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TEST REPORT

KCTL Inc.
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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 : 2019-12-26

2. Use of Report : -

3. Name of Product and Model : Mobile phone / SM-M315F/DS

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

5. FCC ID : A3LSMM315F

6. Date of Test : 2020-01-14 to 2020-01-27

7. Test Standards : FCC Part 2
FCC Part 27 Subpart L

8. Test Results : Refer to the test result in the test report

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

2020-01-30

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
2020-01-30	Initial report	-

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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 Thai Nguyen Co., Ltd
Address	:	506-723 16000 Yen Phong 1 Industrial Zone, Yen Trung Commu Yen Phong District Bac Ninh Province Vietnam
Factory	:	Samsung India Electronics PVT. Ltd
Address	:	B-1, Sector-8 NOIDA Uttar Pradeshe, India 201-305
Factory	:	Samsung Electronics Co., Ltd.
Address	:	94-1, Imsu-dong, Gumi-si, Gyengsangbuk-do, 730-722, Republic of Korea
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 Industry Canada Registration No. : 8035A KOLAS No.: KT231

2. Device information

Equipment under test	:	Mobile Phone
Model	:	SM-M315F/DS
Modulation technique	:	Bluetooth(BDR/EDR)_ GFSK, π/4DQPSK, 8DPSK Bluetooth(BLE)_GFSK WIFI(802.11b/g/n20/n40/ac20/ac40/ac80)_DSSS, OFDM LTE_QPSK, 16QAM WCDMA_QPSK GSM_GMSK, 8-PSK
Number of channels	:	Bluetooth(BDR/EDR)_79ch / Bluetooth(BLE)_40ch 802.11b/g/n_HT20 : 11 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 ㎒)
Power source	:	DC 3.85 V
Antenna specification	:	LTE/GSM/WCDMA_LDS Antenna WIFI/Bluetooth(BDR/EDR/BLE)_LDS Antenna

Antenna gain	:	WIFI/Bluetooth(BDR/EDR/BLE) : -3.4 dBi
		UNII-1 -5.9 dBi
		UNII-2A -6.3 dBi
		UNII-2C -5.3 dBi
		UNII-3 -6.6 dBi
Frequency range	:	Bluetooth(BDR/EDR/BLE)_2 402 ㎒ ~ 2 480 ㎒
		2 412 ㎒ ~ 2 462 ㎒ (802.11b/g/n_HT20)
		UNII-1: 5 180 ㎒ ~ 5 240 ㎒ (802.11a/n_HT20/ac_VHT20)
		UNII-1: 5 190 ㎒ ~ 5 230 ㎒ (802.11n_HT40/ac_VHT40)
		UNII-1: 5 210 ㎒ (802.11ac_VHT80)
		UNII-2A: 5 260 ㎒ ~ 5 320 ㎒ (802.11a/n_HT20/ac_VHT20)
		UNII-2A: 5 270 ㎒ ~ 5 310 ㎒ (802.11n_HT40/ac_VHT40)
		UNII-2A: 5 290 ㎒ (802.11ac_VHT80)
		UNII-2C: 5 500 ㎒ ~ 5 720 ㎒ (802.11a/n_HT20/ac_VHT20)
		UNII-2C: 5 510 ㎒ ~ 5 710 ㎒ (802.11n_HT40/ac_VHT40)
		UNII-2C: 5 530 ㎒ ~ 5 690 ㎒ (802.11ac_VHT80)
		UNII-3: 5 745 ㎒ ~ 5 825 ㎒ (802.11a/n_HT20/ac_VHT20)
		UNII-3: 5 755 ㎒ ~ 5 795 ㎒ (802.11n_HT40/ac_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 13_779.5 ㎒ ~ 784.5 ㎒
		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 1910_1 852.4 ㎒ ~ 1 907.6 ㎒
Software version	:	M315F.001
Hardware version	:	REV1.0
Test device serial No.	:	Conducted(R38MC0ANYKB, R38MC0ANZKH, R38MC0AP17A, R38MC0ANXTJ)
		Radiated(R38MC0ANYWL, R38MC0ANZHK)
Operation temperature	:	-30 ℃ ~ 50 ℃

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
Travel Adapter	Samsung Electronics Co., Ltd.	EP-TA200	R37M4NR27T1SE3	AC 100-240V 50-60 Hz, 0.5A, 9.0V-1.67A, 5.0V-2.0A
Micro USB Data Cable	Samsung Electronics Co., Ltd.	-	-	-

