Calibration Procedure
The measuring object is an RF harmonic mixer, which converts an RF signal at one frequency into a signal at another frequency (here: IF). The conversion loss was measured using a vector network analyzer. The RF output power as well as the IF input power of the corresponding ports of the VNA were traced back to a power sensor. The conversion loss is defined as the ratio of the power at the IF frequency to the power at the RF frequency with a given LO power. (IF: Intermediate frequency; LO: Local Oscillator) The traceability is represented in the table Working Standards used.

Working Standards used

Item	Type	Serial Number	Calibration Certificate Number	Cal. Due
Therm.Power Sensor DC-40GHz	NRP-Z55	130179	0001A300682928	2025-01-31
Thermal Waveguide Power Sensor	NRP90TWG	910001	20A1129129	2026-04-30
Vector Network Analyzer 4 Port	ZVA67	101100	0001A300698540	2024-05-31

Remarks

Environmental Conditions			
Ambient Temperature	(23 ± 1) °C	**Relative Humidity**	20%-70%

Comments on Measurement Results

The reported results apply only to those items specifically listed on this calibration certificate and have been tested for compliance with the specifications. The associated uncertainty of measurement has been taken into account if not otherwise stated.
The non-binary decision rule with guard band is used according to ILAC G8:09/2019 'Guidelines on Decision Rules and Statements of Conformity'. Pass is normally not marked. Conditional Pass is marked with UGB1, Conditional Fail with UGB2 and Fail with Fail.

The reported expanded 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 %. It is consistent with the EA-4/02 M:2022.

In addition to the calibration results, the calibration certificate includes functional measurements that might have an influence on the measurement uncertainty of the calibration results.
The functional measurement results are marked and are not intended to be used to support the further dissemination of metrological traceability. They are intended to verify the requirements on the measurement object according to manufacturer specifications and technical standards.

Outgoing Results

Designation:	**HARMONIC MIXER**
Type:	**FS-Z90**
Material No.:	**1048.0371.02**
Serial No.:	**101811**
Certificate No.:	**0001A300718729**
Referring to Test Documentation:	**5038.8323.01-PB-02.00**

Test Department:	**3MM-P**
Name:	**see certificate**
Date:	**2023-10-31**

The following abbreviations may be used in this document

{a}	No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
{b}	The measurement uncertainty depends on the measurement result. The stated measurement uncertainty is valid for the close area around the specification. Measurement results outside the close area have a higher measurement uncertainty but are within the specification.
{c}	Functional test, therefore no measurement uncertainty is stated.
{d}	Typical value, refer to performance test.
{e}	The measurement uncertainty is taken into account when setting the measuring system.
{g}	Verification of specified requirements, non-accredited measurements. Technical operations that consist of the determination of one or more characteristics to a specified procedure (formerly {f}).
DL or DT	Data Limit for symmetrical tolerance limits
DLL	Datasheet Lower Limit
DUL	Datasheet Upper Limit
MU	Symmetrical Measurement Uncertainty
MLL or MLV	Measurement Uncertainty Lower Value
MUL or MUV	Measurement Uncertainty Upper Value
Nom.	Nominal Value
Dev.	Deviation
Act.	Actual Value
UGB	Uncertainty Guard Band: Measuring uncertainty violates the data (spec.) limit.
UGB1	A compliance statement may be possible where a confidence level of less than 95 % is acceptable.
UGB2	A non-compliance statement may be possible where a confidence level of less than 95 % is acceptable.
DU	Datasheet Uncertainty

Explanation of charts

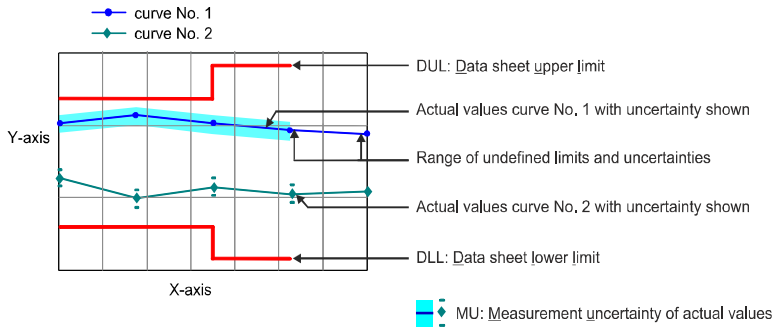


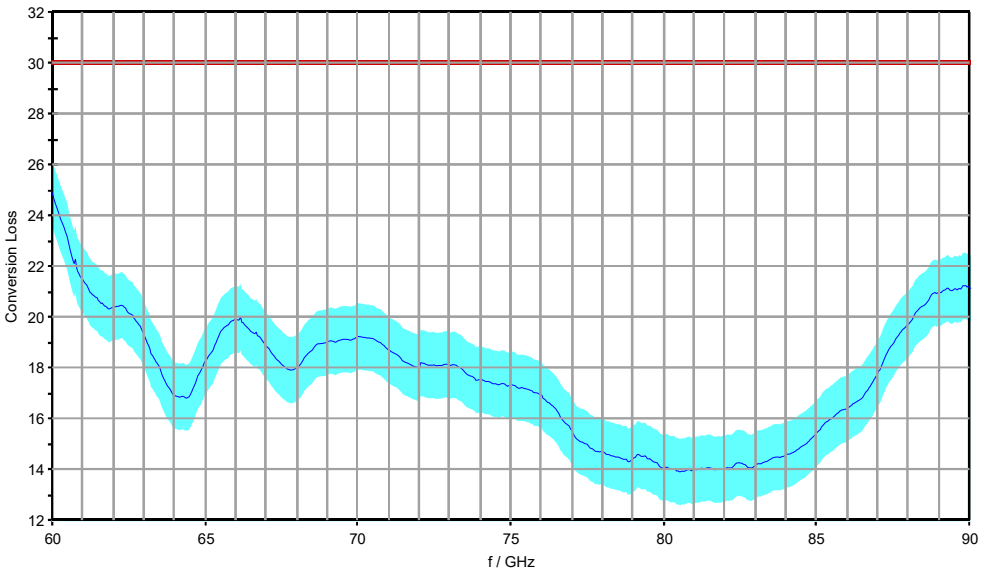
Table of contents

Software used for measurement			
Item	**Type**	**Version**	**Remark**
Suite	Setup	V12.37.04	Test Management Software G5
Test Program (7012.8706.00_)	Component	V01.05	

1. Conversion Loss (6. Harmonic)

1.1 Conversion Loss (IF = 404.4 MHz)

IF = 404.4 MHz, 6. Harmonic

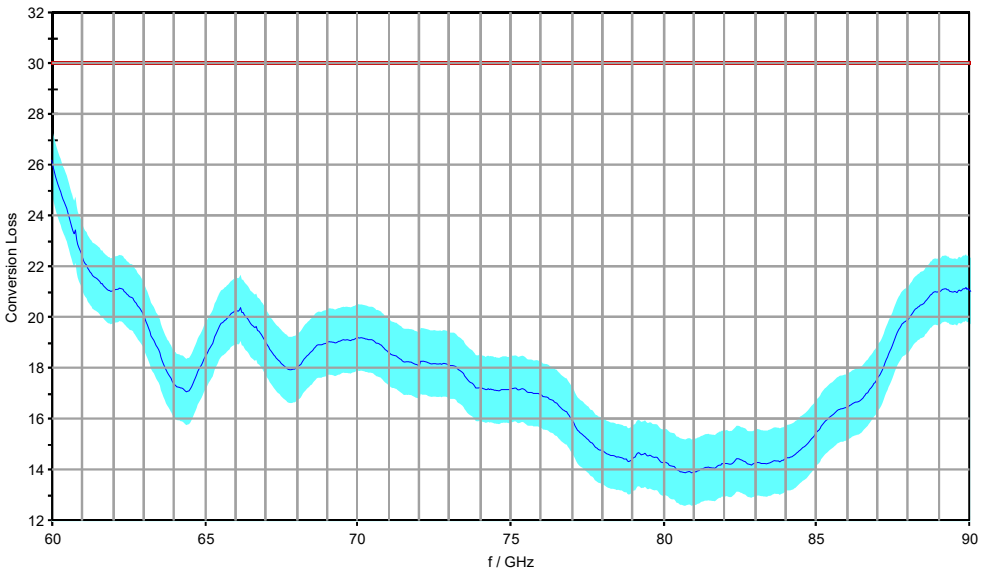


Conversion Loss (IF = 404.4 MHz)

