

for Current & Voltage Transformers & Special Designs



Content Page

1. Instrument Transformer Testing System	6
1.1. Introduction	6
1.2. Principle of accuracy testing of Current Transformer and Voltage Transformer	7
1.3. Tests	7
1.3.1. Power frequency test only possible with EVRU and Measuring Unit	7
1.3.2. Interturn Insulation Test (CT)	8
1.3.3. Polarity Check (VT/PT)	8
1.3.4. Demagnisation (CT)	8
1.3.5. Accuracy Test (VT/CT)	8
1.4. Mode of Operation	8
2. Equipment for Instrument Voltage Transformer Testing	12
2.1. Voltage Measuring Unit WM 303-U	12
2.1.1. Standard Software – Control Program for WM 303-U and WM 303-I	13
2.2. Voltage Transformer Measuring Unit WM 3000-U	14
2.3. Electronic Compensated Standard Voltage Burden ESVB 200	16
2.4. Standard Voltage Burden	17
2.5. Standard Voltage Transformer	18
2.6. High Voltage Generating Transformer	18
2.7. Converter VE 5433 for Electric VTs	19
3. Equipment for Instrument Current Transformer Testing	22
3.1. Current Measuring Unit WM 303-I	22
3.1.1. Software	23
3.2. Current Transformer Measuring Unit WM 3000-I	23
3.3. Electronic Compensated Standard Current Burden ESCB 200	24
3.4. Standard Current Burden	25
3.5. Standard Current Module	26
3.6. Converter II8427 for Rogowski Coils	27
4. Software for Instrument Transformer Testing PT/CT	30
4.1. Standard Software	30
4.2. Advanced Software Package : CheckCon 2005 Basis	30
5. Voltage Regulating Unit for Instrument Transformer Testing	34
5.1. Voltage Regulating Unit	34
5.1.1. Electronic voltage regulating unit EVRU for automatic test equipment	34
5.1.2. Voltage regulating transformer VRT for semi-automatic test equipment	34
6. Measuring Cabinets for Instrument Transformer Testing	38
6.1. Measuring Cabinets for Automatic Test Procedures by Using EVRU	38
6.2. Measuring Cabinets for Semiautomatic Test Produces Using VRT	38





Instrument Transformer Testing System ITTS

1. Instrument Transformer Testing System

1.1. Introduction

ZERA manufactures components and complete testing system for testing laboratories, to test instrument transformers, with an experience of more than 25 years. We are supplier of world-wide customers, manufactures of instrument transformers as well as electricity boards.

The system details are described in the following clauses to provide basic information. But nevertheless it is possible to develop or adapt our system for customer's requirements.



In addition to the facility for the generation of the desired current and/or voltage, a measuring set-up for the verification of instrument transformers for invoicing comprises a standard instrument transformer test set and a standard burden. The standard instrument transformer serves as a reference, i.e. the difference between standard instrument transformer and instrument transformer is the measure for assessing the accuracy. The difference is determined with an instrument transformer test set, kind of balance for AC currents and voltages and the standard burden is used to simulate the loading of the instrument transformer by the electricity meters connected in series and the supply leads. These devices are checked at regular intervals at the PTB for compliance with requirements.¹

ZERA configures instrument transformer test systems for CT or VT/PT testing as well as combined test systems for CT and VT/PT testing. ZERA's test systems can be designed for testing instrument transformer one by one or successive as a charge.



Testing one by one



Successive testing (charge)



Successive testing (charge) - details



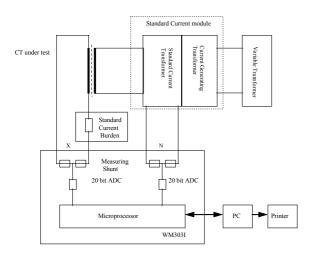
Successive testing (charge) - details

¹ Literature: PTB Testing Instructions, volume 12, Instrument Transformers, 1977, with amendments 5/79

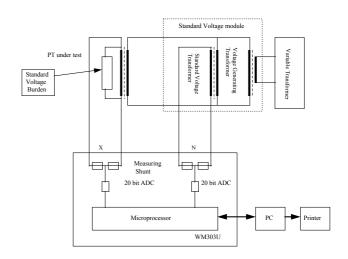


1.2. Principle of accuracy testing of Current Transformer (CT) and Voltage Transformer (VT/PT)

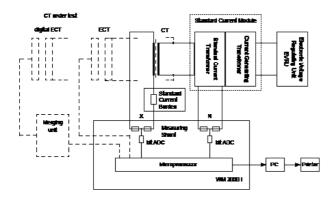
Basic principle of accuracy testing is comparison of unknown CT/VT with standard CT/VT which accuracy is 20 times better than CT/VT under test. This comparison is done with most precision microprocessor based comparator which 20 bit dual ADCs allows the precise detection of signal of standard CT/VT and CT/VT under test.



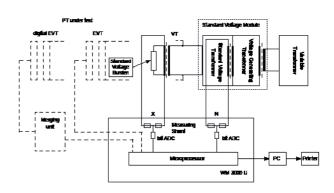
Accuracy Testing of CT



Accuracy Testing of VT/PT



Accuracy Testing of CT/ECT and Rogowski coils



Accuracy Testing of VT/PT/EVT

1.3. Tests

Following tests are possible, details as mentioned below.

1.3.1. Power frequency test (VT) only possible with Electronic Voltage Regulating and Measuring Unit (EVRMU)

The power frequency test of a VT can be done with a frequency up to 360 Hz to reduce the saturation, to IEC the test can be shorter then 60 s but minimal 20 s with a higher frequency.

The maximum voltage of a power frequency test is 240 kV (depending on the generating voltage transformer).

