FREJA 546R

Relay Test System



- **Small, rugged, lightweight, and powerful**
- **Operate with or without a computer**
- **Intuitive manual operation with Smart Touch View Interface or the integrated onboard display**
- **High current, high power output (60 A/319 VA RMS) per phase**
- **Four voltage channels, three current channels, with convertible voltage channels provides one voltage and six currents**
- **Dynamic, transient, and GPS satellite synchronised end to-end testing capability**
- **IEC 61850 GOOSE testing capability and IEC 61850 9-2 LE sampled values compliant**

DESCRIPTION

The FREJA 546R is a multi-purpose, lightweight, 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 has the “smart” combination of being both small and light weight, while also providing high power. The FREJA 546R has a new case design, with improved distributed power supplies for additional reliability as well is a larger on-board display and additional memory.

The FREJA 546R test system can be manually controlled with the integrated onboard display on the FREJA 546R running the new RTMS, Relay Test Management Software. The 25.7 cm onboard display, with its large, easy-to-read full colour, 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 onboard display eliminates the need for a computer when testing virtually all types of relays. 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 every FREJA unit is supplied with Relay Test Management Software (RTMS) for installing on a PC. It does not require a security dongle or license to operate and can be loaded on as many customer-owned computers as required. There are two different levels of RTMS: Standard and Enhanced, see ordering information for details.

APPLICATIONS

The test system may be customised by adding the number of voltage/ current, “VIGEN”, modules needed for specific test applications, with a maximum of three 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 fourth voltage channel provides an AC reference/ synchronising/polarising voltage, or a DC battery simulator voltage source. Each current channel is rated for 32 A at 200 VA RMS continuous, and up to 60 A at 319 VA RMS for short durations. For testing relay panels or electromechanical relays, it has a unique flat power curve from 4 to 32 A that always ensures maximum compliance voltage to the load. With a maximum compliance voltage of 50 V RMS per phase, two channels in series provide 100 V to test high impedance relays. Three currents in parallel provide test currents up to 120 A at 600 VA for testing ground overcurrent relays at high multiples of tap rating. With three currents in parallel it can provide up to 180 A at 957 VA for testing all instantaneous overcurrent relays. Each voltage channel can provide variable outputs of 0–30/150/300 V at 150 VA of output power. Automatic range changing is done on-the-fly and under load. For testing a panel of relays or older electromechanical impedance relays, it has a unique flat power curve from 30 to 150 V always insuring maximum output power to the load. With the VIGEN voltage channels converted to currents, a three channel unit can provide six currents for testing three phase current differential relays, including harmonic restraint transformer differential relays.

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MANUAL OPERATION

RTMS in conjunction with the onboard display allows the user to perform manual, steady-state, and dynamic testing quickly and easily. Ergonomically designed with the control knob and touch screen, the powerful RTMS is extremely easy to use.



Figure 1: FREJA 546R unit

The most significant feature of RTMS is its ability to provide the user with a very simple way to do manual testing, for both commissioning and maintenance, from the simple overcurrent relay to the most complex relays manufactured today. Manual operation is simplified using a built-in computer operating system and onboard display. The touch screen display and RTMS eliminates the need for a computer when testing virtually all types of relays. Enhanced graphics, intuitive menu screens, and touch screen icon buttons are provided to select the desired test function quickly and easily.

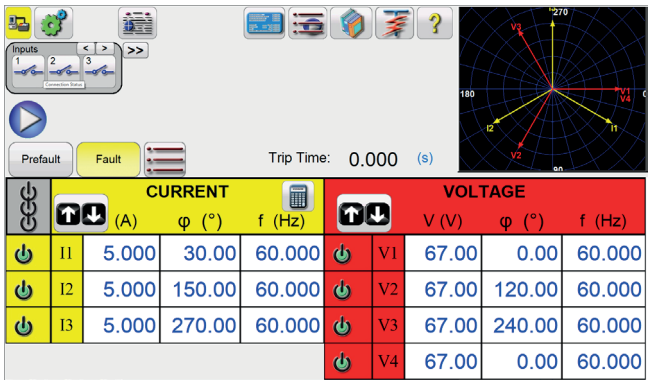


Figure 2: RTMS advanced user interface

For more details on RTMS test capability, see the RTMS data sheet.

FEATURES AND BENEFITS

Touch screen display – Easy to use and read, the display provides manual control of the test set. Colour contrasts accentuate vital information. This reduces human error and time in testing relays.

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 and/or series current channels together to test high burden relays, which also saves time.

High output current – The FREJA 546R provides up 32 A at 200 VA per phase continuous, or up to 60 A at 319 VA with a 1.5 second duty cycle. Three current amplifiers can be paralleled to provide a maximum of 180 A at 900 VA for testing all instantaneous overcurrent relays.

PowerV™ Voltage Amplifier high power output – The FREJA 546R provides a high VA output on the voltage channel at the lower 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.

RTMS graphics and intuitive navigation – New test graphics and intuitive screen navigation saves test time and reduces human error.