2.2. Frequency/channel operations

This device contains the following capabilities:
WIFI(2.4㎓ band 802.11b/g/n(HT20), 5㎓ band 802.11a/n(HT20/HT40)/ac(VHT/20/40/80)),
Bluetooth(BDR/EDR/BLE),
LTE Band 2, LTE Band 4, LTE Band 5, LTE Band 12, LTE Band 13, LTE Band 17, LTE Band 26, LTE Band 41, LTE Band 66, WCDMA 850, WCDMA 1700, WCDMA 1900, GSM 850, GSM 1900

LTE Band 13

Ch.	Frequency (㎒)
23205	779.5
23230	782.0
23255	784.5

Table 2.2.1. 5M BW

Ch.	Frequency (㎒)
-	-
23230	782.0
-	-

Table 2.2.2. 10M BW

3. Maximum ERP/EIRP power

LTE Band 13

Mode	Tx frequency (㎒)	Emission designator	ERP	
			Max. power (dBm)	Max. power (W)
LTE Band 13	779.5 ~ 784.5	4M55G7D	18.86	0.077
		4M56W7D	17.73	0.059
	782.0	9M02G7D	19.03	0.080
		8M97W7D	18.02	0.063

4. Summary of tests

FCC Part section(s)	Parameter	Test Limit	Test Condition	Test results
2.1046	Conducted Output Power	N/A	Conducted	Pass
2.1049	Occupied Bandwidth & 26 dB Bandwidth	N/A		Pass
2.1051 27.53(c)	Band Edge Emissions at Antenna Terminal	<43 + 10Log$_{10}$(P) dB		Pass
	Spurious Emissions at Antenna Terminal	<65 + 10Log$_{10}$(P) dB		Pass
27.50(d)(5)	Peak to Average Power Ratio	< 13 dB		Pass
2.1055 27.54	Frequency stability	Fundamental emissions stay within authorized frequency block		Pass
27.50(b)(10)	Effective Radiated Power	< 3 Watts max. ERP	Radiated	Pass
2.1053 27.53(g) 27.53(f)	Radiated Spurious Emissions	<43 + 10Log$_{10}$(P) dB <-70 dBW/㎒ EIRP - Wideband <-80 dBW/㎒ EIRP- Narrowband		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. 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

Test condition	LTE Band	Modulation	Bandwidth (㎒)	RB size	RB offset
Radiated	B13	QPSK	10	1	0
Conducted		QPSK 16QAM	5, 10	1	0, 24, 49
				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	1.23 dB	
Conducted spurious emissions	1.24 dB	
Radiated spurious emissions	30 MHz ~ 1 GHz	3.66 dB
	Above 1 GHz	3.32 dB

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6. Measurement results explanation example

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

Frequency (㎒)	Factor(㏈)	Frequency (㎒)	Factor(㏈)
30	5.69	11 000	7.34
50	5.83	12 000	7.48
100	6.00	13 000	7.54
200	6.10	14 000	7.61
300	6.19	15 000	7.53
400	6.28	16 000	7.63
500	6.30	17 000	6.29
600	6.32	18 000	7.80
700	6.35	19 000	7.90
800	6.37	20 000	8.14
900	6.42	21 000	7.99
1 000	6.41	22 000	8.67
2 000	6.52	23 000	8.06
3 000	6.55	24 000	8.68
4 000	6.73	25 000	8.57
5 000	6.84	26 000	8.63
6 000	6.90	26 500	9.22
7 000	6.89	27 000	9.33
8 000	7.00	28 000	8.46
9 000	6.82	29 000	8.10
10 000	7.21	30 000	8.11

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

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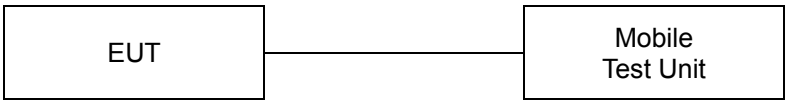
7. Test results

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.

