

KCTL Inc.

65, Sinwon-ro, Yeongtong-gu,
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TEL: 82-31-285-0894 FAX: 82-505-299-8311
www.kctl.co.kr

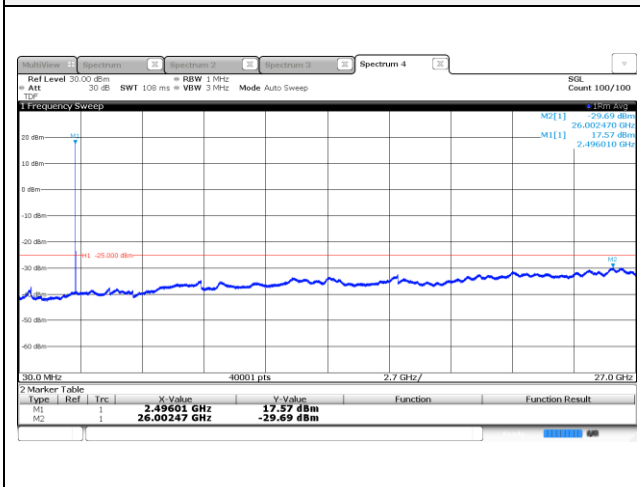
Report No.:
KR19-SRF0023-B

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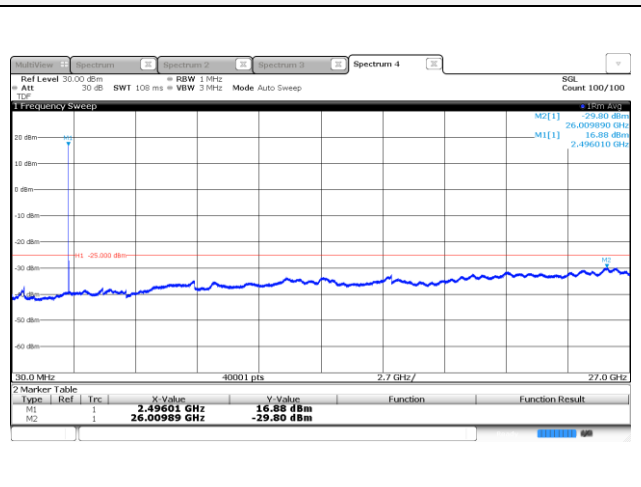


Test mode: LTE Band41

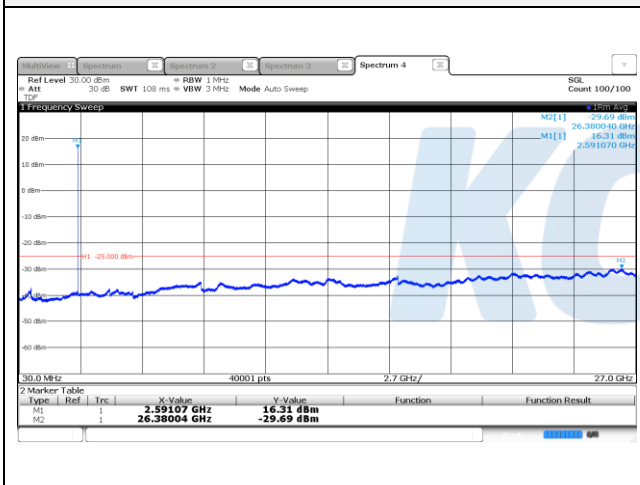
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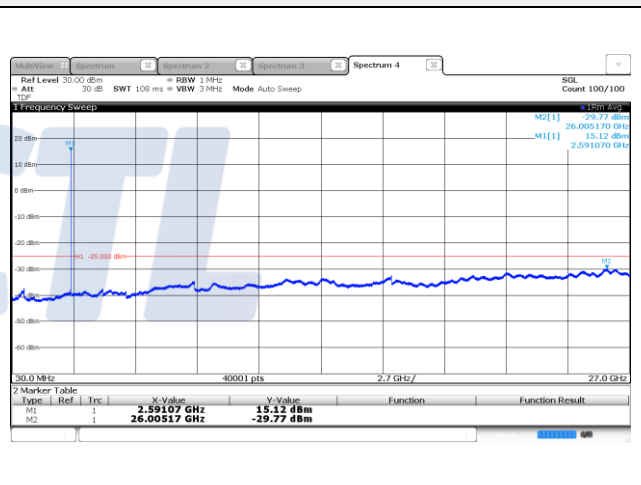
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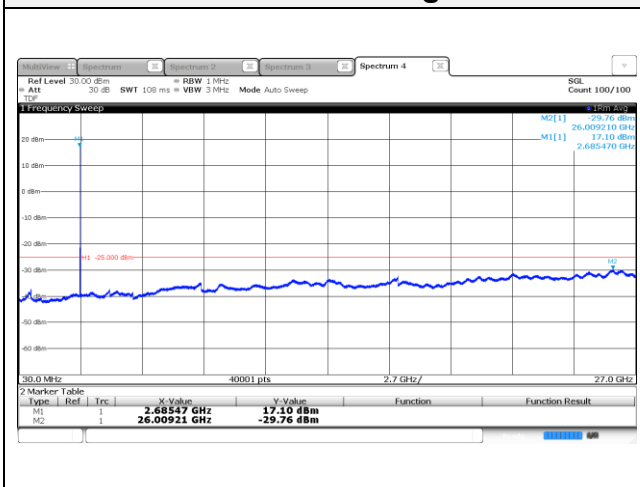
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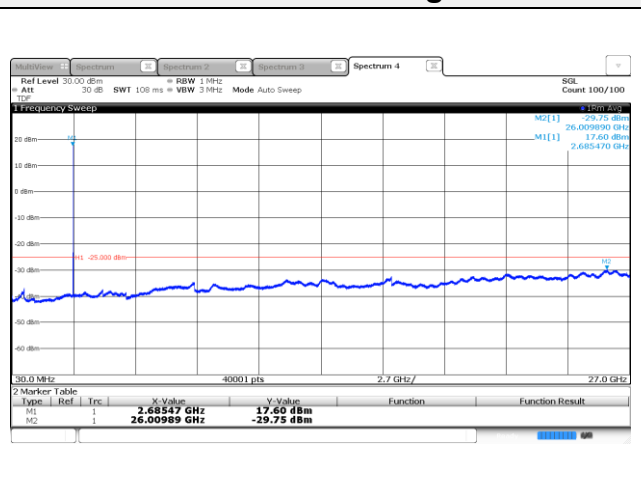
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5M BW / QPSK / High ch.



5M BW / 16QAM / High ch.



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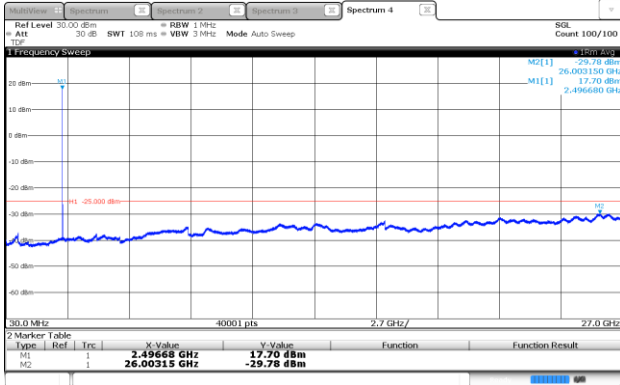
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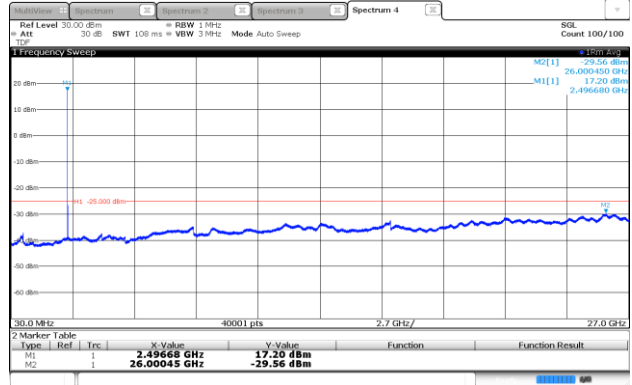
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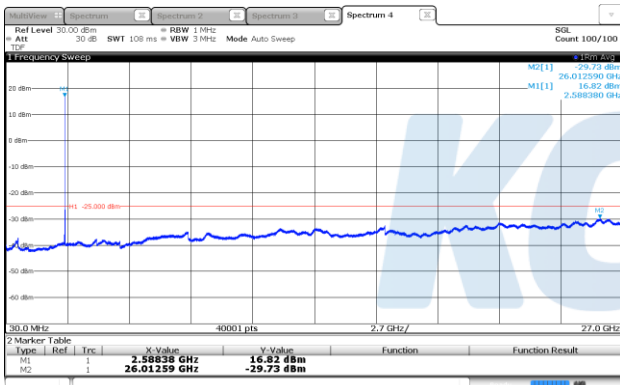
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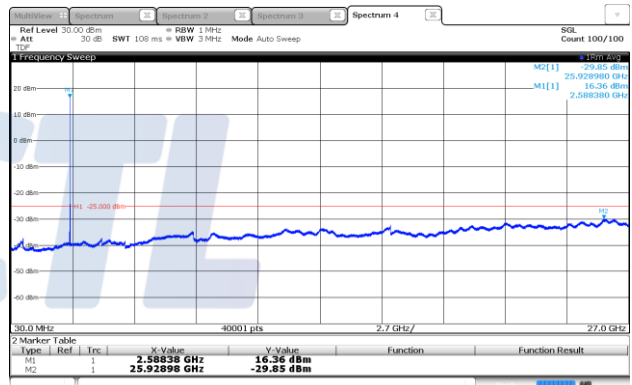
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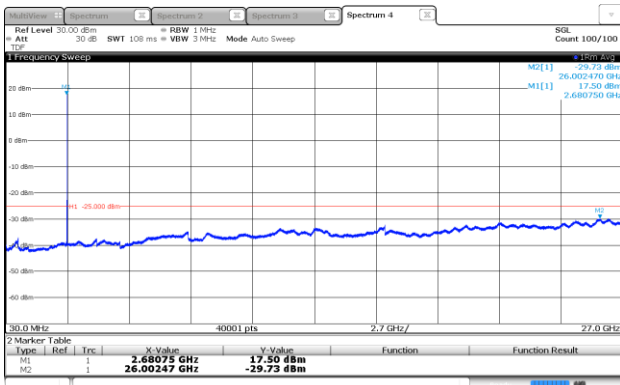
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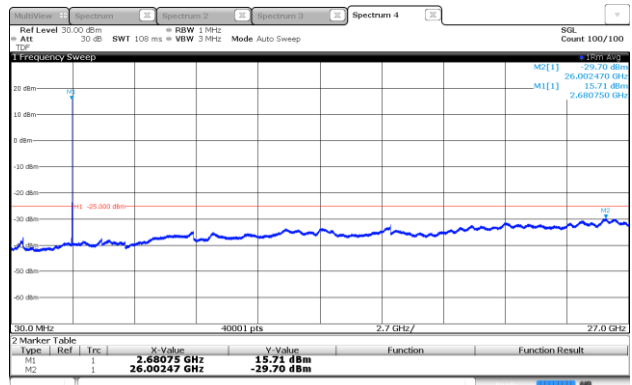
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10M BW / QPSK / High ch.



10M BW / 16QAM / High ch.



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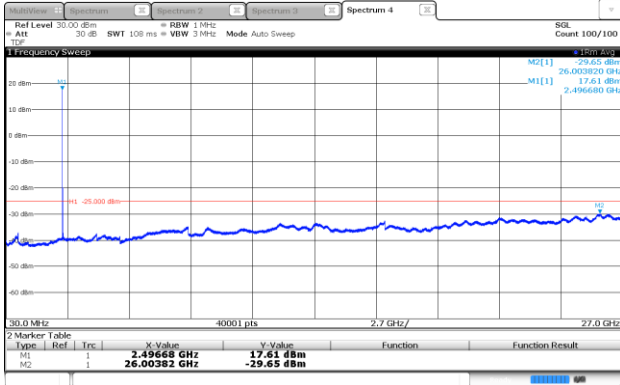
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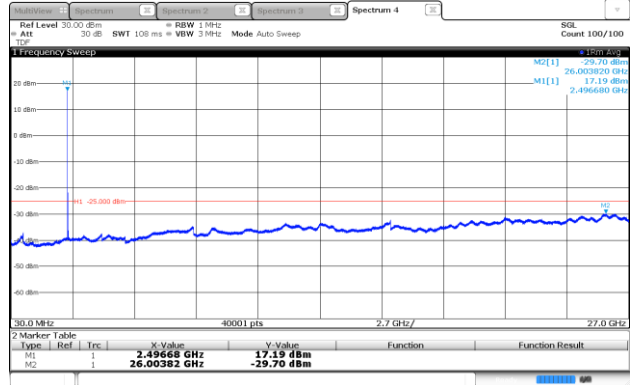
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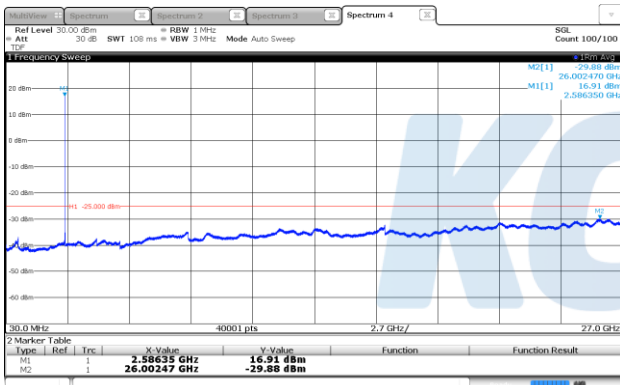
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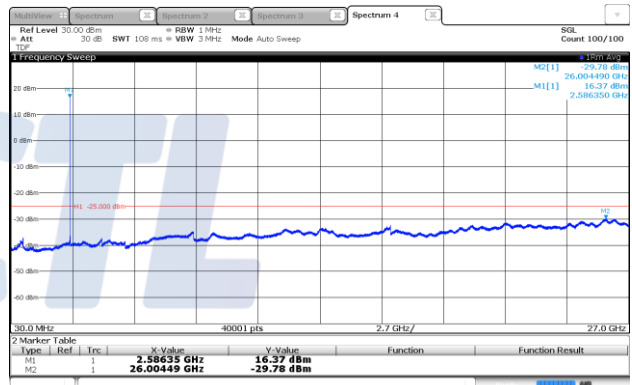
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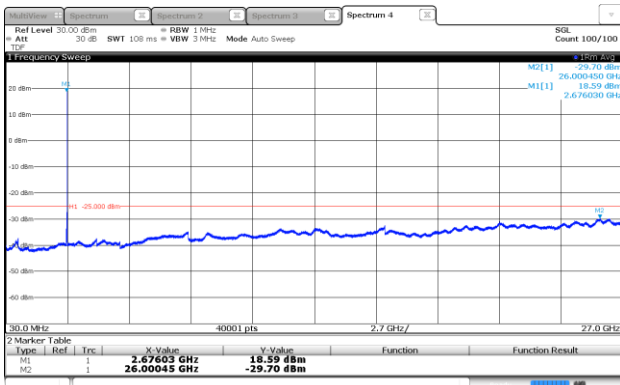
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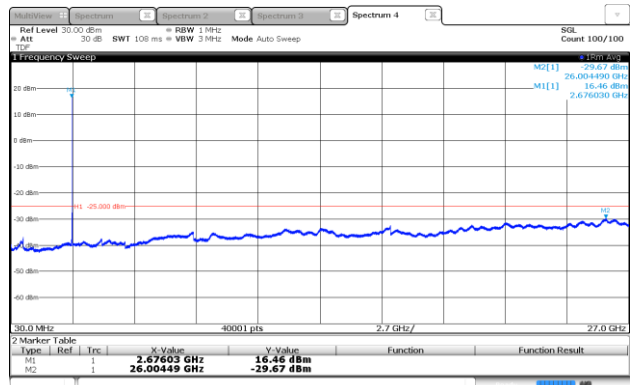
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15M BW / 16QAM / High ch.



