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TEST REPORT

KCTL Inc.
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Suwon-si, Gyeonggi-do, 16677, Korea
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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 : 2021-04-13

2. Use of Report : Certification

3. Name of Product / Model : Mobile Phone / SM-M225FV/DS

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

5. FCC ID : A3LSMM225FV

6. Date of Test : 2021-05-11 to 2021-06-10

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

8. Test method used : FCC Part 2
FCC Part 90 subpart S

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

Affirmation	Tested by Name : Taeyoung Kim (Signature)	Technical Manager Name : Seungyong Kim (Signature)

2021-06-14

KCTL Inc.

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 KCTL Inc.

REPORT REVISION HISTORY

Date	Revision	Page No
2021-06-14	Originally issued	-

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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. Frequency/channel operations 5
3. Maximum ERP/EIRP power 7
4. Summary of tests 8
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 18
7.3. Spurious Emissions at Antenna Terminal 33
7.4. Band Edge Emissions at Antenna Terminal 38
7.5. Frequency stability 50
7.6. Radiated Power (ERP/EIRP) 53
7.7. Radiated Spurious Emissions 57
8. Measurement equipment 61

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	:	Samsung Electronics Vietnam Co., Ltd.
Address	:	Yen Phong Industrial Zone 1, Yen Trung, Yen Phong, Bac Ninh Province, Vietnam
Laboratory	:	KCTL Inc.
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	:	Mobile Phone
Model	:	SM-M225FV/DS
Modulation technique	:	Bluetooth(BDR/EDR)_GFSK, π/4DQPSK, 8DPSK Bluetooth(BLE)_GFSK WIFI(802.11a/b/g/n/ac)_DSSS, OFDM LTE_QPSK, 16QAM, 64QAM WCDMA_QPSK GSM_GMSK, 8-PSK NFC_ASK
Number of channels	:	Bluetooth(BDR/EDR)_79 ch / Bluetooth(BLE)_40 ch 802.11b/g/n_HT20 : 13 ch UNII-1: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) UNII-2A: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) UNII-2C: 12 ch (20 ㎒), 6 ch (40 ㎒), 3 ch (80 ㎒) UNII-3: 5 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) NFC: 1 ch
Power source	:	DC 3.86 ㏸
Antenna specification	:	LTE/WCDMA/GSM_FPCB Antenna WIFI/Bluetooth(BDR/EDR/BLE)_FPCB Antenna NFC_FPCB Antenna

Antenna gain	:	WIFI/Bluetooth(BDR/EDR/BLE)_-4.00 dBi
		UNII-1 : -5.40 dBi
		UNII-2A : -5.80 dBi
		UNII-2C : -4.60 dBi
		UNII-3 : -4.90 dBi
Frequency range	:	Bluetooth(BDR/EDR/BLE)_2 402 ㎒ ~ 2 480 ㎒
		2 412 ㎒ ~ 2 472 ㎒ (802.11b/g/n_HT20)
		UNII-1: 5 180 ㎒ ~ 5 240 ㎒ (802.11a/n/ac_HT20/VHT20)
		UNII-1: 5 190 ㎒ ~ 5 230 ㎒ (802.11n/ac_HT40/VHT40)
		UNII-1: 5 210 ㎒ (802.11ac_VHT80)
		UNII-2A: 5 260 ㎒ ~ 5 320 ㎒ (802.11a/n/ac_HT20/VHT20)
		UNII-2A: 5 270 ㎒ ~ 5 310 ㎒ (802.11n/ac_HT40/VHT40)
		UNII-2A: 5 290 ㎒ (802.11ac_VHT80)
		UNII-2C: 5 500 ㎒ ~ 5 720 ㎒ (802.11a/n/ac_HT20/VHT20)
		UNII-2C: 5 510 ㎒ ~ 5 710 ㎒ (802.11n/ac_HT40/VHT40)
		UNII-2C: 5 530 ㎒ ~ 5 690 ㎒ (802.11ac_VHT80)
		UNII-3: 5 745 ㎒ ~ 5 825 ㎒ (802.11a/n/ac_HT20/VHT20)
		UNII-3: 5 755 ㎒ ~ 5 795 ㎒ (802.11n/ac_HT40/VHT40)
		UNII-3: 5 775 ㎒ (802.11ac_VHT80)
		LTE Band 2_1 850.7 ㎒ ~ 1 909.3 ㎒
		LTE Band 4_1 710.7 ㎒ ~ 1 754.3 ㎒
		LTE Band 5_824.7 ㎒ ~ 848.3 ㎒
		LTE Band 12_699.7 ㎒ ~ 715.3 ㎒
		LTE Band 17_706.5 ㎒ ~ 713.5 ㎒
		LTE Band 26_824.7 ㎒ ~ 848.3 ㎒, 814.7 ㎒ ~ 823.3 ㎒
		LTE Band 41_2 498.5 ㎒ ~ 2 687.5 ㎒
		LTE Band 66_1 710.7 ㎒ ~ 1 779.3 ㎒
		GSM 850_824.2 ㎒ ~ 848.8 ㎒
		GSM 1900_1 850.2 ㎒ ~ 1 909.8 ㎒
		WCDMA 850_826.4 ㎒ ~ 846.6 ㎒
		WCDMA 1700_1 712.4 ㎒ ~ 1 752.6 ㎒
		WCDMA 1900_1 852.4 ㎒ ~ 1 907.6 ㎒
		NFC_13.56 ㎒
Software version	:	M225F.001
Hardware version	:	REV1.0
Test device serial No.	:	Conducted(R38R401M96J, R38R401JDWT)
		Radiated(R38R401K2XZ, R38R401MB9L)
Operation temperature	:	-30 ℃ ~ 50 ℃

2.1. Frequency/channel operations

This device contains the following capabilities:
WiFi (802.11a/b/g/n/ac), Bluetooth (BDR/EDR/BLE), NFC
LTE Band 2, LTE Band 4, LTE Band 5, LTE Band 12, LTE Band 17, LTE Band 26, LTE Band 41, LTE Band 66, GSM 850, GSM 1900, WCDMA 850, WCDMA 1700, WCDMA 1900

LTE Band 26

Ch.	Frequency (㎒)
26697	814.7
26783	823.3
26790	824.0

Table 2.2.1. 1.4M BW

Ch.	Frequency (㎒)
26705	815.5
26775	822.5
26790	824.0

Table 2.2.2. 3M BW

Ch.	Frequency (㎒)
26715	816.5
26765	821.5
26790	824.0

Table 2.2.3. 5M BW

Ch.	Frequency (㎒)
26740	819.0
26790	824.0

Table 2.2.4. 10M BW

Ch.	Frequency (㎒)
26765	821.5
26790	824.0

Table 2.2.5. 15M BW

3. Maximum ERP/EIRP power

LTE Band 26 (Part 90)

Mode	Tx frequency (MHz)	Emission designator	Conducted	
			Max. power (dBm)	Max. power (W)
LTE Band 26	814.7 ~ 823.3	1M10G7D	24.05	0.254
		1M10W7D	23.12	0.205
	815.5 ~ 822.5	2M69G7D	23.90	0.245
		2M69W7D	23.42	0.220
	816.5 ~ 821.5	4M51G7D	24.15	0.260
		4M51W7D	23.38	0.218
	819.0	9M02G7D	24.15	0.260
		8M97W7D	23.48	0.223
	821.5	13M5G7D	23.90	0.245
		13M5W7D	23.43	0.220
Straddle channel	824.0	1M10G7D	24.11	0.258
		1M09W7D	23.22	0.210
		2M69G7D	24.04	0.254
		2M68W7D	23.15	0.207
		4M51G7D	23.98	0.250
		4M48W7D	23.22	0.210
		9M02G7D	24.09	0.256
		8M97W7D	23.18	0.208
		13M5G7D	23.82	0.241
		13M5W7D	22.84	0.192

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 90.691(a)	Band Edge Emissions at Antenna Terminal	<43 + 10Log$_{10}$(P) dB, <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
2.1055 90.213	Frequency stability	< 2.5 ppm		Pass
90.635(b)	Effective Radiated Power	< 100 Watts max. ERP	Radiated	Pass
2.1053 90.691(a)	Radiated Spurious Emissions	<43 + 10Log$_{10}$(P) dB		Pass

Notes:

1. 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

4.1. Worst case orientation

1. 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.
2. All final radiated testing was performed with the EUT in worst case orientation.
3. For Band 26 (Part 90), the fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that **Y** orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in **Y** orientation.
4. All the radiated tests have been performed several case.
   (Stand-alone, with accessories (TA etc.))
   Worst case: Stand-alone

Test condition	LTE Band	Modulation	Bandwidth (MHz)	RB size	RB offset
Radiated	B26 (Part90)	QPSK	1.4	1	0, 3, 5
Conducted		QPSK, 16QAM	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 of 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 (±)	
Conducted RF power	0.9 dB	
Conducted spurious emissions	1.6 dB	
Radiated spurious emissions	Below 1 000 MHz	4.3 dB
	1 000 MHz ~ 18 000 MHz	3.8 dB
	Above 1 8000 MHz	3.8 dB

6. Measurement results explanation example

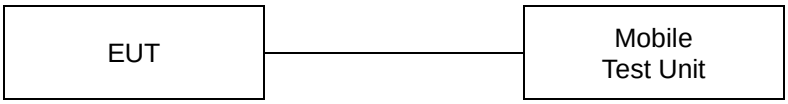
Frequency (㎒)	Factor(㏈)	Frequency (㎒)	Factor(㏈)
30	5.95	11 000	7.27
50	5.97	12 000	7.14
100	5.99	13 000	7.59
200	6.03	14 000	8.02
300	6.06	15 000	8.17
400	6.09	16 000	8.06
500	6.13	17 000	8.14
600	6.15	18 000	8.13
700	6.19	19 000	9.12
800	6.22	20 000	8.71
900	6.22	21 000	8.80
1 000	6.26	22 000	8.72
2 000	7.59	23 000	8.22
3 000	6.64	24 000	8.96
4 000	6.68	25 000	9.46
5 000	6.64	26 000	8.48
6 000	6.65	26 500	8.25
7 000	6.92	27 000	7.82
8 000	7.27	28 000	8.49
9 000	7.14	29 000	9.88
10 000	7.21	30 000	10.60

Note.
Offset(㏈) = RF cable loss(㏈) + Divider (㏈)

7. Test results

7.1. Conducted output power

Test setup



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 ± 2%) by performing the measurement over the on/off burst cycles and then correcting (increasing) the measured level by a factor equal to [10log (1/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:

Offset(dB) = RF cable loss(dB)

Test results

Test Band	Bandwidth (㎒)	Test mode	RB size	RB offset	MPR	Maximum power Frequency (㎒)		
						Low	Middle	High
LTE Band 26	1.4	QPSK	1	0	0	23.84	-	23.89
			1	3	0	23.98	-	24.05
			1	5	0	23.82	-	23.88
			3	0	0	23.84	-	23.91
			3	1	0	23.87	-	24.03
			3	3	0	23.83	-	23.85
			6	0	1	22.80	-	22.87
		16QAM	1	0	1	22.75	-	22.95
			1	3	1	22.83	-	23.12
			1	5	1	22.76	-	22.93
			3	0	1	22.98	-	22.86
			3	1	1	23.09	-	22.86
			3	3	1	22.95	-	22.88
			6	0	2	21.82	-	21.87
		64QAM	1	0	2	21.94	-	22.02
			1	3	2	22.02	-	22.06
			1	5	2	21.96	-	21.98
			3	0	2	21.88	-	21.96
			3	1	2	21.93	-	21.97
			3	3	2	21.90	-	21.95
			6	0	3	20.75	-	20.81
	3	QPSK	1	0	0	23.82	-	23.79
			1	8	0	23.90	-	23.78
			1	14	0	23.86	-	23.75
			8	0	1	22.84	-	22.76
			8	4	1	22.86	-	22.76
			8	7	1	22.87	-	22.70
			15	0	1	22.88	-	22.77
		16QAM	1	0	1	23.40	-	22.91
			1	8	1	23.40	-	22.82
			1	14	1	23.42	-	22.90
			8	0	2	22.04	-	21.72
			8	4	2	22.05	-	21.81
			8	7	2	22.07	-	21.71
			15	0	2	21.86	-	21.80
		64QAM	1	0	2	21.93	-	21.91
			1	8	2	21.94	-	21.86
			1	14	2	22.05	-	21.88
			8	0	3	20.78	-	20.69
			8	4	3	20.84	-	20.72
			8	7	3	20.81	-	20.61
			15	0	3	20.77	-	20.68

