



Test report No. : 32DE0368-SH-02-A
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Issued date : June 8, 2012
FCC ID : SGJ-WFC006
Revised date : September 4, 2012

RADIO TEST REPORT

Test Report No. : 32DE0368-SH-02-A

Applicant : Yokogawa Electric Corporation
Type of Equipment : ISA100 Wireless Module
Model No. : F9195KA
FCC ID : SGJ-WFC006
Test regulation : FCC Part15 Subpart C: 2012
Test result : Complied

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4. The test results in this test report are traceable to the national or international standards.
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Date of test: March 20 to May 29, 2012

Representative test engineer:



Makoto Hosaka
Engineer of WiSE Japan,
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Approved by :



Toyokazu Imamura
Leader of WiSE Japan,
UL Verification Service

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13-EM-F0429

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SECTION 1: Customer information

Company Name : Yokogawa Electric Corporation
Brand Name : YOKOGAWA
Address : 2-9-32, Nakacho, Musashino, Tokyo, 180-8750, Japan
Telephone Number : +81-422-52-5885
Facsimile Number : +81-422-52-2102
Contact Person : Yoshio Yoshida

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment : ISA100 Wireless Module
Model No. : F9195KA
Serial No. : Refer to 4.2 in this report.
Rating : DC5.0V, DC3.3V
Receipt Date of Sample : March 26, 2012
Country of Mass-production : Japan
Condition of EUT : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT : No modification by the test lab.

2.2 Product description

Model: F9195KA (referred to as the EUT in this report) is an ISA100 Wireless Module.

General Specification

Clock frequency(ies) in the system : 50MHz (CPU), 24MHz (radio part)

Radio specification

Equipment type : Transceiver
Frequency of operation : 2405-2475MHz
Bandwidth & channel spacing : 2MHz & 5MHz
Type of modulation : O-QPSK, DSSS
ITU code : G1D
Operation temperature range : -40 to +70 deg. C.

Antenna Type	Sleeve Antenna	Collinear Antenna	Collinear Antenna	Patch compound Antenna
External Antenna Connector Type	N Connector			
External Antenna Cable	Coax antenna cable (less than 3.1dB cable loss)			
Antenna Gain with internal cable loss (direct connecting)	2.14dBi (*1)	6dBi	9dBi	15dBi

*1) In the test report, “+2dBi antenna” means the +2.14dBi antenna.

FCC Part15.31 (e)

The Wireless Module is provided with stable power supply DC 5.0V and DC3.3V from the host device, therefore, the equipment complies power supply regulation.

FCC Part15.203

The EUT has an external antenna connector, but it is installed by the professionals. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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SECTION 3: Test specification, procedures & results

3.1 Test specification

Test specification : FCC Part 15 Subpart C: 2012,
final revised on March 30, 2012 and effective April 30, 2012
Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.209 Radiated emission limits, general requirements
Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz,
and 5725-5850MHz

*The revision on March 30, 2012 does not affect the test specification applied to the EUT.

3.2 Procedures & Results

Item	Test Procedure	Specification	Remarks	Deviation	Worst Margin	Results
Conducted emission	ANSI C63.4:2009 7. AC powerline conducted emission measurements	FCC 15.207	-	N/A	28.7 dB Freq.: 0.24208MHz Detector: Quasi-Peak Phase: N Mode: Tx 2440MHz, Tx Antenna : 15dBi	Complied
6dB bandwidth	ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.247 (a)(2) & 15.209	Conducted	N/A	* See data	Complied
Maximum peak output power	ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.247 (b)(3) & 15.209	Conducted	N/A		Complied
Spurious emission & Restricted band edges	ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.109, 15.247 (d) & 15.209	Conducted / Radiated	N/A	1.0dB Freq.: 916.908MHz Detector: Quasi-Peak Polarization: Horizontal Mode: Tx 2405MHz, Tx Antenna : 2dBi Freq.: 890.735MHz Detector: Quasi-Peak Polarization: Horizontal Mode: Tx 2475MHz, Tx Antenna : 2dBi	Complied
Power density	ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.247 (e) & 15.209	Conducted	N/A	* See data	Complied

Note: UL Japan's EMI Work Procedures No.13-EM-W0420 and 13-EM-W0422.
These tests were also referred to "Guidance on Measurement for Digital Transmission Systems Section15.247".