1.3.2. Interturn Insulation Test (CT)

Only one CT will be tested with an open secondary winding and a primarily current up to 1 x I_N or 1.2 x I_N RMS (1 minute). The peak voltage on the secondary winding of the CT will be measured by a high-impedance peak-voltage meter. The primarily current increase until 1 x I_N or 1.2 x I_N continuously or stops, if the peak voltage of the CT reaches 4.5 kV on the open secondary winding. According to our experience, this high voltage of 4.5 kV appears only during a test with CTs, which have an extreme ratio, e.g. 1000 A : 1 A etc. Continuous decrease of the current to zero after the test.

1.3.3. Polarity Check (VT/PT)

The polarity check takes place during the accuracy test.

1.3.4. Demagnisation (CT)

The demagnetisation will be done before the accuracy test. The current will increase up to e.g. 5 % during the CT secondary side is open; afterwards the current is regulated slowly down to zero.

1.3.5. Accuracy Test (VT/CT)

Carry out of the accuracy test with test points, e.g. $120 - 100 - 20 - 5 - 1 \% I_N$ (CT) or $80 - 100 - 120 \% U_N$ (VT) with the corresponding burdens (operator can prepare his test point table according to their standards). The test takes place according the comparison method or – if the ratio is not equal to a standard current or voltage transformer range – the absolute mode. The test compares the ratio error of the CT or VT under test with the standard transformer of the test equipment. The comparison takes place in a self-adjusting comparator.

The integrated software application presents the following measurement results:

Standard application (WM software, see chapter 2.1.1.)

- rated voltage (% U_N) or current (% I_N)
- ratio error (%)
- phase displace error (min)

Advanced application (CheckCon 2005, see chapter 4.)

- rated voltage (% U_N) or current (% I_N)
- ratio error (%)
- phase displace error (min)
- the PC stores the measurement results, compares these with the errors allowable for the relevant accuracyclass and produces a test protocol.
- VTs or CTs, which errors are outside the allowable limits, will be identified as FAIL.

1.4. Mode of Operation

- the operator connects the primary and secondary terminals of the VT or CT
- he has to insert the identification-numbers of the VT or CT under test
- then the operator can start the test, which will be done automatically
- the accuracy-test normally begins with the lowest (VT) or highest (CT) test point
- to the next test point the voltage/current will be regulated up subsequently
- after the last test point the test voltage is regulated down to zero
- if the VT or CT is completely tested the operator has to disconnect the tested VT or CT
- after all tests the software application presents the test-results and all results will be stored in the data base



EVRMU Singapore



All operations of the source, switches of burden and mode selections must be done in case of a semi-automatic

test equipment manually.

In case of an automatic

test equipment, this will be done automatically, controlled by PC and PLC.







Equipment for Instrument Voltage Transformer Testing

2. Equipment for Instrument Voltage Transformer (VT) Testing

2.1. Voltage Measuring Unit WM 303-U

The WM 303-U is a high precision comparator unit, which compares the voltage signal (magnitude as well as phase displacement) received from the PT under test and standard PT.

Technical Features

- inputs with measuring resistances
- direct A/D conversion of the measuring values by 20 Bit A/D converter
- internal divider to match transformer ratios deviating from those of the standard transformers
- controlling and measuring value indication via PC

Technical Data

General			
Power supply	230 VAC, 185 V 265 V, 47 Hz 65 Hz		
Power consumption	approx. 6 VA		
Voltage ranges	480 - 240 - 120 - 60 - 30 - 15 - 7.5 - 3.75 V automatic and manual ranging ²		
Dimensions (HxWxD)	86 x 483 x 260 mm		
Weight	approx. 4.5 kg		
Technical Specifications			
2 measuring voltage inputs	2 480 V		
Nominal voltage of the standard PT (N)	2 480 V ¹		
Nominal voltage of the normal inductive PT (X)	2 480 V ¹		
Frequency	15 65 Hz		
Resolution ratio error	0.0001 %		
Resolution phase angle error	0.001 min		
Resolution voltage measurement	0.01 %		
Uncertainty voltage measurement	0.1 % of range		
Interface	1 RS232		
Divider Range	$T = \frac{U_{PX}}{U_{SX}} : \frac{U_{PN}}{U_{SN}} = 0.5 2$		
Normal PT			
Uncertainty of ratio measurement	± 100 ppm ³		
Uncertainty of phase angle measurement	± 0.3 min ⁴		
Inherent Burden N side	300 kΩ		
Inherent burden X side	300 kΩ		

¹ With Option 01 (in cooperation with special board 5511): 5 mV ... 480 V

The voltage measuring unit WM 303-U is mounted in a housing for a 19" rack.

Optionally the WM 303-U can be delivered with test certificate of the PTB Braunschweig or with a DKD test certificate of our DKD laboratory.

 $^{^2}$ With Option 01 (in cooperation with special board 5511) : additional ranges 10 mV, 100 mV, 1 V 3 With Option 01 (in cooperation with special board 5511) : 20 mV ... 2 V \pm 200 ppm

⁴ With Option 01 (in cooperation with special board 5511): 20 mV ... 2 V ± 1 min



2.1.1. Standard Software - Control Program for WM 303-U and WM 303-I

The handling of the WM 303-U/I is completely controlled by a computer. The devices have no visualization and operation elements on the frontpanel. They are connected with the computer by datalines, where programs for manual, full- and semiautomatic operation are available. The transformer under test and the standard transformer are connected with the rear of the devices.

