



OPERATION AND SERVICE MANUAL

MODEL SC6540

High Voltage and High Current Scanning Matrix

SERIAL NUMBER

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Item 38616, Ver E3.16

December 2022



*Select models only.
See specs for details.

Associated Research

28105 North Keith Drive - Lake Forest, IL 60045 USA

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DECLARATION OF CONFORMITY



Manufacturer: Associated Research, Inc.
Address: 28105 North Keith Dr.
Lake Forest, IL 60045 USA
Product Name: SC6540® High Voltage and High Current Scanning Matrix
Model Number: SC6540

Conforms to the following Standards:

Safety: UL 61010-1:2012 R7.19,
CAN/CSA-C22.2 NO. 61010-1-12+GI1+GI2 (R2017)+A1,
UL 61010-2-034, Edition 1,
CAN/CSA-C22.2 NO. 61010-2-034:18
IEC 61010-1:2010, IEC 61010-2-030:2010,
IEC 61010-031:2002+A1,
EN 61010-1:2010+A1:2019,
BS EN 61010-1:2010+A1:2019,
EN 61010-2-030:2010, BS EN 61010-2-030: 2010,
EN 61010-031:2002+A1,
BS EN 61010-031:2002+A1:2008,
BS EN IEC 61010-2-034:2021+A11: 2014
EMC: EN 61326-1:2013, BS EN 61326-1:2013
EN 55011 :2009+A1:2010

Supplementary Information:

*The product herewith complies with the requirements of the **Low Voltage Directive 2014/35/EU**, the **EMC Directive 2014/30/EU** and the **RoHS Directive 2011/65/EU** with respect to the following substances: Lead (Pb), Mercury (Hg), Cadmium (Cd), Hexavalent chromium (Cr (VI)), Polybrominated biphenyls (PBB), Polybrominated diphenyl ethers (PBDE), Polybrominated diphenyl ethers (PBDE), Bis phthalate (DEHP), Dibutyl phthalate (DBP), Benzyl butyl phthalate (BBP), Diisobutyl phthalate (DIBP), Deca-BDE included.*

Last two digits of the year in which the CE marking was affixed:05

The technical file and other documentation are on file with Associated Research, Inc.

A handwritten signature in black ink, appearing to read 'Adam Braverman', is written over a horizontal line.

Adam Braverman, President
Associated Research, Inc.
Lake Forest, Illinois USA
December 2022

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1. INTRODUCTION

1.1. Warranty Policies

Ikonix Brand, certifies that the tester listed in this manual meets or exceeds published manufacturing specifications. This tester was calibrated using standards that are traceable to the National Institute of Standards and Technology (NIST).

Your new tester is warranted to be free from defects in workmanship and material for a period of (5) years from date of shipment. We aim to provide an amazing experience and quality testers that last a long time. If you're not satisfied with your tester, return it within 45 days for a full refund. Calibrate annually with us, or one of our authorized partners, and we'll extend your warranty an additional year for the service life of your tester, and at least five years after discontinuation. If it breaks during that time, we promise to fix it for free (unless abuse or excessive damage is present). When your tester reaches the end of its service life, we'll responsibly recycle it and give you a discount on a replacement. Annual calibration and inspection must be made in each successive year starting one year after the original purchase date in order to remain eligible for extended warranty coverage beyond the standard warranty period (five years).

Ikonix Brand recommends that your tester be calibrated on a twelve-month cycle. A return material authorization (RMA) must be obtained from Ikonix Brand. To obtain an RMA please contact our Customer Support team at 1-847-367-4077 or visit arisafety.com. Damages sustained as a result of improper packaging will not be honored. Transportation costs for the return of the tester for warranty service must be prepaid by the customer. Ikonix Brand will assume the return freight costs when returning the tester to the customer. The return method will be at the discretion of Ikonix Brand.

Except as provided, herein Ikonix Brand makes no warranties to the purchaser of this tester and all other warranties, expressed or implied (including, without limitation, merchantability or fitness for a particular purpose), are hereby excluded, disclaimed and waived.

Any non-authorized modifications, tampering or physical damage will void your warranty. Elimination of any connections in the earth grounding system or bypassing any safety systems will void this warranty. This warranty does not cover accessories not of Ikonix Brand manufacture. Parts used must be parts that are recommended by Ikonix Brand as an acceptable specified part. Use of non-authorized parts in the repair of this tester will void the warranty.

*5 year warranty is valid on any model purchased in 2021 or after.

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1.2. Safety Symbols

1.2.1. Product Marking Symbols



Product will be marked with this symbol when it is necessary to refer to the operation and service manual in order to prevent injury or equipment damage.



Product will be marked with this symbol when hazardous voltages may be present.



Product will be marked with this symbol at connections that require earth grounding.

1.2.2. Caution and Warning Symbols



Calls attention to a procedure, practice, or condition that could possibly cause bodily injury or death.



Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

1.3. Glossary of Terms

(As used in this manual)

Alternating Current, AC: Current that reverses direction on a regular basis. Utility power is usually generated in the form of a sinusoid at a frequency of 60 times per second in the United States and 50 times per second in other countries.

Arc: A partial momentary breakdown due to the force of a strong electric field on closely spaced conductors, sometimes evidenced by corona or a luminous flashover.

Breakdown: The failure of insulation to effectively prevent the flow of current. If the test voltage is gradually raised, breakdown will begin suddenly at a certain voltage level and current flow will not be directly proportional to voltage. Once a breakdown occurs, especially for a period of time, the next gradual application of voltage will often cause a breakdown to begin at a lower voltage.

Conductor: A solid or liquid material which permits the flow of electrons. A material which has a volume resistivity of no more than $10^3 \Omega\text{-cm}$.

Current: The movement of electrons through a conductor. Current is measured in amperes (A), milliamperes (mA), microamperes (uA). Symbol = I

Dielectric: An insulating material that is positioned between two conductive materials in such a way that a charge or voltage may appear across the two conductive materials.

Direct Current, DC: Current that flows in one direction only. The source of direct current is said to be polarized and has one terminal that is always at a higher potential than the other.

Frequency: The number of cycles an AC waveform repeats over time. Usually given in Hertz (Hz).

Ground: Refers to the point of low potential in a circuit to which all other voltages are referenced. May or may not be tied to the earth. Also referred to as Earth.

Hot: Used to refer to the test lead or output side of an instrument that is at high potential.

Impedance: The property of capacitive or inductive items to limit certain frequencies.

Insulation: Gas, liquid or solid material which has a volume resistivity of at least $10^{12} \Omega\text{-cm}$ and is used for the purpose of restricting current flow between conductors.

Leakage: AC or DC current flow through insulation and over its surfaces. Current flow is directly proportional to voltage. The insulation is thought of as a constant impedance unless breakdown occurs.

Neutral: The point of low potential in a circuit to which all other voltages are referenced. Also known as Common.

Peak Current: The maximum amplitude of an AC current waveform. For a sinusoid, $1.414 \times$ the RMS value.

Power: The amount of work performed by an energy source over time, given in Watts (W).

PF (Power factor): Power Factor = W/VA where W =Watts (Real Power) and VA =Volts x Amps (apparent power). It is important to note that the closer the power factor is to "1" the more resistive the DUT is. The closer the power factor is to 0 the more reactive (inductive or capacitive) the DUT is.

Reactive Current: The current component due to the reactive impedance of a load. Also called imaginary current.

Real Current: The current component due to the resistance of a load.

Resistance: The property of a substance that impedes current and results in the dissipation of power in the form of heat. The practical unit of resistance is the *ohm* (Ω). Symbol = **R**

Return: The path by which current returns to a source.

RMS: The Root Mean Squared value of a voltage or current waveform. An RMS waveform delivers the same amount of energy to a load as a DC waveform of the same value. For a sinusoid, the RMS value is $.707 \times$ the peak value.

Total Current: The vector sum of the real current component and the reactive current component produced by an applied voltage.

VA: A rating of instantaneous power found by multiplying an instrument's maximum output current by its maximum output voltage.

Voltage: The force which causes current through an electrical conductor, given in volts (V). Symbol = **V**

1.4. Safety

This product and its related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal). Before applying power verify that the instrument is set to the correct line voltage (115 or 230) and the correct fuse is installed.

This product carries an NRTL (Nationally Recognized Testing Laboratory) and comes equipped with an audible and visual failure indicator.

WARNING

The SC6540 has the capability of relaying voltages and currents that can cause **harmful or fatal electric shock**. To prevent accidental injury or death, these safety procedures must be strictly observed when handling and using the test instrument.

1.4.1. Service and Maintenance

User Service

To prevent electric shock do not remove the instrument cover. There are no internal user serviceable parts. Routine maintenance or cleaning of internal parts is not necessary. Avoid the use of cleaning agents or chemicals on the instrument, as some chemicals may damage plastic parts or lettering. Any external cleaning should be done with a clean, dry or slightly damp cloth. Schematics, when provided, are for reference only. Refer servicing and certification to an Associated Research, Inc. authorized service center.

SAFETY

This instrument meets UL requirements for audible and visual failure indication.

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Service Interval

Associated Research, Inc. will not be held liable for injuries suffered if the instrument is not properly maintained and safety checked annually. See section **1.1. Warranty Policies** for more information.

1.4.2. Test Station

Location

Select an area away from the mainstream of activity where employees do not walk while performing their normal duties. If this is not practical because of production line flow, then the area should be roped off and marked for **HIGH VOLTAGE TESTING**. No employees other than test operators should be allowed inside.

If benches are placed back-to-back, be especially careful about the use of the bench opposite the test station. Signs should be posted: **“DANGER – HIGH VOLTAGE TEST IN PROGRESS – UNAUTHORIZED PERSONNEL KEEP AWAY.”**

Work Area

When possible, use the instrument on a non-conducting table or workbench. If you cannot avoid using a conductive surface, be certain that it is connected to a good earth ground and the high voltage connection is insulated from the grounded surface.

There should not be any metal in the work area between the operator and the location where products being tested will be positioned. Any other metal in the work area should be connected to a good ground, never left “floating”.

Keep the area clean and uncluttered. All test equipment and unnecessary test leads should be removed from the test bench and put away. It should be apparent to both the operator and to any observers which product is under test, which product is waiting to be tested and which product has already been tested.

Power

Power to the test station should be arranged so that it can be shut off by one prominently marked switch located at the entrance to the test area. In case of an emergency, anyone should be able to cut off the power before entering the test area to offer assistance.

ESD TESTING

Electrical safety tests should not be performed in or around ESD testing areas. ESD methods should not be employed during electrical safety testing, as this could cause a hazardous condition for equipment and test operators.

More Information

For more information on setting up a safe work station, please visit the Events and Training section of our website at <http://www.asresearch.com/events-training/Default.aspx>

1.4.3. Test Operator

WARNING

This instrument generates voltages and currents that can cause **harmful or fatal electric shock** and must only be operated by a skilled worker trained in its use. **The operator should understand the electrical fundamentals of voltage, current, and resistance.**

WARNING

Do not touch the device under test, high voltage test lead, alligator clip, or clip insulator once the test has been started.

WARNING

Do not touch the front panel when testing or after a malfunction has occurred.

Rules

Operators should be thoroughly trained to follow all national safety standard guidelines for electrical safety testing in the workplace. Defeating any safety system should be considered a serious offense with severe penalties. Allowing unauthorized personnel in the area during a test should also be dealt with as a serious offense. Test operators should be familiar with methods to properly discharge a device under test in case test leads become disconnected during testing.

Refer to the following standards for more information:

- NFPA 70E
- OSHA 1910 subpart (S)
- EN50191

Dress

Operators should not wear jewelry that could accidentally complete a circuit.

WARNING

ESD protocols should not be observed while performing electrical safety tests. Intentionally grounding the test operator could lead to a **harmful or fatal electric shock**.

Medical Restrictions

Personnel with heart ailments or devices such as pacemakers should be informed that the voltages and

KEY SAFETY POINTS TO REMEMBER

- Keep unqualified and unauthorized personnel away from the test area.
- Arrange the test station in a safe and orderly manner.
- In case of any problem, turn off the high voltage first.

currents generated by the instrument are very dangerous. If contacted, the instrument may cause heart-related problems. Please have the test operator consult a physician for recommendations.

1.5. Key Features of the SC6540

CONFIGURABLE SCANNING MATRIX	The SC6540 can be purchased as a “main” scanning matrix with its own power source, or as a “secondary” scanning matrix controlled through an automated Associated Research instrument. Each main Scanner can control up-to four additional secondary Scanners, allowing a total of 80 test points.
UP TO 16 HIGH VOLTAGE SWITCHING OUTPUTS	High voltage outputs are rated for up to 5 kVAC and 6 kVDC to handle a wide range of safety agency specifications.
UP TO 16 HIGH CURRENT SWITCHING OUTPUTS	High current channels allow ground bond testing to be incorporated into automated testing applications. Outputs are rated for up to 40 Amps.
AUTOMATED MULTI-POINT OR MULTI-PRODUCT TESTING CAPABILITIES	When used in conjunction with OMNIA® or HypotULTRA®, the SC6540 reduces test setup time and eliminates operator error to ensure consistent test results.
AUTOMATION INTERFACES FOR SOFTWARE CONTROL	Main Scanners are available with USB/RS-232, GPIB and Ethernet automation interfaces.
FRONT PANEL INDICATORS	LED’s indicate the status of each channel. The operator can clearly see which output is active.
POINT TO POINT CONTINUITY TESTS	High voltage channels can also be used for point-to-point Continuity tests.
COMPACT 2U RACK MOUNT DESIGN	This space saving design allows the SC6540 to be quickly and easily installed into a rack mount system.

2. GETTING STARTED

Introduction

This section contains information for the unpacking, inspection, preparation and storage of your Associated Research, Inc., product.

2.1. Unpacking and Inspection

2.1.1. Packaging

Your instrument was shipped in a custom foam insulated container. If the shipping carton is damaged, inspect the contents for visible damage such as dents, scratches or a broken display. If the instrument is damaged, notify the carrier and Associated Research, Inc.'s customer support department. **Please save the shipping carton and packing material for the carrier's inspection.** Our customer support department will assist you in the repair or replacement of your instrument. Please do not return your product without first notifying us and receiving an RMA (return material authorization) number. To receive an RMA number, please contact our customer support department at 1-800-858-TEST (8378).

2.1.2. Contents of the Carton

Inside the carton should be the following:

DESCRIPTION	AR PART NUMBER
SC6540 SECONDARY	
SC6540 Scanner	SC6540
25-Pin Scanner Bus Cable	38592
High Voltage Interconnect	240-01 ³
Bracket Rack Mount 2U (Qty 2)	38793
Handle Rack Mount 2U (Qty 2)	38794
Screw M4 x 12mm FHMS (Qty 4)	38549 For Rack Mount Handle
SC6540 MAIN	
SC6540 Scanner	SC6540
Line Cord ¹	33189
Fuse (2A, 20mm, Fast-Blow)	38603
USB Cable AB-Type 1.8m	39066
Bracket Rack Mount 2U (Qty 2)	38793
Handle Rack Mount 2U (Qty 2)	38794
Screw M4 x 12mm FHMS (Qty 4)	38549 For Rack Mount Handle
W/ HIGH VOLTAGE MODULE	

DESCRIPTION	AR PART NUMBER
100' White 18AWG Wire	37534
High Voltage Cable Kit	HS-8-13
W/ GROUND BOND MODULE²	
20 Hook-Style Crimp Lugs	38599
W/ HYPOTULTRA 3 INTERCONNECT	
High Voltage Cable	HS-8-12
2 Return Cables	HS-8-11
W/ HYPOTULTRA INTERCONNECT	
High Voltage Cable	HS-8-12
2 Return Cables	HS-8-11
W/ OMNIA 8200 SERIES INTERCONNECT	
High Voltage Cable	HS-8-12
Ground Bond Output Cable	38555
Ground Bond Return Cable	38556
Probe Hi/Probe Lo Cable	38879 ²

¹ The Line Cord is listed as American. Other Line Cord styles are available upon request.

