APPROVAL REPORT FOR THE PATTERN AND CONSTRUCTION OF ELECTRICITY METERS ANNEX II, MODULE B MEASURING INSTRUMENT DIRECTIVE

MANUFACTURER : *Jiangsu Acrel Electrical Manufacturing. Co., Ltd.*

TYPE : *ADL200*

CLASS : *A or B (kWh)*

DESCRIPTION : *Single Phase, Active Import/Export (kWh), Electricity Meter*

Tested in accordance with EN 50470-1: 2006, Electricity metering equipment (AC)
Part 1: General requirements, tests and test conditions.
Metering equipment (class indexes A, B and C)

and

EN 50470-3: 2006, Electricity metering equipment (AC)
Part 3: Particular requirements - Static meters for active energy (class indexes A, B and C)

The meters tested satisfied the required specification.

ISSUED BY:

Mason Gu

CHECKED BY:

K.Hunter
Test Engineer

REPORT ISSUE DATE: 22nd July 2021

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INTRODUCTION

The type tests described were carried out in SCM and SGS Shanghai laboratory on behalf of:

CLIENT DETAILS: Jiangsu Acrel Electrical Manufacturing. Co., Ltd.
No.5,Dongmeng Road,Nanzha Street,Jiangyin City,
Jiangsu Province, China

ORDER No: SH-202102040279

APPLICATION RECEIVED DATE: March 4th 2021

DATE OF RECEIPT OF SAMPLES: March 24th 2021

DATE OF TESTS: March 25th 2021 to May 24th 2021

Conditions under which the type tests took place:

Unless otherwise stated, the meters were examined at an ambient temperature of 23°C ± 2°C, and after the voltage circuits had been connected to reference voltage for at least 1 hour.

Unless otherwise stated, Polyphase tests were tested with a standard phase sequence of L1-L2-L3 (corresponding to the Red, Yellow & Blue phases).

The tests were conducted using equipment, traceable to National and International Standards.

INFORMATION ON THE ELECTRICITY METERS TESTED

Manufacturer	:	Jiangsu Acrel Electrical Manufacturing. Co., Ltd.
Type	:	ADL200
Class	:	A or B (kWh)
Temperature Range	:	-25ºC to +55ºC
Type of circuit	:	1 phase 2 wire
Imin	:	0.5A
Itr	:	1A
In	:	10A
Imax	:	80A
Reference Supply Voltage	:	230V
Rated Frequency	:	50Hz
Pulse output constant	:	1000p/kWh
Manufacturers Serial No.	:	11809192840053，11809192840057， 11809192840047，11809192840054，M7

SUPPORTING DOCUMENTATION

Accredited Laboratory tests reports:

Clause 5.4 Terminal block requirements

SGS. Report No. SHIN2107046133MR Issued: 9th July 2021

SUMMARY OF TEST RESULTS

Test Description	Requirements		Performed	Result
	General EN50470-1 Clause	Static EN50470-3 Clause		
Tests of insulation properties				
Impulse voltage	7.3.3		SGS Shanghai	Complied
AC voltage	7.3.4	7.2	SGS Shanghai	Complied
Tests of accuracy requirements				
Accuracy at reference conditions		8.7.2	SGS Shanghai	Complied
Repeatability		8.7.4	SGS Shanghai	Complied
Meter constant		8.7.10	SGS Shanghai	Complied
Starting condition		8.7.9.2	SCM	Complied
No-load condition		8.7.9.3	SGS Shanghai	Complied
Effect of influence quantities		8.7.5	SGS Shanghai	Complied
Tests of effect of disturbances of long duration				
Severe voltage condition		8.7.7.2	SGS Shanghai	Complied
Reverse phase sequence		8.7.7.3	N/A	N/A
Voltage unbalance		8.7.7.4	N/A	N/A
Short time overcurrents		8.7.8	SCM	Complied
Self-heating		8.7.7.5	SGS Shanghai	Complied
Accuracy in the presence of harmonics		8.7.7.7	SCM	Complied
Odd harmonics and sub-harmonics		8.7.7.9	SCM	Complied
DC and even harmonics		8.7.7.8	SCM	Complied
Operation of auxiliary devices		8.7.7.13	N/A	N/A
Tests of electrical requirements				
Power consumption		7.1	SGS Shanghai	Complied
Heating	7.2		SGS Shanghai	Complied
Tests for electromagnetic compatibility				
Immunity to voltage dips and short interrupts	7.4.4		SCM	Complied
Radio interference suppression	7.4.13		SCM	Complied
Immunity to fast transients	7.4.7	8.7.7.14	SCM	Complied
Immunity to oscillatory waves	7.4.10	8.7.7.16	N/A	N/A
Immunity to radiated RF electromagnetic fields	7.4.6	8.7.7.12	SCM	Complied
Immunity to conducted RF disturbances	7.4.8	8.7.7.15	SCM	Complied
Immunity to electrostatic discharges	7.4.5		SCM	Complied
Immunity to surges	7.4.9		SCM	Complied
Immunity to AC magnetic fields	7.4.12	8.7.7.11	SCM	Complied
Immunity to continuous magnetic fields	7.4.11	8.7.7.10	SCM	Complied
Tests of the effect of climatic environments				
Dry heat test (Test B)	6.3.2		SGS Shanghai	Complied
Cold test (Test A)	6.3.3		SGS Shanghai	Complied
Damp heat cyclic test (Test Db)	6.3.4		SGS Shanghai	Complied
Solar Radiation (Test Sa)	6.3.5		N/A	N/A
Mechanical tests				
Vibration test (Test Fc)	5.2.2.3		SGS Shanghai	Complied
Shock test (Test Ea)	5.2.2.2		SGS Shanghai	Complied
Spring hammer test (Test Eh)	5.2.2.1		SGS Shanghai	Complied
Protection against penetration of dust and water	5.9		SGS Shanghai	Complied
Resistance to heat and fire	5.8		SGS Shanghai	Complied

SUMMARY OF TEST RESULTS (cont.)

Tests performed at SCM and SGS Shanghai Record No.: 2105131425

South China National Centre of Metrology (SCM)
The SCM laboratory is accredited by CNAS (Lab ID: L0730)
CNAS is recognised by the IAF as the accreditation body for China.

SGS-CSTC Standards Technical Service (Shanghai) Co., Ltd. Testing Center (SGS-Shanghai)
The SGS-Shanghai laboratory is accredited by CNAS (Lab ID: L0599)
CNAS is recognised by the IAF as the accreditation body for China.

EN50470-1 GENERAL REQUIREMENTS:

Clause	Requirements	Complied
4.1	Standard reference voltages	Yes
4.2	Standard current & current ranges	Yes
4.3	Standard reference frequency	Yes
5.1	The manufacturer shall specify the mechanical environment the meter is intended for.	Yes
	Meters shall be designed & constructed in such a way to avoid danger in normal use and conditions to avoid: - electric shock - excessive temperature - fire - penetration of solid objects, dust and water	Yes
5.2.1	Case can be sealed or closed in a way that protects internal parts and cannot be accessed without breaking a seal or the case	Yes
5.3	The window shall be transparent	Yes
5.4	Terminal requirements	Yes
	The terminal block material is capable of passing the tests given in EN ISO 75-2	Yes
5.5	The terminals shall have a separate cover which can be sealed independently of the meter cover	Yes
5.6	Clearance and creepage requirements	Yes
5.7	Insulating encased meter of protective class II requirements	Yes
5.10	Register readable under normal conditions and the principal unit is kWh	Yes
	Non-volatile memory has a minimum retention time of 4 months	Yes
	In the case of multiple values displayed by a single display, it shall be possible to display the contents of all relevant memories. Automatic sequencing displays shall display each value for at least 5 seconds	Yes
	The register shall be able to record and display, starting from zero, for a minimum of 4000hrs, the energy corresponding to maximum current at reference voltage and unity power factor	Yes
	The display of the total energy supplied shall not be able to reset during use	Yes
5.11	The meter has a test output capable of being monitored for test purposes	Yes
5.11.1	The maximum pulse frequency of the optical test output shall be ≤ 2.5kHz and the pulse transition time shall be ≤ 20μs	Yes
5.11.2	The wavelength of the radiated signals for emitting systems is between 550nm and 1000nm	Yes
5.12.1	The meter bears the required information on the name plate	Yes
5.12.2	The meter has the connection diagram marked	Yes
5.13	An instruction manual for each meter type is made available	Yes

RELIABILITY & DURABILITY EN50470-3 X-Ref. 9.0 & 10.0

An assessment was made using the failure rates of components in accordance with the SIEMENS NORM SN 29500 Edition 2009-06.

These values were then applied to a spreadsheet (OfgemModelv4.3.xls) in accordance with our guidance notes (Model Guidelines v1.4.doc) and given an overall predicted life, in years.

As part of the type approval process, SGS carried out the assessment to verify that the submitted reliability model accurately reflects the physical sample supplied in order to ascertain an accurate predicted life.

Supporting documentation has been provided and found to be satisfactory where components that are not covered by the SN 29500 (LCD's, Batteries, and Contactors etc.) have been used and any subsequent arguments have been resolved.

The Electronic Metering Reliability Model predicts that this meter has a life of

15.31Years with reference to Reliability Report EMA291455/1/Reliability dated 16th June 2021

Where this relates to a family of meters, the reliability model was performed on the most component populated meter variant, so as to simulate the worst case scenario, and all other meter variants will be at least similar.

SOFTWARE REVIEW EN50470-3 X-Ref. 11.0

A review was carried out in accordance with the Welmec 7.2 2015 Software Guide (Measuring Instruments Directive 2014/32/EU)

The meter was stated to be Type P (Basic requirements for Embedded Software in a Built-for-purpose Measuring Instrument) and under Risk Class C. The meter was also considered for:-

Extension L - Specific software requirements for Long-term storage
Extension T - Specific software requirements for Data transmission
Extension D - Download of legally relevant software
Extension I-3 - Specific software requirements (Active electrical energy meters)

The review was performed on software version V1.01

Documentation provided by the manufacturer satisfied the requirement of the Welmec software guide.