3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied bandwidth (99%)	ANSI C63.4:2009 13. Measurement of intentional radiators, RSS-Gen 4.6.1	RSS-Gen 4.6.1	Conducted	-	-

Note: UL Japan's EMI Work Procedures No.13-EM-W0420 and 13-EM-W0422.

* Other than above, no addition, exclusion nor deviation has been made from the standard.

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3.4 Uncertainty

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

Item	Frequency range	No.1 SAC ^{*1} /SR ^{*2} (±)	No.2 SAC/SR (±)	No.3 SAC/SR (±)
Conducted emission (AC Mains) AMN/LISN	150kHz-30MHz	3.6 dB	3.6 dB	3.6 dB
Radiated emission (Measurement distance: 3m)	9kHz-30MHz	3.7 dB	3.7 dB	3.6 dB
	30MHz-300MHz	4.9 dB	5.1 dB	5.0 dB
	300MHz-1GHz	5.0 dB	5.2 dB	5.0 dB
	1GHz-18GHz	4.8 dB	4.8 dB	4.9 dB
Radiated emission (Measurement distance: 1m)	1GHz-18GHz	5.6 dB	5.6 dB	5.6 dB
	18GHz-40GHz	4.8 dB	4.3 dB	4.4 dB

*1: SAC=Semi-Anechoic Chamber

*2: SR= Shielded Room is applied besides radiated emission

Conducted emission test

The data listed in this test report has enough margin, more than site margin.

Radiated emission test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

Antenna port conducted test

Power measurement uncertainty above 1GHz for this test was: (±) 1.5dB

Spurious emission (Conducted) measurement (below 1GHz) uncertainty for this test was: (±) 1.7dB

Spurious emission (Conducted) measurement (1G-3GHz) uncertainty for this test was: (±) 2.3dB

Spurious emission (Conducted) measurement (3G-18GHz) uncertainty for this test was: (±) 3.0dB

Spurious emission (Conducted) measurement (18G-26.5GHz) uncertainty for this test was: (±) 2.9dB

Bandwidth measurement uncertainty for this test was: (±) 5.4%

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3.5 Test location

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JAB Accreditation No. : RTL02610

	FCC Registration No.	IC Registration No.	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
<input checked="" type="checkbox"/> No.1 Semi-anechoic chamber	697847	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
<input checked="" type="checkbox"/> No.2 Semi-anechoic chamber	697847	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
<input type="checkbox"/> No.3 Semi-anechoic chamber	697847	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5m
<input type="checkbox"/> No.4 Full-anechoic chamber	-	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
<input checked="" type="checkbox"/> No.1 shielded room	-	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
<input type="checkbox"/> No.2 shielded room	-	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
<input type="checkbox"/> No.3 shielded room	-	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
<input type="checkbox"/> No.4 shielded room	-	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
<input type="checkbox"/> No.5 shielded room	-	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
<input checked="" type="checkbox"/> No.6 shielded room	-	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-

3.6 Test setup, Data of test & Test instruments

Refer to APPENDIX 1 to 3.

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SECTION 4: Operation of E.U.T. during testing

4.1 Operating mode

The EUT exercise program used during testing was designed to exercise the various system components in a manner similar to typical use.

Test item	Mode	Tested frequency
All items	Transmitting IEEE 802.15.4	2405MHz, 2440MHz, 2475MHz

* Since the attenuator value is adjusted for each antenna to change the output power, all test items have been performed for each antenna.

Power setting:

Antenna type	2 dBi	6 dBi	9 dBi	15 dBi
Attenuator Setting	2 dB	6 dB	9 dB	15 dB

Test software : YFGW510 Tool, Revision: 0326

Justification: The system was configured in typical fashion (as customer would normally use it) for testing.

