

USER MANUAL

FP-COMB32 - THREE PHASES EXTERNAL CDN



SURGE



EFT / BURST



RING WAVE



SERVICES



www.haefely.com



A Note to Begin

Thank you for choosing the Haefely FP-COMB 32. Please take a little time to read through this user manual and familiarize yourself with the instrument controls and some potential dangers.

We hope you have many productive years of operation from the FP-COMB 32 3 Phases External CDN.

HAEFELY TEST AG

Document Title
Reference No.

User Manual: FP-COMB 32 external 3 phases CDN for AXOS
4701030_00

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1 Safety

1.1 General Safety Information

Significant: Please read carefully the safety requirements before using the FP-COMB 32!


















| | |
|---|---|
|  | This warning sign is visible on the equipment. Meaning: The documentation must be consulted before connecting the equipment to any voltage supply |
|  | Dangerous mains voltage or high voltages are present inside the FP-COMB 32. |
|  | The earth connection on the rear panel of the FP-COMB 32 must be connected to a good earth. If FP-COMB 32 is connected to mains without connection to earth, electrical shock may occur! |
|  | Remove all external connection cables before removing any covers. |
|  | The FP-COMB 32 should only be maintained by trained personnel. |
|  | Do not open any system modules, they contains no user replaceable parts. |
|  | When the unit is in operation, pacemaker users should not be in the vicinity. |
|  | Do not switch on or operate the FP-COMB 32 System if an explosion hazard exists. The system should be operated in a dry room. If condensation is visible the unit should be dried before operating. |
|  | Never touch the Equipment Under Test (EUT), when the FP-COMB 32 is operating. Establish a safety barrier around the test setup (It is possible to create a safety circuit using the pin 4 and pin 5 on the AXOS AUX connector. Refer to AXOS user manual for more details). |
|  | If any part of the FP-COMB 32 is damaged or it is possible that damage has occurred, do not switch on the unit. Example: transportation damage. |
|  | Before opening any units remove the mains power cord. |
|  | Before changing the mains fuse, remove the mains power cord. |
|  | Fuses should only be replaced with the same type and value. |
|  | This user manual is an integral part of the test system. Haefely Test AG and its sales partners refuse to accept any responsibility for consequential or direct damage to persons and/or goods due to none observance of instructions contained herein or due to incorrect use of the FP-COMB 32. |
|  | FP-COMB 32 does not have any "LINE ON/OFF" switch. Once mains voltage is connected to the "EUT supply input" (Rear panel), voltage is present at the EUT supply output on the front panel. |
|  | Before connecting the EUT, switch on FP-COMB 32 (switch on the rear panel). Make sure that the ventilators rotate. Supplying EUT without turning on FP-COMB 32 may damage the unit. |
|  | Never connect a supply voltage directly to the HI/COM surge inputs. This will damage the unit!!! |

Table 1-1: Safety requirements FP-COMB 32

When a test is started on the AXOS the symbol in Figure 1-1 is displayed on the screen.



Figure 1-1: Safety sign

1.2 Safety Standards

The FP-COMB 32 fulfils the requirements of IEC 61010-1.

2 Product description

2.1 Basic information

The AXOS⁵ and AXOS⁸ compact immunity test systems integrate all of the best pieces of our stand alone test systems into one single economic solution. It combines Burst/EFT, Surge combination wave, Ringwave, Telecom Wave (10/700), AC/DC Dips & Interrupts, as well as Magnetic field along with an integrated single-phase coupling / decoupling network (CDN) into one compact test system. This allows a quick and completely automated testing environment to the most common IEC standards.

The FP-COMB 32 has been designed to power EUT with voltages up to 480V AC/DC and currents up to 32A. This three phase external CDN is able to couple Burst/EFT, Surge combination wave and Ringwave with the user friendly interface from AXOS⁵ and AXOS⁸. This CDN may also be used for single phase EUTs whose mains voltage exceeds 264VAC and currents above 16A or 220VDC and currents above 10A.

This unit covers a large range of standards which are listed in the following sections of this document.

2.2 Standards covered by FP-COMB 32

| Standard | Description | Test equipment |
|-------------------|------------------------|---|
| IEC/EN 61000-4-4 | EFT/Burst | AXOS ⁵ and AXOS ⁸ |
| IEC/EN 61000-4-5 | Surge Combination Wave | AXOS ⁵ and AXOS ⁸ |
| IEC/EN 61000-4-12 | Ring Wave | AXOS ⁸ only |
| ANSI IEEE C.37.90 | EFT/Burst | AXOS ⁵ and AXOS ⁸ |
| ANSI/IEEE C62.41 | Ring Wave | AXOS ⁸ only |
| ANSI/IEEE C62.41 | Surge Combination Wave | AXOS ⁵ and AXOS ⁸ |

Table 2-1: basic standards covered by FP-COMB 32

For detailed test description of each particular norm please read IEC/EN standard carefully. This is the overall norm, many product norm consist further tests. Indeed, for many products the requirements will be described more detailed in the product norm. Note: Product norms will be partly fulfilled by the FP-COMB 32 as well. Please contact for further assistance your sales representative or HAEFELY directly.

3 Technical data

3.1 General

| General Data | |
|---------------------------|----------------------------------|
| Control Power | 85V - 264V 50/60 Hz |
| Dimensions (W x H x D) | 19" / 6U (45 x 29 x 49 cm) |
| Weight | 45kg |
| AUX Interface | D-sub 37p for connection to AXOS |
| Sync. output | BNC, 0V – 15V AC |

Table 3-1: General data

3.2 Surge

| IEC / EN 61000-4-5 Edition 3 Surge Combination Wave | |
|---|--|
| Output Voltage | 0.2 – 5.0kV $\pm 10\%$ for AXOS ^o 0.2 – 7.0kV $\pm 10\%$ for AXOS ⁸ |
| Polarity | Positive / negative / alternate |
| Voltage Rise Time | 1.2us $\pm 30\%$ |
| Voltage Duration | 50us +10us/-10us for ANSI coupling paths 50us +10us/-15us for IEC Lx-Ly or Lx-N coupling paths 50us +10us/-30us for IEC Lx-PE coupling paths |
| Output Current | 0.1 – 2.5kA $\pm 10\%$ for AXOS ^o 0.1 – 3.5kA $\pm 10\%$ for AXOS ⁸ |
| Current Rise Time | 8us $\pm 20\%$ for ANSI 8us $\pm 20\%$ for IEC Lx-Ly or Lx-N coupling paths 2.5us $\pm 30\%$ for IEC Lx-PE coupling paths |
| Current Duration | 20us $\pm 20\%$ for ANSI coupling paths 20us $\pm 20\%$ for IEC Lx-Ly or Lx-N coupling paths 25us $\pm 30\%$ for IEC Lx-PE coupling paths |
| Output Impedance | 2 Ohms for ANSI coupling paths 2 Ohms for IEC Lx-Ly or Lx-N coupling paths 12 Ohms for IEC Lx-PE coupling paths |
| Phase Sync | 0 – 359° with 1° steps or asynchronous mode |
| Counter preselect | 1 – 1000 infinite |
| Counter | 100000 |
| Three Phase CDN | 480V AC / 32A 480V DC / 32A |
| Impulse Trigger | automatic 10s – 100 minutes manual external trigger input |

