Performance measuring and monitoring device
Pattern evaluation report

Project number : **11200473**
Test report number : **NMi-11200473-01b**

Applicant : Iskra MIS, d. d.
Ljubljanska cesta 24a
SI-4000 Kranj,
Slovenia

Manufacturer : Iskra MIS

Type : MC330

Test specifications :
- IEC 61557-12
  "Electricity safety in low voltage distribution system up to 1000 V a.c. and 1500 V d.c. - Equipment for testing, measuring or monitoring of protective measures
- IEC 62052-11
  "Electricity metering equipment (AC) - General requirements, tests and test conditions - Part 11: Metering equipment"
- IEC 62053-21
  "Electricity metering equipment (AC) - Particular requirements - Part 21: Static meters for active energy (classes 1 and 2)"
- SEC 50-SDMS-01
  "Specifications for current transformers up to 36 kV"

Testing period : June up to and including September 2011

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Tests	:	The meters as specified in annex 2 were tested for compliance with the standard as specified on page 1 of this test report. The performed tests are stated in annex 1. If applicable specific test conditions are stated at each test.
Results	:	See annex 1 of this test report. The meter fulfils the requirements of the IEC 61557-12, the IEC 62052-11 and the IEC 62053-21, as well as the requirements of the SEC 50-SDMS-0 for all performed tests.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Uncertainty	:	The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, which provides a confidence level of approximately 95%. The total uncertainty of the measurements of the error of indication is 0,12% for power factor=1, and 0,16% for power factor=0,5 inductive or power factor=0,8 capacitive. The total uncertainty in the measurements of power is 0,02 W.
Annexes	:	The complete test report consists of the following annexes: annex 1 : performed tests annex 2 : characteristics of the tested meters annex 3 : test data
Remark	:	This revision is issued due to editorial changes.

Annex 1: Performed tests

In the following tables the performed tests are indicated with the accompanying results, as well as the page number of the appertaining annex where the results are presented.

Requirements of the 61557-12 / IEC 62052-11 / IEC 62053-21 / SEC 50-SDMS-01:

article IEC 61557-12 / IEC62052-11 / IEC 62053-21 / SEC 50-SDMS-01				tests:	passed	annex 3 page
4.7.5.4	-	-	-	temperature influence for phase current and neutral current measurement	√	1
4.7.1.4	-	8.2	-	variation of the error due to a magnetic induction of external origin (0,5 mT)	√	2
-	-	7.2	6.8	variation of the error due to short time overcurrents	√	3
6.1.12	6.3.1, 6.3.2, 6.3.3	-	-	climatic test	√	4
-	6.3.4	-	-	solar radiation	√	5
-	5.2.2.1	-	-	spring hammer test	√	6
4.9.2	5.9	-	-	protection against dust and water	√	6
4.7.5.3.1	-	-	-	Intrinsic uncertainly table for phase current (at reference conditions)	√	7
4.7.15	-	-	-	thermal demand measurements	√	8

Annex 2: Characteristics of the tested meters

Sample number	Model	Serial number	Year of fabrication	I_n [A]	I_{max} [A]	U_{ref} [V]	f_{ref} [Hz]
1.	MC 330	305127	2011	5	10	48...276	60
2.	MC 330	305128	2011	5	10	48...276	60
3.	MC 330	305130	2011	5	10	48...276	60
4.	MC 330	305131	2011	5	10	48...276	60
5.	MC 330	305129	2011	5	10	48...276	60

Software version: 1.16
Hardware version: A

Remarks: The results as mentioned in this test report relate only to the meters which are tested.

The above mentioned characteristics were stated on the PMDs under test and are required by the IEC document.

Photograph:

Annex 3: Test data

Test: Temperature influence for phase current and neutral current measurement

The variation of the error is determined due to variation of the temperature.
The error of indication is measured at a reference temperature of +23°C and at the stated temperatures.
The shift of the error due to the shift of temperature is stated in the following tables.