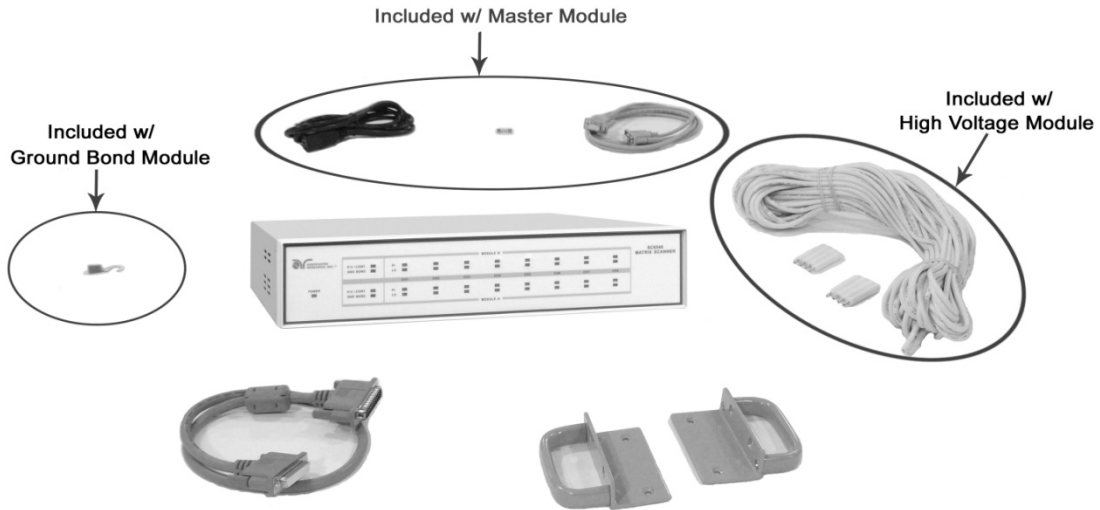
² Part #38879 included only with the 8206, 8256, 8207 and 8257

³ Part # 240-01 is only needed for multiple secondary connection



Only accessories which meet the manufacturer's specification shall be used.

- **NOTE:** The items listed are per module. If two of a particular module have been purchased, then double the amounts listed will be supplied.



SC6540 Contents of the Carton



Additional Carton Contents for use with OMNIA 80xx



Additional Carton Contents for use with OMNIA 81xx and OMNIA 8204/8254



Additional Carton Contents for use with OMNIA 8206, 8256, 8207, 8257



Additional Carton Contents for use with HypotULTRA

2.2. Installation

2.2.1. Work Area

WARNING

Locate a suitable testing area and be sure you have read all safety instructions for the operation of the instrument and suggestions on the test area setup in section **1.4. Safety**.

Make sure the work area you choose has a three-prong grounded outlet capable of supplying the necessary input current to the power source. Be sure the outlet has been tested for proper wiring before connecting the instrument to it.

WARNING

The mains plug is used as the disconnecting device and shall remain readily operable. The socket-outlet shall be installed. Near the equipment and shall be easily

accessible.

2.2.2. Power Requirements

This instrument requires a power source of either 115 volts AC $\pm 10\%$, 50/60 Hz single phase or 230 volts AC $\pm 10\%$, 50/60 Hz single phase. Before applying power verify that the instrument is set to the correct line voltage (115 or 230 volts). Adjust the voltage select switch to 115 for use with a 115 volt input. Adjust the voltage select switch to 230 for use with a 230 volt input. See section **3.2.2. Rear Panel Controls** for an image of the rear panel.

CAUTION

Do not replace the power supply cord with an improperly rated cord. For North American: A UL listed and CSA labeled power cord must be used with the instrument in the

United States and

Canada. The power cord must include a NEMA5-15 style male plug, SVT or SJT cord sets, and be rated for at least 125VAC, 10A, number 16 gauge (or 125VAC, 15A, number 14 gauge) wire or larger, and the length of the cord does not exceed 2 m must be used. For European: A certified power supply cord not lighter than light PVC sheathed flexible cord according to IEC 60227, designation H03 VV-F or H03 VVH2-F (for equipment mass not exceeding 3 kg), or H05 VV-F or H05 VVH2-F2 (for equipment mass exceeding 3 kg), and be rated for at least 3G 0.75 mm² (for rated current up to 10 A) or 3G 1.0mm² (for rated current over 10 A up to 16 A) wire or larger, and the length of the cord does not exceed 2 m must be used.

CAUTION

Do not switch the line voltage selector switch located on the rear panel while the instrument is on or operating. This may cause internal damage and represents a safety risk to the operator.

WARNING

The SC6540 must be connected to a good ground. Be certain that the power wiring is properly polarized and that

the proper low resistance bonding to ground is in place.

2.2.3. Basic Connections

Power Cable

The instrument is shipped with a line cord containing a protective earth ground. When the line cord is connected to an appropriate AC power source the cable will connect the chassis to earth ground.

WARNING

The main plug shall only be inserted in a socket outlet with a protective ground (earth) contact. This protective ground **must not be defeated** by the use of an extension cord without a protective conductor.

Return Connection

When the instrument's return is grounded, any internal and external stray leakage will be monitored due to currents that flow from high voltage to earth ground (such as from high voltage to the chassis of the instrument). These currents are inherent and will cause errors when trying to monitor very low leakage currents in the microamp range.

The output power supplies of this instrument are referenced directly to earth ground. Any conductor that completes a path between the high voltage and earth ground will form a completed circuit.

2.2.4. Environmental Conditions

This equipment is intended for indoor use only. The equipment has been evaluated according to Installation Category II and Pollution Degree 2 as specified in IEC 664.

This instrument may be operated in environments with the following limits:

Temperature..... 41° - 104° F (5° - 40°C)
Relative humidity..... 0 – 80%
Altitude..... 6560 feet (2,000 meters)

WARNING

Keep the ventilation slits uncovered during operation. Failure to do so could cause the instrument to overheat and may damage internal components.

Storage and Shipping Environment

This instrument may be stored or shipped in environments with the following limits:

Temperature..... -40° - 167° F (-40° - 75°C)
Altitude..... 50,000 feet (15,240 meters)

The instrument should also be protected against temperature extremes that may cause condensation within the instrument.

CAUTION

Failure to operate this instrument within the specified conditions could result in damage.

If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired.

More Information

For more information on test operator and workstation safety please visit the Events and Training section of our website at <http://www.asresearch.com/events-training/Default.aspx>

3. SPECIFICATIONS AND CONTROLS

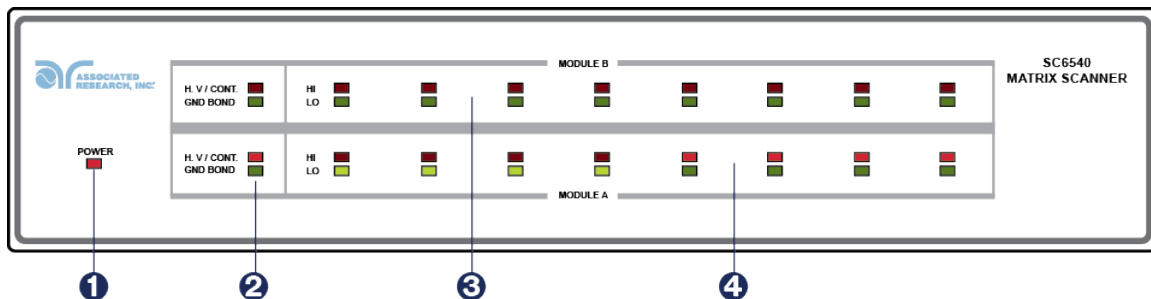
3.1. SC6540 Functional Specifications

	SC6540 MAIN	SC6540 SECONDARY
Input	115 VAC (+/-10%), 50/60 Hz, Single Phase 230 VAC (+/-10%), 50/60 Hz Single Phase User Selectable	NA
Fuse	250V/2A/Fast-Blow	NA
PC Control	GPIO, USB/RS232, or Ethernet	NA
Scanner Control	1 Scanner Bus Output Controls up to 4 additional Secondaries	1 Output and 1 Input
Maximum High Voltage rating	5kV AC & DC	
Maximum Current rating	40 amperes	
Number of possible channels	8 or 16*	
HV output Terminations	100 ft. reel HV cable rated for up to 30 kV with 8 HV connectors	
GND output Terminations	20 terminals provided, to accept 10/12 AWG hookup wire (user supplied wire)	
Temperature	32° - 104° F (0° - 40° C)	
Humidity	0 – 80%	
Altitude	6560ft (2000m)	
Safety Agency Listing	CE, cTUVus, RoHS2	
Dimensions	2U with tilt-up front feet 17 x 4.07 x 12.96 in. W x H x D (432 x 103 x 329 mm)	

Weight	20.05 lbs. max (9.09 kg) (With 2 High Voltage Modules)	15.45 lbs. max (7.01 kg) (With 2 High Voltage Modules)
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*Cabinets can be configured with one or two 8 channel modules as follows; 1 High Voltage module, 1 Ground Bond Module, 2 High Voltage Modules, 2 Ground Bond Modules, or 1 High Voltage + 1 Ground Bond Module.

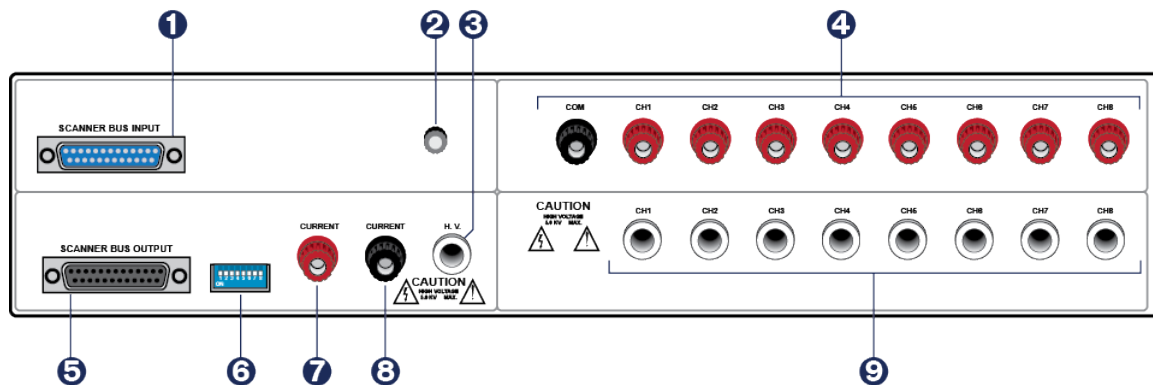
3.2. Instrument Controls



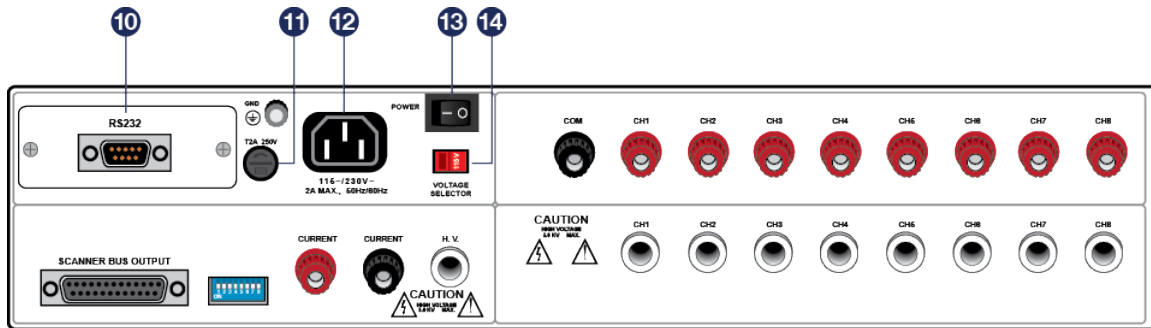
3.2.1. Front Panel Controls

- 1. POWER INDICATOR:** Indicates the power has been turned ON. For a SC6540 Main, this lights when the power switch on the rear panel of the unit is turned ON. For a SC6540 Secondary, this lights when the power switch on the host instrument is turned ON.
- 2. MODULE TYPE INDICATOR:** These LED's indicate the type of module that is installed for the corresponding module slot. If the red LED lights, it indicates that the installed module is a High Voltage / Continuity module. If the green LED lights, it indicates that the installed module is a Ground Bond module.
- 3. MODULE B CHANNEL STATUS INDICATORS:** These LED's indicate the status of each individual channel on Module B. If the red LED lights it indicates a High Voltage/Continuity Current/Ground Bond Channel. If the green LED lights it indicates a Return channel.
- 4. MODULE A CHANNEL STATUS INDICATORS:** These LED's indicate the status of each individual channel on Module A. If the red LED lights it indicates a High Voltage/Continuity Current/Ground Bond Channel. If the green LED lights it indicates a Return channel.

3.2.2. Rear Panel Controls



1. **SCANNER BUS INPUT:** Interconnect port for the control cable between the SC6540 secondary and an automated Associated Research electrical safety tester or SC6540 main Scanner.
2. **SAFETY GROUND CONNECTOR:** Must be connected to a known good ground system to ensure operator safety.
3. **HIGH VOLTAGE INPUT:** Connector for input of high voltage from the host instrument.
4. **GROUND BOND OUTPUTS:** Output channels for application of high current for Ground Bond tests. These outputs are only available on SC6540 Scanners that are configured with a Ground Bond Module.
5. **SCANNER BUS OUTPUT:** Interconnect port for the control cable to another SC6540 in a multiple SC6540 system.
6. **ADDRESS SWITCHES:** 8-pin DIP switch used to address the modules in a SC6540 secondary or used to configure the address of a SC6540 main.
7. **CURRENT INPUT JACK:** Connector used to attach the high current input lead or continuity current input lead from the host instrument.
8. **RETURN INPUT:** Connector for the return of the host instrument with the SC6540. This connection provides the return current path for the high voltage, Ground Bond current, and Continuity current.
9. **HIGH VOLTAGE OUTPUTS:** Eight individual output channels for high voltage tests and Continuity tests. These outputs are only available on SC6540 Scanners that are configured with a High Voltage Module.



- 10. BUS INTERFACE:** Standard 9 pin D-Subminiature connector for the USB/RS-232 Bus interface. Optional IEEE 488 or Ethernet interface available.
- 11. POWER SWITCH:** Switch with international ON (|) and OFF (0) markings.
- 12. FUSE RECEPTACLE:** To change the fuse, unplug the power (mains) cord and turn the fuse receptacle counter-clockwise. The fuse compartment will be exposed. Please replace the fuse with one of the proper rating.
- 13. INPUT POWER RECEPTACLE:** Standard IEC 320 connector for a standard NEMA style line power (mains) cord.
- 14. INPUT VOLTAGE SWITCH:** Line voltage selection is set by the position of the switch. In the “left” position it is set for 110–120 volt operation, in the “right” position it is set for 220–240 volt operation.

