USER GUIDE

FREJA 546R

Relay test system

FREJA 546R pictured with Touch Screen Control and Transducer Options

IMPORTANT

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For Patent information about this instrument refer to the following web site: megger.com/patent

Revision History

Revision	ECN #	Date
1	34671	12/01/2025

Declaration of Conformity

Hereby, Megger Instruments Limited declares that the FREJA 546R, manufactured by Megger Instruments Limited described in this user guide, is in compliance with Directive 2014/53/EU. The full text of Megger Instruments EU declarations of conformity is available at the following internet address:

Megger.com/Company/About-Us/Legal/EU declarations of conformity

Table of Contents

1.0 **Introduction**

This user guide contains information regarding the correct use and safe handling of the FREJA 546R unit. Please read the section 'Safety Precautions'. This section contains information regarding your personal safety when using the FREJA 546R.

1.1 **Product description**

The FREJA 546R is a multipurpose, light-weight, field portable test set capable of testing a wide variety of electro-mechanical, solid-state and microprocessor-based protective relays, motor overload relays and similar protective devices.

The FREJA 546R test system can be manually controlled with the optional built-in STVI (Smart Touch View Interface) touch screen. The touch screen, with its large, full color, high resolution, TFT LCD touch screen allows the user to perform manual, steady-state, and dynamic testing quickly and easily using the manual test screen, as well as using built-in pre-set test routines for most popular relays. The built-in operating system, RTMS software, and touch screen eliminates the need for a computer when testing almost any type of relay. Menu screens and touch screen function buttons are provided to select the desired test function quickly and easily. Tests results can be saved to the internal memory for later download to a USB Thumb drive to transfer or print test reports. For fully automatic testing with a PC, every FREJA 546R unit is supplied with Relay Testing Management Software (RTMS) for installing on a PC.

1.2 **Features**

- **Constant power output –** The current amplifier delivers maximum compliance voltage to the load constantly during the test, and range changing is done automatically under load. This ensures better test results and saves time by not having to turn the outputs off to change ranges. Constant power output in many cases, eliminates the need to parallel or series current channels together to test high burden relays.

- **High output current –** The FREJA 546R provides up 32 Amps at 200 VA per phase continuous, or up to 60 Amperes at 319 VA with a 1.5 second duty cycle. Three current amplifiers can be paralleled to provide a maximum of 180 Amperes at 957 VA for testing all instantaneous overcurrent relays.

- **PowerV™ voltage amplifier high power output –** The FREJA 546R voltage amplifier provides high VA output on the voltage channel at low critical test voltages (from 30 to 150 V). Users who want to test a panel of relays at one time, or certain older electromechanical impedance relays, find it impossible using lower VA rated voltage amplifiers. The high burden voltage feature in the FREJA 546R, when enabled allows the unit to output up to 1 A at 300 V.

- **Convertible voltage channel –** With a 3-channel FREJA 546R, the convertible voltage channel provides three additional current sources for testing three-phase current differential relays, including harmonic restraint transformer differential relays. Paralleled with the main current channel increases the per phase output current to 37 A continuous, and up to 75 A for a short time.

- **Perform multi-phase tests** – With the convertible voltage channels, the FREJA 546R can be interfaced with other FREJA 500 series or 546R units to provide up to a maximum of 30 current channels for testing bus differential protection schemes.

- **Three Ethernet ports** – **IN** Ethernet Port is the primary PC connection port. The Ethernet port provides a high-speed computer interface, and may be used to connect to the IEC 61850 substation bus. The **OUT** Ethernet Port is primarily used to interconnect multiple FREJA units together for synchronous multi-unit operation. The **STVI** PoE (Power over Ethernet) port and is used to connect to the STVI.

- **Low-level Rogowski mode** – In Rogowski mode the current channel will change from a current source to a voltage source, this will allow the current channel to simulate a low-level voltage source from a Rogowski coil. There are three ranges for the Rogowski outputs, 2, 10 and 40 Volts. In addition, the voltage channels may also be placed into a Low-level output to simulate CVT, or other voltage dividers, with two ranges of outputs, 2 and 30 Volts. This feature requires the MLLA (Megger Low Level Adapter) to provide filtering of the low-level outputs from the latest version of voltage/current generators[1] in the Megger FREJA 500 series and FREJA 546R test sets. The MLLA provides the interface from the low-level outputs to the device under test using appropriate interface cables.

- **Low-level current output capability** – The current generators[1] can provide very low current outputs ranging from 0 to 50 mA full scale, or be enabled to provide a voltage output simulating a Rogowski output. In the 50 mA mode the feedback loop will stay on down to test currents as low as 5 mA. This provides test capability for generator anti-motoring and Network relays, which can be set as low as 10 to 7.5 mA.

- **Simultaneously High resolution and accuracy –** Metered outputs provides extremely high accuracy needed for testing a wide variety of devices. Eliminates uncertainty with setting values, with metered values what you see is what you get.

- **Steady-state and dynamic testing capability –** The FREJA 546R provides, either through manual control or computer control, both steady-state and dynamic testing of protective relays. This includes programmable waveforms with harmonics.

- **Output current and voltage sine waves are generated digitally–** Outputs do not vary with sudden changes in input voltage or frequency, which increases test accuracy and reduces testing time.

- **Digital binary inputs and outputs –** Up to 10 programmable inputs, and 6 programmable outputs provide timing and logic operations in real-time with the output voltage and currents. Binary Inputs can be programmed, using Boolean logic, for more complex power system simulations. This provides a low cost, closed loop, power system simulator.

- **Circuit breaker simulator –** Binary outputs provide programmable normally closed or normally open contacts to simulate circuit breaker operation for testing reclosing relays. Sequence of operation, timing, and lockout are easily tested.

- **Performs transient tests –** Perform acceptance or troubleshooting tests by replaying digitally recorded faults or EMTP/ATP simulations in the IEEE C37.111/IEC 60255-24, COMTRADE Standard format.

- **Perform end-to-end tests –** Using the RTMS Sequencer test; with a Megger MGTR GPS satellite receiver (or suitable IRIG-B time code source input into Binary Input #1), the FREJA 546R performs satellite synchronised end-to-end tests.

- **Wide-ranging output frequency –** The output frequency of the current and voltage outputs can be set for any frequency from DC to 1kHz. Popular test frequencies such as 16.66, 25, 33, 50, 60, 100,120,125, 150, 180, 250, 300, and 400 Hz are easily set and controlled. Multi-purpose test system saves time and money.

- **IEC 61850 and Megger GOOSE Configurator** – With IEC 61850 GOOSE option enabled in the FREJA 546R hardware, the Megger GOOSE Configurator (MGC) provides mapping of the binary inputs and outputs of the FREJA 546R test set to the desired GOOSE messages. The GOOSE messages are read from available SCL (Substation Configuration Language) files or may be automatically detected by scanning the substation network in search of available published GOOSE messages. This scanning process is known as GOOSE “sniffing”. The MGC also provides advanced network troubleshooting tasks such as comparing the GOOSE messages available on the network

[1] Requires VIGENS with hardware version 3.5.1 or higher.

with the GOOSE messages described in the SCL files with GOOSE MERGE/COMPARE functionality; this is also a powerful tool for validating the horizontal communication description (GOOSE) in the supplied SCD file at Factory Acceptance Tests (FAT) in IEC 61850 substations. This type of verification is also known as GOOSE Consistency Check.

- **IEC 61850 9-2 LE and Megger Sampled Values Analyser (SVA)** – With IEC 61850 9-2 LE Sampled Values option enabled in the FREJA 546R hardware[2] Sampled Values Analyser (SVA) is used as a testing tool that provides the ability to configure a maximum of three Sampled Value (SV) streams compliant with first edition of IEC 61850 9-2 LE to be used in process bus applications for digital substations. As per IEC 61850 9-2 LE guidelines, FREJA 546R can provide three SV data streams with 4 voltages and 4 currents on each stream. Sampled Values (SV) are used for transmitting digitized values of currents and voltages on ethernet frames using a publisher/subscriber mechanism. In a digital substation environment, merging units are typically used to convert analogue signals from current and voltage transformers into digital streams of data packets at 80 samples per cycle – both for 50 Hz and 60 Hz systems as per IEC 61850 9-2 LE. The merging unit in this scenario acts as an SV publisher. Relays compliant to the protocol can act as an SV subscriber to receive the data packets. Digital signal processors in relays can then process the data measurement and take appropriate actions as per the algorithm. Functional testing of Sampled Values SV-based protective relays with the help of FREJA 546R can be seen as a first step to validate such systems. With the SV-enabled option, FREJA 546R can be used to inject SV streams directly into the relay, thereby mimicking merging units. Additionally, FREJA 546R can also be connected to the network and be used as an SV stream monitoring tool. Either of the OUT or IN ports on FREJA 546R provide the ability to subscribe/publish a maximum of three Sampled Values streams.

1.3 Applications

The test system may be customized by adding the number of Voltage-Current, “VIGEN”, modules needed for specific test applications, with a maximum of 3 channels. For example, the FREJA 546R with three VIGEN Modules provides complete three-phase testing of three-phase impedance, directional power, negative sequence overcurrent and other devices that require a three-phase four-wire wye connected sources. The 4th voltage channel, V4, provides an AC reference / synchronizing / polarizing voltage, or a DC battery simulator voltage source.