Results:

Sample nr. 4							
Phase	U_{ref}	Variation at temperature					Max. temperature coefficient %/K
		-10°C	5°C	40°C	55°C	70°C	
R	$I=0,1I_n$, $\cos(\phi)=1$	+ 0,001	– 0,001	– 0,000	– 0,001	– 0,001	+ 0,000
	$I=0,1I_n$, $\cos(\phi)=0,5$ ind.	+ 0,001	– 0,001	– 0,000	– 0,001	– 0,001	+ 0,000
S	$I=0,1I_n$, $\cos(\phi)=1$	+ 0,001	– 0,001	– 0,000	– 0,001	– 0,001	+ 0,000
	$I=0,1I_n$, $\cos(\phi)=0,5$ ind.	+ 0,001	– 0,001	– 0,001	– 0,001	– 0,001	+ 0,000
T	$I=0,1I_n$, $\cos(\phi)=1$	+ 0,001	– 0,001	– 0,000	– 0,001	– 0,001	+ 0,000
	$I=0,1I_n$, $\cos(\phi)=0,5$ ind.	+ 0,001	– 0,001	– 0,000	– 0,001	– 0,001	+ 0,000
R	$I=0,2I_n$, $\cos(\phi)=1$	+ 0,001	– 0,002	– 0,001	– 0,001	– 0,002	+ 0,000
	$I=0,2I_n$, $\cos(\phi)=0,5$ ind.	+ 0,001	– 0,002	– 0,001	– 0,001	– 0,002	+ 0,000
S	$I=0,2I_n$, $\cos(\phi)=1$	+ 0,001	– 0,002	– 0,001	– 0,001	– 0,002	+ 0,000
	$I=0,2I_n$, $\cos(\phi)=0,5$ ind.	+ 0,001	– 0,002	– 0,001	– 0,001	– 0,002	+ 0,000
T	$I=0,2I_n$, $\cos(\phi)=1$	+ 0,001	– 0,001	– 0,001	– 0,001	– 0,001	+ 0,000
	$I=0,2I_n$, $\cos(\phi)=0,5$ ind.	+ 0,001	– 0,001	– 0,000	– 0,001	– 0,001	+ 0,000
R	$I=0,5I_n$, $\cos(\phi)=1$	+ 0,002	– 0,004	– 0,001	– 0,003	– 0,004	+ 0,000
	$I=0,5I_n$, $\cos(\phi)=0,5$ ind.	+ 0,002	– 0,004	– 0,002	– 0,003	– 0,004	+ 0,000
S	$I=0,5I_n$, $\cos(\phi)=1$	+ 0,003	– 0,004	– 0,002	– 0,003	– 0,004	+ 0,000
	$I=0,5I_n$, $\cos(\phi)=0,5$ ind.	+ 0,003	– 0,005	– 0,002	– 0,003	– 0,005	+ 0,001
T	$I=0,5I_n$, $\cos(\phi)=1$	+ 0,001	– 0,003	– 0,001	– 0,002	– 0,003	+ 0,000
	$I=0,5I_n$, $\cos(\phi)=0,5$ ind.	+ 0,001	– 0,003	– 0,001	– 0,002	– 0,003	+ 0,000
R	$I=I_n$, $\cos(\phi)=1$	+ 0,004	– 0,007	– 0,003	– 0,005	– 0,007	+ 0,001
	$I=I_n$, $\cos(\phi)=0,5$ ind.	+ 0,004	– 0,008	– 0,003	– 0,005	– 0,008	+ 0,001
S	$I=I_n$, $\cos(\phi)=1$	+ 0,005	– 0,008	– 0,003	– 0,005	– 0,008	+ 0,001
	$I=I_n$, $\cos(\phi)=0,5$ ind.	+ 0,005	– 0,008	– 0,003	– 0,005	– 0,008	+ 0,001
T	$I=I_n$, $\cos(\phi)=1$	+ 0,003	– 0,006	– 0,002	– 0,004	– 0,006	+ 0,001
	$I=I_n$, $\cos(\phi)=0,5$ ind.	+ 0,003	– 0,006	– 0,002	– 0,004	– 0,006	+ 0,001
R	$I=0,75I_{max}$, $\cos(\phi)=1$	+ 0,005	– 0,011	– 0,005	– 0,008	– 0,011	+ 0,001
	$I=0,75I_{max}$, $\cos(\phi)=0,5$ ind.	+ 0,006	– 0,010	– 0,004	– 0,007	– 0,010	+ 0,001
S	$I=0,75I_{max}$, $\cos(\phi)=1$	+ 0,006	– 0,011	– 0,005	– 0,008	– 0,011	+ 0,001
	$I=0,75I_{max}$, $\cos(\phi)=0,5$ ind.	+ 0,006	– 0,011	– 0,005	– 0,008	– 0,011	+ 0,001
T	$I=0,75I_{max}$, $\cos(\phi)=1$	+ 0,004	– 0,010	– 0,004	– 0,007	– 0,010	+ 0,001
	$I=0,75I_{max}$, $\cos(\phi)=0,5$ ind.	+ 0,005	– 0,009	– 0,004	– 0,007	– 0,009	+ 0,001
R	$I=I_{max}$, $\cos(\phi)=1$	+ 0,008	– 0,015	– 0,006	– 0,011	– 0,015	+ 0,002
	$I=I_{max}$, $\cos(\phi)=0,5$ ind.	+ 0,008	– 0,014	– 0,006	– 0,010	– 0,014	+ 0,001
S	$I=I_{max}$, $\cos(\phi)=1$	+ 0,008	– 0,012	– 0,005	– 0,008	– 0,012	+ 0,001
	$I=I_{max}$, $\cos(\phi)=0,5$ ind.	+ 0,008	– 0,013	– 0,006	– 0,009	– 0,013	+ 0,001
T	$I=I_{max}$, $\cos(\phi)=1$	+ 0,006	– 0,013	– 0,005	– 0,009	– 0,013	+ 0,001
	$I=I_{max}$, $\cos(\phi)=0,5$ ind.	+ 0,006	– 0,013	– 0,005	– 0,009	– 0,013	+ 0,001

