



Power simulator MI 2191 Instruction manual *Version 1.0, Code No. 20 750 953*

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Mark on your equipment certifies that this equipment meets the requirements of the EU (European Union) concerning safety and interference causing equipment regulations

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Power simulator MI 2191

Main features:

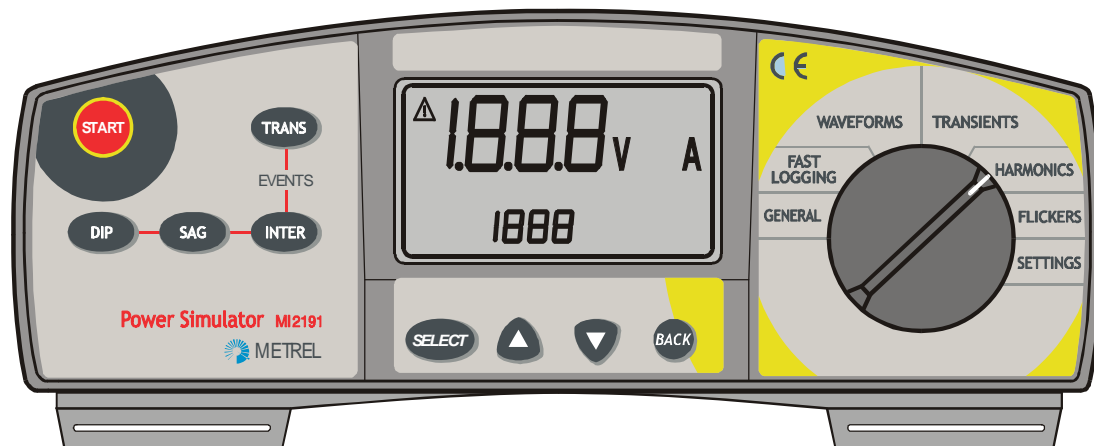
The MI 2191 one phase power simulator, simulates typical voltage and current shapes, including:

- Voltage and Current Harmonics
- Flickers
- Start up events, Inrushes
- Transients
- Dips and Sags
- Voltage interruptions
- Different load conditions
- etc.

Voltage events can be simulated in single, periodic or random mode
PC upgradeable

Section I General information

1. Front plate:



Rotary switch:

General	Simulation of typical one phase voltage and currents. Typical parameters can be selected and set in submenus.
Fast Logging	Simulation of typical voltage and current signals for presentation of Fast Logging function.
Waveforms	Simulation of typical voltage and current signals for presentation of Waveforms function.
Transients	Simulation of typical voltage signals for presentation of Transients function.
Harmonics	Simulation of typical voltage and current signals with different levels of harmonic components.
Flickers	Simulation of typical voltage and current signals with superponed fluctuations for presenting flickers
Settings	not used

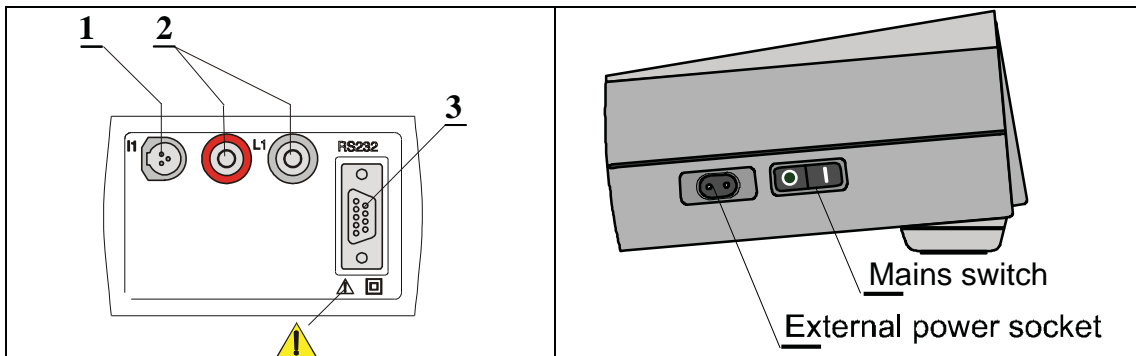
Display

custom type LCD

Keys

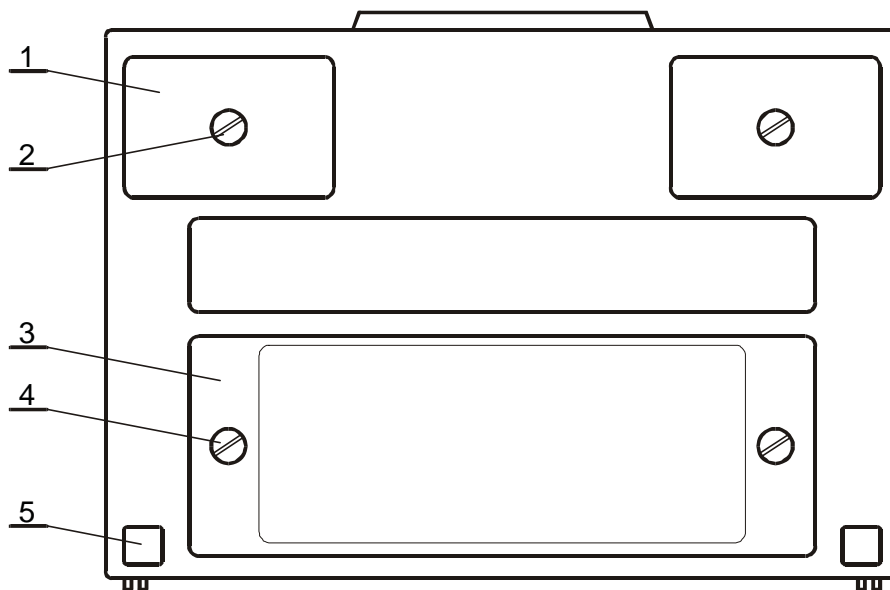
- START** - to begin/end simulation sequence
- DIP** – simulation of voltage dip
- SAG** - simulation of voltage sag
- INTER** – simulation of voltage interruption
- TRANS** – simulation of voltage transient
- SELECT** - to select parameter or voltage waveform
- Up/Down** – to set parameter
- BACK** – Return to initial simulation settings

2. Connectors



- 1. L1 Voltage output
- 2. I1 Current output
- 3. RS232 Communication port (for upgrading firmware only)

3. Bottom View



- 1 Plastic cover (fixes nylon strap to the instrument). There is a screw under this cover that must be unscrewed when opening the instrument for service or calibration purposes.
- 2 Screw (unscrew to remove carrying strap or to open the instrument).
- 3 Fuse compartment cover (view technical specifications).
- 4 Retaining screw (unscrew to replace blown fuse).
- 5 Rubber foot.

4. Power Simulator set

Power Simulator MI 2191
Power cord
Current measuring cable
Instruction Manual
List of warranty
Declaration of conformity

5. Warnings

- If the test equipment is used in a manner not specified in this Users Manual, the protection provided by the equipment may be impaired!
- Never use the simulator if other inputs are already in use on measuring instrument!
- The simulators outputs are not protected. Contact Metrel before connecting the device to any item other than Metrel's Power Quality Analyser, Power Harmonics Analyser or Voltscanner !
- Use original accessories only!
- Do not use the instrument and accessories if any damage is noticed!
- Disconnect all test leads and switch power off before opening Fuse cover!