1 INSULATION EN50470-1 X-Ref. 7.3

1.1 Impulse Voltage Test X-Ref. 7.3.3

Sample No:M7	Test Procedure: EN50470-1 Impulse Voltage

Environmental Conditions

Temperature	21.5°C
Relative Humidity	56.0 %
Barometric Pressure	998 mB

Impulse specification: Test level 6kV @ 0.5J open circuit
Time between impulse's 3s

The meter samples were placed on a flat conducting earth surface with the case wrapped in a conductive foil.

The test voltage was applied 10 times in each polarity between the points listed below:-

1) With one terminal of the voltage circuit connect to earth, the impulse voltage was applied between the common voltage/current meter terminal and earth.

2) With all meter terminals connected together, impulse voltage was applied between the meter terminals and earth.

During the tests auxiliary circuits with reference rated voltage ≤ 40V were connected to earth.

On completion of the above test, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions, with no signs of damage or degradation in the meter's insulation properties.

1.2 AC Voltage Test

EN50470-1 X-Ref. 7.3.4

EN50470-3 X-Ref. 7.2

Sample No: M7	Test Procedure: EN50470-3 AC Voltage

Environmental Conditions

Temperature	21.5°C
Relative Humidity	56.0 %
Barometric Pressure	998 mB

Test level 2kV & 4kV Test duration 1 minute.

The a.c. voltage tests were conducted as follows:

1) Between all meter voltage and current circuits connected together, and earth.

2) Between all circuits not intended to be connected together in service, and earth.

The earth consisting of a conductive foil wrapped around the meter and connected to a flat conducting earth surface, upon which the meter was placed.

During the tests auxiliary circuits with reference rated voltage ≤ 40V were connected to earth.

On completion of the above test, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions, with no signs of damage or degradation in the meter's insulation properties.

2 ACCURACY AT REFERENCE CONDITIONS EN50470-3 X-Ref. 8

2.1 Variation in Current X-Ref. 8.7.2

Sample No: M7	Test Procedure: EN50470-3 Acc 1P2W kWh +P

Test Conditions: *Un:230V* *Fn: 50Hz*
Imin:0.5A *Itr:1A* *Iref:10A* *Imax:80A*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

			Limit of % Error		
CURRENT	PF Cos. ϕ	*% Error*	Accuracy		
			Class A	Class B	Class C
Imin	1.0	0.0579	±2.5	±1.5	±1.0
Itr	-	0.0927	±2.0	±1.0	±0.5
10Itr(Iref/In)	-	0.0868	±2.0	±1.0	±0.5
0.5Imax	-	0.0590	±2.0	±1.0	±0.5
Imax	-	0.0208	±2.0	±1.0	±0.5
Itr	0.5ind	0.2359	±2.0	±1.0	±0.5
10Itr(Iref/In)	-	0.2340	±2.0	±1.0	±0.5
0.5Imax	-	0.1843	±2.0	±1.0	±0.5
Imax	-	0.0973	±2.0	±1.0	±0.5
Itr	0.8cap	0.0215	±2.0	±1.0	±0.5
10Itr(Iref/In)	-	0.0208	±2.0	±1.0	±0.5
0.5Imax	-	-0.0069	±2.0	±1.0	±0.5
Imax	-	-0.0624	±2.0	±1.0	±0.5

Repeatability EN50470-3 X-Ref 8.2

		R1	*R2*	*R3*	Limit of % Error Variation		
CURRENT	PF Cos. ϕ	*% Error Variance*	*% Error Variance*	*% Error Variance*	Accuracy		
					Class A	Class B	Class C
Imin	1.0	0.03	0.03	0.03	±0.25	±0.15	±0.10
Itr	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
10Itr(Iref/In)	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
0.5Imax	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
Imax	-	-0.01	0.00	0.00	±0.20	±0.10	±0.05
Itr	0.5ind	0.00	0.00	0.00	±0.20	±0.10	±0.05
10Itr(Iref/In)	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
0.5Imax	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
Imax	-	-0.01	0.00	0.01	±0.20	±0.10	±0.05
Itr	0.8cap	0.00	0.00	0.01	±0.20	±0.10	±0.05
10Itr(Iref/In)	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
0.5Imax	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
Imax	-	0.00	0.00	-0.01	±0.20	±0.10	±0.05

Variation in Current(cont.)

X-Ref. 8.7.2

Sample No: M7	Test Procedure: EN50470-3 Acc 1P2W kWh -P

Test Conditions: *Un:230V* *Fn: 50Hz*
Imin:0.5A *Itr:1A* *Iref:10A* *Imax:80A*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Export Energy kWh*

			Limit of % Error		
CURRENT	PF Cos. ϕ	*% Error*	Accuracy		
			Class A	Class B	Class C
Imin	1.0	0.1021	±2.5	±1.5	±1.0
Itr	-	0.1028	±2.0	±1.0	±0.5
10Itr(Iref/In)	-	0.1138	±2.0	±1.0	±0.5
0.5Imax	-	0.1321	±2.0	±1.0	±0.5
Imax	-	0.1530	±2.0	±1.0	±0.5
Itr	0.5ind	0.2590	±2.0	±1.0	±0.5
10Itr(Iref/In)	-	0.2802	±2.0	±1.0	±0.5
0.5Imax	-	0.3239	±2.0	±1.0	±0.5
Imax	-	0.3414	±2.0	±1.0	±0.5
Itr	0.8cap	0.0339	±2.0	±1.0	±0.5
10Itr(Iref/In)	-	0.0442	±2.0	±1.0	±0.5
0.5Imax	-	0.0694	±2.0	±1.0	±0.5
Imax	-	0.0973	±2.0	±1.0	±0.5

Repeatability

EN50470-3 X-Ref 8.2

		R1	*R2*	*R3*	Limit of % Error Variation		
CURRENT	PF Cos. ϕ	*% Error Variance*	*% Error Variance*	*% Error Variance*	Accuracy		
					Class A	Class B	Class C
Imin	1.0	0.00	-0.02	0.00	±0.25	±0.15	±0.10
Itr	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
10Itr(Iref/In)	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
0.5Imax	-	0.00	0.00	-0.01	±0.20	±0.10	±0.05
Imax	-	-0.01	-0.01	0.00	±0.20	±0.10	±0.05
Itr	0.5ind	-0.01	0.00	0.01	±0.20	±0.10	±0.05
10Itr(Iref/In)	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
0.5Imax	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
Imax	-	0.01	0.01	0.01	±0.20	±0.10	±0.05
Itr	0.8cap	-0.01	-0.01	0.00	±0.20	±0.10	±0.05
10Itr(Iref/In)	-	0.00	0.00	0.00	±0.20	±0.10	±0.05
0.5Imax	-	0.01	0.00	0.00	±0.20	±0.10	±0.05
Imax	-	-0.01	0.01	-0.01	±0.20	±0.10	±0.05

2.2 Meter Constant X-Ref 8.7.10

The relation between the test output and the meter energy registers were checked to ensure the constant marking on the meter nameplate.

Sample No: M7	Test Procedure: EN50470-3 Meter Constant

Test Conditions: *Un:230V* *Imax:80A* *Cos. ϕ = 1.0, 50Hz*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

Number of Pulses Recorded	Pulse Constant (p/ kWh)	LED Test Output (kWh)	Energy Registered By Meter (kWh)	Percentage difference between Energy Registered and LED Test Output (%)
5004	1000	5.004	5.00	-0.08

Limit of % Error Variation: ± 0.20% for Class A
± 0.10% for Class B
± 0.05% for Class C

During the registration tests, rate registers not active were found not to have been corrupted.

Sample No: M7	Test Procedure: EN50470-3 Meter Constant

Test Conditions: *Un:230V* *Imax:80A* *Cos. ϕ = 1.0, 50Hz*

Test Circuit: *1 phase 2 wire*

Measurement Mode*: Active Export Energy kWh*

Number of Pulses Recorded	Pulse Constant (p/ kWh)	LED Test Output (kWh)	Energy Registered By Meter (kWh)	Percentage difference between Energy Registered and LED Test Output (%)
5013	1000	5.013	5.01	-0.06

Limit of % Error Variation: ± 0.20% for Class A
± 0.10% for Class B
± 0.05% for Class C

During the registration tests, rate registers not active were found not to have been corrupted.

2.3 Starting and No-Load Condition X-Ref. 8.7.9

Initial Start-up of the meter X-Ref. 8.7.9.2

Sample No: M7	Test Procedure: EN50470-3 Start-up

The meter samples were fully functional within 5s after rated voltage Un was applied to the meter terminals.

No-load Condition X-Ref. 8.7.9.3

Sample No: M7	Test Procedure: EN50470-3 Non Registration Test 115(%U)

Tests were conducted as follows;

Test Conditions: *115% Un, current circuits open*

The minimum test duration in minutes being given by

$$\Delta t \geq \frac{240 \times 10^3}{k \cdot m \cdot U_{test} \cdot I_{st}} \text{ [min]}$$

where

k is the meter output constant (pulses per kWh)
m is the number of measuring elements
U_{test} is the test voltage
I_{st} is the starting current

The meter samples were tested for a period of at least Δt minutes, on completion of which, no changes in the energy registers were recorded, and the test output did not produce more than one pulse.

Starting and No-Load Condition (cont.)

Starting X-Ref. 8.7.9.4

Sample No: 11809192840047	Test Procedure: EN50470-3 Starting Current 0.04Itr

The meter commenced and continued to measure the applied active power in the import and export direction.

