PCTEST
7185 Oakland Mills Road, Columbia, MD 21046 USA
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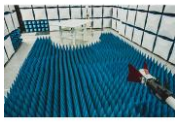

PART 22 MEASUREMENT REPORT

Applicant Name:
Tecore Networks
7030 Hi Tech Drive
Hanover, MD 21076
USA

Date of Testing:
06/03 - 08/04/2021
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M2106040064-04.QLJ

FCC ID:	**QLJMRU-060785**
APPLICANT:	**Tecore Networks**

Application Type:	Certification
Model:	MRU-20W060785
EUT Type:	Low Band mRU
FCC Classification:	Licensed Non-Broadcast Station Transmitter (TNB)
FCC Rule Part:	22
Test Procedure(s):	ANSI C63.26-2015, ANSI/TIA-603-E-2016, KDB 971168 D01 v03r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President

ACCREDITED
CERT #2041.01

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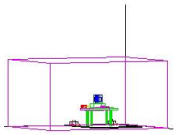
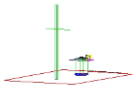


PART 22 MEASUREMENT REPORT



Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	Conducted Power		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
LTE Band 26/5	15MHz (Band 26 only)	QPSK	876.5 - 886.5	22.594	43.54	13M5G7D
		QAM	876.5 - 886.5	22.594	43.54	13M6W7D
	10 MHz	QPSK	874.0 - 889.0	23.067	43.63	8M99G7D
		QAM	874.0 - 889.0	23.388	43.69	8M99W7D
	5 MHz	QPSK	871.5 - 891.5	23.121	43.64	4M52G7D
		QAM	871.5 - 891.5	23.281	43.67	4M49W7D
	3 MHz	QPSK	870.5 - 892.5	23.335	43.68	2M71G7D
		QAM	870.5 - 892.5	23.496	43.71	2M71W7D
	1.4 MHz	QPSK	869.7 - 893.3	23.442	43.70	1M10G7D
		QAM	869.7 - 893.3	23.605	43.73	1M10W7D

EUT Overview

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Tecore Low Band mRU FCC ID: QLJMRU-060785**. The test data contained in this report pertains only to the emissions due to the EUT's LTE Band 26/5 operation under the provisions of Part 22. The EUT generates LTE B26/5 signal using QPSK, 16-QAM, 64-QAM, and 256-QAM modulations. The EUT can transmit four different LTE low band signals at the same time with its single antenna port. The signal output level is set to 20W output per band for a total of 80W output from the antenna port and it is fed via a low loss cable to the input of a spectrum analyzer or a 50Ω load, depending on the type of testing performed. EUT was set up to operate as shown below with a 120 VAC power source. Server equipment was used to control the RF functions of the EUT.

Test Device Serial No.: 20270011
Software Version: mRU 8.0
Firmware: MRAN_015

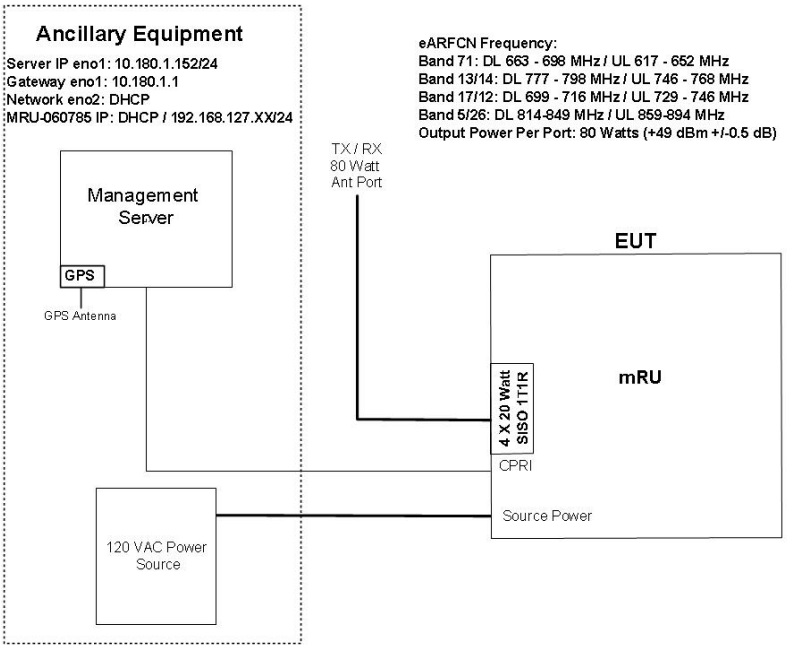


Figure 2-1. Test Setup

2.2 Device Capabilities

This device contains the following capabilities: Multi-band LTE

2.3 Test Configuration

The EUT was tested per the guidance of ANSI/TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

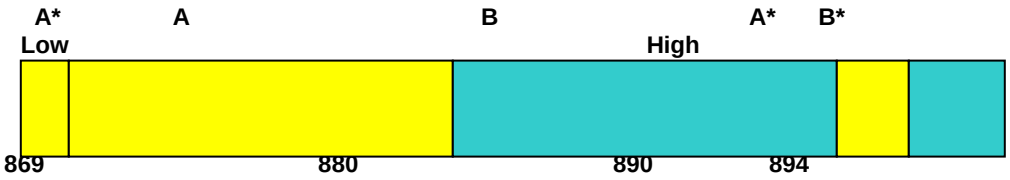
3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI/TIA-603-E-2016) and "Measurement Guidance for Certification of Licensed Digital Transmitters" (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

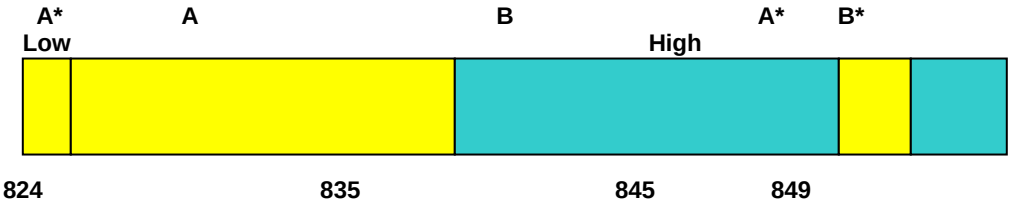
Deviation from Measurement Procedure……..None

3.2 Cellular - Base Frequency Blocks



BLOCK 1: 869 – 880 MHz (A* Low + A)
BLOCK 2: 880 – 890 MHz (B)
BLOCK 3: 890 – 891.5 MHz (A* High)
BLOCK 4: 891.5 – 894 MHz (B*)

3.3 Cellular - Mobile Frequency Blocks



BLOCK 1: 824 – 835 MHz (A* Low + A)
BLOCK 2: 835 – 845 MHz (B)
BLOCK 3: 845 – 846.5 MHz (A* High)
BLOCK 4: 846.5 – 849 MHz (B*)

3.4 Radiated Power and Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting with the antenna port terminated in 50 ohms and was placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated powers measurements, the antenna gains declared by the manufacturer are added to the measured conducted powers to assess compliance with the ERP limit.

For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:

$$E_{[dB\mu V/m]} = \text{Measured amplitude level}_{[dBm]} + 107 + \text{Cable Loss}_{[dB]} + \text{Antenna Factor}_{[dB/m]}$$

And

$$EIRP_{[dBm]} = E_{[dB\mu V/m]} + 20\log D - 104.8;$$ where D is the measurement distance in meters.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 414788 D01.

Radiated power and radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per KDB 971168 D01.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurement antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
	ETS	EMC Cable and Switch System	3/4/2021	Annual	3/4/2022	ETS
-	WL25-1	Conducted Cable Set (25GHz)	2/23/2021	Annual	2/23/2022	WL25-1
-	WL25-3	Conducted Cable Set (25GHz)	3/12/2021	Annual	3/12/2022	WL25-3
Espec	ESX-2CA	Environmental Chamber	8/27/2020	Annual	8/27/2022	17620
Keysight Technologies	N9020A	MXA Signal Analyzer	9/22/2020	Annual	9/22/2021	MY54500644
Keysight Technologies	N9030A	PXA Signal Analyzer	9/2/2020	Annual	9/2/2021	MY55410501
Pasternack	NC-100	Torque Wrench (8in-lbs)	8/5/2020	Biennial	8/5/2022	N/A
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	5/25/2021	Annual	5/25/2022	100348

Table 5-1. Test Equipment

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

2. Equipment with a calibration date of “N/A” shown in this list was not used to make direct calibrated measurements.

6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 8M62G7D
LTE BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

QAM Modulation

Emission Designator = 8M45W7D
LTE BW = 8.45 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

Spurious Radiated Emission

Example: Spurious emission at 3700.40 MHz

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was –81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of –81.0 dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 3700.40 MHz. So, 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.50 dBm so this harmonic was 25.50 dBm – (-24.80) = 50.3 dBc.

7.0 TEST RESULTS

7.1 Summary

Company Name: Tecore Networks

FCC ID: QLJMRU-060785

FCC Classification: Licensed Non-Broadcast Station Transmitter (TNB)

Mode(s): LTE

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Transmitter Conducted Output Power / Effective Radiated Power	22.913(a)(1)(i)	< 500 Watts per emission max. ERP	PASS	Section 7.2
	Occupied Bandwidth	2.1049	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions	2.1051, 22.917(a)	> 43 + 10log10(P[Watts]) at Band Edge and for all out-of-band emissions	PASS	Sections 7.4, 7.5
	Frequency Stability	2.1055, 22.355	< 1.5 ppm	PASS	Section 7.7
RADIATED	Radiated Spurious Emissions	2.1053, 22.917(a)	> 43 + 10 log10 (P[Watts]) for all out-of-band emissions	PASS	Section 7.6

Table 7-1. Summary of Test Results

Notes:

1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2) The analyzer data/plots (Sections 7.2 – 7.5) were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link with the EUT at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
4) All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST EMC Software Tool Ver. 1.1.
5) For the Radiated Emissions test, the EUT was tested for case radiated spurious emissions with the antenna port terminated in 50 ohms while the EUT was set to transmit from antenna port (1 x 20W) at maximum power.

7.2 Transmitter Conducted Output Power / Effective Radiated Power

Test Overview

The EUT was set to transmit in all four available modulations of LTE mode at the maximum output power of 20W for this band or as applicable for the channel through a management server. The output terminal of the EUT was connected through a calibrated cable and 30 dB of external attenuation to a signal analyzer. The signal analyzers' "Channel Power" function was used to measure the conducted output powers in accordance with the guidance of KDB 971168 D01 v03r01.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 5.2.1

Test Settings

1. Power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. Span = 2 - 3 times the OBW
3. RBW = 1 – 5% of the expected OBW
4. VBW ≥ 3 x RBW
5. No. of sweep points ≥ 2 x span / RBW
6. Sweep time = auto-couple
7. Detector = RMS
8. Trigger is set to "free run" for signals with continuous operation.
9. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
10. Trace mode = trace averaging (RMS) over 100 sweeps
11. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

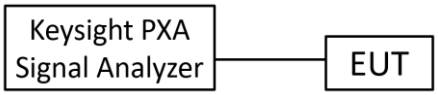


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

LTE Band 26/5

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]	Conducted Power [Watts]	Ant Gain [dBi]	ERP [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
15MHz (Band 26 only)	QPSK	8865	876.5	75 / 0	43.46	22.18	15.00	56.31	427.56	56.99	-0.68
		8915	881.5	75 / 0	43.54	22.59	15.00	56.39	435.51	56.99	-0.60
		8965	886.5	75 / 0	43.47	22.23	15.00	56.32	428.55	56.99	-0.67
	16QAM	8915	881.5	75 / 0	43.52	22.49	15.00	56.37	433.51	56.99	-0.62
	64QAM	8915	881.5	75 / 0	43.54	22.59	15.00	56.39	435.51	56.99	-0.60
	256QAM	8865	876.5	75 / 0	43.53	22.54	15.00	56.38	434.51	56.99	-0.61
10 MHz	QPSK	8840	874.0	50 / 0	43.47	22.23	15.00	56.32	428.55	56.99	-0.67
		8915	881.5	50 / 0	43.63	23.07	15.00	56.48	444.63	56.99	-0.51
		8990	889.0	50 / 0	43.56	22.70	15.00	56.41	437.52	56.99	-0.58
	16QAM	8915	881.5	50 / 0	43.65	23.17	15.00	56.50	446.68	56.99	-0.49
	64QAM	8915	881.5	50 / 0	43.69	23.39	15.00	56.54	450.82	56.99	-0.45
	256QAM	8915	881.5	50 / 0	43.62	23.01	15.00	56.47	443.61	56.99	-0.52
5 MHz	QPSK	8815	871.5	25 / 0	43.48	22.28	15.00	56.33	429.54	56.99	-0.66
		8915	881.5	25 / 0	43.64	23.12	15.00	56.49	445.66	56.99	-0.50
		9015	891.5	25 / 0	43.49	22.34	15.00	56.34	430.53	56.99	-0.65
	16QAM	8915	881.5	25 / 0	43.63	23.07	15.00	56.48	444.63	56.99	-0.51
	64QAM	8915	881.5	25 / 0	43.67	23.28	15.00	56.52	448.75	56.99	-0.47
	256QAM	8915	881.5	25 / 0	43.65	23.17	15.00	56.50	446.68	56.99	-0.49
3 MHz	QPSK	8805	870.5	15 / 0	43.52	22.49	15.00	56.37	433.51	56.99	-0.62
		8915	881.5	15 / 0	43.68	23.33	15.00	56.53	449.78	56.99	-0.46
		9025	892.5	15 / 0	43.41	21.93	15.00	56.26	422.67	56.99	-0.73
	16QAM	8915	881.5	15 / 0	43.71	23.50	15.00	56.56	452.90	56.99	-0.43
	64QAM	8915	881.5	15 / 0	43.63	23.07	15.00	56.48	444.63	56.99	-0.51
	256QAM	8915	881.5	15 / 0	43.70	23.44	15.00	56.55	451.86	56.99	-0.44
1.4 MHz	QPSK	8797	869.7	6 / 0	43.47	22.23	15.00	56.32	428.55	56.99	-0.67
		8915	881.5	6 / 0	43.70	23.44	15.00	56.55	451.86	56.99	-0.44
		9033	893.3	6 / 0	43.23	21.04	15.00	56.08	405.51	56.99	-0.91
	16QAM	8915	881.5	6 / 0	43.65	23.17	15.00	56.50	446.68	56.99	-0.49
	64QAM	8915	881.5	6 / 0	43.70	23.44	15.00	56.55	451.86	56.99	-0.44
	256QAM	8915	881.5	6 / 0	43.73	23.60	15.00	56.58	454.99	56.99	-0.41

