

4740 Discovery Drive | Lincoln, NE 68521 tel- 402.323.6233 | tel -888.657.6860 | fax - 402.323.6238 info@nceelabs.com | http://nceelabs.com

# **FCC/ISED** Test Report

Prepared for: Inovonics

Address:

11000 Westmoor Circle Building 10, Suite 250 Westminster, CO 80021

Product:

EN5061

**Test Report No:** 

Approved by:

R20220503-20-E1

Mahendra Karthik Vepuri, NCE EMC Test Engineer, iNARTE Certified EMC Engineer #EMC-041453-E

DATE:

August 26, 2024

42

Total Pages:

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## **REVISION PAGE**

Rev. No.	Date	Description	
0	31 January 2023	Issued – KVepuri	
Ŭ	0 31 January 2023	Prepared by FLane	
A	26 August 2024	Report Date amended - FL	



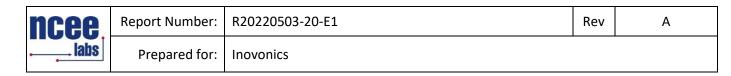
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## CONTENTS

Revi	sion Pa	де	2
1.0	Sum	mary of test results	4
2.0	EUT	Description	5
	2.1	Equipment under test	5
	2.2	Description of test modes	5
	2.3	Description of support units	5
3.0	Labo	pratory and General Test Description	6
	3.1	Laboratory description	6
	3.2	Test personnel	6
	3.3	Test equipment	7
	3.4	General Test Procedure and Setup for Radio Measuremnts	8
4.0	Res	ults	9
	4.1	Output Power	10
	4.1 4.2	Output Power	
		•	11
	4.2	Bandwidth	11 12
	4.2 4.3	Bandwidth	11 12 13
	4.2 4.3 4.4	Bandwidth Duty Cycle Radiated emissions	11 12 13 18
	4.2 4.3 4.4 4.5	Bandwidth Duty Cycle Radiated emissions Conducted AC Mains Emissions	11 12 13 18 21
Арр	4.2 4.3 4.4 4.5 4.6 4.7	Bandwidth Duty Cycle Radiated emissions Conducted AC Mains Emissions Band edges	11 12 13 18 21 22
••	4.2 4.3 4.4 4.5 4.6 4.7 endix A	Bandwidth Duty Cycle Radiated emissions Conducted AC Mains Emissions Band edges Power Spectral Density	11 12 13 18 21 22 23
Арр	4.2 4.3 4.4 4.5 4.6 4.7 endix A endix B	Bandwidth Duty Cycle Radiated emissions Conducted AC Mains Emissions Band edges Power Spectral Density	11 12 13 18 21 22 23 25



## 1.0 SUMMARY OF TEST RESULTS

The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section:

## FCC Part 15.247

The EUT has been tested according to the following specifications:

- (1) US Code of Federal Regulations, Title 47, Part 15
- (2) ISED RSS-Gen, Issue 5
- (3) ISED RSS-247, Issue 2

APPLIED STANDARDS AND REGULATIONS						
Standard Section	Test Type	Result				
FCC Part 15.35 RSS Gen, Issue 5, Section 6.10	Duty Cycle	Pass				
FCC Part 15.247(b)(3) RSS-247 Issue 2 Section 5.4(d)	Peak output power	Pass				
FCC Part 15.247(a)(2) RSS-247 Issue 2 Section 5.2	Bandwidth	Pass				
FCC Part 15.209 RSS-Gen Issue 5, Section 7.3	Receiver Radiated Emissions	Pass				
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 5, Section 8.9	Transmitter Radiated Emissions	Pass				
FCC Part 15.247(e) RSS-247 Issue 2 Section 5.2	Power Spectral Density	Pass				
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 5.5	Band Edge Measurement	Pass				
FCC Part 15.207 RSS-Gen Issue 5, Section 8.8	Conducted Emissions	Pass				



### 2.0 EUT DESCRIPTION

## 2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

EUT	EN5061		
EUT Received	1/18/2023		
EUT Tested	1/24/2023- 1/31/2023		
Serial No.	erial No. 010369(NCEE assigned serial number)		
Operating Band	2400 – 2483.5 MHz		
Device Type	🛛 GMSK 🗆 GFSK 🗆 BT BR 🗆 BT EDR 2MB 🗆 BT EDR 3MB		
Device Type	□ 802.11x		
Power Supply	12 VAC Power Supply; Part No. W48A-J1000-2T		

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

## 2.2 DESCRIPTION OF TEST MODES

The operating range of the EUT is dependent on the device type found in section 2.1:

GMSK Transmissions				
Channel	Frequency			
Low	2402 MHz			
Mid	2440 MHz			
High	2480 MHz			

These are the only representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

#### 2.3 DESCRIPTION OF SUPPORT UNITS

None



## 3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)					
4740 Discovery Drive					
Lincoln, NE 68521					
A2LA Certificate Number:	1953.01				
FCC Accredited Test Site Designation No:	US1060				
Industry Canada Test Site Registration No:	4294A				
NCC CAB Identification No:	US0177				

Environmental conditions varied slightly throughout the tests:

Relative humidity of  $35 \pm 4\%$ Temperature of  $22 \pm 3^{\circ}$  Celsius



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Rev

### 3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Fox Lane	Test Engineer	Review/Testing and Report
2	Karthik Vepuri	Test Engineer	Report
3	Ethan Schmidt	Test Technician	Testing and Report

**Notes:** All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.



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3.3 TEST EQUIPMENT

Prepared for:

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)**	N9038A	MY59050109	July 19, 2022	July 19, 2024
Keysight MXE Signal Analyzer (26.5GHz)**	N9038A	MY56400083	July 19, 2022	July 19, 2024
Keysight EXA Signal Analyzer**	N9010A	MY56070862	July 20, 2021	July 20, 2023
SunAR RF Motion	JB1	A082918-1	July 26, 2022	July 26, 2023
ETS EMCO Red Horn Antenna	3115	00218655	July 21, 2022	July 21, 2023
Com-Power LISN, Single Phase**	LI-220C	20070017	July 18, 2022	July 18, 2024
8447F POT H64 Preamplifier*	8447F POT H64	3113AD4667	March 21, 2022	March 21, 2024
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	August 22, 2022	August 22, 2024
Trilithic High Pass Filter*	6HC330	23042	March 21, 2022	March 21, 2024
ETS – Lindgren- VSWR on 10m Chamber***	10m Semi- anechoic chamber- VSWR	4740 Discovery Drive	July 30, 2020	July 30, 2023
NCEE Labs-NSA on 10m Chamber*	10m Semi- anechoic chamber-NSA	NCEE-001	May 25, 2022	May 25, 2024
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)*	MFR-57500	90-195-040	August 22, 2022	August 22, 2024
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	September 24, 2021	September 24, 2023
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3864	September 24, 2021	September 24, 2023
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	September 24, 2021	September 24, 2023
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	September 24, 2021	September 24, 2023
N connector bulkhead (control room)*	PE9128	NCEEBH2	September 24, 2021	September 24, 2023

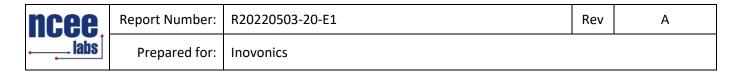
\*Internal Characterization

\*\*2 Year Cal Cycle

\*\*\*3 Year Cal Cycle

### Notes:

All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.



## 3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMNTS

Measurement type presented in this report (Please see the checked box below):

## Conducted $\boxtimes$

The conducted measurements were performed by connecting the output of the transmitter directly into a spectrum analyzer using an impedance matched cable and connector soldered to the EUT in place of the antenna. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.



Figure 1 - Bandwidth Measurements Test Setup

## Radiated ⊠

All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

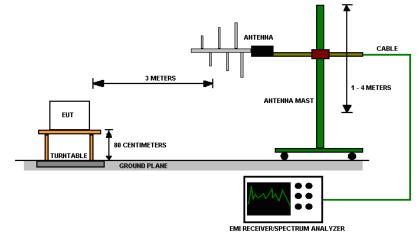


Figure 2 - Radiated Emissions Test Setup



## 4.0 RESULTS

DTS Radio Measurements							
CHANNEL	Transmitter	Occupied Bandwidth (kHz)	6 dB Bandwidth (kHz)	Peak radiated EIRP Power (dBm)	Peak radiated EIRP Power (mW)	PSD (dBm)	RESULT
Low	GMSK 1Mb	1036.6	712.8	11.807	15.160	-4.141	PASS
Mid	GMSK 1Mb	1035.1	706.7	11.534	14.236	-4.429	PASS
High	GMSK 1Mb	1037.7	713.5	8.458	7.011	-7.508	PASS
Occupied Ba	andwidth = N/A;	6 dB Bandwidth Li	mit = 500 kHz	Peak Output Pov	wer Limit = 30	dBm; PSD Li	mit = 8 dBm
			Unrestricted E	Band-Edge			
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Delta (dB)	Min Delta (dB)	Result
Low	GMSK 1Mb	2400.00	20.801	70.107	49.307	20.00	PASS
High	GMSK 1Mb	2483.50	15.722	66.289	50.568	20.00	PASS
		P	eak Restricted	Band-Edge			
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Detector	Limit (dBuV/m @ 3m)	Margin (dB)	Result
Low	GMSK 1Mb	2390.00	53.254	Peak	73.98	20.726	PASS
High	GMSK 1Mb	2483.50	56.513	Peak	73.98	17.467	PASS
*Limit shown	is the peak limi	t taken from FCC	Part 15.209				
	·	Ave	erage Restricte	ed Band-Edge			
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Detector	Limit (dBuV/m @ 3m)	Margin (dB)	Result
Low	GMSK 1Mb	2390.00	41.446	Average	53.98	12.534	PASS
High	GMSK 1Mb	2483.50	45.851	Average	53.98	8.129	PASS
				- 0 -			
*Limit shown is the average limit taken from FCC Part 15.209 Peak Output Power = Value in Appendix C Graph + 107 – 95.23 + Cable Loss + Transducer Loss PSD = Value in Appendix C Graph + 107 – 95.23 + Cable Loss + Transducer Loss							



Test Method: All measurements were performed using the section 11.9.2.2.2 from ANSI C63.10.

Rev

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Limits of power measurements: For FCC Part 15.247 Device: The maximum allowed output power is 30 dBm.

## Test procedures:

Details can be found in section 3.4 of this report.

## Deviations from test standard:

No deviation.

## Test setup:

Details can be found in section 3.4 of this report.

## EUT operating conditions:

Details can be found in section 2.1 of this report.

## Test results:

## Pass

Comments:

- 1. All the output power plots can be found in the Appendix C.
- 2. All the measurements were found to be compliant.
- 3. Tabulated data is listed in section 4.0.



**Test Method**: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

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Rev

### Limits of bandwidth measurements:

#### For FCC Part 15.247 Device:

The 99% occupied bandwidth is for informational purpose only. The 6dB bandwidth of the signal must be greater than 500 kHz.

#### Test procedures:

Details can be found in section 3.4 of this report.

#### Deviations from test standard:

No deviation.

#### Test setup:

Test setup details can be found in section 3.4 of this report.

### EUT operating conditions:

Details can be found in section 2.1 of this report.

### Test results:

## Pass

Comments:

- 1. All the bandwidth plots can be found in the Appendix C.
- 2. All the measurements were found to be compliant.
- 3. Tabulated data is listed in section 4.0.

## 4.3 DUTY CYCLE

## Test Method:

The EUT was transmitting with 100% Duty Cycle during the tests.



## 4.4 RADIATED EMISSIONS

Test Method: ANSI C63.10-2013, Section 6.5, 6.6

#### Limits for radiated emissions measurements:

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (μV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

### NOTE:

1. The lower limit shall apply at the transition frequencies.

2. Emission level (dBuV/m) = 20 \* log \* Emission level ( $\mu$ V/m).

3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

4. The EUT was tested for spurious emissions while running off of battery power and external USB power. The worst-case emissions are presented.

