

## EN 300 328 RF Test Report (Radiated Test)

**Report No.:** RE160104C01-3

**Test Model:** Type1GC

**Received Date:** Jan. 04, 2016

**Test Date:** Feb. 03, 2016

**Issued Date:** Mar. 24, 2016

**Applicant:** Murata Manufacturing Co., Ltd.

**Address:** 10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555, Japan

**Issued By:** Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

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**Test Location:** No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)



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### Release Control Record

Issue No.	Description	Date Issued
RE160104C01-3	Original release.	Mar. 24, 2016

## 1 Certificate of Conformity

**Product:** Communication Module  
**Brand:** MURATA  
**Test Model:** Type1GC  
**Sample Status:** Engineering sample  
**Applicant:** Murata Manufacturing Co., Ltd.  
**Test Date:** Feb. 03, 2016  
**Standards:** EN 300 328 V1.9.1 (2015-02)

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

**Prepared by :**  , **Date:** Mar. 24, 2016  
Polly Chien / Specialist

**Approved by :**  , **Date:** Mar. 24, 2016  
Ken Liu / Senior Manager

## 2 Summary of Test Results

The EUT has been tested according to the following specifications:

EN 300 328 V1.9.1		
Clause	Test Parameter	Results
	<b>Transmitter Parameters</b>	
4.3.2.2	RF Output Power	Refer to Note
4.3.2.3	Power Spectral Density (Modulations other than FHSS equipment)	Refer to Note
4.3.2.4	Duty cycle, Tx-sequence, Tx-gap (Non-adaptive equipment)	Not Applicable
4.3.2.5	Medium Utilisation (Non-Adaptive Equipment)	Not Applicable
4.3.2.6	Adaptivity (Adaptive Equipment)	Refer to Note
4.3.2.7	Occupied Channel Bandwidth	Refer to Note
4.3.2.8	Transmitter Unwanted Emissions in the OOB Domain	Refer to Note
4.3.2.9	Transmitter Unwanted Emissions in the Spurious Domain	Pass
	<b>Receiver Parameters</b>	
4.3.2.10	Receiver Spurious Emissions	Pass
4.3.2.11	Receiver Blocking (Only for Adaptive equipment)	Refer to Note
4.3.2.12	Geo-location capability	Not Applicable

Note: For other test items were recorded in Report No.: RE160104C01.

## 2.1 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Spectrum Analyzer Agilent	N9030A	MY54490617	Jul. 14, 2015	Jul. 13, 2016
Spectrum Analyzer Rohde & Schwarz	FSV40	101042	Sep. 23, 2015	Sep. 22, 2016
Vector signal generator Agilent	E4438C	MY47271120	Sep. 24, 2015	Sep. 23, 2016
Open Switch and Control Unit Rohde & Schwarz	OSP120	B157-100898	Jan. 08, 2016	Jan. 07, 2017
Vector Signal Generator Rohde & Schwarz	SMJ 100A	101943	Dec. 03, 2015	Dec. 02, 2016
RF and Microwave Signal Generator Rohde & Schwarz	SMB100A	177994	Dec. 25, 2015	Dec. 24, 2016
BILOG Antenna SCHWARZBECK	VULB 9168	9168-158	Jan. 18, 2016	Jan. 17, 2017
HORN Antenna ETS	3117	00034128	Jan. 20, 2016	Jan. 19, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170243	Jan. 20, 2016	Jan. 19, 2017
Preamplifier Agilent	8449B	3008A01963	Aug. 22, 2015	Aug. 21, 2016
Preamplifier Agilent	8447D	2944A10627	Aug. 22, 2015	Aug. 21, 2016
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-RF1-03 (274397-4)	Nov. 02, 2015	Nov. 01, 2016
RF signal cable HUBER+SUHNER	CA3501-3501-G.90 (3m) & CA3501-3501-F.90 (2m)	NF090 (3m)*2 & TCF427S (2m)*1	Apr. 07, 2015	Apr. 06, 2016
Software ADT	ADT_Radiated_ V7.6.15.9.4	NA	NA	NA
Antenna Tower Max-Full	MFA-440H	9707	NA	NA
Turn Table ADT	NA	SN40303	NA	NA
Controller Max-Full	MF-7802	MF7802093	NA	NA
Temperature & Humidity chamber TERCHY	MHU-225AU	920842	Jun. 18, 2015	Jun. 17, 2016

- Note:
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
  2. The test was performed in HwaYa RF Chamber 1.
  3. The horn antenna and HP preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.