Table 3-2: Surge data

3.3 Ring Wave

Note: this feature is only available when FP-COMB 32 operates with AXOS⁸

| IEC / EN 61000-4-12 Edition 2 & ANSI/IEEE C62.41 Ring Wave | |
|--|---|
| Output Voltage | 0.2 – 7.0kV ±10% |
| Polarity | Positive / negative / alternate |
| Voltage Rise time | 0.5 μs ±30% |
| Voltage Frequency | 100 kHz |
| Voltage Damping rate | 0,4<peak1/peak2<1,1 0,4<peak3/peak2<0.8 0,4<peak4/peak3<0.8 |
| Current Rise time | <1 μs |
| Output Impedance | 12 Ohm, 30 Ohm selectable via AXOS' display |
| Phase Sync | 0 – 359° with 1° steps or asynchronous mode |
| Counter preselect | 1 – 1000 |
| Counter | infinite 100000 |
| Three Phase CDN | 480V AC / 32A 480V DC / 32A |
| Impulse Trigger | automatic 20s – 100 minutes manual external trigger input |

Table 3-3 Ring Wave data

3.4 Burst

| IEC / EN 61000-4-4 Edition 3 & ANSI IEEE C.37.90 EFT / Burst | |
|--|--|
| Output Voltage | 0.2 – 5.0kV ±10% for AXOS ⁵ and AXOS ⁸ |
| Polarity | Positive / negative / alternate |
| Rise Time | 5.5ns ±1.5ns for L1L2L3NPE coupling path |
| Impulse Duration | 45ns ±15ns for L1L2L3NPE coupling path |
| Burst Mode | normal continuous real random |
| Spike Frequency | 1Hz – 1MHz |
| Burst Duration | 10us – 1s |
| Burst Period | 1ms – 10s |
| Test Time | 1s– 1000 minutes |
| Three Phase CDN | 480V AC / 32A 480V DC / 32A |
| Impulse Trigger | automatic manual external trigger input |

Table 3-4 Burst data

4 Initial operation

4.1 Visual check

During transport FP-COMB 32 may be subjected to excessive shocks and vibrations, even though every care is taken by HAEFELY HIPOTRONICS to provide suitable packaging. Before operating the unit, check for signs of mechanical damage. Damaged packing cases may be a sign of transport damage. Damage caused in transit must be reported to the shipping agent immediately.

4.2 Installation

All safety measures must be followed, as described in Table 1-1.

4.3 Earth connection



The "Earth Stud" on the back panel must always be connected to a solid earth before the "EUT Supply Input" is connected to power source. Cross section of connection must be at least 4mm squared.

4.4 EUT Supply Input

4.4.1 AC EUT Supply

The "EUT Supply Input" is located on the rear panel of the FP-COMB32. The L1, L2, L3, N, PE connections are used to supply AC EUT Supply Input up to 480VAC/32A.

There are five banana-cables delivered with the standard accessories set:

- 3x black: line conductor
- 1x blue: neutral conductor
- 1x green: protection earth conductor

These banana cables shall be mounted on a suitable connection cable/connector.



The EUT Supply Input must be connected to power lines which are protected by a line safety switch equal or less 32A rated current and characteristic B or C.



Inside the FP-COMB 32, there are filter capacitors connected between lines and earth (For example L1-PE) and neutral and earth N-PE, as required by the standard.

These capacitors will cause a residual current, which will trip the residual current circuit breaker.

Hence, an isolation transformer needs to be inserted between main power supply and "EUT Supply Input" as shown in Figure 4-1 below.

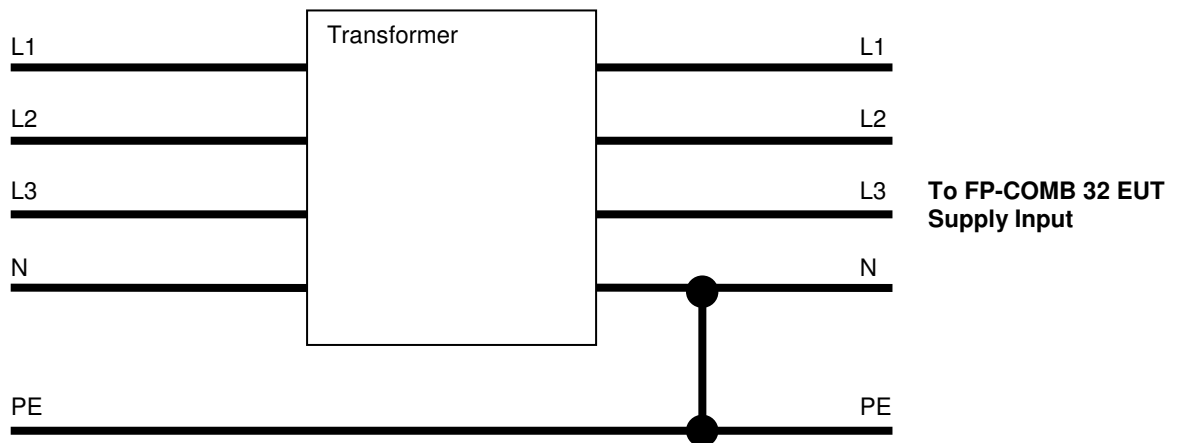


Figure 4-1: Transformer connection

Note:

N and PE need to be connected as shown in the Figure 4-1. This enables that a possible follow current from the mains can be delivered to the EUT.



All further equipment connected after the isolation transformer are not protected any more by the residual current circuit breaker.

4.4.2 DC EUT Supply

The "EUT Supply Input" is located on the rear panel of the FP-COMB32. The L1, N, PE connections are used to supply DC EUT Supply Input up to 480Vdc/32A. The warm point should be connected to L1 and the cold point should be connected to N. Earth remains connected on PE. Leave L2 and L3 unconnected.

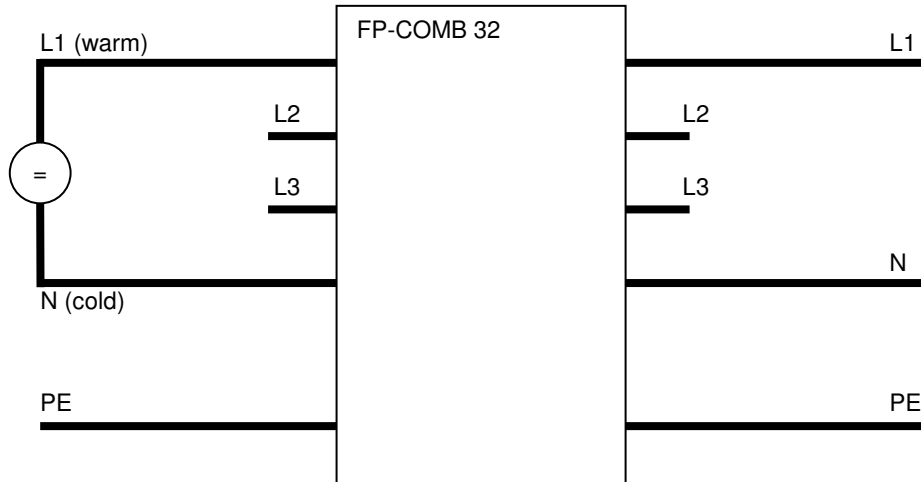


Figure 4-2: DC EUT supply connection



The EUT Supply Input must be connected to power lines which are protected by a line safety switch equal or less 32A rated current and characteristic B or C.