Areas for operation and display

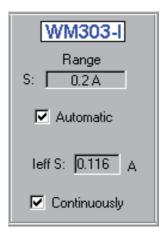
The most important elements of the WM control program are:

- WM 303 base window ¹
- manual verification ¹
- service mode
- frequency ranges
- calibration
- version information
- menu structure
- communication with RS232

WM 303 base window

This region of the main window is an optical representative of the connected transformer test set.

It shows the actually selected range of the standard meter measuring channel and the rms value of the electrical signal. In addition you have the possibility to enable or disable the automatic range selection. The checkbox *Continuously* controls, if the values are measured repeatedly or if the displayed values are frozen.



Manual verification

The manual verification is the most important task of the WM 303 control program.

After entering the parameters of standard transformer and transformer under test, the program shows the measured values and errors.

The selection of the meterrange can be done manually, but it is also possible to enable the automatic range detection of the transformer test set.

To measure and calculate the error of the examinee the program needs the nominal data.

By using the current transformer test set:

- nominal primary current of the standard transformer
- nominal secondary current of the standard transformer
- nominal primary current of the examinee
- nominal secondary current of the examinee

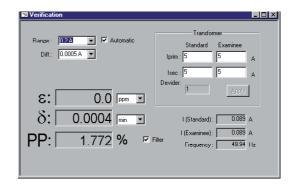
¹ explained in the following topics

Equipment for Instrument Voltage Transformer Testing

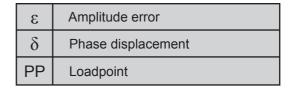
By using the voltage transformer test set:

- nominal primary voltage of the standard transformer
- nominal secondary voltage of the standard transformer
- nominal primary voltage of the PT under test
- nominal secondary voltage of the PT under test

You can modify the values in sequence but they are considered by the calculation only when the *Apply* Button is pressed.



Abbreviations for the measured values:



In order to avoid mistakes by manual calculations you can select your preferred dimension of amplitude error and phase displacement. There is % and *ppm* available for the amplitude error, *crad* (centi rad) and *min* (minutes) for the phase displacement. You can enable a filter function for these values. It reduces the variation of the displayed values. The program calculates changing averages of 20 values.

When *filtering* is actived there is another feature that helps to judge the stability of the measured values. The values are displayed in red colour when the standard deviation exceeds a defined amount. You should not use these values for your evaluation. Wait a short time until they change to black. If they do not turn to black, please eliminate the cause of the fault.

The displayed values of the current, resp. the voltage refers to the fundamental component.

2.2. Voltage Transformer Measuring Unit WM 3000-U

The WM 3000-U is a high precision comparator unit, which compares the voltage signal (magnitude as well as phase displacement) received from a VT or EVT under test and a standard VT.

Technical Features

- inputs with measuring resistances
- input for non-conventional transformers (100 Base-Tx full duplex (RJ45) corresponding to IEC 61850-9-2)
- human machine interface via operation panel and display
- slot for compact PCI interface 3HE-format
- direct A/D conversion of the measuring values by 24 Bit A/D
- converter
- internal divider to match transformer ratios deviating from those of the standard transformers
- PC interface via Ethernet



Technical Data

Voltage transformer measuring unit WM 3000-U with measuring voltage inputs according to IEC60044-2 and IEC60044-7 with automatic or manual range selection.

General	
Power supply	90 V 265 V, 47 65 Hz
Voltage input (N)	20 mV 500 V
Voltage input (X)	20 mV 500 V
Nominal voltage matching	no limit in range, see below
Technical Specifications	
Frequency	15 65 Hz
Resolution ratio error	0.0001 %
Resolution phase angle error	0.01 min
Conventional VT and non-conventional V	/T
Uncertainty of ratio massurement	4 V 500 V
Uncertainty of ratio measurement	± 200 ppm
Internal devider	< 0.5 or devider > 2
Additional error	± 100 ppm
	4 V 500 V
Uncertainty of phase displacement	± 0.3 min
Internal devider	< 0.5 or devider > 2
Additional error	± 0.5 min
Uncertainty of phase displacement	
(non-conventional VT / IEC 61850-9-2)	
Additional error	± 0.5 min
Input impedance (N)	4 V 500 V 380 kΩ
Input impedance (X)	4 V 500 V 380 kΩ
Electronic Voltage Transformer (EVT)	
Uncertainty of ratio measurement	200 mV 15 V : ± 400 ppm 20 mV 200 mV : ± 600 ppm
Internal devider	< 0.5 or devider > 2
Additional error	± 100 ppm
Uncertainty of phase displacement	20 mV 15 V : ± 0.6 min
Internal devider	< 0.5 or devider > 2
Additional error	± 0.5 min
Input impedance (N)	20 mV 15 V > 1 GΩ
Input impedance (X)	20 mV 15 V > 1 GΩ

2.3. Electronic Compensated Standard Voltage Burden ESVB 200

Visualization and operation elements are integrated in the front panel for controlling the burden manually and selecting the burden steps via RS232-interface or manually.