Rev



a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semianechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

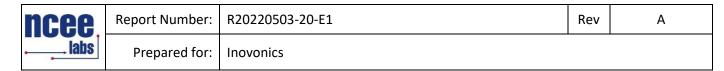
d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise, the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

Rev



#### Test setup:

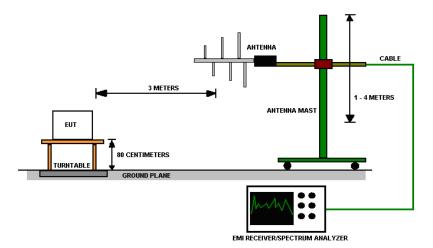


Figure 3 - Radiated Emissions Test Setup

## NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

Deviations from test standard:

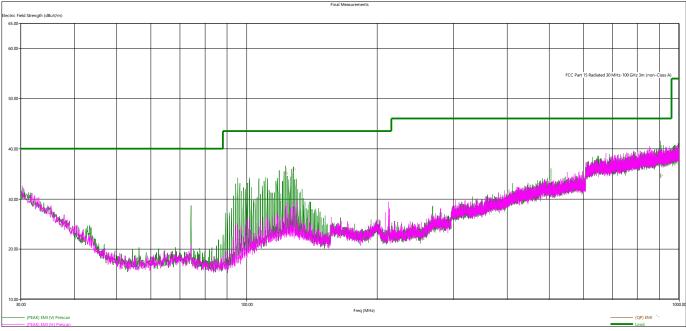
No deviation.

## **EUT operating conditions**

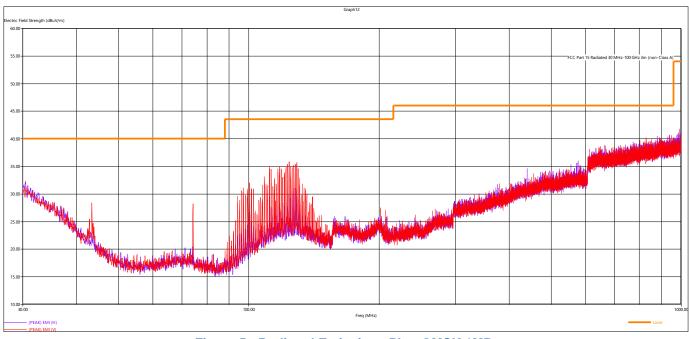
Details can be found in section 2.1 of this report.



**Test results:** 









## REMARKS:

- 1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
- 2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
- 3. The other emission levels were very low against the limit.
- 4. Margin value = Limit value Emission level

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ncee,	Report Number:	R20220503-20-E1	Rev	А
	Prepared for:	Inovonics		

	Quasi-Peak Measurements, GMSK							
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
122.744400	35.10	43.52	8.42	106.00	240.00	V		Rx
128.057040	35.85	43.52	7.67	110.00	288.00	V	Rx	
905.542320	34.60	46.02	11.42	195.00	269.00	V		Rx

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the plot and table above. All other measurements were found to be at least 6 dB below the limit.

	Peak Measurements, GMSK									
Frequency Level Limit Margin Height Angle Pol Channel Modulati										
MHz	dBµV/m	dBµV/m	dB	cm.	deg.					
2401.988000	107.16	NA	NA	214.00	360.00	V	Low	GMSK 1MB		
2439.756000	106.53	NA	NA	319.00	6.00	V	Mid	GMSK 1MB		
2479.718000	103.89	NA	NA	276.00	12.00	V	High	GMSK 1MB		
4880.106000	43.98	73.98	30.00	165.00	52.00	V	Mid	GMSK 1MB		
7320.740000	52.10	73.98	21.88	244.00	55.00	V	Mid	GMSK 1MB		

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the plot and table above. All other measurements were found to be at least 6 dB below the limit.

	Average Measurements, GMSK								
Freq. Avg Level Limit Margin Height Angle Pol Ch. Mod.									
MHz	dBµV/m	dBµV/m	dB	cm.	deg.				
2401.988000	107.05	NA	NA	214.00	360.00	V	Low	GMSK 1MB	
2439.756000	104.32	NA	NA	319.00	6.00	V	Mid	GMSK 1MB	
2479.718000	101.13	NA	NA	276.00	12.00	V	High	GMSK 1MB	
4880.106000	30.78	53.98	23.20	165.00	52.00	V	Mid	GMSK 1MB	
7320.740000	39.14	53.98	14.84	244.00	55.00	V	Mid	GMSK 1MB	

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above. All other measurements were found to be at least 6 dB below the limit.



## 4.5 CONDUCTED AC MAINS EMISSIONS

Test Method: ANSI C63.10-2013, Section(s) 6.2

#### Limits for conducted emissions measurements:

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBµV)		
	Quasi-peak	Average	
0.15-0.5	66 to 56	56 to 46	
0.5-5	56	46	
5-30	60 50		

#### Notes:

1. The lower limit shall apply at the transition frequencies.

The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz
 All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

#### Test Procedures:

- a. The EUT was placed 0.8m above a ground reference plane and 0.8 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits are not reported.
- d. Results were compared to the 15.207 limits.

#### Deviation from the test standard:

No deviation

### EUT operating conditions:

Details can be found in section 2.1 of this report.