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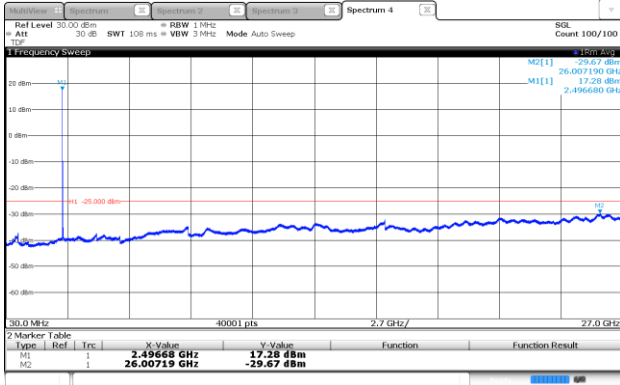
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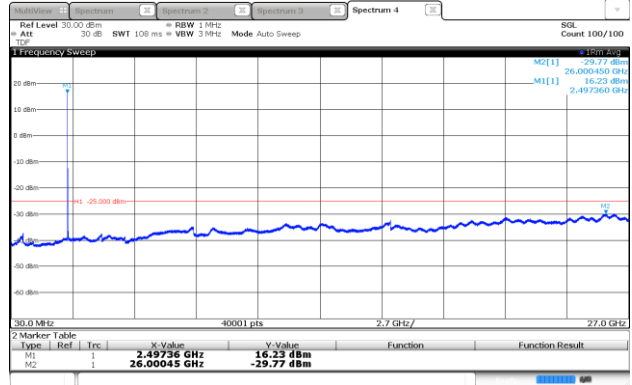
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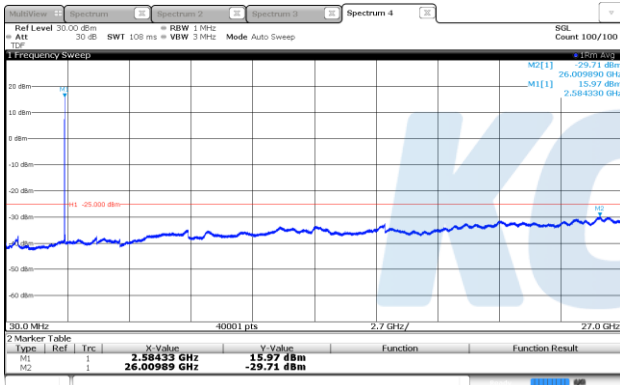
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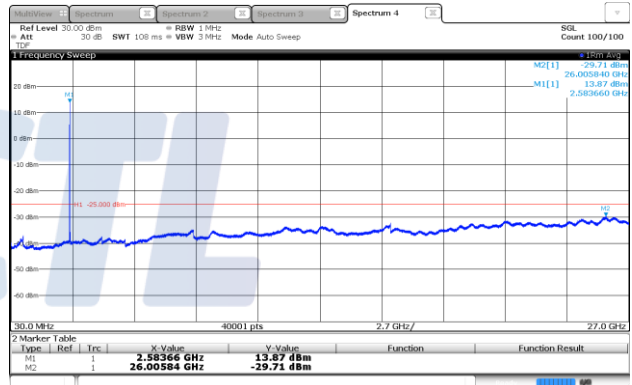
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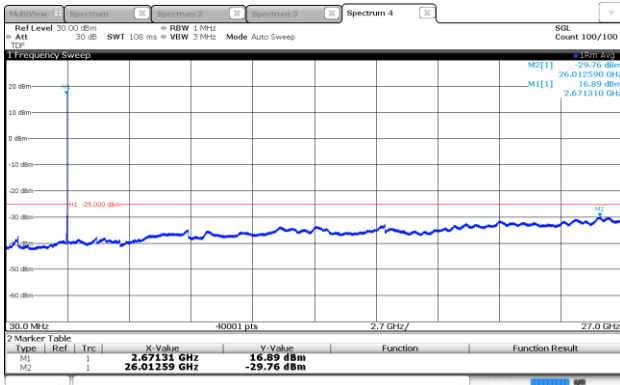
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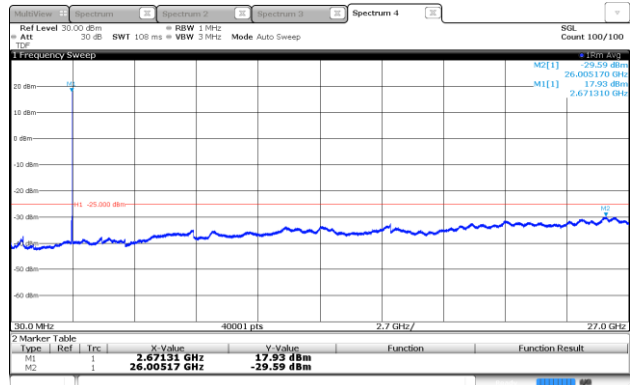
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20M BW / QPSK / High ch.

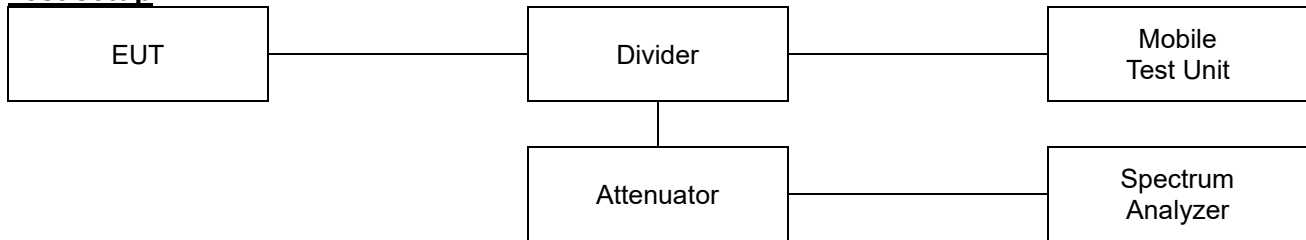


20M BW / 16QAM / High ch.



7.4. Band Edge Emissions at Antenna Terminal

Test setup



Limit

According to §22.917(a), the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P_{Watts}) by a factor of at least $43 + 10\log(P_{\text{Watts}})$ dB.

According to §27.53(m)(4), the attenuation factor shall be not less than $40 + 10\log(P_{\text{Watts}})$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge, $43 + 10\log(P_{\text{Watts}})$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and $55 + 10\log(P_{\text{Watts}})$ dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section.

Test procedure

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

Test settings

- 1) Start frequency was set to 30 MHz 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 $\geq 3 \times$ 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:
 - a) 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.
 - 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) \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

- 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 are necessary to ensure that the maximum power is measured.
- 9) Allow trace to fully stabilize.

Notes:

- Per 22.917(b), compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater.
However in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.
- Per 27.53(m)(6), in the 1 MHz bands immediately outside and adjacent to the frequency block a Resolution bandwidth of at least two percent may be employed, except when the 1 MHz band is 2495-2496 MHz, in which case a resolution bandwidth of at least one percent may be employed.
- All path loss of frequency range was investigated and compensated to spectrum analyzer as TDF function. Please refer to the page 8.
- The EUT was setup to maximum output power as its lowest and highest channel with all bandwidth, modulation.

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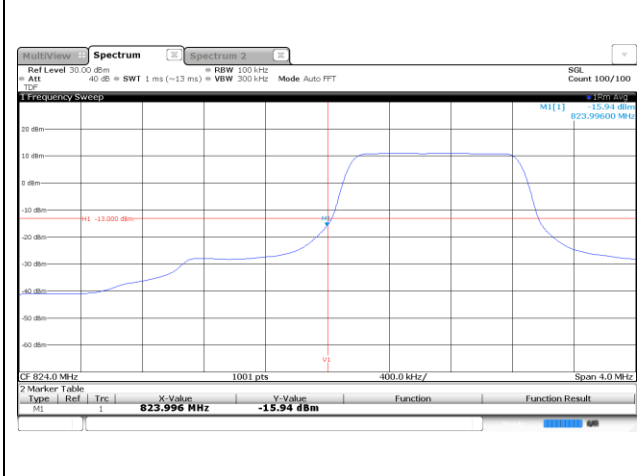
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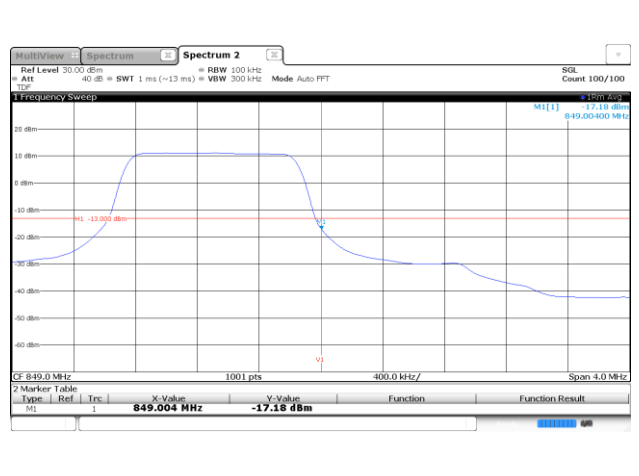
Test results

Test mode: LTE Band5

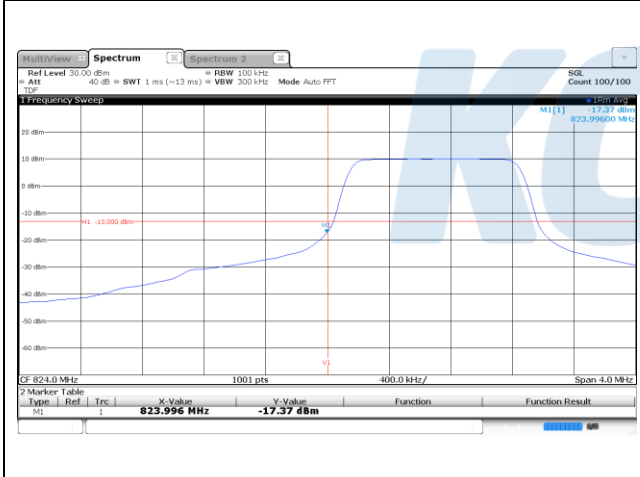
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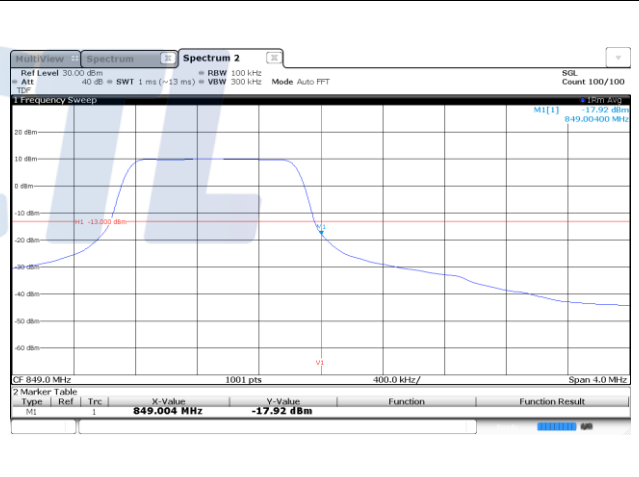
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1.4M BW / 16QAM / Low ch.



1.4M BW / 16QAM / High ch.



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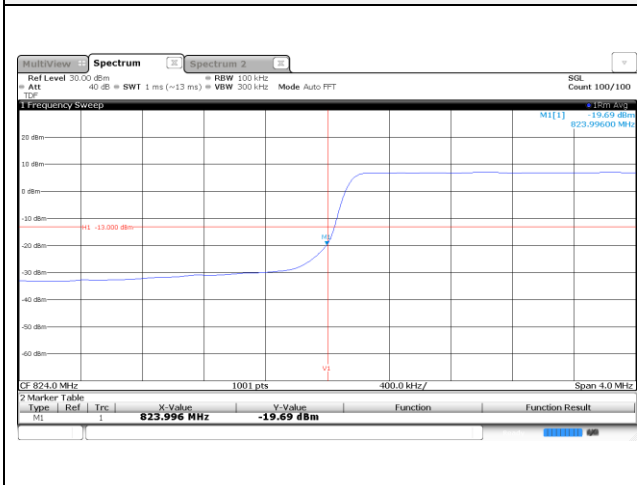
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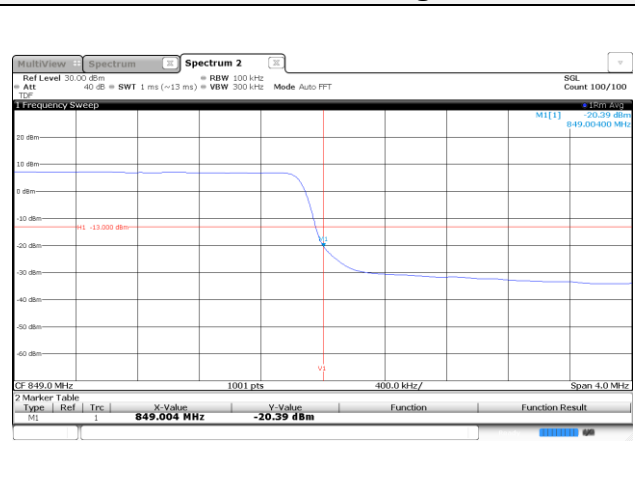
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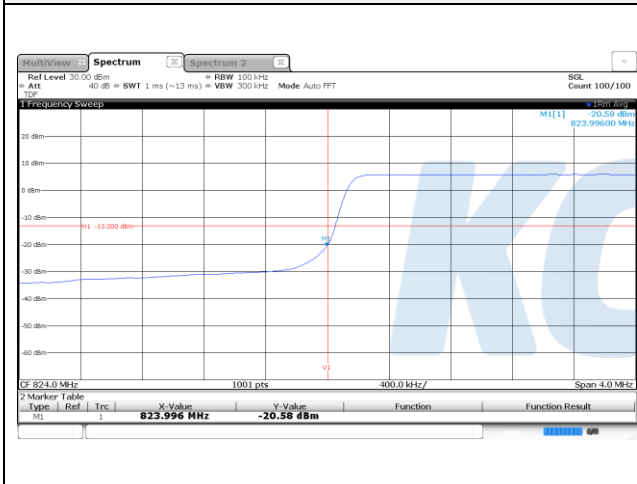
3M BW / QPSK/ Low ch.