Frequency /GHz	Conversion Loss /dB	Uncertainty /dB
60.0	24.9	±1.3
61.0	21.5	±1.3
62.0	20.4	±1.3
63.0	19.4	±1.3
64.0	16.9	±1.3
65.0	18.3	±1.3
66.0	19.9	±1.3
67.0	18.9	±1.3
68.0	18.0	±1.3
69.0	19.1	±1.3
70.0	19.3	±1.3
71.0	18.7	±1.3
72.0	18.0	±1.3
73.0	18.1	±1.3
74.0	17.6	±1.3
75.0	17.4	±1.3
76.0	16.9	±1.3
77.0	15.5	±1.3
78.0	14.7	±1.3
79.0	14.5	±1.3
80.0	14.1	±1.3
81.0	14.0	±1.3
82.0	14.1	±1.3
83.0	14.2	±1.3
84.0	14.6	±1.3
85.0	15.5	±1.3
86.0	16.5	±1.3
87.0	17.9	±1.3
88.0	19.8	±1.3
89.0	21.0	±1.3
90.0	21.1	±1.3

1.2 Conversion Loss (IF = 729 MHz)

IF = 729 MHz, 6. Harmonic

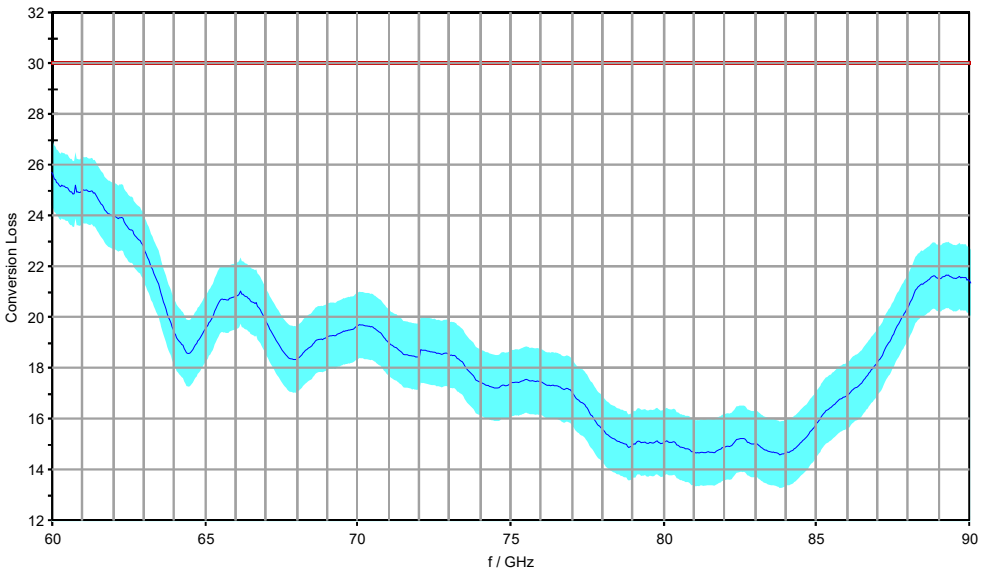


Conversion Loss (IF = 729 MHz)

Frequency /GHz	Conversion Loss /dB	Uncertainty /dB
60.0	26.2	±1.3
61.0	22.4	±1.3
62.0	21.1	±1.3
63.0	20.1	±1.3
64.0	17.4	±1.3
65.0	18.5	±1.3
66.0	20.3	±1.3
67.0	19.0	±1.3
68.0	18.0	±1.3
69.0	19.0	±1.3
70.0	19.2	±1.3
71.0	18.6	±1.3
72.0	18.1	±1.3
73.0	18.1	±1.3
74.0	17.3	±1.3
75.0	17.2	±1.3
76.0	17.0	±1.3
77.0	15.9	±1.3
78.0	14.8	±1.3
79.0	14.5	±1.3
80.0	14.3	±1.3
81.0	14.0	±1.3
82.0	14.3	±1.3
83.0	14.3	±1.3
84.0	14.5	±1.3
85.0	15.5	±1.3
86.0	16.5	±1.3
87.0	17.7	±1.3
88.0	20.0	±1.3
89.0	21.0	±1.3
90.0	21.0	±1.3

1.3 Conversion Loss (IF = 1330 MHz)

IF = 1330 MHz, 6. Harmonic



Conversion Loss (IF = 1330 MHz)

Frequency /GHz	Conversion Loss /dB	Uncertainty /dB
60.0	25.7	±1.3
61.0	25.0	±1.3
62.0	24.0	±1.3
63.0	22.8	±1.3
64.0	19.4	±1.3
65.0	19.5	±1.3
66.0	20.9	±1.3
67.0	19.8	±1.3
68.0	18.4	±1.3
69.0	19.3	±1.3
70.0	19.7	±1.3
71.0	19.0	±1.3
72.0	18.5	±1.3
73.0	18.5	±1.3
74.0	17.5	±1.3
75.0	17.5	±1.3
76.0	17.5	±1.3
77.0	17.0	±1.3
78.0	15.6	±1.3
79.0	15.1	±1.3
80.0	15.1	±1.3
81.0	14.7	±1.3
82.0	15.0	±1.3
83.0	15.1	±1.3
84.0	14.7	±1.3
85.0	15.9	±1.3
86.0	17.0	±1.3
87.0	18.3	±1.3
88.0	20.5	±1.3
89.0	21.5	±1.3
90.0	21.4	±1.3

1.4 Continuity response within 1 GHz

Continuity response within any 1 GHz Band, 6. Harmonic

	DUL /dB	Continuity /dB
max. at IF = 404.4 MHz:	6.0	3.42
max. at IF = 729 MHz:	6.0	3.82
max. at IF = 1330 MHz:	6.0	3.35

Incoming Results

Designation:	**HARMONIC MIXER**
Type:	**FS-Z90**
Material No.:	**1048.0371.02**
Serial No.:	**101811**
Certificate No.:	**0001A300718729**
Referring to Test Documentation:	**5038.8323.01-PB-02.00**

Incoming Results

Test Department:	**3MM-P**
Name:	**see certificate**
Date:	**2023-10-31**

The following abbreviations may be used in this document

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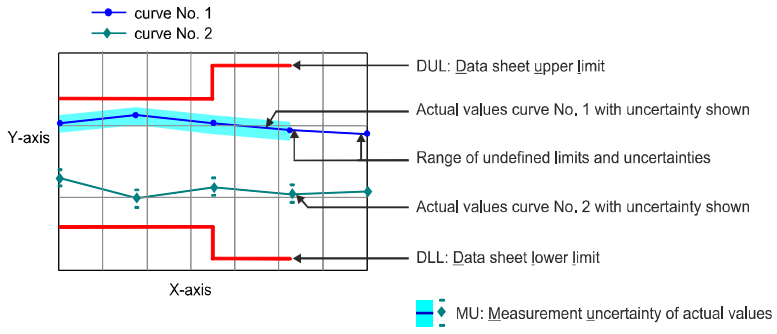
DU	Datasheet Uncertainty