Rev



А

**Test Results:** 

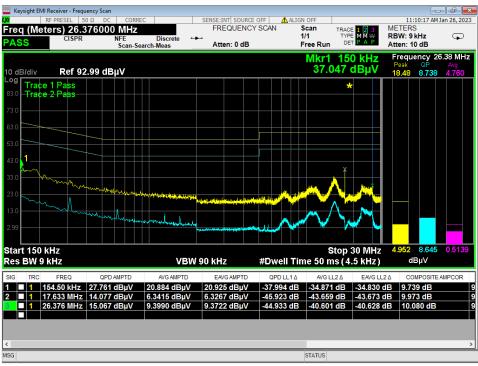


Figure 6 - Conducted Emissions Plot, Line, TX

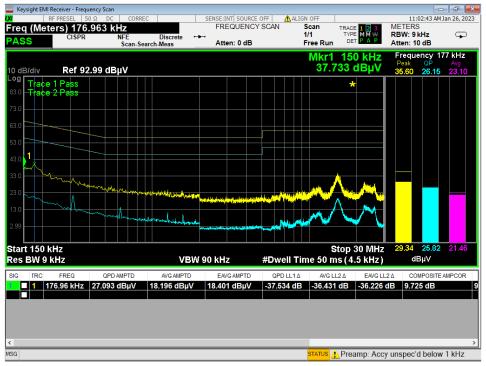


Figure 7 - Conducted Emissions Plot, Neutral, TX



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Figure 9 - Conducted Emissions Plot, Neutral, IDLE

Rev



**Test Method**: All the radio measurements were performed using the sections from ANSI C63.10, Section 11.12.2.5.2. Details about the section used can be found in the spectrum analyzer titles on the graph.

## Limits of band-edge measurements:

## For FCC Part 15.247 Device:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.205(c))

## Test procedures:

The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

### **Deviations from test standard:**

No deviation.

## Test setup:

Test setup details can be found in section 3.4 of this report.

## EUT operating conditions:

Details can be found in section 2.1 of this report.

### Test results:

## Pass

Comments:

- 1. All the band edge plots can be found in the Appendix C.
- 2. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 20 dB between peak and the band edge.
- 3. The restricted band edge compliance is shown by comparing to the general limit defined in Part 15.209.
- 4. Tabulated data is listed in section 4.0.

Rev



**Test Method**: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Rev

А

### Limits of power measurements:

For FCC Part 15.247 Device: The maximum PSD allowed is 8 dBm.

#### Test procedures:

Details can be found in section 3.4 of this report.

## Deviations from test standard:

No deviation.

### Test setup:

Details can be found in section 3.4 of this report.

### EUT operating conditions:

Details can be found in section 2.1 of this report.

## Test results:

## Pass

Comments:

- 1. All the Power Spectral Density (PSD) plots can be found in the Appendix C.
- 2. All the measurements were found to be compliant.
- 3. Tabulated data is listed in section 4.0.

ncee.	Report Number:	R20220503-20-E1	Rev	А
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## APPENDIX A: SAMPLE CALCULATION

## **Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows: FS = RA + AF - (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude AF = Antenna Factor CF = Cable Attenuation Factor AG = Amplifier Gain AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dB $\mu$ V is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB $\mu$ V/m.

 $FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$ 

The 48.1 dB $\mu$ V/m value can be mathematically converted to its corresponding level in  $\mu$ V/m.

Level in  $\mu$ V/m = Common Antilogarithm [(48.1 dB $\mu$ V/m)/20]= 254.1  $\mu$ V/m

AV is calculated by the taking the  $20^{100}(T_{on}/100)$  where  $T_{on}$  is the maximum transmission time in any 100ms window.

ncee	Report Number:	R20220503-20-E1	Rev	А
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## **EIRP Calculations**

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

EIRP (Watts) = [Field Strength (V/m) x antenna distance (m)]<sup>2</sup> / 30

Power (watts) =  $10^{Power} (dBm)/10] / 1000$ 

Voltage ( $dB\mu V$ ) = Power (dBm) + 107 (for 50 $\Omega$  measurement systems)

Field Strength (V/m) =  $10^{Field}$  Strength (dB $\mu$ V/m) / 20] /  $10^{6}$ 

Gain = 1 (numeric gain for isotropic radiator)

Conversion from 3m field strength to EIRP (d=3):

 $EIRP = [FS(V/m) \times d^2]/30 = FS[0.3]$  for d = 3

 $EIRP(dBm) = FS(dB\mu V/m) - 10(log 10^9) + 10log[0.3] = FS(dB\mu V/m) - 95.23$ 

10log( 10^9) is the conversion from micro to milli

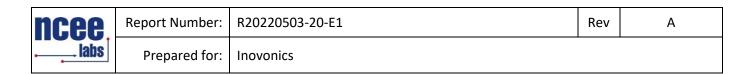


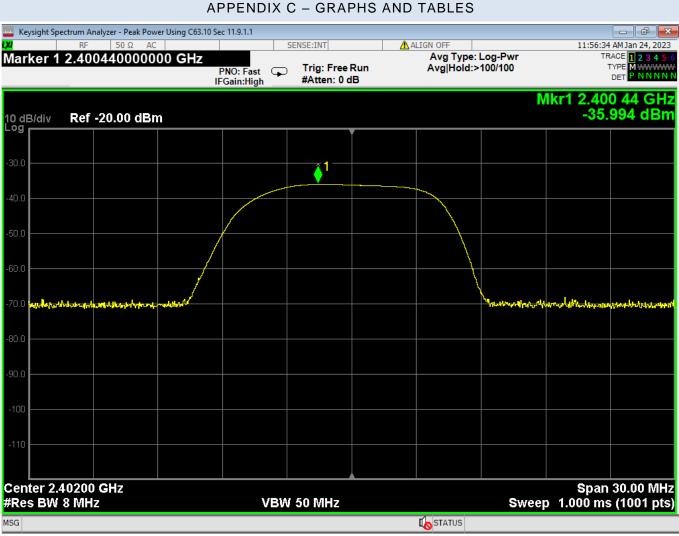
## APPENDIX B - MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)		
Radiated Emissions, 3m	30MHz - 1GHz	±4.31		
Radiated Emissions, 3m	1GHz - 18GHz	±5.08		
Emissions limits, conducted	30MHz – 18GHz	±3.03		

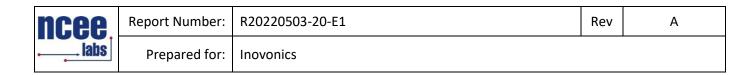
Expanded uncertainty values are calculated to a confidence level of 95%.





