

Name of Accreditation Program	JCSS Accreditation Program
Accreditation Identification	JCSS 0048 Calibration
Name of Conformity Assessment Body	Measurement Standards Center, Keysight Technologies Japan K.K.
Name of Legal Entity	Keysight Technologies Japan K.K. JCN 3010403011350
Inquiry Point	Measurement Standards Center TEL: +81-42-660-8444 FAX: +81-42-660- 8683

*JCN: Japan Corporate Number



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Certificate of Accreditation

International Accreditation Japan (IAJapan) hereby accredits the following conformity assessment body as a calibration laboratory of Japan Calibration Service System.

Accreditation Identification: JCSS 0048 Calibration

Name of Conformity Assessment Body: Measurement Standards Center,
Keysight Technologies Japan K.K.

Name of Legal Entity: Keysight Technologies Japan K.K.

Location of Conformity Assessment Body: 9-1 Takakura-cho, Hachioji-shi, Tokyo 192-8550, JAPAN

Scope of Accreditation: Time & Frequency & Rotational speed,
Electricity (Direct Current & Low Frequency),
Electricity (High Frequency) & Electromagnetic Fields
(as the following pages)

Accreditation Requirement: ISO/IEC 17025:2017*

* The relevant accreditation requirements described in the Accreditation Scheme Document for JCSS are also applied.

Effective Date of Accreditation: 2023-01-28

Expiry Date of Accreditation: 2027-01-27

Date of Initial Accreditation: 1995-06-21

SAITO Kazunori

Chief Executive, International Accreditation Japan (IAJapan)

National Institute of Technology and Evaluation

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- International Accreditation Japan (IAJapan) is a laboratory accreditation body which has signed MRAs of ILAC (International Laboratory Accreditation Cooperation) and APAC (Asia Pacific Accreditation Cooperation).
 - MRA requirements are, in addition to relevant international standards and guides, requirements for participation in proficiency testing programs, surveillance and reassessment, and the policy for the traceability of measurement for MRA purpose.
 - This laboratory fulfills ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation means this laboratory meets both the technical competence requirements and management system requirements that are necessary for it to consistently deliver technically valid test results and calibrations (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).
 - The latest accreditation information is publicly available on IAJapan Website as an accreditation certificate.

General Field of Calibration: Time & Frequency & Rotational speed

Date of Initial Accreditation of the Field: 2005-04-20

Laboratory's permanent facility/On-site Calibration: Laboratory's permanent facility

Calibration and Measurement Capabilities

Calibration Procedures# and Type of Instruments/Materials to be calibrated	Range	Expanded Uncertainty (Level of Confidence Approximately 95 %)
Time & Frequency Counter, etc.	Frequency Standards	1 MHz, 5 MHz, 10 MHz
	Frequency Generator	1 MHz, 5 MHz, 10 MHz
	Frequency Counter	1 MHz, 5 MHz, 10 MHz

#All Calibration Procedures are in-house procedures developed by this laboratory.

*The values in the CMC column exclude sources of uncertainty attributed to a unit under test.

General Field of Calibration: Electricity (Direct Current & Low Frequency)

Date of Initial Accreditation of the Field: 1995-06-21

Laboratory's permanent facility/On-site Calibration: Laboratory's permanent facility

Calibration and Measurement Capabilities

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range	Expanded Uncertainty (Level of Confidence Approximately 95 %)
Direct Current & Low Frequency Measuring Equipment, etc.	DC Resistor	From 1 m Ω less than 10 m Ω	8.5 $\mu\Omega/\Omega$
		From 10 m Ω less than 100 m Ω	3.6 $\mu\Omega/\Omega$
		From 100 m Ω less than 1 Ω	0.97 $\mu\Omega/\Omega$
		1 Ω	0.78 $\mu\Omega/\Omega$
		More than 1 Ω less than 10 Ω	1.1 $\mu\Omega/\Omega$
		10 Ω	0.69 $\mu\Omega/\Omega$
		More than 10 Ω less than 100 Ω	0.92 $\mu\Omega/\Omega$
		100 Ω	0.62 $\mu\Omega/\Omega$
		More than 100 Ω less than 1 k Ω	0.88 $\mu\Omega/\Omega$
		1 k Ω	0.57 $\mu\Omega/\Omega$
		More than 1 k Ω less than 10 k Ω	0.75 $\mu\Omega/\Omega$
		10 k Ω	0.67 $\mu\Omega/\Omega$
		More than 10 k Ω up to 100 k Ω	1.3 $\mu\Omega/\Omega$
		More than 100 k Ω up to 1 M Ω	2.3 $\mu\Omega/\Omega$
		More than 1 M Ω up to 10 M Ω	7.8 $\mu\Omega/\Omega$
		More than 10 M Ω up to 100 M Ω	21 $\mu\Omega/\Omega$
		More than 100 M Ω up to 1 G Ω	37 $\mu\Omega/\Omega$
		More than 1 G Ω up to 10 G Ω	51 $\mu\Omega/\Omega$
More than 10 G Ω up to 100 G Ω	0.013 %		