Each current channel is rated for 32 Amps @ 200 VA rms continuous, and up to 60 Amps @ 319 VA rms for short durations. For testing relay panels or electromechanical relays, it has a unique flat power curve from 4 to 32 Amps that insures maximum compliance voltage to the load at all times.

With a maximum compliance voltage of 50 Volts rms per phase, two channels in series provide 100 Volts to test high impedance relays. Three currents in parallel provide test currents up to 12 Amperes at 600 VA for testing high impedance ground overcurrent relays at high multiples of tap rating.

With three currents in parallel it can provide up to 180 Amps at 957 VA for testing all instantaneous overcurrent relays.

1.4 Megger web site

Occasionally an information bulletin may be issued via the Megger web site. This may concern new accessories, new usage instructions or a software/firmware update. Please occasionally check on the Megger web site for anything applicable to your FREJA 546R.

www.megger.com

[2] Minimum hardware requirement to use the IEC 61850 9-2 LE Sampled Values Option – FREJA 546R VIGEN bootloader version 1.052 and firmware 6.259 or higher.

2.0 Safety Warnings and Standards

This instrument has been designed for operator safety; however, no design can completely protect against incorrect use. This instrument must be operated, used and serviced ONLY by trained, qualified personnel. Misuse of electrical instruments can result in personal injury and damage to the apparatus under test. **Obey all applicable safety rules and regulations at all times.** Electrical circuits are dangerous and **can be lethal** when lack of caution and poor safety practices are used. There are several standard safety precautions that should be taken by the operator.

2.1 Warnings, Cautions and Notes

Where applicable, internationally recognized defined IEC safety markings have been placed in the user guide, and on the instrument, to notify the operator to refer for instructions on correct use or safety related topics. Refer to the following descriptions and table of symbols.

Descriptions
DANGER: Indicates a dangerous situation, which could cause serious injury or death
WARNING: Indicates a potentially dangerous situation, which could cause serious injury or death
CAUTION: Indicates a situation which could lead to damage of the equipment or environment
NOTE: Indicates important instructions to perform the relevant process safely and efficiently
APPLICATION NOTE: Indicates a possible application of the instrument

Symbol	Description
	Direct Current
	Alternating Current
	Both direct and alternating current
	Earth (Safety Ground) Terminal. This terminal **must** be connected to an earth ground before making other connections to the instrument and prior to operating it.
	EU conformity. Equipment complies with current EU directives.
	The crossed out wheeled waste bin placed on Megger products is a reminder not to dispose of the product at the end of its life with general waste.
	Warning/Caution, risk of electric shock. Indicates that high voltage is present on the terminal. Use extreme caution.
	Warning/Caution, this symbol indicates that the operator of the instrument must refer to the user guide for further explanation and clarification.

 **WARNING: Under no circumstances should the operator or technician attempt to open or service any Megger instrument while connected to a power source. Lethal voltages are present and may cause serious injury or death!**

2.2 Additional Safety Warnings

The following are additional safety related items associated with the FREJA 546R.

- The instrument must only be used by suitably trained and competent persons.
- Read and understand all safety precautions and operation instructions before attempting to use this instrument.
- The purpose of this equipment is limited to use as described in this user guide. Should a situation arise that is not covered in the general or specific safety precautions please contact Megger regional representative or Megger, Dallas, Texas, USA.
- Safety is the responsibility of the user. Misuse of this equipment can be extremely dangerous.
- Always start with the power OFF, before connecting the power cord or inserting the batteries. Make sure to connect the earth ground terminal to a suitable earth ground before attempting to make test connections.
- **DO NOT** attempt to use the unit without a safety ground connected.
- If using the power cord, **DO NOT** attempt to use the unit if the power cord ground prong is broken or missing.
- Always use properly insulated test leads. **DO NOT** use cracked or broken test leads.
- Always turn the test system off before disconnecting the power cord.
- **DO NOT** use the FREJA 546R in an explosive atmosphere.
- Observe all safety warnings marked on the equipment and in the user guide.
- For safety related or other important topics in this user guide, like the statement below, will be notated with the adjoined symbol. Read the topic carefully as it may relate either to the safe operation of the instrument or the safety of the operator.

Under no circumstances should the operator put their hand or tools inside the instrument chassis area with the instrument connected to a power source. Lethal voltages are present and may cause serious injury or death!

3.0 Operation

The unit's design is a "modular" concept. All inputs and outputs are clearly marked and logically grouped so continual reference to the user guide should not be necessary once the operator is acquainted with the test system. The unit's Top Panel will appear different among units, since each unit may have up to three Voltage/Current Generator (VIGEN) Modules, and/or Transducer option installed.

3.1 General Description

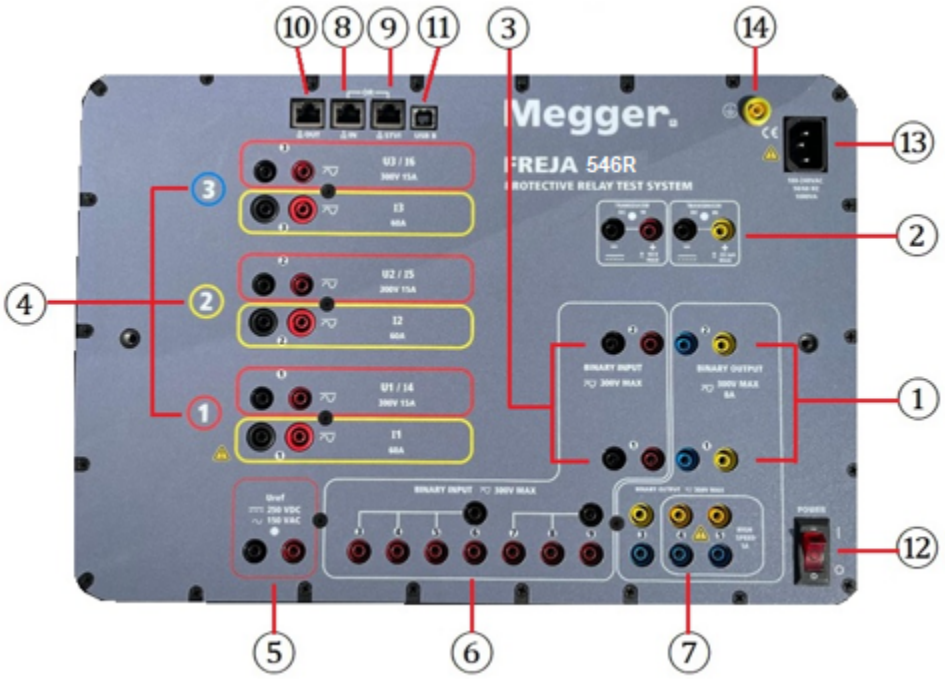


Figure 1 Top Panel FREJA 546R (Pictured with Transducer Option)

3.1.1 Top Panel

1. ① **Binary Outputs**[3] – the three VIGEN modules include Binary Inputs and Binary Outputs. Therefore, with a minimum 2 channel unit there are 2 Binary Outputs (numbered 1 and 2). The 3rd Binary Output will be replaced with DC Input terminals if ordering the unit with the Transducer option. Each Binary Output can be configured as Normally Open or Normally Closed contacts providing logic to the device under test. The Binary Outputs 1, 2, and 3 can switch up to 300 VAC or 250 VDC with 8 Ampere continuous. The programmable wait duration is from 1 millisecond to 10,000 milliseconds.

2. ② **Transducer Input Terminals** - The FREJA 546R may have the optional transducer input terminals[4]. The transducer hardware "T" option can either be ordered with the new test set or later as a factory hardware upgrade. The DC IN Volts range is ± 10 V DC. There are two ranges with the DC IN Amperes; ± 0 to 1 mA or ± 4 to 20 mA.

3. ③ **Binary Inputs** – with a minimum 2 channel unit there are 2 Binary Inputs located on the top panel. The 3rd Binary Input will be replaced with DC Input terminals if ordering the unit with the Transducer option. To serve a wide range of test applications the binary inputs have different voltage thresholds. For typical test applications, binary inputs 1 and 2 may have programmable voltage thresholds from 2 to 150 volts. Binary input 3 has a fixed threshold of 5

[3] If ordering the optional Transducer test feature the number of Binary Outputs and Inputs is reduced by 1
[4] The 3rd Binary Input and Output will be replaced with DC Input terminals if ordering the unit with the Transducer option.

volts. For **GPS End-to-End synchronized relay testing Binary 1** may be connected with a remote trigger pulse from a GPS satellite receiver for external initiation, or the input of an **IRIG-B** signal. There are an additional 7 binary inputs. To monitor TTL signals binary inputs 4 through 6 have a fixed threshold of 3 volts. Binary inputs 7 and 8 have fixed thresholds of 5 volts, and binary inputs 9 and 10 have fixed threshold of 30 volts (for "noisy" test environments). In addition to serving as Timer/Monitor inputs, the Binary Inputs may be programmed to trigger binary output sequence(s). Binary Inputs can also be programmed using Boolean logic for more complex power system simulations.