01 Peak Power, Low Channel, GMSK 1MB

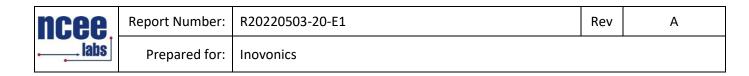
	Uncorrected	Cable	Antenna	Corrected	
Channel	Value	Loss	Factor	Value	
Low	-35.994	8.56	27.471	11.807	



Keysight Spectr	rum Analyzer - Peak Pow	er Using C63.10 Sec 1	1.9.1.1					
XI	RF 50 Ω AC		SI	ENSE:INT	ALIGN OFF		12:16:32	PM Jan 24, 2023
Input Mech	h Atten 0 dB		O:Fast ⊊⊃ ain:High	Trig: Free Ru #Atten: 0 dB	Avg Type: n Avg Hold:>		TR T	ACE 1 2 3 4 5 6 YPE MWWWW DET P N N N N N
10 dB/div	Ref -20.00 dBn	n				N	1kr1 2.43 -36.	8 62 GHz 412 dBm
-30.0				<u>_</u> 1				
-40.0								
-50.0		/						
-60.0								
-70.0 <b>attan</b> tan	peteriolistoriopychilipatho	with the the				www.leternleternleternletern	<sub>ง.ค.</sub> เหล <sub>า</sub> เหล่างสารสารที่สุป	han Maghangata
80.0								
-100								
-110								
Center 2.44 #Res BW 8	1000 GHz MHz		VBW	50 MHz		Swee	Span 5 1.000 ms	30.00 MHz (1001 pts)
MSG								

02 Peak Power, Mid Channel, GMSK 1MB

	Uncorrected	Cable	Antenna	Corrected	
Channel	Value	Loss	Factor	Value	
Mid	-36.412	8.56	27.616	11.534	



🔤 Keysight Spe	ctrum Analyzer - Peak Pov	ver Using C63.10 Sec	11.9.1.1					- 6 ×
XI	RF 50 Ω AC		S	ENSE:INT	ALIGN OFF		12:37:39	PM Jan 24, 2023
Ref Leve	l -20.00 dBm		NO: Fast 😱 Gain:High	Trig: Free Run #Atten: 0 dB	Avg Type: Avg Hold:>	100/100	Т	ACE 1 2 3 4 5 6 YPE M WWWWW DET P N N N N
10 dB/div Log	Ref -20.00 dBr	m				N	lkr1 2.478 -39.	3 41 GHz 534 dBm
-30.0								
-40.0								
-50.0								
-60.0								
-70.0 <mark>akayaan</mark>	กษณ <sub>ี</sub> มีระบบไปของการ/โละไม่ๆไปจะบางสืบ	hoursel			\ 	Humover the terms with	hangentraksportugikas	yogy and all and any south
80.0								
90.0								
-100								
-110								
Center 2.4 #Res BW	18000 GHz		\/B\M	50 MHz		Swoor	Span 5 1.000 ms	30.00 MHz (1001 pts)
ARCES DW	0 WI12		0.000	50-WI112		Sweet	- 1.000 ms	(Toor pts)

03 Peak Power, High Channel, GMSK 1MB

	Uncorrected	Cable	Antenna	Corrected	
Channel	Value	Loss	Factor	Value	
High	-39.534	8.56	27.662	8.458	

ncee,	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

Keysight Spectrum Analyzer - BW using C63.	10 Sec 11.8.1			
₩ RF 50 Ω DC Ref Value -8.00 dBm		SENSE:INT Center Freq: 2.40200000	IIGN OFF	11:53:56 AM Jan 24, 2023 Radio Std: None
	#IFGain:Low	Tria: Erec Dun	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref -8.00 dBm				
Log				
-18.0				
-28.0				
-38.0				
-48.0				
-58.0				
-68.0	hand			
-78.0	and the second			mine
-88.0 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				- man man man
-98.0				
Center 2.402000 GHz				Span 5.000 MHz
#Res BW 100 kHz		VBW 1 MHz		Sweep 1 ms
Occupied Bandwidth		Total Power	-30.0 dBm	
1.0	532 MHz			
Transmit Freq Error	-160 Hz	% of OBW Power	99.00 %	
x dB Bandwidth	712.8 kHz	x dB	-6.00 dB	
MSG				

04 6dB Bandwidth, Low Channel, GMSK 1MB

ncee,	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

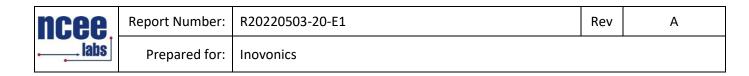
Keysight Spectrum Analyzer - BW using C63.10	) Sec 11.8.1			
₩ RF 50 Ω DC Ref Value -10.00 dBm		SENSE:INT AL	LIGN OFF	12:14:56 PM Jan 24, 2023 Radio Std: None
	#IFGain:Low	Tricy Free Dup	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref -10.00 dBm				
-20.0				
-30.0				
-40.0				
-50.0				
-60.0				
-70.0			- Land	
-80.0			land have	
-90.0 manumman	,			man have have here here here here here here here he
-100				
Center 2.440000 GHz #Res BW 100 kHz		VBW 1 MHz		Span 5.000 MHz Sweep 1 ms
Occupied Bandwidth		Total Power	-30.5 dBm	
1.0	524 MHz			
Transmit Freq Error	-272 Hz	% of OBW Power	99.00 %	
x dB Bandwidth	706.7 kHz	x dB	-6.00 dB	