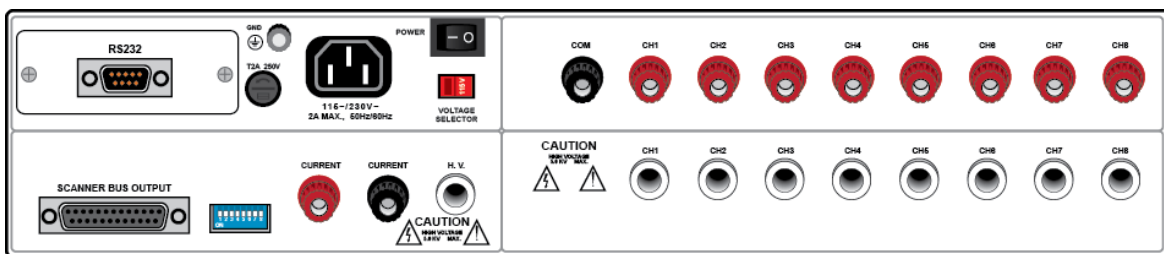
4. OPERATING INSTRUCTIONS

4.1. Scanner Configurations

The SC6540 is available in 2 configurations according to how it sends and/or receives data: a main and a secondary. A main Scanner can only be controlled remotely via a PC. A secondary Scanner can be controlled locally by an Associated Research, Inc. testing instrument or by a main Scanner.

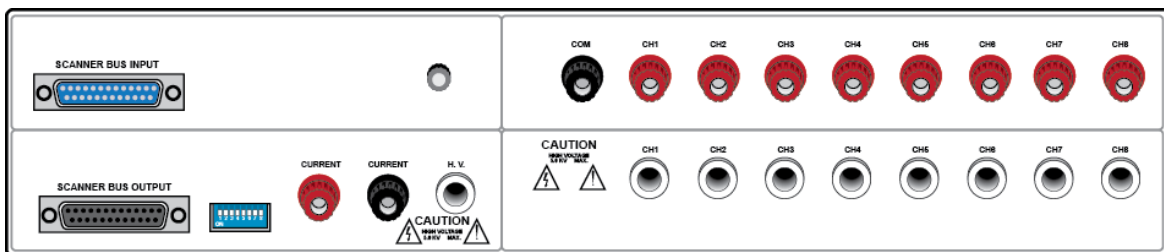
Main

A main Scanner communicates directly with a PC via a USB/RS-232 (standard), GPIB or Ethernet interface. This model receives control information from a PC and can also deliver instructions to up to 4 additional secondary Scanners. A main Scanner can be distinguished by its *power module* located on the upper left side of the rear panel.



Secondary

A secondary Scanner *only* receives data. The data that the secondary receives can come from a main Scanner (remote control) or directly from an Associated Research, Inc. instrument (local control). A secondary Scanner can be distinguished by its input control bus located on the upper left side of the rear panel.



Scanner Modules

All SC6540 Scanners are capable of supporting up to 2 Modules. Each Module consists of either 8 HV (high voltage) ports or 8 GB (ground bond) ports. Module A refers to a row of 8 ports of the Scanner and Module B refers to a row of 8 ports of the Scanner (see Figure 3.0).

Scanner Models

There are 5 different Scanner models available, each varying by Module number and type. See the table below:

MODEL	CONFIGURATION
HH	16 Port HV
HG	8 Port HV, 8 Port GB
HN	8 Port HV
GG	16 Port GB
GN	8 Port GB

- If a Scanner only has 8 ports (HN, GN), these ports will always be located in Module A.

4.2. Operating the SC6540 with HypotULTRA / HypotULTRA III

- **NOTE:** The HypotULTRA III series is discontinued and replaced by HypotULTRA.

4.2.1. Cables and Connections Description

A number of hardware and interconnect cables are included with the SC6540 Scanner depending on its configuration and the number of modules. The following hardware and interconnect cables are included with each of the following items:

DESCRIPTION	AR PART NUMBER
SC6540 SECONDARY AND HYPOTULTRA / HYPOTULTRA III INTERCONNECT CABLES	
1 – 25-Pin Scanner Bus Cable	38592
1 – High Voltage Cable	HS-8-12
2 – Return Cables	HS-8-11
SC6540 MAIN AND HYPOTULTRA / HYPOTULTRA III INTERCONNECT CABLES	
1 – High Voltage Cable	HS-8-12
2 – Return Cables	HS-8-11
SC6540 HIGH VOLTAGE MODULE	
8 – High Voltage Connectors and Assembly Instructions	HS-8-13
1 – 100 ft. (48.75 m) Reel of High Voltage Cable	37534

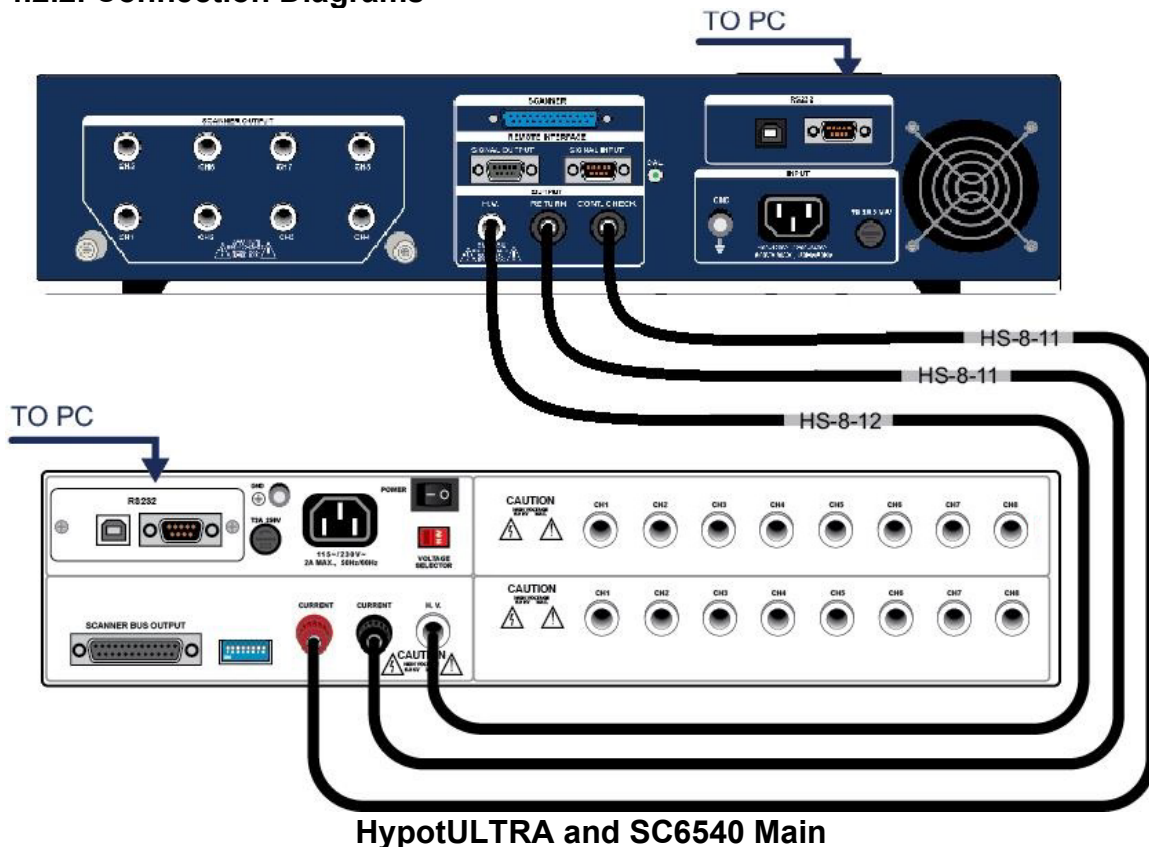
- The 25-pin scanner bus cable (p/n 38592) connects between the rear panel SCANNER connector of HypotULTRA / HypotULTRA III and the rear panel SCANNER BUS INPUT of the SC6540 secondary scanning matrix.

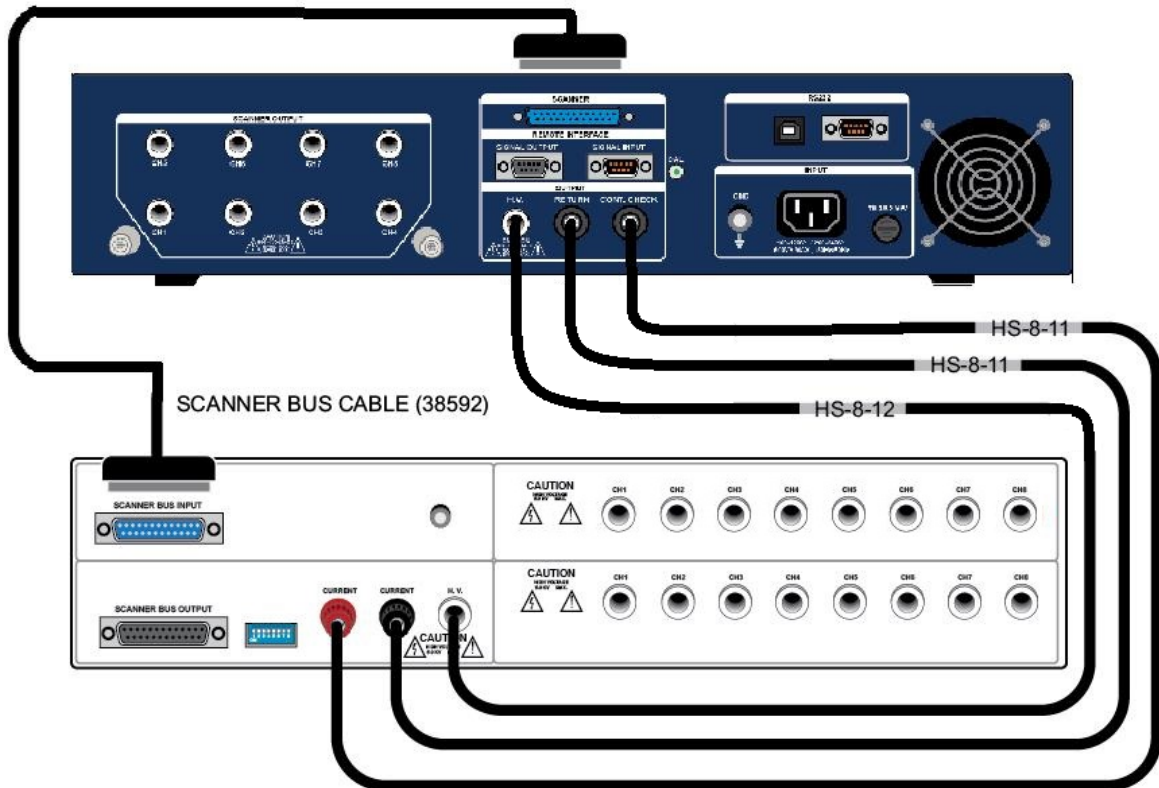
- The high voltage cable (p/n HS-8-12) is used to connect from the high voltage rear output connector of the HypotULTRA / HypotUTLRA III to the rear high voltage input of the SC6540.
- The return cable (p/n HS-8-11) is used to connect from the return rear connector of HypotULTRA / HypotUTLRA III to the rear panel return connection of the SC6540.
- An additional return cable (p/n HS-8-11) is used for Continuity testing. The return cable is used to connect the rear Continuity connector of HypotULTRA / HypotUTLRA III to the rear Current input of the SC6540.
- Eight high voltage connectors (p/n HS-8-13) are provided with a 100 ft. reel of cable and assembly instructions so that each user can assemble the lengths of the high voltage cable to meet their specific needs.

WARNING

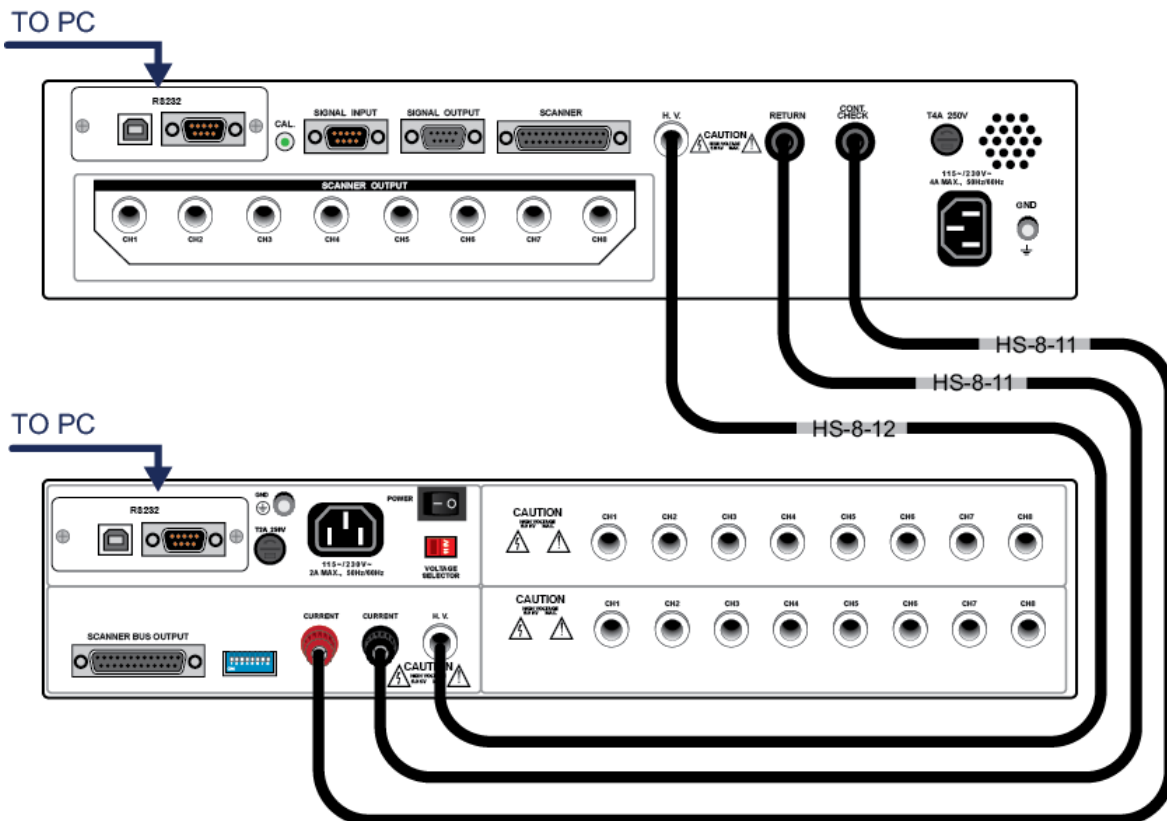
Under certain conditions high voltage can appear on the cabinet of the SC6540. The ground terminal on the rear panel of the SC6540 must be connected to a good earth ground to ensure operator safety.

