



RADIO TEST REPORT

Test Report No. : 13299139S-A-R2

Applicant : Circuit Design Inc.
Type of EUT : UHF Narrow band multi channel transceiver
Model Number of EUT : LMD-401
FCC ID : V9X-LMD401
Test regulation : FCC Part 90 Subpart I: 2020
Test Result : Complied (Refer to SECTION 3.2)

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2. The results in this report apply only to the sample tested.
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7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 13299139S-A-R1. 13299139S-A-R1 is replaced with this report.

Date of test: April 1 to 14, 2020

Representative test engineer: 
Kenichi Adachi
Engineer
Consumer Technology Division

Approved by: 
Toyokazu Imamura
Leader
Consumer Technology Division



CERTIFICATE 1266.03

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 13299139S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13299139S-A	May 11, 2020	-	-
1	13299139S-A-R1	May20, 2020	1-13	Correction of FCC ID “V9X LMD401” to “V9X-LMD401”
2	13299139S-A-R2	May 26, 2020	6 42	Correction of error ("2" and "3", "...the power level off EUT..." to "...the power level of EUT...".) Correction of error. ("cconducted" to "conducted")

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	MCS	Modulation and Coding Scheme
AC	Alternating Current	MRA	Mutual Recognition Arrangement
AFH	Adaptive Frequency Hopping	N/A	Not Applicable
AM	Amplitude Modulation	NIST	National Institute of Standards and Technology
Amp, AMP	Amplifier	NS	No signal detect.
ANSI	American National Standards Institute	NSA	Normalized Site Attenuation
Ant, ANT	Antenna	NVLAP	National Voluntary Laboratory Accreditation Program
AP	Access Point	OBW	Occupied Band Width
ASK	Amplitude Shift Keying	OFDM	Orthogonal Frequency Division Multiplexing
Atten., ATT	Attenuator	P/M	Power meter
AV	Average	PCB	Printed Circuit Board
BPSK	Binary Phase-Shift Keying	PER	Packet Error Rate
BR	Bluetooth Basic Rate	PHY	Physical Layer
BT	Bluetooth	PK	Peak
BT LE	Bluetooth Low Energy	PN	Pseudo random Noise
BW	BandWidth	PRBS	Pseudo-Random Bit Sequence
Cal Int	Calibration Interval	PSD	Power Spectral Density
CCK	Complementary Code Keying	QAM	Quadrature Amplitude Modulation
Ch., CH	Channel	QP	Quasi-Peak
CISPR	Comite International Special des Perturbations Radioelectriques	QPSK	Quadri-Phase Shift Keying
CW	Continuous Wave	RBW	Resolution Band Width
DBPSK	Differential BPSK	RDS	Radio Data System
DC	Direct Current	RE	Radio Equipment
D-factor	Distance factor	RF	Radio Frequency
DFS	Dynamic Frequency Selection	RMS	Root Mean Square
DQPSK	Differential QPSK	RSS	Radio Standards Specifications
DSSS	Direct Sequence Spread Spectrum	Rx	Receiving
EDR	Enhanced Data Rate	SA, S/A	Spectrum Analyzer
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	SG	Signal Generator
EMC	ElectroMagnetic Compatibility	SVSWR	Site-Voltage Standing Wave Ratio
EMI	ElectroMagnetic Interference	TR	Test Receiver
EN	European Norm	Tx	Transmitting
ERP, e.r.p.	Effective Radiated Power	VBW	Video BandWidth
EU	European Union	Vert.	Vertical
EUT	Equipment Under Test	WLAN	Wireless LAN
Fac.	Factor		
FCC	Federal Communications Commission		
FHSS	Frequency Hopping Spread Spectrum		
FM	Frequency Modulation		
Freq.	Frequency		
FSK	Frequency Shift Keying		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
IEC	International Electrotechnical Commission		
IEEE	Institute of Electrical and Electronics Engineers		
IF	Intermediate Frequency		
ILAC	International Laboratory Accreditation Conference		
ISED	Innovation, Science and Economic Development Canada		
ISO	International Organization for Standardization		
JAB	Japan Accreditation Board		
LAN	Local Area Network		
LIMS	Laboratory Information Management System		

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SECTION 1: Customer information

Company Name	:	Circuit Design Inc.
Address	:	7557-1, Hotaka, Azumino, Nagano 399-8303 Japan
Telephone Number	:	+81-263-82-1011
Facsimile Number	:	+81-263-82-1012
Contact Person	:	Maiko Yasunaga

The information provided from the customer is as follows;

- Applicant, Type of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT)
- SECTION 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

Type of Equipment	:	UHF Narrow band multi channel transceiver
Model No.	:	LMD-401
Serial No.	:	Refer to SECTION 4.2
Rating	:	DC 5.0 V (typical) (DC 3.0 to 5.5 V)
Receipt Date of Sample (Information from test lab.)	:	April 1, 2020
Country of Mass-production	:	Japan
Condition of EUT	:	Engineering 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: LMD-401 (referred to as the EUT in this report) is a UHF Narrow band multi channel transceiver.

General Specification

Clock frequency (ies) in the system	:	21.25 MHz
-------------------------------------	---	-----------

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	458.0000 MHz to 462.5000 MHz
Modulation	:	GFSK
Intermediate frequency (IF)	:	1st IF: 21.7 MHz, 2nd IF: 450 kHz
Bandwidth	:	8.5 kHz
Channel spacing	:	12.5 kHz
Antenna type	:	Whip antenna
Antenna Gain	:	1.83 dBi

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 90 Subpart I: 2020
FCC Part 90 final revised on April 1, 2020 and effective June 1, 2020

Title : FCC 47 CFR Part 90 PRIVATE LAND MOBILE RADIO SERVICES

* The revision does not affect the test result conducted before its effective date.

3.2 Procedures and results

Item	Test Procedure	Specification	Test method	Worst margin	Results	Remarks
RF output power	FCC: TIA-603-E 2.2.1 ----- ISED: RSS-Gen	FCC: Section 90.205, 90.217, 90.267 ----- ISED: RSS-119, 5.4, 5.10	Conducted	-	Complied a)	-
Modulation Characteristics	FCC: TIA-603-E 2.2.3, 2.2.6 ----- ISED: RSS-Gen	FCC: Section 2.1033 ----- ISED: RSS-119, 5.2, 5.10	Conducted	-	N/A	*1)
Emission Bandwidth	FCC: TIA-603-E 2.2.11, 1.3.4.4 ----- ISED: RSS-Gen	FCC: Section 90.209, 90.217 ----- ISED: RSS-119, 5.5, 5.10	Conducted	-	Complied b)	*2)
Emission masks	FCC: TIA-603-E 2.2.11, 1.3.4.4 ----- ISED: RSS-Gen	FCC: Section 90.210, 90.217 ----- ISED: RSS-119, 5.5, 5.10	Conducted	-	Complied c)	*2)
Spurious emission at antenna terminals	FCC: TIA-603-E 2.2.13 ----- ISED: RSS-Gen	FCC: Section 90.210, 90.215, 90.217 ----- ISED: RSS-119, 5.8, 5.10	Conducted	-	Complied d)	-
Field Strength of Spurious Emission	FCC: TIA-603-E 2.2.12 ----- ISED: RSS-Gen	FCC: Section 90.210, 90.215, 90.217 ----- ISED: RSS-119, 5.8, 5.10	Radiated	20.4 dB, (925.000 Mhz, Horizontal, Peak Transmitting 462.5 MHz)	Complied e)	-
Frequency Stability	FCC: TIA-603-E 2.2.2 ----- ISED: RSS-Gen	FCC: Section 90.213, 90.217 ----- ISED: RSS-119, 5.2, 5.10	Conducted	-	Complied f)	*2)
Transient Frequency Behavior	FCC: TIA-603-E 2.2.19 ----- ISED: RSS-Gen	FCC: Section 90.214, 90.217 ----- ISED: RSS-119, 5.9	Conducted	-	N/A	*3)
Receiver spurious emissions	FCC: TIA-603-E 2.1.1 ----- ISED: RSS-Gen	FCC: 15.109 ----- ISED: RSS-Gen 7	Radiated	13.7 dB, (3054.099 MHz, Horizontal, Receiving 458 MHz)	Complied e)	*2)

Symbols:

Complied The data of this test item has enough margin, more than the measurement uncertainty.

Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420.

*1) The test is not applicable since this device is set 2.4 kHz deviation as default value. To tuned up cannot be made by end user.

*2) Although the test is not applicable since the power level of EUT is less than 120 mW, the test is conducted for the reference.

*3) The test is not applicable since the power level of EUT is less than 120 mW.

a) Refer to APPENDIX 1 (data of RF output power)

b) Refer to APPENDIX 1 (data of Emission Bandwidth).

c) Refer to APPENDIX 1 (data of Emission masks).

d) Refer to APPENDIX 1 (data of Spurious emission at antenna terminals).

e) Refer to APPENDIX 1 (data of Radiated emission).

f) Refer to APPENDIX 1 (data of Frequency Stability).

These tests were also refer to "Land Mobile FM or PM Communication Equipment and Performance Standards" (TIA-603-E: 2016)

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3.3 Addition to standard

Item	Test Procedure	Specification	Test method	Worst margin	Results	Remarks
99 % Occupied Bandwidth	RSS-Gen 4.6.1	RSS-Gen 4.6.1	Conducted	-	b)	-
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420.						
b) Refer to APPENDIX 1 (data of Emission Bandwidth).						

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

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

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

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Item	Frequency range	Uncertainty (+/-)			
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4,5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.6 dB	2.5 dB	2.6 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.0 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.6 dB	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.0 dB	-
	1 GHz-6 GHz	4.9 dB	4.9 dB	4.9 dB	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Substitution measurement (EUT height: 0.8 m, Distance: 3 m)	
Frequency range	Uncertainty (+/-)
30 MHz - 200 MHz	4.8 dB
200 MHz - 1000 MHz	3.7 dB
1 GHz - 13 GHz	4.9 dB

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.98 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.75 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.89 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.12 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	1.06 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.24 dB
Spurious emission (Conducted) below 1GHz	0.9 dB
Spurious emission (Conducted) 1 GHz-3 GHz	0.9 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.9 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.6 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.0 dB
Bandwidth Measurement	0.07 %
Duty cycle and Time Measurement	0.262 %
Temperature	0.95 deg.C.
Voltage	0.83 %

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3.5 Test Location

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A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D)

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	8.1 x 5.1 x 3.55	8.1 x 5.1	-
No.1 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 shielded room	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	2.55 x 4.1 x 2.5	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

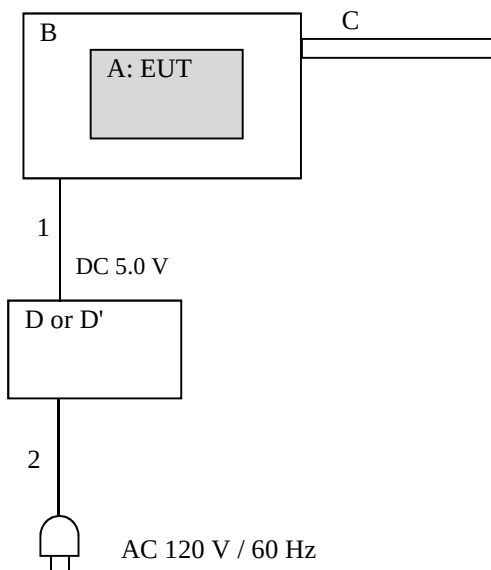
SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Mode	Operation	Tested frequency
Transmitting (unmodulation)	Continuous transmitting non-modulated	458.000 MHz, 462.500 MHz
Transmitting	Continuous transmitting modulated (input signal PN9, 4.8 kHz (worst data (Digital signal)))	458.000 MHz, 462.500 MHz
Receiving	Continuous receiving	458.000 MHz, 462.500 MHz

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

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	UHF Narrow band multi channel transceiver	LMD-401	20200319-1	Circuit Design Inc.	EUT
B	Test board	TB-STD302	-	Circuit Design Inc.	-
C	Whip antenna	ANT-R1G-01-R	-	Circuit Design Inc.	-
D	DC power supply	PAN35-10A	NA000955	Kikusui	*1)
D'	DC power supply	PW16-5ADP	18026330	TEXIO	*2)

*1) used for radiated emission test

*2) used for antenna terminal conducted tests

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC cable	0.6 + 1.5	Unshielded	Unshielded	-
2	AC cable	2.0	Unshielded	Unshielded	-

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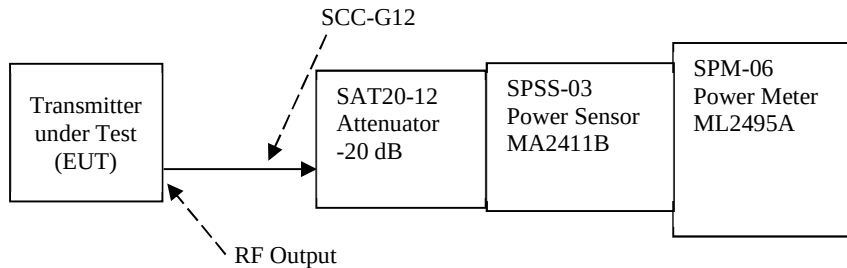
SECTION 5: RF output power

Test Procedure:

This test was measured with a power sensor of power meter connected to the antenna port via attenuator.

Test result: Pass

Measurement Block Diagram of RF power output



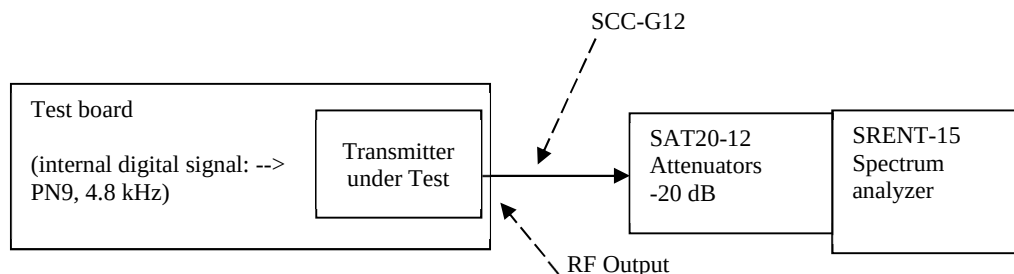
SECTION 6: Emission Bandwidth and Emission masks

Test Procedure:

- 1) Set the reference level the spectrum analyzer to the unmodulated carrier level on the EUT
- 2) The Carrier is modulated by the PN9 digital signal (4.8 kHz) (worst mode).
The input signal shall be established at the frequency of maximum response of the modulation.
(*Emission mask D (406.1 MHz - 430 MHz and 450 MHz - 470 MHz, channel spacing: 12.5 kHz))

Test result: Pass

Measurement Block Diagram



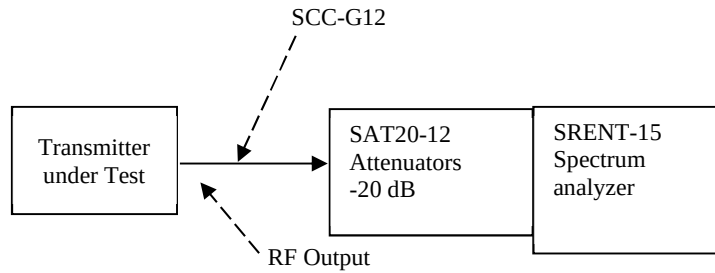
SECTION 7: Spurious emission at antenna terminals

Test Procedure:

- 1) The EUT was aligned for transmitter operation at full rated power.
- 2) Set the reference level the spectrum analyzer to the modulated carrier level on the EUT.
(Since spurious level was no difference between modulation mode and none-modulation mode)
- 3) Output of EUT was connecting with spectrum analyzer through dummy load attenuator 20 dB.