Test Conditions for Direct Connected meters

Class A Active meters: Umin, 0.05Itr, Cos. ϕ = 1.0, 50Hz
Class B Active meters: Umin, 0.04Itr, Cos. ϕ = 1.0, 50Hz
Class C Active meters: Umin, 0.04Itr, Cos. ϕ = 1.0, 50Hz

2.4 Influence of Ambient Temperature X-Ref. 8.7.5.2

Sample No: M7	Test Procedure: EN50470-3 Temp Variation 5ºC to 30ºC

Test Conditions: *Un:230V* *Fn: 50Hz*
Imin:0.5A *Itr:1A* *Iref:10A* *Imax:80A*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

Operating Temperature: *5ºC to 30ºC (Balanced Load)*

Elements/Lines		*Additional % Error*	*Additional % Error*	Limits of additional % error		
CURRENT	PF Cos. ϕ	5ºC	30ºC	Accuracy		
				Class A	Class B	Class C
Imin	1.0	-0.0250	0.1428	±1.8	±0.9	±0.5
Itr	-	0.0236	0.1886	±1.8	±0.9	±0.5
10Itr(Iref/In)	-	0.0968	0.2458	±1.8	±0.9	±0.5
Imax	-	-0.1802	-0.0893	±1.8	±0.9	±0.5
Itr	0.5ind	0.1011	0.2713	±2.7	±1.3	±0.9
10Itr(Iref/In)	-	0.1859	0.3400	±2.7	±1.3	±0.9
Imax	-	-0.1948	0.2628	±2.7	±1.3	±0.9
Itr	0.8cap	-0.0669	0.1064	±2.7	±1.3	±0.9
10Itr(Iref/In)	-	0.0030	0.1736	±2.7	±1.3	±0.9
Imax	-	-0.4535	-0.3717	±2.7	±1.3	±0.9

Influence of Ambient Temperature (cont.)

X-Ref. 8.7.5.2

Sample No: M7 Test Procedure: EN50470-3 Temp Variation -10ºC to 40ºC

Test Conditions: *Un:230V* *Fn: 50Hz*
Imin:0.5A *Itr:1A* *Iref:10A* *Imax:80A*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

Operating Temperature: *-10ºC to 40ºC (Balanced Load)*

Elements/Lines		*Additional % Error*	*Additional % Error*	Limits of additional % error		
CURRENT	PF Cos. ϕ	-10ºC	40ºC	Accuracy		
				Class A	Class B	Class C
Imin	1.0	-0.1436	0.2106	±3.3	±1.6	±1.0
Itr	-	-0.1133	0.2708	±3.3	±1.6	±1.0
10Itr(Iref/In)	-	-0.0414	0.3000	±3.3	±1.6	±1.0
Imax	-	-0.1975	0.0278	±3.3	±1.6	±1.0
Itr	0.5ind	-0.0333	0.3279	±4.9	±2.3	±1.6
10Itr(Iref/In)	-	0.0376	0.3944	±4.9	±2.3	±1.6
Imax	-	-0.2001	-0.0624	±4.9	±2.3	±1.6
Itr	0.8cap	-0.1888	0.1868	±4.9	±2.3	±1.6
10Itr(Iref/In)	-	-0.1363	0.2745	±4.9	±2.3	±1.6
Imax	-	-0.2528	-0.2527	±4.9	±2.3	±1.6

Influence of Ambient Temperature (cont.)

X-Ref. 8.7.5.2

Sample No: M7 Test Procedure: EN50470-3 Temp Variation -25ºC to 55ºC

Test Conditions: *Un:230V* *Fn: 50Hz*
Imin:0.5A *Itr:1A* *Iref:10A* *Imax:80A*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

Operating Temperature: *-25ºC to 55ºC (Balanced Load)*

Elements/Lines		*Additional % Error*	*Additional % Error*	Limits of additional % error		
CURRENT	PF Cos. ϕ	-25ºC	55ºC	Accuracy		
				Class A	Class B	Class C
Imin	1.0	-0.2839	0.2931	±4.8	±2.4	±1.4
Itr	-	-0.2548	0.3523	±4.8	±2.4	±1.4
10Itr(Iref/In)	-	-0.1310	0.3843	±4.8	±2.4	±1.4
Imax	-	-0.2027	0.0087	±4.8	±2.4	±1.4
Itr	0.5ind	-0.1682	0.3610	±7.2	±3.4	±3.1
10Itr(Iref/In)	-	-0.0751	0.4210	±7.2	±3.4	±3.1
Imax	-	-0.1663	-0.0085	±7.2	±3.4	±3.1
Itr	0.8cap	-0.3342	0.2915	±7.2	±3.4	±3.1
10Itr(Iref/In)	-	-0.2721	0.3625	±7.2	±3.4	±3.1
Imax	-	-0.2666	-0.2820	±7.2	±3.4	±3.1

2.5 Voltage Variation

X-Ref. 8.7.5.3

Sample No: M7	Test Procedure: EN50470-3 Voltage Variation

Test Conditions: *Un:230V* *Fn: 50Hz*
Imin:0.5A *Itr:1A* *Iref:10A* *Imax:80A*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

		110% Un *Additional*	90% Un *Additional*	Limit of Additional % Error		
Current	PF Cos. ϕ	*% Error*	*% Error*	Accuracy		
				Class A	Class B	Class C
Imin	1.0	0.1152	0.0921	±1.0	±0.7	±0.2
Itr	-	0.1070	0.1023	±1.0	±0.7	±0.2
10Itr(Iref/In)	-	0.1095	0.1025	±1.0	±0.7	±0.2
Imax	-	0.0416	0.0277	±1.0	±0.7	±0.2
Itr	0.5ind	0.2781	0.2447	±1.5	±1.0	±0.4
10Itr(Iref/In)	-	0.2654	0.2471	±1.5	±1.0	±0.4
Imax	-	0.1460	0.1112	±1.5	±1.0	±0.4
Itr	0.8cap	0.0434	0.0297	±1.5	±1.0	±0.4
10Itr(Iref/In)	-	0.0417	0.0347	±1.5	±1.0	±0.4
Imax	-	-0.0486	-0.0555	±1.5	±1.0	±0.4

2.6 Frequency Variation

X-Ref. 8.7.5.4

Sample No: M7 Test Procedure: EN50470-3 Frequency Variation

Test Conditions: *Un:230V* *Fn: 50Hz*
Imin:0.5A *Itr:1A* *Iref:10A* *Imax:80A*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

		102% Fn *Additional*	98% Fn *Additional*	Limit of Additional % Error		
Current	PF Cos. ϕ	*% Error*	*% Error*	Accuracy		
				Class A	Class B	Class C
Imin	1.0	0.1003	0.0997	±0.8	±0.5	±0.2
Itr	-	0.0949	0.1080	±0.8	±0.5	±0.2
10Itr(Iref/In)	-	0.0908	0.1134	±0.8	±0.5	±0.2
Imax	-	0.0208	0.0416	±0.8	±0.5	±0.2
Itr	0.5ind	0.2571	0.2582	±1.0	±0.7	±0.2
10Itr(Iref/In)	-	0.2510	0.2685	±1.0	±0.7	±0.2
Imax	-	0.1112	0.1390	±1.0	±0.7	±0.2
Itr	0.8cap	0.0240	0.0323	±1.0	±0.7	±0.2
10Itr(Iref/In)	-	0.0191	0.0399	±1.0	±0.7	±0.2
Imax	-	-0.0693	-0.0486	±1.0	±0.7	±0.2

2.7 Composite Error X-Ref. 8.7.6

In addition to the accuracy requirements of clause 8.1 and 8.3, the composite error e_c of the meter shall not exceed the values given below:

		Intrinsic Error	Temp. Error	Voltage Error	Freq. Error	Comp. Error	Operating Temperature -25ºC		
Current	PF Cos. ϕ	*e(Icosϕ)*	-25°C *e(TIcosϕ)*	±10% Un *e(UIcosϕ)*	±2% fn *e(fIcosϕ)*	*% MPE*	Maximum Permissible Error (MPE)		
							Class A	Class B	Class C
Imin	1.0	0.0579	-0.2839	0.1152	0.1003	0.33	±7.0	±3.5	±1.7
Itr	-	0.0927	-0.2548	0.1070	0.1080	0.31	±7.0	±3.5	±1.7
10Itr	-	0.0868	-0.1310	0.1095	0.1134	0.22	±7.0	±3.5	±1.7
Imax	-	0.0208	-0.2027	0.0416	0.0416	0.21	±7.0	±3.5	±1.7
Itr	0.5ind	0.2359	-0.1682	0.2781	0.2582	0.48	±7.0	±3.5	±1.3
10Itr	-	0.2340	-0.0751	0.2654	0.2685	0.45	±7.0	±3.5	±1.3
Imax	-	0.0973	-0.1663	0.1460	0.1390	0.28	±7.0	±3.5	±1.3
Itr	0.8cap	0.0215	-0.3342	0.0434	0.0323	0.34	±7.0	±3.5	±1.3
10Itr	-	0.0208	-0.2721	0.0417	0.0399	0.28	±7.0	±3.5	±1.3
Imax	-	-0.0624	-0.2666	-0.0555	-0.0693	0.29	±7.0	±3.5	±1.3

Composite Error/MPE (cont)

X-Ref. 8.7.6

		Intrinsic Error	Temp. Error	Voltage Error	Freq. Error	Comp. Error	Operating Temperature -10°C		
Current	PF Cos. ϕ	*e(Icosϕ)*	-10°C *e(TIcosϕ)*	±10% Un *e(UIcosϕ)*	±2% fn *e(fIcosϕ)*	*% MPE*	Maximum Permissible Error (MPE)		
							Class A	Class B	Class C
Imin	1.0	0.0579	-0.1436	0.1152	0.1003	0.22	±5.0	±2.5	±1.3
Itr	-	0.0927	-0.1133	0.1070	0.1080	0.21	±5.0	±2.5	±1.3
10Itr	-	0.0868	-0.0414	0.1095	0.1134	0.18	±5.0	±2.5	±1.3
Imax	-	0.0208	-0.1975	0.0416	0.0416	0.21	±5.0	±2.5	±1.3
Itr	0.5ind	0.2359	-0.0333	0.2781	0.2582	0.45	±4.5	±2.5	±1.0
10Itr	-	0.2340	0.0376	0.2654	0.2685	0.45	±4.5	±2.5	±1.0
Imax	-	0.0973	-0.2001	0.1460	0.1390	0.30	±4.5	±2.5	±1.0
Itr	0.8cap	0.0215	-0.1888	0.0434	0.0323	0.20	±4.5	±2.5	±1.0
10Itr	-	0.0208	-0.1363	0.0417	0.0399	0.15	±4.5	±2.5	±1.0
Imax	-	-0.0624	-0.2528	-0.0555	-0.0693	0.28	±4.5	±2.5	±1.0