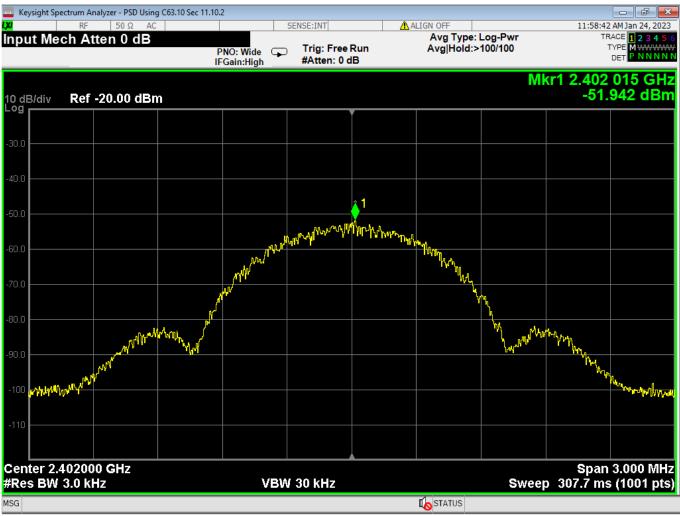
05 6dB Bandwidth, Mid Channel, GMSK 1MB

ncee,	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

Keysight Spectrum Analyzer - BW using C6	3.10 Sec 11.8.1	SENSE:INT	LIGN OFF	12:35:45 PM Jan 24, 2023
Ref Value -10.00 dBm		Center Freq: 2.48000000 Trig: Free Run	) GHz Avg Hold:>10/10	Radio Std: None
	#IFGain:Low	#Atten: 0 dB		Radio Device: BTS
10 dB/div Ref -10.00 dB	m			
-20.0				
-30.0				
-40.0				
-50.0				
-60.0				
-70.0			- And	
-80.0	- Annana -			mannannannan
-90.0				and a warden of the second
-100				
Center 2.480000 GHz				Span 5.000 MHz
#Res BW 100 kHz		VBW 1 MHz		Sweep 1 ms
Occupied Bandwidt	h	Total Power	-33.6 dBm	
	0539 MHz			
Transmit Freq Error	-3.670 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	713.5 kHz	x dB	-6.00 dB	
	7 15.5 KHZ	X UD	-0.00 uB	
MSG				
MSG				

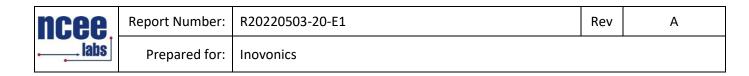
06 6dB Bandwidth, High Channel, GMSK 1MB

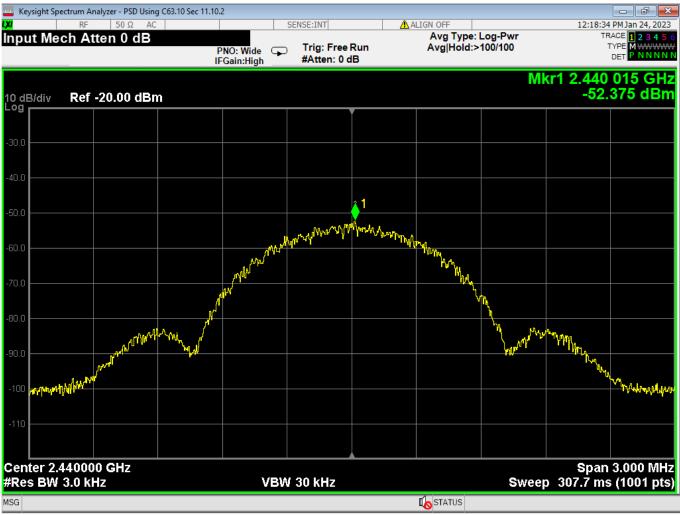




07 PSD, Low Channel, GMSK 1MB

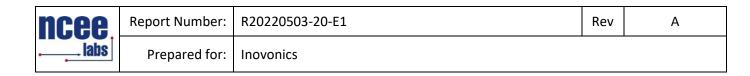
	Uncorrected	Cable	Antenna	Corrected
Channel	Value	Loss	Factor	Value
Low	-51.942	8.56	27.471	-4.141

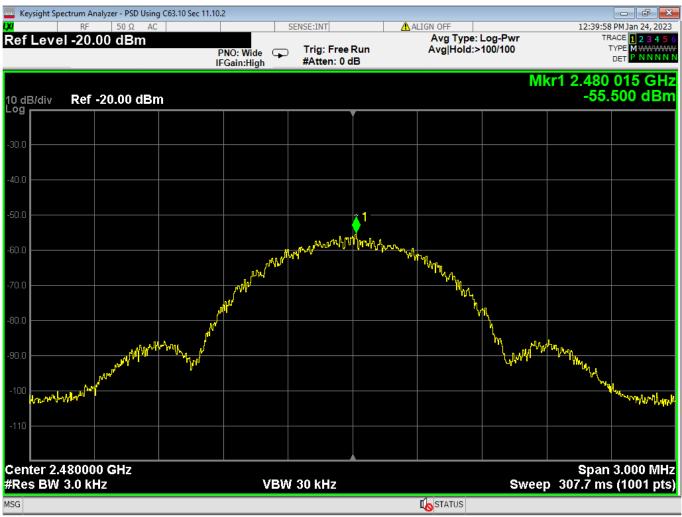




08 PSD, Mid Channel, GMSK 1MB

	Uncorrected	Cable	Antenna	Corrected	
Channel	Value	Loss	Factor	Value	
Mid	-52.375	8.56	27.616	-4.429	





09 PSD, High Channel, GMSK 1MB

	Uncorrected	Cable	Antenna	Corrected
Channel	Value	Loss	Factor	Value
High	-55.5	8.56	27.662	-7.508

ncee	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

	ectrum Analyzer	- Unrestricted LBE (	using C63.10 Sec 11.13.2	2					- @ <b>x</b>
LXI	RF !	50 Ω AC		SENSE:I	NT	ALIGN OFF		11:46:01	AM Jan 24, 2023
Marker 1	2 40223	5224816 G	Hz			Avg Typ	e: Log-Pwr	TR	ACE 1 2 3 4 5 (
markor			PNO: Wide IFGain:High	_ <b>→</b> ₽	g: Free Run ten: 0 dB		d:>1000/1000		
			in ourningin				MI	(r1 2.402	235 CH7
10 dB/div	<b>Def 26</b> (	99 dBµV							07 dBµV
		/3 UDµ¥			Ţ				
77.0							<b>-  </b> <sup>1</sup>		
67.0									
57.0							+/-		
47.0							`		
37.0							$\wedge$	M-	
27.0							/		
17.0 <b>~~~~</b> ^		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		w.m.m.	······································		- ma	ᡫᠬᠬᡃ᠘ <sub>᠕</sub> ᠰᡅ᠆᠆ᠮ᠊ᢑᡢᢇᡀ᠇ᡒ᠇
6.99									
-3.01									
Otort 2.20								Oton 2.4	
#Res BW	90000 GH: / 100 kHz	2	,	VBW 1.0	MHz		Sweet	5.0p 2.4 5 1.467 ms	05808 GHz (1001 pts)
MKR MODE T		X		Y	FUNCTION	FUNCTION WIDTH		JNCTION VALUE	()
	1 f	2.402 2		107 dBµV	TONCHON		1.	SNCHON VALUE	
2 Δ1 · 3 N ·	1 f (Δ) 1 f	<u>-2.3</u> 2.399 8		49.307 dB 801 dBμV					
4		2.335 0	56 GHZ 20.	ουτάδμν					
5 6						+			
7									
9									
10									~
<									>
						<b>I</b> STATUS			