Explanation of charts



Incoming Results

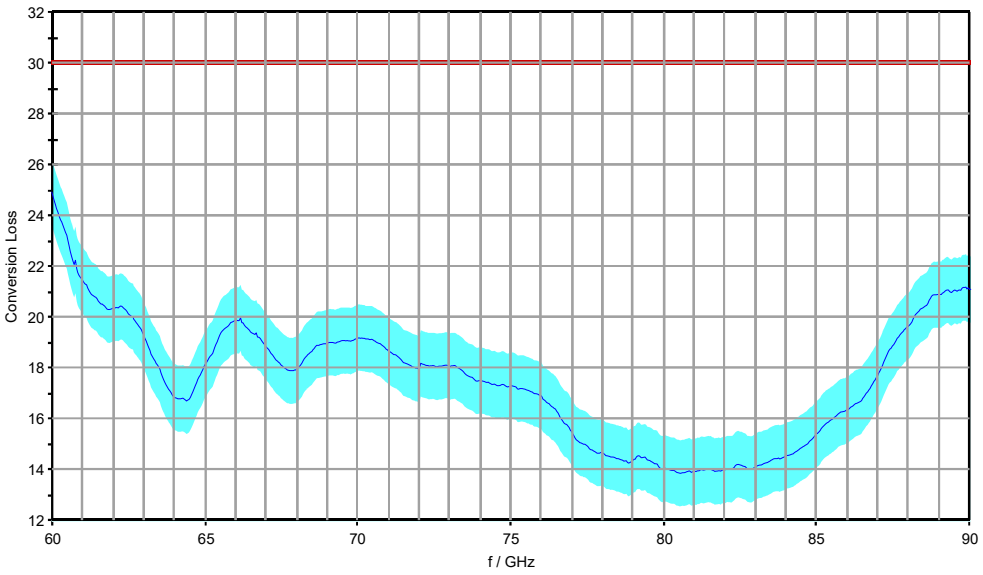
Table of contents

Software used for measurement			
Item	**Type**	**Version**	**Remark**
Suite	Setup	V12.37.04	Test Management Software G5
Test Program (7012.8706.00_)	Component	V01.05	

1. Conversion Loss (6. Harmonic)

1.1 Conversion Loss (IF = 404.4 MHz)

IF = 404.4 MHz, 6. Harmonic



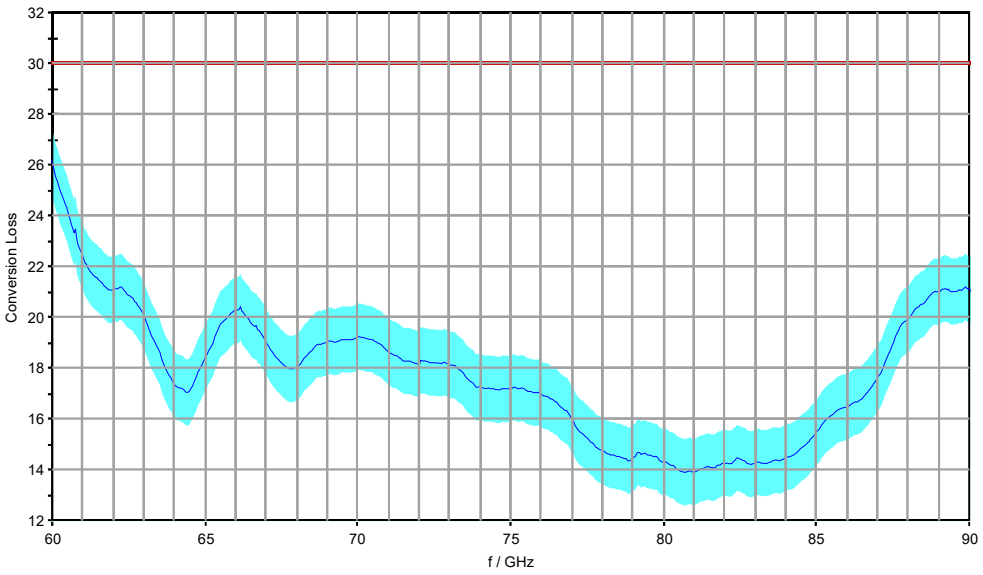
Conversion Loss (IF = 404.4 MHz)

Frequency /GHz	Conversion Loss /dB	Uncertainty /dB
60.0	24.9	±1.3
61.0	21.5	±1.3
62.0	20.4	±1.3
63.0	19.3	±1.3
64.0	16.9	±1.3
65.0	18.2	±1.3
66.0	19.9	±1.3
67.0	18.8	±1.3
68.0	18.0	±1.3
69.0	19.0	±1.3
70.0	19.2	±1.3
71.0	18.7	±1.3
72.0	18.0	±1.3
73.0	18.1	±1.3
74.0	17.5	±1.3
75.0	17.3	±1.3
76.0	16.9	±1.3
77.0	15.4	±1.3
78.0	14.7	±1.3
79.0	14.4	±1.3
80.0	14.1	±1.3
81.0	14.0	±1.3
82.0	14.0	±1.3
83.0	14.2	±1.3
84.0	14.6	±1.3
85.0	15.5	±1.3
86.0	16.4	±1.3
87.0	17.8	±1.3
88.0	19.7	±1.3
89.0	20.9	±1.3
90.0	21.1	±1.3

Incoming Results

1.2 Conversion Loss (IF = 729 MHz)

IF = 729 MHz, 6. Harmonic



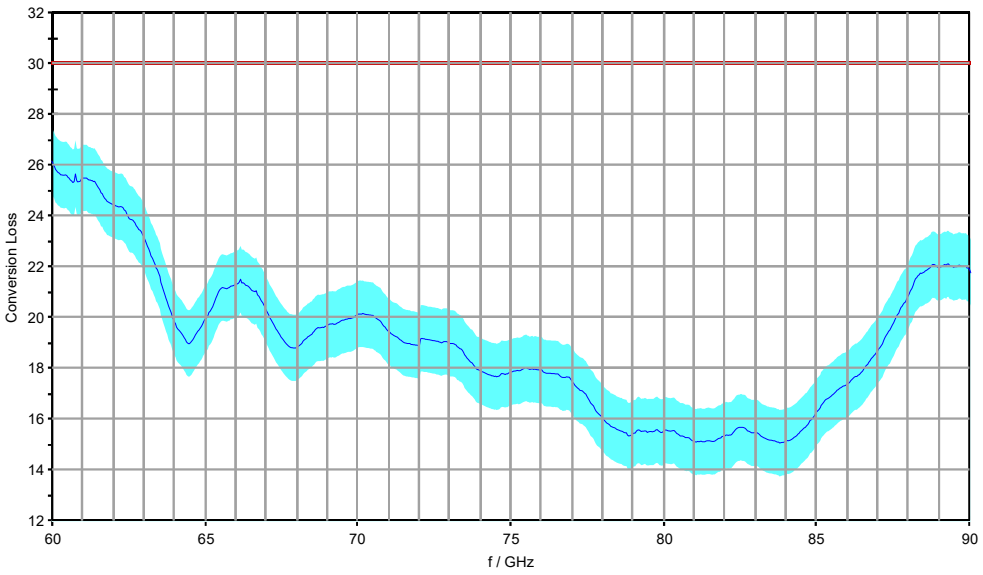
Conversion Loss (IF = 729 MHz)

Frequency /GHz	Conversion Loss /dB	Uncertainty /dB
60.0	26.2	±1.3
61.0	22.5	±1.3
62.0	21.1	±1.3
63.0	20.1	±1.3
64.0	17.4	±1.3
65.0	18.4	±1.3
66.0	20.3	±1.3
67.0	19.0	±1.3
68.0	18.1	±1.3
69.0	19.1	±1.3
70.0	19.3	±1.3
71.0	18.7	±1.3
72.0	18.2	±1.3
73.0	18.2	±1.3
74.0	17.3	±1.3
75.0	17.3	±1.3
76.0	17.0	±1.3
77.0	16.0	±1.3
78.0	14.8	±1.3
79.0	14.5	±1.3
80.0	14.4	±1.3
81.0	14.0	±1.3
82.0	14.3	±1.3
83.0	14.3	±1.3
84.0	14.5	±1.3
85.0	15.6	±1.3
86.0	16.5	±1.3
87.0	17.7	±1.3
88.0	20.0	±1.3
89.0	21.0	±1.3
90.0	21.1	±1.3