Test Band	Bandwidth (㎒)	Test mode	RB size	RB offset	MPR	Maximum power Frequency (㎒)		
						Low	Middle	High
LTE Band 26	5	QPSK	1	0	0	23.90	-	23.86
			1	12	0	24.15	-	24.06
			1	24	0	23.93	-	23.82
			12	0	1	22.81	-	22.93
			12	7	1	22.86	-	22.97
			12	13	1	22.83	-	22.83
			25	0	1	22.90	-	22.92
		16QAM	1	0	1	22.68	-	23.12
			1	12	1	22.95	-	23.38
			1	24	1	22.74	-	23.11
			12	0	2	21.90	-	21.94
			12	7	2	21.94	-	21.96
			12	13	2	21.87	-	21.87
			25	0	2	21.94	-	21.88
		64QAM	1	0	2	21.96	-	21.97
			1	12	2	22.20	-	22.12
			1	24	2	21.88	-	21.95
			12	0	3	20.74	-	20.78
			12	7	3	20.86	-	20.87
			12	13	3	20.78	-	20.80
			25	0	3	20.82	-	20.81
	10	QPSK	1	0	0	-	23.87	-
			1	25	0	-	24.15	-
			1	49	0	-	23.81	-
			25	0	1	-	22.98	-
			25	12	1	-	22.91	-
			25	25	1	-	22.89	-
			50	0	1	-	22.96	-
		16QAM	1	0	1	-	23.39	-
			1	25	1	-	23.48	-
			1	49	1	-	23.40	-
			25	0	2	-	22.10	-
			25	12	2	-	22.08	-
			25	25	2	-	22.01	-
			50	0	2	-	22.02	-
		64QAM	1	0	2	-	22.00	-
			1	25	2	-	22.19	-
			1	49	2	-	22.03	-
			25	0	3	-	20.93	-
			25	12	3	-	20.90	-
			25	25	3	-	20.89	-
			50	0	3	-	20.89	-

Test Band	Bandwidth (㎒)	Test mode	RB size	RB offset	MPR	Maximum power Frequency (㎒)		
						Low	Middle	High
LTE Band 26	15	QPSK	1	0	0	-	23.85	-
			1	36	0	-	23.90	-
			1	74	0	-	23.82	-
			36	0	1	-	23.01	-
			36	18	1	-	22.90	-
			36	37	1	-	22.97	-
			75	0	1	-	22.98	-
		16QAM	1	0	1	-	23.35	-
			1	36	1	-	23.43	-
			1	74	1	-	23.40	-
			36	0	2	-	22.00	-
			36	18	2	-	22.02	-
			36	37	2	-	22.02	-
			75	0	2	-	21.99	-
		64QAM	1	0	2	-	21.98	-
			1	36	2	-	22.02	-
			1	74	2	-	21.97	-
			36	0	3	-	20.93	-
			36	18	3	-	20.96	-
			36	37	3	-	20.93	-
			75	0	3	-	20.89	-

Straddle channel

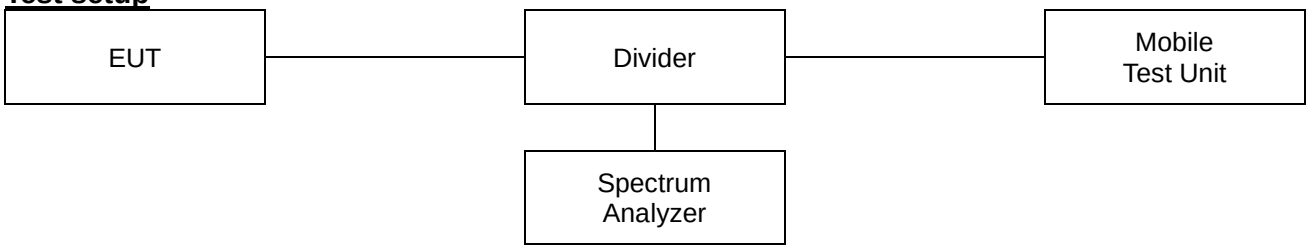
Test Band	Bandwidth (㎒)	Test mode	RB size	RB offset	MPR	Maximum power
LTE Band 26	1.4	QPSK	1	0	0	23.96
			1	3	0	24.11
			1	5	0	23.95
			3	0	0	23.97
			3	1	0	24.08
			3	3	0	23.91
			6	0	1	22.95
		16QAM	1	0	1	23.00
			1	3	1	23.22
			1	5	1	23.01
			3	0	1	22.92
			3	1	1	22.91
			3	3	1	22.90
			6	0	2	21.94
		64QAM	1	0	2	22.07
			1	3	2	22.08
			1	5	2	22.04
			3	0	2	22.03
			3	1	2	22.03
			3	3	2	22.01
			6	0	3	20.83
	3	QPSK	1	0	0	24.02
			1	8	0	24.04
			1	14	0	23.99
			8	0	1	23.03
			8	4	1	23.05
			8	7	1	22.98
			15	0	1	22.98
		16QAM	1	0	1	23.15
			1	8	1	23.07
			1	14	1	23.14
			8	0	2	21.99
			8	4	2	22.06
			8	7	2	21.97
			15	0	2	22.05
		64QAM	1	0	2	22.10
			1	8	2	22.07
			1	14	2	22.08
			8	0	3	20.96
			8	4	3	20.92
			8	7	3	20.87
			15	0	3	20.97

Test Band	Bandwidth (㎒)	Test mode	RB size	RB offset	MPR	Maximum power
LTE Band 26	5	QPSK	1	0	0	23.77
			1	12	0	23.98
			1	24	0	23.77
			12	0	1	22.83
			12	7	1	22.83
			12	13	1	22.75
			25	0	1	22.82
		16QAM	1	0	1	23.00
			1	12	1	23.22
			1	24	1	22.99
			12	0	2	21.81
			12	7	2	21.86
			12	13	2	21.76
			25	0	2	21.78
		64QAM	1	0	2	21.86
			1	12	2	22.08
			1	24	2	21.81
			12	0	3	20.65
			12	7	3	20.76
			12	13	3	20.72
			25	0	3	20.71
	10	QPSK	1	0	0	23.98
			1	25	0	24.09
			1	49	0	23.93
			25	0	1	22.92
			25	12	1	22.95
			25	25	1	22.86
			50	0	1	22.94
		16QAM	1	0	1	23.04
			1	25	1	23.18
			1	49	1	22.98
			25	0	2	21.97
			25	12	2	21.99
			25	25	2	21.93
			50	0	2	21.95
		64QAM	1	0	2	22.09
			1	25	2	22.08
			1	49	2	21.88
			25	0	3	20.85
			25	12	3	20.84
			25	25	3	20.81
			50	0	3	20.84

Test Band	Bandwidth (㎒)	Test mode	RB size	RB offset	MPR	Maximum power
LTE Band 26	15	QPSK	1	0	0	23.73
			1	36	0	23.82
			1	74	0	23.59
			36	0	1	22.76
			36	18	1	22.86
			36	37	1	22.70
			75	0	1	22.81
		16QAM	1	0	1	22.83
			1	36	1	22.84
			1	74	1	22.75
			36	0	2	21.73
			36	18	2	21.80
			36	37	2	21.72
			75	0	2	21.75
		64QAM	1	0	2	21.90
			1	36	2	21.81
			1	74	2	21.77
			36	0	3	20.60
			36	18	3	20.70
			36	37	3	20.59
			75	0	3	20.56

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 ≥ 3 × 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 × 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 ≥ 3 × 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 as its lowest and highest channel with all bandwidth, Modulation.

Test results

Test Band	Bandwidth (㎒)	Frequency (㎒)	Test mode	26㏈ bandwidth (㎒)	99 % bandwidth (㎒)
LTE Band 26	1.4	814.7	QPSK	1.29	1.10
			16QAM	1.29	1.09
		823.3	QPSK	1.29	1.09
			16QAM	1.32	1.10
	3	815.5	QPSK	2.90	2.68
			16QAM	2.90	2.68
		822.5	QPSK	2.89	2.69
			16QAM	2.91	2.69
	5	816.5	QPSK	4.95	4.51
			16QAM	4.95	4.50
		821.5	QPSK	4.92	4.50
			16QAM	4.97	4.51
	10	819.0	QPSK	9.64	9.02
			16QAM	9.74	8.97
	15	821.5	QPSK	14.61	13.49
			16QAM	14.65	13.49

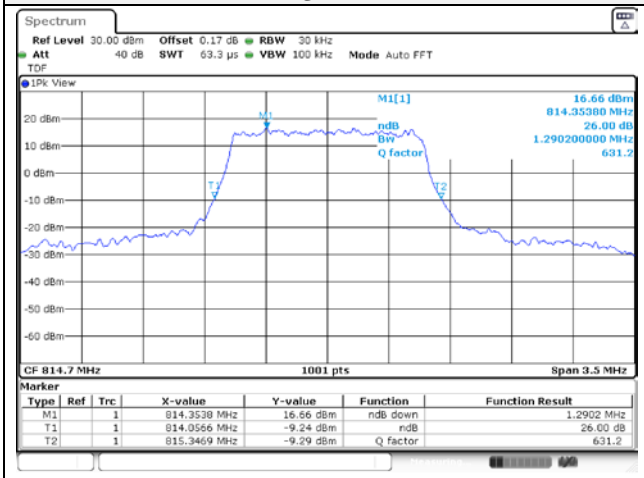
Straddle channel

Test Band	Bandwidth (㎒)	Frequency (㎒)	Test mode	26㏈ bandwidth (㎒)	99 % bandwidth (㎒)
LTE Band 26	1.4	824	QPSK	1.31	1.10
			16QAM	1.28	1.09
	3	824	QPSK	2.91	2.69
			16QAM	2.91	2.68
	5	824	QPSK	4.96	4.51
			16QAM	4.90	4.48
	10	824	QPSK	9.72	9.02
			16QAM	9.77	8.97
	15	824	QPSK	14.61	13.52
			16QAM	14.61	13.49

26dB Bandwidth

Test mode: LTE Band 26

1.4M BW QPSK Low ch.



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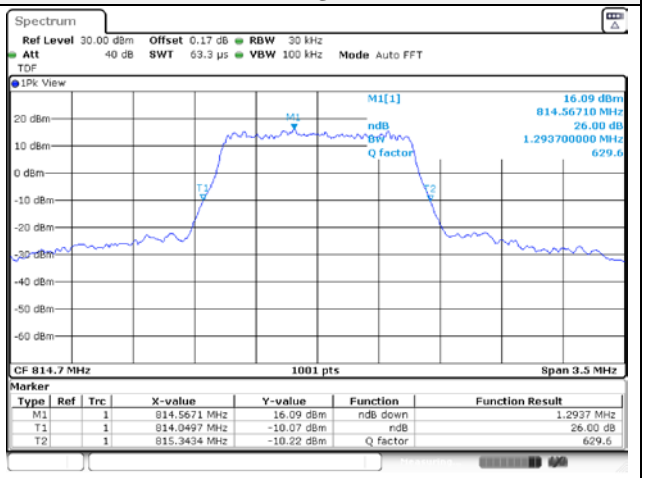

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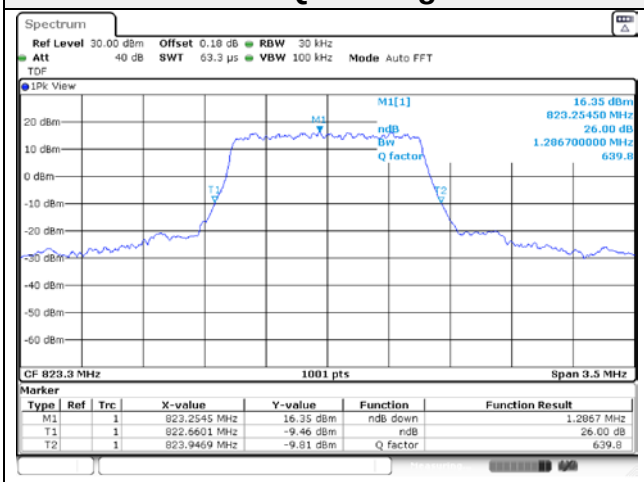

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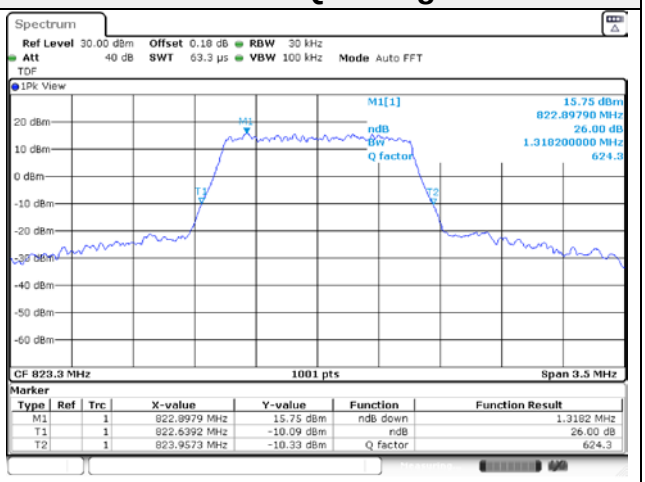

