

Calibration Laboratory of Microwave Measuring Equipment
of MWMLab



Calibration certificate

ISO 17025
ACCREDITED LABORATORY



Accreditation certificate No. № BY/112 5.0065 of 09.01.2015

Certificate number 39-21 Date when calibrated 06.07.2021 Page 1 of 2

Item calibrated Antenna QWH-FPRR00 # 1011500008

Customer Sporton International Inc.

Method of calibration GOST 20271.1, MK KL 8.2-16

All measurements are traceable to the SI units which are realized by national measurement standards of NMI and state standards of RF. Gain measurements above 178 GHz are to confirm operation functionality and traceable only to MWMLab standards and OML. This certificate shall not be reproduced, except in full. Any publication extracts from the calibration certificate requires written permission of the issuing calibration laboratory of microwave measuring equipment.

Authorising
signature



/ Technical manager Date of issue 06.07.2021

Calibration Certificate

Certificate number **39-21**

Page 2 of 2

Calibration is performed by using

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
M 523	Reference power meter	162	24 March 2022	1/111-172-20	RF Power
M 534	Reference power meter	161	24 March 2022	1/111-173-20	RF Power
RG4-14	Signal generator	22	12 October 2021	22-20	RF Power
G4-161m	Signal generator	282	12 October 2021	23-20	RF Power
V7-34	Universal voltmeter	0067787	23 September 2021	2742-42	DC Voltage
RCH3-72	Frequency meter	931200	18 September 2021	2822-43	Frequency
P6-31A	Measuring horn antenna	35864	23 September 2021	2368-43	Gain
P6-32	Measuring horn antenna	115671	23 September 2021	2369-43	Gain

Calibration conditions

Temperature: 23.8 °C.

Humidity: 43.2 %.

Pressure: 100.1 kPa.

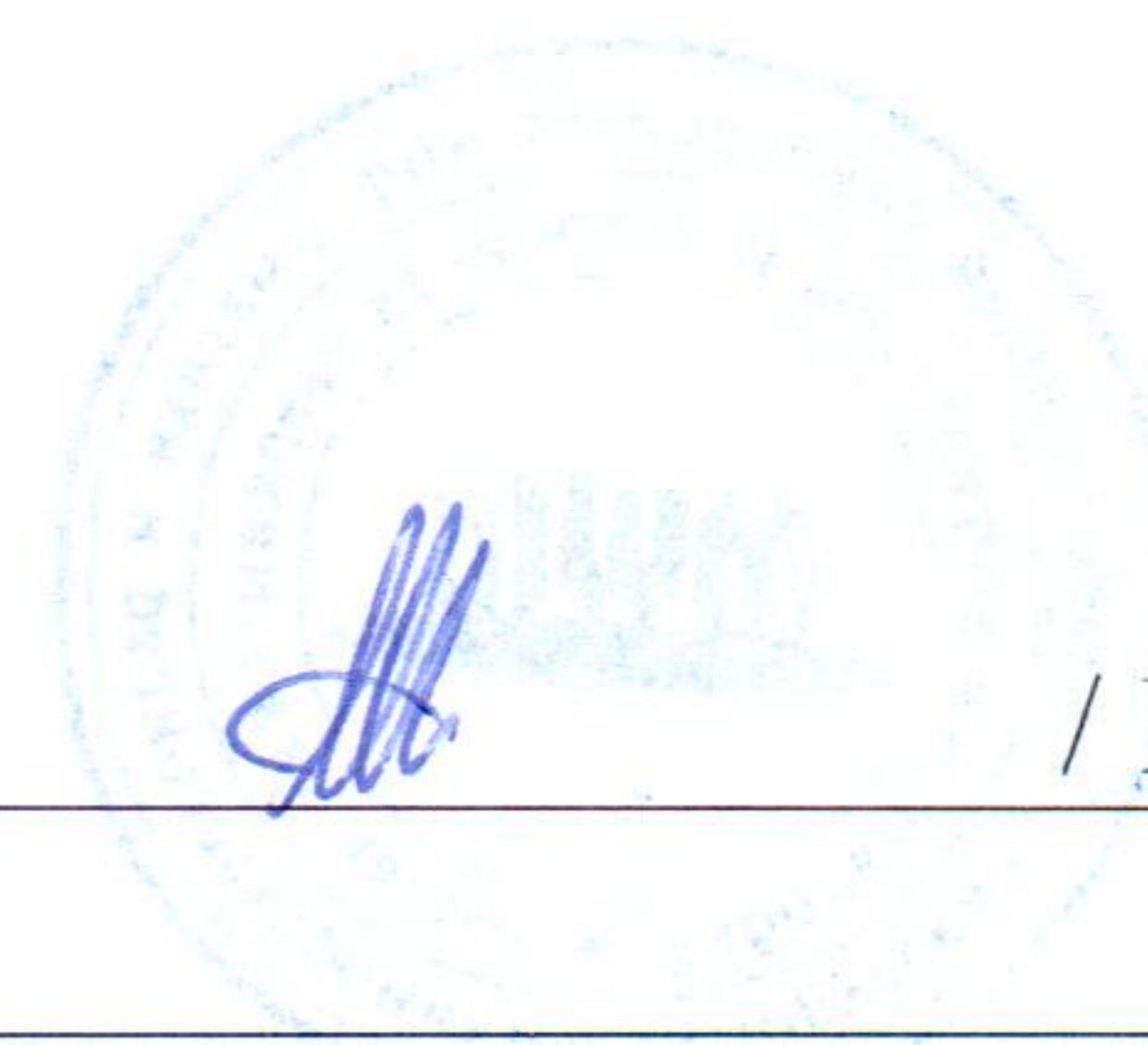
Calibration results are given in the measurement report # 39-21

