



TEST REPORT

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR24-SRF0045 Page(1) of (69)	KCTL
--	--	--

1. Client

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
- Date of Receipt : 2024-03-28

2. Use of Report : Certification

3. Name of Product / Model : Smart Wearable / SM-L315U

4. Derivative Model : SM-L315F

5. Manufacturer / Country of Origin : Samsung Electronics Co., Ltd. / Vietnam

6. FCC ID : A3LSML315

7. Date of Test : 2024-04-01 to 2024-04-22

8. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
 (Address: 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

9. Test method used : FCC Part 2
 FCC Part 90 subpart S
 FCC Part 90 subpart R

10. Test Result : Refer to the test result in the test report

Affirmation	Tested by Name : Kwonse Kim (Signature)	Technical Manager Name : Harim Lee (Signature)
-------------	--	---

2024-04-24

Eurofins KCTL Co.,Ltd.

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by Eurofins KCTL Co.,Ltd.

REPORT REVISION HISTORY

Date	Revision	Page No
2024-04-24	Originally issued	-

This report shall not be reproduced except in full, without the written approval of Eurofins KCTL Co.,Ltd. This document may be altered or revised by Eurofins KCTL Co.,Ltd. personnel only, and shall be noted in the revision section of the document. Any alteration of this document not carried out by Eurofins KCTL Co.,Ltd. will constitute fraud and shall nullify the document. This test report is a general report that does not use the KOLAS accreditation mark and is not related to KS Q ISO/IEC 17025 and KOLAS accreditation.

General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ **Statement not required by the standard or client used for type testing**

CONTENTS

1.	General information	4
2.	Device information	4
2.1.	Accessory information	4
2.2.	Frequency/channel operations.....	5
3.	Maximum output power	6
4.	Summary of tests	7
4.1.	Worst case orientation	8
5.	Measurement uncertainty	9
6.	Measurement results explanation example	10
7.	Test results	11
7.1.	Conducted output power.....	11
7.2.	99% Occupied Bandwidth & 26 dB Bandwidth.....	17
7.3.	Band Edge Emissions at Antenna Terminal	31
7.4.	Spurious Emissions at Antenna Terminal.....	45
7.5.	Peak to Average Power Ratio (PAPR)	50
7.6.	Frequency stability	54
7.7.	Radiated Power (ERP)	58
7.8.	Radiated Spurious Emissions	63
8.	Measurement equipment.....	69

1. General information

Client : Samsung Electronics Co., Ltd.
 Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
 Manufacturer : Samsung Electronics Co., Ltd.
 Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
 Factory 1 : AG TECH CO.,LTD
 Address 1 : Lot G3, Que Vo Industrial Park(Expanded Area), Nam son Ward, Bac Ninh Province, Vietnam
 Factory 2 : ALMUS VINA
 Address 2 : Lot CN07A, Phu Ha Industrial Park, Ha Thach Commune, Phu Tho Town, Phu Tho Province, Vietnam
 Laboratory : Eurofins KCTL Co.,Ltd.
 Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
 Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132
 VCCI Registration No.: R-20080, G-20078, C-20059, T-20056
 CAB Identifier: KR0040
 ISED Number: 8035A
 KOLAS No.: KT231

2. Device information

Equipment under test : Smart Wearable
 Model : SM-L315U
 Derivative model : SM-L315F
 Modulation technique : LTE : QPSK, 16QAM
 Power source : DC 3.88 V
 Antenna specification : PIFA + FPCB Antenna
 Antenna gain : LTE B14 : -13.9 dBi
 : LTE B26 : -13.6 dBi
 Frequency range : LTE B14 : 790.5 MHz ~ 795.5 MHz
 : LTE B26 : 814.7 MHz ~ 848.3 MHz
 Bandwidth : LTE B14 : 5/10 MHz
 : LTE B26 : 1.4/3/5/10/15 MHz
 Software version : L315U.001
 Hardware version : REV1.0
 Test device serial No. : Conducted : R3AX400NZGL
 : Radiated : R3AX400NYFN, R3AX400NX0P
 Operation temperature : 0 °C ~ 35 °C

Note.

1. The product equality letter includes detailed information about the differences between SM-L315U and SM-L315F model.

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source	FCC ID & IC
Wireless charger	RF TECH	EP-OL300	-	5.0 V, 3.0 A	FCC ID : A3LEPOL300 IC : 649E-EPOL300

2.2. Frequency/channel operations

This device contains the following capabilities:

LTE B14/26

LTE B14

Ch.	Frequency (MHz)
23305	790.5
23330	793.0
23355	795.5

Table 2.2-1. 5M BW

Ch.	Frequency (MHz)
-	-
23330	793.0
-	-

Table 2.2-2. 10M BW

LTE B26

Ch.	Frequency (MHz)
26697	814.7
26740	819.0
26783	823.3

Table 2.2-3. 1.4M BW

Ch.	Frequency (MHz)
26705	815.5
26740	819.0
26775	822.5

Table 2.2-4. 3M BW

Ch.	Frequency (MHz)
26715	816.5
26740	819.0
26765	821.5

Table 2.2-5. 5M BW

Ch.	Frequency (MHz)
26740	819.0

Table 2.2-6. 10M BW

Ch.	Frequency (MHz)
26765	821.5

Table 2.2-7. 15M BW

3. Maximum output power

LTE B14

Mode	Tx frequency (MHz)	Emission designator	ERP	
			Max. power (dBm)	Max. power (W)
LTE B14	790.5 ~ 795.5	4M55G7D	10.44	0.011
		4M58W7D	9.43	0.009
	793.0	9M02G7D	10.19	0.010
		9M04W7D	9.17	0.008

LTE B26

Mode	Tx frequency (MHz)	Emission designator	Conducted	
			Max. power (dBm)	Max. power (W)
LTE B26	814.7 ~ 823.3	1M11G7D	22.77	0.189
		1M11W7D	21.81	0.152
	815.5 ~ 822.5	2M72G7D	22.47	0.177
		2M72W7D	21.93	0.156
	816.5 ~ 821.5	4M56G7D	22.44	0.175
		4M55W7D	21.90	0.155
	819.0	9M04G7D	22.32	0.171
		9M07W7D	21.72	0.149
	821.5	13M4G7D	22.52	0.179
		13M5W7D	21.79	0.151
Straddle channel	824.0	1M11G7D	22.16	0.164
		1M10W7D	21.59	0.144
		2M71G7D	22.15	0.164
		2M73W7D	21.58	0.144
		4M55G7D	22.12	0.163
		4M53W7D	21.55	0.143
		9M04G7D	22.42	0.175
		9M04W7D	21.91	0.155
		13M5G7D	22.42	0.175
		13M5W7D	21.83	0.152

4. Summary of tests

FCC Part section(s)	Parameter	Test Limit	Test Condition	Test results
2.1046 90.635	Conducted Output Power	<100 Watts	Conducted	Pass
2.1049	Occupied Bandwidth & 26 dB Bandwidth	N/A		Pass
2.1051 90.543(e) 90.691(a)	Band Edge Emissions at Antenna Terminal	<65 + 10Log ₁₀ (P) dB between 769-775 MHz and 799-805 MHz, <43 + 10Log ₁₀ (P) dB between 775-788 MHz, above 805 MHz and below 758 MHz, <50 + 10Log ₁₀ (P) dB at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge		Pass
	Spurious Emissions at Antenna Terminal			Pass
-	Peak to Average Power Ratio	<13 dB		Pass
2.1055 90.539(e) 90.213	Frequency stability	<1.25 ppm, <2.5 ppm		Pass
22.913(a)(5)	Effective Radiated Power	<7 Watts max. ERP	Radiated	Pass
90.542(a)(7)		<3 Watts max. ERP		Pass
2.1053 90.691(a) 90.543(e)(f)	Radiated Spurious Emissions	<43 + 10Log ₁₀ (P) dB, <-70dBW/MHz EIRP (Wideband), <-80dBW/MHz EIRP (Narrowband) In the 1559 – 1610 MHz band		Pass

Notes:

- The test procedure(s) in this report were performed in accordance as following.
 - ANSI C63.26-2015
 - ANSI/TIA-603-E-2016
 - KDB 971168 D01 v03r01
 - KDB 971168 D02 v02r02

4.1. Worst case orientation

- All modes of operation were investigated and the worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations in the test data.
- In the case of radiated spurious emissions, only the worst case bandwidth results were reported.
- Output power measurements were measured on all of modulation. All tests except output power was performed with below modulation with highest power.
 - LTE: QPSK, 16QAM
- However, the PAPR was evaluated for all wave forms and modulations during pre-test, then all bandwidth was performed for the modulations with the highest result.
 - LTE: QPSK, 16QAM
- All configurations have been performed (Stand-alone, Stand-alone with TA and Strap).
- The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z and all of the radiated tests have been performed with the accessories as below. It was determined that below orientation was worst case orientation for each band.