6. Maintenance

Cleaning

To clean the surface of instrument, use a soft cloth slightly moistened with soapy water or spirit. Then leave the instrument to dry totally before use.

- Do not use liquids based on petrol or hydrocarbons!
- Do not spill cleaning liquid over the instrument!

Service, Upgrading

For repairs under warranty or possible upgrading please contact METREL.

Manufacturer's address:

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SI-1354 Horjul
Tel.: +386 1 755 82 00
Fax.: +386 1 754 92 26
<http://www.metrel.si>;
[E-mail:metrel@metrel.si](mailto:metrel@metrel.si)



The Instrument contains no user serviceable parts. Service must only be carried out only by an authorized dealer

Section II Technical specifications

Voltage output

Port: L1

Output voltage (peak to peak): -400 to 400V, arbitrary, AC type

Max.output power: 3W

Output resistance: ca. 1,8k Ω

Frequency: 50/60 Hz

Resolution: 8 bits

Accuracy: $\pm(5\%+10V)$

Current output

Port: I1

Output (peak to peak) voltage: -2 to 2V, arbitrary

Output resistance: ca. 320 Ω

Frequency: 50/60 Hz

Resolution: 8 bits

Accuracy: $\pm(5\%+0.05V)$

General

Power supply: AC 115V / 230V, 50Hz / 60Hz, 12VA, contact METREL for selected option

Fuses:

F1: T200mA 250V 5x20 - **POWER SUPPLY PROTECTION**

F2: T1000mA 250V 5x20 – **VOLTAGE OUTPUT SHORT CIRCUIT PROTECTION !**

Display: custom type

Connection to PC: serial port RS232

Dimensions: (wxhxd) 265 x 110 x 185mm

Overvoltage category: CAT II, 300V

Pollution degree 2

Temperature range: 0 - 40°C

Maximum humidity: 85% RH

Applicable standards

The Power Simulator is designed in accordance to the following European standard:

Safety

- EN 61010-1

Electromagnetic compatibility (noise and immunity):

- EN/IEC 61326-1

Section III MI 2191 Operation

1. General

In this position the following functions are performed:

- different disturbance signals can be added to an ideal sinusoidal voltage and current waveform.
- the amplitude and frequency of the voltage and current can be varied.
- voltage events can be simulated during the output sequence. The events can be added manually (single, repeatedly or randomly).

1.1 Setting a general sequence:

1. Set to **GENERAL** position with rotary switch. The actual set voltage value is displayed:

Upper screen: U (voltage RMS value)	Lower screen: 100 – 230V
-------------------------------------	--------------------------

2. By using **Select** key further parameters can be checked (Upper screen). Use **Up/Down** keys to change the actual setting (lower screen). The new settings will remain valid until the next change or a return to default settings.

Upper screen	Lower screen
I (current RMS value)	0, 300 – 1000 A
chr (load character)	r ,rC, rL, C, L, g, gC
HU (voltage harmonics)	no, Lo, hi
HI (current harmonics)	no, Lo, hi
FLI (flicker)	no, Lo, hi
Fr	50, 60 Hz
Sin, Per, rAn (mode of inserted voltage event)*	I, d, S, t (voltage events)**

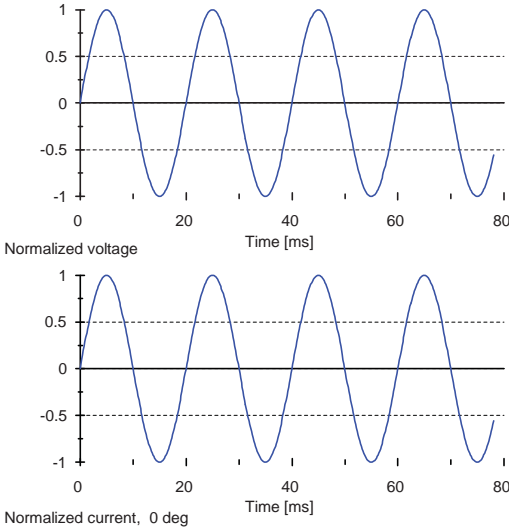
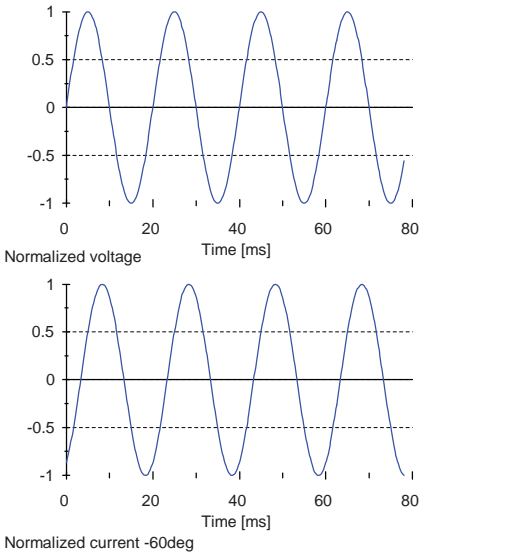
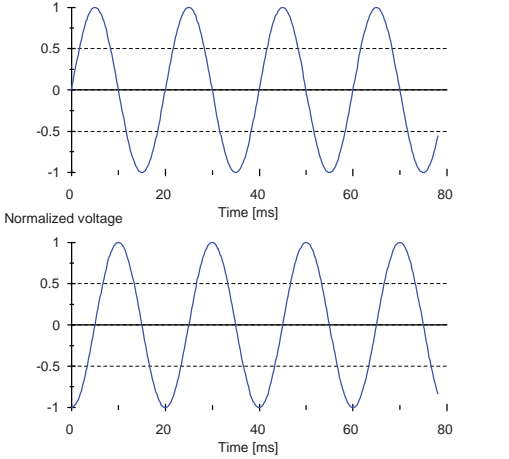
* Use **Up/Down** keys to select insertion mode