Steady-State and Dynamic test 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 DC offset and harmonics.

Digital inputs and outputs – Up to ten programmable inputs, and six 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 and normally open contacts to simulate circuit breaker operation for testing reclosing relays. Sequence of operation, timing, and lockout are easily tested.

Performs transient tests – The FREJA 546R can 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 Doble-Megger MGTR GPS satellite receiver (or suitable IRIG-B time code source input into Binary Input #1), the FREJA 546R perform satellite-synchronised end-to-end tests.

Perform multi-phase tests – The FREJA 546R can be interconnected with other FREJA units to increase the total number of test currents for testing multi-phase bus differential protection schemes. For example, a three-channel FREJA 546R may be interconnected with four more FREJA 546R units, providing up to a maximum of 30 current channels.

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Ethernet ports – The PC IN port is the primary PC connection port. The OUT ethernet port is primarily used to interconnect multiple FREJA units together for synchronous multi-unit operation may be used to connect to the IEC 61850 substation bus. The ISOLATED ethernet port provides secure isolation when testing IEC 61850 devices (for customers who require secure isolation from their IEC 61850 substation bus).

Immediate error indication – Audio and visual alarms indicate when amplitude or waveforms of the outputs are in error due to short circuit, open circuit, or thermal overload.

IEC 61850 and Doble-Megger GOOSE Configurator – With the IEC 61850 GOOSE option enabled in the FREJA hardware the Doble-Megger GOOSE Configurator (MGC) provides mapping of the binary inputs and outputs of the FREJA 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 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 Doble-Megger Sampled Values Analyser (SVA) – With IEC 61850 9-2 LE Sampled Values option enabled in the FREJA hardware 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 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 can be used to inject SV streams directly into the relay thereby mimicking merging units. Additionally, FREJA can also be connected to the network and be used as an SV stream monitoring tool. Either of the OUT (PC) or IN ports on FREJA provide the ability to subscribe/publish a maximum of three Sampled Values streams. Minimum hardware requirement to use the IEC 61850 9-2 LE Sampled Values Option – FREJA VIGEN bootloader version >/= 1.052 and firmware 6.259 or higher.

Low-level Rogowski mode – In the Low-level Rogowski mode, the current channels will convert from a current source to a millivolt source. This will allow the current channel to simulate a low-level voltage source from a Rogowski coil. The MLLA will provide filtering of the low-level outputs from the latest version of voltage/current generators in the Doble-Megger FREJA series test sets. The MLLA provides the interface from the low-level outputs to the device under test using appropriate interface cables (see MLLA data sheet for ordering and unit compatibility information).

Low-level output capability[2/3] – The current generators 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 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 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.

Variable voltage threshold[2/3] – The variable voltage threshold will either start or stop the timer. The continuity indicator will glow (application) or not glow (removal) upon the application or removal of either an AC or DC voltage. The programmable voltage threshold is available on binary inputs 1 and 2, with a programmable range from 5 to 150 Volts AC/DC.

Open communication architecture – The FREJA 546R can be used with third party software for more flexible automated control.

NON-DISPLAY MODEL

A non-display model is offered for those who prefer to only run RTMS from a PC. This reduces cost for those not requiring a touch screen display.



Figure 3: FREJA 546R non-display unit

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SPECIFICATIONS[1]

Input power
90 to 264 Volts AC, 1Ø, 50/60 Hz, 1800 VA.

Outputs
All outputs are independent from sudden changes in line voltage and frequency. All outputs are regulated so changes in load impedance do not affect the output. Each output (VIGEN) module consists of one voltage amplifier, and a current amplifier. The voltage amplifier may be converted to a current source. Therefore, one amplifier module may be used to test single phase current differential relays, including harmonic restraint.

Output current sources
The FREJA 546R with three VIGEN modules can provide up to six current sources: three high current/high power, and three convertible voltage channels providing lower current/high power. The per channel output current and power ratings are specified in AC RMS values and peak power ratings.

Per channel output

Output current	Power	Max V
50 mA[2]	5 VA	10.0 V RMS
1 A	5 VA	15.0 V RMS
4 A	200 VA (282 peak)	50.0 V RMS
15 A	200 VA (282 peak)	13.34 V RMS
32 A	200 VA (282 peak)	6.25 V RMS
60 A	319 VA (430 peak)	5.32 V RMS
DC 200 Watts		

Duty cycle: 32 A Continuous, 60 A 1.5 seconds or 90 cycles

Three currents channels in parallel

Output current	Power	Max V
12 A	600 VA (848 peak)	50.0 V RMS
45 A	600 VA (848 peak)	13.4 V RMS
96 A	600 VA (848 peak)	6.25 V RMS
180 A	957 VA (1290 peak)	5.32 V RMS

AC Low-level Rogowski output (converted current channels)[2/3]
Each current channel can provide the following voltage outputs with the following Ranges:

Output voltage	Max I
0 - 2 V RMS	10 mA
0 - 10 V RMS	100 mA
0 - 40 V RMS	25 mA

Duty cycle: Continuous

Two current channels in series
With two current channels in series, the compliance voltage doubles to provide 4 A at 100 V RMS and up to 32 A at 12.5 V RMS.

