

## 5. Peak-Average Ratio

### 5.1. Limit

#### FCC

- §22.913(d) Measurement of the ERP of Cellular base transmitters and repeaters must be made using an average power measurement technique. The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB.

- §27.50(d)(5), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

#### IC

- RSS-132 Issue 3

5.4, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

- RSS-139 Issue 3

6.5, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1 % of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

- RSS-199 Issue 3

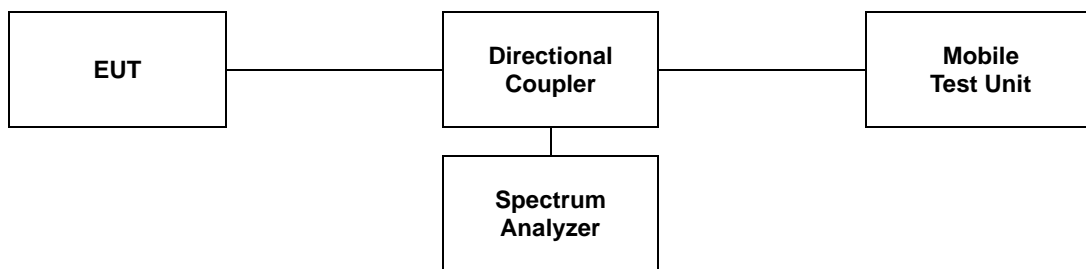
4.4, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

## 5.2. Test Procedure

The test follows section 5.2.3.4 of ANSI C63.26-2015.

See instrumentation-specific application literature for further guidance regarding use of the CCDF capability. The following guidelines are offered for performing a CCDF measurement.

- a. Set resolution/measurement bandwidth  $\geq$  OBW or specified reference bandwidth.
- b. Set the number of counts to a value that stabilizes the measured CCDF curve.
- c. Set the measurement interval as follows:
  - 1) For continuous transmissions, set to greater of  $[10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$  or 1 ms.
  - 2) 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.
  - 3) 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.
- d. Record the maximum PAPR level associated with a probability of 0.1 %.
- e. The peak power level is calculated from the sum of the PAPR value from step d) to the measured average power.