The ESVB 200 is designed for the testing of voltage transformers according to IEC 60044-2 and ANSI, for the following data:



General	
Power supply	230 VAC, -15 % +10 %, 47 Hz 63 Hz
Power consumption	approx. 30 VA
Dimensions (HxWxD)	310 x 483 x 580 mm
Weight	approx. 53 kg
Load Range	max. 200 % U _N
Technical Specifications	
Test voltage U _N	100 - 110 - 115 - 120 - 190 - 200 V 100/3 - 110/3 - 115/3 - 120/3 - 190/3 - 200/3 V 100/√3 - 110/√3 - 115/√3 - 120/√3 - 190/√3 V 200/√3 V
Burden Steps	0,01 VA and cos ß 0.01 The burden steps can be selected in steps of 0.01 VA in the range of 0 200 VA $\cos\beta = 0.1 \dots 1 \text{ inductive up to } \cos\beta = 1 10 \text{ VA} \dots 25 \text{ VA} \\ \cos\beta = 0.2 \dots 1 \text{ inductive up to } \cos\beta = 1 5 \text{ VA} \dots 120 \text{ VA} \\ \cos\beta = 0.5 \dots 1 \text{ inductive up to } \cos\beta = 1 2.5 \text{ VA} \dots 200 \text{ VA} \\ \cos\beta = 0.7 \dots 0.85 \text{ induc. up to } \cos\beta = 1 1 \text{ VA} \dots 200 \text{ VA} $
Accuracy within the load range ¹	$(\Delta R / Z)$ or $(\Delta X / Z) \le \pm 3 \%$
Test frequency	50 Hz / 60 Hz
Interface	1 RS232

¹ related to Z



2.4. Standard Voltage Burden

Example: SVB 238-1M-I

The SVB 238-1M-I is designed for the testing of voltage transformers according to IEC 60044-2.

Technical Data

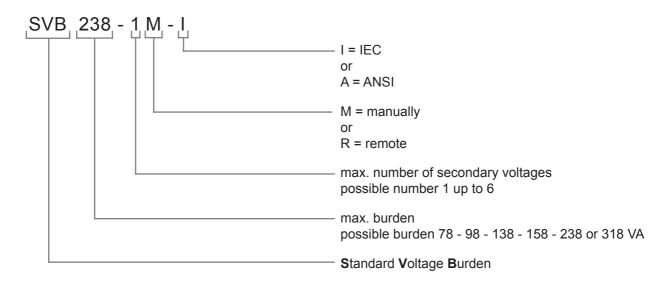
U _N				e.g. 1	10/√	3 V, 50 H	Ηz			
	Burden steps can be selected in the groups A, B, C, D									
	Α	0	_	1.25	-	2.5	_	3.75	VA	cosφ = 0.8
	+									
	В	0		5	_	10	_	15	VA	cosφ = 0.8
	+									
	С	0	ı	20	-	40	_	60	VA	cosφ = 0.8
	+									
	D	0	_	0	_	80	_	160	VA	cosφ = 0.8
	max. burden 238.75 VA									
H										
Ē	Burden step ranges 0 238.75 VA in steps of 1.25 VA									
L	Load range			80 120 % U _N						
7	Accuracy in the load range				≤ ± 3	%	- 1			
	Selection of the burden steps				manu	ally				

Possible secondary voltage can be:

$$U_N = 100 - 110 - 115 - 120 - 190 - 200 V$$

 $100/3 - 110/3 - 115/3 - 120/3 - 190/3 - 200/3 V$
 $100/\sqrt{3} - 110/\sqrt{3} - 115/\sqrt{3} - 120/\sqrt{3} - 190/\sqrt{3} V - 200/\sqrt{3} V$

Syntax:



2.5. Standard Voltage Transformer (SVT)

Technical Data

Voltage ranges for singlepole isolated transformers		
U _{Npr}	e.g. 6/√3 - 10/√3 - 15/√3 - 20/√3 - 30/√3 - 60/√3 kV	
U _{Nsec}	e.g. 100/√3 - 110/√3 V, 50 Hz	
Voltage ranges for doublepole isolated transformers		
U _{pr}	e.g. 6 - 10 - 15- 20- 30 - 60 kV	
U _{Nsec}	e.g. 100 V and 110 V	
Max. operating voltage U _M	e.g. 72 kV	
Frequency	50 or 60 Hz	
Load range	40 120 % U _N	
Secondary burden	e.g. 6 VA, cos β = 1	
Accuracy over the range	40 120 % U _N	
Accuracy	$F \le \pm 0.02 \%$ $\delta \le \pm 1 \min$	



The error values of the standard transformer can be entered into the software. The software CheckCon will eliminate the error values by compensation (see chapter 4).

The max. secondary burden of the standard voltage transformer is tuned to the connection cables and the input of the measuring unit. Other tapings or required voltage ranges can also be supplied. The customer has to specify this data at the time of inquiry.

The standard voltage transformer can optionally be delivered with a PTB test certificate. Maximum U_N of a standard voltage transformer is 200 kV by now.

2.6. High Voltage Generating Transformer (HVT)

HVT is designed for generation of the test voltage during the accuracy tests.

Also the test voltage with 150 or 300 Hz to test the insulation of the primary winding can be generated with this transformer.

Technical Data

General	
Primary voltage	e.g. 200 V or 400 V, 50 / 60 Hz
Secondary voltage	e.g. 10 - 20 - 40 - 75 kV
Output power	e.g. 2.5 - 5 - 10 - 15 kVA
Impedance voltage	e.g. U _K ≈ 6 %



Other tapings or required voltage ranges can also be supplied. The customer has to specify this data at the time of inquiry.

IMPORTANT!

The insulationtest with 150 Hz or 300 Hz frequency tests are carried out by manual adjustment of the loadpoint. Also a peak voltmeter for high voltage up to 70 kV must be available. This test is possible only with EVRU and available as option.



2.7. Converter VE 5433 for Electric VTs

General	
Uncertainty of ratio measurement	± 200 ppm ± 1 % of reading
Uncertainty of phase angle measurement	± 0.7 min ± 1 % of reading
Inherent Burden N side	300 kW
Inherent burden X side	> 1 MΩ
Resolution voltage measurement	0.1 %
Uncertainty voltage measurement	1 % rdg. ± 1 % of range







Equipment for Instrument Current Transformer Testing

3. Equipment for Instrument Current Transformer (CT) Testing

3.1. Current Measuring Unit WM 303-I

The WM 303-I is a high precision comparator unit, which compares the current signal (magnitude as well as phase displacement) received from the CT under test and standard CT.