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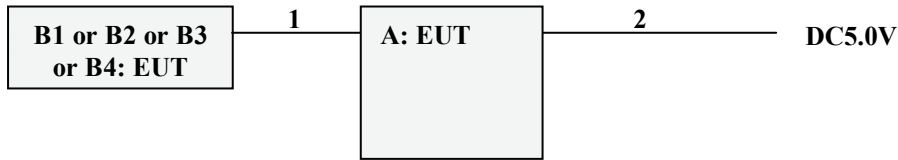
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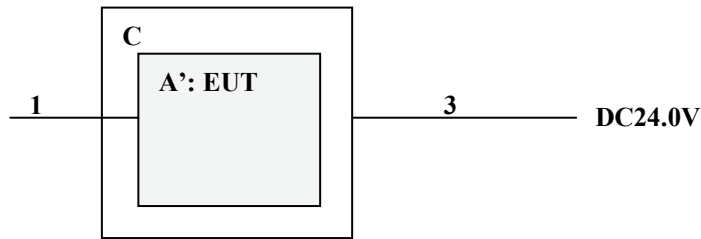
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4.2 Configuration and peripherals

Spurious emission (Radiated) test



Antenna Terminal test



* Test data was taken under worse case conditions.

Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	ISA100 Wireless Module	F9195KA	00:00:64:94:F1:6F	Yokogawa Electric Corporation	EUT Used to Spurious emission (radiated)
A'	ISA100 Wireless Module	F9195KA	00:00:64:94:F1:83	Yokogawa Electric Corporation	EUT Used to Antenna Terminal test
B1	Sleeve antenna	ASSL-NP-0400	-	HOKO ELECTRONICS CO., LTD.	2dBi
B2	Collinear Antenna	ASCL-NP-00200	-	HOKO ELECTRONICS CO., LTD.	6dBi
B3	Collinear Antenna	ASCL-NP-00300	-	HOKO ELECTRONICS CO., LTD.	9dBi
B4	Patch compound Antenna	MTA-11PA15-YO	0001	Alfact co.,ltd.	15dBi
C	Gateway (GW)	YFGW510	72	Yokogawa Electric Corporation	-

List of cables used

No.	Cable Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Antenna	0.1	Shielded	Shielded	-
2	DC	1.4	Unshielded	Unshielded	-
3	DC	2.6	Unshielded	Unshielded	-

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SECTION 5: Conducted emission

5.1 Operating environment

Test place : See test data (APPENDIX 1)
Temperature : See test data (APPENDIX 1)
Humidity : See test data (APPENDIX 1)

5.2 Test configuration

EUT was placed on a platform of nominal size, 1.0m by 1.5m, raised 0.8m above the conducting ground plane.

The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity.

The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and was flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. DC power supply was located 80cm from LISN and excess AC cable was bundled in center. I/O cables that were connected to the peripherals were bundled in center. They were folded back and for the forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane.

Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the input power source.

Photographs of the set up are shown in APPENDIX 3.

5.3 Test conditions

Frequency range : 0.15 - 30MHz
EUT position : Table top

5.4 Test procedure

The AC Mains Terminal Continuous disturbance Voltage had been measured with the EUT via DC power supply within a shielded room. The DC power supply was connected to a Line Impedance Stabilization Network (LISN).

An overview sweep with peak detection has been performed.

The measurements had been performed with a quasi-peak detector and if required, an average detector.

The conducted emission measurements were made with the following detector of the test receiver.

Detector Type : Quasi-Peak/ Average
IF Bandwidth : 9kHz

5.5 Results

Summary of the test results : Pass

Refer to APPENDIX 1

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SECTION 6: 6dB bandwidth & Occupied bandwidth (99%)

Test procedure

The bandwidth was measured with a spectrum analyzer connected to the antenna port.

