




RADIO TEST REPORT


Test Report No.: 10007357S-A

Applicant : Yokogawa Electric Corporation
Type of Equipment : VN210 Module
Model No. : VN210
FCC ID : SGJ-WFC001
Test regulation : FCC Part15 Subpart C: 2012
Test result : **Complied**
(Spurious emission test only)

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6. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.

Date of test: April 26 to 27, 2013

Tested by: 
Akio Hayashi
Engineer of WiSE Japan,
UL Verification Service

Approved by : 
Toyokazu Imamura
Leader of WiSE Japan,
UL Verification Service



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Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN
Telephone : +81 463 50 6400
Facsimile : +81 463 50 6401

13-EM-F0429

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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 : +81-422-52-2102
Contact Person : Yota Furukawa

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-FF00-0002-043A
Rating : DC 3.3V
Country of Mass-production : USA
Condition of EUT : Production model
Receipt Date of Sample : April 24, 2013
Modification of EUT : No modification by the test lab.

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 are 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)
Patch compound antenna with I/F circuit (MTA-11PA15-YO with
I/F circuit) *1)
Patch compound antenna with short stub circuit (MTA-11PA15-YO
with short stub circuit) *1)
Antenna connector type : MMCX type
Antenna gain : AT1089 (= ASSL-NP-00200): 2dBi ,
ASSL-STP-00200: 2.14dBi ,
AT1090: 6dBi
AT1091: 9dBi
MTA-11PA15-YO: 15dBi *1)
ITU code : G1D
Operating Voltage (Radio part) : DC 3.3V
Operation temperature range : -40 to +85deg.C.

*1): This application's additional antennas.

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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.

SECTION 3: Test specification, procedures & results

3.1 Test specification

Test specification : Test specification: FCC Part 15 Subpart C: 2012, final revised on December 27, 2012 and effective January 28, 2013
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 C63.10:2009	FCC 15.207	-	N/A	N/A	N/A *1)
6dB Bandwidth	ANSI C63.10:2009	FCC 15.247 (a)(2) & 15.209	Conducted	N/A	N/A	N/A *1)
Maximum Peak Output Power	ANSI C63.10:2009	FCC 15.247 (b)(3) & 15.209	Conducted	N/A	N/A	N/A *1)
Out of Band Emission & Restricted Band Edges	ANSI C63.10:2009	FCC 15.109, 15.247 (d) & 15.209	Conducted	N/A	N/A	N/A *1)
Out of Band Emission & Restricted Band Edges	ANSI C63.10:2009	FCC 15.109, 15.247 (d) & 15.209	Radiated		5.1dB (2484.785MHz, Peak, Horizontal, Tx 2475MHz,)	Complied
Power Density	ANSI C63.10:2009	FCC 15.247 (e) & 15.209	Conducted	N/A	N/A	N/A *1)

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

These tests were also referred to KDB 558074 v02 "Guidance on Measurement for Digital Transmission Systems Section15.247".

*1) This test is no change in this application from original application (refer to the test report 30JE0035-SH-C-R2).

3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied Bandwidth (99%)	ANSI C63.10:2009, RSS-Gen 4.6.1	-	Conducted	-	-

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

*1) This test is no change in this application from original application (refer to the test report 30JE0035-SH-C-R2).

*2) Highest antenna gain (in additional antenna) is 15dBi, and Maximum peak output power limit is reduced by 3dB (= Limit: 27dBm, 15dBi is 9dB higher than 6dBi). But Maximum peak output power is 6.05mW (= 7.82dBm), therefore, Maximum peak output power has enough margin. (margin 19.18dB)

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

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Facsimile : +81 463 50 6401

3.4 Uncertainty

EMI

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	4.0 dB	4.0 dB	3.9 dB
	150kHz-30MHz	3.6 dB	3.6 dB	3.5 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	4.9 dB
	300MHz-1GHz	5.0 dB	5.2 dB	4.9 dB
	1GHz-18GHz	4.8 dB	4.8 dB	4.9 dB
	18GHz-26.5GHz	4.8 dB	4.5 dB	4.5 dB
Radiated emission (Measurement distance: 10m)	9kHz-30MHz	3.5 dB	3.6 dB	-
	30MHz-300MHz	4.9 dB	5.1 dB	-
	300MHz-1GHz	4.9 dB	5.0 dB	-
Radiated emission (Measurement distance: 1m)	1GHz-18GHz	5.6 dB	5.6 dB	5.6 dB
	18GHz-40GHz	4.6 dB	4.3 dB	4.4 dB

*1: SAC=Semi-Anechoic Chamber

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

*3: Value of Antenna Terminal Voltage measurement is also applies to the No.5 and No.6 Shielded Room.