Definition: Variation = (Error at specified temperature) - (Average error at +23°C)

Test: Variation of the error due to a magnetic induction of external origin (0,5 mT)

The influence of an external magnetic field on the registration of the meter is investigated, with a field strength of 0,5 mT.
An external magnetic field is made with the help of a round coil with a diameter of 1 meter. The meter is placed into the middle of the coil.
The measurements are performed with a variable phase shift between the current that caused the magnetic field and the measuring circuit voltage of the meter.
The phase shift is adjusted between 0° and 360°. For each measurement the coil and the meter are placed in several positions.

Results: Active energy measurements:

Sample nr. 4 $U=U_{ref}$, $I=I_n$ and $\cos(\phi)=1$	
Variation [%]	< 0,05

Definition: Variation = (Error with an external magnetic field) - (Error at reference conditions)

Remark: The uncertainty in the generated magnetic field is 1%.

Test: Variation of the error due to short time overcurrents

The meter is tested by applying an impulse current to the current circuit of the meter. During the test the voltage circuits were energized with the reference voltage. Before and after the test the error of indication is measured at reference conditions.

The test is performed in accordance with IEC 62053-21/22 section 7.2 and SEC 50-SDMS-01 clause 6.8.

The impulse current had the following characteristics:
- 300A current, for 1 second at rated frequency

The tests is performed with sample nr. 5.

Results: The difference in the error of indication at reference conditions before and after the test was not greater than the uncertainty of the measurements.

Test: Climatic influences

The meter is exposed to the following climatic tests:
- dry heat test (70 °C for 72 hours) - according to IEC 60068-2-2
- cold test (-25 °C for 72 hours) - according to IEC 60068-2-1
- damp heat, cyclic test (upper temperature 55 °C, 6 cycles) - according to IEC 60068-2-30.

After the test the following dielectric tests are performed:
- an impulse voltage test (peak level 4,8 kV)
- an AC voltage test (test voltage 4 kV)

The dry heat and cold test are performed with sample nr. 4.
The damp heat, cyclic test is performed with sample nr. 3.

Results:			
	Compliance with dielectric tests	:	yes
	Damage after the test or visible corrosion	:	no
	Change of information after the test	:	no

Test: Solar radiation test

The meter is exposed to solar radiation.
The test is carried out according to IEC 60068-2-5, under the following conditions:

- meter in non-operating condition
- test procedure A (8 h irridiation and 16 h darkness)
- upper temperature : 55 °C
- duration of the test : 3 cycles or 3 days

The test is performed with sample nr. 2.

Result:

After the test all markings were clearly visible. The function of the meter is not impaired.

Test: Spring hammer test

The mechanical strength of the meter case is tested with a spring hammer (IEC 60068-2-75), with a kinetic energy of 0,22 J.

The test is performed with sample nr. 3.

Result: The meter case was not damaged; no affection of the meter functions took place. After the test it was not possible to touch live parts.

Test: Protection against penetration of dust and water

The protection against penetration of dust and water is tested according to IEC 60529, conform IP54.

The test is performed with sample nr. 3.

Result: Ingress of dust and water of any quantity to impair the operation of the meter has not been detected. The insulation strength test in accordance with par. 5.4.6 has been carried out and no performance degradation of the insulation properties was detected.