4.2.2. Connection Diagrams

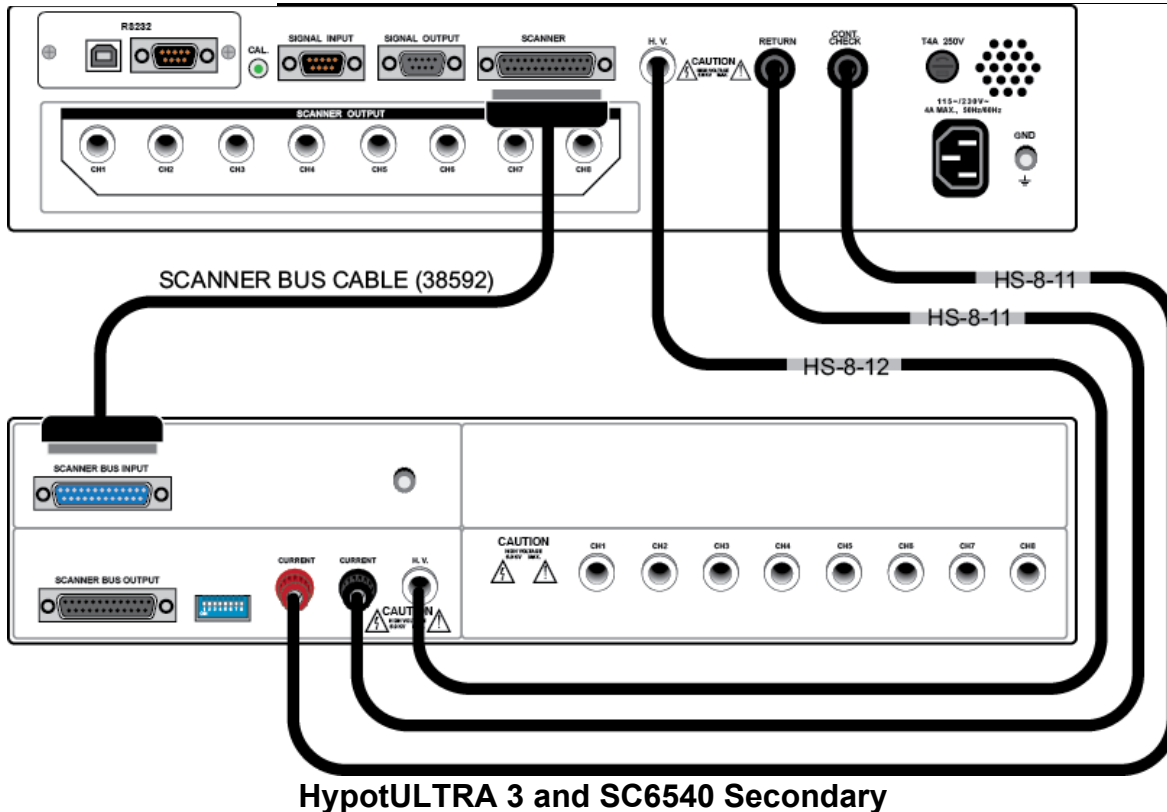




HypotULTRA and SC6540 Secondary



HypotULTRA 3 and SC6540 Main

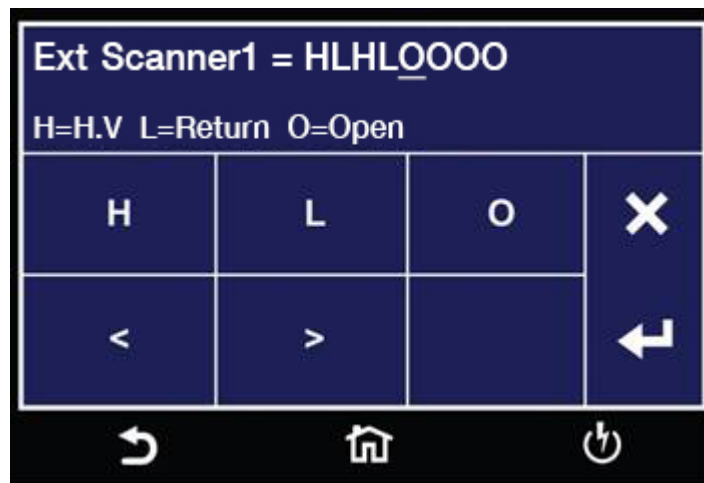
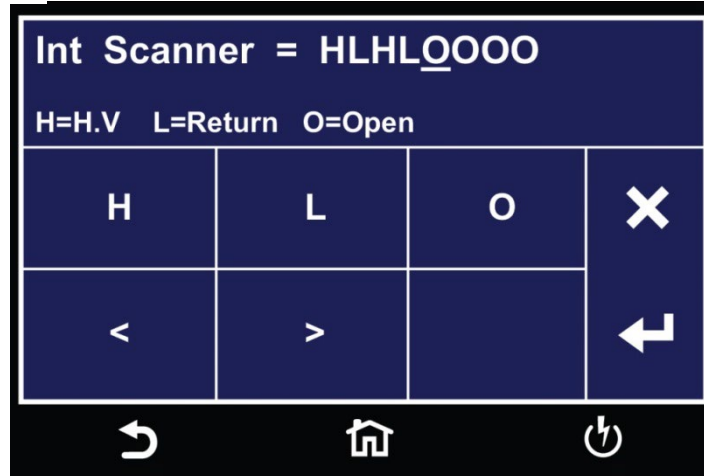


4.2.3. Setup

The SC6540 Scanner channels can be set as High (H) for high voltage or Continuity testing output, Low (L) for the return connection, or Open (O) for OFF. Channel setup is done using the HypotULTRA / HypotULTRA III menu or accompanying automation software. For information on SC6540 setup through Associated Research's Autware Automation Software, consult the Autware3 help file.

The following setup procedure will refer to setup through the HypotULTRA setup menu:

From the Test Parameter Review screen (ACW, DCW, CONT, or IR) you can scroll to find the Scanner settings. Below is an example of the Int Scanner Test Parameter screen.



The above images show a HypotULTRA with 8 Internal Scanner channels and 8 external channels. The “Int Scanner” parameter in the menu pertains to an internal 8-channel Scanner and the “Ext Scanner1” parameter pertains to an 8-channel high voltage SC6540 Scanner.

NOTE: The HypotULTRA can only control up to one external 8-channel scanner (model HN). To control more than 8 external channels, automation software must be used.

To set the scanner channels use the back (<) and forward (>) arrows to select scanner channels and set the channels to High (H), Low (L) or Open (O). Use the enter key (↵) to save the values and move on to the next test parameter

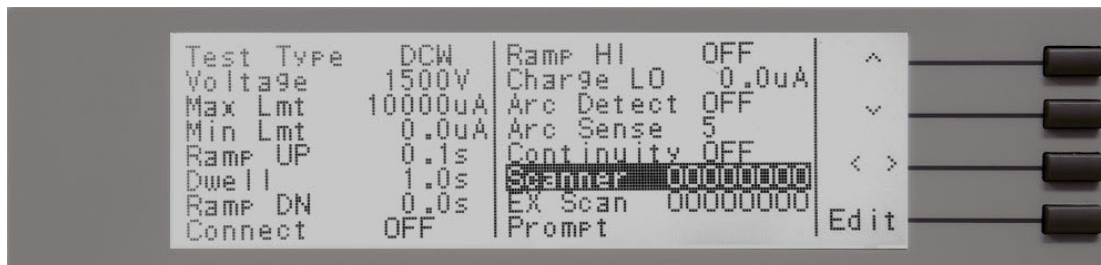
H (High) – High voltage output channel for a high voltage test or current output for a continuity test.

L (Low) – High voltage return channel for a high voltage test or a current return for a continuity test.

O (Open) – Channel is neither an output nor a return.

The following setup procedure will refer to setup through the HypotULTRA III setup menu:

From the Test Parameter Review screen (ACW, DCW, CONT, or IR) you can scroll to find the Scanner settings. Below is an example of the ACW Withstand Test Parameter Review screen.



The above menu shows a HypotULTRA III with 16 Scanner channels (8 internal and 8 external). The “Scanner” parameter in the menu pertains to an internal 8-channel Scanner and the “Ex Scanner” parameter pertains to an 8-channel high voltage SC6540 Scanner.

- **NOTE:** The HypotULTRA III can only control up to one external 8-channel scanner (model HN). To control more than 8 external channels, automation software must be used.

Navigate the Setup Test Parameters screen using the arrow keys located on the right side of the HypotULTRA III LCD and select the “Edit” soft key to modify the Scanner channels.

After pressing the “Edit” soft key, the HypotULTRA III will display the Scanner Settings Edit screen. Using the four soft keys located next to the HypotULTRA LCD, set the 8 channels of the Scanner to one of three different states:

H (High) – High voltage output channel for a high voltage test or current output for a continuity test.

L (Low) – High voltage return channel for a high voltage test or a current return for a continuity test.

O (Open) – Channel is neither an output nor a return.

4.2.4. Operation

Once the SC6540 is incorporated into a test system, it will act as an extension of the HypotULTRA / HypotULTRA III. The outputs will only activate while a test is being performed, and will deactivate when the test is not running. When a failure is detected, the test will stop, the output will be deactivated and the HypotULTRA / HypotULTRA III will give a visual and audible indication of failure. If steps were connected in sequence and the Fail Stop is set to ON, the HypotULTRA / HypotULTRA III will indicate a failure once it reaches the output that is connected to the defective device. If Fail Stop is set to OFF, the HypotULTRA / HypotULTRA III will continue to test the rest of the channels.

- **NOTE:** To ensure operator safety, familiarity with the HypotULTRA / HypotULTRA III's operational features is required.

WARNING

Make sure the test operator is aware of the dangers of high voltage testing before operating this equipment.

Secondary Scanner Power

Once the SC6540 secondary is connected to HypotULTRA / HypotULTRA III, the "power on" LED will light as soon as the power switch of the HypotULTRA / HypotULTRA III is turned on.

Main Scanner Power

The SC6540 main is powered on by putting the switch on the rear panel of the unit in the ON position. The SC6540 Scanner channels will activate when the TEST signal is sent via a PC.

LED Indicators

During a test, individual LED indicators for each output indicate whether the output is set as High, Low or Open. If the channel is set as a High Voltage Output or Continuity Current Output, the red LED will light. If the channel is set as Return, the green LED will light. If the high voltage channel set to Open, no LED will light.

CAUTION

Multiple high voltage or Continuity current channels can be set to activate simultaneously. However, when configured this way the SC6540 cannot provide an indication of which output detected failure. Therefore, each item or test point would again have to be re-tested individually if the operator needs to determine the exact point of failure.

4.3. Operating the SC6540 with OMNIA 8100/8200 Series

NOTE: The Omnia I (8100) series is discontinued and replaced by Omnia II (8200) series.

4.3.1. Cables and Connections Description

A number of hardware and interconnect cables are included with the SC6540 Scanner depending on its configuration and the number of modules. The following hardware and interconnect cables are included with each of the following items:

DESCRIPTION	AR PART NUMBER
SC6540 SECONDARY AND OMNIA 8200 INTERCONNECT CABLES	
1 – 25-Pin Scanner Bus Cable	38592
1 – High Voltage Cable	HS-8-12
1 – Ground Bond Output Cable	38555
1 – Ground Bond Return Cable	38556
2 – Probe HI/LO to Current/Return Cables	38879 ¹
SC6540 MAIN AND OMNIA 8200 INTERCONNECT CABLES	
1 – High Voltage Cable	HS-8-12
1 – Ground Bond Output Cable	38555
1 – Ground Bond Return Cable	38556
2 – Probe HI/LO to Current/Return Cables	38879 ¹
SC6540 SECONDARY AND OMNIA 8100 INTERCONNECT CABLES	
1 – 25-Pin Scanner Bus Cable	38592
1 – High Voltage Cable	HS-8-12
1 – Ground Bond Output Cable	38555
1 – Ground Bond Return Cable	38556
SC6540 MAIN AND OMNIA 8100 INTERCONNECT CABLES	
1 – High Voltage Cable	HS-8-12
1 – Ground Bond Output Cable	38555
1 – Ground Bond Return Cable	38556
SC6540 HIGH VOLTAGE MODULE	
8 – High Voltage Connectors and Assembly Instructions	HS-8-13
1 – 100 ft. (48.75 m) Reel of High Voltage Cable	37534
SC6540 GROUND BOND MODULE	
20 – Hook-style Crimp Lugs	38599

¹ Included with Omnia 8206, 8256, 8207 and 8257 only.

High Voltage Connections

- The 25-pin control cable (p/n 38592) connects between the rear panel SCANNER 1 or SCANNER 2 connector of OMNIA and the rear panel SCANNER BUS INPUT connector of the SC6540.
- The high voltage cable (p/n HS-8-12) is used to connect from the high voltage rear output connector of OMNIA to the rear high voltage input of the SC6540
- The Ground Bond return cable (p/n 38556 for the 8100/8200) is used to connect from the return rear connector OMNIA to the rear panel return connection of the SC6540.
- The red Ground Bond output cable (p/n 38555 for the 8100/8200) is used to connect between the rear panel current output of OMNIA and the rear panel current input of the SC6540.
- The high voltage to banana style connection cable (p/n 38879) is used to connect between the rear panel probe hi and probe lo terminals on the 8200 series and the rear panel current and return of the SC6540. NOTE: these connections are utilized for the 8206, 8256, 8207 and 8257 only.
- Eight high voltage connectors (p/n HS-8-13) are provided with a reel of cable and assembly instructions so that each user can assemble the lengths of the high voltage cable to meet their specific needs.

WARNING

Under certain conditions high voltage can appear on the cabinet of the SC6540. The ground terminal on the rear panel of the SC6540 must be connected to a good earth ground to ensure operator safety.

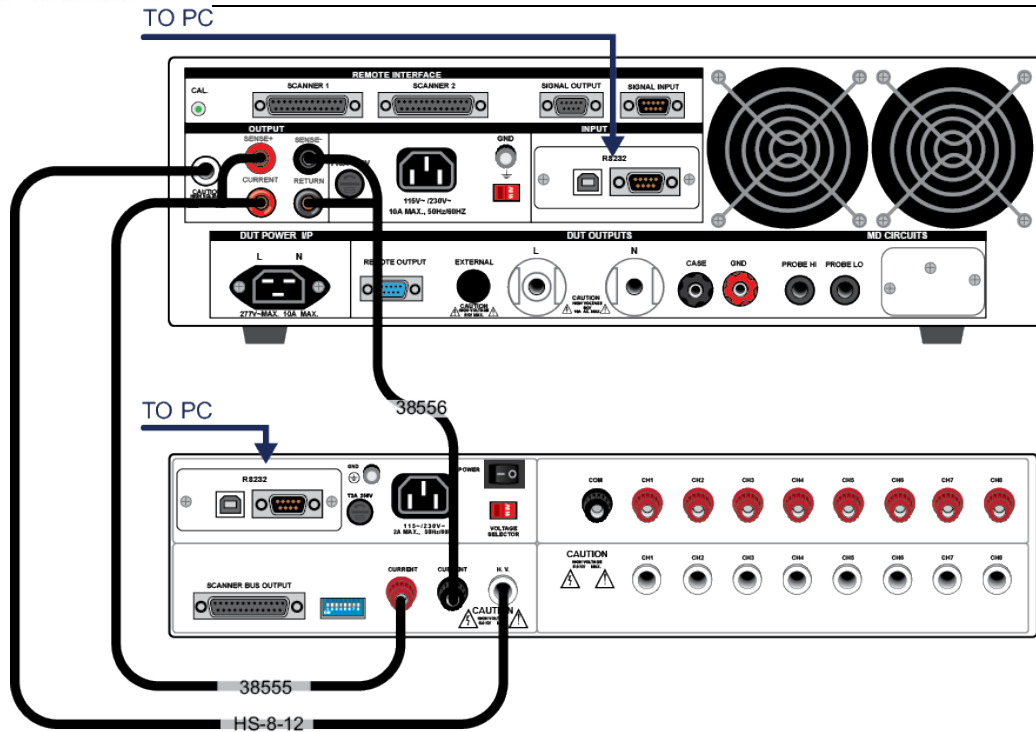
Ground Bond Connections

The rear panel of the SC6540 can include up to sixteen output terminals for Ground Bond testing if this configuration is selected at the time of purchase.