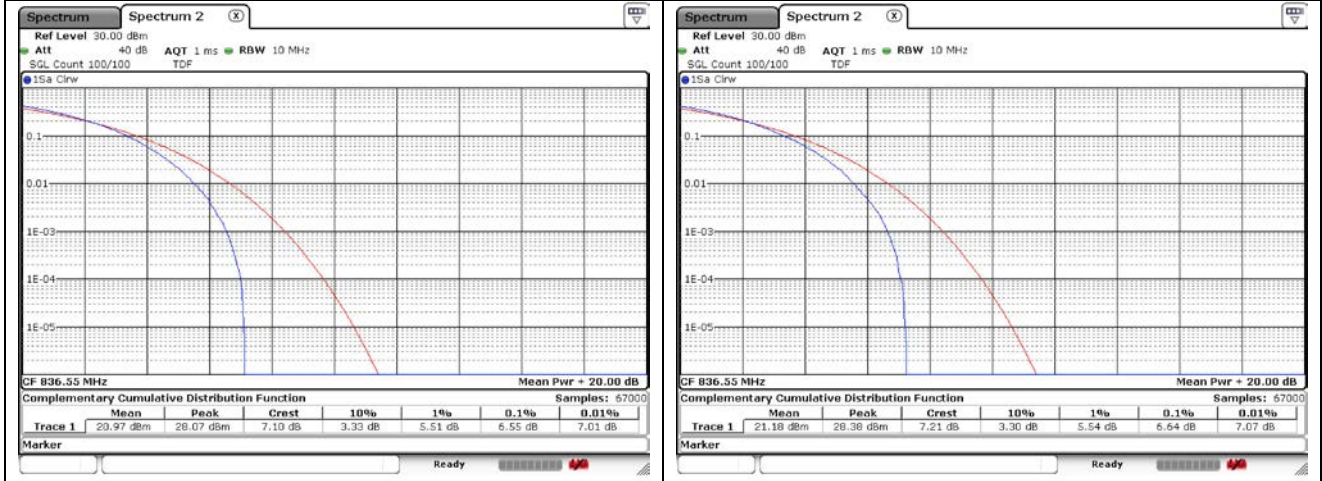
### 5.3 Test Results

Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

Band	PCC			SCC			PAR (dB)
	BW (MHz)	Frequency (MHz)	Channel	BW (MHz)	Frequency (MHz)	Channel	64QAM
5B	3	834.1	20501	5	838.0	20540	6.55
	5	835.0	20510	3	838.9	20549	6.64
	5	831.8	20478	10	839.0	20550	6.72
	10	834.0	20500	5	841.2	20572	6.70
	10	831.6	20476	10	841.5	20575	6.70
7C	10	2 525.6	21006	20	2 540.0	21150	7.33
	20	2 530.1	21051	10	2 544.5	21195	7.33
	15	2 530.1	21051	15	2 542.1	21171	7.04
	15	2 530.1	21051	10	2 542.1	21171	7.07
	15	2 525.3	21003	20	2 542.4	21174	7.13
	20	2 527.6	21026	15	2 544.7	21197	7.04
	20	2 525.1	21001	20	2 544.9	21199	7.42
66B	5	1 752.6	132398	5	1 757.4	132446	6.90
	5	1 750.3	132375	10	1 757.5	132447	7.22
	10	1 752.5	132397	5	1 759.7	132469	7.07
	5	1 748.1	132353	15	1 757.4	132446	6.87
	15	1 752.6	132398	5	1 761.9	132491	6.84
	10	1 750.1	132373	10	1 760.0	132472	7.16
66C	10	1 747.9	132351	15	1 759.9	132471	6.99
	15	1 750.1	132373	10	1 762.1	132493	6.99
	10	1 745.6	132328	20	1 760.0	132472	6.90
	20	1 750.1	132373	10	1 764.5	132517	6.81
	15	1 747.5	132347	15	1 762.5	132497	7.65
	15	1 745.3	132325	20	1 762.4	132496	7.01
	20	1 747.6	132348	15	1 764.7	132519	6.96
	20	1 752.5	132397	5	1 764.2	132514	6.90
	5	1 745.8	132330	20	1 757.5	132447	7.13
20	1 745.1	132323	20	1 764.9	132521	7.51	

