



RADIO TEST REPORT

Test Report No.: 31DE0149-SH-01-A

Applicant : Yokogawa Electric Corporation
Type of Equipment : VN210 Module
Model No. : VN210
FCC ID : SGJ-WFC001
Test regulation : FCC Part15 Subpart C: 2010
Test result : **Complied**
(Spurious emission test only)

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3. This sample tested is in compliance with the limits of the above regulation.
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Date of test: November 29, 2010

Tested by: *K. Adachi*
Kenichi Adachi
EMC Services

Approved by : *I. Isozaki*
Ichiro Isozaki
Leader of Shonan EMC Lab.

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MF058d (15.09.10)

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SECTION 1: Customer information

Company Name : Yokogawa Electric Corporation
 Address : 2-9-32 Nakacho Musashino-shi Tokyo, 180-8750 Japan
 Telephone Number : +81-422-52-6149
 Facsimile Number : +81-422-52-4891
 Contact Person : Hitoshi Yasui

SECTION 2: Equipment under test (E.U.T.)**2.1 Identification of E.U.T.**

Type of Equipment : VN210 Module
 Model Number : VN210
 Serial Number : 0022-FF00-0002-05BA
 Rating : DC 3.3V
 Country of Mass-production : USA
 Condition of EUT : Production model
 Receipt Date of Sample : November 29, 2010
 Modification of EUT : The test lab did not make the modification to the EUT supplied from the customer to have it pass the tests.

2.2 Product description

Model: VN210 (referred to as the EUT in this report) is a VN210 Module.
 The clock frequencies used in EUT: Timer Clock: 32.768kHz, RF Clock: 24MHz.

The test items of this report is the item in which the change according to the additional antennas influences from original application.

<Radio part>

Equipment type : Transceiver
 Frequency of operation : 2405MHz to 2475MHz
 Radio part clock frequency : 24MHz
 Bandwidth / Channel spacing : 2.65MHz / 5MHz
 Type of modulation : ISA100.11a (O-QPSK)
 Antenna type : Sleeve antenna (AT1089, ASSL-STP-00200),
 Collinear antenna (AT1090, AT1091) *1)
 Antenna connector type : MMCX type
 Antenna gain : AT1089 (= ASSL-NP-00200): 2dBi ,
 ASSL-STP-00200: 2.14dBi ,
 AT1090: 6dBi *1),
 AT1091: 9dBi *1)
 ITU code : G1D
 Operating Voltage (Radio part) : DC 3.3V
 Operation temperature range : -40 to +85deg.C.

*1): This application's additional antennas.

FCC 15.31 (e) / 212

The RF Module do not have voltage regulator. However, this application limited the host equipment, And EUT's voltage is supplied from voltage regulator of the limited host. Therefore, the test voltage was only the voltage of EUT specification. Therefore, this EUT complies with the requirement.

FCC Part 15.203 / 212

The EUT has a unique coupling/antenna connector (MMCX).
 And the installation and replacement of antenna are done by professionals as directed in the user's manual.
 Therefore the equipment complies with the requirement of 15.203 and 15.212.

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SECTION 3: Test specification, procedures & results

3.1 Test specification

Test specification : FCC Part 15 Subpart C: 2010, final revised on October 13, 2010
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

3.2 Procedures & Results

Item	Test Procedure	Specification	Remarks	Deviation	Worst Margin	Results
Conducted Emission	ANSI C63.4:2003 7. AC powerline conducted emission measurements	FCC 15.207	-	N/A	N/A	N/A *1)
6dB Bandwidth	ANSI C63.4:2003 13. Measurement of intentional radiators	FCC 15.247 (a)(2) & 15.209	Conducted	N/A	N/A	N/A *1)
Maximum Peak Output Power	ANSI C63.4:2003 13. Measurement of intentional radiators	FCC 15.247 (b)(3) & 15.209	Conducted	N/A		N/A *1)
Out of Band Emission & Restricted Band Edges	ANSI C63.4:2003 13. Measurement of intentional radiators	FCC 15.109, 15.247 (d) & 15.209	Conducted / Radiated	N/A	Tx 7.0dB (960.002MHz, QP, Horizontal, Tx 2475MHz,) Rx 25.0dB (2440MHz, AV, Horizontal/Vertical, Rx)	Complied
Power Density	ANSI C63.4:2003 13. Measurement of intentional radiators	FCC 15.247 (e) & 15.209	Conducted	N/A	N/A	N/A *1)

Note: UL Japan's EMI Work Procedures No.QPM05 and QPM15.

These tests were also referred to "Guidance on Measurement for Digital Transmission Systems Section15.247".

*1) This tests is not change in this application from original application.(Refer to 30JE0035-SH-C-R2.)

3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied Bandwidth (99%)	ANSI C63.4:2003 13. Measurement of intentional radiators, RSS-Gen 4.6.1	RSS-Gen 4.6.1	Conducted	-	N/A *1)

Note: UL Japan's EMI Work Procedures No.QPM05 and QPM15.

*1) This tests is not change in this application from original application.(Refer to 30JE0035-SH-C-R2.)