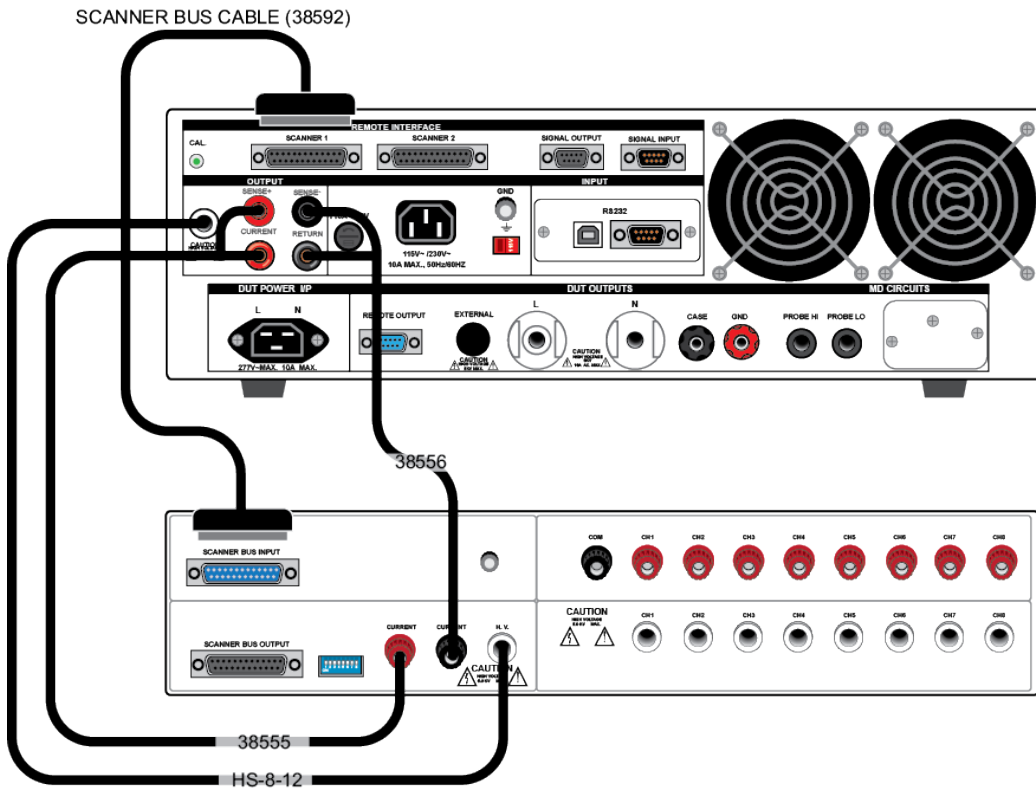
- We recommend using standard 12 gauge wire for operation at 30 amps and 10 gauge wire for 40 amps.

The wires should be attached using the hook-style crimp lugs provided, to minimize connection resistance. The Kelvin connection of an Associated Research ground bond tester will end at the ground bond input terminals of the SC6540 scanner. For this reason, the wire lengths going from the SC6540 high current outputs and the high current return should be kept as short as possible to limit the effect of test lead resistance.

4.3.2. Connection Diagrams



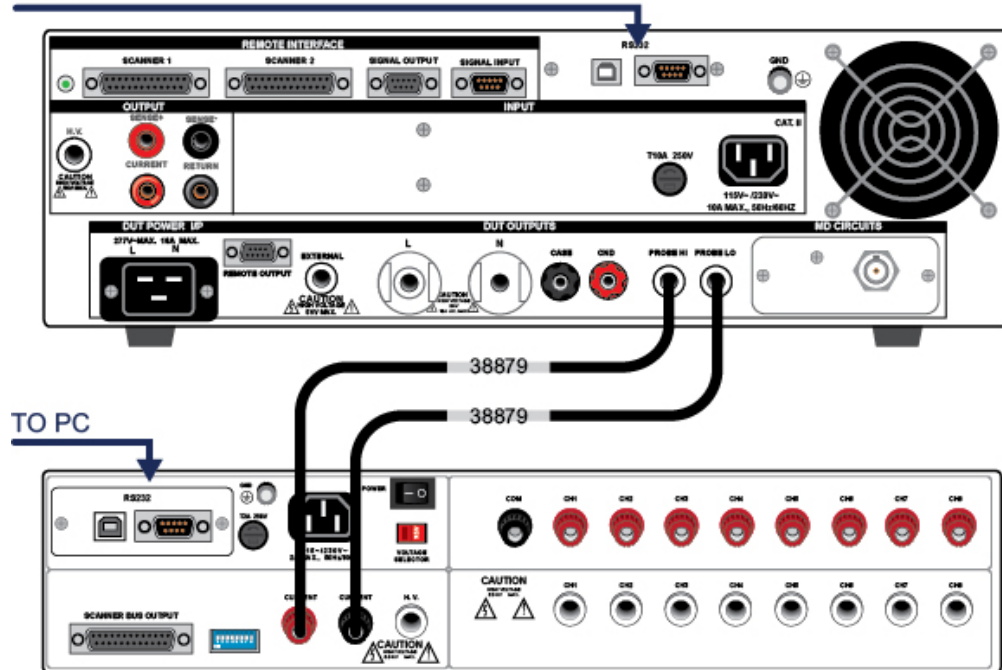
OMNIA 8100 Series and SC6540 Main



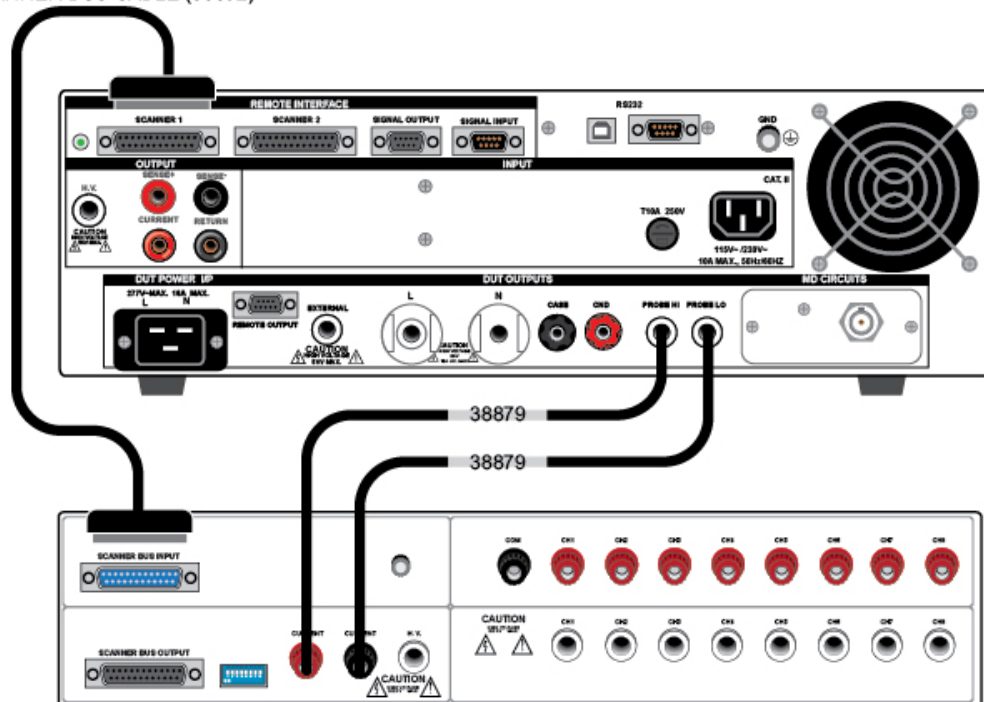
OMNIA 8100 Series and SC6540 Secondary



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OMNIA 8200 Series and SC6540 Main – Line Leakage Testing²
SCANNER BUS CABLE (38592)



OMNIA 8200 Series and SC6540 Secondary – Line Leakage Testing²

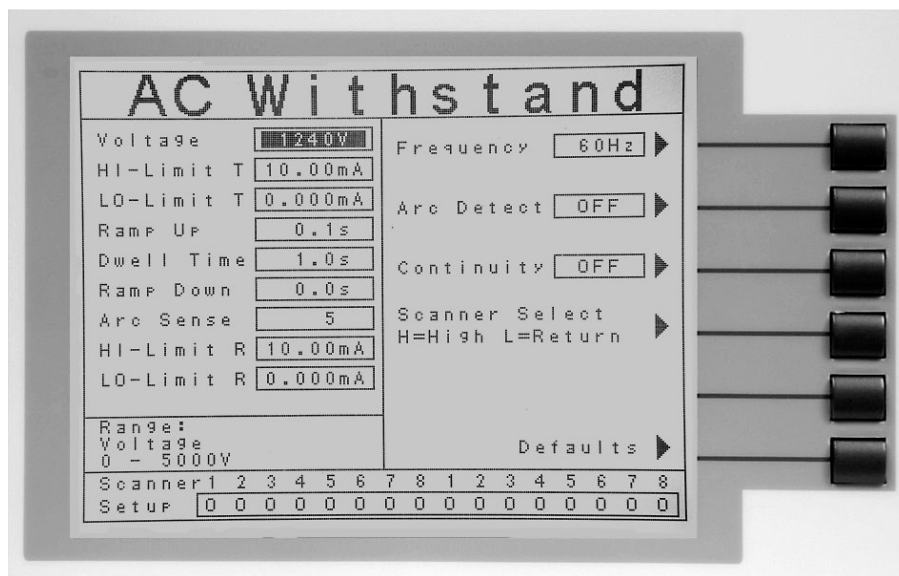
² Line leakage testing only available on 8206, 8256, 8207 and 8257

4.3.3. Setup

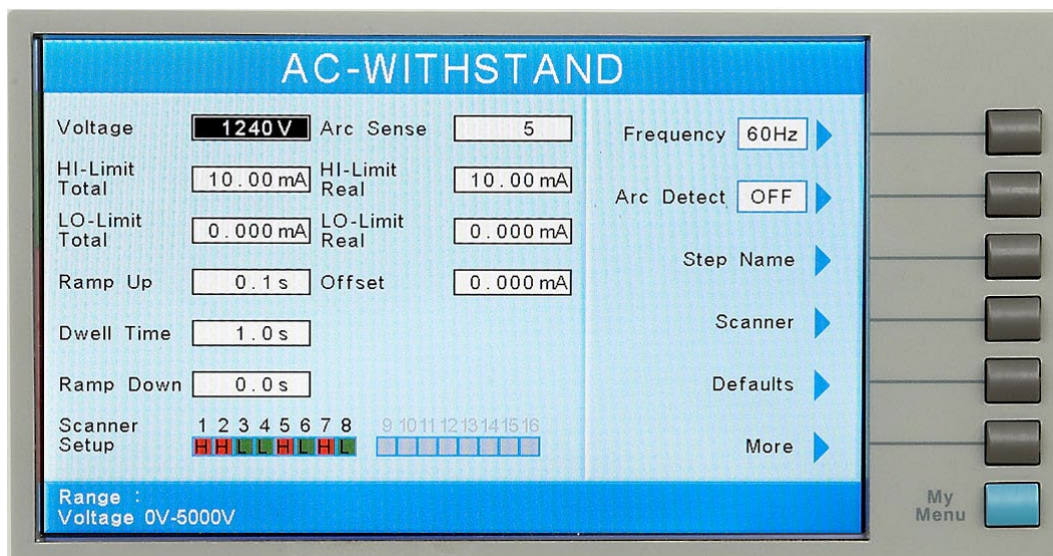
The SC6540 Scanner channels can be set as High (H) for high voltage or Continuity testing output, Low (L) for the return connection, or Open (O) for OFF. Channel setup is done using the OMNIA menu or accompanying automation software. For information on SC6540 setup through Associated Research's Autware Automation Software, consult the Autware S8456 manual.

The following setup procedure will refer to setup through the OMNIA setup menu:

If you are in the Setup Test Parameters screen (ACW, DCW, IR, Ground Bond or Continuity), you will find the Scanner settings. Below is an example of the ACW Withstand Test Setup Menu.



OMNIA 8100 Series and SC6540 Secondary



OMNIA 8200 Series and SC6540 Secondary

The two menus above show an OMNIA and OMNIA II connected to a 16-channel Scanner configuration and 8-channel Scanner respectively. This configuration can be one external 16-channel Scanner (8 high voltage ports and 8 high current ports), or two external 16-channel Scanners (8 high voltage ports and 8 high current ports). With two external 16-channel Scanners, one Scanner should be connected to the Scanner 1 connector on the rear panel of OMNIA and OMNIA II and the second Scanner should be connected to the Scanner 2 connector on the rear panel of OMNIA and OMNIA II.

- Each Scanner port on the rear panel can only control 8 channels of each type (HV or HC) at a time, which makes it possible to control a maximum total of 16 possible external Scanner channels of each type (HV or HC). To control more than 16 external channels, automation software must be used along with a SC6540 Main and a PC.

Navigate the Test Setup screen using the arrow keys located on the OMNIA keypad until you reach the Scanner Setup parameters. The Scanner channels can be set using the “Scanner Select” soft key located to the right of the LCD display. The Scanner channels can be set to one of three different states:

H (High) – High voltage output channel for a high voltage test, current output for a ground bond or continuity test or probe hi channel for a line leakage test (8206, 8256, 8207, 8257 units only).

L (Low) – High voltage return channel for a high voltage test, a current return for a ground bond or continuity test or probe lo channel for a line leakage test (8206, 8256, 8207, 8257 units only).

O (Open) – Channel is neither an output nor a return.

4.3.4. Operation

Once the SC6540 is incorporated into a test system, it will act as an extension of the OMNIA. The outputs will only activate while a test is being performed, and will deactivate when the test is not running. When a failure is detected, the test will stop, the output will be deactivated and the OMNIA will give a visual and audible indication of failure. If steps were connected in sequence, the OMNIA will indicate a failure once it reaches the output that is connected to the defective device. The SC6540 will not continue to test the other outputs until the RESET button is pressed, the defective item is removed, and the TEST switch is pressed once again. The SC6540 will then begin to test from the first step in the program.

- **NOTE:** To ensure operator safety, familiarity with the OMNIA’s operational features is required.

Make sure the test operator is aware of the dangers of high voltage testing before operating this equipment.

Secondary Scanner Power

Once the SC6540 secondary is connected to OMNIA, the “power on” LED will light as soon as the power switch of the OMNIA is turned on.