Radiated emission test

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

3.5 Test location

UL Japan, Inc. Shonan EMC Lab.

1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN

Telephone number : +81 463 50 6400

Facsimile number : +81 463 50 6401

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 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 semi-anechoic chamber	-	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
<input 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 type="checkbox"/> No.6 shielded room	-	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
<input type="checkbox"/> No.7 shielded room	-	-	2.76 x 3.76 x 2.4	2.76 x 3.76	-

3.6 Test setup, Data of EMI & Test instruments

Refer to APPENDIX 1, 2 and 4.

UL Japan, Inc.

Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

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.

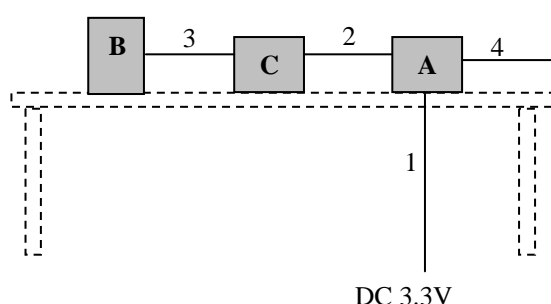
Test sequence is used : Transmitting (Tx) 2405MHz (with normal modulation, Continuous Transmitting)
Transmitting (Tx) 2440MHz (with normal modulation, Continuous Transmitting)
Transmitting (Tx) 2475MHz (with normal modulation, Continuous Transmitting)

*EUT has the power settings by the software as follows;

Software: Test PIS Ver. 1.0.0.0

Power settings: Fixed

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-FF00-0002-043A	YOKOGAWA	EUT	SGJ-WFC001
B	Patch compound antenna	MTA-11PA15-YO	R0808B	YOKOGAWA	EUT	
C *1)	Short stub circuit	F9193AA	NOF257	YOKOGAWA	EUT	
	I/F circuit	F9924BE	Y2MA181			

*1) Short stub circuit and I/F circuit have same role as a device connecting the VN210 module and Antenna.

The board named as 'Short stub circuit' and 'I/F circuit' have some different types. These parts of the role connecting between VN210 and Antenna were designed as the same circuit.

So the carrier level and noise levels were previously confirmed at each device with the representative model Short stub circuit (F9193AA) and I/F circuit (F9924BE). And the test was made at the Short stub circuit (F9193AA) that has the maximum noise.

List of cables used

No.	Name	Length (m)	Shield	
			Cable	Connector
1	DC cable	0.8	Unshielded	Unshielded
2	Antenna cable	0.22 *2)	Shielded	Shielded
		0.05 *3)		
3	Antenna cable	0.16 *2)	Shielded	Shielded
		0.10 *3)		
4	Signal cable	0.05	Unshielded	Unshielded

*2) Used only for the Short Stub / *3) Used only for the I/F circuit

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1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

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SECTION 5: Radiated emission

5.1 Operating environment

The test was carried out in No.1 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, 0.5m by 0.5m, raised 80cm above the conducting ground plane.

The table is made of Styrofoam. That has very low permittivity.

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

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 15GHz) / 1m(above15GHz)
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 15GHz) / 1m(above 15GHz) (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 3). 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.

