



Report No.: FG0O1212

# FCC RADIO TEST REPORT

FCC ID : 2AQ68T99B226 Equipment : LTE Small Cell

Model Name : T99B226

Applicant : HON LIN Technology Co., Ltd

11F, No. 32, Jihu Rd., Neihu Dist., Taipei City, Taiwan.

Manufacturer: HON LIN Technology Co., Ltd

11F, No. 32, Jihu Rd., Neihu Dist., Taipei City, Taiwan.

Standard : FCC 47 CFR Part 2, 96

The product was received on Oct. 12, 2020 and testing was started from Oct. 17, 2020 and completed on Nov. 18, 2020. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI / TIA-603-E and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

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# History of this test report

Report No. : FG0O1212

Report No.	Version	Description	Issued Date
FG0O1212	01	Initial issue of report	Jan. 18, 2021

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## **Summary of Test Result**

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Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046	Conducted Output Power	Reporting only	-
3.3	§96.41	Peak-to-Average Ratio	Pass	
0.4	§96.41	Effective Isotropic Radiated Power	Pass	-
3.4	\$ <del>90.4</del> 1	Power Density.	Pass	-
3.5	§2.1049 §96.41	Occupied Bandwidth	Reporting only	-
3.6	§2.1051 §96.41	Conducted Band Edge Measurement	Pass	-
3.7	§2.1051 §96.41	Conducted Spurious Emission	Pass	
4.4	§2.1051 §96.41	Radiated Spurious Emission	Pass	Under limit 0.82 dB at 14242.000 MHz

#### **Declaration of Conformity:**

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

#### **Comments and Explanations:**

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Wii Chang Report Producer: Dara Chiu

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## 1 General Description

## 1.1 Product Feature of Equipment Under Test

LTE and GNSS

Product Specification subjective to this standard							
Sample 1	EUT with Internal Antenna Sku						
Sample 2	EUT with External Antenna Sku						
Antenna Type / Gain	WWAN <external antenna="">: Monopole Antenna, peak gain: 7.47dBi <internal antenna="">: Patch Antenna, peak gain: 13.2dBi GPS/Glonass: External Antenna</internal></external>						

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**Remark:** The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

## 1.2 Modification of EUT

No modifications are made to the EUT during all test items.

1.3 Testing Location

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No.
Test Site No.	TH05-HY
Test Engineer	Sherry Wu and Luffy Lin
Temperature (°C)	23 ~ 25
Relative Humidity (%)	51 ~ 56

Test Site SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory					
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855				
Test Site No.	Sporton Site No.				
rest site No.	03CH12-HY				
Test Engineer	Jack Cheng, Lance Chiang, and Chuan Chu				
Temperature (°C)	22.3 ~ 26.4				
Relative Humidity (%)	58 ~ 66				

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC Designation No.: TW1190 and TW0007

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## 1.4 Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

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- + ANSI C63.26-2015
- ANSI / TIA-603-E
- FCC 47 CFR Part 2, 96
- FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- FCC KDB 940660 D01 Part 96 CBRS Eqpt v02
- FCC KDB 662911 D02 MIMO with Cross Polarized Antenna v01
- FCC KDB 412172 D01 Determining ERP and EIRP v01r01
- FCC KDB 414788 D01 Radiated Test Site v01r01

#### Remark:

- **1.** All test items were verified and recorded according to the standards and without any deviation during the test.
- 2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.
- **3.** The TAF code is not including all the FCC KDB listed without accreditation.

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#### **Test Configuration of Equipment Under Test** 2

#### 2.1 Test Mode

Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas. License Digital Systems v03r01 with maximum output power.

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For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z, and the worst cases which listed below were recorded in this report

- X Plane with PoE Plane for LTE Band 48 (Outdoor External Ant.) 1.
- 2. Z Plane with PoE Plane for LTE Band 48CA (Outdoor External Ant.)
- X Plane with PoE Plane for LTE Band 48 (Outdoor Internal Ant.) 3.
- X Plane with PoE Plane for LTE Band 48CA (Outdoor Internal Ant.) 4.

T1 11	D 1		В	andwid	lth (MH	lz)		Modulation			RB#			Test Channel		
Test Items	Band	1.4	3	5	10	15	20	QPSK	16QAM	64QAM	1	Half	Full	L	М	Н
Max. Output Power	48	-	-		v		v	v	v	v	٧	v	v	v	v	v
Peak EIRP Density	48	-	-		v		v	v	v	v			v	v	v	v
26dB and 99% Bandwidth	48	-	-		v		v	v	v	v			v	v	v	v
Conducted Band Edge	48	-	-		v		v	V	v	v			v	v	v	v
Peak-to-Aver age Ratio	48	-	-				v	v	v	v	٧		v	v	v	v
Conducted Spurious Emission	48	-	-		v		v	v	v	v	٧		v	v	v	v
E.I.R.P	48	-	•		v		v	v	v	v	٧			v	v	v
Radiated Spurious Emission	48						w	orst Case	)					v	v	v
1. The mark "v" means that this configuration is chosen for testing 2. The mark "-" means that this bandwidth is not supported. 3. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emis different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emis reported.						nder										

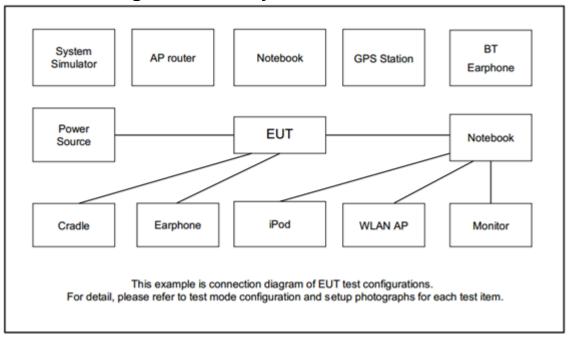
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Test Items	Band	Bandwidth (MHz)					Modulation			RB#			Test Channel							
		20+20	20+15	15+20	20+10	10+20	20+5	5+20	15+15	15+10	10+15	QPSK	16QAM	64QAM	1	Half	Full	L	М	н
Max. Output Power	48_CA	v							-	-	-	v	v	v	v	v	v	v	v	v
Peak EIRP Density	48_CA	v							-	-	-	v	v	v	v	v	v	v	v	v
26dB and 99% Bandwidth	48_CA	v							•	•	-	v	v	v			v	v	v	v
Conducted Band Edge	48_CA	v							•	•	•	>	v	v			v	v		v
Conducted Spurious Emission	48_CA	v							•	•	•	>	v	v			v	v	٧	v
E.I.R.P.	48_CA	v							-	-	-	v	v	v	v			v	v	v
Radiated Spurious Emission	48_CA								Wors	t Cas	e							v	v	v
Remark	2. The 3. The diff	e mark e devi	mark "v" means that this configuration is chosen for testing mark "-" means that this bandwidth is not supported. device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission teserent RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are													er				

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## 2.2 Connection Diagram of Test System



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2.3 Support Unit used in test configuration

Item	Equipment	Brand Name	Model No.	FCC ID	Data Cable	Power Cord
1.	Power Supply	GWINSTEK	PSS-2002	N/A	N/A	Unshielded, 1.8 m
12	LTE Base Station	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m
3.	Fixture	INTEL	NGFF Card Carrier	N/A	N/A	N/A

## 2.4 Measurement Results Explanation Example

#### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

#### Example:

 $Offset(dB) = RF \ cable \ loss(dB) + attenuator \ factor(dB).$ 

$$= 4.2 + 10 = 14.2 (dB)$$

**Remark:** The 10 log (NANT) parameter has been included in the test data, where NANT is the number of Tx.

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# 2.5 Frequency List of Low/Middle/High Channels

LTE Band 48 Channel and Frequency List							
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest			
20	Channel	55340	55990	56640			
20	Frequency	3560.0	3625.0	3690.0			
10	Channel	55290	55990	56690			
	Frequency	3555.0	3625.0	3695.0			

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LTE Band 48_CA Channel and Frequency List						
BW [MHz]	Channel	/Frequency(MHz)	Lowest	Middle	Highest	
	DCC	Channel	55340	55891	56442	
20 + 20	PCC	Frequency	3560	3615.1	3670.2	
20 + 20	200	Channel	55538	56089	56640	
	SCC	Frequency	3579.8	3634.9	3690	

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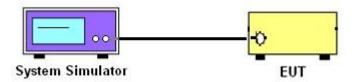
## 3 Conducted Test Items

## 3.1 Measuring Instruments

See list of measuring instruments of this test report.

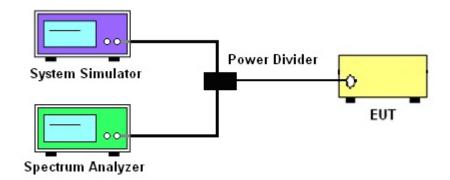
#### 3.1.1 Test Setup

## 3.1.2 Conducted Output Power



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# 3.1.3 EIRP, Power Density, Peak-to-Average Ratio, Occupied Bandwidth, Conducted Band-Edge, and Conducted Spurious Emission



#### 3.1.4 Test Result of Conducted Test

Please refer to Appendix A.

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## 3.2 Conducted Output Power

## 3.2.1 Description of the Conducted Output Power Measurement

A system simulator was used to establish communication with the EUT. Its parameters were set to force the EUT transmitting at maximum output power. The measured power in the radio frequency on the transmitter output terminals shall be reported.