Table 7-2. Transmitter Conducted Output Power / Effective Radiated Power (LTE Band 26/5)

7.3 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 4.2

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

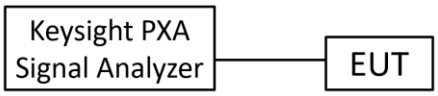
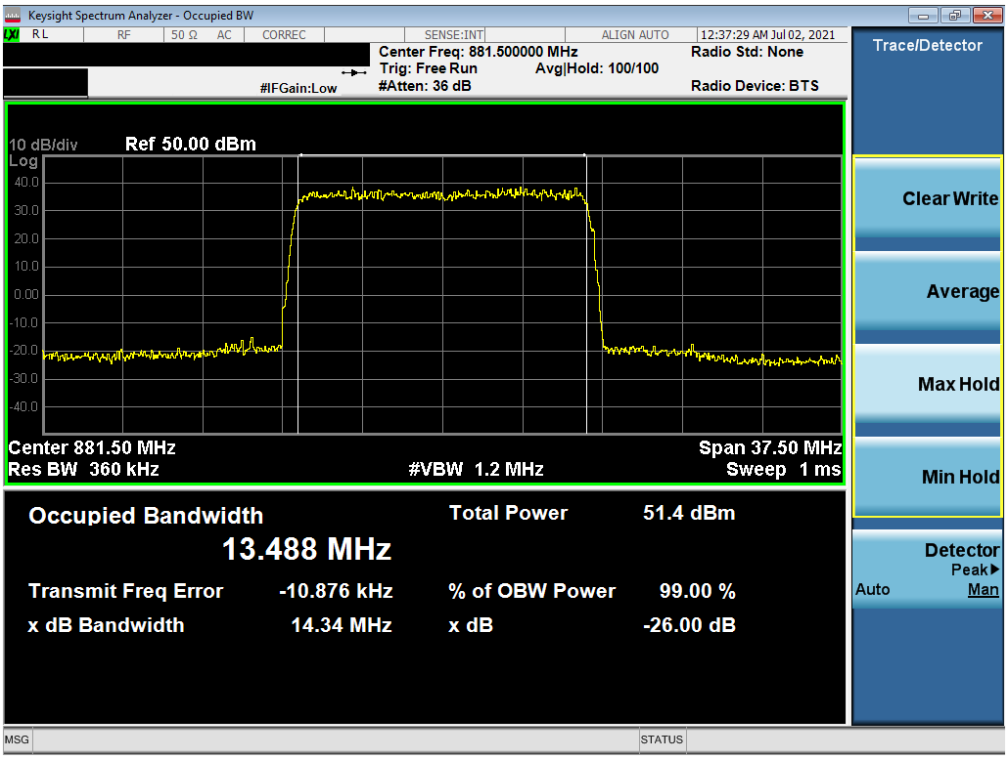


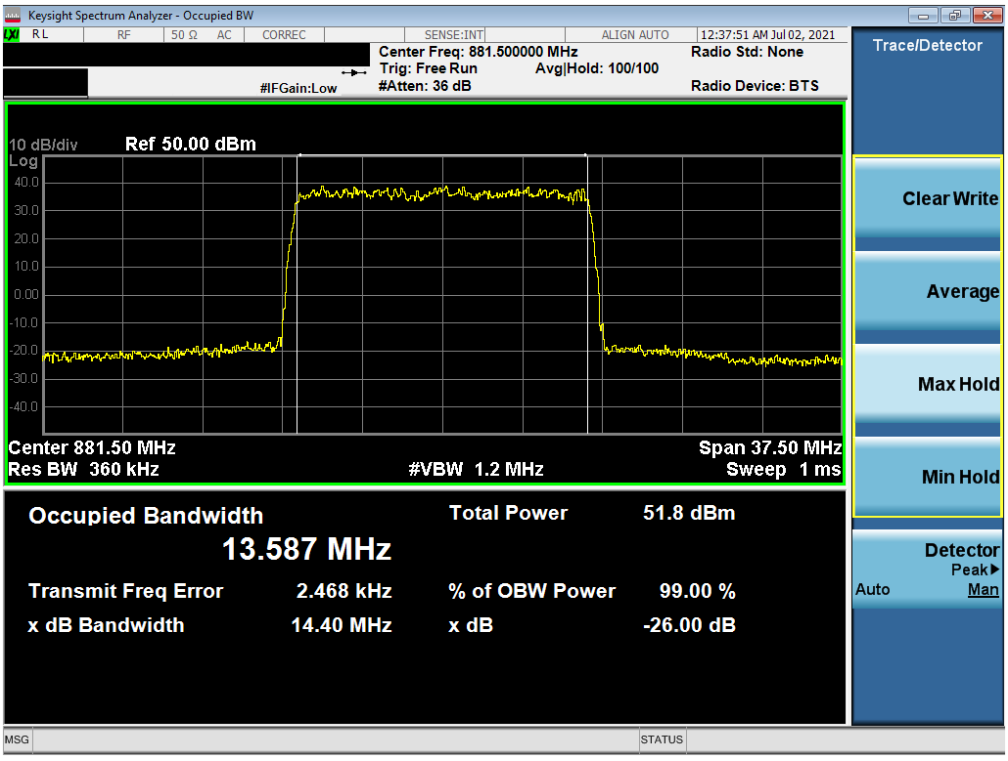
Figure 7-2. Test Instrument & Measurement Setup

Test Notes

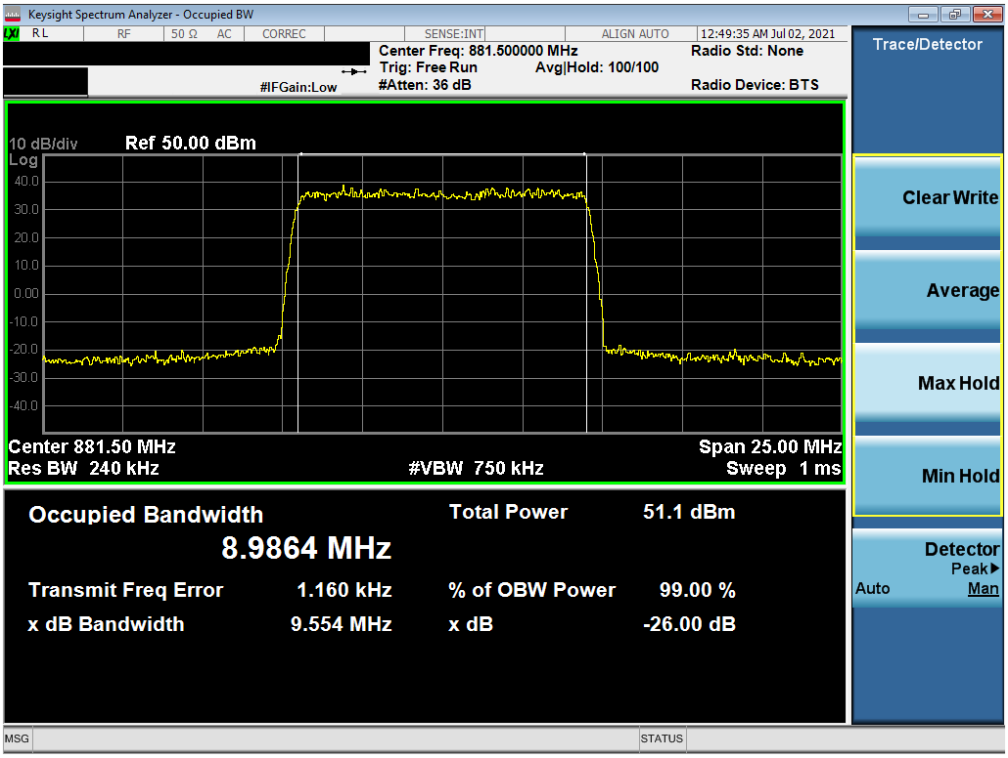
None.



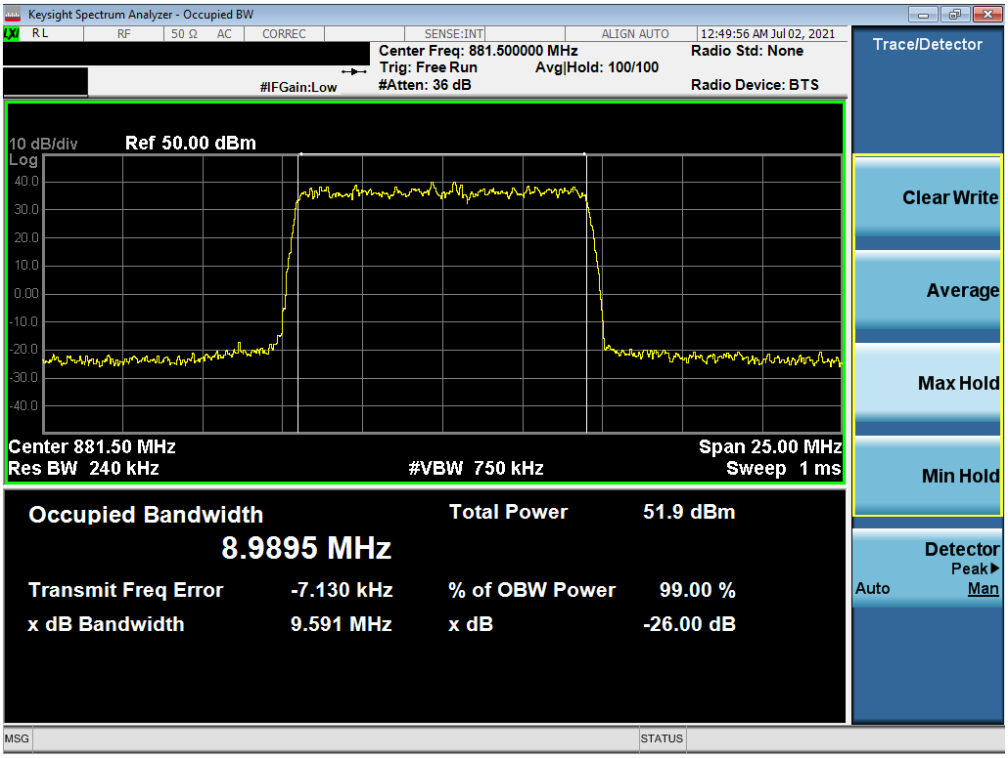
Plot 7-1. Occupied Bandwidth Plot (LTE Band 26 - 15MHz QPSK - Full RB)