HERRA N. W. CO.

Technical Features

- inputs with measuring resistances
- direct A/D conversion of the measuring values by 20 Bit A/D converter
- internal divider to match transformer ratios deviating from those of the standard transformers
- controlling and measuring value indication via PC

Technical Data

General	
Power supply	230 VAC, 185 V 265 V, 47 Hz 65 Hz
Power consumption	approx. 55 VA
Current ranges	10 A - 5 A - 2 A - 1 A - 500 mA - 200 mA 100 mA, automatic and manual ranging
Dimensions (HxWxD)	129 x 483 x 260 mm
Weight	approx. 10.5 kg
Technical Specifications	
2 measuring current inputs	10 mA10.5 A
Nominal current of the CT (N)	10 mA 10 A
Nominal current of the normal CT (X)	10 mA 10 A
Frequency	15 65 Hz
Resolution ratio error	0.0001 %
Resolution phase angle error	0.001 min
Interface	1 RS232
Divider Range	$T = \frac{U_{PX}}{U_{SX}} : \frac{U_{PN}}{U_{SN}} = 0.5 \dots 2$
Normal CT	
Uncertainty of ratio measurement	50 mA 10 A : ± 100 ppm 10 mA 50 mA : ± 200 ppm
Uncertainty of phase displacement	50 mA 10 A : ± 0.5 min 10 mA 50 mA : ± 1 min
Inherent Burden N side	2 mΩ
Inherent burden X side	2 mΩ
Resolution current measurement	0.01 %
Uncertainty current measurement	50 mA 10 A : 0.1 % of range 10 mA 50 mA : 0.5 % of range

The voltage measuring unit WM 303-I is mounted in a housing for a 19" rack.

Optionally the WM 303-I can be delivered with test certificate of the PTB Braunschweig or with a DKD test certificate of our DKD laboratory.



3.1.1. Software

For information about the WM software see chapter 2.1.1.

3.2. Current Transformer Measuring Unit WM 3000-I

The WM 3000-I is a high precision comparator unit, which compares the current signal (magnitude as well as phase displacement) received from a CT under test and a standard CT.

Technical Features

- inputs with measuring resistances
- input for non-conventional transformers (100 Base-Tx full duplex (RJ45) corresponding to IEC 61850-9-2)
- human machine interface via operation panel and display
- internal converter for Rogowski coil and other electronic CTs
- slot for compact PCI interface 3HE-format
- direct A/D conversion of the measuring values by 24 Bit A/D
- converter
- internal divider to match transformer ratios deviating from those of the standard transformers
- PC interface via Ethernet

General	
Power supply	90 V 265 V, 47 65 Hz
Current input (N)	10 mA 15 A
Current input (X)	10 mA 15 A
Nominal current matching	no limit in range, see below
Technical Specifications	
Frequency	15 65 Hz
Resolution ratio error	0.0001 %
Resolution phase angle error	0.01 min
	13/7
Conventional VT and non-conventio	nai v i
Uncertainty of ratio measurement	50 mA 15 A : ± 200 ppm
(absolute mode)	10 mA 50 mA : ± 400 ppm
Internal devider	< 0.5 or devider > 2
Additional error	± 100 ppm
Uncertainty of ratio measurement (difference mode)	50 mA 15 A : ± 50 ppm
Additional error	± 1.5 ppm / % of rdg.
Uncertainty of ratio measurement (difference mode)	10 mA 50 mA : ± 100 ppm
Additional error	± 3 ppm / % of rdg.

Conventional VT and non-conventional VT			
Uncertainty of ratio measurement (difference mode)	10 mA 50 mA : ± 100 ppm		
Additional error	± 3 ppm / % of rdg.		
Uncertainty of phase displacement (absolute mode)	50 mA 15 A : ± 0.5 min 10 mA 50 mA : ± 1 min		
Internal devider	< 0.5 or devider > 2		
Additional error	± 0.5 min		
Uncertainty of phase displacement (difference mode)	50 mA 15 A : ± 0.2 min 10 mA 50 mA : ± 0.5 min		
Uncertainty of phase displacement (non-conventional CT / IEC 61850-9-2) Additional error	± 0.5 min		
Inherent burden N side	< 5 mΩ		
Inherent burden X side	< 5 mΩ		
Electronic Voltage Transformer (EVT) / Rogowski CT			
Uncertainty of ratio measurement	$U_N = 22.5 \text{ mV} \dots 150 \text{ mV} : \pm 400 \text{ ppm}$ $U_N = 200 \text{ mV} \dots 4 \text{ V} : \pm 200 \text{ ppm}$		
Uncertainty of phase displacement	$U_N = 22.5 \text{ mV} \dots 150 \text{ mV} : \pm 1.1 \text{ min}$ $U_N = 200 \text{ mV} \dots 4 \text{ V} : \pm 0.7 \text{ min}$		
Input impedance	> 1 GΩ		

3.3. Electronic Compensated Standard Current Burden ESCB 200

The ESCB 200 is designed for the testing of current transformers according to IEC 60044-2 and ANSI, for the following data:

Visualization and operation elements are integrated in the front panel for controlling the burden manually and selecting the burden steps via RS232-interface or manually.



