SPECIFICATION

eKAM

Electronic primary injection test system

DOCUMENT No. SIE49175, Rev. 3 March 2020

TABLE OF CONTENTS

SPECIFICATIONS **1**

1 GENERAL **7**

2 APPLICABLE STANDARDS **14**

3 CHARACTERISTICS **16**

3.1 HIGH POWER GENERATOR 16
3.1.1 Output frequency *16*
3.1.2 Other features of high powergenerator *16*
3.2 EXTERNAL INPUTS MEASUREMENT 17
3.3 TIMER 17
3.4 PHASE ANGLE 18
3.5 OTHER MEASUREMENTS 18
3.6 DISPLAY 19
3.7 TEST CONTROL 19
3.8 MENU SELECTIONS 19
3.9 STANDARD CONNECTION CABLES 26
3.10 OTHER CHARACTERISTICS 27

4 OPTIONS **28**

4.1 TRANSIT CASES (CODE PII37175, PII51175) 28
4.2 PADS LICENSE (CODE PII10176P) 29
4.3 REMOTE SAFETY SWITCH (CODE PII42175) 29
4.4 WARNING STROBE LIGHT (CODE PII43175) 30
4.5 BUX 2000, BUX 3000, BUX 5000 CURRENT BOOSTER (CODES PII56175, PII50175, PII63175) 31
4.6 STEP & TOUCH TESTING KIT (CODE PII81175) 34
4.6.1 STLG current injection power transformer for ground tests (code PII70175) *34*
4.6.2 Cable set for STLG (code PII75175) *34*
4.6.3 Transport case for STLG (code PII19175) *35*
4.6.4 STSG safety grounding module(code PII71175) *35*
4.6.5 Transport case for STSG (code PII80175) *35*
4.6.6 Ground Grid Test Accessories Kit (code PII76175) *36*
4.7 CYLINDRICAL STUDS (CODE PII72175, PII73175, PII74175) 37
4.8 FOLDABLE TROLLEY (CODE PII18175) 38
4.9 POWER FACTOR CORRECTION MODULE FOR STLG (CODE PII85175) 38
4.10 SURGE ARRESTER FOR STSG (CODE PII77175) 38
4.11 CURRENT CLAMP METER FOR STLG AND STSG(CODE PII79175) 39

5 PROTECTIONS **40**

Page left intentionally blank.

Disclaimer

Every effort has been made to make this material complete, accurate, and up-to-date. In addition, changes are periodically added to the information herein; these changes will be incorporated into new editions of the publication.

ISA reserves the right to make improvements and/or changes in the product(s) and/or the program(s), described in this document without notice, and shall not be responsible for any damages, including but not limited to consequential damages, caused by reliance on the material presented, including but not limited to typographical errors.

Copies, reprints or other reproductions of the content or of parts of this publication shall only be permitted with ISA prior written consent.

All trademarks are the property of their respective holders.

Copyright 2020© ISA S.r.l. Italy - All rights reserved

Page left intentionally blank.

1 GENERAL

The portable, high power, test set eKAM connected to a BUX high current generatorallows performing tests foreseen by international Standards on CTs and on high current relays. With the option STLG + STSG it is also possible to execute Earth Resistance, Step and Touch and Line Impedance measurements.

Keyboard, dedicated keys, control knob and display can control the test set. Test results and settings can be saved in a PC by the software suite TDMS, which comes with the device. The optional PADS program allows also controlling the device from the PC.

The following table lists the tests performable by the Current Transformers:

No.	Test
1	Ratio Polarity and Burden
2	Ratio IEC61850-9-2LE

Table 1 - Current Transformer tests

BUX is one of the three available options: BUX 2000 (for tests up to 2.000 A), BUX 3000 (for tests up to 3.000 A), BUX 5000 (for tests up to 5.000 A). The Ratio test for Not-Conventional transformer with the option IEC61850-9-2LE is available only in remote control mode, using the PADS software.

The Ratio test for Not-Conventional transformer with the option IEC61850-9-2LE is available only in remote control mode, using the PADS software.

Tests on CTs are performed in accordance with the following standards:

- IEC EN 60044-1
- IEC EN 61869-2
- ANSI/IEEE C57.13.1

Earth resistance and step and touch tests are performed according to the following standards:

- IEC EN 50522:2011
- IEEE 80:2000
- IEEE 81:1983
- DIN VDE 0101
- CENELEC HD 63761

eKAM has the facility to test (CT ratio and polarity) not conventional CT equipped with the IEC 61850-9-2 (SV) protocol.

eKAM generates current into the primary side of the CT under test and then reads the data (Sample Values) from the network using the SW PADS connected to its Ethernet port.

The following table lists the optional modules that enhance the eKAM features:

Item	Option	Code	Description
1	Transit Cases	PII37175 PII51175	They allow transporting the device and the BUX unit
2	PADS license	PII10176P	PC Remote control of the test set
3	Remote Safety Switch	PII42175	When the Remote Safety Switch is connected and enabled, it avoids any current or voltage generation from pressing START/STOP button on the eKAM only
4	Warning Strobe Light	PII43175	It alerts when the test is performed
5	BUX 2000 BUX 3000 BUX 5000	PII56175 PII50175 PII63175	These options perform high current tests, with currents up to 2.000 A (BUX 2000), 3.000 A(BUX 3000) or 5.000A and 7.000A (BUX 5000)
6	Step & Touch testing kit	PII81175	Kit elements: • STLG Line & Ground Grid module (100 A booster), code PII70175 • Cables set for STLG, code PII75175 • Heavy duty plastic transport case for STLG, code PII19175 • STSG Safety grounding module, code PII71175 • Heavy duty plastic transport case for STSG, code PII 80175 • Step & Touch, Earth resistance/resistivity accessories, code PII76175
7	Studs for Test & Touch testing kit	PII72175 PII73175 PII74175	• Stud 20 mm • Stud 25 mm • Stud 16 mm
8	Foldable Trolley	PII18175	The trolley eases the transport of eKAM
9	Power factor correction module	PII85175	Module to increase the current in the grounding and Step and Touch tests (for STLG option)
10	Surge arrester for STSG	PII77175	Surge arrester spare parts
11	Current Clamp meter	PII79175	To measure the current flowing into the ground connections (for STSG and STLG options)

Table 1 - Optional modules

The basic eKAM function is to generate currents (through BUX),or voltages (through STLG), as requested by the type of test to be performed; only one test at a time. The test is selected on the LCD screen by means of the multi-function knob. Test results are kept in local memory or in a USB pen drive, and can be transferred to a PC later, along with settings.

The external options BUX 2000, BUX 3000, BUX5000 or STLG are supplied by theeKAM high power AC voltage output, (called EXT. BOOSTER);this output it is not insulated from the mains.

In local control mode, the selected output is adjustable and metered on the large, graphic LCD display. With the control knob and the LCD display it is possible to enter the MENU mode, which allows setting many functions: this makes eKAM a very powerful testing device, with manual and automatic testing capabilities, and with the possibility to transfer test results to a PC via ETHERNET or Pen Drive.

In the PC control mode, the PADS program allows performing the same tests as in the local mode, with the same control windows. It allows also downloading, displaying and analyzing test results obtained in local mode.

PADS operates with all WINDOWS versions.

The ease of operation has been the first goal of eKAM: this is why the LCD is graphic, and so large. With it, the dialogue in menu mode is made easy. Besides, all eKAM outputs relevant to the selected test are continuously measured, and output values are displayed, with no extra effort to the operator.

Four measurement inputs are available on the eKAM front panel:

- DC voltage, up to 10 V DC
- AC or DC voltage
    - High range, up to 300 V
    - Low range, up to 3 V
- AC or DC current, up to 10 A

All inputs, unless the 3 V and 300 V voltage measurements, are isolated among them, and allow measuring CT outputs or any other source.

It is available also a binary input, that can be configured as dry (voltage free) or wet (maximum input voltage 300 V).

This input it's used to measure the time delay of a contact coming from a relay or other devices.

The instrument is housed in a transportable aluminum box, which is provided with cover and handles for ease of transportation. An optional trolley is also available.