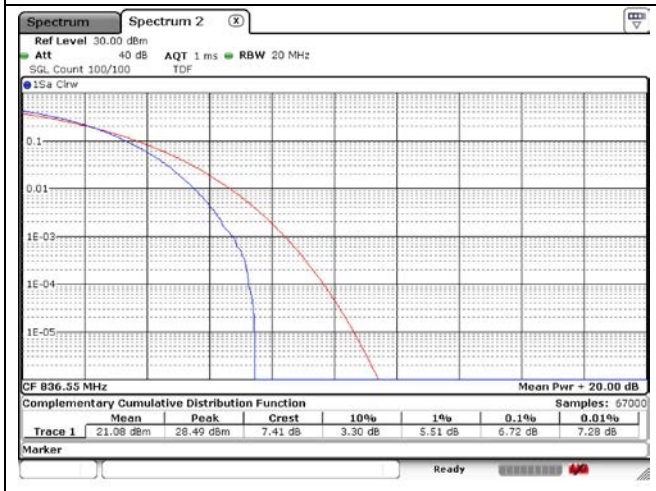
**- Test plots**

**ULCA 5B**

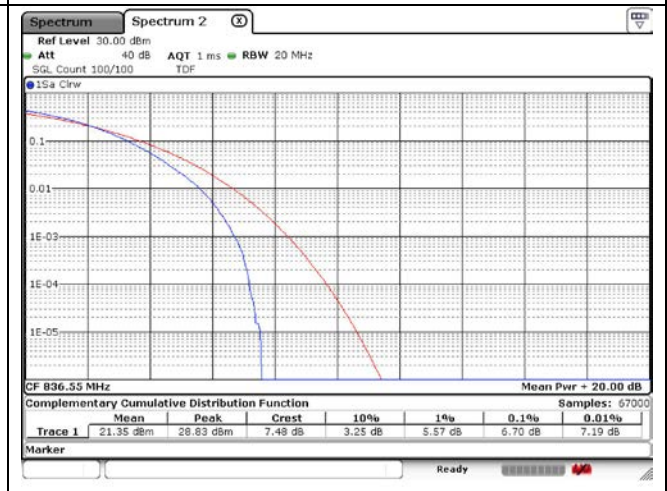


3 MHz + 5 MHz 64QAM Middle Channel - Full RB

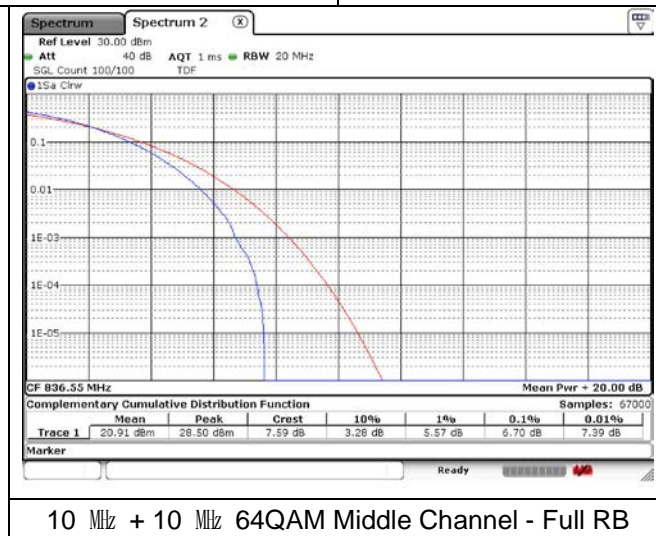
5 MHz + 3 MHz 64QAM Middle Channel - Full RB