10 LBE, unrestricted GMSK 1MB

ncee.	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

🔤 Keysight Sp	ectrum Analyzer - U	Inrestricted HBE Using (	C63.10 Sec 11.13.2						
LXI		Ω DC		SENSE:INT	4	ALIGN OFF		12:41:50	PM Jan 24, 2023
Marker 1	2.4802318	331500 GHz				Avg Type	: Log-Pwr	TR/	ACE 1 2 3 4 5
maritor			PNO: Wide 🗔	Trig: Free	Run	Avg Hold:	>1000/1000	т	
			IFGain:High	#Atten: 0	dB			l i i i i i i i i i i i i i i i i i i i	DET PANNN
							MK	r1 2.480	
10 dB/div	Ref 86.99	dBuV						66.2	89 dBµV
Log					<b>v</b>				
77.0									
11.0						<b>_</b> 1			
67.0									
57.0									
47.0									
37.0					↓/	+	<u> </u>		
27.0									
27.0				0.0			h		2A3
17.0		www.co.co.co.co.co.co.co.co.co.co.co.co.co.	mon man	- present "V"			www	$\sim$	when and
6.99									
-3.01									
0.01									
<b>0</b> 4	74705 011-				A			<b>0</b> 4 0 40	
	74785 GHz						_	Stop 2.48	3500 GHz
#Res BW	100 kHz		#VE	3W 300 kH;	Z		Sweep	1.000 ms	(1001 pts)
MKR MODE T	RCI SCI I	X	Y	FUI	NCTION FUN	CTION WIDTH	FUI	ICTION VALUE	
	1 5	2.480 232 GI		dBµV			101	CHON VALUE	
2 A1 <sup>4</sup>	1 f (Δ)	3.268 M	$H_{z}(\Lambda) = 50.5$	68 dB					
	1 f	2.483 50 G	Hz 15.722	dBuV					
4		2.400 00 01							
5									
6									
7									
8									
9									
10									
11									v
<									>
-									
MSG						<b>STATUS</b>			

11 HBE, unrestricted GMSK 1MB

ncee.	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

		ec 6.10.5	1	A 41701 055	1		
RF 50 9		SENSE:I	NT	ALIGN OFF			AM Jan 24, 2 ACE 1 2 3 4
Arker 2 2.3898000	PI		g: Free Run ten: 0 dB	Avg Hold	:>1000/1000	т	
Ref Offset 3	6.12 dB				М	kr2 2.389	
dB/div Ref 88.11						41.4	49 dB
🗧 Trace 1 Pass							
Trace 2 Pass							
				1			
1	and an	and a start of the	antal of a banand		And have a street on the same	- ԴիուՈւ, թացրութերութերութերութ ԴիուՈւ, թացրութերութերութերութերութերութերութերութե	
.1						· · ·	
.1							
.1							
11							
39							
art 2.380000 GHz		#VBW 50	MHz*		Sweep	Stop 2.39 1.000 ms	00000 G (1001 p
es BW 1.0 MHz							
	X	Y	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
N 1 f	2.386 30 GHz	53.254 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
N 1 f N 2 f		-	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
N 1 f N 2 f	2.386 30 GHz	53.254 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
	2.386 30 GHz	53.254 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
R MODE TRC SCL N 1 f N 2 f	2.386 30 GHz	53.254 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
R MODE TRC SCL N 1 f N 2 f	2.386 30 GHz	53.254 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
R MODE TRC SCL N 1 f N 2 f	2.386 30 GHz	53.254 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
MODE TRC SCL N 1 f N 2 f	2.386 30 GHz	53.254 dBµV	FUNCTION		FU	NCTION VALUE	