Test result: Pass

Measurement Block Diagram



SECTION 8: Field Strength of Spurious Emission

Test Procedure:

- 1) The EUT was aligned for transmitter operation at full rated power.
- 2) Set the reference level the spectrum analyzer to the modulated carrier level on the EUT.
(Since spurious level was no difference between modulation mode and none-modulation mode)
- 3) Tune-up the transmitter (EUT)
- 4) For each spurious measurement the receiving antenna is adjusted to the correct length for the frequency involved. These measurements are made from the lowest radio frequency generated in the EUT or 30 MHz to the tenth harmonics of the carrier.
- 5) EUT was placed on a urethane plate form of nominal size, 0.5 m by 0.5 m raised 0.8 m above the conducting ground plane.
The Radiated Electric Field Strength intensity has been measured in semi anechoic chamber on a ground plane (above 1 GHz only) and at a distance of 3 m.
The measuring antenna height was varied between 1 to 4m and the turn table was rotated a full revolution in order to obtain the maximum value of the electric field strength.
The measurements were performed for both vertical and horizontal antenna polarization.
- 6) Exchanged the EUT to the Substitution Antenna, the measurement was set for the same height 1.5 m as the EUT. The frequency below 1 GHz of the Substitution Antenna was used the Half wave dipole Antenna, which was tuned the measured frequency in 1).
The frequency above 1 GHz of the Substitution Antenna was used Horn Antenna.
The Substitution Antenna was connected to the Signal Generator, and the polarized electromagnetic radiation of the Substitution Antenna was matched with the one of the measuring Antenna, which was set with the Signal Generator to the measured frequency in 1). Then, we set with the Output power (CW) of the Signal Generator where the measuring electromagnetic field strength is equal to the measured value in 1) by means of varying the measuring antenna height between 1 to 4 m to obtain maximum receiving level.
Its Output power of Signal Generator was recorded.
- 7) Below 1 GHz:
Effective radiated power was calculated by subtracting the cable loss and the attenuator loss connected between the Signal Generator and the Substitution Antenna from the Output power of the Signal Generator recorded in 2).
For the usage of the Antenna (Horn Antenna) except for the Half wave dipole Antenna (2.15 dBi) for the Substitution Antenna, the Effective radiated power was calculated by compensating the finite difference in the Antenna gain of the Half wave dipole Antenna, and Substitution Antenna.
Above 1 GHz:
Equivalent isotropic radiated power was calculated by subtracting the cable loss and the attenuator loss connected between the signal generator and the substitution antenna from the output power of the signal generator recorded in 2).
For the usage of the antenna (horn antenna) for the substitution antenna, the equivalent isotropic radiated power was calculated by compensating the finite substitution antenna.

Frequency	Below 1 GHz	Above 1 GHz
Instrument used	Spectrum Analyzer	Spectrum Analyzer
IF Bandwidth	Peak: RBW: 10 kHz/VBW: 300 kHz	Peak: RBW: 1 MHz/VBW: 3 MHz

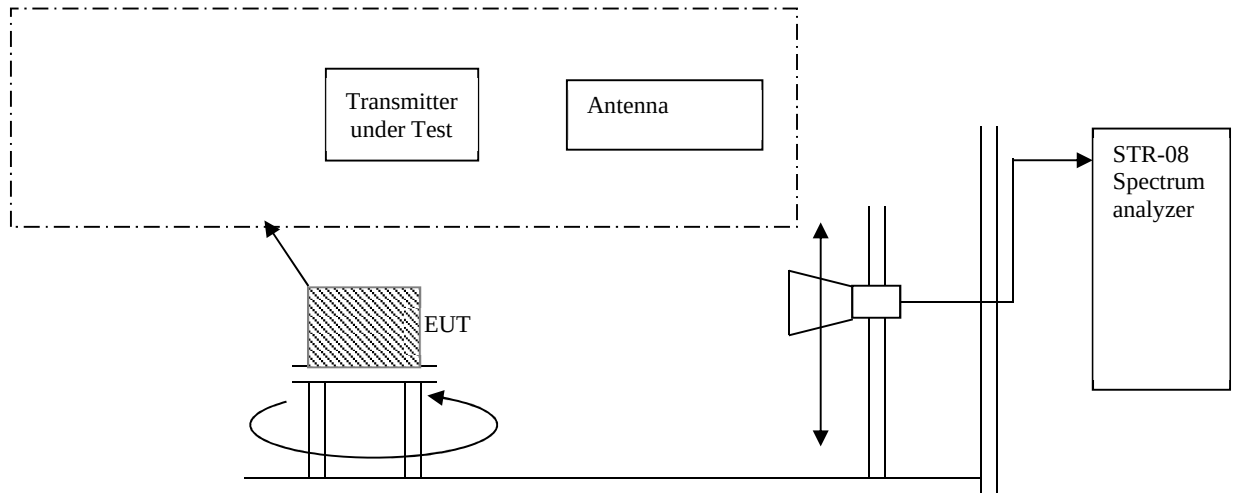
Transmitter Spurious Limit : Carrier Level [dBm] – 30 [dB] (for FCC part 90.217)

- 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.

	Antenna polarization	Spurious (Below 30 MHz)	Spurious (30 MHz-1 GHz)	Spurious (Above 1 GHz)
Transmitting	Horizontal	X	Z	Z
	Vertical	X	X	X
Receiving	Horizontal		Y	Y
	Vertical		X	Z

Test result: Pass

Measurement Block Diagram



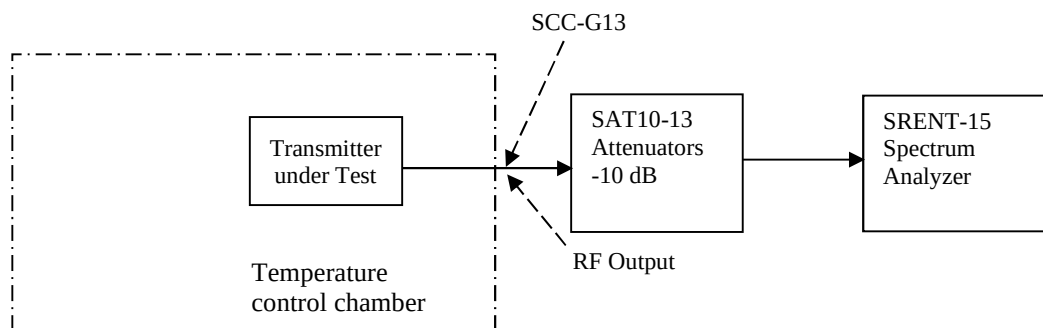
SECTION 9: Frequency Stability

Test Procedure:

This test was measured with a spectrum analyzer connected to the antenna port via attenuator.

Test result: Pass

Measurement Block Diagram



APPENDIX 1: Data of Radio tests

RF output power

Company	Circuit Design Inc.	UL Japan, Inc. Shonan EMC Lab.	
Equipment	UHF Narrow Band Multi Channel Transceiver	No.5 Shielded Room	
Model	LMD-401	Regulation	FCC section 90.217
Serial No.	20200319-1	Date	April 1, 2020
Power	DC 5 V	Temperature	24 deg.C
Mode	Transmitting (unmodulation)	Humidity	47 %RH
		ENGINEER	Kenichi Adachi

DC 5 V (* P/M: Power Meter with power sensor, PK: Peak, AV: Average)

Freq. [MHz]	P/M (PK) Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
458.0000	-10.72	0.66	20.13	10.07	10.16	20.79	120.00	10.72
462.5000	-10.67	0.66	20.13	10.12	10.28	20.79	120.00	10.67

DC 3.0 V (* P/M: Power Meter with power sensor, PK: Peak, AV: Average)

Freq. [MHz]	P/M (PK) Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
458.0000	-10.96	0.66	20.13	9.83	9.62	20.79	120.00	10.96
462.5000	-10.92	0.66	20.13	9.87	9.71	20.79	120.00	10.92

DC 5.5 V (* P/M: Power Meter with power sensor, PK: Peak, AV: Average)

Freq. [MHz]	P/M (PK) Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
458.0000	-10.72	0.66	20.13	10.07	10.16	20.79	120.00	10.72
462.5000	-10.67	0.66	20.13	10.12	10.28	20.79	120.00	10.67

* Reference limit: 6 W e.r.p. (for fixed or mobile), 2 W e.r.p. (for portable) (section 90.267(e)(2), 90.267(g)(2))

(Reference)

Maximum permissible exposure (MPE)

For the calculation of the MPE, a reference antenna with a gain of 1.83 dBi (= 1.52) has been assumed.

Freq.	Max power	Antenna Gain	Power density at 20cm	Power density at 20cm	Limit1	Limit2
[MHz]	[mW]	[]	[mW/cm^2]	[W/m^2]	[mW/cm^2]	[W/m^2]
458.0000	10.16	1.52	0.003	0.031	0.305	1.724
462.5000	10.28	1.52	0.003	0.031	0.308	1.736

Calculation:

Power density at 20cm [mW/cm^2] = (Max power [mW] x Antenna gain []) / (4 x pi x (r = 20 [cm])^2)

Power density at 20cm [W/m^2] = Power density at 20cm [mW/cm^2] x 10

* Limit1 for maximum permissible exposure (MPE) according to FCC 1.1310 table1(b) (= f [MHz] /1500)

* Limit2 for maximum permissible exposure (MPE) according to RSS-102 section 4 and Safety Code 6 section 2.2 table 6 (=0.02619 x f [MHz] ^ (0.6834))

UL Japan, Inc.

Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Emission Bandwidth

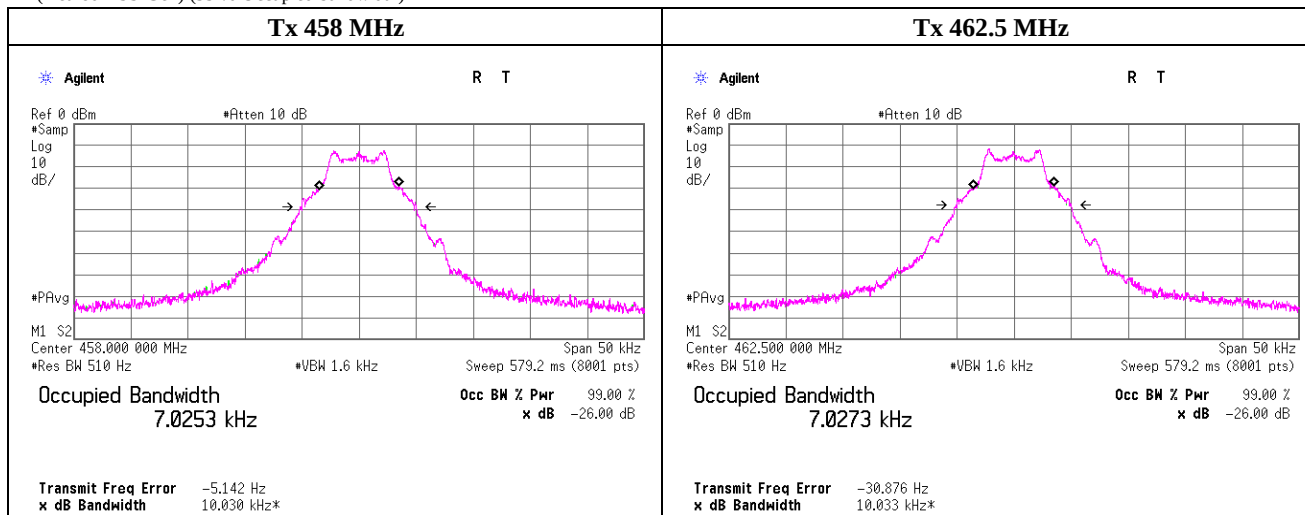
UL Japan, Inc. Shonan EMC Lab.
No.5 Shielded Room

Company Circuit Design Inc.
Equipment UHF Narrow Band Multi Channel Transceiver
Model LMD-401
Serial No. 20200319-1
Power DC 5 V
Mode Transmitting
input signal: PN9, 4.8 kHz (worst data (Digital signal))

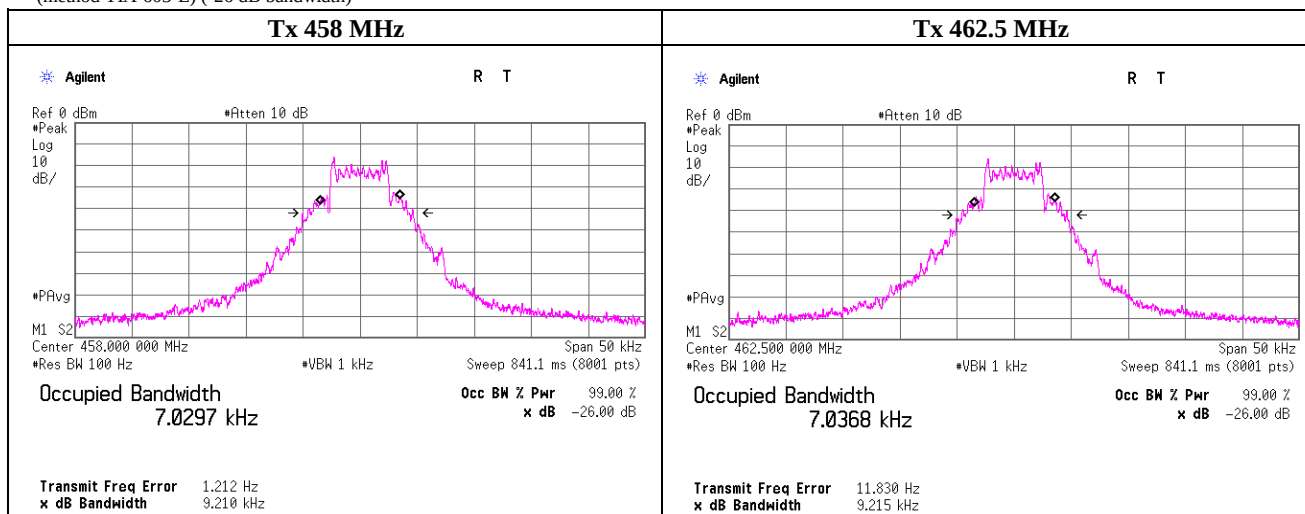
Regulation FCC part 90, section 90.209
RSS-119, section 5.5, table 3
Date April 1, 2020
Temperature 24 deg.C
Humidity 47 %RH
ENGINEER Kenichi Adachi

Freq. [MHz]	(Reference) 26dB bandwidth [kHz]	99% Occupied bandwidth [kHz]
458.0000	9.210	7.0253
462.5000	9.215	7.0273

(method RSS-Gen) (99 % Occupied bandwidth)



(method TIA-603-E) (-26 dB bandwidth)



UL Japan, Inc.