Summary of the test results: Pass
Refer to APPENDIX 1

SECTION 7: Maximum peak output power

Test procedure

The Maximum Peak Output Power was measured with a power meter connected to the antenna port.

Summary of the test results: Pass
Refer to APPENDIX 1

SECTION 8: Spurious emission (Antenna port conducted)

Test procedure

The spurious emission was measured with a spectrum analyzer connected to the antenna port.

In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.

Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9kHz-150kHz:RBW=200Hz, 150kHz-30MHz:RBW=10kHz)

Summary of the test results: Pass
Refer to APPENDIX 1

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SECTION 9: Radiated emission

9.1 Operating environment

Test place : See test data (APPENDIX 1)
Temperature : See test data (APPENDIX 1)
Humidity : See test data (APPENDIX 1)

9.2 Test configuration

EUT was placed on a platform of nominal size, 0.5m by 0.5m, raised 0.8m above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength. Photographs of the set up are shown in APPENDIX 3.

9.3 Test conditions

Frequency range : 30MHz to 25GHz
EUT position : Table top

9.4 Test procedure

The Radiated Electric Field Strength intensity has been measured on a semi-anechoic chamber with a ground plane and at a distance of 3m (below 15GHz) / 1m (above 15GHz). Measurements were performed with quasi-peak, peak and average detector. The measuring antenna height was varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity. The measurements were performed for both vertical and horizontal antenna polarization.

The radiated emission measurements were made with the following detection of the test receiver and spectrum analyzer.

Frequency	30-1000MHz	1-25GHz		20dBc
Detection type	Quasi-Peak	Peak	* Average	Peak
IF Bandwidth	120kHz	RBW: 1MHz VBW: 3MHz	RBW: 1MHz VBW: 10Hz	RBW: 100kHz VBW: 300kHz

* When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Worst position:

EUT Antenna Type		2dBi			6dBi		
Frequency range		Below 1GHz	Above 1GHz	Carrier	Below 1GHz	Above 1GHz	Carrier
EUT module	Horizontal	X	Y	Z	X	X	Z
	Vertical	Z	Y	Z	Z	Y	Z
EUT Antenna	Horizontal	Y	Y	Y	Y	Y	Y
	Vertical	X	X	X	X	X	X

EUT Antenna Type		9dBi			15dBi		
Frequency range		Below 1GHz	Above 1GHz	Carrier	Below 1GHz	Below 1GHz	Carrier
EUT module	Horizontal	X	X	Z	X	Y	Z
	Vertical	Z	Y	Z	Z	Y	Z
EUT Antenna	Horizontal	Y	Y	Y	X *1)		
	Vertical	X	X	X			

* The definition of the axis was listed in a 'Pre-check of the worst position' in APPENDIX.

