Application Note

CMS 356 calibration

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Date
May, 18, 2017

Related OMICRON Product
CMS 356

Application Area
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Keywords
Calibration, Verification

Version
v 1.0

Document ID
ANS_17012_ENU

General information

OMICRON electronics GmbH including all international branch offices is henceforth referred to as OMICRON.

The product information, specifications, and technical data embodied in this application note represent the technical status at the time of writing and are subject to change without prior notice.

We have done our best to ensure that the information given in this application note is useful, accurate and entirely reliable. However, OMICRON does not assume responsibility for any inaccuracies which may be present.

OMICRON translates this application note from the source language English into a number of other languages. Any translation of this document is done for local requirements, and in the event of a dispute between the English and a non-English version, the English version of this note shall govern.

Table of content

1 Safety instructions

This application note may only be used in conjunction with the relevant product manuals which contain all safety instructions. The user is fully responsibility for any application that makes use of OMICRON products.

Instructions are always characterized by a ▶ symbol even if they are included to a safety instruction.

DANGER

Death or severe injury caused by high-voltage or current if the respective protective measures are not complied with.

- Carefully read and understand the contents of this application note (as well as the manuals of the systems involved) before you start to work with it.
- Please contact OMICRON Support if you have any questions or doubts regarding the safety or operating instructions.
- Follow each instruction listed in the manuals particularly the safety instructions, since this is the only way to avoid danger that can occur when working at high-voltage or high current systems.
- Only use the equipment according to its intended purpose to guarantee safe operation.
- Existing national safety standards for accident prevention and environmental protection may supplement the equipment's manual.

Only experienced and competent professionals who are trained for working in high-voltage or high current environments may perform the applications in this document. In addition the following qualifications are required:

- Authorized to work in environments of energy generation, transmission or distribution and familiar with the approved operating practices in such environments.
- Familiar with the five safety rules.
- Good knowledge of the CMS 356.

1.1 Introduction

Use the procedures in this section to verify that CMS 356 accuracy is within the limits stated in the unit's one-year accuracy specifications. Specifications and characteristics are subject to change without notice; please refer to the OMICRON website (http://www.omicronenergy.com) for the most recent specifications. You can perform these verification procedures:

> When you first receive the CMS 356 to make sure that it was not damaged during shipment.
> To verify that the CMS 356 meets factory specifications.
> To determine if calibration adjustment is required.

1.2 Factory service

If the CMS 356 is to be returned to OMICRON for calibration adjustment or repair, consult the Technical Support.

1.3 Verification test requirements

Be sure that you perform these verification tests:

> Under the proper environmental conditions
> After the specified warmup period
> Using the correct line voltage
> Using the proper and calibrated test equipment
> Using the specified output signal and reading limits

1.3.1 Environmental conditions

Conduct your performance verification procedures in a test environment with:

> An ambient temperature of 23 °C ± 5 °C (73 °F ± 9 °F).
> A relative humidity of less than or equal to 80 %, unless otherwise noted.

1.3.2 Warmup period

Allow the CMS 356 to warm up for at least 25 minutes before conducting the verification procedures.

If the instrument has been subjected to temperature extremes (those outside the ranges stated above), allow additional time for the internal temperature of the instrument to stabilize. Typically, allow one extra hour to stabilize a unit that is 10 °C (18 °F) outside the specified temperature range.

Also, allow the test equipment to warm up for the minimum time specified by the manufacturer.

1.3.3 Power supply

The CMS 356 requires a supply voltage of 100 V to 240 V and a nominal frequency of 50 Hz or 60 Hz. Verification tests should be performed within this range.

1.3.4 Suggested test equipment

The following table summarizes the suggested verification equipment. You can use other equipment if that equipment has specifications that meet or exceed those listed in the table below. Test equipment uncertainty adds to the uncertainty of each measurement. Generally test equipment uncertainty should be at least four times more accurate than the corresponding CMS 356 specifications. The following table lists the uncertainties of the recommended test equipment. The test equipment has to be calibrated.