4. ④ **Voltage/Current Generator Module (or VIGEN)** –There are three available slots for the VIGEN Modules. The slots are numbered 1 to 3 from bottom to top, with the topmost VIGEN numbered 3. The three phase voltages and currents are noted by the red and yellow outlines surrounding each output channel. Phases A, B and C Voltage Channels (V1, V2 and V3) are denoted by the red color. Phases A, B and C Current Channels (I1, I2 and I3) are denoted by the yellow color. When the voltage generators are converted to current generators, they will change on the touch screen display as V1 = I4, V2 = I5 and V3 = I6. For more details on the VIGEN output capabilities see section **3.3**.

5. ⑤ **AC/DC AUX (V4) Output** – the FREJA 546R provides an AC/DCV AUX Output with a continuously variable dc output voltage from 10 to 250 VDC, at 100 Watts (3.33 Amperes Max) providing logic voltage for solid-state relays, or use as a reference ac voltage source for synchronizing or polarization potential from 0 – 150 VAC, 100 VA. When powered ON, the LED above the output terminals illuminates.

6. ⑥ **Binary Inputs** – additional, independent, galvanically isolated, Start/Stop or Monitor circuits to monitor operation of relay contacts or trip SCR. Continuity light is provided for each input gate. Upon sensing continuity, or voltage applied, the lamp will glow. In addition to serving as wet/dry contacts the Binary Inputs may be programmed to trigger binary output sequence(s). Binary Inputs can also be programmed using Boolean logic for more complex power system simulations. The Binary Inputs will accept a voltage range of 5 to 300 VAC or 5 to 250 VDC, or dry Normally Open / Normally Closed contacts.

7. ⑦ **Binary Outputs** – additional Binary Outputs can be configured as Normally Open or Normally Closed contacts providing logic to the device under test. Binary Output 4[5] has an AC Rating of 400 V max., Imax: 8 Amperes, 2000 VA maximum breaking capacity, and a DC Rating of 300 V max., Imax: 8 Amperes, 80 Watts, with a Response Time: < 10ms. Binary Outputs 5 and 6 are high speed and have an AC / DC Voltage Rating of 400 V peak, Imax: 1 Ampere, with a Response Time: < 1ms typical. The programmable wait duration is from 1 millisecond to 10,000 milliseconds. An LED directly above the terminals indicates the status of the contact. ON indicates closed, and OFF indicates open.

8. ⑧ **IN** Ethernet Port is a 10/100BaseTX port, and is the primary PC connection port. This port supports MDI/MDI-X auto cross over configuration, which means both standard and "crossover" Ethernet cables may be used. This port provides the optimal method for downloading EMTP files, DFR streaming, and updating the unit's firmware as required. This port may also be used for connecting to the IEC 61850 substation bus for use in testing IEC 61850 devices. For multiple unit operation, the unit providing the OUT link is providing the master phase reference to all units "downstream".

9. ⑨ **STVI** Interface – This Ethernet port is used to connect to the optional STVI (Smart Touch View Interface) controller, when installed in the enclosure lid. It can also be used to connect the STVI-10 hand held controller. The STVI interface port is a POE (Power Over Ethernet) port, which provides power to the STVI. The STVI includes two USB Type A ports to update the firmware in the FREJA as well as update the RTMS software using a USB memory stick. It may also be used to download test results from the FREJA for download into another PC with Power DB software for storage or printing. See the datasheet for the STVI for more information.

[5] If Transducer option is installed the binary output labels are reduced to 3,4 and 5.

10. ⑩ **OUT** Ethernet Port is a 10/100BaseTX port, and is primarily used to interconnect multiple FREJA units together for synchronous multi-unit operation. It is also be used to provide access to the substation IEC 61850 network. For multiple unit operation, the unit providing the OUT link is providing the master phase reference to all units “downstream”. With the PC connected to the IN Port, the FREJA and the PC share the same Ethernet network connection, and thus will not have a secure isolation from each other. When testing IEC 61850 devices connect the PC to the USB port to isolate the PC from the IEC 61850 substation bus.

11. ⑪ **USB** Interface - USB Interface requires a Type B “downstream” connector, and is primarily used as a communication and control port when used with a PC and Megger software for automated relay testing.

12. ⑫ **POWER ON/OFF *Switch*** – used to switch unit on and off. The switch will glow when the unit is on.

13. ⑬ **Incoming Power / Line Cord** – the input line cord, ground terminal, are mounted on the top panel of the test set.

14. ⑭ **Earth Ground Jack**– use this terminal to connect chassis ground to earth ground. A chassis ground (earth) point on the front panel is provided as an additional safety ground.

3.1.2 Touch Screen Control Panel:

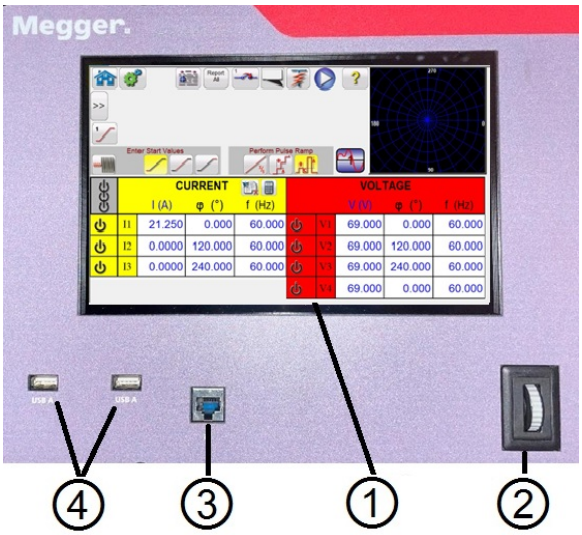


Figure 2 FREJA 546R Touch Screen Control Panel

1. ① **LCD Touch Screen Display** – this 8.5-inch touch panel display provides high resolution, and features Wide Viewing Angle Technology with high luminance for reading in direct sunlight.

2. ② **Control Knob** – this knob will adjust values once the box location of the value to be changed is selected. May also be used to scroll through test reports.

3. ③ **STVI Ethernet Port** – used to connect the Touch Screen Control Panel to the STVI port on the FREJA 546R unit.

4. ④ **USB Interface** – two Type A ports are primarily used to update the firmware in the FREJA 546R unit as well as update the on-board software using a USB memory stick. It may also be used to download test results from the FREJA 546R for download into another PC with Power DB software for storage or printing. In addition, the user can use a USB keyboard, as well as a mouse, in conjunction with the on-board software. Keyboard and/or mouse are not provided with the accessories.

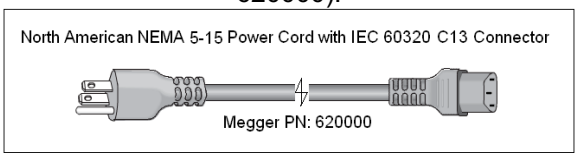
3.2 Input Power

The input voltage rating is 90 to 264 VAC, 50/60 Hertz. Input current required varies with the number of output modules in use, load, and input voltage value. With three VIGENS, the maximum input power is 1800VA. The input is protected by a power ON/OFF switch / circuit breaker.

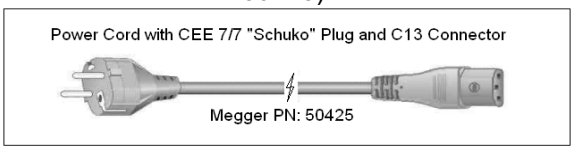
3.2.1. Input Power Cord

Depending on the country, the power cord can come with a NEMA 5-15 male connector, a CEE 7/7 Schuko two prong connector, with International Color-Coded pig-tail wires (light blue, brown and green with yellow stripe) with the insulation jacket stripped ready for installation of the appropriate male connector, or with UK power cord.

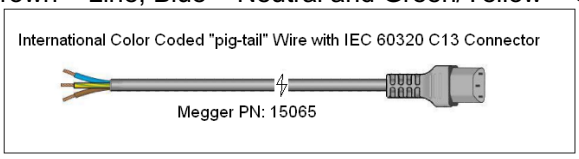
Model FREJA 546R X0PXCX**A**XXX comes with a North American power cord (part number 620000).



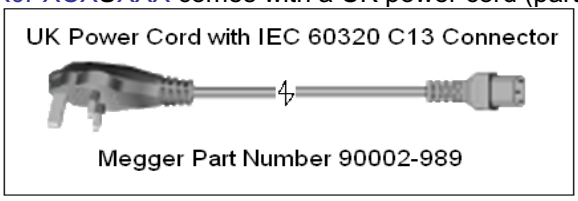
Model FREJA 546R X0PXCX**E**XXX comes with a Continental Europe power cord (part number 50425).



Model FREJA 546R X0PXCX**I**XXX comes with an International Color Code power cord. The cord, part number 15065, is ready for wiring to the appropriate plug (depending on country). The following colors apply, Brown = Line, Blue = Neutral and Green/Yellow = Ground.



Model FREJA 546R X0PXCX**U**XXX comes with a UK power cord (part number 90002-989).



3.3 Voltage - Current Generator (VIGEN) Module

Voltages and Currents are noted by the red and yellow outline surrounding each output channel. Phases 1, 2 and 3 voltage channels are denoted by the red color. Phases 1, 2 and 3 current channels are

denoted by the yellow color. All outputs are independent from sudden changes in mains voltage and frequency, and are regulated so changes in load impedance do not affect the output.

3.3.1. Convertible Voltage/Current Amplifier

Figure 3 FREJA 546R Voltage Channel

The FREJA 546R PowerV™ voltage amplifier provides a flat power curve from 30 to 150 Volts in the 150V range to permit testing of high current applications such as panel testing.