#	Parameter	Specifications required	Specifications tested and measured
1	Frequency range	90 – 140 GHz	Corresponds
2	Antenna Gain	22.5* dBi	Corresponds (Table 1)
3	Antenna Factor	49.5 dB/m	Corresponds (Table 1)

* – Expanded uncertainty of measurements 2.2 dB.

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008 (GUM). The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %. This probability corresponds to a coverage factor of $k=2$ for a normal distribution.

Signature of the person who has performed calibration



/ Engineer

**Calibration Laboratory of
Microwave Measuring Equipment**

Accreditation certificate

No. BY/112 5.0065

Address: 6, P. Brovki str., Minsk
220013, Belarus

Phone/Fax: +375 17 2938496



Technical Manager

July 6, 2021

MEASUREMENT REPORT # 39-21

July 6, 2021

Customer:	Sporton International Inc.
Item calibrated:	Antenna QWH-FPRR00 # 1011500008
Method of calibration:	GOST 20271.1, MK KL 8.2-16
Number of samples:	One
Delivery date of the sample:	21.06.2021
Date of calibration:	From 21.06.2021 to 06.07.2021

MEASUREMENT CONDITIONS

Temperature: 23.8 °C	Humidity: 43.2 %	Pressure: 100.1 kPa
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MEASUREMENT EQUIPMENT

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
M 523	Reference power meter	162	24 March 2022	1/111-172-20	RF Power
M 534	Reference power meter	161	24 March 2022	1/111-173-20	RF Power
RG4-14	Signal generator	22	12 October 2021	22-20	RF Power
G4-161m	Signal generator	282	12 October 2021	23-20	RF Power
V7-34	Universal voltmeter	0067787	23 September 2021	2742-42	DC Voltage
RCH3-72	Frequency meter	931200	18 September 2021	2822-43	Frequency
P6-31A	Measuring horn antenna	35864	23 September 2021	2368-43	Gain
P6-32	Measuring horn antenna	115671	23 September 2021	2369-43	Gain

MEASUREMENT RESULTS

Distance between tested and generating antenna 1.0 m.

Table 1

Frequency, GHz	90	115	140
Power density of electromagnetic field, W/m ²	0.283	0.344	0.312
Maximum level of measured power, dBm	-14.1	-14,6	-17.1
Gain, dBi	21.9	22.7	22.4
Expanded uncertainty, dB	2.0	2.2	2.2
Antenna Factor, dB/m	47.4	48,7	50,8

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008 (GUM). The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %. This probability corresponds to a coverage factor of $k=2$ for a normal distribution.