Manufacturer	Model	Description	Used for:	Uncertainty
OMICRON	VEHK0003	Connection Cable CMC – CMLIB A	all	N/A
OMICRON	VEHZ1101	CMLIB A	all	N/A
Keysight	3458A	Digital Reference Multimeter	ACV	See below
N/A	N/A	10 - 20 mΩ, 0.02 % tolerance, 10 ppm / K resistor, low impedance	ACI	Measurement uncertainty < 100ppm
Clarke-Hess	6000A	Phase Meter	Phase	See below
Clarke-Hess	650	Phase shunt	Current phase	± 5 m°
N/A	N/A	AC / DC Signal Source	Inputs	See below

Table 1 Recommended test equipment

Refer to the manufacturer's specifications to calculate the uncertainty, which varies for each function and range test point. .....

1.4 Verification limits

Use the accuracy specifications listed in the CMS 356 Reference Manual as verification limits.
They do not include test equipment uncertainty. If a particular measurement falls outside the allowable range, recalculate new limits based on both the CMS 356 specifications and corresponding test equipment specifications.

1.5 Test considerations

When performing the verification procedures:

- Be sure that the test equipment is properly warmed up for 90 minutes.
- Ensure that the CMLIB A is connected to the "AMP. IN" socket on the CMS 356.
- Launch the CMS 356 web interface.

2 Amplitude verification of voltage outputs

2.1 Configuration

Configure the CMS 356 as follows:

- Analog input range: ±7.071 V_{peak} (5 V_{rms})

- Enable Voltage outputs
- Select the configuration 4x300 V, 85 VA @ 85 V, 1 A_{rms}
- Disable voltage limits

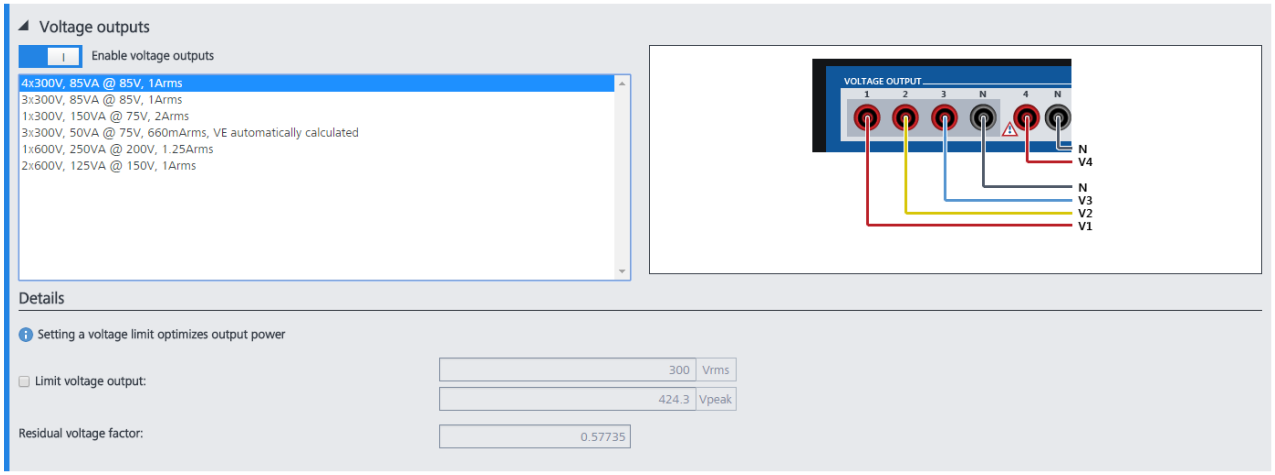

Figure 1 Voltage output configuration

- Disable Current outputs

- Map output signal V1 to input 1, V2 to input 2, V3 to input 3 and V4 to input 4.

