Bode 100 - Information

Detailed Functional & Calibration Check of Bode 100

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Contact support@omicron-lab.com for technical support.

1 Check of factory calibration

The following checks will help you to decide if it is required to send the Bode 100 to OMICRON Lab for calibration.

Note:

It is assumed that the user manual of the Bode 100 was read and understood prior the measurements described in this document are executed. If you do not have a manual at hand you can download it at https://www.omicron-lab.com/downloads/vector-network-analysis/bode-100/.

1.1 Test of output signal shape

Measurement Setup:

Please connect the Source output of Bode 100 to an oscilloscope

Figure 1: test signal shape - connection setup

Equipment Setup:

Please select the measurement type “Gain / Phase”, select the source settings as follows and start a continuous measurement:
Frequency: 10 MHz - Fixed
Output level: 0 dBm

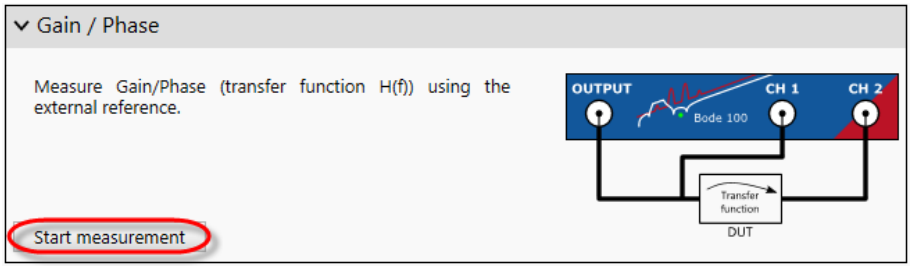

Figure 2: test signal shape - measurement type setting

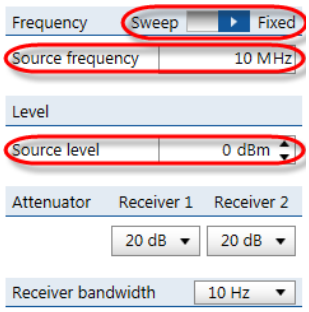

Figure 3: test signal shape - measurement settings

Figure 4: test signal shape - start continuous measurement

Expected Measurement result:

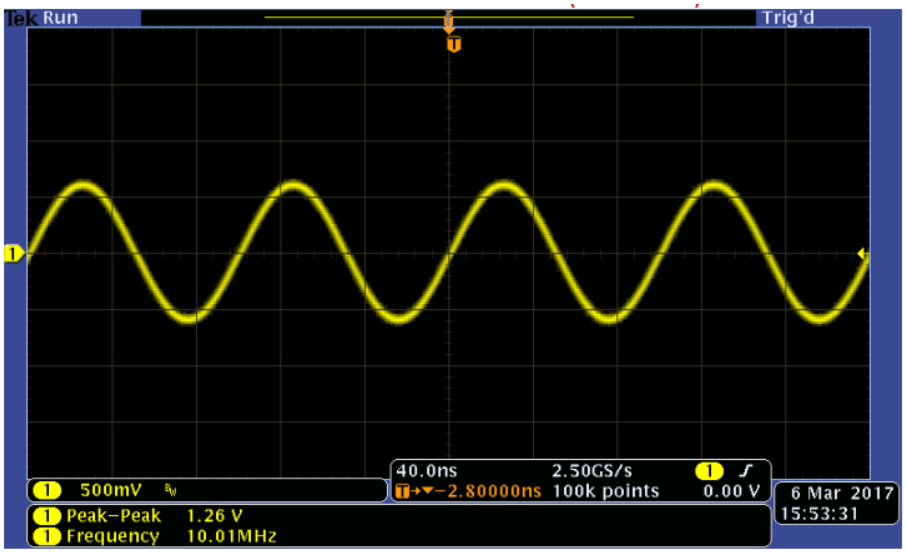

Figure 5: test signal shape - expected result

Waveform: **sinusoidal**
$V_{peak\text{-}peak}$: ~ 1.26 Volts (more accurate measurement follows)
Frequency: ~ 10 MHz (more accurate measurement follows)

If the waveform looks nice, the source amplifiers are working properly.

1.2 Accuracy of output frequency

Measurement Setup:

Please connect the output of the Bode 100 to a frequency counter which is locked to a high stable frequency normal (e.g. Rubidium, GPS etc.).

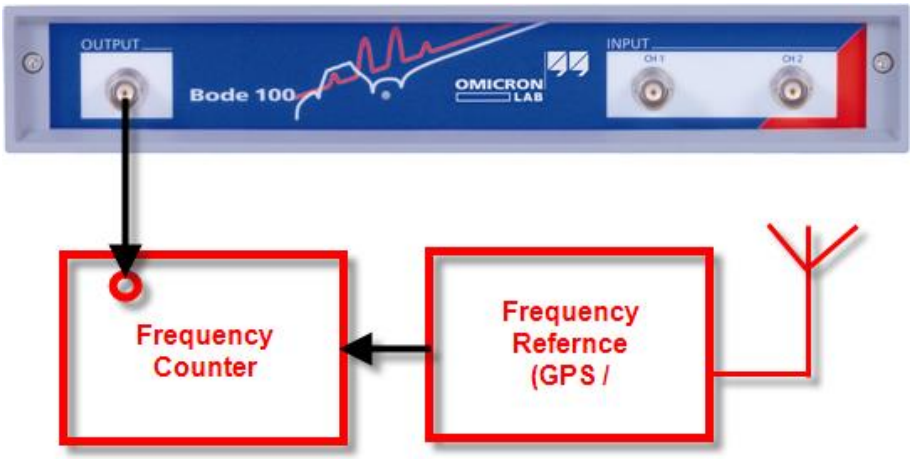

Figure 6: output frequency accuracy - connection setup

Equipment Setup:

Please select the measurement type “Gain / Phase”, select the source settings as follows and start a continuous measurement:
Frequency: 10 MHz - Fixed
Output level: 0 dBm