Main Scanner Power

The SC6540 main is powered on by putting the switch on the rear panel of the unit in the ON position.

LED Indicators

The two leftmost LEDs for Module A and Module B indicate the type of module that has been installed. If the Red LED is illuminated there is a High Voltage module present. If the Green LED is illuminated there is a Ground Bond module present. During a test, individual LED indicators for each output indicate whether the output is set as High, Low or Open. If the channel is set as a High Voltage Output, Ground Bond Output or Continuity Current Output, the red LED will light. If the channel is set as Return, the green LED will light. If the high voltage channel set to Open, no LED will light.

CAUTION

Multiple high voltage or Continuity current channels can be set to activate simultaneously. However, when configured this way the SC6540 cannot provide an indication of which output detected failure. Therefore, each item or test point would again have to be re-tested individually if the operator needs to determine the exact point of failure.

4.4. Interfacing Multiple SC6540s

The SC6540's modular design allows the operator to interface multiple scanning matrixes with an Associated Research automated electrical safety tester. One SC6540 main Scanner has the ability to control up to four SC6540 secondary Scanners.

4.4.1. Scanner Interconnection

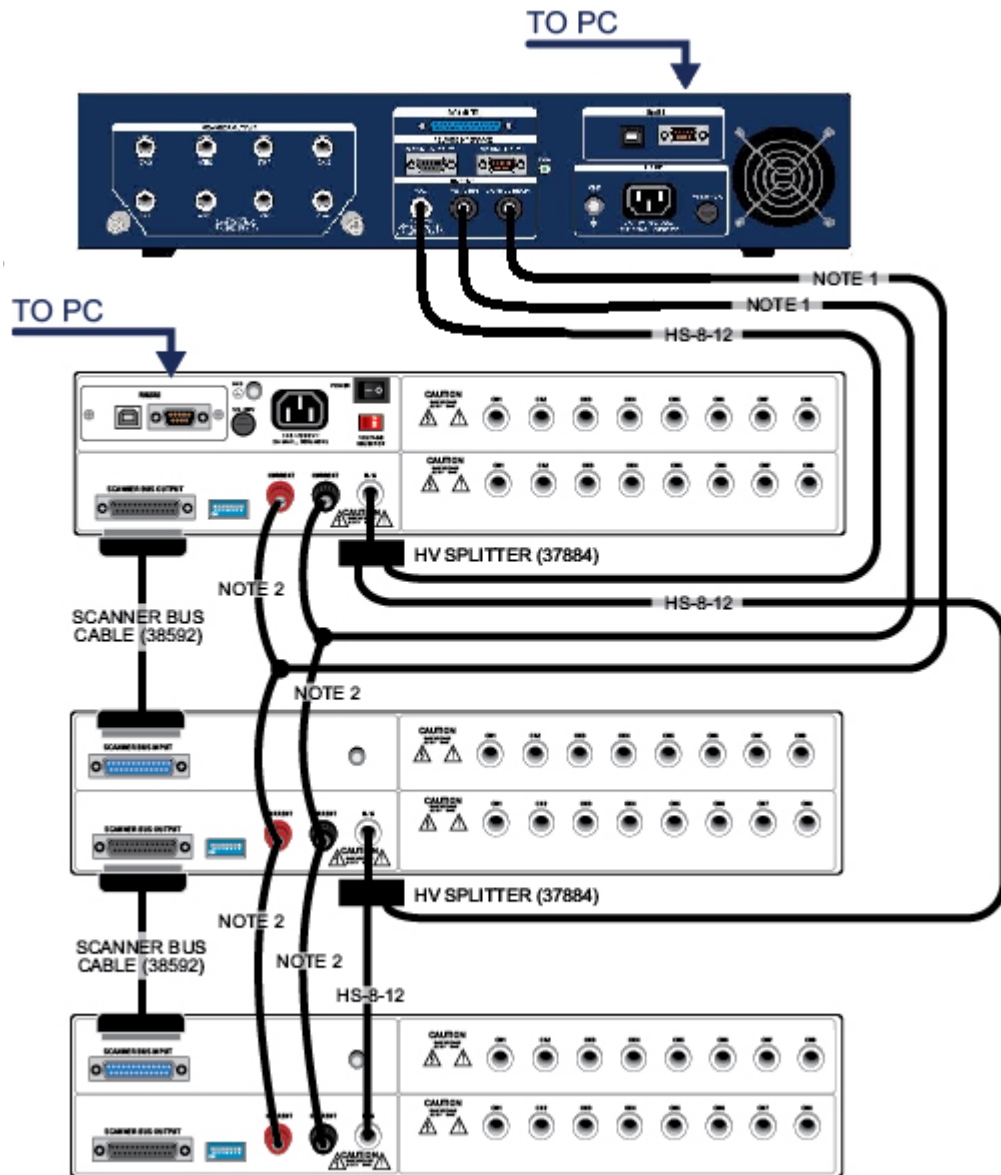
An SC6540 main scanning matrix can be controlled by a GPIB, USB/RS232 or Ethernet interface. Both interfaces come standard on the rear panel of the instrument. To connect an SC6540 secondary to a SC6540 main, simply connect the main's Scanner Bus Output connector to the secondary's Scanner Bus Input connector with the 25-pin Scanner Bus Cable (p/n 38592) that is included with the SC6540 secondary Scanner. For systems that contain more than one secondary, connect the Scanner Bus Output connector on the first secondary to the Scanner Bus Input connector on the second secondary with a second 25-pin Scanner Bus Cable. This procedure should be followed with each additional secondary that is added to the system.

The Scanner Interconnect Kit (p/n 240-01) comes complete with the following items:

DESCRIPTION	AR PART NUMBER
SC6540 SCANNER INTERCONNECT KIT	240-01
1 – High Voltage Splitter	37884
1 – High Voltage Cable	HS-8-12
4 – Hook-style Crimp Lugs	38599

- The high voltage splitter should be connected to the high voltage input terminal on the rear panel of the SC6540 main. This allows for a high voltage input cable from the host instrument and an output terminal for connection of high voltage to the next Scanner.
- If more than one SC6540 secondary is used, then an additional splitter is needed. All SC6540 Scanners in the system should be configured with a high voltage splitter except for the last one in the sequence (Amount of Splitters Needed = Total # of SC6540s – 1). The high voltage cable is used to connect from the splitter to the next SC6540 Scanner.
- Four hook-style crimp lugs are supplied for tying the Current and Return terminals from one Scanner to the Current and Return terminals on the next Scanner. The lugs should be attached to user-supplied wire. Two terminals are supplied per binding post (Current and Return). One terminal is for the connection coming from the previous Scanner (if applicable) and one is for the connection to the next Scanner (if applicable), creating a daisy chain configuration.
- For Ground Bond applications we recommend using 10AWG wire for 40A testing and 12AWG for 30A testing.

4.4.2. Connection Diagram



HypotULTRA and SC6540 Scanner Interconnection Example with 1 Main and 2 Secondary

- Refer to the connection diagram of the applicable safety tester for the required cabling.
- Use supplied Hook-Style Crimp Lugs and user specified wire for Scanner-to-Scanner interconnection.

4.4.3. Scanner Addressing

Addressing Main Units

The address switches located on the rear of the Scanner must be configured in order to ensure proper communication. The 8 pin DIP switch on the SC6540 main should be configured to the GPIB address (if applicable) you wish to use. This will allow the computer to communicate correctly with the main Scanner(s) connected to the bus. The 8 pin DIP switch uses pins 1-5 to set the GPIB address. Pins 6 through 8 on the main scanner are not used. The DIP switch is set in the up position for ON and in the down position for OFF. This is opposite to what the “ON” position is shown on the actual DIP switch on the rear of the panel of the unit. The DIP switch is arranged from pin 1 to pin 5 according to the following Binary Code.

PIN 1 = 1
PIN 2 = 2
PIN 3 = 4
PIN 4 = 8
PIN 5 = 16

The GPIB address number is the sum of the total binary code on the DIP switch. The GPIB address must be selected before turning “ON” the unit.

Example: If you wish to set the address number on the main Scanner to 9, you must turn “ON” (UP) DIP switch pins 1 and 4 and turn “OFF” (DOWN) pins 2, 3 and 5. If you wish to set the address number to 8, you must turn “ON” DIP switch 4 and turn “OFF” pins 1, 2, 3, and 5. A default address number of 9 is set at the factory. For more information on GPIB or USB/RS232, consult section **5. Bus Remote Interface GPIB/USB/RS232/Ethernet.**

Addressing Secondary Units

Each of the SC6540 secondary units also have an 8 pin DIP address switch which must be configured based upon the type of module installed (HV or High Current) and the total number of points controlled by each main for each function. The first 4 switches set the address for Module A, (the lower scanner), and the last four switches set the address for Module B, (the upper scanner) installed in each secondary unit. The DIP switches in the secondary Scanner are arranged with the following Binary Code for setting the circuit address (not the GPIB address):

PIN 1 = 1
PIN 2 = 2
PIN 3 = 4
PIN 4 = 8

Continued on following page...

PIN 5 = 1
PIN 6 = 2
PIN 7 = 4
PIN 8 = 8

Channel Assignment

Each Scanner is capable of supporting two 8-channel modules. Each module is physically marked on the front and rear panel with channel numbers 1 through 8. To direct the control signals to the correct channel when using multiple scanners, the address setting function must be used. By setting the address you are configuring a set of virtual channel numbers for each of the modules.

Each high voltage module must have its own unique address to operate correctly. This is also the same for each individual high current module. Since high current and high voltage modules are for different test functions, a common address setting can be shared between two modules of different types. The following grid shows the set of channel numbers that are assigned for each unique address setting.

ADDRESS SETTING	VIRTUAL CHANNEL NUMBERS
0	1-8
1	9-16
2	17-24
3	25-32
4	33-40
5	41-48
6	49-56
7	57-64
8	65-72
9	73-80

Examples: Setting the DIP switches

Example 1: Setting up a test with either 80 HV test points or 80 High Current test points.

The DIP switches on the main Scanner must be set to the correct GPIB address (if applicable). A circuit address must also be assigned for each module of 8 channel Scanners. The main scanner automatically assigns a circuit address for the two 8 channel modules installed in the main.

- The circuit address will be automatically set to 0 for modules A and B if both of the modules are of different types (1 HV and 1 High Current).

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	Address 6	PIN 2 = ON
		PIN 3 = ON
	Position B Address 7	PIN 4 = OFF
		PIN 5 = ON
Secondary 4	Address 8	PIN 6 = ON
		PIN 7 = ON
		PIN 8 = OFF
		PIN 1 = OFF
	Position B Address 9	PIN 2 = OFF
		PIN 3 = OFF
		PIN 4 = ON
		PIN 5 = ON
	Position B Address 9	PIN 6 = OFF
		PIN 7 = OFF
		PIN 8 = ON
		PIN 1 = OFF

Example 2: A system requiring both 40 High Current and 40 High Voltage test points can be set up in either of the following configurations.

The GPIB address should be set on the main Scanner and the main Scanner would automatically assign the circuit address for the type of modules installed in it. If a high current module is installed into position A and a high voltage module is installed in position B, a circuit address of 0 will be assigned to both positions because they represent test points 1-8 for both test functions.

SCANNER TYPE	POSITION	CIRCUIT ADDRESS	CHANNELS
Main HC	A	Automatically assigned 0	1-8
Main HV	B	Automatically assigned 0	1-8
Secondary 1 HC	A	1	9-16
Secondary 1 HV	B	1	9-16
Secondary 2 HC	A	2	17-24
Secondary 2 HV	B	2	17-24
Secondary 3 HC	A	3	25-32
Secondary 3 HV	B	3	25-32
Secondary 4 HC	A	4	33-40
Secondary 4 HV	B	4	33-40

HV			
----	--	--	--

Example 3: A test system requiring 40 HV and 40 HC points set up in a different configuration.

The main Scanner and the first secondary Scanner are set up with high voltage modules in modules A and B. The second secondary Scanner is set up with one high voltage module and one high current module. The remaining secondary Scanners are set up with all high current modules.

SCANNER TYPE	POSITION	CIRCUIT ADDRESS	CHANNELS
Main HV	A	Automatically assigned 0	1-8
Main HV	B	Automatically assigned 1	9-16
Secondary 1 HV	A	2	17-24
Secondary 1 HV	B	3	25-32
Secondary 2 HV	A	4	33-40
Secondary 2 HC	B	0	1-8
Secondary 3 HC	A	1	9-16
Secondary 3 HC	B	2	17-24
Secondary 4 HC	A	3	25-32
Secondary 4 HC	B	4	33-40

5. BUS REMOTE INTERFACE GPIB / USB / RS-232 / ETHERNET

This section provides information on the proper use and configuration of the bus remote interface. The USB/RS-232 remote interface is standard on the SC6540 but the GPIB (IEEE-488) and interface option can be substituted for the USB/RS-232 interface. The USB/RS-232 interface uses the same command set as the GPIB interface for setting test parameters; however, many functions of the GPIB 488.2 interface are not available through USB/RS-232. The IEEE-488 interface included with the SC6540 conforms to the requirements of the IEEE-488.2 standard.

The USB/RS-232 interface card requires the user to download a driver in order for the instrument to recognize the USB interface. The driver can be found on the Associated Research, Inc. website:

<http://www.asresearch.com/products/software/USB-driver.aspx>

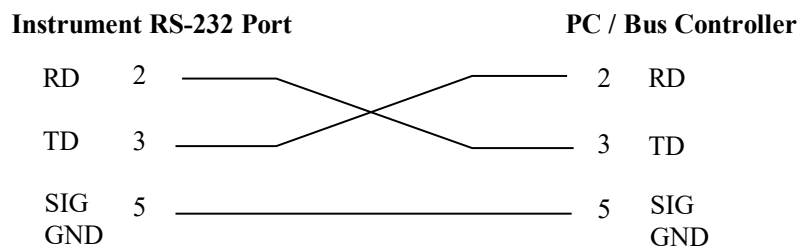
Click on “USB/RS-232 Driver” to download the driver. This link contains an automatic extract and install program. Follow the instructions of the installation program to initialize the driver install. NOTE: The USB port acts as a USB to RS-232 converter. As a result, the PC will recognize the USB port as a virtual COM port.

5.1. USB/RS-232 Interface

This interface provides all of the control commands and parameter setting commands of the GPIB interface with the exception of some of the 488.2 Common Commands and SRQ capability. All commands can be found in section **5.5. USB/RS-232/GPIB Command List**. The identification command *IDN and the Status Reporting commands are also available through USB/RS-232.

5.1.1. RS-232 Connector

The RS-232 cabling should be configured as follows for a 9-pin serial port interface:



5.1.2. Communications Port Configuration

The COM port should have the following configuration:

- 9600 baud
- 8 data bits
- 1 stop bit
- No parity

This interface does not support XON/XOFF protocol or any hardware handshaking. The controller should be configured to ignore the handshaking lines DTR (pin 4), DSR (pin 6) CTS (pin 8) and RTS (pin 7). If the port cannot be configured through software to ignore these lines the handshake lines should be jumpered together in two different sets. Pins 4 and 6 should be jumpered together and pins 7 and 8 should be jumpered together at the controller end of the cable.