Test: Intrinsic uncertainly table for phase current (at reference conditions)

The error of the meter is measured under reference conditions at different values of the current and power factor, while using the test points as indicated in table 20 of the EN 61557-12 document.

Results:

Current	Power factor	Error [%]
		Sample nr. 4
10% In phase R	1	-0,040
	0,5 ind.	-0,020
10% In phase S	1	-0,040
	0,5 ind.	-0,020
10% In phase T	1	-0,060
	0,5 ind.	-0,040
20% In phase R	1	-0,035
	0,5 ind.	-0,025
20% In phase S	1	-0,045
	0,5 ind.	-0,025
20% In phase T	1	-0,040
	0,5 ind.	-0,040
50% In phase R	1	-0,020
	0,5 ind.	-0,020
50% In phase S	1	-0,004
	0,5 ind.	0,000
50% In phase T	1	-0,016
	0,5 ind.	-0,020
In phase R	1	-0,024
	0,5 ind.	-0,024
In phase S	1	-0,048
	0,5 ind.	-0,048
In phase T	1	-0,048
	0,5 ind.	-0,048
0,75 Imax phase R	1	-0,013
	0,5 ind.	0,000
0,75 Imax phase S	1	-0,013
	0,5 ind.	-0,013
0,75 Imax phase T	1	-0,027
	0,5 ind.	-0,027
Imax phase R	1	-0,010
	0,5 ind.	-0,010
Imax phase S	1	-0,010
	0,5 ind.	-0,020
Imax phase T	1	-0,030
	0,5 ind.	-0,030

Test: Demand measurements

The MC330 meter provides exponential based demand measurement, which mimics the behavior of analog thermal demand meters.

The performance of the meter is only verified for reference current. The demand values indicated by the meter are captured every 30 seconds and presented in the following table.

Thermal current demand measurement: after reset of MD values.