Band	Strap	With charger	Without charger		
		X-axis	X-axis	Y-axis	Z-axis
LTE B14	With strap	O	-	-	-
	Without strap	-	-	-	-
LTE B26 (Part 90)	With strap	O	-	-	-
	Without strap	-	-	-	-

7. Test Condition

- The measurement was performed with various configurations then worst results are reported.

1) Radiated measurement

Test Description	Mode	Condition		Test Channel
Effective Radiated power / Effective Isotropic power	LTE	QPSK, 16QAM	RB Size: 1	Low, Middle, High
Radiated Spurious Emissions	LTE	QPSK	RB Size: 1	Low, Middle, High

Band	Bandwidth (MHz)	RB size	RB offset
LTE B14	5, 10	1	Low, Middle, High
LTE B26 (Part 90)	1.4, 3, 5, 10, 15		

2) Conducted measurement

Test Description	Mode	Condition		Test Channel
OBW & 26 dB BW	LTE	QPSK, 16QAM	RB Size: Full	Low, Middle, High
PAPR	LTE	QPSK, 16QAM	RB Size: Full	Middle
Band Edge	LTE	QPSK	RB Size: 1, Full	Low, High
Spurious Emissions	LTE	QPSK	RB Size: 1	Low, Middle, High

Band	Bandwidth (MHz)	RB size	RB offset
LTE B14	5, 10	1	0, 24, 49
		Full	0
LTE B26 (Part 90)	1.4, 3, 5, 10, 15	1	0, 5, 14, 24, 49, 74
		Full	0

5. 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 indicated a 95 % level of confidence. The measurement data shown herein 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.

Parameter	Expanded uncertainty ($\pm$)	
Conducted RF power	0.9 dB	
Conducted spurious emissions	1.9 dB	
Radiated spurious emissions	Below 1 000 MHz	2.5 dB
	1 000 MHz ~ 18 000 MHz	2.5 dB
	Above 1 8000 MHz	2.6 dB

6. Measurement results explanation example

Frequency (MHz)	Factor(dB)	Frequency (MHz)	Factor(dB)
30	5.82	16 000	9.29
50	6.09	17 000	9.50
100	6.15	18 000	9.55
200	6.09	19 000	9.31
300	6.28	20 000	8.51
400	6.51	21 000	9.00
500	6.57	22 000	9.52
600	6.62	23 000	9.53
700	6.67	24 000	9.95
800	6.70	25 000	10.82
900	6.74	26 000	10.60
1 000	6.76	26 500	10.73
2 000	7.06	27 000	10.59
3 000	7.25	28 000	11.48
4 000	7.39	29 000	10.38
5 000	7.54	30 000	10.69
6 000	7.94	31 000	11.57
7 000	8.10	32 000	11.70
8 000	8.21	33 000	12.00
9 000	8.26	34 000	11.88
10 000	7.36	35 000	11.65
11 000	8.35	36 000	11.80
12 000	8.40	37 000	11.51
13 000	8.62	38 000	10.82
14 000	8.71	39 000	11.00
15 000	9.02	40 000	11.30

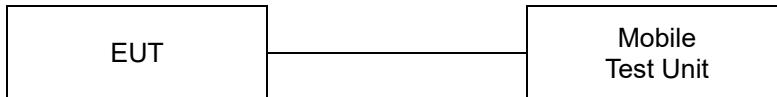
Note.

- Offset(dB) = RF cable loss(dB) + Divider (dB)

7. Test results

7.1. Conducted output power

Test setup



Limit

According to §90.635(b)

The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

Test procedure

971168 D01 v03r01 – Section 5.2

ANSI C63.26-2015 – Section 5.2.4.2

CFR 47 - Section §2.1046

Test settings

When an average power meter is used to perform RF output power measurements, the fundamental condition that measurement be performed only over durations of active transmissions at maximum output power level applies. Thus, an average power meter can always be used to perform the measurement when the EUT can be configured to transmit continuously.

If the EUT cannot be configured to transmit continuously (i.e., burst duty cycle < 98%), then the following options can be implemented to facilitate measurement of the average power with an average power meter:

- a) A gated average power meter can be used to perform the measurement if the gating parameters can be adjusted such that the power is measured only during active transmission bursts at maximum output power levels.
- b) A conventional average power meter with no signal gating capability can also be used if the measured burst duty cycle is constant (i.e., duty cycle variations are less than or equal to $\pm 2\%$) by performing the measurement over the on/off burst cycles and then correcting (increasing) the measured level by a factor equal to $[10\log (1/\text{duty cycle})]$. See 5.2.4.3.4 for guidance with respect to measuring the transmitter duty cycle.

See item r) of 4.1 for more information regarding power meter functional requirements and limitations, and consult the instrumentation-specific application literature for proper set-up and use.

Notes:

1. Offset(dB) = RF cable loss(dB)

Test results

Test Band	Bandwidth (MHz)	Test mode	RB size	RB offset	Maximum Average power (dBm)		
					Channel		
					Low	Middle	High
LTE B14	5	QPSK	1	0	22.63	22.53	22.49
			1	12	22.53	22.51	22.45
			1	24	22.45	22.47	22.41
			12	0	21.91	21.87	21.88
			12	7	21.85	21.89	21.84
			12	13	21.83	21.86	21.82
			25	0	21.87	21.89	21.84
		16QAM	1	0	21.62	21.82	21.77
			1	12	21.52	21.77	21.71
			1	24	21.49	21.74	21.68
			12	0	20.93	20.88	20.87
			12	7	20.84	20.83	20.83
			12	13	20.85	20.83	20.84
			25	0	20.83	20.86	20.85
	10	QPSK	1	0	-	22.69	-
			1	25	-	22.59	-
			1	49	-	22.45	-
			25	0	-	21.94	-
			25	12	-	21.87	-
			25	25	-	21.82	-
			50	0	-	21.91	-
		16QAM	1	0	-	22.18	-
			1	25	-	21.76	-
			1	49	-	21.95	-
			25	0	-	20.94	-
			25	12	-	20.89	-
			25	25	-	20.89	-
			50	0	-	20.95	-

Test Band	Bandwidth (MHz)	Test mode	RB size	RB offset	Maximum Average Power (dBm)		
					Channel		
					Low	Middle	High
LTE B26	1.4	QPSK	1	0	22.36	22.12	22.35
			1	3	22.28	22.09	22.32
			1	5	22.34	22.05	22.30
			3	0	22.77	21.34	21.69
			3	1	22.76	21.43	21.65
			3	3	22.73	21.45	21.59
			6	0	21.78	21.56	21.65
		16QAM	1	0	21.54	21.44	21.81
			1	3	21.65	21.43	21.67
			1	5	21.60	21.34	21.67
			3	0	21.78	20.55	20.71
			3	1	21.76	20.52	20.12
			3	3	21.73	20.44	20.25
			6	0	20.79	20.56	20.63
	3	QPSK	1	0	22.47	22.01	22.32
			1	8	22.44	21.99	22.29
			1	14	22.42	22.01	22.27
			8	0	21.81	22.47	21.66
			8	4	21.77	22.46	21.62
			8	7	21.71	22.47	21.56
			15	0	21.77	21.42	21.62
		16QAM	1	0	21.93	21.39	21.78
			1	8	21.79	21.29	21.64
			1	14	21.79	21.35	21.64
			8	0	20.83	21.42	20.68
			8	4	20.24	21.32	20.09
			8	7	20.37	21.35	20.22
			15	0	20.75	20.41	20.60
	5	QPSK	1	0	22.29	22.28	22.44
			1	12	22.25	22.31	22.41
			1	24	22.18	22.25	22.39
			12	0	21.74	21.65	21.78
			12	7	21.66	21.59	21.74
			12	13	21.65	21.55	21.68
			25	0	21.74	21.68	21.74
		16QAM	1	0	21.47	21.59	21.90
			1	12	21.37	21.55	21.76
			1	24	21.31	21.43	21.76
			12	0	20.73	20.82	20.80
			12	7	20.72	20.81	20.21
			12	13	20.68	20.50	20.34
			25	0	20.74	20.72	20.72