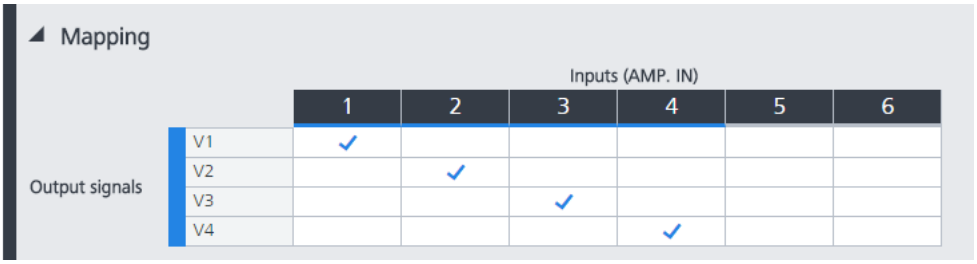

Figure 2 Mapping of voltage outputs to low level inputs

2.2 Connections

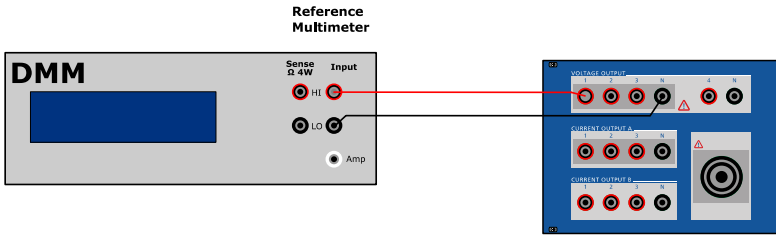

Figure 3 Voltage output setup

2.3 Verification

To verify the amplitude accuracy of the voltage outputs:

- ▶ Connect the signal source to the corresponding CMS 356 input.
- ▶ Connect the CMS 356 input to the reference multimeter.

- ▶ On the reference multimeter, select a suitable measuring mode for the measurement.
- ▶ On the reference multimeter, select a suitable range for the measurement.

- ▶ Apply a certain calibration signal to the CMS 356 input.
- ▶ Verify that the displayed readings on the reference multimeter fall within the specified limits.
- ▶ Switch off the calibration signal.

- ▶ Connect the CMS 356 output to the reference multimeter.

- ▶ On the reference multimeter, select a suitable measuring mode for the measurement.
- ▶ On the reference multimeter, select a suitable range for the measurement.

- ▶ Apply the calibration signal again to the CMS 356 input.
- ▶ Verify that the displayed readings on the reference multimeter fall within the specified limits.
- ▶ Switch off the calibration signal.

- ▶ Repeat these steps for each amplitude, frequency and channel.

3 Amplitude verification of current outputs

3.1 Configuration

Configure the CMS 356 as follows:

- Analog input range: ±7.071 V_{peak} (5 V_{rms})
- Disable Voltage outputs
- Enable Current outputs
- Select the configuration 6x32 V, 430VA @ 25 A, 25 V_{rms}
- Disable current limits

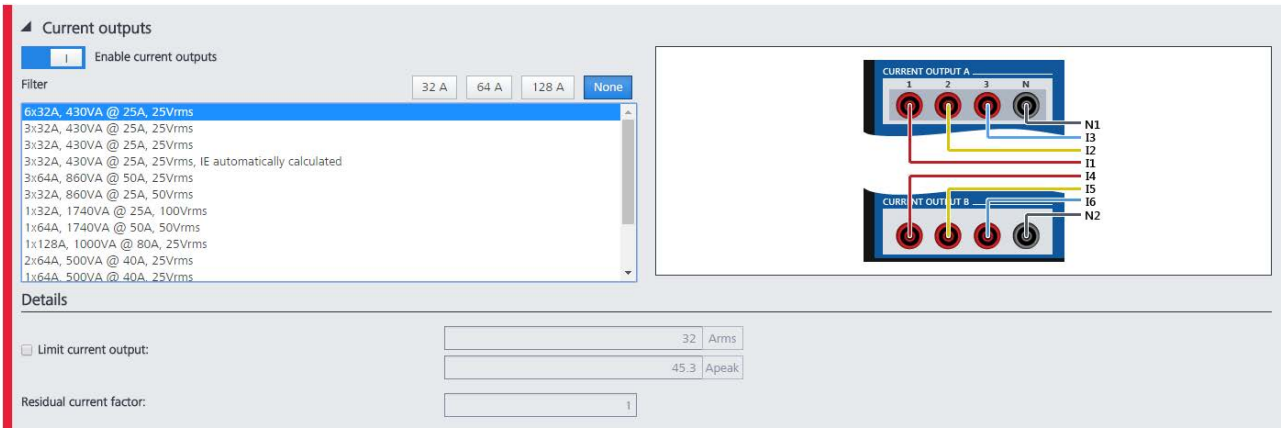

Figure 4 Current output configuration

- Map output signal I1 to input 1, I2 to input 2, I3 to input 3, I4 to input 4, I5 to input 5 and I6 to input 6.