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#### 3.2.2 Test Procedures

- 1. The transmitter output port was connected to the system simulator.
- 2. Set EUT at maximum power through the system simulator.
- 3. Select lowest, middle, and highest channels for each band and different modulation.
- 4. Measure and record the power level from the system simulator.

Remark: EIRP use worst case measure the total power to cover per 10MHz Power.

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## 3.3 Peak-to-Average Ratio

#### 3.3.1 Description of the PAR Measurement

Power Complementary Cumulative Distribution Function (CCDF) curves provide a means for characterizing the power peaks of a digitally modulated signal on a statistical basis. A CCDF curve depicts the probability of the peak signal amplitude exceeding the average power level. Most contemporary measurement instrumentation include the capability to produce CCDF curves for an input signal provided that the instrument's resolution bandwidth can be set wide enough to accommodate the entire input signal bandwidth. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

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#### 3.3.2 Test Procedures

The testing follows ANSI C63.26-2015 Section 5.2.6

- 1. The EUT was connected to spectrum and system simulator via a power divider.
- 2. Set the CCDF (Complementary Cumulative Distribution Function) option in spectrum analyzer.
- 3. The highest RF powers were measured and recorded the maximum PAPR level associated with a probability of 0.1 %.
- 4. Record the deviation as Peak to Average Ratio

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## 3.4 EIRP and Power Density

## 3.4.1 Description of the EIRP and Power Density Measurement

The EIRP of mobile transmitters must not exceed 23 dBm /10 megahertz for LTE Band 42 and Band 43, and Band 48.

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The testing follows ANSI C63.26-2015 Section 5.2.5.5

According to KDB 412172 D01 Power Approach,

 $EIRP = P_T + G_T - L_C$ , where

 $P_T$  = transmitter output power in dBm

 $G_T$  = gain of the transmitting antenna in dBi

L<sub>C</sub> = signal attenuation in the connecting cable between the transmitter and antenna in dB

EIRP and PSD limits for CBRS equipment as below tabel:

Device	Maximum EIRP	Maximum PSD
	(dBm/10 MHz)	(dBm/MHz)
End User Device	23	n/a
Category A CBSD	30	20
Category B CBSD	47	37

#### 3.4.2 Test Procedures

The testing follows ANSI C63.26-2015 Section 5.2.4.5

- 1. Set instrument center frequency to OBW center frequency.
- 2. Set span to at least 1.5 times the OBW.
- 3. Set the RBW to the specified reference bandwidth (often 1 MHz).
- 4. Set VBW ≥ 3 × RBW.
- 5. Detector = RMS (power averaging).
- 6. Ensure that the number of measurement points in the sweep  $\ge 2 \times \text{span/RBW}$ .
- 7. Sweep time = auto couple.
- 8. Employ trace averaging (RMS) mode over a minimum of 100 traces.
- 9. Use the peak marker function to determine the maximum amplitude level within the reference bandwidth (PSD).

10. Determine the EIRP by adding the effective antenna gain to the adjusted power level.

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3.5 Occupied Bandwidth

3.5.1 Description of Occupied Bandwidth Measurement

The occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the

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total mean transmitted power.

The 26 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 26 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of

the emission bandwidth.

The occupied bandwidth shall not exceed the equipment's channel bandwidth, which is declared by the

manufacturer.

3.5.2 Test Procedures

The testing follows ANSI C63.26-2015 Section 5.4.3 (26dB) and Section 5.4.4 (99OB)

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.

The spectrum analyzer center frequency is set to the nominal EUT channel center frequency.
 The span range for the spectrum analyzer shall be between two and five times the anticipated

OBW.

3. The nominal resolution bandwidth (RBW) shall be in the range of 1 to 5 % of the anticipated

OBW, and the VBW shall be at least 3 times the RBW.

4. Set the detection mode to peak, and the trace mode to max hold.

5. Determine the reference value: Set the EUT to transmit a modulated signal. Allow the trace to

stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace.

(this is the reference value)

6. Determine the "-26 dB down amplitude" as equal to (Reference Value – X).

7. Place two markers, one at the lowest and the other at the highest frequency of the envelope of

the spectral display such that each marker is at or slightly below the "-X dB down amplitude" determined in step 6. If a marker is below this "-X dB down amplitude" value it shall be placed

as close as possible to this value. The OBW is the positive frequency difference between the

two markers.

8. Use the 99 % power bandwidth function of the spectrum analyzer and report the measured

bandwidth.

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## 3.6 Conducted Band Edge

#### 3.6.1 Description of Conducted Band Edge Measurement

The power of any emission outside outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

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#### 3.6.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 6.1.

- 1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
- 2. The band edges of low and high channels for the highest RF powers were measured.
- 3. Set RBW >= 1% EBW in the 1MHz band immediately outside and adjacent to the band edge.
- 4. Beyond the 1 MHz band from the band edge, RBW=1MHz was used
- 5. Set spectrum analyzer with RMS detector.
- The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
- 7. The conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0-10 megahertz above the upper SAS-assigned channel edge and within 0-10 megahertz below the lower SAS-assigned channel edge. At all frequencies greater than 10 megahertz above the upper SAS assigned channel edge and less than 10 MHz below the lower SAS assigned channel edge, the conducted power of any emission shall not exceed -25 dBm/MHz

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## 3.7 Conducted Spurious Emission

#### 3.7.1 Description of Conducted Spurious Emission Measurement

96.41 (e)(2)

The conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40dBm/MHz.

#### 3.7.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 6.1.

- 1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
- The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
   The path loss was compensated to the results for each measurement.

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- 3. The middle channel for the highest RF power within the transmitting frequency was measured.
- 4. The conducted spurious emission for the whole frequency range was taken.
- 5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz.
- 6. Set spectrum analyzer with RMS detector.
- 7. Taking the record of maximum spurious emission.
- 8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
- 9. The limit line is -40dBm/MHz.

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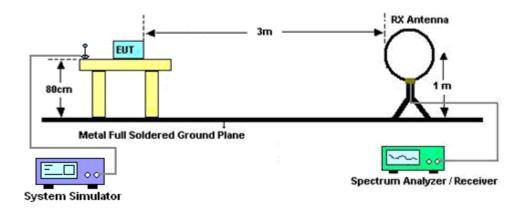
## 4 Radiated Test Items

## 4.1 Measuring Instruments

See list of measuring instruments of this test report.

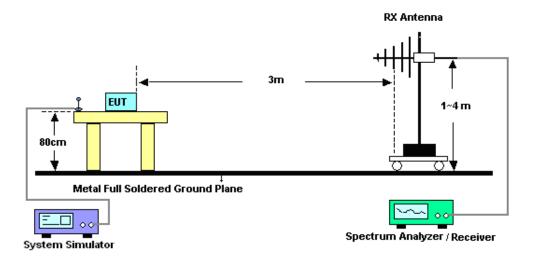
## 4.2 Test Setup

For radiated emissions below 30MHz



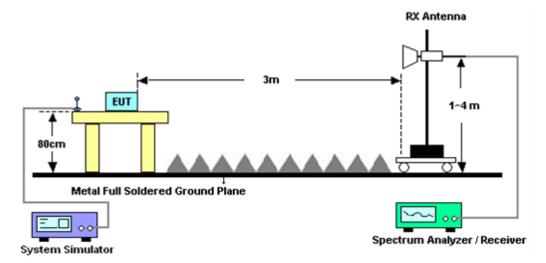
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#### For radiated emissions from 30MHz to 1GHz



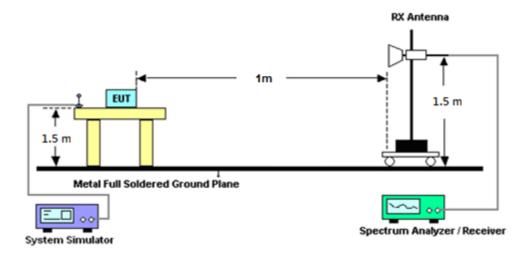
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#### <For radiated emissions from 1 ~ 18GHz>



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#### <For radiated emissions from 18 ~ 40GHz>



#### 4.3 Test Result of Radiated Test

Please refer to Appendix B.

#### Note:

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

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## 4.4 Radiated Spurious Emission

#### 4.4.1 Description of Radiated Spurious Emission Measurement

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E.

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The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least -40dBm / MHz.

The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

#### 4.4.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 7 and ANSI / TIA-603-E Section 2.2.12.

- 1. The EUT was placed on a turntable with 0.8 meter height for frequency below 1GHz and 1.5 meter height for frequency above 1GHz respectively above ground.
- 2. The EUT was set 3 meters from the receiving antenna mounted on the antenna tower.
- 3. The table was rotated 360 degrees to determine the position of the highest spurious emission.
- 4. The height of the receiving antenna is varied between 1m to 4m to search the maximum spurious emission for both horizontal and vertical polarizations.
- 5. During the measurement, the system simulator parameters were set to force the EUT transmitting at maximum output power.
- 6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
- A horn antenna was substituted in place of the EUT and was driven by a signal generator.
   Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.