5.1.3. Sending and Receiving Commands

Sending Data

Once a command is sent to the instrument over the USB/RS-232 bus the instrument will send one of two responses. If the transfer was recognized and completed the instrument will return with 06 hex or 6 decimal, the Acknowledge (ACK) ASCII control code. If there is an error with the command string that is sent, the instrument will respond with 15 hex or 21 decimal, the Not Acknowledge (NAK) ASCII control code. The ACK or NAK response allows for software handshaking to monitor and control data flow.

Receiving Data

When requesting data from the instrument it will automatically send the data back to the controller input buffer. The controller input buffer will accumulate data being sent from the instrument, including the ACK and NAK response strings, until it has been read by the controller.

5.2. GPIB Interface

This interface is optional on the SC6540 and provides all of the control commands and parameter setting commands of the USB/RS-232 interface along with 488.2 Common Commands and SRQ capability. All commands can be found in section **5.5. USB/RS-232/GPIB Command List**.

Signals and Lines

The GPIB consists of 16 signal lines and 8 ground-return or shield drain lines. The 16 signal lines are grouped into 8 data lines, 3 handshake lines and 5 interface management lines.

Data Lines: The eight data lines, DI01 through DI08 carry data and command messages. The 7-bit ASCII or ISO code set is used and the eighth bit DI08 is unused.

Handshake Lines: The transfer of message bytes between devices is done via three asynchronously control lines. Referred to as three-wire interlocked handshake. This guarantees that message bytes on the data lines are sent and received without transmission error.

NRFD (not ready for data) indicates when a device is ready or not ready to receive a message byte.

NDAC (not data accepted) indicates when a device has or has not accepted a message byte.

DAV (data valid) tells when the signals on the data lines are stable (valid) and can be accepted safely by devices.

Interface Management Lines: Five lines are used to manage the flow of information across the interface.

ATN (attention) ATN is driven true by the controller when it uses the data lines to send commands, and drivers ATN false when a Talker can send data messages.

IFC (interface clear) IFC is driven by the system controller to initialize the bus and become CIC.

REN (remote enable) The REN line is driven by the controller which is used to place devices in remote or local program mode.

SRQ (service request) The SRQ line can be driven by any device to asynchronously request service from the Controller.

EOI (end or identify) This line has two purposes- the Talker uses this line to mark the end of a message string, and the Controller uses it to tell devices to identify their response in a parallel poll.

GPIB Connector

Connection is usually accomplished with a 24-conductor cable with a plug on one end and a connector at the other end. Devices may be connected in a linear, star or a combination configuration.

The standard connector is the Amphenol or Cinch Series 57 Microribbon or AMP CHAMP type. The GPIB uses negative logic with standard transistor-transistor logic (TTL) levels. When DAV is true, for example, it is a TTL low level (≤ 0.8 V), and when DAV is false, it is a TTL high level (≥ 2.0 V).

Restrictions and Limitations on the GPIB

- A maximum separation of 4 m between any two devices and an average separation of 2 m over the entire bus.
 - A maximum total cable length of 20 m.
 - No more than 15 device loads connected to each bus, with no less than two-thirds powered on. For example 1 GPIB controller and a maximum of 14 GPIB instruments.
- **NOTE:** A bus extender, which is available from numerous manufacturers, is available to overcome these limitations.

5.3. GPIB Address Setup

This is an 8-pin DIP switch. Pins 1 through 5 are used to set the GPIB address. Pins 6 through 8 are not used. The DIP switch is set in the up position for ON and in the down position for OFF. This is opposite to the way the “On” position is shown on the actual DIP switch on the rear panel of the unit. The DIP switch is arranged from pin 1 to pin 5 according to the following Binary Code:

PIN 1	=	1
PIN 2	=	2
PIN 3	=	4
PIN 4	=	8
PIN 5	=	16

The GPIB address number is the sum of the total binary code on the DIP switch. The GPIB address must be set before the unit is turned on.

EXAMPLES: If you wish to set the address number to 9, you must turn “ON” (UP) DIP switch pin 1 and pin 4 and turn “OFF” (DOWN) pin 2, pin 3 and pin 5. If you wish to set the address number to 8, you must turn “ON” DIP switch pin 4 and turn “OFF” pin 1, pin 2, pin 3 and pin 5.

- A default address number of 9 is set at the factory.

5.4. Interface Functions

The capability of a device connected to the bus is specified by its interface functions. These functions provide the means for a device to receive, process, and send messages over the bus. The interface functions are listed in the chart below.

GPB 488.1 INTERFACE FUNCTIONS

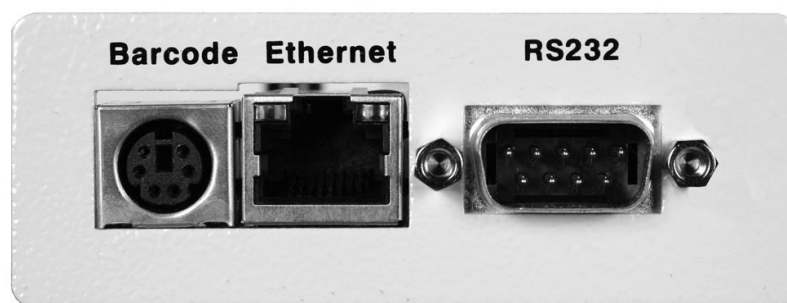
INTERFACE FUNCTION	SUBSET	DESCRIPTION
Source Handshake	SH1	Complete Source handshake capability
Acceptor Handshake	AH1	Complete Acceptor handshake capability
Talker	T6	Talker functions (unaddress if MLA)
Listener	L4	Listener functions (unaddress if MTA)
Service Request	SR1	Complete Service request capability
Remote Local	RL0	No remote/local capability
Parallel Poll	PP0	No parallel poll capability
Device Clear	DC1	Complete Device clear capability
Device Trigger	DT0	No device trigger capability
Controller	C0	No controller capability
Electrical Interface	E2	Three-state drivers

Controllable Items	Test and Reset control.
	Setting of test parameters for tests.
	Reading of instrument status and test results.
Data Codes	ASCII
Delimiter	NL (+ EOI)

5.5. Ethernet Interface

The Ethernet Interface option provides RS-232 and Ethernet communication interfaces. The barcode port is non-functional when used with an SC6540 scanner.

The Ethernet Card has three input/output ports, shown in the following figure:



The Ethernet port is for use with a standard CAT-5 Ethernet cable and may be connected to any compatible PC. The 9-pin D-type subminiature connector labeled "RS232" is for connection of the SC6540 to an RS-232 communication bus. All of the Ethernet commands (excluding the query commands) will respond with the 06 hex (6 decimal) Acknowledge (ACK) ASCII control code if the transfer

was recognized by the instrument. If there was an error with the command string, the instrument will respond with 15 hex (21 decimal), the Not Acknowledge (NAK) ASCII control code. The presence of this response does not mean that the instrument (in the case of these commands only) completed the command.

These commands require a restarting of the hardware that controls the Ethernet Protocols. As a result, the user must wait before the Ethernet Card will respond to another command. See the table below for the approximate wait times necessary after one of the commands in the table is sent. In addition, the current socket connection between the user's terminal and the Ethernet Card is no longer valid, and the user will need to close their current connection and establish a new one. See section **5.7.5. Ethernet Settings Commands and Companion Queries** for a full list of the Ethernet protocol commands.

Ethernet Card Settings Command Wait Times

IP MODE	COMMAND	WAIT TIME AFTER COMMAND IS SENT*
Manual	SIA, SGA, SSM	8 seconds
	SIM 0	14 seconds
Auto	SDN	14 seconds
	SIM 1	8 seconds

*Wait times are approximate and can vary based on the user's network.

Ethernet Interface

The Ethernet interface provides all of the function control of the standard RS-232 interface. Some commands are only exclusive to GPIB control.

Default Settings

The default settings for the Ethernet interface are as follows:

IP Setup: AUTO
 IP Address: 010.000.000.000
 Gateway IP: 000.000.000.000
 Subnet Mask: 255.000.000.000

The source port number for the Ethernet Card in TCP connections is 10001.

Ethernet Card Setup

In order to setup the Ethernet card, the operator will need information from the local network administrator. Please have your network administrator fill out the required information on the next page and keep it for your records:

Associated Research, Inc.
Ethernet Card Communications Information
(To be completed by Network Administrator)

Ethernet Card Address: _____:_____:_____:_____:_____

Device Name: _____

Device IP Address: _____._____._____._____

Gateway IP Address: _____._____._____._____

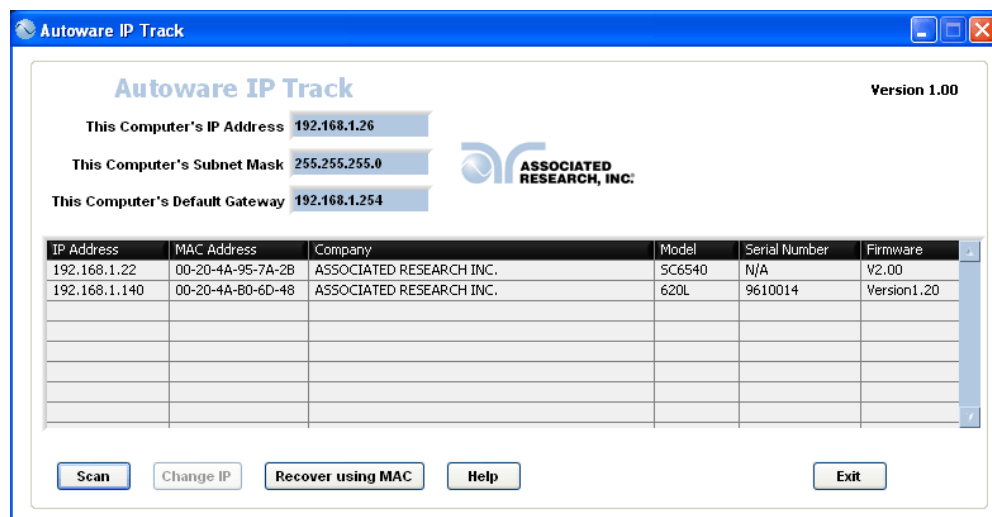
Subnet Mask: _____._____._____._____

5.6. Autoware IP Track

The SC6540 scanner does not contain a display to keep track of Ethernet settings. The Autoware IP Track program can be used to track the SC6540 Ethernet settings including IP Address, Subnet Mask and Default Gateway. The Autoware IP Track program can be downloaded from the Associated Research, Inc. website:

<http://www.asresearch.com/products/software/index.shtml>

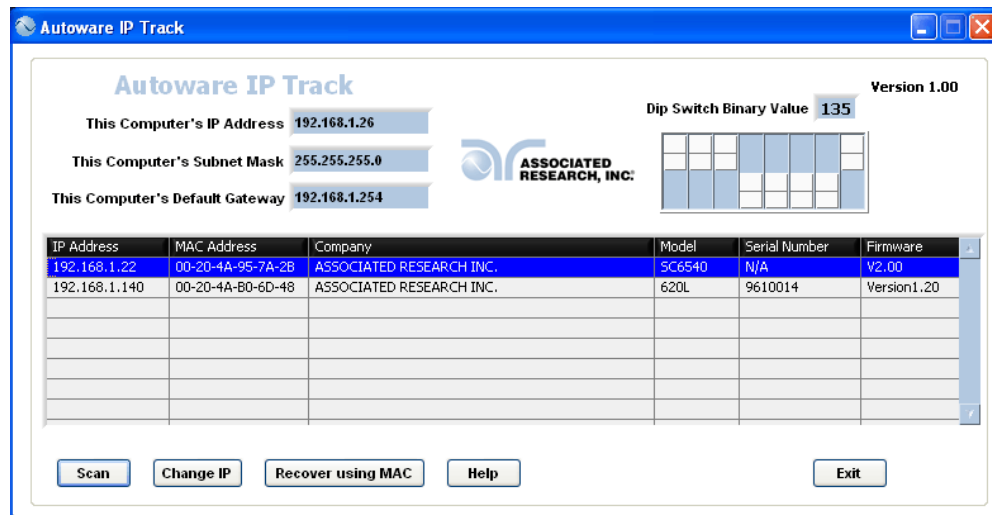
This editor menu can be used to keep track of multiple units connected to a network. There are three fields at the top of this editor that are associated with the PC settings: This Computer's IP Address, This Computer's Subnet Mask and This Computer's Default Gateway. This will show the user the settings of the associated PC. The image below illustrates the Autoware IP Track window:



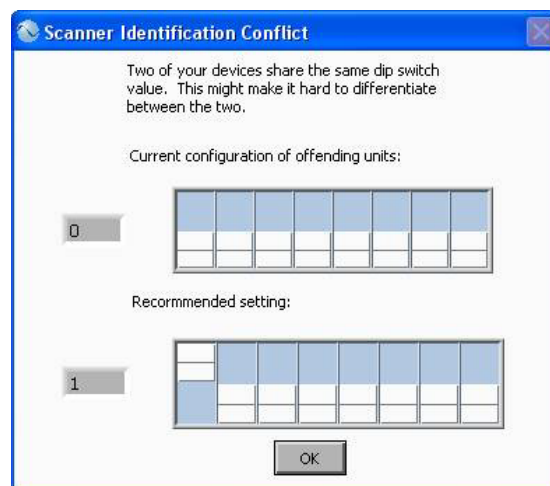
Below the computer settings, the Autoware IP Track displays all the models connected to the network. Each model has a displayed IP Address, MAC Address, Company (Associated Research, Inc.), Model, Serial Number and Firmware. For example:

IP Address: 192.168.1.45
 MAC Address: 00-22-4A-E0-7D-49
 Company: Associated Research, Inc.
 Model: SC6540
 Serial Number: 1234567
 Firmware: V2.00

This feature is also helpful for keeping track of multiple main SC6540 scanners. This feature allows the user to keep track of all scanners by serial number, IP address, MAC address and dip switch configuration. If a scanner is highlighted, the dip switch configuration will appear on the top right hand side of this screen along with the dip switch binary value. This also allows the user to keep track of multiple main scanners by the value of the dip switches.



If two scanners have the same dip switch configuration, the user will be warned and the program will recommend that the configuration be changed to the next available decimal value:

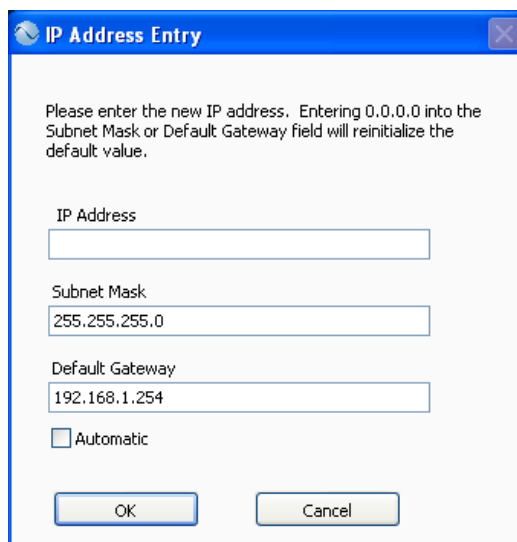


A unit can also be edited by using the SCAN, CHANGE IP and RECOVER USING MAC buttons located at the bottom of the Autoware IP Track screen. The user can also receive information about the Autoware IP Track with the HELP button.

SCAN: Pressing this button will initiate a full scan of the network. Any units connected to the network will then be displayed on this screen.

