

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 38-21 Date when calibrated 06.07.2021 Page 1 of 2

Item calibrated Antenna QWH-EPRR00 # 1372000000

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.*

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/ Technical manager Date of issue 06.07.2021

# Calibration Certificate

Certificate number **38-21**

Page 2 of 2

## Calibration is performed by using

| Model   | Model Description      | Equipment ID | Cal Due Date      | Certificate Number | Trace Value |
|---------|------------------------|--------------|-------------------|--------------------|-------------|
| M 546   | Reference power meter  | 163          | 24 March 2022     | 1/111-174-20       | 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    |
| G4-186  | Signal generator       | 5            | 12 October 2021   | 21-20              | 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        |
| P6-134  | Measuring horn antenna | 14002        | 23 September 2021 | 2372-43            | Gain        |

## Calibration conditions

Temperature: 23.8 °C.

Humidity: 43.2 %.

Pressure: 100.1 kPa.

## Calibration results are given in the measurement report # 38-21

| # | Parameter       | Specifications required | Specifications tested and measured |
|---|-----------------|-------------------------|------------------------------------|
| 1 | Frequency range | 60 – 90 GHz             | Corresponds                        |
| 2 | Antenna Gain    | 22.5* dBi               | Corresponds (Table 1)              |
| 3 | Antenna Factor  | 45.5 dB/m               | Corresponds (Table 1)              |

\* – Expanded uncertainty of measurements 2.0 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 # 38-21**

July 6, 2021

|                              |                                        |
|------------------------------|----------------------------------------|
| Customer:                    | Sporton International Inc.             |
| Item calibrated:             | <b>Antenna QWH-EPRR00 # 1372000000</b> |
| 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 |
|----------------------|------------------|---------------------|

## MEASUREMENT EQUIPMENT

| Model   | Model Description      | Equipment ID | Cal Due Date      | Certificate Number | Trace Value |
|---------|------------------------|--------------|-------------------|--------------------|-------------|
| M 546   | Reference power meter  | 163          | 24 March 2022     | 1/111-174-20       | 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    |
| G4-186  | Signal generator       | 5            | 12 October 2021   | 21-20              | 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        |
| P6-134  | Measuring horn antenna | 14002        | 23 September 2021 | 2372-43            | Gain        |

## MEASUREMENT RESULTS

Distance between tested and generating antenna 1.5 m.

Table 1

| Frequency, GHz                                           | 60    | 75    | 90    |
|----------------------------------------------------------|-------|-------|-------|
| Power density of electromagnetic field, W/m <sup>2</sup> | 0.125 | 0.128 | 0.156 |
| Maximum level of measured power, dBm                     | -14.2 | -15.3 | -16.2 |
| Gain, dBi                                                | 21.8  | 22.5  | 22.4  |
| Expanded uncertainty, dB                                 | 2.0   | 2.0   | 2.0   |
| Antenna Factor, dB/m                                     | 44.0  | 45.2  | 46.9  |

*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  
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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

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/ Technical manager Date of issue 06.07.2021

# Calibration Certificate

Certificate number **39-21**

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## 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  
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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:             | <b>Antenna QWH-FPRR00 # 1011500008</b> |
| 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 |
|----------------------|------------------|---------------------|

## 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 <sup>2</sup> | 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



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

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Calibration Laboratory of Microwave Measuring Equipment  
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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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/ Technical manager Date of issue 06.07.2021

# Calibration Certificate

Certificate number **40-21**

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## 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.

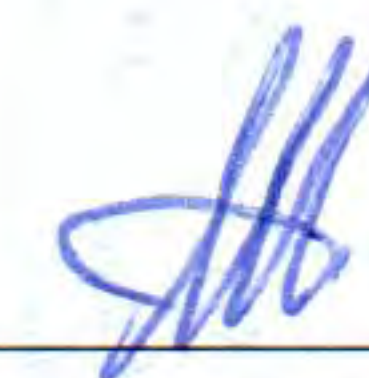
## Calibration results are given in the measurement report # 40-21

| # | 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

Phone/Fax: +375 17 2938496



Technical Manager

July 6, 2021

**MEASUREMENT REPORT # 40-21**

July 6, 2021

|                              |                                           |
|------------------------------|-------------------------------------------|
| Customer:                    | Sporton International Inc.                |
| Item calibrated:             | <b>Antenna QWH-GPRR00 # QWH-GPRR00-01</b> |
| 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 |
|----------------------|------------------|---------------------|

## 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 <sup>2</sup> | 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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Accreditation certificate No. № BY/112 5.0065 of 09.01.2015

Certificate number 36-21 Date when calibrated 06.07.2021 Page 1 of 2

Item calibrated Antenna QWH-UPRR00 # 1410300003

Customer Sporton International Inc.

Method of calibration GOST 20271.1, MK KL 8.2-16

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