removed before connecting the DUT to the SA-2005. A serious hazard may occur if the patient is connected when testing with the SA-2005. Do not connect any leads from the patient directly to the SA-2005 or DUT while it is powered by the SA-2005.

WARNING - MODIFICATIONS

The SA-2005 is intended for use within the published specifications. Any application beyond these specifications or any unauthorized user modifications may result in hazards or improper operation.

WARNING - CLEANING

Disconnect Line Power to the SA-2005 before attempting to clean it. Do not immerse. The SA-2005 should be cleaned by wiping gently with a damp, lint-free cloth. A mild detergent can be used if desired.

WARNING - LIQUIDS

Do not submerge or spill liquids on the SA-2005. In the event of a spill onto the SA-2005, Do not operate the SA-2005 regardless of fluid type.

WARNING - VOLTAGE

When the SA-2005 is in Lead Isolation mode and the ISO key is depressed, 110% of line voltage is applied to the Patient lead connectors and/or External test leads. Although this voltage is applied through an internal current limiting resistance of 121 kΩ (per standard test specifications), Do not touch the test leads, connections or DUT while the ISO key is depressed.

CAUTION - USAGE

The SA-2005 is not a continuous duty device, it is intended for short duration testing within the current limits and duty periods specified. Do not leave the DUT connected to the SA-2005 for extended time periods.
Do not to drop the SA-2005.

CAUTION - ENVIRONMENT

Exposure to environmental conditions outside the specifications can adversely affect the performance of the SA-2005. Allow SA-2005 to acclimate to specified conditions for at least 30 minutes before attempting to operate it.

CAUTION - INSPECTION

The SA-2005 should be inspected before each use for obvious signs of abuse or wear. The SA-2005 should not be used and should be serviced if any parts are in question.

CAUTION - SERVICE

The SA-2005 is intended to be serviced only by authorized service personnel. Troubleshooting and service procedures should only be performed by qualified technical personnel.

CAUTION - FUSE

Only replace the SA-2005 fuse with the specified type and rating.

NOTICE – SYMBOLS

Symbol	Description
	**Caution** (Consult Manual for Further Information)
	**Electrical Caution** (Consult Manual for Further Information)
	Per European Council Directive 2002/95/EC, do not dispose of this product as unsorted municipal waste.

NOTICE – ABBREVIATIONS

Amp	**Ampere(s)**
AAMI	**Association for the Advancement of Medical Instrumentation**
C	**Celsius**
cm	**centimeter(s)**
°	**degree(s)**
DUT	**Device Under Test**
Euro	**European**
ft	**feet**
FS	**Full Scale**
Hz	**hertz**
IEC	**International Electrotechnical Commission**
ISO	**Isolation**
kg	**kilogram(s)**
kHz	**kilohertz**
kΩ	**kilohm(s)**
LED	**Light Emitting Diode**
MAP	**Mains on Applied Parts**
MHz	**Megahertz**
µA	**microampere(s)**
mA	**milliampere(s)**
mm	**millimeter(s)**
NEMA	**National Electrical Manufacturers Association**
Ω	**Ohm(s)**
PC	**Personal Computer**
Lbs	**pounds**
RH	**Relative Humidity**
RMS	**Root Mean Square**
USA	**United States of America**
V	**Volt(s)**
VA	**Volt-Ampere(s)**
VAC	**Volt(s) Alternating Current**
W	**Watt(s)**

NOTICE – PERFORMING TESTS

REFER TO DUT MANUFACTURER'S SERVICE MANUAL FOR TEST PROCEDURES AND MEASUREMENT LIMITS.

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NOTICE – CONTACT INFORMATION

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BC BIOMEDICAL
SA-2005 SERIES
ELECTRICAL SAFETY ANALYZER

The Model SA-2005 Series is a Microprocessor based Electrical Safety Analyzer. It allows for a multitude of tests to be performed on a device using the same unit and lead connections. The following are highlights of some of the main features:

SA-2005:

- LED STATUS INDICATORS
- AUDIO FEEDBACK
- TOUCH CONTROL KEYS – NO KNOBS
- 5 UNIVERSAL PATIENT LEAD INPUTS
- HIGH IMPACT PLASTIC CASE
- LINE VOLTAGE MEASUREMENT
- DEVICE UNDER TEST CURRENT MEASUREMENT
- EARTH / GROUND LEAD RESISTANCE
- EARTH / GROUND LEAKAGE CURRENT
- ENCLOSURE / CHASSIS LEAKAGE CURRENT
- EXTERNAL RESISTANCE
- EXTERNAL LEAKAGE CURRENT
- SOURCE WIRING INTEGRITY MONITOR
- TRUE RMS MEASUREMENTS
- AAMI ES1-1993 or IEC 601 SELECTABLE TEST LOADS
- 90 TO 264 VAC OPERATION
- 20 AMP RATING (SA-2005 and SA-2005-INTL Models)
- 10 AMP RATING (SA-2005-AUS Models)
- SELF TEST POINTS
- EXTERNALLY REPLACEABLE GROUND FUSE
- AUTOMATIC LOAD REVERSAL DELAY
- PATIENT LEAD TO LEAD LEAKAGE CURRENT
- PATIENT LEAD TO EARTH / GROUND LEAKAGE CURRENT
- PATIENT ISOLATION LEAKAGE CURRENT
- EXTERNAL ISOLATION LEAKAGE CURRENT

AVAILABLE MODELS:

- SA-2005 – STANDARD MODEL WITH HOSPITAL-GRADE NEMA 5-15P LINE PLUG AND HOSPITAL-GRADE NEMA 5-20R DUT TEST RECEPTACLE FOR USE IN THE US AND OTHER COMPATIBLE COUNTRIES

- SA-2005-INTL – INTERNATIONAL MODEL, IEC C20 RECEPTACLE PIGTAIL (MUST USE COUNTRY-SPECIFIC LINE CORD – SEE ACCESSORIES SECTION) AND UNIVERSAL DUT TEST RECEPTACLE THAT WORKS WITH THE FOLLOWING COUNTRY-SPECIFIC PLUGS:
  - NEMA 5-15P, NEMA 5-20P, NEMA 6-15P and NEMA 6-20P (US/NORTH AMERICA)
  - UK1-13P and UK3-5P (UK)
  - SW1-10P (SWITZERLAND)
  - IT1-10P (ITALY)
  - IS1-16P (ISRAEL)
  - JA1-15P (JAPAN)
  - EU1-16P (EURO) CEE 7/7 “SCHUKO” (NOTE: MUST USE SCHUKO GROUNDING ADAPTER TO PERFORM LEAKAGE MEASUREMENTS, SEE OPTIONAL ACCESSORIES SECTION)
  - DE1-13P (DENMARK) (NOTE: NO EARTH/GROUND PIN, THEREFORE LEAKAGE MEASUREMENTS NOT APPLICABLE)
  - EUROPLUG CEE 7/16 (NOTE: NO EARTH/GROUND PIN, THEREFORE LEAKAGE MEASUREMENTS NOT APPLICABLE)

- SA-2005-AUS – AUSTRALIAN MODEL, AU1-10P LINE PLUG AND AU1-10R DUT TEST RECEPTACLE FOR USE IN AUSTRALIA/NEW ZEALAND AND OTHER COMPATIBLE COUNTRIES

OPTIONS

- -R ADDS RS-232 SERIAL COMMUNICATIONS
  AVAILABLE MODELS:
  - SA-2005-R
  - SA-2005-INTL-R
  - SA-2005-AUS-R

STANDARD ACCESSORIES

- BC20-20110 8 FT CHASSIS TEST LEAD (BLACK)
- BC20-30107 SOFT CARRYING CASE
- UF-0250-01 REPLACEMENT GROUND LEG FUSE
- BC20-204XX (SA-2005-INTL ONLY) – REFER TO PAGE 8

OPTIONAL ACCESSORIES

- BC20-20111 8 FT EXTERNAL TEST LEAD (RED)
- BC20-20112 16 FT CHASSIS TEST LEAD (BLACK)
- BC20-20113 16 FT EXTERNAL TEST LEAD (RED)

- BC20-20200 REPLACEMENT SA-2005-INTL DUT INTERNATIONAL RECEPTACLE ADAPTER
- BC20-20221 SCHUKO GROUNDING ADAPTER
- BC20-41337 RS-232 COMMUNICATIONS CABLE (DB-9M to DB-9F)
- BC20-41339 USB TO RS-232 ADAPTER
- CS-2000-U 1 AMP CURRENT SOURCE - USA/NORTH AMERICA
- CS-2000-E 1 AMP CURRENT SOURCE - EURO (SCHUKO)