Voltage Range	**Power / Current (Max)**
30.00V	150VA @ 5.0A
150.00V	150VA Constant Output Power from 30 to 150 Volts
300.00V	150VA @ 0.5A

Voltage Amplifier in Current Mode :
The FREJA 546R voltage amplifier is convertible to a current source with the following output capability. Output power ratings are specified in rms values and peak power ratings.

Output Current	**Power**	**Max V**	**Duty Cycle**
5 Amperes	150 VA (212 peak)	30.0 Vrms	Continuous
15 Amperes	120 VA	8.0 Vrms	1.5 sec.

With a 3 channel FREJA 546R unit, convertible channels in conjunction with the three main current channels, provides 6 currents for testing three phase current differential relays. When the voltage generators are converted to current generators, they will change on the touch screen display as current phases 4, 5 and 6.

The voltage amplifier output is protected from short circuits and thermally protected against prolonged overloads. In case of a short circuit or a thermal overload, the amplifier will automatically turn off, and the touch screen will display a message to the user indicating which condition exists. If RTMS software running on a PC is used, a similar message will appear.

3.3.2. Current Amplifier

Figure 4 FREJA 546R Current Channel

The FREJA 546R current amplifier Constant Power Output feature delivers maximum compliance voltage to the load constantly during the test, and range changing is done automatically, on-the-fly, under load. This ensures better test results, saves time by not having to turn the outputs off to change output taps or ranges, and unlike single range current amplifiers ensures a higher compliance voltage at lower test currents. Constant Power Output in many cases eliminates the need to parallel or series current channels together to test high burden relays.

The following are typical output current and associated available compliance voltage values for the FREJA 546R Current channel. The per channel output current and power ratings are specified in AC rms values and peak power ratings. Specified duty cycles are based upon typical room ambient temperature.

Output Current	**Power**	**Max V / Duty Cycle**

50 mA[6]	0.5 VA	10.0 Vrms Continuous
1 Ampere	15 VA	15.0 Vrms Continuous
4 Amperes	200 VA (282 peak)	50.0 Vrms Continuous
15 Amperes	200 VA (282 peak)	13.4 Vrms Continuous
32 Amperes	200 VA (282 peak)	6.25 Vrms 15 minutes
60 Amperes	319 VA (424 peak)	5.32 Vrms 1.5 sec
DC 200 Watts		

The current amplifier output is protected from open circuits and thermally protected against prolonged overloads. In case of an open circuit or a thermal overload, the amplifier will automatically turn off, and the touch screen will display a message to the user indicating which condition exists. If RTMS software running on a PC is used, a similar message will appear.

3.4 Binary Inputs and Outputs

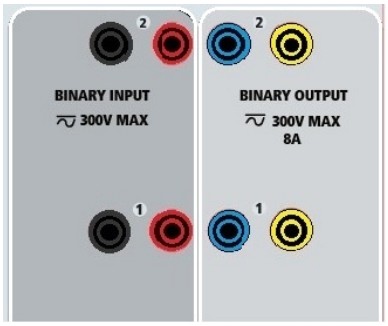


Figure 5 Binary Inputs and Outputs 1 and 2

Binary Inputs and Outputs are clearly marked and logically grouped. The unit's Top Panel will appear different among units, which means Binary Input / Output 1 will always be occupied, while Binary Input / Output 2 may, nor may not, depending on the configuration. If the Transducer option is installed Binary Input / Output 3 will be replaced by the DC Input terminals, with a different overlay. The Binary Inputs are used to monitor relay trip contacts for performing pickup and dropout tests as well as for performing timing functions. The Binary Outputs are used to simulate normally open / normally closed contacts for testing breaker failure schemes, or similar power system operations. In addition, they may also be used to switches AC/DC voltages and currents.

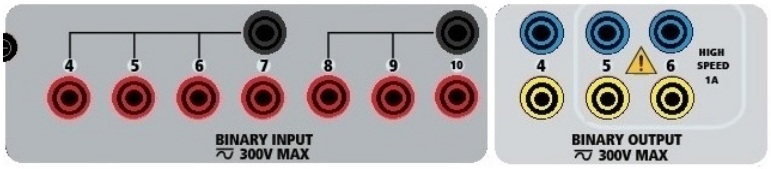


Figure 6 Binary Inputs 4 to 10 and Binary Outputs[5] 4 to 6

3.4.1 Binary Inputs

The binary inputs are specifically designed to measure high speed operation of electro-mechanical, solid-state and microprocessor-based protection relays. All binary Inputs default to Monitor Mode, Contact change of state, latched OFF.

If using the touch screen or RTMS Software to change a binary input from Contact change of state to Voltage Applied / Removed, click on or touch the Input Type window and a sine wave will appear where the Contact icon was indicating. The input is now set for voltage sensing.

To change the binary input from Monitor mode to Timer Mode, click on or touch the Use as Monitor button and the display window will change to show Use as Trip, Latched, meaning the binary input is now set to

[6] Requires VIGENS with hardware version 3.5.1 or higher.

stop the timer upon sensing the first contact closure (if the Input Type is set for contact) or upon sensing voltage if the Input Type is set to Voltage Sensing.

3.4.1.1 Start, Stop, and Monitor Gates

In the FREJA 546R there are up to ten identical, independent, programmable gate circuits that permit simple selection of the desired mode for timing or contact monitoring operation.

To monitor operation of the contacts or trip SCR in the device under test, a light is provided for each gate. The gate circuit is isolated for voltage-sensing and can monitor solid-state logic signals. Each light will illuminate once contacts close or voltage is applied to the gate.

3.4.1.1.1 Dry Contacts Open

Timer stops or a continuity indicator goes out at the opening of normally closed contacts, or when conduction through a semiconductor device, such as a triac or a transistor, is interrupted.

3.4.1.1.2 Dry Contacts Close

Timer stops or a continuity indicator glows at the closing of the normally open contacts, or upon conduction through a semiconductor device such as a triac or a transistor.

3.4.1.1.3 Application or Removal of AC or DC voltage

This will either start the Timer or stop the Timer. The continuity indicator will glow (application) or darkens (removal) upon the application or removal of either an AC or DC voltage. To serve a wide range of test applications the binary inputs have different voltage thresholds. For typical test applications, binary inputs 1 and 2 may have programmable voltage thresholds from 2 to 150 volts. Binary input 3 has a fixed threshold of 5 volts. To monitor TTL signals binary inputs 4 through 6 have a fixed threshold of 3 volts. Binary inputs 7 and 8 have fixed thresholds of 5 volts, and binary inputs 9 and 10 have fixed threshold of 30 volts (for “noisy” test environments). A higher threshold voltage helps to eliminate false triggers due to a noisy source. Lower thresholds allow starting and stopping of timer from TTL voltage signals. The allowable voltage applied is 5 to 300 Volts AC or 5 to 300 Volts DC, current limiting resistors provide protection.

3.4.1.1.4 The Timer can be started when turning on any selected generators.

3.4.1.1.5 The Timer can be started simultaneously with a change in Frequency, Phase Angle, or Amplitude. Also, it can be started simultaneously with a Voltage or Current waveform step.

3.4.2 Binary Outputs

Binary Outputs 1 and 2 are rated for 300 V at 8 Amperes. Each Binary Output can be configured as normally open or normally closed contacts providing logic to the device under test. Binary Outputs 3 and 4 have a rating of 300 V AC/DC, 8 Amperes and a maximum of 2000 VA breaking capacity (80 watts DC), with a response time of less than 10ms. Binary Outputs 5 and 6 are high-speed and have an AC/DC voltage rating of 400 volts peak, 1 ampere and a response time typically less than 1ms.

The contacts may be programmed to open or close, thus simulating circuit breaker operation. The programmable wait duration is from 1 millisecond to 10,000 milliseconds. A fused test lead (fused at 500 mA) is available as an optional accessory to help protect from blowing the internal fuse of binary outputs 5 & 6. The test lead is blue in color so that the user knows it applies to the blue binary outputs. The barrel holder of the test lead is CE marked with a 1000 V, CAT III rating, and marked FUSED 500 mA / 1000 V/ 50 KA.

3.5 **AC/DC AUX Output (V4)**

Figure 7 AC/DC AUX V4 Output Terminals

The FREJA 546R includes an AC/DC Auxiliary Output that provides a variable DC output from 5 to 250 VDC rated at 100 Watts, 3.33 Amperes max. User may select from normal setting values of 24, 48, 125, or 250 VDC, or enter the desired output voltage in the window provided, see the RTMS software Configuration Screen. Source may also be used as a synchronizing or polarization voltage providing 0 – 150 Volts AC at 100 VA. The output is variable using the touch screen Control Knob, or the PC up/down cursor arrows.

CAUTION:

NOTE: DC voltage is ON and available when the output is turned on using the LCD touch screen or via software command. Do not plug or insert any test lead into the BATTERY SIMULATOR binding posts without first connecting the test leads to the load!

4.0 SETUP

4.1 Unpack System

Unpack the unit and check for evidence of any shipping damage. If there is any visual damage, immediately notify the freight carrier to make a damage claim, and notify Megger of the damage.

CAUTION:

Potentially lethal voltages may be present on the output terminals. It is highly recommended the operator read the user manual thoroughly and have an understanding of the test set operation prior to turning power on.

