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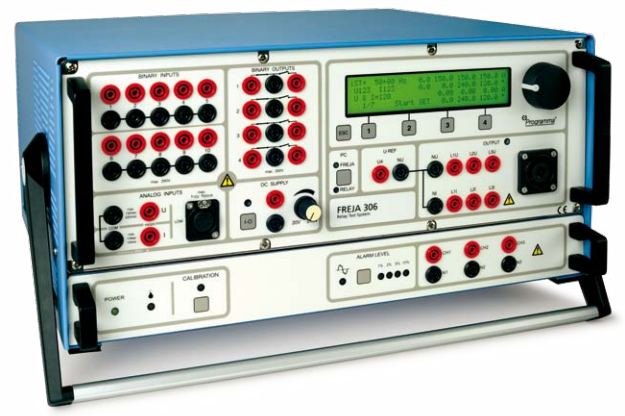
FREJA 306
Relay Test System



- **Manual and PC remote control**
- **Easy to use**
- **Excellent software provides great visuals and simple setup**
- **High performance amplifiers**
- **Lightweight and portable**
- **User can calibrate the unit**

Description

FREJA™ 306 is the latest member of the relay testing equipment from Megger, quick and easy to use, like the FREJA 300. The rugged hardware design is built for field use over a wide temperature range, with the possibilities of intelligent software to perform rapid testing.

FREJA 306 can be operated with or without a PC. After being put into the Local mode, FREJA 306 can be used stand-alone without a PC. Using the Local mode is easy.

FREJA 306 is an excellent choice when you want more current outputs, higher amps (3 x 15 A + 3 x 35 A), VA or compliance voltage. Use it to test differential relays with 6 currents, or virtually any single or 3-phase relay.

When testing 1-phase relays, you can make use of either the high current (over 100 A), or the very high compliance voltage. This now makes it possible to test high impedance relays of different kinds, like rotating disc relays, earth protection relays, etc.

FREJA 306 can also be used as a disturbance simulator and create and generate simulated disturbances, or import actual recorded disturbances from e.g. EMTP or COMTRADE files.

With the built-in DC source you can directly supply the protection relay.

With use of the GPS receiver accessory, GPS200 – MGTR, several FERJA 306 can be synchronized to perform end-to-end testing with the test sets allocated in different substations.

A FREJA 300 can be upgraded to a FREJA 306.

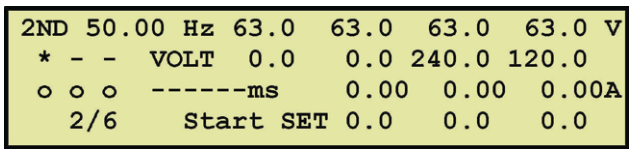
Application

FREJA 306 is intended primarily for secondary testing of protection relays. Virtually all types of protection relays can be tested.

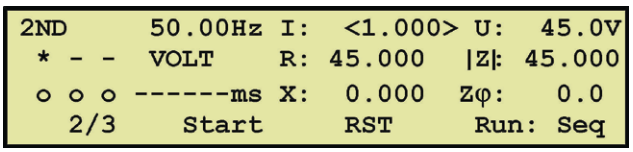
Examples of what FREJA 306 can test	ANSI® No.
Distance protection relay	21
Synchronising or synchronism-check relays	25
Undervoltage relays	27
Directional Power relays	32
Undercurrent or underpower relays	37
Negative sequence overcurrent relays	46
Overcurrent-/ ground fault relays	50
Inverse time overcurrent-/ ground fault relays	51
Power factor relays	55
Overvoltage relays	59
Voltage or current balance relays	60
Directional overcurrent relays	67
DC overcurrent relays	76
Phase-angle measuring or out-of-step protection relays	78
Automatic reclosing devices	79
Frequency relays	81
Differential protection relays	87
Directional voltage relays	91
Voltage and power directional relays	92

Local Mode - without PC

Using the dial by turning and clicking it is easy to make the settings. All settings are saved automatically when you exit, but if you prefer you can assign the settings a name and save them separately for convenient access when you conduct your next test. The display can also show the measured value that is being generated. This feature is equivalent to three voltmeters and three ammeters that present RMS values for all generators.



Local Mode General



Local Mode Rx (I)