Composite Error/MPE (cont)

X-Ref. 8.7.6

		Intrinsic Error	Temp. Error	Voltage Error	Freq. Error	Comp. Error	Operating Temperature Range 5°C		
Current	PF Cos. ϕ	*e(Icosϕ)*	5°C *e(TIcosϕ)*	±10% Un *e(UIcosϕ)*	±2% fn *e(fIcosϕ)*	*% MPE*	Maximum Permissible Error (MPE)		
							Class A	Class B	Class C
Imin	1.0	0.0579	-0.0250	0.1152	0.1003	0.17	±3.5	±2.0	±1.0
Itr	-	0.0927	0.0236	0.1070	0.1080	0.18	±3.5	±2.0	±1.0
10Itr	-	0.0868	0.0968	0.1095	0.1134	0.20	±3.5	±2.0	±1.0
Imax	-	0.0208	-0.1802	0.0416	0.0416	0.19	±3.5	±2.0	±1.0
Itr	0.5ind	0.2359	0.1011	0.2781	0.2582	0.46	±3.5	±2.0	±0.7
10Itr	-	0.2340	0.1859	0.2654	0.2685	0.48	±3.5	±2.0	±0.7
Imax	-	0.0973	-0.1948	0.1460	0.1390	0.30	±3.5	±2.0	±0.7
Itr	0.8cap	0.0215	-0.0669	0.0434	0.0323	0.09	±3.5	±2.0	±0.7
10Itr	-	0.0208	0.0030	0.0417	0.0399	0.06	±3.5	±2.0	±0.7
Imax	-	-0.0624	-0.4535	-0.0555	-0.0693	0.47	±3.5	±2.0	±0.7

Composite Error/MPE (cont)

X-Ref. 8.7.6

		Intrinsic Error	Temp. Error	Voltage Error	Freq. Error	Comp. Error	Operating Temperature 30°C		
Current	PF Cos. ϕ	*e(Icosϕ)*	30°C *e(TIcosϕ)*	±10% Un *e(UIcosϕ)*	±2% fn *e(fIcosϕ)*	*% MPE*	Maximum Permissible Error (MPE)		
							Class A	Class B	Class C
Imin	1.0	0.0579	0.1428	0.1152	0.1003	0.22	±3.5	±2.0	±1.0
Itr	-	0.0927	0.1886	0.1070	0.1080	0.26	±3.5	±2.0	±1.0
10Itr	-	0.0868	0.2458	0.1095	0.1134	0.30	±3.5	±2.0	±1.0
Imax	-	0.0208	-0.0893	0.0416	0.0416	0.11	±3.5	±2.0	±1.0
Itr	0.5ind	0.2359	0.2713	0.2781	0.2582	0.52	±3.5	±2.0	±0.7
10Itr	-	0.2340	0.3400	0.2654	0.2685	0.56	±3.5	±2.0	±0.7
Imax	-	0.0973	0.2628	0.1460	0.1390	0.35	±3.5	±2.0	±0.7
Itr	0.8cap	0.0215	0.1064	0.0434	0.0323	0.12	±3.5	±2.0	±0.7
10Itr	-	0.0208	0.1736	0.0417	0.0399	0.18	±3.5	±2.0	±0.7
Imax	-	-0.0624	-0.3717	-0.0555	-0.0693	0.39	±3.5	±2.0	±0.7

Composite Error/MPE (cont)

X-Ref. 8.7.6

		Intrinsic Error	Temp. Error	Voltage Error	Freq. Error	Comp. Error	Operating Temperature 40°C		
Current	PF Cos. ϕ	*e(Icosϕ)*	40°C *e(TIcosϕ)*	±10% Un *e(UIcosϕ)*	±2% fn *e(fIcosϕ)*	*% MPE*	Maximum Permissible Error (MPE)		
							Class A	Class B	Class C
Imin	1.0	0.0579	0.2106	0.1152	0.1003	0.27	±5.0	±2.5	±1.3
Itr	-	0.0927	0.2708	0.1070	0.1080	0.32	±5.0	±2.5	±1.3
10Itr	-	0.0868	0.3000	0.1095	0.1134	0.35	±5.0	±2.5	±1.3
Imax	-	0.0208	0.0278	0.0416	0.0416	0.07	±5.0	±2.5	±1.3
Itr	0.5ind	0.2359	0.3279	0.2781	0.2582	0.55	±4.5	±2.5	±1.0
10Itr	-	0.2340	0.3944	0.2654	0.2685	0.59	±4.5	±2.5	±1.0
Imax	-	0.0973	-0.0624	0.1460	0.1390	0.23	±4.5	±2.5	±1.0
Itr	0.8cap	0.0215	0.1868	0.0434	0.0323	0.20	±4.5	±2.5	±1.0
10Itr	-	0.0208	0.2745	0.0417	0.0399	0.28	±4.5	±2.5	±1.0
Imax	-	-0.0624	-0.2527	-0.0555	-0.0693	0.28	±4.5	±2.5	±1.0

Composite Error/MPE (cont)

X-Ref. 8.7.6

		Intrinsic Error	Temp. Error	Voltage Error	Freq. Error	Comp. Error	Operating Temperature 55°C		
Current	PF Cos. ϕ	*e(Icosϕ)*	55°C *e(TIcosϕ)*	±10% Un *e(UIcosϕ)*	±2% fn *e(fIcosϕ)*	*% MPE*	Maximum Permissible Error (MPE)		
							Class A	Class B	Class C
Imin	1.0	0.0579	0.2931	0.1152	0.1003	0.34	±7.0	±3.5	±1.7
Itr	-	0.0927	0.3523	0.1070	0.1080	0.39	±7.0	±3.5	±1.7
10Itr	-	0.0868	0.3843	0.1095	0.1134	0.42	±7.0	±3.5	±1.7
Imax	-	0.0208	0.0087	0.0416	0.0416	0.06	±7.0	±3.5	±1.7
Itr	0.5ind	0.2359	0.3610	0.2781	0.2582	0.57	±7.0	±3.5	±1.3
10Itr	-	0.2340	0.4210	0.2654	0.2685	0.61	±7.0	±3.5	±1.3
Imax	-	0.0973	-0.0085	0.1460	0.1390	0.22	±7.0	±3.5	±1.3
Itr	0.8cap	0.0215	0.2915	0.0434	0.0323	0.30	±7.0	±3.5	±1.3
10Itr	-	0.0208	0.3625	0.0417	0.0399	0.37	±7.0	±3.5	±1.3
Imax	-	-0.0624	-0.2820	-0.0555	-0.0693	0.30	±7.0	±3.5	±1.3

3 VARIATION OF ERROR DUE TO DISTURBANCES OF LONG DURATION

EN50470-3 X-Ref. 8.7.7

3.1 Severe Voltage Variation

X-Ref. 8.7.7.2

Sample No: M7 Test Procedure: EN50470-3 Severe Voltage Variation

Test Conditions: *Un:230V* *Iref:10A* *Fn: 50Hz*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

		80% Un	115% Un	Critical Change % Error Limit		
Current	PF Cos. ϕ	*% Error*	*% Error*	Accuracy		
				Class A	Class B	Class C
10Itr (Iref)	1.0	*0.0651*	*0.0964*	±3.0	±2.1	±0.6
10Itr (Iref)	0.5ind	*0.2201*	*0.2716*	±4.5	±3.0	±1.2

		< 80% Un	Critical Change % Error Limit		
Current	PF Cos. ϕ	*% Error*	Accuracy		
			Class A	Class B	Class C
10Itr (Iref/In)	1.0	*0.0521*	+10 to -100	+10 to -100	+10 to -100
10Itr (Iref/In)	0.5ind	*0.2026*	+10 to -100	+10 to -100	+10 to -100

3.2 Short-time Over Current X-Ref. 8.7.8

Sample No: 11809192840047	Test Procedure: EN50470-3 Short-Time Over-Current

Environmental Conditions

Temperature	21.5 °C
Relative Humidity	56.0 %
Barometric Pressure	998 mB

The test was applied under the following conditions:

Meter for direct connection:

Impulse current applied: 30.Imax for one half cycle at rated frequency = 10ms

The test was applied under the following conditions:

Meter for connection through current transformer:

Impulse current applied: 20.Imax for 0.5seconds

On completion of the above test, the meters voltage circuits were energised at reference voltage for 1 hour after which the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions.

Test Conditions: *Un:230V* *Itr:1A* *Fn: 50Hz*

Test Circuit: *1 phase 2 wire*

			Critical Change % Error Limit		
Current	PF Cos. ϕ	*% Error*	Accuracy		
			Class A	Class B	Class C
10Itr/Ib	1.0	0.094	±1.5	±1.5	±1.5

3.3 Influence of Self Heating X-Ref. 8.7.7.5

The meter voltage circuits were energised at reference voltage for at least 1 hour (class A), 2 hours(class B & C), without any current in the current circuits, after which the meter's maximum rated current was applied and the meter error determined every 5 minutes.

The test was conducted at power factors of both Cos. ϕ = 1.0 and Cos. ϕ = 0.5 ind.