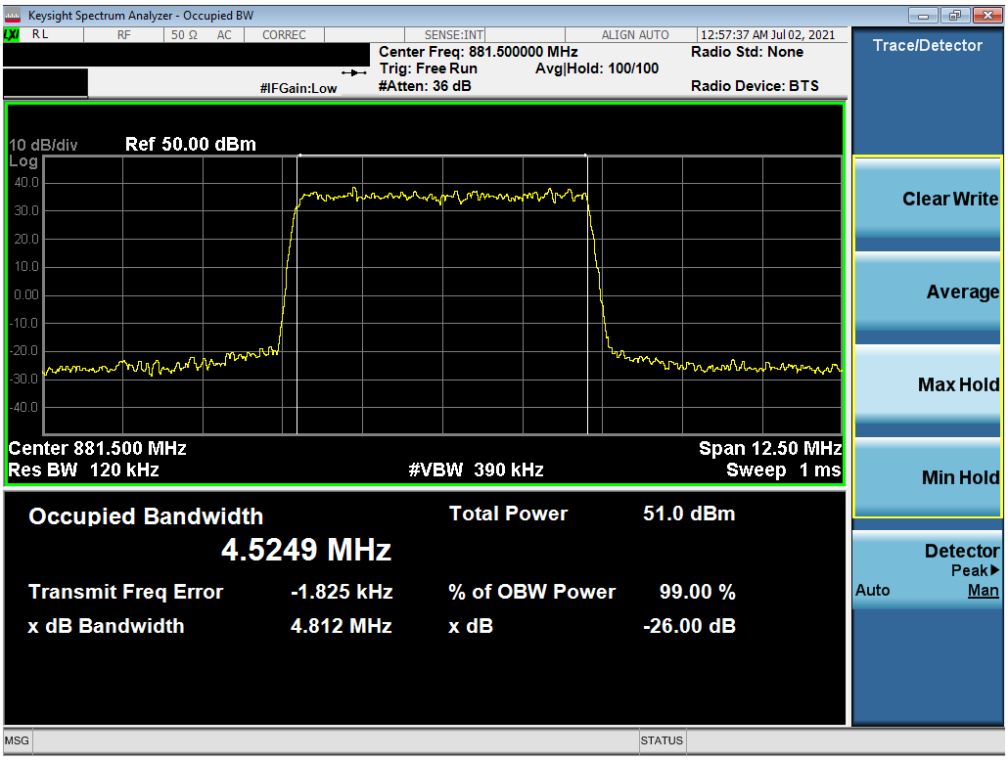
Plot 7-2. Occupied Bandwidth Plot (LTE Band 26 - 15MHz 16-QAM - Full RB)



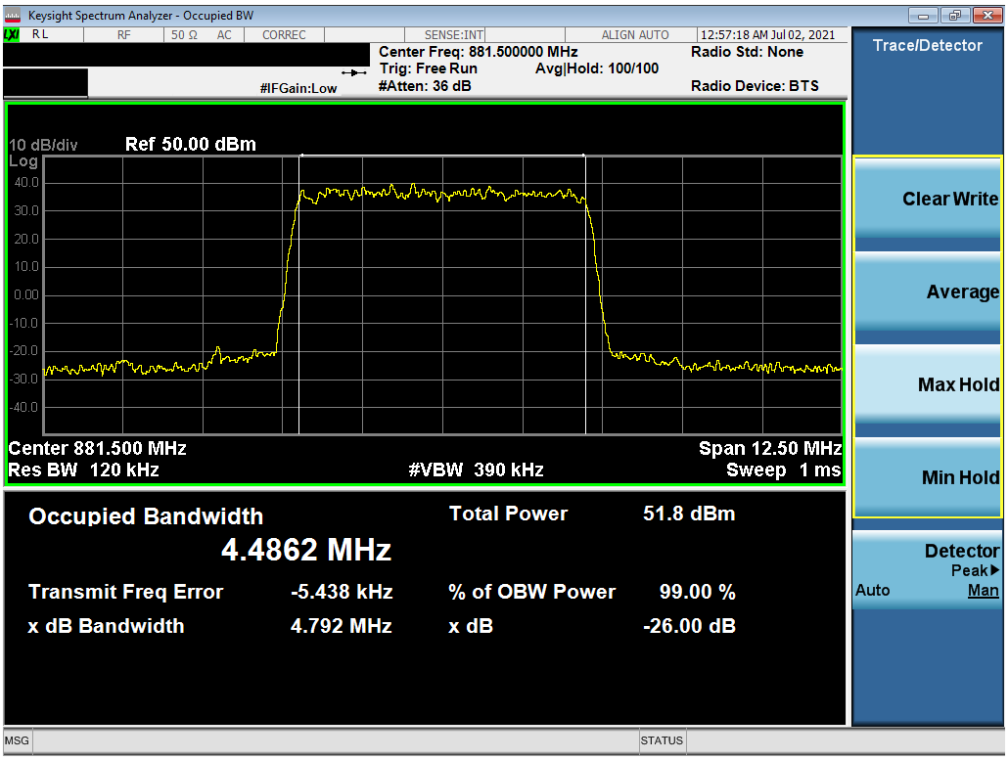
Plot 7-3. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz QPSK - Full RB)



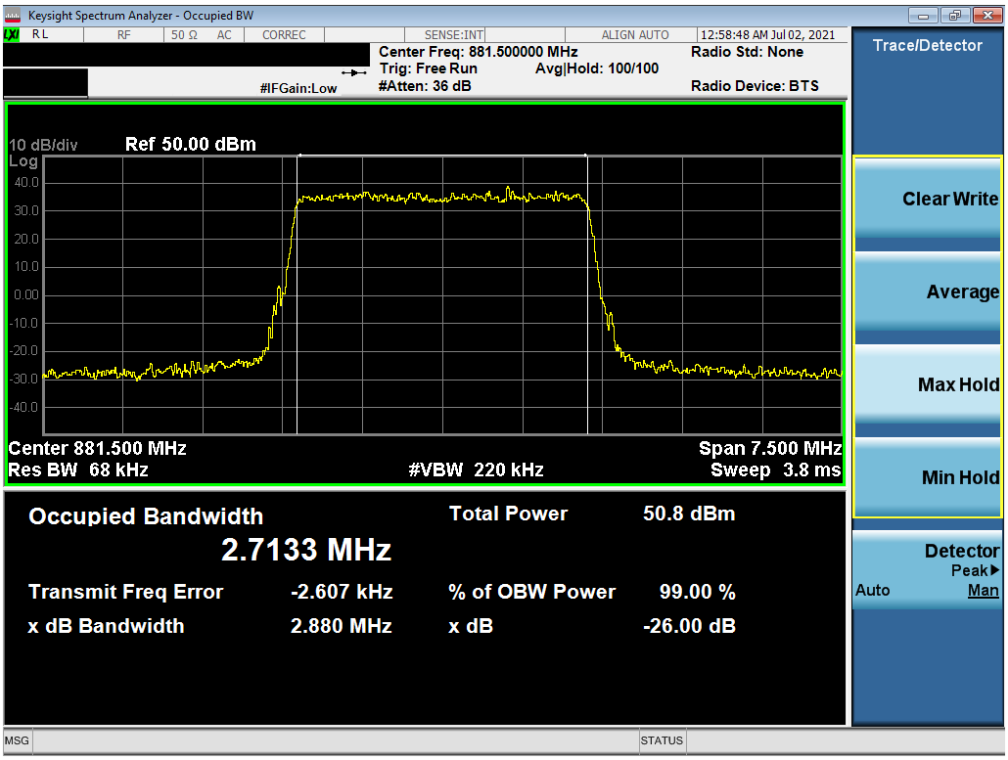
Plot 7-4. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 16-QAM - Full RB)



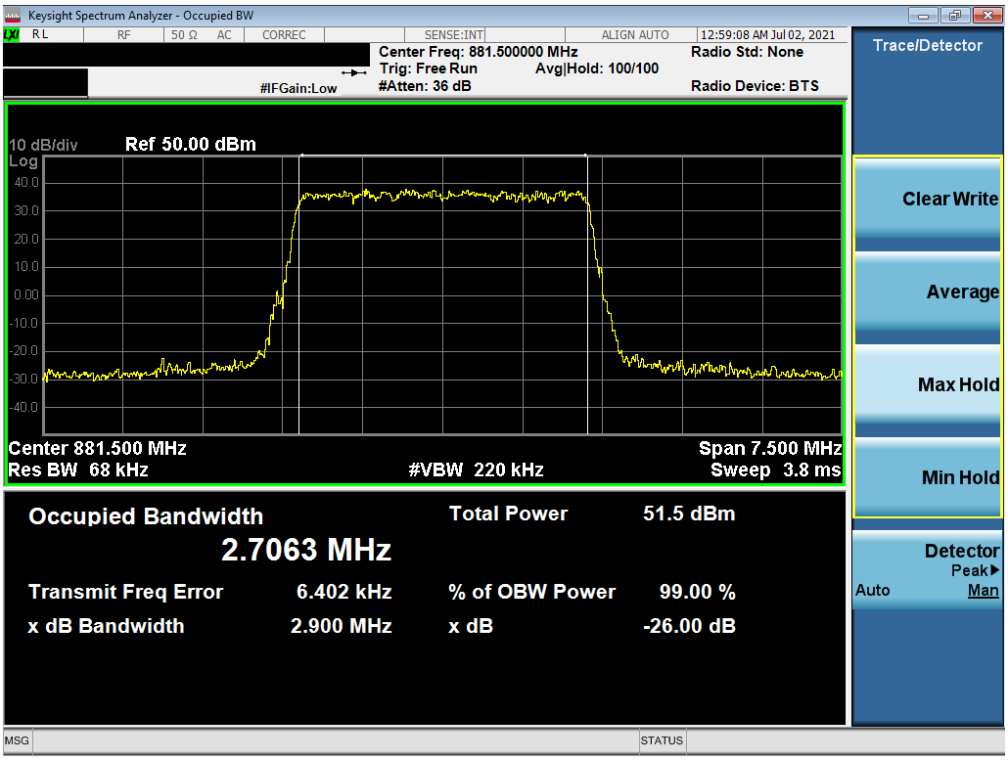
Plot 7-5. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz QPSK - Full RB)



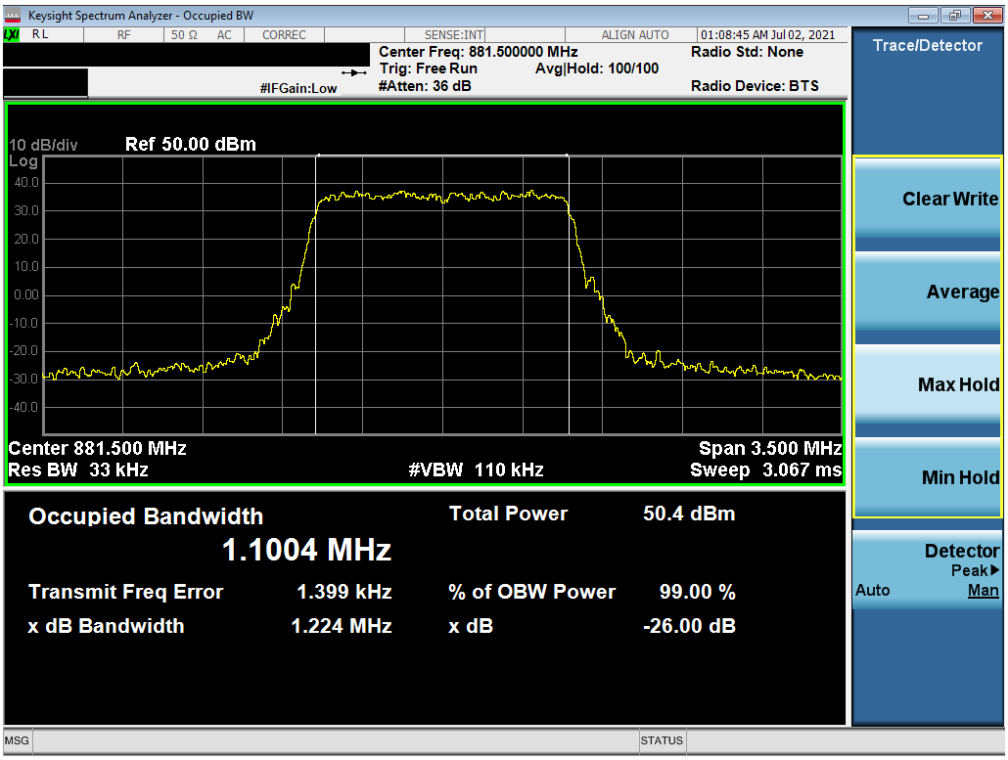
Plot 7-6. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz 16-QAM - Full RB)



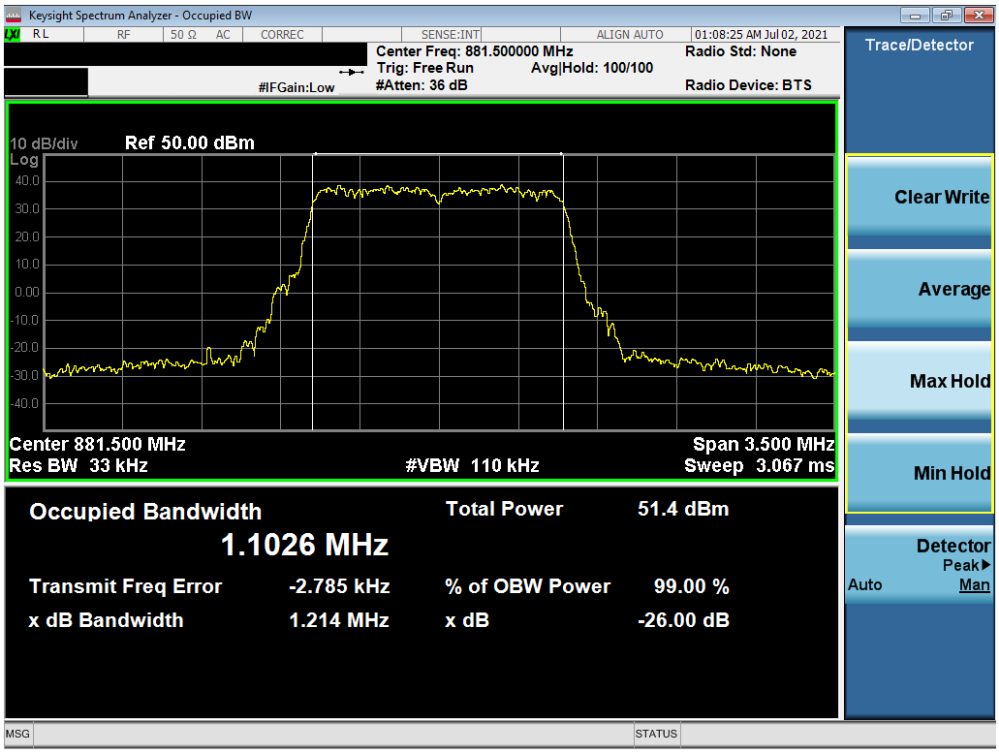
Plot 7-7. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz QPSK - Full RB)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz 16-QAM - Full RB)