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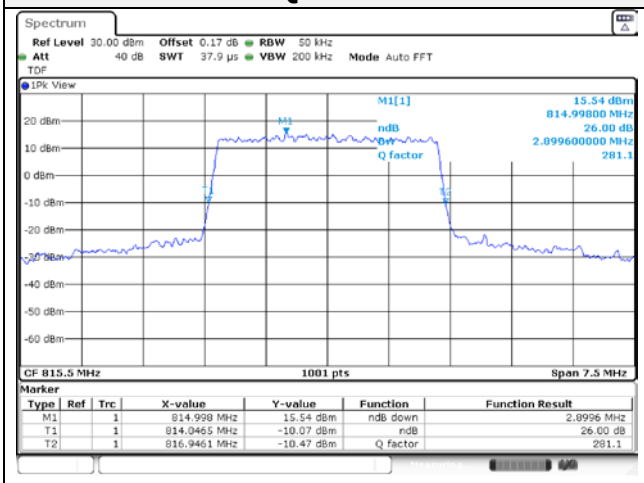

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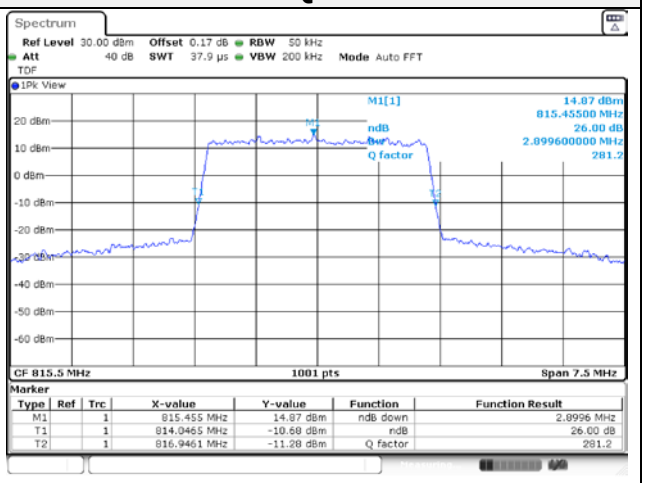

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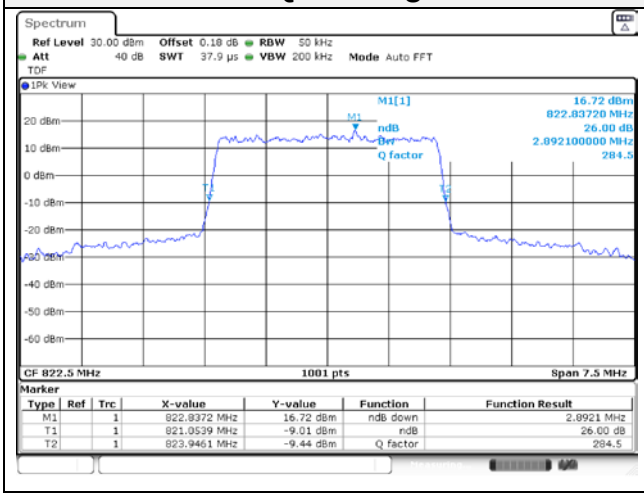

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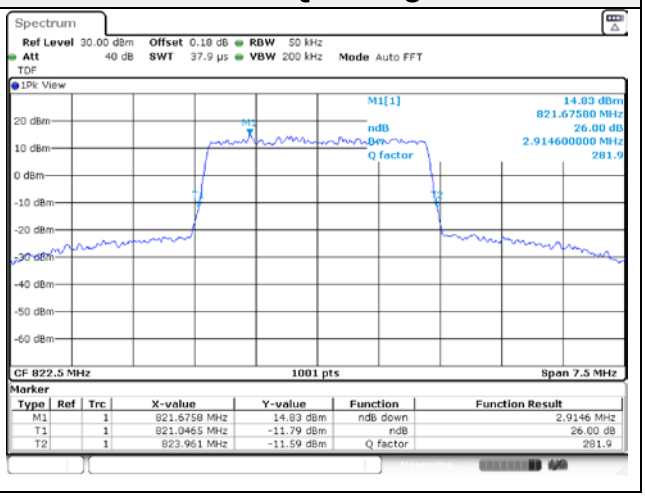

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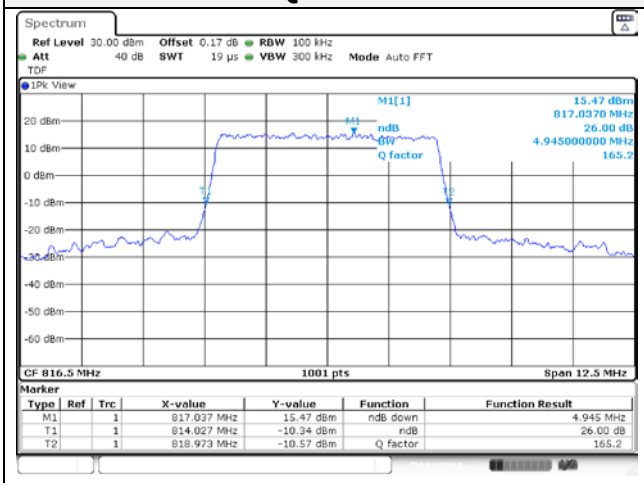

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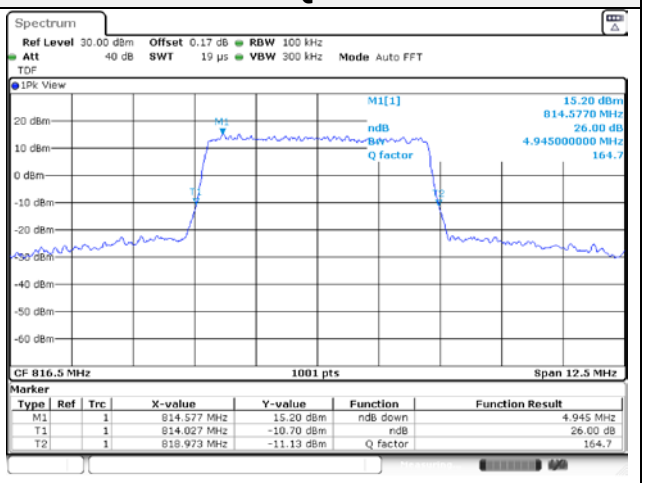

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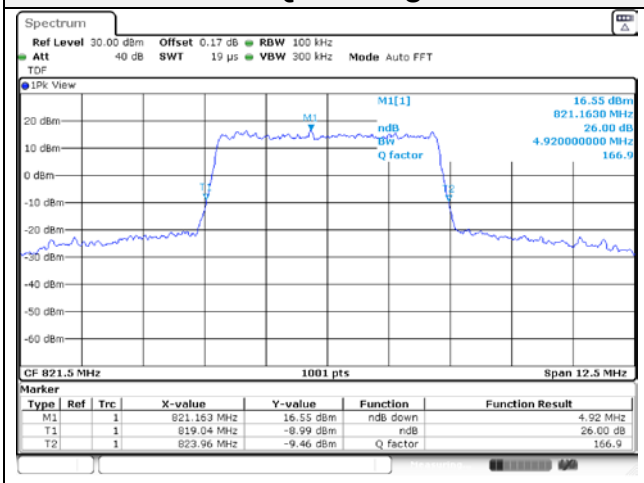

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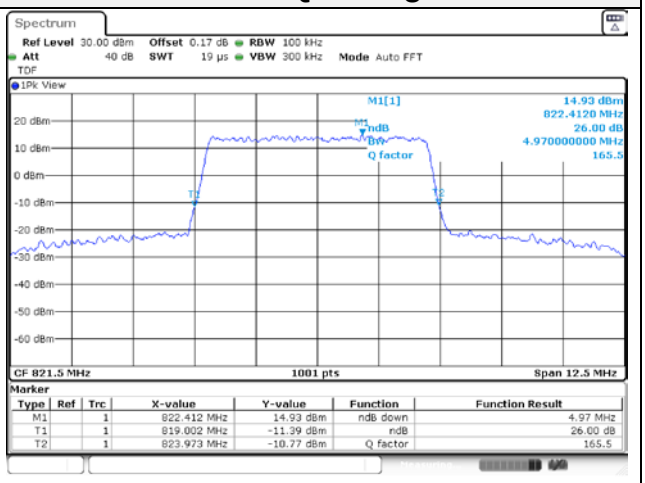
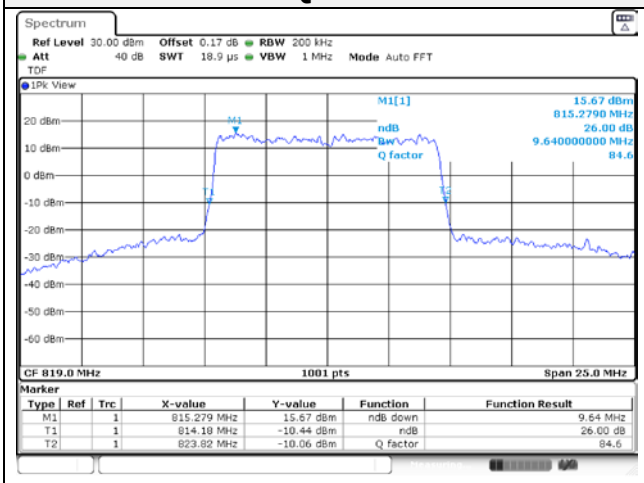


10M BW QPSK Mid ch.



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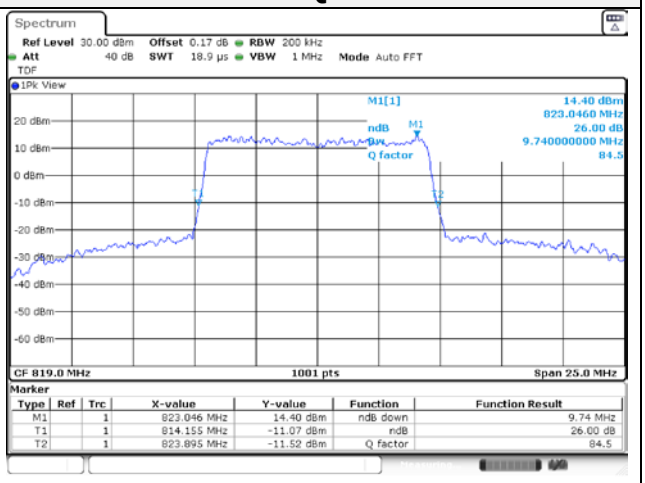

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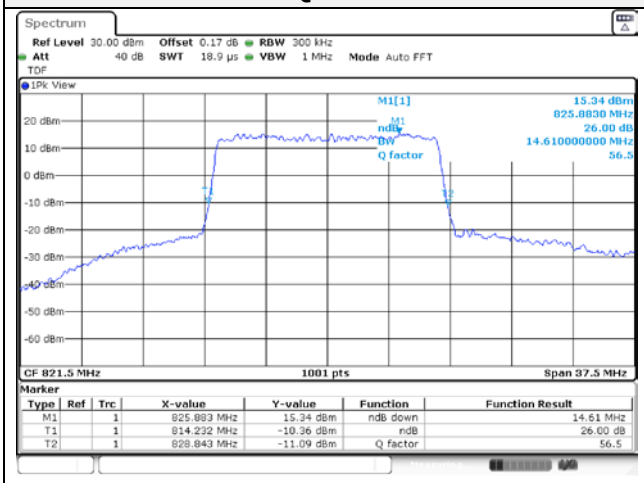

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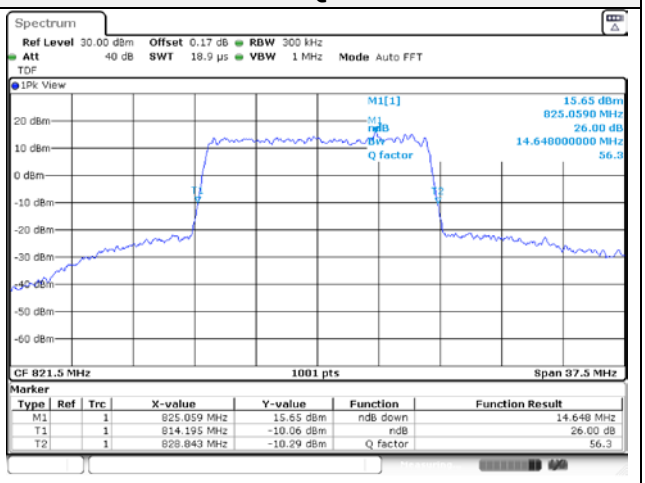