5 MHz + 10 MHz 64QAM Middle Channel - Full RB

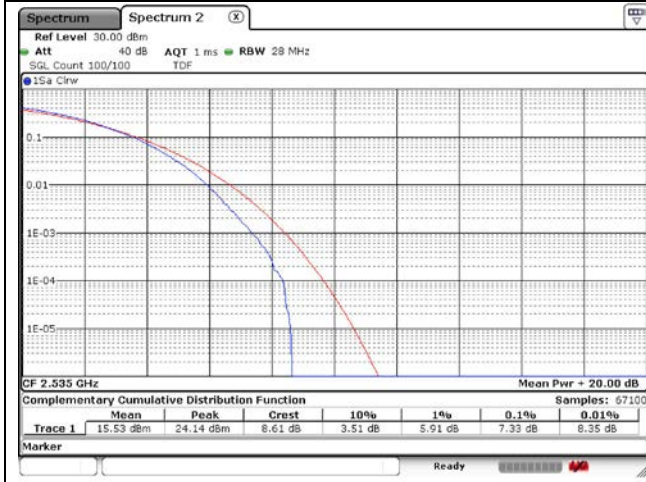


10 MHz + 5 MHz 64QAM Middle Channel - Full RB



10 MHz + 10 MHz 64QAM Middle Channel - Full RB

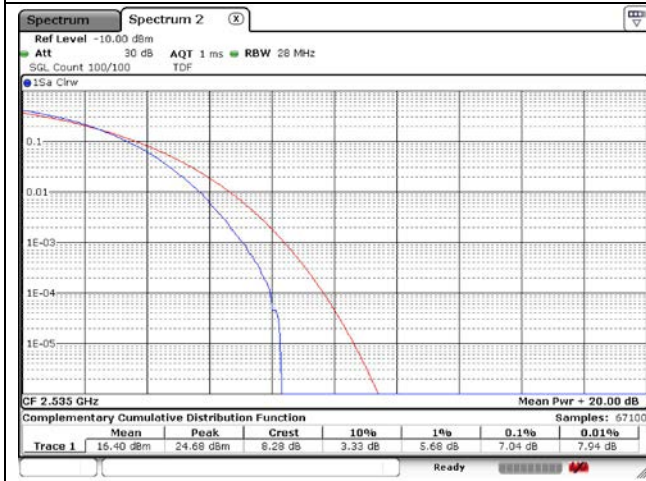
**ULCA 7C**



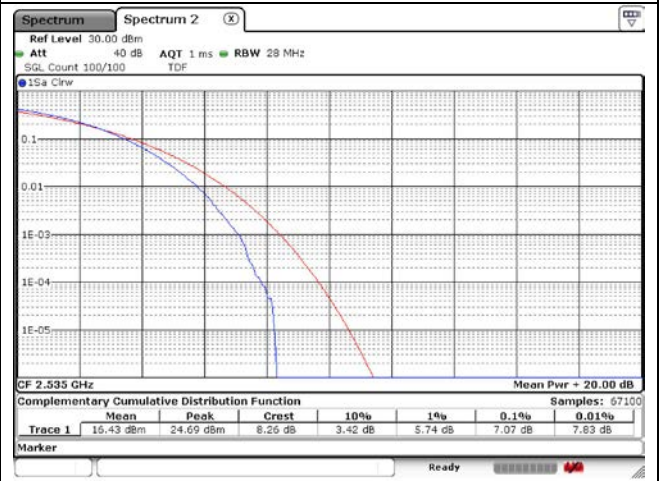
10 MHz + 20 MHz 64QAM Middle Channel - Full RB