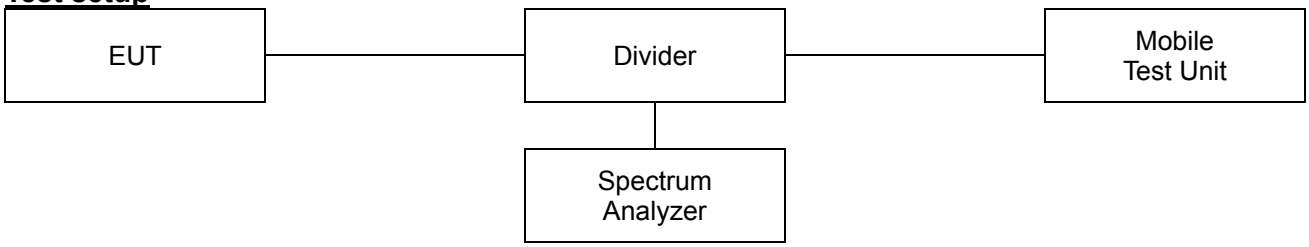
See item r) of 4.1 for more information regarding power meter functional requirements and limitations, and consult the instrumentation-specific application literature for proper set-up and use.

Test results

Test Band	Bandwidth (㎒)	Test mode	RB size	RB offset	MPR	Maximum power Frequency (㎒)		
						Low	Middle	High
LTE Band 13	5	QPSK	1	0	0	24.43	24.32	24.44
			1	12	0	24.37	24.28	24.38
			1	24	0	24.35	24.21	24.47
			12	0	1	23.71	23.68	23.61
			12	7	1	23.63	23.68	23.60
			12	13	1	23.60	23.63	23.60
			25	0	1	23.68	23.68	23.63
		16QAM	1	0	1	23.37	23.77	23.46
			1	12	1	23.13	23.77	23.44
			1	24	1	23.28	23.70	23.42
			12	0	2	22.64	22.62	22.64
			12	7	2	22.63	22.55	22.66
			12	13	2	22.57	22.60	22.65
			25	0	2	22.75	22.64	22.66
	10	QPSK	1	0	0	-	**24.52**	-
			1	25	0	-	24.44	-
			1	49	0	-	24.35	-
			25	0	1	-	23.72	-
			25	12	1	-	23.65	-
			25	25	1	-	23.63	-
			50	0	1	-	23.65	-
		16QAM	1	0	1	-	23.79	-
			1	25	1	-	23.68	-
			1	49	1	-	23.69	-
			25	0	2	-	22.67	-
			25	12	2	-	22.65	-
			25	25	2	-	22.58	-
			50	0	2	-	22.76	-

7.2. 99% Occupied Bandwidth & 26 dB Bandwidth

Test setup



Limit

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."

k) 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 u pper 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 13	5	779.5	QPSK	5.45	4.55
			16QAM	5.46	4.56
		782.0	QPSK	5.43	4.52
			16QAM	5.37	4.53
		784.5	QPSK	5.42	4.53
			16QAM	5.31	4.53
	10	782.0	QPSK	10.22	9.02
			16QAM	10.12	8.97

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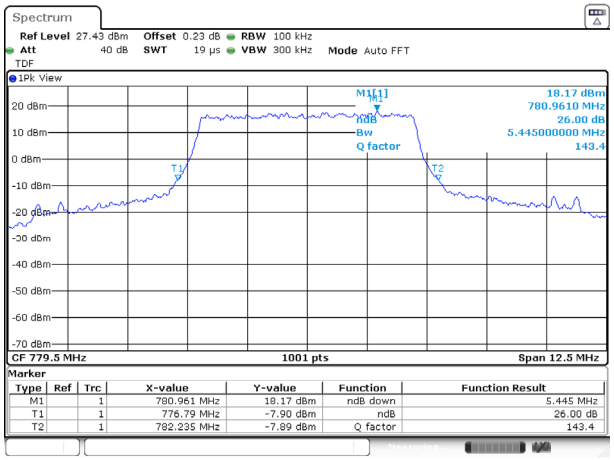
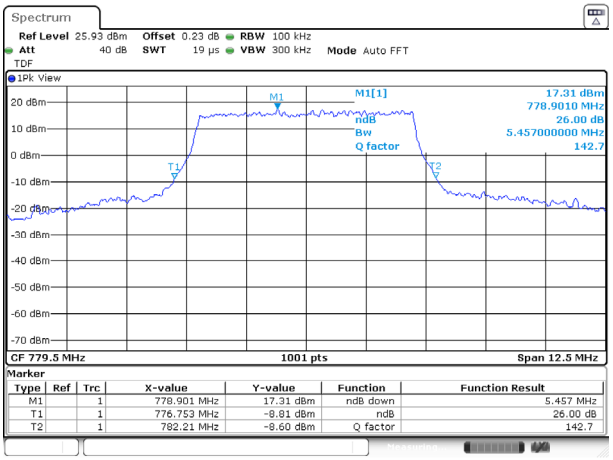
26dB Bandwidth