Shonan EMC Lab.

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

Telephone : +81 463 50 6400

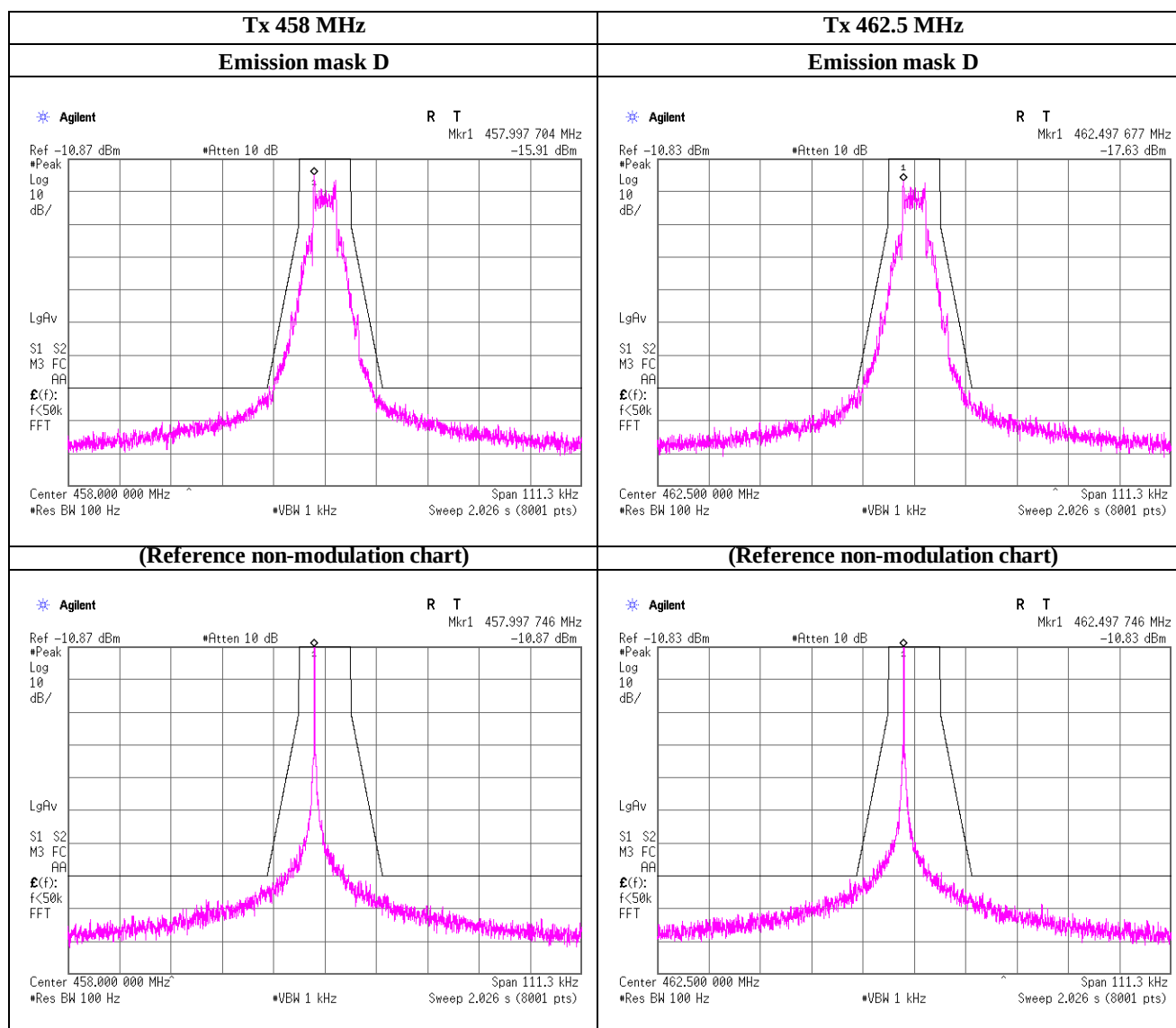
Facsimile : +81 463 50 6401

Emission masks

Company Circuit Design Inc.
Equipment UHF Narrow Band Multi Channel Transceiver
Model LMD-401
Serial No. 20200319-1
Power DC 5 V
Mode Transmitting
input signal: PN9, 4.8kHz (worst data (Digital signal))

UL Japan, Inc. Shonan EMC Lab.
No.5 Shielded Room

Regulation FCC part 90, section 90.210
RSS-119, section 5.8.3
Date April 1, 2020
Temperature 24 deg.C
Humidity 47 %RH
ENGINEER Kenichi Adachi



* Limit is

center frequency to +/-5.625 kHz (width 11.25 kHz) is 0 [dB], +5.625 kHz to +/-12.5 kHz is $-7.27 * (fd - 2.88 \text{ [kHz]})$ [dB] and +/-12.5 kHz outside is -70 [dB]

*Span was set value 111.25 kHz (= (authorized bandwidth)11.25 [kHz] + 50 [kHz] x 2).

*It was originally only that was the limit of -30 dB of 90.217, however, the severe of limit of RSS-119 / FCC 90.217 was used.

UL Japan, Inc.

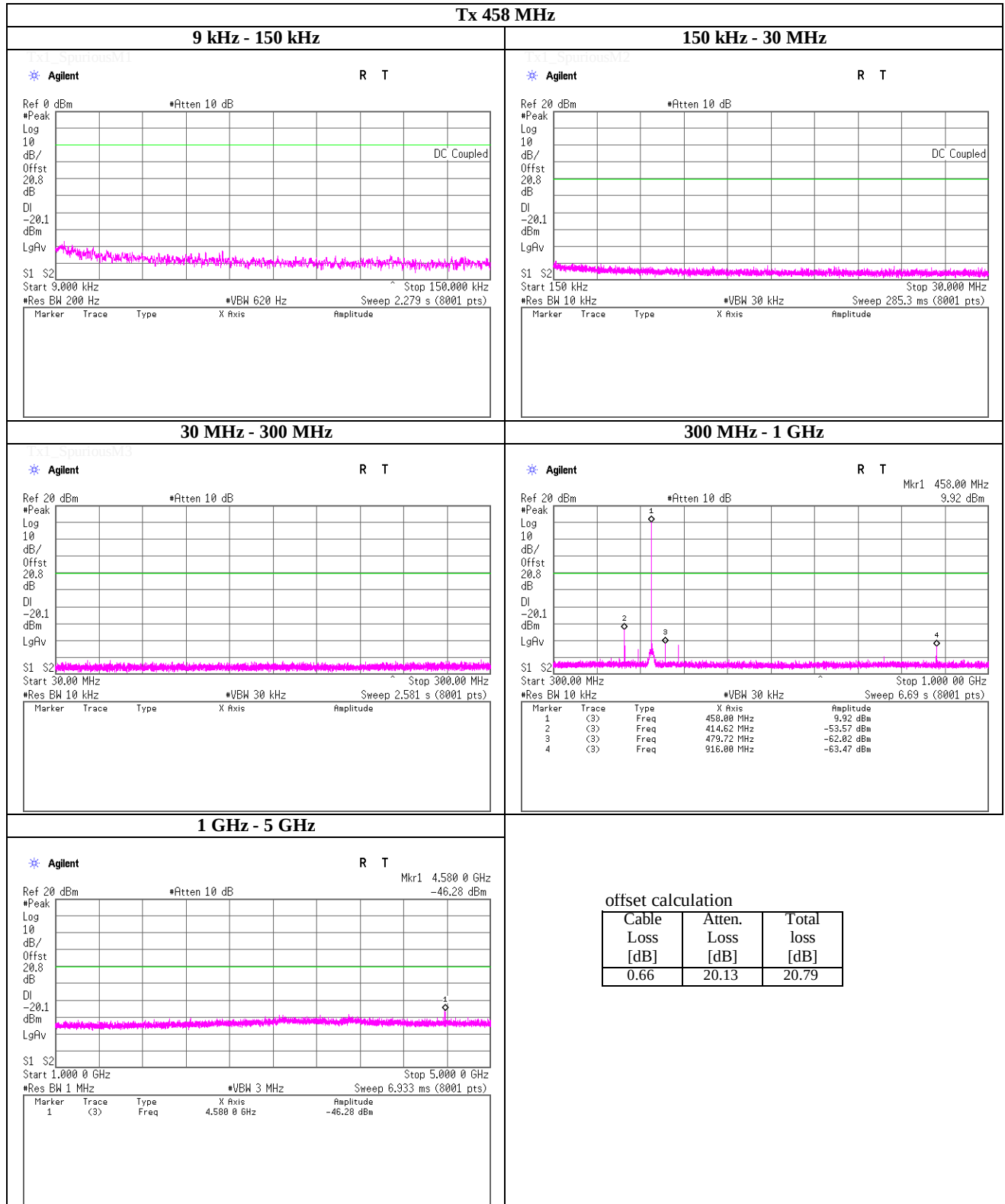
Shonan EMC Lab.

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

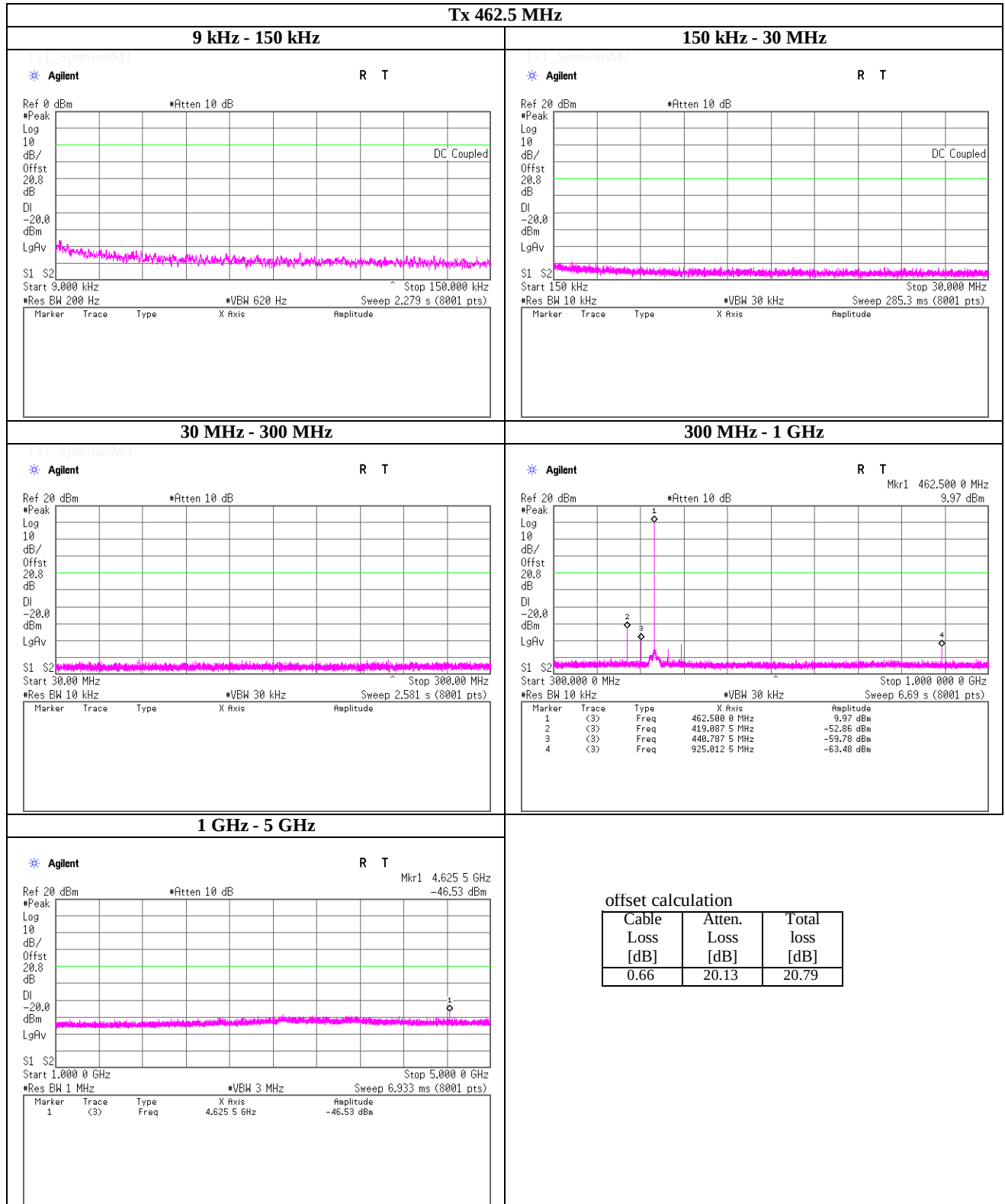
Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Spurious emission at antenna terminal