4.5 Connection to EUT

The L1, L2, L3, N and PE banana sockets on the front panel are the outputs of the Three Phase CDN. For power line testing, the EUT is connected here.

Five banana plugs (not delivered) are required to connect the EUT

- 3x black: line conductor
- 1x blue: neutral conductor
- 1x green: protection earth conductor

These banana plugs shall be mounted on a suitable connection cable.

5 General operation

5.1 Front view

The Figure 5-1 shows the front view of the FP-COMB 32. In the Table 5-1 is the detail description of every physical input and output.



Figure 5-1: FP-COMB 32 front view

| Pos. | Function | Description |
|------|------------------------------|---|
| 1 | Power LED | LED is ON as long as CDN is powered (rear panel switch) |
| 2 | Active LED | LED is ON as long as a test using FP-COMB 32 is running |
| 3 | HI input for Surge/Ringwave | Surge and Ringwave input for impulses delivered by AXOS ⁵ or AXOS ⁸ |
| 4 | COM input for Surge/Ringwave | |
| 5 | Burst input | Burst input for impulses delivered by AXOS ⁵ or AXOS ⁸ |
| 6 | L1 output to EUT | Connection for EUT to the coupling/decoupling network |
| 7 | L2 output to EUT | |
| 8 | L3 output to EUT | |
| 9 | N output to EUT | |
| 10 | PE output to EUT | |
| 11 | PE | Connection to ground reference plane or the verification adapter |
| 12 | PE | |

Table 5-1: Description front view function

5.2 Rear view

The rear view of the FP-COMB 32 is shown in Figure 5-2. A detailed description of every input and output is written in the Table 5-2 below the graphic.



Figure 5-2: FP-COMB 32 rear view

| Pos. | Function | Description |
|------|---|---|
| 1 | L1 "EUT Supply Input" (direct connection of power supply via banana plug) | Direct connection of power supply to the EUT. It can either be connected to a DC power supply or to AC power supply. Awareness, the power supply should NOT be secured by a ground fault Switch. If yes please take section 4.4 in consideration. |
| 2 | L2 "EUT Supply Input" (direct connection of power supply via banana plug) | |
| 3 | L3 "EUT Supply Input" (direct connection of power supply via banana plug) | |
| 4 | N "EUT Supply Input" (direct connection of power supply via banana plug) | |
| 5 | PE "EUT Supply Input" (direct connection of power supply via banana plug) | |
| 6 | "Link" | Data communication with AXOS to drive FP-COMB 32 |
| 7 | "Sync" | Synchronization output signal for AXOS |
| 8 | Electrical grounding | The generator must always be connected to a reference earth before every use |
| 9 | Main power switch for FP-COMB 32 | Switching on/off power supply |

Table 5-2: description rear view

5.3 Connections to AXOS⁵ or AXOS⁸

Front view

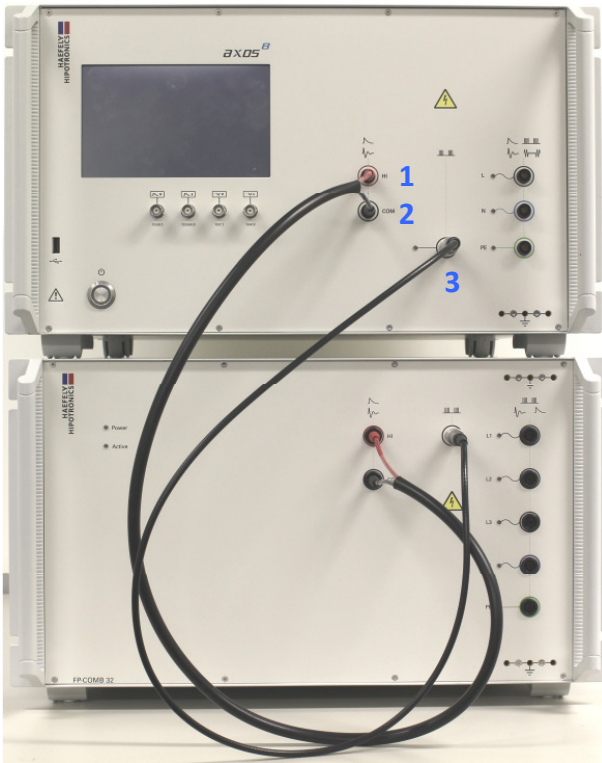


Figure 5-3: connection to AXOS - Front

Rear view

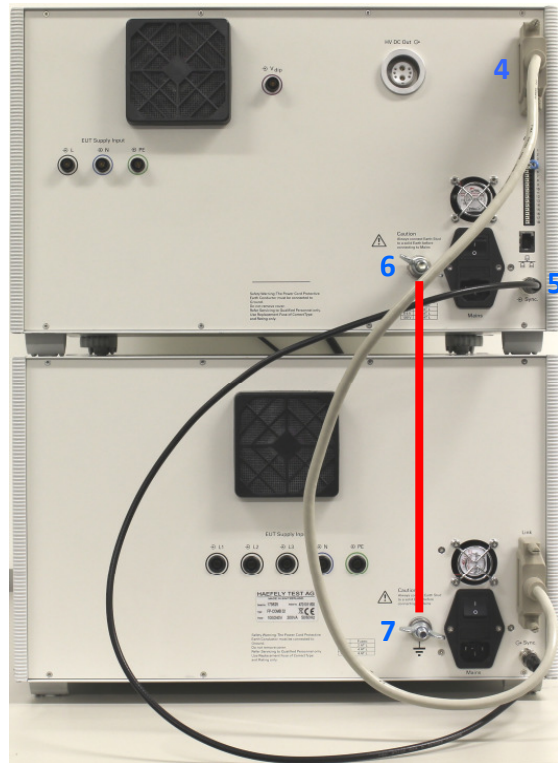


Figure 5-4: connection to AXOS - Rear

| Pos. | Function | Description |
|-------|----------------------------|--|
| 1 | HI Surge/Ringwave (RED) | Surge and Ringwave impulse link between AXOS and FP-COMB 32 using banana cables (1m) |
| 2 | COM Surge/Ringwave (BLACK) | |
| 3 | Burst SHV connector | Link for Burst impulses, SHV-SHV cable (1m) |
| 4 | Link Sub-D 37 | Link for data/control of FP-COMB 32 (1m) |
| 5 | Sync | BNC cable for synchronization signal (1m) |
| 6 & 7 | Earth connections | Delivered grounding cable (1m), painted in red, most important connection |

6 Surge

6.1 General information

Please read carefully this document and AXOS manual in detail before first use of the Surge generator. The short voltage impulse stays on the EUT during several μ s. The peak voltage gets up to 7 kV. The generator fulfils the requirements according to the IEC 61000-4-5 norm.

