



1/LC10.001

CERTIFICADO DE CALIBRACIÓN

Certificate of Calibration

Número: 201804600809

Number

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**LABORATORIO CENTRAL OFICIAL DE ELECTROTECNIA
FUNDACIÓN PARA EL FOMENTO DE LA INNOVACIÓN INDUSTRIAL**

LCOE

Polígono Ind. El Lomo - C/ Diesel, 13 - 28906 Getafe (Madrid)

Teléfono: 91 601 12 40 seccion6@ffii.es

Fax: 91 695 78 76 www.f2i2.net

INSTRUMENTO <i>Instrument</i>	Three-phase power analyzer
MARCA <i>Mark</i>	MONSOL
MODELO <i>Model</i>	CcM4
IDENTIFICACIÓN <i>Identification</i>	Serie03_Número03
SOLICITANTE <i>Applicant</i>	MONSOL. ZERO POINT ENERGY, S.L. C/ La Gitanilla, 17. Nave 01. Portón A 29004 MÁLAGA
FECHA/S DE CALIBRACIÓN <i>Date/s of Calibration</i>	16/04/2018

Signatario/s autorizado/s
Authorized signatory/ies

Fecha de emisión junto a la firma
Date of issue next to the signature

Technical Manager

Realizado por: Borja Mora Merino
Performed by: Calibration Technician

Este Certificado se expide de acuerdo con las condiciones de la acreditación concedida por ENAC, que ha comprobado las capacidades de medida del laboratorio y su trazabilidad a patrones nacionales. ENAC es firmante del Acuerdo de Reconocimiento Mutuo (MLA) de calibración de European Cooperation for Accreditation (EA) y de International Laboratory Accreditation Cooperation (ILAC).

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1. Characteristics of the instrument under calibration

Mark: MONSOL
Model: CcM4
Identification: Serie03_Número03

The system under calibration is composed by the following elements:

Firmware CcM4

Mark: CSS 7.4.0
Model: CcM4_1.3_18_04_14
Serial number: 0x0000FFFF

2. Calibration procedure used

The calibration has been performed following the procedure PS6.16 of L.C.O.E.

3. Standard instruments used in the calibration

The calibration has been performed using the standards VI1PA05 and VI3SOFT01 of L.C.O.E.

4. Calibration uncertainty

The expanded measurement uncertainty indicated in the results tables has been obtained multiplying the typical uncertainty by the coverage factor $k = 2$, that for a normal probability distribution corresponds to a probability around 95%. The typical uncertainty has been determined following the document EA 4 / 02 M and the Guide to the Expression of Uncertainty in Measurement JCGM 100.

5. Calibration and environmental conditions

The instrument under calibration has been inside the laboratory for at least two hours before the beginning of the calibration. Calibration has been performed in the measuring points indicated in the result tables by request of the applicant. Calibration has been carried out in the laboratory L10 at the ambient temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$, and relative humidity lower than 60%.

6. Calibration results

Adjustments in the unit under test have not been performed before the beginning or during the calibration. Calibration results are summarized in the calibration tables.

7. Labelling or sealing

A calibration label has been stucked on the instrument under calibration.

8. Measurement traceability

Measurement traceability is referred to our reference standards periodically calibrated in national laboratories participating in intercomparisons accepted by the BIPM or in laboratories accredited by ENAC or by other accreditation bodies recognized by ENAC.

9. Reception date

16/04/2018.