Test Band	Bandwidth (MHz)	Test mode	RB size	RB offset	Maximum Average Power (dBm)		
					Channel		
					Low	Middle	High
LTE B26	10	QPSK	1	0	-	22.32	-
			1	25	-	22.21	-
			1	49	-	22.08	-
			25	0	-	21.62	-
			25	12	-	21.55	-
			25	25	-	21.51	-
			50	0	-	21.56	-
		16QAM	1	0	-	21.72	-
			1	25	-	21.52	-
			1	49	-	21.47	-
			25	0	-	20.63	-
			25	12	-	20.56	-
			25	25	-	20.50	-
	15	QPSK	50	0	-	20.55	-
			1	0	-	22.52	-
			1	36	-	22.20	-
			1	74	-	22.08	-
			36	0	-	21.65	-
			36	18	-	21.55	-
		16QAM	36	37	-	21.49	-
			75	0	-	21.57	-
			1	0	-	21.79	-
			1	36	-	21.57	-
			1	74	-	21.37	-
			36	0	-	20.62	-
			36	18	-	20.53	-
			36	37	-	20.47	-
			75	0	-	20.58	-

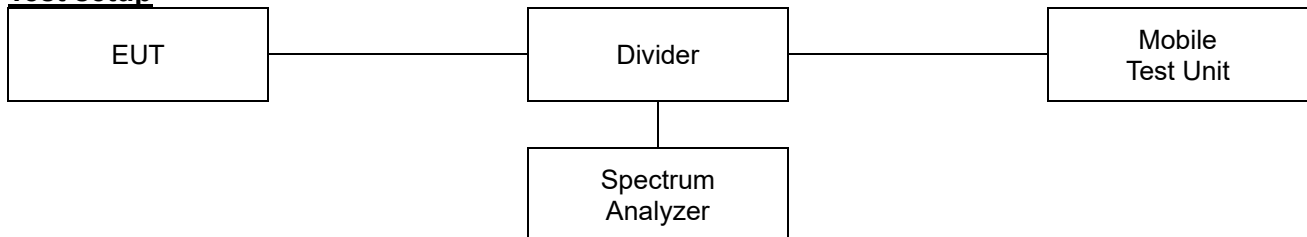
Straddle channel

Test Band	Bandwidth (MHz)	Test mode	RB size	RB offset	Maximum Average Power (dBm)
LTE B26	1.4	QPSK	1	0	22.16
			1	3	22.13
			1	5	21.99
			3	0	21.41
			3	1	21.38
			3	3	21.40
			6	0	21.41
		16QAM	1	0	21.59
			1	3	21.59
			1	5	21.55
			3	0	20.31
			3	1	20.27
			3	3	20.29
			6	0	20.42
	3	QPSK	1	0	22.15
			1	8	22.12
			1	14	21.98
			8	0	21.40
			8	4	21.37
			8	7	21.39
			15	0	21.40
		16QAM	1	0	21.58
			1	8	21.58
			1	14	21.54
			8	0	20.30
			8	4	20.26
			8	7	20.28
			15	0	20.41
	5	QPSK	1	0	22.12
			1	12	22.09
			1	24	21.95
			12	0	21.37
			12	7	21.34
			12	13	21.36
			25	0	21.37
		16QAM	1	0	21.55
			1	12	21.55
			1	24	21.51
			12	0	20.27
			12	7	20.23
			12	13	20.25
			25	0	20.38
	10	QPSK	1	0	22.35
			1	25	22.42
			1	49	22.40
			25	0	21.79
			25	12	21.75
			25	25	21.69
			50	0	21.75
		16QAM	1	0	21.91
			1	25	21.77
			1	49	21.77
			25	0	20.81
			25	12	20.22
			25	25	20.35
			50	0	20.73

Test Band	Bandwidth (MHz)	Test mode	RB size	RB offset	Maximum Average Power (dBm)
LTE B26	15	QPSK	1	0	22.42
			1	36	22.34
			1	74	22.32
			36	0	21.71
			36	18	21.67
			36	37	21.61
			75	0	21.67
		16QAM	1	0	21.83
			1	36	21.69
			1	74	21.69
			36	0	20.73
			36	18	20.14
			36	37	20.27
			75	0	20.65

7.2. 99% Occupied Bandwidth & 26 dB Bandwidth

Test setup



Limit

According to §2.1049

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.

Test procedure

971168 D01 v03r01 – Section 4.2 and 4.3

ANSI C63.26-2015 – Section 5.4.3 and 5.4.4

Test settings

◆ 26dB Bandwidth

- c) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.
- d) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set $\geq 3 \times \text{RBW}$.
- e) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
- d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target “-X dB” requirement, i.e., if the requirement calls for measuring the -26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.
- e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.
- f) Determine the reference value by either of the following:
 - 1) 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).
 - 2) Set the EUT to transmit an unmodulated carrier. Set the spectrum analyzer marker to the level of the carrier.
- g) Determine the “-X dB amplitude” as equal to (Reference Value - X). Alternatively, this calculation can be performed on the spectrum analyzer using the delta-marker measurement function.
- h) If the reference value was determined using an unmodulated carrier, turn the EUT modulation on, then either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise the trace from step f) shall be used

for step i).

- i) 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 amplitude” determined in step f). If a marker is below this “-X dB amplitude” value it should be as close as possible to this value. The OBW is the positive frequency difference between the two markers.
- j) The spectral envelope can cross the “-X dB amplitude” at multiple points. The lowest or highest frequency shall be selected as the frequencies that are the farthest away from the center frequency at which the spectral envelope crosses the “-X dB amplitude.”
- j) The OBW shall be reported by providing plot(s) of the measuring instrument display, to include markers depicting the relevant frequency and amplitude information (e.g., marker table). The frequency and amplitude axis and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

◆ 99% Occupied Bandwidth

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of $1.5 \times \text{OBW}$ is sufficient).
- b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set $\geq 3 \times \text{RBW}$.
- c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
- d) Set the detection mode to peak, and the trace mode to max-hold.
- e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.
- f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

Notes:

1. The EUT was setup to maximum output power with all bandwidth and modulation.

Test results

Test Band	Bandwidth (MHz)	Channel	Test mode	26dB bandwidth (MHz)	99 % bandwidth (MHz)
LTE B14	5	Low	QPSK	5.47	4.55
			16QAM	5.48	4.58
		Middle	QPSK	5.38	4.52
			16QAM	5.37	4.55
		High	QPSK	5.35	4.55
			16QAM	5.27	4.55
	10	Middle	QPSK	10.17	9.02
			16QAM	10.32	9.04

Test Band	Bandwidth (MHz)	Channel	Test mode	26dB bandwidth (MHz)	99 % bandwidth (MHz)
LTE B26	1.4	Low	QPSK	1.37	1.10
			16QAM	1.36	1.10
		Middle	QPSK	1.33	1.10
			16QAM	1.34	1.11
		High	QPSK	1.36	1.09
			16QAM	1.34	1.10
	3	Low	QPSK	3.10	2.72
			16QAM	3.12	2.72
		Middle	QPSK	3.15	2.71
			16QAM	3.15	2.71
		High	QPSK	3.10	2.70
			16QAM	3.13	2.71
	5	Low	QPSK	5.47	4.56
			16QAM	5.41	4.55
		Middle	QPSK	5.45	4.55
			16QAM	5.43	4.55
		High	QPSK	5.45	4.55
			16QAM	5.40	4.53
	10	Middle	QPSK	10.37	9.04
			16QAM	10.42	9.07
	15	Middle	QPSK	15.29	13.45
			16QAM	15.06	13.49