12 LBE, Restricted GMSK 1MB

ncee.	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

	er - Restricted HBE C63.10 S	ec 6.10.5					- F
RF	50 Ω AC	SE	NSE:INT	ALIGN OFF			PMJan 24, 2
ırker 2 2.4835	16500000 GHz			Avg Typ			
		PNO: Fast	Trig: Free Run	Avg Hol	d:>1000/1000		YPE MA₩ DET PAN
PREAD	MP	IFGain:High	#Atten: 0 dB				
D. (					Mkr	2 2.483 51	65G
	set 36.65 dB						39 dB
a – – – – – – – – – – – – – – – – – – –	.64 dBµV					40.0	
Trace 1 Pass			Ĭ				
Trace 2 Pass							
.6							
_ <b>∆'</b>							
2 - 2 - 2	har har har and a	All and and a sector to add					
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.6							
.6							
e							
.6							
64							
26							
36							
	-					<b>O</b> tom 0.5/	
art 2.483500 GH						Stop 2.50	00000
art 2.483500 GH		VBW	50 MHz*		Swee	Stop 2.50 p 1.000 ms	)0000 Q (1001
art 2.483500 GH es BW 1.0 MHz		VBW	50 MHz*	FUNCTION WIDTH		Stop 2.50 p 1.000 ms	)0000 0 (1001
art 2.483500 GH es BW 1.0 MHz	x	Y	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 C (1001
art 2.483500 GH es BW 1.0 MHz	2	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 Q (1001 p
art 2.483500 GH es BW 1.0 MHz MODE TRC SCL N 1 f N 2 f	2 X 2.483 533 0 G	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 C (1001
art 2.483500 GH es BW 1.0 MHz MODE TRC SCL N 1 f N 2 f	2 X 2.483 533 0 G	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 C (1001 j
Art 2.483500 GH es BW 1.0 MHz MODE TRC SCL N 1 f N 2 f	2 X 2.483 533 0 G	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 C (1001
Art 2.483500 GH es BW 1.0 MHz MODE TRC SCL N 1 f N 2 f	2 X 2.483 533 0 G	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 Q
art 2.483500 GH es BW 1.0 MHz MODE TRC SCL N 1 f N 2 f	2 X 2.483 533 0 G	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 G (1001 p
art 2.483500 GH es BW 1.0 MHz MODE TRC SCL N 1 f N 2 f	2 X 2.483 533 0 G	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 <b>(</b> (1001
art 2.483500 GH es BW 1.0 MHz MODE TRC SCL N 1 f N 2 f	2 X 2.483 533 0 G	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 ( (1001)
art 2.483500 GH es BW 1.0 MHz MODE TRC SCL N 1 f N 2 f	2 X 2.483 533 0 G	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 <b>(</b> (1001
art 2.483500 GH es BW 1.0 MHz MODE TRC SCL N 1 f N 2 f	2 X 2.483 533 0 G	Y Hz 56.513 dE	FUNCTION	FUNCTION WIDTH		p 1.000 ms	00000 <b>(</b> (1001

13 HBE, Restricted GMSK 1MB

ncee,	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

Keysight Spectrum Analyzer - BW using C63.	TO SECTION			
RF 50 Ω DC			IGN OFF	11:54:55 AM Jan 24, 202
ef Value -8.00 dBm		Center Freq: 2.40200000		Radio Std: None
	#IFGain:Low	Trig: Free Run #Atten: 0 dB	Avg Hold:>10/10	Radio Device: BTS
0 dB/div Ref -8.00 dBm				
.og				
18.0				
28.0				
38.0				
18.0				
			<b>A</b>	
58.0				
68.0	J~~		Juny	
78.0				
38.0				man and man and a marker of the second secon
8.0				
8.0				Span 5.000 MH
8.0		VBW 470 kHz		Span 5.000 MH
enter 2.402000 GHz Res BW 47 kHz		VBW 470 kHz Total Power	-29.9 dBm	Span 5.000 MH Sweep 2.733 m
Res BW 47 kHz			-29.9 dBm	Span 5.000 MH
enter 2.402000 GHz Res BW 47 kHz Occupied Bandwidth	n )366 MHz		-29.9 dBm	Span 5.000 MH
enter 2.402000 GHz Res BW 47 kHz Occupied Bandwidth				Span 5.000 MH
enter 2.402000 GHz Res BW 47 kHz Occupied Bandwidth 1.0 Transmit Freq Error	0366 MHz 1.956 kHz	Total Power % of OBW Power	99.00 %	Span 5.000 MH
enter 2.402000 GHz Res BW 47 kHz Occupied Bandwidth 1.0	)366 MHz	Total Power		Span 5.000 MH
enter 2.402000 GHz Res BW 47 kHz Occupied Bandwidth 1.0 Transmit Freq Error	0366 MHz 1.956 kHz	Total Power % of OBW Power	99.00 %	Span 5.000 MH
Res BW 47 kHz Occupied Bandwidth 1.0 Transmit Freq Error	0366 MHz 1.956 kHz	Total Power % of OBW Power	99.00 %	Span 5.000 MH
enter 2.402000 GHz Res BW 47 kHz Occupied Bandwidth 1.0 Transmit Freq Error	0366 MHz 1.956 kHz	Total Power % of OBW Power x dB	99.00 %	Span 5.000 MH

14 Occupied Bandwidth, Low Channel, GMSK 1MB

ncee,	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

Keysight Spectrum Analyzer - BW using C63.1	0 Sec 11.8.1			
		SENSE:INT Center Freq: 2.44000000		12:15:49 PM Jan 24, 2023 Radio Std: None
Ref Value -10.00 dBm	#IFGain:Low	Talas Fase Dave	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref -10.00 dBm				
-20.0 -30.0				
-40.0		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
-60.0	/			
-70.0	M		hand	
-90.0				when my white the second where the
Center 2.440000 GHz #Res BW 47 kHz		VBW 470 kHz		Span 5.000 MHz Sweep   2.733 ms
Occupied Bandwidth	351 MHz	Total Power	-30.4 dBm	
Transmit Freq Error	1.929 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	684.9 kHz	x dB	-6.00 dB	
MSG				

15 Occupied Bandwidth, Mid Channel, GMSK 1MB

ncee,	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

www. Keysight Spectrum Analyzer - BW using C63	.10 Sec 11.8.1			
LX/ RF 50 Ω DC			IGN OFF	12:36:46 PM Jan 24, 2023
Ref Value -10.00 dBm		Center Freq: 2.48000000		Radio Std: None
	⊂ #IFGain:Low	Trig: Free Run #Atten: 0 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref -10.00 dBn Log	<u>n</u>			
-20.0				
-30.0				
-40.0				
-50.0		m		
-60.0	/			
-70.0				
-80.0			have the	
-90.0	- The and a start of the start			
When the second				- the second
-100				
Center 2.480000 GHz				Span 5.000 MHz
#Res BW 47 kHz		VBW 470 kHz		Sweep 2.733 ms
TRES DW 47 KHZ		<b>VBVV</b> 470 KHZ		Sweep 2.755 IIs
Occupied Bandwidt	'n	Total Power	-33.4 dBm	
1.(	0377 MHz			
Transmit Freq Error	-1.168 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	685.5 kHz	x dB	-6.00 dB	
	00010 1112			
ISG			I STATUS	

16 Occupied Bandwidth, High Channel, GMSK 1MB

ncee.	Report Number:	R20220503-20-E1	Rev	А
labs	Prepared for:	Inovonics		

## REPORT END