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Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range	Expanded Uncertainty (Level of Confidence Approximately 95 %)	
Direct Current & Low Frequency Measuring Equipment, etc.	DC Resistance Measuring Equipment	From 1 m Ω less than 10 m Ω	0.011 %	
		From 10 m Ω less than 100 m Ω	12 $\mu\Omega/\Omega$	
		From 100 m Ω less than 1 Ω	4.9 $\mu\Omega/\Omega$	
		From 1 Ω less than 10 Ω	2.5 $\mu\Omega/\Omega$	
		From 10 Ω up to 100 Ω	1.6 $\mu\Omega/\Omega$	
		More than 100 Ω up to 1 k Ω	0.82 $\mu\Omega/\Omega$	
		More than 1 k Ω up to 10 k Ω	0.84 $\mu\Omega/\Omega$	
		More than 10 k Ω up to 100 k Ω	1.7 $\mu\Omega/\Omega$	
		More than 100 k Ω up to 1 M Ω	3.3 $\mu\Omega/\Omega$	
		More than 1 M Ω up to 10 M Ω	8.5 $\mu\Omega/\Omega$	
		More than 10 M Ω up to 100 M Ω	31 $\mu\Omega/\Omega$	
		More than 100 M Ω up to 1 G Ω	55 $\mu\Omega/\Omega$	
		More than 1 G Ω up to 10 G Ω	0.012 %	
		More than 10 G Ω up to 100 G Ω	0.021 %	
	DC Voltage Source	From 100 mV less than 1 V	2.5 $\mu\text{V}/\text{V}$	
		From 1 V less than 10 V	1.3 $\mu\text{V}/\text{V}$	
		10 V	0.30 $\mu\text{V}/\text{V}$	
		100 V	0.73 $\mu\text{V}/\text{V}$	
		More than 10 V up to 1000 V (except 100 V)	1.5 $\mu\text{V}/\text{V}$	
	DC Voltage Measuring Equipment	From 1 mV less than 10 mV	3.2 $\mu\text{V}/\text{V}$	
		From 10 mV less than 100 mV	3.0 $\mu\text{V}/\text{V}$	
		From 100 mV less than 1 V	2.5 $\mu\text{V}/\text{V}$	
		From 1 V less than 10 V	1.6 $\mu\text{V}/\text{V}$	
		10 V	0.67 $\mu\text{V}/\text{V}$	
		More than 10 V less than 100 V	2.0 $\mu\text{V}/\text{V}$	
		100 V	1.6 $\mu\text{V}/\text{V}$	
		More than 100 V less than 1000 V	3.6 $\mu\text{V}/\text{V}$	
	DC Voltage Resistive Divider	3000 V	1000:1	0.0058 %
		1500 V	1000:1	0.0058 %
		10 kV	10000:1	0.079 %
		5 kV	10000:1	0.079 %

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Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range	Expanded Uncertainty (Level of Confidence Approximately 95 %)
Direct Current & Low Frequency Measuring Equipment, etc.	Direct Current Source	From 100 pA up to 200 pA	$\sqrt{(0.0327)^2 + (4.62 \times 10^{-11}/I)^2} \%$
		More than 200 pA up to 2 nA	$\sqrt{(0.00929)^2 + (2.89 \times 10^{-10}/I)^2} \%$
		More than 2 nA up to 20 nA	$\sqrt{(0.00841)^2 + (3.57 \times 10^{-10}/I)^2} \%$
		More than 20 nA up to 200 nA	$\sqrt{(0.00787)^2 + (1.83 \times 10^{-9}/I)^2} \%$
		More than 200 nA up to 2 μ A	$\sqrt{(0.00668)^2 + (6.45 \times 10^{-9}/I)^2} \%$
		More than 2 μ A up to 20 μ A	$\sqrt{(0.00668)^2 + (4.08 \times 10^{-8}/I)^2} \%$
		More than 20 μ A less than 100 μ A	$\sqrt{(0.00157)^2 + (4.08 \times 10^{-7}/I)^2} \%$
		From 100 μ A up to 10 mA	3.5 μ A/A
		More than 10 mA up to 100 mA	5.6 μ A/A
	More than 100 mA up to 1 A	9.1 μ A/A	
	Direct Current Measuring Equipment	From 1 pA up to 20 pA	$\sqrt{(0.0312)^2 + (1.15 \times 10^{-13}/I)^2} \%$
		More than 20 pA up to 200 pA	$\sqrt{(0.0312)^2 + (1.15 \times 10^{-12}/I)^2} \%$
		More than 200 pA up to 2 nA	$\sqrt{(0.00660)^2 + (1.15 \times 10^{-11}/I)^2} \%$
		More than 2 nA up to 20 nA	$\sqrt{(0.00529)^2 + (8.66 \times 10^{-11}/I)^2} \%$
		More than 20 nA less than 100 nA	$\sqrt{(0.00438)^2 + (5.77 \times 10^{-10}/I)^2} \%$
		From 100 nA less than 1 μ A	12 μ A/A
		From 1 μ A less than 10 μ A	11 μ A/A
		From 10 μ A less than 100 μ A	7.0 μ A/A
		From 100 μ A up to 10 mA	3.5 μ A/A
More than 10 mA up to 100 mA		5.6 μ A/A	
More than 100 mA up to 1 A	9.1 μ A/A		

#All Calibration Procedures are in-house procedures developed by this laboratory.

[Note] I: Input Current under calibration [A]

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)
Direct Current & Low Frequency Measuring Equipment, etc.	AC Voltage Source	1 kHz	From 1 V less than 10 V	24 μ V/V
		10 V	From 20 Hz less than 1 kHz	27 μ V/V
			From 1 kHz up to 20 kHz	24 μ V/V
			More than 20 kHz up to 100 kHz	25 μ V/V
			1 MHz	0.064 %
		1 kHz	More than 10 V up to 100 V	27 μ V/V
	700 V		33 μ V/V	
	AC Voltage Measuring Equipment	1 kHz	From 10 mV less than 100 mV	37 μ V/V
			From 100 mV less than 1 V	30 μ V/V
			From 1 V less than 10 V	25 μ V/V
		10 V	From 20 Hz less than 1 kHz	28 μ V/V
			From 1 kHz up to 100 kHz	25 μ V/V
			1 MHz	59 μ V/V
		1 kHz	More than 10 V up to 100 V	28 μ V/V
			700 V	34 μ V/V
	AC-DC Voltage Comparator	10 V	From 20 Hz less than 1 kHz	27 μ V/V
			From 1 kHz up to 100 kHz	24 μ V/V
			1 MHz	58 μ V/V
		1 kHz	1 V	24 μ V/V
			100 V	27 μ V/V
			700 V	33 μ V/V
	Alternating Current Source	1 kHz	From 0.1 mA up to 100 mA	60 μ A/A
			More than 100 mA up to 1 A	90 μ A/A
	Alternating Current Measuring Equipment	1 kHz	From 0.1 mA up to 100 mA	88 μ A/A
More than 100 mA up to 1 A			0.011 %	