In General waveforms are specified as open circuit voltage (OCV) and short circuit current (SCC). The Surge is applied directly from the AXOS surge outputs to FP-COMB 32's HI and COM inputs.

For a detailed description of this standard please read the topic "test instrumentation" in the IEC 61000-4-5 norm.

6.2 SURGE Menu

Test requirements must be achieved by the user according to the IEC 61000-4-5 norm. The safety standards as written in Table 1-1 must be unconditionally fulfilled, when operating the FP-COMB 32.

Two menus in the AXOS surge application are specific to the FP-COMB 32. These menus will be described in the next sections.

For a detailed description of the surge application, please refer to the AXOS user manual.

6.2.1 Output & Coupling Paths menu

In the "Output & Coupling Paths" menu the automatic 3 phase CDN FP-COMB 32 gets indicated automatically when connected. It can be then activated by selecting the appropriate radio button. An additional radio button permits user to select the IEC or ANSI mode.

The screenshot shows the "Output & Coupling Paths" dialog box. It features two main panels. The left panel, titled "Output", contains three radio button options: "Line", "Direct Output", and "FP-SURGE 100M2", with "FP-COMB 32" selected. The right panel, titled "Coupling Paths", includes radio buttons for "1 Phase", "2 Phases", and "3 Phases", with "3 Phases" selected. Below these are checkboxes for various coupling paths: L1 - N, L2 - PE, L2 - L3, L2 - N, L3 - PE, L1 - L3, L3 - N, N - PE, L1 - PE, and L1 - L2. There are also "All" and "None" buttons. At the bottom are "OK" and "Cancel" buttons.

Figure 6-1: Surge Coupling paths

The following table indicates the available coupling paths regarding the amount of phases selected:

| Phases | Mode | Coupling Path | | Coupling elements | | Synchronization | | |
|----------|----------|---------------|------------|-------------------|----------|-----------------|-------|----|
| | | HIGH | COM | Capacitor | Resistor | HIGH | COM | |
| 1 Phase | IEC | L1 | N | 18 uF | 0 Ohm | L1 | N | |
| | | L1 | PE | 9 uF | 10 Ohm | L1 | PE | |
| | | N | PE | 9 uF | 10 Ohm | N | PE | |
| | | ANSI | L1+N | PE | 9 uF | 0 Ohm | L1 | PE |
| | | | L1 | N | 18 uF | 0 Ohm | L1 | N |
| | | N | PE | 9 uF | 0 Ohm | L1 | PE | |
| | | L1 | PE | 9 uF | 0 Ohm | L1 | PE | |
| | | N+PE | L1 | 9 uF | 0 Ohm | N | L1 | |
| | | L1+PE | N | 9 uF | 0 Ohm | L1 | N | |
| | | 2 Phases | IEC | L1 | N | 18 uF | 0 Ohm | L1 |
| L2 | N | | | 18 uF | 0 Ohm | L2 | N | |
| L1 | PE | | | 9 uF | 10 Ohm | L1 | PE | |
| L2 | PE | | | 9 uF | 10 Ohm | L2 | PE | |
| N | PE | | | 9 uF | 10 Ohm | N | PE | |
| | L1 | | L2 | 18 uF | 0 Ohm | L1 | L2 | |
| | ANSI | | L1+L2+N | PE | 9 uF | 0 Ohm | L1 | PE |
| | | | L1 | N | 18 uF | 0 Ohm | L1 | N |
| | L2 | | N | 18 uF | 0 Ohm | L2 | N | |
| | N | | PE | 9 uF | 0 Ohm | L1 | PE | |
| 3 Phases | IEC | L1 | PE | 9 uF | 0 Ohm | L1 | PE | |
| | | L2 | PE | 9 uF | 0 Ohm | L2 | PE | |
| | | L3 | PE | 9 uF | 10 Ohm | L3 | PE | |
| | | N | PE | 9 uF | 10 Ohm | N | PE | |
| | | L1 | L2 | 18 uF | 0 Ohm | L1 | L2 | |
| | | L2 | L3 | 18 uF | 0 Ohm | L2 | L3 | |
| | | L1 | L3 | 18 uF | 0 Ohm | L1 | L3 | |
| | | ANSI | L1+L2+L3+N | PE | 9 uF | 0 Ohm | L1 | PE |
| | | | L2 | L1 | 18 uF | 0 Ohm | L2 | L1 |
| | | L3 | L2 | 18 uF | 0 Ohm | L3 | L2 | |
| L1 | L3 | 18 uF | 0 Ohm | L1 | L3 | | | |
| N | PE | 9 uF | 0 Ohm | L1 | PE | | | |
| | L1 | PE | 9 uF | 0 Ohm | L1 | PE | | |
| | L2 | PE | 9 uF | 0 Ohm | L2 | PE | | |
| | L3 | PE | 9 uF | 0 Ohm | L3 | PE | | |
| | L1+L2+L3 | N | 9 uF | 0 Ohm | L1 | N | | |
| | L1+L2+L3 | PE | 9 uF | 0 Ohm | L1 | PE | | |

Table 6-1: Surge Coupling Paths

Note: For DC applications user should select the radio button “1 phase”.

6.2.2 Properties menu

In the figure below is the properties menu displayed.

Figure 6-2: Surge properties

The following table describes the different functions in more detail. The window is closed once settings are confirmed with the “OK” button.

| Position | Description |
|--|---|
| External (Pin11 on Aux) | External condition (e.g. device or PLC signal), the position becomes 1 and causes an action (Ignore, Alarm, Test Stop or test stop & line off) |
| Line Current | Not available as long as FP-COMB 32 is selected in the “Output & Coupling Paths” menu. |
| Peak voltage | It defines a range (min. and max.) for the peak voltage value of the surge waveform. If output impulse is outside the defined range, an action is triggered which can be: Ignore, Alarm, or Test Stop. This feature is used to set a possible “DUT Fail” criterion. |
| Peak current | It defines a range (min. and max.) for the peak current value of the surge waveform. If output impulse is outside the defined range, an action is triggered which can be: Ignore, Alarm, or Test Stop. This feature is used to set a possible “DUT Fail” criterion. |
| Action: Ignore, Alarm, Test stop, Test stop & line off | Due to EUT fails, AXOS causes an action which can be: Ignore, Alarm, Test Stop. “Test stop & line off” is not available as long as FP-COMB 32 is selected in the “Output & Coupling Paths” menu. |
| Turn Line off | Not available as long as FP-COMB 32 is selected in the “Output & Coupling Paths” menu. |
| Sound | Acoustic signal when test ends |

Table 6-2: Surge properties

6.2.3 Line Synchronization AC

To synchronize the ringwave signal with the main supply source it is necessary to adjust in the menu “Synchronization” and then “External Sync”. FP-COMB 32’s sync output has to be connected to AXOS’ sync input using the BNC cable delivered in the accessory kit. Further adjustments of the angle can be done in a range from 0° to 359°. However, if no power supply is connected to the EUT input at the rear view, it has to be entered “Async.”, otherwise it is impossible to get an impulse of AXOS.