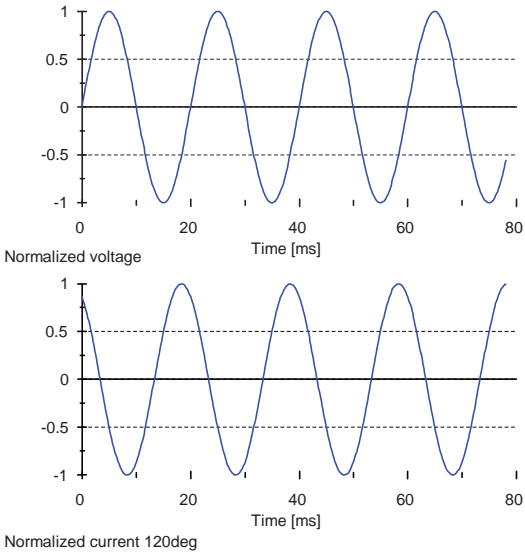
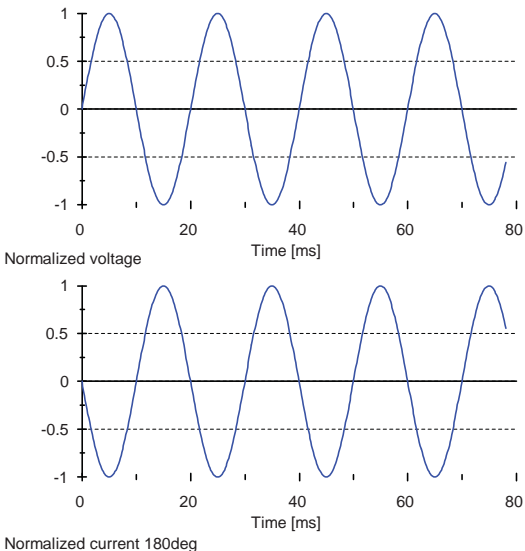
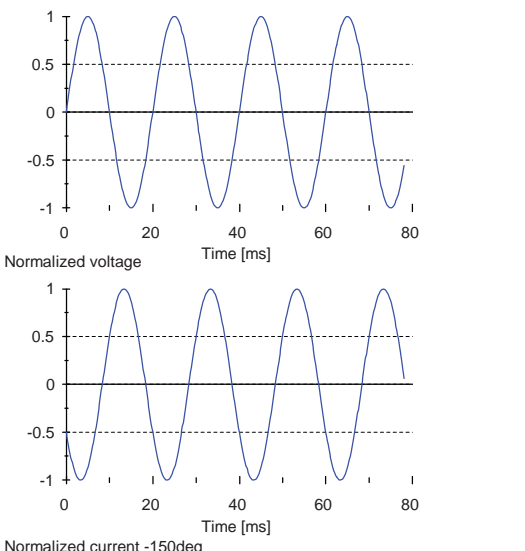
The events are set on or off in any combination (periodic and random mode) by using the appropriate **Events key :

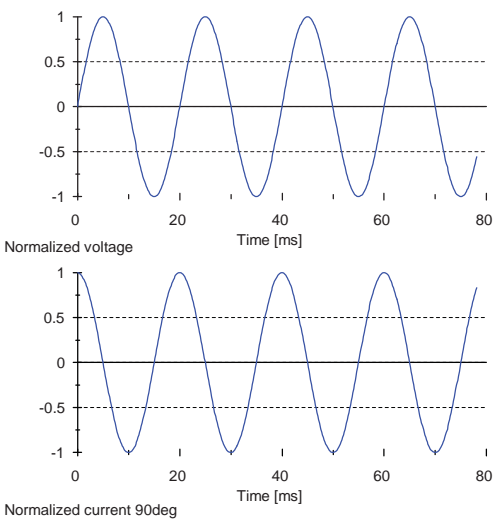
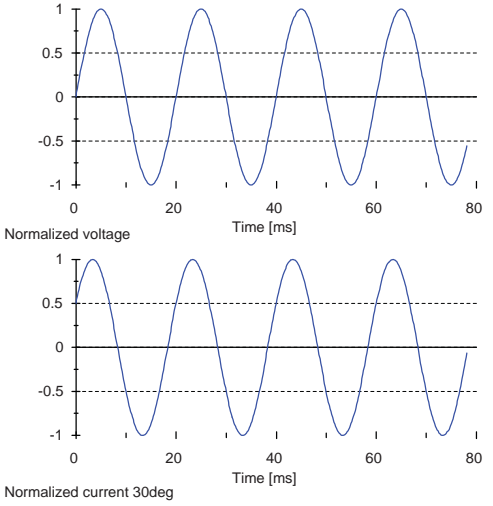
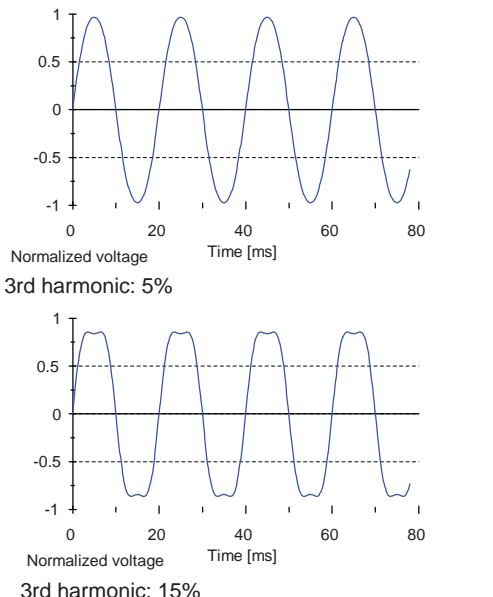
I Interruption
d Dip
S Sag
t Transient

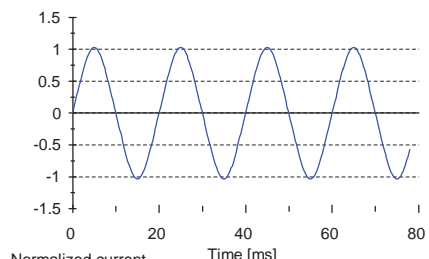
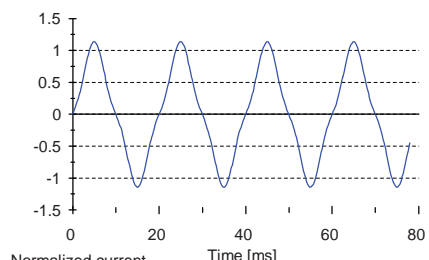
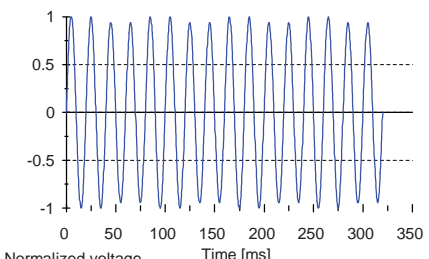
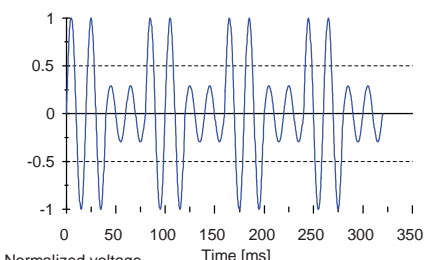
Default settings are: 230V, 1000A, r, no, no, no, 50, Sin
 The settings can be returned to default by using the **BACK** key.
 The settings cannot be changed after the sequence is started.