The following image exhibits the eKAM, with the protection cover lifted:



Figure 1–eKAM

The following image exhibits the front panel:

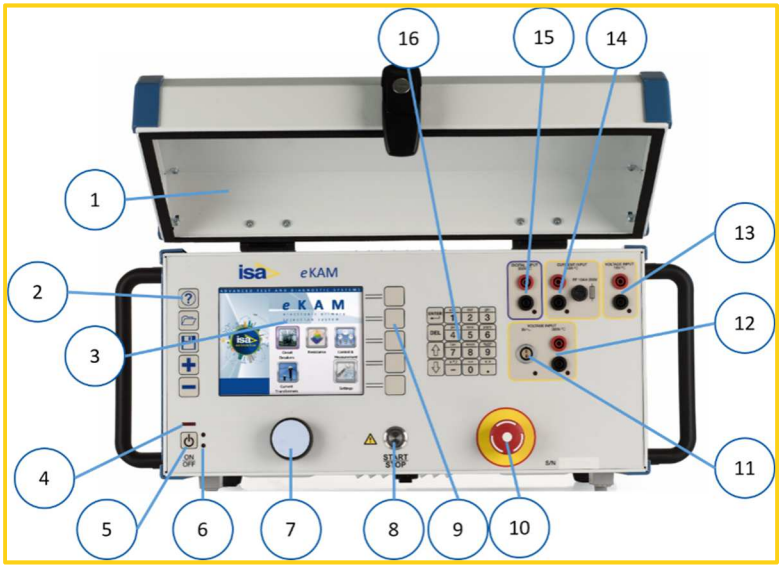


Figure 2 - Test set front panel

The following table lists all the elements of the front panel:

ITEM	Component		
1	Cover		
2	Pushbuttons		Help. Pressing it, the screen displays the information related to the test performed
			Open file. It allows to access the list of saved test results (the list can be located in the internal memory or on the USB key)
			Save file. It allows saving the test result. Pressing it, it is possible to access the list of saved test results (the list can be located in the internal memory or on the USB key)
			Increment and decrement buttons. To input a value, select the field, and then: • Edit the desired value, via the keypad • Increment or decrement the value, pressing the above pushbuttons • Rotate the knob clockwise (increment) or anti-clockwise (decrement) • Press the keyboard up key to increment, and the keyboard down key to decrement The amount of the increment or decrement is: ten units, for the plus and minus keys; one unit, for the knob, and one tenth, for the up-down arrows
			
3	Display		
4	Power-on light: it is ON when the test set is operating		
5	Power ON and OFF push-button		
6	Mains lights: they turn on very shortly as the test set is connected to the mains		
7	MENU control knob, with switch		
8	Test START and STOP push-button		
9	5-keys keyboard for menu functions		
10	Emergency push-button with lock-in		

Table 2 - Frontal panel components (1/2)

<table>
<tr><th>ITEM</th><th colspan="3">Component</th></tr>
<tr><td>11</td><td colspan="3">AC voltage input connector, up to 3 V. The LED turns ON when it is active
 ATTENTION: The connector to this input can be removed only acting on the connector body. Do not pull the cable</td></tr>
<tr><td>12</td><td colspan="3">AC or DC voltage input sockets, up to 300 V. The LED turns ON when it is active</td></tr>
<tr><td>13</td><td colspan="3">DC voltage input sockets, up to 10 V. The LED turns ON when it is active</td></tr>
<tr><td>14</td><td colspan="3">AC or DC current input sockets, up to 10 A, fuse protected. Fuse rating: FF 10 A 250 V. The LED turns ON when it is active</td></tr>
<tr><td>15</td><td colspan="3">Digital input sockets, dry or wet up to 300 V. The LED turns ON when the input is closed or with voltage</td></tr>
<tr><td>16</td><td>keyboard16 keys</td><td></td><td>• The twelve buttons to the right behave as a portable phone
• ENTER confirms what is edited
• DEL
  • If the field is numeric, it deletes the first digit to the left. It is not possible to select the digit to delete; as the wheel is touched, the digit changes
  • If the field is alphabetic, it is possible to use the knob to reach for the letter to be deleted: the deleted letter is the one to the left with respect to the cursor. If the cursor is completely to the left, DEL deletes the letter to the right
• As explained above the arrows, when the context is numeric, increment or decrement the value; in a selection page, they allow to move around</td></tr>
</table>

Table 3 – Frontal panel components (2/2)

The following image exhibits the side panel on the right:

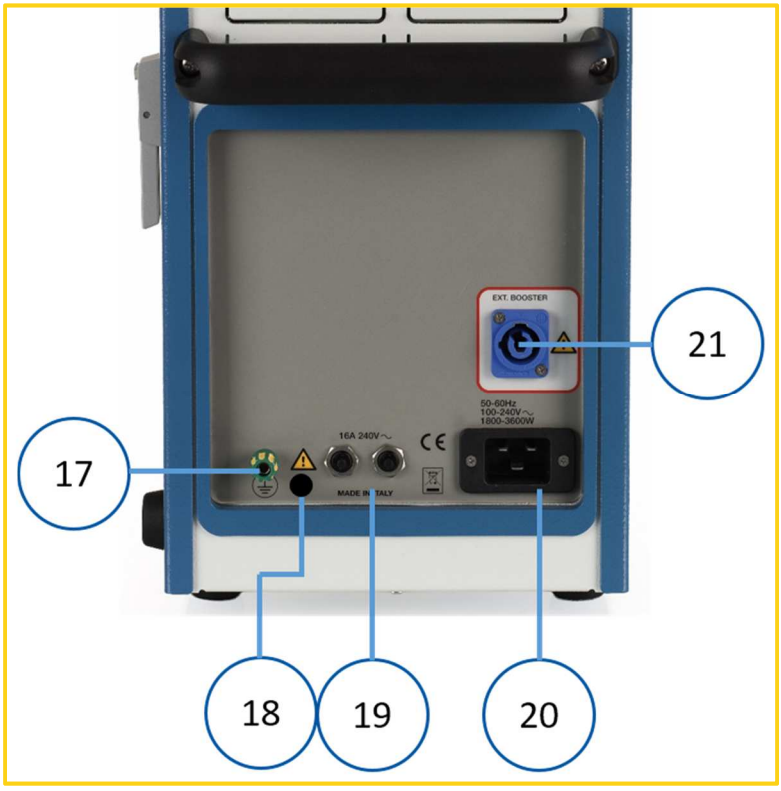


Figure 3 - Right panel components

The following table lists the elements of the right panel:

ITEM	Component
17	Ground connection socket
18	F6 fuse
19	Resettable power supply automatic fuses, rated 16 A 240 V
20	Power supply plug
21	Power supply connection to external optional modules (BUX2000, BUX3000, BUX5000, STLG)

Table 4 – Right panel components

The following image exhibits the side panel on the left:

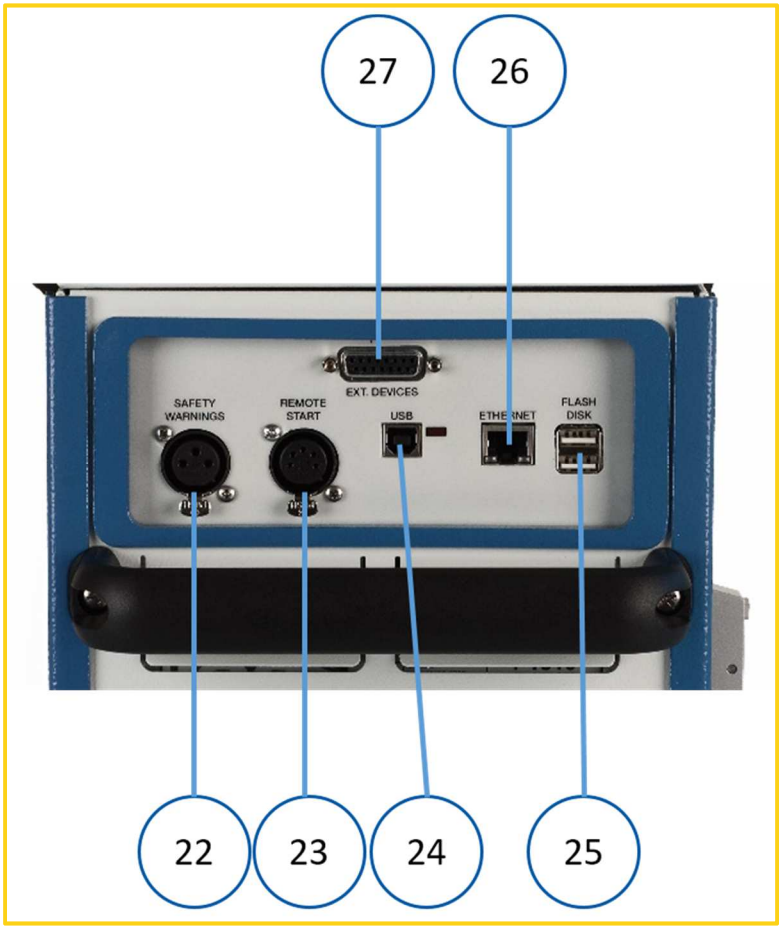


Figure 4 – Left panel components

The following table lists the elements of the left panel:

ITEM	Component
22	Alarm output connector, for the light strobe with buzzer option PII43175
23	Remote start input connector, for the remote push-button option PII42175
24	USB connection (for internal purposes only)
25	Flash disk connector for the local test results saving or for moving the local test results from the local memory
26	ETHERNET connection to the PC. It incorporates two lights which turn on when the test set is connected
27	Connector (for internal purposes only)

Table 5 – Left panel components

2 APPLICABLE STANDARDS

The test set conforms to the EEC directives regarding Electromagnetic Compatibility and Low Voltage instruments.