Straddle channel

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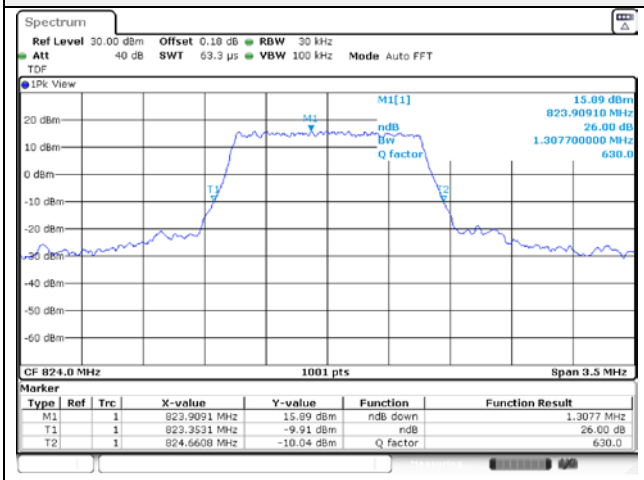
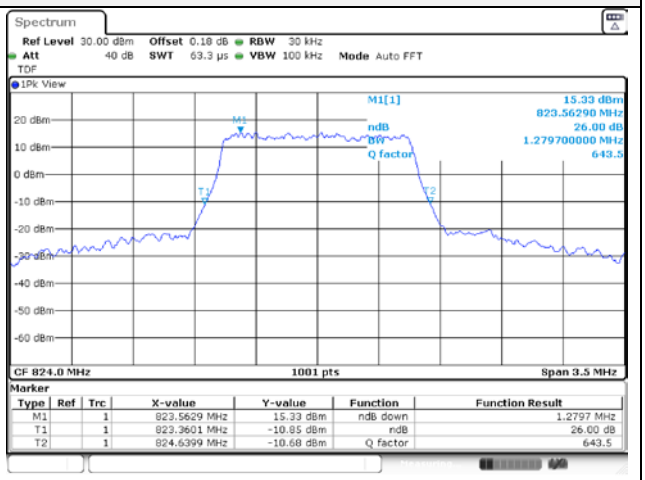
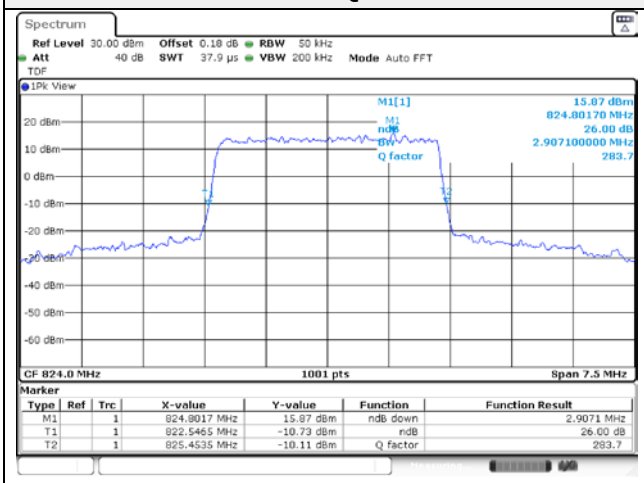


1.4M BW 16QAM



3M BW QPSK



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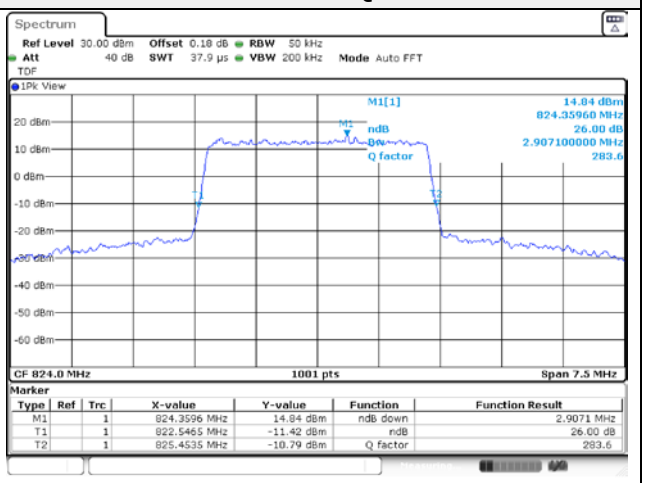

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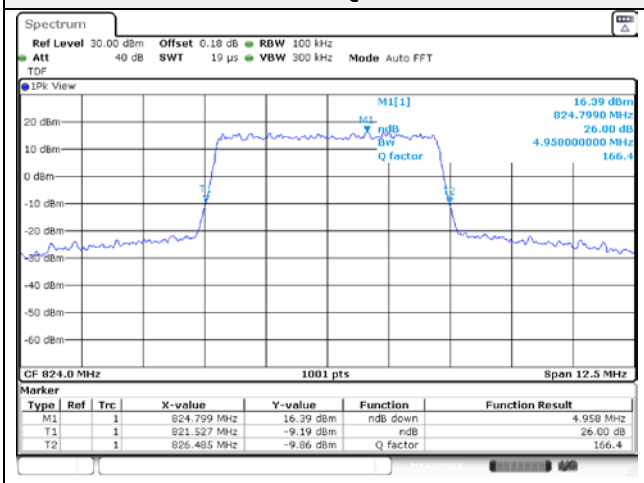

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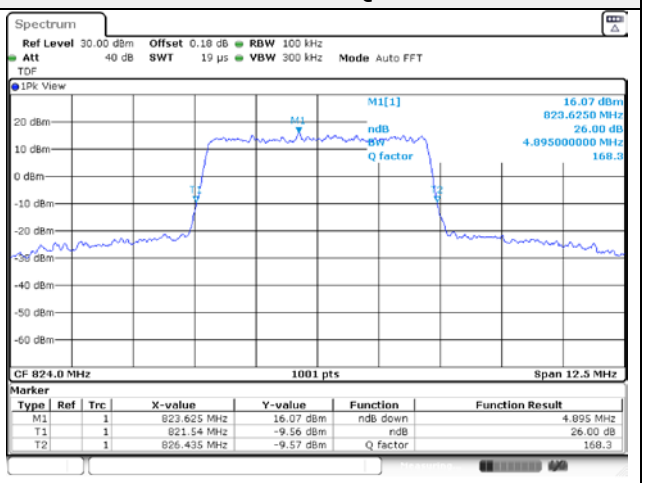
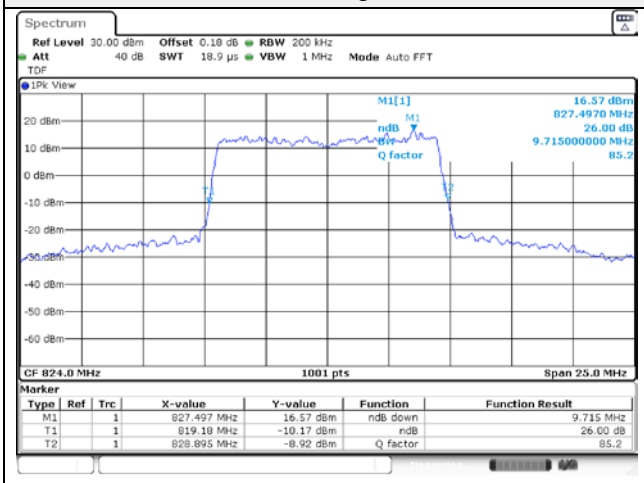


10M BW QPSK



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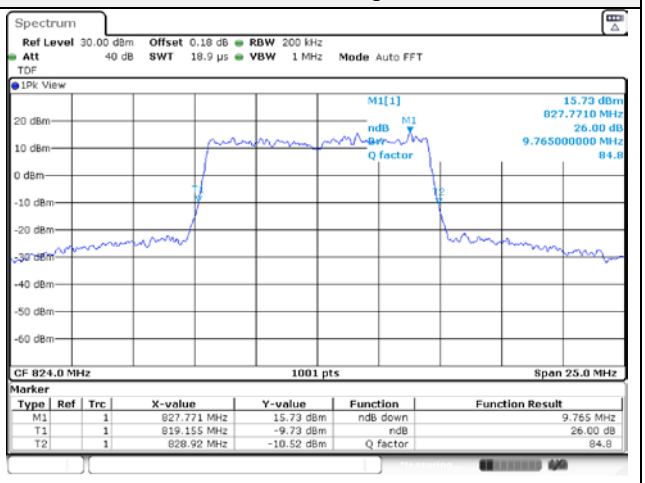
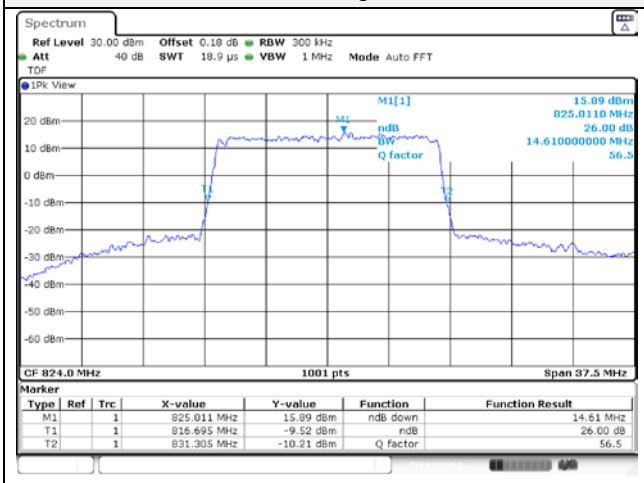


15M BW QPSK



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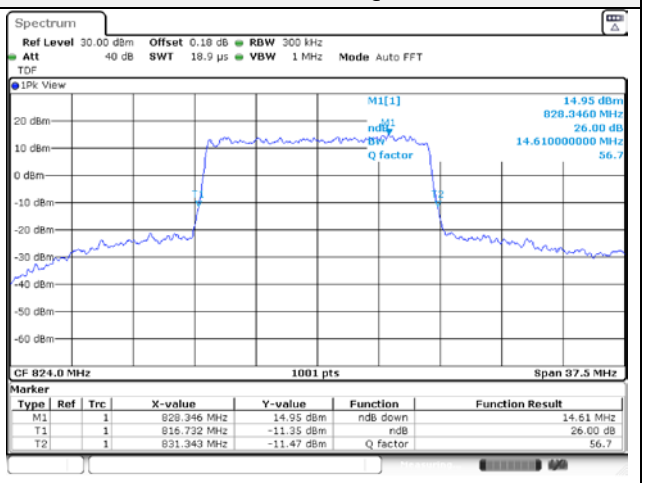
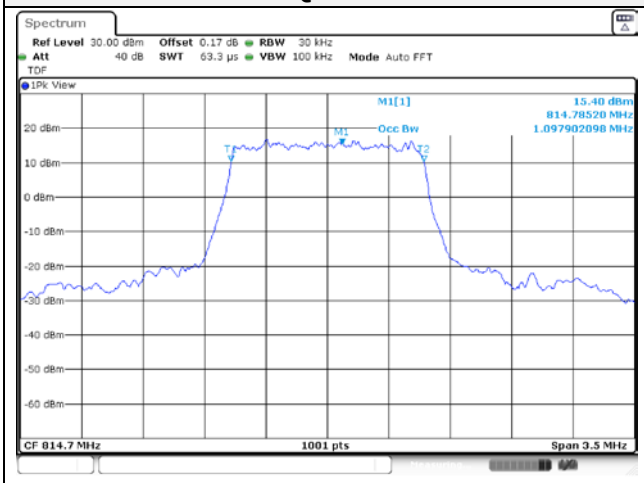
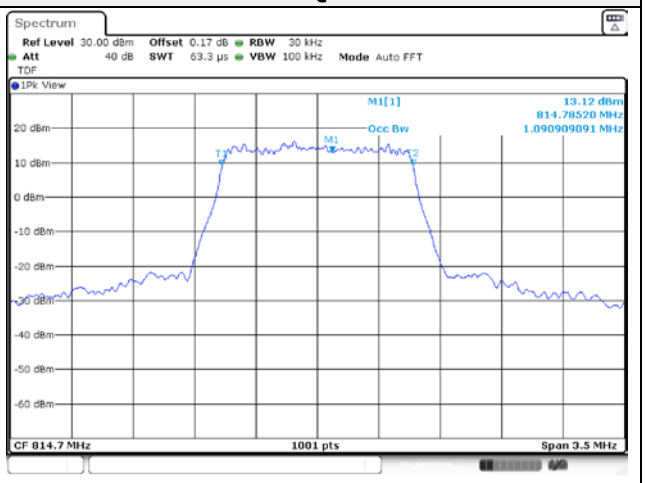
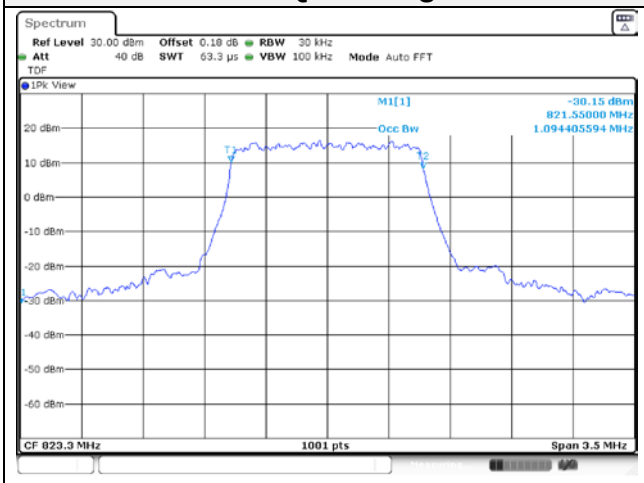
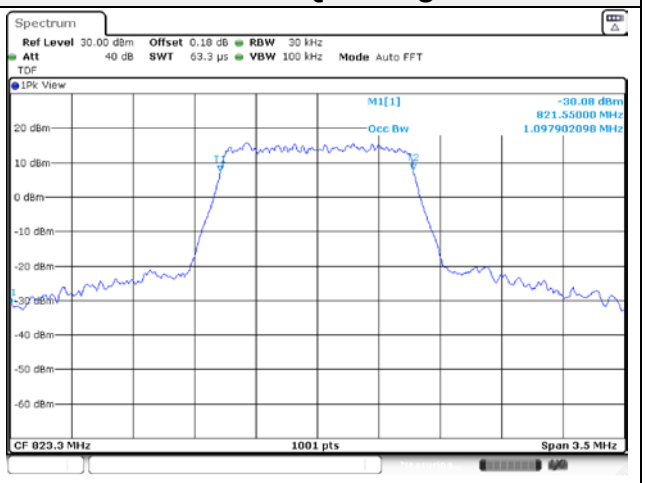
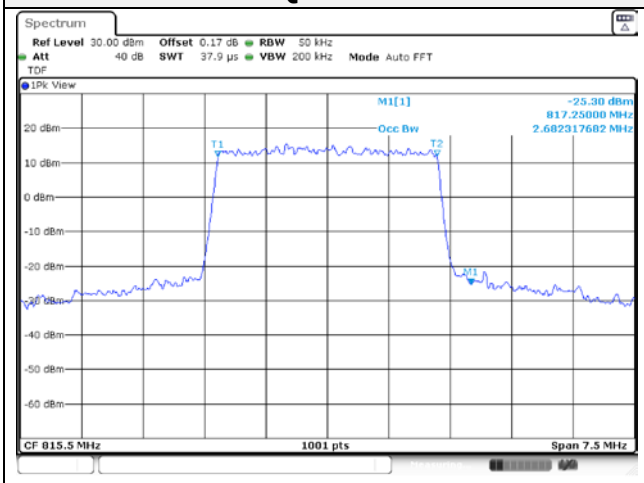