Test mode: LTE Band 13

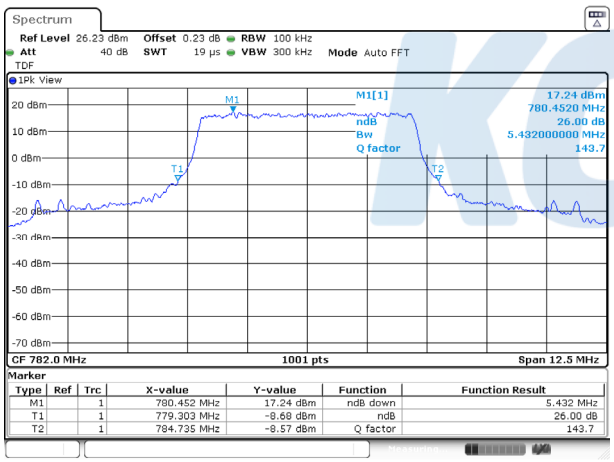
5M BW / QPSK / Low ch.



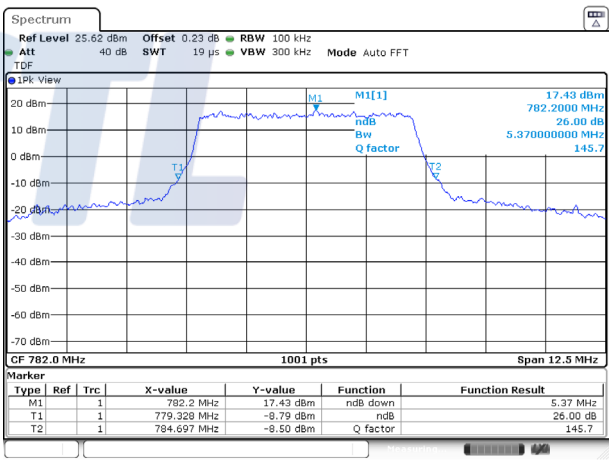
5M BW / 16QAM / Low ch.



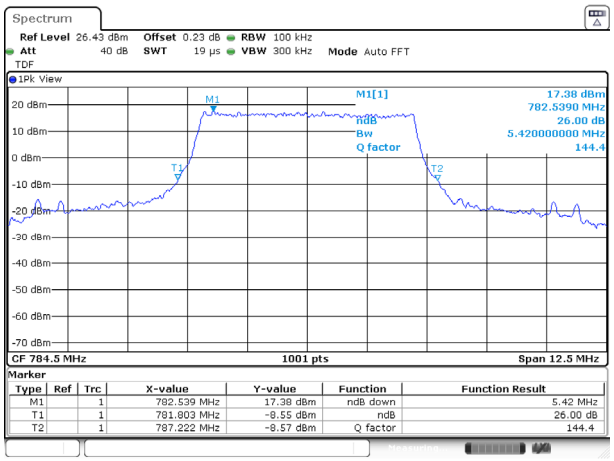
5M BW / QPSK / Mid ch.



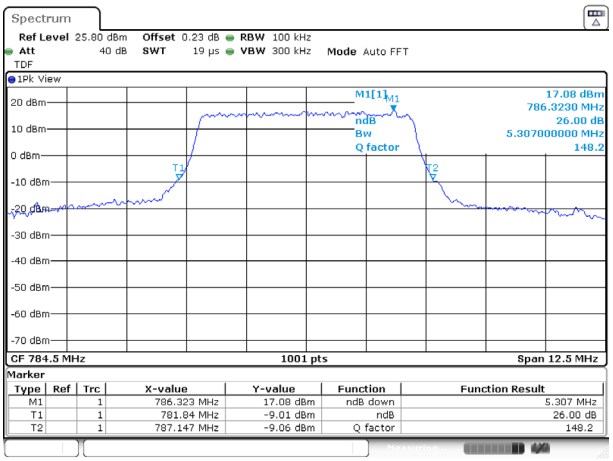
5M BW / 16QAM / Mid ch.