The following table lists the standards related to the EMC Directive, 2014/30/UE:

Standard	Title	Requirement
EN 61326-1	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements	
IEC EN 61000-3-2	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	Harmonic content of power supply Acceptable limits: basic
IEC 61000-3-3	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection	Limitation of voltage fluctuations and flicker Acceptable limits: basic
CISPR 16-1	Specification for radio disturbance and immunity measurement apparatus and methods	Acceptable limits for conducted emission: • 0,15÷0.5 MHz: 79 dB pk; 66 dB avg • 0,5÷5 MHz: 73 dB pk; 60 dB avg • 5÷30 MHz: 73 dB pk; 60 dB avg Acceptable limits for radiated emission: • 30÷230 MHz: 40 dB (30 m) • 230÷1.000 MHz: 47 dB (30 m)
IEC EN 61000-4-2	Electromagnetic compatibility (EMC)- Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	Immunity tests for ESD Test values: 8 kV in air; 4 kV in contact
IEC EN 61000-4-3	Electromagnetic compatibility (EMC)- Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	Immunity tests for radio frequency interference Test values (f= 900±5 MHz): field 10 V/m, modulated AM 80%; 1 kHz
IEC EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	Immunity tests for high speed transients (burst) Test values: 2 kV peak; 5/50 ns
IEC EN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	Immunity tests for surge Test values: 1 kV peak differential mode; 2 kV peak common mode; 1.2/50 us
IEC EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	Immunity to low-voltage sinusoidal waveform Test values: 0.15-80 MHz, 10 Vrms, 80% AM 1 kHz
IEC EN 61000-4-8	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	Immunity tests for low frequency magnetic fields. Test values: 30 Arms/m
IEC EN 61000-4-11	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	Immunity test for power supply drops. Test value: 1 cycle; 100% drop

Table 6 – Standards related to the EMC Directive

The following table lists the standards related to the LV Directive, 2006/95/EC:

Standard	Title	Requirement
IEC EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements	For a pollution degree 2: dielectric rigidity 1,4 kV AC, 1 minute The rigidity is 4600 V AC 1 minute between the high voltage output and the rest of inputs and outputs. • Inputs/outputs protection: IP 2X, per IEC 60529, for all but high voltage outputs; IP4X for high voltage outputs • Insulation resistance, at 500 V DC: > 10 MΩ • Ground resistance, at 200 mA DC: < 0,1 Ω • Operating temperature: (-10÷55) °C; storage: (-20÷70) °C • Operating relative humidity: 5÷95%, without condensing. Storage relative humidity: 0÷96%, without condensing • Altitude: less than 2.000 m
IEC 60068-2-6	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	Vibration: 20 m/s^2 at 10÷150 Hz
IEC 60068-2-27	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	Shock: 15 g; 11 ms; half-sine

Table 7 - Standards related to the LV Directive

3 CHARACTERISTICS

3.1 High power generator

Output adjustment is performed automatically, as a function of the selected test.

For the high power output to the external modules, the following applies:

- **Type of generator**. Electronic type D switching amplifier
- **Output adjustable** from zero to the maximum value(0÷220) V AC
- The specified **output power** is available at 25°C maximum of external temperature, and with a power supply error of 2% maximum. For higher temperatures, the maximum power decreases of 20 VA/°C
- The specified **output characteristics** may vary for frequencies below 50Hz and above 60 Hz
- The **generated frequency** can be synchronized with the mains (for STLGwith the Power Line Synchronizer option)

The output feeds the external modules BUX 2000, BUX 3000,BUX5000 orSTLG.

Other output characteristics:

Insulation	Output not insulated from the mains supply. The insulation it's provided by the external modules
Output voltage	Adjustable in the range (0÷220) V AC
Output power	Supply 230 V: 1.500 VA steady, 4.000 VA during 5 minutes; 5.000 VA during 25 s
	Supply 110 V: 1.360 VA steady, 2.500 VA during 1 minute; 3.150 VA during 25 s

Table 8 – High power generator: output characteristics

This output goes to a safety connector.

3.1.1 Output frequency

The following table lists features of the output frequency:

Frequency	15÷500 Hz
Frequency resolution	10 mHz
Frequency accuracy	< 100 ppM (for BUX, output current>200 A)

Table 9 – High power generator: frequency range

3.1.2 Other features of high powergenerator

The following table lists other features of main outputs:

Zero crossing control	The generation starts and stops on the zero crossing
Over-current	Alarm message
Thermal protection	For: Power supply, Power amplifier, Power transformer. The operator is alerted by a message

Table 10 – High power generator: other features

3.2 External inputs measurement

Four metering inputs are available in eKAM, insulated between them and with respect to the rest of the test set:

- AC or DC current, up to 10 A, with two 4 mm safety banana sockets. This input is also protected by a FF10A fuse
- AC voltage, with two independent connections, in alternative:
    - High range, up to 300 V AC (four ranges with automatic selection), with two 4 mm safety banana sockets
    - Low range, up to 3 V AC (three ranges with automatic selection), with a shielded connector
- DC voltage, up to 10 V DC (four ranges with automatic selection), with two 4 mm safety banana sockets. On the same sockets is also available an Ohmmeter, for the 2-wire resistance measurements from 0,1÷20 kΩ

Above inputs allow measuring CT outputs or any other source. The selected input is shown in the front panel with a LED. All inputs have two or more metering ranges, with automatic range selection. Resolution and accuracy:

Input	Range	Impedance	Resolution	Typical error		Guaranteed error	
				[<%rdg]	[<%rg]	[±%rdg]	[±%rg]
AC current	10 A 1 A	0,1 Ω	1 mA 0.1 mA	<0,05%	<0,05%	±0,10%	±0,10%
DC current	10 A 1 A	0,1 Ω	1 mA 0.1 mA	<0,03%	<0,08%	±0,05%	±0,15%
High AC voltage range (sockets)	300 V 30 V 3 V 300 mV	500 kΩ	15 mV 1,5 mV 0,15 mV 0,015 mV	<0,05% <0,05% <0,10% <0,15%	<0,05%	±0,10% ±0,10% ±0,20% ±0,30%	±0,1%
Low AC voltage range (connector)	3 V 300 mV 30 mV	10 MΩ	150 µV 30 µV 3 µV	<0,03% <0,08% <0,1%	<0,05% <0,08% <0,25%	±0,05% ±0,15% ±0,2%	±0,10% ±0,15% ±0,50%
DC voltage	10 V 1 V 100 mV 10 mV	500 kΩ	400 µV 75 µV 4 µV 0.4 µV	<0,03% <0,03% <0,05% <0,05%	<0,08% <0,08% <0,10% <0,15%	±0,05% ±0,05% ±0,10% ±0,10%	±0,15% ±0,15% ±0,20% ±0,30%

Table 11 - Resolution and accuracy

3.3 Timer

The eKAMis able to measure a time delay coming from a relay or other device through its binary input.

At the test start with voltage or current generation, a timer is started; the timer stops when the relay has tripped. It is also possible to start or stop the timer when the voltage on analog inputs 10V or 300V is greater or lower of a specified value.

Characteristics of the Digital input:

- The input is insulated with respect to all other inputs and high power output
- The input may be selected as Normally Open or Normally Closed
- The timer can start from an analog input (current or voltage)
- The timer can start and stop at the changing of the binary input, programmed as dry or wet
- Type of input: dry or wet. If wet maximum input voltage: 300V DC
- With the dry input selection, the wetting voltage is 24 V nominal (unregulated); the test current is greater than 2 mA nominal. With a resistance less than 200 kΩ the contact can be seen closed
- With the voltage input selection (wet), four thresholds can be selected: 5 V, 24 V, 48 V or >100 V
- When the input is closed or with voltage, an LED on the front panel turns on
- Wrong selection protection. If a voltage is applied when dry input is selected, input circuits are not damaged, if the voltage is less than 300 V
- Input connection: two 4 mm banana safety sockets
- Time measurement: elapsed time between the test start and the Digital input
- Timer resolution: 1 ms
- Timer accuracy, digital input: ±0,01% of the measurement ±0,1 ms, for inputs lasting more than 1 ms
- Maximum measured time: 9.999 s

3.4 Phase angle

The test set measures the phase angle between the two AC selected parameters, which are used during the test.

The following table lists the resolution and the accuracy:

Measurement	Range	Resolution	Accuracy
Phase	(0÷360) °	0,01 °	Typical ±0,15° Guaranteed ±0,3°

Table 12 - Phase angle resolution and accuracy

The angles accuracy is valid for values greater than 10% of the measurement range used.

Phase shift variation (temperature function)angle temperature drift: ±0,002 °/°C.