Voltage calibration

Unit under test range		Reference value		Unit under test		Calibration uncertainty
Range	Channel			Readings	Error	
230 V	1	155,7918 V	50 Hz	155,73 V	-0,058 V	0,032 V
230 V	1	238,6796 V	50 Hz	238,71 V	0,030 V	0,048 V
230 V	2	155,8034 V	50 Hz	155,76 V	-0,043 V	0,031 V
230 V	2	238,69 V	50 Hz	238,78 V	0,090 V	0,048 V
230 V	3	155,8128 V	50 Hz	155,68 V	-0,129 V	0,032 V
230 V	3	238,69 V	50 Hz	238,64 V	-0,052 V	0,048 V

Current calibration

Unit under test range		Reference value		Unit under test		Calibration uncertainty
Range	Channel			Readings	Error	
63 A	1	0,5001 A	50 Hz	0,45 A	-0,0501 A	0,0064 A
63 A	1	1,0000 A	50 Hz	0,98 A	-0,0200 A	0,0059 A
63 A	1	2,0020 A	50 Hz	2,02 A	0,0180 A	0,0057 A
63 A	1	5,0030 A	50 Hz	4,97 A	-0,0330 A	0,0059 A
63 A	1	10,0084 A	50 Hz	10,01 A	0,0016 A	0,0061 A
63 A	1	49,980 A	50 Hz	49,94 A	-0,042 A	0,016 A
63 A	2	0,5002 A	50 Hz	0,45 A	-0,0502 A	0,0064 A
63 A	2	1,0000 A	50 Hz	0,98 A	-0,0200 A	0,0059 A
63 A	2	2,0020 A	50 Hz	2,02 A	0,0180 A	0,0057 A
63 A	2	5,0030 A	50 Hz	4,97 A	-0,0330 A	0,0059 A
63 A	2	10,0060 A	50 Hz	10,01 A	0,0040 A	0,0061 A
63 A	2	49,943 A	50 Hz	49,95 A	0,007 A	0,011 A
63 A	3	0,5001 A	50 Hz	0,45 A	-0,0501 A	0,0064 A
63 A	3	1,0000 A	50 Hz	0,98 A	-0,0200 A	0,0059 A
63 A	3	2,0016 A	50 Hz	2,02 A	0,0184 A	0,0057 A
63 A	3	5,0020 A	50 Hz	4,97 A	-0,0320 A	0,0059 A
63 A	3	10,0086 A	50 Hz	9,98 A	-0,0286 A	0,0061 A
63 A	3	49,995 A	50 Hz	49,92 A	-0,075 A	0,011 A

Active power calibration at 50 Hz

Unit under test range		Reference value				Unit under test			Calibration uncertainty
Voltage	Current	Voltage	Current	cos ϕ	Power	Channel	Readings	Error	
230 V	63 A	230 V	0,5 A	1	119 W	1	124 W	4,62 W	0,58 W
230 V	63 A	230 V	1 A	1	239 W	1	241 W	2,27 W	0,58 W
230 V	63 A	230 V	1 A	0,5i	119 W	1	124 W	4,67 W	0,58 W
230 V	63 A	230 V	1 A	0,8c	191 W	1	193 W	2,00 W	0,58 W
230 V	63 A	230 V	2 A	1	478 W	1	480 W	2,22 W	0,59 W
230 V	63 A	230 V	2 A	0,5i	239 W	1	243 W	4,34 W	0,58 W
230 V	63 A	230 V	2 A	0,8c	382 W	1	383 W	0,60 W	0,58 W
230 V	63 A	230 V	5 A	1	1194 W	1	1190 W	-4,00 W	0,63 W
230 V	63 A	230 V	10 A	1	2387 W	1	2376 W	-10,7 W	1,4 W
230 V	63 A	230 V	10 A	0,5i	1191 W	1	1191 W	-0,2 W	1,3 W
230 V	63 A	230 V	10 A	0,8c	1911 W	1	1891 W	-19,9 W	1,4 W
230 V	63 A	230 V	50 A	1	11933 W	1	12066 W	132,3 W	7,9 W
230 V	63 A	230 V	50 A	0,5i	5988 W	1	6091 W	102,5 W	7,8 W
230 V	63 A	230 V	50 A	0,8c	9521 W	1	9649 W	128,7 W	6,8 W