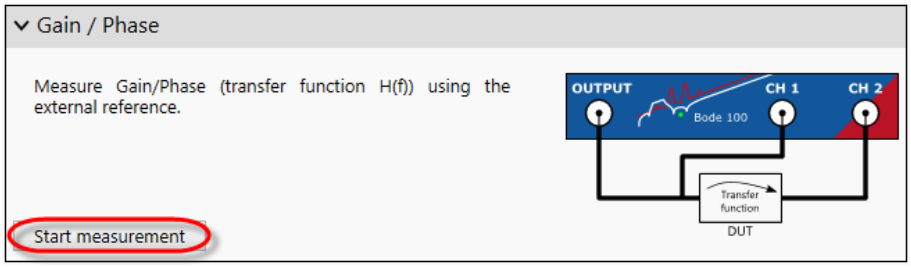

Figure 7: output frequency accuracy - measurement type setting

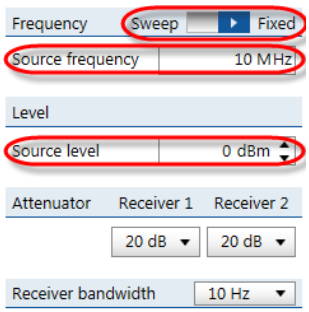

Figure 8: output frequency accuracy - measurement setting

Figure 9: output frequency accuracy - start continuous measurement

Expected Measurement result:

Measured frequency: 10 MHz

Maximum tolerance for Bode 100 Revision 1:
± 15 ppm ≙ ± 150 Hz @ 10 MHz (< 1 year after adjustment)
± 25 ppm ≙ ± 250 Hz @ 10 MHz (< 3 years after adjustment)

Maximum tolerance for Bode 100 Revision 2:
± 2 ppm ≙ ± 20 Hz @ 10 MHz (< 1 year after adjustment)
± 4 ppm ≙ ± 40 Hz @ 10 MHz (< 3 years after adjustment)

If you measure a higher frequency deviation, please send the Bode 100 in for calibration / adjustment.

1.3 Accuracy of output level

Measurement Setup:

Please connect the Source output of Bode 100 to a calibrated 50 Ω power meter.

Figure 10: output level accuracy - connection setup

Equipment Setup:

Please select the measurement type “Gain / Phase”, select the source settings as follows and start a continuous measurement:
Frequency: 1 MHz – Fixed (or whatever frequency your power meter is made for)
Output level: 0 dBm / 13 dBm / -27 dBm

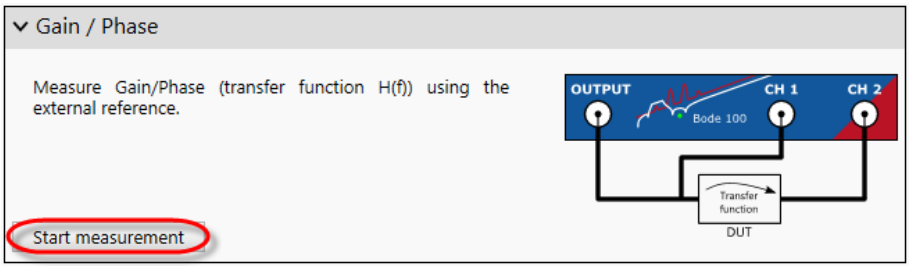

Figure 11: output level accuracy - measurement type setting

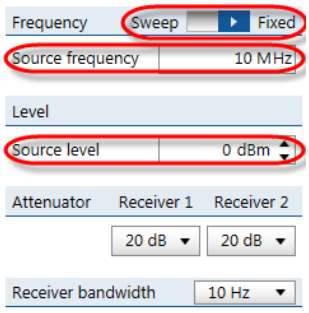

Figure 12: output level accuracy - measurement settings

Figure 13: output level accuracy - start continuous measurement

Expected Measurement result:

Measured output power: 0 dBm / 13 dBm / - 27 dBm
Measured output power tolerance @ 23°C ± 5°C:
max. ± 0.3 dB (1 Hz to < 1 MHz)
max. ± 0.6 dB (1 MHz to 40 MHz for Bode 100 R1)
max. ± 0.6 dB (1 MHz to 50 MHz for Bode 100 R2)

If you measure a higher power deviation, please send in the Bode 100 for calibration / adjustment.

1.4 Accuracy of Gain/Phase factory calibration

Measurement Setup:

Connect the Source of Bode 100 to the two inputs using the cables and the T-BNC Adapter delivered with Bode 100.

Figure 14: gain/phase accuracy - connection setup

Equipment Setup:

Please select the measurement type “Gain / Phase” and apply the following settings in the hardware setup:

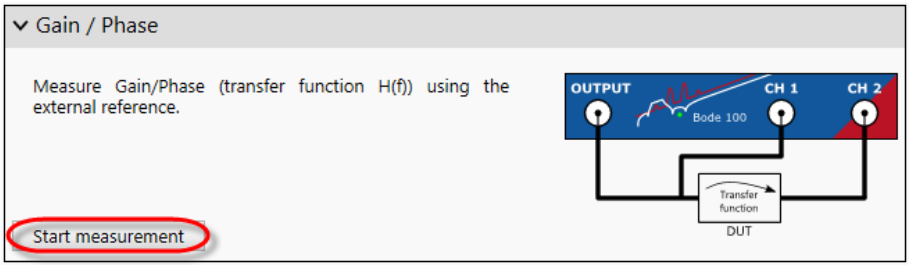

Figure 15: gain/phase accuracy - gain/phase measurement

Figure 16: gain/phase accuracy - open hardware setup

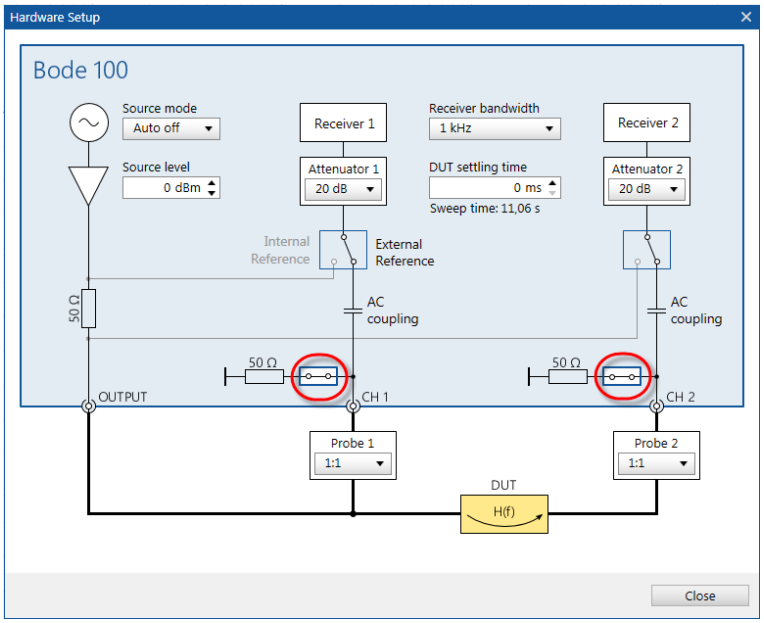

Figure 17: gain/phase accuracy - hardware setup

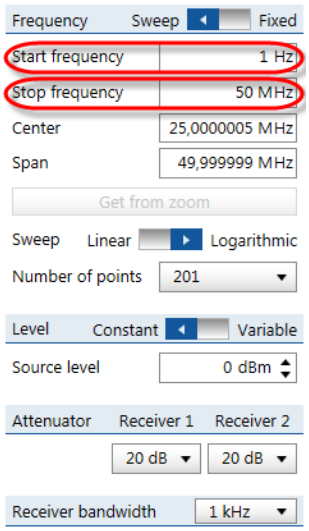

Figure 18: gain/phase accuracy - measurement settings

Then start a single measurement.

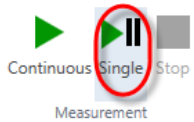

Figure 19: gain/phase accuracy - start single sweep

For better visibility change the chart setup to “one axis per chart” as well as set the trace settings as can be seen below:

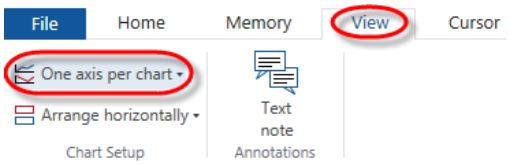

Figure 20: gain/phase accuracy - chart setup

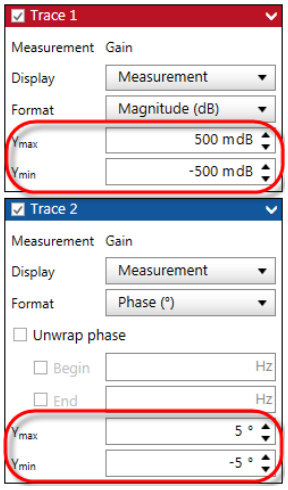

Figure 21: gain/phase accuracy - trace settings

Expected Measurement results:

Gain: 0 dB
Tolerance: max. ± 0.2 dB from 1 Hz to 50 MHz

Phase: 0°
Tolerance: max ± 3° from 1 Hz to 50 MHz

If you measure a higher gain/phase deviation please send in the Bode 100 for calibration / adjustment.

The following measurement results are an example and can be slightly different from the measurement with other devices.