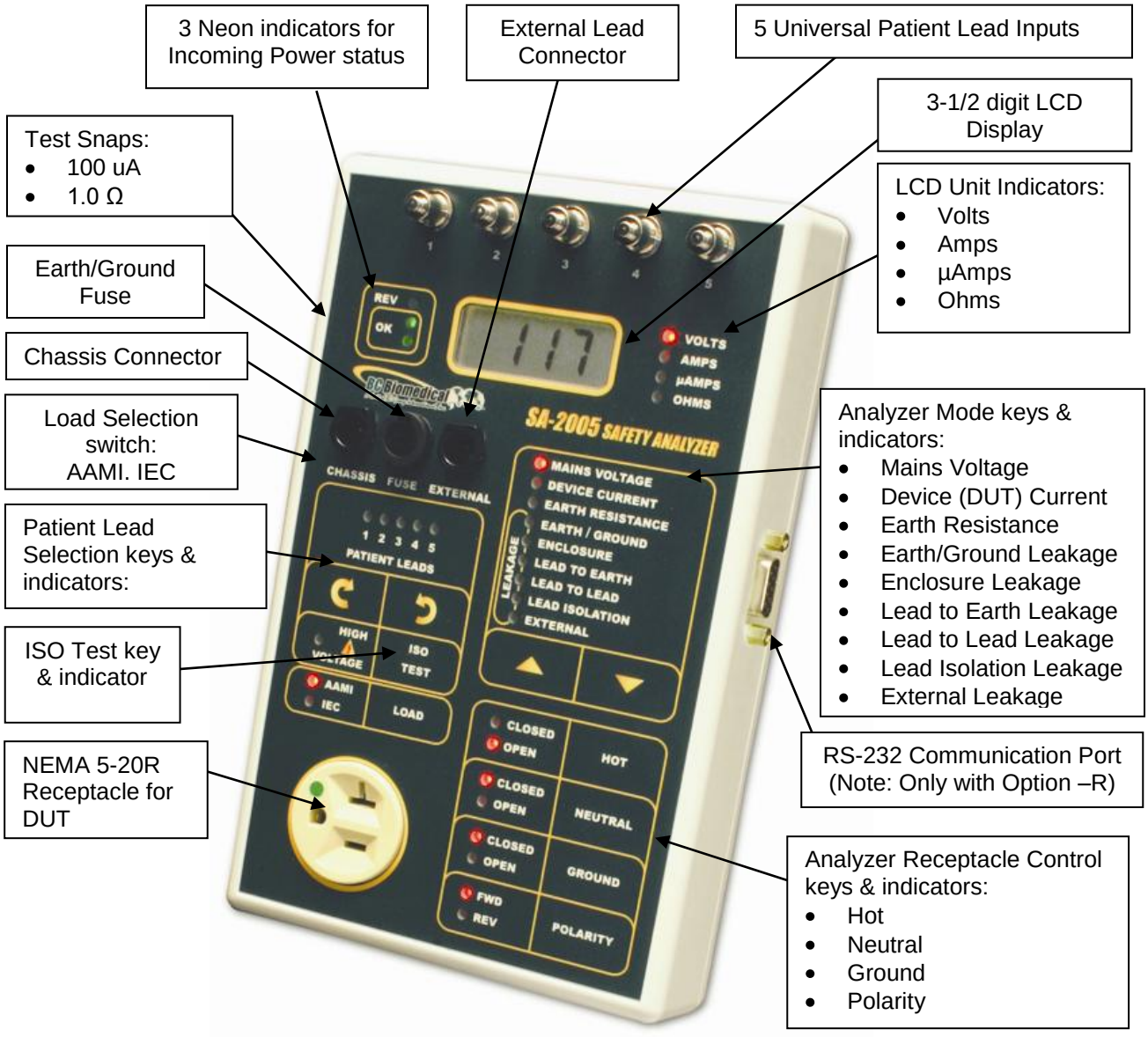
SA-2005-INTL LINE CORDS: (REFER TO PAGE 8 FOR DETAILS)

- BC20-20400 NEMA 5-20P PLUG LINE CORD (USA/NORTH AMERICA)
- BC20-20401 JA1-15P PLUG LINE CORD (JAPAN)
- BC20-20402 UK1-13P PLUG LINE CORD (UK)
- BC20-20403 CEE 7/7 “SCHUKO” PLUG LINE CORD (EURO)
  NOTE: INCLUDES BC20-20221 GROUNDING ADAPTER
- BC20-20409 BSS546A PLUG LINE CORD (INDIA/SOUTH AFRICA)
- BC20-20410 SW1-10P PLUG LINE CORD (SWITZERLAND)
- BC20-20412 IT1-10P PLUG LINE CORD (ITALY)
- BC20-20416 AUSTRALIA PLUG LINE CORD

LAYOUT

This section looks at the layouts of the SA-2005 Models and gives descriptions of the elements that are present.