3.5 Other measurements

Starting from the internal and external measurements, the test set computes derived measurements, according to the test selection.

The following table lists the available measurements (the accuracy is the sum of voltage, current and possibly angle accuracy):

No.	Parameter/AC outputs	Derived from	Formula	Units
1	CT Ratio	I_{out}, I_{in} or V_{out}, V_{in}	$Rat=I_{out}/I_{in}$ $Rat=V_{out}/V_{in}$	-
2	CT Polarity	φ I_{out}, I_{in} or φ V_{out}, V_{in}	K => φ < 10 °	-
3	CT Burden	V_{out}, I_{out}	$VA=IN^2 \cdot V_{out}/I_{out}$	VA

Table 13 - Available measurements

The following table lists the parameters for the CT ratio measurement:

Range	Resolution	Ratio range	Typical accuracy	Maximum accuracy
0÷9.999	1	0.8÷166	0,20%	0,40%
		167÷1.666	0,25%	0,50%
		1.667÷9.999	0,30%	0,60%

Table 14 - Parameters for CT ratio measurement

For the polarity test, the phase shift between the two parameters is tested. Answer is OK if phase shift is less than 10°. The ratio and the polarity are checked also for non-conventional transformers through IEC61850-9-2LE protocol.

3.6 Display

The following image exhibits the eKAM display:



Figure 5 - eKAM display

The following table lists the main features of the display:

Pixel	Light	LCD type	View area
640x480, colors	Backlight	TFT	132x99 mm

Table 15 - Main features of the display

3.7 Test control

Test control: by the START/STOP pushbutton. Pressing it, the output is generated, after test selection, according to the type of test. During ON, if a manual control test is selected, the operator adjusts the output at the desired value.

Test saving:

- Automatic save
- After operator confirmation

3.8 Menu selections

The following image exhibits the Home page of the test set of the Test Plan Editor:



Figure 6 – Home page

The menu is entered pressing the knob and selecting the item moving the knob.

The Test Plan Editor is an innovative and advanced software module, allowing the operator to define and plan a sequence of tests. The operator defines the desired sequence of tests and sets the parameters of each test: the Editor creates a sequence of tests to be performed automatically. The feature is available for the tests of Current, Voltage and Power transformers.

Test plans can be saved or recalled, like test results. Up to 64 settings can be stored and recalled; setting no. 0 is the default one, and pops up at power-on. Settings are permanently stored in the memory; new settings can be written to the same address after confirmation. For normal mode operation it is possible to recall the standard setting, which cannot be modified.

For instance, in the Home page select the icon “Current Transformers” and press the knob:



Figure 7 – “Current Transformers" icon

The following image exhibits the “Current Transformers – Header and Nominal Values” page (tab Description), visible at first time in which entering this section, or pressing the button “Header/Nominal Values”:

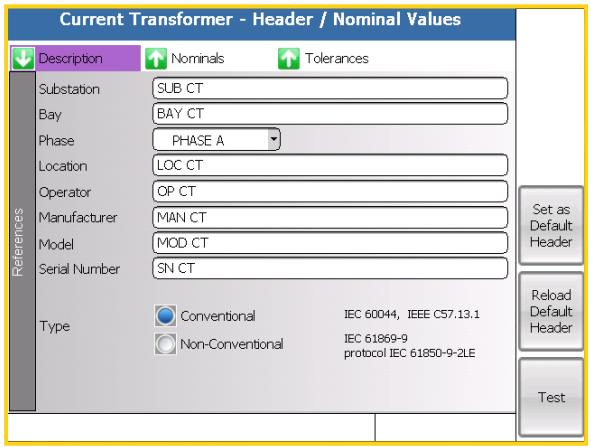


Figure 8 - "Current Transformers/Header and Nominal Values" page (tab Description)

The following image exhibits the tab “Nominals” (Conventional Type without the IEC61850-9-2LE output):

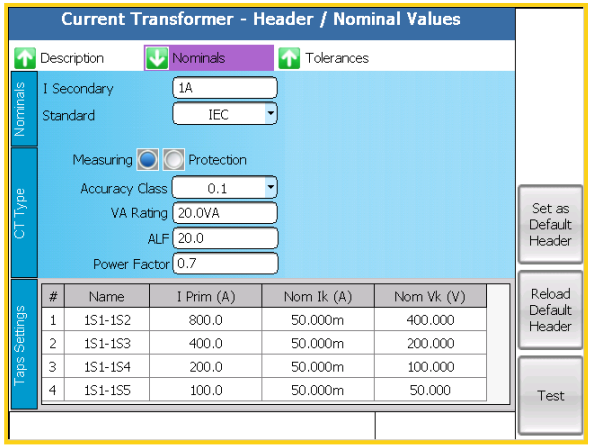


Figure 9 - "Current Transformers/Header and Nominal Values" page (tab Nominals)

From these nominal data, the program computes the nominal saturation knee.

The following image exhibits the tab “Tolerances”:

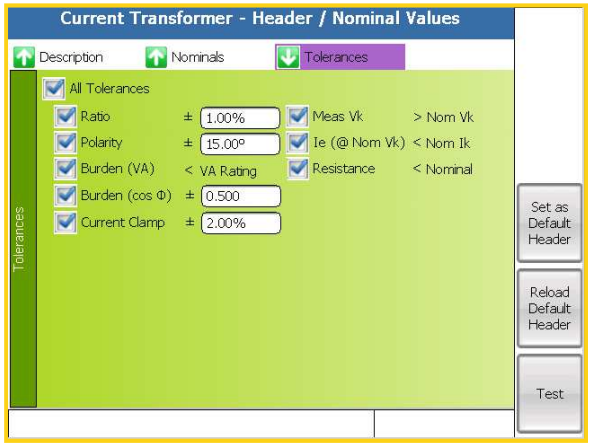


Figure 10 - "Current Transformers/Header and Nominal Values" page (tab Tolerances)

The page allows setting the tolerances for each of the available tests. If the tolerance is exceeded, the deviation is shown in the test result table.

After having set this basic information, pressing the shortcut “Edit Test Plan” at the side of the icon and enter the Editor mode; else, it is possible to continue with a single test.

The following image exhibits the “Current Transformers” test page (Conventional Type):

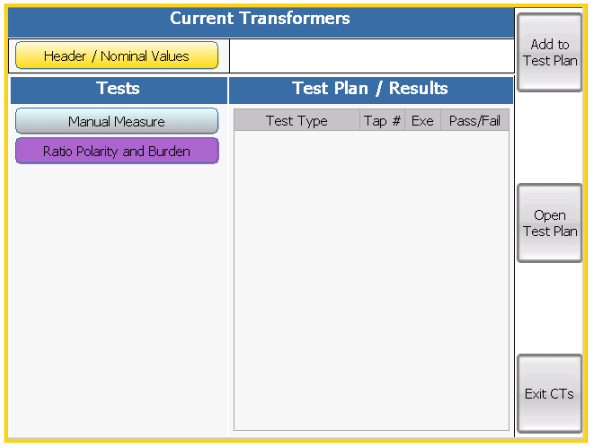


Figure 11 - "Current Transformers" test page (Conventional Type)

The page allows selecting the test to be performed: the corresponding window is opened, and test parameters can be programmed

For instance, the following image exhibits the “CTs – Ratio Polarity and Burden Current Method” page:

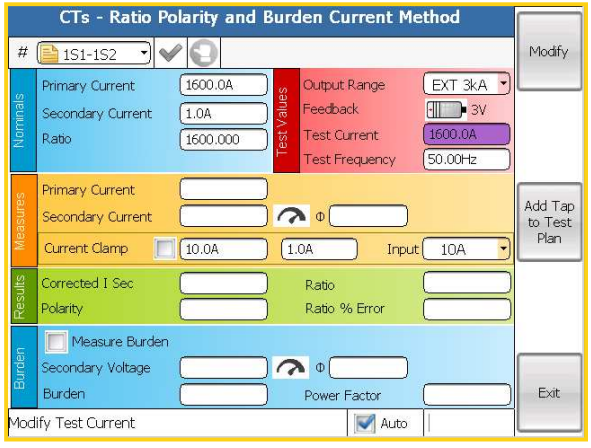


Figure 12 - "CTs – Ratio Polarity and Burden Current Method" page

As the test programming is finished, pressing the shortcut “Exit” by the side of the icon, it is possible to come back to the test selection table. Pressing here the shortcut “Exit Ct’s” by the side of the icon, it is possible to come back to the main menu, and the Editing is finished.

At the end of the programming, starting the first test, the test set executes the complete sequence. During the test, test results are stored in the memory.

At the end of the tests, settings and results can be downloaded to a PC, with PADS program included in the TDMS suite, which comes with the device. The software allows saving test results into a file, examining them, printing them.