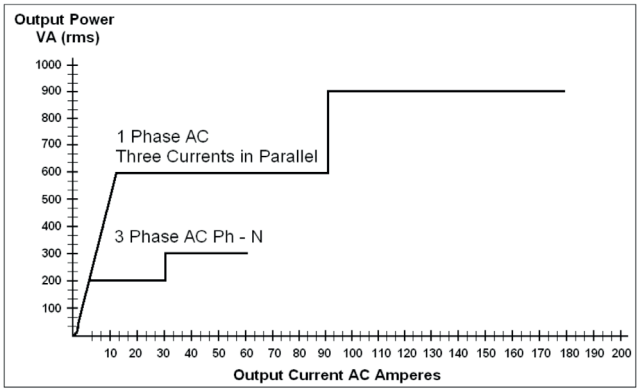


Figure 4: Current output power curve

Current amplifier – extended power range
The FREJA 546R's current amplifier provides a unique flat power curve from 4 to 32 A per phase to permit testing of electromechanical high impedance relays, and other high burden applications, with an extended operating range up to 60 A at 319 VA RMS for short durations.

AC voltage output
The FREJA 546R can provide three voltage sources 0 to 300 V AC/DC. The unit can provide a fourth AC/DC voltage source to serve as either a reference synchronising voltage or as a battery simulator, see AC/DC AUX voltage channel.

Outputs are rated with the following ranges:

Output voltage	Power	Max I
2 V[2]	0.02 VA	10 mA
30 V	150 VA	5 A
150 V	150 VA	Variable[4]
300 V	150 VA	0.5 A
DC 150 Watts		

Duty cycle: Continuous

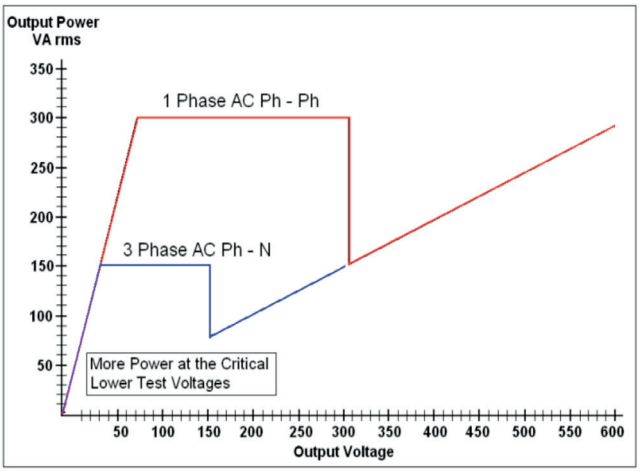


Figure 5: Voltage output power curve

Note: Two Voltage Channels can be put in series to obtain up to 600 V AC.

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PowerV™ voltage amplifier - extended power range

The FREJA 546R's voltage amplifier provides a flat power curve from 30 to 150 V in the 150 V range to permit testing of high current applications such as panel testing, and older electromechanical distance relays which demand a higher power voltage source to properly test.

Voltage amplifier in current mode

The voltage channels are convertible to a current source with the following output capability. Output power ratings are specified in AC RMS values and peak power ratings.

Output current	Power	Max V
5 A	150 VA (212 peak)	30.0 V RMS
15 A	120 VA	8.0 V RMS

Duty cycle: 5 A Continuous, 15 A for 1.5 seconds or 90 cycles

Phase angle, voltage and current

Ranges
0.00 to 359.99 degrees, counter clockwise, or clockwise rotation, or 0.00 to ± 180.00 degrees
Accuracy: ± 0.02° typical, < 0.1 ° guaranteed at 50/60 Hz
Resolution: 0.001

Frequency

The output modules provide a variable frequency output with the following ranges and accuracy.
Ranges
DC: 0.001 to 3000.000 Hz
Output amplifiers can provide transient signals with a range of DC to 10 kHz for transient playback using IEEE-C37.111 Standard COMTRADE files.
Resolution: 0.001 Hz
Frequency accuracy: 2.5 ppm typical
25 ppm, 0° to 50° C, at 50/60 Hz maximum
AC/DC AUX: 250 ppm, 50/60 Hz maximum

Total harmonic distortion

Less than 0.1 % typical, 2 % maximum at 50/60 Hz

Metering

Measured output quantities such as AC Amperes, AC Volts, DC Volt, DC Amperes, and time may be simultaneously displayed on the touch screen. Pre-set AC and DC outputs display the approximate voltage/current output prior to initiation. This provides a fast, easy method for pre-set of outputs. Other values that may be displayed, depending on which test screen is in view, are phase angle, frequency, Ohms, Watts, VA, and power factor. Accuracies are specified from 10 to 100 % of range, 25 °C ± 5 °C, 50 to 60 Hz.