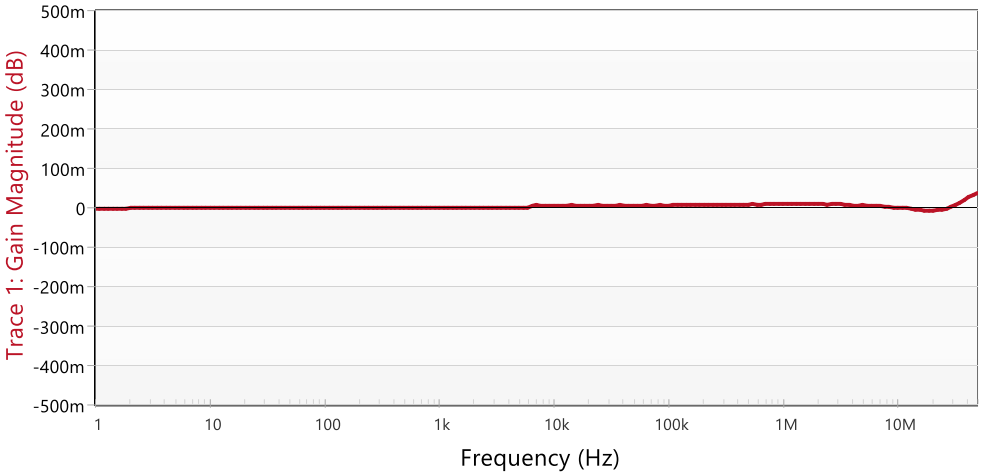

Figure 22: gain/ phase accuracy – magnitude (dB) measurement

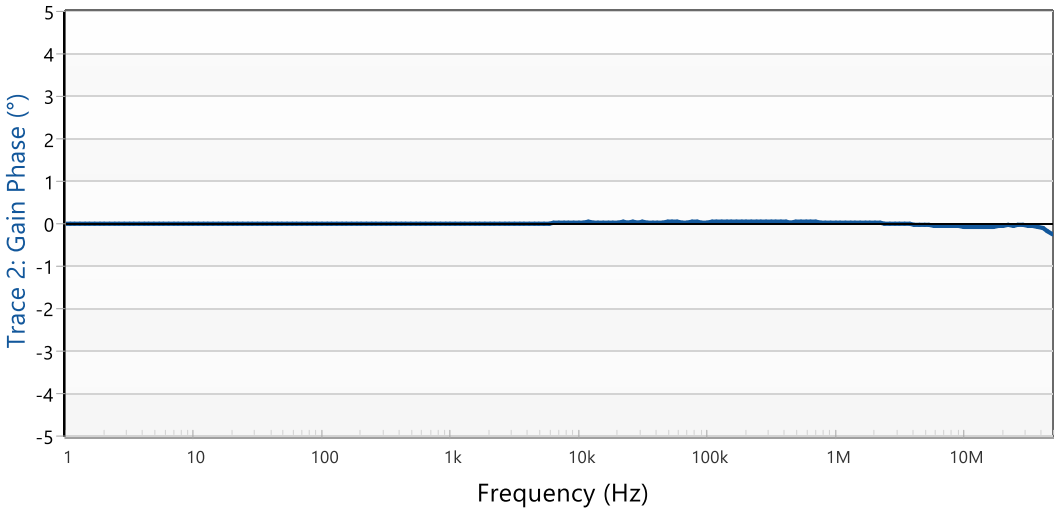

Figure 23: gain/phase accuracy - phase (°) measurement

1.5 Noise floor / Channel isolation

Measurement Setup:

Disconnect all BNC cables from Bode 100.
Do not connect anything to the front side BNC connectors!

Equipment Setup:

Please select the measurement type “transmission / reflection” and apply the following settings:

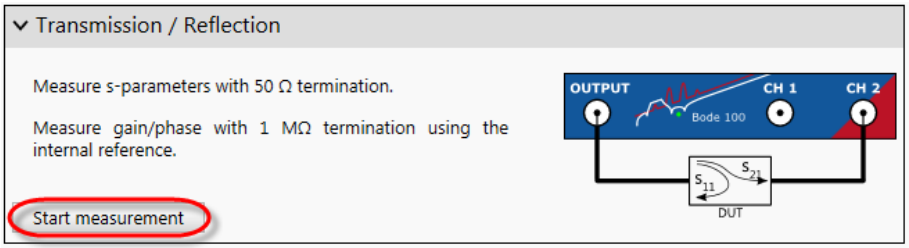

Figure 24: dynamic range / isolation - transmission / reflection measurement

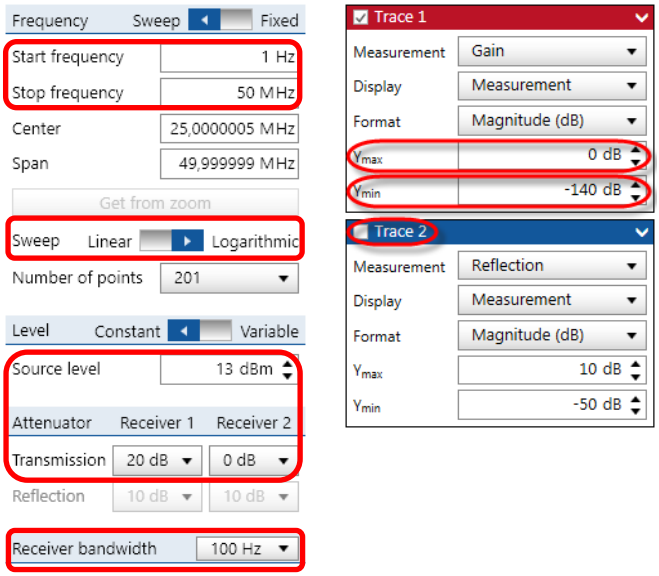

Figure 25: noise floor / isolation – measurement & trace settings

After that, start a single measurement.

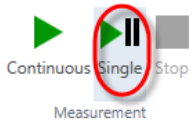

Figure 26: dynamic range / isolation - start single sweep

Expected Measurement results:

Gain: max. - 100 dB for 1 Hz to 50 MHz

If you measure a gain higher than -100 dB please send in the Bode 100 for calibration / adjustment.

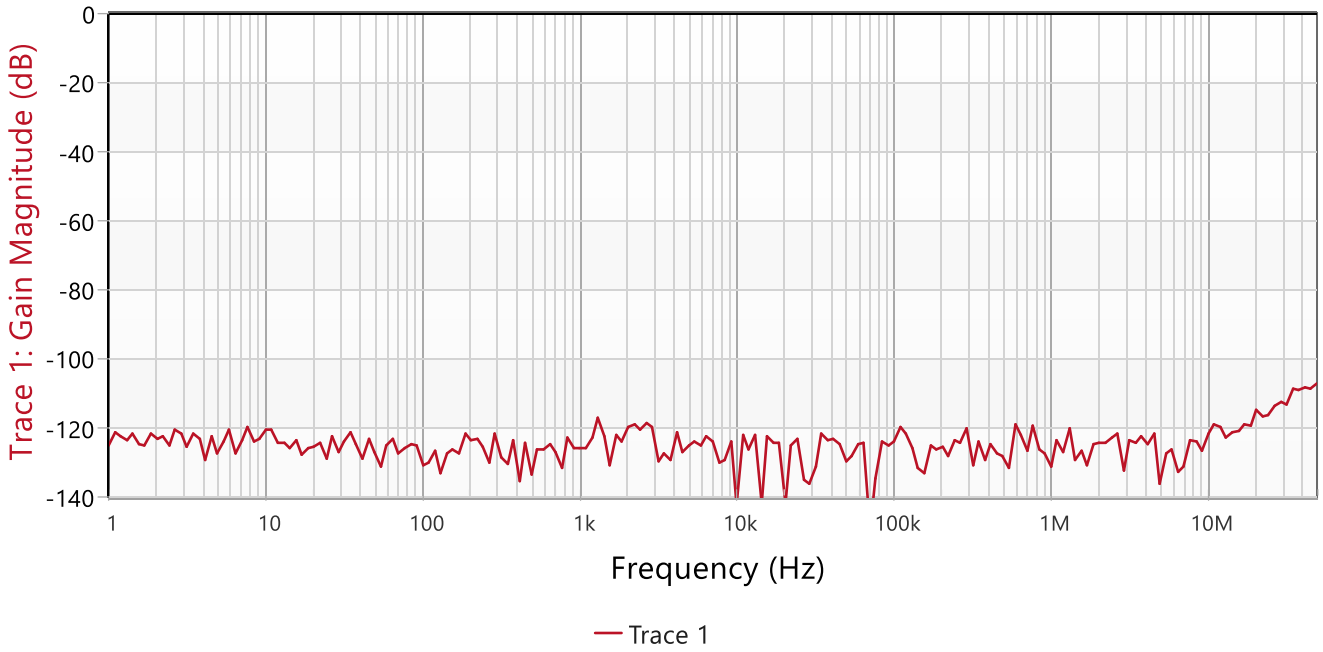

Figure 27: noise floor / isolation – magnitude (dB) measurement

1.6 Accuracy of impedance calibration

Measurement Setup:

Connect the 50 Ω BNC Load connector to the output of the Bode 100.