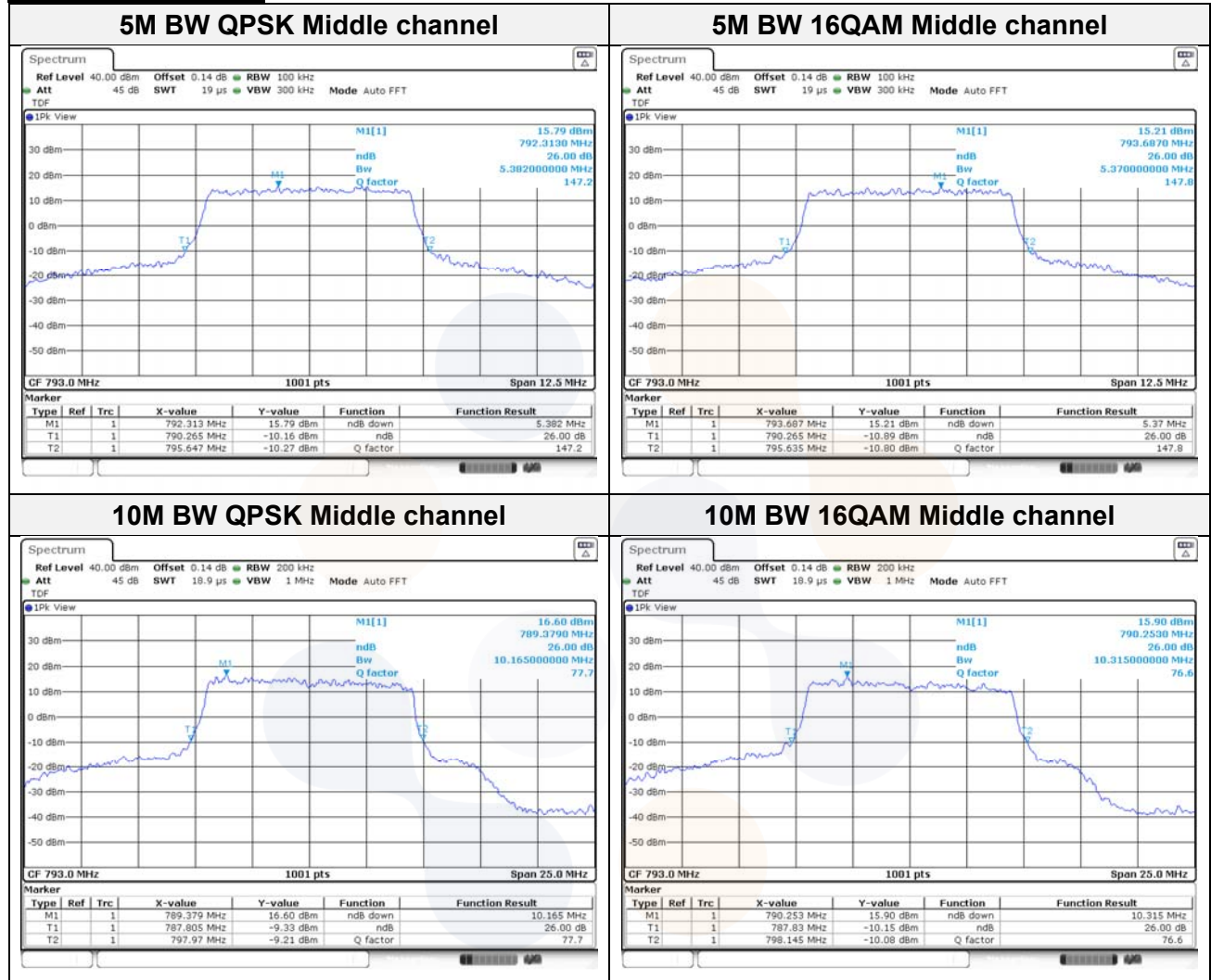
Straddle channel

Test Band	Bandwidth (MHz)	Channel	Test mode	26dB bandwidth (MHz)	99 % bandwidth (MHz)
LTE B26	1.4	Middle	QPSK	1.33	1.11
			16QAM	1.36	1.10
	3	Middle	QPSK	3.13	2.71
			16QAM	3.12	2.73
	5	Middle	QPSK	5.45	4.55
			16QAM	5.46	4.53
	10	Middle	QPSK	10.32	9.04
			16QAM	10.34	9.04
	15	Middle	QPSK	15.14	13.49
			16QAM	15.25	13.45