AC voltage amplitude

Accuracy: ± 0.05 % reading + 0.02 % range typical
± 0.15 % reading + 0.05 % range maximum
Resolution: 0.01
Measurements: AC RMS
Ranges: 30, 150, 300 V

DC voltage amplitude

Accuracy: 0.1 % range typical, 0.25 % range maximum
Resolution: 0.01
Measurements: RMS
Ranges: 30, 150, 300 V

AC low-level voltage output[2]

Range: 2 V
Accuracy: 0 – 1 V: 0.5 mV typical and 1 mV guaranteed
1 – 2 V: 0.5 mV typical and 2 mV guaranteed
Resolution: 0.001
Measurements: AC RMS

AC low-level Rogowski output (converted current channels)[2/3]

Range: 2 V
Accuracy: 0 – 1 V: 0.5 mV typical and 1 mV guaranteed
1 – 2 V: 0.5 mV typical and 2 mV guaranteed
Resolution: 0.001
Measurements: AC RMS
Ranges: 10, 40 V
Accuracy: ± 0.05 % of reading + 0.02 % of range typical
± 0.15 % of reading + 0.05 % of range guaranteed
Resolution: 0.001
Measurements: AC RMS

AC current amplitude

Accuracy: ± 0.05 % reading + 0.02 % range typical
± 0.15 % reading + 0.05 % range maximum
Resolution: 0.001/0.01
Measurements: AC RMS
Ranges: 32, 60 A

AC low current[2]

Range: 50 mA
Accuracy: ± 0.5 mA typical and 1 mA guaranteed
Resolution: 0.0001
Measurements: AC RMS

DC current amplitude

Accuracy: ± 0.05 % reading + 0.02 % range typical
± 0.15 % reading + 0.05 % range maximum
Resolution: 0.001/0.01
Measurements: RMS
Range: 30 A

Convertible source in AC current mode

Accuracy: ± 0.05 % reading + 0.02 % range typical
± 0.15 % reading + 0.05 % range or ± 12.5 mA whichever is greater
Resolution: 0.001
Measurements: AC RMS
Ranges: 5, 15 A

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Timer
The timer-monitor input is designed to monitor and time-tag inputs, like a sequence of events recorder. In addition, the binary input controls enable the user to perform logic and/or functions, and conditionally control the binary output relay to simulate circuit breaker, trip, reclose, and carrier control operation in real-time. The "Timer" function displays in "Seconds", "Milliseconds", "Minutes", "Hours", or "Cycles", with the following range and resolution:

Seconds: 0.0001 to 99999.9 **(Auto ranging)**
Cycles: 0.01 to 99999.9 **(Auto ranging)**
± 0.001 % of reading, typical
± 2 least significant digit
± 0.005 % of reading from 0 to 50 °C maximum

Binary input – start/stop/monitor gate
9 independent, galvanically isolated inputs monitor operation of relay contacts or trip SCR, continuity light is provided for the input gate. Upon sensing continuity, the lamp will glow. In addition to serving as wet/dry contacts the binary inputs may be programmed to trigger binary output sequence(s).
Input rating: Up to 300 V AC/DC
Variable voltage threshold:
Range: 5 – 150 V AC/DC
Accuracy: 5 – 30 V, ± 3 V
31 – 99.9 V, ± 6 V
100 – 150, ±10 V

Binary output relays
FREJA 546R has independent, galvanically isolated, output relay contacts to accurately simulate relay or power system inputs to completely test relays removed from the power system. The binary output simulates normally open, or normally closed, contacts for testing breaker failure schemes. The binary output can be configured to change state based on binary input logic.

High current output relays 1 and 2:
AC rating: 400 V max., I max: 8 A, 2000 VA max.
DC rating: 300 V max.: 8 A, 80 W
Response time: < 10 ms
High speed output relays 3, 4, and 5:
AC/DC rating: 400 V peak, I max: 1 A
Response time: < 1 ms typical

Waveform storage
Each output channel can store waveforms for playback on command. End-to-end playback of stored waveforms is possible, when triggered externally by a GPS receiver. Each channel can store up to 256 000 samples.

Protection
Voltage outputs are protected from short circuits and prolonged overloads. Current outputs are protected against open circuits and overloads.

DC IN inputs (Transducer feature)
DC IN voltage
Range: 0 to ± 10 V DC
Accuracy: ± 0.001 % reading + 0.005 % range typical
± 0.003 % reading + 0.02 % range max
Resolution: 0.001
Measurements: Average

DC IN Amperes
Ranges: 0 to ± 1 mA DC
4 to ± 20 mA DC
Accuracy: ± 0.001 % reading + 0.005 % range typical
± 0.003 % reading + 0.02 % range max
Resolution: 0.001
Measurements: Average

AC/DC AUX voltage channel
The AC/DC AUX voltage channel can be either a variable AC voltage source to use as a polarising or synchronising voltage source, or a battery simulator with a variable DC output voltage.