EIRP (dBm) = S.G. Power - Tx Cable Loss + Tx Antenna Gain ERP (dBm) = EIRP - 2.15

8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

The limit line is -40dBm/MHz

9. The EUT antenna is termincated by 500hm, a representative external antenna is listed in report for reference

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# 5 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	Rohde & Schwarz	FSV40	101909	10Hz~40GHz	May 19, 2020	Oct. 17, 2020 ~ Dec. 11, 2020	May 18, 2021	Conducted (TH05-HY)
Programmable Power Supply	GW Instek	SPS-606	GES842931	0V~60V 0A~6A	Aug. 19, 2020	Oct. 17, 2020 ~ Dec. 11, 2020	Aug. 18, 2021	Conducted (TH05-HY)
Coupler	Warison	20dB 25W SMA Directional Coupler	#B	1-18GHz	Jan. 11, 2020	Oct. 17, 2020 ~ Dec. 11, 2020	Jan. 10, 2021	Conducted (TH05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Dec. 26, 2019	Oct. 27, 2020 ~ Nov. 18, 2020	Dec. 25, 2020	Radiation (03CH12-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	40103 & 07	30MHz~1GHz	Apr. 29, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Apr. 28, 2021	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-1212	1GHz~18GHz	May 20, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	May 19, 2020	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120D	9120D-1241	1GHz ~ 18GHz	Jul. 15. 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Jul. 14. 2021	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA91705 84	18GHz~40GHz	Dec. 10, 2019	Oct. 27, 2020 ~ Nov. 18, 2020	Dec. 09, 2020	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA91709 80	18GHz ~ 40GHz	Jan. 10, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Jan. 09, 2021	Radiation (03CH12-HY)
Preamplifier	COM-POWER	PA-103	161075	10MHz~1GHz	Mar. 25, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Mar. 24, 2021	Radiation (03CH12-HY)
Preamplifier	Keysight	83017A	MY57280120	1GHz~26.5GHz	Jul. 20, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Jul. 19, 2021	Radiation (03CH12-HY)
Preamplifier	Jet-Power	JPA0118-55-30 3K	1710001800 054002	1GHz~18GHz	Feb. 07, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Feb. 06, 2021	Radiation (03CH12-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz~40GHz	Dec. 13, 2019	Oct. 27, 2020 ~ Nov. 18, 2020	Dec. 12, 2020	Radiation (03CH12-HY)
Spectrum Analyzer	Agilent	N9010A	MY54200485	10Hz~44GHz	Feb. 10, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Feb. 09, 2021	Radiation (03CH12-HY)
Signal Generator	Anritsu	MG3694C	163401	0.1Hz~40GHz	Feb. 15, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Feb. 14, 2021	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9kHz~30MHz	Mar. 12, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Mar. 11, 2021	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0058/126E	30MHz~18GHz	Dec. 12, 2019	Oct. 27, 2020 ~ Nov. 18, 2020	Dec. 11, 2020	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30MHz~40GHz	Feb. 25, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Feb. 24, 2021	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30MHz~40GHz	Feb. 25, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Feb. 24, 2021	Radiation (03CH12-HY)
Hygrometer	TECPEL	DTM-303B	TP140349	N/A	Oct. 02, 2020	Oct. 27, 2020 ~ Nov. 18, 2020	Oct. 01, 2021	Radiation (03CH12-HY)
Controller	EMEC	EM1000	N/A	Control Turn table & Ant Mast	N/A	Oct. 27, 2020 ~ Nov. 18, 2020	N/A	Radiation (03CH12-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1m~4m	N/A	Oct. 27, 2020 ~ Nov. 18, 2020	N/A	Radiation (03CH12-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Oct. 27, 2020 ~ Nov. 18, 2020	N/A	Radiation (03CH12-HY)
Software	Audix	E3 6.2009-8-24	RK-000989	N/A	N/A	Oct. 27, 2020 ~ Nov. 18, 2020	N/A	Radiation (03CH12-HY)

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# 6 Uncertainty of Evaluation

#### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.07
---	------

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#### Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of	3.21
Confidence of 95% (U = 2Uc(y))	3.21

#### <u>Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)</u>

Measuring Uncertainty for a Level of	3.80
Confidence of 95% (U = 2Uc(y))	3.80

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# **Appendix A. Test Results of Conducted Test**

# Conducted Output Power(Average power) <MIMO 4TX Port 1>

	LTE Band 48 Maximum Average Power [dBm]										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest					
20	100	0	QPSK	22.74	23.90	21.65					
20	100	0	16-QAM	22.10	23.96	20.95					
20	100	0	64-QAM	22.77	23.96	21.97					

LTE Band 48 Maximum Average Power [dBm]										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest				
10	50	0	QPSK	23.42	23.66	23.94				
10	50	0	16-QAM	23.80	23.74	23.94				
10	50	0	64-QAM	23.93	23.79	23.94				

## <MIMO 4TX Port 2>

LTE Band 48 Maximum Average Power [dBm]											
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest					
20	100	0	QPSK	23.37	23.38	22.70					
20	100	0	16-QAM	23.24	23.48	22.32					
20	100	0	64-QAM	23.16	23.58	22.73					

	LTE Band 48 Maximum Average Power [dBm]										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest					
10	50	0	QPSK	23.93	23.90	23.76					
10	50	0	16-QAM	23.87	23.95	23.70					
10	50	0	64-QAM	23.68	23.85	23.71					

## <MIMO 4TX Port 3>

	LTE Band 48 Maximum Average Power [dBm]											
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest						
20	100	0	QPSK	22.39	23.92	21.49						
20	100	0	16-QAM	21.75	23.88	21.23						
20	100	0	64-QAM	22.60	23.92	21.50						

	LTE Band 48 Maximum Average Power [dBm]										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest					
10	50	0	QPSK	23.98	23.81	22.50					
10	50	0	16-QAM	23.97	23.99	22.36					
10	50	0	64-QAM	23.95	23.96	23.93					

## <MIMO 4TX Port 4>

_												
	LTE Band 48 Maximum Average Power [dBm]											
	BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest					
	20	100	0	QPSK	22.71	23.84	22.29					
	20	100	0	16-QAM	21.63	23.91	22.17					
	20	100	0	64-QAM	22.67	23.95	21.86					

	LTE Band 48 Maximum Average Power [dBm]										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest					
10	50	0	QPSK	23.84	23.80	23.96					
10	50	0	16-QAM	23.81	23.92	23.78					
10	50	0	64-QAM	23.95	23.89	23.79					

## <MIMO 4TX Port combine>

	LTE Band 48 Maximum Average Power [dBm]										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest					
20	100	0	QPSK	28.84	29.79	28.08					
20	100	0	16-QAM	28.25	29.83	27.73					
20	100	0	64-QAM	28.83	29.88	28.06					

	LTE Band 48 Maximum Average Power [dBm]										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest					
10	50	0	QPSK	29.90	29.81	29.60					
10	50	0	16-QAM	29.88	29.92	29.51					
10	50	0	64-QAM	29.90	29.89	29.86					



<MIMO 2TX Port 1&3>

LTE Band 48C_CA Maximum Average Power [dBm]											
BW [MHz]	PCC		SCC		Mod						
DVV [IVITIZ]	RB Size	RB Offset	RB Size	RB Offset	WIOG	Lowest	Middle	Highest			
20+20	100	0	100	0	QPSK	26.26	26.87	26.59			
20+20	100	0	100	0	16-QAM	25.37	26.36	26.40			
20+20	100	0	100	0	64-QAM	25.43	26.34	26.47			



## <MIMO 2TX Port 1&4>

	LTE Band 48C_CA Maximum Average Power [dBm]										
BW [MHz]	PCC		SCC		Mod						
BVV [IVITIZ]	RB Size	RB Offset	RB Size	RB Offset	WOO	Lowest	Middle	Highest			
20+20	100	0	100	0	QPSK	25.44	26.39	26.14			
20+20	100	0	100	0	16-QAM	26.46	26.39	26.39			
20+20	100	0	100	0	64-QAM	25.42	26.37	26.20			



## <MIMO 2TX Port 2&3>

LTE Band 48C_CA Maximum Average Power [dBm]											
BW [MHz]	PO	PCC		SCC							
BVV [IVITIZ]	RB Size	RB Offset	RB Size	RB Offset	Mod	Lowest	Middle	Highest			
20+20	100	0	100	0	QPSK	26.13	26.17	26.07			
20+20	100	0	100	0	16-QAM	26.13	26.25	26.17			
20+20	100	0	100	0	64-QAM	26.18	26.24	26.36			



<MIMO 2TX Port 2&4>

LTE Band 48C_CA Maximum Average Power [dBm]											
DIA/ FRALL 1	PCC		SCC		Mod						
BW [MHz]	RB Size	RB Offset	RB Size	RB Offset	Mod	Lowest	Middle	Highest			
20+20	100	0	100	0	QPSK	26.28	26.40	26.17			
20+20	100	0	100	0	16-QAM	26.15	26.36	26.17			
20+20	100	0	100	0	64-QAM	26.45	26.49	26.11			