Figure 28: impedance accuracy - connection setup

Equipment Setup:

Please select the measurement type “one-port” and apply the following settings:

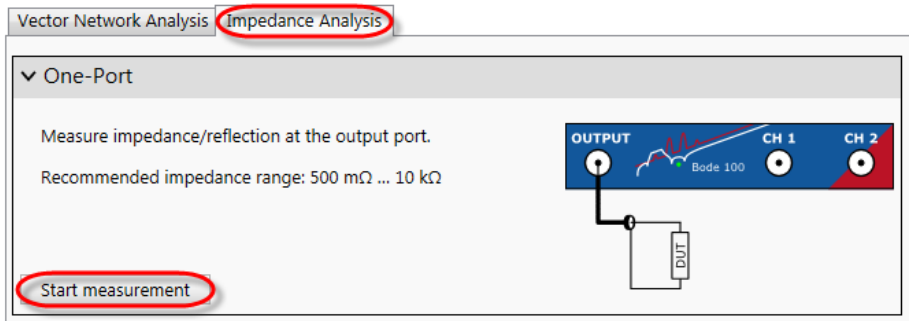

Figure 29: impedance accuracy - measurement type

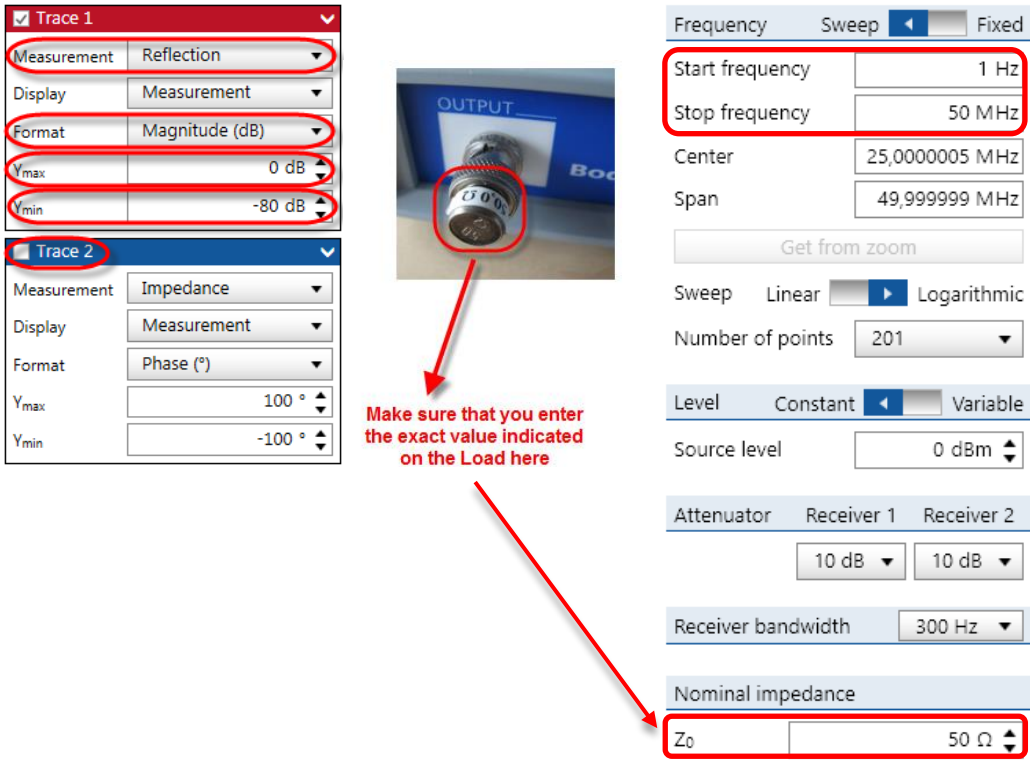

Figure 30: impedance accuracy - measurement & trace settings

Expected Measurement results:

Reflection: max. - 35 dB for 1 Hz to 50 MHz

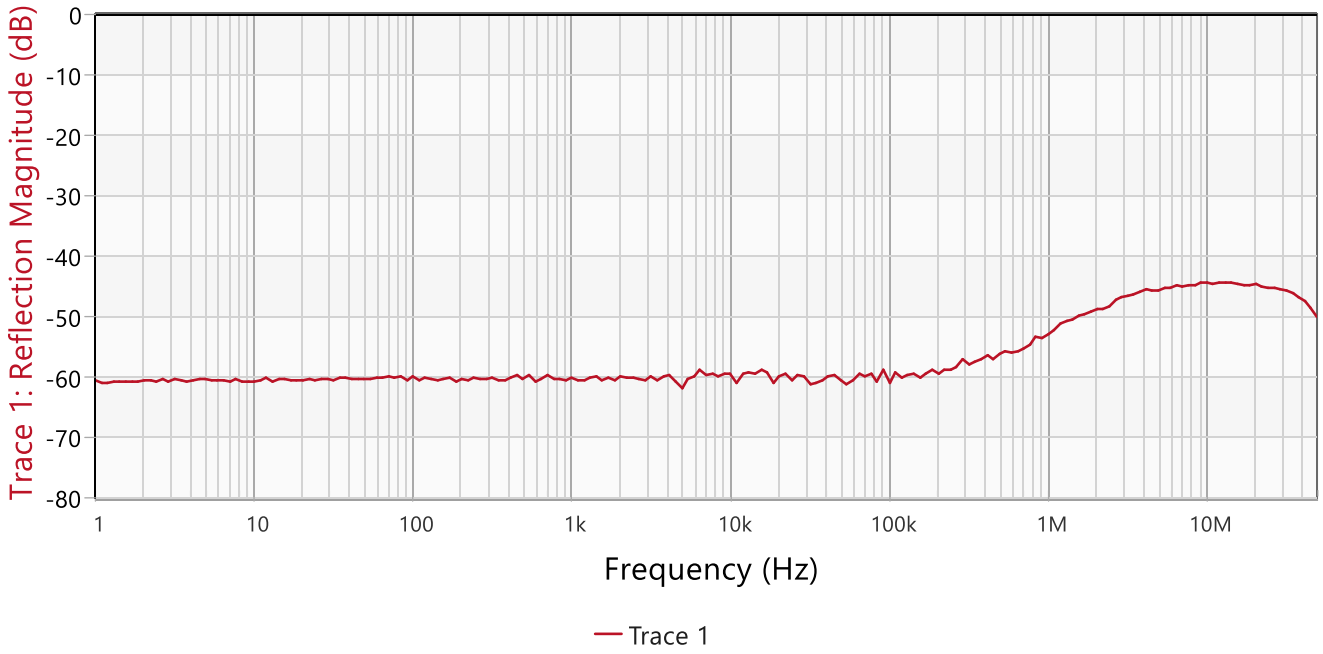

Figure 31: impedance accuracy – reflection magnitude (dB) measurement

If you measure a higher reflection than -35 dB please re-start the Internal Device Calibration and re-perform this test. If this does not help, please send the Bode 100 in for calibration / adjustment.

1.7 Quick check of attenuators

By having a look at the level indicators in the lower right corner of the status bar a quick check of the input attenuators can be performed. This is just a qualitative check that proves that the attenuators do their job in general.

Measurement setup:

Connect the Source of Bode 100 to the two inputs using the cables and the T-BNC Adapter delivered with Bode 100.

Figure 32: quick check attn. - measurement setup

Equipment setup:

Please select the measurement type “Gain / Phase” and apply the following settings in the hardware setup:

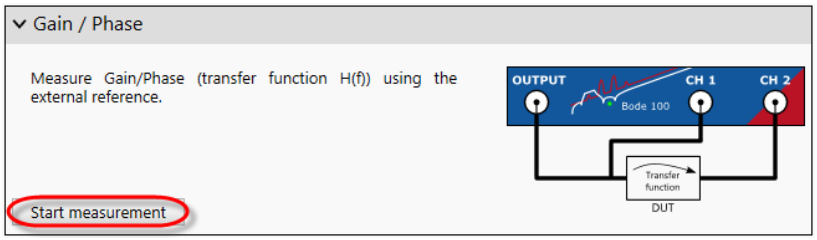

Figure 33: quick check attn. - measurement type

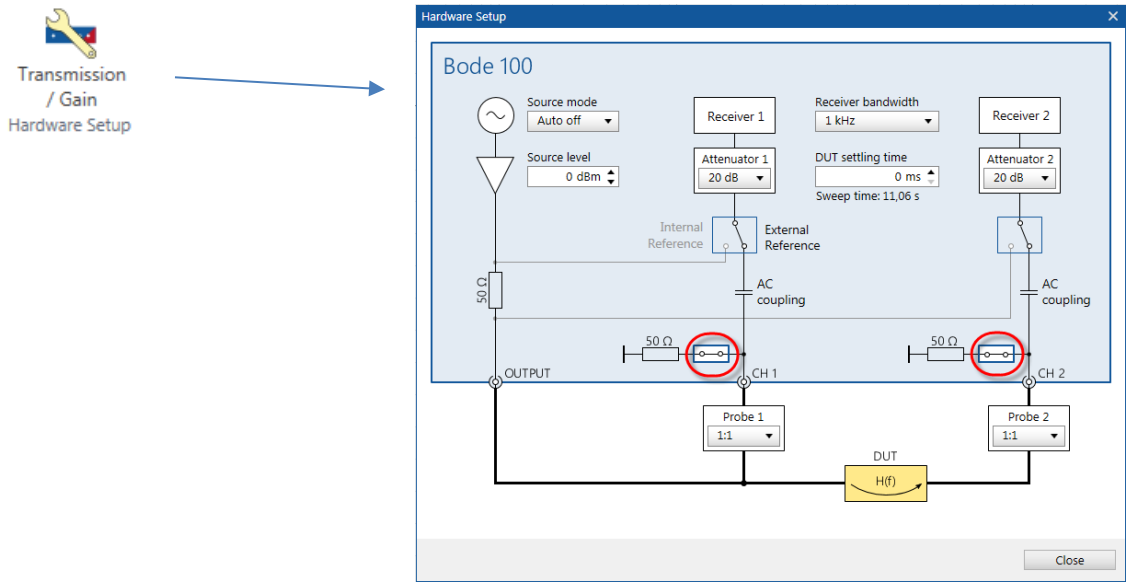

Figure 34: quick check attn. – open and change hardware setup

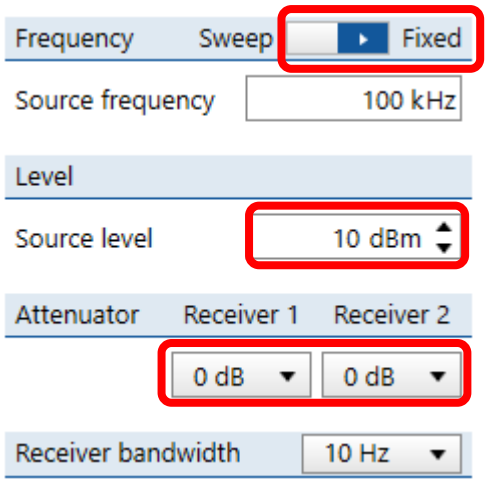

Figure 35: quick check attn. - measurement settings

Expected Measurement results:

Press the “continuous measurement” button and check if the results fit the expected results below:

Attenuator CH1	Attenuator CH2	Expected Result
0 dB	0 dB	
10 dB	10 dB	
20 dB	20 dB	
30 dB	30 dB	
40 dB	40 dB	

1.8 Check of attenuator correction

This chapter shows how to do a rough check of the attenuator correction.