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Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)
Low Frequency Impedance Measuring Equipment, etc.	Capacitor	From 0.08 pF less than 1 pF	1 kHz	Capacitance: 1.0×10^{-15} F
		1 pF	1 kHz	Capacitance: 2.7 μ F/F D factor: 1.3×10^{-5}
			More than 1 kHz up to 13 MHz	Capacitance: $2(a^2+b^2)^{1/2}$ μ F/F $a=13.5, b=7.5f^2$ D factor: $2(a^2+b^2)^{1/2}$ μ F/F $a=9 \times 10^{-6}, b=2.2f \times 10^{-6}$
		More than 1 pF less than 10 pF	1 kHz	Capacitance: 2.7 μ F/F D factor: 1.3×10^{-5}
		10 pF	1 kHz	Capacitance: 1.5 μ F/F D factor: 1.3×10^{-5}
			More than 1 kHz up to 13 MHz	Capacitance: $2(a^2+b^2)^{1/2}$ μ F/F $a=12, b=0.4f^2$ D factor: $2(a^2+b^2)^{1/2}$ $a=6.5 \times 10^{-6}, b=0.8f \times 10^{-6}$
		More than 10 pF less than 100 pF	1 kHz	Capacitance: 1.5 μ F/F D factor: 1.3×10^{-5}
		100 pF	1 kHz	Capacitance: 0.80 μ F/F D factor: 1.3×10^{-5}
			More than 1 kHz up to 13 MHz	Capacitance: $2(a^2+b^2)^{1/2}$ μ F/F $a=12, b=0.4f^2$ D factor: $2(a^2+b^2)^{1/2}$ $a=6.5 \times 10^{-6}, b=0.8f \times 10^{-6}$
		More than 100 pF less than 1000 pF	1 kHz	Capacitance: 1.5 μ F/F D factor: 1.3×10^{-5}
		1000 pF	From 120 Hz up to 100 kHz (except 1 kHz)	Capacitance: 3.3 μ F/F D factor: 1.5×10^{-5}
			1 kHz	Capacitance: 1.5 μ F/F D factor: 1.3×10^{-5}
			More than 100 kHz up to 13 MHz	Capacitance: $2(a^2+b^2)^{1/2}$ μ F/F $a=17, b=1.4f^2$ D factor: $2(a^2+b^2)^{1/2}$ $a=7 \times 10^{-6}, b=3.2f \times 10^{-6}$

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[Note] f : Frequency under calibration [MHz], D factor: Dissipation factor

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)
Low Frequency Impedance Measuring Equipment, etc.	Capacitor	10 nF	120 Hz, 1 kHz	Capacitance: 8.0 $\mu\text{F}/\text{F}$ D factor: 1.6×10^{-5}
			10 kHz	Capacitance: 6.1 $\mu\text{F}/\text{F}$ D factor: 1.5×10^{-5}
			More than 120 Hz up to 100 kHz (except 1 kHz, 10 kHz)	Capacitance: 15 $\mu\text{F}/\text{F}$ D factor: 1.7×10^{-5}
		100 nF	120 Hz	Capacitance: 12 $\mu\text{F}/\text{F}$ D factor: 1.8×10^{-5}
			1 kHz	Capacitance: 9.3 $\mu\text{F}/\text{F}$ D factor: 1.7×10^{-5}
			10 kHz	Capacitance: 12 $\mu\text{F}/\text{F}$ D factor: 1.7×10^{-5}
			More than 120 Hz up to 100 kHz (except 1 kHz, 10 kHz)	Capacitance: 21 $\mu\text{F}/\text{F}$ D factor: 2.1×10^{-5}
		1 μF	120 Hz	Capacitance: 16 $\mu\text{F}/\text{F}$ D factor: 2.0×10^{-5}
			1 kHz	Capacitance: 12 $\mu\text{F}/\text{F}$ D factor: 1.9×10^{-5}
			10 kHz	Capacitance: 18 $\mu\text{F}/\text{F}$ D factor: 1.9×10^{-5}
			More than 120 Hz up to 100 kHz (except 1 kHz, 10 kHz)	Capacitance: 37 $\mu\text{F}/\text{F}$ D factor: 3.3×10^{-5}
		10 μF	From 20 Hz less than 120 Hz	Capacitance: 43 $\mu\text{F}/\text{F}$ D factor: 1.4×10^{-4}
			120 Hz	Capacitance: 22 $\mu\text{F}/\text{F}$ D factor: 2.3×10^{-5}
			1 kHz	Capacitance: 16 $\mu\text{F}/\text{F}$ D factor: 2.1×10^{-5}
			More than 120 Hz up to 10 kHz (except 1 kHz)	Capacitance: 49 $\mu\text{F}/\text{F}$ D factor: 2.3×10^{-5}
			More than 10 kHz up to 100 kHz	Capacitance: 0.049 % D factor: 6.7×10^{-4}
		100 μF	From 120 Hz less than 1 kHz	Capacitance: 29 $\mu\text{F}/\text{F}$ D factor: 2.6×10^{-5}
			1 kHz	Capacitance: 21 $\mu\text{F}/\text{F}$ D factor: 2.7×10^{-5}

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[Note] D factor: Dissipation factor

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)
Low Frequency Impedance Measuring Equipment, etc.	Capacitor	More than 1 pF less than 100 μ F (except 10 pF, 10 nF, 100 nF, 1 μ F, 10 μ F)	More than 100 k Ω	Capacitance: $10 \times (Z + 5.5) \mu\text{F}/F$ D factor: $70 \times (Z + 0.2) \times 10^{-6}$
			More than 1 k Ω up to 100 k Ω	Capacitance: 71 $\mu\text{F}/F$ D factor: 3.8×10^{-5}
		From 20 Hz up to 100 kHz (except less than 100 pF: up to 1 kHz, more than 1000 pF: less than 120 Hz, 100 pF: from 1 kHz, 1000 pF: from 120 Hz)	From 10 Ω up to 1 k Ω	Capacitance: 57 $\mu\text{F}/F$ D factor: 3.5×10^{-5}
			From 1 Ω less than 10 Ω	Capacitance: 0.032 % D factor: 2.4×10^{-4}
		$Z = 1/(\omega C)$	Less than 1 Ω	Capacitance: 0.059 % D factor: 7.2×10^{-4}
				More than 1 pF less than 1000 pF (except 10 pF, 100 pF)
		More than 100 kHz up to 13 MHz	Up to 1.6 M Ω	