Incoming Results

1.3 Conversion Loss (IF = 1330 MHz)

IF = 1330 MHz, 6. Harmonic



Conversion Loss (IF = 1330 MHz)

Frequency /GHz	Conversion Loss /dB	Uncertainty /dB
60.0	26.2	±1.3
61.0	25.5	±1.3
62.0	24.5	±1.3
63.0	23.2	±1.3
64.0	19.9	±1.3
65.0	19.9	±1.3
66.0	21.3	±1.3
67.0	20.3	±1.3
68.0	18.8	±1.3
69.0	19.7	±1.3
70.0	20.1	±1.3
71.0	19.5	±1.3
72.0	18.9	±1.3
73.0	19.0	±1.3
74.0	17.9	±1.3
75.0	17.9	±1.3
76.0	18.0	±1.3
77.0	17.5	±1.3
78.0	16.0	±1.3
79.0	15.5	±1.3
80.0	15.6	±1.3
81.0	15.1	±1.3
82.0	15.4	±1.3
83.0	15.5	±1.3
84.0	15.2	±1.3
85.0	16.3	±1.3
86.0	17.4	±1.3
87.0	18.8	±1.3
88.0	20.9	±1.3
89.0	22.0	±1.3
90.0	21.8	±1.3

1.4 Continuity response within 1 GHz

Continuity response within any 1 GHz Band, 6. Harmonic

	DUL /dB	Continuity /dB
max. at IF = 404.4 MHz:	6.0	3.46
max. at IF = 729 MHz:	6.0	3.75
max. at IF = 1330 MHz:	6.0	3.34

Incoming Results

Radiometer Physics
A Rohde & Schwarz Company

Calibration Certificate
Kalibrierschein

Certificate Number 24-0140-101128-03
Zertifikatsnummer

Unit Data

Item / Gegenstand: **Harmonic Mixer, 90 GHz to 140 GHz**

Manufacturer / Hersteller: **RPG Radiometer physics GmbH**

Type / Typ: **RPG FS-Z140**

Material Number / Materialnummer: **3622.0708.02**

Serial Number / Seriennummer: **101128**

Asset Number / Inventarnummer:

Order Data

Customer / Auftraggeber:
Sporton International Inc.
6F., Sec. 1, Hsin Tai Wu Rd 106
Xizhi Dist.
221 New Taipei City
Taiwan

Order Number / Bestellnummer: **8800047909**

Date of Receipt / Eingangsdatum: **2023-10-27**

Performance

Place and Date of Calibration / Ort und Datum der Kalibrierung: **Meckenheim, 2023-11-03**

Scope of Calibration / Umfang der Kalibrierung: **Standard Calibration**

Statement of Compliance (Incoming) / Konformitätsaussage (Anlieferung): **All measured values are within the data sheet specifications.**

Statement of Compliance (Outgoing) / Konformitätsaussage (Auslieferung): **All measured values are within the data sheet specifications.**

Extend of Calibration Documents / Umfang des Kalibrierdokuments:
2 pages Calibration Certificate
4 pages Outgoing Results
3 pages Incoming Results

This calibration certificate documents, that the named item is tested and measured against defined specifications. Measurement results are located usually in the corresponding interval with a probability of approx. 95% (coverage factor k = 2). Calibration is performed with test equipment and standards directly or indirectly traceable by means of approved calibration techniques to the PTB/DKD or other national/international standards, which realize the physical units of measurement according to the International System of Units (SI). In all cases where no standards are available, measurements are referenced to standards of the R&S laboratories. Principles and methods of calibration correspond with EN ISO/IEC 17025. This calibration certificate may not be reproduced other than in full. Calibration certificates without signatures are not valid. The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein dokumentiert, dass der genannte Gegenstand nach festgelegten Vorgaben geprüft und gemessen wurde. Die Messwerte lagen im Regelfall mit einer Wahrscheinlichkeit von annähernd 95% im zugeordneten Werteintervall (Erweiterte Messunsicherheit mit k = 2). Die Kalibrierung erfolgte mit Messmitteln und Normalen, die direkt oder indirekt durch Ableitung mittels anerkannter Kalibriertechniken rückgeführt sind auf Normale der PTB/DKD oder anderer nationaler/internationaler Standards zur Darstellung der physikalischen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI). Wenn keine Normale existieren, erfolgt die Rückführung auf Bezugsnormale der R&S-Laboratorien. Grundsätze und Verfahren der Kalibrierung beziehen sich auf EN ISO/IEC 17025. Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Kalibrierscheine ohne Unterschriften sind ungültig. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

RPG Radiometer physics GmbH; Meckenheim

Date of Issue / Ausstellungsdatum: **2023-11-06**

Head of Laboratory / Laborleitung: Emons

Person Responsible / Bearbeiter: Gottbehüt

RPG Radiometer physics GmbH • Werner-von-Siemens-Str. 4 • 53340 Meckenheim • Telephone national: 02225/99981-0 international: 0049 2225-99981-0
Fax: 02225/99981-99 • Managing Director: Achim Walber • Company's Place of Business: Meckenheim
Commercial Register No.: Bonn, HRB 10291 • VAT Identification No.: DE 123 377 395

Calibration Method
Kalibrieranweisung
RPG-PAQA-TN-2014-002

Relative Humidity 20 % - 80 %
Relative Luftfeuchte

Ambient Temperature
Umgebungstemperatur
$(23\ ^{+7}_{-3})$ °C

Working standards used (having a significant effect on the accuracy)
Verwendete Gebrauchsnormale (mit signifikantem Einfluss auf die Genauigkeit)

Item Gegenstand	Type Typ	Serial Number Seriennummer	Calibration Certificate Number Kalibrierscheinnummer	Cal. Due Kalibr. bis
Vector Network Analyzer	R&S® ZVA40	100103	0001A300715526	2026-10-04
Powersensor	R&S® NRP-Z55	140093	0001-300700427	2025-06-06

UGB1 **A compliance statement may be possible where a confidence level of less than 95 % is acceptable.**
Die Bestätigung der Konformität ist möglich, sofern ein Grad des Vertrauens von weniger als 95 % akzeptabel ist.

UGB2 **A non-compliance statement may be possible where a confidence level of less than 95 % is acceptable.**
Die Bestätigung der Nicht-Konformität ist möglich, sofern ein Grad des Vertrauens von weniger als 95 % akzeptabel ist.

Ref.: ILAC-G8:03/2009 'Guidelines on the Reporting of Compliance with Specification'.

Notes
Anmerkungen

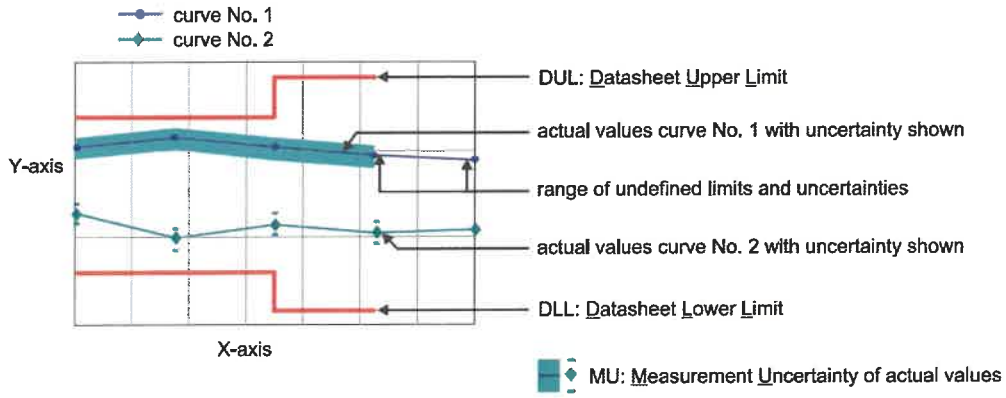
If the new product is stored under the climate conditions as specified in the data sheet upon delivery, the product's accuracy is not significantly affected within 12 month after its calibration in our factory. In this case, the recommended calibration interval starts on the date when the product is actually put into operation.