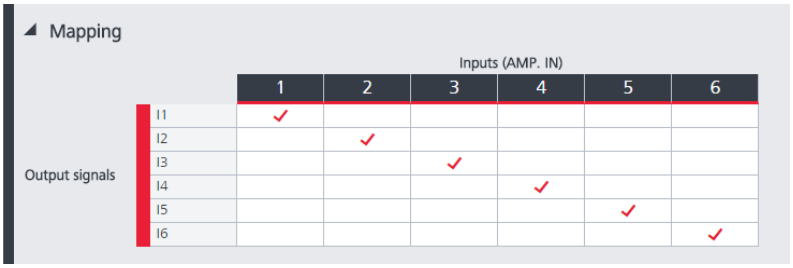

Figure 5 Mapping of current outputs to low level inputs

3.2 Connections

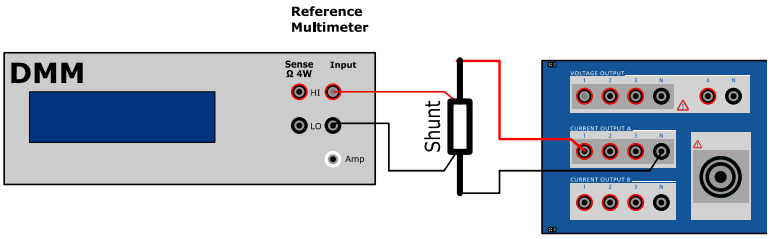

Figure 6 Current output setup

3.3 Verification

To verify the amplitude accuracy of the current outputs:

- ▶ Connect the signal source to the corresponding CMS 356 input.
- ▶ Connect the shunt to the CMS 356 output.
- ▶ Connect the CMS 356 input to the reference multimeter.

- ▶ On the reference multimeter, select a suitable measuring mode for the measurement.
- ▶ On the reference multimeter, select a suitable range for the measurement.

- ▶ Apply a certain calibration signal to the CMS 356 input.
- ▶ Verify that the displayed readings on the reference multimeter fall within the specified limits.
- ▶ Switch off the calibration signal.

- ▶ Connect the shunt sense to the reference multimeter.

- ▶ On the reference multimeter, select a suitable measuring mode for the measurement.
- ▶ On the reference multimeter, select a suitable range for the measurement.

- ▶ Apply the calibration signal again to the CMS 356 input.
- ▶ Verify that the displayed readings on the reference multimeter fall within the specified limits.
- ▶ Switch off the calibration signal.

- ▶ Repeat these steps for each amplitude, frequency and channel.

4 Phase verification

We recommend to measure the phase with a reference phase meter.

Measure the phase between the reference channel V1 and the output channel.

4.1 Phase verification of voltage outputs

4.1.1 Configuration

- ▶ Select the **desired** configuration (see 2.1).

4.1.2 Connections

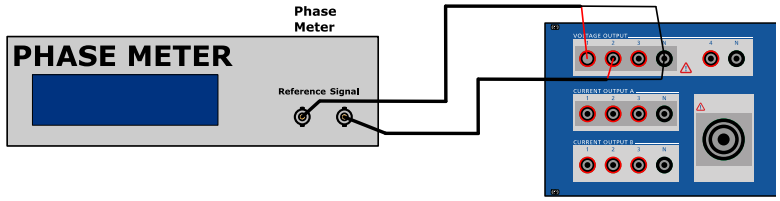

Figure 7 Phase verification setup for voltage outputs.

4.1.3 Verification

To verify the phase accuracy of the voltage outputs:

- ▶ Connect Voltage Output 1 (V1) to the reference connector on the reference phase meter (Figure 7).
- ▶ Connect the channel to be tested to the signal connector on the reference phase meter (Figure 7).
- ▶ On the reference phase meter, select a suitable measuring mode and range for the measurement.
- ▶ Apply a certain calibration signal to CMS 356 input 1 and to the CMS 356 input for the channel to be tested.
- ▶ Verify that the displayed readings on the reference phase meter fall within the specified limits.
- ▶ Switch off the calibration signal.
- ▶ Repeat these steps for each phase angle, amplitude, range and channel.

4.2 Phase verification of current outputs

To perform high accurate phase measurements, we recommend using **low inductive shunts** (see 1.3.4).

4.2.1 Configuration

Configure the CMS 356 as follows:

- Analog input range: ±7.071 V_{peak} (5 V_{rms})

- Enable Voltage outputs
- Select 3x300 V, 85 VA @ 85 V, 1A_{rms}
- Disable voltage limits

- Enable Current outputs
- Select the configuration 6x32 V, 430VA @ 25 A, 25 V_{rms}
- Disable current limits

- For current output A verification map output signal V1 to input 1, I1 to input 4, I2 to input 5, I3 to input 6.

