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 **01-20** **Date when calibrated** **20.01.20** **Page** 1 **of** 2

Item calibrated Conical Horn Antenna WR15CH_001

Customer Bureau Veritas Group Consumer Products Services Division, Taiwan Branch E-2, No.1, Lixing 1st Rd., East Dist., Hsinchu City 300, Taiwan, R.O.C.

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. Conversion loss 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** **20.01.20**

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

Calibration Certificate

Certificate number **01-20**

Calibration is performed by using

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
M3-75	Power meter	002189	12 March 2021	06-19	RF Power
G4-186	Signal generator	5	10 July 2020	23-19	RF Power Frequency
G4-161	Signal generator	3	10 July 2020	22-19	RF Power Frequency
RCH3-72	Frequency meter	931200	13 September 2020	2261-43	Frequency
P6-134	Measuring horn antenna	14002	23 September 2021	2372-43	Gain

Calibration conditions

Temperature: 21.8 °C.
Humidity: 37.0 %.
Pressure: 100.0 kPa.

Calibration results are given in the measurement report # 01-20

#	Parameter	Specifications required	Specifications tested and measured
1	Frequency range	50 – 75 GHz	Corresponds
2	Antenna Gain	21* dBi	Corresponds (Table 1)
3	Antenna Factor	46 dB/m	Corresponds (Table 1)

* – Expanded uncertainty of measurements 2.8 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

January 20, 2020

MEASUREMENT REPORT # 01-20

January 20, 2020

Customer:	Bureau Veritas Group Consumer Products Services Division, Taiwan Branch E-2, No.1, Lixing 1st Rd., East Dist., Hsinchu City 300, Taiwan, R.O.C.
Item calibrated:	Conical Horn Antenna WR15CH_001
Method of calibration:	GOST 20271.1, MK KL 8.2-16
Number of samples:	One
Delivery date of the sample:	29.11.2019
Date of calibration:	From 09.12.2019 to 20.01.2020

MEASUREMENT CONDITIONS

Temperature: 21.8 °C	Humidity: 37 %	Pressure: 100.0 kPa

MEASUREMENT EQUIPMENT

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
M3-75	Power meter	002189	12 March 2021	06-19	RF Power
G4-186	Signal generator	5	10 July 2020	23-19	RF Power Frequency
G4-161	Signal generator	3	10 July 2020	22-19	RF Power Frequency
RCH3-72	Frequency meter	931200	13 September 2020	2261-43	Frequency
P6-134	Measuring horn antenna	14002	23 September 2021	2372-43	Gain

MEASUREMENT RESULTS

Distance between tested and generating antenna 1 m.

Table 1

Frequency, GHz	50	55	65	75
Power density of electromagnetic field, W/m^2	0.15	0.18	0.23	0.26
Maximum level of measured power, dBm	-15.0	-14.7	-14.2	-14.2
Gain, dBi	18.7	19.0	20.0	20.5
Expanded uncertainty, dB	2.8	2.8	2.8	2.8
Antenna Factor, dB/m	45.6	46.1	46.5	47.2

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

Quality Manager

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 **02-20** **Date when calibrated** **20.01.20** **Page** 1 **of** 2

Item calibrated Conical Horn Antenna WR10CH_001

Customer Bureau Veritas Group Consumer Products Services Division, Taiwan Branch E-2, No.1, Lixing 1st Rd., East Dist., Hsinchu City 300, Taiwan, R.O.C.

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. Conversion loss measurements above 178 GHz are to confirm operation functionality and traceable only to MWMLab standards and OML.

Authorising signature / Technical manager **Date of issue** **20.01.20**

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 **02-20** Page 2 of 2

Calibration is performed by using

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
M3-75	Power meter	002189	12 March 2021	06-19	RF Power
G4-186	Signal generator	5	10 July 2020	23-19	RF Power Frequency
RG4-14	Signal generator	22	10 July 2020	24-19	RF Power Frequency
RCH3-72	Frequency meter	931200	13 September 2020	2261-43	Frequency
P6-31A	Measuring horn antenna	35864	23 September 2021	2368-43	Gain

Calibration conditions

Temperature: 21.8 °C.
Humidity: 37.0 %.
Pressure: 100.0 kPa.