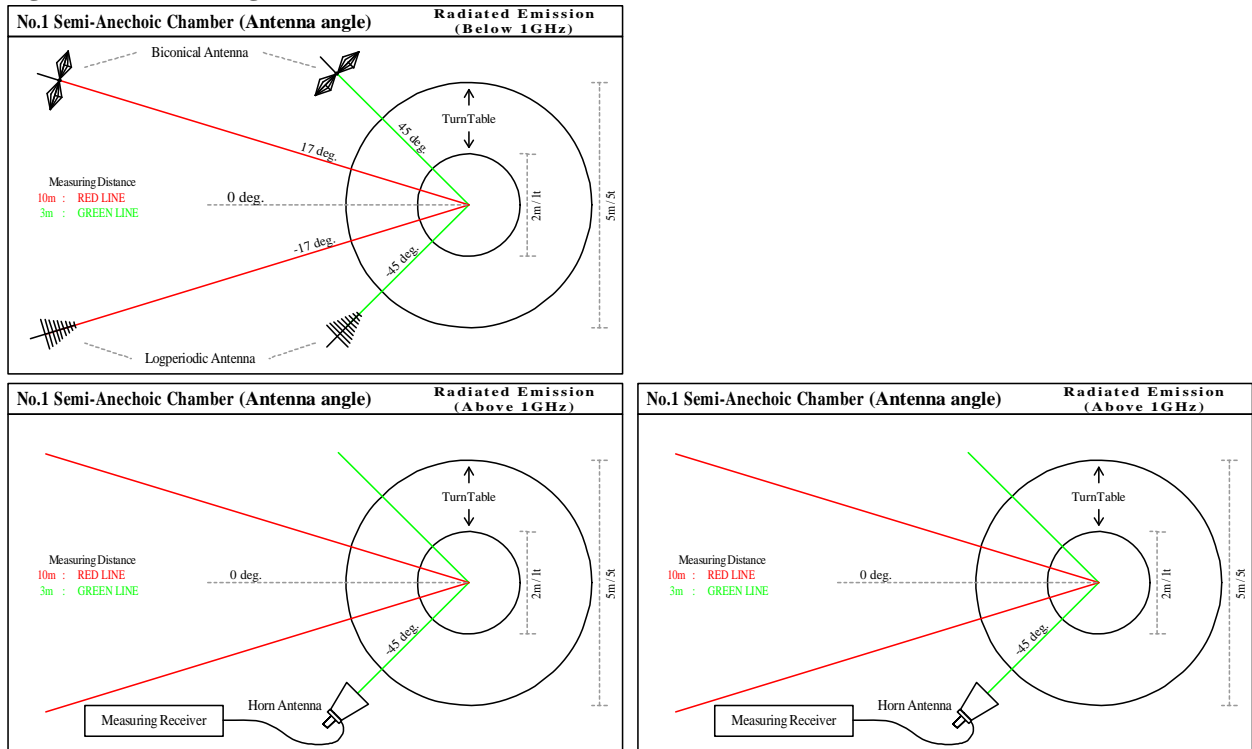
Combinations of the worst case

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

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Figure 1. Antenna angle



5.5 Band edge

Band edge level at 2398.9MHz and 2400MHz are less than 20dB of peak point of the carrier.
 Band edge level at 2390MHz, 2483.5MHz, 2484.785MHz are 2499.58MHz are 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 1

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APPENDIX 1: Data of Radio tests