Sample No: M7	Test Procedure: EN50470-3 (Class B) Self Heating

Test Conditions: *Un:230V* *Fn: 50Hz*
Imax:80A *PF: Cos. ϕ = 1.0, Cos.ϕ = 0.5*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Energy kWh*

Measurement mode-Active Energy kWh

Elapsed Test time (minutes)	Un Im Cos.ϕ = 1.0	Un Im Cos.ϕ = 0.5
	% Error	*% Error*
1	0.0416	0.2087
5	0.0382	0.2262
10	0.0521	0.2331
15	0.0660	0.2331
20	0.0695	0.2331
25	0.0799	0.2401
30	0.0869	0.2262
35	0.0834	0.2366
40	0.0938	0.2331
45	0.0834	0.2262
50	0.0903	0.2331
55	0.0938	0.2262
60	0.0973	0.2262

Critical Change of % Error Limit:

Class C ±0.2% @ Cos. ϕ = 1.0 & ±0.2% @ Cos. ϕ = 0.5ind
Class B ±0.7% @ Cos. ϕ = 1.0 & ±1.0% @ Cos. ϕ = 0.5ind
Class A ±1.0% @ Cos. ϕ = 1.0 & ±1.5% @ Cos. ϕ = 0.5ind

3.4 Harmonic Components in the Current and Voltage Circuits X-Ref. 8.7.7.7

Sample No: 11809192840047	Test Procedure: EN50470-3 Harmonics Tests

Test Conditions: *Un:230V* *Fn: 50Hz* *PF: Cos. ϕ = 1.0*
Iref:10A *Imax:80A*

Fundamental Frequency Current: I_0 = 0.5 Imax
Fundamental frequency Voltage: U_0 = Un
Content of 5th Harmonic Current: I_5 = 40% of I_0
Content of 5th Harmonic Voltage: U_5 = 10% of Un

Resulting harmonic power due to the 5th harmonic presence: $P_{resultant}$ = 1.04 P_0

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Energy kWh*

Waveform	*% Error*	Critical Change % Error Limit Accuracy		
		Class A	Class B	Class C
Fundamental Only (P_0) 0.5 Imax	*0.046*	-	-	-
Fundamental + 5th Harmonic ($P_{resultant}$ = 1.04 P_0)	*0.042*	±1.0	±0.8	±0.5

3.5 Influence of Odd and Sub Harmonics in the AC Current Circuit X-Ref. 8.7.7.9

Sample No: 11809192840047	Test Procedure: EN50470-3 Harmonics Tests

Test Conditions: *Un:230V* *Fn: 50Hz* *PF: Cos. ϕ = 1.0*
5Itr:5A

Reference Current Waveform: I_{ref} = 5Itr or 0.5In
Reference Voltage: U = Un
Test Current Phase-Fired Waveform: $I_{test} = 2 \cdot I_{ref}$
Firing Points: 5ms and 15ms ± 1ms
Test Current Burst fired Waveform: $I_{test} = 2 \cdot I_{ref}$
Distortion Factor on the Voltage Waveform: < 0.5 % THD

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Energy kWh*

Waveform	*% Error*	Critical Change % Error Limit Accuracy		
		Class A	Class B	Class C
Fundamental Only 5Itr / 0.5Ib	*0.059*	-	-	-
Waveform Phase-fired Test current	*0.104*	±6.0	±3.0	±1.5
Waveform Burst fired Test current	*0.031*	±6.0	±3.0	±1.5

3.6 Influence of D.C. and Even Harmonics in the A.C Current Circuit X-Ref. 8.7.7.8

Sample No: 11809192840047	Test Procedure: EN50470-3 Harmonics Tests

Test Conditions: *Un:230V* *Fn: 50Hz*
Imax:80A *PF: Cos. ϕ = 1.0*

Test Circuit: *1 phase 2 wire. In the case of Polyphase meter's tests were conducted on element L1 only.*

A.C current: 0.707Imax - fundamental waveform (I_{ref})
Equivalent half wave DC current: 0.707Imax. (I_{Test})

		Critical Change % Error Limit		
Test Current	*% Error*	Accuracy		
		Class A	Class B	Class C
0.707Imax (I_{ref})	*0.594*	-	-	-
0.707Imax (I_{test})	*-0.246*	±6.0	±3.0	±1.5

4 ELECTRICAL REQUIREMENTS EN50470-1 X-Ref. 7

4.1 Power Consumption EN50470-3 X-Ref. 7.1

Sample No: M7	Test Procedure: EN50470-3 Power Consumption

Environmental Conditions

Temperature	21.5 °C
Relative Humidity	56.0 %
Barometric Pressure	998 mB

	Volts/V	Amps/A	VA	Watts/W
Wiring Configuration: 1 Phase 2 Wire Voltage Circuit: **L1**	*230*	*0.017*	*3.91*	*0.58*
Current Circuit: **L1**	*0.0057*	*10*	*0.057*	---

Power consumption limits shall not exceed the following based on IEC 62053-61: 1998-02

Voltage Circuits	Single Phase		Two Element		Three Element	
Basic Meter	2W	10VA	2W	10VA	2W	10VA
Multi-Energy Meter	3W	15VA	2.5W	12.5VA	2W	10VA
Multi-Function Meter	5W	25VA	3.5W	17.5VA	3W	15VA

Current Circuits
Direct connected 2.5VA for Class A
4.0VA for Class B & Class C

4.2 Test of Influence of Heating

EN50470-1 X-Ref. 7.2

Sample No: M7	Test Procedure: EN50470-3 Heating

Test Conditions: *115%Un:264.5V* *Imax:80A* *Fn: 50Hz*

Ambient Temperature	:	40°C
Test Duration	:	2 hours
Surface Temperature Rise	:	17.6 K

Permissible temperature rise: 25K

Surface temperature of the meter was measured on the meter back, approximately 10mm above the meter terminal block.

On completion of the above tests, the meters were found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions, with no signs of damage or degradation in the meter's insulation properties.

5 ELECTROMAGNETIC COMPATIBILITY (E.M.C.) EN50470-1 X-Ref. 7.4

5.1 Immunity to Voltage Dips and Interruptions X-Ref. 7.4.4

Sample No: 11809192840047	Test Procedure: EN50470-3 Voltage Dips

Environmental Conditions

Power Supply	230V, 50Hz
Temperature	21.5°C
Relative Humidity	56%
Barometric Pressure	998mB

Test Circuit: *1 phase 2 wire, in the case of Polyphase meters tests were conducted on each voltage circuit in turn.*

The tests were applied under the following conditions;

- voltage and auxiliary circuits energised with reference voltage
- current circuits open.

Test a)	Voltage interruption of :	V = 100%
	Interruption time :	1s
	Number of interruptions :	3
	Restoring time between interruption :	50ms
Test b)	Voltage interruption of :	V = 100%
	Interruption time:	20ms
	Number of interruptions:	1
Test c)	Voltage depression of :	V=50%
	Depression time:	60s
	Number of depressions:	1

The application of the above tests did not produce a change in the meter registers of more than ***x*** kWh, and the test output did not produce a signal equivalent of more than ***x*** kWh, where ***x*** is given by

$$x = 10^{-6} \cdot m \cdot Un \cdot Imax$$

5.2 Immunity to Electrostatic Discharges (ESD) EN50470-1 X-Ref. 7.4.5

Sample No: 11809192840047	Test Procedure: EN50470-3 Electrostatic Discharge

The meter was tested in accordance with IEC 61000-4-2 as follows:

Environmental Conditions

Power Supply	230V, 50Hz
Temperature	21.5°C
Relative Humidity	52%
Barometric Pressure	998mB

E.S.D Generator specification:

Test level severities:	8kV contact, conductive surfaces / coupling planes 15kV air gap discharge - non conducting surfaces
Polarity:	Positive and negative
Number of discharges:	10 at each polarity
Rise time of discharge current:	<1ns
Pulse duration (50%):	30ns
Time between discharges:	1s

Meter in operating condition with the voltage and auxiliary circuits energised. Current circuits open.

The application of the electrostatic discharge did not produce a change in the meter registers of more than ***x*** kWh, and the test output did not produce a signal equivalent of more than ***x*** kWh, where ***x*** is given by

$$x = 10^{-6} \cdot m \cdot Un \cdot Imax$$

On completion of the above tests, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions.

5.3 Immunity to Electromagnetic HF Fields

EN50470-1 X-Ref. 7.4.6
EN50470-3 X-Ref. 8.7.7.12

Sample No: 11809192840054	Test Procedure: EN50470-1 Radiated Immunity

The meter was tested in accordance with IEC 61000-4-3 in the SCM Anechoic chamber as follows:

Environmental Conditions

Temperature	21.5°C
Relative Humidity	56%
Barometric Pressure	998mB

Port: Enclosure
Test Level: 10 V/m (test 1) & 30 V/m (test 2)
Frequency Range: 80-2000 MHz
Dwell Time:
Frequency Step Size: 1%
Modulation: 80%, 1 kHz Amplitude Modulation.

Operating Mode:

Test 1) Voltage and auxiliary circuits energised with reference voltage, current (10Itr) in the current circuits, Cos. $\phi = 1$.

Test 2) Voltage and auxiliary circuits energised with reference voltage, without any current in the current circuits. Current circuits open circuit.