6.2.4 Phase order detection

In the “Output & Coupling paths” menu can be selected for each IEC and ANSI mode if one, two or three phases are used to power the EUT.

- For one or two phases application, no error message is displayed if the phases are swapped.
- If the three-phase mode is selected FP-COMB 32 checks if the phases are connected in the right order and displays an error message if two phases are swapped. If this is the case swap any two phases at the “EUT supply input” on the rear panel and restart the test.
- For DC applications user should select the radio button “1 phase”.

7 Ring Wave

7.1 General Information

The ringwave feature is only available with AXOS⁸. FP-COMB 32 is able to couple Ringwave impulses in accordance to the IEC 61000-4-12 ed.2 and ANSI C62.41 norms. Test level up to 7 kV is defined. It can be selected between an impedance of 12 Ohm and 30 Ohm on AXOS' touch screen.

For a detailed description of the ringwave impulse please refer to the IEC 61000-4-12 ed.2 and ANSI C62.41 standards.

7.2 Ring Wave menu

Test requirements must be achieved by the user according to the IEC 61000-4-12 norm. The safety standards as written in Table 1-1 must be unconditionally fulfilled, when operating the AXOS.

Two menus in the AXOS ringwave application are specific to the FP-COMB 32. These menus will be described in the next sections.

For a detailed description of the ringwave application, please refer to the AXOS⁸ user manual.

7.2.1 Output & Coupling Paths menu

In the "Output & Coupling Paths" menu the automatic 3 phase CDN FP-COMB 32 gets indicated automatically when connected. It can be then activated by selecting the appropriate radio button. An additional radio button permits user to select the IEC or ANSI mode.

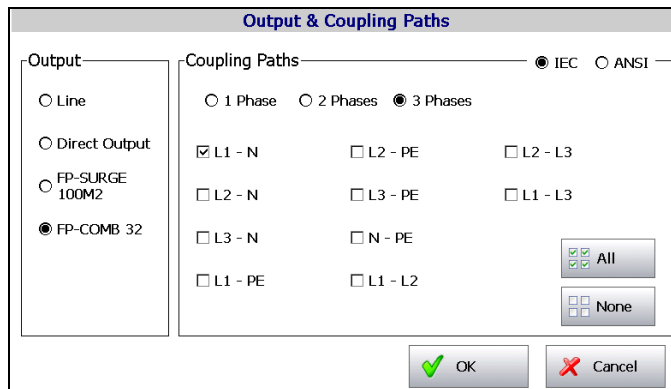


Figure 7-1: Ringwave Coupling paths

The following table indicates the available coupling paths regarding the amount of phases selected:

| Phases | Mode | Coupling Path | | Coupling elements | | Synchronization | |
|----------|------|---------------|-------|-------------------|----------|-----------------|-----|
| | | HIGH | COM | Capacitor | Resistor | HIGH | COM |
| 1 Phase | IEC | L1 | N | 9 uF | 0 Ohm | L1 | N |
| | | L1 | PE | 9 uF | 0 Ohm | L1 | PE |
| | | N | PE | 9 uF | 0 Ohm | N | PE |
| | ANSI | L1+N | PE | 9 uF | 0 Ohm | L1 | PE |
| | | L1 | N | 9 uF | 0 Ohm | L1 | N |
| | | N | PE | 9 uF | 0 Ohm | L1 | PE |
| | | L1 | PE | 9 uF | 0 Ohm | L1 | PE |
| | | N+PE | L1 | 9 uF | 0 Ohm | N | L1 |
| | | L1+PE | N | 9 uF | 0 Ohm | L1 | N |
| | | L1+PE | N | 9 uF | 0 Ohm | L1 | N |
| 2 Phases | IEC | L1 | N | 9 uF | 0 Ohm | L1 | N |
| | | L2 | N | 9 uF | 0 Ohm | L2 | N |
| | | L1 | PE | 9 uF | 0 Ohm | L1 | PE |
| | | L2 | PE | 9 uF | 0 Ohm | L2 | PE |
| | | N | PE | 9 uF | 0 Ohm | N | PE |
| | | L1 | L2 | 9 uF | 0 Ohm | L1 | L2 |
| | ANSI | L1+L2+N | PE | 9 uF | 0 Ohm | L1 | PE |
| | | L1 | N | 9 uF | 0 Ohm | L1 | N |
| | | L2 | N | 9 uF | 0 Ohm | L2 | N |
| | | N | PE | 9 uF | 0 Ohm | L1 | PE |
| | | L1 | PE | 9 uF | 0 Ohm | L1 | PE |
| | | L2 | PE | 9 uF | 0 Ohm | L2 | PE |
| | | L1+L2 | N | 9 uF | 0 Ohm | L1 | N |
| L1+L2 | PE | 9 uF | 0 Ohm | L1 | PE | | |
| 3 Phases | IEC | L1 | N | 9 uF | 0 Ohm | L1 | N |
| | | L2 | N | 9 uF | 0 Ohm | L2 | N |
| | | L3 | N | 9 uF | 0 Ohm | L3 | N |
| | | L1 | PE | 9 uF | 0 Ohm | L1 | PE |
| | | L2 | PE | 9 uF | 0 Ohm | L2 | PE |
| | | L3 | PE | 9 uF | 0 Ohm | L3 | PE |
| | | N | PE | 9 uF | 0 Ohm | N | PE |
| | | L1 | L2 | 9 uF | 0 Ohm | L1 | L2 |
| | | L2 | L3 | 9 uF | 0 Ohm | L2 | L3 |
| | | L1 | L3 | 9 uF | 0 Ohm | L1 | L3 |
| | ANSI | L1+L2+L3+N | PE | 9 uF | 0 Ohm | L1 | PE |
| | | L2 | L1 | 9 uF | 0 Ohm | L2 | L1 |
| | | L3 | L2 | 9 uF | 0 Ohm | L3 | L2 |
| | | L1 | L3 | 9 uF | 0 Ohm | L1 | L3 |
| | | N | PE | 9 uF | 0 Ohm | L1 | PE |
| | | L1 | PE | 9 uF | 0 Ohm | L1 | PE |
| L2 | PE | 9 uF | 0 Ohm | L2 | PE | | |
| L3 | PE | 9 uF | 0 Ohm | L3 | PE | | |
| L1+L2+L3 | N | 9 uF | 0 Ohm | L1 | N | | |
| L1+L2+L3 | PE | 9 uF | 0 Ohm | L1 | PE | | |

Table 7-1: Ring Wave Coupling Paths

Note: For DC applications user should select the radio button "1 phase".

