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MARSENERGO
INSTRUMENTS FOR POWER INDUSTRY

Making energy visible

Portable three-phase reference instrument for accuracy testing
of current/voltage instrument transformers and electric energy meters

Energomonitor -3.3T1

accuracy class 0.1



Functionality and options

1. As a reference meter: on-site testing and calibration of single-/three-phase electric energy meters and other measuring instruments (up to 0.5 accuracy class)

1



SH-I, SH-E
(scanning heads for reading pulses from discs or LEDs)



CTB (Block of Current Transformers
0.5; 1; 5; 50 A)



Phantom Power
Source Energoforma 3.3



"EmCounter"
and "Energoform" SW

2. As a CT or VT test comparator: on-site accuracy testing and calibration of current and voltage instrument transformers

2.1 Accuracy testing and calibration of CTs (0.2S accuracy class or less accurate) up to 5000 A

2



CTCS (Current Transformer Calibration Switch)



Reference Current Transformers
PCTI 100 and PCTI 5000



Source of test current IT 5000




"Transformer Test" SW




Burden Box (conventional type)


2.2 Accuracy testing and calibration of VTs (0.2 accuracy class or less accurate) up to 330 kV




Reference Unit
(Capacitive HV Transducer CHVT)




Control Panel
(Console)



Source of test voltage 50,
100, 150 kV



"Transformer Test" SW




Burden Box (conventional type)

3. Inspection of secondary circuits of instrument transformers:

3.1 Determining voltage drop in the VT-to-meter connection line (two EM3.3T1 devices are used)

3.2 Measuring secondary burden of CTs and VTs under test

3



TMBD
(Transformer Burden)



High-precision current clamps 10 A (3 pcs)



Measurement procedure

4. Logging of basic network parameters

- Logging of averaged values

4

Averaging period	Continuous logging	Parameters
3 s	9.5 h	U I P Q S PF ϕ f, THDu;
1 min	8 days	THDi; Ku(n); Ki(n); negative and zero sequence ratios
30 min	7.5 months	



"EmWorkNet" SW



"Oscilloscope" SW

- Logging of instantaneous values (like in an oscilloscope) that are captured with 78 μ s intervals (3 phase voltages and three phase currents). Time of continuous logging is 9 minutes.

Current clamps



10, 100 A



1000 A



1000 A (high-precision)



ME FLEX
30/300/3000 A

Measurements

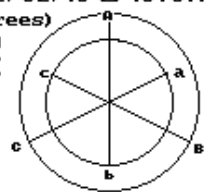
Measured values

- **Voltage and current:**
 - * RMS of phase and phase-to-phase voltages and currents,
 - * RMS of 1st voltage and current harmonics,
 - * Average-rectified values of phase voltages and currents,
 - * Average (DC component) values of phase voltages;
- **Energy;**
- **Frequency;**
- **Phase angles** (display of current and voltage vectors);
- **Current and voltage harmonics** from 1st to 40th;
- **Harmonic powers and phase angles between harmonics;**
- **Waveforms** (phase voltages and currents);
- **Power:**
 - * Each phase and total values of active, reactive and apparent power,
 - * Power factor and $\text{tg } \varphi$.

12/02/13 13:01:20				
CURRENT AND VOLTAGE				
	A	B	C	
RMS U(V)	60.034	60.025	60.016	
I(A)	5.0011	5.0005	5.0013	
Average U(V)	0.0187	0.0437	0.0122	
I(A)	-0.0028	0.0009	0.0026	
Average-Rectified U(V)	54.051	54.042	54.032	
I(A)	4.5031	4.5016	4.5035	
		A-B	B-C	C-A
RMS U(V)	103.97	103.95	103.96	

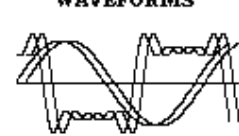
120 V/C 10 A 3-Ph 4-wire

12/02/13 13:01:20			
PHASE ANGLES (degrees)			
$\angle U_A(t) - U_B(t)$	119.984		
$\angle U_B(t) - U_C(t)$	119.976		
$\angle U_C(t) - U_A(t)$	119.976		
$\angle U_A(t) - I_A(t)$	59.968		
$\angle U_B(t) - I_B(t)$	59.960		
$\angle U_C(t) - I_C(t)$	59.968		