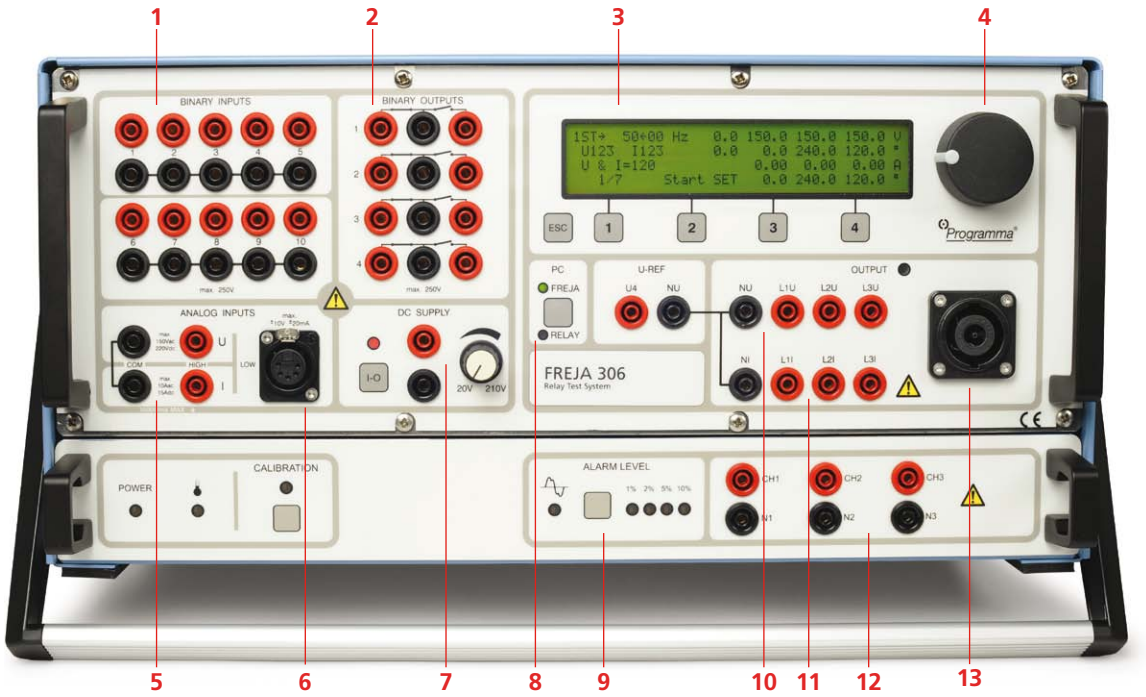
With a PC - FREJA Win

There are a number of instrument programs. You start the different programs at the Control center, where you also save and recall results. Since the test set-ups/results are saved via a regular Microsoft® Explorer display, you can create your own test object structures.

For FREJA Win there is no longer any license file needed and no license keys for the FREJA test sets. Once installed on your PC you can freely control any FREJA test set.

Features and benefits

1. Binary inputs – Response-time compensated
2. Binary outputs – Operating-time compensated
3. Display and buttons used in the Local Mode.
4. Dial, press to Enter.
5. Analog inputs, HIGH, for volt- and ammeter
6. Analog inputs, LOW, for measurement transducers
7. DC-supply, connect to (12) to read the values
8. Switch, PC to FREJA 300/306 or relay
9. Distortion alarm
10. Voltage outputs – Standard
11. Current outputs – Standard
12. Current outputs – High-end
13. Multiconnector for voltage (L1U, L2U, L3U, NU) and current (L1I, L2I, L3I, NI).



FREJA Win

In FREJA™ Win, the all-round General instrument program serves as a convenient, easy to understand, user-friendly toolbox. On the Connect page, you can enter information about how to connect the relay, including pictures if so desired.

On the Sequence page, you can vary all generator parameters independently. You can have up to 25 different states (prefault, fault1, prefault, fault2, prefault, fault3 etc.). This is useful when testing autoreclose relays or motor protection. It's also possible to generate up to the 25th harmonic.

On the Ramp page, you can ramp all generator parameters independently. Amplitudes and angles are shown on a vector diagram, and values can be set using the knob on FREJA or the PC keyboard and mouse, on-line as well.

Distance instrument

Configuration page

The Distance instrument program is designed to test distance relays. On the Configuration page, you enter the number of zones that are to be tested and also the time and impedance tolerances, thereby creating an automatic test. No programming is needed. Later, when you recall this object via the Control center, all settings are re-established so that you can start testing immediately.

Connect page

On the Connect page you enter information about how to make connections to the relay, including pictures if so desired. Since this information is saved together with the object in the Control center, it can be displayed again the next time you want to test this relay.

Zt page

The Zt page is designed for time testing of a distance relay. Normally, you test one type of fault at a time when testing relays. With FREJA Win, however, you can test all seven fault types automatically if so desired. All you have to do is press the <Start> button. FREJA will test all seven fault types automatically and then compare the readings with the theoretical values that you entered on the Configuration page. If the readings are OK, a green lamp lights. If not, a red lamp lights. If you want to check the reverse direction, the test can start below zero ohms in the 3rd quadrant.

Control center

RX-ramp page

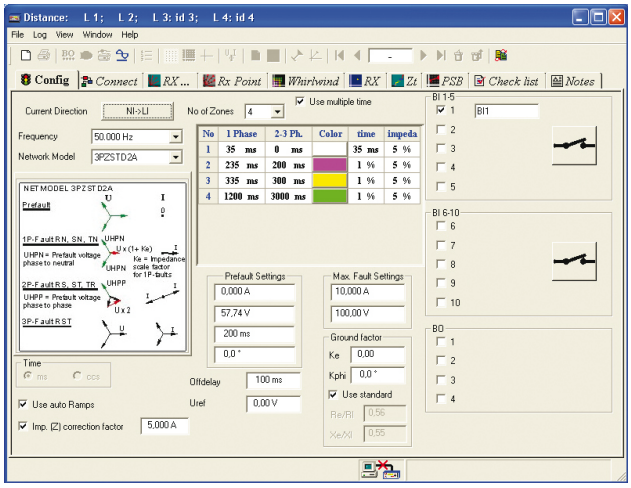
The RX-ramp page, which is part of the Distance instrument program, is designed to test the reach of a distance relay. First, you define the start and stop angles and the delta phi between the ramps. Then press the <Start> button and relax. FREJA will automatically test all seven types of faults using the timesaving "search-half" method. You can also define your own ramps, using the mouse to specify starting and ending points wherever desired. If you have defined a theoretical reference graph, the program will compare the actual test result with your graph and check for any deviations from the tolerances entered on the Configuration page. If the results are OK, a green lamp lights. If not, a red lamp lights.