Ranges (AC)	Power	Max I
30 V	100 VA	3.33 A
150 V	100 VA	0.67 A

AC Accuracy: ± 0.05 % reading + 0.02 % range typical
± 0.15 % reading + 0.05 % range
Resolution: 0.001
Measurements: RMS

Battery Simulator
When the AUX voltage channel is used as a battery simulator there are four common voltage level selections to choose from, 24, 48, 125 & 250 V or a variable DC output ranging from 5 – 250 V at 100 W, 4 A max, providing capability to power up relays with redundant power supplies.

Ranges (DC)	Power	Max I
30 V	100 Watts	3.33 A
250 V	100 Watts	0.4 A

DC Accuracy: Typical < 1%, Guaranteed < 5% ± 1 V

The Battery Simulator is Galvanically Isolated from other outputs and protected against short circuit and overload conditions.

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Environmental

Operating temperature: 14 to 122 °F (-10 to 50 °C)
Storage temperature: -13 to 158 °F (-25 to 70 °C)
Relative humidity: 5 – 95 % RH, non-condensing

CE-marking

EMC EN 61326:
LVD EN/IEC 61010-1:2001 (Second Edition)

Conformance standards

Safety: EN 61010-1
Shock: EN/IEC 60068-2-27
Vibration: EN/IEC 60068-2-6
Transit drop: ISTA 1A
Free fall: EN/IEC 60068-2-32
Drop/topple: EN/IEC 60068-2-31

Electromagnetic compatibility
Emissions: EN 61326-2-1, EN 61000-3-2/3,
FCC Subpart B of Part 15 Class A
Immunity: EN 61000-4-2/3/4/5/6/8/11

Weight

30.09 lb. (13.65 kg)

Dimensions

16.9 L x 12.9 W x 9.3 H (429 mm x 328 mm 236 mm)

Enclosure and transit cases

The unit comes mounted in a rugged metal enclosure for field portability.

IEC enclosure rating: IP30
Optional hard-sided transit case is available. The robust design of the optional hard-sided transit case provides protection when transporting the unit over rugged terrain and long distances. An optional soft-sided case has approximately 1 inch of padding, which provides moderate protection against rain, dust, vibration, and shock.

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ORDERING INFORMATION

STYLE NUMBER IDENTIFICATION

Model F546 - 3 0 R [ ] C [ ] [ ] [ ] T [ ]

Voltage/current module

Display option
0 = Without display
2 = With onboard display

Hardware option
0 = Without low-level option
2 = With low-level output option

Power cord option
A = North American power cord
I = International power cord
E = Continental Europe power cord
U = United Kingdom power cord

Test lead option
0 = Without leads
1 = With leads

Internal software option
0 = RTMS Enhanced option
1 = RTMS Enhanced and IEC 61850 GOOSE hardware license option
2 = RTMS Enhanced and IEC 61850 9-2 LE hardware license option
3 = RTMS Enhanced and IEC 61850 GOOSE and 9-2 LE hardware license option

DESCRIPTIONS OF HARDWARE OPTIONS

This modular system lets you select the testing capabilities you need and expand as testing requirements change. Customise the system by selecting items below.

Voltage/current module: The FREJA 546R has three voltage/current modules.

Display option: Enter the number **0** for the unit to be supplied without a display or the number **2** for the unit to be supplied with an onboard display.

Hardware option:

0 = Enter the number **0** for the unit to be supplied without the low-level option.

2 = Enter the number **2** for the unit to be supplied with the low-level option.

Power cord option: Customers can choose which type of power cord they want the unit to come with.

- **A** option – NEMA 5-15 to IEC60320 C13 connectors, UL and CSA approved for countries with NEMA outlets.
- **I** option – International colour-coded wires (light blue, brown, and green with yellow stripe) insulation jacket stripped ready for male connector with IEC 60320 C13 connector. CE marked.
- **E** option – CEE 7/7 “Schuko” plug to IEC 60320 C13 connector is CE marked.
- **U** option – United Kingdom power cord with IEC 60320 C13 connector, and 13 A fuse. BS 1363 / CE marked.

Internal software option:

0 = Enter the number **0** for the unit to be supplied with RTMS Enhanced option.

1 = Enter the number **1** for the unit to be supplied with the IEC 61850 GOOSE hardware license enabled on the unit.

2 = Enter the number **2** for the unit to be supplied with the IEC 61850 9-2 LE hardware license enabled on the unit.

3 = Enter the number **3** for the unit to be supplied with IEC 61850 GOOSE and IEC 61850 9-2 LE hardware licenses enabled.

Test leads option: Enter the number **1** for the unit to be supplied with test leads. Enter **0** for the unit without test leads.

DESCRIPTIONS OF SOFTWARE OPTIONS

Description	Part number
RTMS Enhanced software	84973
Optional software	
Doble-Megger GOOSE Configurator and Sampled Values Analyser stand-alone software	1007-246
IEC 61850 GOOSE hardware upgrade kit	83646
IEC 61850-9-2LE Sampled Values hardware upgrade kit	1013-856
FREJA IEC 61850 GOOSE and IEC 61850-9-2LE Sampled Values hardware upgrade kit	1013-938
Low-level hardware upgrade kit (includes Rogowski, low-current and variable voltage on B/I 1 feature)[2/3]	87416

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DESCRIPTIONS OF SOFTWARE

Included software

Every unit is supplied with Relay Test Management Software (RTMS) for installing on a PC. RTMS does not require a security dongle or license to operate and can be loaded on as many customer-owned computers as required. The powerful RTMS can be run directly from a PC providing both manual and automatic test capabilities. See the RTMS data sheet for more detailed descriptions of test features and capabilities.