4.1.1 Initial Start Up

1. If using the STVI PC version software, connect the **IN** Ethernet Port on the FREJA 546R unit to the PC Ethernet port.

2. Before connecting power to the unit, make sure the POWER ON/OFF Switch is in the OFF position (0). Plug the unit line cord into an appropriate power source and turn the POWER ON/OFF Switch to ON (I). As the FREJA 546R unit goes through its power up sequence, in about a minute the STVI power up screen will appear, then the manual startup screen will appear.

4.2 Communication Ports

There are several communication ports. These ports are: USB, and three Ethernet ports.

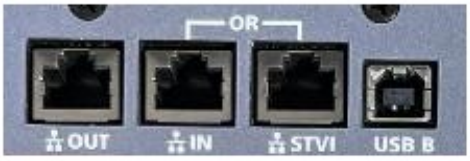
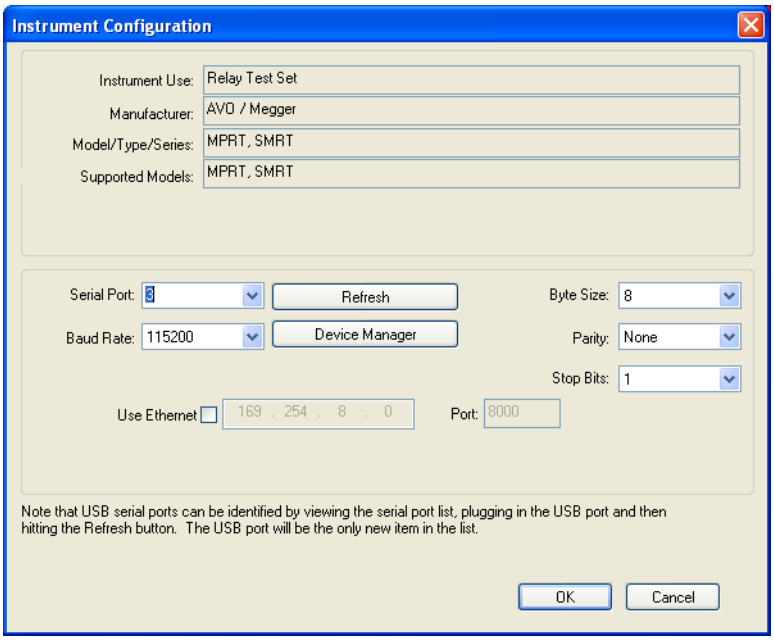


Figure 8 FREJA 546R Communication Ports

4.2.1 **USB 2.0** Interface

The optional STVI has two USB Type A ports intended for use with downloading new RTMS Software, FREJA firmware, or stored PowerDB test results. A USB keyboard or mouse can also be used with the STVI. The FREJA 546R Type B USB Interface requires a Type B “downstream” connector, and is primarily used as a communication and control port when used with a PC and Megger RTMS PC version software for automated relay testing. It is recommended that you use the Ethernet port for high-speed communication and control of the FREJA unit. To use the USB port will require the user to configure the PC com port for USB operation. Clicking on the Instrument Setup icon on the PowerDB tool bar  , the Instrument Configuration Screen (shown in the following figure)



provides the user with access to the PC Device Manager screen. Click on the Device Manager button and navigate to the USB Ports file directory. Since the FREJA 546R **defaults to a baud rate of 115,200**, the user will need to configure their PC USB output com port to match. Returning to the Instrument Configuration screen the user will need to check off the Use Ethernet check box, and set the Baud rate, Byte Size and Stop Bits as shown.

4.2.2 **IN** Ethernet Port

IN Ethernet Port is the primary PC connection port for automated relay testing. This port supports MDI/MDI-X auto cross over configuration, which means both standard and “crossover” Ethernet cables may be used. Use this port for standard automated relay testing. This port provides the optimal method for downloading EMTP files, DFR streaming, and updating the unit’s firmware as required. For multiple unit operation, the unit providing the OUT link is providing the master phase reference to all units “downstream”. For multiple unit operation connect the OUT port to the downstream FREJA unit IN port. The RTMS Software will automatically configure when the units are powered up.

4.2.2.1 Setting FREJA 546R IP Address for Operation with a PC

With the Ethernet cable supplied with the unit, connect the **IN** Ethernet Port on the FREJA 546R unit to the PC Ethernet port. Turn the test set on. As the FREJA 546R unit goes through its power up sequence, in less than a minute the STVI power up screen will appear. If using the PC version of the RTMS Software it will auto-detect the FREJA 546R unit connected to the PC. Once it auto-detects the unit, and determines the configuration of the FREJA 546R unit connected, the Manual screen will appear. The unit might not auto detect due to firewall settings. In this case the firewall can be turned off or you can enter the IP address directly using the PowerDB instrument configuration screen by clicking on the Instrument

Setup icon on the PowerDB tool bar  . From the Instrument Configuration Screen, shown in the following figure, click off the check mark in the Auto Discover Unit box.

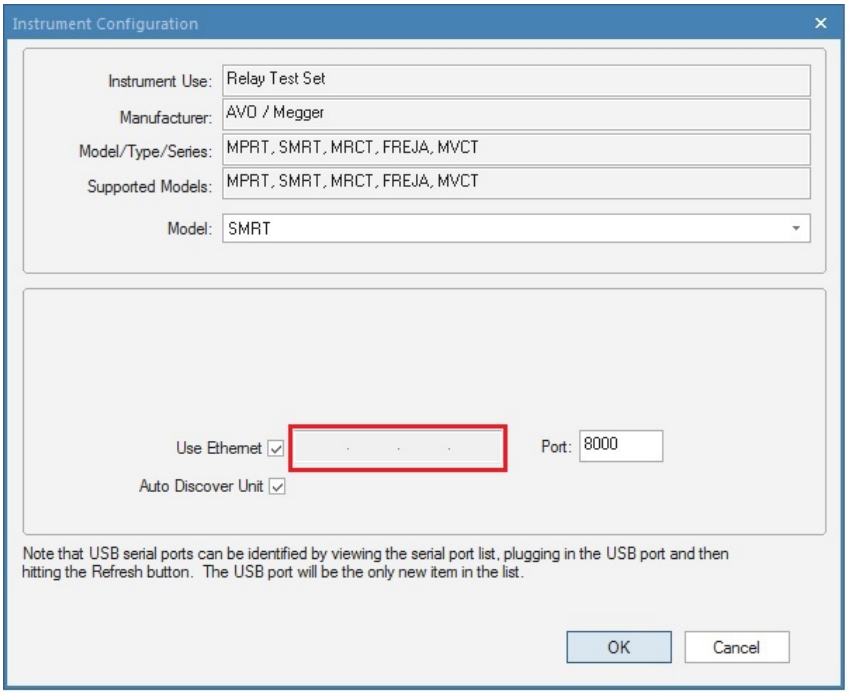


Figure 9 PowerDB Instrument Setup Screen

With the Auto Discover Unit box checked the RTMS software should find the unit. If not, the IP address can be entered in the box highlighted in the figure above. Also note that the IP address is also printed on the unit nameplate sticker. If the unit is on a network with a DHCP server, the user must use the Auto Discovery mode.

4.2.3 **STVI** Ethernet Port

This Ethernet port is used to connect to the optional STVI (Smart Touch View Interface) controller, when installed in the enclosure lid. It can also be used to connect the STVI-10 hand held controller. The STVI interface port is a POE (Power Over Ethernet) port, which provides power to the STVI. The STVI includes two USB Type A ports to update the firmware in the FREJA as well as update the RTMS software using a USB memory stick. It may also be used to download test results from the FREJA for download into another PC with Power DB software for storage or printing.

4.2.4 **OUT** Ethernet Port

The OUT Ethernet Port is a 10/100BaseTX port, and is primarily used to interconnect multiple FREJA 546R units together for synchronous multi-unit operation. It is also used to provide access to the substation IEC 61850 network (when enabled). The FREJA 546R with the IEC 61850 option enabled provides selectable priority, VLAN-ID, and meets the IEC 61850-5 standard Type 1A, Class P 2/3, for high-speed trip and reclose simulations. For multiple unit operation, the unit providing the OUT link is providing the master phase reference to all units “downstream”. With the PC connected to the IN Port, the FREJA 546R and the PC share the same Ethernet network connection, and thus will not have a secure isolation from each other. When testing IEC 61850 devices connect the PC to the USB port to isolate the PC from the IEC 61850 substation bus.

4.2.4.1 Setting FREJA 546R IP Address for Networks or IEC 61850 Operations

 The FREJA 546R maybe controlled over a network. This provides remote control of the FREJA 546R unit virtually over any distance allowing one PC to control at least two units simultaneously, such as

in end-to-end testing. ***Connecting the FREJA 546R to a Local Area Network or a Wide Area Network could permit unauthorized operation of the unit***.

Through the IN Ethernet port, the FREJA 546R integrates into a network just like a PC or server. To use this feature requires the user to setup the IP configuration of the FREJA 546R for their LAN. Note that the FREJA 546R when turned on will automatically search for and acquire a network address if connected to a network. If it fails to automatically acquire an address check to make sure you are properly connected using a standard Ethernet cable. ***Do not*** use a "cross-over" Ethernet cable (a cross over cable is designed for use from your PC to the test set, not to a network). If the unit still fails to acquire an address, then there may be other issues. This will probably require assistance from your company's information management department.