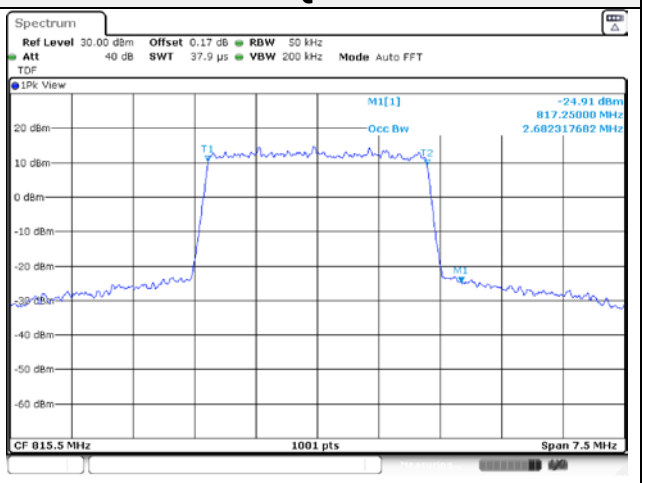
99% Occupied Bandwidth
Test mode: LTE Band 26

1.4M BW QPSK Low ch.	1.4M BW 16QAM Low ch.
	
1.4M BW QPSK High ch.	**1.4M BW 16QAM High ch.**
	

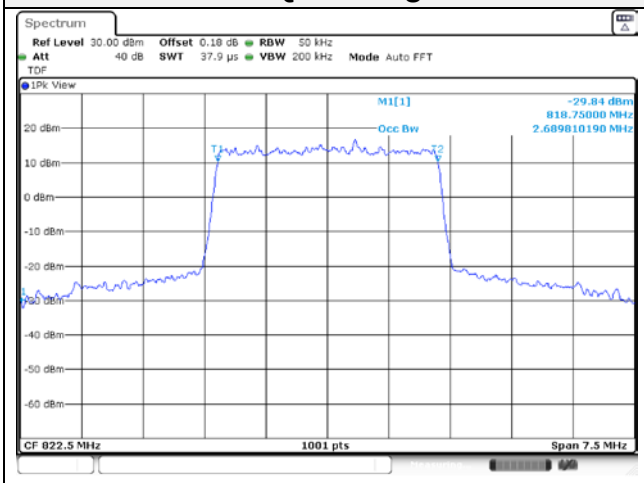
3M BW QPSK Low ch.



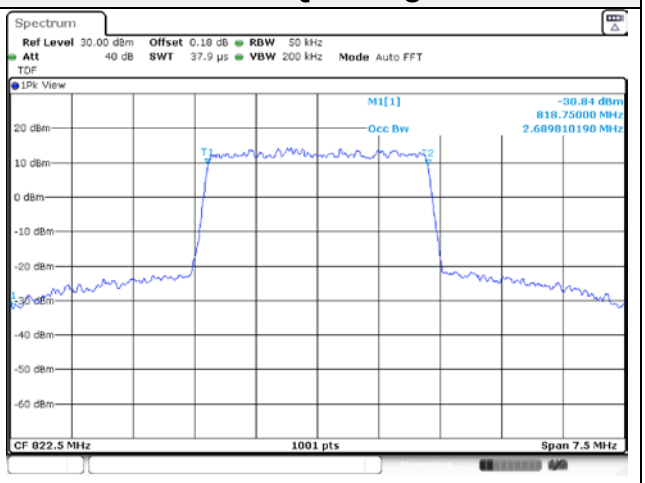
3M BW 16QAM Low ch.



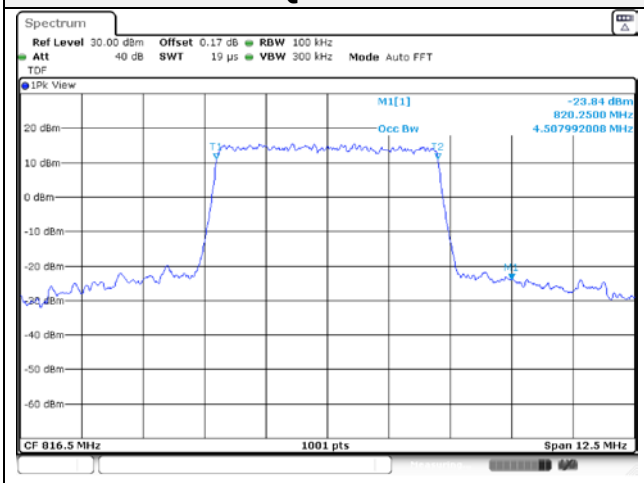
3M BW QPSK High ch.



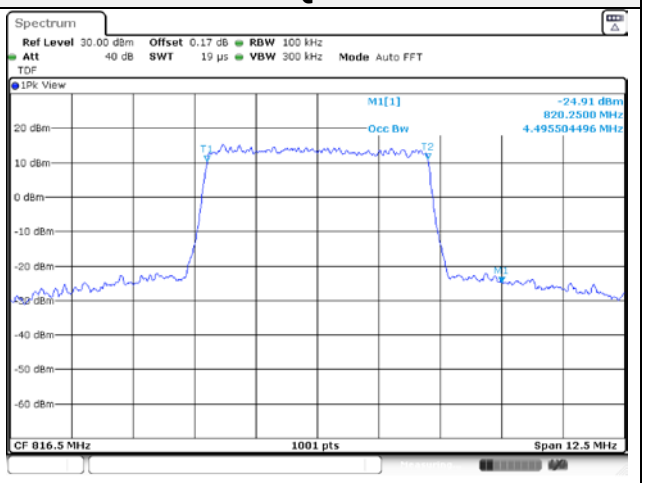
3M BW 16QAM High ch.



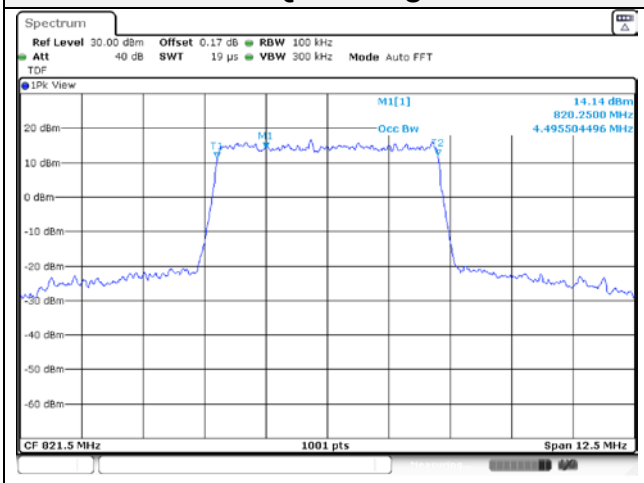
5M BW QPSK Low ch.



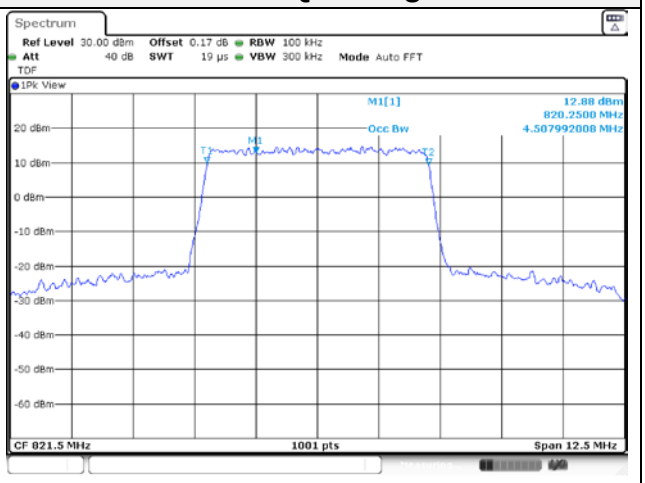
5M BW 16QAM Low ch.



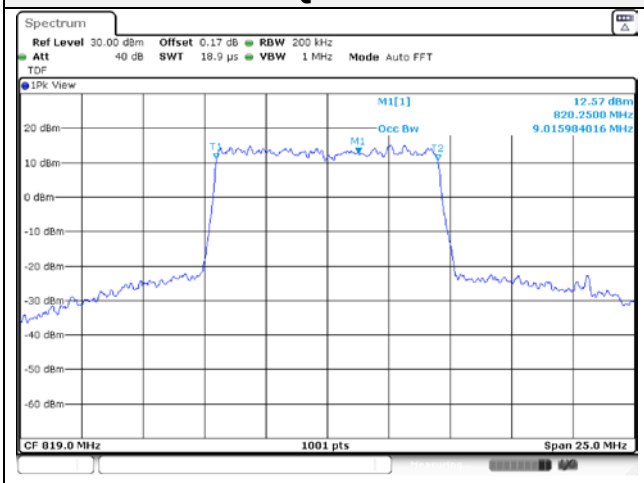
5M BW QPSK High ch.



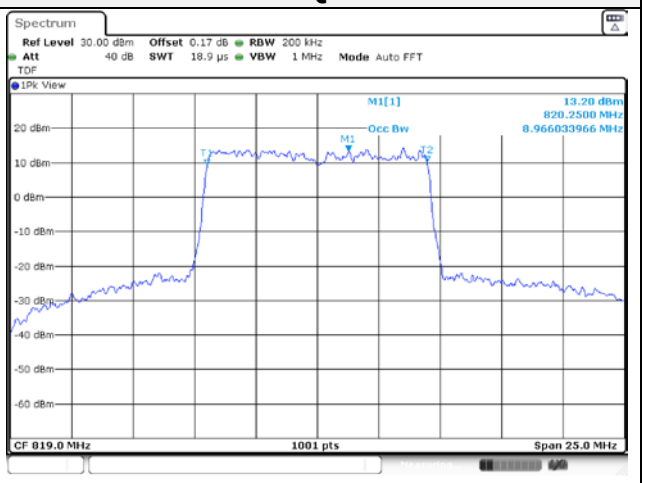
5M BW 16QAM High ch.



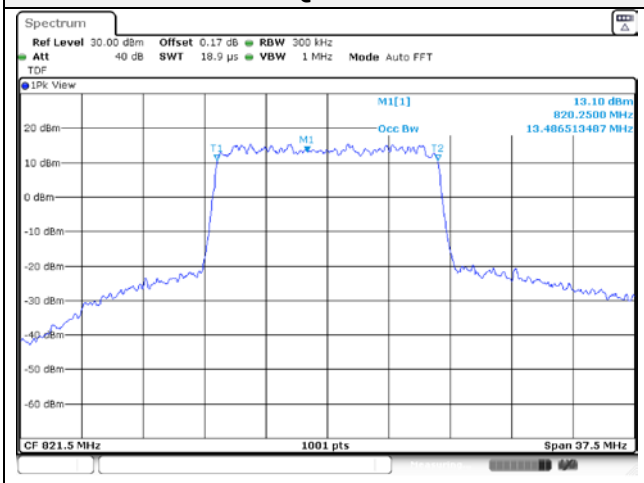
10M BW QPSK Mid ch.