RX page

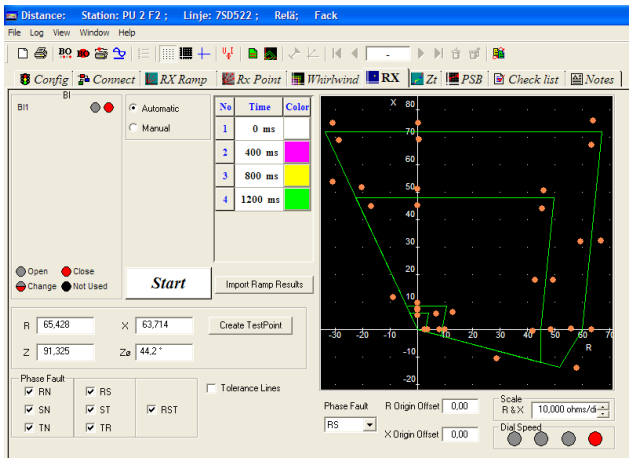
The RX page enables you to define test points manually. You can define different points on the oscilloscope using the mouse or keyboard. Select the automatic mode and press the <Start> button. FREJA will test all points for the selected fault types. The points will be assigned different colors, depending on the trip time. If you select the manual mode, you can use the dial to search for a boundary.

Reference graphs

Efficient testing and performance analysis require well-defined reference values. FREJA can automatically create the IEC and



Distance, Config



Distance, Rx

IEEE® standard curves for overcurrent relays. It is also possible to create reference graphs in the impedance plane using the included library of distance relays made by major manufacturers and/or create other characteristics using the standard circular lens and linear elements (including mho, quadrilateral and ice-cream cone shapes).

The cut and paste buttons make it easy to take copies of the first zone and then edit these copies by inserting zone 2 and zone 3 values.

State-of-the-art distance relays having sophisticated impedance characteristics and several setting groups require many parameter settings. The optional ProGraph feature enables you to import the parameter settings from a master selectivity plan prepared in Microsoft® Excel. This eliminates manual transfer errors, and the FREJA software creates the reference graph automatically.

Some relay manufacturers can create a RIO-file with the settings of the relay. Using the FREJA RIO-converter you can create reference graphs based on these settings.

A feature is the ready-made current curves available for many relay types.

Current instrument

The Current testing instrument is designed to test all types of current relays, from electro-mechanic with or without an induction disc to modern numerical relays.

The Config page is where the relay settings will be entered.

In the Pick-up page the system will not just get the pick-up value (start current) but also the drop out and it will also calculate automatically the hysteresis.

The time test, check the trip time at different current values, will be done in the Time test page. A reference curve can be created in the same way as in Distance, by choosing the corresponding time curve and entering the settings. The time test can be run also in a logarithmic scale, time, current or both.

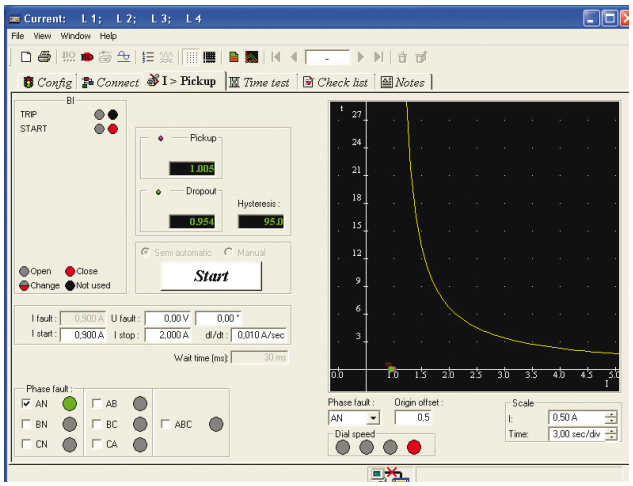
Voltage instrument

The Voltage testing instrument is designed to test all types of voltage relays, from electro-mechanic to modern numerical relays.

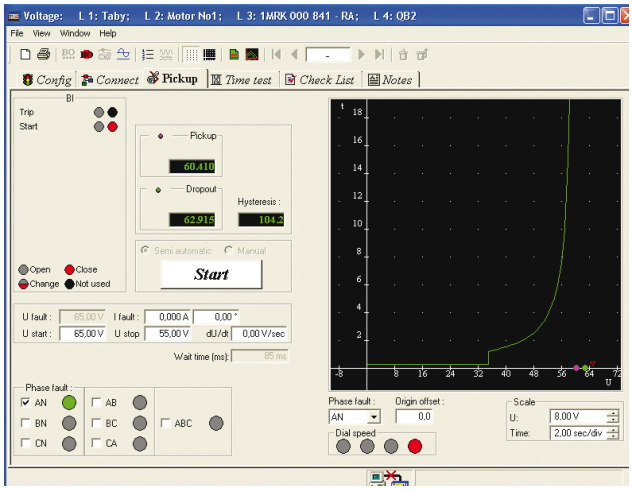
The Config page is where the relay settings will be entered.

In the Pick-up page the system will not just get the pick-up value (start voltage) but also the drop out and the hysteresis will be calculate automatically.