Plot 7-9. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz QPSK - Full RB)



Plot 7-10. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz 16-QAM - Full RB)

7.4 Spurious and Harmonic Emissions at Antenna Terminal

Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is 43 + 10 $log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 10GHz (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

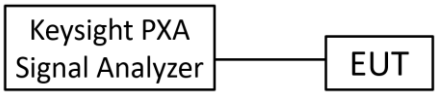
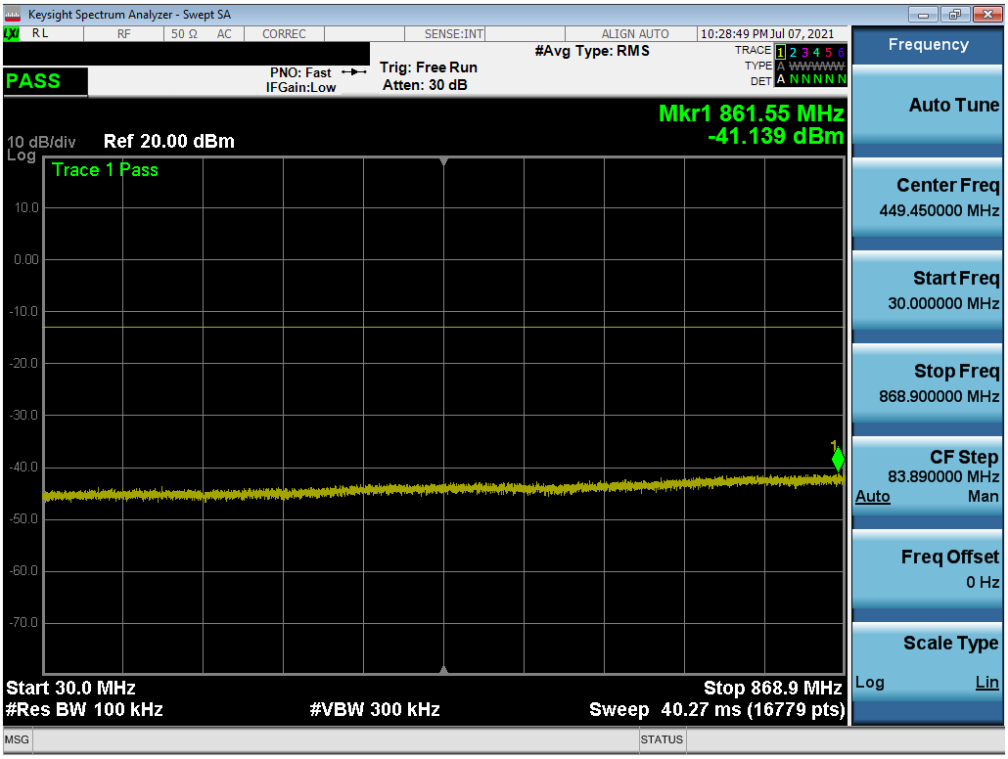


Figure 7-3. Test Instrument & Measurement Setup

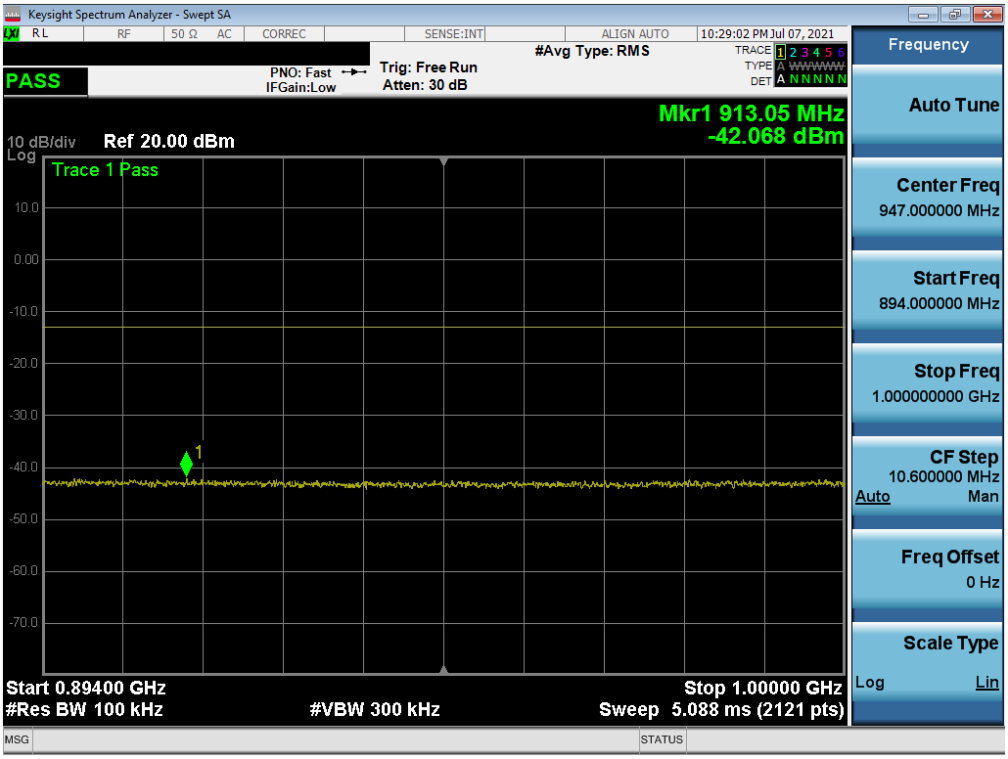
Test Notes

Per Part 22 and RSS-132, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

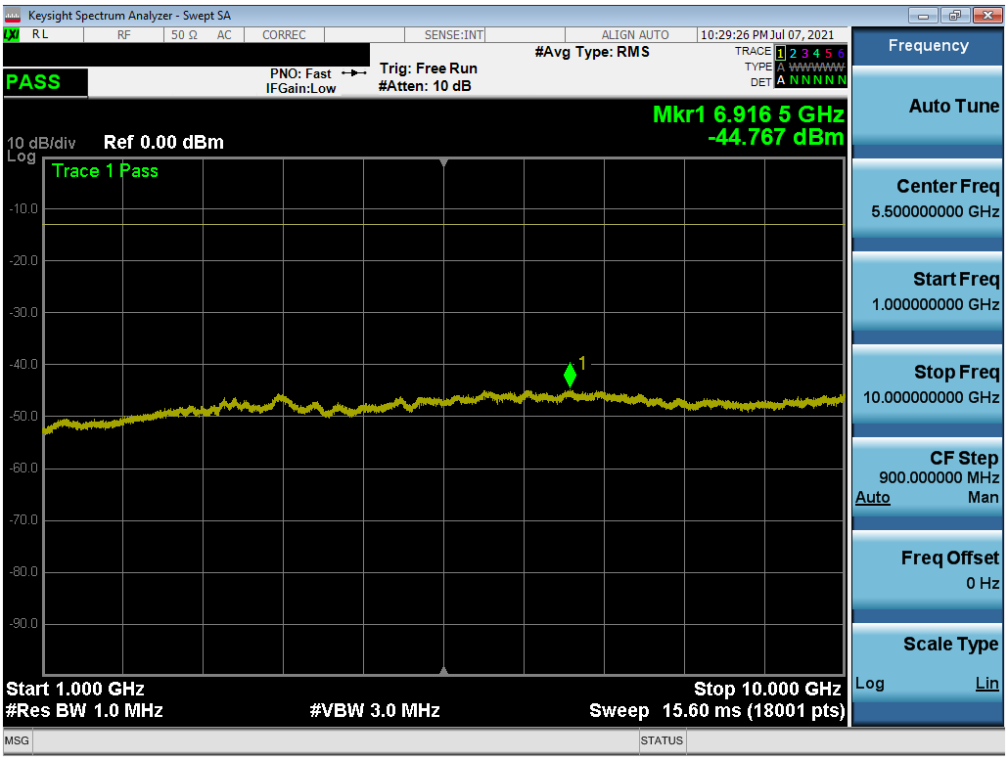
LTE Band 26/5



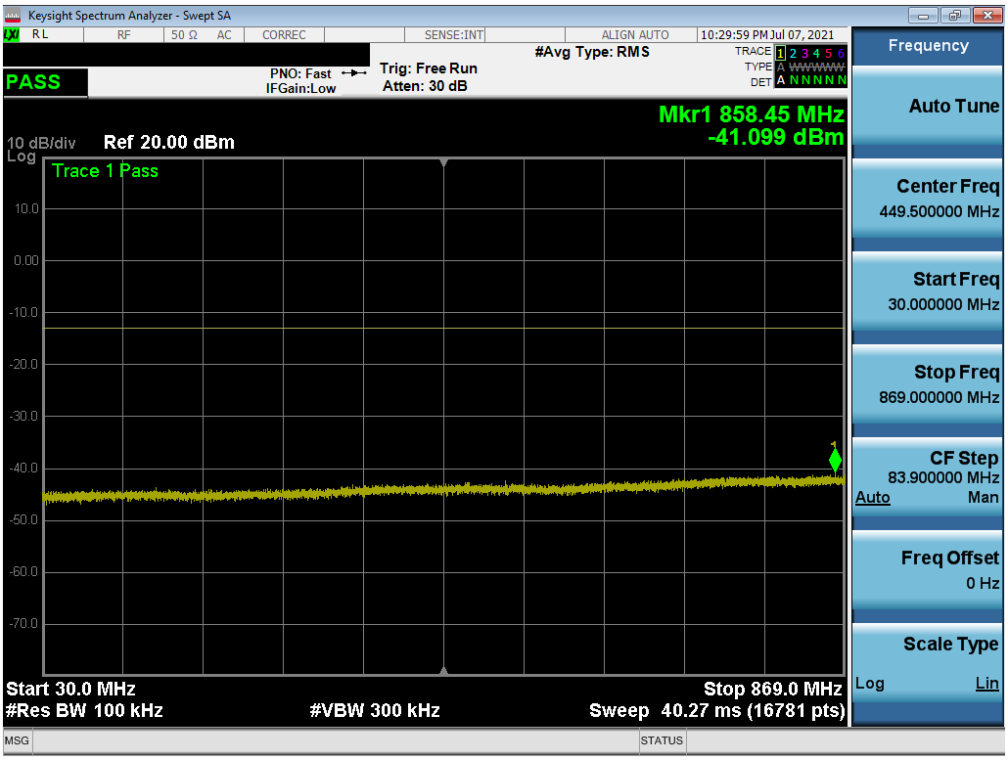
Plot 7-11. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK – Full RB - Low Channel)



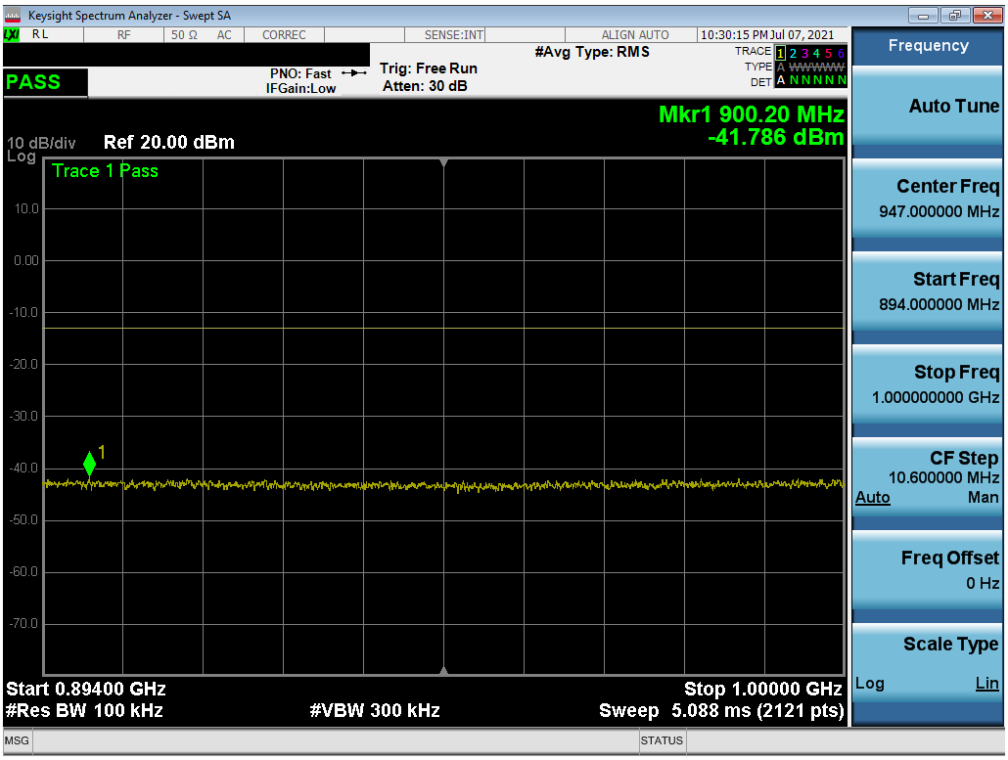
Plot 7-12. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - Low Channel)