## 2.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

Parameter	Uncertainty
Radio frequency	$\pm 1.06 \times 10^{-8}$
Total RF power, conducted	1.371 dB
RF power density, conducted	2.889 dB
All emissions, radiated	$\pm 3.0127$ dB
Temperature	$\pm 0.23$ °C
Humidity	$\pm 0.3$ %
DC and low frequency voltages	$\pm 0.3$ %

## 2.3 Maximum Measurement Uncertainty

For the test methods, according to ETSI EN 300 328 standard, the measurement uncertainty figures shall be calculated in accordance with ETR 100 028-1 [4] and shall correspond to an expansion factor (coverage factor)  $k = 1,96$  or  $k = 2$  (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Maximum measurement uncertainty

Parameter	Uncertainty
Radio frequency	$\pm 1 \times 10^{-5}$
Total RF power, conducted	$\pm 1.5$ dB
RF power density, conducted	$\pm 3$ dB
All emissions, radiated	$\pm 6.0$ dB
Temperature	$\pm 1$ °C
Humidity	$\pm 5.0$ %
DC and low frequency voltages	$\pm 3.0$ %
Time	$\pm 5$ %

## 2.4 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

Product	Communication Module
Brand	MURATA
Test Model	Type1GC
Status of EUT	Engineering sample
Nominal Voltage	3.6Vdc (host)
Voltage Operation Range	3.6Vdc
Temperature Operating Range	-40~85°C
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: 11.0/ 5.5/ 2.0/ 1.0Mbps 802.11g: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0Mbps 802.11n (HT20): up to 65Mbps
Operating Frequency	2412 ~ 2472MHz
Number of Channel	802.11b, 802.11g, 802.11n (HT20): 13
Antenna Type	Monopole pattern antenna with 1.2dBi gain
Antenna Connector	NA
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. The EUT provides one completed transmitter and one receiver.

Modulation Mode	TX Function
802.11b	1TX
802.11g	1TX
802.11n (HT20)	1TX

2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

### 3.2 Description of Test Modes

13 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency	Channel	Frequency
1	2412 MHz	8	2447 MHz
2	2417 MHz	9	2452 MHz
3	2422 MHz	10	2457 MHz
4	2427 MHz	11	2462 MHz
5	2432 MHz	12	2467 MHz
6	2437 MHz	13	2472 MHz
7	2442 MHz		

### 3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to		Description
	SE< 1G	SE≥ 1G	
-	√	√	-

Where SE<1G: Unwanted Emissions in the Spurious Domain below 1 GHz SE≥1G: Unwanted Emissions in the Spurious Domain above 1 GHz

Note: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane**.

#### Unwanted Emissions in the Spurious Domain Test (Below 1 GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 13	1	DSSS	DBPSK	1.0

#### Unwanted Emissions in the Spurious Domain Test (above 1 GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
TX						
-	802.11b	1 to 13	1, 13	DSSS	DBPSK	1.0
-	802.11g	1 to 13	1, 13	OFDM	BPSK	6.0
RX						
-	802.11b	1 to 13	1, 13	DSSS	DBPSK	1.0

#### Test Condition:

Applicable to	Environmental Conditions	Input Power (System)	Tested by
SE<1G	23deg. C, 70%RH	230Vac, 50Hz	Kevin Kuo
SE≥1G	23deg. C, 70%RH	230Vac, 50Hz	Kevin Kuo

### 3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Notebook	DELL	E5430	FKKCYW1	FCC DoC Approved	-
B.	Power Supply	TOPWARD	6303D	802236	NA	-
C.	Jig board	NA	NA	NA	NA	Provided by manufacturer

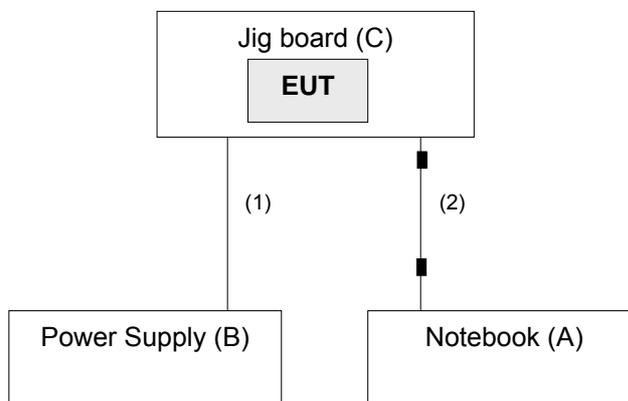
Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items A, B acted as communication partners to transfer data and under test table during test.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC power cable	4	1.8	-	0	-
2.	USB cable	1	1.8	Y	2	Provided by manufacturer

**NOTE:** The core(s) is(are) originally attached to the cable(s).

#### 3.3.1 Configuration of System under Test



### 3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

**ETSI EN 300 328 V1.9.1 (2015-02)**

All test items have been performed and recorded as per the above standard.