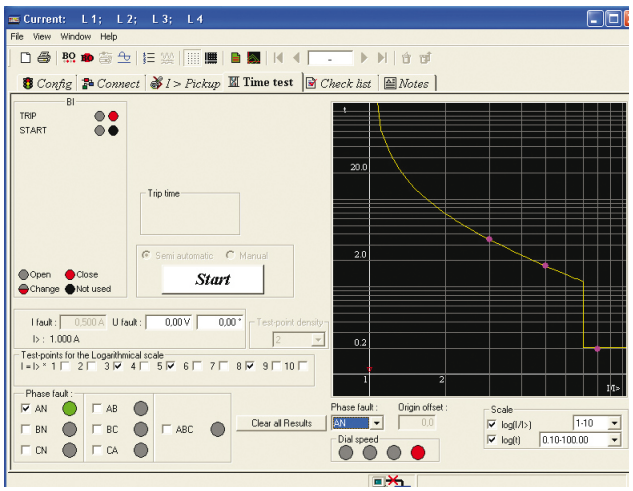
The time test, check the trip time at different voltage values, will be done in the Time Test page. A reference curve can be created in the same way as in Distance, by choosing the corresponding time



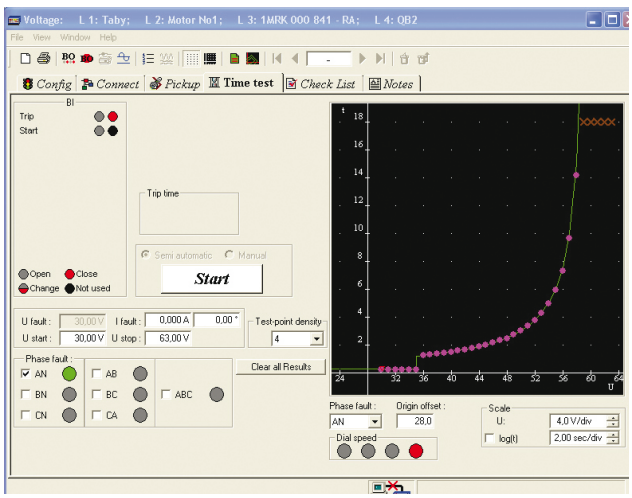
Current instrument, Pick-up



Voltage instrument, Pick-up



Current instrument, Time test



Voltage instrument, Time test

curve and entering the settings. The time test can be run also in a logarithmic scale, time, current or both.

Frequency instrument

In the Frequency instrument a pre-fault an fault frequency can be generated manually in Manual page as well as an automatic sequence of pre-fault, fault, from a set start value to set stop value to Scan the trip time at different frequency values, useful for relays with two stages.

The Ramp mode will find the set fault frequency.

Autoreclose instrument

The Autoreclose instrument is a combination between Sequence in General and RX in Distance. This is just because it is easier to simulate pre-fault, energizing and dead times as vectors and in the same way it is easier to simulate a fault in a impedance plane.

This instrument will test any autorecloser function on today's modern relays.

Auto 300

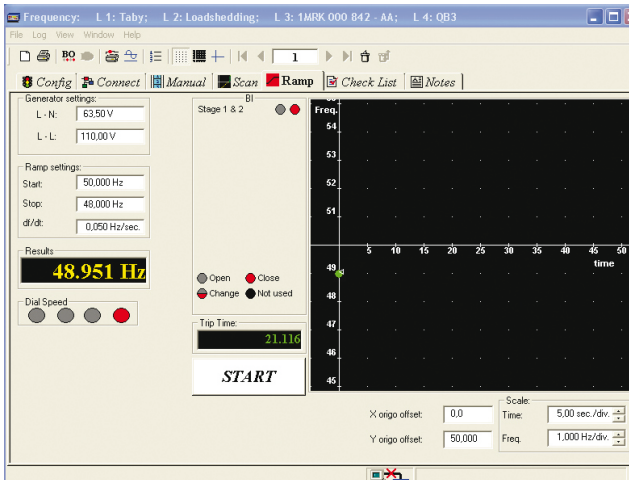
If we take as an example a modern distance relays has several functions activated, besides the distance elements.

By using Auto 300 we can link together different tests made in different instruments, to create an automatic test sequence, so at the end we will have on test containing elements from Distance, Current, Sync and Voltage, for example.

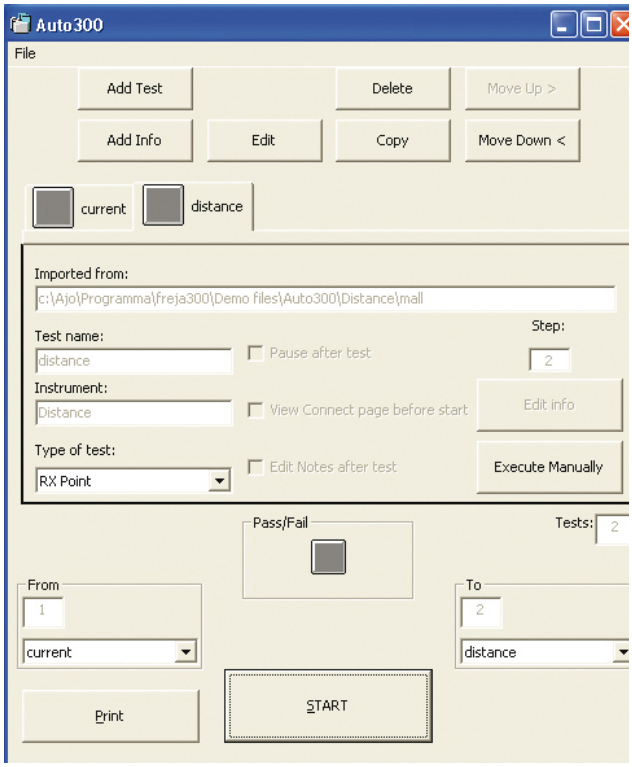
Transducers instrument

The Transducers instrument will test any transducers by checking the output of the transducers and compare it to the settings made in Config.