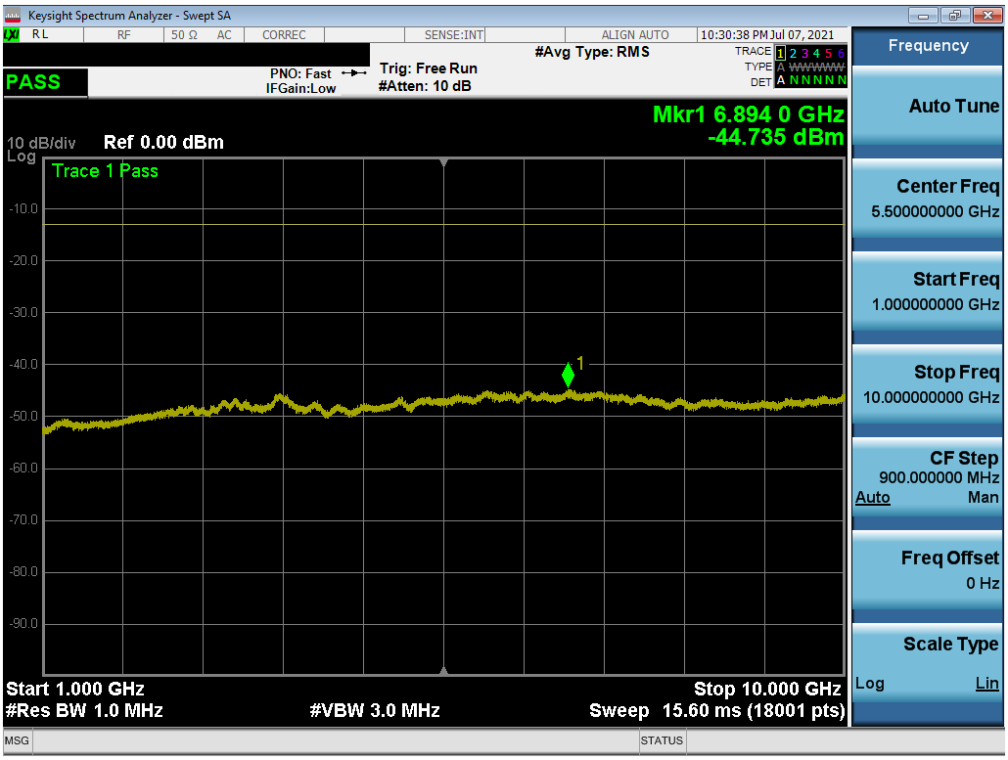
Plot 7-13. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - Low Channel)



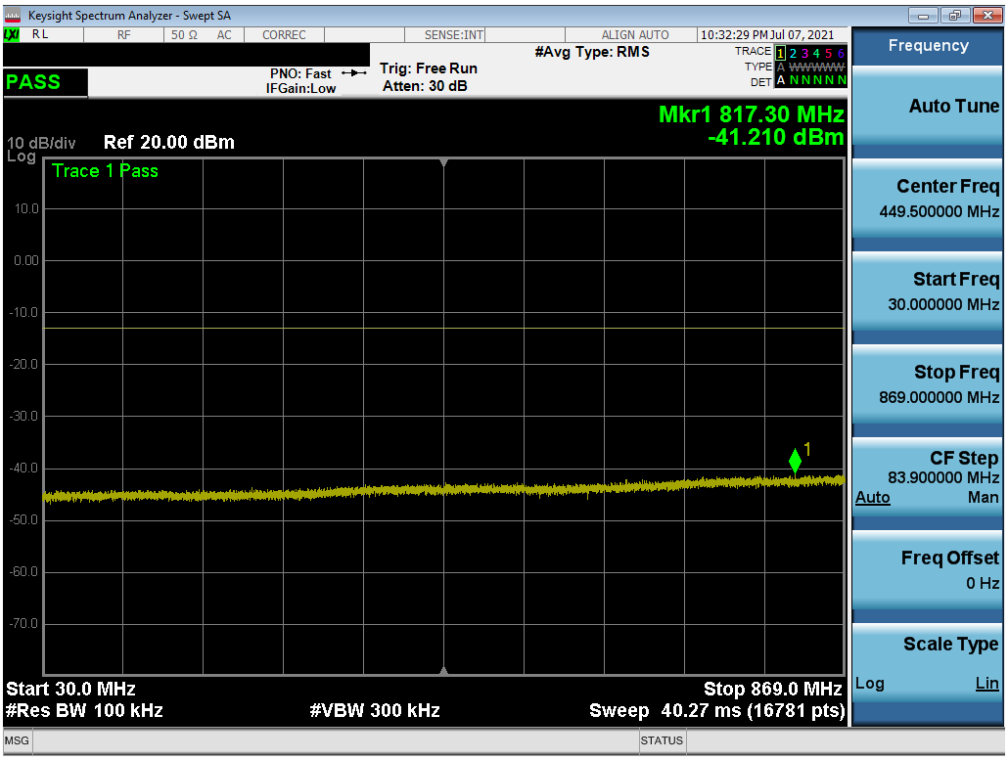
Plot 7-14. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - Mid Channel)



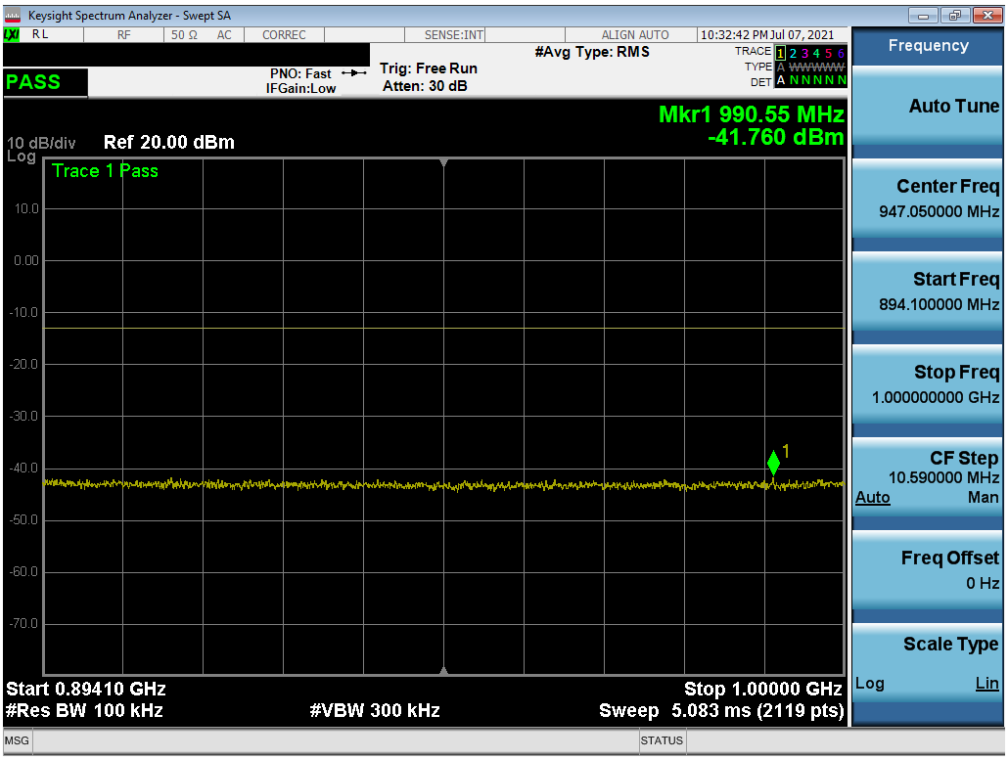
Plot 7-15. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - Mid Channel)



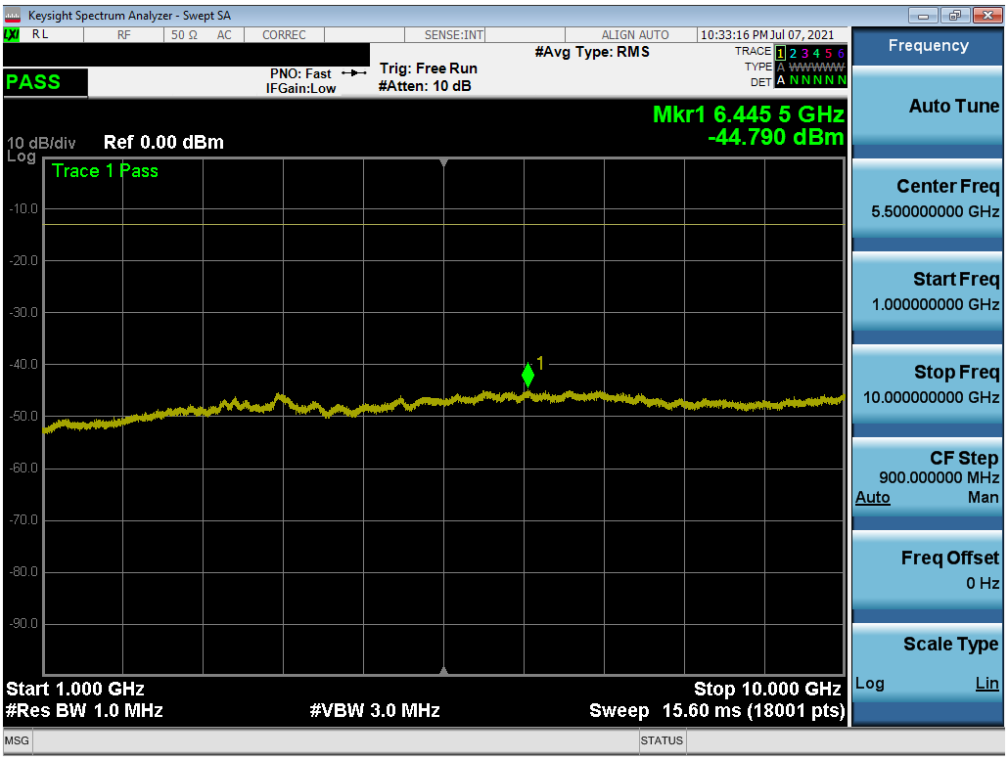
Plot 7-16. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - Mid Channel)



Plot 7-17. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - High Channel)



Plot 7-18. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - High Channel)



Plot 7-19. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - High Channel)

7.5 Band Edge Emissions at Antenna Terminal

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is 43 + 10 $log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW ≥ 1% of the emission bandwidth
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

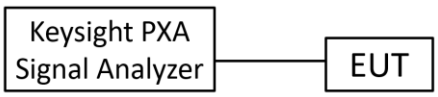
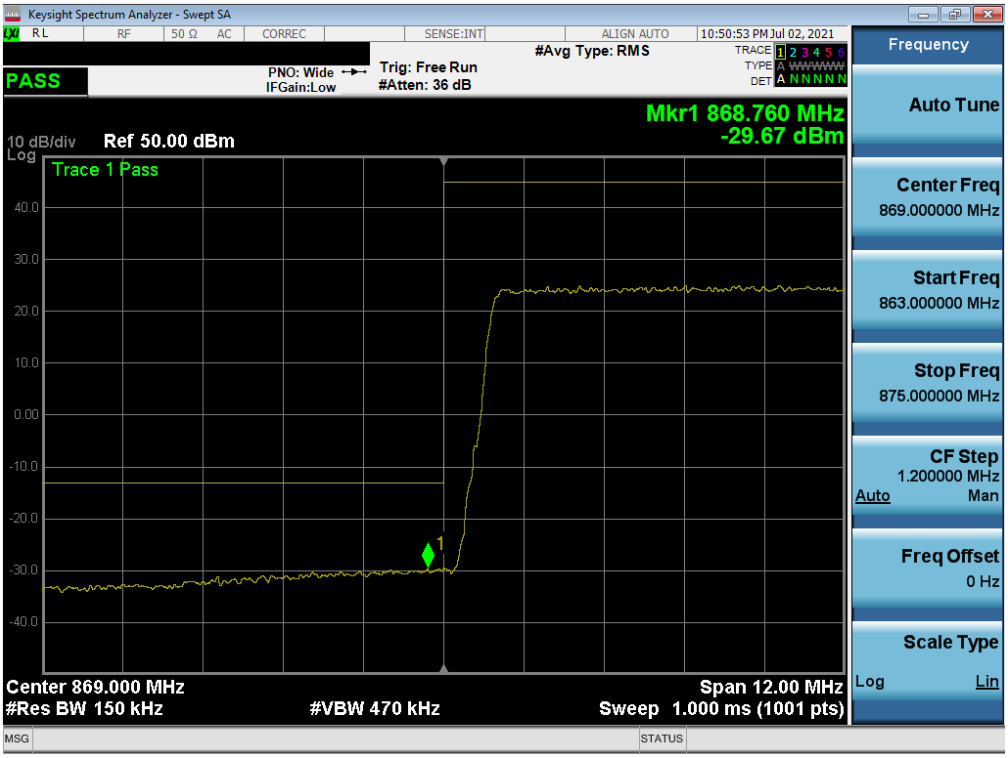