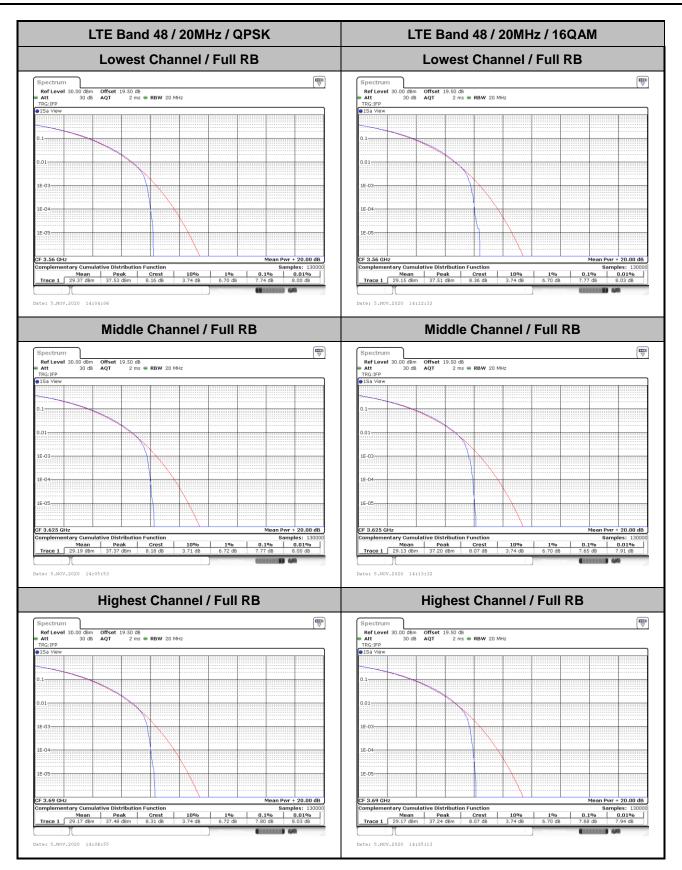
## LTE Band 48 < MIMO 4TX Port 1>

# Peak-to-Average Ratio

Mode		Limit: 13dB			
Mod.	QP	SK	16	Lillit: 130B	
RB Size	1RB	Full RB	1RB	Full RB	Result
Lowest CH	N/A	7.74	N/A	7.77	
Middle CH	N/A	7.77	N/A	7.65	PASS
Highest CH	N/A	7.80	N/A	7.68	1
Mode		LTE Band	48 / 20MHz		Limit: 13dB
Mod.	64C	AM		Lillit. 130B	
RB Size	1RB	Full RB	-	-	Result
Lowest CH	N/A	7.74	-	-	
Middle CH	N/A	7.80	-	-	PASS
Highest CH	N/A	7.80	-	-	

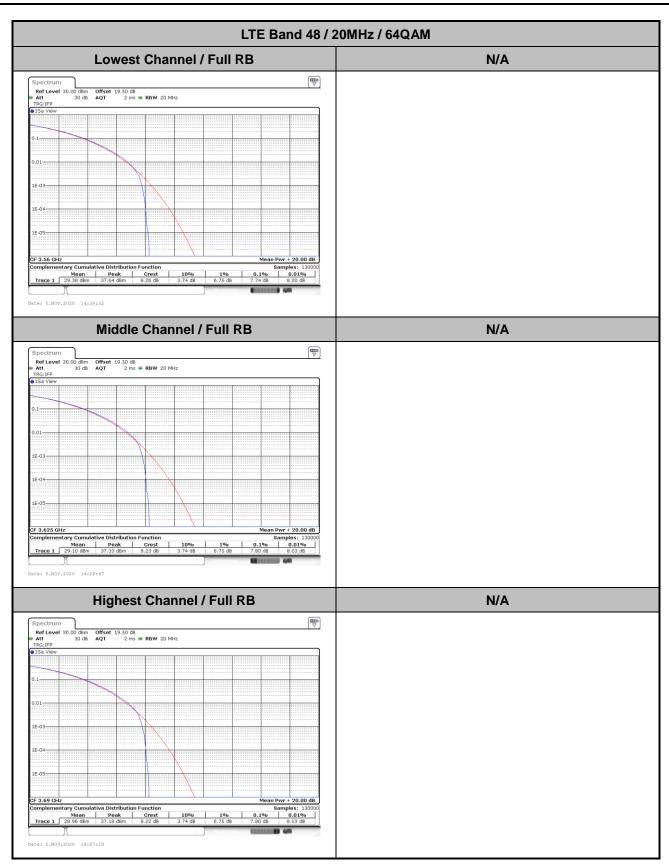
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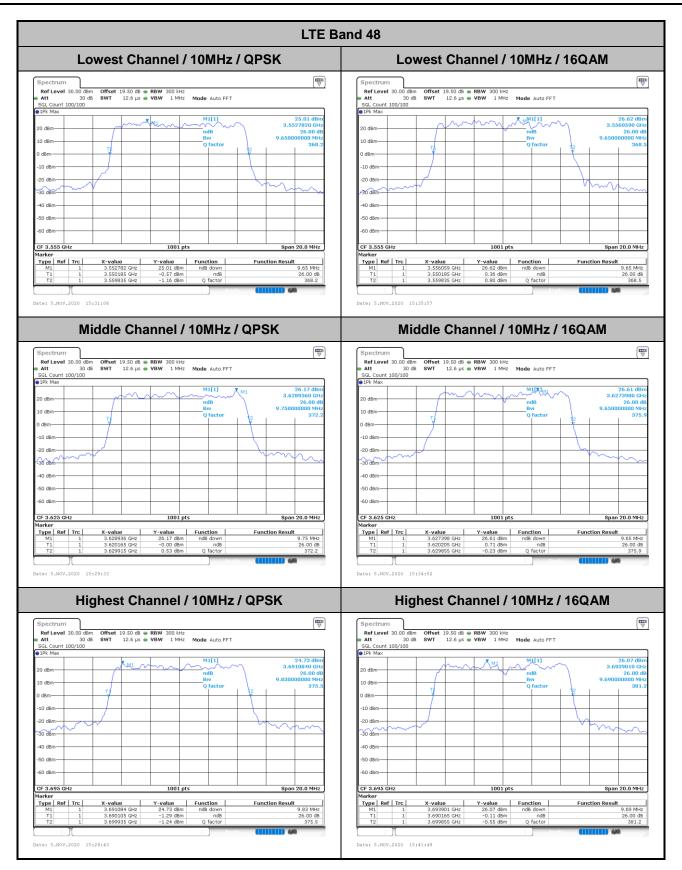
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# 26dB Bandwidth

Mode		LTE Band 48 : 26dB BW(MHz)										
BW	1.4MHz		3MHz		5MHz		10MHz		15MHz		20MHz	
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Lowest CH	-	-	-	-			9.65	9.65			18.74	18.82
Middle CH	-	-	-	-			9.75	9.65			18.98	18.90
Highest CH	-	-	-	-			9.83	9.69			18.74	18.86
Mode					LTE Ba	and 48 :	26dB BV	V(MHz)				
BW	1.4	ЛHz	3MHz		5MHz		10MHz		15MHz		20MHz	
Mod.	64QAM		64QAM		64QAM		64QAM		64QAM		64QAM	
Lowest CH	-	-	-	-		-	9.81	-		-	18.74	-
Middle CH	-	-	-	-		-	9.71	-		-	18.98	-
Highest CH	-	-	-	-		-	9.63	-		-	18.86	-

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LTE Band 48 Lowest Channel / 20MHz / QPSK Lowest Channel / 20MHz / 16QAM 
 Ref Level
 30.00 d8m
 Offset
 19.50 d8 • RBW
 300 kHz
 Att
 30 d8
 SWT
 18.9 µs • VBW
 1 MHz
 Mode
 Auto FFT

 SGL Count 100/100
 13Pk Max
 Mode
 Auto FFT
 Auto FFT
 Ref Level 30.00 dBm Offset 19.50 dB • RBW 300 kHz

Att 18.9 µs • VBW 1 MHz

SGL Count 100/100

PIR Max Mode Auto FFT 22.28 dBr 3.5542460 GH -30 a6h -50 dBm-50 dBm Span 40.0 MHz Type | Ref | Trc | Type | Ref | Trc | Function Result Middle Channel / 20MHz / QPSK Middle Channel / 20MHz / 16QAM **T** SGL Count 100/100

1Pk Max 30 dB Offset 30 dB SWT
Count 100/100
Max 19.50 dB • RBW 300 kHz 18.9 µs • VBW 1 MHz Mode Auto FFT 19.50 dB **RBW** 300 kHz 18.9 μs **VBW** 1 MHz Mode Auto FET 22.39 dBr 3.6218430 GH 26.00 d 18.981000000 MH 10 dBm dBm-CF 3.625 GH CF 3.625 GHz Marker 1001 pts Function Result 18.981 MHz 26.00 dB 190.8 Function Result