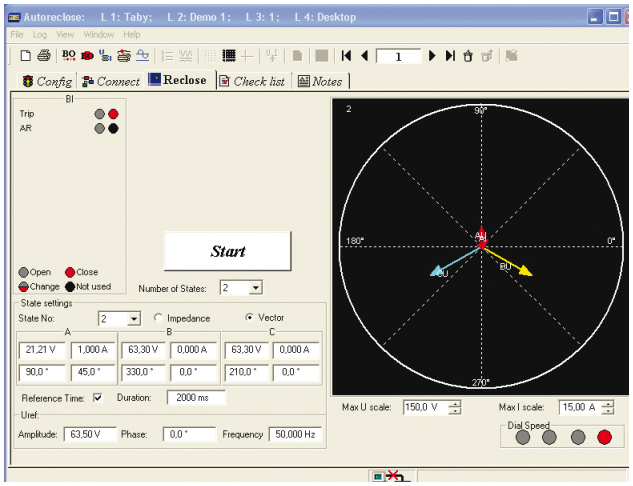
The result will be showed in linear format, full scale, relative and absolute error.



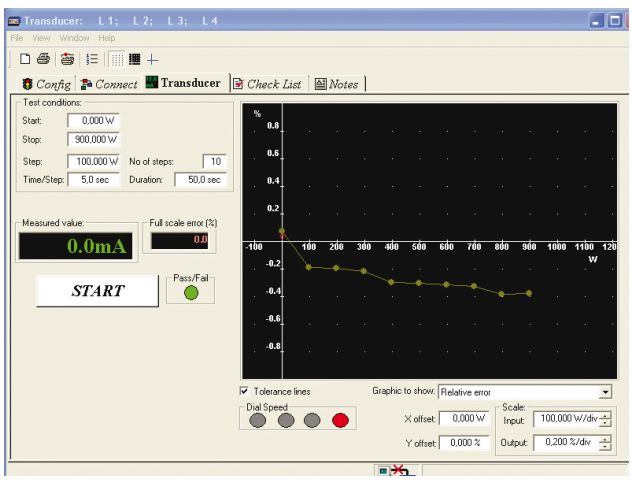
Frequency instrument, Ramp



Auto 300



Autoreclose instrument



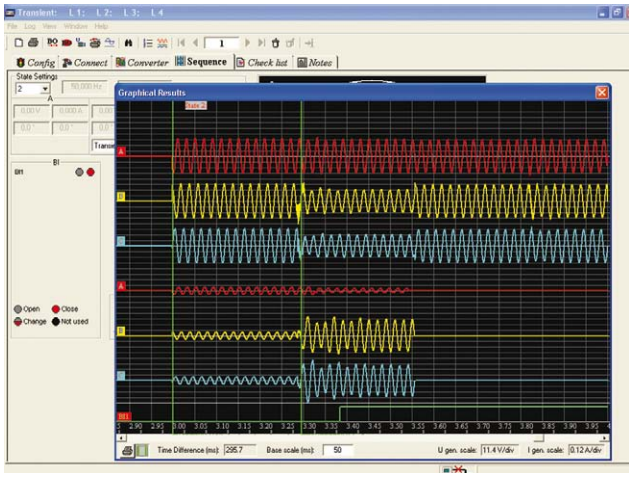
Transducers instrument

Transient instrument

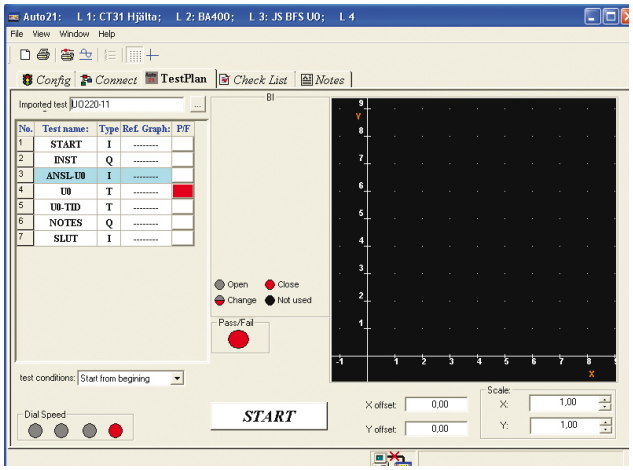
With the help of Transient, Freja will generate (playback) a waveform recorded by a disturbance recorder. The file formats supported by Transient are COMTRADE, ASCII, EMTP WAX, EMTP PC and Inductic 65.

Auto 21

Auto 21 is a converter that will convert old test plans made with Freja 21/21D and using Freja DOS software, to a Windows compatible format that ken be used together with FrejaWin and Freja.



Transient instrument



Auto 21 instrument

Sync instrument

U-f Min & Max

The U-f Min & Max part of the Sync instrument program is designed especially to test voltage and frequency boundaries for a synchronizing relay. This test is carried out automatically. Simply press the <Start> button, whereupon the program itself searches for the boundaries.

Synchronizing page

The Synchronizing page is designed to measure lead-time. It also enables you to measure the pulses sent out from the synchronizing relay.