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[Note] f : Frequency under calibration [MHz],

Z : Impedance under calibration frequency [M Ω],

D factor: Dissipation factor

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)
Low Frequency Impedance Measuring Equipment, etc.	Capacitance Measuring Equipment	1 pF	1 kHz	Capacitance: 2.9 μ F/F D factor: 1.4×10^{-5}
			More than 1 kHz less than 12.5 kHz	Capacitance: 0.039 % D factor: 1.1×10^{-3}
			From 12.5 kHz less than 48 kHz	Capacitance: 0.011 % D factor: 1.7×10^{-4}
			From 48 kHz up to 2 MHz	Capacitance: 68 μ F/F D factor: 3.9×10^{-5}
			More than 2 MHz up to 13 MHz	Capacitance: 0.26 % D factor: 1.8×10^{-4}
		More than 1 pF less than 10 pF	1 kHz	Capacitance: 2.9 μ F/F D factor: 1.4×10^{-5}
		10 pF	1 kHz	Capacitance: 1.6 μ F/F D factor: 1.4×10^{-5}
			More than 1 kHz less than 12.5 kHz	Capacitance: 69 μ F/F D factor: 1.5×10^{-4}
			From 12.5 kHz up to 2 MHz	Capacitance: 30 μ F/F D factor: 3.2×10^{-5}
			More than 2 MHz up to 13 MHz	Capacitance: 0.015 % D factor: 1.5×10^{-4}
		More than 10 pF less than 100 pF	1 kHz	Capacitance: 1.6 μ F/F D factor: 1.4×10^{-5}
		100 pF	From 20 Hz less than 125 Hz	Capacitance: 0.083 % D factor: 5.6×10^{-3}
			From 125 Hz less than 1 kHz	Capacitance: 0.015 % D factor: 8.8×10^{-5}
			1 kHz	Capacitance: 0.83 μ F/F D factor: 1.4×10^{-5}
			More than 1 kHz up to 2 MHz	Capacitance: 26 μ F/F D factor: 3.0×10^{-5}
			More than 2 MHz up to 13 MHz	Capacitance: 0.016 % D factor: 1.3×10^{-4}
		More than 100 pF less than 1000 pF	1 kHz	Capacitance: 1.6 μ F/F D factor: 1.4×10^{-5}

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[Note] D factor: Dissipation factor

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)
Low Frequency Impedance Measuring Equipment, etc.	Capacitance Measuring Equipment	1000 pF	From 20 Hz less than 125 Hz	Capacitance: 0.011 % D factor: 5.5×10^{-4}
			From 125 Hz less than 1 kHz	Capacitance: 59 $\mu\text{F}/\text{F}$ D factor: 8.9×10^{-5}
			1 kHz	Capacitance: 1.6 $\mu\text{F}/\text{F}$ D factor: 1.4×10^{-5}
			More than 1 kHz up to 2 MHz	Capacitance: 40 $\mu\text{F}/\text{F}$ D factor: 2.4×10^{-5}
			More than 2 MHz up to 13 MHz	Capacitance: 0.049 % D factor: 1.2×10^{-4}
		10 nF	120 Hz	Capacitance: 15 $\mu\text{F}/\text{F}$ D factor: 1.7×10^{-5}
			1 kHz	Capacitance: 13 $\mu\text{F}/\text{F}$ D factor: 1.7×10^{-5}
			10 kHz	Capacitance: 14 $\mu\text{F}/\text{F}$ D factor: 1.7×10^{-5}
			More than 120 Hz up to 100 kHz (except 1 kHz, 10 kHz)	Capacitance: 20 $\mu\text{F}/\text{F}$ D factor: 1.9×10^{-5}
		100 nF	120 Hz	Capacitance: 13 $\mu\text{F}/\text{F}$ D factor: 1.9×10^{-5}
			1 kHz	Capacitance: 10 $\mu\text{F}/\text{F}$ D factor: 1.8×10^{-5}
			10 kHz	Capacitance: 12 $\mu\text{F}/\text{F}$ D factor: 1.8×10^{-5}
			More than 120 Hz up to 100 kHz (except 1 kHz, 10 kHz)	Capacitance: 22 $\mu\text{F}/\text{F}$ D factor: 2.1×10^{-5}
		1 μF	120 Hz	Capacitance: 17 $\mu\text{F}/\text{F}$ D factor: 2.2×10^{-5}
			1 kHz	Capacitance: 14 $\mu\text{F}/\text{F}$ D factor: 2.0×10^{-5}
			10 kHz	Capacitance: 18 $\mu\text{F}/\text{F}$ D factor: 2.1×10^{-5}
			More than 120 Hz up to 100 kHz (except 1 kHz, 10 kHz)	Capacitance: 38 $\mu\text{F}/\text{F}$ D factor: 3.4×10^{-5}

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[Note] D factor: Dissipation factor

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)	
Low Frequency Impedance Measuring Equipment, etc.	Capacitance Measuring Equipment	10 μ F	From 20 Hz less than 120 Hz	Capacitance: 43 μ F/F D factor: 1.4×10^{-4}	
			120 Hz	Capacitance: 25 μ F/F D factor: 2.6×10^{-5}	
			1 kHz	Capacitance: 20 μ F/F D factor: 2.3×10^{-5}	
			More than 120 Hz up to 10 kHz (except 1 kHz)	Capacitance: 51 μ F/F D factor: 2.6×10^{-5}	
			More than 10 kHz up to 100 kHz	Capacitance: 0.050 % D factor: 6.8×10^{-4}	
			100 μ F	From 120 Hz less than 1 kHz	Capacitance: 30 μ F/F D factor: 3.0×10^{-5}
				1 kHz	Capacitance: 22 μ F/F D factor: 3.1×10^{-5}
			More than 1 pF less than 100 μ F (except 10 pF, 10 nF, 100 nF, 1 μ F, 10 μ F)	More than 100 k Ω	Capacitance: $10 \times (Z + 5.5) \mu$ F/F D factor: $70 \times (Z + 0.2) \times 10^{-6}$
				More than 1 k Ω up to 100 k Ω	Capacitance: 71 μ F/F D factor: 3.8×10^{-5}
				From 10 Ω up to 1 k Ω	Capacitance: 57 μ F/F D factor: 3.5×10^{-5}
		From 1 Ω less than 10 Ω		Capacitance: 0.032 % D factor: 2.4×10^{-4}	
		Less than 1 Ω		Capacitance: 0.059 % D factor: 7.2×10^{-4}	
		More than 1 pF less than 1000 pF (except 10 pF, 100 pF) More than 100 kHz up to 13 MHz	Up to 1.6 M Ω	Capacitance: (0.03f+0.006) % D factor: $(5f+2.5) \times 10^{-4}$	