18.901 MHz
26.00 dB
192.0 
 X-value
 Y-value
 Function

 3.621843 GHz
 22.39 dBm
 ndB down

 3.61545 GHz
 -3.51 dBm
 ndB

 3.634431 GHz
 -3.23 dBm
 Q factor
 Type Ref Trc Type | Ref | Trc | 
 X-value
 Y-value
 Function

 3.629437 GHz
 23.91 dBm
 nd8 down

 3.61545 GHz
 -1.92 dBm
 nd8

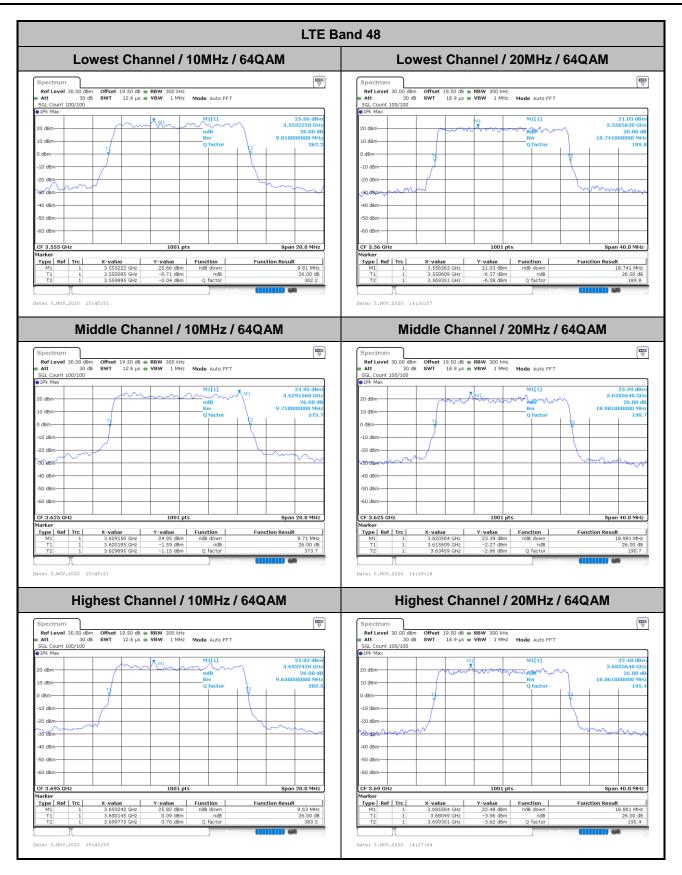
 3.634351 GHz
 -2.13 dBm
 Q factor
 Date: 5.NOV.2020 14:13:14 Highest Channel / 20MHz / QPSK Highest Channel / 20MHz / 16QAM **T** Ref Level 30.00 dBm

Att 30 dB

SGL Count 100/100 M1 M1[1] 21.85 dBn 3.6925570 GH: 26.00 dE 18.741000000 MH: 24.12 dBr M1[1] WILLI MILLI 10 dBm-197 -40 dBm -60 dBm-60 dBm Date: 5.NOV.2020 14:24:41

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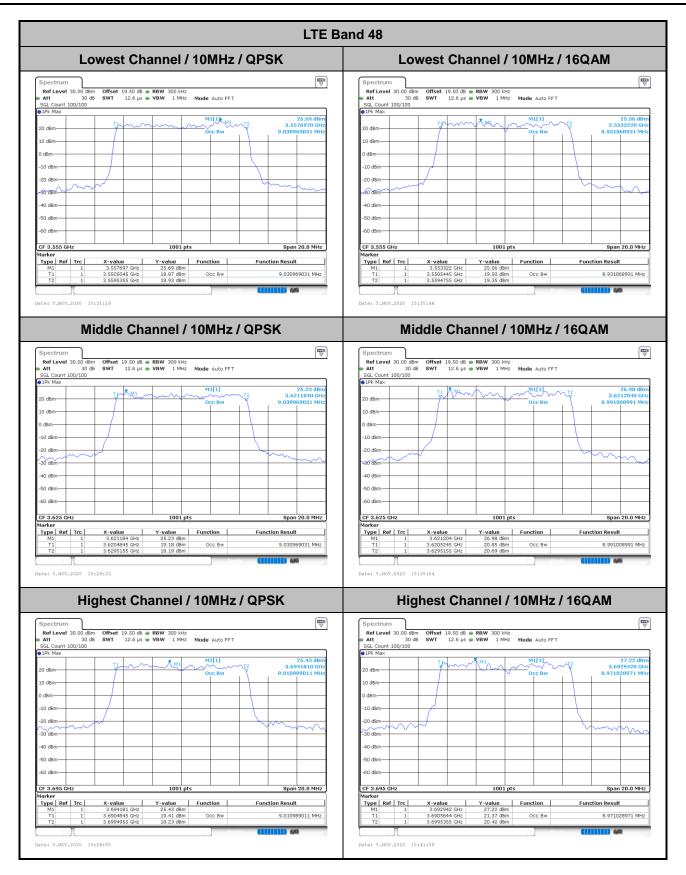
TEL: 886-3-327-3456 4Tx MIMO1 FAX: 886-3-328-4978 Page Number : A41-7 of 27

## Occupied Bandwidth

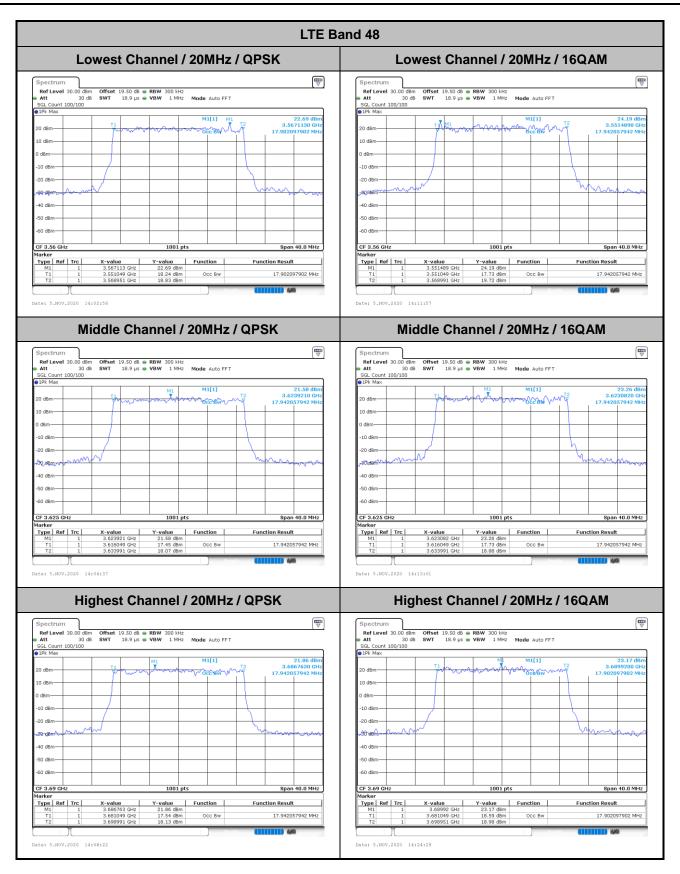
Mode	LTE Band 48 : 99%OBW(MHz)												
BW	1.4MHz		3MHz		5MHz		10MHz		15MHz		20MHz		
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	
Lowest CH	-	-	-	-	-	-	9.03	8.93	-	-	17.90	17.94	
Middle CH	-	-	-	-	-	-	9.03	8.99	-	-	17.94	17.94	
Highest CH	-	-	-	-	-	-	9.01	8.97	-	-	17.94	17.90	
Mode		LTE Band 48 : 99%OBW(MHz)											
BW	1.4MHz		3MHz		5MHz		10MHz		15MHz		20MHz		
Mod.	64QAM	-	64QAM	-	64QAM	-	64QAM	-	64QAM	-	64QAM	-	
Lowest CH	-	-	-	-	-	-	9.01	-	-	-	17.98	-	
Middle CH	-	-	-	-	-	-	8.95	-	-	-	17.90	-	
Highest CH	-	-	-	-	-	-	8.95	-	-	-	17.86	-	

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LTE Band 48 Lowest Channel / 10MHz / 64QAM Lowest Channel / 20MHz / 64QAM -10 dBm -20 dBm -50 dBm-1001 pts 1arker Type | Ref | Trc | Y-value Function 2 25.03 dBm Type | Ref | Trc | Y-value Function Function Result Function Result X-value Occ Bw Occ Bw 17.982017982 MHz 9.010989011 MHz 3.551009 GHz 3.568991 GHz Middle Channel / 10MHz / 64QAM Middle Channel / 20MHz / 64QAM SGL Count 100/100 19.50 dB • RBW 300 kHz 12.6 µs • VBW 1 MHz Mode Auto FFT 19.50 dB • RBW 300 kHz 18.9 µs • VBW 1 MHz Mode Auto FFT -Zwh dBm--20 dBm--50 dBm-CF 3.625 GH CF 3.625 GHz Marker 1001 pts 1001 pts 
 X-value
 Y-value
 Function

 3.623681 GHz
 25.36 dBm

 3.6205045 GHz
 20.08 dBm
 Occ Bw

 3.6294555 GHz
 19.04 dBm
 Type Ref Trc Type Ref Trc X-value Y-value Function
3.625879 GHz 21.44 dBm
3.616009 GHz 18.64 dBm 0000 Bm **Function Result Function Result** 8.951048951 MHz 3.616009 GHz 3.6339111 GHz Occ Bw 17,902097902 MHz Date: 5.NOV.2020 14:29:29 Highest Channel / 10MHz / 64QAM Highest Channel / 20MHz / 64QAM Ref Level 30.00 dBm

Att 30 dB

SGL Count 100/100

1Pk Max SGL Cou 1Pk Max M1[1] M1 72 25.49 dBr 21.53 dBr M1[1] M1 10 dBm-40 dBm -60 dBm-60 dBm 17.862137862 MHz Date: 5.NOV.2020 14:27:33