For all models, the user controls all Analyzer functions via light touch keys. There is an audio click when any key is depressed, while a “Razz” or error tone consisting of a rapid succession of beeps is sounded if an invalid key is depressed. Analyzer modes and status are indicated by 29 LEDs as well as 3 Neon lamps. A 3-1/2 digit LCD display conveys DUT test results to the user.



SA-2005 Layout (SA-2005-R shown)

Universal International Receptacle for DUT

SA-2005-INTL Layout
(SA-2005-INTL-R shown)

Australian Receptacle for DUT

SA-2005-AUS Layout

The SA-2005-INTL and SA-2005-AUS Model Layouts are shown above, note that the only differences from the standard model are the Line cords and the DUT test Receptacles.

Note: The RS-232 connector isn't shown for the SA-2005-AUS above, but is an available option (see previous section).

Display

The main information in the system is presented in the 3-1/2 digit LCD display. This data is provided as simple meter readings with the measurement units indicated to the right by one of four LED indicators.

Function Selection

Nine LEDs and two keys make up the Function Selection Section. The keys are up and down arrows. When depressed, they step the Analyzer through the available options. The LED next to the currently selected option is illuminated.

Load Selection

The unit may either use the AAMI ES1-1993 or IEC 601 Test load for measurements. This is selected by the Load Selection switch.

Analyzer Test Receptacle Control

There are four keys and 8 LEDs in the Analyzer Test Receptacle Control Section. They allow the manual control of the power connections that are made to the DUT. Internally, a series of relays are switched by the microprocessor based on the keys that are depressed. The LEDs indicate the current state of the power connections to the Receptacle.

Note: The Forward/Reverse Polarity key has a safety delay feature, preventing damage to the internal relays and the DUT. When the key is depressed, the DUT power is disabled and the safety delay is activated. When this delay is complete, the internal relays switch the polarity to the DUT and apply power. This delay allows any reactive power stored in the DUT to self-discharge before the polarity is reversed.

Note: The unit will power up with the Neutral and Ground Closed, in Forward Polarity and with the Hot Open. It is recommended that the unit be returned to this condition when plugging and unplugging the DUT.

Patient Lead Control

There are five patient leads. During testing, it is necessary to select between these leads, select all of them and apply High Voltage to them. This section provides the control keys to do these test configurations and the LEDs to indicate the current state.

There is one LED and an internal relay for each lead. The LEDs and the markings below each LED indicate when that relay is on, thus selecting the indicated lead. The Up and Down arrow keys sequentially select each lead in order and scroll through from None, to 1-5 to All and around again.

To apply High Voltage to the leads, the “ISO” Test key is depressed. It is only active in the Lead Isolation mode. It is a momentary key so that High Voltage is only applied while the key is held down.

Power Outlet Indicators

Three Neon indicators help verify the polarity and wiring of the wall receptacle that the Safety Analyzer is plugged into.

Self-Test Snaps

There are two snaps on the side of the unit that allow for a quick self-test of the Analyzer. They provide a fixed 1.0 Ohm resistance to Earth/Ground and a 100 µAmp leakage current source to Earth/Ground when the Chassis lead is applied and the Analyzer set to the proper mode.

Connectors

There are two connectors for test cables on the unit. One is for the Chassis lead and the other is for one of two different leads used for external testing. The test cables simply plug into the sockets. There is a release pin on the cable plug that must be depressed to remove the cable.

Fuse

There is a fuse in the ground leg of the Analyzer Test Receptacle. This is to help prevent damage from excess ground current. It is located on the face for ease of replacement.

Test Receptacle

This receptacle is for the connection of the DUT. The Receptacle Rating depends on the specific Analyzer model. SA-2005 models use a Hospital Grade North American/USA standard NEMA 5-20R receptacle rated 20 Amps @ 125 VAC. SA-2005-INTL models use a universal international receptacle rated 20 Amps @ 250 VAC. SA-2005-AUS models use an Australian-specific AU1-10R receptacle rated 10 Amps @ 240 VAC. An external patch cord may be necessary to connect devices utilizing different types of plugs to the Analyzer receptacle.

Power Cord

The Power Cord, which is connected internally, provides power to both the Safety Analyzer and the DUT through the Test Receptacle. The Power Cord varies depending on the Analyzer model. SA-2005 models use a NEMA 5-15P plug designed to plug into a NEMA 5-15R or 5-20R Receptacle. SA-2005-INTL models have a short IEC C20 plug for which a country-specific adapter cable must be connected – See the following section for this information. SA-2005-AUS models use an Australian AU1-10P plug intended for operation with Australian and New Zealand AU1-10R Receptacles.