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[Note] f : Frequency under calibration [MHz],

Z : Impedance under calibration frequency [M Ω],

D factor: Dissipation factor

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)
Low Frequency Impedance Measuring Equipment, etc.	AC Resistor	1 Ω	1 kHz	Series Resistance: 0.028 %
		10 Ω	From 20 Hz less than 1 MHz	Series Resistance: 0.018 %
				Reactance: 0.0035 Ω
			1 MHz	Series Resistance: 0.013 %
			Reactance: 0.0032 Ω	
			2 MHz	Series Resistance: 0.016 %
			Reactance: 0.0035 Ω	
			3 MHz	Series Resistance: 0.021%
			Reactance: 0.0035 Ω	
			4 MHz	Series Resistance: 0.030 %
			Reactance: 0.0038 Ω	
		5 MHz	Series Resistance: 0.045 %	
		Reactance: 0.0043 Ω		
		10 MHz	Series Resistance: 0.18 %	
		Reactance: 0.011 Ω		
		13 MHz	Series Resistance: 0.31 %	
		Reactance: 0.014 Ω		
		From 10 Ω less than 50 Ω (except 10 Ω : from 20 Hz up to 1 MHz, 2 MHz, 3 MHz, 4 MHz, 5 MHz, 10 MHz, 13 MHz)	From 20 Hz less than 1 MHz	Series Resistance: 0.018 %
				Reactance: 0.018 Ω
			1 MHz	Series Resistance: 0.013 %
		Reactance: 0.016 Ω		
		More than 1 MHz up to 13 MHz	Series Resistance: 0.31 %	
		Reactance: 0.070 Ω		
		100 Ω	From 20 Hz less than 1 MHz	Series Resistance: 0.018 %
				Reactance: 0.035 Ω
			1 MHz	Series Resistance: 0.013 %
			Reactance: 0.032 Ω	
			2 MHz	Series Resistance: 0.016 %
			Reactance: 0.033 Ω	
			3 MHz	Series Resistance: 0.020%
			Reactance: 0.035 Ω	
		4 MHz	Series Resistance: 0.024 %	
		Reactance: 0.032 Ω		
5 MHz	Series Resistance: 0.035 %			
Reactance: 0.032 Ω				
10 MHz	Series Resistance: 0.14 %			
Reactance: 0.062 Ω				
13 MHz	Series Resistance: 0.22 %			
Reactance: 0.064 Ω				

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Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)	
Low Frequency Impedance Measuring Equipment, etc.	AC Resistor	From 50 Ω less than 500 Ω (except 100 Ω : from 20 Hz up to 1 MHz, 2 MHz, 3 MHz, 4 MHz, 5 MHz, 10 MHz, 13 MHz)	From 20 Hz less than 1 MHz	Series Resistance: 0.018 % Reactance: 0.31 Ω	
			1 MHz	Series Resistance: 0.013 % Reactance: 0.30 Ω	
			More than 1 MHz up to 13 MHz	Series Resistance: 0.22 % Reactance: 0.32 Ω	
			1 k Ω	From 20 Hz less than 100 kHz	Parallel Resistance: 0.018 % Susceptance: 0.35 μS
				100 kHz, 1 MHz	Parallel Resistance: 0.013 % Susceptance: 0.32 μS
				2 MHz	Parallel Resistance: 0.014 % Susceptance: 0.32 μS
				3 MHz	Parallel Resistance: 0.017 % Susceptance: 0.32 μS
				4 MHz	Parallel Resistance: 0.025 % Susceptance: 0.32 μS
				5 MHz	Parallel Resistance: 0.034 % Susceptance: 0.32 μS
		10 MHz		Parallel Resistance: 0.13 % Susceptance: 0.60 μS	
		13 MHz		Parallel Resistance: 0.22 % Susceptance: 0.61 μS	
		From 500 Ω less than 5 k Ω (except 1 k Ω : from 20 Hz up to 100 kHz, 1 MHz, 2 MHz, 3 MHz, 4 MHz, 5 MHz, 10 MHz, 13 MHz)		From 20 Hz less than 100 kHz	Parallel Resistance: 0.018 % Susceptance: 0.70 μS
			100 kHz	Parallel Resistance: 0.013 % Susceptance: 0.64 μS	
			More than 100 kHz up to 13 MHz	Parallel Resistance: 0.22 % Susceptance: 1.2 μS	
			10 k Ω	From 20 Hz less than 100 kHz (except 1 kHz, 10 kHz)	Parallel Resistance: 0.018 % Susceptance: 0.035 μS
				1 kHz, 10 kHz	Parallel Resistance: 0.013 % Susceptance: 0.027 μS
				100 kHz	Parallel Resistance: 0.013 % Susceptance: 0.032 μS
		1 MHz		Parallel Resistance: 0.014 % Susceptance: 0.032 μS	