*2) Highest antenna gain (in additional antenna) is 9dBi, and Maximum peak output power limit is reduced by 1dB (= Limit: 29dBm, 9dBi is 3dB higher than 6dBi). But Maximum peak output power is 6.05mW (= 7.82dBm), therefore, Maximum peak output power has enough margin. (margin 21.18dB)

*3) 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	9kHz-150kHz	3.7 dB	3.1 dB	3.5 dB
	150kHz-30MHz	3.0 dB	2.6 dB	3.1 dB
Conducted emission (Communication port) ISN	150kHz-30MHz	3.8 dB	3.6 dB	3.9 dB
Radiated emission (Measurement distance: 3m)	9kHz-30MHz	3.4 dB	2.7 dB	3.4 dB
	30MHz-300MHz	4.6 dB	4.5 dB	4.9 dB
	300MHz-1GHz	4.5 dB	4.6 dB	5.1 dB
	1GHz-18GHz	3.9 dB	3.9 dB	4.0 dB
	18GHz-26.5GHz	4.4 dB	4.4 dB	4.4 dB
Radiated emission (Measurement distance: 10m)	9kHz-30MHz	3.2 dB	2.5 dB	-
	30MHz-300MHz	4.6 dB	4.5 dB	-
	300MHz-1GHz	4.4 dB	4.4 dB	-

*1: SAC=Semi-Anechoic Chamber

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

Radiated emission test

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

3.5 Test location

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JAB Accreditation No. : RTL02610

No.1/ No.2/ No.3 anechoic chamber has been fully described in a report submitted to FCC office, and accepted on April 17, 2009 (Registration No.: 697847).

IC Registration No. : 2973D-1 (No1 Semi-Anechoic Chamber)

2973D-2 (No2 Semi-Anechoic Chamber)

2973D-3 (No3 Semi-Anechoic Chamber)

Test room	Width x Depth x Height (m)	Test room	Width x Depth x Height (m)
No.1 Semi-Anechoic Chamber	20.6 x 11.3 x 7.65 Maximum measurement distance: 10m	No.1 Shielded room	6.8 x 4.1 x 2.7
No.2 Semi-Anechoic Chamber	20.6 x 11.3 x 7.65 Maximum measurement distance: 10m	No.2 Shielded room	6.8 x 4.1 x 2.7
No.3 Semi-Anechoic Chamber	12.7 x 7.7 x 5.35 Maximum measurement distance: 5m	No.3 Shielded room	6.3 x 4.7 x 2.7
No.4 Semi-Anechoic Chamber	8.1 x 5.1 x 3.55	No.4 Shielded room	4.4 x 4.7 x 2.7
		No.5 Shielded room	7.8 x 6.4 x 2.7
		No.6 Shielded room	7.8 x 6.4 x 2.7

3.6 Test setup, Data of EMI & Test instruments

Refer to APPENDIX 1 to 3.

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

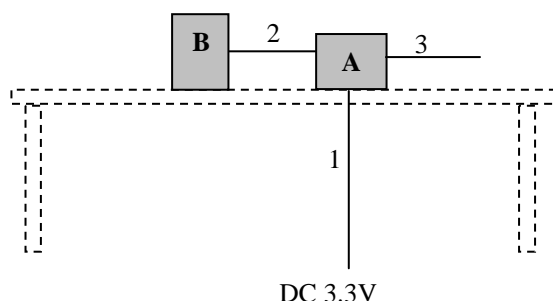
4.1 Operating mode

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

Test sequence is used : Transmitting (Tx) 2405MHz (with normal modulation, Continuous Transmitting)
Transmitting (Tx) 2440MHz (with normal modulation, Continuous Transmitting)
Transmitting (Tx) 2475MHz (with normal modulation, Continuous Transmitting)
Receiving (Rx) 2440MHz (Continuous Receiving)

* EUT's antenna had used bigger gain antenna from 6dBi antenna or 9dBi antenna.

4.2 Configuration and peripherals



*. Cabling and setup were taken into consideration and test data was taken under worse case conditions.

Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks	FCC ID
A	VN210 Module	VN210	0022-FF00-0002-05BA	YOKOGAWA	EUT	SGJ-WFC001
B	Collinear antenna	AT-1091	1	YOKOGAWA	EUT	

List of cables used

No.	Name	Length (m)	Shield	
			Cable	Connector
1	DC cable	1.0	Unshielded	Unshielded
2	Antenna cable	0.4	Shielded	Shielded
3	Signal cable	0.05	Unshielded	Unshielded

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SECTION 5: Radiated emission

5.1 Operating environment

The test was carried out in No.2 Semi-Anechoic Chamber.

Temperature : See test data (APPENDIX 2)

Humidity : See test data (APPENDIX 2)

5.2 Test configuration

EUT was placed on a platform of nominal size, 1m by 1.5m, raised 80cm above the conducting ground plane.

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

The rear of EUT, including its peripherals was aligned and flushed with rear of tabletop. 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.

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 1.

5.3 Test conditions

Frequency range : 30MHz to 26GHz

Test distance : 3m(below 13GHz) / 1m(above13GHz)

EUT position : Table top

EUT operation mode : Refer to SECTION 4.1

5.4 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 13GHz) / 1m(above 13GHz) (Refer to Figure 1). 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.