Description of output signals:

 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current, 0 deg</p>	<p>r pure resistive load ($\Phi = 0^\circ$)</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current -60deg</p>	<p>rL resistive load with inductive component ($0^\circ < \Phi < 90^\circ$), Φ is set to 40°</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current -90deg</p>	<p>L pure inductive load ($\Phi = 90^\circ$)</p>

 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current 120deg</p> <p>Time [ms]</p>	<p>gL generator with inductive component on load side ($90^\circ < \Phi < 180^\circ$), Φ is set to 120°</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current 180deg</p> <p>Time [ms]</p>	<p>g pure generator on load side ($\Phi = 180^\circ$)</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current -150deg</p> <p>Time [ms]</p>	<p>gC generator with capacitive component on load side ($-180^\circ < \Phi < -90^\circ$), Φ is set to -150°</p>

 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current 90deg</p> <p>Time [ms]</p>	<p>C pure capacitive load ($\Phi = -90^\circ$)</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current 30deg</p> <p>Time [ms]</p>	<p>rC resistive load with capacitive component ($-90^\circ < \Phi < 0^\circ$), Φ is set to -60°</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>3rd harmonic: 5%</p> <p>Normalized voltage</p> <p>Time [ms]</p> <p>3rd harmonic: 15%</p>	<p>HU HU, no: no harmonic components HU, Lo: 3rd harmonic (h3) \approx 5% HU, hi: 3rd harmonic (h3) \approx 15%</p>

 <p>Normalized current</p> <p>Time [ms]</p> <p>3rd harmonic: 5%</p>  <p>Normalized current</p> <p>Time [ms]</p> <p>3rd harmonic: 15%</p>	<p>HI</p> <p>HI, no: no harmonic components</p> <p>HI, Lo: 3rd harmonic (h_3) $\approx 5\%$</p> <p>HI, hi: 3rd harmonic (h_3) $\approx 15\%$</p> <p>Note: by changing the load characteristic the waveform shape is also changed (due to the different phase shifts of main and harmonic components).</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Lo flicker</p>  <p>Normalized voltage</p> <p>Time [ms]</p> <p>Hi flicker</p>	<p>FLI</p> <p>FLI, no</p> <p>FLI, Lo: Pst ≈ 0.8</p> <p>FLI, hi: Pst \approx out of range</p> <p>NOTE:</p> <p>In FLI (Lo, hi) r character is used.</p>

1.2 Start (stop) a general sequence

The sequence starts after pressing the START key and is stopped when pressing START again.

V and A signs are displayed while the sequence is active.

There is a few seconds delay prior to the sequence commencing to allow for internal calculations (. . . is flashing during this period).

1.3 Inserting voltage events into a general voltage sequence

Four different voltage events can be inserted into a general voltage sequence:
Dips, Sags, Interruptions and Transients

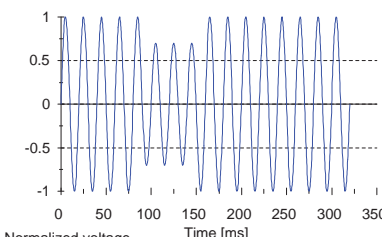
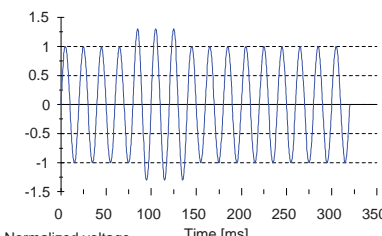
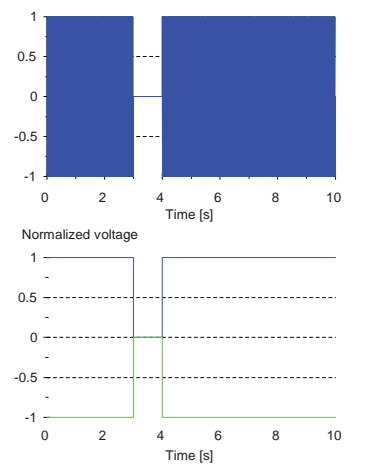
Three event insertion modes can be set:

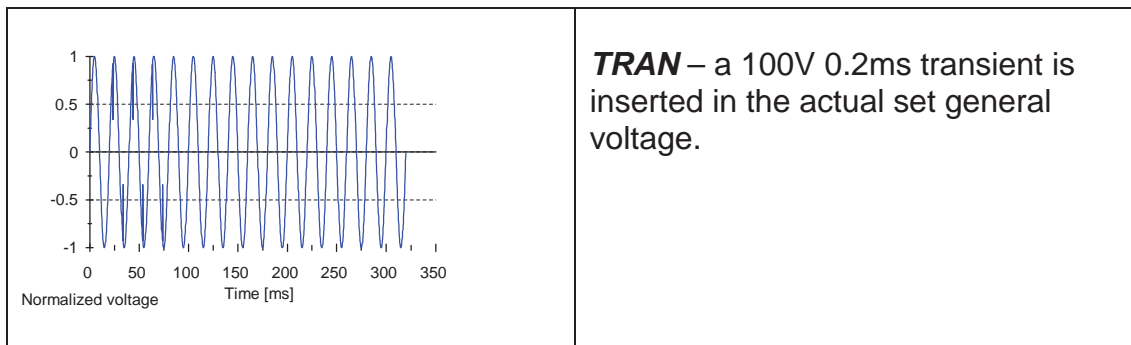
- (Sin) single** a single event is inserted after pressing the appropriate event key during the active sequence
- (PEr) periodic** the selected events are inserted periodically (once per 10s) during active sequence
- (rAn) random** the selected events are inserted randomly until another mode is selected. This mode is the best approximation of real occurrences on the mains.

Note:

In single mode the events **can be simulated during the sequence**.

Description of signals:

	<p>DIP - one actual set general voltage period amplitude is lowered for 30% (no impact on current).</p>
	<p>SAG - one actual set general voltage period amplitude is increased for 30% (no impact on current)</p>
	<p>INTER – the voltage and current are switched off for 1second.</p>



2. Waveforms

In this position the following functions are performed:

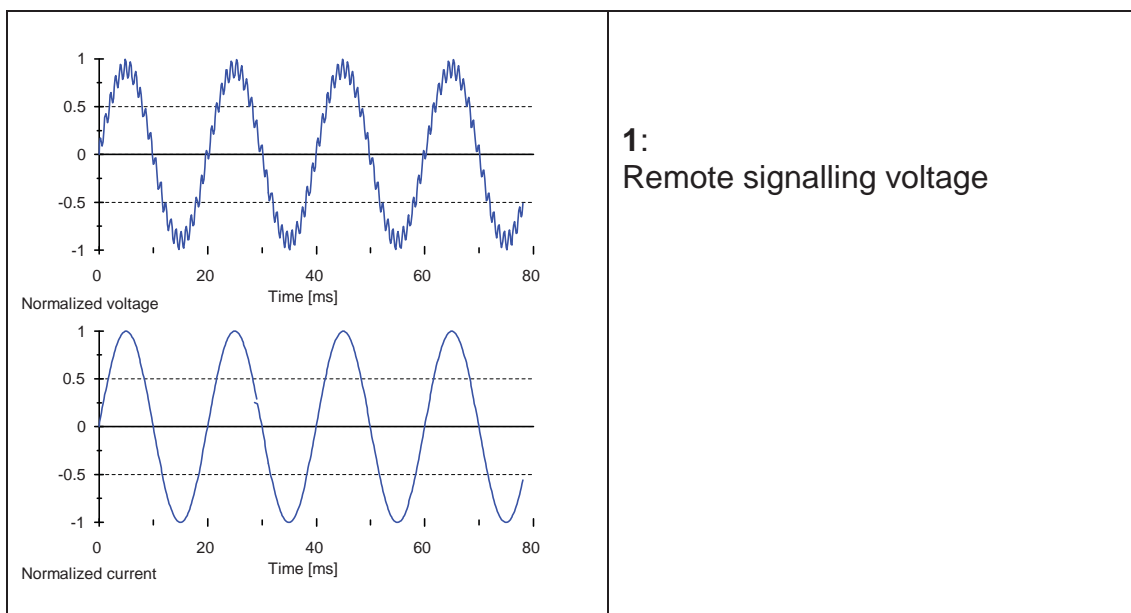
- different voltage and currents waveforms can be selected. The waveforms simulate typical phenomena that often occur on power systems.