General	
Power supply	230 VAC, -15 % +10 %, 47 Hz 63 Hz
Power consumption	approx. 30 VA
Dimensions (HxWxD)	310 x 483 x 580 mm
Weight	approx. 65 kg
Load Range	max. 200 % I _N

Technical Specifications		
Test current I _N	1 - 2 - 5 A	
Burden Steps	The burden steps can be selected in the range of 0 200 VA in steps of 0.01 VA and cos β 0.01 cos β 0.5 - 1 = 5 200 VA cos β 1 = 1 200 VA	
Accuracy within the load range ¹	$(\Delta R / Z)$ or $(\Delta X / Z) \le \pm 3 \%$	
Test frequency	50 Hz / 60 Hz	
Interface	1 RS232	

¹ related to Z

3.4. Standard Current Burden

Example: SCB 60-2M-I

The SCB 60-2M-I is designed for measuring current transformers according to IEC 60044-2.

Design of the standard current burden as 19"-unit.



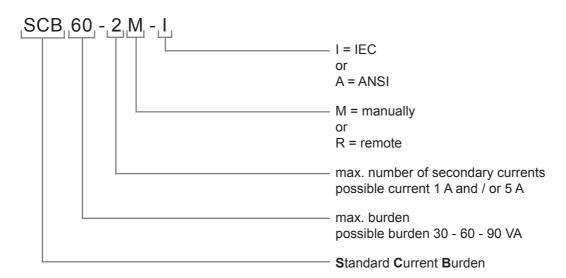
Technical Data

Sec	1 A and 5 A, 50 Hz
Burden steps	cos β = 1 : 1 - 1,25 - 1,5 - 2 - 2,5 - 3,75 VA $cos β = 0.8$: 5 - 6.25 - 7.5 - 10 - 11.25 - 15 - 20 - 25 - 30 - 45 - 60 VA
Load range	1 200 % I _N or 1 120 % I _N
Accuracy in the load range	≤±3 %

The burden steps can be selected manually or via PLC for PC control, in case of automatic test system.

Following different burden modules with 1, 2 or 3 secondary current ranges are available:

Syntax:



3.5. Standard Current Module (SCM)

The standard current module is built into one housing with a test current generating transformer and a standard current transformer.

This compact design is developed by ZERA to offer a very proper component in terms of technology and budget, combined with a reduction of wiring.

The current generating transformer is designed for the connection to the output voltage 0 ... 200 V or 0 ... 400 V of the voltage regulating unit (EVRU), see chapter 5. The output power of the SCM is the determining requirement for the EVRU and VRT. So select the SCM and then EVRU and VRT.

This combination is available as different modules to meet the requirements of various customers world wide.

Frequency 50 or 60 Hz

Examples

Module	Current range	I _N sec	Load range	Max. current	o/p power
SCM 1000-200	1000 - 800 - 750 600 - 500 - 400 300 - 250 - 200 150 - 125 - 100 80 - 75 - 60 - 50 40 - 30 - 25 - 20 15 - 10 - 5 A	1 A and 5 A	1 200 %	2000 A	10 kVA
SCM 2000-120	2000 - 1600 - 1250 - 1200 A additional to SCM 1000-200	1 A and 5 A	1 120 %	2400 A	10 kVA
SCM 3000-120	3000 - 2500 - 2000 - 1600 - 1250 - 1200 A additional to SCM1000-200	1 A and 5 A	1 120 %	3600 A	15 kVA
SCM 2000-200	2000 - 1600 - 1250 - 1200 A additional to SCM 1000-200	1 A and 5 A	1 200 %	4000 A	20 kVA
SCM 3000-200	3000 - 2500 - 2000 - 1600 - 1250 - 1200 A additional to SCM 1000-200	1 A and 5 A	1 200 %	6000 A	30 kVA

Maximum nominal current of a standard current module is 10000 A by now.

The max. secondary burden of the standard current transformer is tuned to the connection cables and the input of the measuring unit.

Accuracy of the standard transformer in the measuring ranges mentioned above:

 $F \le \pm 0.02$ % (higher accuracy on request)

 $\delta \ \leq \pm \ 1 \ min$



The error values of the standard transformer can be entered into the software. The software CheckCon will eliminate the error values by compensation (see chapter 4).

Simultaneous connection of the ranges for the test current and the standard current transformer will be done by links and selector. In a full automatic test equipment the ranges will be switched over automatically by pneumatic, controlled by a PLC.

Note: The required maximum current should be specified by the customer at the time of inquiry.

The current transformers under test are connected to the output of the current combination by links at one side of the unit.

Separate standard current transformer can be supplied, if the user has its own set of current generating unit. Also the current generating transformer can be delivered separately.