Frequency	: 30M-1GHz	1G-26GHz
Detection Type	: Quasi-Peak	Peak Average
IF Bandwidth	: 120kHz	RBW:1MHz/VBW:3MHz RBW:1MHz/VBW:3MHz - duty factor *

* We deemed the worst case was with duty 100%. So we performed the test with 100% duty. But we could not detect the worst duty cycle at the real operation (Refer the chart in APPENDIX 4). However, we applied the following values of the customer declaration were adopted as worst case.

$$\text{duty factor} = 20 \times \log \left(\left(\text{worst on times} = 4.096 [\text{ms}] \right) / \left(\text{worst 1 slot times} = 136.5333[\text{ms}] \right) \right)^{-1} = 30.46\text{dB}$$

The equipment (module and antenna) was previously checked at each position of three axes X, Y and Z. The position in which the maximum noise occurred was chosen to put into measurement. See the photographs in appendix.

Combinations of the worst case

	Worst position	
	Below 1GHz	Above 1GHz
Antenna position axis	Horizontal: X, Vertical: Y	Horizontal: X, Vertical: Y
Module position axis	Horizontal: Y, Vertical: Z	Horizontal: Y, Vertical: Z

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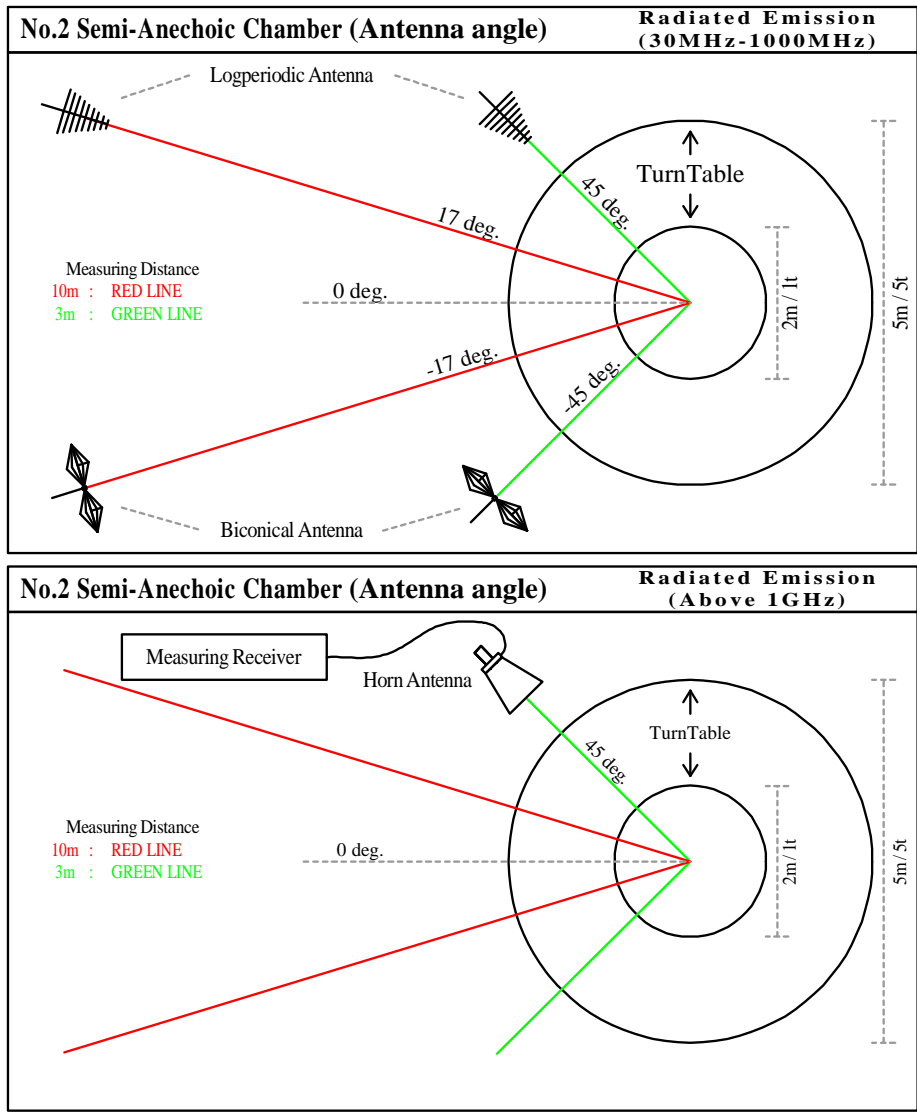
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Figure 1. Antenna angle



5.5 Band edge

Band edge level at 2400MHz is less than 20dB of peak point of the carrier. Refer to the data of Out of Band Emissions (Antenna Port Conducted). Band edge level at 2390MHz and 2483.5MHz is below the limits of FCC 15.209. Refer to the data of Radiated emission.

5.6 Results

Summary of the test results : Pass *No noise was detected above the 5th order harmonics.
Refer to APPENDIX 2

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