5.0 Current Sources

5.1 Parallel Operation

Each FREJA 546R current amplifier is capable of providing 32 Amperes continuous, and up to 60 amperes for 1.5 seconds for testing instantaneous trip elements. When more than 32 Amperes single phase is required for long durations, or 60 Amperes for testing instantaneous elements, two or three current channels may be connected in parallel to provide 60 or 90 Amperes continuous, and up to 120 or 180 amperes for short durations.

To parallel the current channels of the unit, perform the following:

If using the sleeved multi-lead current test leads (part number 2008-541), all of the black return leads are interconnected together inside the sleeve so they will all share the return current together. Connect each current channel to the relay under test (both red and black terminals to the load). Each Megger test lead is rated for 32 Amperes continuous. If using test leads other than those supplied by Megger ensure that the wire has sufficient size to carry the test current.

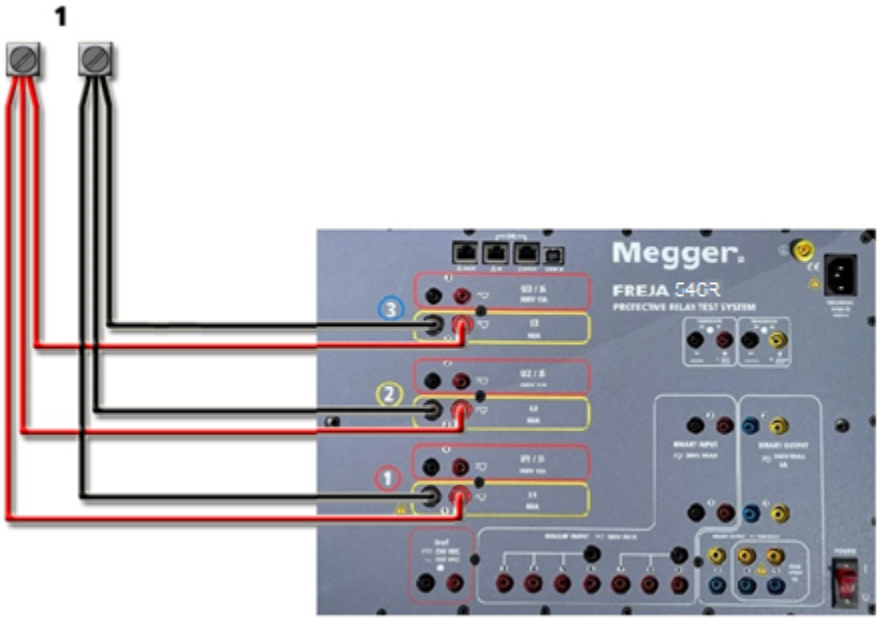


Figure 10 Parallel of All Three Current Outputs

5.1.1 Manual Test Screen - Single Phase Up To 180 Ampere

For ease of use and operator convenience, go to the software  Configuration screen and select the Operating Mode of ***3 Voltages – 1 Current @ 180A***. When you return to the manual test screen there will be one current channel displayed, as shown in the following figure.

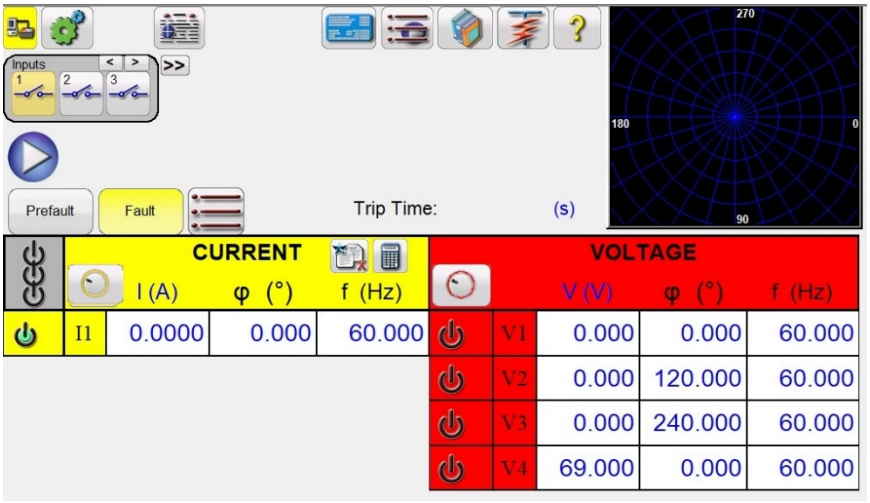


Figure 11 Manual Test Screen – Single Phase Current Operation

The software will automatically set all three currents in phase with each other and divide the current equally between the three current amplifiers. When setting an output, simply enter the value of the desired output current. For example, for an output of 75 Amperes, enter 75, while each current amplifier will be providing 25 Amperes. The current can also be phase shifted. Simply enter the desired phase angle and all three currents will be phase shifted together.

If two current channels that are to be used in parallel, leave the unit in the default three phase configuration. Connect the two current outputs to the load as shown in the following figure.

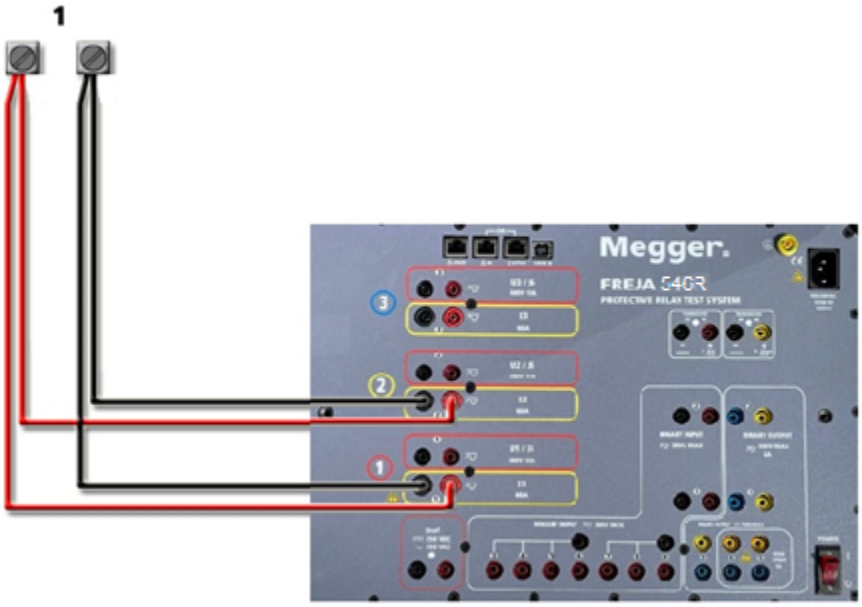


Figure 12 Two Currents in Parallel

Set each channel to one-half of the output requirement. **Be sure and reset current channel #2 to 0 degrees so that it will be in-phase with current channel #1**. With both current channels selected, turn output on by pressing or clicking on the ALL ON/OFF button. Always use the ALL ON/OFF button to turn both current channels on and off together. For manually ramping outputs, if using the PC version of the RTMS Software the ⇧⇩ buttons will be displayed. If using the touch screen, the Control Knob icon will be displayed. Pressing either of these two will present the user with a window to select the desired level of increment for manually ramping the outputs, the desired channel(s) to be ramped, and what is to be adjusted (amplitude, phase angle or frequency).

5.2 Currents in Series Operation

Two current channels may be connected in series in order to double the available compliance voltage. High impedance electromechanical ground (earth) overcurrent relays have always been difficult to test at high multiples of tap due to the winding impedance and saturation characteristics. The peak voltage required can exceed the maximum output voltage of one FREJA 546R current output channel, depending on the required test current. By connecting two current outputs in series, the compliance voltage is doubled, providing higher test currents through the load. Connect the two current amplifiers in a “push-push” configuration as shown in the following figure.

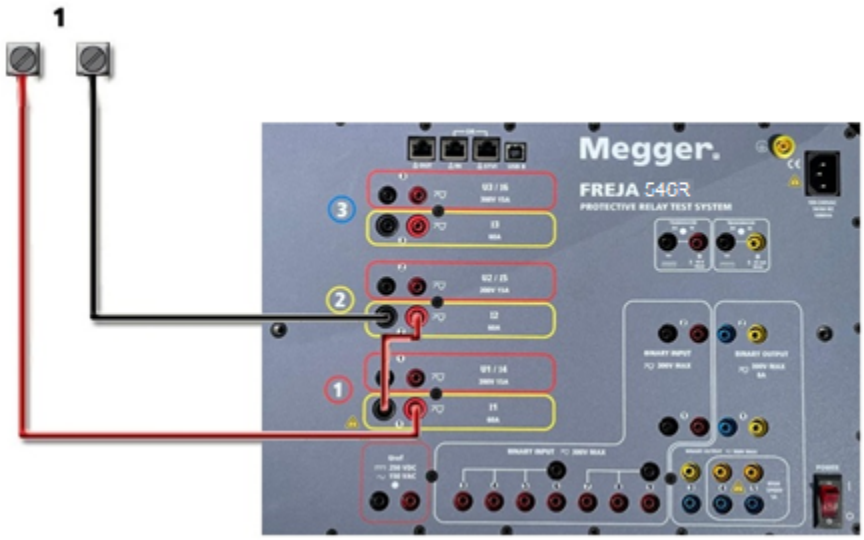


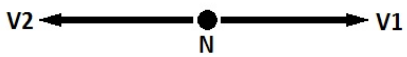
Figure 13 Series Two Currents

The two current channels that are to be used in series, set each to the same test current magnitude, and phase angle. Select both current channels and turn output on by pressing or clicking on the ALL ON/OFF button. Always use the ALL ON/OFF button to turn both current channels on and off together. For manually ramping outputs, if using the PC version of the RTMS Software the ⇧⇩ buttons will be displayed. If using the touch screen, the Control Knob icon will be displayed. Pressing either of these two will present the user with a window to select the desired level of increment for manually ramping the outputs, the desired channel(s) to be ramped, and what is to be adjusted (amplitude, phase angle or frequency).