7.2.2 Properties menu

In the Figure 7-2 below is the properties menu displayed. The Table 7-2 explains the function more detailed.

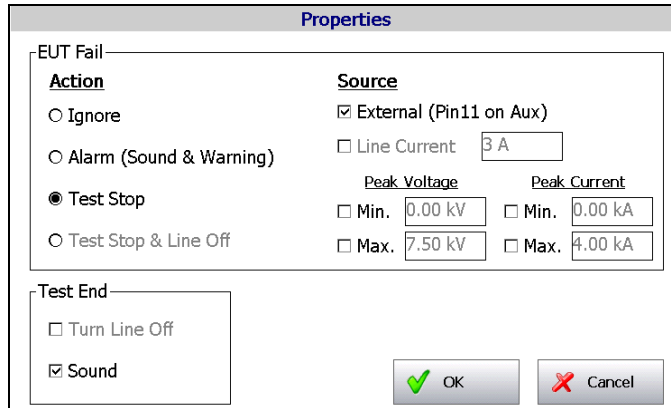


Figure 7-2: Ring Wave properties

The window gets closed, when confirming the “OK” button.

| Position | Description |
|--|---|
| External (Pin11 on Aux) | External condition (e.g. device or PLC signal), the position becomes 1 and causes an action (Ignore, Alarm, Test Stop or test stop & line off) |
| Line Current | Not available as long as FP-COMB 32 is selected in the “Output & Coupling Paths” menu. |
| Peak voltage | It defines a range (min. and max.) for the peak voltage value of the surge waveform. If output impulse is outside the defined range, an action is triggered which can be: Ignore, Alarm, or Test Stop. This feature is used to set a possible “DUT Fail” criterion. |
| Peak current | It defines a range (min. and max.) for the peak current value of the surge waveform. If output impulse is outside the defined range, an action is triggered which can be: Ignore, Alarm, or Test Stop This feature is used to set a possible “DUT Fail” criterion. |
| Action: Ignore, Alarm, Test stop, Test stop & line off | Due to EUT fails, AXOS [®] causes an action which can be: Ignore, Alarm, Test Stop. “Test stop & line off” is not available as long as FP-COMB 32 is selected in the “Output & Coupling Paths” menu. |
| Turn Line off | Not available as long as FP-COMB 32 is selected in the “Output & Coupling Paths” menu. |
| Sound | Acoustic signal when test ends |

Table 7-2: Ring Wave properties

7.2.3 Line Synchronization AC

To synchronize the ringwave signal with the main supply source it is necessary to adjust in the menu “Synchronization” and then “External Sync”. FP-COMB 32’s sync output has to be connected to AXOS’ sync input using the BNC cable delivered in the accessory kit. Further adjustments of the angle can be done in a range from 0° to 359°. However, if no power supply is connected to the EUT input at the rear view, it has to be entered “Async.”, otherwise it is impossible to get an impulse of AXOS.

7.2.4 Phase order detection

In the “Output & Coupling paths” menu can be selected for each IEC and ANSI mode if one, two or three phases are used to power the EUT.

- For one or two phases application, no error message is displayed if the phases are swapped.
- If the three-phase mode is selected FP-COMB 32 checks if the phases are connected in the right order and displays an error message if two phases are swapped. If this is the case swap any two phases at the “EUT supply input” on the rear panel and restart the test.
- For DC applications user should select the radio button “1 phase”.

8 Electrical Fast Transient Burst

8.1 General information

AXOS' Burst generator generates Electrical Fast Transient Bursts (EFT) as described in IEC 61000-4-4. The source impedance of the generator is 50 Ω . The burst is a common mode transient, coupled simultaneously to all selected paths with respect to ground.

Test requirements must be achieved by the user according to the IEC 61000-4-4 norm. The safety standards as written in capture Figure 1-1 must be unconditionally fulfilled.

8.2 Burst menu

For a detailed description of the burst application, please refer to the AXOS user manual.

Two menus are FP-COMB 32 specific and will be described in the next sections.

8.2.1 Output & Coupling Paths menu

In Burst testing mode every line signal gets tested against GND. In the “Output & Coupling Paths” menu the automatic 3 phase CDN FP-COMB 32 gets indicated automatically when connected. It can be then activated by selecting the appropriate radio button. The coupling is in accordance to the IEC/ANSI standard.

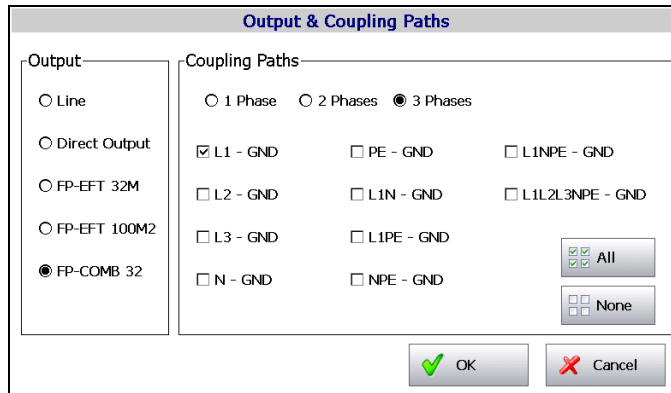


Figure 8-1: Burst Coupling paths

The following table describes the available coupling paths regarding the amount of selected phases in the “Output & Coupling Paths” menu.

| Phases | Coupling path | Coupling capacitor | Synchronization | |
|---------------|---------------|--------------------|-----------------|-----|
| | | | HIGH | COM |
| 1 Phase | L1 | 33 nF | L1 | GND |
| | N | 33 nF | L1 | GND |
| | PE | 33 nF | L1 | GND |
| | L1+N | 33 nF | L1 | GND |
| | L1+PE | 33 nF | L1 | GND |
| | N+PE | 33 nF | L1 | GND |
| | L1+N+PE | 33 nF | L1 | GND |
| 2 Phases | L1 | 33 nF | L1 | GND |
| | L2 | 33 nF | L2 | GND |
| | N | 33 nF | L1 | GND |
| | PE | 33 nF | L1 | GND |
| | L1+N | 33 nF | L1 | GND |
| | L1+PE | 33 nF | L1 | GND |
| | N+PE | 33 nF | L1 | GND |
| 3 Phases | L1+N+PE | 33 nF | L1 | GND |
| | L1 | 33 nF | L1 | GND |
| | L2 | 33 nF | L2 | GND |
| | L3 | 33 nF | L3 | GND |
| | N | 33 nF | L1 | GND |
| | PE | 33 nF | L1 | GND |
| | L1+N | 33 nF | L1 | GND |
| | L1+PE | 33 nF | L1 | GND |
| | N+PE | 33 nF | L1 | GND |
| | L1+N+PE | 33 nF | L1 | GND |
| L1+L2+L3+N+PE | 33 nF | L1 | GND | |

Table 8-1: Burst Coupling paths

Note: For DC applications user should select the radio button “1 phase”.