20 MHz + 10 MHz 64QAM Middle Channel - Full RB

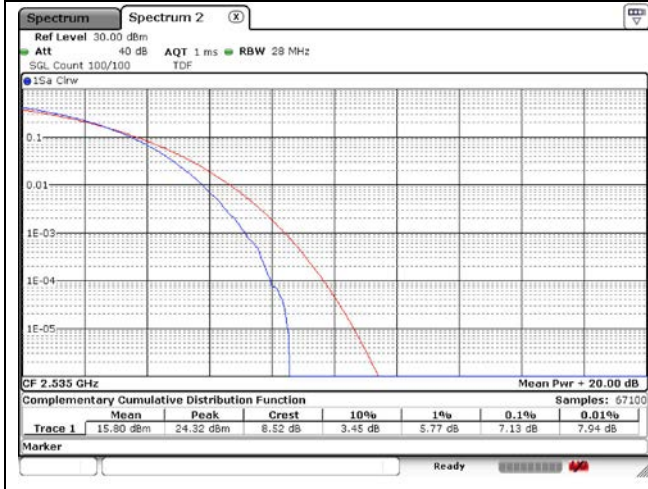


15 MHz + 15 MHz 64QAM Middle Channel - Full RB



15 MHz + 10 MHz 64QAM Middle Channel - Full RB

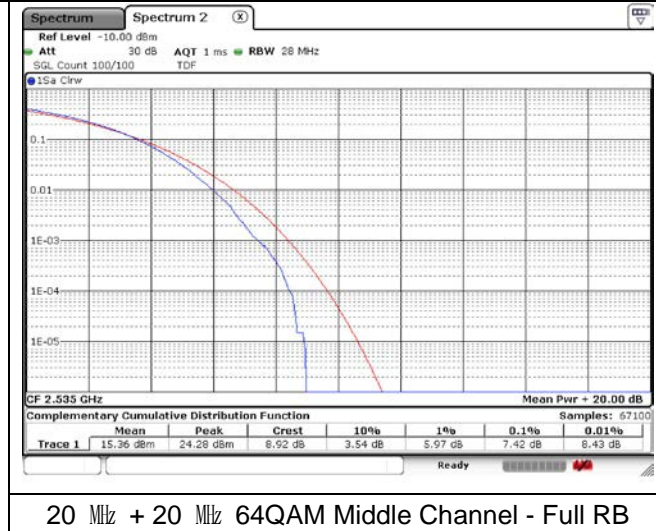
**ULCA 7C**



15 MHz + 20 MHz 64QAM Middle Channel - Full RB

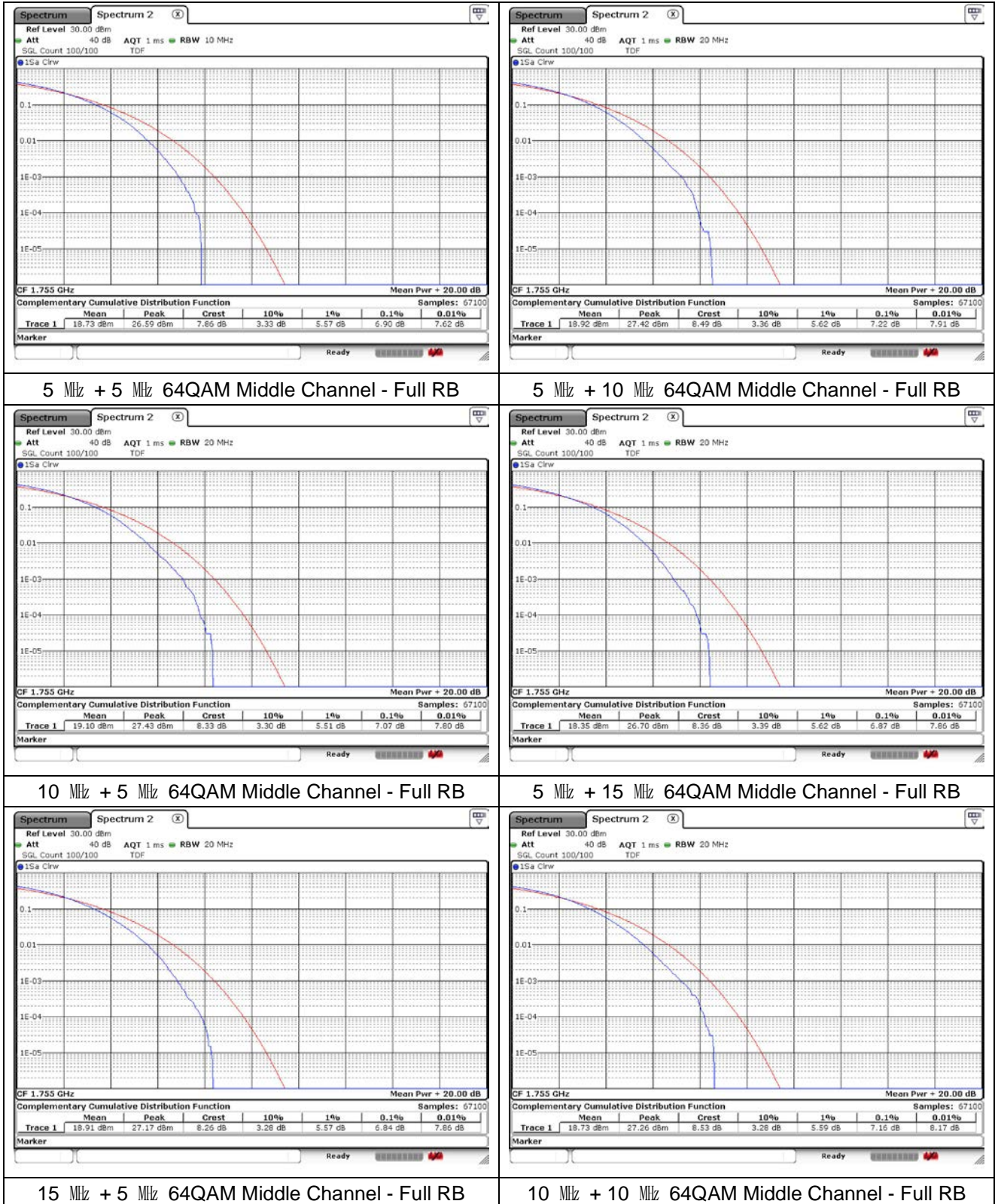