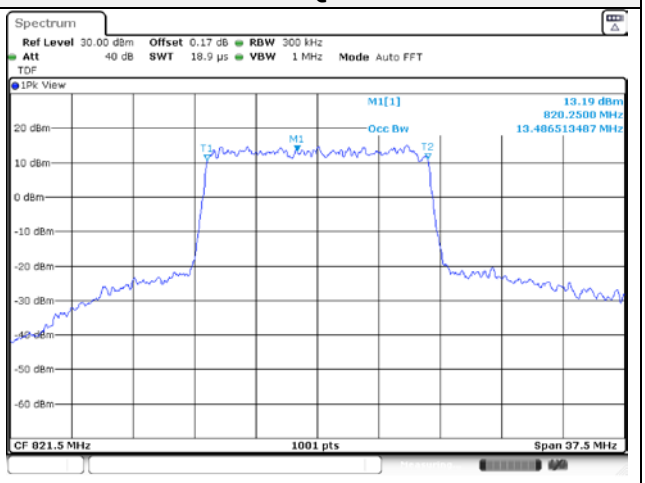
10M BW 16QAM Mid ch.



15M BW QPSK Mid ch.

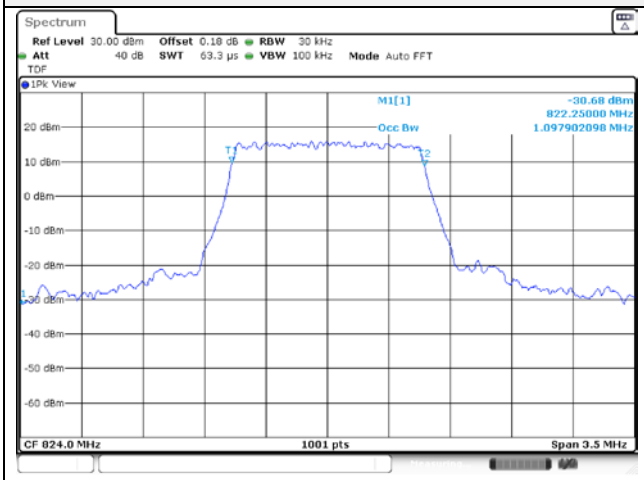


15M BW 16QAM Mid ch.

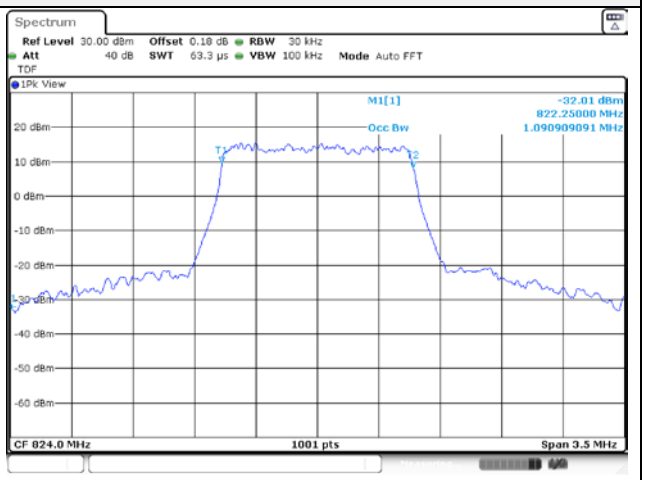


Straddle channel

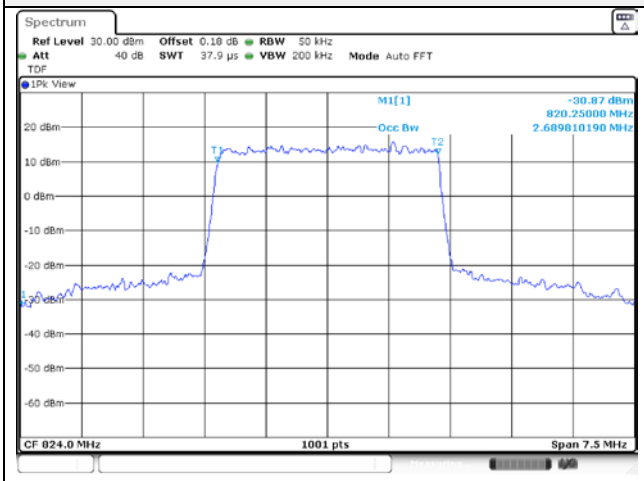
1.4M BW QPSK



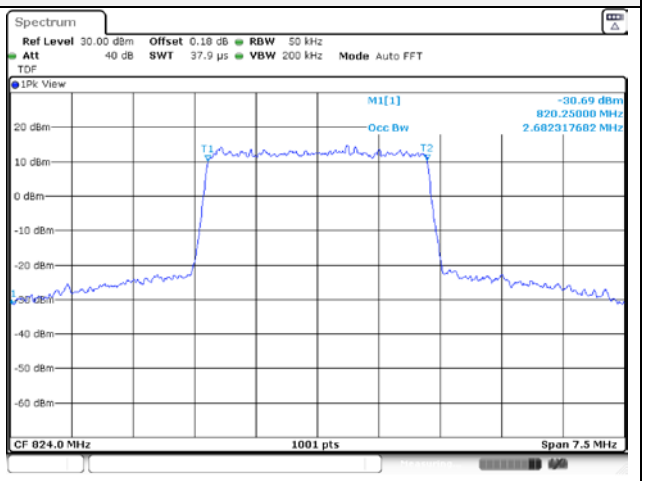
1.4M BW 16QAM



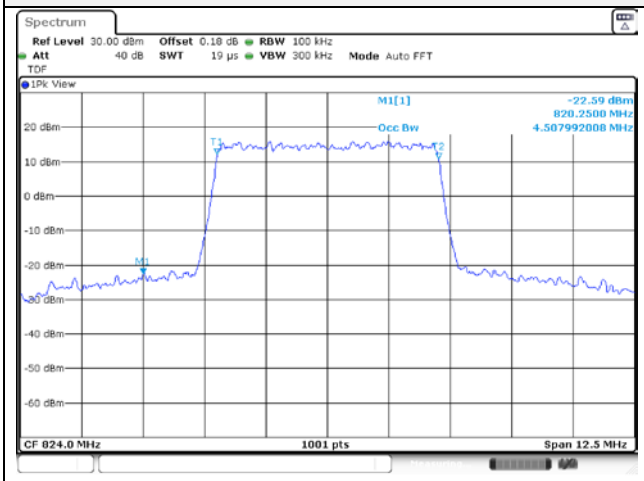
3M BW QPSK



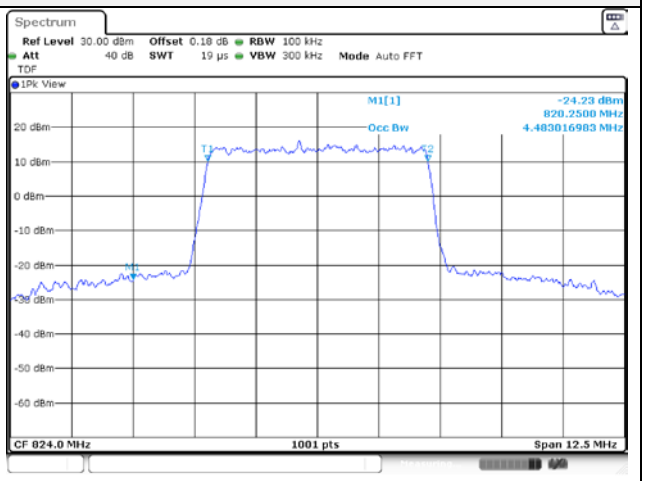
3M BW 16QAM

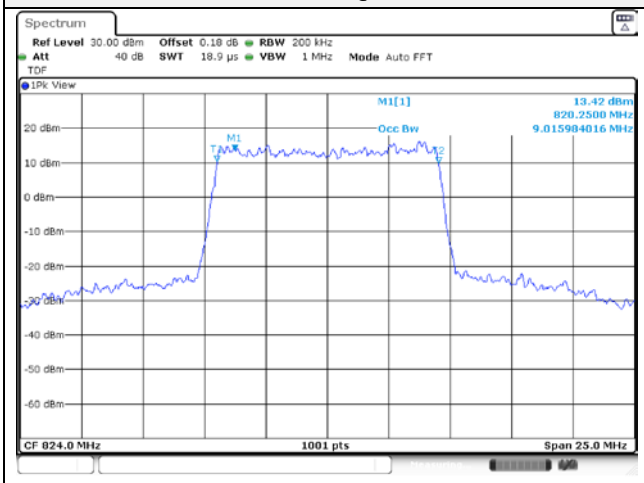
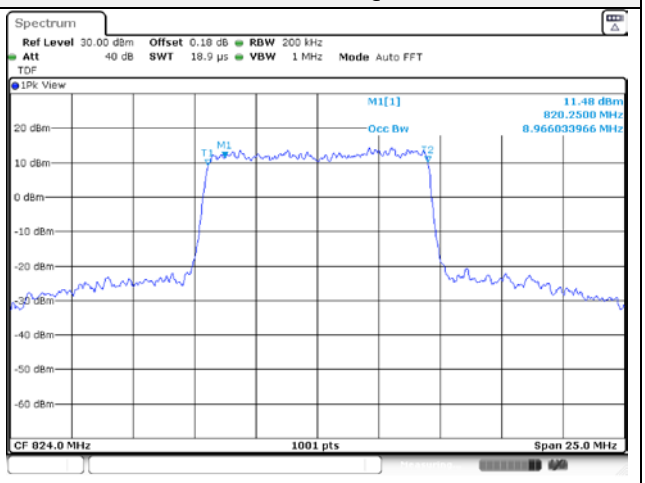
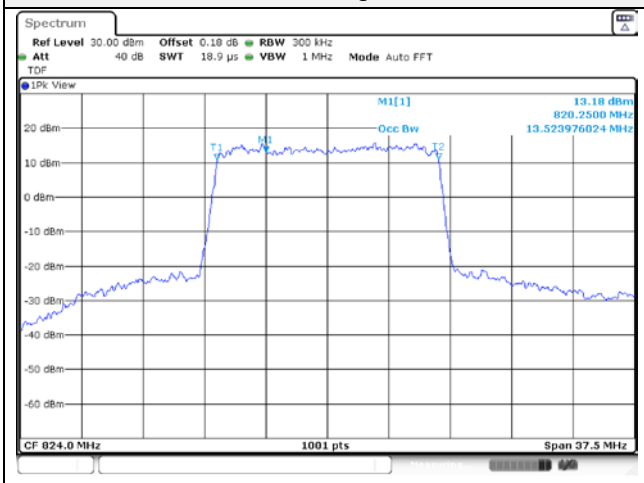
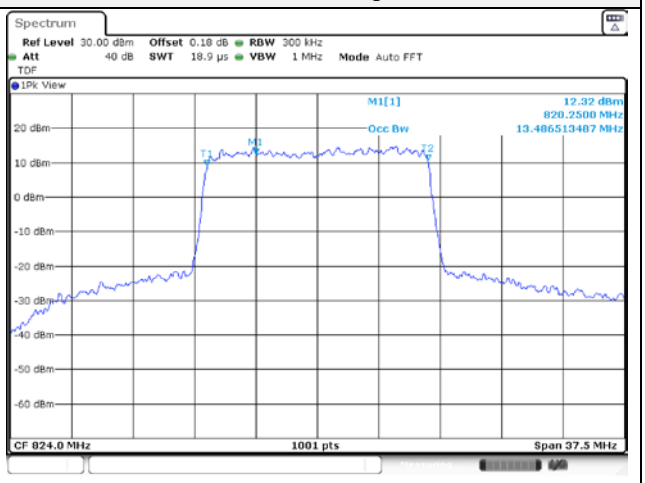


5M BW QPSK



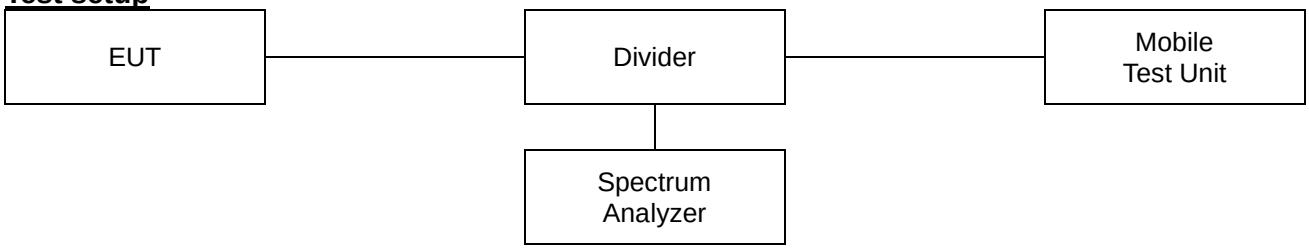
5M BW 16QAM



10M BW QPSK	10M BW 16QAM
	
15M BW QPSK	**15M BW 16QAM**
	

7.3. Spurious Emissions at Antenna Terminal

Test setup



Limit

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 ㎑, 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 + 10Log_{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 ㎑.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 ㎑, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log_{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 ㎑.