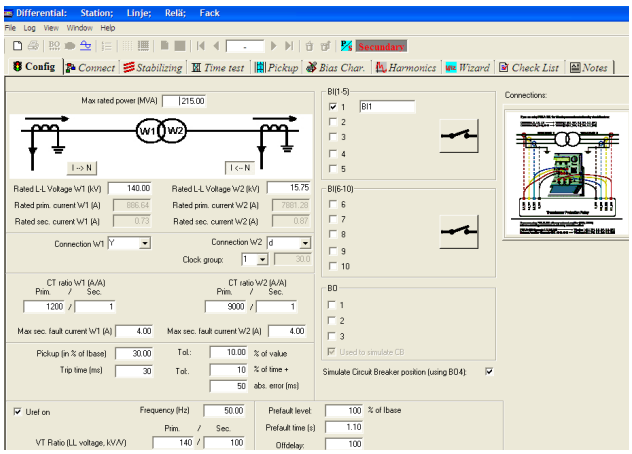
Synchro Check page

The Synchro Check page is designed to test synchrocheck relays.

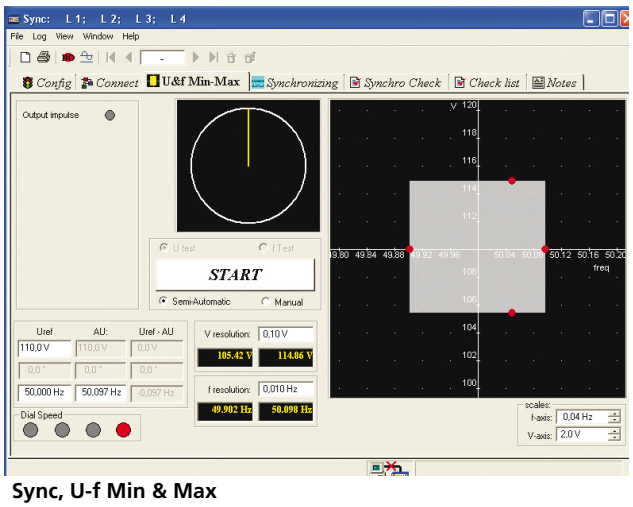
First set the phase angle to +20° (or some other starting point). Then change the phase angle until you reach the boundary. You press the <Save> button to store the result. Now test on the other side, starting at -20°, change the phase angle until you reach the other boundary.

Differential instrument

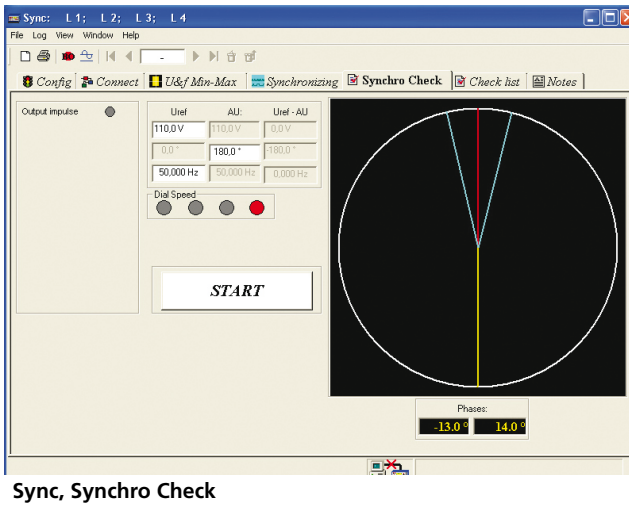
The Differential instrument is designed to test transformer protection relays and works with FREJA 306 or with FREJA 300 together with external amplifiers CA30 or CA3, as it makes use of 6 current generators.



Differential instrument



Sync, U-f Min & Max



Sync, Synchro Check

It can be used to test multi winding transformer protection relays, by testing a pair of windings at a time.

FREJA Differential can also be used to test differential generator protection relays and line differential protection relays.

The data for the protected power transformer are entered in a very intuitive way that cannot be misunderstood by the user. This is done by using buttons and icons that immediately show to the user the effect of his choices. The injected currents are shown both in primary and secondary values, depending on the entered current transformers information and star point earthing.

The Stabilizing page has the purpose of verifying that the connections and settings in FREJA are correct by generating external faults and verifying that the relay is stable. The operator is also requested to read the measured values by the relay and enter them in the test page. The values will then be reported in the final report.

The Time Test page allows to verify the operate time of the differential relay. Several fault injections can be programmed and the page reports the statistics of the measured operate times (minimum, maximum and average values).

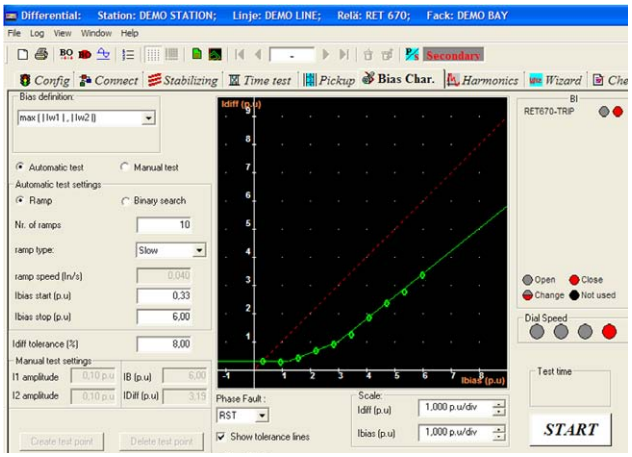
The Pick-up page allows the test of the minimum operating current of the differential relay for each winding, which is a test on the sensitivity of the relay. This test also makes use of pseudo-continuous ramp injections.