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Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)	
Low Frequency Impedance Measuring Equipment, etc.	AC Resistor	From 5 k Ω less than 50 k Ω (except 10 k Ω : from 20 Hz up to 100 kHz, 1 MHz)	From 20 Hz less than 100 kHz	Parallel Resistance: 0.019 % Susceptance: 0.070 μ S	
			From 100 kHz up to 1 MHz	Parallel Resistance: 0.014 % Susceptance: 0.064 μ S	
		100 k Ω	From 20 Hz less than 100 kHz	Parallel Resistance: 0.019 % Susceptance: 0.0035 μ S	
			100 kHz, 1 MHz	Parallel Resistance: 0.014 % Susceptance: 0.0032 μ S	
		From 50 k Ω up to 100 k Ω (except 100 k Ω : from 20 Hz up to 100 kHz, 1 MHz)	From 20 Hz less than 100 kHz	Parallel Resistance: 0.019 % Susceptance: 0.0070 μ S	
			From 100 kHz up to 1 MHz	Parallel Resistance: 0.014 % Susceptance: 0.0064 μ S	
		AC Resistance Measuring Equipment	1 Ω	1 kHz	Resistance: 0.029 %
			More than 1 Ω up to 10 Ω	1 MHz	Resistance: 0.014 % Reactance: 0.0033 Ω
	2 MHz			Resistance: 0.018 % Reactance: 0.0040 Ω	
	3 MHz			Resistance: 0.022 % Reactance: 0.0039 Ω	
	4 MHz			Resistance: 0.031 % Reactance: 0.0039 Ω	
	5 MHz			Resistance: 0.046 % Reactance: 0.0045 Ω	
	10 MHz			Resistance: 0.19 % Reactance: 0.012 Ω	
	13 MHz			Resistance: 0.32 % Reactance: 0.015 Ω	
	More than 1 MHz Less than 13 MHz (except 2 MHz, 3 MHz, 4 MHz, 5 MHz, 10 MHz)			Resistance: 0.32 % Reactance: 0.015 Ω	

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Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)	
Low Frequency Impedance Measuring Equipment, etc.	AC Resistance Measuring Equipment	From 10 Ω up to 100 Ω (except 10 Ω : from 1 MHz up to 13 MHz)	From 20 Hz less than 1 MHz	Resistance: 0.019 %	Reactance: 0.036 Ω
			1 MHz	Resistance: 0.014 %	Reactance: 0.033 Ω
			2 MHz	Resistance: 0.017 %	Reactance: 0.034 Ω
			3 MHz	Resistance: 0.021 %	Reactance: 0.036 Ω
			4 MHz	Resistance: 0.025 %	Reactance: 0.033 Ω
			5 MHz	Resistance: 0.036 %	Reactance: 0.033 Ω
			10 MHz	Resistance: 0.15 %	Reactance: 0.065 Ω
			13 MHz	Resistance: 0.23 %	Reactance: 0.069 Ω
			More than 1 MHz less than 13 MHz (except 2 MHz, 3 MHz, 4 MHz, 5 MHz, 10 MHz)	Resistance: 0.23 %	Reactance: 0.069 Ω
			More than 100 Ω up to 1 k Ω	From 20 Hz less than 100 kHz	Resistance: 0.019 %
		100 kHz, 1 MHz		Resistance: 0.013 %	Susceptance: 0.33 μS
		2 MHz		Resistance: 0.015 %	Susceptance: 0.33 μS
		3 MHz		Resistance: 0.018 %	Susceptance: 0.33 μS
		4 MHz		Resistance: 0.025 %	Susceptance: 0.33 μS
		5 MHz		Resistance: 0.034 %	Susceptance: 0.33 μS
		10 MHz		Resistance: 0.14 %	Susceptance: 0.61 μS
		13 MHz		Resistance: 0.23 %	Susceptance: 0.62 μS
		More than 1 MHz less than 13 MHz (except 2 MHz, 3 MHz, 4 MHz, 5 MHz, 10MHz)		Resistance: 0.23 %	Susceptance: 0.62 μS

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Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)	
Low Frequency Impedance Measuring Equipment, etc.	AC Resistance Measuring Equipment	More than 1 k Ω up to 10 k Ω	From 1 kHz less than 100 kHz	Resistance: 0.019 % Susceptance: 0.036 μ S	
			100 kHz	Resistance: 0.013 % Susceptance: 0.033 μ S	
			More than 100 kHz up to 1 MHz	Resistance: 0.014 % Susceptance: 0.033 μ S	
		More than 10 k Ω up to 100 k Ω	From 100 kHz up to 1 MHz	Resistance: 0.014 % Susceptance: 0.0033 μ S	
		Inductive Voltage Divider	In-phase (1 kHz)	More than 0 less than 0.01	0.010×10^{-6}
				From 0.01 less than 0.1	0.020×10^{-6}
	From 0.1 less than 1			0.10×10^{-6}	
	Quadrature (1 kHz)		More than 0 less than 1	0.20×10^{-6}	

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General Field of Calibration: Electricity (High Frequency) & Electromagnetic Field
Date of Initial Accreditation of the Field: 1995-06-21
Laboratory's permanent facility/On-site Calibration: Laboratory's permanent facility
Calibration and Measurement Capabilities

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)	
Radio Frequency Measuring Equipments	RF Power Source	1 mW	50 MHz	0.65 %	
	RF Power Measuring Equipment	1 mW	From 10 MHz less than 20 MHz	0.58 %	
			From 20 MHz less than 50 MHz	0.44 %	
			50 MHz	0.42 %	
			More than 50 MHz up to 300 MHz	0.44 %	
			More than 300 MHz up to 6 GHz	0.54 %	
			More than 6 GHz up to 13 GHz	0.8 %	
			More than 13 GHz up to 16 GHz	1.1 %	
			17 GHz, 18 GHz, 19 GHz	1.2 %	
			More than 16 GHz less than 19 GHz (except 17 GHz, 18 GHz)	1.4 %	
			20 GHz, 21 GHz, 22 GHz 23 GHz, 24 GHz, 25 GHz	1.4 %	
			More than 19 GHz less than 25 GHz (except 20 GHz, 21 GHz, 22 GHz, 23 GHz, 24 GHz)	1.5 %	
			More than 25 GHz up to 26.5 GHz	2.5 %	
			From 1 μ W less than 1 mW	From 10 MHz less than 50 MHz	0.79 %
				50 MHz	0.51 %
				More than 50 MHz up to 2 GHz	0.63 %
				More than 2 GHz up to 6 GHz	0.91 %
				More than 6 GHz up to 12 GHz	1.2 %
				More than 12 GHz up to 18 GHz	1.7 %
				More than 18 GHz up to 25 GHz	2.0 %
More than 25 GHz up to 26.5 GHz	3.0 %				