RTMS Template Manager – RTMS Template Manager is included with RTMS, allowing users to download new versions of relay templates as they are released from the Doble-Megger Cloud and will update the user's local PC data base (Internet connection is required). RTMS Template Manager also provides documents and how-to videos to support relay testing.

Additional optional software

Doble-Megger GOOSE Configurator software – The FREJA unit is certified by KEMA as being compliant with IEC 61850 protocol. With the IEC 61850 GOOSE hardware enabled, in conjunction with the Doble-Megger GOOSE Configurator (MGC) software, the FREJA unit can be used in the testing or commissioning of IEC 61850 compliant devices. See RTMS datasheet for details.

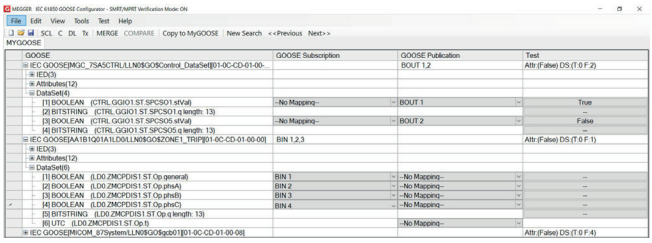


Figure 6: Doble-Megger GOOSE Configurator software

Doble-Megger Sampled Values Analyser software – The FREJA unit is certified by KEMA as being compliant with IEC61850-9-2LE guidelines. With the IEC 61850 Sampled Values hardware enabled, in conjunction with the Doble-Megger Sampled Values Analyser software, the FREJA unit is user configurable to provide Sampled Values for testing or commissioning devices which require Sampled Values. When configured, the FREJA unit can provide three data streams of four voltages and four currents each.

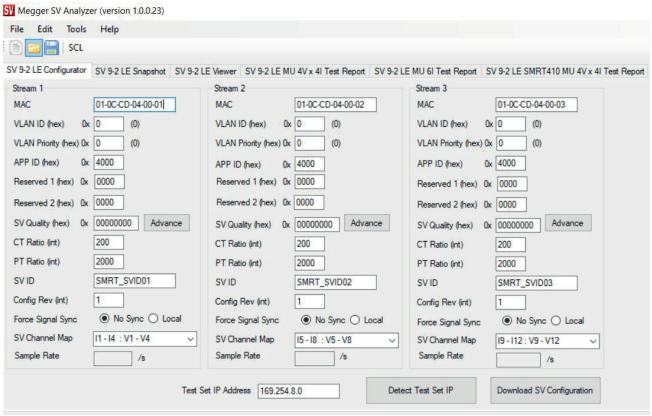


Figure 7: Doble-Megger Sampled Values Configurator

FREJA IEC 61850 GOOSE license upgrade kit – The IEC 61850 GOOSE test feature is a hardware enabled option. RTMS will automatically recognize if the GOOSE feature if enabled in the FREJA. There are two ways to determine if the unit has the IEC 61850 test capability enabled: First there is nameplate or a sticker on the back of the unit that will state "IEC 61850 ENABLED". The second way to determine if the unit has been enabled is to power up the unit and go to the Configuration Screen in RTMS and it will either state IEC 61850 ENABLED or DISABLED. The IEC 61850 GOOSE test feature can be enabled by the customer in the field by purchasing the IEC 61850 GOOSE license upgrade kit, part number 1001-044. The kit will include an IEC 61850 GOOSE license certificate, with a unique 32-digit code number assigned specifically to the unit (requires the customer to provide the unit serial number when ordering the kit). The kit also includes step-by-step instructions on how to enable the feature with the 32-digit code.

FREJA IEC 61850 Sampled Values license upgrade kit – The IEC 61850-9-2LE Sampled Values test feature is a hardware enabled option. The IEC 61850-9-2LE Sampled Values test feature can be enabled by the customer in the field by purchasing the FREJA IEC 61850-9-2LE Sampled Values License Upgrade Kit, part number 88695. The kit will include an IEC 61850-9-2LE Sampled Values License Certificate, with a unique 32-digit code number assigned specifically to the unit (requires the customer to provide the unit serial number when ordering the kit). The kit also includes step-by-step instructions on how to enable the feature with the 32-digit code.

FREJA IEC 61850 GOOSE and IEC 61850-9-2LE Sampled Values hardware upgrade kit – The IEC 61850 GOOSE the IEC 61850-9-2LE Sampled Values test feature is a hardware enabled option. The IEC 61850 GOOSE and IEC 61850-9-2LE Sampled Values test feature can be enabled by the customer in the field by purchasing the IEC 61850 GOOSE and FREJA IEC 61850-9-2LE Sampled Values hardware upgrade kit, part number 88696. The kit will include IEC 61850 GOOSE and IEC 61850-9-2LE Sampled Values license certificates, with unique 32-digit code numbers assigned specifically to the unit (requires the customer to provide the unit serial number when ordering the kit). The kit also includes step-by-step instructions on how to enable these features with the 32-digit code.