CHANGE IP: This feature will allow the user to manually change the IP address of a unit on the network. The user must first highlight a unit on the network to use this feature. If a unit is highlighted and this button is pressed, the ADDRESS IP ENTRY window will prompt the user: "Please enter the new IP address. Entering 0.0.0.0 into the Subnet Mask or Default Gateway field will reinitialize the default value." The user can then enter a new IP address for the instrument. If the user would like the DHCP server to

automatically scan for available IP addresses, the AUTO button at the bottom of the screen must be checked. Press OK to save the changes. Press CANCEL to exit this window without saving the changes.



IP Address Entry

Please enter the new IP address. Entering 0.0.0.0 into the Subnet Mask or Default Gateway field will reinitialize the default value.

IP Address

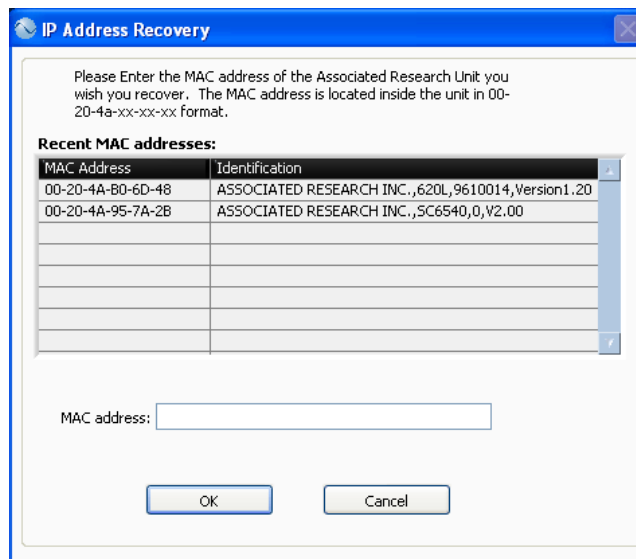
Subnet Mask

Default Gateway

☐ Automatic

OK Cancel

RECOVER USING MAC: If a unit on the network cannot be found via a system scan, the user can attempt to find the unit using this feature. If the user hits the RECOVER USING MAC button, the program will display a window with the following message: “Please Enter the MAC address of the Associated Research Unit you wish you recover. The MAC address is located inside the unit in 00-20-4a-xx-xx-xx format.” The user can type the MAC address of the associated unit into the MAC Address field and hit OK to attempt a recovery of the instrument. Press CANCEL to exit this window without saving the changes.



IP Address Recovery

Please Enter the MAC address of the Associated Research Unit you wish you recover. The MAC address is located inside the unit in 00-20-4a-xx-xx-xx format.

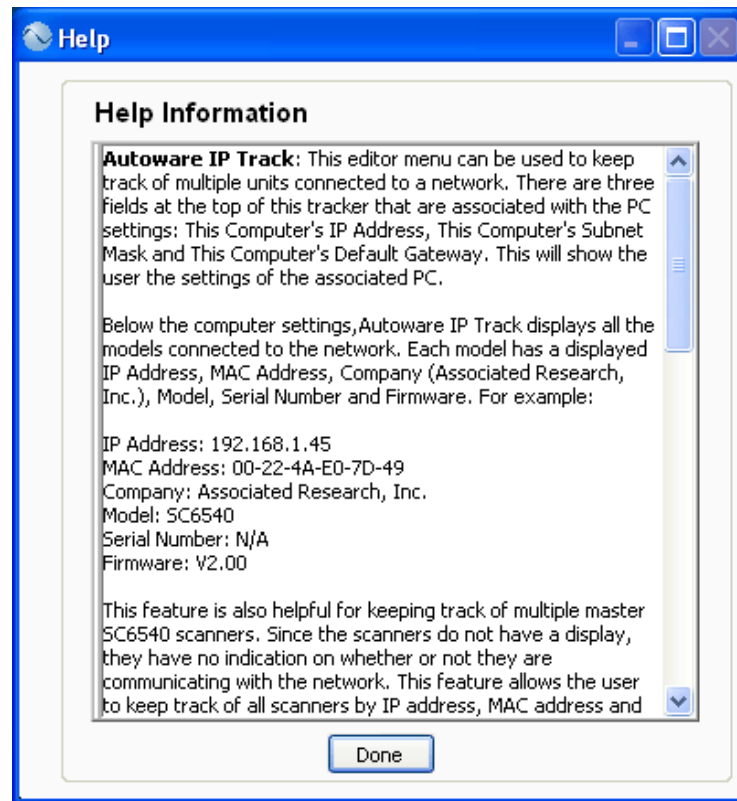
Recent MAC addresses:

MAC Address	Identification
00-20-4A-B0-6D-48	ASSOCIATED RESEARCH INC., 620L, 9610014, Version 1.20
00-20-4A-95-7A-2B	ASSOCIATED RESEARCH INC., SC6540, 0, V2.00

MAC address:

OK Cancel

HELP: Pressing this button will display information about the Autoware IP Track and its features.



BACK: Pressing this button will return the user to the SETUP SYSTEM PARAMETERS window.

5.7. GPIB / USB / RS-232 / Ethernet Interface Command List

Echo and Response Considerations

USB/RS-232 Responses

The USB/RS-232 bus will automatically send any response back to the controller's input buffer.

GPIB Queries and Responses

The GPIB bus will not send any data to the controller without being queried. A GPIB read command must be sent after a command string to retrieve any data from a query command (?).

5.7.1. Rules for Sending Commands to the Instrument

The following conventions are used to describe the commands syntax for the SC6540:

- Braces ({ }) enclose each parameter for a command string.
- Triangle brackets (< >) indicate that you must substitute a value for the enclosed parameter.
- The Pipe (|) is used to separate different parameter options for a command.
- The command and the parameter data must be separated with a space.
- Each command string should be terminated by the ASCII control code, New Line (NL), (OAh) or the end of line (EOL) message for GPIB.
- All commands that end with a question mark (?) are query commands and required an IEEE-488 read command to retrieve the data from the device's output buffer.

5.7.2. Scanner Channel Configuration Commands

The following commands are used to create or modify Test Setup Files.

COMMAND	DESCRIPTION	VALUE
HV <channel configuration>	High Voltage channel set	H,L,O
CONT <channel configuration>	Continuity channel set	H,L,O
GND <channel number>	Ground Bond channel set	channel number = 1 - 80
CH:HV <channel numbers>	High Voltage channel set	channel number = 1 - 80
CH:CONT <channel numbers>	Continuity channel set	channel number = 1 - 80
CH:RTN <channel numbers>	Return channel set	channel number = 1 - 80
GNDHV x,<channel configuration>	Return channel set	X= 1-80 channel configuration= H, L, O

(1) "Valid ASCII" is the character set that is available from the front panel LCD user interface. Consisting of upper case alphabet (A-Z), numbers (0-9) and decimal point (.), asterisk (*), dash (-), under bar (_), tilde (~) and space (SP).

HV <channel configuration>

Set High Voltage channels in sequential order with values H (High), L(Return), O(Open). All channels that are not assigned a value (H,L or O) will be automatically set to O(Open). For example, HV HOHL will set channels 1 and 3 High, channel 2 Open, and channel 4 Low. All other channels will be set to Open.

CONT <channel configuration>

Set Continuity channels in sequential order with values H(High), L(Return), O(Open). All channels that are not assigned a value (H,L or O) will be automatically set to O(Open). For example, CONT HOHL will set channels 1 and 3 High, channel 2 Open, and channel 4 Low. All other channels will be set to Open.

GND <channel number>

Set an individual channel for a High Current Ground Bond test. For example, GND 1 will set channel 1 as a Ground Bond output.

CH:HV <channel numbers>

Set individual channels as H(High) for a High Voltage test. Channels must be separated with a comma. For example, CH:HV 1,2 will set channels 1 and 2 High and all other channels will remain unchanged.

CH:CONT <channel numbers>

Set individual channels as High for a Continuity Test. Channels must be separated with a comma. For example, CH:CONT 1,2 will set channels 1 and 2 High and all other channels will remain unchanged.

CH:RTN <channel numbers>

Set individual channels as Low (Return). Channels must be separated with a comma. For example, CH:RTN 1,2 will set channels 1 and 2 as Return and all other channels will remain unchanged.

GNDHV x,<channel configuration>

Set both the High Voltage and High Current channels at the same time. Channels must be separated by a comma. This command allows the scanners with the main modules to run DualCheck with tests. In this command, x will equal a value from 1-80 depending on how many secondary scanners are connected and the channel configuration will be H (High), L (Low) or O (Open). For example, the syntax for this command for 1 main with 8 GND channels and 8 HV channels would be GNDHV 3, HLOOOOL.

5.7.3. Query Commands

These query commands will retrieve data from the instrument. The GPIB bus application requires an IEEE-488 read command to be sent after the query command. These commands include functions for retrieving test data, test results and remote hardware status as well as setup file information.

5.7.4. IEEE 488.2 Common Commands

These commands are required by the IEEE-488.2 standard with the exception of *PSC, *PSC?. Most of these commands are not available over the RS-232 bus except for the *IDN? command which can be used to retrieve the instrument identification information, and the four status reporting commands *ESR?, *ESE, *ESE? and *STB?

COMMAND	NAME	DESCRIPTION
*IDN?	Identification Query	Associated Research Inc., Model Number, Serial Number, Firmware Revision
*RST	Reset Command	Resets SC6540
*TST?	Self-Test Query	00H=OK 01H=TEST EEPROM ERROR
*CLS	Clear Status Command	Clear Standard Event Status Register Clear Service Request Register
*OPC	Operation Complete Command	When all selected pending operations complete, ESR BIT0 = 1
*OPC?	Operation Complete Query	When all selected pending operations complete, Output Queue = 1
*WAI	Wait-to-Continue Command	
*PSC {1 0}	Power-on Status Clear Command	1 = Power-on clear enable registers 0 = Power-on load previous enable registers
*PSC?	Power-on Status Clear Query	
*ESR?	Standard Event Status Register Query	0 - 255
*ESE <value>	Standard Event Status Enable Command	value = 0 - 255
*ESE?	Standard Event Status Enable Query	0 - 255
*STB?	Read Status Byte Query	Read Status Byte
*SRE <value>	Service Request Enable Command	value = 0 - 255
*SRE?	Service Request Enable Query	0 - 255

*IDN?

Read the instrument identification string. Company = Associated Research Inc.

Note: serial number information is not stored in the instrument's memory; a serial number of "0" will be returned in the character string.

***RST**

Reset the instrument to original power on configuration. Does not clear Enable register for Standard Summary Status or Standard Event Registers. Does not clear the output queue. Does not clear the power-on-status-clear flag.

***TST?**

Performs a self-test of the instrument data memory. Returns 0 if it is successful or 1 if the test fails.

***CLS**

Clears the Status Byte summary register and event registers. Does not clear the Enable registers.

***OPC**

Sets the operation complete bit (bit 0) in the Standard Event register after a command is completed successfully.

***OPC?**

Returns an ASCII "1" after the command is executed.

***WAI**

After the command is executed, it prevents the instrument from executing any further query or commands until the no-operation-pending flag is TRUE.

***PSC {1|0}**

Sets the power-on status clear bit. When set to 1 the Standard Event Enable register and Status Byte Enable registers will be cleared when power is turned ON. 0 setting indicates the Enable registers will be loaded with Enable register masks from non-volatile memory at power ON.

***PSC?**

Queries the power-on status clear setting. Returns 0 or 1.

***ESR?**

Queries the Standard Event register. Returns the decimal value of the binary-weighted sum of bits.

***ESE <value>**

Standard Event enable register controls which bits will be logically OR'd together to generate the Event Summary bit 5 (ESB) within the Status Byte.

***ESE?**

Queries the Standard Event enable register. Returns the decimal value of the binary-weighted sum of bits.

***STB?**

Read the Status Byte. Returns the decimal value of the binary-weighted sum of bits.

***SRE <value>**

Service Request enable register controls which bits from the Status Byte should be use to generate a service request when the bit value = 1.

***SRE?**

Queries the Service Request enable register. Returns the decimal value of binary-weighted sum of bits.

5.7.5. Ethernet Card Setting Commands and Companion Queries

These commands require Ethernet protocol.

COMMAND	NAME	VALUE
SIM {1 0} SIM?	Set IP Mode	1=Manual, 0=Auto (DHCP/BOOTP)
SIA <value> SIA?	Set IP Address	Dotted decimal form. Ex. 192.168.1.50
SGA <value> SGA?	Set Gateway IP Address	Dotted decimal form
SSM <value> SSM?	Set Subnet Mask	Dotted decimal form
SDN <value> SDN?	Set Device Name	8 character max, must start with a letter
MAC?	MAC Address Query	Example response: 00:20:4A:8B:B4:30
DIP?	DIP Switch Query	Binary Value of DIP Switch Configuration

5.7.6. Status Reporting

Status reporting system is configured using two types of registers. An Event Register and a Summary register. The summary register is known as the Status Byte register and records high-level summary information acquired by the event registers.

An Event register report defined conditions or messages at each bit. The bits are latched and remain at an active state until the register is either Read or Cleared. Reading the event register automatically clears the register and sets all bits to

inactive state or 0. When querying an event register the information is returned as a decimal number representing the binary-weighted sum of all bits within the register.

The Enable registers bits represent the selection of bits that will be logically-ORed together to form the summary bit in the status byte. The *CLS command will not clear the enable registers and if you wish to clear the register you must set it to a value of 0. Like the event register, the enable register is represented as a decimal number that equals the binary-weighted sum of all bits.

The enable register will clear to value of 0 at power up unless the *PSC 0 command had been executed before power-off. The *PSC command tells the device whether or not it should clear the enable registers at power-on. Using this command will allow SQRs to function immediately after power-on.

		STANDARD EVENT REGISTER		STATUS BYTE REGISTER	
Bit	Binary weight	Event Register	Enable Register	Summary Register	Enable Register
0	1	Operation Complete		not used	
1	2	not used		not used	
2	4	Query Error		not used	
3	8	not used		not used	
4	16	Execution Error		Message Available (MAV)	
5	32	Command Error		Event Summary Bit (ESB)	
6	64	not used		Request Service (RQS) or Main Summary Status (MSS)	
7	128	Power On		not used	

*ESR?

*ESE
*ESE?

*STB? | SPOLL

*SRE
*SRE?

5.7.7. GPIB Service Request

The service request capability is not available with the RS-232 interface. The SRQ line will be activated only after one or more of the service request functions have been enabled using the Status Byte Enable Register command *SRE.

The status byte bit assignments are as described in the previous section for status reporting. When the instrument has requested service, the enabled bit or bits and the RQS bit 6 will be active or 1. Bit 4, 5, and 7 are not used and will be set to false, or 0 for all status byte reads.

After the serial poll (SPOLL) is executed the RQS bit will be cleared to 0, and the remaining bits will remain unchanged. The status byte will not change value until the event register is read and cleared for the corresponding status byte bit.

For example after the All Pass SRQ has been enabled, when the test(s) have finished with pass indications the instrument will set the hardware SRQ line and output the status byte of 41 hex. This means that bit 6 and bit 0 are set to a value of 1. After reading the status byte the status byte value will change to 01 hex.

FOR MORE INFORMATION ON IEEE (GPIB) PLEASE CONTACT

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