Optionally, PADS allows controlling the device from the PC. It is also possible to edit settings with PADS, and to upload them to STS.

In general, the test is performed ramping the parameter until the desired value is reached; after the necessary test duration, the parameter is reduced to zero.

The following tables summarizes all tests and the corresponding performances.

The following table lists the Current Transformers tests (eKAM connected to BUX option):

No.	Test	Test description
1	Ratio Polarity and Burden	The ratio measurement is performed applying high current to the CT primary, and measuring the CT secondary current. The burden can be by-passed, or left in series for the measurement: in this instance, the voltage drop is measured. The secondary current can be measured by a clamp. Input parameters are the following: • The nominal primary and secondary current, from which the program computes the nominal ratio • The nominal test current The display shows: • The actual current output • The corresponding current input, and the value of the secondary current with the nominal primary current* • Actual ratio and ratio error • Phase shift and polarity* When the burden is tested, the following parameters are displayed • The voltage-drop across the burden • For the burden: VA rating at the nominal current, angle, power factor *For Non - CT transformers equipped with IEC61850-9-2LE interface, the eKAM reads the CT samples output from its Ethernet interface to measure ratio and polarity
2	Ratio IEC61850-9-2LE	Ratio measure and currents polarity for Not Conventional Transformers. The test is executed applying current to the primary side and reading the corresponding “Sample Values”. The test is executed using the test set remote connection with the PC, using the PDS program. Input parameters are the following: • Nominal primary current • Test current and frequency • The sender MAC address • The recipient MAC address • The svID (sample value ID) • The Stream Number The results are the following: • The primary current • The measured Sample Values • The angle between the primary current and the Sample Values • Corrected primary current, polarity, error ratio and error %

Table 16 - Current Transformers tests

The following table lists other possible tests on circuit breaker (eKAM connected to a BUX option):

No.	Test	Test description
1	Primary and secondary M.V. CB and relay tests	The selection allows injecting the test parameter, and measuring the relay threshold and trip delay. The tests are feasible using the trigger input logic, or by stopping the test when the current disappears (M.V. CB). With the option BUX 2000, BUX 3000 and BUX5000 it is possible to perform high current tests. Input parameters are the following: • Current range, output current • Frequency It is possible set the type of digital input (NO-NC, wet-dry, voltage threshold). The display shows the following data: • Test current or test voltage • Trip delay • External voltage and current measurements

Table 17–Test on a circuit breaker

The following image displays a test executed on an overcurrent relay referred to a circuit breaker with a trigger stop on a binary input:

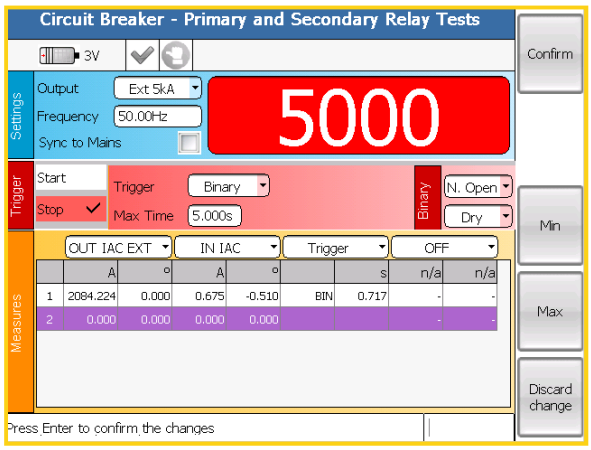


Figure 13 - Test executed on an overcurrent relay

The following table lists the Resistances tests (eKAM connected to STLG option):

No.	Test	Test description
1	Earth Resistance	For the resistivity test, input parameters are the following: • Test voltage • Test frequency The measurements are narrow filtered in order to reduce the noise, coming from the environment. Input parameters are the following: • Output voltage range • Test voltage • Test frequency The display shows the following: • Test probe distance • Output voltage • Test probe voltage • Output current • Phase shift • Earth resistance • Evaluation Ground Resistance Values: from 0,05 Ω to 300 Ω The test of ground grid resistance is performed applying current between the ground grid and the auxiliary ground spikes. Normally with the STLG option the test is performed using an overhead line to connect to the remote ground
2	Step and Touch	The step and touch voltages test is performed applying current between the ground grid and the auxiliary ground spikes, and measuring the step or touch voltage with the test probes. With the STLG option, the current generation is performed using an overhead line to connect to the remote ground. Thanks to the STLG option, higher test currents can be achieved. Input parameters are the following: • Substation fault current • Fault clearance time • Parallel resistance on the test probes Other selections are the following: • Output voltage range • Test voltage • Test frequency • Selection the current range Last, the operator selects the measurement mode: manual or on STS and the reference standard. The display shows the following: • Test current • Location description • Location coordinates • Measured voltage • Voltage in case of actual fault

Table 18 - Resistances tests (1/2)

No.	Test	Test description
3	Line Impedance	Test parameters are the following: • Line impedance • Earth impedance • Mutual factor The test is performed applying voltage to the line to be tested, and measuring the corresponding current and voltage. The test is performed with the STLG option. Input parameters are the following: • Type of test • Phase under test • Frequency For the line impedance test, the display shows the following data: • Test voltage • Test current • Line impedance, argument, R and X components For the earth impedance test, the display shows the following: • Test voltage and current • Impedance and argument of: Z, ZL, ZE, earth coefficient KE For the mutual factor test, the display shows: • Module and phase of the mutual factor • ZL module and resistive component • External voltage, current, phase angle

Table 17– Resistances tests

The following image exhibits the “Resistance” test page:

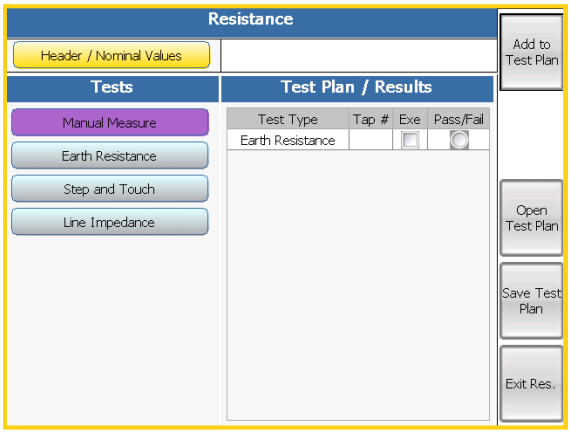


Figure 14 - “Resistance” test page

The following images exhibit the “Earth Resistance” test page and “Step and Touch” test page:

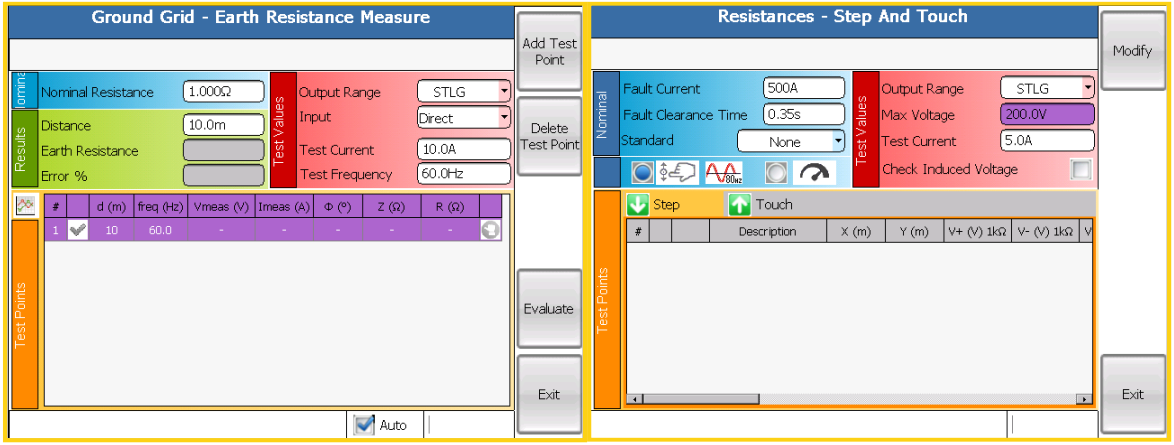


Figure 15 - “Earth Resistance” test page and “Step and Touch” test page

3.9 Standard connection cables

The following table lists the supplied standard connection cables:

Item	Description
1	No. 1 Mains supply cable, 2 m long
2	No. 1 Grounding cable, 6 m long, 6 mm^2, terminated on one side with a terminator, and on the other side with an earth connection clamp (No. 2 cables for the option PII57175)
3	No. 1 Interface cable for the USB port
4	No. 1 ETHERNET interface cable
5	No. 1 USB pen drive
6	No. 1 cable for the 10A measurement to be connected to the secondary of the CT 2,5 mm^2, 10 m long
7	No. 4 crocodiles for measurements connections (2 red, 2 black)
8	No. 1 adaptor for 10V input - measuring BUX cable
9	No. 2 short cables, 2m long (red and black), for other measurements.
10	No. 1 cable for voltage measurements 1 mm^2, 10 m long