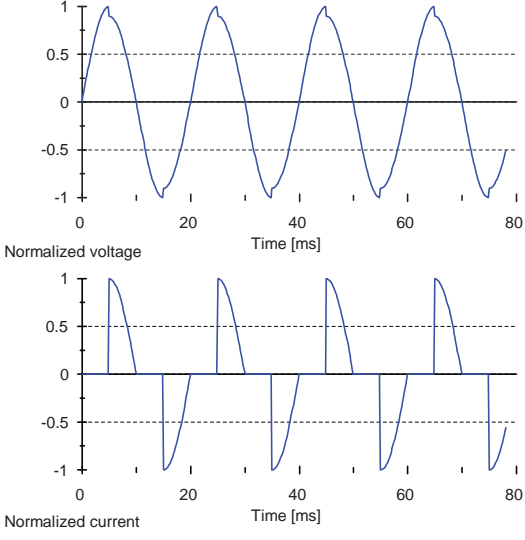
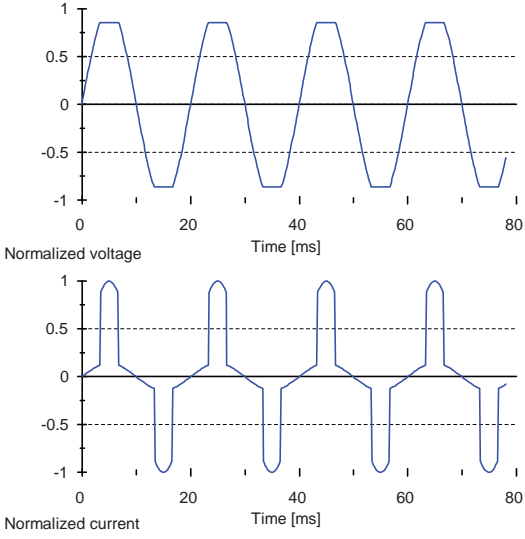
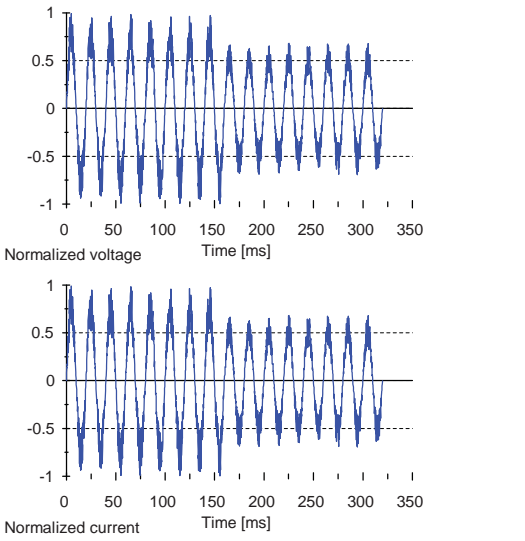
2.1 Setting a Waveform sequence:

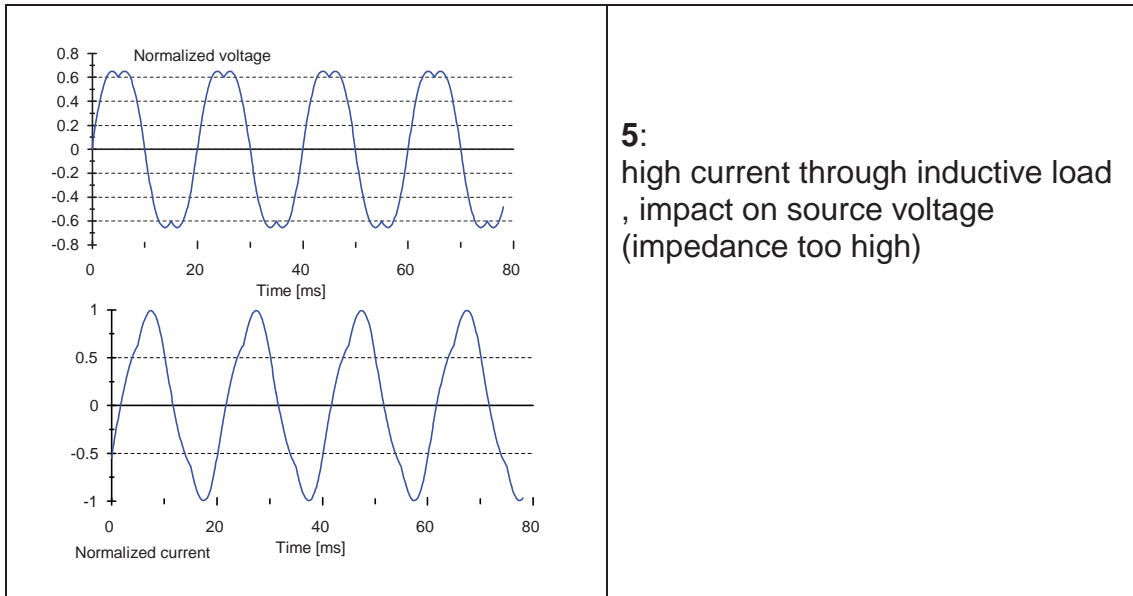
1. Set **Waveform** position with rotary switch. The actual set sequence number is displayed:

2. By using **Select** key further signals can be selected (1 - 2 – 3 – 4 – 1 ...). New settings will stay valid until the next change or a return to the default setting (1, **BACK** key).

Description of signals:



 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current</p> <p>Time [ms]</p>	<p>2: triac controlled load, impact on source voltage (too high impedance)</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current</p> <p>Time [ms]</p>	<p>3: high current spikes through 1 phase rectifier, impact on source voltage (saturated transformer)</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current</p> <p>Time [ms]</p>	<p>4: excessive noise coupled to source voltage, problem on source side</p>



2.2 Start (stop) a Waveform sequence

The sequence starts after pressing the START key and is stopped by pressing START again.

V and A signs are displayed while the sequence is active.

There is a few seconds delay prior to the sequence commencing to allow for internal calculations (. . . is flashing during this period).