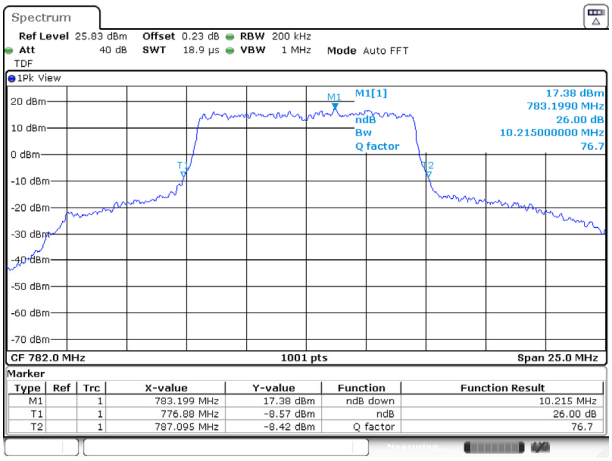
5M BW / QPSK / High ch.



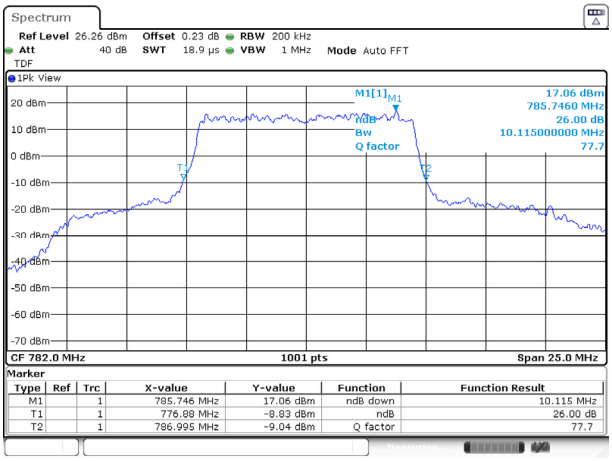
5M BW / 16QAM / High ch.



10M BW / QPSK / Mid ch.



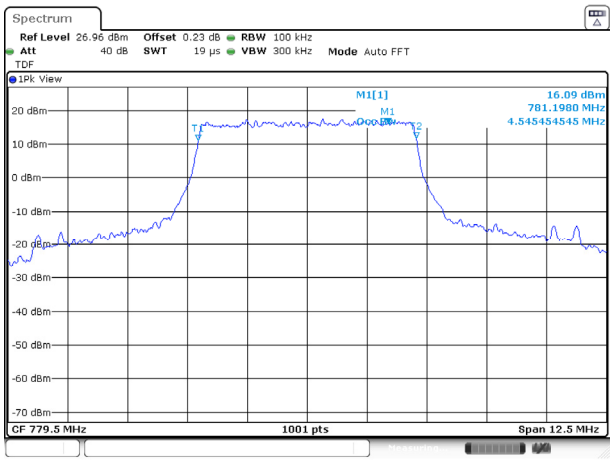
10M BW / 16QAM / Mid ch.



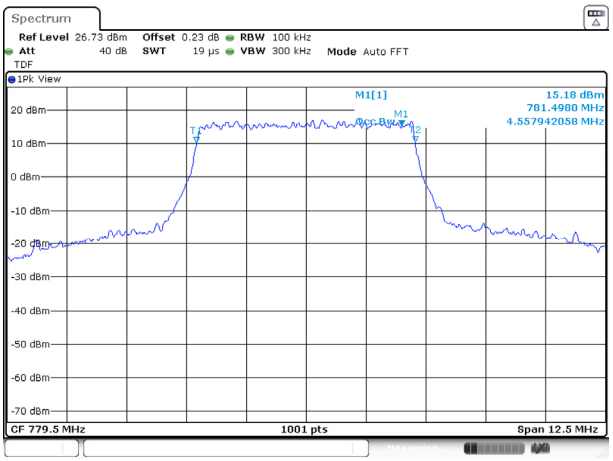
99% Occupied Bandwidth

Test mode: LTE Band 13

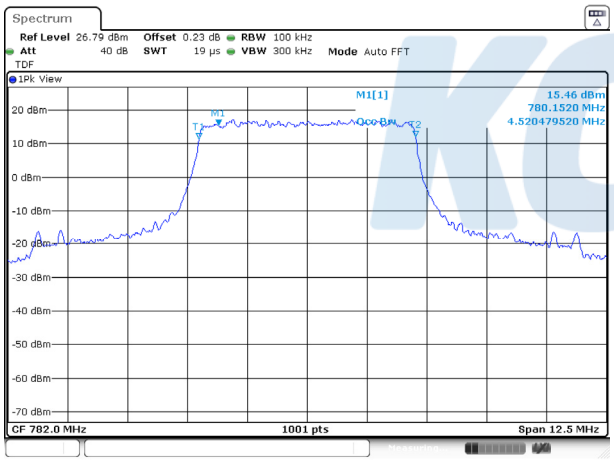
5M BW / QPSK / Low ch.