In order to simplify the report, only Middle channel test plots are attached

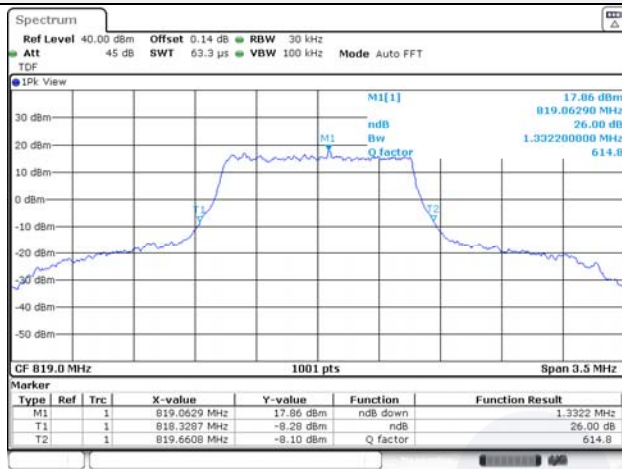
26dB Bandwidth

Test mode: LTE B14

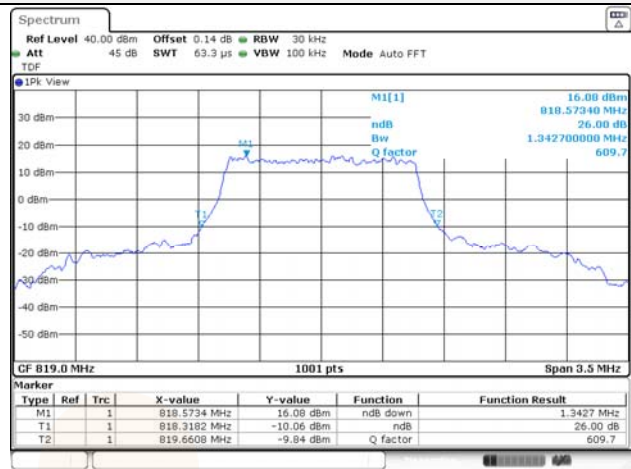


Test mode: LTE B26

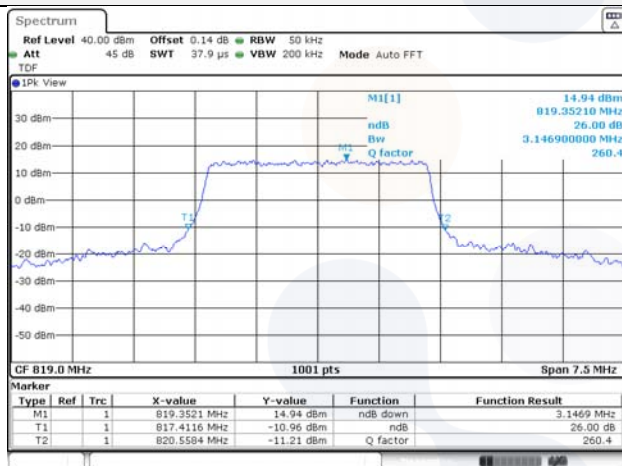
1.4M BW QPSK Middle channel



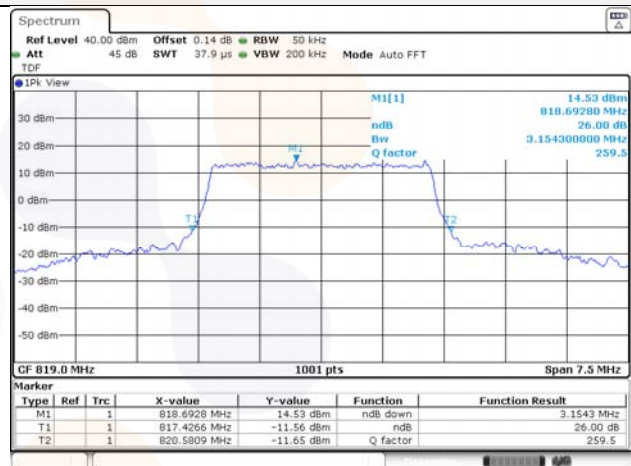
1.4M BW 16QAM Middle channel



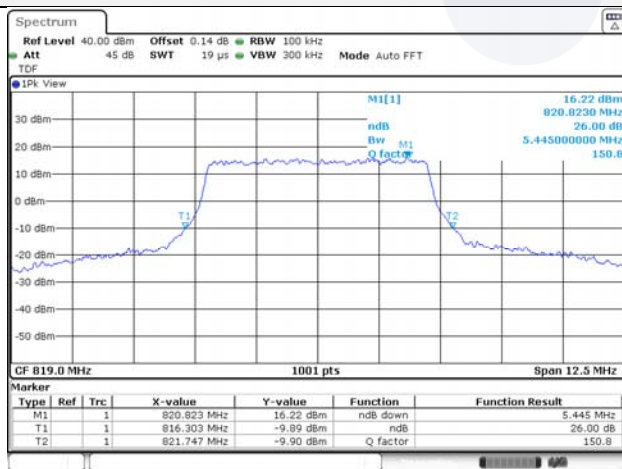
3M BW QPSK Middle channel



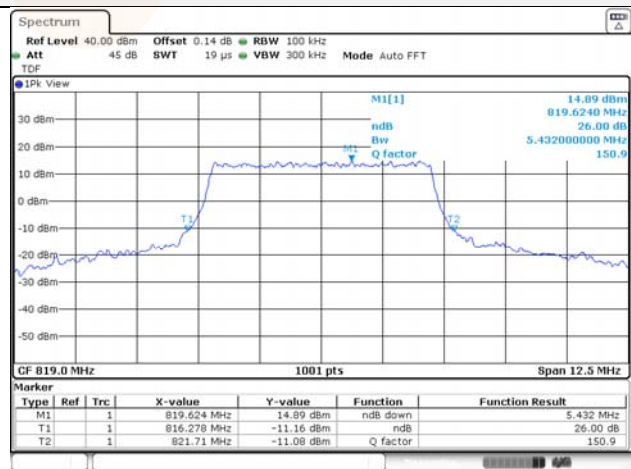
3M BW 16QAM Middle channel



5M BW QPSK Middle channel



5M BW 16QAM Middle channel



10M BW QPSK Middle channel



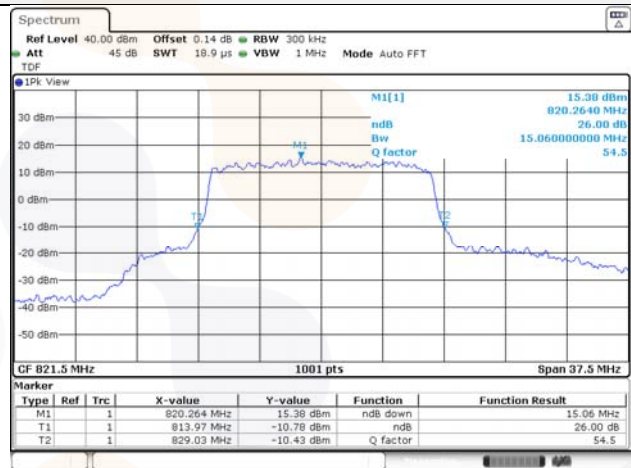
10M BW 16QAM Middle channel



15M BW QPSK Middle channel

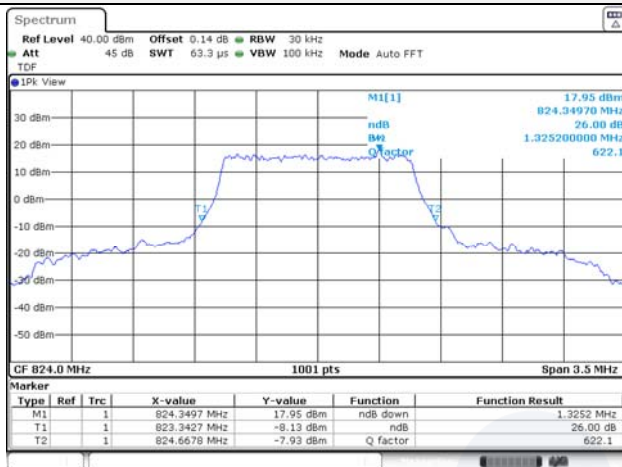


15M BW 16QAM Middle channel

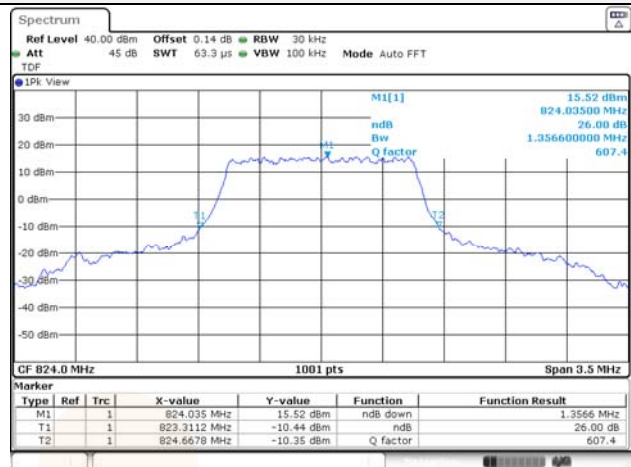


LTE B26 (Straddle channel)