Outgoing Results

The following abbreviations may be used in this document

{a}	No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
{b}	The measurement uncertainty depends on the measurement result. The stated measurement uncertainty is valid for the close area around the specification. Measurement results outside the close area have a higher measurement uncertainty but are within the specification.
{c}	Functional test, therefore no measurement uncertainty is stated.
{d}	Typical value, refer to performance test.
{e}	The measurement uncertainty is taken into account when setting the measuring system.
DL or DT	Data Limit for symmetrical tolerance limits
DLL	Datasheet Lower Limit
DUL	Datasheet Upper Limit
MU	Measurement Uncertainty
MLL or MLV	Measurement Uncertainty Lower Value
MUL or MUV	Measurement Uncertainty Upper Value
Nom.	Nominal Value
Dev.	Deviation
MErr.	Measurement Error
Act.	Actual Value
UGB	Uncertainty Guard Band: Measuring uncertainty violates the data (spec.) limit.
UGB1	Measurement results marked as UGB1 show conformity with a probability of >50 %and <95 %.
UGB2	Measurement results marked as UGB2 show non-conformity with a probability of >50 %and <95 %.
DU	Datasheet Uncertainty

Explanation of charts



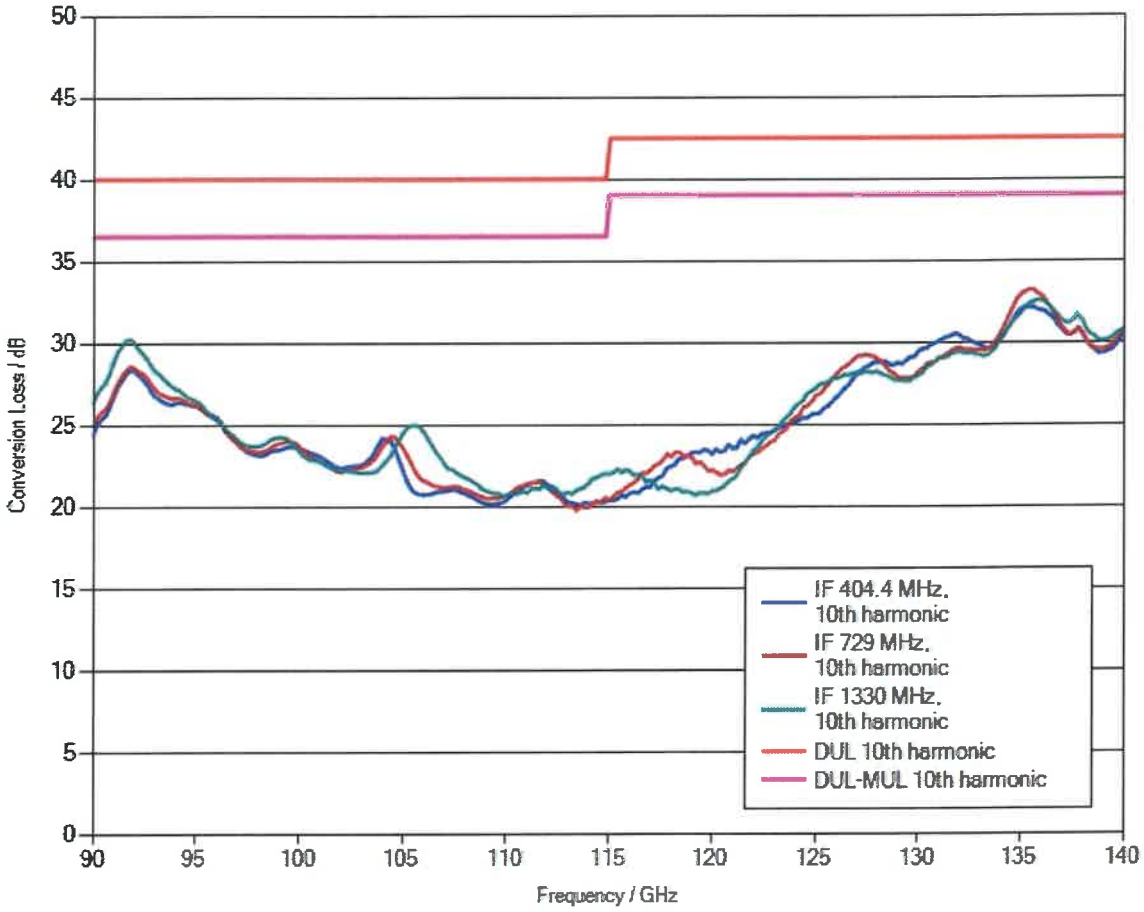
Software used for measurement

Item Type	Version	Remark
Measurement Studio Professional Edition	2013	
MixerCertification	7_15	

1.1 Conversion loss

LO level +14 dBm nominal
Bias 0 A

Measurement uncertainty: 3.5 dB



Note: Numeric calibration data can be found attached to the PDF file of the calibration certificate. Click the "paper clip" symbol to display the file.

The file has been renamed for safety reasons.
When downloading the file onto your PC, please delete the ".file" extension and unzip the data.

1.2 Frequency response within 1 GHz

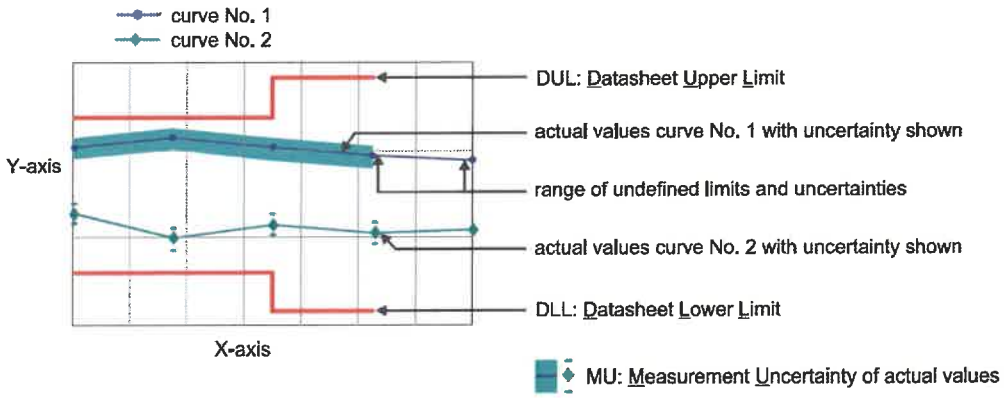
	DUL	Actual (worst case)	Evaluation
IF = 404.4 MHz, 10th harmonic	6 dB	2.49 dB	PASS
IF = 729 MHz, 10th harmonic	6 dB	2.09 dB	PASS
IF = 1330 MHz, 10th harmonic	6 dB	2.24 dB	PASS

1 Incoming Results

The following abbreviations may be used in this document

{a}	No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
{b}	The measurement uncertainty depends on the measurement result. The stated measurement uncertainty is valid for the close area around the specification. Measurement results outside the close area have a higher measurement uncertainty but are within the specification.
{c}	Functional test, therefore no measurement uncertainty is stated.
{d}	Typical value, refer to performance test.
{e}	The measurement uncertainty is taken into account when setting the measuring system.
DL or DT	Data Limit for symmetrical tolerance limits
DLL	Datasheet Lower Limit
DUL	Datasheet Upper Limit
MU	Measurement Uncertainty
MLL or MLV	Measurement Uncertainty Lower Value
MUL or MUV	Measurement Uncertainty Upper Value
Nom.	Nominal Value
Dev.	Deviation
MErr.	Measurement Error
Act.	Actual Value
UGB	Uncertainty Guard Band: Measuring uncertainty violates the data (spec.) limit.
UGB1	Measurement results marked as UGB1 show conformity with a probability of >50 %and <95 %.
UGB2	Measurement results marked as UGB2 show non-conformity with a probability of >50 %and <95 %.
DU	Datasheet Uncertainty