*1) EUT Antenna (15dBi):X axis only

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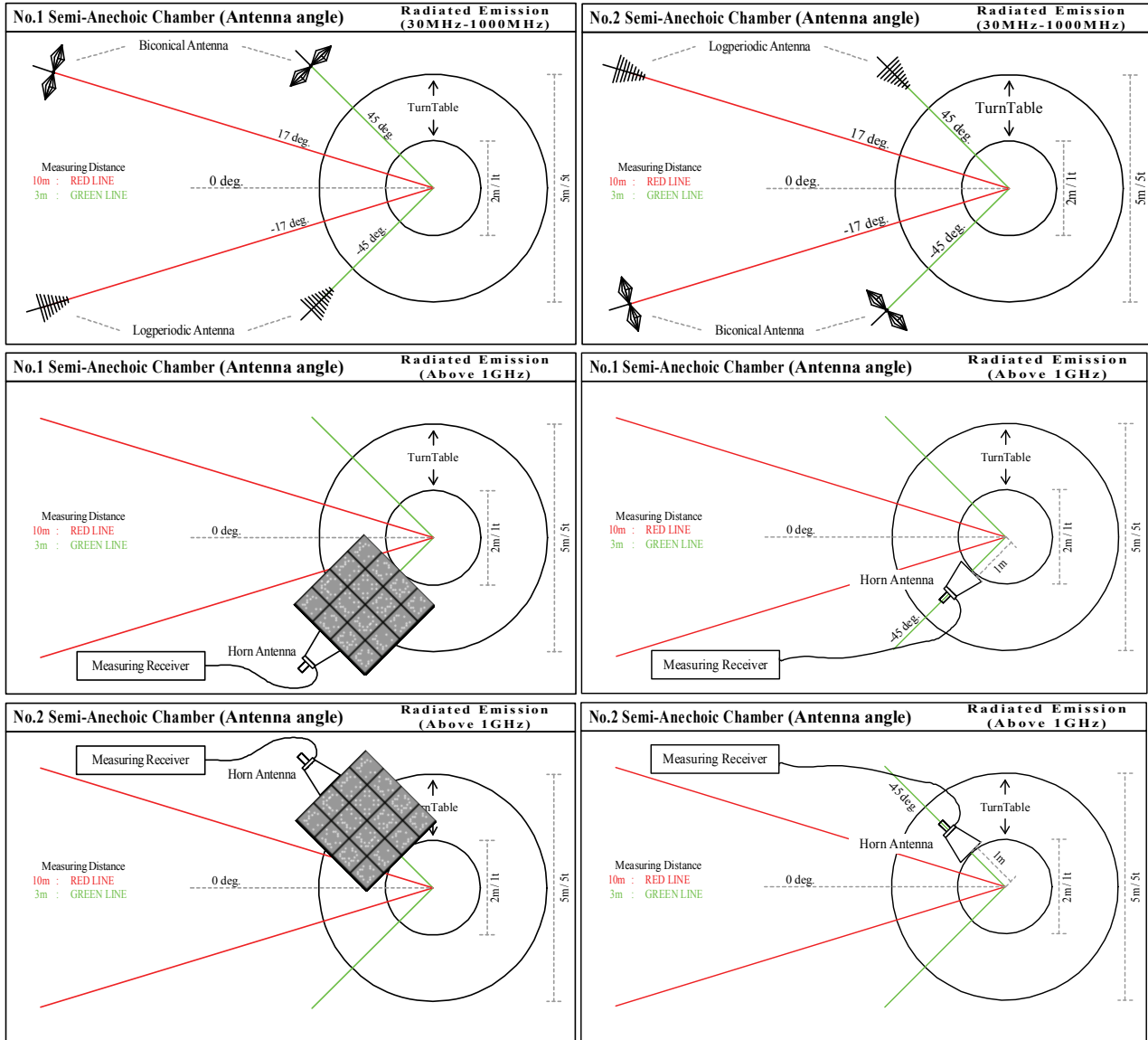
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Figure 1. Antenna angle



9.5 Band edge

Band edge level at 2400MHz is less than 20dB of peak point of the carrier. Band edge level at 2390MHz and 2483.5MHz is below the limits of FCC 15.209. Refer to the data.

9.6 Results

Summary of the test results : Pass *No noise was detected above the 6th order harmonics.
Refer to APPENDIX 1

SECTION 10: Peak Power density

Test procedure

The peak power density was measured with a spectrum analyzer connected to the antenna port.

Instrument used : Spectrum Analyzer *1)
RBW / VBW : 30kHz / 100kHz *2)

*1) PSD Option 1 of " Measurement of Digital Transmission Systems Operating under Section 15.247".

*2) The test was not performed at RBW: 3kHz that was stated in the Regulation. However, the measurement value with RBW: 3kHz is less than the value of RBW: 30kHz and the test data met the limit with RBW: 30kHz.

Summary of the test results: Pass

Refer to APPENDIX 1

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Contents of APPENDIXES

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6dB bandwidth
Maximum peak output power
Radiated emission
Spurious emission (Antenna port conducted)
Peak power density
99% Occupied bandwidth

APPENDIX 2: Test instruments

Test instruments

APPENDIX 3: Photographs of test setup

Conducted emission
Radiated emission
Pre-check of the worst position

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