8.2.2 Properties menu

The next window shows the property window of the Burst waveform. Detailed description of each parameter can be read in the Table 8-2.

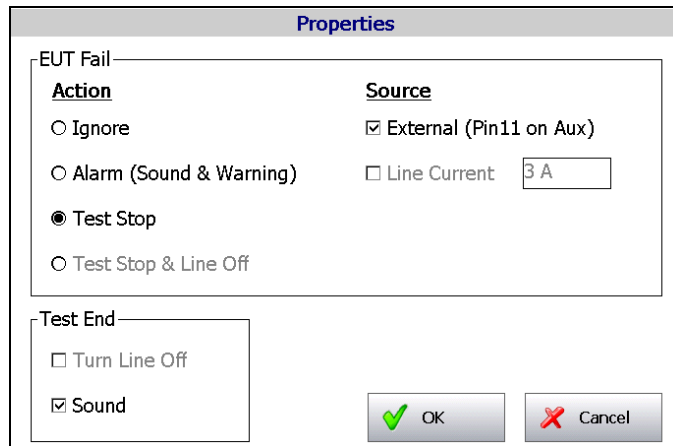


Figure 8-2: BURST properties

| Position | Description |
|--|---|
| External (Pin11 on Aux) | External condition (e.g. device or PLC signal), the position becomes 1 and causes an action (Ignore, Alarm, Test Stop or test stop & line off) |
| Line Current | Not available as long as FP-COMB 32 is selected in the "Output & Coupling Paths" menu. |
| Action: Ignore, Alarm, Test stop, Test stop & line off | Due to EUT fails, AXOS [®] causes an action which can be: Ignore, Alarm, Test Stop. "Test stop & line off" is not available as long as FP-COMB 32 is selected in the "Output & Coupling Paths" menu. |
| Turn Line off | Not available as long as FP-COMB 32 is selected in the "Output & Coupling Paths" menu. |
| Sound | Acoustic signal when test ends |

Table 8-2: BURST properties description

After selection has been finished, the button "OK" must be confirmed and setting gets applied to the Burst generator.

8.2.3 Line Synchronization AC

To synchronize the Burst/EFT signal with the main supply source it is necessary to adjust in the menu "Synchronization" and then "External Sync". FP-COMB 32's sync output has to be connected to AXOS' sync input using the BNC cable delivered in the accessory kit. Further adjustments of the angle can be done in a range from 0° to 359°. However, if no power supply is connected to the EUT input at the rear view, it has to be entered "Async.", otherwise it is impossible to get an impulse of AXOS.

8.2.4 Phase order detection

In the "Output & Coupling paths" menu can be selected for each IEC and ANSI mode if one, two or three phases are used to power the EUT.

- For one or two phases application, no error message is displayed if the phases are swapped.
- If the three-phase mode is selected FP-COMB 32 checks if the phases are connected in the right order and displays an error message if two phases are swapped. If this is the case swap any two phases at the "EUT supply input" on the rear panel and restart the test.
- For DC applications user should select the radio button "1 phase".

9 Error messages

9.1 Error messages

In the menu is a short summary of specific possible alarm messages which can occur when operating the FP-COMB 32.

9.2 Troubleshooting

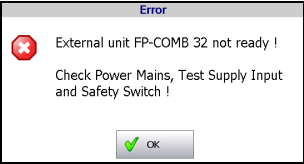
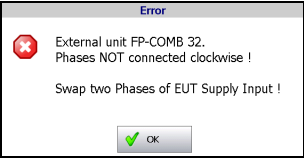
| Alarm message | Possible cause | Action needed |
|--|---|--|
|  <p>External unit FP-COMB 32 not ready ! Check Power Mains, Test Supply Input and Safety Switch !</p> | <ul style="list-style-type: none"> • FP-COMB 32 is switched off • Safety switch is open | <ul style="list-style-type: none"> • Power FP-COMB 32 on • Check safety switch |
|  <p>External unit FP-COMB 32. Phases NOT connected clockwise ! Swap two Phases of EUT Supply Input !</p> | Start test with wrong phase order | Swap two phases at the EUT supply input |

Table 9-1: Error messages

For other messages please refer to the AXOS manual.

10 Service

10.1 General information

10.2 Verification

In the next under captures are descriptions of our additional verification equipment for AXOS and FP-COMB 32. If further information required of any of the equipment, please either contact your sales representatives or the HAEFELY TEST AG technical support team directly.

10.2.1 Waveform OCV (Surge)

The HAEFELY PDP8000 is a differential impulse measurement probe that can be used to measure surge pulses. Two banana plug cables are provided as the High and Common inputs to the PDP8000, and a coaxial output is provided for connection to an oscilloscope. The divider ratio is 1000:1 and the PDP8000 is rated up to 8kV for surge, 690VAC or 400VDC. The two banana plug will be directly connected to “direct” or “line” output in the front view.

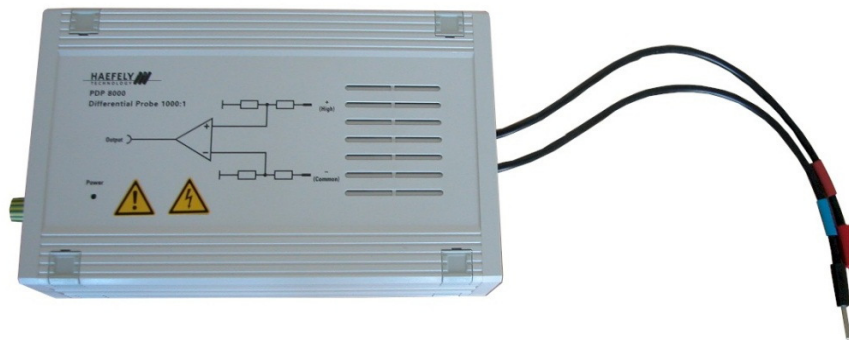


Figure 10-1: PDP 8000

10.2.2 Waveform SCC (Surge)

The current transformer is necessary to verify the SCC waveform. The outgoing BNC output creates the connection to the oscilloscope. The SCC gets displayed on the oscilloscope. It represents the signal in accordance to the IEC 61000-4-5. Significant: Do not connect the “EUT Supply Input” with external power supply at the rear view, when using the current transformer. It can be directly purchased through the HAEFELY TEST AG or contact your sales representative.



Figure 10-2: Current transformer

10.2.3 Electrical fast transient/Burst

The HAEFELY EFT Verification Kit includes a 50 Ω and 1000 Ω attenuator as required in the IEC 61000-4-4 standard. The appropriate attenuator is fitted to the "Burst" coaxial output, and an oscilloscope is then connected to the output of the attenuator. For measuring the waveform at the output of the coupling filter, single phase and three phase adapters are available. NOTE: Be sure to disconnect mains power from the "EUT Supply Input" before connecting the measuring attenuators. Measuring attenuators are designed for burst voltages only and will be destroyed if subjected to AC/DC voltage.