Calibration results are given in the measurement report # 02-20

#	Parameter	Specifications required	Specifications tested and measured
1	Frequency range	75 – 110 GHz	Corresponds
2	Antenna Gain	21* dBi	Corresponds (Table 1)
3	Antenna Factor	49 dB/m	Corresponds (Table 1)

* – Expanded uncertainty of measurements 2.8 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

January 20, 2020

MEASUREMENT REPORT # 02-20

January 20, 2020

Customer:	Bureau Veritas Group Consumer Products Services Division, Taiwan Branch E-2, No.1, Lixing 1st Rd., East Dist., Hsinchu City 300, Taiwan, R.O.C.
Item calibrated:	Conical Horn Antenna WR10CH_001
Method of calibration:	GOST 20271.1, MK KL 8.2-16
Number of samples:	One
Delivery date of the sample:	29.11.2019
Date of calibration:	From 09.12.2019 to 20.01.2020

MEASUREMENT CONDITIONS

Temperature: 21.8 °C	Humidity: 37 %	Pressure: 100.0 kPa

MEASUREMENT EQUIPMENT

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
M3-75	Power meter	002189	12 March 2021	06-19	RF Power
G4-186	Signal generator	5	10 July 2020	23-19	RF Power Frequency
RG4-14	Signal generator	22	10 July 2020	24-19	RF Power Frequency
RCH3-72	Frequency meter	931200	13 September 2020	2261-43	Frequency
P6-31A	Measuring horn antenna	35864	23 September 2021	2368-43	Gain

MEASUREMENT RESULTS

Distance between tested and generating antenna 0.8 m.

Table 1

Frequency, GHz	75	92.5	110
Power density of electromagnetic field, W/m^2	0.20	0.29	0.37
Maximum level of measured power, dBm	-16.2	-15.5	-15.1
Gain, dBi	19.9	20.6	21.5
Expanded uncertainty, dB	2.8	2.8	2.8
Antenna Factor, dB/m	47.9	49.0	49.6

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 _____

Quality Manager _____

This Measurement report issued in duplicate and sent to:
1. Bureau Veritas Group Consumer Products Services Division, Taiwan Branch E-2, No.1, Lixing 1st Rd., East Dist., Hsinchu City 300, Taiwan, R.O.C.
2. Calibration Laboratory of Microwave Measuring Equipment

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 **04-20** **Date when calibrated** **20.01.20** **Page** 1 **of** 2

Item calibrated Conical Horn Antenna QWH-UCRR00 # 924200002

Customer Bureau Veritas Group Consumer Products Services Division, Taiwan Branch E-2, No.1, Lixing 1st Rd., East Dist., Hsinchu City 300, Taiwan, R.O.C.

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. Conversion loss 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** **20.01.20**

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

Calibration Certificate

Certificate number **04-20** Page 2 of 2

Calibration is performed by using

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
E4418B/ N8486AR	Power meter	US39251390/ MY52270003	19 November 2020	2978-43	RF Power
M3-75	Power meter	002189	12 March 2021	06-19	RF Power
MG3694C	Signal generator	133805	21 August 2020	2066-43	RF Power Frequency
G4-161	Signal generator	3	10 July 2020	22-19	RF Power Frequency
RCH3-72	Frequency meter	931200	13 September 2020	2261-43	Frequency
P6-11B	Measuring horn antenna	08051	23 September 2021	2370-43	Gain
P6-133	Measuring horn antenna	15005	23 September 2021	2374-43	Gain

Calibration conditions

Temperature: 21.8 °C.
Humidity: 37.0 %.
Pressure: 100.0 kPa.

Calibration results are given in the measurement report # 04-20

#	Parameter	Specifications required	Specifications tested and measured
1	Frequency range	33 – 55 GHz	Corresponds
2	Antenna Gain	21* dBi	Corresponds (Table 1)
3	Antenna Factor	43 dB/m	Corresponds (Table 1)

* – Expanded uncertainty of measurements 2.5 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

January 20, 2020

MEASUREMENT REPORT # 04-20

January 20, 2020

Customer:	Bureau Veritas Group Consumer Products Services Division, Taiwan Branch E-2, No.1, Lixing 1st Rd., East Dist., Hsinchu City 300, Taiwan, R.O.C.
Item calibrated:	Conical Horn Antenna QWH-UCRR00 # 924200002
Method of calibration:	GOST 20271.1, MK KL 8.2-16
Number of samples:	One
Delivery date of the sample:	29.11.2019
Date of calibration:	From 09.12.2019 to 20.01.2020