Figure 7-4. Test Instrument & Measurement Setup

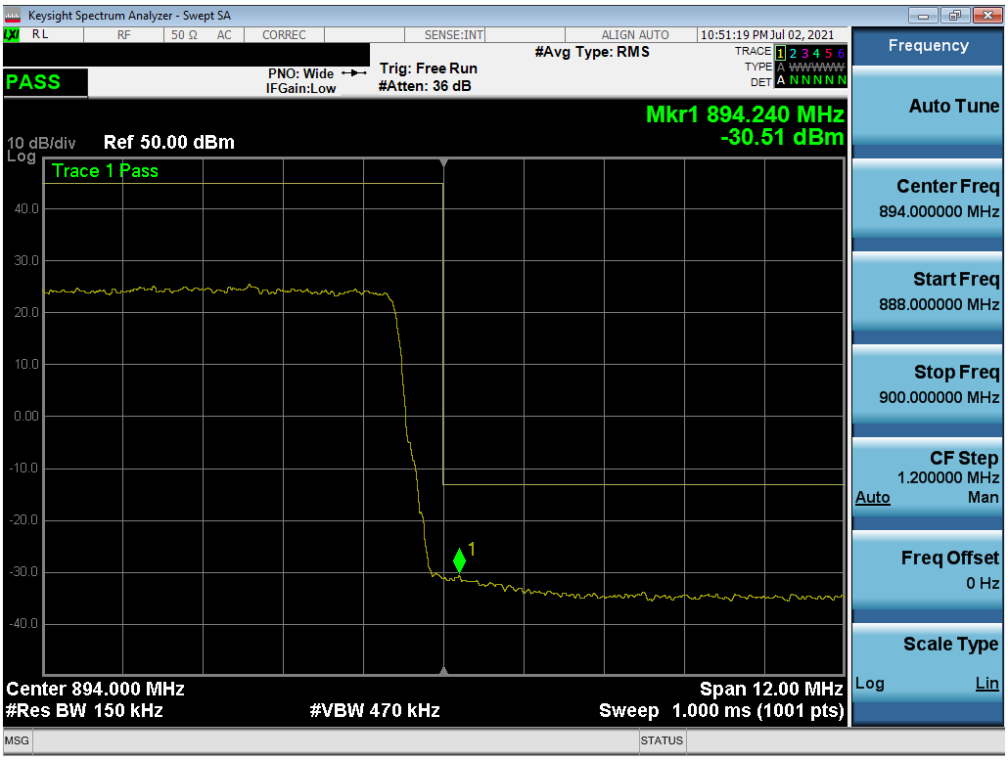
Test Notes

Per 22.917(b) and RSS-132(5.5), in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

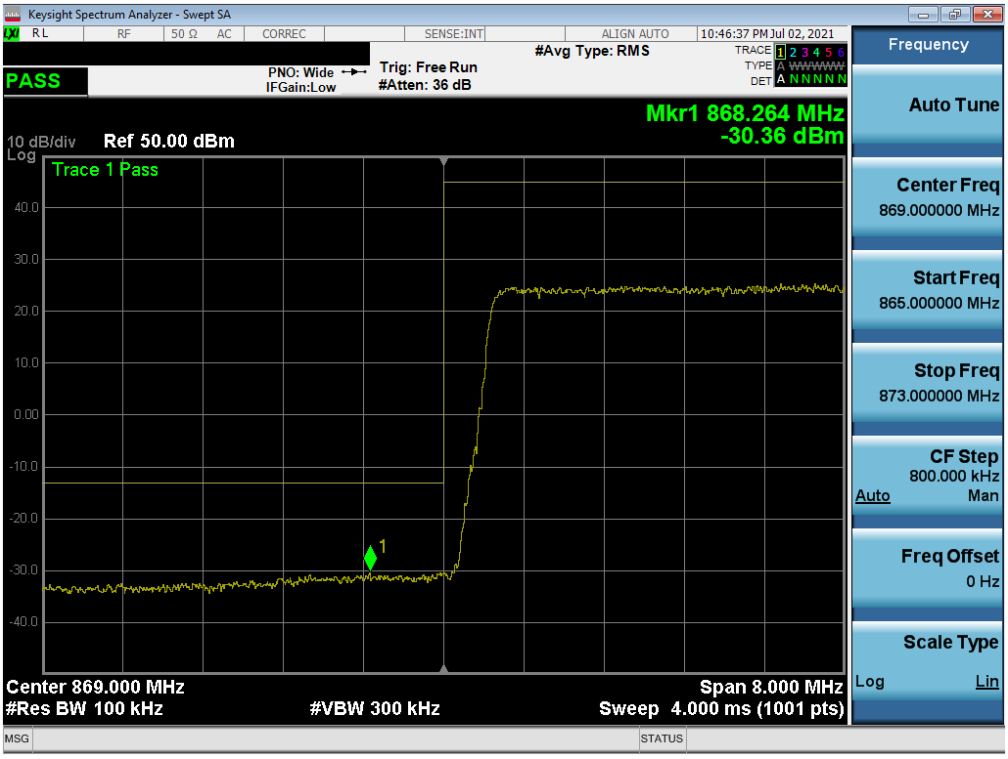
LTE Band 26/5



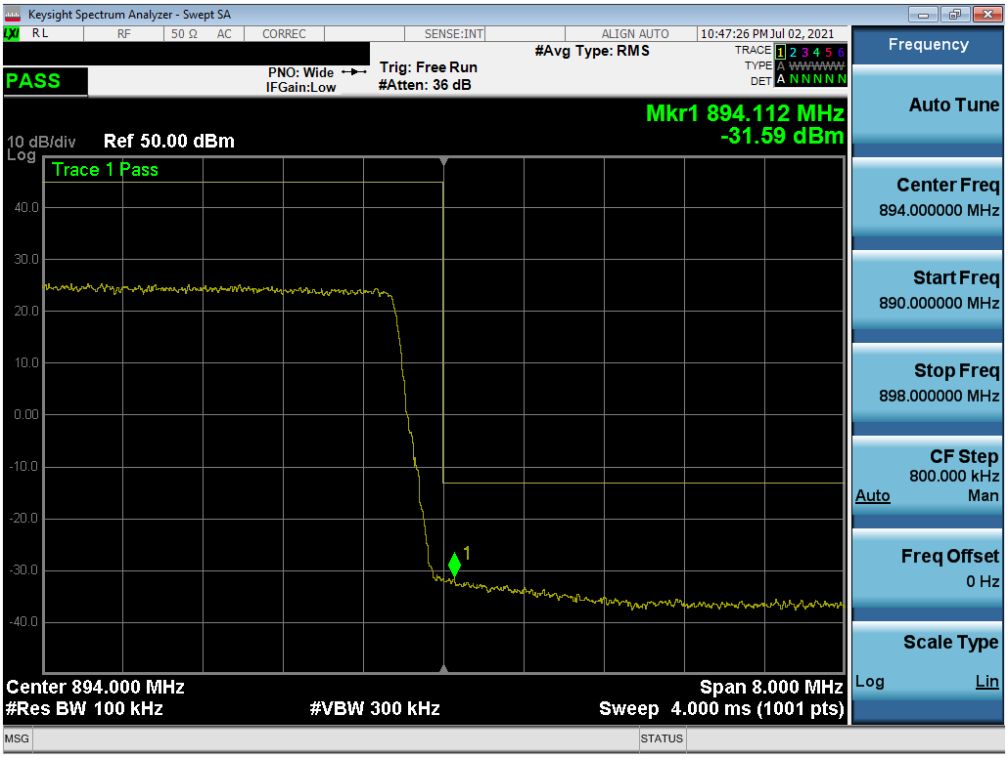
Plot 7-20. Lower Band Edge Plot (LTE Band 26 - 15MHz QPSK – Full RB)



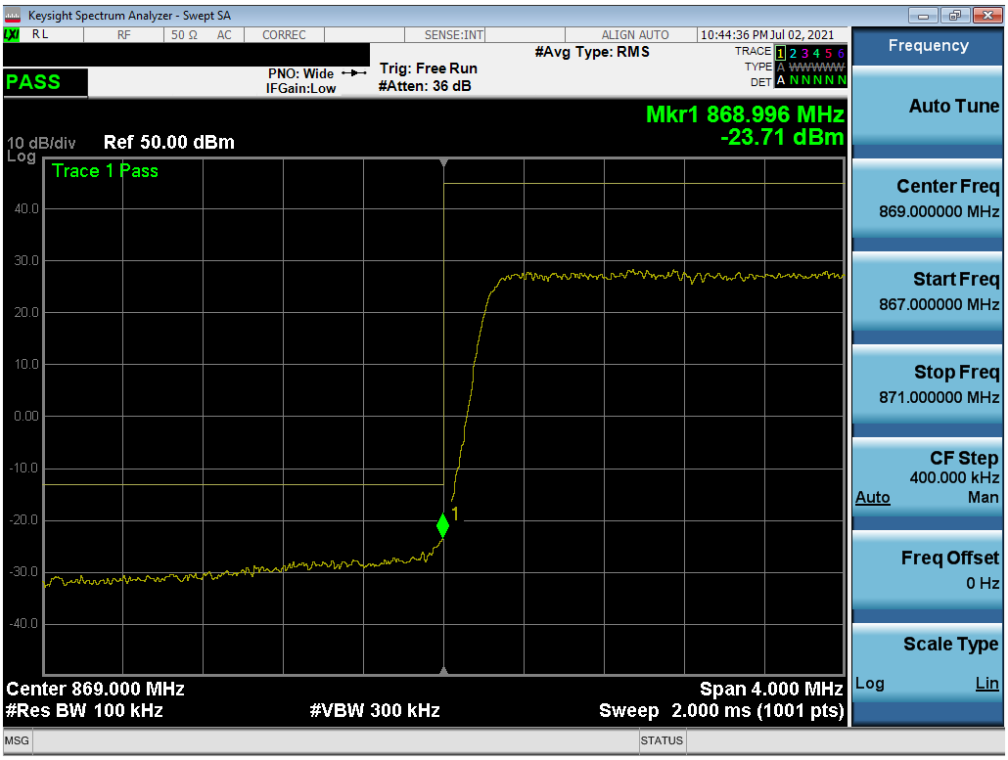
Plot 7-21. Upper Band Edge Plot (LTE Band 26 - 15MHz QPSK – Full RB)



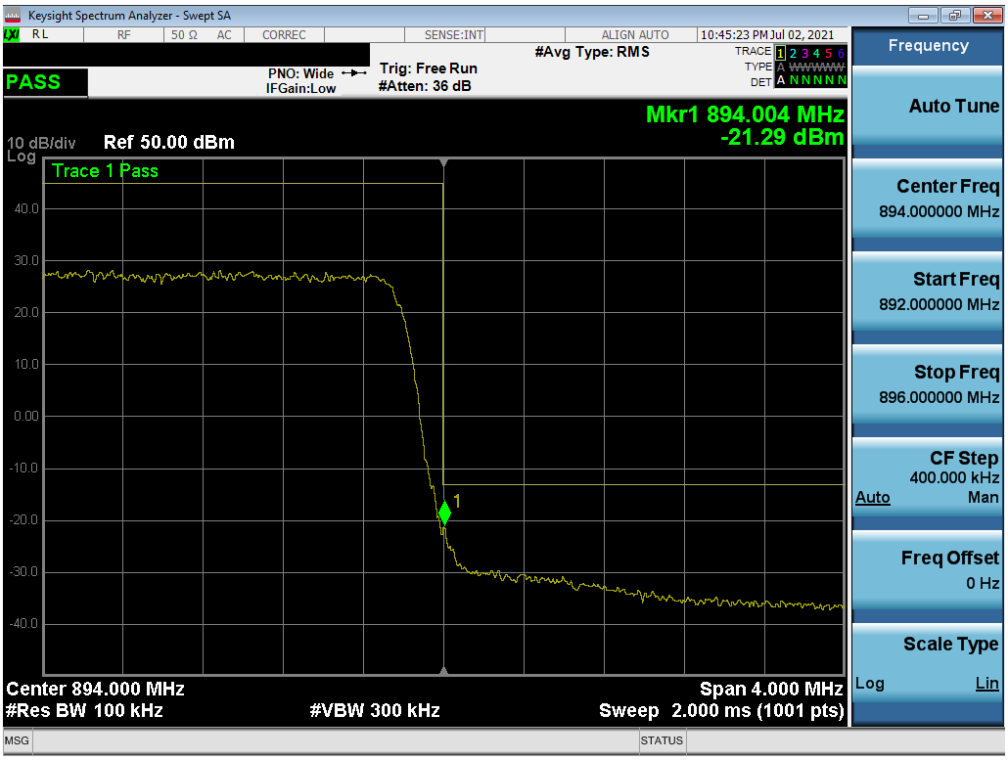
Plot 7-22. Lower Band Edge Plot (LTE Band 26/5 - 10MHz QPSK – Full RB)