Radiated emission

APPENDIX 2: Test instruments

Test instruments

APPENDIX 3: Worst Duty Specification

Worst Duty Specification

APPENDIX 1: Photographs of test setup

Radiated emission

Pre-check of worst position

APPENDIX 1: Data of Radio tests

Radiated Emission

Test place	No.1 Semi Anechoic Chamber	No.1 Semi Anechoic Chamber
Date	April 27, 2013	April 28, 2013
Temperature / Humidity	25 deg.C, 37 %RH	21 deg.C, 41 %RH
Engineer	Akio Hayashi	Wataru Kojima
	(1-18GHz)	(30M-1GHz, 18-25GHz)
Mode	Tx, 2405 MHz	
Remarks	Short Stub circuit	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	348.593	QP	45.8	15.1	7.3	31.8	36.4	46.0	9.6	100	333	
Hori.	361.042	QP	44.7	15.3	7.4	31.8	35.6	46.0	10.4	254	345	
Hori.	2213.207	PK	29.4	27.4	3.6	0.0	60.4	73.9	13.5	100	224	
Hori.	2236.598	PK	30.6	27.4	3.6	0.0	61.6	73.9	12.3	100	221	
Hori.	2357.192	PK	32.0	27.5	3.7	0.0	63.2	73.9	10.7	100	227	
Hori.	2380.621	PK	35.3	27.6	3.7	0.0	66.6	73.9	7.3	100	219	
Hori.	2390.000	PK	33.1	27.6	3.7	0.0	64.4	73.9	9.5	100	226	
Hori.	4810.000	PK	66.6	31.2	6.7	41.8	62.7	73.9	11.2	100	120	
Hori.	12025.000	PK	45.7	39.0	10.8	39.9	55.6	73.9	18.3	100	0	
Vert.	37.340	QP	39.5	15.7	7.0	31.8	30.4	40.0	9.6	100	25	
Vert.	348.593	QP	45.3	15.1	7.3	31.8	35.9	46.0	10.1	129	171	
Vert.	361.039	QP	47.2	15.3	7.4	31.8	38.1	46.0	7.9	100	173	
Vert.	373.492	QP	45.0	15.6	7.6	31.8	36.4	46.0	9.6	101	167	
Vert.	2213.207	PK	30.8	27.4	3.6	0.0	61.8	73.9	12.1	116	222	
Vert.	2236.598	PK	31.2	27.4	3.6	0.0	62.2	73.9	11.7	100	220	
Vert.	2357.192	PK	32.4	27.5	3.7	0.0	63.6	73.9	10.3	121	221	
Vert.	2380.621	PK	36.2	27.6	3.7	0.0	67.5	73.9	6.4	117	220	
Vert.	2390.000	PK	35.0	27.6	3.7	0.0	66.3	73.9	7.6	107	224	
Vert.	4810.000	PK	66.2	31.2	6.7	41.8	62.3	73.9	11.6	116	135	
Vert.	12025.000	PK	45.1	39.0	10.8	39.9	55.0	73.9	18.9	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2213.207	AV	29.4	27.4	3.6	0.0	-30.5	29.9	53.9	24.0	
Hori.	2236.598	AV	30.6	27.4	3.6	0.0	-30.5	31.1	53.9	22.8	
Hori.	2357.192	AV	32.0	27.5	3.7	0.0	-30.5	32.7	53.9	21.2	
Hori.	2380.621	AV	35.3	27.6	3.7	0.0	-30.5	36.1	53.9	17.8	
Hori.	2390.000	AV	33.1	27.6	3.7	0.0	-30.5	33.9	53.9	20.0	
Hori.	4810.000	AV	66.6	31.2	6.7	41.8	-30.5	32.2	53.9	21.7	
Hori.	12025.000	AV	45.7	39.0	10.8	39.9	-30.5	25.1	53.9	28.8	
Vert.	2213.207	AV	30.8	27.4	3.6	0.0	-30.5	31.3	53.9	22.6	
Vert.	2236.598	AV	31.2	27.4	3.6	0.0	-30.5	31.7	53.9	22.2	
Vert.	2357.192	AV	32.4	27.5	3.7	0.0	-30.5	33.1	53.9	20.8	
Vert.	2380.621	AV	36.2	27.6	3.7	0.0	-30.5	37.0	53.9	16.9	
Vert.	2390.000	AV	35.0	27.6	3.7	0.0	-30.5	35.8	53.9	18.1	
Vert.	4810.000	AV	66.2	31.2	6.7	41.8	-30.5	31.8	53.9	22.1	
Vert.	12025.000	AV	45.1	39.0	10.8	39.9	-30.5	24.5	53.9	29.4	

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amplifier) - Duty factor

* Since the emission at 2380.621MHz, 2390MHz etc. is not the out of band emission shown in the chart of Band Edge, normally the duty cycle correction does not need to be carried out. But 8.2.4 Alternative 1 was applied to AV detection, since the duty cycle is less than 98% and video triggering or signal gating cannot be used.

*Duty factor = 20 x log(((worst on times = 4.096 [ms]) / (worst 1 slot times = 136.5333[ms]))^(-1)) = 30.46 dB

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

20dBc Data Sheet (RBW 100kHz, VBW 300kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2405.000	PK	80.2	27.6	3.7	0.0	111.5	-	-	Carrier(100k/300k)
Hori.	1924.901	PK	25.4	26.9	3.3	0.0	55.6	91.5	35.9	20dBc
Hori.	2140.885	PK	23.5	27.4	3.5	0.0	54.4	91.5	37.1	20dBc
Hori.	2398.900	PK	40.1	27.6	3.7	0.0	71.4	91.5	20.1	20dBc
Hori.	2400.000	PK	36.9	27.6	3.7	0.0	68.2	91.5	23.3	20dBc
Hori.	7215.000	PK	51.5	36.0	8.3	41.4	54.4	91.5	37.1	20dBc
Hori.	9620.000	PK	47.9	38.1	9.4	40.6	54.8	91.5	36.7	20dBc
Vert.	2405.000	PK	80.4	27.6	3.7	0.0	111.7	-	-	Carrier(100k/300k)
Vert.	1924.901	PK	25.4	26.9	3.3	0.0	55.6	91.7	36.1	20dBc
Vert.	2140.885	PK	25.2	27.4	3.5	0.0	56.1	91.7	35.6	20dBc
Vert.	2398.900	PK	40.5	27.6	3.7	0.0	71.8	91.7	19.9	20dBc
Vert.	2400.000	PK	37.2	27.6	3.7	0.0	68.5	91.7	23.2	20dBc
Vert.	7215.000	PK	52.1	36.0	8.3	41.4	55.0	91.7	36.7	20dBc
Vert.	9620.000	PK	51.3	38.1	9.4	40.6	58.2	91.7	33.5	20dBc

Result = Reading + Ant.Fac. + Loss(Cable+Attenuator+Filter) - Gain(Amplifier)

UL Japan, Inc.

Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Emission

Test place	No.1 Semi Anechoic Chamber	No.1 Semi Anechoic Chamber
Date	April 27, 2013	April 28, 2013
Temperature / Humidity	25 deg.C, 37 %RH	21 deg.C, 41 %RH
Engineer	Akio Hayashi	Wataru Kojima
	(1-18GHz)	(30M-1GHz, 18-25GHz)
Mode	Tx, 2440 MHz	
Remarks	Short Stub circuit	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	348.593	QP	45.8	15.1	7.3	31.8	36.4	46.0	9.6	100	333	
Hori.	361.042	QP	44.7	15.3	7.4	31.8	35.6	46.0	10.4	254	345	
Hori.	2200.643	PK	31.1	27.4	3.6	0.0	62.1	73.9	11.8	100	229	
Hori.	2223.914	PK	32.9	27.4	3.6	0.0	63.9	73.9	10.0	100	228	
Hori.	2367.911	PK	31.5	27.6	3.7	0.0	62.8	73.9	11.1	100	227	
Hori.	2488.602	PK	32.8	27.7	3.8	0.0	64.3	73.9	9.6	100	228	
Hori.	4880.000	PK	65.3	31.3	6.7	41.7	61.6	73.9	12.3	100	117	
Hori.	7320.000	PK	56.4	36.2	8.3	41.4	59.5	73.9	14.4	131	102	
Hori.	12200.000	PK	46.8	38.9	10.6	39.9	56.4	73.9	17.5	100	0	
Vert.	37.340	QP	39.5	15.7	7.0	31.8	30.4	40.0	9.6	100	25	
Vert.	348.593	QP	45.3	15.1	7.3	31.8	35.9	46.0	10.1	129	171	
Vert.	361.039	QP	47.2	15.3	7.4	31.8	38.1	46.0	7.9	100	173	
Vert.	373.492	QP	45.0	15.6	7.6	31.8	36.4	46.0	9.6	101	167	
Vert.	2200.643	PK	30.3	27.4	3.6	0.0	61.3	73.9	12.6	121	223	
Vert.	2223.914	PK	31.9	27.4	3.6	0.0	62.9	73.9	11.0	113	223	
Vert.	2367.911	PK	31.0	27.6	3.7	0.0	62.3	73.9	11.6	117	226	
Vert.	2488.602	PK	32.3	27.7	3.8	0.0	63.8	73.9	10.1	110	224	
Vert.	4880.000	PK	66.0	31.3	6.7	41.7	62.3	73.9	11.6	100	133	
Vert.	7320.000	PK	55.1	36.2	8.3	41.4	58.2	73.9	15.7	100	114	
Vert.	12200.000	PK	45.8	38.9	10.6	39.9	55.4	73.9	18.5	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2200.643	AV	31.1	27.4	3.6	0.0	-30.5	31.6	53.9	22.3	
Hori.	2223.914	AV	32.9	27.4	3.6	0.0	-30.5	33.4	53.9	20.5	
Hori.	2367.911	AV	31.5	27.6	3.7	0.0	-30.5	32.3	53.9	21.6	
Hori.	2488.602	AV	32.8	27.7	3.8	0.0	-30.5	33.8	53.9	20.1	
Hori.	4880.000	AV	65.3	31.3	6.7	41.7	-30.5	31.1	53.9	22.8	
Hori.	7320.000	AV	56.4	36.2	8.3	41.4	-30.5	29.0	53.9	24.9	
Hori.	12200.000	AV	46.8	38.9	10.6	39.9	-30.5	25.9	53.9	28.0	
Vert.	2200.643	AV	30.3	27.4	3.6	0.0	-30.5	30.8	53.9	23.1	
Vert.	2223.914	AV	31.9	27.4	3.6	0.0	-30.5	32.4	53.9	21.5	
Vert.	2367.911	AV	31.0	27.6	3.7	0.0	-30.5	31.8	53.9	22.1	
Vert.	2488.602	AV	32.3	27.7	3.8	0.0	-30.5	33.3	53.9	20.6	
Vert.	4880.000	AV	66.0	31.3	6.7	41.7	-30.5	31.8	53.9	22.1	
Vert.	7320.000	AV	55.1	36.2	8.3	41.4	-30.5	27.7	53.9	26.2	
Vert.	12200.000	AV	45.8	38.9	10.6	39.9	-30.5	24.9	53.9	29.0	

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amplifier) - Duty factor

* Since the emission at 2367.911MHz, 2488.602MHz etc. is not the out of band emission shown in the chart of Band Edge, normally the duty cycle correction does not need to be carried out. But 8.2.4 Alternative 1 was applied to AV detection, since the duty cycle is less than 98% and video triggering or signal gating cannot be used.