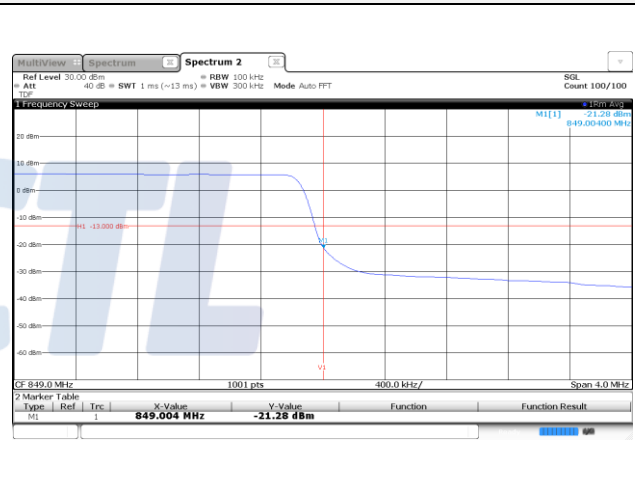
3M BW / QPSK/ High ch.



3M BW / 16QAM / Low ch.



3M BW / 16QAM / High ch.



KCTL Inc.

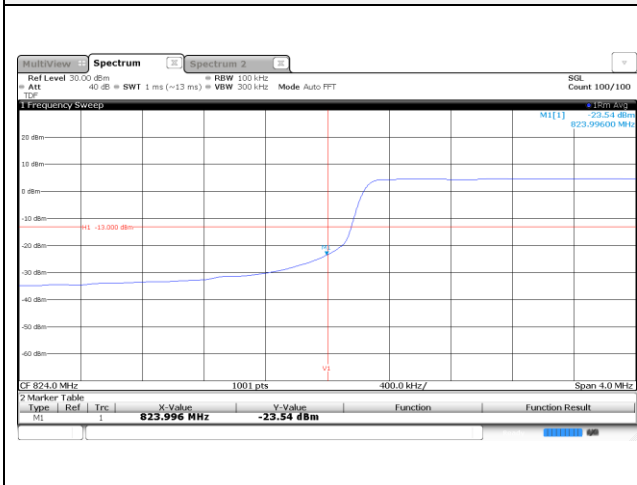
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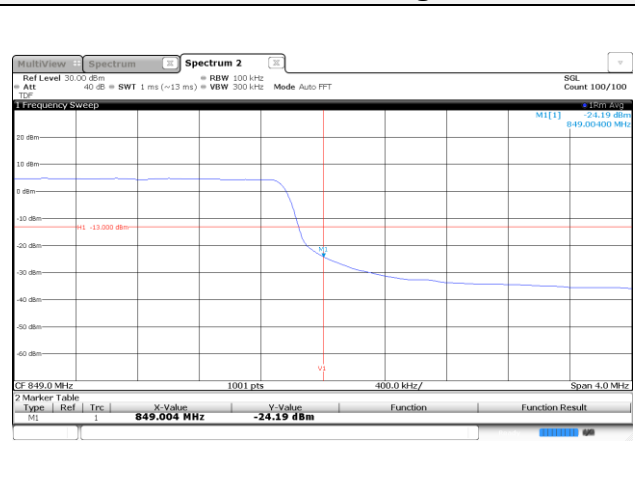
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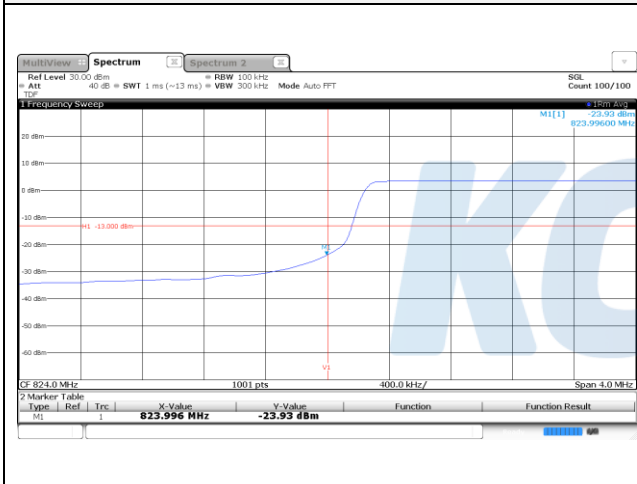
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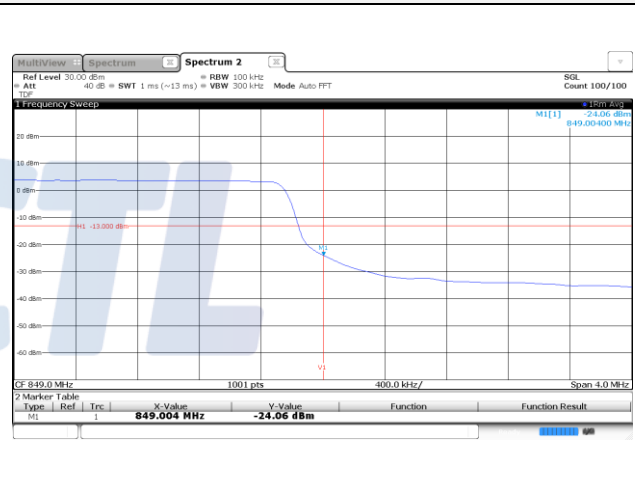
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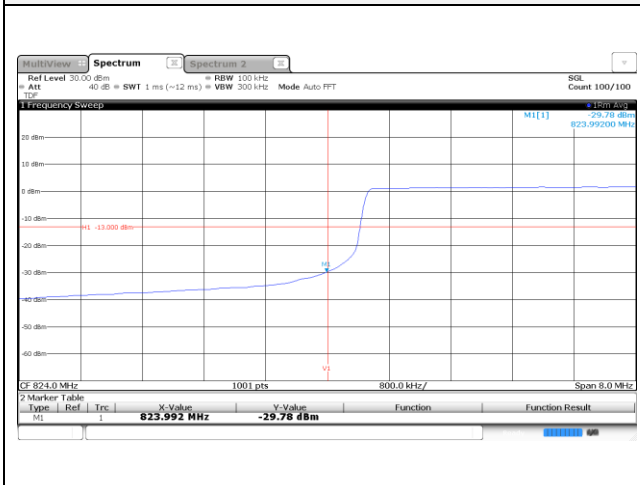
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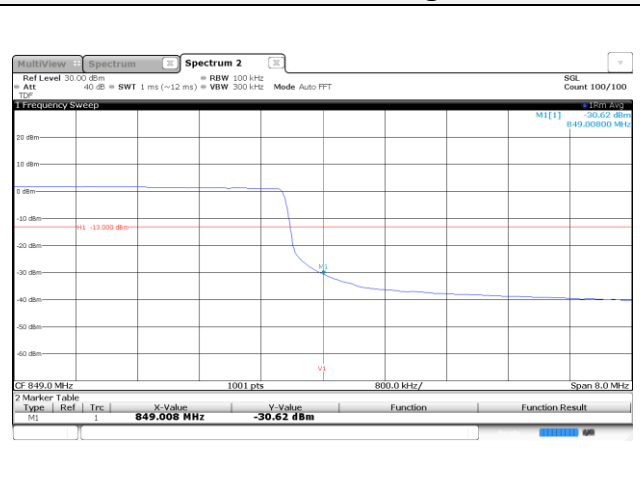
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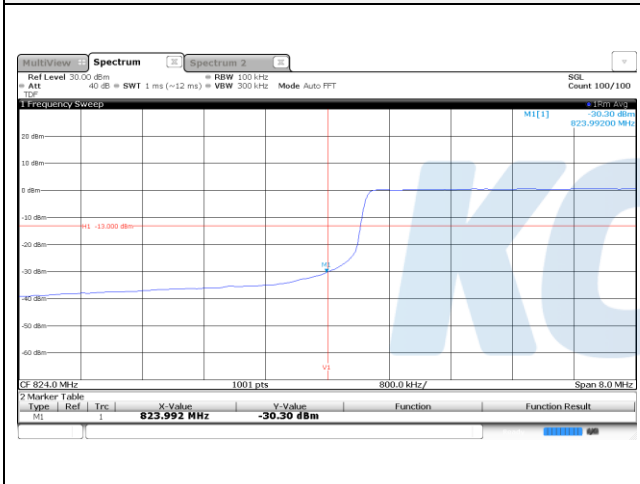
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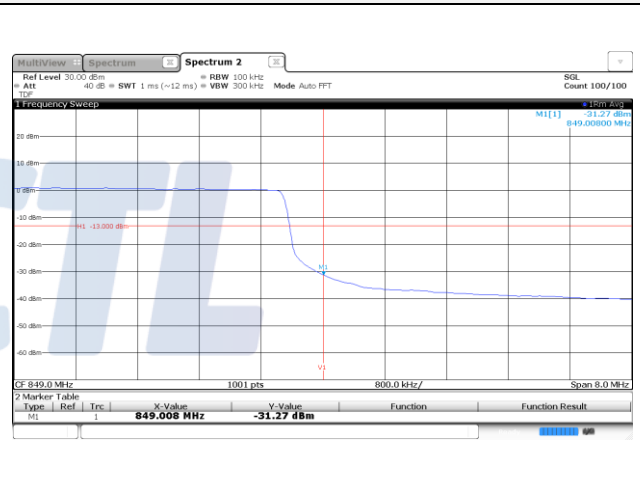
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10M BW / 16QAM / Low ch.



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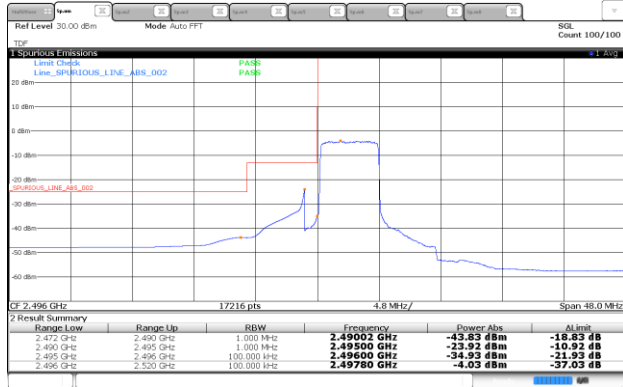
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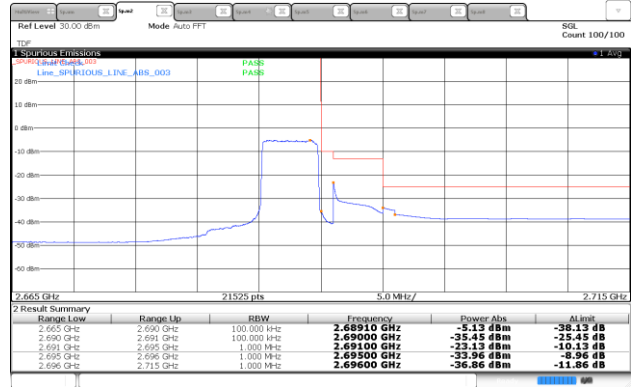


Test mode: LTE Band41

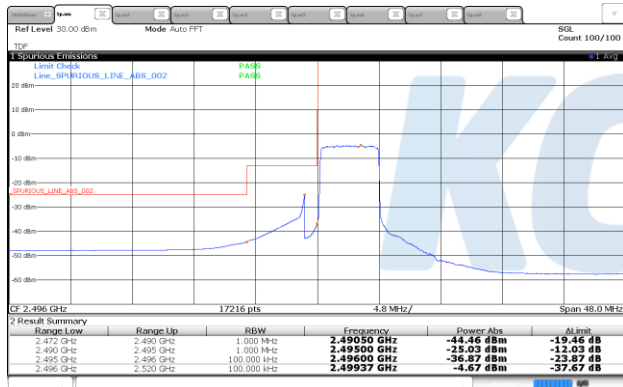
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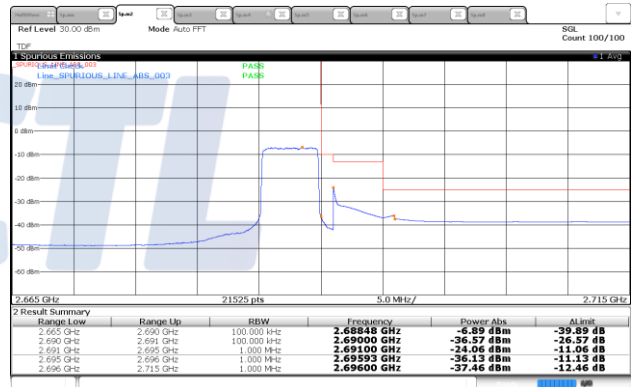
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5M BW / 16QAM / Low ch.



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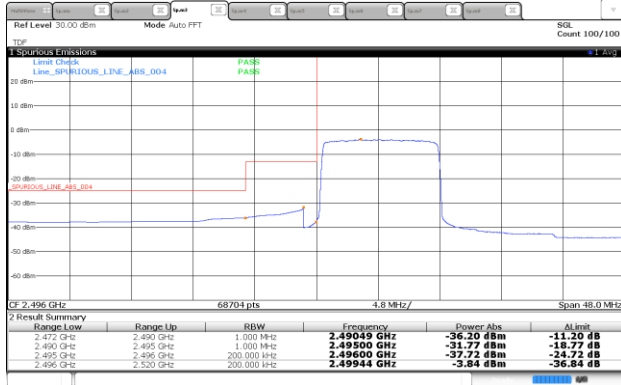
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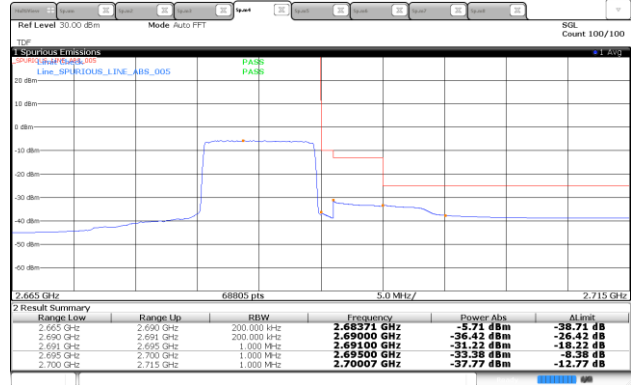
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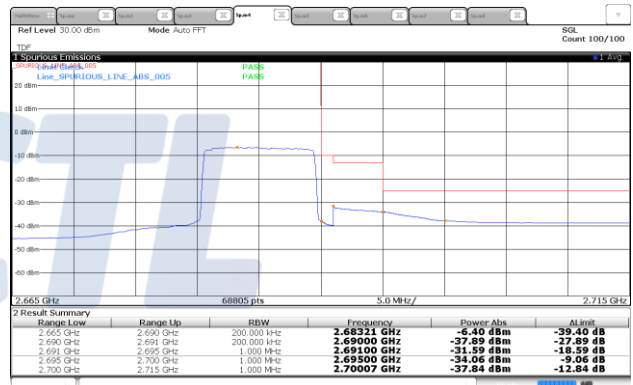
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10M BW / 16QAM / Low ch.