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## **Power Density**

Mode	LTE Band 48 : Conducted Power Density (dBm/MHz)											
BW	1.4MHz		3MHz		5MHz		10MHz		15MHz		20MHz	
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Lowest CH	-	-	-	-	-	-	21.85	22.33	-	-	19.11	19.33
Middle CH	-	-	-	-	-	-	21.67	22.09	-	-	18.88	19.30
Highest CH	-	-	-	-	-	-	22.66	21.48	-	-	17.79	19.29
Mode			Lī	ΓE Band	48 : Cor	nducted	Power D	ensity (	dBm/MH	z)		
BW	1.4MHz		3MHz		5MHz		10MHz		15MHz		20MHz	
Mod.	64QAM	-	64QAM	-	64QAM	-	64QAM	-	64QAM	-	64QAM	-
Lowest CH	-	-	-	-	-	-	21.81	-	-	-	18.57	-
Middle CH	-	-	-	-	-	-	21.42	-	-	-	18.81	-
Highest CH	-	-	-	-	-	-	21.23	-	-	-	18.27	-

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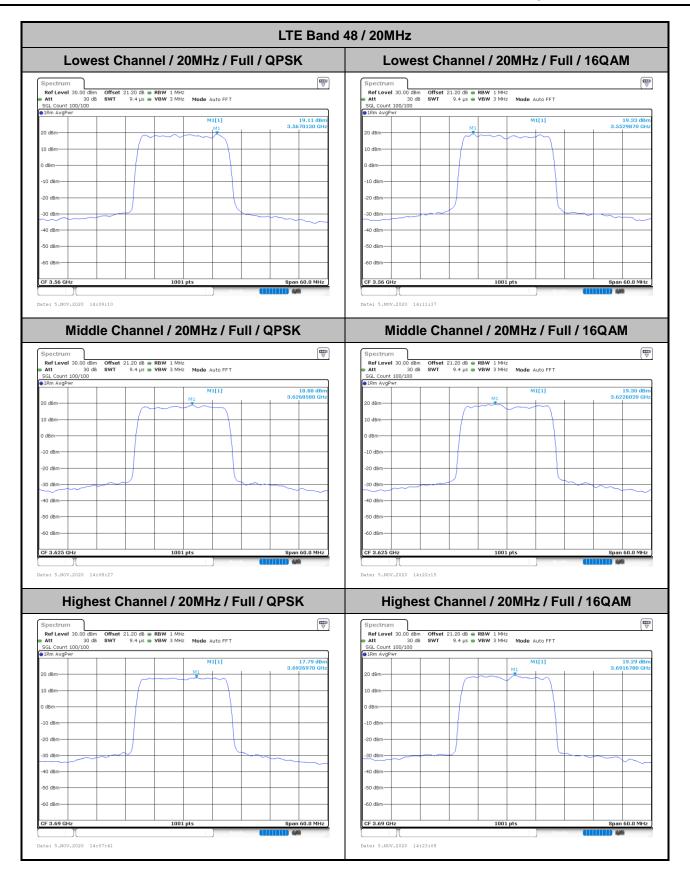
Mode	LTE Band 48 : EIRP Power Density (dBm/MHz)											
BW	1.4MHz		3MHz		5MHz		10MHz		15MHz		20MHz	
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Lowest CH	-	-	-	-			35.05	35.53			32.31	32.53
Middle CH	-	-	-	-			34.87	35.29			32.08	32.5
Highest CH	-	-	-	-			35.86	34.68			30.99	32.49
Mode	LTE Band 48 : EIRP Power Density (dBm/MHz)											
BW	1.4MHz		3MHz		5MHz		10MHz		15MHz		20MHz	
Mod.	64QAM	-	64QAM	-	64QAM	-	64QAM	-	64QAM	-	64QAM	-
Lowest CH	-	-	-	-		-	35.01	-		-	31.77	-
Middle CH	-	-	-	-		-	34.62	-		-	32.01	-
Highest CH	-	-	-	-		-	34.43	-		-	31.47	-
Antenna Gain	13.2 dBi											
Limit	37dBm / MHz											
Result	Pass											

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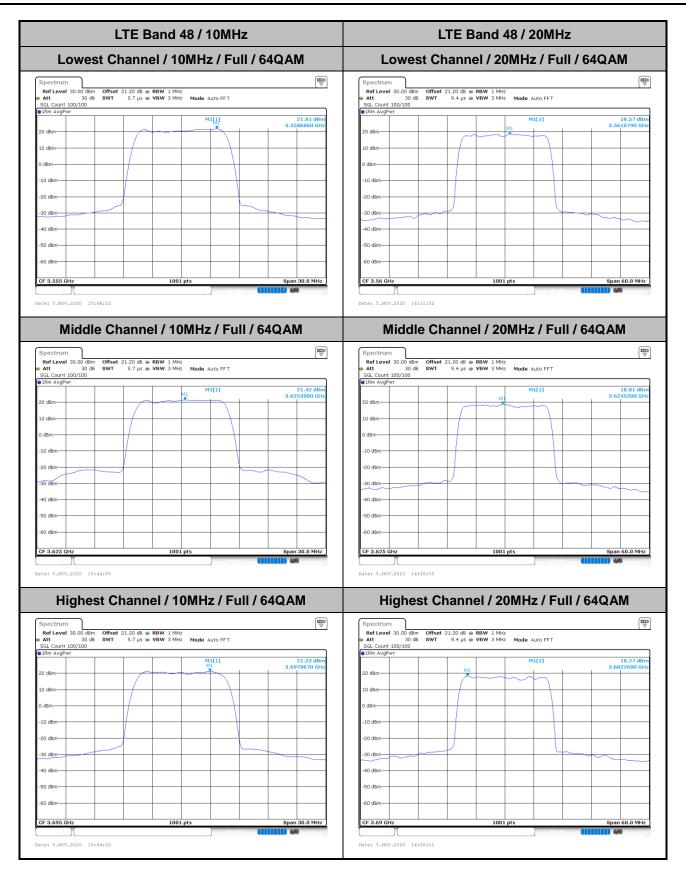
LTE Band 48 / 10MHz Lowest Channel / 10MHz / Full / QPSK Lowest Channel / 10MHz / Full / 16QAM Date: 5.NOV.2020 15:36:20 Middle Channel / 10MHz / Full / QPSK Middle Channel / 10MHz / Full / 16QAM Date: 5.NOV.2020 15:34:38 Highest Channel / 10MHz / Full / QPSK Highest Channel / 10MHz / Full / 16QAM Ref Level 30.00 dBm
Att 30 dB
SGL Count 100/100
1Rm AvgPwr 21.48 dBn 3.6929020 GHz Date: 5.NOV.2020 15:41:35

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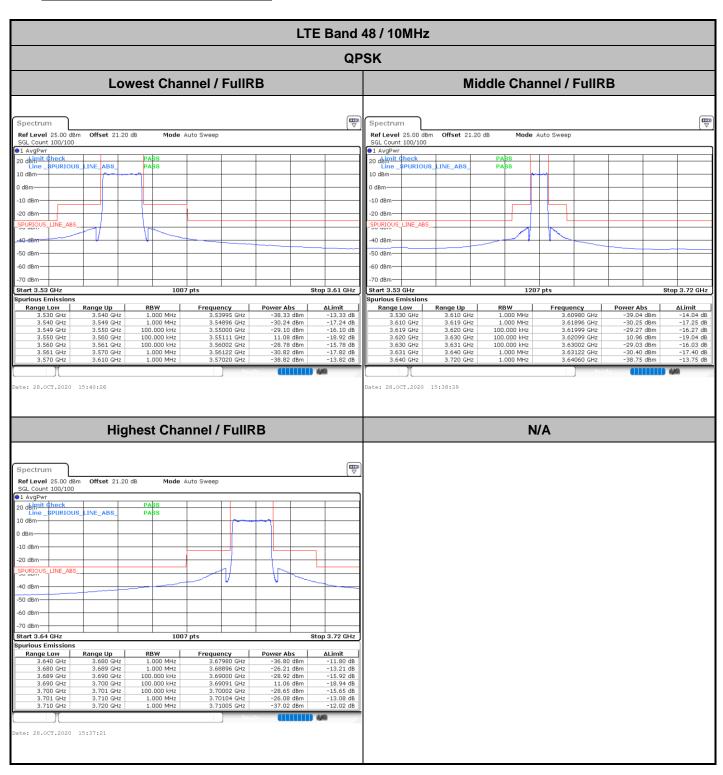


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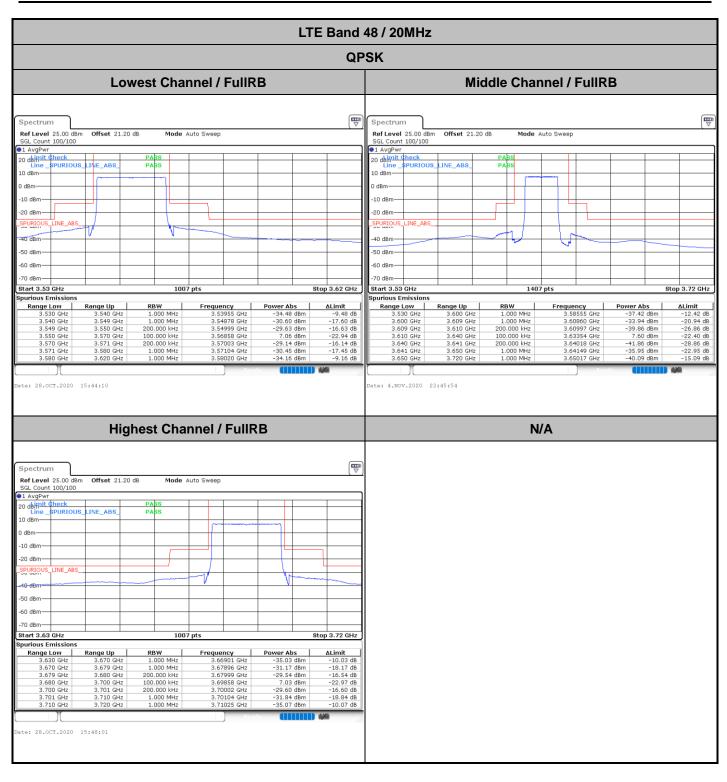
TEL: 886-3-327-3456 4Tx MIMO1
FAX: 886-3-328-4978 Page Number : A41-15 of 27