Test Results (80-2000MHz)

EUT Face	Polarity	*Test 1 Maximum % Error Observed*	*Test 2*	Critical Change % Error Limit	
				Accuracy	
				Class B	Class C
Front	Horizontal	*0.39*	*Note 1*	±2.0	±1.0
Front	Vertical	*0.41*	*Note 1*	±2.0	±1.0
Rear	Horizontal	*0.41*	*Note 1*	±2.0	±1.0
Rear	Vertical	*0.42*	*Note 1*	±2.0	±1.0
LHS	Horizontal	*0.43*	*Note 1*	±2.0	±1.0
LHS	Vertical	*0.41*	*Note 1*	±2.0	±1.0
RHS	Horizontal	*0.39*	*Note 1*	±2.0	±1.0
RHS	Vertical	*0.40*	*Note 1*	±2.0	±1.0

Note 1: No change of register information and no signal outputs observed

The application of the RF electromagnetic field did not produce a change in the meter registers of more than ***x*** kWh, and the test output did not produce a signal equivalent of more than ***x*** kWh, where ***x*** is given by

$$\boldsymbol{x} = 10^{-6} \cdot m \cdot Un \cdot Imax$$

where

x is the critical change value in kWh
m is the number of measuring elements
Un is the reference voltage
Imax is the maximum current

5.4 Immunity to Electrical Fast Transients

EN50470-1 X-Ref. 7.4.7
EN50470-3 X-Ref. 8.7.7.14

Sample No: 11809192840053	Test Procedure: EN50470-1 Fast Transient Bursts

The meter was tested in accordance with IEC 61000-4-4 as follows:

Environmental Conditions

Temperature	21.5°C
Relative Humidity	52%
Barometric Pressure	998mB

Transient/Burst specification:

Pulse level severity: 4kV – current and voltage circuits
2kV – auxiliary circuits
Rise time: 5ns
Width: 50ns
Repetition Rate: 5 kHz
Burst Duration: 15ms
Burst Period: 300ms
Burst Generation: Asynchronous (Common mode)

Operating mode:

The meter voltage circuits were energised at reference voltage Un, with 10Itr Cos. ϕ = 1.0 in the current circuits.

Test voltage severity level ±4kV, Repetition Rate 5kHz voltage and current circuits
Test voltage severity level ±2kV, Repetition Rate 5kHz auxiliary circuits > 40V

The test voltage was applied on the current and voltage circuits in common mode, for a test duration of 60 seconds at each polarity.

Immunity to Electrical Fast Transients (cont)

Test Results

		Critical Change % Error Limit		
Test Voltage (kV)	*% Error*	Accuracy		
		Class A	Class B	Class C
No FTB applied		-	-	-
±4 (Voltage & Current Circuits)	*-0.12*	±6.0	±4.0	±2.0
±2 (Auxiliary Circuits of > 40V)		±6.0	±4.0	±2.0

On completion of the above test, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions, with no signs of damage or corruption to meter register data.

5.5 Immunity to Conducted Disturbances

EN50470-1 X-Ref. 7.4.8
EN50470-3 X-Ref. 8.7.7.15

Sample No: 11809192840057	Test Procedure: EN50470-1 Conducted Immunity

The meter was tested in accordance with IEC 61000-4-6 as follows:

Environmental Conditions

Temperature	21.5°C
Relative Humidity	52%
Barometric Pressure	998mB

Ports: Current, Voltage and Auxiliary Circuits
Test Level: 10 V
Frequency Range: 0.15 to 80 MHz
Dwell Time: 2 Secs
Frequency Step Size: 1%
Modulation: 80%, 1kHz Amplitude Modulation.

Operating Mode:

Voltage and auxiliary circuits energised with reference voltage and with 10Itr applied

Test Results:

MUT Port	Frequency Range (MHz)	*Maximum % Error Observed*	Critical Change % Error Limit Accuracy		
			Class A	Class B	Class C
Voltage & Current Circuits	0.15 to 80	*0.08*	±3.0	±2.0	±1.0

5.6 Immunity to Surges

EN50470-1 X-Ref 7.4.9

Sample No: 11809192840047	Test Procedure: EN50470-1 Surge

The meter was tested in accordance with IEC 61000-4-5 as follows:

Environmental Conditions

Temperature	21.5°C
Relative Humidity	56%
Barometric Pressure	998mB

Ports:	Voltage and Auxiliary Circuits
Test Voltage:	4kV mains, 1kV auxiliary
Test Mode:	Differential (line to line)
Phase Angle:	60° and 240° relative to zero crossing
Number of Tests:	5 positive and 5 negative
Repetition Rate:	1/min

Operating mode:

The meter voltage circuits were energised at reference voltage Un, without any current in the current circuits

The application of the surge immunity test voltage did not produce a change in the meter registers of more than ***x*** kWh and the test output did not produce a signal equivalent of more than ***x*** kWh, where ***x*** is given by

$$x = 10^{-6} \cdot m \cdot Un \cdot Imax$$

5.7 Radio Interference Measurement EN50470-1 X-Ref. 7.4.13

Radiated Emissions

Sample No: 11809192840057	Test Procedure: EN50470-1 Radiated Emissions

The meter was tested in accordance with EN55022 as follows:

Environmental Conditions

Power Supply	230V, 50Hz
Temperature	21.5°C
Relative Humidity	56%
Barometric Pressure	998mB

The MUT compliance measurements were performed in the SCM Semi-Anechoic chamber (which is in compliance with the site attenuation requirements of EN55016-1-4:2007, A1:2008).

The measurement distance was 3m and the limit has been adjusted using inverse proportionality factor of 20dB per decade.

Operating Mode

The MUT was operated with voltage and auxiliary circuits energised with reference voltage and a current of between 0.1Iref and 0.2Iref and 1m leads attached to all terminals.

Radiated Emissions (cont)

Results: Pass

Limit values of equipment

Frequency/MHz	Test distance 10m,QP/dB(μV/m)
30～230	30
230～1000	37

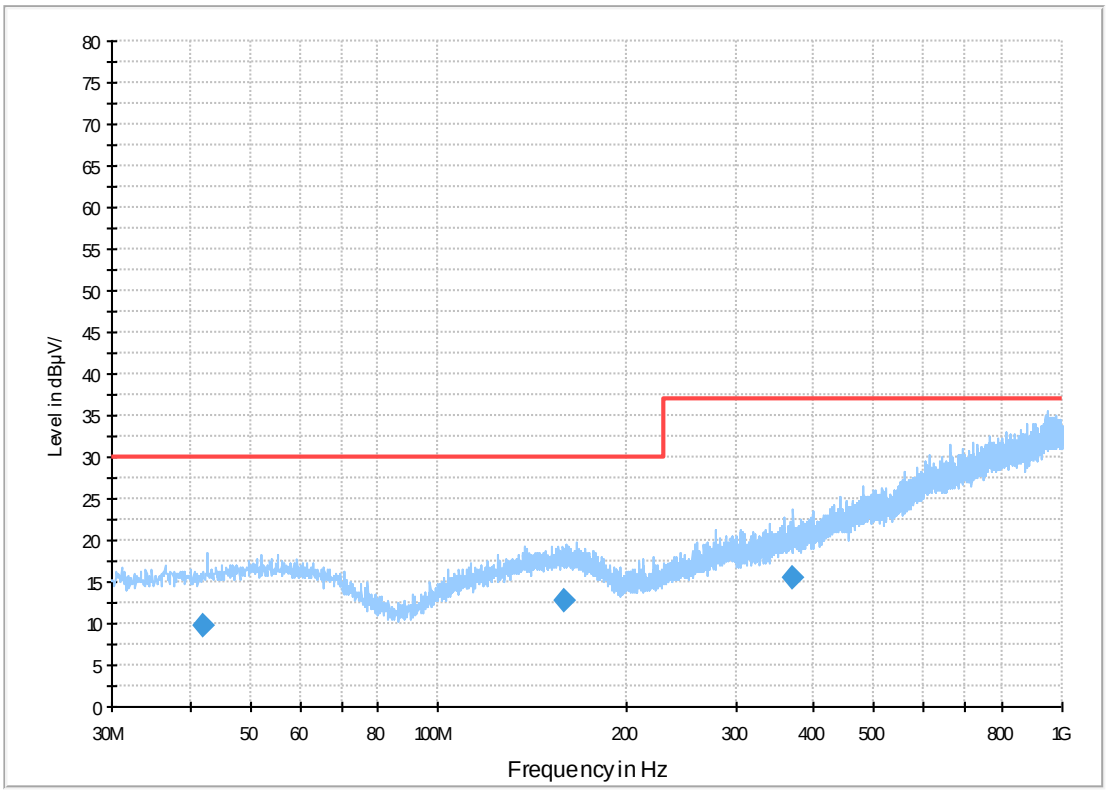
Horizontal Polarisation Worse Case Emissions Compliance Measurements 30 – 1000MHz

Test data

Sample No.	Frequency	Measuring value	Antenna Factor +Cable loss	Standard value	Over limit	Detector	Height	Azimuth
	MHz	dB(μV/m)	dB	dB(μV/m)	dB		cm	deg
-	41.875600	9.7	13.2	30.0	20.3	QP	100.0	31.0
	159.069800	12.7	15.2	30.0	17.3	QP	100.0	-73.0
	370.718600	15.6	17.9	37.0	21.4	QP	100.0	136.0

Test curves

RE 30MHz-1GHz



Radiated Emissions (cont)