Figure 10-3: EFT Verification Kit

10.2.4 Burst verification adapter

Additionally, an EFT verification adapter is available for testing of every single phase (L, N, PE front view from AXOS[®]). It gets connected with the PE pin and every single phase (L1, L2, L3, N, PE Figure 5-1). The BNC output of the burst adapter is then connected to the oscilloscope. Do not connect "EUT Supply Input" to power supply, when verification of burst output.

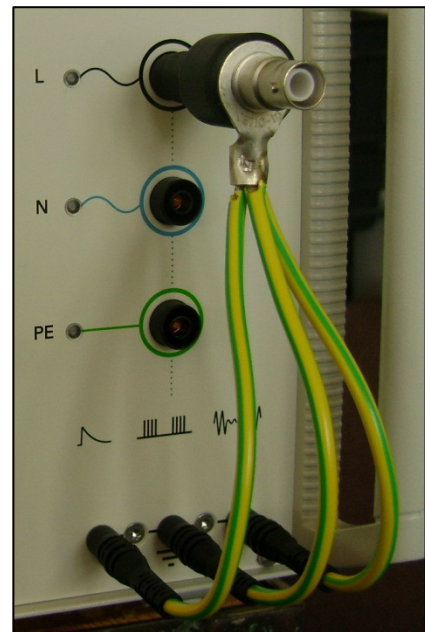


Figure 10-4: Burst verification adapter

10.3 Calibration

Calibration period of the FP-COMB 32 has to be determined by the user, and depends on the intensity of use and end user requirements. However, it is recommended every 2 years. The FP-COMB 32 is factory calibrated before shipped and supplied with the calibration certificate in accordance to ISO 9001 management standard. If required do contact HAEFELY for calibration in accordance to ISO 17025. It is done by one of the international calibration organizations.

10.4 Recycling

When the instrument reaches the end of its working life it can, if required, be disassembled and recycled. No special instructions are necessary for dismantling.

The instrument is constructed of metal parts (mostly aluminium) and synthetic materials. The various component parts can be separated and recycled, or disposed of in accordance with the associated local rules and regulations.

11 Accessories and Options

11.1 FP-COMB 32 accessories

| Article | Article number |
|---|----------------|
| 1m cable Red/Black for Surge/Ringwave signals | 4701031 |
| 1m SHV/SHV cable for Burst signal | 0938371 |
| 1m 50 Ohms BNC cable for synchronization signal | 0758941 |
| 1m SUB-D cable 37 conductors | 0781424 |
| 1m Earth cable AXOS to FP-COMB 32 | 2513271 |
| 2m banana cable black | 0781798 |
| 2m banana cable blue | 0781799 |
| 2m banana cable green | 0781800 |

Table 11-1: Accessories for FP-COMB 32

11.2 FP-COMB 32 options

| Article | Description | Article number |
|-------------|--|----------------|
| PDP 8000 | HV differential Probe 1000:1 for Surge | 2499911 |
| CP 101 | Current Probe Model for Surge | 2499931 |
| Calibration | Accredited Calibration | 2490926 |

Table 11-2: Article for FP-COMB 32

12 Additions

12.1 Addresses

12.1.1 International customer service

e-Mail: EMC-Support@haefely.com

Address: Haefely Test AG
Birsstrasse 300
4052 Basel / Switzerland

Fax : + 41.61.373 45 99
Internet: www.haefelyEMC.com

12.1.2 USA customer service

e-Mail: EMC-Support@haefely.com

Address: Hipotronics Inc.
Department EMC
1650 Route 22
Brewster, NY 10509 / USA

Telephone : + 845 279 3644
Fax : + 845 279 2467
Internet: www.haefelyEMC.com

12.1.3 China customer service

e-Mail: EMC-Support@haefely.com

Address: Haefely Representative Office
8-1-602, Fortune Street
No.67, Chaoyang Road, Chaoyang District
Beijing, China 100025

Telephone : +86 10 8578 8099 / 8199 / 8299
Fax : +86 10 8578 9908
Internet: www.haefelyEMC.com

12.1.4 India customer service

e-Mail: EMC-Support@haefely.com

Address: Burndy Technology and Global Business Pvt. Ltd
Kerala
Athulya, 1st Floor, Infopark, Kakkanad
682030 Kochi, India

Telephone : +91 4844241075
Internet: www.haefelyEMC.com

12.2 Manufacturer

E-Mail: EMC-Sales@haefely.com

Address: Haefely Test AG
Birsstrasse 300
4052 Basel / Switzerland

Telephone: + 41.61.373 41 11
Fax: + 41.61.373 49 12
Internet: www.haefelyEMC.com

12.3 Glossary of terms and abbreviations



Meaning: Helpful hints, notes, tips or remarks



Meaning: Attention!

| | |
|--------|--|
| EUT | Equipment Under Test |
| CDN | Coupling Decoupling Network |
| HV | High Voltage |
| LED | Light Emitting Diode |
| IEC | International Electro-technical Committee |
| EN | European Norm |
| ANSI | American National Standards Institute |
| EMC | Electro Magnetic Compatibility |
| EMV | German equivalent of EMC |
| DEC | Decoupling network |
| PCD | Coupling / Decoupling module (Electrical circuit for transferring energy between networks with the minimum loss and that attenuates the Surge signal so that it does not cause undue interference to equipment other than the EUT) |
| STBY | Standby |
| HV DC | High Voltage Direct Current |
| Hybrid | Same as Combination |
| f.s.d. | full scale deflection |

12.4 Reference

- [1] IEC 61000-4-5 Testing and measurement techniques-Surge immunity test, part 4-5, edt.2, 2005/11
- [2] IEC 61000-4-4 Testing and measurement techniques – Electrical fast transient/burst immunity test, part 4-4, edt.2, 2004/07
- [3] IEC 61000-4-11 Testing and measurement techniques-voltage dips, short interruptions and voltage variations immunity tests, part 4-11, edition. 2, 2004/03
- [4] IEC 61000-4-12 Testing and measurement techniques – Ring Wave immunity test, part 4-12, edt. 2, 2006/9
- [5] ANSI C62.41

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13 Appendix

13.1 CE conformity



Declaration of Conformity

Haefely Test AG
Birsstrasse 300
4052 Basel
Switzerland

declare, under his own responsibility, that the product here mentioned, complies with the requirements of the listed standards or other normative documents.

So, the product complies with the requirements of the EMC directive 2004/108/EC and the low voltage directive 2006/95/EC.

Product: **External 3 phases CDN – FP-COMB32**

Description: The FP-COMB32 CDN is used to test 3 phases-powered EUT by coupling burst, surge and ringwave impulses from AXOS5 or AXOS8.

Standards: EN 61010-1: 2010
EN 61326-1: 2013

R. Schönbucher
Quality Department Manager
Haefely Test AG
4052 Basel
Switzerland

Basel, Mai 14, 2014

A handwritten signature in blue ink, appearing to read 'R. Schönbucher', written over a horizontal dotted line.

(Signature)

Haefely Test AG, Birsstrasse 300, CH-4052 Basel / Switzerland
www.haefely.com