20 MHz + 15 MHz 64QAM Middle Channel - Full RB

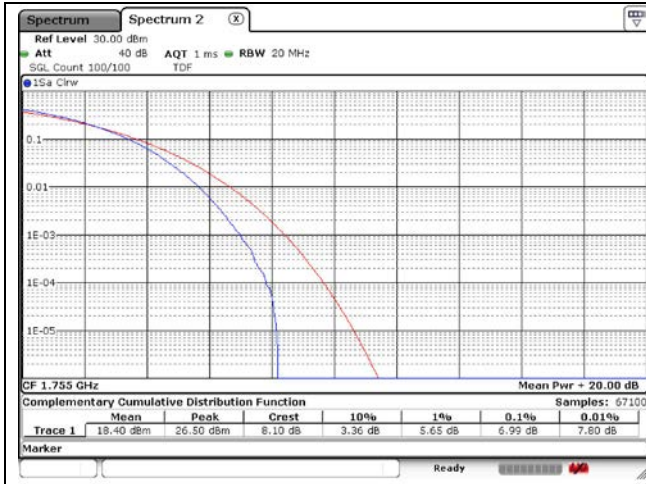


20 MHz + 20 MHz 64QAM Middle Channel - Full RB

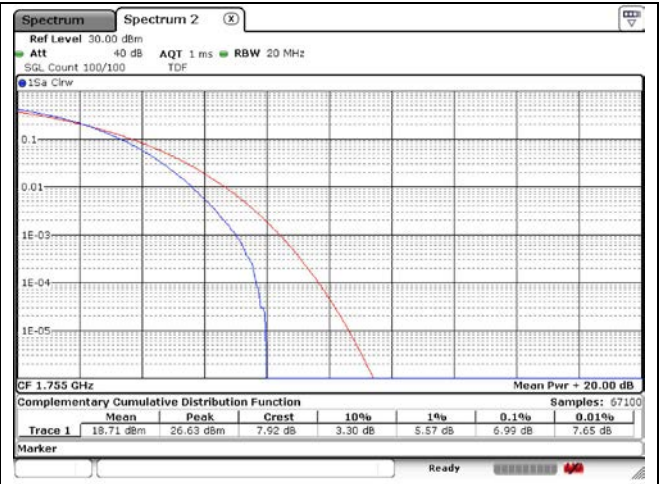
**ULCA 66B**



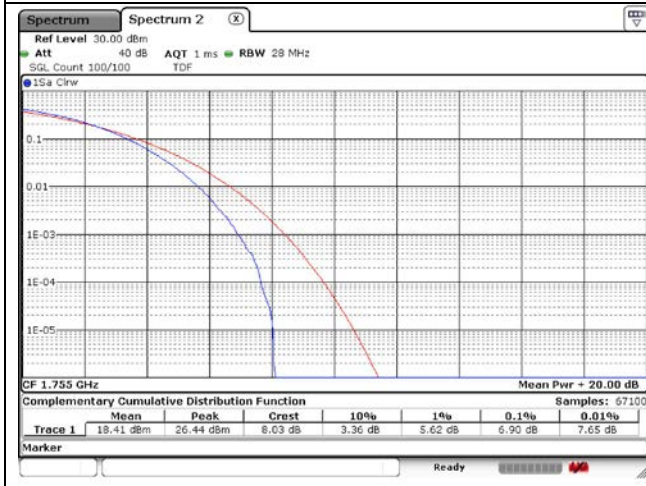
**ULCA 66C**



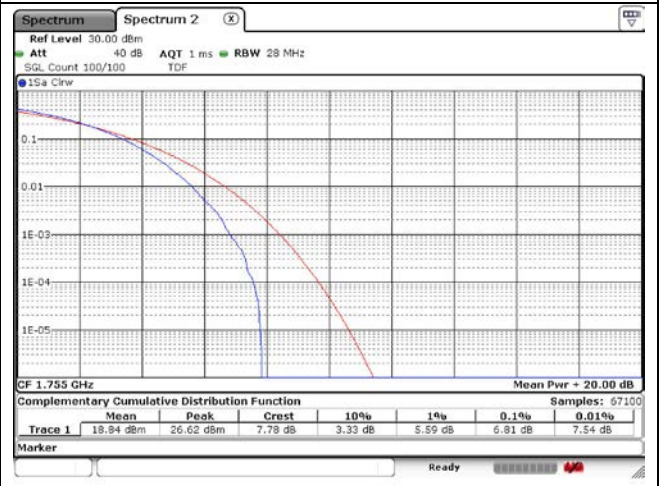
10 MHz + 15 MHz 64QAM Middle Channel - Full RB