Results: Pass

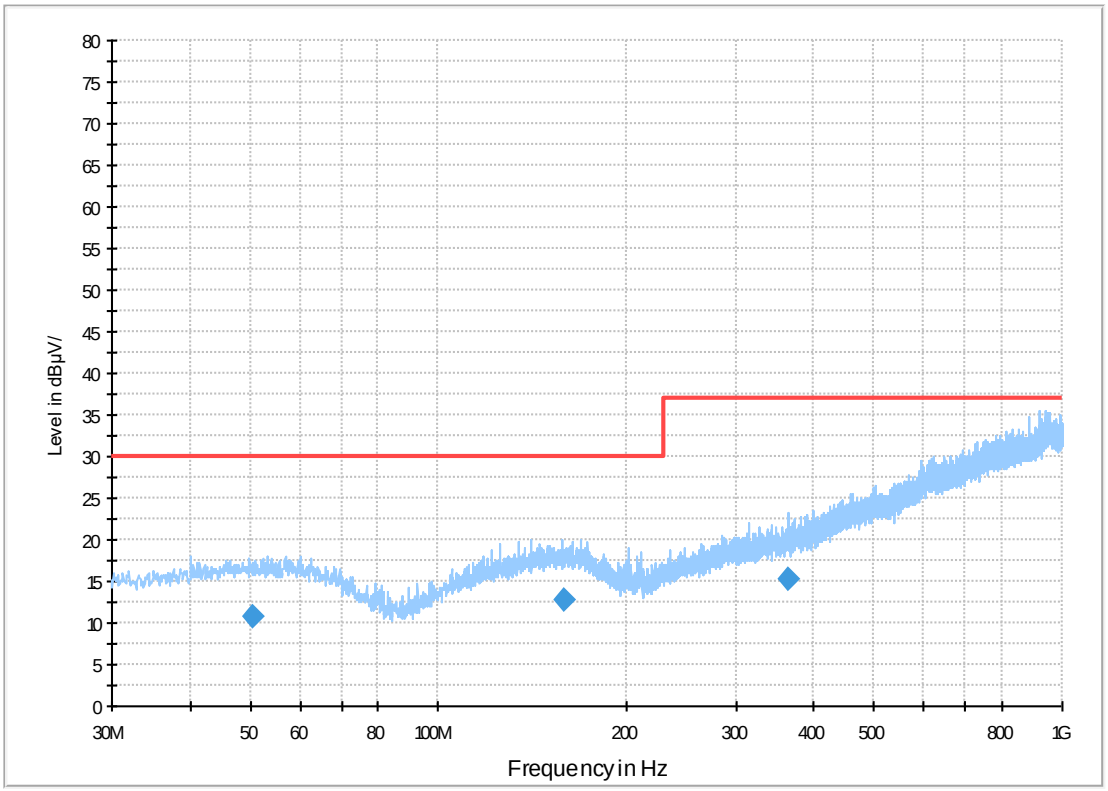
Vertical Polarisation Worse Case Emissions Compliance Measurements 30 – 1000MHz

Test data

Sample No.	Frequency	Measuring value	Antenna Factor +Cable loss	Standard value	Over limit	Detector	Height	Azimuth
	MHz	dB(µV/m)	dB	dB(µV/m)	dB		cm	deg
-	50.310600	10.7	13.8	30.0	19.3	QP	100.0	-60.0
	158.866600	12.7	15.2	30.0	17.3	QP	180.0	-128.0
	363.556200	15.4	17.7	37.0	21.6	QP	100.0	-135.0

Test curves

RE 30MHz-1GHz



Conducted Emissions

Sample No: 11809192840053	Test Procedure: EN50470-1 Conducted Emissions

The meter was tested in accordance with EN55022 as follows:

Environmental Conditions

Power Supply	230V, 50Hz
Temperature	21.5°C
Relative Humidity	56%
Barometric Pressure	998mB

The emissions on the AC mains were measured in the frequency range 0.15 – 30 MHz

Operating Mode

The MUT was operated with voltage and auxiliary circuits energised with reference voltage and a current of between 0.1Iref and 0.2Iref and 1m leads attached to all terminals.

Conducted Emissions (cont)

Results: Pass

Equipment Limit values

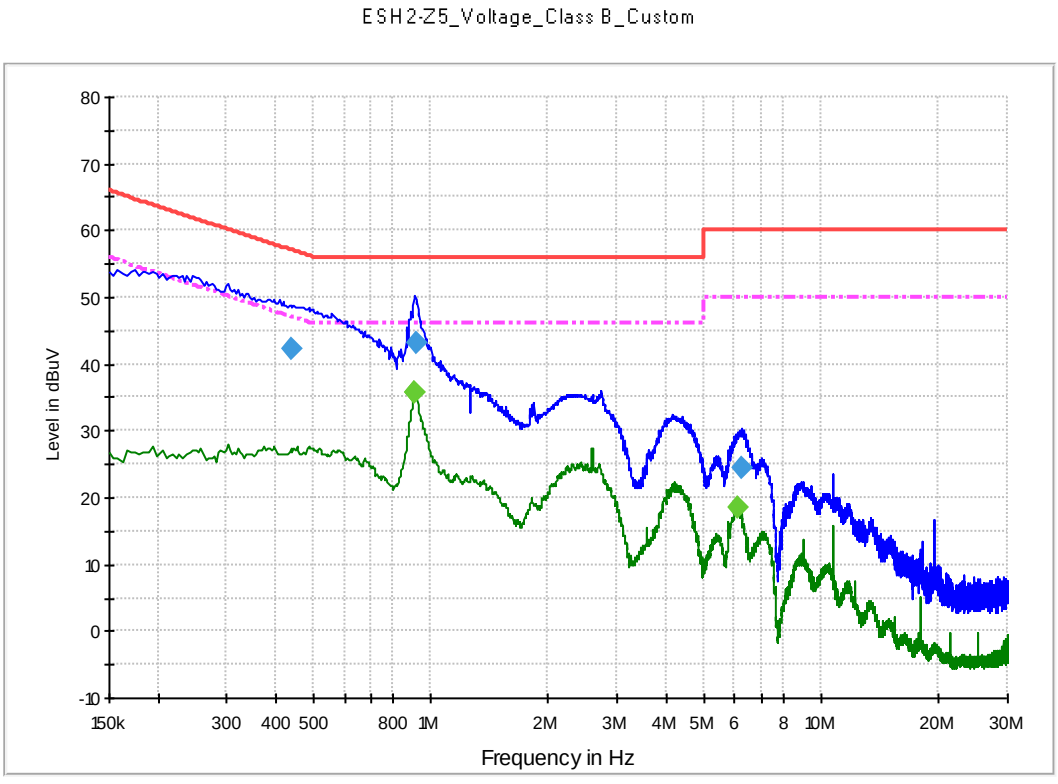
Frequency(MHz)	AVG /dB(μV)	QP /dB(μV)
0.15～0.5	56～46	66～56
0.5～5	46	56
5～30	50	60

Line 1 Terminal Worst Case Emissions Compliance Measurements

Data of conducted emission

Sample No.	Frequency	Measuring value	Corr. factors+ Cable loss	Standard value	Over Limit	Detector
	MHz	dB(μV)	dB	dB(μV)	dB	
-	0.441000	42.3	10.1	57.0	14.7	QP
	0.917000	43.2	10.1	56.0	12.8	QP
	6.245000	24.4	10.3	60.0	35.6	QP
	0.913000	35.8	10.1	46.0	10.2	AVG
	0.913000	35.9	10.1	46.0	10.1	AVG
	6.081000	18.6	10.3	50.0	31.4	AVG

Curves of conducted emission



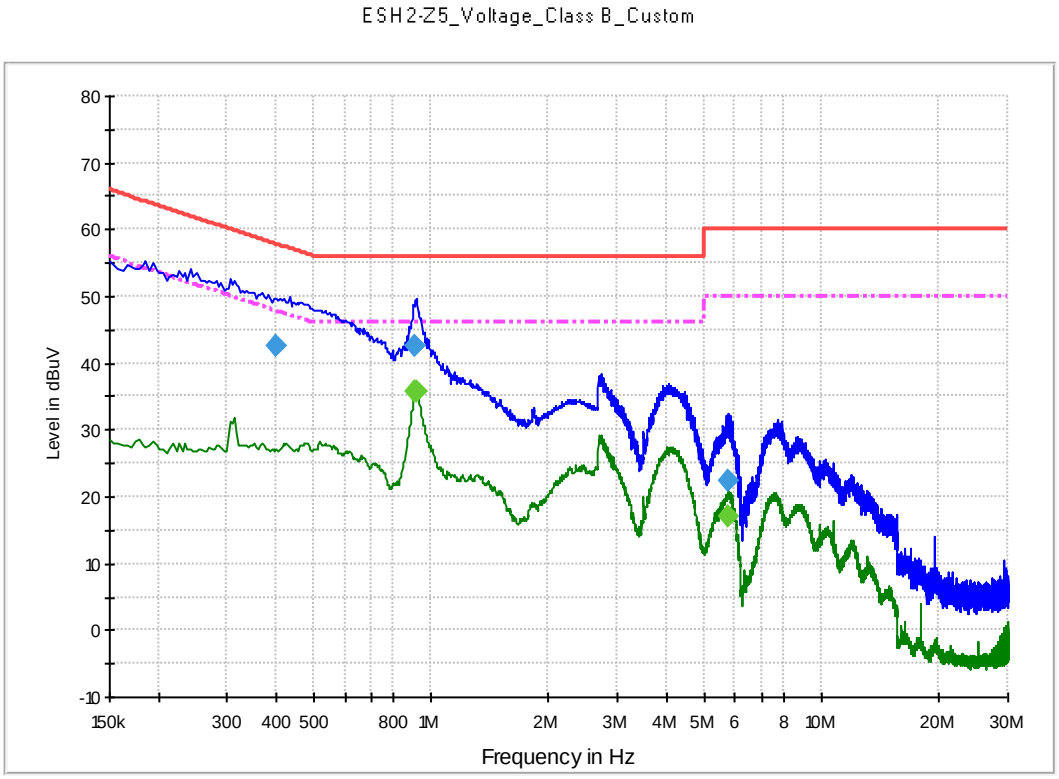
Conducted Emissions (cont)

Neutral Terminal Worst Case Emissions Compliance Measurements

Data of conducted emission

Sample No.	Frequency	Measuring value	Corr. factors+ Cable loss	Standard value	Over Limit	Detector
	MHz	dB(μV)	dB	dB(μV)	dB	
-	0.401000	42.6	10.1	57.8	15.2	QP
	0.905000	42.7	10.1	56.0	13.3	QP
	5.773000	22.5	10.3	60.0	37.5	QP
	0.909000	35.9	10.1	46.0	10.1	AVG
	0.917000	35.7	10.1	46.0	10.3	AVG
	5.753000	17.0	10.3	50.0	33.0	AVG