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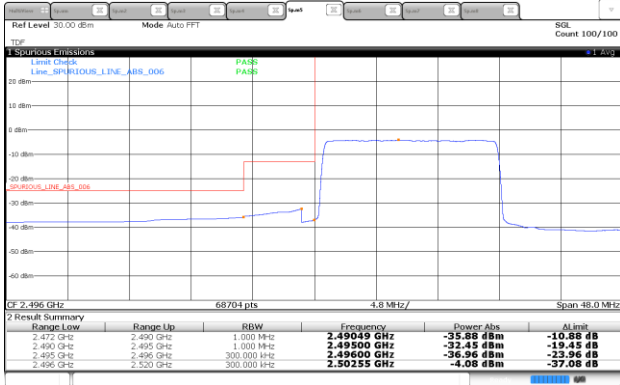
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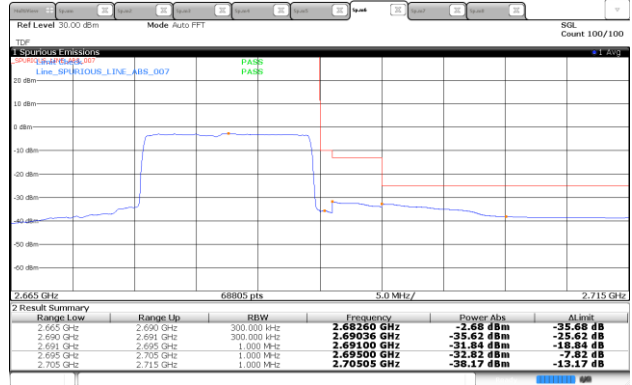
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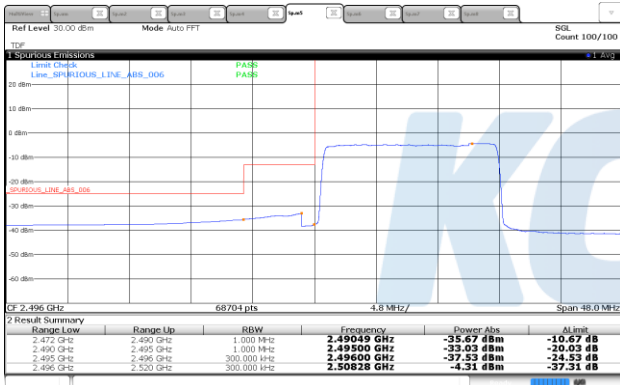
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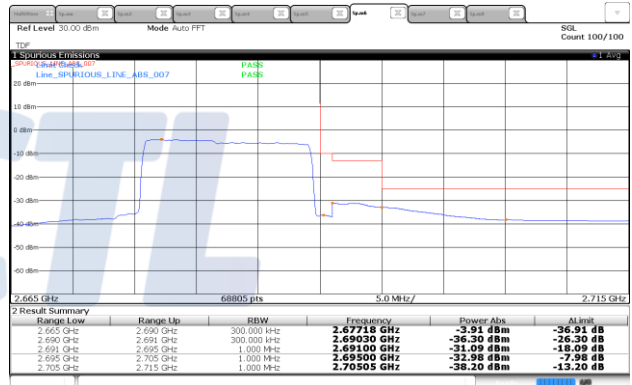
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KCTL Inc.

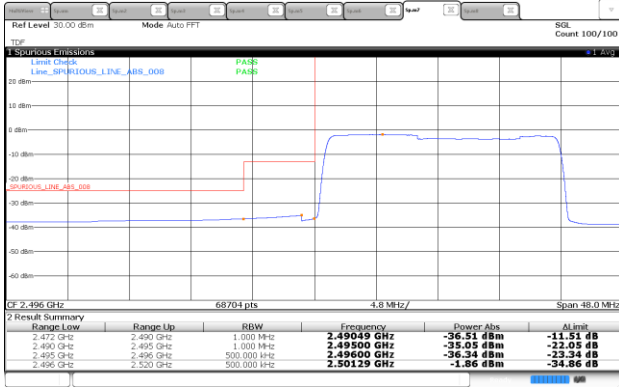
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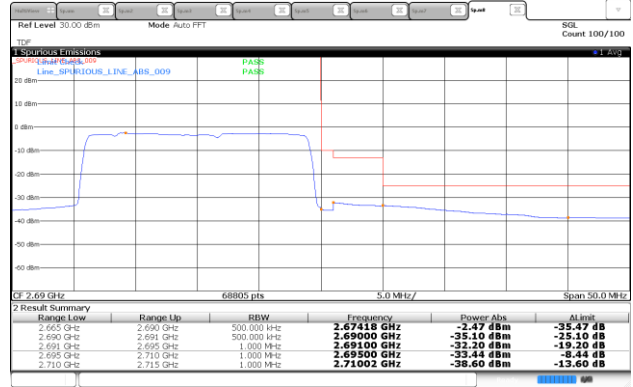
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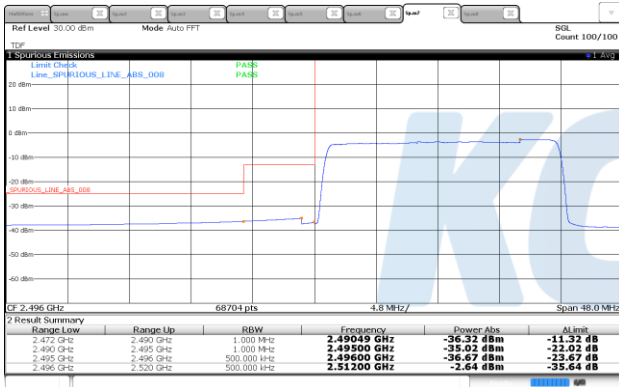
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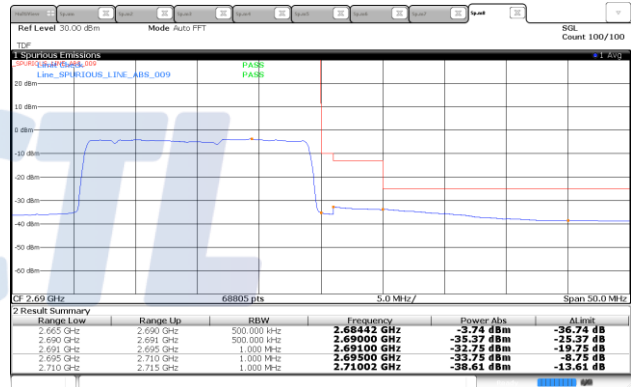
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20M BW / 16QAM / Low ch.

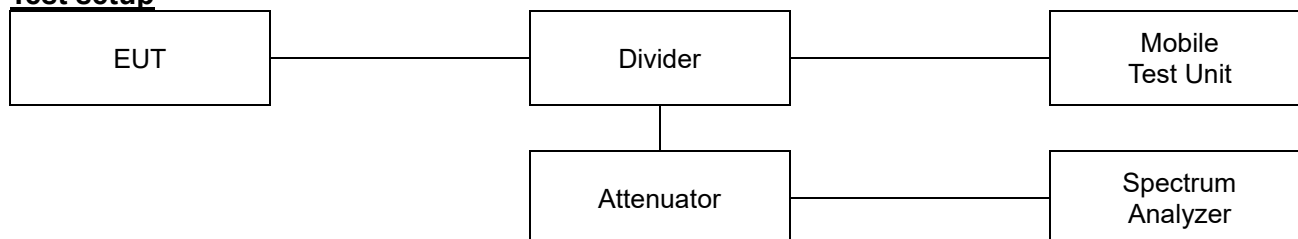


20M BW / 16QAM / High ch.



7.5. Peak to Average Power Ratio (PAPR)

Test setup



Limit

According to §22.913(d), the peak-to-average ratio(PAR) of the transmission must not exceed 13 dB.

Test procedure

971168 D01 v03r01 - Section 5.7.2

ANSI 63.26-2015 – Section 5.2.3.4

Test settings

5.2.3.4 Measurement of peak power in a broadband noise-like signal using CCDF

- 1) Set resolution/measurement bandwidth \geq OBW or specified reference bandwidth
- 2) Set the number of counts to a value that stabilizes the measured CCDF curve.
- 3) Set the measurement interval as follows:
 - a) For continuous transmissions, set to the greater of $[10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$ or 1 ms.
 - b) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.
 - c) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.
- 4) Record the maximum PAPR level associated with a probability of 0.1%

5.2.6 Peak-to-average power ratio

Use one of the procedures presented in 5.2(ANSI C63.26-2015) to measure the total peak power and record as P_{PK} .

Use one of the applicable procedure presented 5.2(ANSI C63.26-2015) to measure the total average power and record as P_{AG} . Determine the P.A.P.R from:

$$PAPR(\text{dB}) = P_{PK}(\text{dBm or dBW}) - P_{AG}(\text{dBm or dBW})$$

Notes:

1. All path loss of frequency range was investigated and compensated to spectrum analyzer as TDF function. Please refer to the page 8.

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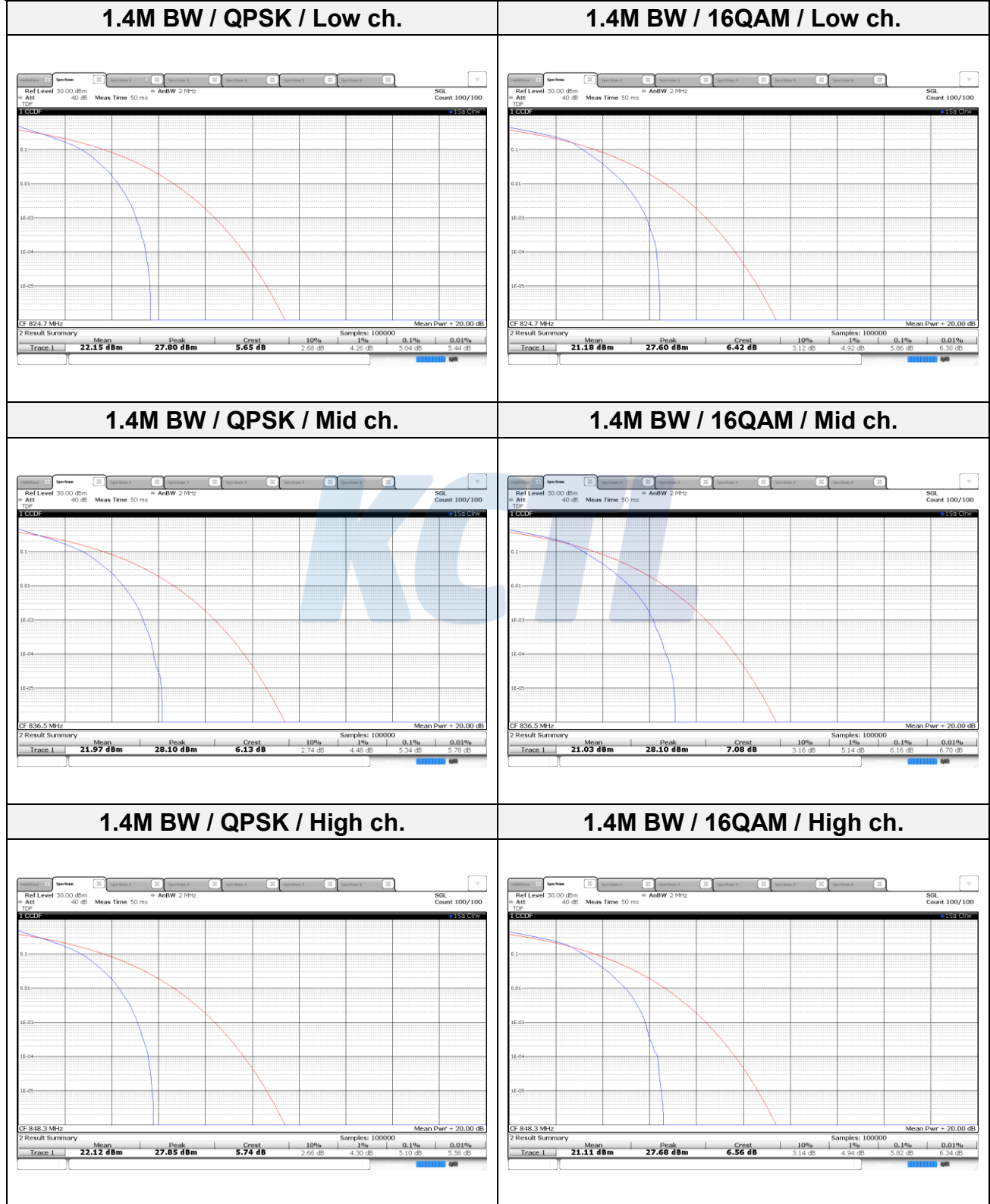
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Test results