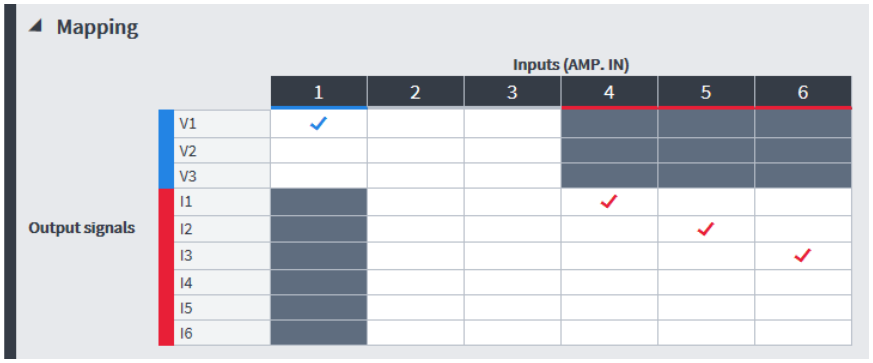

Figure 8: Mapping for current output A phase verification

- For current output B verification map output signal V1 to input 1, I4 to input 4, I5 to input 5, I6 to input 6.

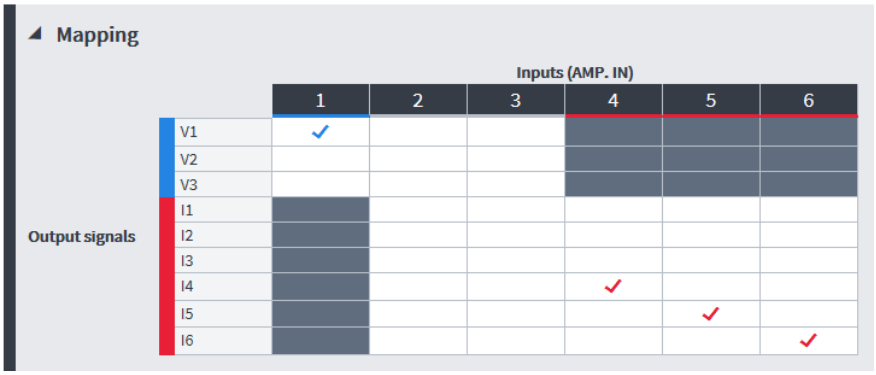

Figure 9: Mapping for current output B phase verification

4.2.2 Connections

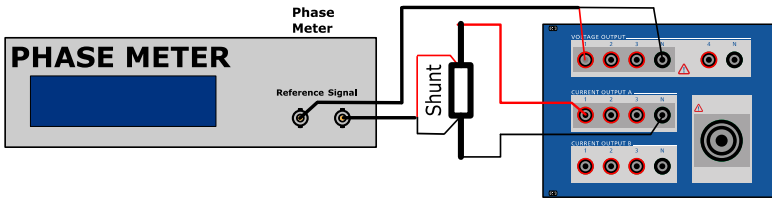

Figure 10 Phase verification setup for current outputs

4.2.3 Verification

To verify the phase accuracy of the current outputs:

- ▶ Connect voltage output 1 (V1) to the reference connector on the reference phase meter (Figure 10).
- ▶ Connect the channel to be tested to the phase shunt.
- ▶ Connect the phase shunt sense to the signal connector on the reference phase meter.

- ▶ On the reference phase meter, select a suitable measuring mode and range for the measurement.

- ▶ Apply a calibration signal to CMS 356 input 1 and to the CMS 356 input for the channel to be tested.
- ▶ Verify that the displayed readings on the reference phase meter fall within the specified limits.
- ▶ Switch off the calibration signal.

- ▶ Repeat these steps for each phase, amplitude, range and channel.

5 List of literature

[1] CMS 356 Getting Started, OMICRON electronics GmbH; 2017; ENU 1114 03 02

[2] CMS 356 Reference Manual, OMICRON electronics GmbH; 2017; ENU 1114 04 02

[3] CMLIB A Reference Manual; OMICRON electronics GmbH; 2000; ENU 1023 04 01

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