Engineer



This measurement report issued in duplicate and sent to:

1. Sporton International Inc.
2. Calibration Laboratory of Microwave Measuring Equipment

Duplication of Measurement report (complete or partial) must be authorized by the laboratory.

Calibration Laboratory of Microwave Measuring Equipment
of MWMLab



Calibration certificate

ISO 17025
ACCREDITED LABORATORY



Accreditation certificate No. № BY/112 5.0065 of 09.01.2015

Certificate number 40-21 Date when calibrated 06.07.2021 Page 1 of 2

Item calibrated Antenna QWH-GPRR00 # QWH-GPRR00-01

Customer Sporton International Inc.

Method of calibration GOST 20271.1, MK KL 8.2-16

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Authorising
signature



/ Technical manager Date of issue 06.07.2021

Calibration Certificate

Certificate number **40-21**

Page 2 of 2

Calibration is performed by using

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
M 523	Reference power meter	162	24 March 2022	1/111-172-20	RF Power
M 514	Reference power meter	165	24 March 2022	1/111-176-20	RF Power
RG4-14	Signal generator	22	12 October 2021	22-20	RF Power
02	Frequency multiplier	02	11 January 2023	05-21	RF Power
V7-34	Universal voltmeter	0067787	23 September 2021	2742-42	DC Voltage
RCH3-72	Frequency meter	931200	18 September 2021	2822-43	Frequency
P6-32	Measuring horn antenna	115671	23 September 2021	2369-43	Gain

Calibration conditions

Temperature: 23.8 °C.

Humidity: 43.2 %.

Pressure: 100.1 kPa.

Calibration results are given in the measurement report # 40-21

#	Parameter	Specifications required	Specifications tested and measured
1	Frequency range	140 – 220 GHz	Corresponds
2	Antenna Gain	22.5* dBi	Corresponds (Table 1)
3	Antenna Factor	52.5 dB/m	Corresponds (Table 1)

* – Expanded uncertainty of measurements 2.2 dB.

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008 (GUM). The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %. This probability corresponds to a coverage factor of $k=2$ for a normal distribution.

Signature of the person who has performed calibration



/ Engineer

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220013, Belarus

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Technical Manager

July 6, 2021

MEASUREMENT REPORT # 40-21

July 6, 2021

Customer:	Sporton International Inc.
Item calibrated:	Antenna QWH-GPRR00 # QWH-GPRR00-01
Method of calibration:	GOST 20271.1, MK KL 8.2-16
Number of samples:	One
Delivery date of the sample:	21.06.2021
Date of calibration:	From 21.06.2021 to 06.07.2021

MEASUREMENT CONDITIONS

Temperature: 23.8 °C	Humidity: 43.2 %	Pressure: 100.1 kPa
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MEASUREMENT EQUIPMENT

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
M 523	Reference power meter	162	24 March 2022	1/111-172-20	RF Power
M 514	Reference power meter	165	24 March 2022	1/111-176-20	RF Power
RG4-14	Signal generator	22	12 October 2021	22-20	RF Power
02	Frequency multiplier	02	11 January 2023	05-21	RF Power
V7-34	Universal voltmeter	0067787	23 September 2021	2742-42	DC Voltage
RCH3-72	Frequency meter	931200	18 September 2021	2822-43	Frequency
P6-32	Measuring horn antenna	115671	23 September 2021	2369-43	Gain

MEASUREMENT RESULTS

Distance between tested and generating antenna 1.0 m (140 GHz) and 0.5 m (180, 220 GHz).

Table 1

Frequency, GHz	140	180	220
Power density of electromagnetic field, W/m ²	0.311	1.04	1.53
Maximum level of measured power, dBm	-17.5	-13.6	-13.6
Gain, dBi	21.9	22.7	22.9
Expanded uncertainty, dB	2.2	2.2	2.2
Antenna Factor, dB/m	51.3	52.6	54.2

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008 (GUM). The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %. This probability corresponds to a coverage factor of $k=2$ for a normal distribution.

Engineer



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