Test mode: LTE Band5



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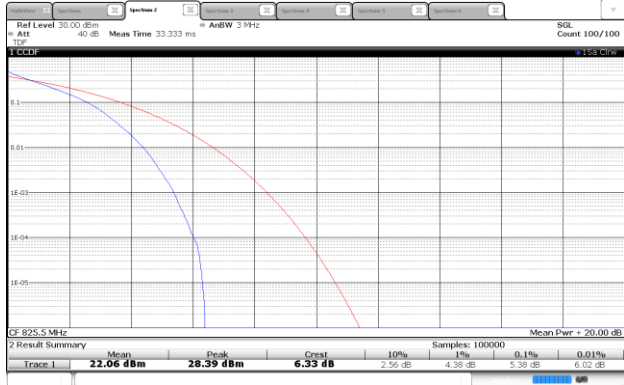
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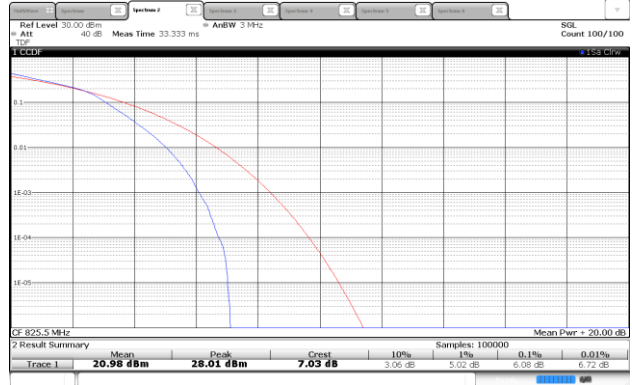
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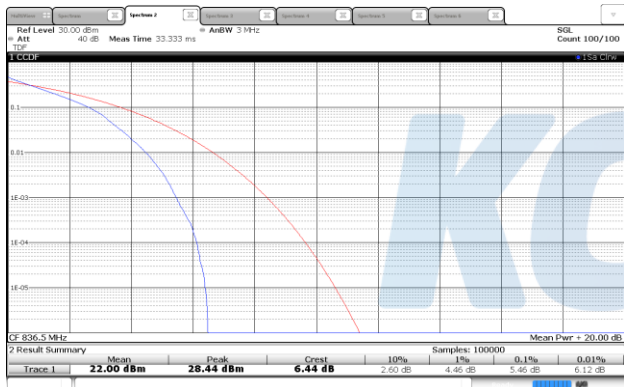
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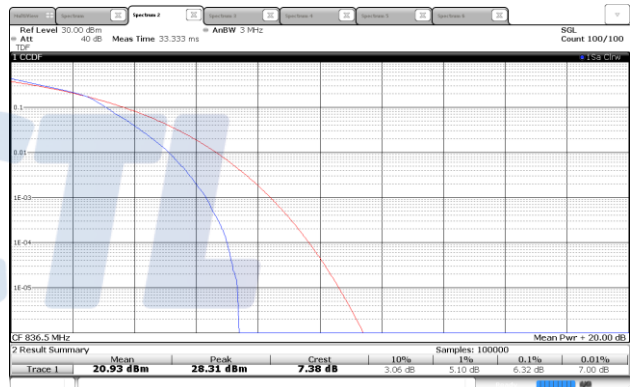
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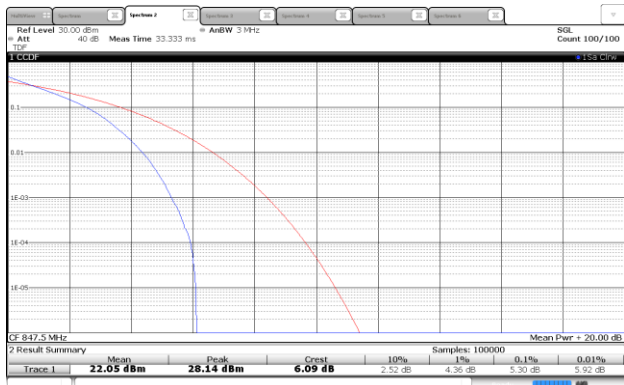
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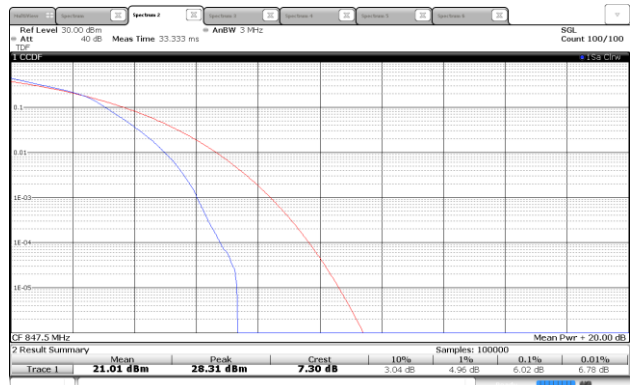
3M BW / 16QAM / Mid ch.



3M BW / QPSK / High ch.



3M BW / 16QAM / High ch.



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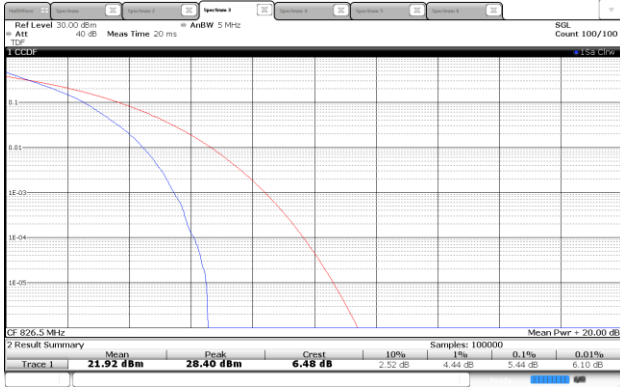
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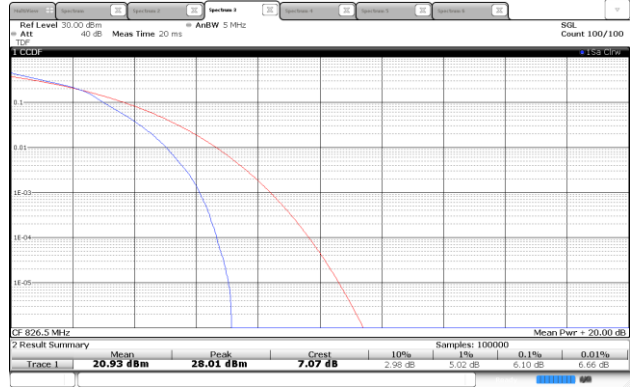
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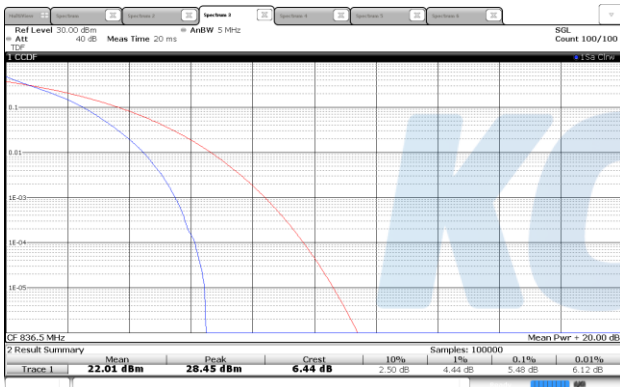
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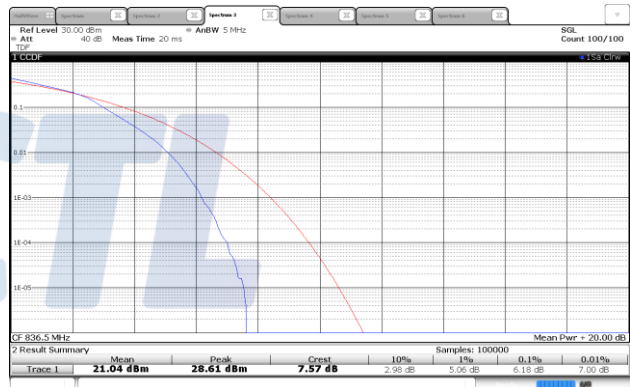
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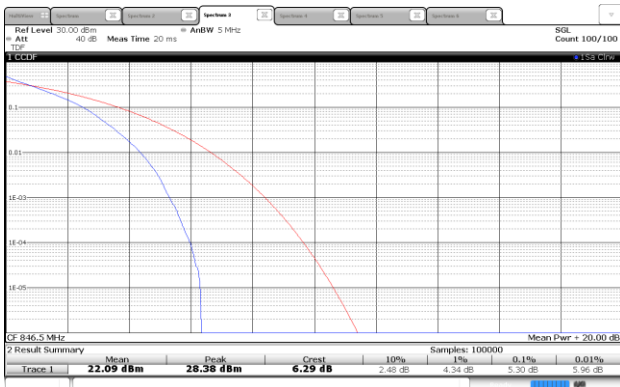
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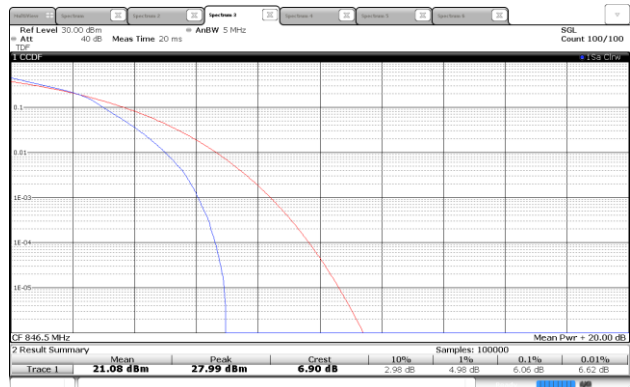
5M BW / 16QAM / Mid ch.



5M BW / QPSK / High ch.



5M BW / 16QAM / High ch.



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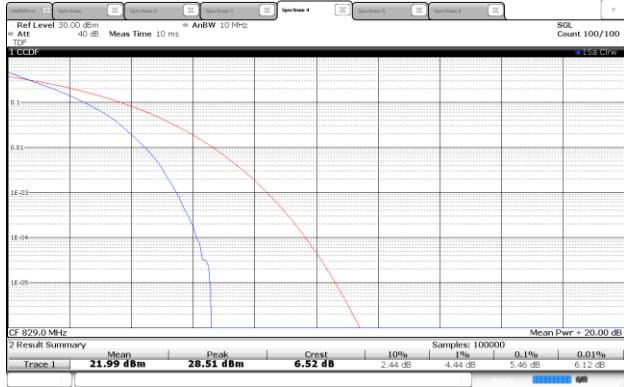
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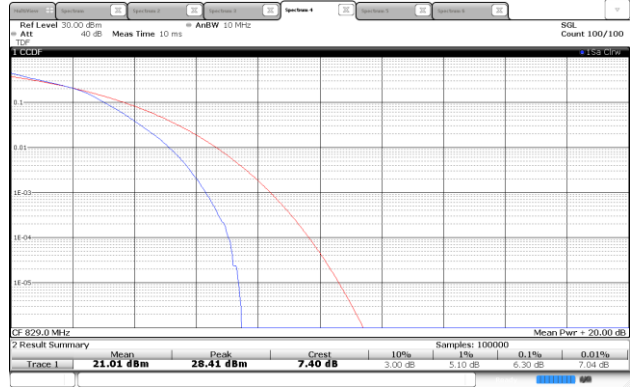
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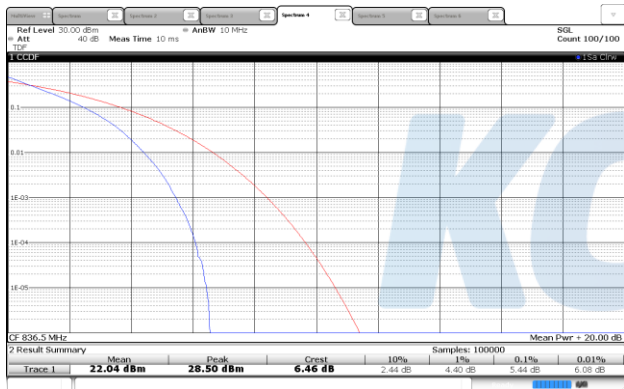
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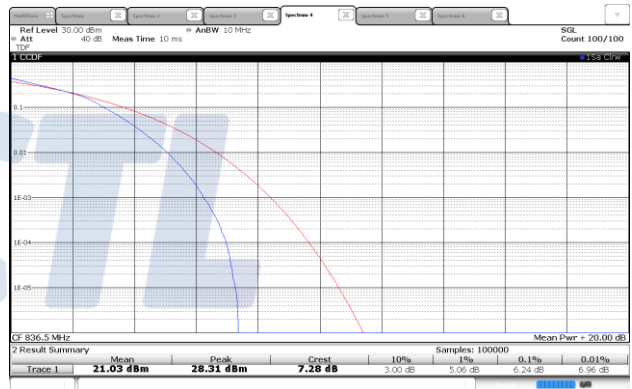
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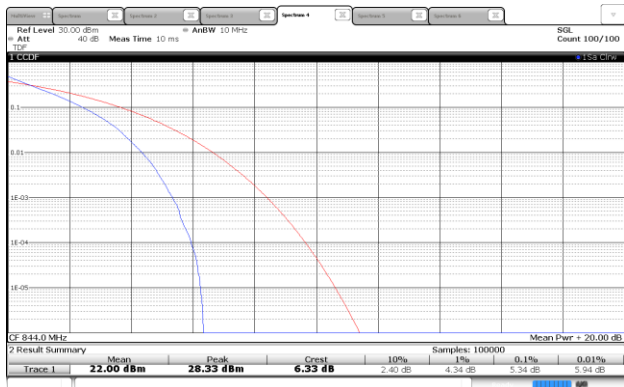
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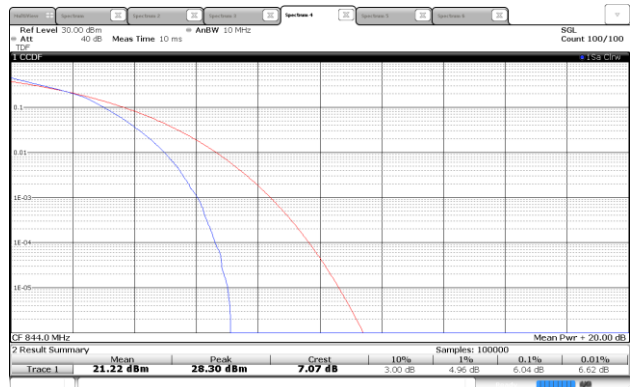
10M BW / 16QAM / Mid ch.



10M BW / QPSK / High ch.

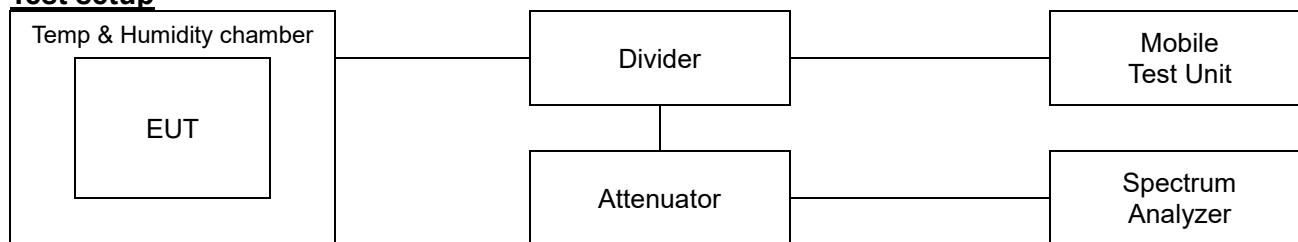


10M BW / 16QAM / High ch.