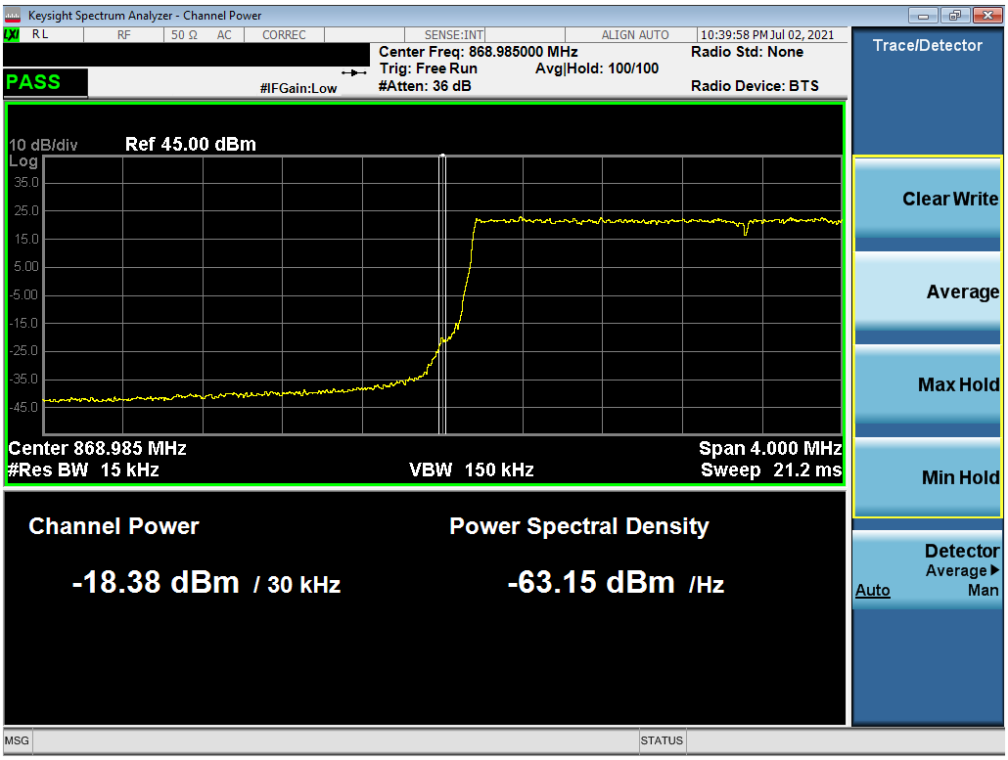
Plot 7-23. Upper Band Edge Plot (LTE Band 26/5 - 10MHz QPSK – Full RB)



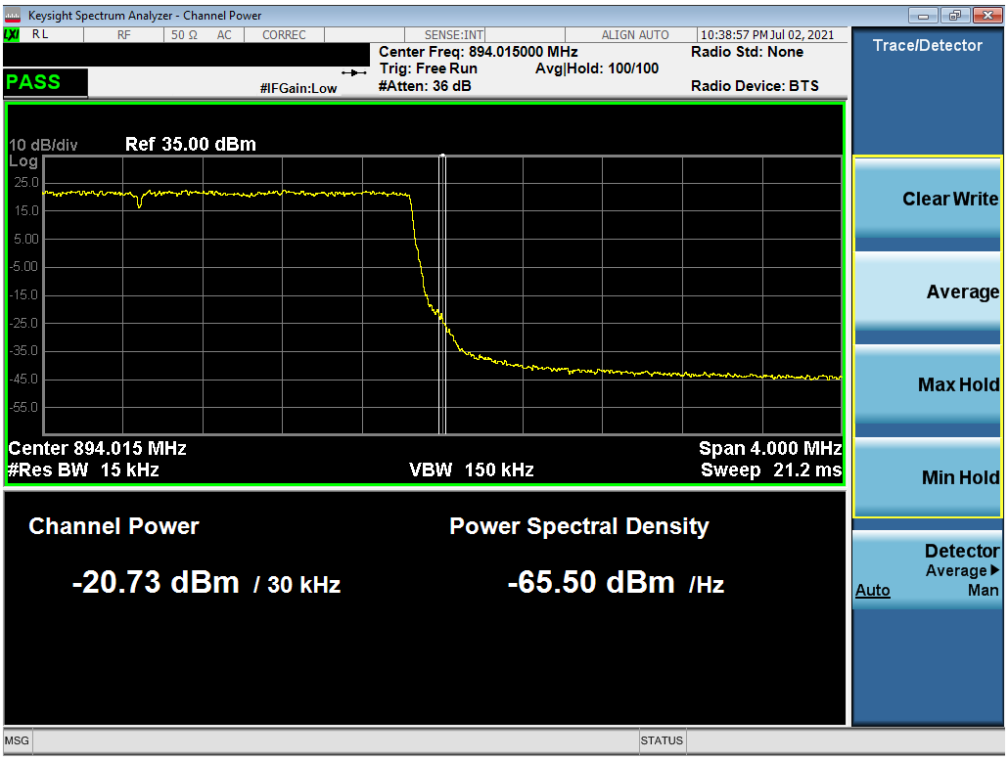
Plot 7-24. Lower Band Edge Plot (LTE Band 26/5 - 5MHz QPSK – Full RB)



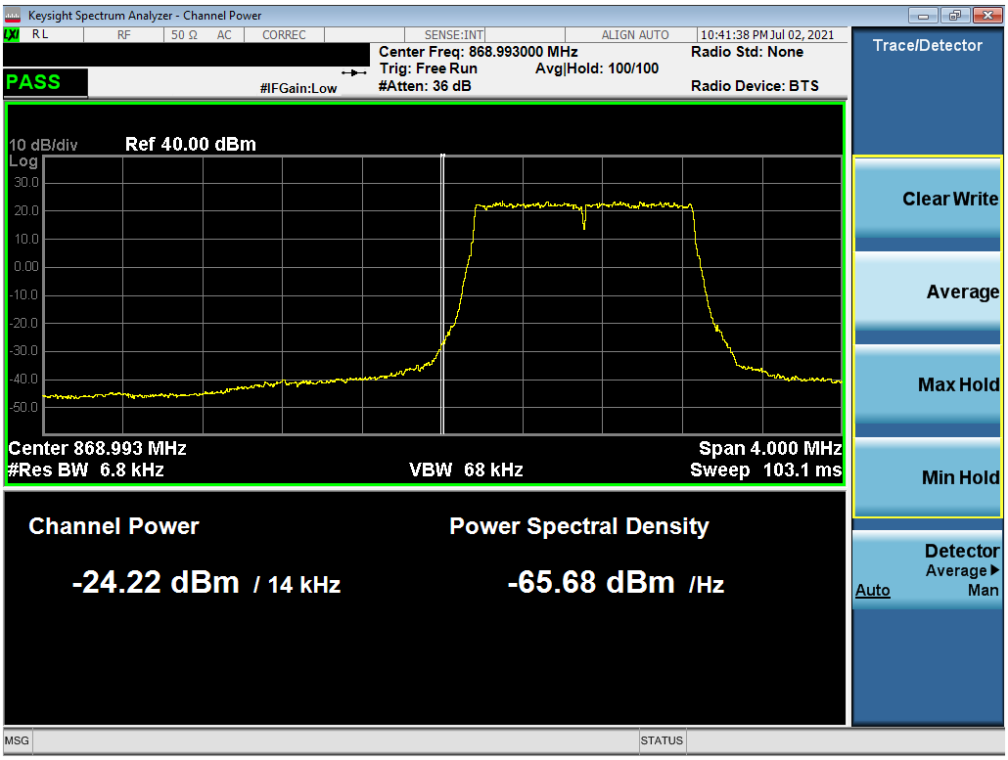
Plot 7-25. Upper Band Edge Plot (LTE Band 26/5 - 5MHz QPSK – Full RB)



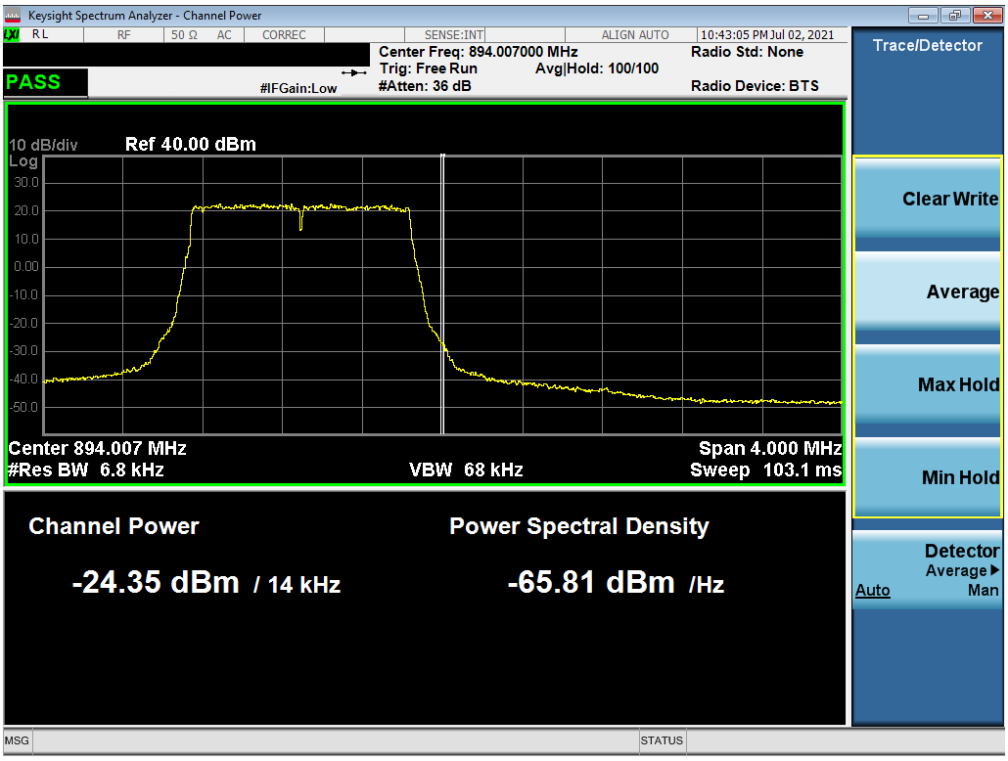
Plot 7-26. Lower Band Edge Plot (LTE Band 26/5 - 3MHz QPSK – Full RB)



Plot 7-27. Upper Band Edge Plot (LTE Band 26/5 - 3MHz QPSK – Full RB)



Plot 7-28. Lower Band Edge Plot (LTE Band 26/5 – 1.4MHz QPSK – Full RB)



Plot 7-29. Upper Band Edge Plot (LTE Band 26/5 – 1.4MHz QPSK – Full RB)

7.6 Radiated Spurious Emissions Measurements

Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in KDB 971168 with the EUT transmitting with a RF port terminated by a 50-ohm load. Measurements on signals operating below 1GHz are performed using horizontally and vertically polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.8