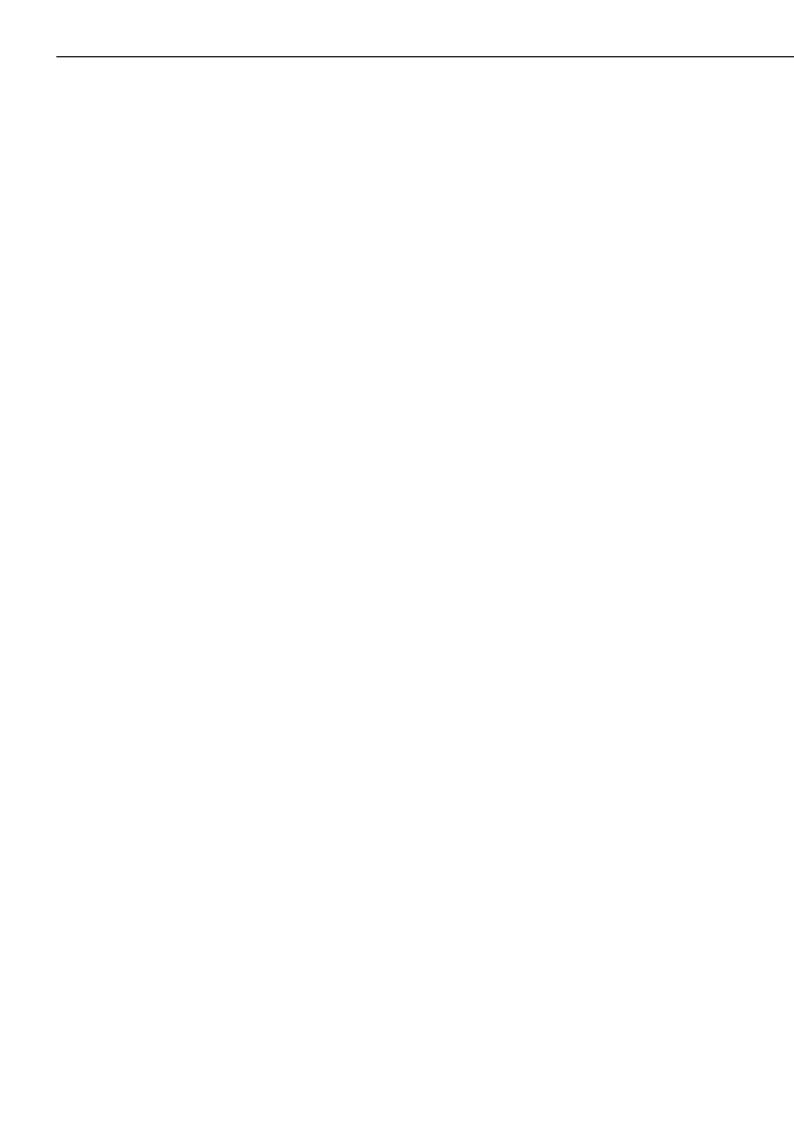
The standard current transformer can be delivered optionally with a PTB test certificate.

3.6. Converter II8427 for Rogowski Coils (ECTs)

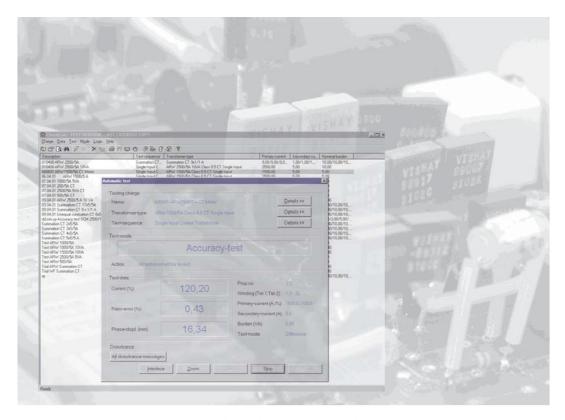


General	
Uncertainty of ratio measurement	$U_N = 22.5 \text{ mV} \dots 150 \text{ mV} : \pm 300 \text{ ppm}$ $U_N = 200 \text{ mV} \dots 4 \text{ V} : \pm 200 \text{ ppm}$
Uncertainty of phase displacement	$U_N = 22.5 \text{ mV} \dots 150 \text{ mV} : \pm 1.1 \text{ min}$ $U_N = 200 \text{ mV} \dots 4 \text{ V} : \pm 0.7 \text{ min}$
Inherent burden N side	2 mΩ
Working range	5 200 %
Resolution current measurement	0.1 %
Uncertainty current measurement	1 % rdg. ± 1 % of range







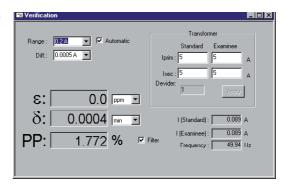


Software for Instrument Transformer Testing CT / PT

4. Software for Instrument Transformer Testing PT/CT

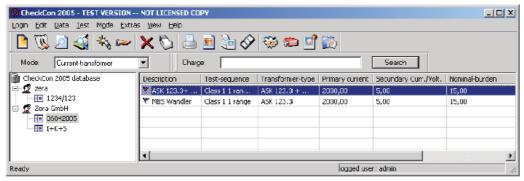
4.1. Standard Software

For further information about the standard software for WM 303-U and WM 303-I see chapter 2.1.1.



4.2. Advanced Software Package: CheckCon 2005 Basis

A Windows XP operating system is used, the data base is realized by MS-Access.



CheckCon 2005 (main menu)

Software allows operator to

- enter the details of CT/PT under test (type table)
- enter the error class table
- prepare the test sequence table including load points, burden acceptance criteria etc.
- conduct the testing in semi automatic or manual way
- evaluate the results of CT/PT under test
- compensation of error of standard CT/PT
- printout of the test reports
- possibility to connect a labelprinter
- possibility to connect a barcode scanner to read the serial number and property number
- possibility to transfer the test results to a host computer



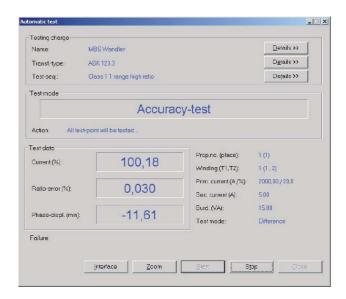
In manual mode the operator sets the load point and performs the measurement. The results are not stored or printed out.

In semi-automatic mode the PC guides the operator to make manual regulations and operations during all tests and stores the results.

The menu software language is English.

For further information or download a demo version of CheckCon visit our homepage

www.zera.de









Voltage Regulating Unit for Instrument Transformer Testing

5. Voltage Regulating Unit for Instrument Transformer Testing

5.1. Voltage Regulating Unit

The voltage regulating unit is suitable for supply of variable voltage to high voltage and/or current generating transformers. It is available in two types.

5.1.1. Electronic voltage regulating unit EVRU for automatic test equipment

The EVRU feeds variable voltage to high voltage and/or current generating transformers in automatic testing of CT/VT system or where power frequency withstand test has to be conducted.