## **Conducted Band Edge**

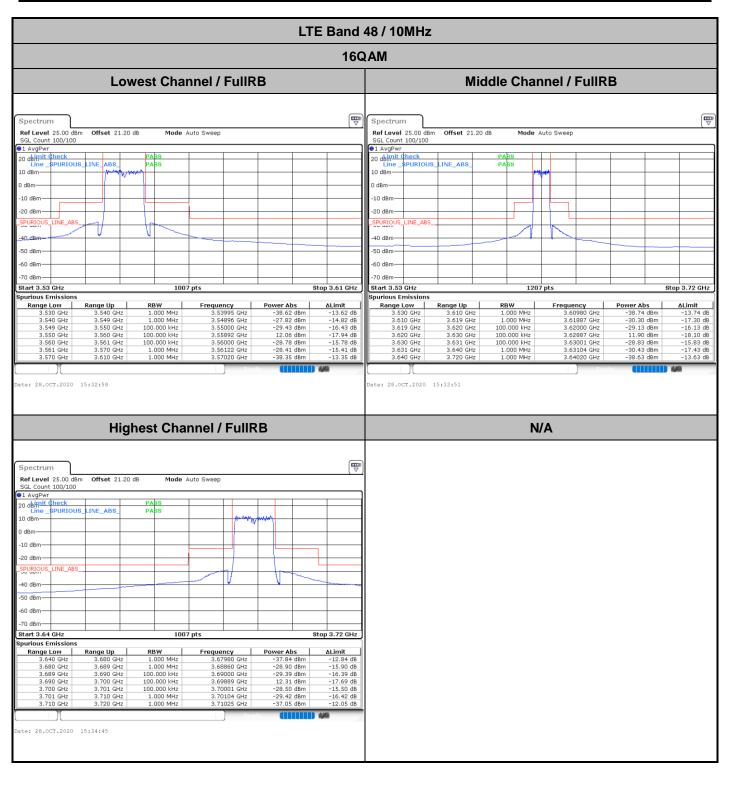


Report No.: FG0O1212

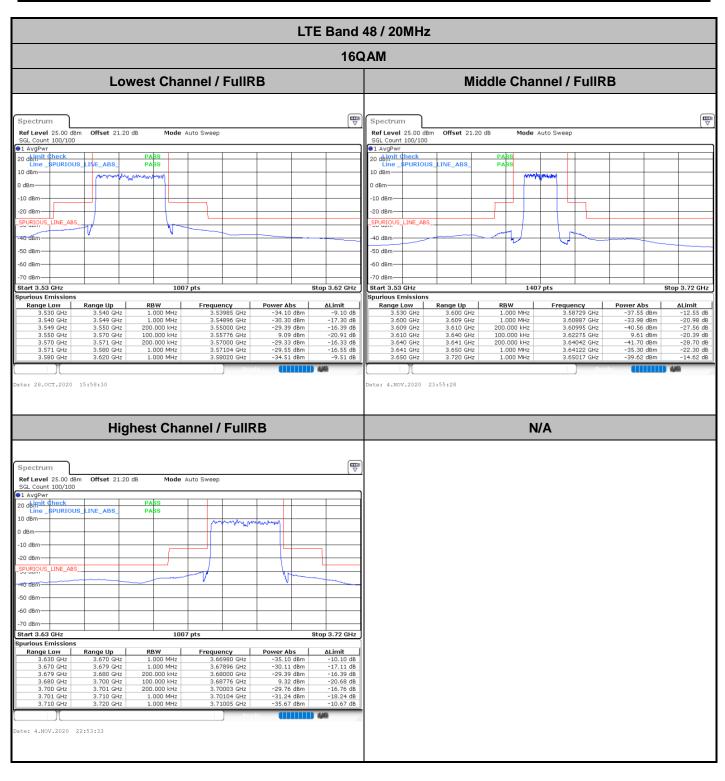
TEL: 886-3-327-3456 4Tx MIMO1 FAX: 886-3-328-4978 Page Number : A41-16 of 27



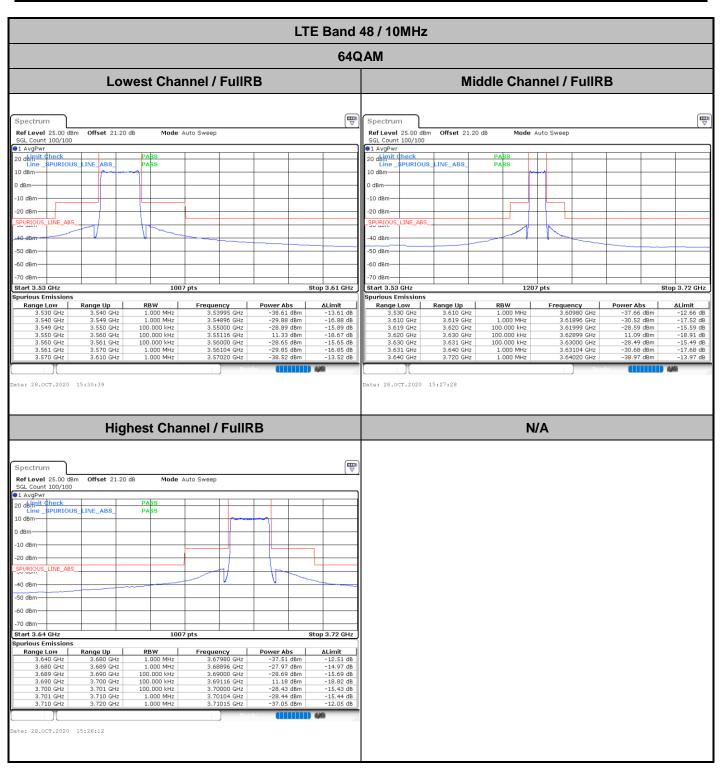
TEL: 886-3-327-3456 4Tx MIMO1 FAX: 886-3-328-4978 Page Number: A41-17 of 27



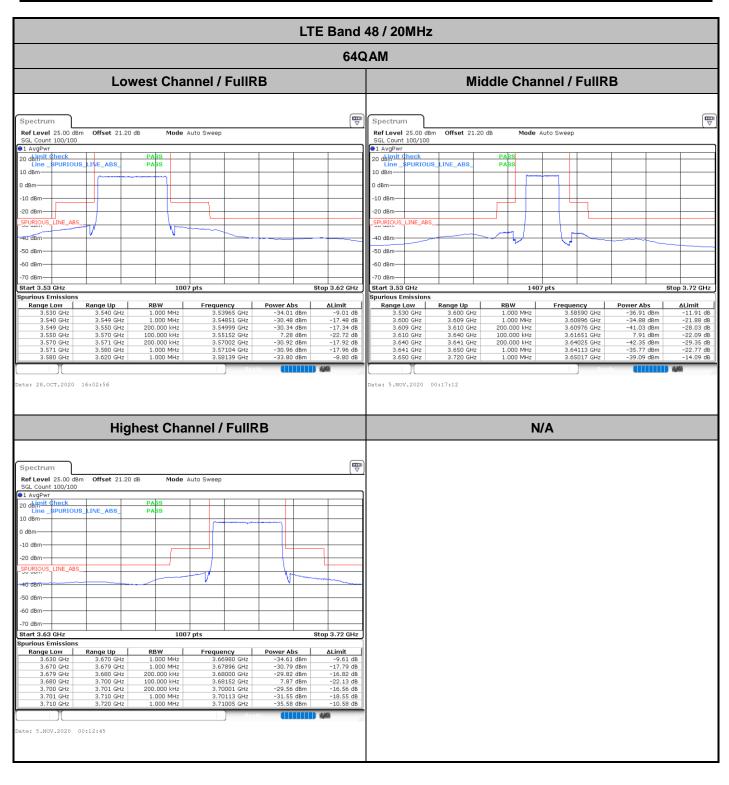
TEL: 886-3-327-3456 4Tx MIMO1 FAX: 886-3-328-4978 Page Number: A41-18 of 27