## 4 Test Procedure and Results

### Transmitter Parameters

#### 4.1 Transmitter Spurious Emissions

##### 4.1.1 Limits of Transmitter Spurious Emissions

Frequency Range	Maximum Power Limit	Bandwidth
30 MHz to 47 MHz	-36dBm	100kHz
47 MHz to 74 MHz	-54dBm	100kHz
74 MHz to 87,5 MHz	-36dBm	100kHz
87,5 MHz to 118 MHz	-54dBm	100kHz
118 MHz to 174 MHz	-36dBm	100kHz
174 MHz to 230 MHz	-54dBm	100kHz
230 MHz to 470 MHz	-36dBm	100kHz
470 MHz to 862 MHz	-54dBm	100kHz
862 MHz to 1 GHz	-36dBm	100kHz
1GHz ~ 12.75GHz	-30dBm	1MHz

##### 4.1.2 Test Procedure

Refer to chapter 5.3.10.2 of ETSI EN 300 328 V1.9.1.

Measurement Method	
<input type="checkbox"/> Conducted measurement	<input checked="" type="checkbox"/> Radiated measurement
<p><u>For Conducted measurement:</u></p> <p>The level of unwanted emissions shall be measured as their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation).</p>	
<p><u>Conducted measurement (For equipment with multiple transmit chains):</u></p> <p><input type="checkbox"/> Option 1: The results for each of the transmit chains for the corresponding 1MHz segments shall be added and compared with the limits.</p> <p><input type="checkbox"/> Option 2: The results for each of the transmit chains shall be individually compared with the limits after these limits have been reduced by <math>10 \times \log(N)</math> (number of active transmit chains)</p>	

##### 4.1.3 Deviation from Test Standard

No deviation.

#### 4.1.4 Test Setup

1. For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration).
2. The equipment was configured to operate under its worst case situation with respect to output power.
3. The test setup has been constructed as the normal use condition. Controlling software (provided by manufacturer) has been activated to set the EUT on specific status.

#### 4.1.5 Test Results

Below 1GHz Worst-case Data: 802.11b

Frequency Range	30MHz ~ 1GHz	Operating Channel	1
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Spurious Emission Level				
Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
54.98	V	-67.39	-54.00	-13.39
56.98	H	-70.56	-54.00	-16.56
89.40	V	-70.25	-54.00	-16.25
99.59	H	-70.84	-54.00	-16.84
165.99	H	-68.66	-36.00	-32.66
229.76	V	-67.99	-54.00	-13.99
233.22	H	-66.86	-36.00	-30.86
527.98	V	-69.19	-54.00	-15.19
663.27	V	-69.75	-54.00	-15.75
666.44	H	-68.30	-54.00	-14.30
792.02	V	-65.63	-54.00	-11.63
798.31	H	-66.48	-54.00	-12.48

Above 1GHz Worst-case Data:

802.11b

Frequency Range	1GHz ~ 12.75GHz	Operating Channel	1, 13
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Spurious Emission Level					
Channel	Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
1	4823.99	V	-52.39	-30.00	-22.39
	4824.04	H	-51.80	-30.00	-21.80
13	4944.04	V	-51.49	-30.00	-21.49
	4944.16	H	-50.85	-30.00	-20.85

802.11g

Frequency Range	1GHz ~ 12.75GHz	Operating Channel	1, 13
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Spurious Emission Level					
Channel	Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
1	4823.77	H	-51.29	-30.00	-21.29
	4824.24	V	-51.60	-30.00	-21.60
13	4944.01	H	-51.71	-30.00	-21.71
	4944.47	V	-51.53	-30.00	-21.53

## Receiver Parameters

### 4.2 Receiver Spurious Radiation

#### 4.2.1 Limit of Receiver Spurious Radiation

Frequency Range	Maximum Power Limit
30 MHz ~ 1 GHz	-57dBm
1 GHz ~ 12.75 GHz	-47dBm

#### 4.2.2 Test Procedure

Refer to chapter 5.3.11.2 of ETSI EN 300 328 V1.9.1.

Measurement Method	
<input type="checkbox"/> Conducted measurement	<input checked="" type="checkbox"/> Radiated measurement
<p><u>For Conducted measurement:</u></p> <p>The level of unwanted emissions shall be measured as their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation).</p>	
<p><u>Conducted measurement (For equipment with multiple transmit chains):</u></p> <p><input type="checkbox"/> Option 1: The results for each of the transmit chains for the corresponding 1MHz segments shall be added and compared with the limits.</p> <p><input type="checkbox"/> Option 2: The results for each of the transmit chains shall be individually compared with the limits after these limits have been reduced by <math>10 \times \log(N)</math> (number of active transmit chains)</p>	

#### 4.2.3 Deviation from Test Standard

No deviation.