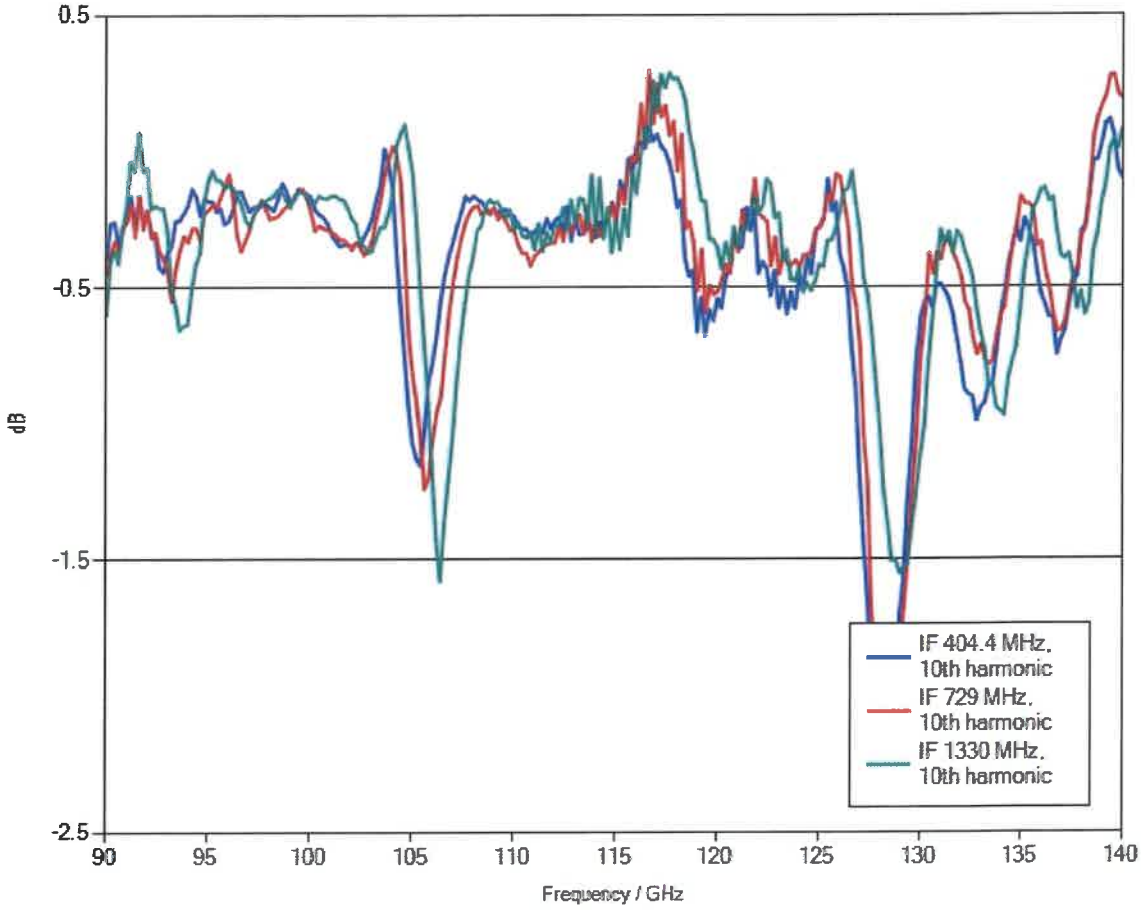
Explanation of charts



Software used for measurement

Item Type	Version	Remark
Measurement Studio Professional Edition	2013	
MixerCertification	7_15	

1.1 Deviation between actual and previous conversion loss



Radiometer Physics
A Rohde & Schwarz Company

Calibration Certificate
Kalibrierschein

Certificate Number 24-0220-101014-03
Zertifikatsnummer

Unit Data

Item Gegenstand	**Harmonic Mixer, 140 GHz to 220 GHz**
Manufacturer Hersteller	**RPG Radiometer physics GmbH**
Type Typ	**RPG FS-Z220**
Material Number Materialnummer	**3593.3250.02**
Serial Number Seriennummer	**101014**
Asset Number Inventarnummer	

Order Data

Customer Auftraggeber	**Sporton International Inc.** **6F., Sec. 1, Hsin Tai Wu Rd 106** **Xizhi Dist.** **221 New Taipei City** **Taiwan**
Order Number Bestellnummer	**8800047911**
Date of Receipt Eingangsdatum	**2023-10-27**

Performance

Place and Date of Calibration Ort und Datum der Kalibrierung	**Meckenheim, 2023-11-06**
Scope of Calibration Umfang der Kalibrierung	**Standard Calibration**
Statement of Compliance (Incoming) Konformitätsaussage (Anlieferung)	**All measured values are within the data sheet specifications.**
Statement of Compliance (Outgoing) Konformitätsaussage (Auslieferung)	**All measured values are within the data sheet specifications.**
Extend of Calibration Documents Umfang des Kalibrierdokuments	**2 pages Calibration Certificate** **4 pages Outgoing Results** **3 pages Incoming Results**

This calibration certificate documents, that the named item is tested and measured against defined specifications. Measurement results are located usually in the corresponding interval with a probability of approx. 95% (coverage factor k = 2). Calibration is performed with test equipment and standards directly or indirectly traceable by means of approved calibration techniques to the PTB/DKD or other national/international standards, which realize the physical units of measurement according to the International System of Units (SI). In all cases where no standards are available, measurements are referenced to standards of the R&S laboratories. Principles and methods of calibration correspond with EN ISO/IEC 17025. This calibration certificate may not be reproduced other than in full. Calibration certificates without signatures are not valid. The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein dokumentiert, dass der genannte Gegenstand nach festgelegten Vorgaben geprüft und gemessen wurde. Die Messwerte lagen im Regelfall mit einer Wahrscheinlichkeit von annähernd 95% im zugeordneten Werteintervall (Erweiterte Messunsicherheit mit k = 2). Die Kalibrierung erfolgte mit Messmitteln und Normalen, die direkt oder indirekt durch Ableitung mittels anerkannter Kalibriertechniken rückgeführt sind auf Normale der PTB/DKD oder anderer nationaler/internationaler Standards zur Darstellung der physikalischen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI). Wenn keine Normale existieren, erfolgt die Rückführung auf Bezugsnormale der R&S-Laboratorien. Grundsätze und Verfahren der Kalibrierung beziehen sich auf EN ISO/IEC 17025. Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Kalibrierscheine ohne Unterschriften sind ungültig. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

RPG Radiometer physics GmbH; Meckenheim

Date of Issue Ausstellungsdatum	**Head of Laboratory** Laborleitung	**Person Responsible** Bearbeiter
2023-11-06	Emons	Gottbehüt

RPG Radiometer physics GmbH • Werner-von-Siemens-Str. 4 • 53340 Meckenheim • Telephone national: 02225/99981-0 international: 0049 2225-99981-0
Fax: 02225/99981-99 • Managing Director: Achim Walber • Company's Place of Business: Meckenheim
Commercial Register No.: Bonn, HRB 10291 • VAT Identification No.: DE 123 377 395

Calibration Method
Kalibrieranweisung

RPG-PAQA-TN-2014-002

Relative Humidity 20 % - 80 %
Relative Luftfeuchte

Ambient Temperature
Umgebungstemperatur

$(23\ ^{+7}_{-3})$ °C

Working standards used (having a significant effect on the accuracy)
Verwendete Gebrauchsnormale (mit signifikantem Einfluss auf die Genauigkeit)

Item Gegenstand	**Type** Typ	**Serial Number** Seriennummer	**Calibration Certificate Number** Kalibrierscheinnummer	**Cal. Due** Kalibr. bis
Vector Network Analyzer	R&S® ZVA40	100103	0001A300715526	2026-10-04
Powersensor	R&S® NRP-Z55	140093	0001-300700427	2025-06-06

UGB1 **A compliance statement may be possible where a confidence level of less than 95 % is acceptable.**
Die Bestätigung der Konformität ist möglich, sofern ein Grad des Vertrauens von weniger als 95 % akzeptabel ist.