Spurious emission at antenna terminal



DATA OF RADIATED EMISSION(below 30MHz) TEST

UL Japan,Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

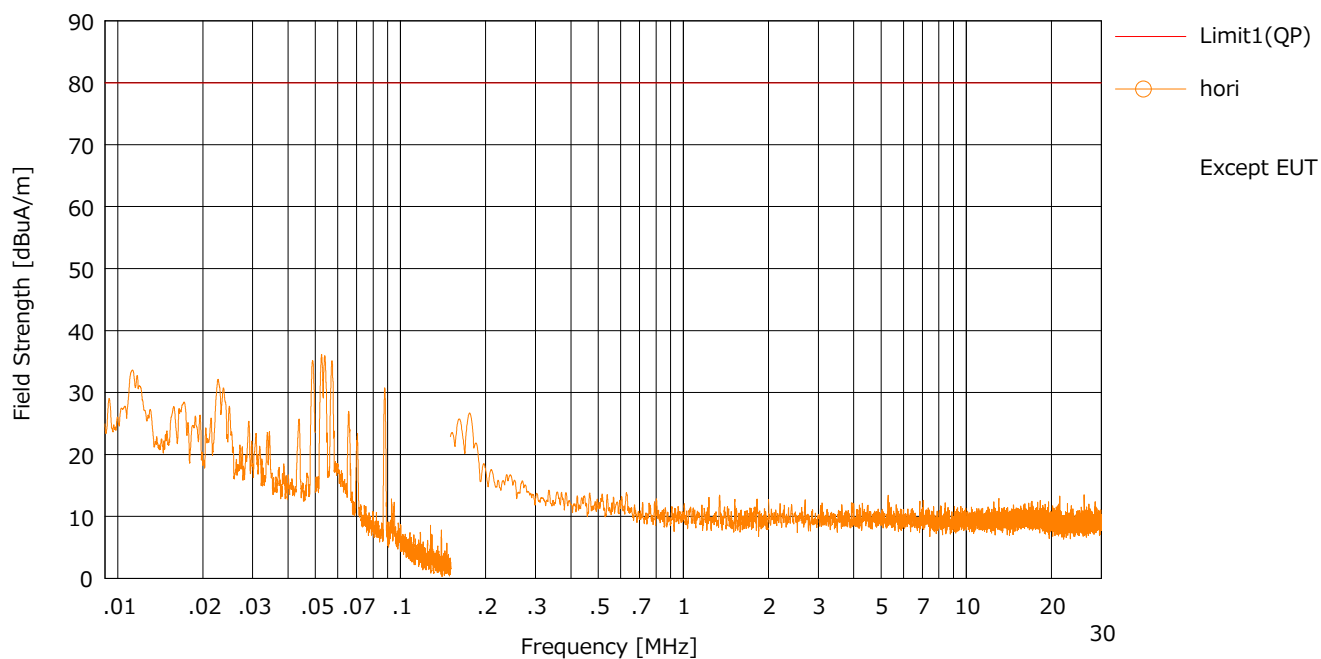
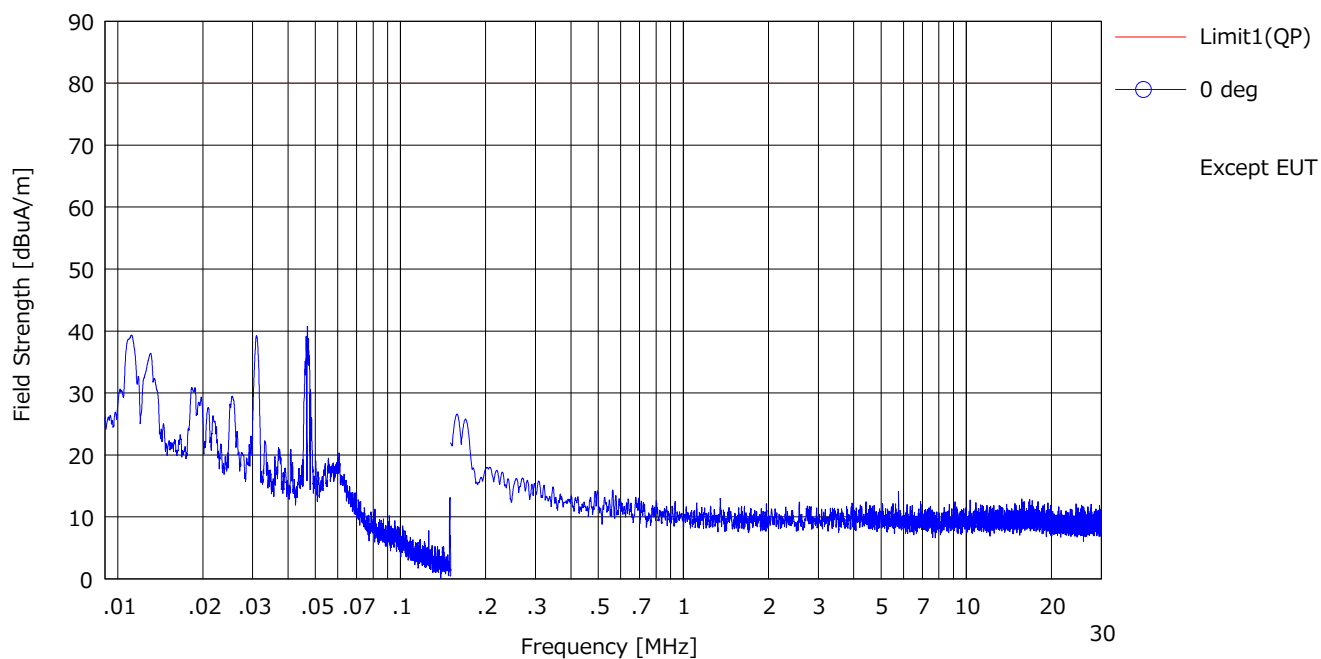
Date : 2020/04/14

Company : Circuit Design, Inc.
Kind of EUT : UHF Narrow band multi channel transceiver
Model No. : LMD-401
Serial No. : 20200319-1
Remarks : EUT & antenna worst-axis: H: X, V: X

Mode : Transmitting 458.0000MHz
Order No. : 13299139S
Power : DC 5 V
Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC part 90, carrier level=109.94 dBuV/m, Spurious, PK

Engineer : Takahiro Kawakami



DATA OF RADIATED EMISSION(below 30MHz) TEST

UL Japan,Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

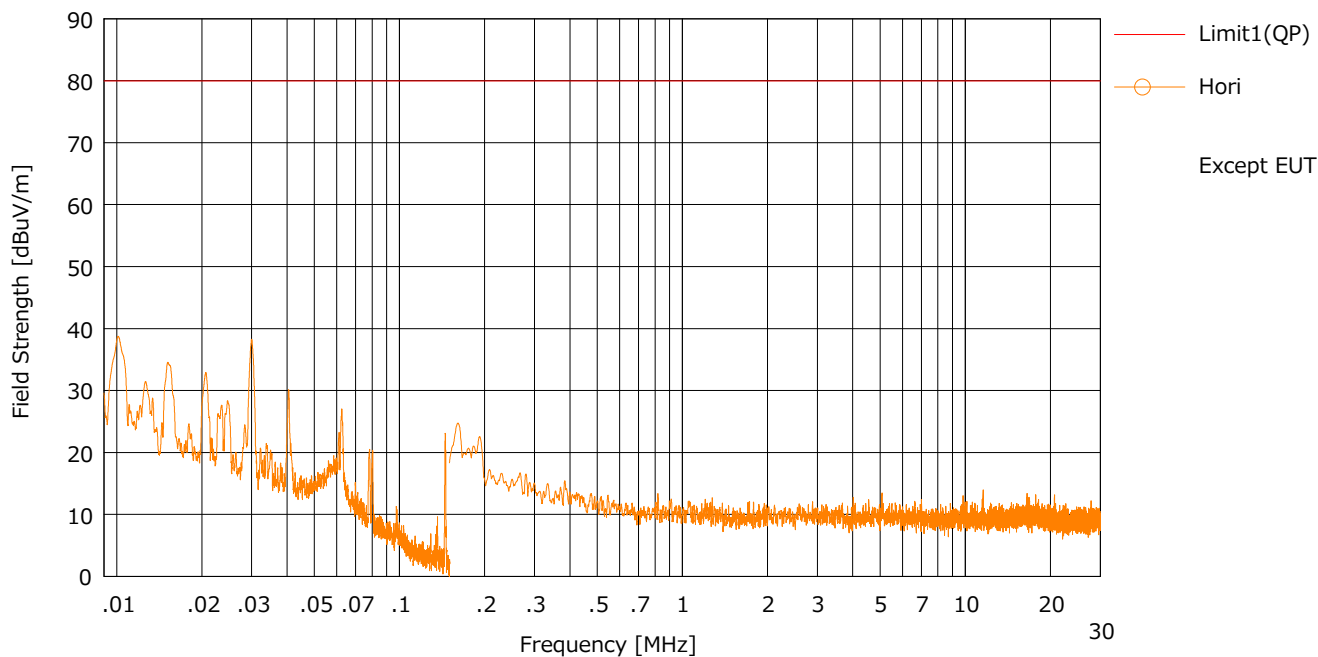
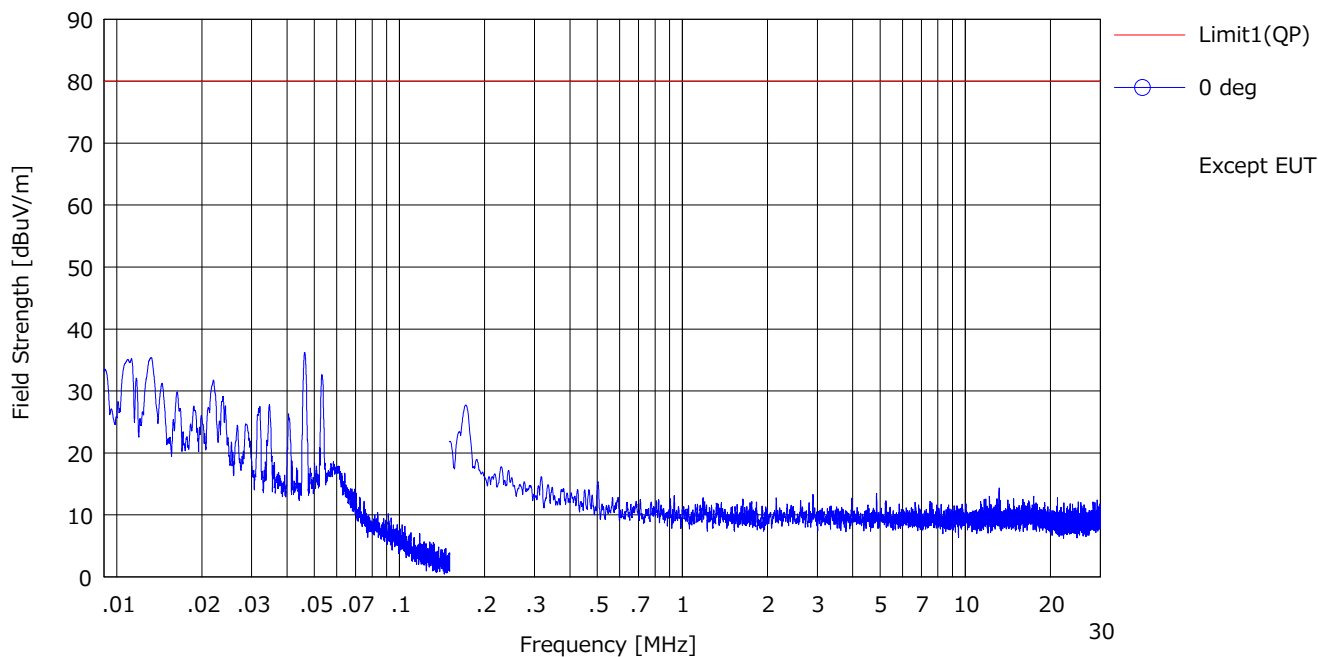
Date : 2020/04/14

Company : Circuit Design, Inc.
Kind of EUT : UHF Narrow band multi channel transceiver
Model No. : LMD-401
Serial No. : 20200319-1
Remarks : EUT & antenna worst-axis: H: X, V: X

Mode : Transmitting 462.5000MHz
Order No. : 13299139S
Power : DC 5 V
Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC part 90, carrier level=109.87 dBuV/m, Spurious, PK

Engineer : Takahiro Kawakami



DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

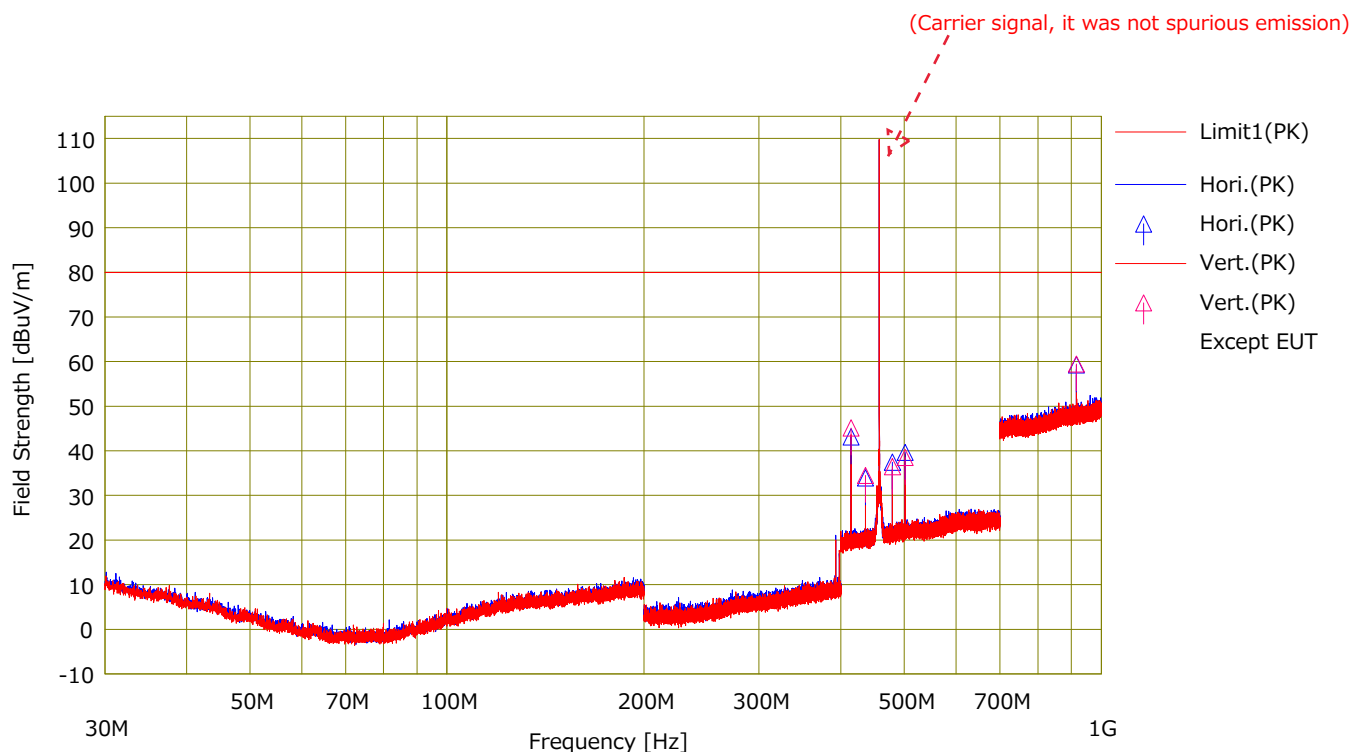
Date : 2020/04/13

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst-axis: H: Z, V: X

Mode : Transmitting 458.0000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 35 %RH

Limit : FCC part 90, carrier level=109.94 dBuV/m, Spurious, PK

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading (PK)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (PK)	Limit (PK)	Margin (PK)	Pola [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	414.600	40.18	15.72	19.16	31.94	43.12	79.94	36.8	Hori.	211	314	LP	
2	436.299	30.66	15.97	19.25	31.94	33.94	79.94	46.0	Hori.	211	306	LP	
3	479.700	32.96	17.01	19.40	31.93	37.44	79.94	42.5	Hori.	195	288	LP	
4	501.400	34.58	17.50	19.47	31.92	39.63	79.94	40.3	Hori.	179	282	LP	
5	916.000	27.47	21.62	41.07	30.92	59.24	79.94	20.7	Hori.	211	299	LP	
6	414.600	42.18	15.72	19.16	31.94	45.12	79.94	34.8	Vert.	121	212	LP	
7	436.299	31.21	15.97	19.25	31.94	34.49	79.94	45.4	Vert.	112	206	LP	
8	479.700	31.96	17.01	19.40	31.93	36.44	79.94	43.5	Vert.	100	206	LP	
9	501.400	33.43	17.50	19.47	31.92	38.48	79.94	41.4	Vert.	100	199	LP	
10	916.000	27.67	21.62	41.07	30.92	59.44	79.94	20.5	Vert.	106	206	LP	

Calculation: Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]

Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna SHA*:Horn

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

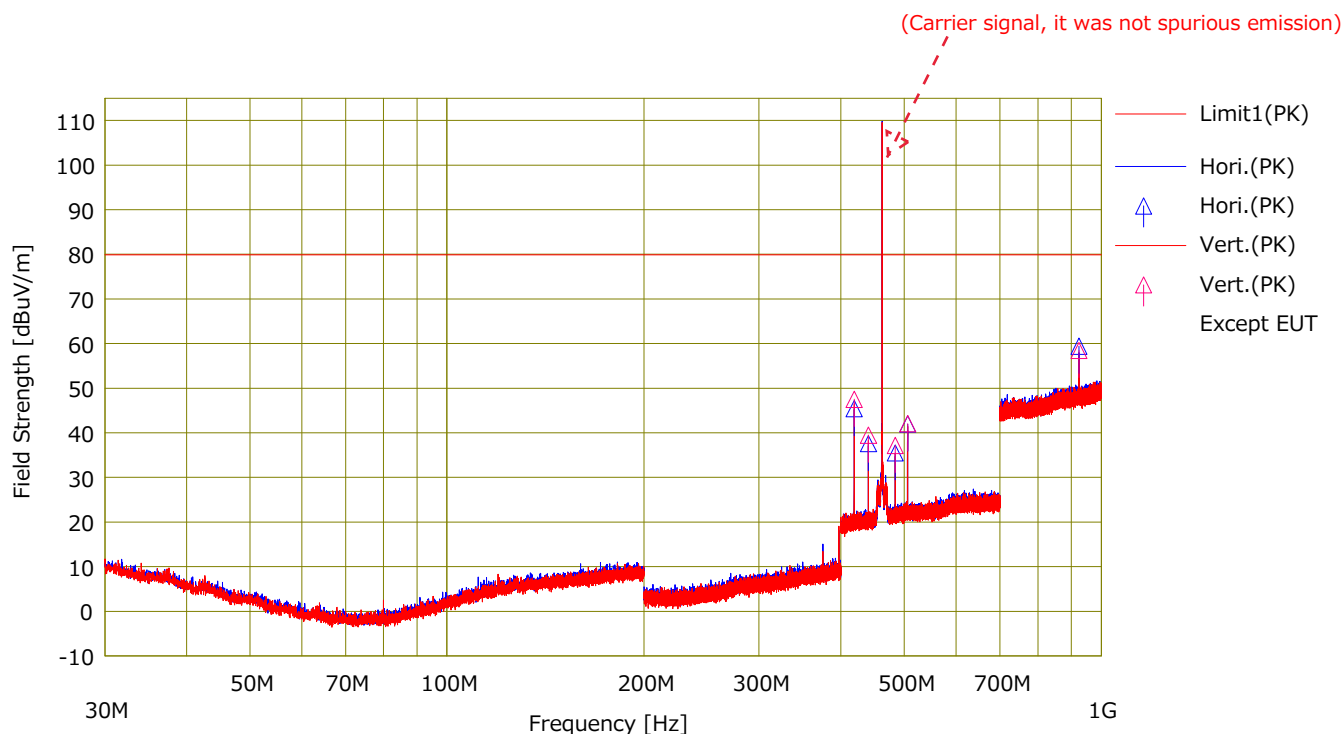
Date : 2020/04/13

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst-axis: H: Z, V: X

Mode : Transmitting 462.5000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 35 %RH

Limit : FCC part 90, carrier level=109.87 dBuV/m, Spurious, PK

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading (PK)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (PK)	Limit (PK)	Margin (PK)	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	419.100	42.38	15.79	19.18	31.94	45.41	79.87	34.4	Hori.	210	312	LP	
2	440.800	34.18	16.05	19.27	31.94	37.56	79.87	42.3	Hori.	210	305	LP	
3	484.200	30.86	17.14	19.41	31.93	35.48	79.87	44.3	Hori.	196	286	LP	
4	505.900	36.88	17.51	19.48	31.93	41.94	79.87	37.9	Hori.	182	281	LP	
5	925.000	27.45	21.70	41.10	30.85	59.40	79.87	20.4	Hori.	212	298	LP	
6	419.100	44.48	15.79	19.18	31.94	47.51	79.87	32.3	Vert.	122	216	LP	
7	440.800	36.08	16.05	19.27	31.94	39.46	79.87	40.4	Vert.	108	212	LP	
8	484.200	32.55	17.14	19.41	31.93	37.17	79.87	42.7	Vert.	105	207	LP	
9	505.900	36.98	17.51	19.48	31.93	42.04	79.87	37.8	Vert.	100	198	LP	
10	925.000	26.46	21.70	41.10	30.85	58.41	79.87	21.4	Vert.	105	291	LP	

Calculation: Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]

Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna SHA*: Horn

DATA OF RADIATED EMISSION(SUBSTITUTION) TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

Date : 2020/04/13

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst-axis: H: Z, V: X

Mode : Transmitting 458.0000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 35 %RH

Limit : FCC part 90, Substitution -13 dBm(=P-(43+log(P))), Spurious, Peak

Engineer

: Kenichi Adachi

<< ERP DATA >>

No.	Freq. [MHz]	Reading <PK> [dBuV]	SG Level [dBm]	TX Ant.Gain [dBi]	TX Loss [dB]	ERP		Margin [dB]	Pola.	Height [cm]	Angle [deg]	TX Ant.Type	Comment
						Result [dBm]	Limit [dBm]						
1	414.600	40.18	-46.24	2.15	14.94	-61.18	-13.00	48.1	Hori.	211	314	Dipol	
2	436.299	30.66	-55.72	2.15	15.11	-70.83	-13.00	57.8	Hori.	211	306	Dipol	
3	479.700	32.96	-50.08	2.15	15.43	-65.51	-13.00	52.5	Hori.	195	288	Dipol	
4	501.400	34.58	-47.78	2.15	15.57	-63.35	-13.00	50.3	Hori.	179	282	Dipol	
5	916.000	27.47	-29.46	2.15	17.87	-47.33	-13.00	34.3	Hori.	211	299	Dipol	
6	414.600	42.18	-39.92	2.15	14.94	-54.86	-13.00	41.8	Vert.	121	212	Dipol	
7	436.299	31.21	-51.92	2.15	15.11	-67.03	-13.00	54.0	Vert.	112	206	Dipol	
8	479.700	31.96	-50.56	2.15	15.43	-65.99	-13.00	52.9	Vert.	100	206	Dipol	
9	501.400	33.43	-47.38	2.15	15.57	-62.95	-13.00	49.9	Vert.	100	199	Dipol	
10	916.000	27.67	-26.84	2.15	17.87	-44.71	-13.00	31.7	Vert.	106	206	Dipol	

Calculation: Result[dBm] = SG level[dB] + Tx Ant Gain[dBi] - Tx Loss (Cable+ATT)[dB] - 2.15[dB]

Tx Ant: 120MHz turned Dipole(30M-120M), Dipole(120M-1G) / Rx-Ant: Biconical(25M-200M), Logperiodic(200M-1G)

DATA OF RADIATED EMISSION(SUBSTITUTION) TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

Date : 2020/04/13

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst-axis: H: Z, V: X

Mode : Transmitting 462.5000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 35 %RH

Limit : FCC part 90, Substitution -13 dBm(=P-(43+log(P))), Spurious, Peak

Engineer

: Kenichi Adachi

<< ERP DATA >>

No.	Freq. [MHz]	Reading <PK> [dBuV]	SG Level [dBm]	TX Ant.Gain [dBi]	TX Loss [dB]	ERP		Margin [dB]	Pola.	Height [cm]	Angle [deg]	TX Ant.Type	Comment
						Result [dBm]	Limit [dBm]						
1	419.100	42.38	-44.04	2.15	14.97	-59.01	-13.00	46.0	Hori.	210	312	Dipol	
2	440.800	34.18	-52.20	2.15	15.15	-67.35	-13.00	54.3	Hori.	210	305	Dipol	
3	484.200	30.86	-52.18	2.15	15.46	-67.64	-13.00	54.6	Hori.	196	286	Dipol	
4	505.900	36.88	-45.49	2.15	15.59	-61.08	-13.00	48.0	Hori.	182	281	Dipol	
5	925.000	27.45	-29.48	2.15	17.93	-47.41	-13.00	34.4	Hori.	212	298	Dipol	
6	419.100	44.48	-37.62	2.15	14.97	-52.59	-13.00	39.5	Vert.	122	216	Dipol	
7	440.800	36.08	-47.05	2.15	15.15	-62.20	-13.00	49.2	Vert.	108	212	Dipol	
8	484.200	32.55	-49.97	2.15	15.46	-65.43	-13.00	52.4	Vert.	105	207	Dipol	
9	505.900	36.98	-43.83	2.15	15.59	-59.42	-13.00	46.4	Vert.	100	198	Dipol	
10	925.000	26.46	-28.05	2.15	17.93	-45.98	-13.00	32.9	Vert.	105	291	Dipol	

Calculation: Result[dBm] = SG level[dB] + Tx Ant Gain[dBi] - Tx Loss (Cable+ATT)[dB] - 2.15[dB]

Tx Ant: 120MHz turned Dipole(30M-120M), Dipole(120M-1G) / Rx-Ant: Biconical(25M-200M), Logperiodic(200M-1G)

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

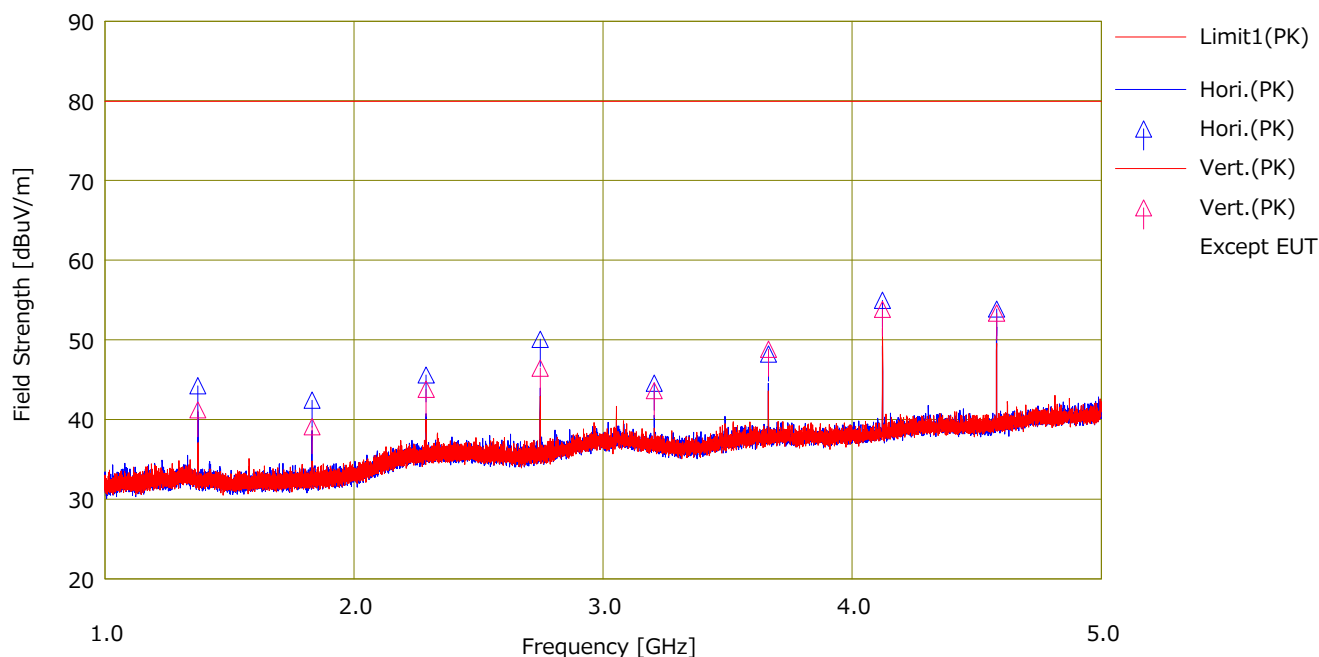
Date : 2020/04/14

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst-axis: H: Z, V: X

Mode : Transmitting 458.0000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC part 90, carrier level=109.94 dBuV/m, Spurious, PK

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading (PK)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (PK)	Limit (PK)	Margin (PK)	Pola [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	1374.000	55.89	25.78	3.70	41.13	44.24	79.94	35.7	Hori.	106	309	31SH3	
2	1832.000	54.38	25.76	3.67	41.39	42.42	79.94	37.5	Hori.	111	316	31SH3	
3	2290.000	54.56	28.52	4.13	41.63	45.58	79.94	34.3	Hori.	115	327	31SH3	
4	2748.000	58.70	28.54	4.59	41.76	50.07	79.94	29.8	Hori.	116	331	31SH3	
5	3206.000	52.55	29.16	4.85	41.98	44.58	79.94	35.3	Hori.	100	329	31SH3	
6	3664.000	55.78	29.65	5.02	42.24	48.21	79.94	31.7	Hori.	102	302	31SH3	
7	4122.000	62.01	30.15	5.26	42.46	54.96	79.94	24.9	Hori.	109	326	31SH3	
8	4580.000	60.18	31.04	5.54	42.89	53.87	79.94	26.0	Hori.	110	341	31SH3	
9	1374.000	52.86	25.78	3.70	41.13	41.21	79.94	38.7	Vert.	141	68	31SH3	
10	1832.000	51.06	25.76	3.67	41.39	39.10	79.94	40.8	Vert.	136	81	31SH3	
11	2290.000	52.78	28.52	4.13	41.63	43.80	79.94	36.1	Vert.	106	144	31SH3	
12	2748.000	55.08	28.54	4.59	41.76	46.45	79.94	33.4	Vert.	112	102	31SH3	
13	3206.000	51.59	29.16	4.85	41.98	43.62	79.94	36.3	Vert.	111	16	31SH3	
14	3664.000	56.39	29.65	5.02	42.24	48.82	79.94	31.1	Vert.	100	21	31SH3	
15	4122.000	60.89	30.15	5.26	42.46	53.84	79.94	26.1	Vert.	100	194	31SH3	
16	4580.000	59.66	31.04	5.54	42.89	53.35	79.94	26.5	Vert.	149	52	31SH3	

Calculation: Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT/filter)[dB]-Gain(AMP)[dB]

Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna SHA*: Horn

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

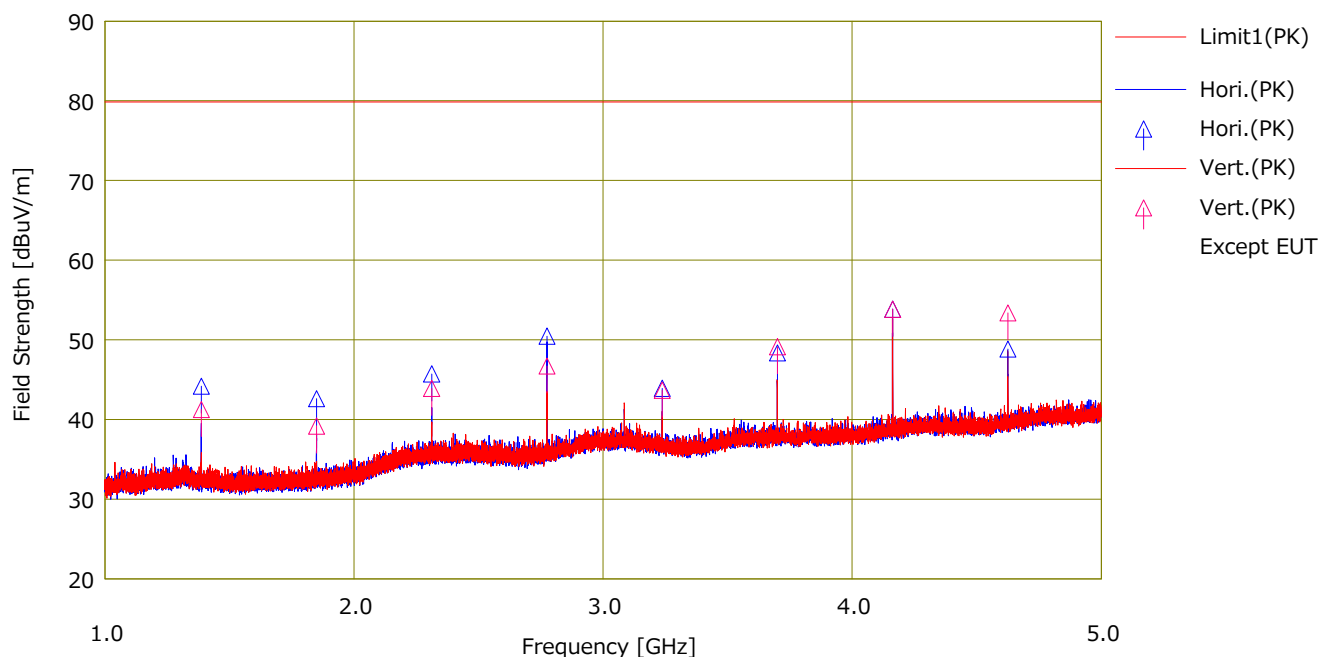
Date : 2020/04/14

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst-axis: H: Z, V: X

Mode : Transmitting 462.5000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC part 90, carrier level=109.87 dBuV/m, Spurious, PK

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading (PK) [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (PK) [dBuV/m]	Limit (PK) [dBuV/m]	Margin (PK) [dB]	Pola [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	1387.500	55.87	25.76	3.68	41.13	44.18	79.87	35.6	Hori	107	307	31SH3	
2	1850.000	54.49	25.84	3.68	41.41	42.60	79.87	37.2	Hori	112	315	31SH3	
3	2312.500	54.72	28.49	4.16	41.64	45.73	79.87	34.1	Hori	114	323	31SH3	
4	2775.000	58.98	28.63	4.62	41.77	50.46	79.87	29.4	Hori	115	334	31SH3	
5	3237.500	52.02	29.03	4.86	42.00	43.91	79.87	35.9	Hori	100	331	31SH3	
6	3700.000	55.86	29.72	5.04	42.25	48.37	79.87	31.5	Hori	101	303	31SH3	
7	4162.500	60.86	30.22	5.28	42.51	53.85	79.87	26.0	Hori	110	324	31SH3	
8	4625.000	54.98	31.20	5.56	42.90	48.84	79.87	31.0	Hori	109	338	31SH3	
9	1387.500	52.94	25.76	3.68	41.13	41.25	79.87	38.6	Vert.	139	66	31SH3	
10	1850.000	51.08	25.84	3.68	41.41	39.19	79.87	40.6	Vert.	135	83	31SH3	
11	2312.500	52.88	28.49	4.16	41.64	43.89	79.87	35.9	Vert.	105	146	31SH3	
12	2775.000	55.22	28.63	4.62	41.77	46.70	79.87	33.1	Vert.	113	100	31SH3	
13	3237.500	51.78	29.03	4.86	42.00	43.67	79.87	36.2	Vert.	109	14	31SH3	
14	3700.000	56.64	29.72	5.04	42.25	49.15	79.87	30.7	Vert.	100	23	31SH3	
15	4162.500	60.86	30.22	5.28	42.51	53.85	79.87	26.0	Vert.	100	193	31SH3	
16	4625.000	59.52	31.20	5.56	42.90	53.38	79.87	26.4	Vert.	147	49	31SH3	

Calculation: Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT/filter)[dB]-Gain(AMP)[dB]

Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna SHA*: Horn

DATA OF RADIATED EMISSION(SUBSTITUTION) TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

Date : 2020/04/14

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst-axis: H: Z, V: X

Mode : Transmitting 458.0000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC part 90, Substitution -13 dBm(=P-(43+log(P))), Spurious, Peak
 Engineer

: Takahiro Kawakami

<< EIRP DATA >>

No.	Freq.	Reading	SG Level	TX Ant.Gain	TX Loss	EIRP		Margin	Pola.	Height	Angle	TX Ant.Type	Comment
		<PK>				Result	Limit						
	[MHz]	[dBuV]	[dBm]	[dBi]	[dB]	[dBm]	[dBm]	[dB]		[cm]	[deg]		
1	1374.000	55.89	-57.25	6.66	4.44	-55.03	-13.00	42.0	Hori.	106	309	Horn	
2	1832.000	54.38	-59.93	9.71	5.14	-55.36	-13.00	42.3	Hori.	111	316	Horn	
3	2290.000	54.56	-57.87	8.86	5.77	-54.78	-13.00	41.7	Hori.	115	327	Horn	
4	2748.000	58.70	-51.47	10.34	6.33	-47.46	-13.00	34.4	Hori.	116	331	Horn	
5	3206.000	52.55	-57.55	11.39	6.86	-53.02	-13.00	40.0	Hori.	100	329	Horn	
6	3664.000	55.78	-54.00	11.95	7.36	-49.41	-13.00	36.4	Hori.	102	302	Horn	
7	4122.000	62.01	-46.84	12.07	7.82	-42.59	-13.00	29.5	Hori.	109	326	Horn	
8	4580.000	60.18	-46.80	12.13	8.27	-42.94	-13.00	29.9	Hori.	110	341	Horn	
9	1374.000	52.86	-60.95	6.66	4.44	-58.73	-13.00	45.7	Vert.	141	68	Horn	
10	1832.000	51.06	-65.40	9.71	5.14	-60.83	-13.00	47.8	Vert.	136	81	Horn	
11	2290.000	52.78	-57.52	8.86	5.77	-54.43	-13.00	41.4	Vert.	106	144	Horn	
12	2748.000	55.08	-53.02	10.34	6.33	-49.01	-13.00	36.0	Vert.	112	102	Horn	
13	3206.000	51.59	-59.95	11.39	6.86	-55.42	-13.00	42.4	Vert.	111	16	Horn	
14	3664.000	56.39	-53.35	11.95	7.36	-48.76	-13.00	35.7	Vert.	100	21	Horn	
15	4122.000	60.89	-47.23	12.07	7.82	-42.98	-13.00	29.9	Vert.	100	194	Horn	
16	4580.000	59.66	-47.88	12.13	8.27	-44.02	-13.00	31.0	Vert.	149	52	Horn	

Calculation: Result[dBm] = SG level[dB] + Tx Ant Gain[dBi] - Tx Loss (Cable)[dB]

Tx Antenna: Horn(1G-40G) / Rx-Antenna: Horn(1G-40G)

DATA OF RADIATED EMISSION(SUBSTITUTION) TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

Date : 2020/04/14

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst-axis: H: Z, V: X

Mode : Transmitting 462.5000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC part 90, Substitution -13 dBm(=P-(43+log(P))), Spurious, Peak

Engineer

: Takahiro Kawakami

<< EIRP DATA >>

No.	Freq. [MHz]	Reading <PK>	SG Level [dBm]	TX Ant.Gain [dBi]	TX Loss [dB]	EIRP		Margin [dB]	Pola.	Height [cm]	Angle [deg]	TX Ant.Type	Comment
		[dBuV]				Result [dBm]	Limit [dBm]						
1	1387.500	55.87	-57.87	6.75	4.46	-55.58	-13.00	42.5	Hori.	107	307	Horn	
2	1850.000	54.49	-58.89	9.72	5.17	-54.34	-13.00	41.3	Hori.	112	315	Horn	
3	2312.500	54.72	-57.62	9.05	5.80	-54.37	-13.00	41.3	Hori.	114	323	Horn	
4	2775.000	58.98	-51.39	10.38	6.36	-47.37	-13.00	34.3	Hori.	115	334	Horn	
5	3237.500	52.02	-57.98	11.59	6.90	-53.29	-13.00	40.2	Hori.	100	331	Horn	
6	3700.000	55.86	-53.33	11.94	7.39	-48.78	-13.00	35.7	Hori.	101	303	Horn	
7	4162.500	60.86	-48.41	12.02	7.86	-44.25	-13.00	31.2	Hori.	110	324	Horn	
8	4625.000	54.98	-52.42	12.09	8.31	-48.64	-13.00	35.6	Hori.	109	338	Horn	
9	1387.500	52.94	-60.47	6.75	4.46	-58.18	-13.00	45.1	Vert.	139	66	Horn	
10	1850.000	51.08	-64.82	9.72	5.17	-60.27	-13.00	47.2	Vert.	135	83	Horn	
11	2312.500	52.88	-57.83	9.05	5.80	-54.58	-13.00	41.5	Vert.	105	146	Horn	
12	2775.000	55.22	-53.15	10.38	6.36	-49.13	-13.00	36.1	Vert.	113	100	Horn	
13	3237.500	51.78	-58.57	11.59	6.90	-53.88	-13.00	40.8	Vert.	109	14	Horn	
14	3700.000	56.64	-53.00	11.94	7.39	-48.45	-13.00	35.4	Vert.	100	23	Horn	
15	4162.500	60.86	-47.08	12.02	7.86	-42.92	-13.00	29.9	Vert.	100	193	Horn	
16	4625.000	59.52	-47.84	12.09	8.31	-44.06	-13.00	31.0	Vert.	147	49	Horn	

Calculation: Result[dBm] = SG level[dB] + Tx Ant Gain[dBi] - Tx Loss (Cable)[dB]

Tx Antenna: Horn(1G-40G) / Rx-Antenna: Horn(1G-40G)

Frequency Stability

UL Japan, Inc. Shonan EMC Lab.

No.5 Shielded Room

Company Circuit Design Inc.
 Equipment UHF Narrow Band Multi Channel Transceiver
 Model LMD-401
 Serial No. 20200319-1
 Power DC 5 V
 Mode Transmitting 458 MHz

Regulation FCC part 90 subpart I, 90.213
 RSS-119 section 5.3
 Date April 6, 2020
 Temperature 22 deg.C
 Humidity 29 %RH
 ENGINEER Kenichi Adachi

Temperature Variation: -30 deg.C

* This limit is severer limit value is applied.

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	458.0000	457.994419	458.005194	457.999807	-0.000194	-0.42249	1.500
after 2 minutes	458.0000	457.994950	458.004825	457.999888	-0.000113	-0.24563	1.500
after 5 minutes	458.0000	457.995006	458.004794	457.999900	-0.000100	-0.21834	1.500
after 10 minutes	458.0000	457.994950	458.004819	457.999885	-0.000115	-0.25218	1.500

Temperature Variation: -20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	458.0000	457.995225	458.005056	458.000141	0.000141	0.30677	1.500
after 2 minutes	458.0000	457.995200	458.005000	458.000100	0.000100	0.21834	1.500
after 5 minutes	458.0000	457.995175	458.005025	458.000100	0.000100	0.21834	1.500
after 10 minutes	458.0000	457.995181	458.005144	458.000163	0.000162	0.35480	1.500

Temperature Variation: -10 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	458.0000	457.995162	458.005156	458.000159	0.000159	0.34716	1.500
after 2 minutes	458.0000	457.995244	458.005156	458.000200	0.000200	0.43668	1.500
after 5 minutes	458.0000	457.995169	458.005144	458.000157	0.000157	0.34170	1.500
after 10 minutes	458.0000	457.995181	458.005012	458.000097	0.000097	0.21070	1.500

Temperature Variation: 0 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	458.0000	457.994562	458.005306	457.999934	-0.000066	-0.14410	1.500
after 2 minutes	458.0000	457.995088	458.004994	458.000041	0.000041	0.08952	1.500
after 5 minutes	458.0000	457.995062	458.005000	458.000031	0.000031	0.06769	1.500
after 10 minutes	458.0000	457.995056	458.005381	458.000219	0.000218	0.47707	1.500

Temperature Variation: 10 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	458.0000	457.995038	458.004988	458.000013	0.000013	0.02838	1.500
after 2 minutes	458.0000	457.995050	458.004856	457.999953	-0.000047	-0.10262	1.500
after 5 minutes	458.0000	457.995006	458.005012	458.000009	0.000009	0.01965	1.500
after 10 minutes	458.0000	457.995050	458.004850	457.999950	-0.000050	-0.10917	1.500

* calculation: Measure frequency = (Measure Low frequency + Measure High frequency) / 2

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Frequency Stability

Temperature Variation: 20 deg.C

* This limit is severer limit value is applied.

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	458.0000	457.994944	458.004875	457.999910	-0.000090	-0.19760	1.500
after 2 minutes	458.0000	457.994962	458.004850	457.999906	-0.000094	-0.20524	1.500
after 5 minutes	458.0000	457.994944	458.004850	457.999897	-0.000103	-0.22489	1.500
after 10 minutes	458.0000	457.994938	458.005144	458.000041	0.000041	0.08952	1.500

Temperature Variation: 30 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	458.0000	457.994912	458.005144	458.000028	0.000028	0.06114	1.500
after 2 minutes	458.0000	457.994881	458.005162	458.000022	0.000022	0.04694	1.500
after 5 minutes	458.0000	457.994925	458.004812	457.999869	-0.000131	-0.28712	1.500
after 10 minutes	458.0000	457.995100	458.004825	457.999963	-0.000038	-0.08188	1.500

Temperature Variation: 40 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	458.0000	457.994856	458.004681	457.999769	-0.000231	-0.50546	1.500
after 2 minutes	458.0000	457.994831	458.005069	457.999950	-0.000050	-0.10917	1.500
after 5 minutes	458.0000	457.994819	458.005069	457.999944	-0.000056	-0.12227	1.500
after 10 minutes	458.0000	457.994825	458.005106	457.999966	-0.000034	-0.07533	1.500

Temperature Variation: 50 deg.C

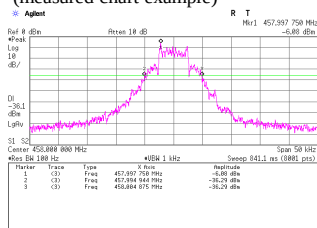
Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	458.0000	457.994756	458.004712	457.999734	-0.000266	-0.58079	1.500
after 2 minutes	458.0000	457.994806	458.004519	457.999663	-0.000338	-0.73690	1.500
after 5 minutes	458.0000	457.994769	458.004656	457.999713	-0.000288	-0.62773	1.500
after 10 minutes	458.0000	457.994806	458.004688	457.999747	-0.000253	-0.55240	1.500

Temperature Variation: 60 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	458.0000	457.994750	458.004656	457.999703	-0.000297	-0.64847	1.500
after 2 minutes	458.0000	457.994700	458.004969	457.999835	-0.000165	-0.36135	1.500
after 5 minutes	458.0000	457.994706	458.004575	457.999641	-0.000360	-0.78493	1.500
after 10 minutes	458.0000	457.994712	458.004969	457.999841	-0.000159	-0.34825	1.500

* calculation: Measure frequency = (Measure Low frequency + Measure High frequency) / 2

(measured chart example)



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Frequency Stability

UL Japan, Inc. Shonan EMC Lab.