The source is equipped with remote control via PC control by V24 (RS232) interface or for manual mode by push buttons.

Design of the cabinet as 19"-single or double cabinet (depending on the output power).



General	
Mains voltage	3 x 230 / 400 V, -15% + 10%, 50 / 60 Hz
Output voltage	selectable to 0 200 V or 0 400 V
Output frequency	40 70 - 150 - 300 (50Hz), 180 - 360 (60Hz) Hz
Output power	min. 8 kVA increasing in steps of 4 kVA ¹ (max. 80 kVA)

¹ based on the power requirement for highvoltage and current generating unit

Alternative

5.1.2. Voltage regulating transformer VRT for semi-automatic test equipment

The VRT feeds variable voltage to the high voltage or high current generating transformers manual/semi-automatic testing of CT/VT.

The output voltage is adjusted manually or by motor controlled from pushbutton available at control desk.

General	
Mains voltage	400 V, 50 / 60 Hz
Output voltage	selectable to 0 200 V or 0 400 V
Output frequency	mains frequency
Output power	max. 10 up to 100 kVA 1

¹ based on the power requirement for highvoltage and current generating unit









Measuring Cabinets for Instrument Transformer Testing

6. Measuring Cabinets for Instrument Transformer Testing

6.1. Measuring Cabinets for Automatic Test Procedures by Using EVRU

It is possible to deliver the cabinet as a 19" cabinet or test table for the incorporation of e.g.:

- measuring unit WM 303-U/I or WM 3003 U/I
- standard current burden SCB or electronic compensated standard current burden ESCB 200
- standard voltage burden SVB or electronic compensated standard voltage burden ESVB 200
- peak voltmeter
- PC for automatic test procedures

The instrument housing of the cabinet is equipped with:

- 1 analogue voltmeter Cl.1, indication 0 ... 120 % (voltage transformer test equipment) connected to the secondary side of the standard voltage transformer
- 1 analogue ammeter Cl.1, indication 0 ... 200 % (current transformer test equipment) connected to the secondary side of the standard current transformer
- 1 analogue voltmeter Cl.1, indicates the output voltage of the amplifier

All operating elements for the manual operation are mounted on the cabinet-front (or table top). For the automatic test procedure these elements indicate the adjusted loadpoint.

6.2. Measuring Cabinets for Semiautomatic Test Produces Using VRT

For the incorporation of e.g.:

- measuring unit WM 303-U/I or WM 3003 U/I
- standard current burden SCB or electronic compensated standard current burden ESCB 200
- standard voltage burden SVB or electronic compensated standard voltage burden ESVB 200
- peak voltmeter
- PC for semiautomatic test modes

The instrument housing of the cabinet is equipped with:

- 1 analogue voltmeter Cl. 1, indication 0 ... 120 %, connected to the secondary side of the standard voltage transformer
- 1 analogue ammeter Cl. 1, indication 0 ... 120 % connected to the secondary side of the standard current transformer

All operating elements for the manual operation are mounted on the cabinet-front (or table top).

- main switch
- emergency stop switch
- push buttons for
 - control circuit ON/OFF
 - test circuit ON/OFF
 - switch for the generating transformers
 - control of the regulating transformer
- safety circuit
- selector for I_N and U_N
- balance burden for U_{sec} and I_{sec} circuits





Reference list

- ABB, Hungary
- ABB s.r.o., Czech. Rep.
- ABB Stotz-Kontakt GmbH, Germany
- Amptronic, Malaysia
- AREVA Energietechnik, Germany
- Cegelec, Germany
- Ceylon Electricity Board, Sri Lanka
- · China National Aero, China
- Chinney, Hongkong
- CLP, Hongkong
- ELEQ, Netherlands
- EnBW System Intrast, Germany
- Endesa, Germany
- Energiedienst Holding AG, Germany
- EPRO, Austria
- EWE Aktiengesellschaft, Germany
- FAGET, Netherlands
- Faget, Netherlands
- G&M Comércio, Spain
- GEW, Germany
- HEAG Südhessische, Germany
- ICMET, Romania
- IEC, Israel
- · Kainos, Spain
- Kel AG, Germany
- KERI, Korea
- Kleinwandlerbau KWK, Germany
- Korea Electrotechnol, Korea
- Korea Research, Korea
- KRISS, Korea
- LEW Netzservice GmbH, Germany
- Lysverker, Norway
- MBS, Germany
- Moeller GmbH, Germany
- Moeller Manuf. LT, U.K.
- National Electricity Company, Bulgaria
- Norm Ltd., Turkey
- Pan-Amp Controls, Singapore
- Peterreins Schalterbau, Germany
- PTB, Germany
- REDUR Messwandler, Germany
- REZA Transwerke, Iran
- Ritz, Germany, Turkey, Austria
- Rockwell Automation, Suisse
- RWE Systems AG, Germany
- SC Luxten Lighting, Rumänien
- Serta Transformadores Ltda., Brasilia
- SML, India
- SOMA, Germany
- Stadtwerke Düsseldorf, Germany

- Südzucker AG, Germany
- Süwag Energie AS, Germany
- TNB, Malaysia
- Trench Germany GmbH, Germany
- Tübitak Gebze, Turkye
- TWB AG, Greece
- Uni Duisburg-Essen, Germany
- VSE, Germany
- Walter Schork GmbH, Germany
- WTW, Germany
- Wuppertaler Stadtwerke, Germany



ZERA GmbH Hauptstraße 392 53639 Königswinter Germany

 Phone
 +49 2223-704-0

 Fax
 +49 2223-704-70

 Mail
 zera@zera.de

 Web
 www.zera.de