Communications (Optional)

On Analyzer models with the –R option, a DB-9 RS-232 Communications port is provided to interface the analyzer with a PC. Data from the Analyzer display may be transferred over this communications link as well as full control over all analyzer functions and settings. For further details, see the Communication Protocol section.

TESTING

The SA-2005 Models allow the user a great deal of flexibility in testing. Any of the basic tests can be run and in almost any sequence. The information in this section presents a systematic approach that is just one way to proceed. It is only presented as a guide and it is the responsibility of the user to establish which tests are required.

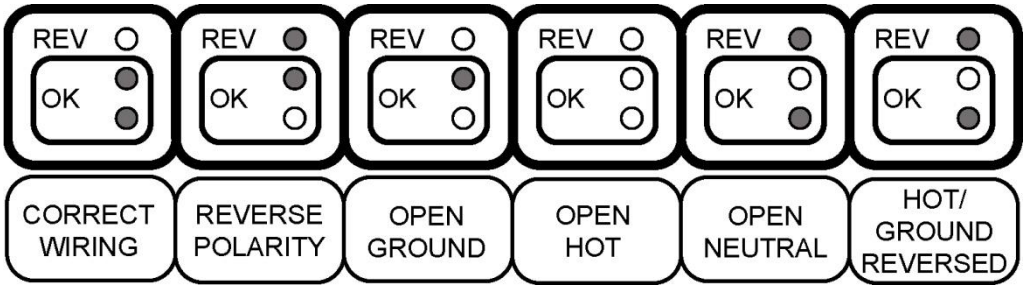
NOTICE – PERFORMING TESTS

REFER TO DUT MANUFACTURER'S SERVICE MANUAL FOR TEST PROCEDURES AND MEASUREMENT LIMITS.

The Analyzer requires a good Earth/Ground connection for operation. It should be plugged into a "Hospital Grade" receptacle where available. This is necessary for both valid test results and personal safety.

Power Receptacle Confirmation

Once plugged in, the first step is to ensure that the wall receptacle the Safety Analyzer is plugged into is wired properly (120 VAC Non-Isolated Power Systems Only). There are three neon indicators in the unit that provide this confirmation. The REV indicator is red and the other two are green. If the two green indicators are on, the receptacle is wired correctly. If not, utilize the following patterns to help determine the problem. Do not proceed with any testing until you get only the two green lights.



NOTE: Neutral/Ground Reversal is not checked.
NOTE: These Indicators are valid only for 120 VAC Non-Isolated Power Systems.

Mains Voltage

With the Mains Voltage function selected, the display will show the Voltage that is present on the incoming power lines. This is measured from Line to Neutral. Note that the voltage may drop when the DUT is turned on. Ensure that this value is within the DUT specifications.

Device Current

With the Device Current function selected, the display will show the current draw of the DUT. The Receptacle should be configured with HOT-CLOSED, NEUTRAL-CLOSED, GROUND-CLOSED and POLARITY-FWD. Refer to the Specifications section for current capacity and permitted duty cycle for this test mode.

Earth Resistance

With the Earth Resistance function selected, the display will show the resistance between the Chassis Test lead and Receptacle Earth/Ground. This resistance is a combination of the resistance within the DUT enclosure and the resistance of the Earth/Ground Lead in the DUT power cord.

NOTE: This test has no meaning for equipment that does not use a grounded cord.

The test requires that the Chassis Test lead be plugged into the Chassis Connector. The other end should be connected to a solid ground point on the DUT.

The display is in hundredths of Ω and will read to 19.99 Ω. Over-range shows as "1_ _ _".

Earth/Ground Leakage Current

With the Earth/Ground Leakage function selected and the Ground-Open, the display will show the leakage current in the ground wire of the DUT.

NOTE: This test has no meaning for equipment that does not use a grounded cord.

Selecting this function automatically opens the connection to Earth/Ground and passes any leakage current through a 1000 Ω load with either AAMI ES1-1993 or IEC 601 frequency compensation as selected by the Load Selection switch.

Enclosure Leakage

With the Enclosure function selected, the display will show the leakage current between the Enclosure (Chassis) and Earth/Ground.

The test requires that the Chassis Test lead be plugged into the Chassis Connector. The other end should be connected to a solid ground point on the DUT.