7.6. Frequency stability

Test setup



Limit

According to §2.1055(a),

The frequency stability shall be measured with variation of ambient temperature as follows:

- 1) From -30° to $+50^{\circ}$ centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
- 2) From -20° to $+50^{\circ}$ centigrade for equipment to be licensed for use in the maritime services under part 80 of this chapter, except for class A, B, and S emergency position indicating radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the local television transmission service and point-to-point microwave radio service under part 21 of this chapter, equipment licensed for use aboard aircraft in the aviation services under part 87 of this chapter, and equipment authorized for use in the family radio service under part 95 of this chapter.
- 3) From 0° to $+50^{\circ}$ centigrade for equipment to be licensed for use in the radio broadcast Services under part 73 of this chapter.

According to §2.1055(d),

The frequency stability shall be measured with variation of primary supply Voltage as follows:

- 1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand-carried battery equipment.
- 2) For hand-carried, battery-powered equipment, reduce primary supply voltage to the battery operating and point which shall be specified by the manufacturer.
- 3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

According to §22.355,

The carrier frequency of each transmitter in the public mobile services must be maintained within the tolerances given in Table of this section.

For mobile devices operating in the 824 to 849 MHz band at a power level than or equal to 3 Watts, the limit specified in Table C-1 is ± 2.5 ppm.

According to §27.54,

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the Authorized bands of operation.

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KCTL**Test procedure**

ANSI 63.26-2015 – Section 5.6

Test settings

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

Notes:

1. All path loss of frequency range was investigated and compensated to spectrum analyzer as TDF function. Please refer to the page 8.

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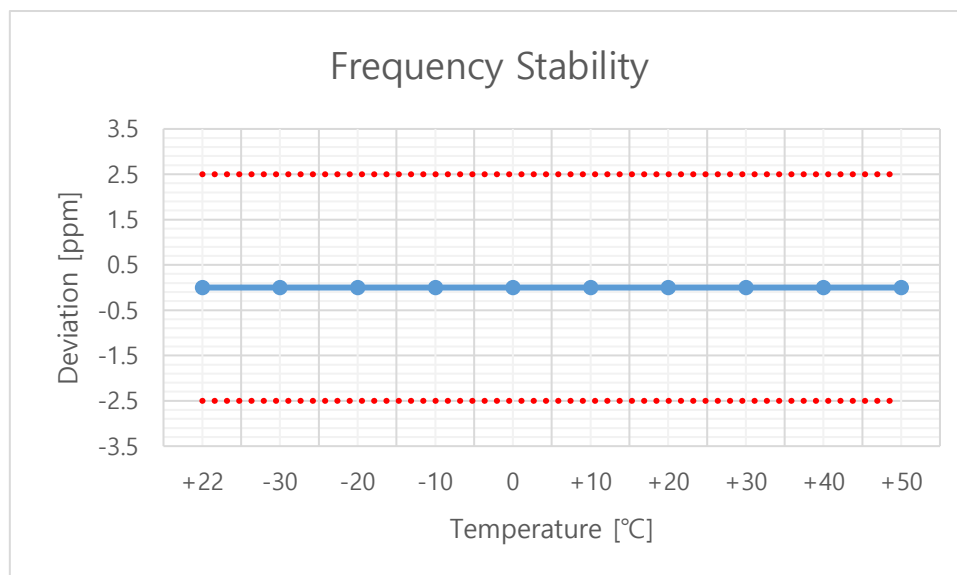
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**Test results**

Test mode : LTE Band5
Frequency (Hz) : 836 500 000
Channel : 20525
Deviation limit : ±0.00025% or 2.5ppm

Voltage (%)	Power (V)	Temp. (°C)	Frequency (Hz)	Frequency error (Hz)	Deviation	
					(ppm)	(%)
100%	3.85	+22(Ref)	836 500 002	2	0.0	0.000 000
		-30	836 499 999	-1	0.0	0.000 000
		-20	836 499 999	-1	0.0	0.000 000
		-10	836 499 998	-2	0.0	0.000 000
		0	836 499 999	-1	0.0	0.000 000
		+10	836 500 001	1	0.0	0.000 000
		+20	836 500 000	0	0.0	0.000 000
		+30	836 500 001	1	0.0	0.000 000
		+40	836 500 000	0	0.0	0.000 000
115%	4.43	+22(Ref)	836 500 001	1	0.0	0.000 000
End point	3.40	+22(Ref)	836 500 000	0	0.0	0.000 000



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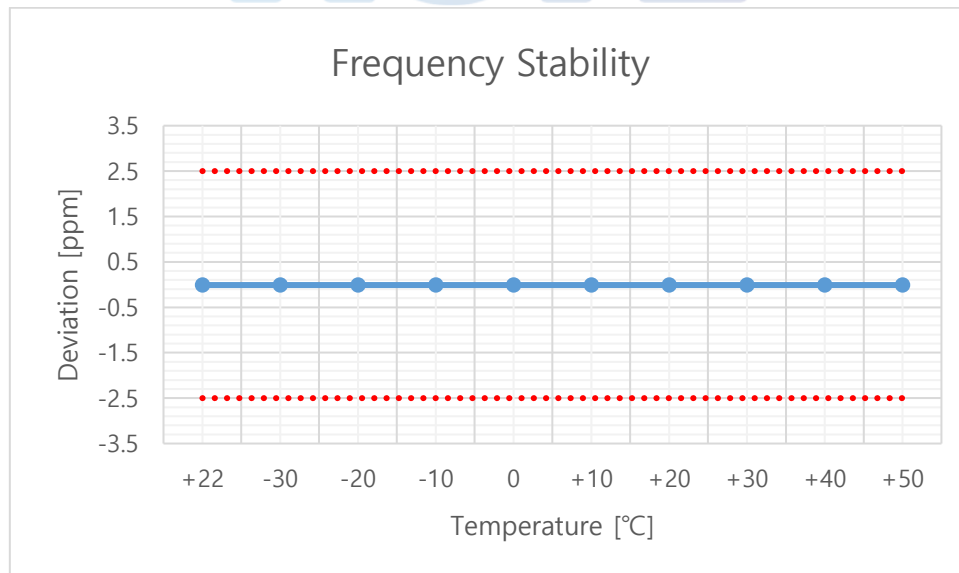
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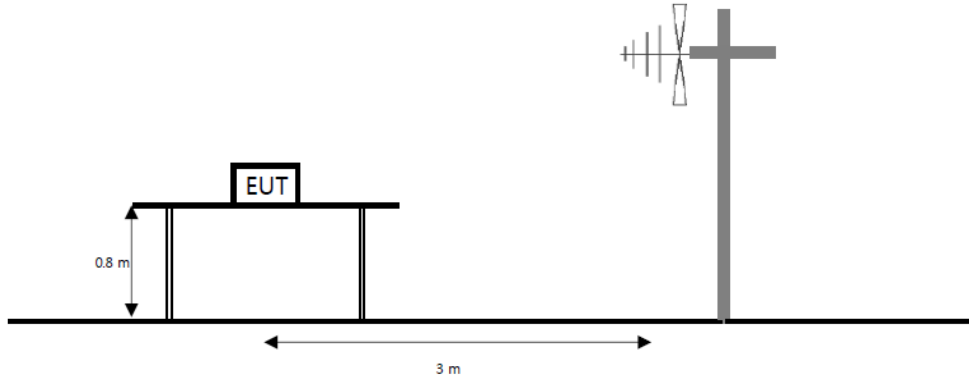
Test mode : LTE Band41
Frequency (Hz) : 2 593 000 000
Channel : 20175
Deviation limit : ±0.00025% or 2.5ppm

Voltage (%)	Power (V)	Temp. (°C)	Frequency (Hz)	Frequency error (Hz)	Deviation	
					(ppm)	(%)
100%	3.85	+22(Ref)	2 592 999 976	-24	0.0	-0.000 001
		-30	2 592 999 981	-19	0.0	-0.000 001
		-20	2 592 999 981	-19	0.0	-0.000 001
		-10	2 592 999 976	-24	0.0	-0.000 001
		0	2 592 999 979	-21	0.0	-0.000 001
		+10	2 592 999 981	-19	0.0	-0.000 001
		+20	2 592 999 981	-19	0.0	-0.000 001
		+30	2 592 999 975	-25	0.0	-0.000 001
		+40	2 592 999 975	-25	0.0	-0.000 001
		+50	2 592 999 974	-26	0.0	-0.000 001
115%	4.43	+22(Ref)	2 592 999 982	-18	0.0	-0.000 001
End point	3.40	+22(Ref)	2 592 999 978	-22	0.0	-0.000 001

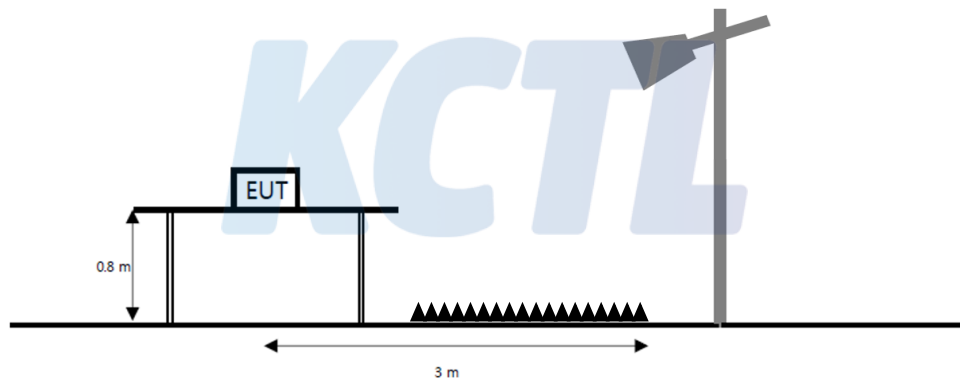


7.7. Radiated Power (ERP/EIRP)**Test setup**

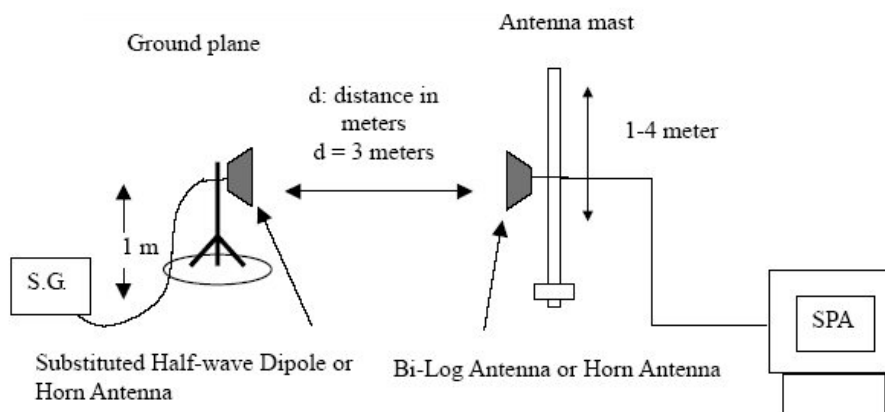
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz emissions, whichever is lower.



The diagram below shows the test setup for substituted method.



Limit

According to §22.913(a)(5), the ERP of transmitters in the cellular radiotelephone service must not exceed the limits in this section. The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

According to §27.50(h)(2), mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

Test procedure

971168 D01 v03r01 - Section 5.2 and 5.8

ANSI 63.26-2015 – Section 5.2

ANSI/TIA-603-E-2016 - Section 2.2.17

Test settings

- 1) RBW = 1 % to 5 % of the OBW.
- 2) VBW $\geq 3 \times$ RBW.
- 3) SPAN = 2 \times to 3 \times the OBW.
- 4) Number of measurement points in sweep $\geq 2 \times$ span / RBW.
- 5) Sweep time :
 - 1) Auto couple, or
 - 2) $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission period})]$ for single sweep (automation-compatible) measurement. Transmission period is the on and off time of the transmitter.
- 6) Detector = RMS
- 7) If the EUT can be configured to transmit continuously, then set the trigger to free run.
- 8) If the EUT cannot be configured to transmit continuously, then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Verify that the sweep time is less than or equal to the transmission burst duration. Time gating can also be used under similar constraints (i.e., configured such that measurement data is collected only during active full-power transmissions).
- 9) Trace mode = trace averaging (RMS) over 100 sweeps.
- 10) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function, with the band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
- 11) Allow trace to fully stabilize.

Notes:

1. On a test site, the EUT shall be placed at 80 cm height on a turn table, and in the position close To normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to Correspond to the fundamental frequency of the transmitter.
3. The turntable is rotated through 360°, and the receiving antenna scans in order to determine the Level of the maximized emission.
4. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.
5. The maximum signal level detected by the measuring receiver shall be noted.
6. The EUT was replaced by half-wave dipole (1 GHz below) or horn antenna (1 GHz above) connected to a signal generator.
The power is calculated by the following formula;
$$Pd(\text{dBm}) = Pg(\text{dBm}) - \text{Cable loss (dB)} + \text{Antenna gain (dB)}$$

Note. Pd is the dipole equivalent power and Pg is the generator output power into the substitution antenna.
7. The test antenna shall be raised and lowered through the specified range of height to ensure that The maximum signal is received.
8. The input signal to the substitution antenna shall be adjusted to the level that produces a level Detected by the measuring corrected for the change of input attenuator setting of the measuring Receiver.
9. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for Any change of input attenuator setting of the measuring receiver.
10. The measurement shall be repeated with the test antenna and the substitution antenna Orientated for horizontal polarization.

Test results**Test mode: LTE Band5**

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	ERP	
		[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
1.4 M	QPSK	824.70	H	-0.60	3.80	24.42	20.02	0.100
		836.50	H	-0.50	3.84	25.42	21.08	0.128
		848.30	H	-0.50	3.87	25.67	21.30	0.135
	16QAM	824.70	H	-0.60	3.80	23.17	18.77	0.075
		836.50	H	-0.50	3.84	24.21	19.87	0.097
		848.30	H	-0.50	3.87	24.55	20.18	0.104
3 M	QPSK	825.50	H	-0.60	3.80	23.77	19.37	0.086
		836.50	H	-0.50	3.84	25.37	21.03	0.127
		847.50	H	-0.50	3.87	25.76	21.39	0.138
	16QAM	825.50	H	-0.60	3.80	22.53	18.13	0.065
		836.50	H	-0.50	3.84	24.15	19.81	0.096
		847.50	H	-0.50	3.87	24.65	20.28	0.107
5 M	QPSK	826.50	H	-0.60	3.80	23.79	19.39	0.087
		836.50	H	-0.50	3.84	25.20	20.86	0.122
		846.50	H	-0.50	3.87	25.94	21.57	0.144
	16QAM	826.50	H	-0.60	3.80	22.67	18.27	0.067
		836.50	H	-0.50	3.84	24.11	19.77	0.095
		846.50	H	-0.50	3.87	24.75	20.38	0.109
10 M	QPSK	829.00	H	-0.60	3.80	24.02	19.62	0.092
		836.50	H	-0.50	3.84	25.15	20.81	0.121
		844.00	H	-0.50	3.87	25.70	21.33	0.136
	16QAM	829.00	H	-0.60	3.80	22.96	18.56	0.072
		836.50	H	-0.50	3.84	24.07	19.73	0.094
		844.00	H	-0.50	3.87	24.54	20.17	0.104

Note.