#### 4.2.4 Test Setup

1. For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration).
2. Testing was performed when the equipment was in a receive-only mode.
3. The test setup has been constructed as the normal use condition. Controlling software (provided by manufacturer) has been activated to set the EUT on specific status.

#### 4.2.5 Test Results

Worst-case Data: 802.11b

Frequency Range	30MHz ~ 1GHz	Operating Channel	1
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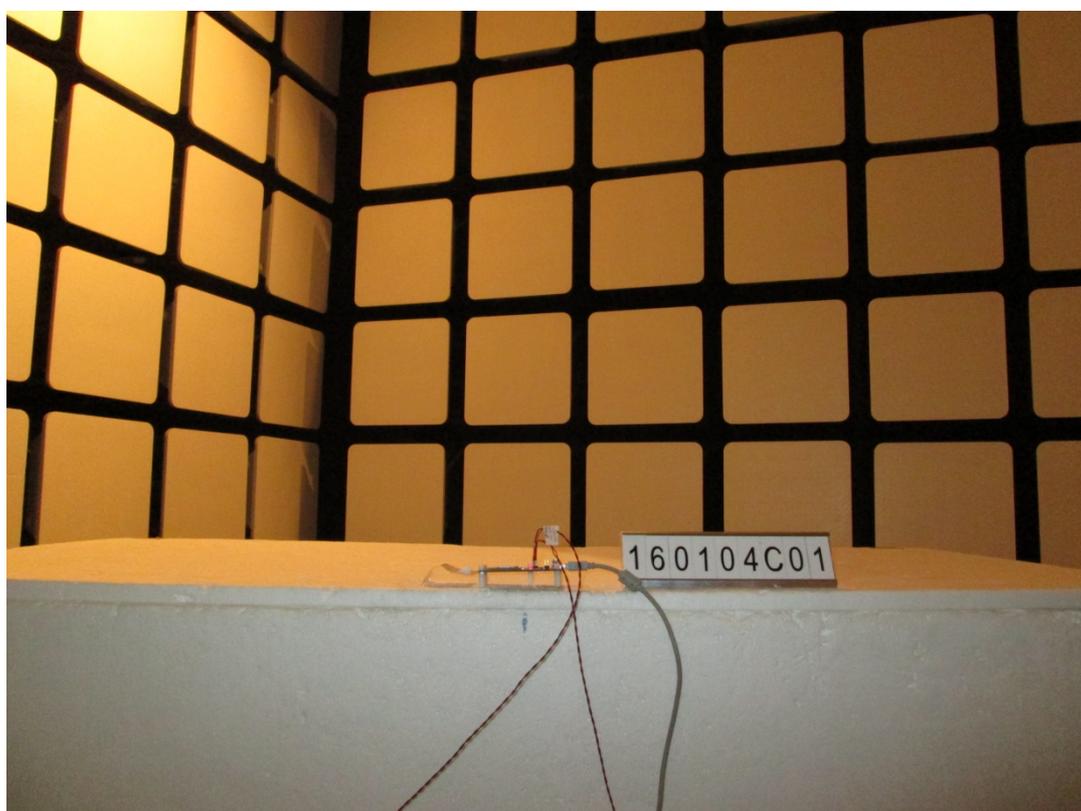
Spurious Emission Level				
Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
97.64	V	-69.48	-57.00	-12.48
97.69	H	-73.08	-57.00	-16.08
165.99	H	-73.71	-57.00	-16.71
166.28	V	-65.77	-57.00	-8.77
240.00	H	-68.68	-57.00	-11.68
240.00	V	-71.79	-57.00	-14.79
431.99	H	-71.02	-57.00	-14.02
431.99	V	-72.24	-57.00	-15.24
589.16	H	-70.01	-57.00	-13.01
796.60	V	-64.44	-57.00	-7.44
935.45	H	-64.29	-57.00	-7.29
950.76	V	-65.64	-57.00	-8.64

Frequency Range	1GHz ~ 12.75GHz	Operating Channel	1, 13
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Spurious Emission Level					
Channel	Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
1	4823.85	H	-51.24	-47.00	-4.24
	4823.85	V	-52.01	-47.00	-5.01
13	4943.95	V	-51.55	-47.00	-4.55
	4944.20	H	-52.00	-47.00	-5.00

## 5 Photographs of the Test Configuration

### Spurious Emission Test





## Appendix - Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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