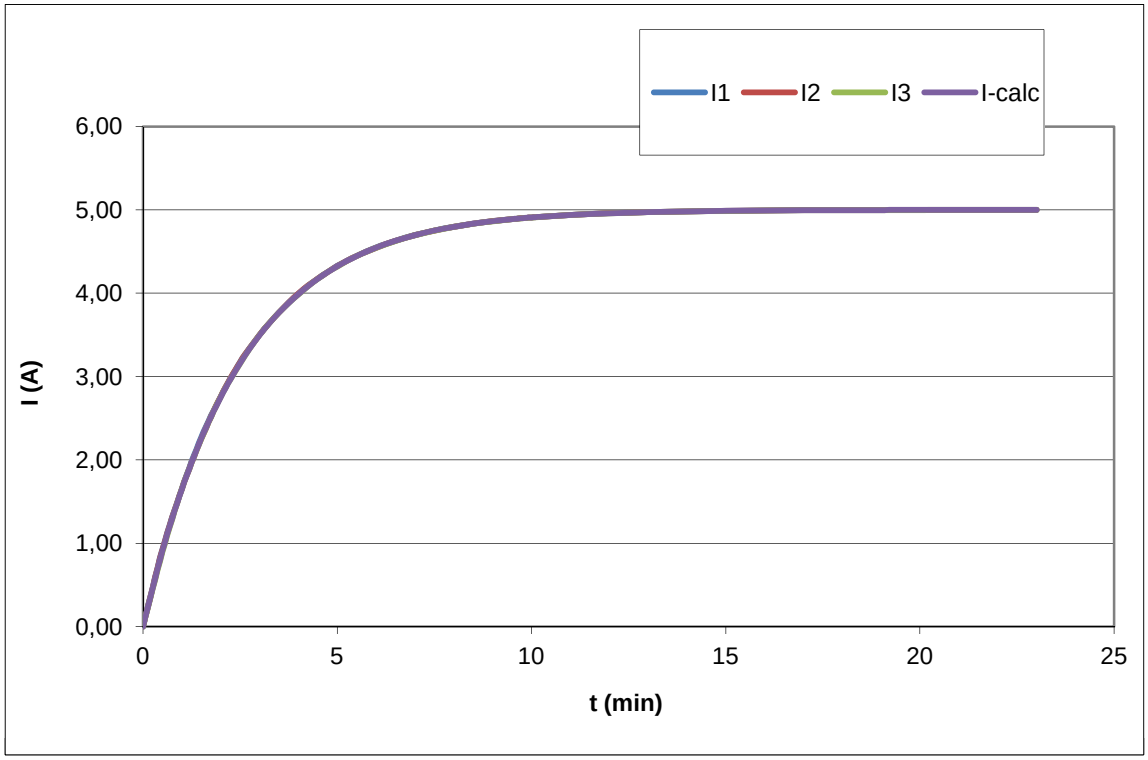
Thermal const. = 2,5 min. Set time const. = 15 min.		Sample nr. 5					
		I = 5 A			P = 3450 W S = 3450 VA		
Time	Set	Measured			Set	Measured	
t(min)	I-calc	I1(A)	I2(A)	I3(A)	P-calc	P(kW)	S(kVA)
00:00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
00:30	0,91	0,93	0,92	0,89	0,63	0,64	0,64
01:00	1,65	1,65	1,65	1,65	1,14	1,14	1,14
01:30	2,26	2,27	2,25	2,25	1,56	1,55	1,55
02:00	2,75	2,76	2,76	2,76	1,90	1,90	1,90
02:30	3,16	3,18	3,17	3,16	2,18	2,18	2,18
03:00	3,49	3,50	3,50	3,50	2,41	2,41	2,41
03:30	3,77	3,77	3,77	3,77	2,60	2,60	2,60
04:00	3,99	4,00	4,00	3,99	2,75	2,76	2,76
04:30	4,17	4,17	4,17	4,17	2,88	2,88	2,88
05:00	4,32	4,33	4,33	4,32	2,98	2,98	2,98
05:30	4,45	4,45	4,45	4,45	3,07	3,07	3,07
06:00	4,55	4,55	4,55	4,55	3,14	3,14	3,14
06:30	4,63	4,63	4,63	4,63	3,19	3,19	3,19
07:00	4,70	4,70	4,70	4,70	3,24	3,24	3,24
07:30	4,75	4,75	4,75	4,75	3,28	3,28	3,28
08:00	4,80	4,80	4,80	4,80	3,31	3,31	3,31
08:30	4,83	4,83	4,83	4,83	3,33	3,33	3,33
09:00	4,86	4,86	4,86	4,86	3,36	3,35	3,35
09:30	4,89	4,89	4,89	4,89	3,37	3,37	3,37
10:00	4,91	4,91	4,91	4,91	3,39	3,39	3,39
11:00	4,94	4,94	4,94	4,94	3,41	3,41	3,41
12:00	4,96	4,96	4,96	4,96	3,42	3,42	3,42
13:00	4,97	4,97	4,97	4,97	3,43	3,43	3,43
14:00	4,98	4,98	4,98	4,98	3,44	3,44	3,44
15:00	4,99	4,99	4,99	4,99	3,44	3,44	3,44
16:00	4,99	4,99	4,99	4,99	3,44	3,44	3,44
17:00	4,99	4,99	4,99	5,00	3,45	3,45	3,45
18:00	5,00	5,00	5,00	5,00	3,45	3,45	3,45
19:00	5,00	5,00	5,00	5,00	3,45	3,45	3,45
20:00	5,00	5,00	5,00	5,00	3,45	3,45	3,45
23:00	5,00	5,00	5,00	5,00	3,45	3,45	3,45
Error % of Thermal demand values							
t(min)		I1	I2	I3	-	P(kW)	S(kVA)
Thermal const.	02:30	0,46	0,42	-0,11	-	-0,17	-0,13
Time const.	15:00	-0,01	-0,01	-0,05	-	-0,04	-0,04
Final	20:00	-0,01	-0,01	-0,01	-	-0,05	-0,05