1. E.R.P & E.I.R.P(dBm) = Substitute Level(dB) + Antenna gain(dBi) - C.L(Cable loss) (dB)

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**Test mode: LTE Band41**

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	EIRP	
		[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
5 M	QPSK	2 498.5	H	9.80	6.62	15.64	18.82	0.076
		2 593.0	H	9.50	6.74	14.50	17.26	0.053
		2 687.5	H	9.50	6.87	17.46	20.09	0.102
	16QAM	2 498.5	H	9.80	6.62	14.63	17.81	0.060
		2 593.0	H	9.50	6.74	12.69	15.45	0.035
		2 687.5	H	9.50	6.87	14.33	16.96	0.050
10 M	QPSK	2 501.0	H	9.80	6.74	16.77	19.83	0.096
		2 593.0	H	9.50	6.74	15.02	17.78	0.060
		2 685.0	H	9.50	6.87	17.06	19.69	0.093
	16QAM	2 501.0	H	9.80	6.74	13.69	16.75	0.047
		2 593.0	H	9.50	6.74	14.21	16.97	0.050
		2 685.0	H	9.50	6.87	15.28	17.91	0.062
15 M	QPSK	2 503.5	H	9.70	6.74	16.15	19.11	0.081
		2 593.0	H	9.50	6.74	15.37	18.13	0.065
		2 682.5	H	9.50	6.87	17.24	19.87	0.097
	16QAM	2 503.5	H	9.70	6.74	16.82	19.78	0.095
		2 593.0	H	9.50	6.74	13.72	16.48	0.044
		2 682.5	H	9.50	6.87	14.27	16.90	0.049
20 M	QPSK	2 506.0	H	9.80	6.74	16.38	19.44	0.088
		2 593.0	H	9.50	6.74	14.83	17.59	0.057
		2 680.0	H	9.50	6.87	17.57	20.20	0.105
	16QAM	2 506.0	H	9.80	6.74	16.17	19.23	0.084
		2 593.0	H	9.50	6.74	15.28	18.04	0.064
		2 680.0	H	9.50	6.87	16.49	19.12	0.082

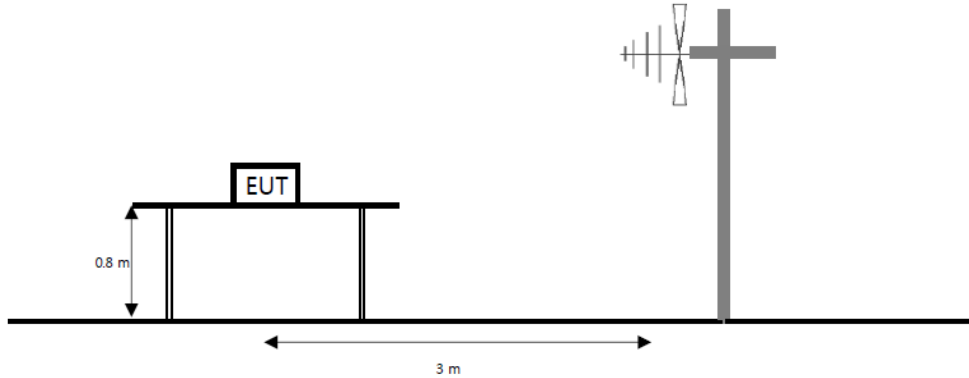
Note.

1. E.R.P & E.I.R.P(dBm) = Substitute Level(dB) + Antenna gain(dBi) - C.L(Cable loss) (dB)

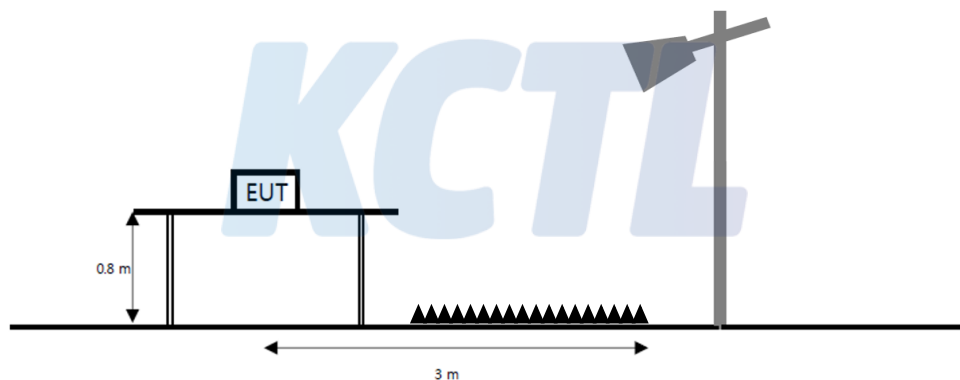
7.8. Radiated Spurious Emissions

Test setup

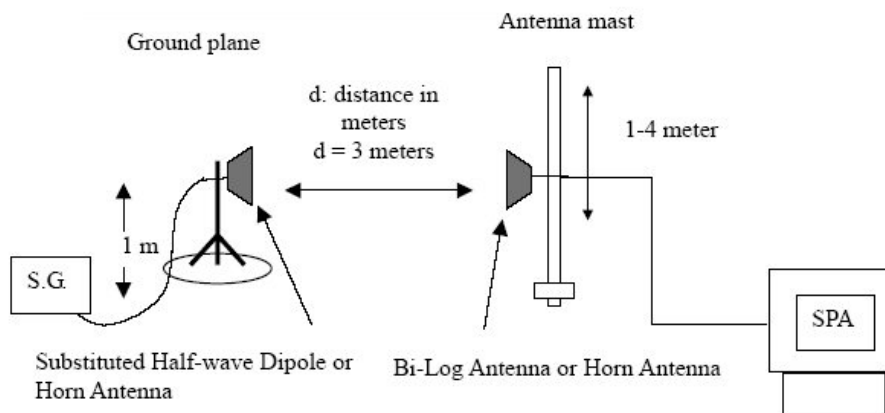
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz emissions, whichever is lower.



The diagram below shows the test setup for substituted method.



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KCTL**Limit**

According to §22.917(a), the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10\log(P_{\text{Watts}})$ dB.

According to §27.53(m)(4), the minimum permissible attenuation level of any spurious emission is $53 + 10\log(P_{\text{Watts}})$ dB.

Test procedure

971168 D01 v03r01 - Section 6.2

ANSI 63.26-2015 – Section 5.5

ANSI/TIA-603-E-2016 - Section 2.2.12

Test settings

- 1) RBW = 1 kHz for below 1 GHz and 1 MHz for above 1 GHz.
- 2) VBW $\geq 3 \times$ RBW.
- 3) Detector = RMS
- 4) Trace mode = Max hold
- 5) Sweep time = Auto couple
- 6) Number of sweep points $\geq 2 \times$ span / RBW
- 7) Allow trace to fully stabilize.

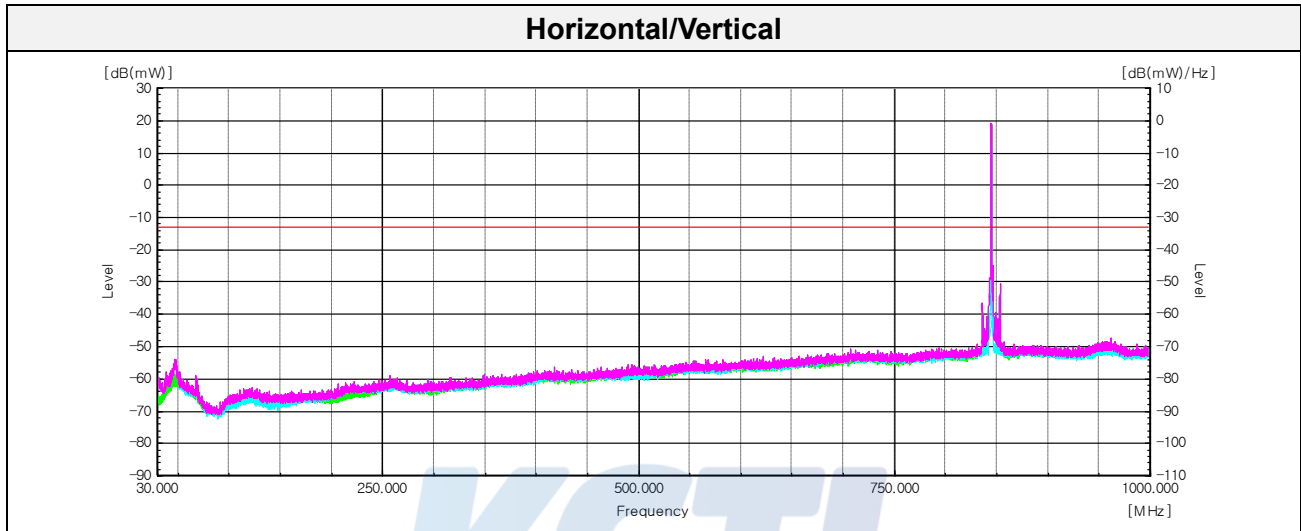
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Notes:

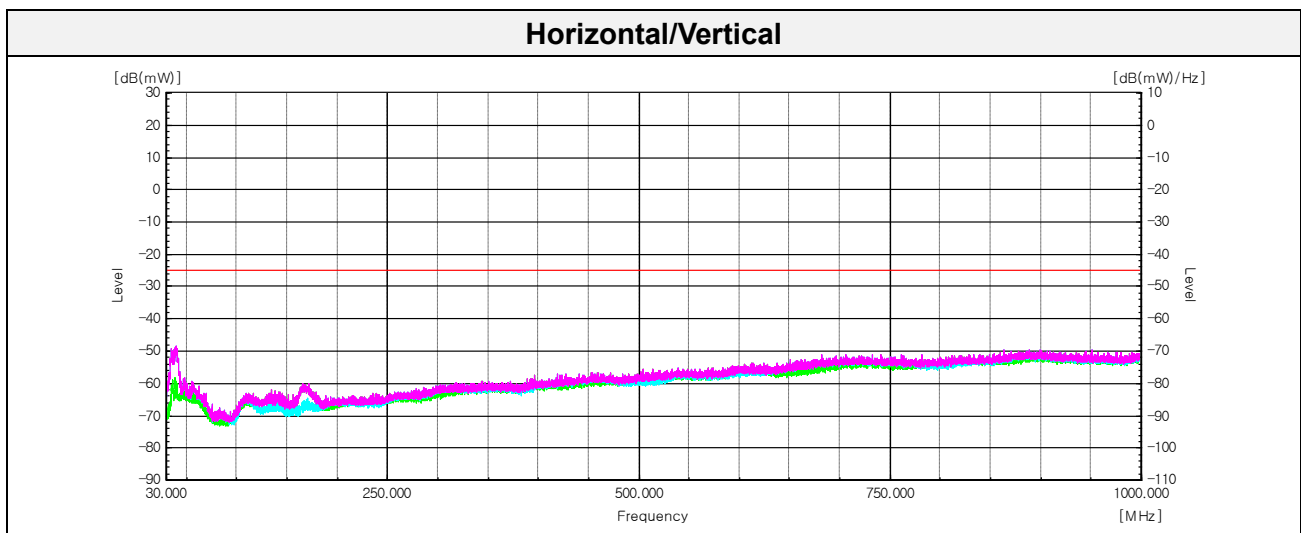
1. On a test site, the EUT shall be placed at 80 cm height on a turn table, and in the position close to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to correspond to the fundamental frequency of the transmitter.
3. The turntable is rotated through 360°, and the receiving antenna scans in order to determine the level of the maximized emission.
4. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.
5. The maximum signal level detected by the measuring receiver shall be noted.
6. The EUT was replaced by half-wave dipole (1 GHz below) or horn antenna (1 GHz above) connected to a signal generator.
7. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
8. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring corrected for the change of input attenuator setting of the measuring receiver.
9. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.
10. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

Test results (Below 1 000 MHz) – Worst case

Test mode : LTE Band5
Frequency (MHz) : 846.5
Channel : 20625
Bandwidth (MHz) : 5

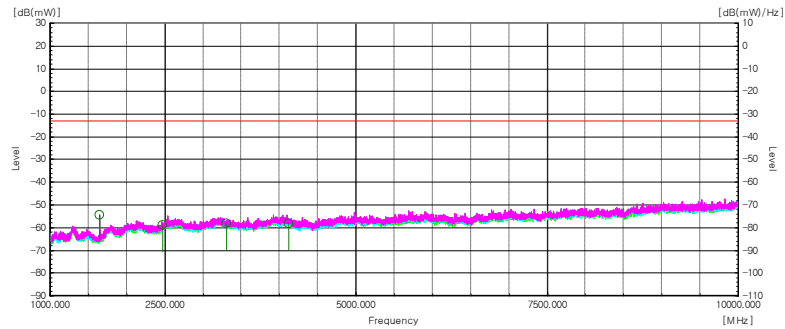


Test mode : LTE Band41
Frequency (MHz) : 2 680.0
Channel : 41490
Bandwidth (MHz) : 20



Note.

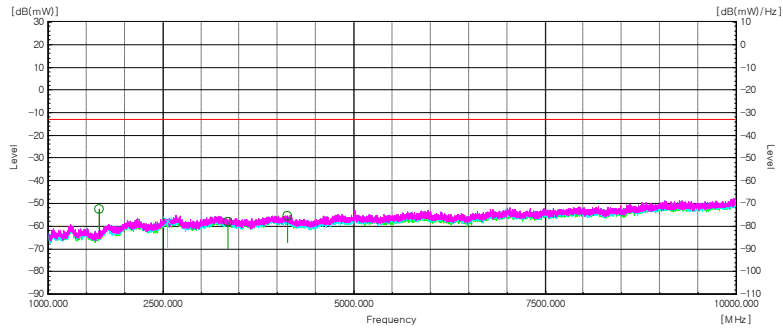
- 1. No spurious emission were detected below 1 000 MHz.

Test results (Above 1 000 MHz)Test mode : LTE Band5Frequency(MHz) : 826.5Channel : 20425Bandwidth(MHz) : 5

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 649.07	H	8.4	5.38	-57.62	-54.60	-13.00	41.60
	2 473.16	H	9.8	6.62	-62.28	-59.10	-13.00	46.10
	3 307.26	H	9.3	7.78	-59.82	-58.30	-13.00	45.30
	4 122.35	H	9.9	9.35	-58.75	-58.20	-13.00	45.20

Note.