MEASUREMENT CONDITIONS

Temperature: 21.8 °C	Humidity: 37 %	Pressure: 100.0 kPa

MEASUREMENT EQUIPMENT

Model	Model Description	Equipment ID	Cal Due Date	Certificate Number	Trace Value
E4418B/ N8486AR	Power meter	US39251390/ MY52270003	19 November 2020	2978-43	RF Power
M3-75	Power meter	002189	12 March 2021	06-19	RF Power
MG3694C	Signal generator	133805	21 August 2020	2066-43	RF Power Frequency
G4-161	Signal generator	3	10 July 2020	22-19	RF Power Frequency
RCH3-72	Frequency meter	931200	13 September 2020	2261-43	Frequency
P6-11B	Measuring horn antenna	08051	23 September 2021	2370-43	Gain
P6-133	Measuring horn antenna	15005	23 September 2021	2374-43	Gain

MEASUREMENT RESULTS

Distance between tested and generating antenna 2 m.

Table 1

Frequency, GHz	33	44	55
Power density of electromagnetic field, W/m^2	0.022	0.057	0.049
Maximum level of measured power, dBm	-20.0	-16.4	-17.2
Gain, dBi	18.4	20.3	21.3
Expanded uncertainty, dB	2.5	2.5	2.5
Antenna Factor, dB/m	42.2	42.8	42.9

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 _____

Quality Manager _____

Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902
Phone: 434-297-3257
Fax: 434-297-3258

Certificate of Conformance

To: Keysight Technologies, Inc.
1424 FOUNTAINGROVE PARKWAY
DOCK 4LS
Santa Rosa, CA 95403-1799
United States

From: Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902

Packing List No: 142094
Shipping Date: 10/17/14
Today's Date: 10/20/14
PO Number: 9000686880

Attn: Erik Diez
Phone: 1-707-577-4607
FedEx Priority Overnight: 771547491617 / 771547491514

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR10.0SGX WR10.0SGX - Frequency Extender; SN: VDI SGX 004.	14278A-01
1	EA	VDIWR10.0SAX WR10.0SAX - Frequency Extender; SN: VDI SAX 013.	14278A-02
1	EA	VDI10.0SWG2-30 WR10SWG - Waveguide Straight with Attenuation.	14278A-03

The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

Authorized Signature
Virginia Diodes, Inc

Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902
Phone: 434-297-3257
Fax: 434-297-3258

Certificate of Conformance

To: Keysight Technologies, Inc.
1424 FOUNTAINGROVE PARKWAY
DOCK 4LS
Santa Rosa, CA 95403-1799
United States

From: Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902

Packing List No: 142094
Shipping Date: 10/17/14
Today's Date: 10/20/14
PO Number: 9000686880

Attn: Erik Diez
Phone: 1-707-577-4607
FedEx Priority Overnight: 771547491617 / 771547491514

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR10.0SGX WR10.0SGX - Frequency Extender; SN: VDI SGX 004.	14278A-01
1	EA	VDIWR10.0SAX WR10.0SAX - Frequency Extender; SN: VDI SAX 013.	14278A-02
1	EA	VDI10.0SWG2-30 WR10SWG - Waveguide Straight with Attenuation.	14278A-03

The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

Authorized Signature
Virginia Diodes, Inc

Virginia Diodes, Inc

Certificate of Conformance

To: Agilent Technogies
1424 Fountaingrove Parkway
Dock 4LS
Santa Rosa, CA 95403
United States

From: Virginia Diodes, Inc

Packing List No: 141195
Shipping Date: 06/19/14
Today's Date: 06/19/14
PO Number: 9000666533

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR15.0SGX WR15.0SGX - Frequency Extender; SN: VDI SGX 007.	14097B-01

The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

Authorized Signature
Virginia Diodes, Inc

Virginia Diodes, Inc

Certificate of Conformance

To: Agilent Technogies
1424 Fountaingrove Parkway
Dock 4LS
Santa Rosa, CA 95403
United States

From: Virginia Diodes, Inc

Packing List No: 141195
Shipping Date: 06/19/14
Today's Date: 06/19/14
PO Number: 9000666533

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR15.0SAX WR15.0SAX - Frequency Extender; SN: VDI SAX 012.	14097B-02

The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

Authorized Signature
Virginia Diodes, Inc