3. Fast logging

In this position the following functions are performed:

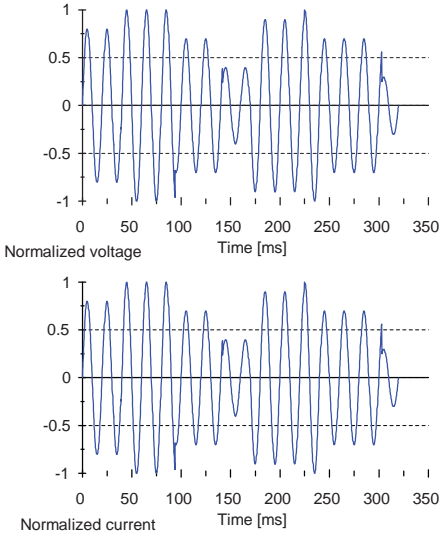
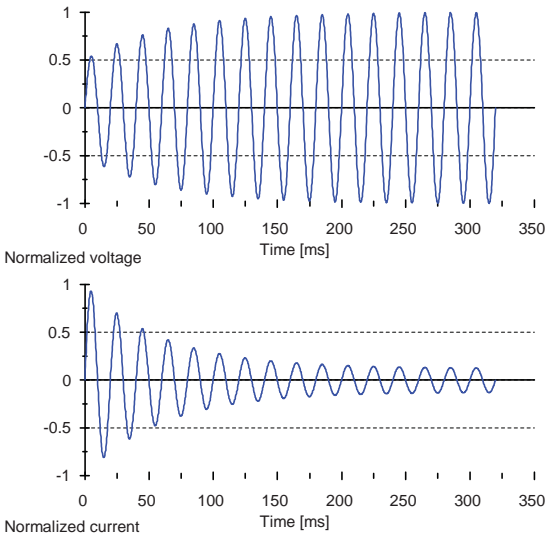
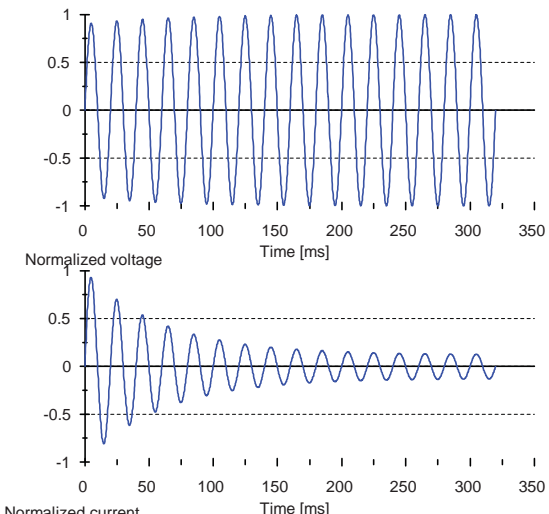
- different voltage and currents waveforms can be selected. The waveforms simulate typical phenomena that often occur on power systems.

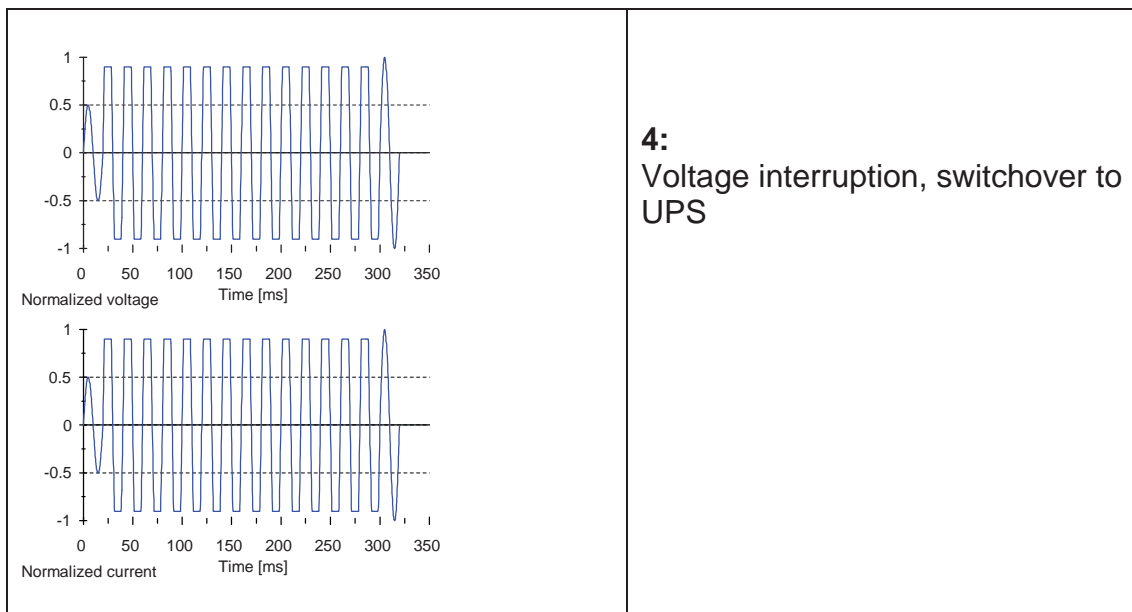
3.1 Setting a Fast Logging sequence:

1. Set **FAST LOGGING** position with rotary switch. The actual set sequence number is displayed:

2. By using **Select** key further signals can be selected (1 - 2 - 3 - 4 - 1 ...). New settings will stay valid until the next change or until a return to the default setting (1, **BACK** key).

Description of signals:

 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current</p> <p>Time [ms]</p>	<p>1: Excessive voltage fluctuations (failure on source side)</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current</p> <p>Time [ms]</p>	<p>2: High inrush current, impact on source voltage (too high impedance)</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current</p> <p>Time [ms]</p>	<p>3: High inrush current, no impact on source voltage (low impedance)</p>



3.2 Start (stop) a Fast Logging sequence

The sequence starts after pressing the START key and is stopped after pressing START again.

V and A signs are displayed while the sequence is active.

There is a few seconds delay prior to the sequence commencing to allow for internal calculations (. . . is flashing during this period).

4. Transients

In this position the following functions are performed:

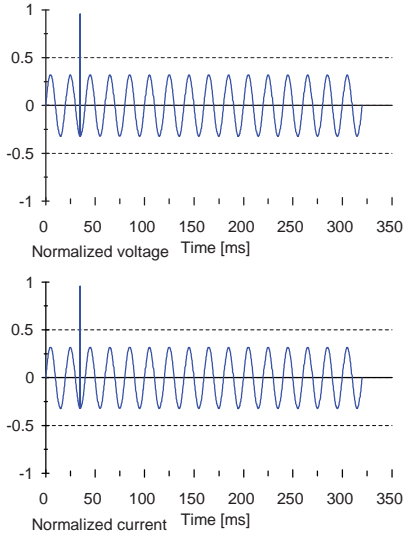
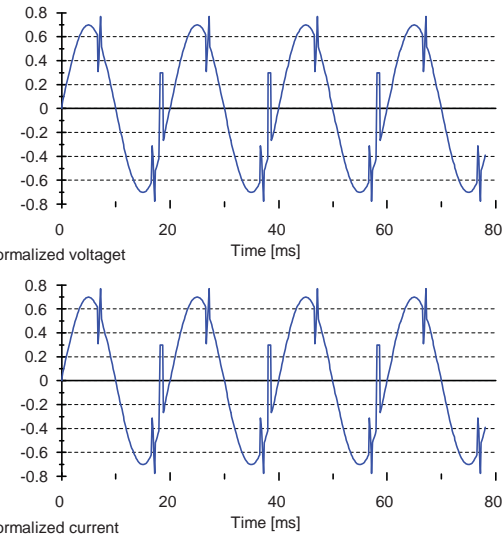
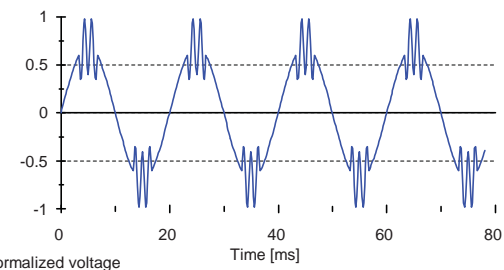
- different voltage transients can be selected. The transient shapes simulate typical phenomena that can occur on power systems.