NOTE: If a non-conductive enclosure is used, a 200 cm^2 conductive foil pad should be used. This foil is to be placed in close contact with the enclosure and connected to the Chassis Test lead.

Any leakage current will flow through the Chassis Test lead and then through a 1000 Ω load with either AAMI ES1-1993 or IEC 601 frequency compensation as selected by the Load Selection switch.

Lead to Earth/Ground Leakage

With the Lead to Earth/Ground function selected, the display will show the leakage current between the selected lead and Earth/Ground.

Attach the patient leads to the connectors on the top of the Safety Analyzer. The Up and Down arrow keys may then be used to select any individual lead or all of the leads.

This test should be done for each lead individually and all leads together.

This test measures the leakage current that would flow through the leads if the patient were to come into contact with Earth/Ground.

Lead to Lead Leakage

With the Lead to Lead function selected, the display will show the leakage current between the selected Patient Lead and all other patient leads.

Attach the patient leads to the connectors on the top of the Safety Analyzer. The Up and Down arrow keys may then be used to select any individual lead. Internally, relays connect the leads as necessary. The LEDs indicate the selected lead.

This test should be done for each lead individually.

This test measures the current that would flow from a lead to other leads. Normally these are Auxiliary currents from bias, measurement and sensing circuits.

Lead Isolation

With the Lead Isolation function selected and the "ISO" Test key depressed, the display will show the leakage current between the selected Patient Lead(s) and Earth/Ground.

WARNING

The SA-2005 applies 110% of line voltage to the Patient leads or External test leads during the Isolation test. Although this is current limited by a 121 kΩ internal resistor, per standard test specifications, care should be taken to prevent contact with this voltage. Do not touch the test leads, connections or DUT while depressing the Isolation Test key.

Attach the patient leads to the connectors on the top of the Safety Analyzer. The Up and Down arrow keys may then be used to select any individual lead and all of the leads.

As each lead and then All leads are selected, depress and hold the “ISO” Test key. This will apply 110% of the line voltage through a 121 kΩ resistor to the selected lead(s) and measure the current that flows to Earth/Ground through a 1000 Ω load with either AAMI ES1-1993 or IEC 601 frequency compensation as selected by the Load Selection switch.

This test is to be done for each lead individually and All leads together.

This test measures the leakage current that would flow through the lead(s) if the patient were to come into contact with Line voltage. This is referred to as MAP (MAINS on Applied Parts).

Point to Point Measurements

The unit has the ability to measure Leakage Current, Isolation Leakage Current and Resistance between two points, utilizing two test leads. These tests are separated because they use a slightly different setup than the previous tests.

Point to Point Leakage Current

With the External function selected, the display will show the leakage current between the test leads.

The test requires that the Chassis Test lead be plugged into the Chassis Connector and the External Test lead be plugged into the External Connector. The other ends of the leads are then attached to the points of interest.

Any current flowing between the test points is passed through a 1000 Ω load with either AAMI ES1-1993 or IEC 601 frequency compensation as selected by the Load Selection switch.

Point to Point Isolation Leakage Current

WARNING

The SA-2005 applies 110% of line voltage to the Patient leads or External test leads during the Isolation test. Although this is current limited by a 121 kΩ internal resistor, per standard test specifications, care should be taken to prevent contact with this voltage. Do not touch the test leads, connections or DUT while depressing the Isolation Test key.

With the External function selected and the “ISO” Test key depressed, the display will show the isolation leakage current between the test leads.

The test requires that the Chassis Test lead be plugged into the Chassis Connector and the External Test lead be plugged into the External Connector. The other ends of the leads are then attached to the points of interest.

Depress and hold the Isolation Voltage key. This will apply 110% of the line voltage through a 121 kΩ resistor to the test leads and measure the current that flows through a 1000 Ω load with either AAMI ES1-1993 or IEC 601 frequency compensation as selected by the Load Selection switch.

Point to Point Resistance

With the Earth Resistance function selected, the display will show the resistance between the two test leads.

The test requires two Chassis Test leads, one in the Chassis Connector and the second in the External Connector. The opposite cable ends should be connected to the points of interest.

NOTE: Remove any device plugged into the Analyzer Test Receptacle. If there is a DC voltage present between the two test points, the reading may contain an error. This can be checked by reversing the connections. If the readings differ, average the two to get the actual resistance value.

COMMUNICATION PROTOCOL

The communication protocol provides a means to completely configure and use the Analyzer from a PC or other device with RS-232 communications interface. This provides for hands free or automated operation of the equipment.