*Duty factor = 20 x log(((worst on times = 4.096 [ms]) / (worst 1 slot times = 136.5333[ms]))^(-1)) = 30.46 dB

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

20dBc Data Sheet (RBW 100kHz, VBW 300kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2440.000	PK	79.9	27.6	3.8	0.0	111.3	-	-	Carrier(100k/300k)
Hori.	2127.860	PK	24.9	27.4	3.5	0.0	55.8	91.3	35.5	20dBc
Hori.	2392.375	PK	27.9	27.6	3.7	0.0	59.2	91.3	32.1	20dBc
Hori.	9760.000	PK	48.0	38.1	9.4	40.6	54.9	91.3	36.4	20dBc
Vert.	2440.000	PK	79.7	27.6	3.8	0.0	111.1	-	-	Carrier(100k/300k)
Vert.	2127.860	PK	24.7	27.4	3.5	0.0	55.6	91.1	35.5	20dBc
Vert.	2392.375	PK	27.6	27.6	3.7	0.0	58.9	91.1	32.2	20dBc
Vert.	9760.000	PK	48.5	38.1	9.4	40.6	55.4	91.1	35.7	20dBc

Result = Reading + Ant.Fac. + Loss(Cable+Attenuator+Filter) - Gain(Amplifier)

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Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Emission

Test place	No.1 Semi Anechoic Chamber	No.1 Semi Anechoic Chamber
Date	April 27, 2013	April 28, 2013
Temperature / Humidity	25 deg.C, 37 %RH	21 deg.C, 41 %RH
Engineer	Akio Hayashi	Wataru Kojima
	(1-18GHz)	(30M-1GHz, 18-25GHz)
Mode	Tx, 2475 MHz	
Remarks	Short Stub circuit	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	348.592	QP	45.2	15.1	7.3	31.8	35.8	46.0	10.2	100	335	
Hori.	361.043	QP	44.5	15.3	7.4	31.8	35.4	46.0	10.6	246	336	
Hori.	863.997	QP	34.6	22.5	9.9	31.6	35.4	46.0	10.6	100	220	
Hori.	2211.417	PK	32.7	27.4	3.6	0.0	63.7	73.9	10.2	100	228	
Hori.	2483.500	PK	33.7	27.6	3.8	0.0	65.1	73.9	8.8	100	228	
Hori.	2484.785	PK	37.4	27.6	3.8	0.0	68.8	73.9	5.1	100	226	
Hori.	2499.580	PK	35.8	27.7	3.8	0.0	67.3	73.9	6.6	100	224	
Hori.	4950.000	PK	65.8	31.5	6.8	41.6	62.5	73.9	11.4	100	123	
Hori.	7425.000	PK	54.3	36.3	8.3	41.4	57.5	73.9	16.4	100	143	
Hori.	12375.000	PK	45.0	38.9	10.4	39.8	54.5	73.9	19.4	100	0	
Vert.	37.349	QP	39.6	15.7	7.0	31.8	30.5	40.0	9.5	100	1	
Vert.	348.593	QP	46.4	15.1	7.3	31.8	37.0	46.0	9.0	124	183	
Vert.	361.037	QP	47.8	15.3	7.4	31.8	38.7	46.0	7.3	100	173	
Vert.	373.491	QP	45.2	15.6	7.6	31.8	36.6	46.0	9.4	100	162	
Vert.	2211.417	PK	31.9	27.4	3.6	0.0	62.9	73.9	11.0	100	225	
Vert.	2483.500	PK	34.4	27.6	3.8	0.0	65.8	73.9	8.1	113	226	
Vert.	2484.785	PK	37.2	27.6	3.8	0.0	68.6	73.9	5.3	113	226	
Vert.	2499.580	PK	35.8	27.7	3.8	0.0	67.3	73.9	6.6	114	225	
Vert.	4950.000	PK	65.0	31.5	6.8	41.6	61.7	73.9	12.2	128	133	
Vert.	7425.000	PK	55.9	36.3	8.3	41.4	59.1	73.9	14.8	100	110	
Vert.	12375.000	PK	44.9	38.9	10.4	39.8	54.4	73.9	19.5	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2211.417	AV	32.7	27.4	3.6	0.0	-30.5	33.2	53.9	20.7	
Hori.	2483.500	AV	33.7	27.6	3.8	0.0	-30.5	34.6	53.9	19.3	
Hori.	2484.785	AV	37.4	27.6	3.8	0.0	-30.5	38.3	53.9	15.6	
Hori.	2499.580	AV	35.8	27.7	3.8	0.0	-30.5	36.8	53.9	17.1	
Hori.	4950.000	AV	65.8	31.5	6.8	41.6	-30.5	32.0	53.9	21.9	
Hori.	7425.000	AV	54.3	36.3	8.3	41.4	-30.5	27.0	53.9	26.9	
Hori.	12375.000	AV	45.0	38.9	10.4	39.8	-30.5	24.0	53.9	29.9	
Vert.	2211.417	AV	31.9	27.4	3.6	0.0	-30.5	32.4	53.9	21.5	
Vert.	2483.500	AV	34.4	27.6	3.8	0.0	-30.5	35.3	53.9	18.6	
Vert.	2484.785	AV	37.2	27.6	3.8	0.0	-30.5	38.1	53.9	15.8	
Vert.	2499.580	AV	35.8	27.7	3.8	0.0	-30.5	36.8	53.9	17.1	
Vert.	4950.000	AV	65.0	31.5	6.8	41.6	-30.5	31.2	53.9	22.7	
Vert.	7425.000	AV	55.9	36.3	8.3	41.4	-30.5	28.6	53.9	25.3	
Vert.	12375.000	AV	44.9	38.9	10.4	39.8	-30.5	23.9	53.9	30.0	