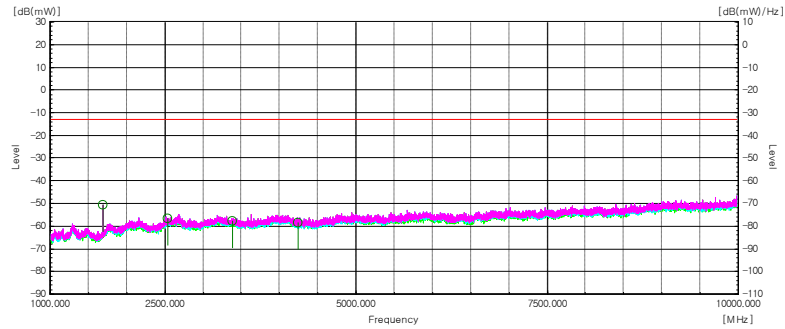
1. Limit Calculation(dBm)= 43 + 10log(P_{Watts}) [dBc]

Test mode : LTE Band5**Frequency(MHz)** : 836.5**Channel** : 20525**Bandwidth(MHz)** : 5

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 669.07	H	8.5	5.38	-55.82	-52.70	-13.00	39.70
	2 556.17	V	9.8	6.74	-60.96	-57.90	-13.00	44.90
	3 346.26	H	9.3	7.78	-59.62	-58.10	-13.00	45.10
	4 131.35	H	10.1	9.35	-56.15	-55.40	-13.00	42.40

Note.

1. Limit Calculation(dBm)= 43 + 10log(P_[watts]) [dBc]

Test mode : LTE Band5**Frequency(MHz)** : 846.5**Channel** : 20625**Bandwidth(MHz)** : 5

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 689.08	H	8.6	5.38	-54.02	-50.80	-13.00	37.80
	2 533.17	H	9.7	6.74	-59.76	-56.80	-13.00	43.80
	3 383.27	H	9.2	7.78	-59.42	-58.00	-13.00	45.00
	4 236.36	H	10.3	9.61	-59.39	-58.70	-13.00	45.70

Note.

1. Limit Calculation(dBm)= 43 + 10log(P_[watts]) [dBc]

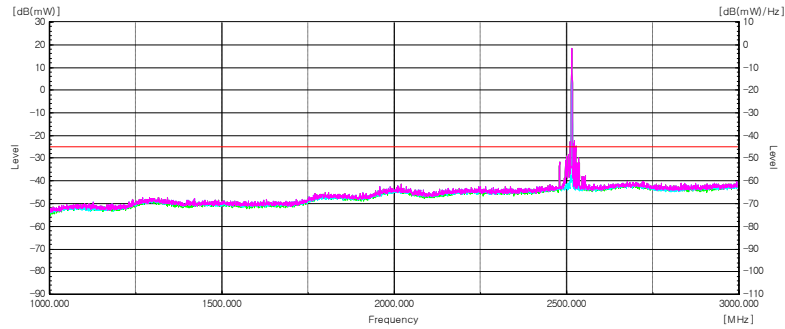
Test mode : LTE Band41

Frequency(MHz) : 2 506.0

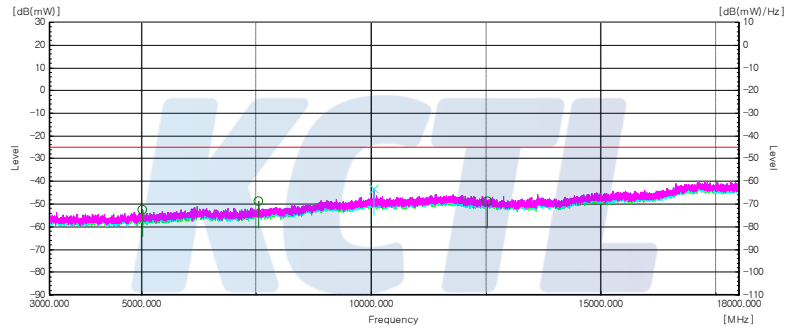
Channel : 39750

Bandwidth(MHz) : 20

1 000 MHz to 3 000 MHz



Above 3 000 MHz



Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	5 029.14	H	10.9	10.46	-53.14	-52.70	-25.00	27.70
	7 544.30	H	11.0	13.24	-46.86	-49.10	-25.00	24.10
	10 059.47	V	12.2	14.88	-40.62	-43.30	-25.00	18.30
	12 530.63	H	13.5	16.52	-45.68	-48.70	-25.00	23.70

Note.

1. Limit Calculation(dBm)= 55 + 10log(P_[watts]) [dBc]
2. No spurious emission were detected 1 000 MHz to 3 000 MHz.

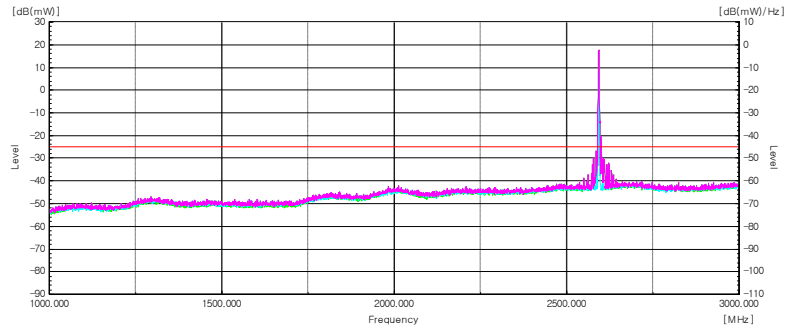
Test mode : LTE Band41

Frequency(MHz) : 2 593.0

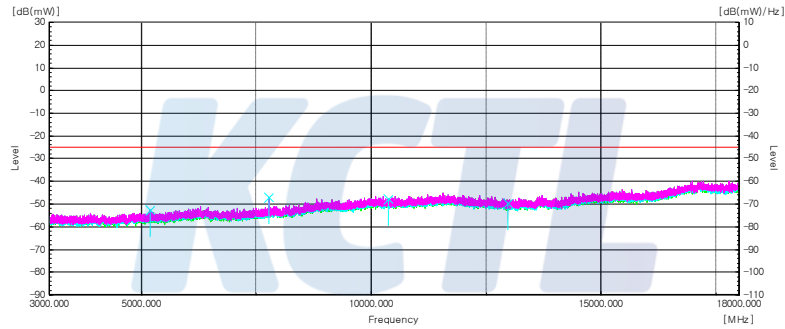
Channel : 40620

Bandwidth(MHz) : 20

1 000 MHz to 3 000 MHz



Above 3 000 MHz



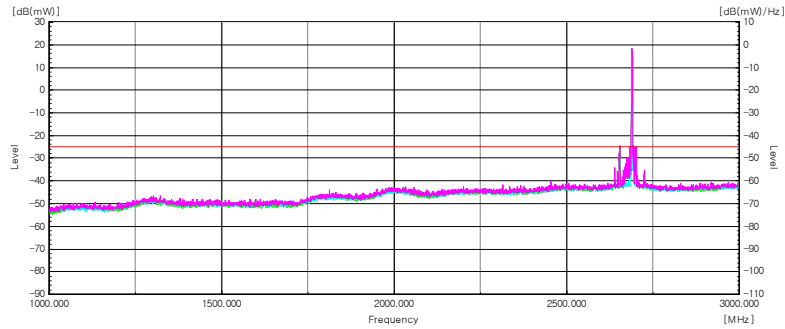
Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	5 186.15	V	10.9	10.63	-52.87	-52.60	-25.00	27.60
	7 779.32	V	11.6	13.31	-45.39	-47.10	-25.00	22.10
	10 372.49	V	12.6	15.06	-45.44	-47.90	-25.00	22.90
	12 965.66	V	13.4	17.05	-45.85	-49.50	-25.00	24.50

Note.

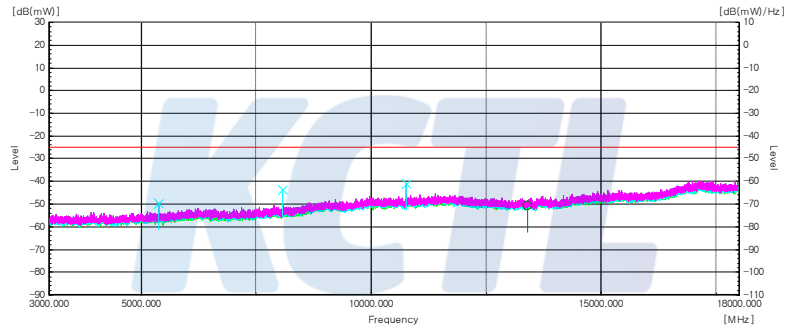
1. Limit Calculation(dBm)= 55 + 10log(P_{Watts}) [dBc]
2. No spurious emission were detected 1 000 MHz to 3 000 MHz.

Test mode : LTE Band41
Frequency(MHz) : 2 680.0
Channel : 41490
Bandwidth(MHz) : 20

1 000 MHz to 3 000 MHz



Above 3 000 MHz



Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	5 378.16	V	11.1	10.88	-49.82	-49.60	-25.00	24.60
	8 066.34	V	11.4	13.75	-41.45	-43.80	-25.00	18.80
	10 755.52	V	12.8	15.40	-38.60	-41.20	-25.00	16.20
	13 400.69	H	12.7	17.11	-46.39	-50.80	-25.00	25.80

Note.

1. Limit Calculation(dBm)= 55 + 10log(P_[watts]) [dBc]
2. No spurious emission were detected 1 000 MHz to 3 000 MHz.

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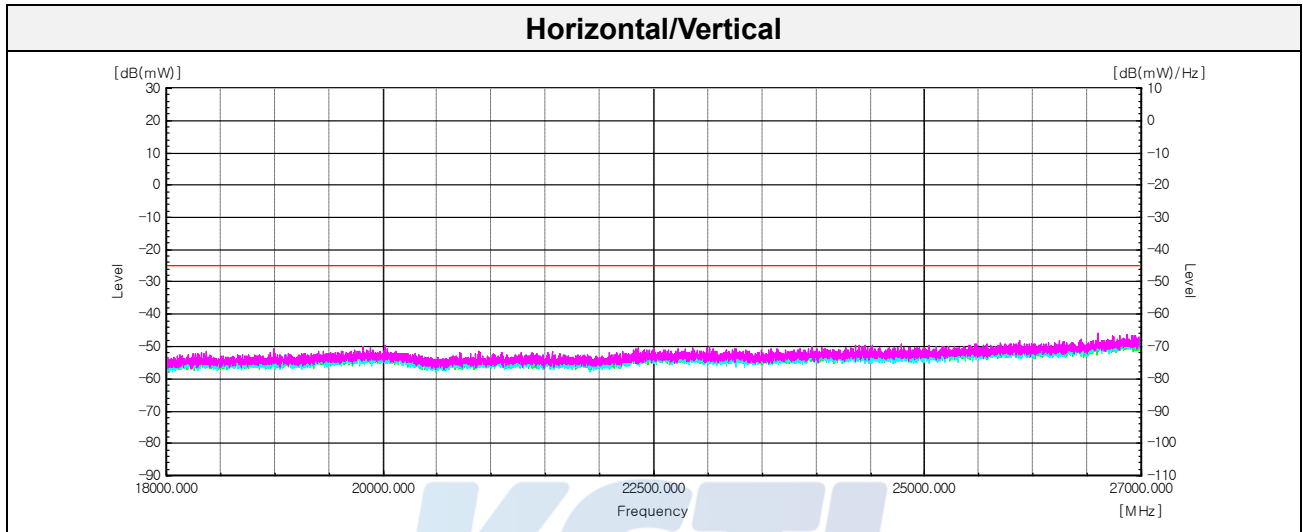
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Test results (Above 18 GHz to 27 GHz) – Worst case

Test mode : LTE Band41
Frequency (MHz) : 2 680.0
Channel : 41490
Bandwidth(MHz) : 20



Note.

1. No spurious emissions were detected above 18GHz.

8. Geo-location mechanism

The device uses a geo-location mechanism based on the cellular MCC codes in order to only enable certain LTE bands when the device is not in the USA.

The validation of this mechanism is provided below.

The device was configured for cellular communications to a test set and the MCC code was adjusted on the test set between the US MCC and then an MCC code valid for a country where the LTE band is supported.

Mode	MCC = USA	MCC = Non US
LTE Band7	Did not connect	Connected (Singapore)
LTE Band40	Did not connect	Connected (Singapore)
LTE Band41	Connected (USA)	Connected (Singapore)

Note.

1. The verification tests confirmed the operational of the geo-location mechanism.

KCTL

Test results

Mode	MCC = USA	MCC = Non US
LTE Band7		
LTE Band40		
LTE Band41		

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9. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R & S	FSW50	101013	19.05.14
Spectrum Analyzer	AGILENT	N9040B	MY57010132	19.10.12
Power Divider	Aeroflex/ Weinschel, Inc.	1580-1	NX380	19.08.02
Wideband Radio Communication Tester	R & S	CMW500	102159	19.08.08
Wideband Radio Communication Tester	R & S	CMW500	106840	20.01.25
Radio Communication Analyzer	Anritsu	MT8820C	6201010005	19.08.02
High pass Filter	Wainwright Instruments GmbH	WHKX3.0/18G- 12SS	44	20.01.25
High pass Filter	Wainwright Instruments GmbH	WHKX1.0/1.5S- 10SS	14	20.01.25
Attenuator	Weinschel ENGINEERING	10	AJ1239	19.05.14
ATTENUATOR	API Inmet	40AH2W-10	15	19.05.17
Biconical VHF-UHF Broadband Antenna	SCHWARZBECK	VUBA9117	275	20.04.13
Horn Antenna	ETS.lindgren	3115	62589	19.08.24
Horn Antenna	ETS.lindgren	3116	00086635	19.05.10
Horn Antenna	Steatite Antennas	QMS-00225	17790	19.08.24
Bilog Antenna	Teseq GmbH	CBL 6143A	35039	19.05.19
Horn Antenna	ETS.lindgren	3117	161225	19.05.18
Amplifier	SONOMA INSTRUMENT	317	321041	20.01.04
Amplifier	L-3 Narda-MITEQ	AFS5-00101800-25- S-5	2054570	19.10.18
Amplifier	L-3 Narda-MITEQ	JS44-18004000-33- 8P	2000997	19.08.02
RF Selector	TOYO Corporation	NS5800	1003-010	N/A
Band Selector	TOYO Corporation	NS5800	1003-135	N/A
Band Selector	TOYO Corporation	NS5800	1003-320	N/A
Antenna Mast	MATURO	EAS 1.5	042/8941211	N/A
Antenna Mast	MATURO	EAS 1.5	043/8941211	N/A
Turn Table	MATURO	TT 0.8 PF	041/8941211	N/A
Cable Assembly	Radiall	R286303620	1649.241	N/A
Cable Assembly	Radiall	TESTPRO 3	-	N/A

End of test report