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Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)
Radio Frequency Measuring Equipments	Attenuator		From 100 kHz up to 2 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00062)^2 + \left(\frac{6.49 \times 10^{-6}}{A} \right)^2} \right)$ dB
		From 0 dB up to 40 dB	More than 2 GHz up to 8 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00084)^2 + \left(\frac{2.59 \times 10^{-6}}{A} \right)^2} \right)$ dB
			More than 8 GHz up to 26.5 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00107)^2 + \left(\frac{2.59 \times 10^{-6}}{A} \right)^2} \right)$ dB
		More than 40 dB up to 80 dB	From 100 kHz up to 2 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00101)^2 + \left(\frac{5.79 \times 10^{-8}}{A} \right)^2} \right)$ dB
		More than 80 dB up to 110 dB	From 100 kHz up to 2 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00116)^2 + \left(\frac{4.60 \times 10^{-8}}{A} \right)^2} \right)$ dB
		More than 40 dB up to 110 dB	More than 2 GHz up to 8 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00108)^2 + \left(\frac{1.63 \times 10^{-7}}{A} \right)^2} \right)$ dB
			More than 8 GHz up to 26.5 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00127)^2 + \left(\frac{1.63 \times 10^{-7}}{A} \right)^2} \right)$ dB
		Attenuation Measuring Equipment	10 dB	30 MHz
	From 0 dB up to 40 dB		From 100 kHz up to 2 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00062)^2 + \left(\frac{6.49 \times 10^{-6}}{A} \right)^2} \right)$ dB
			More than 2 GHz up to 8 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00084)^2 + \left(\frac{2.59 \times 10^{-6}}{A} \right)^2} \right)$ dB
			More than 8 GHz up to 26.5 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00107)^2 + \left(\frac{2.59 \times 10^{-6}}{A} \right)^2} \right)$ dB
	More than 40 dB up to 80 dB		From 100 kHz up to 2 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00101)^2 + \left(\frac{5.79 \times 10^{-8}}{A} \right)^2} \right)$ dB

		More than 80 dB up to 110 dB	From 100 kHz up to 2 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00116)^2 + \left(\frac{4.60 \times 10^{-8}}{A} \right)^2} \right)$ dB
		More than 40 dB up to 110 dB	More than 2 GHz up to 8 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00108)^2 + \left(\frac{1.63 \times 10^{-7}}{A} \right)^2} \right)$ dB
			More than 8 GHz up to 26.5 GHz	$20 \times \log_{10} \left(1 + \sqrt{(0.00127)^2 + \left(\frac{1.63 \times 10^{-7}}{A} \right)^2} \right)$ dB

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*) Conversion equation of A : $A = 10^{\left(\frac{-x}{20}\right)}$, x : Attenuation of DUT[dB]

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range		Expanded Uncertainty (Level of Confidence Approximately 95 %)	
Radio Frequency Measuring Equipments	RF Impedance	Type-N 50 Ω Reflection Coefficient $ S_{ii} $ up to 0.2	From 9 kHz Less than 10 MHz	Amplitude: 0.0022 Phase: arcsine (0.0022/ $ S_{ii} $)	
			From 10 MHz up to 2 GHz	Amplitude: 0.0038 Phase: arcsine (0.0038/ $ S_{ii} $)	
			More than 2 GHz up to 3 GHz	Amplitude: 0.0032 Phase: arcsine (0.0032/ $ S_{ii} $)	
			More than 3 GHz up to 9 GHz	Amplitude: 0.0037 Phase: arcsine (0.0037/ $ S_{ii} $)	
			More than 9 GHz up to 12 GHz	Amplitude: 0.0042 Phase: arcsine (0.0042/ $ S_{ii} $)	
			More than 12 GHz up to 18 GHz	Amplitude: 0.0053 Phase: arcsine (0.0053/ $ S_{ii} $)	
		3.5 mm 50 Ω Reflection Coefficient $ S_{ii} $ up to 0.2	From 9 kHz less than 10 MHz	Amplitude: 0.0082 Phase: arcsine (0.0082/ $ S_{ii} $)	
			From 10 MHz up to 50 MHz	Amplitude: 0.0091 Phase: arcsine (0.0091/ $ S_{ii} $)	
			More than 50 MHz less than 100 MHz	Amplitude: 0.019 Phase: arcsine (0.019/ $ S_{ii} $)	
			From 100 MHz up to 2 GHz	Amplitude: 0.0041 Phase: arcsine (0.0041/ $ S_{ii} $)	
			More than 2 GHz up to 8 GHz	Amplitude: 0.0046 Phase: arcsine (0.0046/ $ S_{ii} $)	
			More than 8 GHz up to 20 GHz	Amplitude: 0.0055 Phase: arcsine (0.0055/ $ S_{ii} $)	
		7 mm 50 Ω Reflection Coefficient $ S_{ii} $ up to 0.02	More than 20 GHz up to 26.5 GHz	Amplitude: 0.0062 Phase: arcsine (0.0062/ $ S_{ii} $)	
			From 200 MHz up to 1.4 GHz	Amplitude: 0.0017 Phase: arcsine (0.0017/ $ S_{ii} $)	
		7 mm 50 Ω Reflection Coefficient $ S_{ii} $ up to 0.2	From 1.6 GHz less than 2 GHz	Amplitude: 0.0017 Phase: arcsine (0.0017/ $ S_{ii} $)	
			From 9 kHz less than 10 MHz	Amplitude: 0.0017 Phase: arcsine (0.0017/ $ S_{ii} $)	
			From 10 MHz up to 6 GHz	Amplitude: 0.0024 Phase: arcsine (0.0024/ $ S_{ii} $)	
			More than 6 GHz up to 12 GHz	Amplitude: 0.0031 Phase: arcsine (0.0031/ $ S_{ii} $)	
				More than 12 GHz up to 18 GHz	Amplitude: 0.0037 Phase: arcsine (0.0037/ $ S_{ii} $)

#All Calibration Procedures are in-house procedures developed by this laboratory.

Phase Unit : ° (Uncertainty of phase is 180° in case the laboratory can't calculate it.)