UGB2 **A non-compliance statement may be possible where a confidence level of less than 95 % is acceptable.**
Die Bestätigung der Nicht-Konformität ist möglich, sofern ein Grad des Vertrauens von weniger als 95 % akzeptabel ist.

Ref.: ILAC-G8:03/2009 'Guidelines on the Reporting of Compliance with Specification'.

Notes
Anmerkungen

If the new product is stored under the climate conditions as specified in the data sheet upon delivery, the product's accuracy is not significantly affected within 12 month after its calibration in our factory. In this case, the recommended calibration interval starts on the date when the product is actually put into operation.

Outgoing Results

The following abbreviations may be used in this document

{a}	No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
{b}	The measurement uncertainty depends on the measurement result. The stated measurement uncertainty is valid for the close area around the specification. Measurement results outside the close area have a higher measurement uncertainty but are within the specification.
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MErr.	Measurement Error
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UGB1	Measurement results marked as UGB1 show conformity with a probability of >50 %and <95 %.
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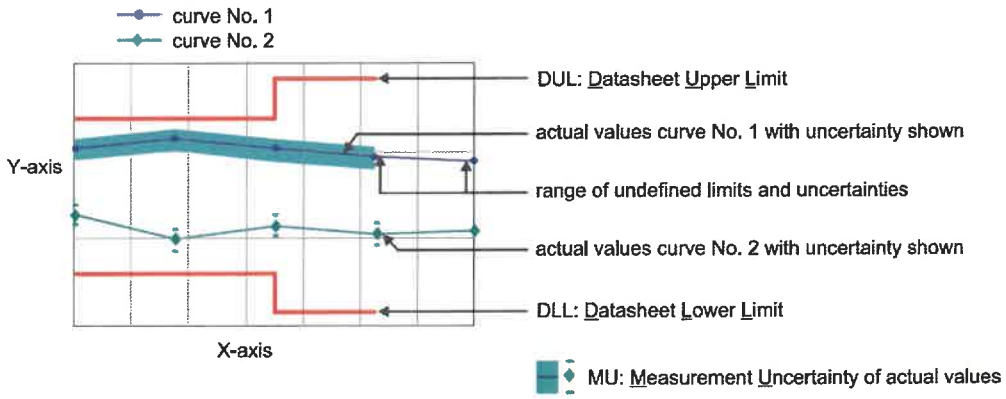
DU	Datasheet Uncertainty

Explanation of charts



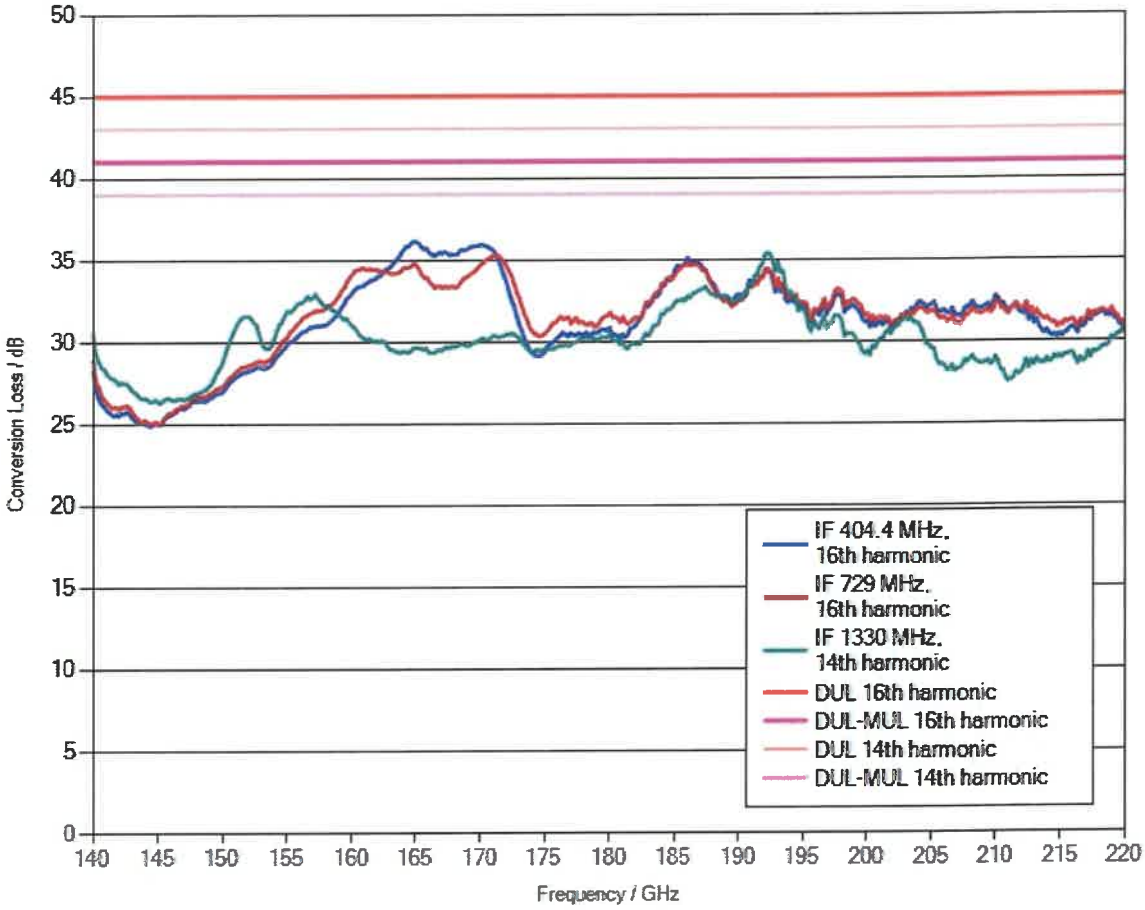
Software used for measurement

Item Type	Version	Remark
Measurement Studio Professional Edition	2013	
MixerCertification	7_15	

1.1 Conversion loss

LO level +13 dBm nominal
Bias 0 A

Measurement uncertainty: 4 dB



Note: Numeric calibration data can be found attached to the PDF file of the calibration certificate. Click the "paper clip" symbol to display the file.

The file has been renamed for safety reasons.
When downloading the file onto your PC, please delete the ".file" extension and unzip the data.

1.2 Frequency response within 1 GHz

	DUL	Actual (worst case)	Evaluation
IF = 404.4 MHz, 16th harmonic	6 dB	2.61 dB	PASS
IF = 729 MHz, 16th harmonic	6 dB	2.54 dB	PASS
IF = 1330 MHz, 14th harmonic	6 dB	2.39 dB	PASS

1 Incoming Results

The following abbreviations may be used in this document

{a}	No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
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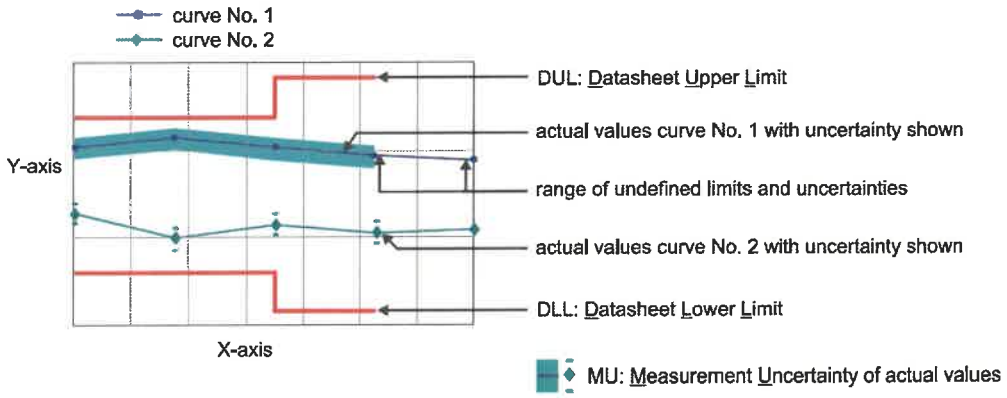
UGB2	Measurement results marked as UGB2 show non-conformity with a probability of >50 %and <95 %.
DU	Datasheet Uncertainty