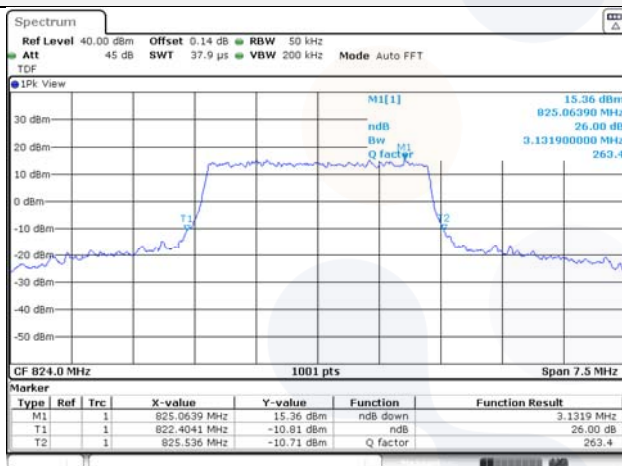
1.4M BW QPSK



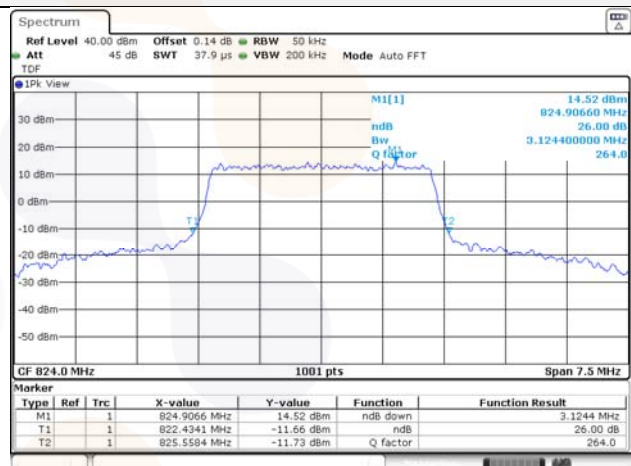
1.4M BW 16QAM



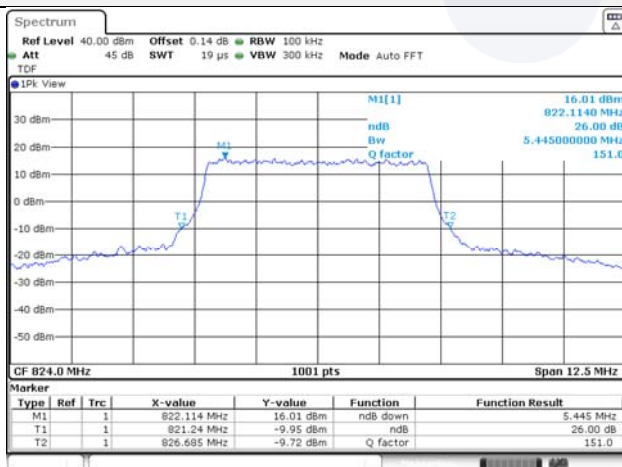
3M BW QPSK



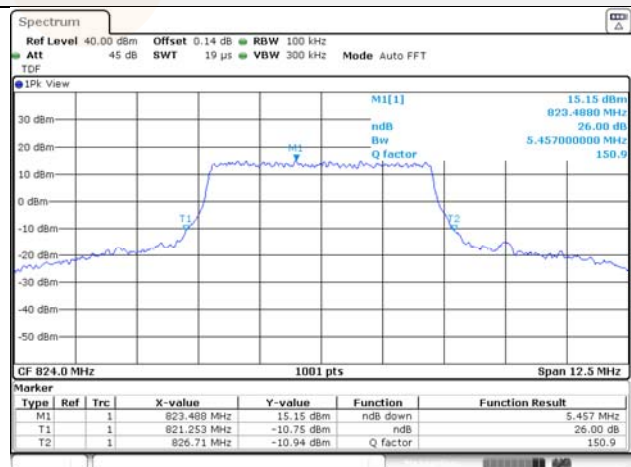
3M BW 16QAM



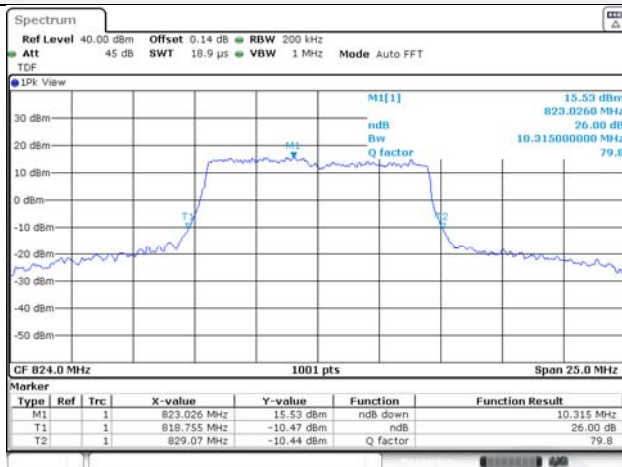
5M BW QPSK



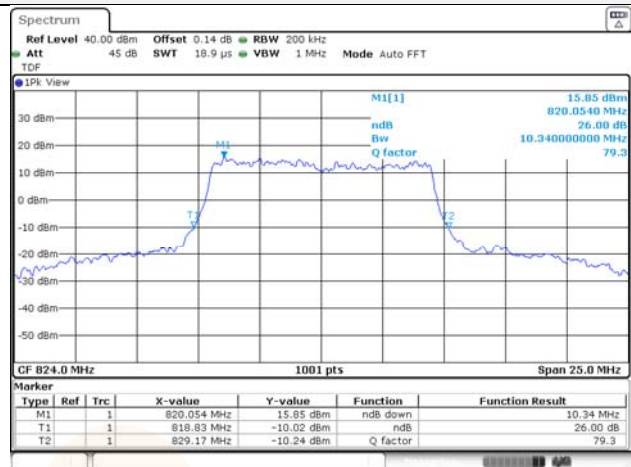
5M BW 16QAM



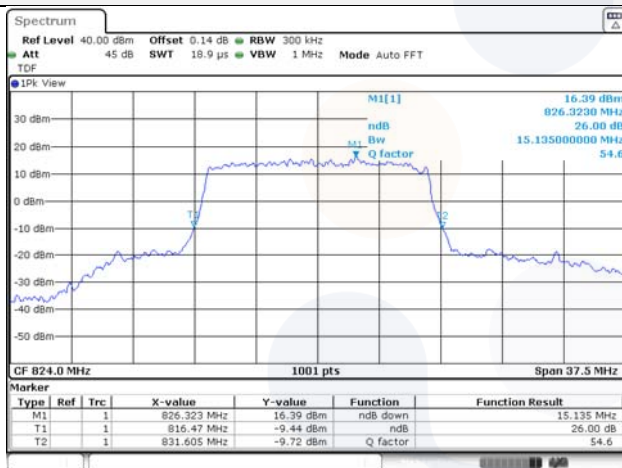
10M BW QPSK



10M BW 16QAM



15M BW QPSK

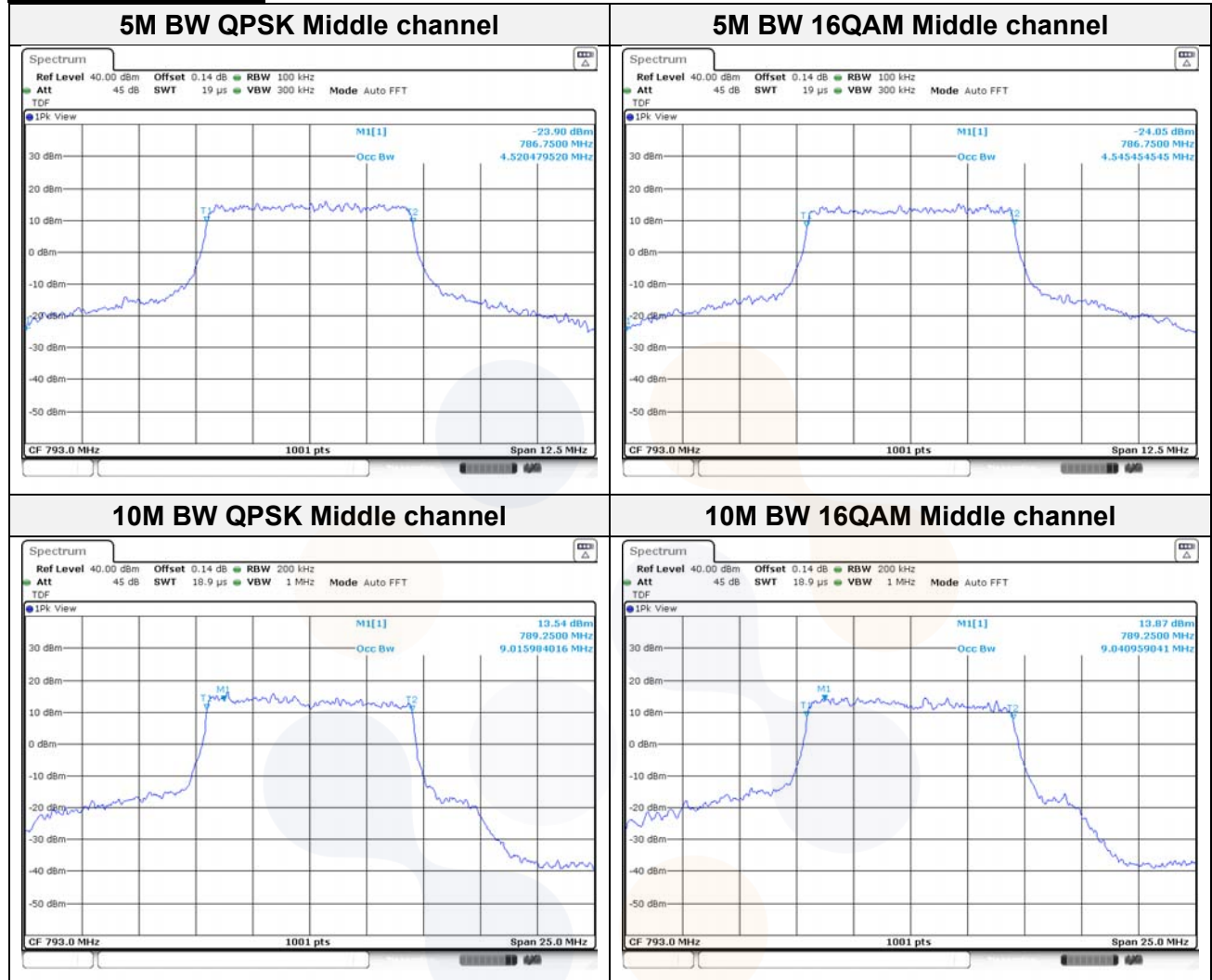


15M BW 16QAM



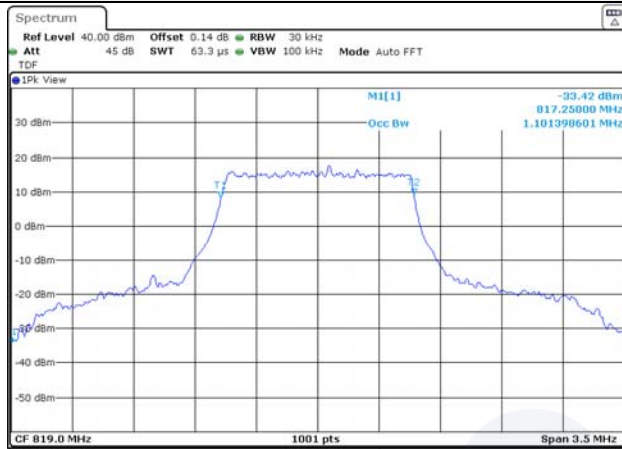
99% Occupied Bandwidth

Test mode: **LTE B14**

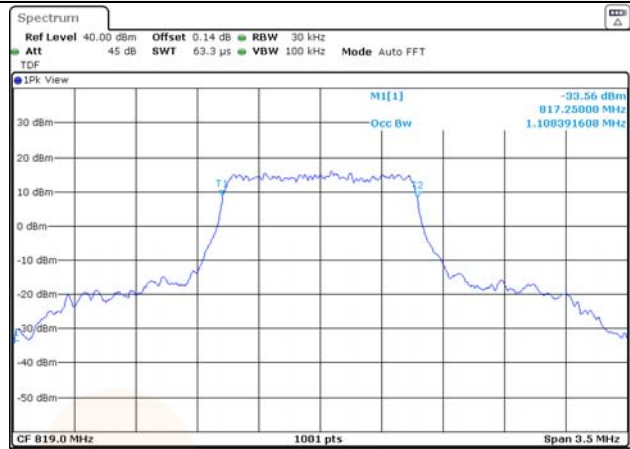


Test mode: LTE B26

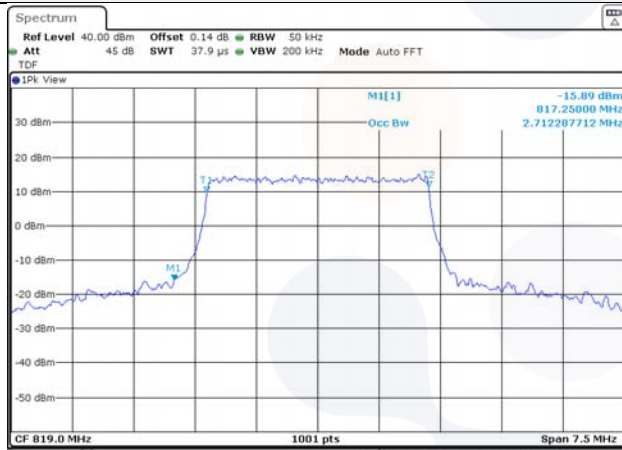
1.4M BW QPSK Middle channel



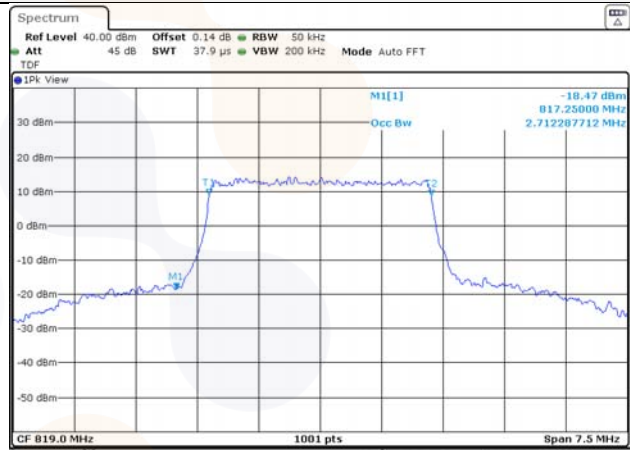
1.4M BW 16QAM Middle channel



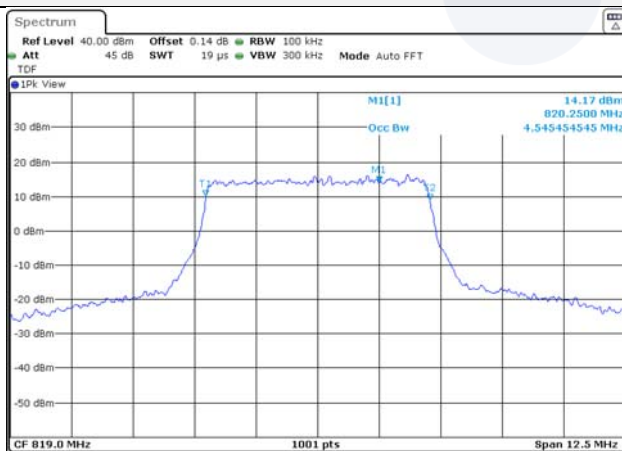
3M BW QPSK Middle channel



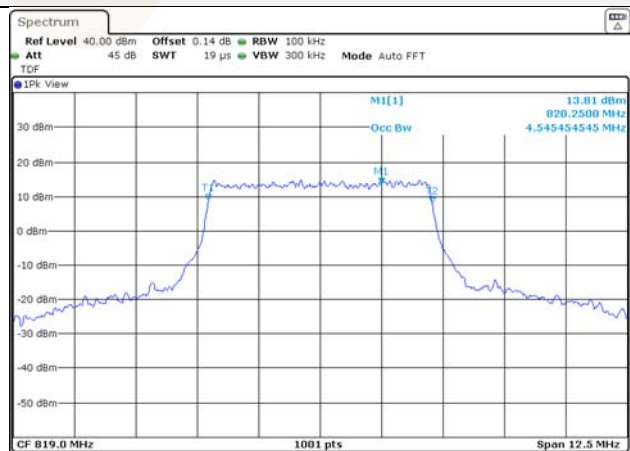
3M BW 16QAM Middle channel



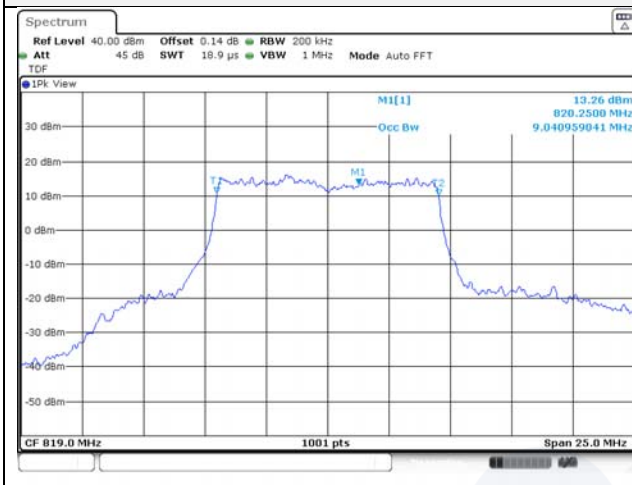
5M BW QPSK Middle channel



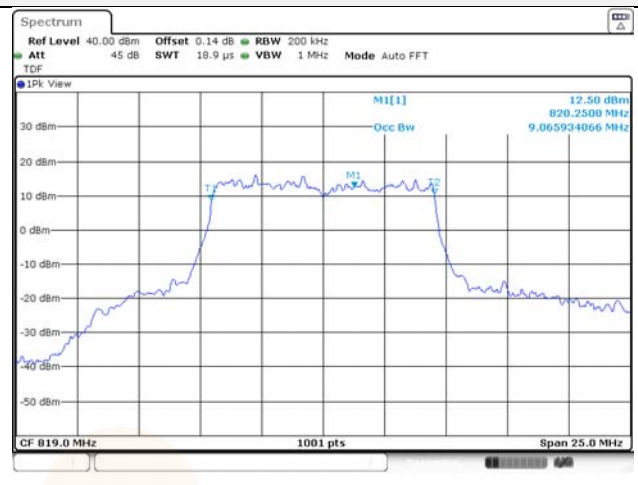
5M BW 16QAM Middle channel



10M BW QPSK Middle channel



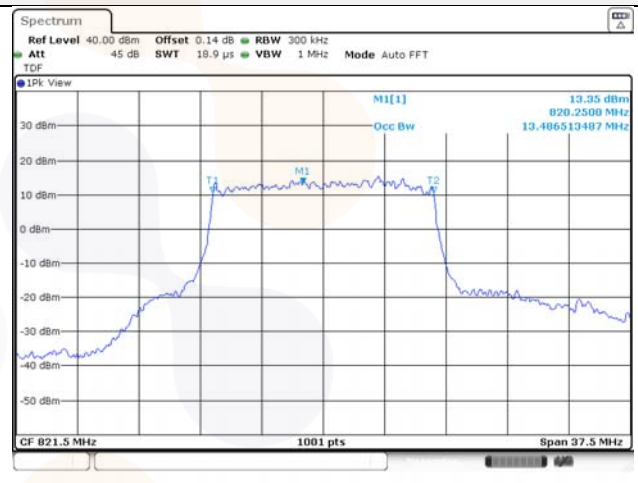
10M BW 16QAM Middle channel



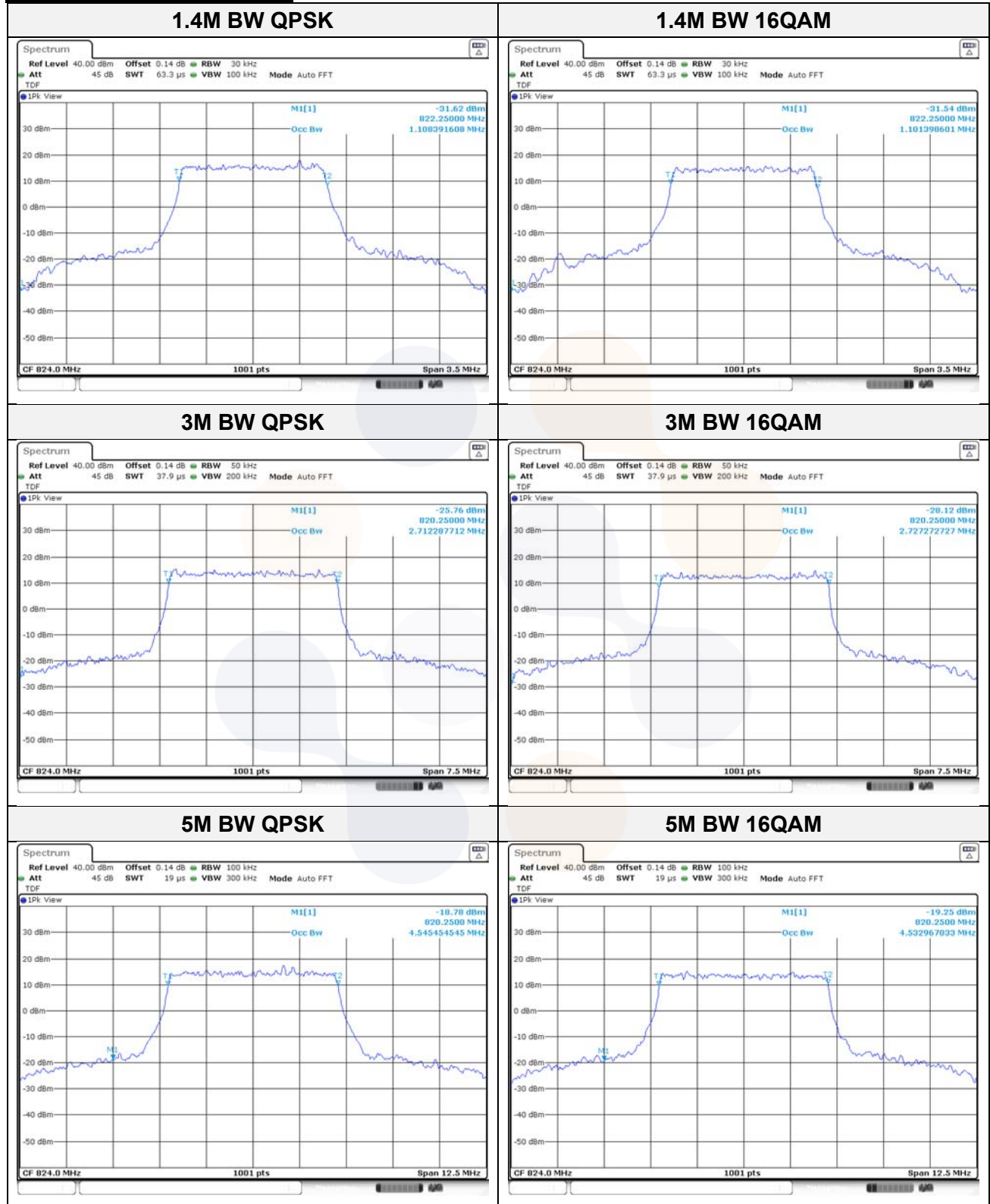
15M BW QPSK Middle channel



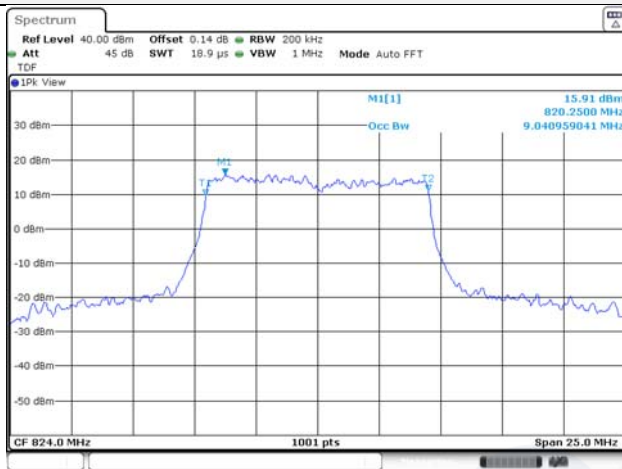
15M BW 16QAM Middle channel



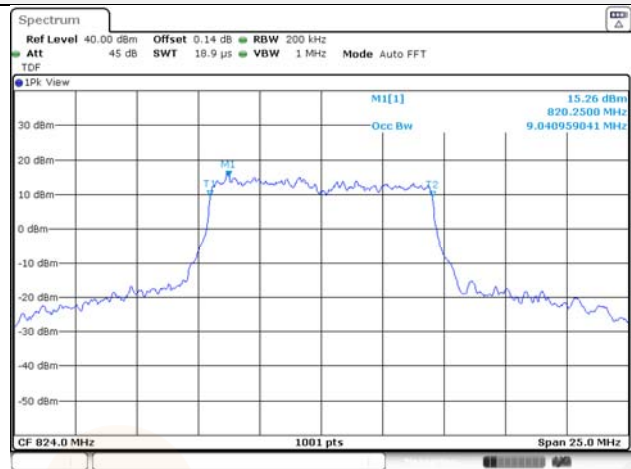
LTE B26 (Straddle channel)



10M BW QPSK



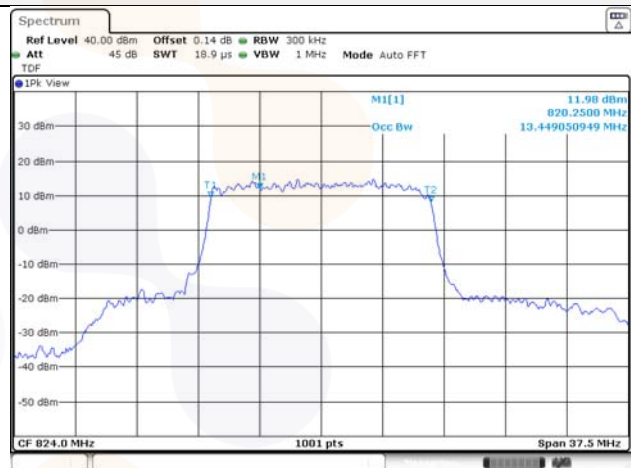
10M BW 16QAM



15M BW QPSK

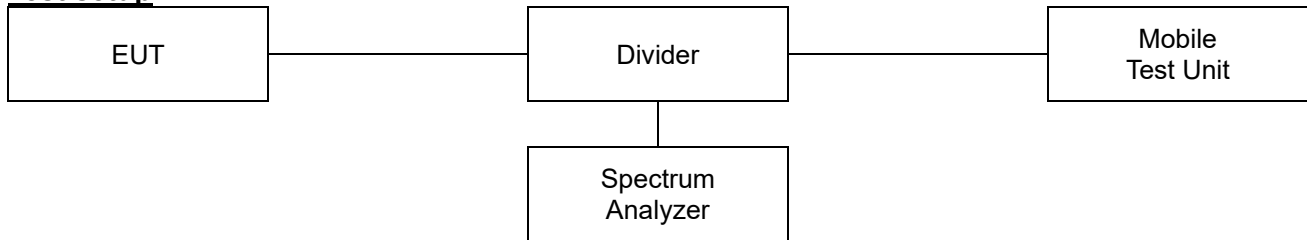


15M BW 16QAM



7.3. Band Edge Emissions at Antenna Terminal

Test setup



Limit

According to §90.543(e),