Communication Port

The Serial port is configured as 115,200 Baud Rate, 8 Data Bits, 1 Stop Bit, and No Parity.

Command Syntax

The command description is broken into columns; the KEYWORD, the NODE and the VALUE.

The KEYWORD provides the name of the command. The actual name of the command consists of one or more keywords since SCPI commands are based on a hierarchical structure, also known as a **tree system**.

In such a system, associated commands are grouped together under a common node in the hierarchy, analogous to the way leaves at a same level are connected at a common branch. This and similar branches are connected to fewer and thicker branches, until they meet at the root of the tree. The closer to the root, the higher a node is considered in the hierarchy. To activate a particular command, the full path to it must be specified.

This path is represented in the following tables by placing the highest node in the left-most position. Further nodes are indented one position to the right, below the parent node.

The highest level node of a command is called the Keyword, followed by the Node, and then the value.

Some commands allow for reading and writing data and some commands are Read Only. To indicate a read function, a question mark (?) is placed at the end of the command path. For example, to change the mode to Earth Resistance measurement, “CONFigure:MODE ERESistance<cr>”, where <cr> indicates a carriage-return. To read the current operating mode of the device, a mode read command would be “CONFigure:MODE?<cr>”, which would return the current operating mode of the device.

Lowercase letters indicate the **long-form** of the command (for example, **CONFigure:MODE MVOLtage**) and can be omitted for simplification. Uppercase letters indicate the abbreviated, or **short-form,** of the commands and must be included (for example, **CONF:MODE MVOL**).

All commands sent to the unit are terminated with a Carriage Return.

NOTE: Commands can be entered in either upper or lowercase or a mixture of the two,

uppercase and lowercase. Commands sent to the device are not case sensitive. Upper case characters in the command summary table below are used to show the shortened versions of the commands if available.

SA-2005-R Communication Command Summary

Keyword	Node	Value	Description
CONFigure	MODE	MVOLtage DCURrent ERESistance EGROund ENCLosure LEARth LLEAd LISOlation EXTernal	Mains Voltage Device Current Earth Resistance Earth / Ground Leakage Enclosure Leakage Lead to Earth Leakage Lead to Lead Leakage Lead Isolation External Measurement
	LEADSelect	NONe n (1 to 5) ALL	No Leads Selected n Lead only All Leads Active
	HOT	OPEN CLOSed	Receptacle Hot Lead Open Receptacle Hot Lead Closed
	NEUtral	OPEN CLOSed	Receptacle Neutral Lead Open Receptacle Neutral Lead Closed
	GROUnd	OPEN CLOSed	Receptacle Ground Lead Open Receptacle Ground Lead Closed
	POLarity	FWD REV	Receptacle Polarity Forward Receptacle Polarity Reversed (reverse HOT/NEUTRAL)
	ISO	ON OFF	Isolation Test ON Isolation Test OFF
	FILter	AAMI IEC	Set AAMI test load Set IEC test load
SYSTem	UNITs?	Returns the units of Measure (Volts, Amps, uA, Ohms) [Read Only]	
	MEASurement?	Returns the latest measurement [Read Only]	
	KEY	MUP	Changes Mode Up one position
		MDN	Changes Mode Down one position
		LECW	Changes Output / Lead Select Clockwise one position
		LECCW	Changes Output / Lead Select Counter-Clockwise one position
		HOT	Duplicates the HOT key press
		NEUtral	Duplicates the Neutral Key press
		GROUnd	Duplicates the Ground key press
		POLarity	Duplicates the Polarity key press
		ISO	Duplicates the ISO Test key press
	MODel?	Returns Safety Analyzer Model [Read Only]	
	VERsion?	Returns Firmware Version [Read Only]	

MANUAL REVISIONS

Revision #	Revisions Made
Rev 01	Origination

LIMITED WARRANTY

WARRANTY: BC GROUP INTERNATIONAL, INC. WARRANTS ITS NEW PRODUCTS TO BE FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP UNDER THE SERVICE FOR WHICH THEY ARE INTENDED. THIS WARRANTY IS EFFECTIVE FOR TWELVE MONTHS FROM THE DATE OF SHIPMENT.

EXCLUSIONS: THIS WARRANTY IS **IN LIEU OF** ANY OTHER WARRANTY EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF **MERCHANTABILITY** OR FITNESS FOR A PARTICULAR PURPOSE.

BC GROUP INTERNATIONAL, INC. IS NOT LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

NO PERSON OTHER THAN AN OFFICER IS AUTHORIZED TO GIVE ANY OTHER WARRANTY OR ASSUME ANY LIABILITY.