Measurement setup:

Connect the Source of Bode 100 to the two inputs using the cables and the T-BNC Adapter delivered with Bode 100.

Figure 36: test attenuators - measurement setup

Equipment setup:

Please select the measurement type “Gain / Phase” and apply the following settings in the hardware setup:

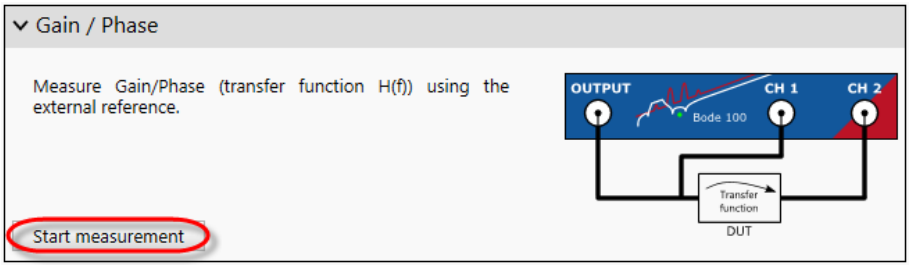

Figure 37: test attenuators - measurement type

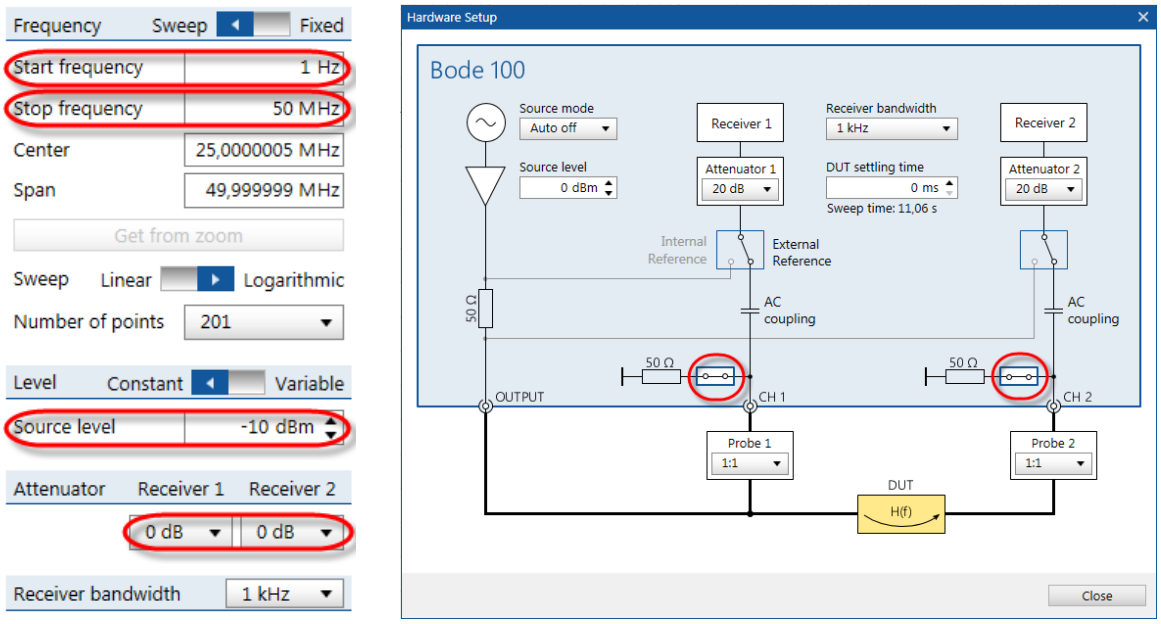

Figure 38: test attenuators – measurement settings and hardware setup

Then start a single measurement for each attenuator setting as seen below.

ATTENTION:
The Level needs to be -10 dBm to avoid an overload at the input of Bode 100.

Expected Measurement results:

Attenuator CH1	Attenuator CH2	Expected Result
0 dB	0 dB	Gain: 0dB Tolerance: max. ± 0.2 dB for 1 Hz to 50 MHz Phase: 0° Tolerance: max ± 3° for 1 Hz to 50 MHz
10 dB	10 dB	
20 dB	20 dB	
30 dB	30 dB	
40 dB	40 dB	
0 dB	10 dB	Gain: 0dB Tolerance: max. ± 0.2 dB for 1 Hz to 50 MHz Phase: 0° Tolerance: max ± 4° for 1 Hz to 50 MHz
0 dB	20 dB	
0 dB	30 dB	
0 dB	40 dB	
10 dB	0 dB	
10 dB	20 dB	
10 dB	30 dB	
10 dB	40 dB	
20 dB	0 dB	
20 dB	10 dB	
20 dB	30 dB	
20 dB	40 dB	
30 dB	0 dB	
30 dB	10 dB	
30 dB	20 dB	
30 dB	40 dB	
40 dB	0 dB	Gain: 0dB Tolerance: max. ± 0.3 dB for 1 Hz to 50 MHz Phase: 0° Tolerance: max ± 6° for 1 Hz to 50 MHz
40 dB	10 dB	
40 dB	20 dB	
40 dB	30 dB	

If you measure a higher gain/phase deviation, please send the Bode 100 in for calibration.