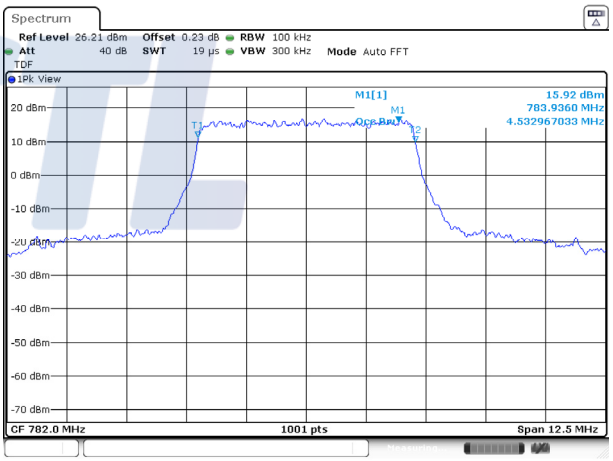
5M BW / 16QAM / Low ch.



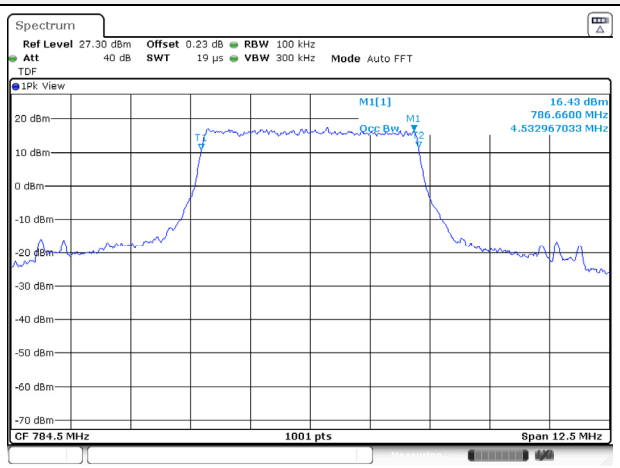
5M BW / QPSK / Mid ch.



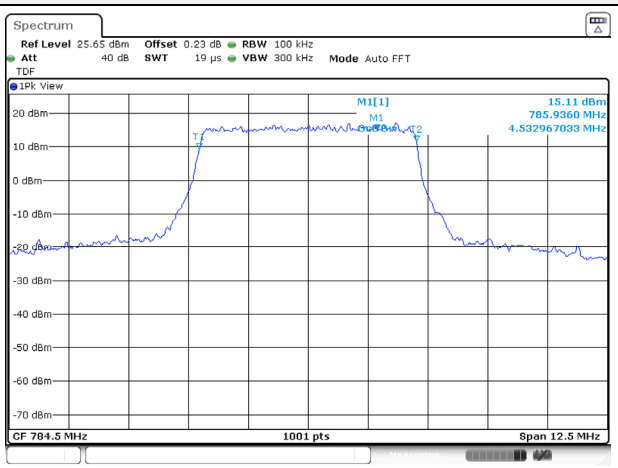
5M BW / 16QAM / Mid ch.