Table 18 - Cables provided with the unit

3.10 Other characteristics

The following table list other characteristics of the eKAM:

Item	Characteristic	Description
1	Memory	• Up to 64 test plans • More than 1.000 test results
2	Interfaces	• ETHERNET for the PC connection. The Ethernet port can be used also for remote service and maintenance • USB port for the USB key: this serves to download test settings and results
3	Interfaces to external modules	• Debug connector. Reserved for internal purposes • Alarms interface from the modules
4	Other interfaces	• Remote Start input. The test is started pressing the button on the option PII42175 • Safety warning. It can be connected to the strobe with light PII43175. In case of alarm, the output drives the optional flashing siren and light
5	Mains supply	100÷230 V ±15%; 48÷62 Hz
6	Power consumption	Less than 1 kW in normal use; 1,8 kW (3.600 VA; 16 A) when generating the maximum power on High AC voltage output or high DC current output. For a maximum period of 25 s, the supply power can be up to 3,6 kW, (7.000 VA; 32 A) when generating the maximum power on the options BUX 2000, BUX 3000, BUX5000 and STLG
7	Dimensions	450 (W) x 400 (H)x230 (D) mm eKAMweight: 17 kg
8	Accessories	• User manual, in English • No 5 spare fuses, type T16A • Connection cables, provided in a case with handle and wheels

Table 19 - Other characteristics of the eKAM

	ATTENTION: If the supply is less than 184 V AC, the test set does not guarantee the full output power on BUXor STLG options

4 OPTIONS

4.1 Transit cases (code PII37175, PII51175)

The following image exhibits a transit case for eKAM (PII37175):



Figure 16 - Transport case for eKAM

Thefollowing image exhibits the transit case for BUX (PII51175):



Figure 17 - Transport case for BUX

There are more models of the same BUX transit case, but all of them allow transporting the device. The case has handles and wheels.

The following table lists the Transit case main characteristics:

Characteristic	Note
Handling	Handles on the top and on the side
Wheel	2
Dimensions	450 x 550 x 850 mm
Weight	15 kg

Table 20 – Transit case main characteristics

4.2 PADS license (code PII10176P)

The software PADS allows connecting to the PC theeKAM.

Software features are the following:

- To download from the test set test results and settings, and to save them into a file
- To open and save test results in the formats: MDB (ACCESS), XLSX (EXCEL), CSV and JPEG
- To display in real time, the measurements performed by the test set, with possibility to pause the test (when applicable)
- To display, save and print test results diagrams
- To zoom and compare different curves of more than one result
- To edit, display and print the test report, with the following information:
    - Place, substation name, line, phase, model, serial number, operator, date and time
    - Nominal values: type of device, power, primary and secondary voltage or current
    - Parameters tolerances
    - Test result table, with comments about the test results OK or NO
    - Notes and comments

The program allows also to do the following:

- Upload or download test settings
- Upload or download test set calibration parameters

To control eKAM from PADS, software is subject to license that is the following:

- PADS software Primary - Primary test, CTs Modules

	ATTENTION: The software runs with any WINDOWS© environment. Windows, EXCEL and Access are trademarks of Microsoft Corporation

4.3 Remote Safety Switch (code PII42175)

The following image exhibits the Remote Safety Switch:



Figure 18 - Remote Safety Switch

When the Remote Safety Switch is connected and enabled, it avoids any current or voltage generation from pressing START/STOP button on the eKAM only.

The cable length is 20 m.

4.4 Warning Strobe Light (code PII43175)

The following image exhibits the Warning Strobe Light:



Figure 19 - Warning Strobe Light

The Warning Strobe Light alerts when the test is performed. A siren is also included.

It has to be connected to the Safety Warnings (22) connector. The following image exhibits the (22) connector:

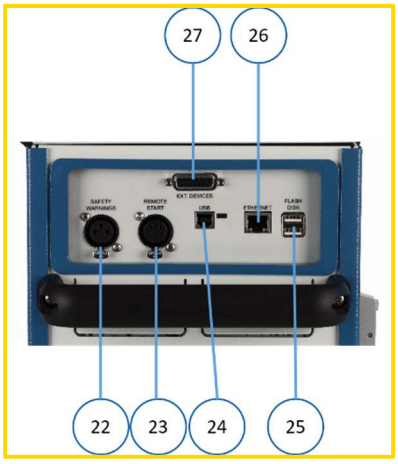


Figure 20 - Safety Warnings (28) connector

4.5 BUX 2000, BUX 3000, BUX 5000 current booster (codes PII56175, PII50175, PII63175)

The optional current boosters BUX 2000, BUX 3000 and BUX 5000 allow performing tests up to respectively 2.000 A, 3.000 A and 5.000 A.

For BUX5000 it is also possible to perform tests up to 7.000 A (without clamps and with cables short circuited), using the primary supply input called “BUX 7000” and selecting “BUX 7000” in the “Hardware Settings” panel.

The following image exhibits the BUX 3000 and BUX 5000 options:



Figure 21 - BUX 3000 option

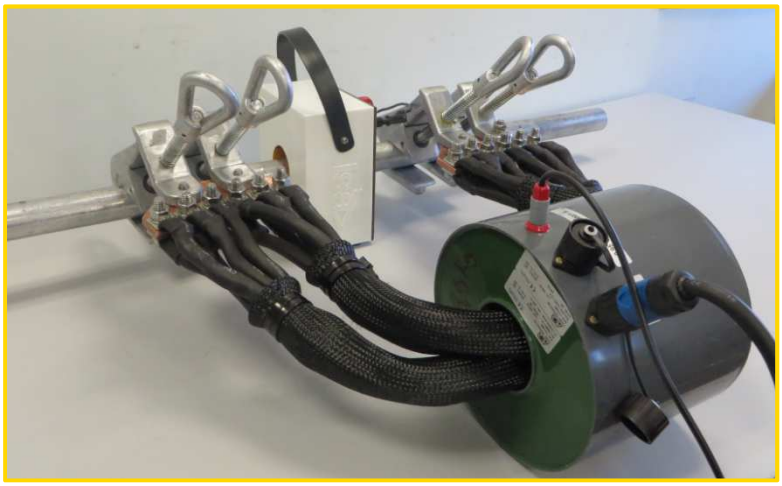


Figure 22 - BUX 5000 option connected to a CT under test

The high current booster options allow performing the following tests:

- Manual measures, whenever high AC current is necessary
- CT ratio, polarity and burden
- High current relay tests

The option avoids wasting power on the connection cables, by putting the BUX option as close as possible to the test object. This approach is particularly useful when the test is performed on CTs in the field, which are some meters tall.

BUX 5000, BUX 3000 and BUX 2000 characteristics are the following:

- Output current available 20 m far from the eKAM control unit
- Frequency: 15÷500 Hz (The output amplitude may decrease for frequency below 50 Hz and above 60 Hz)
- Output current metering ratio: 1.000/1 A for BUX 2000 and BUX 3000, 4.000/1A for BUX 5000
- Accuracy class: typical ±0,1% of reading ±0,1% of range; guaranteed ±0,2% of reading ±0,2% of range
- High current cable, made of 4 cables, 95 mm^2, 1,2 m long, with 2 high current clamps for BUX 3000
- High current cable, made 4 cables, 95 mm^2, 2 m long, with 2 high current clamps for BUX 2000
- High current cable, made 12 cables, 95 mm^2, 0,8 m long, with 4 high current clamps for BUX 5000
- High current cables and clamps weight: 8,2 kg for BUX 3000, 14 kg for BUX 5000
- BUX 2000 output voltage (2 turns, 2.000A): 2,6 V
- BUX 3000 output voltage (1 turn, 3.000 A): 1,6 V
- BUX 5000 output voltage (1 turn, 5.000 A): 1,3 V
- BUX 5000 output voltage (2 turn, 2.500A): 2,6 V
- BUX 5000 output voltage using 7.000 A primary supply (1 turn, 7.000 A, cables short circuited without clamps): 0,95 V
- BUX 2000 weight: 18 kg
- BUX 3000 weight: 15 kg
- BUX 5000 weight: 19 kg
- BUX 2000 and BUX 3000 Dimensions: external diameter 190 mm; height 120 mm
- BUX 5000 Dimensions: external diameter 200 mm; height 170 mm

The high current clamps for the connection to the bar, have the following characteristics:

- Material: aluminum
- Opening range: from 5 to 60 mm
- Short-circuit current rating: 41 kA ÷ 1 s
- Applicable standard: EN 61230
- Hole to lift the clamp to the gate, and ring to tight from the bottom

The BUX options are provided with the following cables:

- No. 1 Voltage supply cable, 20 m long, 2 wires. Terminated on one side with a connector for the eKAM EXT. BOOSTER output and on the other side with a connector for the BUX module
- No. 1 Metering cable, 20 m long, 2 wires. Terminated on one side with a connector for the 3 V AC input of eKAM and on the other side with the connector for current measurement of the BUX module. The cable includes a shunt, which converts the output current into voltage

The following table lists the maximum test currents and durations for power supply of 110 V for BUX 2000:

Test current [A]	Output power [VA]	On duration [s]
500	700	Infinite
1,000	1,500	600
1,300	2,400	200

Table 21 - Max test currents and durations (110 V) for BUX 2000

The following table lists the maximum test currents and durations for power supply of 230 V for BUX 2000:

Test current [A]	Output power [VA]	On duration [s]
500	700	Infinite
1.000	1.500	60
2.000	5.000	25

Table 22 - Max test currents and durations (230 V) for BUX 2000

The following table lists the maximum test currents and durations for power supply of 110 V for BUX 3000:

Test current [A]	Output power [VA]	On duration [s]
500	300	Infinite
1.000	900	Infinite
1.500	1.500	1.200
2.000	2.400	300

Table 23 - Max test currents and durations (110 V) for BUX 3000

The following table lists the maximum test currents and durations for the power supply of 230 V for BUX 3000:

Test current [A]	Output power [VA]	On duration [s]
500	300	Infinite
1.000	900	Infinite
1.500	1.500	1.200
2.000	2.400	300
2.500	3.400	120
3.000	4.800	60

Table 24 - Max test currents and durations (230 V) for BUX 3000

The following table lists the maximum test currents and durations for power supply of 110 V for BUX 5000:

Test current [A]	Output power [VA]	On duration [s]
500	300	Infinite
1.000	900	> 30 min.
1.500	1.800	1.200
2.000	2.400	300

Table 25 - Max test currents and durations (110 V) for BUX 5000

The following table lists the maximum test currents and durations for the power supply of 230 V for BUX 5000:

Test current [A]	Output power [VA]	On duration [s]
500	600	Infinite
1.000	1.200	> 30 min.
1.500	1.800	1.200
2.000	2.400	300
2.500	3.000	120
3.000	3.600	30
4.000	4.800	20
5.000	6.300	10

Table 26 - Max test currents and durations (230 V) for BUX 5000

4.6 Step & Touch testing kit (code PII81175)

4.6.1 STLG current injection power transformer for ground tests (code PII70175)

The following image exhibits the STLG option:



Figure 23 - STLG option

It is a high power, five taps transformer, which acts as an impedance adaptor, increasing the impedance at high test currents. A high current switch allows selecting the desired current range. A voltage meter displays the generated voltage or the voltage on the line due to the inductive couplings.Output current and voltage are measured and sent back to eKAM measuring inputs; a third output allows eKAM to understand which one is the selected range.

The STLG option characteristics are the following:

- Input: form eKAM, via the booster connector
- Output current ranges: 11, 22, 35, 55, 105 A AC. Corresponding no-load voltages: 540, 270, 160, 108, 55 V
- Output current connection: via high current sockets
- Output power: 1,800 VA steady; 5,500 VA peak for 5 s, 5,200 VA on the 105 A range
- High current selector switch, to connect the selected tap to the output current sockets
- Analogue voltage meter, to display the voltage at the output sockets. Range: 600 V AC
- Outputs to eKAM:
    - Selected current output range, to the 10 V voltage input
    - Output current, to the 10 A current input
    - Output voltage, to the 300V voltage input

4.6.2 Cable set for STLG (code PII75175)

All the followings connection cables are included in the option:

- No. 1 Cable, 6 m long, for the connection of the eKAM BOOSTER connector
- No. 2 Cables, 6 m long, for the current output connection, terminated with “Kelvin” type clamps
- No. 6 cables, red and black, 6 m long
- No. 1 cable for the connection of the STLG voltage meter output to the eKAMinput voltage 300 V
- No. 1 bridge, to short circuit the current meter output if it is not connected to eKAM
- Cable transport case

	ATTENTION: For safety reasons, STLG must always acts together with the STSG option

4.6.3 Transport case for STLG (code PII19175)

Heavy duty plastic transport case:

- Transport case: black plastic case, with handles
- Weight: 25 kg
- Dimensions: 23 x 33 x 44 cm

4.6.4 STSG safety grounding module(code PII71175)

It is used with the STLG option, to increase the operator safety.The following image exhibits the STSG option:



Figure 24 - STSG option

During tests, STSG is connected to the out of service overhead line to be tested. The purpose of the STSG device is to protect the operator against possible high voltage spikes during the operations.

STSG incorporates three voltage suppressors (one for each line) and one high current switch, to connect the three lines in parallel when necessary.

The STSG option characteristics are the following:

- Nominal AC spark-over voltage: <1.000 V_{rms}
- Impulse spark-over voltage: <2.000 V_{peak}
- Short-circuit proof with 25 kA_{eff}/100 ms; 36 kA_{eff}/75 ms
- Connection via three cylindrical studs 16, 20 or 25 mm diameter, for the clamps connection. Each stud is connected to the voltage suppressor. The stud dimensions must be specified at order
- Tightening torque: ≥15 Nm
- Metallic aluminum box with handle
- Weight: 9,1 kg (with grounding cable)
- Dimensions: 41 x 21 x 13,5 cm
- Grounding cable, included: 95 mm^2, 2m; terminated with a universal clamp

The device must be connected to the ground and to the HV line.

	ATTENTION: Connection cables to the HV line are not included in the option

4.6.5 Transport case for STSG (code PII80175)

Heavy duty plastic transport case:

- Transport case: black plastic case, with handles
- Weight: 4 kg
- Dimensions: 50 x 40 x 20 cm

4.6.6 Ground Grid Test Accessories Kit (code PII76175)

The following image exhibits the Ground Grid Test Accessories Kit:



Figure 25- Ground Grid Test Accessories Kit

This option applies to STS 5000 and STS 4000 models.

The following table lists the elements of the Ground Grid Test Accessories Kit:

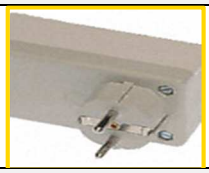
Quantity	Element	Characteristic
2	Earth Screw	0,95 m long, with 4 mmm sockets
1	Spanner	To screw the spike into the ground
4	Earth electrode	0,5 m long, with 4 mmm sockets
1	Transport bag	To carry earth spikes, electrodes and spanner
3	Cable	1,5 mm^2, 200 m long, mounted on reel, terminated on one side with safety 4 mm socket and on the other side with safety 4 mm banana plug
2	Rectangular probe	With shaft 0,8 m long, with safety 4 mm sockets. Material: zinc-plated iron, dimensions 250 x 120 mm, thickness 10 mm, with rubber protection on the foot, on the rod and on the handle, and two safety sockets. The surface in touch with the ground is limited to 300 cm^2
1	Line synchronizer	
1	Digital multimeter CAT III 600V, TRUE RMS, Accuracy AC ±1 % +3 digits	
1	Resistance selector for Step and Touch test	

Table 27 - Elements of the Ground Grid Test Accessories Kit

4.7 Cylindrical studs (code PII72175, PII73175, PII74175)

The following table lists the studs for the STSG option:

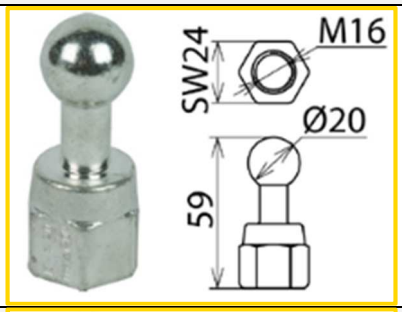
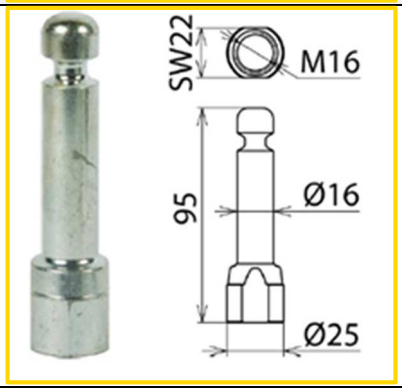
Stud code	Drawing	Characteristics
PII72175		max short circuit current: 0,5 s: 33,5 kA max short circuit current: 1,0 s: 23,7 kA
PII73175		max short circuit current: 0,5 s: 42,0 kA max short circuit current: 1,0 s: 29,6 kA
PII74175		max short circuit current: 0,5 s: 42,0 kA max short circuit current: 1,0 s: 29,6 kA

Table 28- Studs characteristics

4.8 Foldable Trolley (code PII18175)

The following image exhibits the Foldable Trolley:



Figure 26 - Foldable Trolley

The trolley eases the handling of eKAM.