1.9 Quick check of AC coupling capacitors at input channels 1 & 2

Measurement Setup:

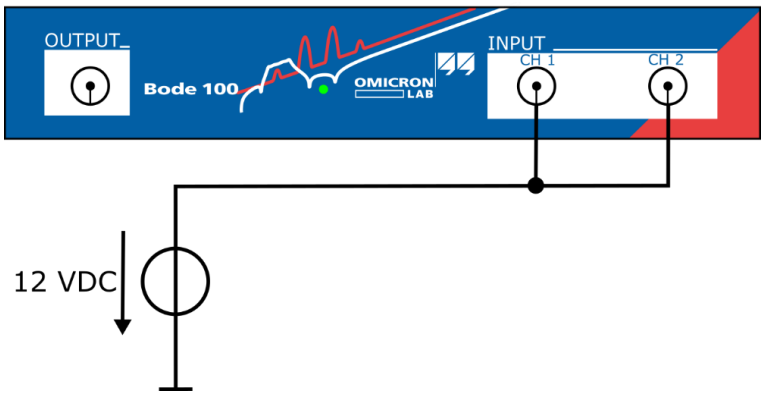

Figure 39: DC-Block - measurement setup

Attention:

Make sure that the **50 Ohm termination** of CH1 and CH2 are **switched OFF before you connect the DC voltage.** Otherwise the inputs of the Bode 100 will be destroyed!

Please use a DC Voltage Supply with low ripple and noise to avoid overload caused by the ripple on the DC voltage.

Equipment setup:

First, select the measurement type “Gain / Phase” and start a continuous measurement.

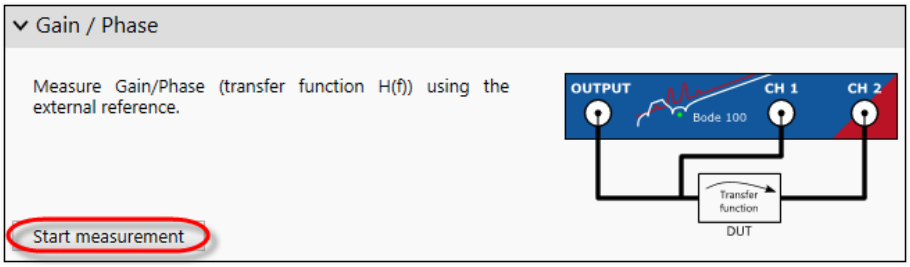

Figure 40: DC- Block – measurement type

Afterwards, connect the 12 VDC and switch it on.

Expected Measurement result:

A short overload might appear when switching on the 12 VDC (up to 2 seconds).
No continuous OVERLOAD should occur.

1.10 Check of internal connections & output impedance

In the following, the internal connections from the receivers to the 50 Ω output impedance are tested. Additionally, the output of the Bode 100 will be checked.

Measurement Setup:

OPEN:

SHORT:

LOAD (50 Ω):

Equipment Setup:

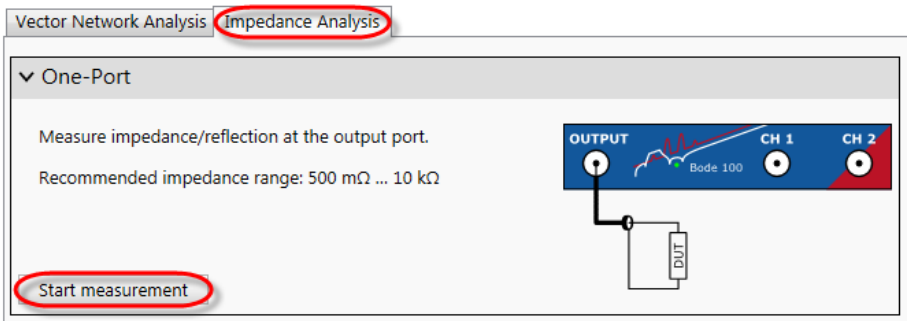

Figure 41: Internal connection check - measurement mode

Use the “One-Port” impedance measurement method and set the frequency to “Fixed” as well as follows:

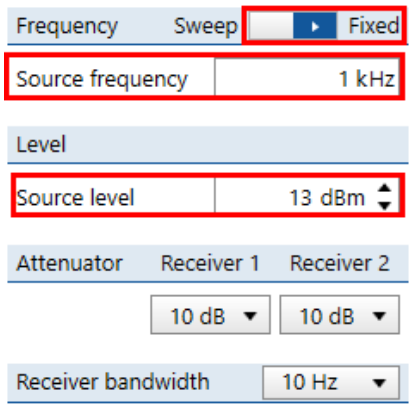

Figure 42: Internal connection check - measurement settings

After that, please start a continuous sweep.

Expected measurement results:

Receiver levels should look similar to the following when source frequency is set to 1 kHz:

OPEN	
SHORT	
LOAD (50 Ω)	

In the following, the source frequency must be changed between 1 kHz and 100 kHz.

	1 kHz	**100 kHz**
OPEN	>85 kΩ (typ. 100 kΩ)	>75 kΩ (typ. 90 kΩ)
SHORT	<20 mΩ (typ. 10 mΩ)	<50 mΩ (typ. 10 mΩ)
LOAD (50 Ω)	<51 Ω & >49 Ω (typ. 50 Ω)	<51 Ω & >49 Ω (typ. 50 Ω)

2 Calibration service

ISO9001 Factory Calibration
Calibration and adjustment of the Bode 100 is performed in our ISO 9001-2008 certified development center. If a unit is sent in for calibration, we perform a complete factory calibration including adjustment like during manufacturing. This ensures that the Bode 100 has the same accuracy as when it was manufactured.

IEC17025 Calibration
Together with an external calibration lab we offer an ISO/IEC17025 calibration as an add-on to our factory calibration.

For further information please contact our support team: support@omicron-lab.com

OMICRON Lab is a division of OMICRON electronics specialized in providing Smart Measurement Solutions to professionals such as scientists, engineers and teachers engaged in the field of electronics. It simplifies measurement tasks and provides its customers with more time to focus on their real business.

OMICRON Lab was established in 2006 and is meanwhile serving customers in more than 50 countries. Offices in America, Europe, East Asia and an international network of distributors enable a fast and extraordinary customer support.

OMICRON Lab products stand for high quality offered at the best price/value ratio on the market. The products' reliability and ease of use guarantee trouble-free operation. Close customer relationship and more than 30 years in-house experience enable the development of innovative products close to the field.

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