Power calibration at 50 Hz

Unit under test range		Reference value				Unit under test			Calibration uncertainty
Voltage	Current	Voltage	Current	cos ϕ	Power	Channel	Readings	Error	
230 V	63 A	230 V	0,5 A	1	119 W	2	124 W	4,60 W	0,58 W
230 V	63 A	230 V	1 A	1	239 W	2	243 W	4,26 W	0,58 W
230 V	63 A	230 V	1 A	0,5i	119 W	2	125 W	5,26 W	0,82 W
230 V	63 A	230 V	1 A	0,8c	191 W	2	195 W	3,99 W	0,58 W
230 V	63 A	230 V	2 A	1	478 W	2	481 W	3,17 W	0,59 W
230 V	63 A	230 V	2 A	0,5i	239 W	2	244 W	5,31 W	0,58 W
230 V	63 A	230 V	2 A	0,8c	382 W	2	384 W	1,57 W	0,58 W
230 V	63 A	230 V	5 A	1	1194 W	2	1194 W	0,30 W	0,85 W
230 V	63 A	230 V	10 A	1	2388 W	2	2381 W	-6,5 W	1,4 W
230 V	63 A	230 V	10 A	0,5i	1192 W	2	1197 W	5,40 W	0,90 W
230 V	63 A	230 V	10 A	0,8c	1911 W	2	1901 W	-9,9 W	1,9 W
230 V	63 A	230 V	50 A	1	11938 W	2	12061 W	123,0 W	5,3 W
230 V	63 A	230 V	50 A	0,5i	5985 W	2	6086 W	100,6 W	3,1 W
230 V	63 A	230 V	50 A	0,8c	9517 W	2	9635 W	118,0 W	3,7 W

Power calibration at 50 Hz

Unit under test range		Reference value				Unit under test			Calibration uncertainty
Voltage	Current	Voltage	Current	cos ϕ	Power	Channel	Readings	Error	
230 V	63 A	230 V	0,5 A	1	119 W	3	124 W	4,62 W	0,58 W
230 V	63 A	230 V	1 A	1	239 W	3	243 W	4,24 W	0,58 W
230 V	63 A	230 V	1 A	0,5i	119 W	3	124 W	4,67 W	0,58 W
230 V	63 A	230 V	1 A	0,8c	191 W	3	195 W	3,97 W	0,58 W
230 V	63 A	230 V	2 A	1	478 W	3	480 W	2,18 W	0,59 W
230 V	63 A	230 V	2 A	0,5i	239 W	3	243 W	4,36 W	0,58 W
230 V	63 A	230 V	2 A	0,8c	382 W	3	384 W	1,57 W	0,58 W
230 V	63 A	230 V	5 A	1	1194 W	3	1190 W	-4,00 W	0,63 W
230 V	63 A	230 V	10 A	1	2388 W	3	2376 W	-12,6 W	1,4 W
230 V	63 A	230 V	10 A	0,5i	1193 W	3	1194 W	1,40 W	0,70 W
230 V	63 A	230 V	10 A	0,8c	1911 W	3	1903 W	-8,4 W	1,9 W
230 V	63 A	230 V	50 A	1	11934 W	3	12031 W	97,2 W	9,6 W
230 V	63 A	230 V	50 A	0,5i	5989 W	3	6074 W	85,9 W	8,9 W
230 V	63 A	230 V	50 A	0,8c	9519 W	3	9669 W	149,6 W	8,4 W

Calibration in energy at 50 Hz, with an integration time of 15 minutes

Unit under test range		Reference value				Unit under test		Calibration uncertainty
Voltage	Current	Voltage	Current	cos ϕ	Energy	Channel	Error	
230 V	63 A	230 V	10 A	1	593,7 Wh	1	-6,60 Wh	0,59 Wh
230 V	63 A	230 V	10 A	1	592,4 Wh	2	-4,36 Wh	0,59 Wh
230 V	63 A	230 V	10 A	1	592,3 Wh	3	-4,33 Wh	0,59 Wh