For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than $76 + 10\log(P)$ dB in a 6.25 kHz band segment, for base and fixed stations.
- (2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than $65 + 10\log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations.
- (3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least $43 + 10\log(P)$ dB.
- (4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.
- (5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

According to §90.691(a),

Out-of-band emission requirement shall apply only to the "outer" channels Included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

- (1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10\log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz where f is greater than 12.5 kHz.
- (2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10\log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

Test procedure

971168 D01 v03r01 - Section 6

971168 D02 v02r02 – Section VIII

ANSI C63.26-2015 – Section 5.7

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) Set the RBW > 1% of the emission bandwidth.
- 4) Set the VBW $\geq 3 \times$ RBW.
- 5) Set the number of sweep points $\geq 2 \times$ Span/RBW
- 6) Detector = RMS
- 7) Trace mode = trace average
- 8) Sweep time should be auto for peak detection. For RMS detection the sweep time should be set as follows:
 - If the device can be configured to transmit continuously (duty cycle $\geq 98\%$), set the (sweep time) > (number of points in sweep) $\times$ (symbol period) (e.g., by a factor of 10 $\times$ symbol period $\times$ number of points) Increasing the sweep time (i.e., slowing the sweep speed) will allow for averaging over multiple symbols.
 - If the device cannot transmit continuously (duty cycle < 98%), a gated sweep shall be used when possible (i.e., gate triggered such that the analyzer only sweeps when the device is transmitting at full power), set the sweep time > (number of points in sweep) $\times$ (symbol period) but the sweep time shall always be maintained at a value that is less than or equal to the minimum transmission time
 - If the device cannot be configured to transmit continuously (duty cycle > 98%), and a free-running sweep must be used, set the sweep time so that the averaging is performed over multiple on/off cycles by setting the sweep time > (number of points in sweep) $\times$ (transmitter period) (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by $[10 \log (1/\text{duty cycle})]$. This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation $\leq \pm 2\%$).
 - If the device cannot be configured to transmit continuously and a free-running sweep must be used, and if the transmissions exhibit a non-constant duty cycle (duty cycle variations > $\pm 2\%$), set the sweep time so that the averaging is performed over the on-period by setting the sweep time > (symbol period) $\times$ (number of points), while also maintaining the sweep time < (transmitter on-time). The trace mode shall be set to max hold, since not every display point will be averaged only over just the on-time. Thus, multiple sweeps (e.g., 100) in maximum hold are necessary to ensure that the maximum power is measured.
- 9) Allow trace to fully stabilize.