120 V/C 10 A 3-Ph 4-wire

12/02/13 13:01:20			
WAVEFORMS			
U_A	= 99.905 V		
U_C	= 113.73 V		
I_A	= 3.950 A		
I_C	= 4.224 A		



Select Channel: [1] [2] [3] [7] [8]
Reset Measurement: [ENT]

120 V/C 10 A 3-Ph 4-wire

12/02/13 13:01:20			
ACTIVE POWER			
	A	B	C
P (W)	144.48	288.87	288.90
Pz (W)	722.270		
RMS U(V)	57.774	57.766	57.755
I(A)	5.0023	5.0008	5.0027
PF	0.49L	0.99L	0.99L

60 V/C 10 A 3-Ph 4-wire

12/07/13 13:01:20			
REACTIVE POWER			
At Fout : (+)	A	B	C
$\sqrt{S} \cdot PF$	260.06	259.91	259.98
Qz (Var)	779.986		
cross-conn.	259.98	259.84	260.14
Qz (Var)	779.978		
UI sin(φ)	260.07	259.92	259.98
Qz (Var)	779.991		
$\text{tg}(\varphi)$	1.667	1.664	1.665
$\text{tg}(\varphi)z$	1.669		

120 V/C 10 A 3-Ph 4-wire

12/02/13 13:01:20			
Individual Harmonic Ratios: % THDu = 24.47%			
1	100.00	100.00	100.00
2	00.00	00.00	00.00
3	00.00	00.00	00.00
4	00.00	00.00	00.00
5	00.00	00.00	00.00
6	00.00	00.00	00.00
7	00.00	00.00	00.00
8	00.00	00.00	00.00
9	00.00	00.00	00.00
10	09.99	19.95	09.95

120 V/C 10 A 3-Ph 4-wire

Testing of meters

EM 3.3T1 provides for performance and accuracy testing of electric energy meters (class 0.5 or less accurate). Test results acquired from up to 200 meters (up to 10 measurements per test) can be kept in the internal memory. With EmWorkNet, test results are loaded to a PC for viewing and managing. Test reports are generated automatically.

Testing of current and voltage instrument transformers

In this mode, EM 3.3T1 works as a comparator and provides for testing of voltage transformers (class up to 0.2) and 1A or 5A current transformers (class up to 0.2S). The internal memory can store test results from up to 200 CTs and/or VTs. Automatic report generation and log management functions are available with Transformer Test software.

12/02/13 13:01:20			
	A (A-B)	B (B-C)	C (C-A)
U_{ph} (V)	60.032	60.018	60.011
I_{ph} (A)	5.0004	5.0004	5.0009
U_{line} (V)	103.96	103.94	103.96
PF	0.50L	0.50L	0.49L
Pz (W)			450.205
Pulse counting time (s)	6	Sz (Var)	
ERROR (%)	0.25	in	00001000
STOP MEASUREMENT N 0 1		out	00014520
REMAINING TIME (sec)	5	←	0000086
		→	00000990

120 V/C 10 A 3-Ph 4-wire

12/07/13 13:01:20			
	S_n	U_n	
S_n	7.5 VA	U_n	100.000 V
S_n	30.0 VA	U_{Bq}	60.020 V
S/S_n	25.0 %	U_{Bq}	61.013 V
		U_{Bq}/U_n	61.01 %
ERROR			
$(U_{Aq} - U_{Bq})/U_{Bq}$	Rough	exactly	
	-0.173 %	-0.067 %	
$U_{Aq} - U_{Bq}$	0.030 V	1.179 V	
START MEASUREMENT N 0 1			