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

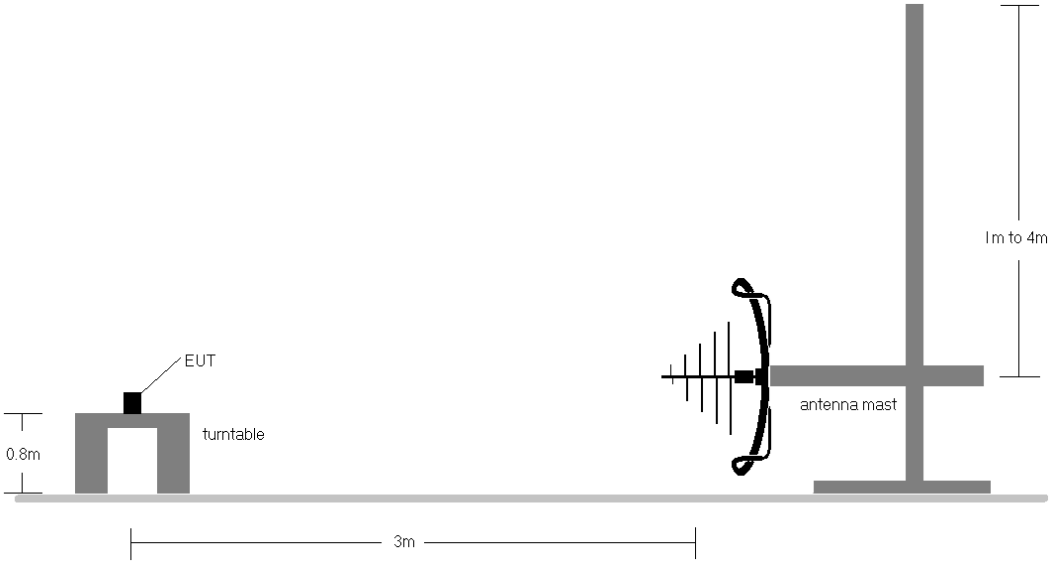


Figure 7-5. Test Instrument & Measurement Setup < 1GHz

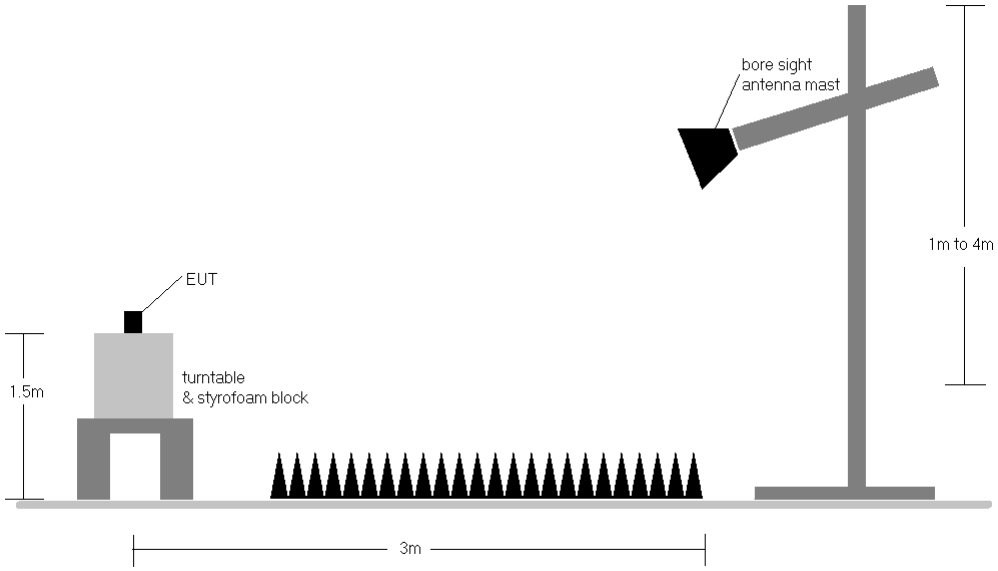


Figure 7-6. Test Instrument & Measurement Setup >1 GHz

Test Notes

1) Field strengths are calculated using the Measurement quantity conversions in KDB 971168 Section 5.8.4.

   a) E(dBµV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m)
   b) EIRP (dBm) = E(dBµV/m) + 20logD – 104.8; where D is the measurement distance in meters.

2) The EUT was tested in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

3) This unit was tested with an external 120 VAC power source

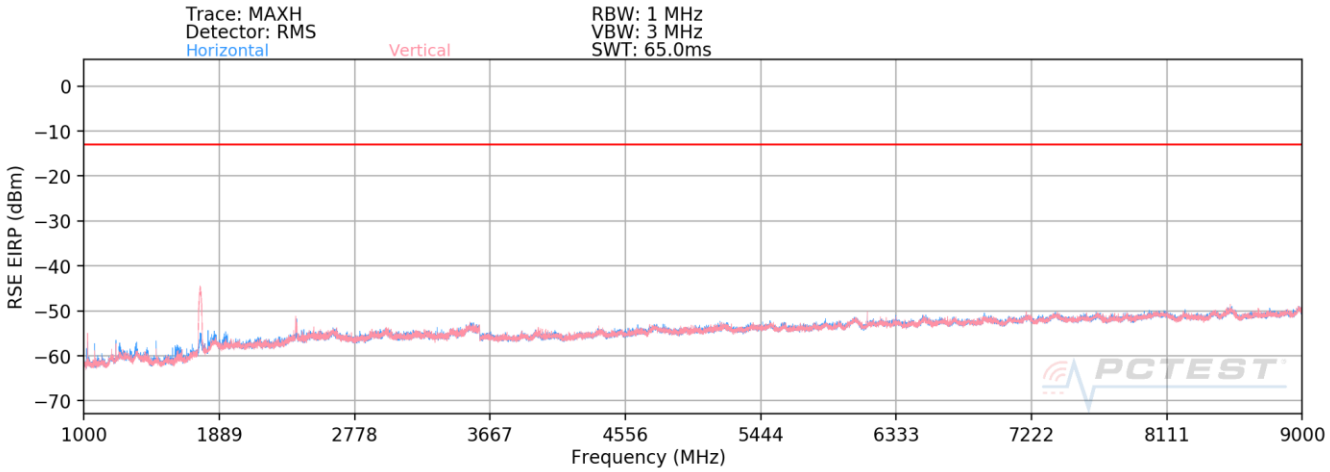
4) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

5) The EUT was also tested with all four LTE bands transmitting at the same time for a total of 80W output power. The worst-case emissions are reported.

6) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

7) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

LTE Band 26/5



Plot 7-30. Radiated Spurious Plot (LTE Band 26/5)

Bandwidth (MHz):	10
Frequency (MHz):	874.0
RB / Offset:	50 / 0

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1748.0	V	264	362	-56.87	-0.85	49.28	-45.98	-13.00	-32.98
2622.0	V	-	-	-76.60	3.36	33.76	-61.50	-13.00	-48.50
3496.0	V	-	-	-76.46	2.84	33.38	-61.88	-13.00	-48.88
4370.0	V	-	-	-78.04	4.79	33.75	-61.51	-13.00	-48.51

Table 7-3. Radiated Spurious Data (LTE Band 26/5 – Low Channel)

Bandwidth (MHz):	10
Frequency (MHz):	881.5
RB / Offset:	50 / 0

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1763.0	V	158	348	-56.77	-0.76	49.47	-45.79	-13.00	-32.79
2644.5	V	-	-	-75.58	3.13	34.55	-60.71	-13.00	-47.71
3526.0	V	-	-	-77.03	3.57	33.54	-61.71	-13.00	-48.71
4407.5	V	-	-	-77.58	4.49	33.91	-61.35	-13.00	-48.35

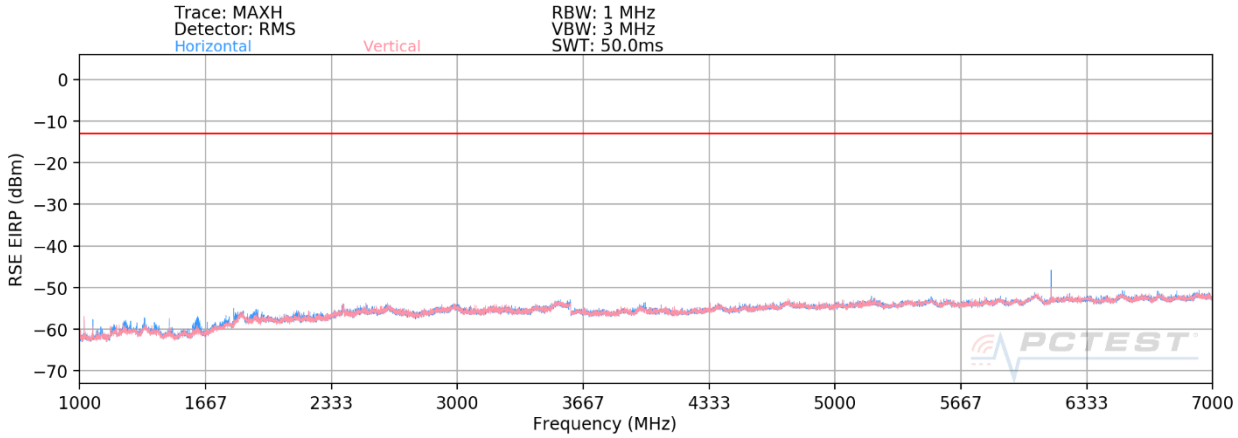
Table 7-4. Radiated Spurious Data (LTE Band 26/5 – Mid Channel)

Bandwidth (MHz):	10
Frequency (MHz):	889.0
RB / Offset:	50 / 0

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1778.00	V	380	364	-55.04	-0.53	51.43	-43.83	-13.00	-30.83
2667.00	V	-	-	-75.72	2.64	33.92	-61.33	-13.00	-48.33
3556.00	V	-	-	-77.19	3.51	33.32	-61.93	-13.00	-48.93
4445.00	V	-	-	-77.68	3.98	33.30	-61.96	-13.00	-48.96

Table 7-5. Radiated Spurious Data (LTE Band 26/5 – High Channel)

LTE Band 71 – 12 – 14 – 26



Plot 7-31. Radiated Spurious Plot (LTE Band 71 – 12 – 14 – 26)

Mode:	LTE Band 71 + 12 + 14 + 26
Bandwidth (MHz):	20 + 10 + 10 + 15
Frequency (MHz):	634.5 + 737.5 + 763 + 881.5

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1023.5	H	149	347	-67.43	-3.76	35.81	-59.45	-13.00	-46.45
1070.3	H	136	346	-65.65	-3.42	37.93	-57.32	-13.00	-44.32
1966.1	H	269	287	-69.66	1.04	38.38	-56.88	-13.00	-43.88
6144.0	H	180	174	-64.93	6.70	48.77	-46.49	-13.00	-33.49
7052.0	H	-	-	-78.54	7.12	35.58	-59.68	-13.00	-46.68

Table 7-6. Radiated Spurious Data (LTE Band 71 – 12 – 14 – 26) – Mid Channel)

7.7 Frequency Stability / Temperature Variation

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-E-2016. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

For Part 22 and RSS-132, the frequency stability of the transmitter shall be maintained within ±0.00015% (±1.5 ppm) of the center frequency.

Test Procedure Used

ANSI/TIA-603-E-2016

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber.

Test Notes

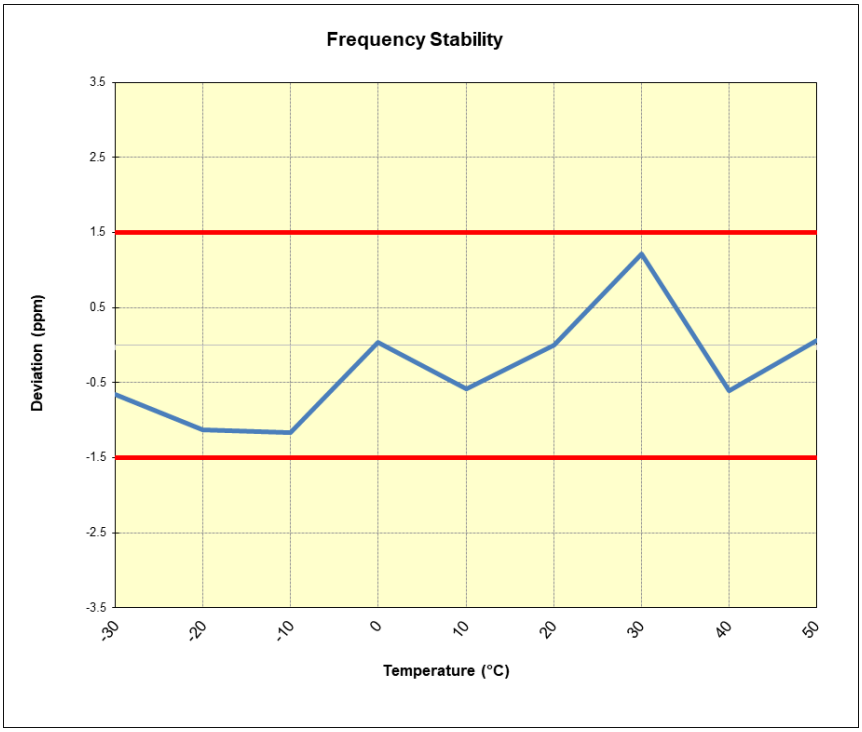
None

LTE Band 26/5

Operating Frequency (Hz):	881,500,000
Ref. Voltage (VAC):	120.00
Deviation Limit:	± 0.00015% or 1.5 ppm

Voltage (%)	Power (VAC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	120.00	- 30	881,500,347	-583	-0.0000661
		- 20	881,499,941	-989	-0.0001122
		- 10	881,499,903	-1,027	-0.0001165
		0	881,500,965	35	0.0000040
		+ 10	881,500,412	-518	-0.0000588
		+ 20 (Ref)	881,500,930	0	0.0000000
		+ 30	881,501,998	1,068	0.0001212
		+ 40	881,500,400	-530	-0.0000601
		+ 50	881,500,981	51	0.0000058
85 %	102.00	+ 20	881,500,866	-64	-0.0000073
115 %	138.00	+ 20	881,500,123	-807	-0.0000915

Table 7-7. LTE Band 26/5 Frequency Stability Data



Plot 7-32. LTE Band 26/5 Frequency Stability Chart

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Tecore Low Band mRU FCC ID: QLJMRU-060785** complies with all the requirements of Part 22 of the FCC rules.