6.0 Voltage Sources

6.1 Outputs Summed Together

Two voltage channels may be used to sum the voltage outputs to obtain higher than rated voltage provided the load is ungrounded. Connect the load between the voltage channel posts, set V_1 Phase to 0° and set V_2 Phase to 180°. The voltage outputs will add so the total voltage is the sum of the two voltage amplitudes, V_1 and V_2 as can be seen in the following figure.



The user must connect the associated voltage channels black common returns together, when series operation is required (see the following figure). Remove external commons when testing is completed. DO NOT attempt to series more than two voltage channels together, since the voltage test leads are only rated up to 600 V.

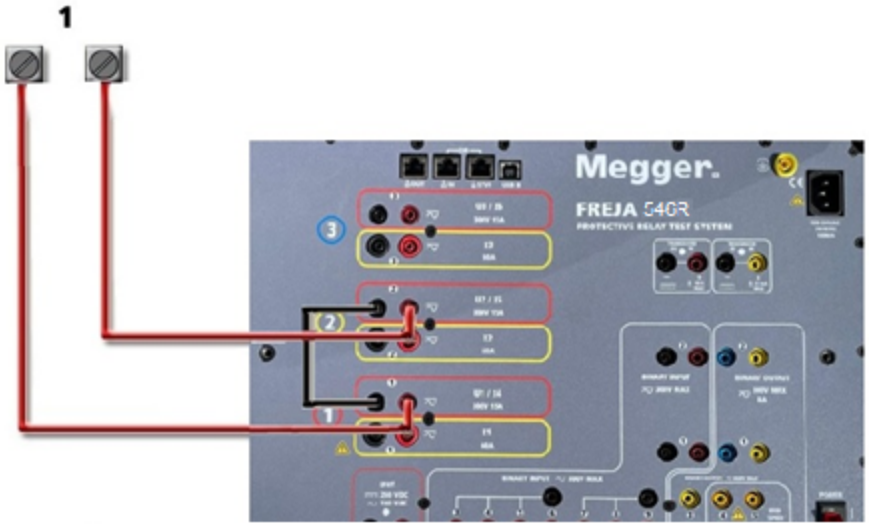


Figure 14 Series of Voltage Channels

6.2 **3Ø, 3-Wire, Open-Delta**

See the RTMS software user guide for detailed descriptions and use of the Open-Delta and T-Connection.

6.2.1 Balanced Open Delta

The Open-Delta configuration is the easy to use when a balanced three-phase source is required because the amplitude and phase relationship can be set directly. No calculations are necessary. When using the Open-Delta configuration, it is suggested to use voltage channel #1, designated V_1, and voltage channel #2, designated V_2, while the COMMON binding post is designated V_g. With this arrangement, the magnitude and phase angle of the potentials can be easily calculated and set. For the balanced three-phase condition V_{1g} and V_{2g} are equal in magnitude and separated by an angle of 60º. This is done by setting the V_1 and V_2 potentials equal in magnitude, setting 0° on V_1 and 300º (60 degrees leading assuming that the default phase rotation is set to 360 Lag) on V_2, see the following figure.

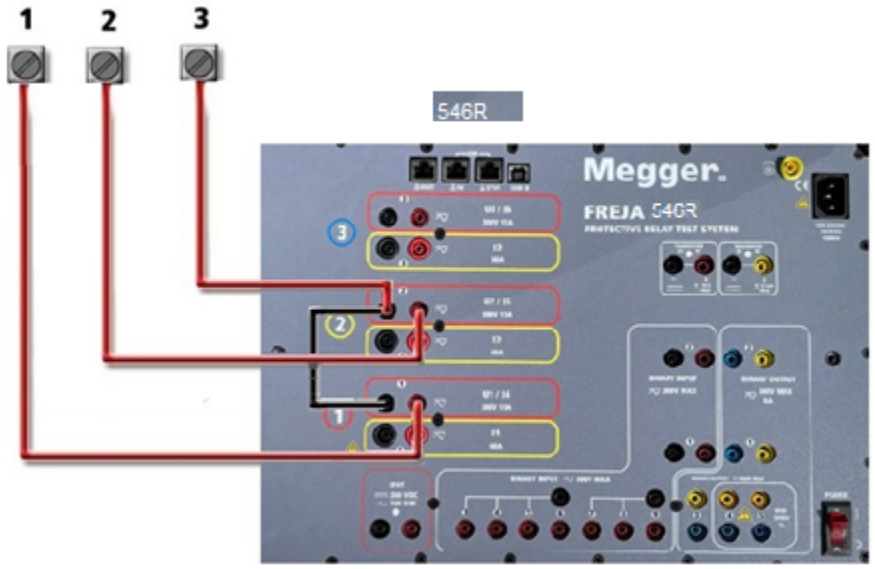


Figure 15 Three Phase Open Delta Connections

6.3 **3Ø, 4-Wire, Y-Connection**

A three-phase, four-wire potential system can be provided using three output modules. The vector relationships are referenced below. This Y-Connection has the advantage of being able to supply a higher line-to-line voltage (1.73 x phase-to-neutral voltage). It is ideally suited for simulating phase-to-ground faults. Voltage channel #1 is designated as V_a with its phase relationship set for 0°. Voltage channel #2 is then designated as V_b and phase angle set for 120°. Finally, voltage channel #3 is designated V_c and phase angle set for 240° (for a 1-2-3 counter clockwise rotation). V_a, V_b and V_c are connected to the voltage potential binding posts on the respective test set.

If using the sleeved multi-lead voltage test leads (part number 2001-395), all of the black return leads are interconnected together inside the sleeve so they will all share the return together. Therefore, only one return lead is provided on the relay connection side of the sleeved leads (similar to the connections in the following figure).

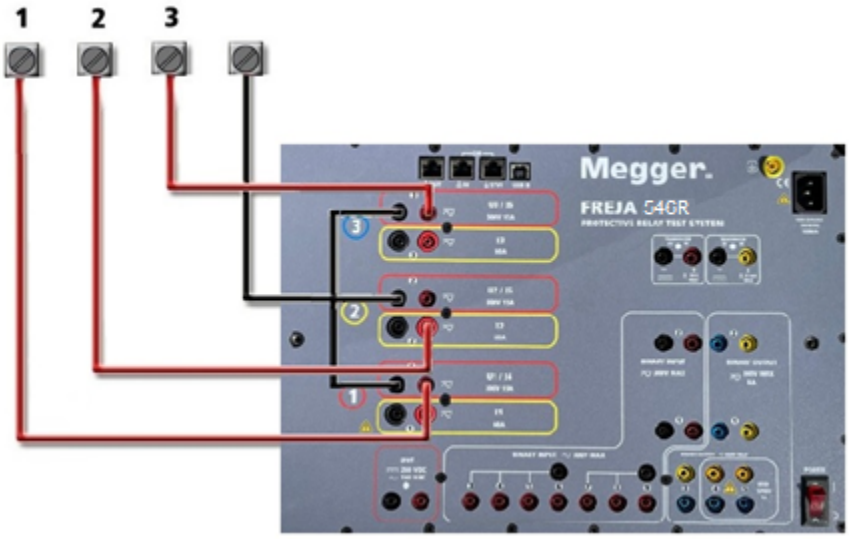


Figure 16 Three Phase Four Wire Test Connections

7.0 **Warranty Statement**

Megger warrants the product is free of defects in material and workmanship for a period of one (1) year from date of shipment. This warranty is non-transferable. This warranty is limited and shall not apply to equipment that has damage, or cause of defect, due to accident, negligence, and improper operation, faulty installation by the purchaser, or improper service or repair by any person, company or corporation not authorized by Megger. Megger will, at its' option, either repair or replace those parts and/or materials it deems to be defective.

The warranty is in lieu of all other warranties, either expressed or implied on the part of Megger and in no event shall Megger be liable for the consequential damages due to the breach thereof.

7.1 **Preventive Maintenance**

The unit utilizes surface mount technology (SMT) and other components which require little or no service except for routine cleaning, etc. The unit should be serviced in a clean atmosphere away from energized electrical circuits.

7.1.1 Examine the unit every six months for:

Dust and Dirt	To clean the unit, disconnect the power cord from the unit. Never use spray liquids or industrial cleaners. Some cleaning solvents can damage electrical components, and should never be used. Water and a mild soap may be used. Use a lightly damp cloth (not dripping wet) to wipe off the unit. A dirty heat sink can cause thermal overloads. Remove dust with dry, low pressure, compressed air. Either remove the module from the chassis or simply apply air forcing the dust away from the heat sink through the sides of the unit.
Moisture	Remove moisture as much as possible by putting the test set in a warm, dry environment.