When not used, it can be folded, to minimize the volume.

The following table lists the main characteristics:

Characteristic	Value
Material	Stainless Steel
Weight	19 kg
Dimensions (closed)	68 x 34 x 106 cm
Wheel dimensions	Ø 25 x 9 cm

Table 29 - Trolley characteristics

4.9 Power factor correction module for STLG (code PII85175)

This option is applicable only the STLG option. It is a module to increase the current in the grounding and step and touch tests; the module has many capacitors and it allows to reduce the reactive component of the line, to obtain the increasing of the STLG test generated current.

- Dimensions: 325L, 295A, 285P. Aluminum case with handles
- Weight: 12 kg
- Selectable capacitance nominal values: 600 µF, 400 µF, 200 µF, 150 µF and 100 µF
- Maximum voltage: 600 V (range 100 µF and 150 µF), 450 V on the others
- Maximum current: 60 A

4.10 Surge arrester for STSG (code PII77175)

If a high voltage spike occurs on the line during the execution of the tests, the STSG surge arresters must be replaced. Technical characteristics:

- Nominal AC spark-over voltage: < 940 V_{rms}
- Impulse spark-over voltage: < 1,600 V_{peak}
- Short-circuit proof with 25 kA_{eff}/100 ms; 36 kA_{eff}/75 ms

4.11 Current Clamp Meter for STLG and STSG(code PII79175)

The following image exhibits the current clamp meter:



Figure 27 – Current Clamp Meter

When it is necessary to use the STSG and STLG options to execute the test, the optionsare connected to a transmission line. The line is put out of service, and connected to earth on both sides. Before connection to the HV line, it is necessary to measure the current flowing into the ground connections, using a clamp meter, to evaluate the residual voltage coupling.

The following table lists the Current Clamp Meter main characteristics:

Characteristic	Value
Maximum current	400 A AC
Digits	4
Accuracy	±2% +5 digits
Clamp opening	37 mm

Table 30 - Current Clamp Meter main characteristics

5 PROTECTIONS

The protections of the eKAM are the following:

- If the test set is not connected to the ground, the test set does not allow for power generation, and warns the operator with a diagnostic message and a fixed led light
- Fuse on the mains supply
- Fuse on the current meter input
- At power-on, a diagnostic sequence controls
    - Key microprocessor board components
    - Auxiliary supply voltages.

If something is wrong, the operator is alerted by a message.

- Emergency pushbutton: if pressed, all main outputs are removed
- If maximum current limit or time duration for the electronic generator are trespassed, the generation is interrupted, and the operator is warned by an alarm message
- The current measurement input is protected against wrong connections

REVISIONS

The following table lists the revisions of the document:

No.	Date	Description
1	February 2016	First issue
2	March 2016	Second issue
3	March 2020	Third issue

Table 31 - Revisions

Page left intentionally blank.

LIST OF FIGURES

FIGURE 1–EKAM 9
FIGURE 2 - TEST SET FRONT PANEL 10
FIGURE 3 - RIGHT PANEL COMPONENTS 12
FIGURE 4 – LEFT PANEL COMPONENTS 13
FIGURE 5 - EKAM DISPLAY 19
FIGURE 6 – HOME PAGE 19
FIGURE 7 – "CURRENT TRANSFORMERS" ICON 20
FIGURE 8 - "CURRENT TRANSFORMERS/HEADER AND NOMINAL VALUES" PAGE (TAB DESCRIPTION) 20
FIGURE 9 - "CURRENT TRANSFORMERS/HEADER AND NOMINAL VALUES" PAGE (TAB NOMINALS) 20
FIGURE 10 - "CURRENT TRANSFORMERS/HEADER AND NOMINAL VALUES" PAGE (TAB TOLERANCES) 21
FIGURE 11 - "CURRENT TRANSFORMERS" TEST PAGE (CONVENTIONAL TYPE) 21
FIGURE 12 - "CTS – RATIO POLARITY AND BURDEN CURRENT METHOD" PAGE 21
FIGURE 13 - TEST EXECUTED ON AN OVERCURRENT RELAY 23
FIGURE 14 - "RESISTANCE" TEST PAGE 25
FIGURE 15 - "EARTH RESISTANCE" TEST PAGE AND "STEP AND TOUCH" TEST PAGE 25
FIGURE 16 - TRANSPORT CASE FOR EKAM 28
FIGURE 17 - TRANSPORT CASE FOR BUX 28
FIGURE 18 - REMOTE SAFETY SWITCH 29
FIGURE 19 - WARNING STROBE LIGHT 30
FIGURE 20 - SAFETY WARNINGS (28) CONNECTOR 30
FIGURE 21 - BUX 3000 OPTION 31
FIGURE 22 - BUX 5000 OPTION CONNECTED TO A CT UNDER TEST 31
FIGURE 23 - STLG OPTION 34
FIGURE 24 - STSG OPTION 35
FIGURE 25- GROUND GRID TEST ACCESSORIES KIT 36
FIGURE 26 - FOLDABLE TROLLEY 38
FIGURE 27 – CURRENT CLAMP METER 39

LIST OF TABLES

TABLE 1 - OPTIONAL MODULES 8
TABLE 2 - FRONTAL PANEL COMPONENTS (1/2) 10
TABLE 3 – FRONTAL PANEL COMPONENTS (2/2) 11
TABLE 4 – RIGHT PANEL COMPONENTS 12
TABLE 5 – LEFT PANEL COMPONENTS 13
TABLE 6 – STANDARDS RELATED TO THE EMC DIRECTIVE 14
TABLE 7 - STANDARDS RELATED TO THE LV DIRECTIVE 15
TABLE 8 – HIGH POWER GENERATOR: OUTPUT CHARACTERISTICS 16
TABLE 9 – HIGH POWER GENERATOR: FREQUENCY RANGE 16
TABLE 10 – HIGH POWER GENERATOR: OTHER FEATURES 16
TABLE 11 - RESOLUTION AND ACCURACY 17
TABLE 12 - PHASE ANGLE RESOLUTION AND ACCURACY 18
TABLE 13 - AVAILABLE MEASUREMENTS 18
TABLE 14 - PARAMETERS FOR CT RATIO MEASUREMENT 18
TABLE 15 - MAIN FEATURES OF THE DISPLAY 19
TABLE 16 - CURRENT TRANSFORMERS TESTS 22
TABLE 17– RESISTANCES TESTS 25
TABLE 18 - CABLES PROVIDED WITH THE UNIT 26
TABLE 19 - OTHER CHARACTERISTICS OF THE EKAM 27
TABLE 20 – TRANSIT CASE MAIN CHARACTERISTICS 28
TABLE 21 - MAX TEST CURRENTS AND DURATIONS (110 V) FOR BUX 2000 33
TABLE 22 - MAX TEST CURRENTS AND DURATIONS (230 V) FOR BUX 2000 33
TABLE 23 - MAX TEST CURRENTS AND DURATIONS (110 V) FOR BUX 3000 33
TABLE 24 - MAX TEST CURRENTS AND DURATIONS (230 V) FOR BUX 3000 33
TABLE 25 - MAX TEST CURRENTS AND DURATIONS (110 V) FOR BUX 5000 33
TABLE 26 - MAX TEST CURRENTS AND DURATIONS (230 V) FOR BUX 5000 33
TABLE 27 - ELEMENTS OF THE GROUND GRID TEST ACCESSORIES KIT 36
TABLE 28- STUDS CHARACTERISTICS 37
TABLE 29 - TROLLEY CHARACTERISTICS 38
TABLE 30 - CURRENT CLAMP METER MAIN CHARACTERISTICS 39
TABLE 31 - REVISIONS 41

ISA HEADQUARTER

I.S.A. S.r.l.
via Prati Bassi 22, 21020 Taino (Va) – ITALY
Phone: +39 0331956081
Fax: +39 0331957091
Email: isa@isatest.com

REGIONAL OFFICES

ISA ADVANCE INSTRUMENTS (I) Pvt. Ltd.
C-33, Ground Floor, Sector-2, NOIDA-201
301, Uttar Pradesh, INDIA
Phone: +91120 4543853 / 54 / 4222712
Fax: +91120 4574772
Email: info.asia@isatest.com

ISA PACIFIC PTE Ltd
Blk 10, Kaki Bukit Ave 4, #08-68, Premier@kaki Bukit
Singapore, 415874
Phone: +65 6278 3280
Fax: +65 6278 2381
Email isatest@singnet.com.sg

ISA Latin America
Belo Horizonte
Phone: +55 31 9208 3336
Email: nivalda.martins@isatest.com

ISA GCC
Office no 713, Business Avenue Building Port Saeed Road, Dubai - United Arab Emirates
Phone: +971 4 2956664
Fax: +971 42956099
Email:imteyaz.siddiqui.GCC@isatest.com