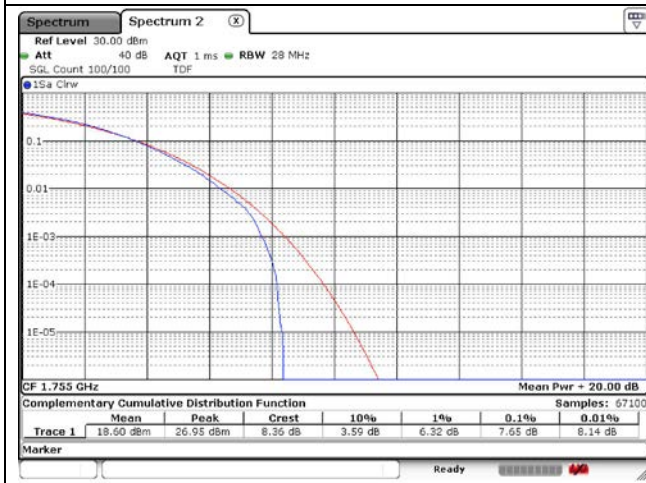
15 MHz + 10 MHz 64QAM Middle Channel - Full RB



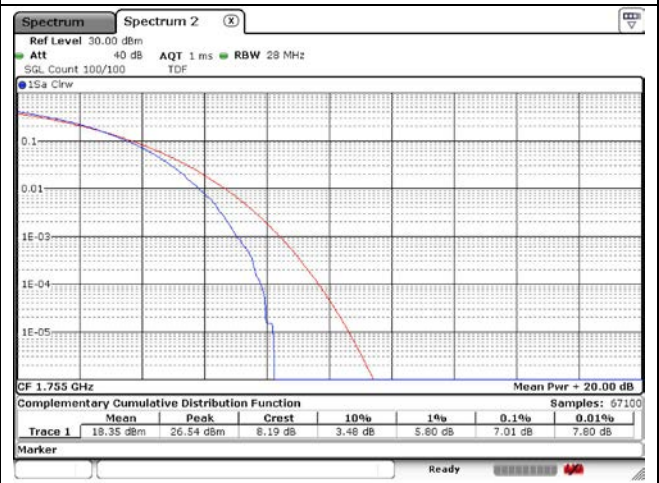
10 MHz + 20 MHz 64QAM Middle Channel - Full RB



20 MHz + 10 MHz 64QAM Middle Channel - Full RB



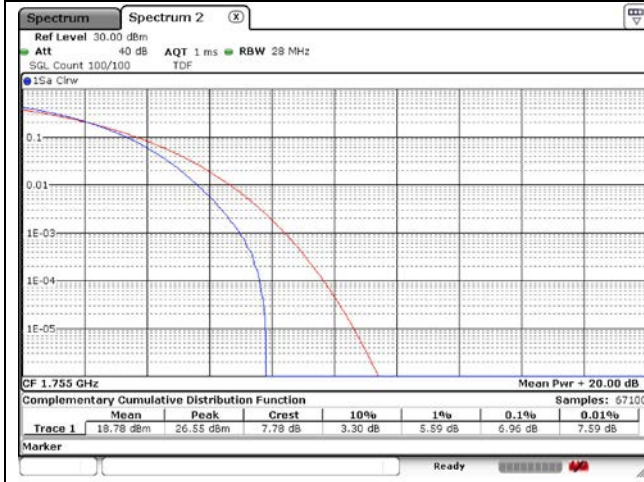
15 MHz + 15 MHz 64QAM Middle Channel - Full RB