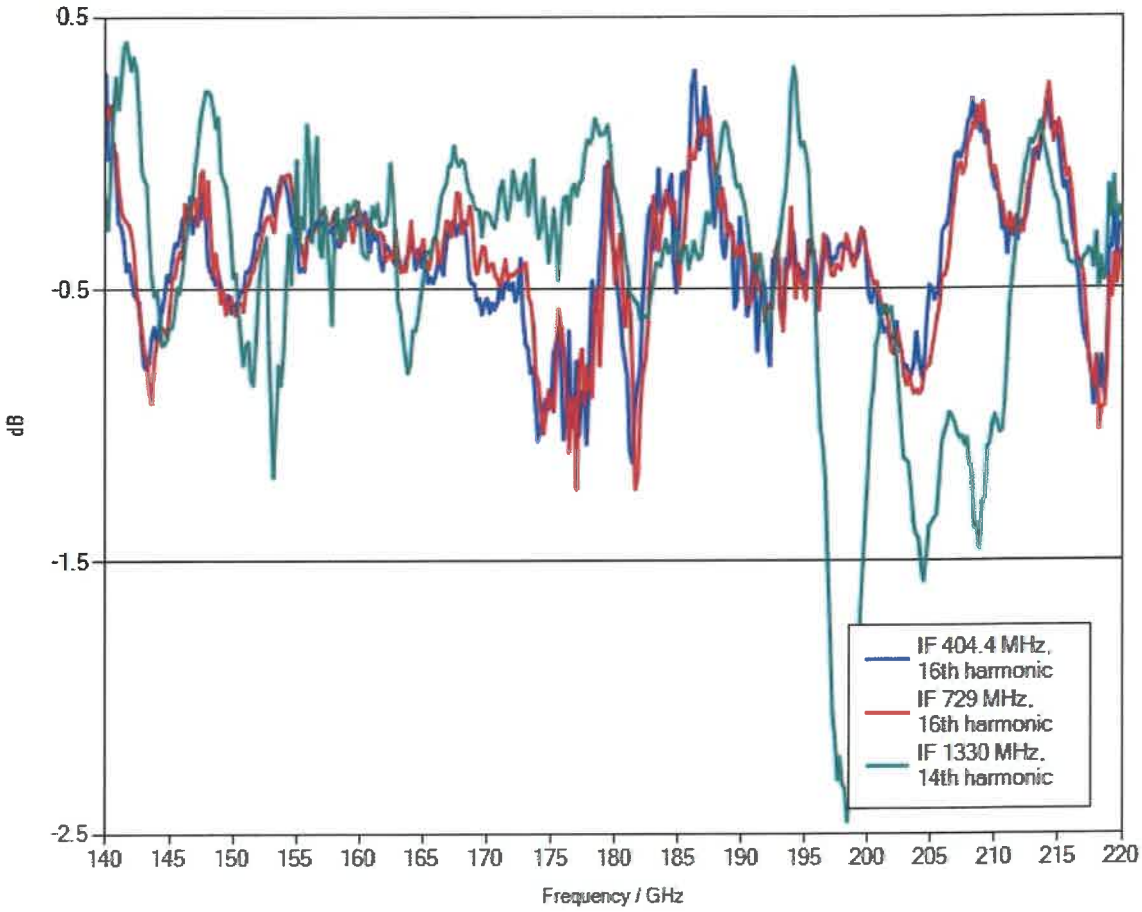
Explanation of charts



Software used for measurement

Item Type	Version	Remark
Measurement Studio Professional Edition	2013	
MixerCertification	7_15	

1.1 Deviation between actual and previous conversion loss



Calibration Laboratory of Microwave Measuring Equipment of MWMLab

ISO 17025
ACCREDITED LABORATORY

Calibration certificate

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

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**

MWM Lab. BSUIR, 6, P.Brovki str., Minsk, 220013, Belarus *Phone/Fax: +375 17 293-84-96/E-mail: info@mwmlab.com*

Calibration Certificate

Certificate number **36-21**

Calibration is performed by using

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
M1-11	Calibrator of power with wattmeter M3-22A	841202/ 037410	08 December 2021	3882-43	RF Power
M 568	Reference power meter	164	24 March 2022	1/111-175-20	RF Power
G4-161	Signal generator	3	12 October 2021	20-20	RF Power
MG3694C	Signal generator	133805	11 September 2021	2726-43	RF Power Frequency
V7-34	Universal voltmeter	0067787	23 September 2021	2742-42	DC Voltage
RCH3-72	Frequency meter	931200	18 September 2021	2822-43	Frequency
P6-133	Horn antenna	15005	23 September 2021	2374-43	Gain
P6-11B	Measuring horn antenna	08051	23 September 2021	2370-43	Gain

Calibration conditions

Temperature: 23.8 ºC.
Humidity: 43.2 %.
Pressure: 100.1 kPa.

Calibration results are given in the measurement report # 36-21

#	Parameter	Specifications required	Specifications tested and measured
1	Frequency range	40 – 60 GHz	Corresponds
2	Antenna Gain	22.5* dBi	Corresponds (Table 1)
3	Antenna Factor	42 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

MWM Lab. BSUIR, 6, P.Brovki str., Minsk, 220013, Belarus *Phone/Fax: +375 17 293-84-96/E-mail: info@mwmlab.com*

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 # 36-21

July 6, 2021

Customer:	Sporton International Inc.
Item calibrated:	**Antenna QWH-UPRR00 # 1410300003**
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
M1-11	Calibrator of power with wattmeter M3-22A	841202/ 037410	08 December 2021	3882-43	RF Power
M 568	Reference power meter	164	24 March 2022	1/111-175-20	RF Power
G4-161	Signal generator	3	12 October 2021	20-20	RF Power
MG3694C	Signal generator	133805	11 September 2021	2726-43	RF Power Frequency
V7-34	Universal voltmeter	0067787	23 September 2021	2742-42	DC Voltage
RCH3-72	Frequency meter	931200	18 September 2021	2822-43	Frequency
P6-133	Horn antenna	15005	23 September 2021	2374-43	Gain
P6-11B	Measuring horn antenna	08051	23 September 2021	2370-43	Gain

MEASUREMENT RESULTS

Distance between tested and generating antenna 2.0 m.

Table 1

Frequency, GHz	40	50	60
Power density of electromagnetic field, W/m^2	0.050	0.070	0.070
Maximum level of measured power, dBm	-14.3	-14.2	-15.8
Gain, dBi	22.3	22.8	22.8
Expanded uncertainty, dB	2.0	2.0	2.0
Antenna Factor, dB/m	40.0	41.5	43.0

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

ISO 17025
ACCREDITED LABORATORY

ИСО 9001

Calibration certificate

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.

Authorising signature / Technical manager **Date of issue** **06.07.2021**

MWM Lab. BSUIR, 6, P.Brovki str., Minsk, 220013, Belarus *Phone/Fax: +375 17 293-84-96/E-mail: info@mwmlab.com*

Calibration Certificate

Certificate number **38-21**

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 ºC.
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

MWM Lab. BSUIR, 6, P.Brovki str., Minsk, 220013, Belarus *Phone/Fax: +375 17 293-84-96/E-mail: info@mwmlab.com*

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:	**Antenna QWH-EPRR00 # 1372000000**
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