7.1.2 Updating FREJA 546R Firmware

Download Firmware Upgrade via Megger Website

Updating Firmware via Megger Website
To download the latest FREJA 546R firmware from the Megger website,

1. Go to WWW.Megger.com
2. Go to **Products** / **Relay and protection testing** / **Multi-phase relay testing solutions** and click on the picture of your FREJA 546R unit.
3. Click on the **Product support** tab, and click on the Software and firmware updates.
4. Click on the FREJA 546R Firmware 50 Hz or 60 Hz Download button
5. You will see a pdf document with detailed instructions on how to update the firmware on the FREJA 546R unit. Download the **FREJA 546R Firmware** and install per the instructions.

USB Memory Stick: With the FREJA 546R and STVI powered up, insert the USB memory stick into the USB port on the touch screen control panel of the FREJA 546R. Press the **Configuration** Screen button, and then press the **Update Firmware** button in the Configuration Screen. At that point the user will be presented with the IP Address selection screen, with the serial number of the unit. Select the unit by Pressing or clicking the serial number and the upgrade process will automatically start. Observe the STVI display screen, and the unit. At the completion of the download, the user will note the fans spin-up, and the LED's will be flashing rapidly on the FREJA 546R unit. There will be an instruction to reboot (turn off and back on) the test system.

PC and RTMS Software: If using the PC version of the RTMS Software, it is very similar to the USB Stick method. Upon clicking on the Update Firmware button, the familiar Windows *Open File* browser dialog box will appear. Using the *Look In* pull-down menu, navigate to where the new firmware was downloaded onto the PC, click on and open the file folder FREJA 546R_LDR (FREJA 546R Loader). There you will find the new firmware file. Click on the file, and click on Open. You will be requested to select a unit from the IP Address screen. Select the unit by clicking on the serial number and the upgrade process will automatically start. At the completion of the download, the user will note the fans spin-up, and the LED's will be flashing rapidly on the FREJA 546R unit. There will be an instruction to reboot (turn off and back on) the test system. Note that after rebooting the FREJA 546R unit, if using the PC version of the RTMS Software you will have to restart the RTMS Software on your PC in order to regain control of the FREJA 546R unit.

7.2 Service and Repair Instructions

The FREJA 546R are designed as modular units. In most cases, if any one module should experience a problem it should not cause the entire test system to be non-functional. Basic troubleshooting information is provided to guide the technician to the possible source of a problem.

Since FREJA 546R use Surface Mount Technology, repairs of the individual modules are beyond the scope of the basic troubleshooting guide, and should be referred to the Service Department at Megger or handled through the Megger Representative.

If the unit is still within the original warranty period, or limited warranty period following factory servicing, **the factory must be contacted before attempting any repairs or the warranty will be void.**

7.2.1 Basic Troubleshooting

The troubleshooting information relies on the technician to have a good understanding of the operation of the unit. The technician should contact the factory before attempting repairs. Provide the Megger serial number of the FREJA 546R when making inquiries.

WARNING It is necessary to energize the FREJA 546R to properly troubleshoot some of the modules. The technician must take all applicable safety precautions for working near energized circuits.

NOTES

Before suspecting a failure in the FREJA 546R, review the General Description and Operation sections to ensure that the problem is not a result of operating error.

Preliminary testing of the FREJA 546R within its specified limits can help determine if a malfunction actually exists, identify the type of malfunction and define the general area of the failure.

Common causes of malfunctions, other than improper operation, are incorrect power input (voltage above or below specified limits), incorrect test signal voltages applied to the Binary Input gates (outside of the specified AC/DC Applied/Removed limits), and contact or circuit resistance too great for the Dry Contact gates to operate properly on the Monitor/Start/Stop gates. Typical malfunctions for the VI-Gen amplifiers are external short circuits on the voltage output and open circuits on the current output. The battery simulator and VI-Gen voltage and current outputs can be easily checked using a voltmeter and ammeter.

NOTE: There are three different modules that make up a FREJA 546R; the System Board (front panel), VIGEN FULL (VIGEN#1, and #2) and VIGEN LITE (VIGEN #3).

7.2.1.1 Power Input

Input voltage affects the whole unit and may or may not cause permanent damage if voltage is incorrect. These problems can often be corrected by simply using a better source of input power.

Some symptoms are as follows:

Low voltage: Erratic operation, no output, input power circuit breaker operation.

High voltage: Circuit breaker operation, or power supply failure in Input Power Module.

7.2.1.2 VIGEN Input Power, Communication and Control

Basic troubleshooting is as follows.

1. No power: Check the ON/OFF circuit breaker. Does the ON/OFF switch light up? If it does not light up, then power is not getting to the unit. Check power source and line cord. If it lights up then the power is getting to the unit. Contact the factory or Megger representative for further instructions.

2. Erratic Manual Control: Individual Output Module communication cable is not properly connected thus cannot receive proper commands. Look through the air intake holes on the left side of the unit to observe the VI-Gen LEDs. Each module has some green LEDs that blink. These are associated with the Ethernet communications. If there are no blinking LEDs on one or both modules, then the module(s) is not communicating. Contact the factory or Megger representative for further instructions.

7.2.1.3 Binary Inputs, and Binary Outputs

If all the items external of the Timer assembly are in proper order, then the problem may exist within the Binary Input / Output assembly itself.

Some basic troubleshooting can pinpoint problems to the approximate cause.

Binary Inputs - Basic troubleshooting is as follows:

1. Timer does not stop: Jumper the appropriate Binary Input terminals manually. If LED above the selected input lights, check the Binary Input setup screen to verify that the selected binary input is properly setup as a Timer stop post. Check Timer stop settings as N.O. (Normally Open) to close, and Latch On. If LED does not light up, the Binary Input will need to be repaired or replaced. Contact the factory or Megger representative for further instructions.

2. Counting errors: AC applied or removed Stop signals can create, what appears to be poor repeatability, an inaccuracy or a malfunction in the Timer. The lower the voltage level, the more serious the "error" will be. What appears to be an error, however, is actually a variation in the point on the sine wave at which the voltage is great enough to cause the gate circuit to operate. If the circuit used for the timing test has a low AC voltage and the point at which the contact in the test circuit opens or closes, is at or close to zero on the sine wave, the period of time before the voltage level will be high enough to trigger the gate circuit can be as much as 4 milliseconds. The total timing variation can be as much as 8 milliseconds. The shorter the duration of the timing test, the more significant the variation becomes. Therefore, if small timing variations would present a problem, it is recommended that an AC voltage of 115 volts or above or a DC voltage be used for voltage applied/removed test selections.
   When the FREJA 546R Timer calibration is being tested, the AC voltage variable is often overlooked. This is particularly true when the Timer is compared to a counter and the two are triggered simultaneously with an electronic switch. For best results, a DC voltage should be used to eliminate the variable. If testing the AC voltage Timer Stop characteristics is desired, then the Stop signal must be triggered at the same point on the sine wave to assure that the gate signal will be repeatable. Ideally, the signal should be at a point near peak in the positive direction. In addition, the specified rms AC voltage values for the various Stop control selections must be adhered to.

   Another source of apparent "error" can be the programmable de-bounce feature. If using electro-mechanical contacts for stopping the Timer, and if those contacts have a tendency to bounce, there could be a difference between an external standard timer and the FREJA 546R unit Timer, depending on the programmed de-bounce period set in the FREJA 546R unit. To determine the programmed value, look at the Binary Input Setup Screen and see what the De-bounce setting value is. If a timing error or variation persists after all the suspected causes of error have been eliminated, then it is possible that the Binary Input circuit is malfunctioning. Contact factory for return instructions.

   Binary Outputs - Basic troubleshooting is as follows:

   Binary Output LED is ON but output contacts ***not closed***: Using a continuity tester check to see if output circuit is open circuited. If circuit is open then it is possible that the internal surface mounted fuse element has been blown. Note: an optional in-line fused test lead Part Number: 568026 are available to provide protection from switching too high current, see

FREJA 546R Ordering Information under Optional Additional Accessories. The unit will need to be returned to the factory for further inspection and repair.

 Contact the factory for a Repair Authorization Number and return instructions if service is required. A Repair Authorization (RA) number will be assigned for proper handling of the unit when it arrives at the factory. Any non-warranty repair cost incurred for the repair or replacement of parts and/or materials shall be the responsibility of the purchaser.

Provide the factory with model number, Unit serial number, nature of the problem or service, return address, your name, and how to contact you should the factory need to discuss the service request.

You may need to provide a purchase order number, cost limit, billing, and return shipping instructions. If an estimate is requested, provide the name and contact information.

8.0 Preparation for Reshipment

 Save the original shipping container for future use. The shipping container is designed to withstand the rigors of shipping via a common commercial carrier. For example, you may wish to reship your unit to Megger for an annual calibration recertification.

Pack the equipment appropriately to prevent damage during shipment. If a reusable container is utilized, the unit will be returned in the same shipping container if it is in suitable condition.

Add the Return Authorization Number to the address label of the shipping container for proper identification and quicker handling.

 NOTE: Ship the equipment without nonessential items such as test leads, etc. These items are not needed by the factory to perform service.