FREJA Low-level hardware upgrade kit – The low-level hardware upgrade kit, with a unique 32-digit code number assigned specifically to the FREJA unit when ordered (requires the customer to provide the unit serial number when ordering the kit). This will enable the low-level Rogowski feature to be used with the MLLA to test relays with Rogowski inputs provided the hardware revision in the FREJA is 3.51 or higher.

Note: For the upgrade of FREJA units with hardware revision older than 3.51, please contact your local Doble-Megger sales representative as the unit will have to be returned to Doble-Megger or an ASC for the upgrade and calibration.

FREJA 546R
Relay Test System

TEST LEADS AND ACCESSORIES

All units are supplied with a power cord, an Ethernet communication cable, and instruction manual on a USB stick.

INCLUDED STANDARD ACCESSORIES	
Description	**Part number**
Power Cord - Depending on the style number, the unit will be supplied with one of the following:	
Line cord, North American	620000
Line cord, Continental Europe with CEE 7/7 Schuko Plug	50425
Line cord, International colour-coded wire	15065
Line cord, United Kingdom	90002-989
Ethernet cable for interconnection to PC, 210cm (7 ft.) long (Qty. 1 ea.)	90003-684
Instruction manual USB	80989

TABLE OF ACCESSORIES

Test leads and accessories are supplied with the selection of the test leads option. With the test leads option, the number and type of leads varies depending on the unit that is ordered. Test leads and accessories can be ordered individually, see part numbers below.

	DESCRIPTIONS OF TEST LEADS AND ACCESSORIES	Qty.	Part No.
	**Accessory carry case:** Used to carry power cord, ethernet cable, optional STVI, test leads and accessories.	1	2003-725
	**Sleeved pair of test leads:** Sleeved test leads, one **red**, one **black**, 200 cm (78.7") long, 600 V, 32 A CAT II	4	2008-539-2
	**Cable/spade lug adapter (small):** Small lug fit most new relay small terminal blocks. Lug adapter, **red**, 4.1 mm, rated up to 1000 V/20 A CAT II	14	684004
	**Cable/spade lug adapter (small):** Small lug fit most new relay small terminal blocks. Lug adapter, **black**, 4.1 mm, rated up to 1000 V/20 A CAT II	14	684005
	**Jumper lead:** Jumper lead, **black**, 12.5 cm (5 in) long, use with voltage/current outputs, 600 V, 32 A CAT II	4	2001-573
	**Sleeved combination voltage test leads:** Three common leads connect to the test set, which are interconnected to one black common to connect to the relay. Sleeved, three **red** and **black**, 200 cm (78.7 in) long, 600 V, 32 A CAT II*	1	2008-540-2
	**Sleeved combination current test leads:** Three pairs of leads connect to the test set, and to the relay under test. Sleeved, three **red** and **black**, 200 cm (78.7") long, 600 V, 32 A CAT II*	1	2008-541-2

FREJA 546R
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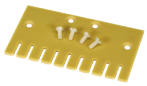
OPTIONAL TEST LEADS AND ACCESSORIES (NOT INCLUDED IN THE FREJA 546R TEST LEAD OPTION)

Optional test leads and accessories can be ordered individually, see description and part numbers below. **The following accessories and part numbers are in quantities of 1 each. Order the appropriate number required.**