In the page Bias Characteristic it is possible to test the operating relay characteristic by running pseudo-continuous ramps (for testing the static accuracy of the relay) or ramps done by sequences of pre-fault and fault steady state simulations, called as “binary search”, more suitable for commissioning tests. The characteristic can be tested with or without making use of the reference graph.

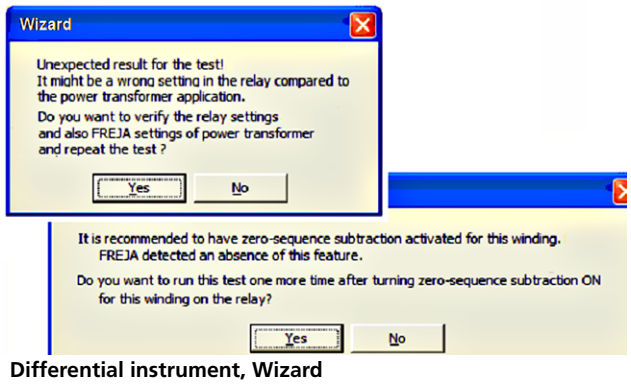
The Harmonics page verifies the relay capability of not issuing the trip signal for faults in the trip area of the restrained characteristic, when a certain level of harmonics is present in the fault currents, for each winding of the power transformer. The purpose of this feature is to keep the relay stable during transformer energising or during transformer overexcitation

A very important test, introduced by Programma for the first time, is called Wizard. It will help discovering wrong settings for the differential transformer relays that might cause unwanted trip for external ground faults.

The Wizard will ask important and clear application questions to the relay engineer and will perform some simple tests on the relay in a semi-automatic manner. Depending on the application information entered by the user, the Wizard will report if the relay seems to be correctly set or not with a clear information to the user.



Differential instrument, Bias Char.



Differential instrument, Wizard

Specifications FREJA 306

Specifications are valid for resistive load, nominal voltage supply and ambient temperature +25°C ±3°C, (77°F ±5.4°F) after 30 minutes warm up time. All hardware data are for full scale values. Specifications are subject to change without notice.

Environment

Application field	For use in high-voltage substations and industrial environments.
Temperature	
Operating	0°C to +50°C (32°F to +122°F)
Storage & transport	-40°C to +70°C (-40°F to +158°F)
Humidity	5% – 95% RH, non-condensing
Altitude (operational)	3000 m Full duty cycle up to 2000 m. Duty cycle limitation based on internal over temperature protection for altitudes >2000 m.

CE-marking

EMC	2004/108/EC
LVD	2006/95/EC

General

Mains input (nominal)	100 – 240 V AC, 50–60 Hz
Power consumption	1200 VA + 1500 VA (max)
Dimensions	
Instrument	450 x 224 x 410 mm (17.7" x 8.8" x 16.1")
Transport case	610 x 345 x 660 mm (24" x 13.6" x 26")
Weight	
Instrument	23 kg (50.7 lbs)
Transport case	12 kg (26.4 lbs)
Display	LCD
Available languages	English, French, German, Spanish, Swedish

Measurement section

Binary inputs

Number	10 Inputs (2 groups of 5 independent)
Type	Dry or wet contacts 275 V DC, 240 V AC Response-time compensated
Internal resolution time	50 µs
Galvanic isolation	Galvanically separated from the amplifier section. Two galvanically separated groups: 1 to 5 and 6 to 10
Max measuring time	15264 h (636 days)

Range	**Resolution**
0 - 9.9 ms	0.1 ms
10 ms - 60 min	1 ms
1 h - 15264 h	1 s

DC current measuring input, LOW

Measuring range	±20 mA
Resolution	SW 0.1 µA HW 0.6 µA
Inaccuracy	0.01% typical, 0.03% guaranteed (= 6 µA)

DC voltage measuring input, LOW

Measuring range	±10 V
Resolution	SW 0.1 mV HW 0.3 mV
Inaccuracy	0.01% typical, 0.03% guaranteed (= 3 mV)

AC / DC current measuring input, HIGH [1)]

Measuring range	±14 A DC, 10 A AC_{RMS}
Inaccuracy	DC <0.1%, AC <0.3%

AC / DC voltage measuring input, HIGH [1)]

Measuring range	±220 V DC, 150 V AC_{RMS}
Inaccuracy	DC <0.05%, AC <0.2%

Measurement, internally generated values

Inaccuracy	
Voltage AC / DC	<1% ±1digit
Current AC / DC	<2% ±2digit

Binary outputs

Number	2 x 4 (NO & NC)
Type	Zero-potential contacts, controlled via software Response time compensated
Break capacity AC	240 V AC, max 8 A, max load 2000 VA
Break capacity DC	275 V DC, max 8 A, max load 240 W

Low level outputs (Rogowski option)

Setting range	
LLU	3 X 0...2 V_{RMS}
LLI	3 X 0...2 V_{RMS}
Max. output current	5 mA
Inaccuracy	<0.1% typ. (<0.2% guaranteed)
Resolution	250 µV
Distortion (THD+N) [2)]	<0.05% typ. (<0.1% guaranteed)
Max. generating time	5 minutes

Generator section

Voltage outputs

Range	
4-phase AC	4 x 150 V
1-phase AC (L-L)	2 x 300 V
DC (L-N)	180 V
Power	
3-phase AC	3 x 82 VA at 150 V
1-phase AC (L-L)	1 x 140 VA at 300 V
DC (L-N)	87 W
Resolution	
SW	10 mV
HW	6.5 mV
Inaccuracy [3)] (guaranteed)	(±0.01% of range) + (±0.05% of reading)
Distortion (THD+N) [4)]	0.02% typical (0.04% max)