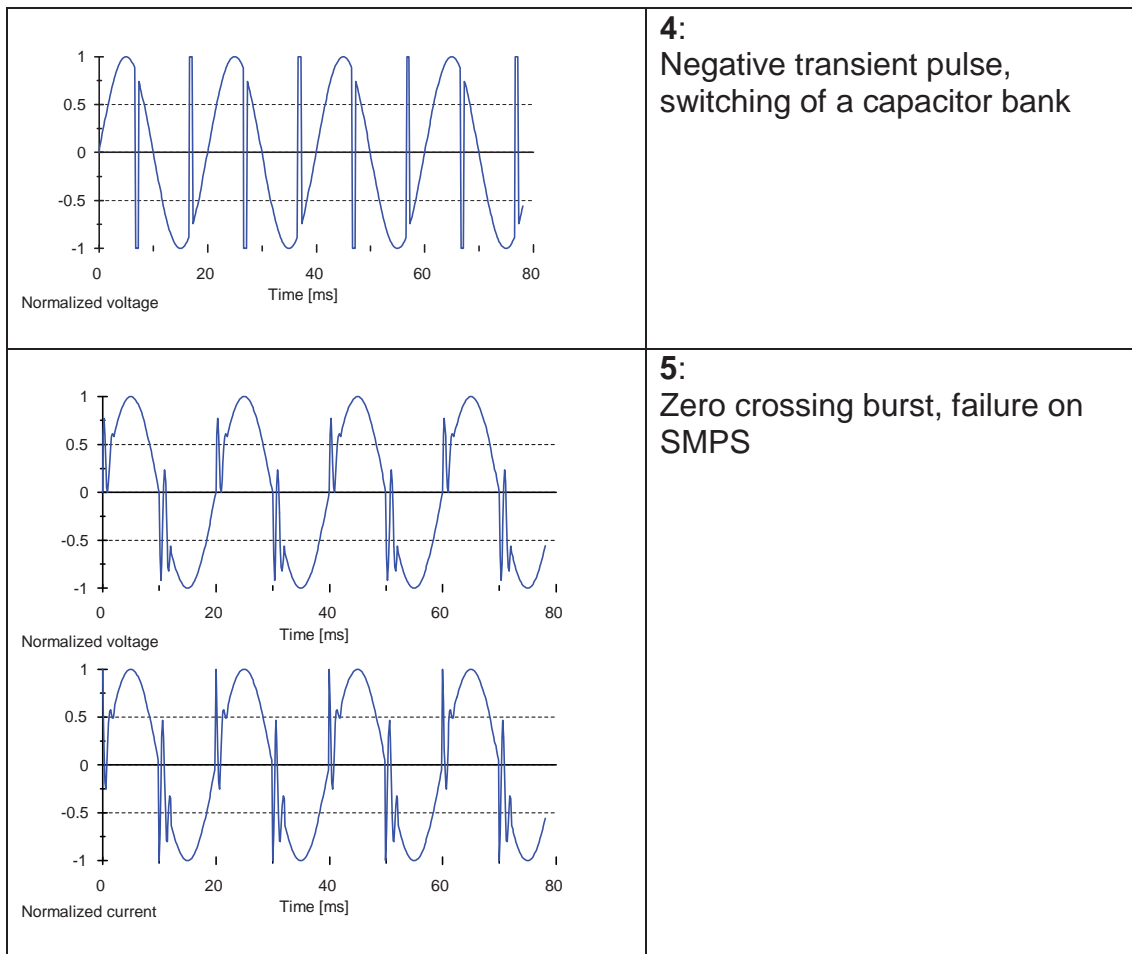
4.1 Setting a Transients sequence:

1. Select **TRANSIENTS** position with rotary switch. The actual set sequence number is displayed:

2. By using **Select** key further signals can be selected (1 - 2 – 3 – 4 –1 ...). New settings will stay valid until the next change or until a return to the default setting (1, **BACK** key).

Description of signals:

 <p>Normalized voltage Time [ms]</p> <p>Normalized current Time [ms]</p>	<p>1: High transient pulse caused by lightning</p>
 <p>Normalized voltage Time [ms]</p> <p>Normalized current Time [ms]</p>	<p>2: Transients caused by SCR switching</p>
 <p>Normalized voltage Time [ms]</p>	<p>3: Burst transients, sparking through bad load contact</p>



4.2 Start (stop) a Transients sequence

The sequence starts after pressing the START key and is stopped after pressing START again.

The V and A signs are displayed when the sequence is active.

There is a few seconds delay prior to the sequence commencing to allow for internal calculations (. . . is flashing during this period).

5. Harmonics

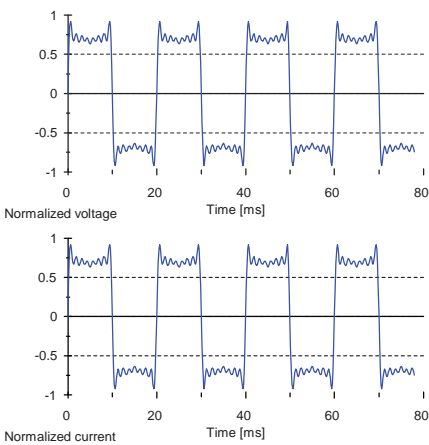
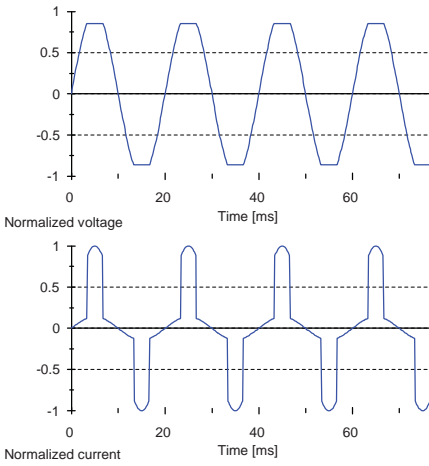
In this position the following functions are performed:

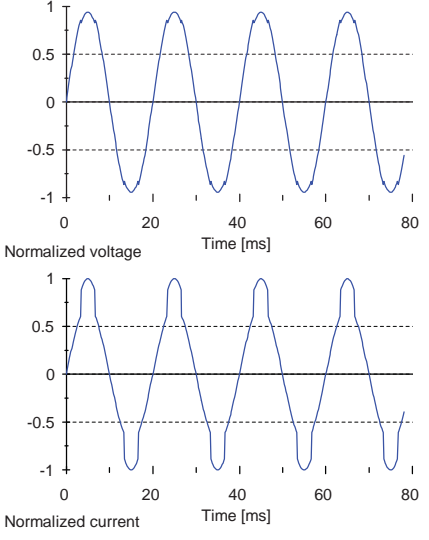
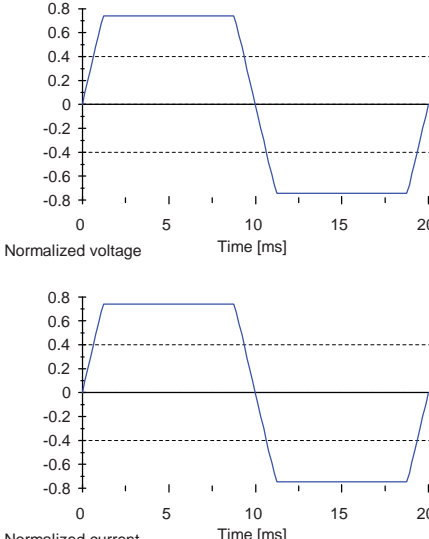
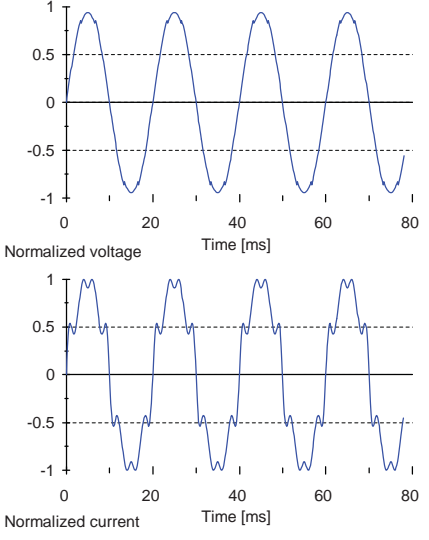
- different voltage and current waveforms with increased harmonics content can be selected. The waveform simulates typical phenomena that can often occur on a power system.

5.1 Setting a Harmonics sequence:

1. Select **HARMONICS** position with rotary switch. The actual set sequence number is displayed:
2. By using **Select** key other signals can be selected (1 - 2 - 3 - 4 - 5 - 1...). New settings will stay valid until the next change or until a return to the default setting (1, **BACK** key).

Description of signals:

	<p>1: Highly distorted signal of a simple chopper voltage convertor</p>
	<p>2: Excessive distortion through saturated source</p>

 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current</p> <p>Time [ms]</p>	<p>3: Distorted load current, no impact on source</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current</p> <p>Time [ms]</p>	<p>4: UPS power supply signal</p>
 <p>Normalized voltage</p> <p>Time [ms]</p> <p>Normalized current</p> <p>Time [ms]</p>	<p>5: high current harmonic values (capacitive load)</p>

5.2 Start (stop) a Harmonics sequence

The sequence starts after pressing the START key and is stopped after pressing START again.

V and A signs are displayed while the sequence is active.

There is a few seconds delay prior to the sequence commencing to allow for internal calculations (. . . is flashing during this period).

6. Flickers

In this position the following functions are performed:

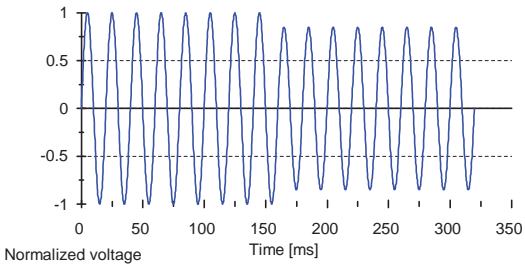
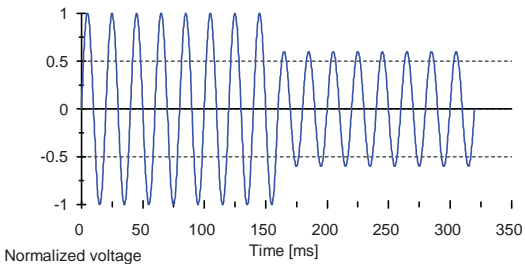
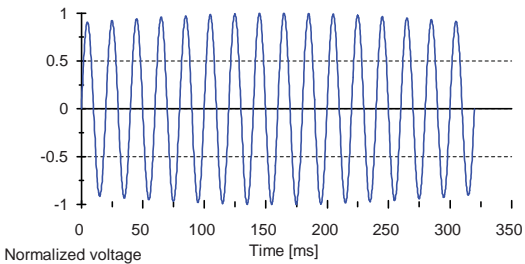
- different voltage waveforms with high flicker values can be selected. The waveforms simulate typical phenomena that cause flickers on power systems.

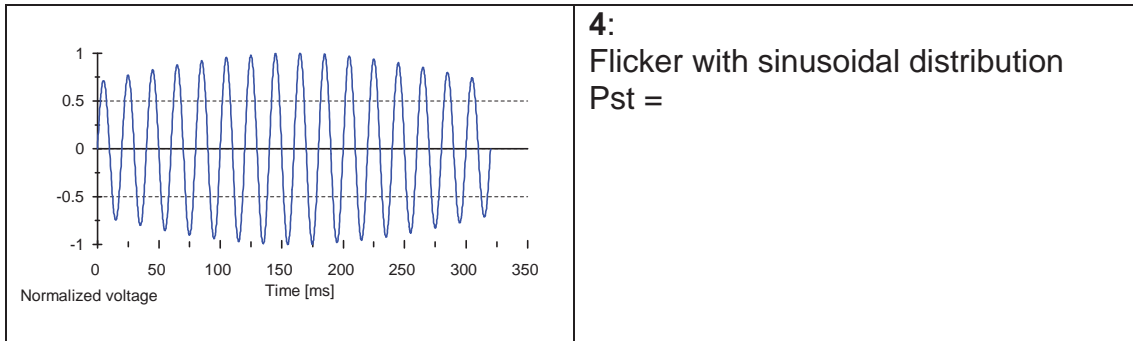
6.1 Setting a Flickers sequence:

1. Select **FLICKER** position with rotary switch. The actual set sequence number is displayed:

2. By using **Select** key other signals can be selected (**1 - 2 - 3 - 4 - 1 ..**). The new settings will stay valid until the next change or a return to the default setting (1, **BACK** key).

Description of signals:

 <p>Normalized voltage</p> <p>Time [ms]</p>	<p>1: Flicker with square distribution Pst =</p>
 <p>Normalized voltage</p> <p>Time [ms]</p>	<p>2: Flicker with square distribution Pst =</p>
 <p>Normalized voltage</p> <p>Time [ms]</p>	<p>3: Flicker with sinusoidal distribution Pst =</p>



6.2 Start (stop) a Flicker sequence

The sequence starts after pressing the START key and is stopped by pressing START again.

V and A signs are displayed while the sequence is active.

There is a few seconds delay prior to the sequence commencing to allow for internal calculations (. . . is flashing during this period).