Test procedure

971168 D01 v03r01 - Section 6
ANSI 63.26-2015 – Section 5.7

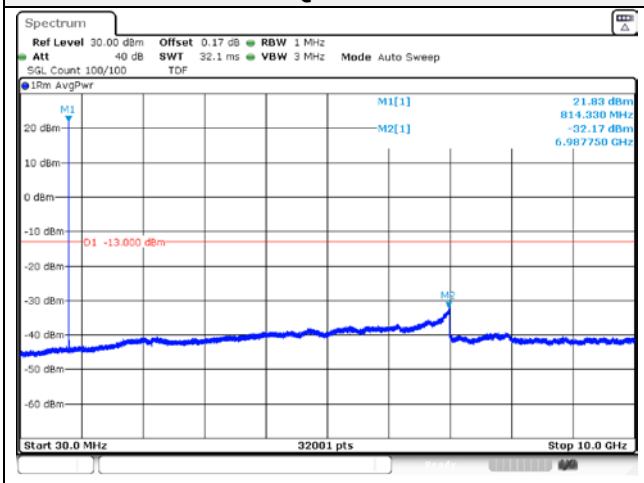
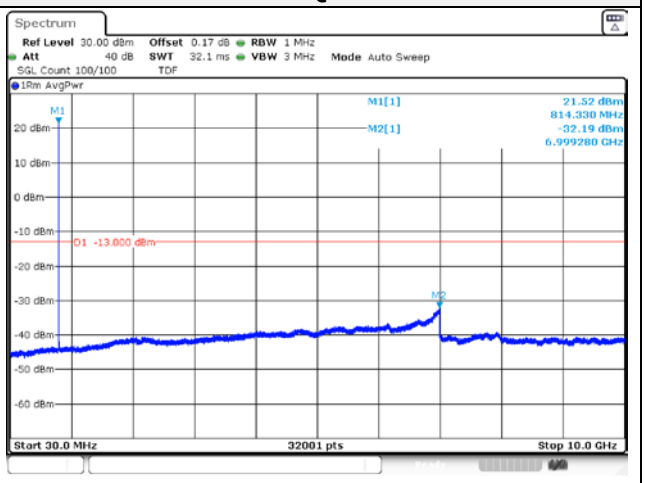
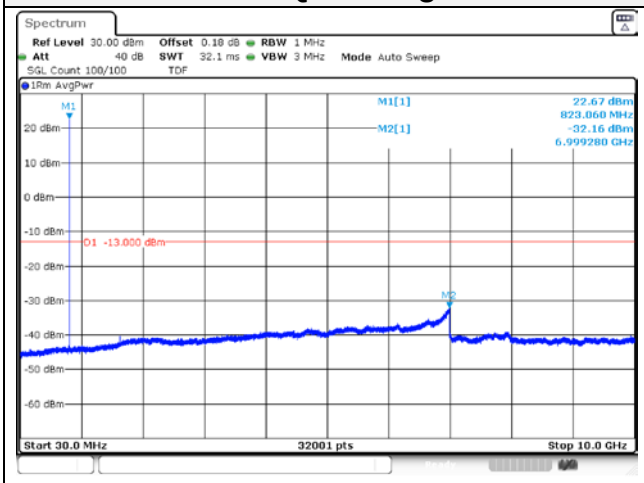
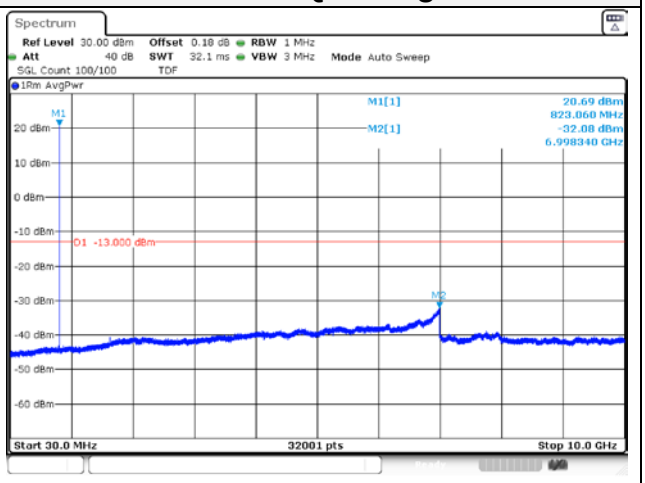
Test settings

1) Start frequency was set to 30 ㎒ and stop frequency was set to at least 10th the fundamental frequency.
2) Detector = RMS
3) Sweep time = auto couple.
4) Trace mode = trace average
5) Allow trace to fully stabilize.
6) Please see test notes below RBW and VBW settings.

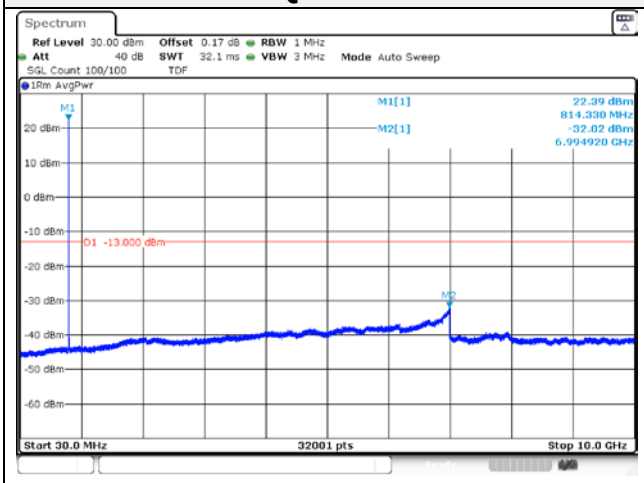
Notes:

1. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 100 ㎑ or greater for frequencies less than 1 ㎓ and 1 ㎒ or greater for frequencies greater than 1 ㎓.
   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 emissions are attenuated at least 26 ㏈ below the transmitter power.

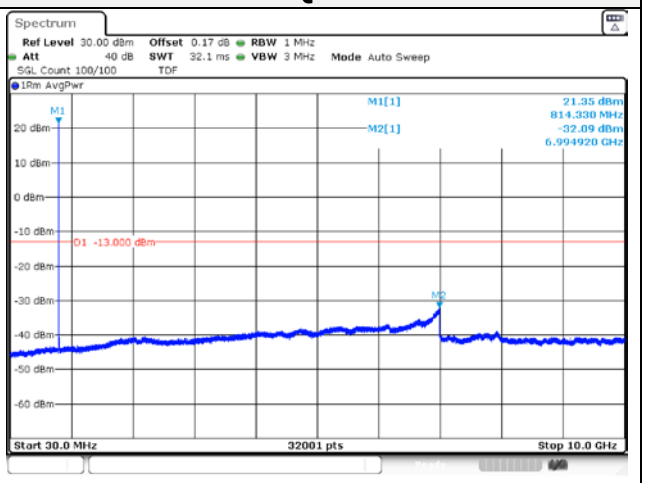
Test results
Test mode: LTE Band 26

1.4M BW QPSK Low ch.	1.4M BW 16QAM Low ch.
	
1.4M BW QPSK High ch.	**1.4M BW 16QAM High ch.**
	

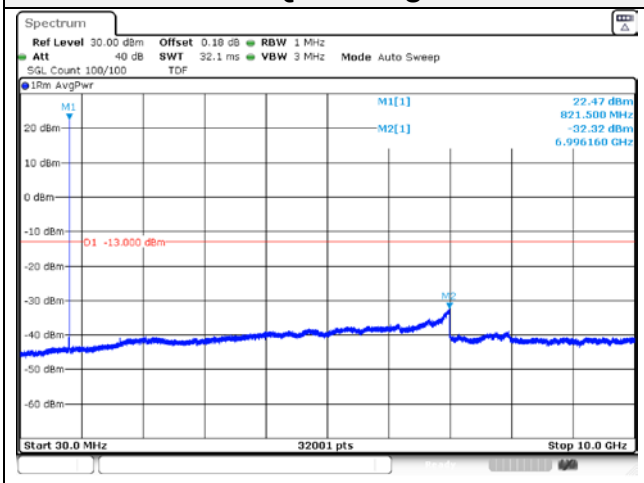
3M BW QPSK Low ch.



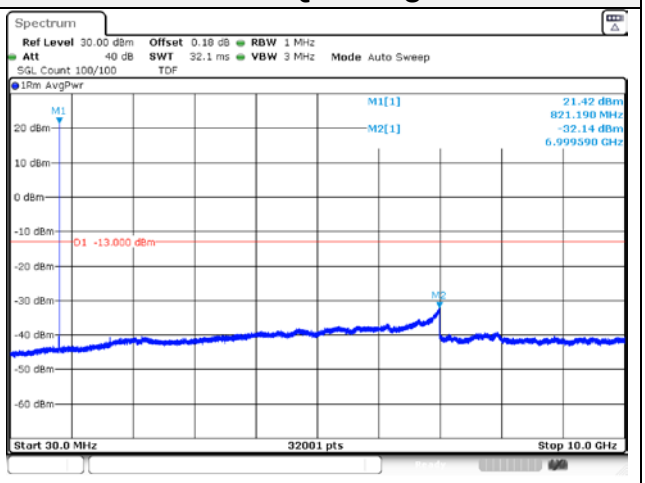
3M BW 16QAM Low ch.



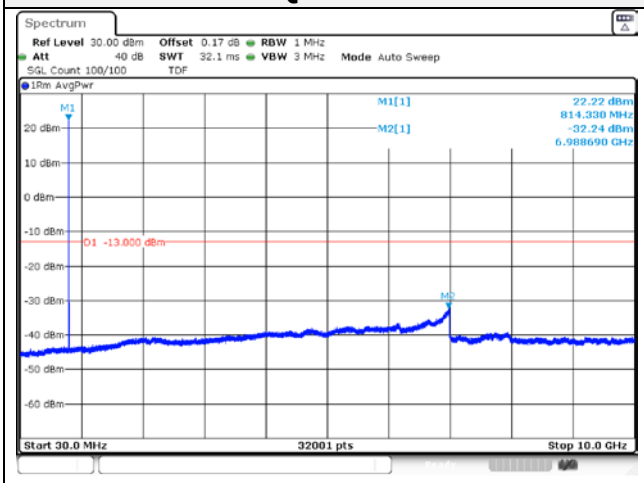
3M BW QPSK High ch.



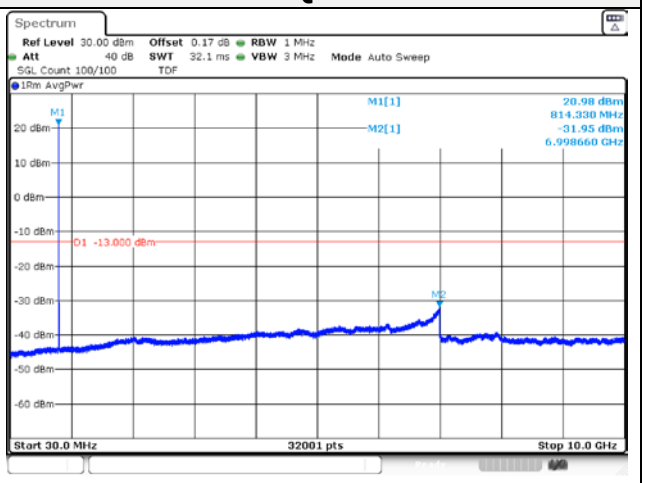
3M BW 16QAM High ch.



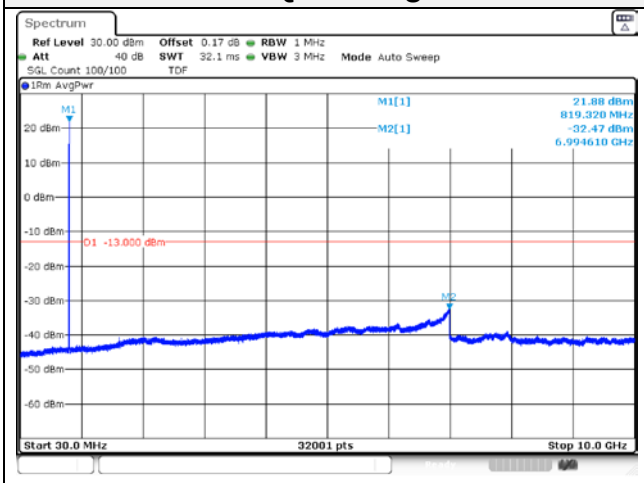
5M BW QPSK Low ch.