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amplifier) - Duty factor

* Since the emission at 2483.5MHz, 2484.785MHz, etc. is not the out of band emission shown in the chart of Band Edge, normally the duty cycle correction does not need to be carried out. But 8.2.4 Alternative 1 was applied to AV detection, since the duty cycle is less than 98% and video triggering or signal gating cannot be used.

*Duty factor = 20 x log(((worst on times = 4.096 [ms]) / (worst 1 slot times = 136.5333[ms]))^(-1)) = 30.46 dB

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

20dBc Data Sheet (RBW 100kHz, VBW 300kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2475.000	PK	79.4	27.6	3.8	0.0	110.8	-	-	Carrier(100k/300k)
Hori.	2114.882	PK	24.8	27.4	3.5	0.0	55.7	90.8	35.1	20dBc
Hori.	2522.715	PK	23.4	27.7	3.8	0.0	54.9	90.8	35.9	20dBc
Hori.	9900.000	PK	45.9	38.1	9.3	40.7	52.6	90.8	38.2	20dBc
Vert.	2475.000	PK	79.5	27.6	3.8	0.0	110.9	-	-	Carrier(100k/300k)
Vert.	2114.882	PK	24.7	27.4	3.5	0.0	55.6	90.9	35.3	20dBc
Vert.	2522.715	PK	22.5	27.7	3.8	0.0	54.0	90.9	36.9	20dBc
Vert.	9900.000	PK	49.8	38.1	9.3	40.7	56.5	90.9	34.4	20dBc

Result = Reading + Ant.Fac. + Loss(Cable+Attenuator+Filter) - Gain(Amplifier)

UL Japan, Inc.**Shonan EMC Lab.****1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa 259-1220 JAPAN****Telephone : +81 463 50 6400****Facsimile : +81 463 50 6401**

APPENDIX 2

Test Instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAEC-01(NSA)	Semi-Anechoic Chamber	TDK	SAEC-01(NSA)	1	RE	2012/09/11 * 12
SAF-04	Pre Amplifier	TOYO Corporation	TPA0118-36	1440489	RE	2013/03/19 * 12
SCC-G01	Coaxial Cable	Suhner	SUCOFLEX 104A	46497/4A	RE	2013/04/09 * 12
SCC-G21	Coaxial Cable	Suhner	SUCOFLEX 104	296169/4	RE	2012/05/22 * 12
SHA-01	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-725	RE	2012/08/20 * 12
SOS-01	Humidity Indicator	A&D	AD-5681	4062555	RE	2013/02/27 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2013/03/28 * 12
SJM-08	Measure	PROMART	SEN1935	-	RE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RF,LF)	-	RE	-
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2012/12/18 * 12
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM3640	RE	2013/03/14 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2013/03/19 * 12
SCC-G15	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2		2013/03/16 * 12
SAF-01	Pre Amplifier	SONOMA	310N	290211	RE	2013/02/12 * 12
SAT6-05	Attenuator	JFW	50HF-006N	-	RE	2013/02/12 * 12
SAT3-04	Attenuator	JFW	50HF-003N	-	RE	2013/02/12 * 12
SBA-01	Biconical Antenna	Schwarzbeck	BBA9106	91032664	RE	2012/10/08 * 12
SCC-A1/A3/A5/A7/A8/A13/SRSE-01	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-269(RF Selector)	RE	2013/04/04 * 12
SCC-A2/A4/A6/A7/A8/A13/SRSE-01	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-269(RF Selector)	RE	2013/04/04 * 12
SLA-01	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0888	RE	2012/11/18 * 12
STR-01	Test Receiver	Rohde & Schwarz	ESU40	100093	RE	2012/10/04 * 12

The expiration date of the calibration is the end of the expired month .