Current outputs

Standard outputs – L1I, L2I, L3I

Range	
3-phase AC	3 x 15 A
1-phase AC [2]	1 x 45 A
DC (L-N)	15 A
3-channel DC	–
Power	
3-phase AC	3 x 87 VA
1-phase AC [2]	1 x 250 VA
DC (L-N)	3 x 87 W (max)
Resolution	
SW	1 mA
HW	0.65 mA
Inaccuracy [3] *(guaranteed)*	(±0.01% of range) + (±0.3% of reading)
Distortion (THD+N) [4]	0.1% typical (0.2% max)

High-end outputs – Ch1, Ch2, Ch3

Voltage transients - Immunity	2500 V transient level (to chassis) + working voltage level (255 V)
Working voltage	255 V Not to be used on live circuits
Application	
3-phase AC (per phase)	250 VA, 5 A < I ≤ 25 A 200 VA, 25 A < I ≤ 30 A 150 VA, 30 A < I ≤ 35 A
1-phase AC (3 ch. in parallel)	750 VA, 15 A < I ≤ 75 A 600 VA, 75 A < I ≤ 90 A 450 VA, 90 A < I ≤ 100 A
3-ch. DC	3 x ±20 A
Compliance voltage	≤50 Vrms
Time limits	
Continuous	3 x 20 A, 150 VA (max)
0.5 s on 1 s off repeatedly	3 x 35 A
Resolution	1.6 mA
inaccuracy[5] *typical*	< 0.3% (of reading), 0.5 A < I ≤ 35 A < 8 mA, 0 A < I ≤0.5 A
Phase inaccuracy[5]	< ±0.2°
Distortion (THD+N)[6]	< 0.4% typical

Generators, general

Frequency range	
Continuous signals	DC – 2000 Hz
Transient signals	DC – 3.5 kHz
Frequency resolution	1 mHz
Frequency inaccuracy	0.01%
Phase angle range	0 – 360°
Phase resolution	0.1°
Phase inaccuracy [3]	±0.1°
Connection (Amplifier outputs)	4 mm stackable safety plugs or 8-pin amplifier multiconnector

All seven generators are continuously and independently adjustable in amplitude and phase. No switching of range is necessary. All current and voltage outputs are fully overload- and short-circuit-proof and protected against external high voltage transient signals and overtemperature.

Note! To allow continuous generation of high DC current (12–15 A), a minimum load impedance of 0.2 Ohm is required. For lower load impedances, e.g. short-circuit, the time is limited to 1 minute.

DC auxiliary voltage output

Range	20 – 210 V DC
Output power	75 W at 210 V

Other

On-line measurement of the current and voltage output, presented on the built-in display.

Calibration check when the temperature is changed. Full calibration can be conducted a any time using the FREJA calibration box. This means you do not need to send away FREJA for calibration. Only the calibration box needs to be sent for calibration once per year.

Connection to IBM compatible PC (minimum Pentium II 266 MHz, 32 Mb RAM, Win 95/98/2000/XP, NT 4.0) via the serial port.

1) 50 or 60 Hz AC + harmonics only.

2) THD+N: Values at 50/60 Hz, at max amplitude, 50% power and resistive load. Measurement bandwidth 22 Hz – 22 kHz.

3) For sinusoidal signals at 50/60 Hz.

4) Parallel connection.

5) Values at max amplitude, 50% power and resistive load.

6) THD+N: Values at 25 A, 125 VA.

Optional accessories

Multi cable

GPS200 – MGTR GPS unit with accessories

Test lead set

Calibration box

Ordering information

Item	Art. No.
FREJA 306 Complete with: FREJA Win, Two test lead sets, Hard transport case	CF-29091
Same as above but with soft transport case	CF-29090
FREJA 306 basic unit	CF-29001
FREJA 306, LLA Rogowski option Complete with: FREJA Win, Two test lead sets, Hard transport case	CF-29095
Same as above but with soft transport case	CF-29094
FREJA 306 Basic Unit, LLA Rogowski option	CF-29004
Optional	
FREJA Win Software	CF-90090
Rebuild FREJA 300 to FREJA 306	CF-90090
FREJA Win upgrade	CF-8282X
Optional accessories	
FREJA Multi-cable Shortens hookup time considerably. Consists of a multi-pole connector that connects to FREJA's three voltage and three current outputs, and a number of banana plugs that connect to the protection relay that is to be tested.	GA-00103

Item	Art. No.
Test lead set With touch-proof contacts. 2 x 0.25 m (0.8 ft) / 2.5 mm^2 2 x 0.5 m (1.6 ft) / 2.5 mm^2 8 x 2 m (6.5 ft) / 2.5 mm^2 Weight: 0.8 kg (1.8 lbs). Normally you need two sets.	GA-00032
Calibration box	CF-90100
GPS200 – MGTR The GPS receiver GPS200 – MGTR makes it possible to synchronize two or more FREJA to conduct end-to-end testing. End-to-end testing provides quick, reliable results showing how two or more protection relay systems interact. The unit comes with a 15 m (50 ft) cable and an allweather antenna. Longer cables can be ordered.	CF-90150
Cable organizer Velcro straps, 10 pcs.	AA-00100
Floor stand FREJA 300/306 For working in standing position with FREJA	GB-00300
IPS RELEX IPS RELEX is a database for relay protection. For more information please visit our web site or contact customer service relay protection department.	