No.5 Shielded Room

Company Circuit Design Inc.
 Equipment UHF Narrow Band Multi Channel Transceiver
 Model LMD-401
 Serial No. 20200319-1
 Power DC 5 V
 Mode Transmitting 462.5 MHz

Regulation FCC part 90 subpart I, 90.213
 RSS-119 section 5.3
 Date April 6, 2020
 Temperature 22 deg.C
 Humidity 29 %RH
 ENGINEER Kenichi Adachi

Temperature Variation: -30 deg.C

* This limit is severer limit value is applied.

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	462.5000	462.495419	462.504838	462.500129	0.000129	0.27784	1.500
after 2 minutes	462.5000	462.495094	462.504988	462.500041	0.000041	0.08865	1.500
after 5 minutes	462.5000	462.495031	462.504838	462.499935	-0.000066	-0.14162	1.500
after 10 minutes	462.5000	462.494975	462.504806	462.499891	-0.000110	-0.23676	1.500

Temperature Variation: -20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	462.5000	462.495181	462.505000	462.500091	0.000090	0.19568	1.500
after 2 minutes	462.5000	462.495150	462.505138	462.500144	0.000144	0.31135	1.500
after 5 minutes	462.5000	462.495194	462.505000	462.500097	0.000097	0.20973	1.500
after 10 minutes	462.5000	462.495169	462.505050	462.500110	0.000110	0.23676	1.500

Temperature Variation: -10 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	462.5000	462.495169	462.505019	462.500094	0.000094	0.20324	1.500
after 2 minutes	462.5000	462.495169	462.505000	462.500085	0.000084	0.18270	1.500
after 5 minutes	462.5000	462.495169	462.505150	462.500160	0.000159	0.34486	1.500
after 10 minutes	462.5000	462.495194	462.505150	462.500172	0.000172	0.37189	1.500

Temperature Variation: 0 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	462.5000	462.495094	462.504912	462.500003	0.000003	0.00649	1.500
after 2 minutes	462.5000	462.495081	462.505050	462.500066	0.000066	0.14162	1.500
after 5 minutes	462.5000	462.495088	462.505050	462.500069	0.000069	0.14919	1.500
after 10 minutes	462.5000	462.495094	462.505044	462.500069	0.000069	0.14919	1.500

Temperature Variation: 10 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	462.5000	462.495044	462.504900	462.499972	-0.000028	-0.06054	1.500
after 2 minutes	462.5000	462.495038	462.504919	462.499979	-0.000022	-0.04649	1.500
after 5 minutes	462.5000	462.495031	462.505312	462.500172	0.000171	0.37081	1.500
after 10 minutes	462.5000	462.495044	462.504888	462.499966	-0.000034	-0.07351	1.500

* calculation: Measure frequency = (Measure Low frequency + Measure High frequency) / 2

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Frequency Stability

Temperature Variation: 20 deg.C

* This limit is severer limit value is applied.

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	462.5000	462.494950	462.504888	462.499919	-0.000081	-0.17514	1.500
after 2 minutes	462.5000	462.494962	462.504788	462.499875	-0.000125	-0.27027	1.500
after 5 minutes	462.5000	462.494962	462.504788	462.499875	-0.000125	-0.27027	1.500
after 10 minutes	462.5000	462.494944	462.505156	462.500050	0.000050	0.10811	1.500

Temperature Variation: 30 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	462.5000	462.495100	462.504719	462.499910	-0.000090	-0.19568	1.500
after 2 minutes	462.5000	462.494906	462.504844	462.499875	-0.000125	-0.27027	1.500
after 5 minutes	462.5000	462.494956	462.504700	462.499828	-0.000172	-0.37189	1.500
after 10 minutes	462.5000	462.494900	462.505156	462.500028	0.000028	0.06054	1.500

Temperature Variation: 40 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	462.5000	462.495300	462.504644	462.499972	-0.000028	-0.06054	1.500
after 2 minutes	462.5000	462.494875	462.504769	462.499822	-0.000178	-0.38486	1.500
after 5 minutes	462.5000	462.495294	462.504650	462.499972	-0.000028	-0.06054	1.500
after 10 minutes	462.5000	462.494881	462.504756	462.499819	-0.000181	-0.39243	1.500

Temperature Variation: 50 deg.C

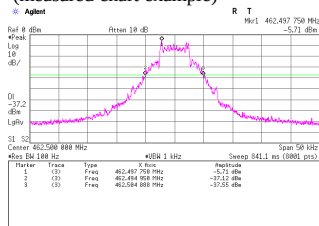
Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	462.5000	462.494781	462.504519	462.499650	-0.000350	-0.75676	1.500
after 2 minutes	462.5000	462.494762	462.504638	462.499700	-0.000300	-0.64865	1.500
after 5 minutes	462.5000	462.494781	462.504688	462.499735	-0.000266	-0.57405	1.500
after 10 minutes	462.5000	462.494762	462.504669	462.499716	-0.000285	-0.61514	1.500

Temperature Variation: 60 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency torerance (ppm)	Limit (ppm)
startup	462.5000	462.494731	462.504681	462.499706	-0.000294	-0.63568	1.500
after 2 minutes	462.5000	462.494744	462.504525	462.499635	-0.000365	-0.79027	1.500
after 5 minutes	462.5000	462.494750	462.504644	462.499697	-0.000303	-0.65514	1.500
after 10 minutes	462.5000	462.494744	462.504538	462.499641	-0.000359	-0.77622	1.500

* calculation: Measure frequency = (Measure Low frequency + Measure High frequency) / 2

(measured chart example)



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Frequency Stability

Company Circuit Design Inc.
 Equipment UHF Narrow Band Multi Channel Transceiver
 Model LMD-401
 Serial No. 20200319-1
 Power DC 5 V
 Mode Transmitting 458 MHz

UL Japan, Inc. Shonan EMC Lab.

No.5 Shielded Room

Regulation FCC part 90 subpart I, 90.213
 RSS-119 section 5.3
 Date April 7, 2020
 Temperature 24 deg.C
 Humidity 30 %RH
 ENGINEER Kenichi Adachi

Voltage Variation: DC 3 V**Temperature Variation: 20 deg.C**

* This limit is severer limit value is applied.

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	458.0000	457.994506	458.004719	457.999613	-0.000387	-0.84607	1.500
after 2 minutes	458.0000	457.994512	458.004719	457.999616	-0.000384	-0.83952	1.500
after 5 minutes	458.0000	457.994525	458.004456	457.999491	-0.000510	-1.11245	1.500
after 10 minutes	458.0000	457.994531	458.004356	457.999444	-0.000557	-1.21507	1.500

Voltage Variation: DC 5 V**Temperature Variation: 20 deg.C**

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	458.0000	457.994444	458.005162	457.999803	-0.000197	-0.43013	1.500
after 2 minutes	458.0000	457.994994	458.004806	457.999900	-0.000100	-0.21834	1.500
after 5 minutes	458.0000	457.994912	458.005200	458.000056	0.000056	0.12227	1.500
after 10 minutes	458.0000	457.994906	458.005144	458.000025	0.000025	0.05459	1.500

Voltage Variation: DC 5.5 V**Temperature Variation: 20 deg.C**

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	458.0000	457.995119	458.004862	457.999991	-0.000010	-0.02074	1.500
after 2 minutes	458.0000	457.994894	458.005150	458.000022	0.000022	0.04803	1.500
after 5 minutes	458.0000	457.994494	458.005169	457.999832	-0.000168	-0.36790	1.500
after 10 minutes	458.0000	457.994931	458.004806	457.999869	-0.000132	-0.28712	1.500

* calculation: Measure frequency = (Measure Low frequency + Measure High frequency) / 2

UL Japan, Inc.**Shonan EMC Lab.**

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Telephone : +81 463 50 6400

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Frequency Stability

		UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room	
Company	Circuit Design Inc.	Regulation	FCC part 90 subpart I, 90.213
Equipment	UHF Narrow Band Multi Channel Transceiver		RSS-119 section 5.3
Model	LMD-401	Date	April 7, 2020
Serial No.	20200319-1	Temperature	24 deg.C
Power	DC 5 V	Humidity	30 %RH
Mode	Transmitting 462.5 MHz	ENGINEER	Kenichi Adachi

Voltage Variation: DC 3 V

Temperature Variation: 20 deg.C

* This limit is severer limit value is applied.

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	462.5000	462.494825	462.504362	462.499594	-0.000406	-0.87892	1.500
after 2 minutes	462.5000	462.494538	462.504431	462.499485	-0.000516	-1.11459	1.500
after 5 minutes	462.5000	462.494531	462.504350	462.499441	-0.000560	-1.20973	1.500
after 10 minutes	462.5000	462.494519	462.504344	462.499432	-0.000568	-1.22919	1.500

Voltage Variation: DC 5 V

Temperature Variation: 20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	462.5000	462.494919	462.505131	462.500025	0.000025	0.05405	1.500
after 2 minutes	462.5000	462.494931	462.505200	462.500066	0.000066	0.14162	1.500
after 5 minutes	462.5000	462.494938	462.504850	462.499894	-0.000106	-0.22919	1.500
after 10 minutes	462.5000	462.494944	462.504694	462.499819	-0.000181	-0.39135	1.500

Voltage Variation: DC 5.5 V

Temperature Variation: 20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Low frequency (MHz)	Measure High frequency (MHz)	Measure frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (ppm)	Limit (ppm)
startup	462.5000	462.494919	462.504881	462.499900	-0.000100	-0.21622	1.500
after 2 minutes	462.5000	462.494912	462.505144	462.500028	0.000028	0.06054	1.500
after 5 minutes	462.5000	462.494919	462.505144	462.500032	0.000031	0.06811	1.500
after 10 minutes	462.5000	462.494900	462.504831	462.499866	-0.000135	-0.29081	1.500

* calculation: Measure frequency = (Measure Low frequency + Measure High frequency) / 2

UL Japan, Inc.

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DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

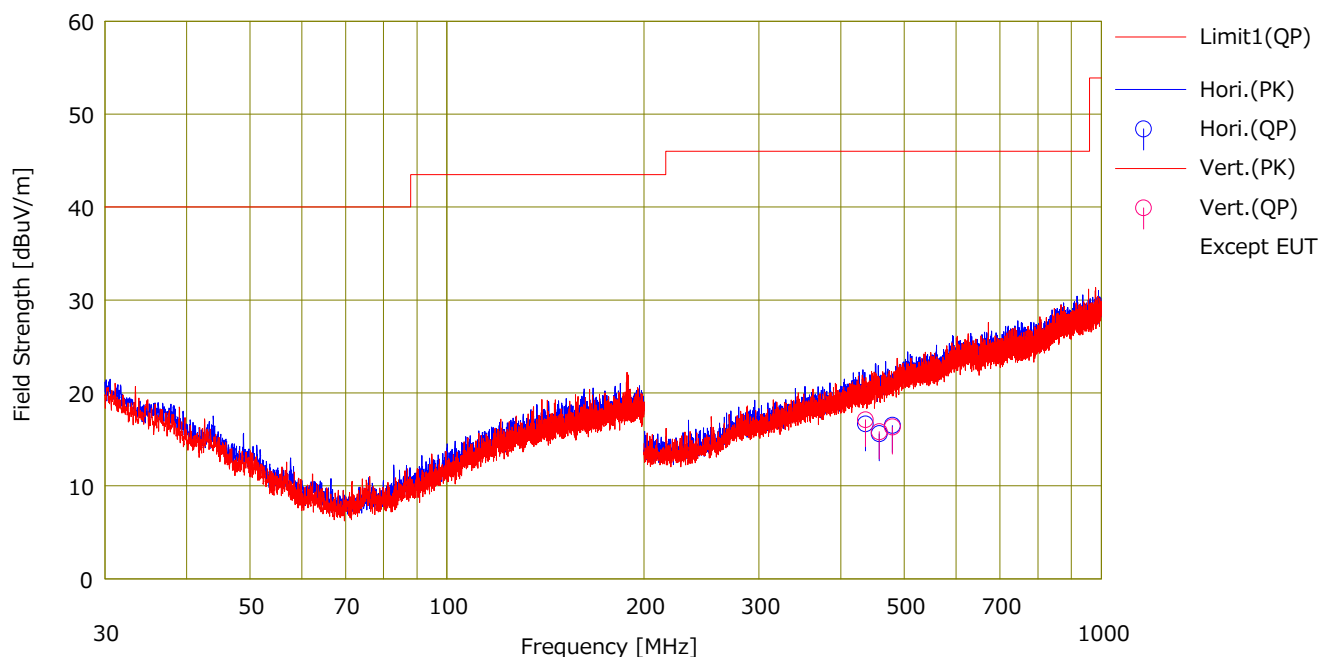
Date : 2020/04/14

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst axis: H: Y, V: X

Mode : Receiving 458.0000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC_Part 15 Subpart B(15.109)_Class B

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading (QP)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP)	Limit (QP)	Margin (QP)	Pola [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	436.299	23.23	15.97	9.41	31.94	16.67	46.00	29.3	Hori.	100	81	LP	
2	458.000	21.66	16.39	9.49	31.94	15.60	46.00	30.4	Hori.	100	81	LP	
3	479.700	21.86	17.01	9.56	31.93	16.50	46.00	29.5	Hori.	100	81	LP	
4	436.299	23.68	15.97	9.41	31.94	17.12	46.00	28.8	Vert.	138	101	LP	
5	458.000	21.88	16.39	9.49	31.94	15.82	46.00	30.1	Vert.	138	101	LP	
6	479.700	21.69	17.01	9.56	31.93	16.33	46.00	29.6	Vert.	138	101	LP	

Calculation: Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT+ΔAF)[dB]-Gain(AMP)[dB]

Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna **HA*: Horn

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

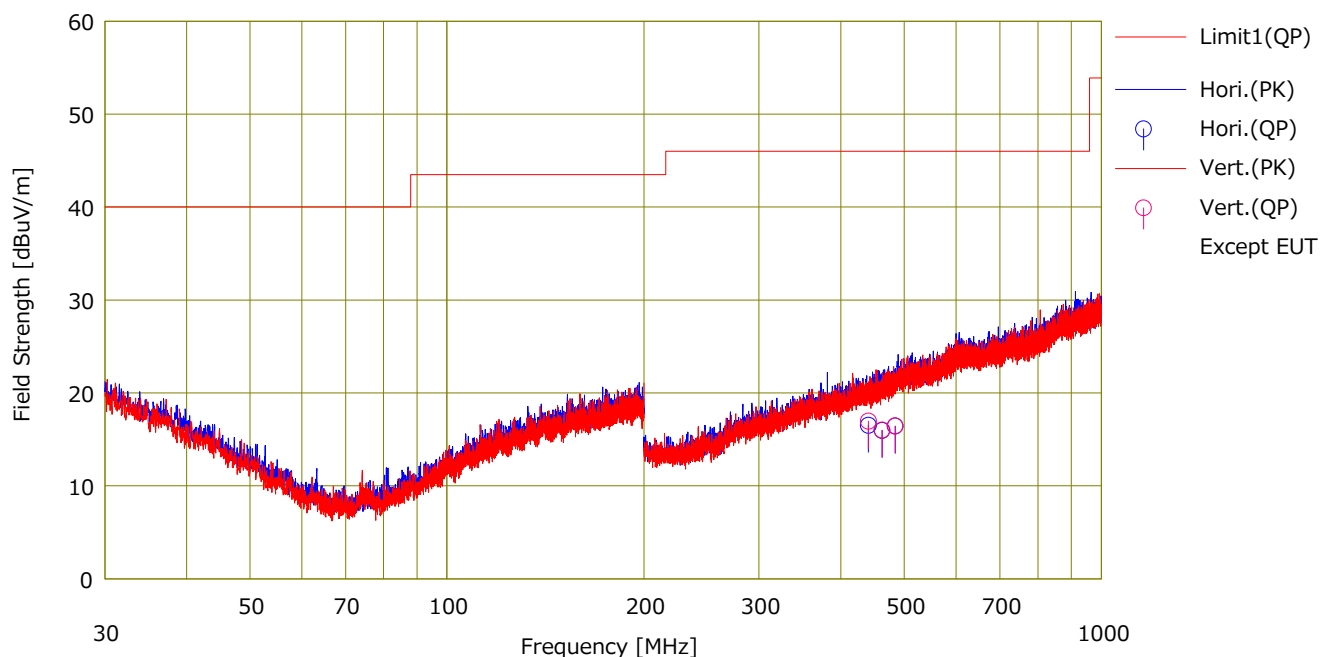
Date : 2020/04/14

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst axis: H: Y, V: X

Mode : Receiving 462.5000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC_Part 15 Subpart B(15.109)_Class B

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading (QP)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP)	Limit (QP)	Margin (QP)	Pola [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	440.800	22.98	16.05	9.43	31.94	16.52	46.00	29.4	Hori.	100	83	LP	
2	462.500	21.86	16.54	9.51	31.94	15.97	46.00	30.0	Hori.	100	83	LP	
3	484.200	21.65	17.14	9.57	31.93	16.43	46.00	29.5	Hori.	100	83	LP	
4	440.800	23.42	16.05	9.43	31.94	16.96	46.00	29.0	Vert.	129	102	LP	
5	462.500	21.88	16.54	9.51	31.94	15.99	46.00	30.0	Vert.	129	102	LP	
6	484.200	21.66	17.14	9.57	31.93	16.44	46.00	29.5	Vert.	129	102	LP	

Calculation: Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT+ΔAF)[dB]-Gain(AMP)[dB]

Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna **HA*: Horn

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

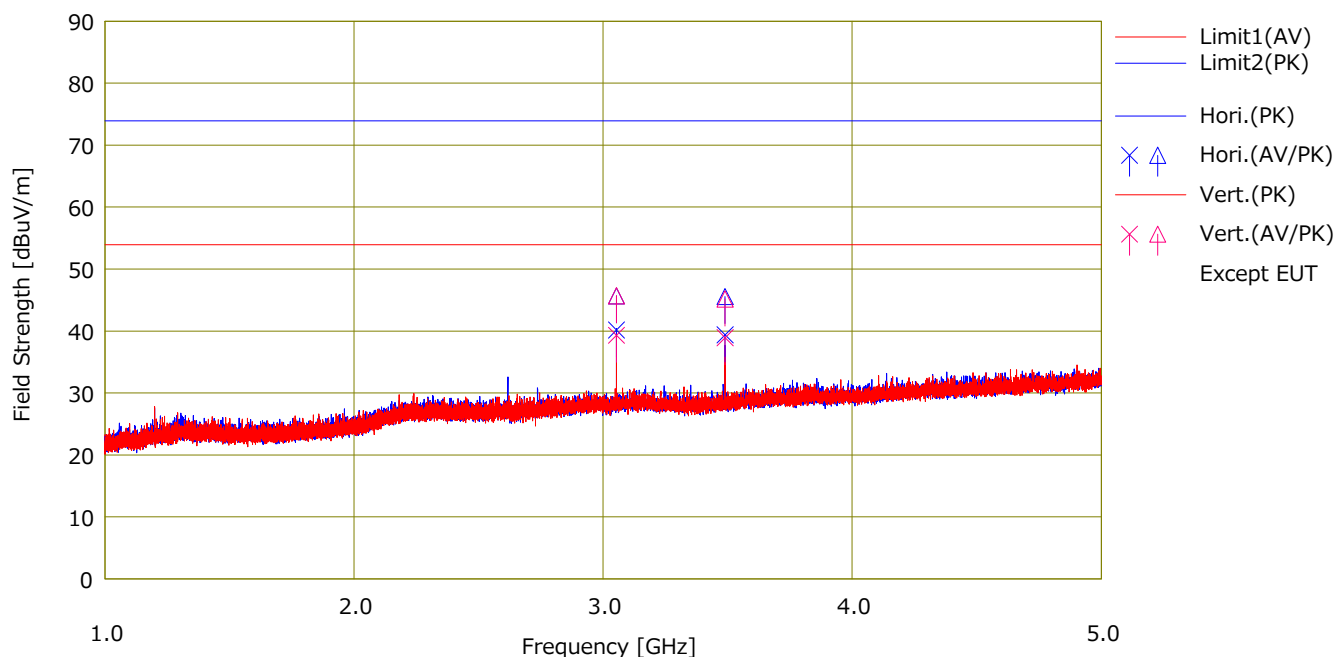
Date : 2020/04/14

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst axis: H: Y, V: Z

Mode : Receiving 458.0000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC_Part 15 Subpart B(15.109)_Class B

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result		Limit		Margin		Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		(AV) [dBuV]	(PK) [dBuV]				(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dB]	(PK) [dB]					
1	3054.099	48.84	54.34	29.15	4.04	41.87	40.16	45.66	53.90	73.90	13.7	28.2	Hori.	110	286	31SH3	(AV: VBW 10 Hz)
2	3490.400	48.16	54.32	29.09	4.32	42.18	39.39	45.55	53.90	73.90	14.5	28.3	Hori.	115	19	31SH3	(AV: VBW 10 Hz)
3	3054.099	47.98	54.38	29.15	4.04	41.87	39.30	45.70	53.90	73.90	14.6	28.2	Vert.	104	350	31SH3	(AV: VBW 10 Hz)
4	3490.400	47.70	53.94	29.09	4.32	42.18	38.93	45.17	53.90	73.90	14.9	28.7	Vert.	129	0	31SH3	(AV: VBW 10 Hz)

Calculation: Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT/filter)[dB]-Gain(AMP)[dB]

Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna SHA*: Horn

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Semi-Anechoic Chamber

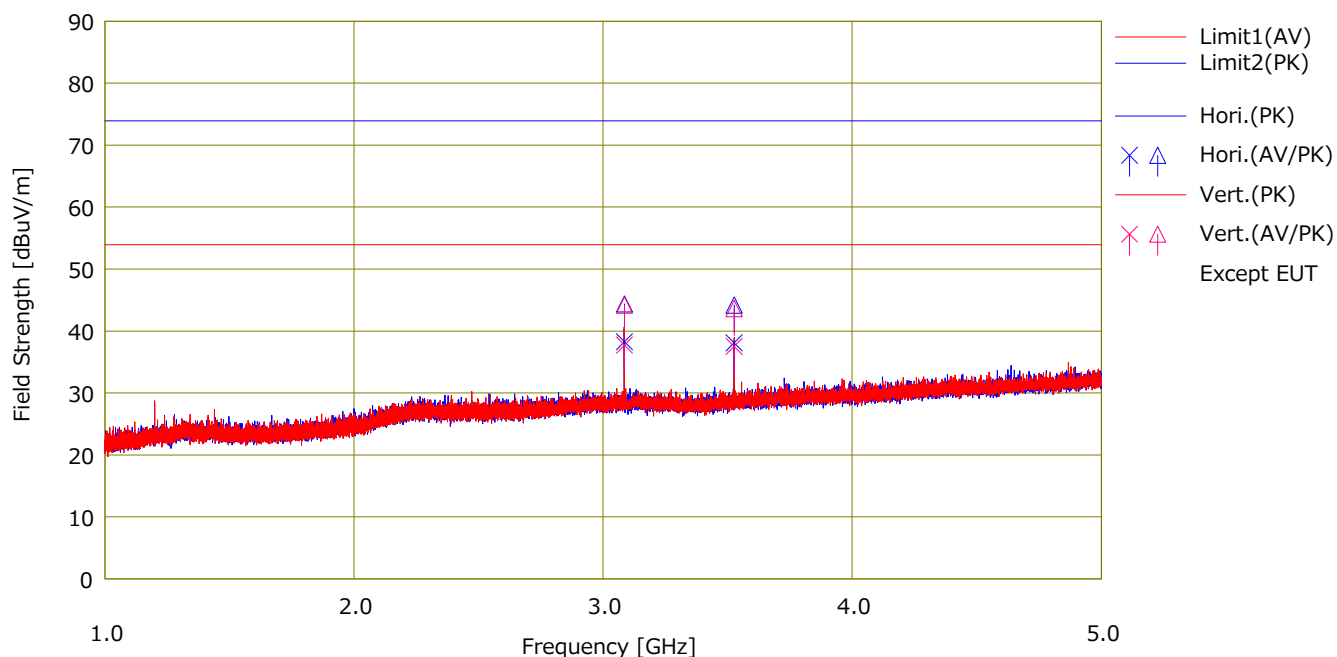
Date : 2020/04/14

Company : Circuit Design, Inc.
 Kind of EUT : UHF Narrow band multi channel transceiver
 Model No. : LMD-401
 Serial No. : 20200319-1
 Remarks : EUT & antenna worst axis: H: Y, V: Z

Mode : Receiving 462.5000MHz
 Order No. : 13299139S
 Power : DC 5 V
 Temp./Humi. : 22 deg.C / 37 %RH

Limit : FCC_Part 15 Subpart B(15.109)_Class B

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result		Limit		Margin		Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		(AV) [dBuV]	(PK) [dBuV]				(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dB]	(PK) [dB]					
1	3085.600	46.89	52.98	29.22	4.06	41.89	38.28	44.37	53.90	73.90	15.6	29.5	Hori.	109	288	31SH3	(Av: VBW 10 Hz)
2	3526.400	46.66	52.79	29.26	4.35	42.20	38.07	44.20	53.90	73.90	15.8	29.7	Hori.	113	21	31SH3	(Av: VBW 10 Hz)
3	3085.600	46.33	52.78	29.22	4.06	41.89	37.72	44.17	53.90	73.90	16.1	29.7	Vert.	102	356	31SH3	(Av: VBW 10 Hz)
4	3526.400	46.12	52.22	29.26	4.35	42.20	37.53	43.63	53.90	73.90	16.3	30.2	Vert.	128	0	31SH3	(Av: VBW 10 Hz)

Calculation: Result[dBuV/m] = Reading[dBuV] + Ant.Fac[dB/m] + Loss(Cable+ATT/filter)[dB] - Gain(AMP)[dB]

Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna SHA*:Horn

APPENDIX 2

Test Instruments

EMI test equipment

Test Name	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Interval (Month)
AT	KTS-07	145111	Digital Tester	SANWA	PC500	7019232	2019/10/01	12
AT	SAT10-13	151610	Attenuator	Weinschel Corp.	54A-10	81626	2020/03/02	12
AT	SAT20-12	160495	Attenuator	Weinschel Corp.	54A-20	86752	2019/12/12	12
AT	SCC-G12	145040	Coaxial Cable	Suhner	SUCOFLEX 102	30790/2	2020/03/02	12
AT	SCC-G13	145166	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	2019/12/12	12
AT	SCH-01	145200	Temperature and Humidity Chamber	ESPEC	PL-1KT	14020837	2020/04/02	12
AT	SOS-19	175823	Humidity Indicator	CUSTOM	CTH-201	-	2019/12/19	12
AT	SPM-06	146267	Power Meter	ANRITSU	ML2495A	850009	2019/05/22	12
AT	SPSS-03	146309	Power sensor	ANRITSU	MA2411B	917063	2019/05/22	12
AT	SRENT-15	160899	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46185516	2020/01/15	12
RE	COTS-SEMI-5	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,ME,PE)	-	-	-
RE	KDA-06	146348	Dipole Antenna	Schwarzbeck Mess - Elektronik	UHAP	1049	2020/02/01	12
RE	KHA-02	144941	Horn Antenna	Schwarzbeck Mess - Elektronik	BBHA9120D	230	2019/05/09	12
RE	KJM-02	146432	Measure	TAJIMA	GL19-55	-	-	-
RE	SAEC-03(NSA)	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2020/04/12	12
RE	SAF-03	145126	Pre Amplifier	SONOMA	310N	290213	2020/02/19	12
RE	SAF-06	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2020/02/20	12
RE	SAT10-17	167093	Attenuator	JFW	50HF-010N	-	2020/02/21	12
RE	SAT30-01	145044	Attenuator	JFW	50HF-030N	-	2019/07/18	12
RE	SAT6-13	167094	Attenuator	JFW	50HF-006N	-	2020/02/21	12
RE	SAT6-15	167096	Attenuator	JFW	50HF-006N	-	2020/02/21	12
RE	SBA-03	145023	Biconical Antenna	Schwarzbeck Mess - Elektronik	BBA9106	91032666	2019/05/07	12
RE	SCC-07	145162	Coaxial Cable	Fujikura,HP,Mini-Circuits,Fujikura	5D2W	-	2019/09/26	12
RE	SCC-C1/C2/C3/C4/C5/C10/SRSE-03	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2019/04/19	12
RE	SCC-G42	151618	Coaxial Cable	Junkosha	J12J103275-00	FEB-28-17-017	2020/03/04	12
RE	SCC-G43	156380	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104_E	SN MY 13406/4E	2019/07/03	12
RE	SCC-G58	183047	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800287/4A	2019/07/23	12
RE	SCC-M1	194601	Coaxial Cable	Fujikura	5D-2W	-	2019/12/17	12
RE	SFL-01	145300	Highpass Filter	MICRO-TRONICS	HPM50115	1	2019/11/06	12
RE	SHA-03	145501	Horn Antenna	Schwarzbeck Mess - Elektronik	BBHA9120D	9120D-739	2019/06/26	12
RE	SLA-07	145529	Logperiodic Antenna	Schwarzbeck Mess - Elektronik	VUSLP9111B	196	2019/05/07	12
RE	SOS-23	191840	Humidity Indicator	CUSTOM	CTH-201	-	2019/12/12	12
RE	SSG-02	146226	Signal Generator	Keysight Technologies Inc	E8257D-540	MY48051404	2020/01/29	12
RE	STR-08	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2019/11/22	12
RE	STS-03	146210	Digital Hitester	Hioki	3805-50	80997823	2019/10/01	12
RE	TLP-05	174863	Loop Antenna	Rohde & Schwarz	HFH2-Z2	826532/009	2019/11/12	12

*Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

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,

AT: Antenna terminal conducted test