As for some calibrations performed after the tested dates , those test equipment have been controlled by means of an unbroken chains of calibrations .

All equipment is calibrated with valid calibrations . Each measurement data is traceable to the national or international standards .

Test Item :

RE: Radiated emission

APPENDIX 3

Duty cycle specification

Maximum transmitter duty cycle in Nivis ISA system: 3%

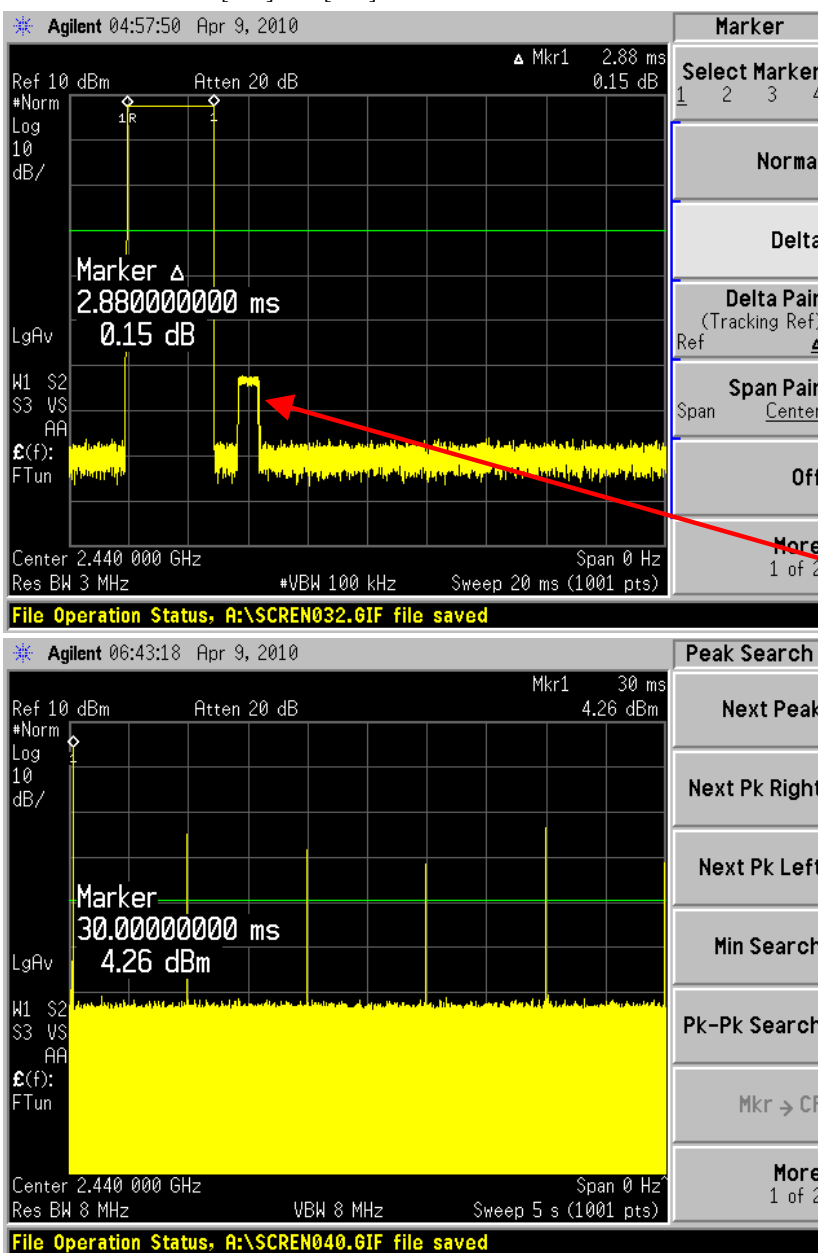
Maximum "ON" time – 4.096ms

Minimum timeslot duration –136.5333ms

Yokogawa Electric Corporation
 Tomoyuki.Kamoshita
 2010.5.27

(Reference data)

Yokogawa Electric Corporation
 by Tomoyuki Kamoshita
 0.00288[sec.] / 1.0[sec.] = 0.288 %



from other party
of communication
equipment