	DESCRIPTIONS OF OPTIONAL TEST LEADS AND ACCESSORIES	Qty.	Part No.
	**Individual (non-sleeved) test leads:** Excellent for widely separated individual terminal test connections. Test lead, **red**, use with voltage/current output, or binary I/O, 200 cm long (78.7 in) 600 V/32 A CAT II.	1	620143
	Individual (non-sleeved) test leads: Excellent for widely separated individual terminal test connections. Test lead, **black**, use with voltage/current output , or binary I/O, 200 cm long (78.7 in) 600 V/32 A CAT II.	1	620144
	**Individual (non-sleeved) extra-long lest leads:** Excellent for widely separated individual terminal test connections. Extra-long test lead, **black**, use with voltage/current output, or binary I/O, 360 cm long (12 ft) 600 V/ 32 A CAT II.	1	2003-172
	Individual (non-sleeved) extra-long test leads: Excellent for widely separated individual terminal test connections. Extra-long test lead, **red**, use with voltage/current output, or binary I/O, 360 cm long (12 ft) 600 V/ 32 A CAT II.	1	2003-173
	**Cable/spade lug adapter (large):** Large spade lug fits older relay terminal blocks, or STATES® Company FTP10 or FTP14 test paddles, ABB, or General Electric test plugs with screw down terminals. Lug adapter, **red**, 6.2 mm, use with test leads up to 1000 V/20 A CAT II.	1	684002
	Cable/spade lug adapter (large): Large spade lug fits older relay terminal blocks, or STATES® Company FTP10 or FTP14 Test paddles, ABB, or General Electric test plugs with screw down terminals. Lug adapter, **black**, 6.2 mm, use with test leads up to 1000 V/20 A CAT II.	1	684003
	**Alligator/crocodile clip:** Excellent for test connections to terminal screws and pins where spade lugs cannot be used. Alligator clip, **red**, use with test leads up to 1000 V/32 A CAT III.	1	684006
	Alligator/crocodile clip: Excellent for test connections to terminal screws and pins where spade lugs cannot be used. Alligator clip, **black**, use with test leads up to 1000 V/32 A CAT III.	1	684007
	**Flexible test lead adapter with retractable insulated sleeve:** Use for connection to old style non-safety sockets with retractable protective sleeve on one end. Retractable sleeve test lead, **red**, 50 cm (20 in) long, use with test leads up to 600 V/32 A CAT II.	1	90024-780
	Flexible test lead adapter with retractable insulated sleeve: Use for connection to old style non-safety sockets with retractable protective sleeve on one end. Retractable sleeve test lead, **black**, 50 cm (20 in) long, use with test leads up to 600 V/32 A CAT II.	1	90024-781
	Flexible test lead adapter: Use with rail-mounted terminals or screw clamp connections where spade lugs and crocodile/alligator clips cannot be used. Flexible test lead adapter, **black**, 1.8 mm male pin, use with test leads up to 1000 V/32 A CAT III.	1	90001-845
	**Parallel test lead adapter:** Used when paralleling up to three current test leads together to a common test point. Usually used when connecting to a test paddle (like the pictured States Company test paddle.)	1	1002-286
	**RLC, Relay Lead Connector:** Excellent for easily connecting three-phase voltage and current leads to the test system. Two sets of test leads (one for voltages and one for currents), sleeved, 4 mm (0.16 in) terminals with retractable safety shrouds, colour coded **red**, **yellow**, **blue**, **black**, 200 cm long (78.7") 600 V/ 32 A CAT II	1	RLC
	**Arc Flash Simulator:** The Doble-Megger arc flash simulator provides a focused high-intensity bright white light to simulate an arc flash for testing arc flash protection relays and systems.	1	AFS
	**Doble-Megger Low Level Adapter (Set of three filters):** The MLLA provides filtering of the low-level outputs from the latest version[2] of voltage/current generators in the Doble-Megger FREJA series test sets. It also provides the interface from the low-level outputs to the device under test using appropriate interface cables. **For individual filters and interface cables, see the MLLA datasheet**.	Set of three filters	MLLA

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DESCRIPTIONS OF OPTIONAL TEST LEADS AND ACCESSORIES	Qty.	Part No.
	**Doble-Megger GPS timing reference:** The MGTR is a small, lightweight, field portable, GPS satellite receiver system specifically designed to perform end-to-end tests of line protection schemes. The unit comes with a GPS Antenna, power supply, and a stainless-steel antenna mount. Cable length depends on the ordering part number.		
	GPS Timing Reference Model MGTR-III, with 50 Ft. Cable	1	MGTR-III-50
	GPS Timing Reference Model MGTR-III, with 100 Ft. Cable	1	MGTR-III-100
	**STATES® 10-pole test paddle:** Use with STATES FMS test switch or ABB FT-1 10-pole test switch. Easy to insert • Straight front connect • Accepts standard, safety, and retractable banana jacks • Replaceable isolator kit	1	JTP10
	**STATES® Replaceable isolator:** Use with STATES® 10-pole test paddle	1	TP750
	**STATES® Test paddle kit:** JTP10 Test Paddle • 150 lb I Probe, 15000, leads w/Red and Black Banana Jacks • Lead Test Safety 200 cm MC Red • Lead Test Safety 200 cm MC Black • Lug Adapter Cable 6.2 mm Red • Lug Adapter Cable 6.2 mm Black • Twisted Red and Black test lead wire • Kit Bag	1	JTPKIT
	**Hard-sided transit case for F546R:** Includes custom designed foam inserts for the FREJA unit and accessory case. Transit case includes retractable handle, polyurethane wheels with stainless steel bearings, double-throw latches, fold down handles, and stainless steel hardware and padlock protection, with O-ring seal making the case water-tight, with an IP 67 rating. Tested and certified to US Department of Defense Standards for impact, vibration, and low/high storage temperatures. The case is small, and weighs only 25 pounds (11.25 kg).	1	1017-263

[1] Doble-Megger reserves the right to change product specifications at any time.
[2] Requires VIGENS with hardware version 3.5.1 or higher.
[3] For the ability to test relays with low level inputs by simulating signals from non-conventional CTs and VTs with low level interfaces, i.e., Rogowski coils will require the Doble-Megger MLLA (Low Level Adapter).
[4] PowerV™ voltage amplifier output current varies depending on the voltage setting on the 150 Volt range, see curve.

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FREJA_546R_DS_EN_V05

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