REMEDIES: THE PURCHASER'S SOLE AND EXCLUSIVE REMEDY SHALL BE: (1) THE REPAIR OR REPLACEMENT OF DEFECTIVE PARTS OR PRODUCTS, WITHOUT CHARGE. (2) AT THE OPTION OF **BC GROUP INTERNATIONAL, INC.**, THE REFUND OF THE PURCHASE PRICE.

SPECIFICATIONS

MAINS VOLTAGE	
RANGE	90 to 264 VAC, 50/60 Hz
ACCURACY	± 3% of Reading, ± 1 digit

DEVICE CURRENT	
RANGE	0 to 19.99 Amps, RMS
ACCURACY	± 5% of Reading, ± 1 digit

EARTH RESISTANCE		
RANGE	0 to 19.99 Ω	
ACCURACY	0 to 1.99 Ω	± 1% Range
	2.00 to 19.99 Ω	± 1% Range
CURRENT SOURCE	10 mA (Note: 1 Amp Current Source Available as an optional accessory, see description section for ordering information on the CS-2000 Series)	

LEAKAGE CURRENT		
RANGE	0 to 1999 µA, RMS	
ACCURACY	DC	± 1% Reading, ±1 digit
	25 Hz up to 1 kHz	± 1% Reading, ±1 digit
	1 kHz up to 100 kHz	± 2.5% Reading, ±1 digit
	100 kHz to 1 MHz	± 5% Reading, ± 1 digit
LEAKAGE LOAD	1000 Ω AAMI ES1-1993 or IEC 601 User Selectable	
LEAD ISOLATION TEST (MAP)	110% Line Voltage, ± 5% Internally Current-Limited by 121 kΩ resistor	
FUSE	250 mA, 250 V, 5x20 mm, Fast Acting (Receptacle Ground Leg) BC Part No. UF-0250-01	

ELECTRICAL		
OPERATING LINE VOLTAGE	90 to 264 VAC, 50/60 Hz	
LINE PLUG	SA-2005 MODELS	NEMA 5-15P
	SA-2005-INTL MODELS	Universal IEC C20 Receptacle Pigtail Cord Must use Country-specific Line Cord (see Accessories section)
	SA-2005-AUS MODELS	AU1-10P (AS/NZS 3112)
DUT CURRENT CAPACITY	SA-2005 & SA-2005-INTL MODELS	15 Amps, 30 minutes 20 Amps, 5 minutes
	SA-2005-AUS MODELS	10 Amps, 30 minutes
DUT RECEPTACLE	SA-2005 MODELS	20 Amps @ 125 VAC Capacity Hospital Grade NEMA 5-20R Compatible with: NEMA 5-15P and 5-20P Plugs
	SA-2005-INTL MODELS	20 Amps @ 250 VAC Capacity International Receptacle Compatible with: ○ NEMA 5-15P, NEMA 5-20P, NEMA 6-15P and NEMA 6-20P (US/NORTH AMERICA) ○ UK1-13P and UK3-5P (UK) ○ SW1-10P (SWITZERLAND) ○ IT1-10P (ITALY) ○ IS1-16P (ISRAEL) ○ JA1-15P (JAPAN)

ELECTRICAL (continued)		
DUT RECEPTACLE (continued)	SA-2005-INTL MODELS	○ EU1-16P (EURO) CEE 7/7 “SCHUKO” (NOTE: MUST USE BC20-20221 GROUNDING ADAPTER) ○ DE1-13P (DENMARK) ○ EUROPLUG CEE 7/16
	SA-2005-AUS MODELS	10 Amps @ 240 VAC Capacity AU1-10R (AS/NZS 3112) Compatible with: AU1-10P Plugs
POWER CONSUMPTION	5 VA (5 W)	

PHYSICAL & ENVIRONMENTAL		
DISPLAY	Non-Backlit 3½ Digit LCD 0.5 inches (12.7 mm) Digit Height	
CONSTRUCTION	ENCLOSURE	ABS Plastic
	OVERLAY	Back-printed Lexan
SIZE	8.65 x 5.73 x 2.40 Inches (219.7 x 145.5 x 61.0 mm)	
WEIGHT	≤ 3.0 Lbs (1.36 kg)	
OPERATING RANGE	15 to 40 °C (59 to 104 °F) 10 to 90% RH, Non-Condensing	
STORAGE RANGE	-20 to 65 °C (-4 to 149 °F)	

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