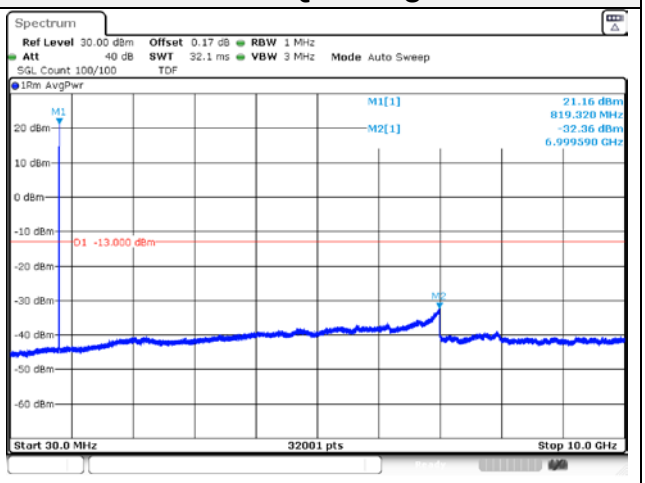
5M BW 16QAM Low ch.



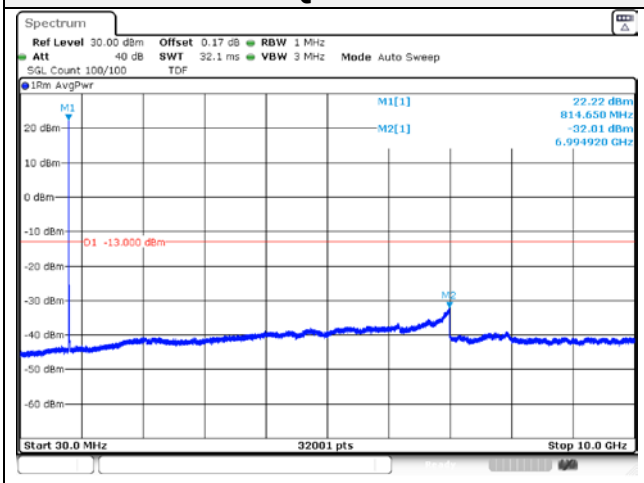
5M BW QPSK High ch.



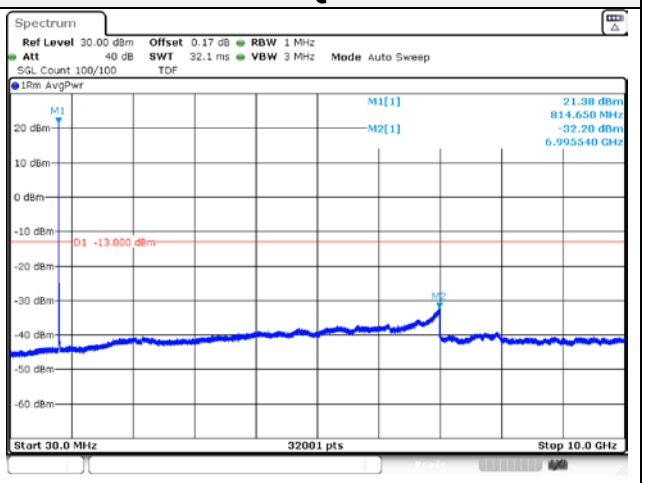
5M BW 16QAM High ch.



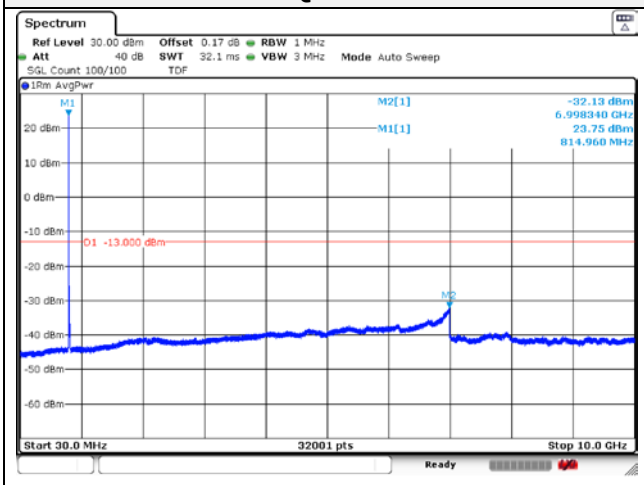
10M BW QPSK Mid ch.



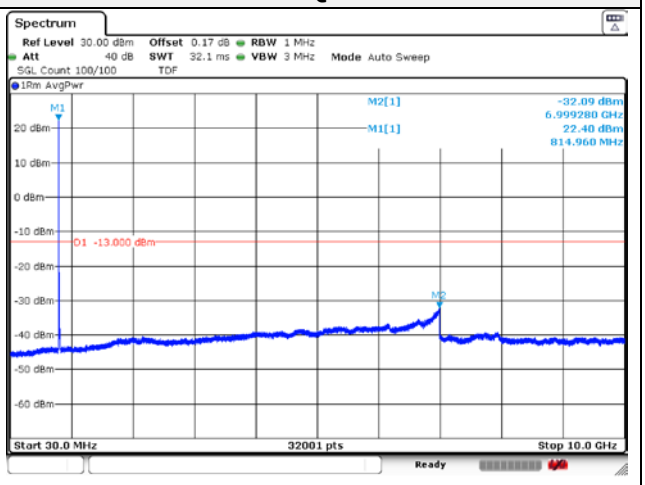
10M BW 16QAM Mid ch.



15M BW QPSK Mid ch.

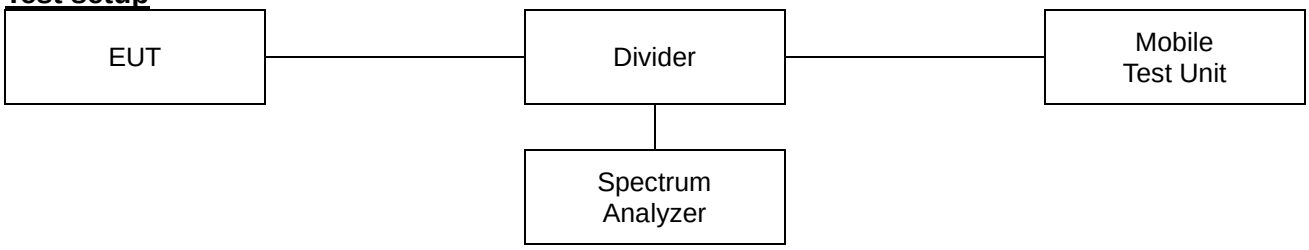


15M BW 16QAM Mid ch.



7.4. Band Edge Emissions at Antenna Terminal

Test setup



Limit

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 ㎑, 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 + 10Log_{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 ㎑.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 ㎑, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log_{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 ㎑.

Test procedure

971168 D01 v03r01 - Section 6
ANSI C63.26-2015 – Section 5.7

Test settings

1) Start frequency was set to 30 ㎒ and stop frequency was set to at least 10th the fundamental frequency.
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 ≥ 3 x RBW.
5) Set the number of sweep points ≥ 2 x 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:
   a) If the device can be configured to transmit continuously (duty cycle ≥ 98%), set the (sweep time) > (number of points in sweep) x (symbol period) (e.g., by a factor of 10 x symbol period x number of points) Increasing the sweep time (i.e., slowing the sweep speed) will allow for averaging over multiple symbols.
   b) 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) x (symbol period) but the sweep time shall always be maintained at a value that is less than or equal to the minimum transmission time

c) 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) × (transmitter period) (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by [10 log (1/duty cycle)]. This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation ≤ ±2%).

d) 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 > ±2%), set the sweep time so that the averaging is performed over the on-period by setting the sweep time > (symbol period) × (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 art necessary to ensure that the maximum power is measured.

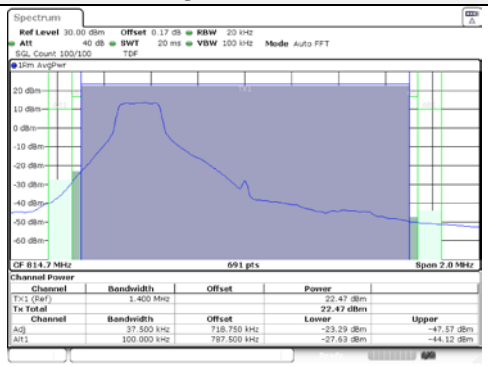
9) Allow trace to fully stabilize.

Notes:

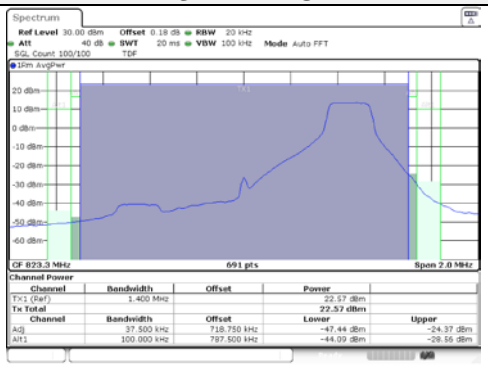
1. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 ㎒ or greater. however in the 1 ㎒ bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be 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 emissions are attenuated at least 26 ㏈ below the transmitter power.
2. The EUT was setup to maximum output power as its lowest and highest channel with all bandwidth, modulation and RB configurations.

Test results
Test mode: LTE Band 26

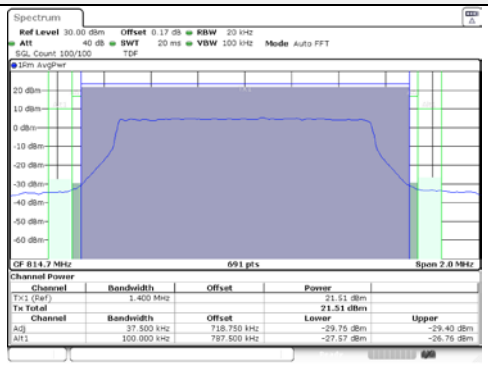
1.4M BW QPSK Low ch. 1RB



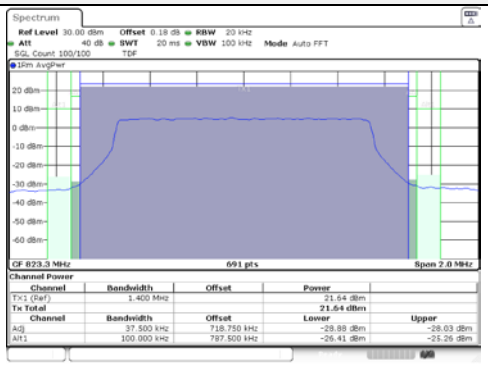
1.4M BW QPSK High ch. 1RB



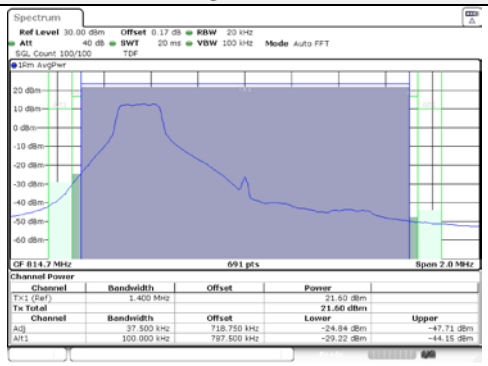
1.4M BW QPSK Low ch. FRB



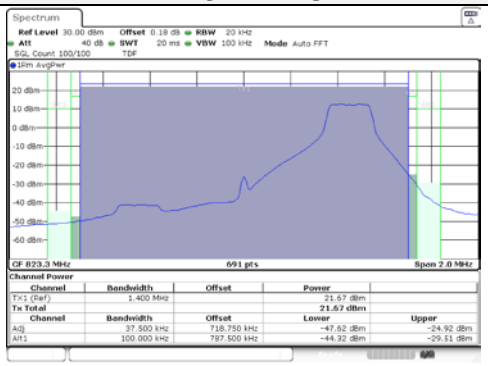
1.4M BW QPSK High ch. FRB



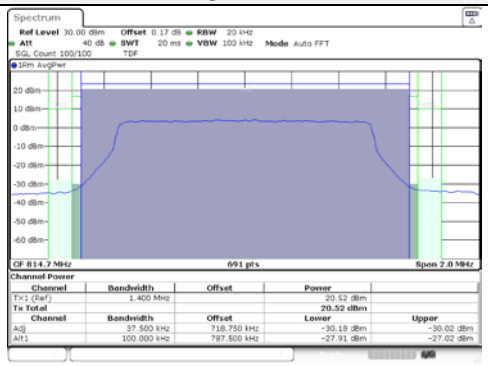
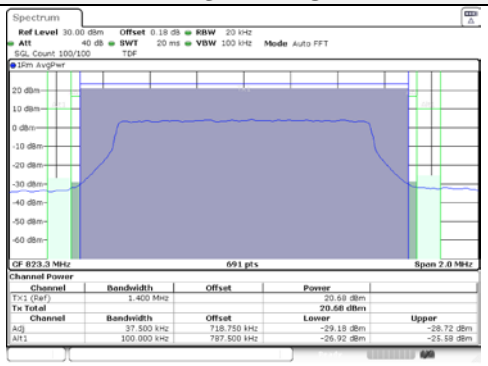
1.4M BW 16QAM Low ch. 1RB



1.4M BW 16QAM High ch. 1RB



1.4M BW 16QAM Low ch. FRB



1.4M BW 16QAM High ch. FRB