120 V/C 10 A 3-Ph 4-wire

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Metrological data

Measured values	Measurement ranges	Limits of permissible fundamental error	
		with Current Transformers Block (CTB)	with High Precision Current Clamps
RMS of AC voltage (U)	1 to 360 V ($U_N = 60; 120; 240$ V)	0.1 % ¹	
RMS of AC current (I)	5 mA to 60 A (CTB: $I_N = 0.5; 5; 50$ A)	0.1 % ²	—
	50 mA to 4500 A (Clamps: $I_N = 10; 100; 1000; 300; 3000$ A)	—	0.5 % ³
Phase angle between 1st harmonics of phase voltages	0° to 360°	Absolute: 0.1°	
Phase angle between 1st voltage and 1st current harmonics in the same phase	0° to 360°	Absolute	
		0.2°	0.5°
Active power (P), W	$0.01U_N$ to $1.5U_N$, $PF = 1$	Relative	
	$0.1I_N \leq I < 1.5I_N$	0.1 %	0.5 %
	$0.01I_N \leq I < 0.1I_N$	0.2 %	—
Reactive power (Q), Var	$0.05I_N U_N$ to $1.5I_N \cdot 1.2U_N$	Relative	
	$PF_R = 1$	0.3 %	1.0 %
	$PF_R = 0.45L \dots 0 \dots -0.45C$	0.5 %	2.0 %
Power Factor	-1.0 to +1.0	Absolute	
		0.02	0.05
AC frequency	45 to 70 Hz	Absolute: 0.01 %	
Negative and zero sequence voltage ratios, %	0 to 50 %	Absolute: 0.2	
Total Harmonic Distortion of voltage THD _U and individual voltage harmonic ratios $K_{U(n)}$ (n from 2 to 40)	0 to 49.9 %	Absolute: 0.05 % (THD _U ; $K_{U(n)} < 1.0$)	
		Relative: 5.0 % (THD _U ; $K_{U(n)} \geq 1.0$)	
Total Harmonic Distortion of current THD _I and individual current harmonic ratios $K_{I(n)}$ (n from 2 to 40)	0 to 49.9 %	Absolute: 0.1 (THD _I ; $K_{I(n)} < 1.0$)	
		Relative: 10.0 % (THD _I ; $K_{I(n)} \geq 1.0$)	
Ratio (modular) error of current and voltage instrument transformers δ	1 to 100 %	Absolute: $(0.02 + 0.02 \delta)$ %	
Angle error of current and voltage instrument transformers Δ	0.1' to 180°	$(1.0 + 0.1 \Delta)$ '	
Duration of voltage dips and swells	from 0.02 s	0.02 s	
Voltage dip depth	10 to 100 %	Relative: 10.0 %	
Voltage swell height (over-voltage factor)	1.10 to 7.99 relative units	Relative: 2.0 %	
Flicker short-term perceptibility	0.25 to 10	5.0 % ($\Delta U/U \leq 20$ %)	

¹ $\pm[0.1 + 0.01((U_N/U) - 1)]$ %

² $\pm[0.1 + 0.01((I_N/I) - 1)]$ %

³ $\pm[0.5 + 0.05((I_N/I) - 1)]$ %

⁴ $\pm[0.25 + 0.02((P_N/P) - 1)]$ %

⁵ $\pm[1.0 + 0.1((P_N/P) - 1)]$ %

Pulse input and output

Parameter	Input	Output
Level	5...15 V	5 V
Max. frequency	36 kHz	18 kHz
Pulse duration	>10 μ s	10 \pm 2 μ s
Constant	1...999 999 999 pulses/(kW · h)	$C = 14\ 400\ 000 / (I_N \cdot U_N)$ pls/(W · h)

Technical data

Mains supply	100...264 V, (50 \pm 5) Hz	Overall dimensions (Length \times Width \times Height)	Maximum 250 \times 280 \times 80 mm
Power consumption from mains	20 VA, or less	Weight	2.0 kg, or less
Consumed DC power (12 V from Power Adaptor or Rechargeable Power Supply)	8 VA, or less	<i>Operating conditions</i>	
Time of operation when powered from Rechargeable Power Supply	minimum 2 h	Ambient temperature	-20 to 55 °C
<i>Safety requirements per IEC 61010-1</i>		Relative humidity	up to 90 % at 30 °C
Ingress protection rating	IP 40	Atmospheric pressure	70–106.7 kPa (537–800 mm Hg)
Category of measurements	II or III		
Electric shock protection	Double insulation		

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