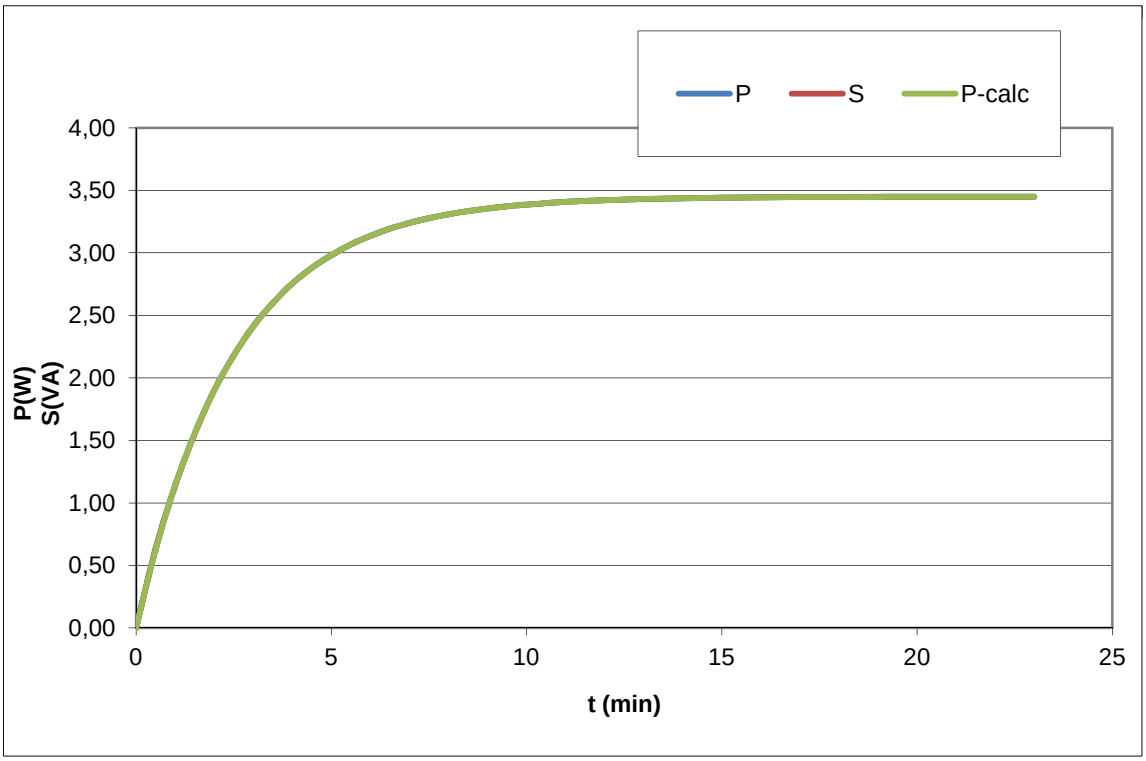
Thermal current demand measurement: after current change from 5 A to 0 A

Thermal const. = 2,5 min. Set time const. = 15 min.		Sample nr. 5					
		I = 5 A (for t < 0) I = 0 A (for t > 0)			P = 0 W S = 0 VA		
Time	Set	Measured			Set	Measured	
t(min)	I-calc	I1(A)	I2(A)	I3(A)	P-calc	P(kW)	S(kVA)
00:00	5,00	5,00	5,00	5,00	3,45	3,45	3,45
00:30	4,09	4,09	4,09	4,09	2,82	2,81	2,82
01:00	3,35	3,36	3,36	3,37	2,31	2,31	2,32
01:30	2,74	2,74	2,74	2,74	1,89	1,88	1,89
02:00	2,25	2,25	2,25	2,25	1,55	1,55	1,55
02:30	1,84	1,85	1,84	1,84	1,27	1,26	1,26
03:00	1,51	1,51	1,51	1,51	1,04	1,04	1,04
03:30	1,23	1,24	1,24	1,24	0,85	0,85	0,85
04:00	1,01	1,01	1,01	1,01	0,70	0,69	0,70
04:30	0,83	0,83	0,83	0,83	0,57	0,57	0,57
05:00	0,68	0,68	0,68	0,68	0,47	0,46	0,47
05:30	0,55	0,56	0,56	0,56	0,38	0,38	0,38
06:00	0,45	0,45	0,46	0,46	0,31	0,31	0,31
07:00	0,30	0,31	0,31	0,31	0,21	0,21	0,21
08:00	0,20	0,20	0,20	0,20	0,14	0,14	0,14
09:00	0,14	0,14	0,14	0,14	0,09	0,09	0,09
10:00	0,09	0,09	0,09	0,09	0,06	0,06	0,06
11:00	0,06	0,06	0,06	0,06	0,04	0,04	0,04
12:00	0,04	0,04	0,04	0,04	0,03	0,03	0,03
14:00	0,02	0,02	0,02	0,02	0,01	0,01	0,01
15:00	0,01	0,01	0,01	0,01	0,01	0,01	0,01
16:00	0,01	0,01	0,01	0,01	0,01	0,01	0,01
18:00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
20:00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
22:00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Error % of Thermal demand values							
t(min)		I1	I2	I3	-	P(kW)	S(kVA)
Thermal const.	02:30	0,47	0,28	-0,19	-	-0,64	-0,38
Time const.	15:00	0,05	0,13	0,21	-	-0,17	0,20

Results: The percentage error is not greater than the uncertainty of the measurements.

Thermal current demand measurement: after reset of MD values.





Thermal current demand plot: after current change from 5 A to 0 A