TEL: 886-3-327-3456 4Tx MIMO1 FAX: 886-3-328-4978 Page Number : A41-19 of 27

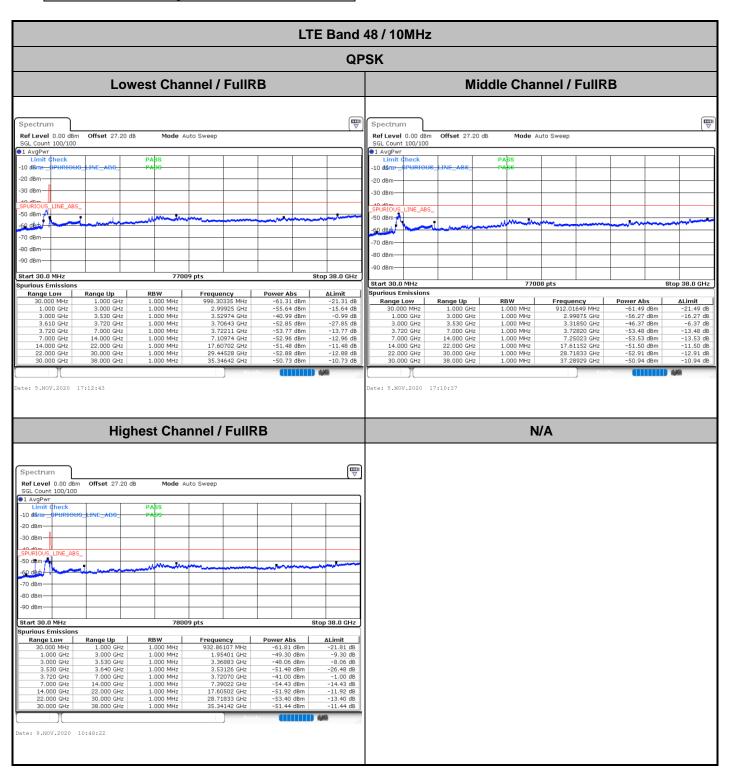


TEL: 886-3-327-3456 4Tx MIMO1 FAX: 886-3-328-4978 Page Number: A41-20 of 27



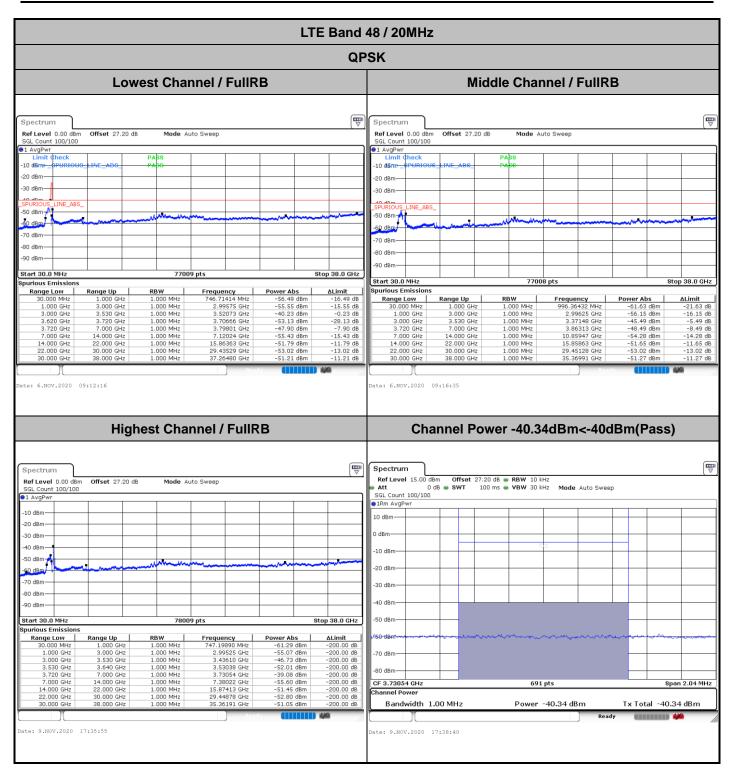
TEL: 886-3-327-3456 4Tx MIMO1 FAX: 886-3-328-4978 Page Number: A41-21 of 27

## **Conducted Spurious Emission**



Report No.: FG0O1212

TEL: 886-3-327-3456 4Tx MIMO1 FAX: 886-3-328-4978 Page Number : A41-22 of 27



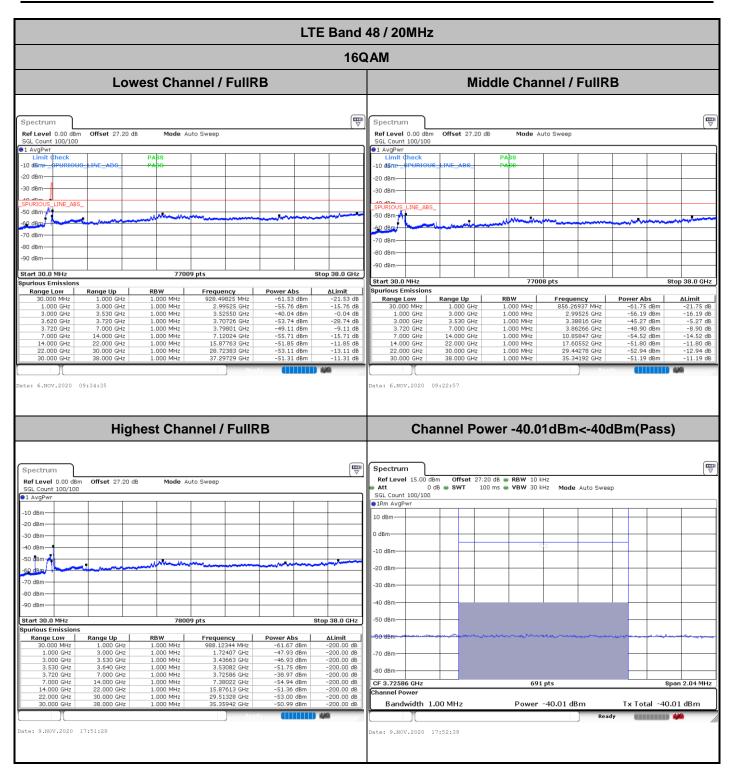
TEL: 886-3-327-3456 4Tx MIMO1 FAX: 886-3-328-4978 Page Number : A41-23 of 27

LTE Band 48 / 10MHz **16QAM Lowest Channel / FullRB** Middle Channel / FullRB Spectrum Spectrum Ref Level 0.00 dBm Offset 27.20 dB Mode Auto Sweep Ref Level 0.00 dBm Offset 27.20 dB Mode Auto Sweep SGL Count 100/100 SGL Count 100/100 91 AvgPwr □ imit ¢heck SGL coc.. ●1 AvgPwr Limit ¢he -10 dBrne 20 dBm -20 dBm 30 dBm -50 dBm--60 dBm -50 dBm-Å 60.dBm 70 dBm -80 dBm -80 dBm 90 dBm -90 dBm Start 30.0 MHz 77009 pts Stop 38.0 GHz Start 30.0 MHz 7700 Stop 38.0 GHz rious Emissions Frequency
938.67816 MHz
2.99525 GHz
3.52974 GHz
3.71159 GHz
3.72914 GHz
10.66099 GHz
17.61352 GHz
29.49228 GHz
37.26280 GHz Power Abs
-61.35 dBm
-55.12 dBm
-41.97 dBm
-52.61 dBm
-54.11 dBm
-52.67 dBm
-51.49 dBm
-52.83 dBm
-50.88 dBm Range Up

1.000 GHz
3.000 GHz
3.530 GHz
3.720 GHz
7.000 GHz
14.000 GHz
22.000 GHz
30.000 GHz
38.000 GHz RBW
1.000 MHz
1.000 MHz -21.35 dB -15.12 dB -1.97 dB -27.61 dB -14.11 dB -12.67 dB -11.49 dB -12.83 dB Spurious Emissions Range Low
30.000 MHz
1.000 GHz
3.000 GHz
3.720 GHz
7.000 GHz
14.000 GHz
22.000 GHz Range Up 1.000 GHz 3.000 GHz 3.530 GHz 7.000 GHz 14.000 GHz 22.000 GHz 30.000 GHz 38.000 GHz 1.000 MHz Frequency 901.35182 MHz 2.99525 GHz 3.32168 GHz 3.77833 GHz 7.25023 GHz 15.84413 GHz 29.44278 GHz 35.35842 GHz Power Abs
-61.52 dBm
-55.54 dBm
-46.63 dBm
-53.01 dBm
-53.13 dBm
-51.39 dBm
-52.75 dBm -21.52 dB -15.54 dB -6.63 dB -13.01 dB -13.13 dB -11.39 dB -12.75 dB -10.96 dB 1.000 GHz 3.000 GHz 3.000 GHz 3.610 GHz 3.720 GHz 7.000 GHz 14.000 GHz 22.000 GHz 50.88 dBn 38.000 GHz te: 5.NOV.2020 17:02:30 ate: 5.NOV.2020 17:05:08 **Highest Channel / FullRB** N/A **W** Ref Level 0.00 Offset 27.20 dB Mode Auto Sweep Ref Level 0.00 dBm SGL Count 100/100 ●1 AvgPwr Limit ¢heck -10 dBme -20 dBm-30 dBm 70 dBm 80 dBm 90 dBm Start 30.0 MHz Stop 38.0 GHz 78009 pts Range Low 30,000 MHz 1,000 GHz 3,000 GHz 3,000 GHz 3,530 GHz 7,000 GHz 14,000 GHz 22,000 GHz 30,000 GHz Range Up 1.000 GHz 3.000 GHz 3.530 GHz 3.640 GHz 7.000 GHz 14.000 GHz 22.000 GHz 30.000 GHz 38.000 GHz 1.000 MHz 936.73913 MHz
1.95451 GHz
3.36300 GHz
3.55181 GHz
3.72023 GHz
7.39022 GHz
17.60152 GHz
29.46178 GHz
35.35042 GHz Power Abs
-61.88 dBm
-43.23 dBm
-47.93 dBm
-51.06 dBm
-40.70 dBm
-54.57 dBm
-51.95 dBm
-53.18 dBm
-51.35 dBm ∆Limit ate: 9.NOV.2020 10:54:06

Report No.: FG0O1212

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