Curves of conducted emission



5.8 Magnetic Induction of External origin 0.5mT

EN50470-1 X-Ref. 7.4.12
EN50470-3 X-Ref 8.7.7.11

AC magnetic induction of external origin, produced by a coil of one metre diameter, field strength at its centre 0.5mT (400 Ampere turns)

Sample No: 11809192840057	Test Procedure: EN50470-3 AC Mag Fields

Test Conditions: *Un:230V* *Fn: 50Hz*
Iref:10A *PF: Cos. ϕ = 1.0*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

Phase angle of the field with respect to U3 (Vph)	Direction of field orientation			Critical Change % Error Limit		
	X - X	Y - Y	Z - Z	Accuracy		
	% Error	*% Error*	% Error	Class A	Class B	Class C
No Field Applied	0.11	0.10	0.13	-	-	-
0°	0.12	0.11	0.13	±3.0	±2.0	±1.0
30°	0.12	0.11	0.12	±3.0	±2.0	±1.0
60°	0.12	0.11	0.13	±3.0	±2.0	±1.0
90°	0.11	0.12	0.13	±3.0	±2.0	±1.0
120°	0.12	0.11	0.13	±3.0	±2.0	±1.0
150°	0.12	0.11	0.13	±3.0	±2.0	±1.0
180°	0.12	0.11	0.13	±3.0	±2.0	±1.0
210°	0.12	0.11	0.13	±3.0	±2.0	±1.0
240°	0.12	0.11	0.13	±3.0	±2.0	±1.0
270°	0.13	0.12	0.13	±3.0	±2.0	±1.0
300°	0.13	0.13	0.12	±3.0	±2.0	±1.0
330°	0.12	0.11	0.12	±3.0	±2.0	±1.0
360°	0.12	0.11	0.13	±3.0	±2.0	±1.0

5.9 Continuous Magnetic Induction of External Origin

EN50470-1 X-Ref.7.4.11
EN50470-3 X-Ref 8.7.7.10

The continuous magnetic induction was obtained using an electromagnetic coil of 1000 Ampere-turns. This magnetic field was applied to all accessible surfaces of the meter samples when mounted as for normal use.

Sample No: 11809192840047	Test Procedure: EN50470-3 DC Magnetic Field P

Test Conditions: *Un:230V* *Fn: 50Hz*
Iref:10A *PF: Cos. ϕ = 1.0*

Test Circuit: *1 phase 2 wire*

Measurement Mode: *Active Import Energy kWh*

		Critical Change % Error Limit		
Electromagnetic Position	*% Error*	Accuracy		
		Class A	Class B	Class C
No field applied	*0.016*	-	-	-
Left side of meter	*0.032*	±3.0	±2.0	±1.0
Front of meter	*0.036*	±3.0	±2.0	±1.0
Right side of meter	*0.028*	±3.0	±2.0	±1.0
Top of meter	*0.030*	±3.0	±2.0	±1.0

6 CLIMATIC INFLUENCES EN50470-1 X-Ref. 6

6.1 Dry Heat Test X-Ref. 6.3.2

Sample No: M7	Test Procedure: EN50470-1 Dry Heat

The meter was tested in accordance with IEC 60068-2-2 as follows:

Meter in the non-operating condition
Method Bb (with gradual change of temperature)
Temperature +70°C ± 2°C
Duration of the test 72h

On completion of the above test, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions with no signs of damage or degradation in the meter's insulation properties.

6.2 Cold Test

X-Ref. 6.3.3

Sample No: M7	Test Procedure: EN50470-1 Cold

The meter was tested in accordance with IEC 60068-2-1 as follows:

Meter in the non-operating condition
Method Ab (with gradual change of temperature)
Temperature -25°C ± 3°C
Duration of the test 72h

On completion of the above test, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions, with no signs of damage or corruption to meter register data.

6.3 Damp Heat Cyclic Test

X-Ref. 6.3.4

Sample No: M7	Test Procedure: EN50470-1 Damp Heat

The meter was tested in accordance with IEC 60068-2-30 as follows:

Meter with reference voltage applied
Upper Temperature of +40°C
Duration of the test: 6 cycles

On completion of the above test, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions with no signs of damage or degradation in the meter's insulation properties.

7 MECHANICAL REQUIREMENTS EN50470-1 X-Ref. 5

7.1 Vibration Test X-Ref. 5.2.2.3

Sample No: M7	Test Procedure: EN50470-1 Vibration

Environmental Conditions

Temperature	21.5° C
Relative Humidity	56.0 %
Barometric Pressure	998 mB

The meter was tested in accordance with IEC 60068-2-6 as follows:

Meter in the non-operating condition
Test Procedure A
Frequency Range of 10 Hz to 150 Hz (Transition frequency of 60 Hz)
For F < 60 Hz, constant amplitude of movement 0.075 mm
For F > 60 Hz, constant acceleration of 9.8 m/s^2 (1g)
10 sweep cycles per axis

On completion of the above test, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions.

7.2 Shock Test

X-Ref. 5.2.2.2

Sample No: M7	Test Procedure: EN50470-1 Shock

Environmental Conditions

Temperature	21.5° C
Relative Humidity	56.0 %
Barometric Pressure	998 mB

The meter was tested in accordance with IEC 60068-2-27 as follows:

Meter in the non-operating condition
Half Sine Pulse
Peak Acceleration of 30 gn (300 m/s^2)
Pulse Duration of 18 ms

On completion of the above test, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions.

7.3 Spring Hammer Test

X-Ref. 5.2.2.1

Sample No: M7	Test Procedure: EN50470-1 Spring Hammer

Environmental Conditions

Temperature	21.5° C
Relative Humidity	56.0 %
Barometric Pressure	998 mB

The meter was tested in accordance with IEC 60068-2-75 as follows:

Kinetic Energy of Spring Hammer 0.2 Nm ± 0.02 Nm

The meter case and terminal cover where acted upon all external surfaces, including the display window. After the test no damage was evident and the meter continued to function correctly.

7.4 Penetration of Dust & Water

X-Ref. 5.9

Sample No: M7	Test Procedure: EN50470-1 Dust & Water

The meter was tested in accordance with IEC 60529 as follows:

Dust Test: IP5X, non-operating condition, Neither under, nor over pressure

Water Test: IPX1, non-operating condition

The meter is put inside the meter box

On completion of the above test, the meter was found to function correctly and within the accuracy specification when subsequently operated under reference operating conditions with no signs of damage or degradation in the meter's insulation properties.

7.5 Resistance to Heat & Fire

X-Ref. 5.8

Sample No: M7	Test Procedure: EN50470-1 Heat & Fire

The meter was tested in accordance with IEC 60695-2-11 as follows:

Test: Terminal block tested at 960°C for 30 seconds.

Result: Flames extinguish with 30 seconds

Test: Terminal cover and meter case tested at 650°C for 30 seconds.

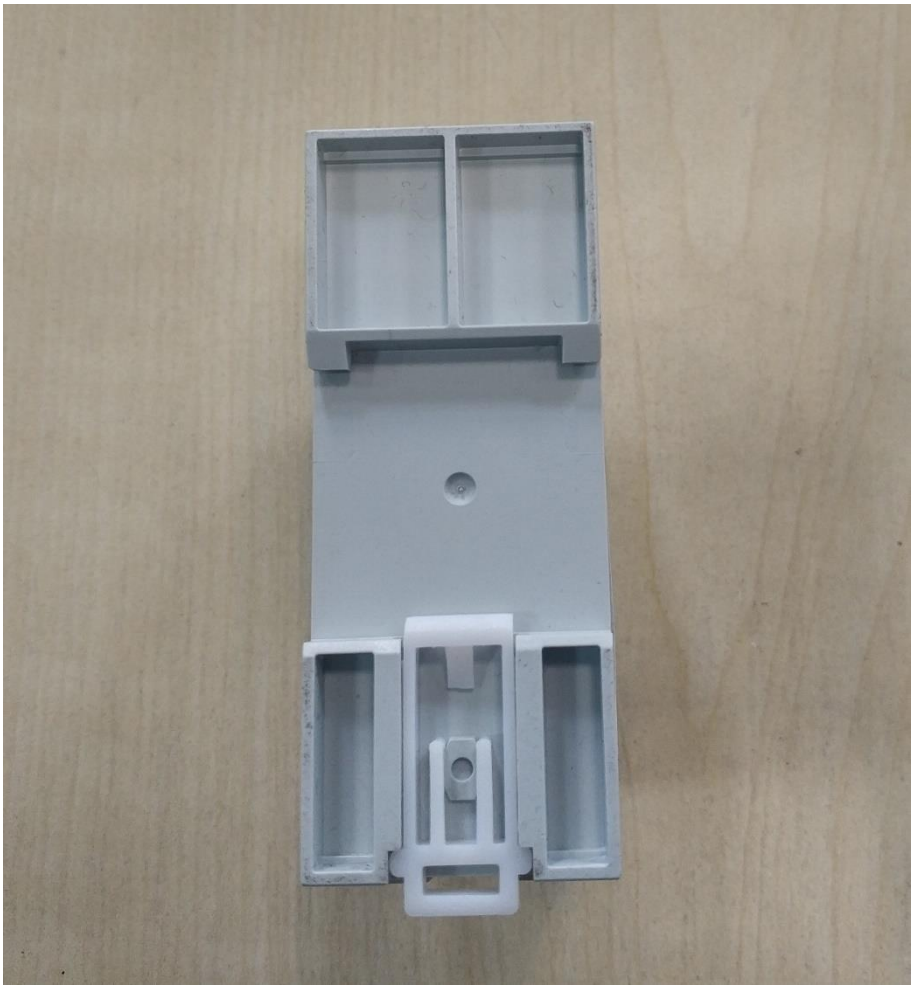
Result: Does not produce drips or flames

ANNEX A - Photographs of Meters Under Test

Front of Meter Under Test

Side of Meter Under Test

Rear of Meter Under Test



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