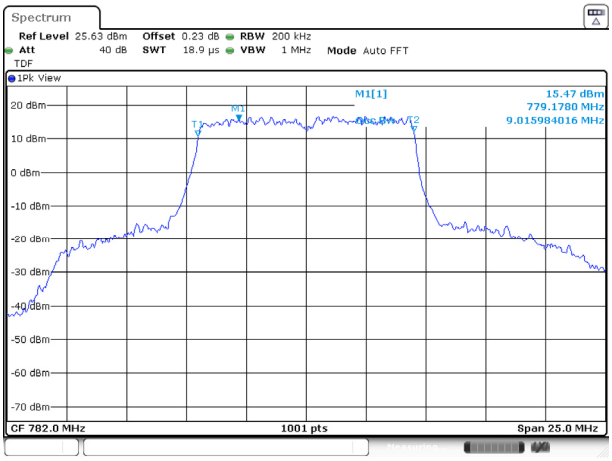
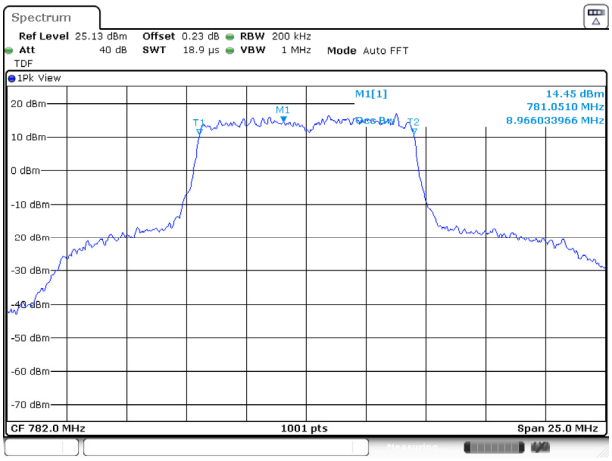


5M BW / QPSK / High ch.



5M BW / 16QAM / High ch.



10M BW / QPSK / Mid ch.	10M BW / 16QAM / Mid ch.
	

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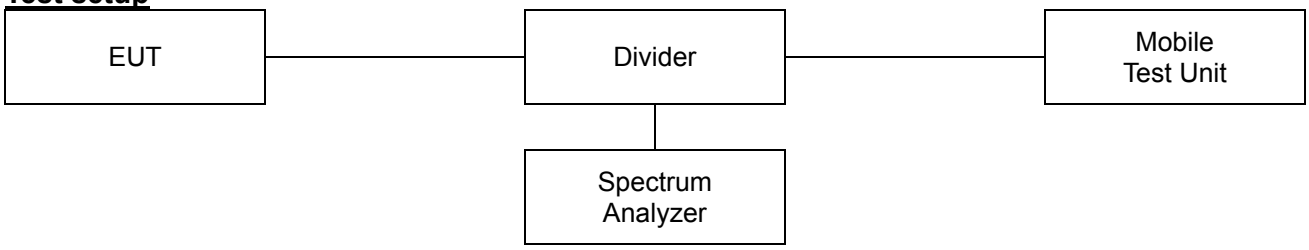
7.3. Spurious Emissions at Antenna Terminal

Test setup



Limit

According to §27.53(c)(2), on any frequency outside the 776-788 ㎒ band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10log($P_{[Watts]}$) ㏈.

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.

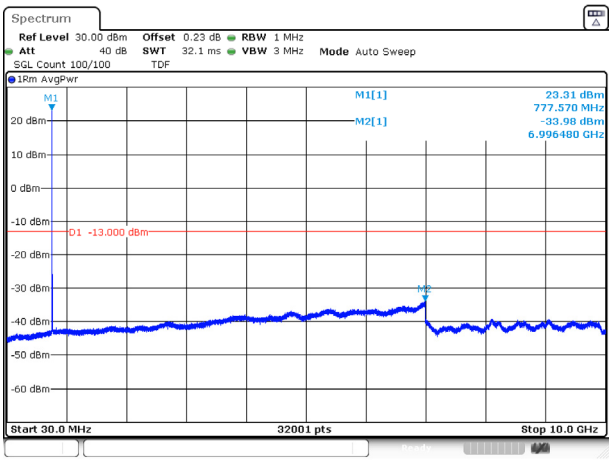
Notes:

1. Per 27.53(c), 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.

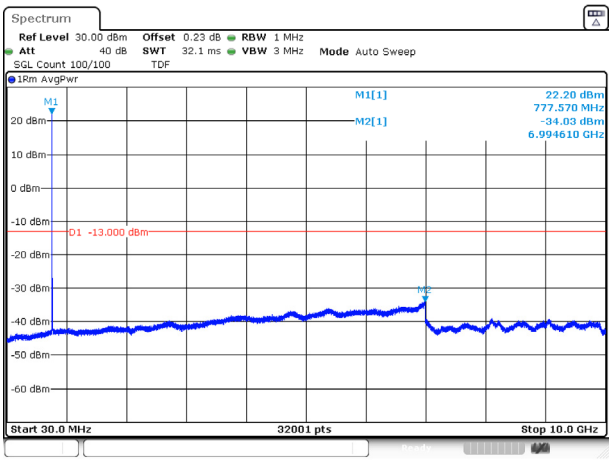
Test results

Test mode: LTE Band 13

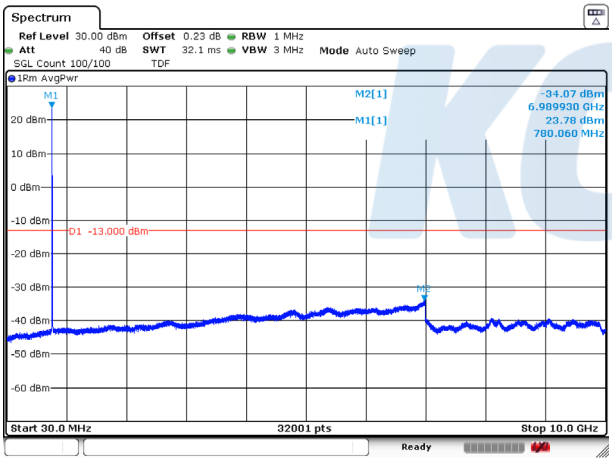
5M BW / QPSK / Low ch.



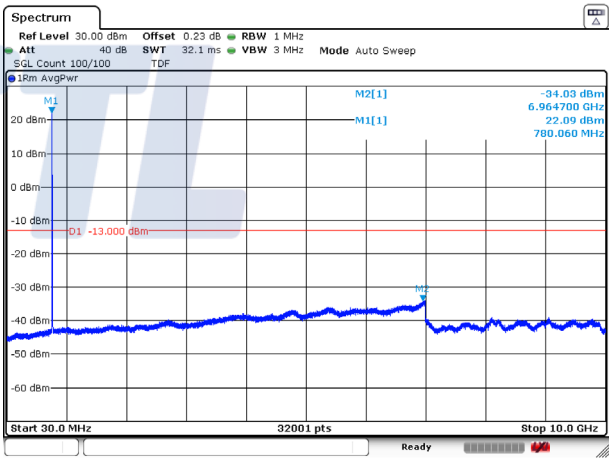
5M BW / 16QAM / Low ch.



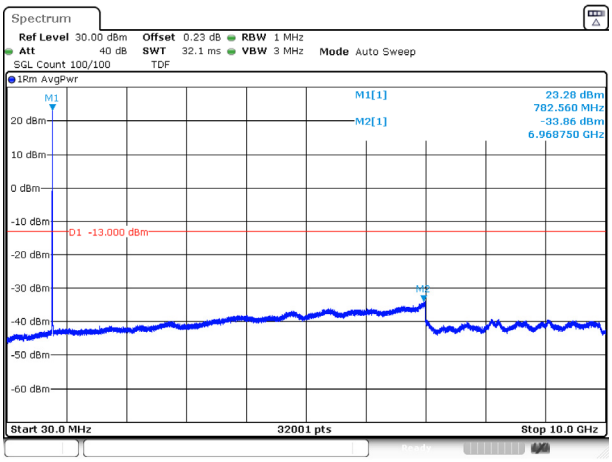
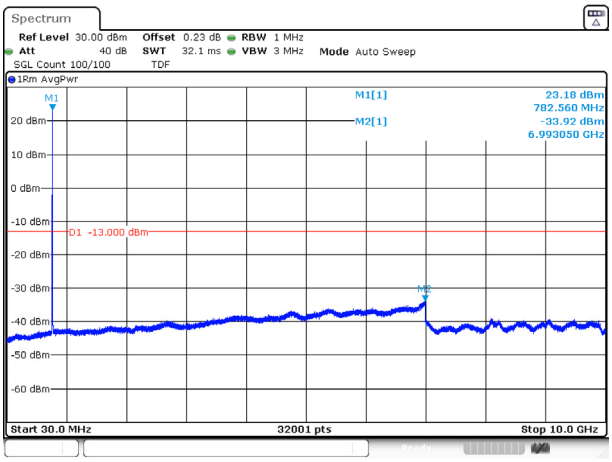
5M BW / QPSK / Mid ch.



5M BW / 16QAM / Mid ch.



5M BW / QPSK / High ch.



5M BW / 16QAM / High ch.