Calibration Procedures# and Type of Instruments/Materials to be calibrated		Range			Expanded Uncertainty (Level of Confidence Approximately 95 %)
Radio Frequency Measuring Equipments	RF Impedance	Type-N 50 Ω	Reflection Coefficient $ S_{ii} $ up to 1 (S_{11}, S_{22})	From 9 kHz up to 18 GHz	Amplitude: $U_{SRM} = U_{RM} + F$ $U_{RM} = 2 \times (A^2 + B^2 + C^2 + D^2 + E^2)^{1/2}$ $A = 1 - S_{ii} / \Gamma_s \times U_L$ $B = S_{ii} \times (\Gamma_s - S_{ii}) \times U_L$ $C = S_{ii} / \Gamma_s \times U_s$ $D = U_D$ $E = U_v$ $F = 2 \times S_{21_DUT} S_{12_DUT} \times U_L$ Phase: Arcsine ($U_{SRM} / S_{ii} $) + U_p
		3.5 mm 50 Ω		From 9 kHz up to 33 GHz	
		7 mm 50 Ω		From 9 kHz up to 18 GHz	
		Type-N 50 Ω	Transmission Coefficient $ S_{ij} $ From 0.001 up to 1 (S_{21}, S_{12})	From 9 kHz up to 18 GHz	Amplitude: $U_{STM} = 20 \log(1+X)$ [dB] $X = 2 \times (G^2 + H^2 + I^2 + J^2 + K^2)^{1/2}$ $G = (S_{11_DUT} + \Gamma_v) \times U_L$ $H = (S_{22_DUT} + \Gamma_v) \times U_L$ $I = U_{D2}$ $J = 0.00043$ $K = 1.82 \times 10^{-5} / S_{ij} $ Phase: arcsine (X)
		3.5 mm 50 Ω		From 9 kHz up to 33 GHz	
		7 mm 50 Ω		From 9 kHz up to 18 GHz	

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Γ_{DUT} : Reflection Coefficient of DUT. S_{11_DUT} , S_{21_DUT} , S_{12_DUT} , S_{22_DUT} : S parameter of DUT.

$S_{21_DUT} = S_{12_DUT} = 0$ in the case of One Port.

Γ_s , U_s , U_L , U_D , U_v , U_p , U_{D2} are numerical value in the following table.

Type-N50Ω	Frequency range	$\Gamma S = - \exp\{-j0.352013 \times freq(\text{GHz})\} \text{ ref.} -20.1689^{\circ} \times freq(\text{GHz})w$
	From 9 kHz less than 10 MHz	$UL : 0.00108 \quad US : 0.00210 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	From 10 MHz up to 2 GHz	$UL : 0.00187 \quad US : 0.00336 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 2 GHz up to 3 GHz	$UL : 0.00164 \quad US : 0.00341 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 3 GHz up to 9 GHz	$UL : 0.00205 \quad US : 0.00459 \quad UD : 0.0006 \quad Uv : 0.0004 \quad UD2 : 0.0010$
	More than 9 GHz up to 12 GHz	$UL : 0.00273 \quad US : 0.00516 \quad UD : 0.0006 \quad Uv : 0.0004 \quad UD2 : 0.0010$
	More than 12 GHz up to 18 GHz	$UL : 0.00318 \quad US : 0.00714 \quad UD : 0.0006 \quad Uv : 0.0004 \quad UD2 : 0.0010$
		Less than 40 MHz $U_p = 0.52$, From 40 MHz $U_p = 0.1$
3.5mm	Frequency range	$\Gamma S = - \exp\{-j0.399825 \times freq(\text{GHz})\} \text{ ref.} -22.9083^{\circ} \times freq(\text{GHz})$
	From 9 kHz less than 10 MHz	$UL : 0.00405 \quad US : 0.00759 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	From 10 MHz up to 50 MHz	$UL : 0.00455 \quad US : 0.00710 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 50 MHz less than 100 MHz	$UL : 0.00902 \quad US : 0.00858 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	From 100 MHz up to 2 GHz	$UL : 0.00203 \quad US : 0.00370 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 2 GHz up to 8 GHz	$UL : 0.00233 \quad US : 0.00411 \quad UD : 0.0006 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 8 GHz up to 20 GHz	$UL : 0.00295 \quad US : 0.00580 \quad UD : 0.0006 \quad Uv : 0.0004 \quad UD2 : 0.0010$
	More than 20 GHz up to 26.5 GHz	$UL : 0.00418 \quad US : 0.00646 \quad UD : 0.0006 \quad Uv : 0.0004 \quad UD2 : 0.0013$
	More than 26.5 GHz up to 33 GHz	$UL : 0.00568 \quad US : 0.00777 \quad UD : 0.0012 \quad Uv : 0.0004 \quad UD2 : 0.0033$
		Less than 100 MHz $U_p = 0.61$, From 100 MHz $U_p = 1.42$
7mm	Frequency range	$\Gamma S = -1$
	From 9 kHz up to 5 MHz	$UL : 0.00068 \quad US : 0.00128 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 5 MHz up to 10 MHz	$UL : 0.00068 \quad US : 0.00168 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 10 MHz up to 20 MHz	$UL : 0.00103 \quad US : 0.00385 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 20 MHz less than 40 MHz	$UL : 0.00103 \quad US : 0.00455 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	From 40 MHz up to 6 GHz	$UL : 0.00103 \quad US : 0.00201 \quad UD : 0.0003 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 6 GHz up to 12 GHz	$UL : 0.00152 \quad US : 0.00244 \quad UD : 0.0006 \quad Uv : 0.0004 \quad UD2 : 0.00067$
	More than 12 GHz up to 18 GHz	$UL : 0.00187 \quad US : 0.00327 \quad UD : 0.0006 \quad Uv : 0.0004 \quad UD2 : 0.0010$
	Less than 40 MHz $U_p = 0.52$, From 100 MHz $U_p = 0.45$	
		Γv : up to 2 GHz; 0.2, More than 2 GHz up to 18 GHz; 0.3, More than 18 GHz up to 26.5 GHz; 0.35, More than 26.5 GHz up to 33 GHz; 0.4

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