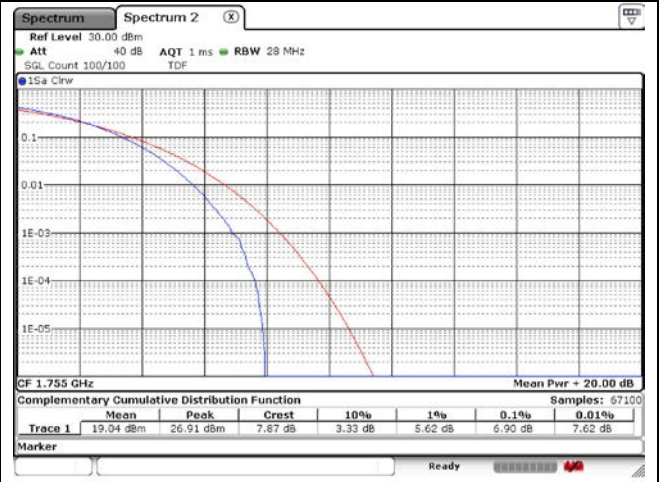
15 MHz + 20 MHz 64QAM Middle Channel - Full RB



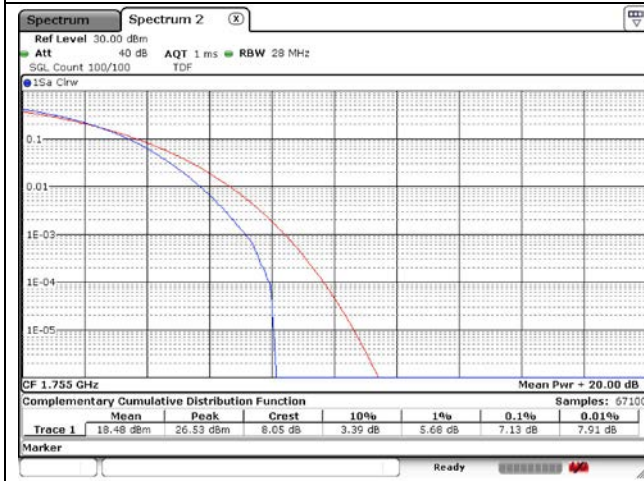
**ULCA 66C**



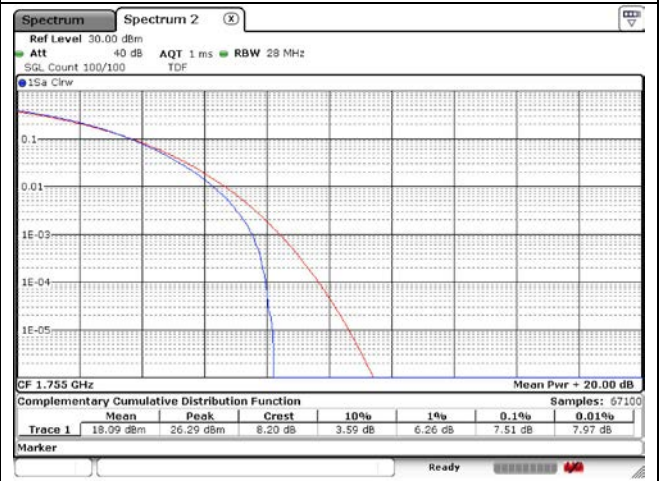
20 MHz + 15 MHz 64QAM Middle Channel - Full RB



20 MHz + 5 MHz 64QAM Middle Channel - Full RB



5 MHz + 20 MHz 64QAM Middle Channel - Full RB



20 MHz + 20 MHz 64QAM Middle Channel - Full RB

## 6. Spurious Emissions at Antenna Terminal

### 6.1. Limit

#### FCC

- §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  $43 + 10 \log_{10}(P)$  dB.

- §27.53(h)(1), for operations in the 1 695-1 710 MHz, 1 710-1 755 MHz, 1 755-1 780 MHz, 1 915-1 920 MHz, 1 995-2 000 MHz, 2 000-2 020 MHz, 2 110-2 155 MHz, 2 155-2 180 MHz, and 2 180-2 200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10}(P)$  dB.

- §27.53(m)(4), for mobile digital stations, the attenuation factor shall be not less than  $40 + 10 \log_{10}(P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log_{10}(P)$  dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and  $55 + 10 \log_{10}(P)$  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. In addition, the attenuation factor shall not be less than  $43 + 10 \log_{10}(P)$  dB on all frequencies between 2 490.5 MHz and 2 496 MHz and  $55 + 10 \log_{10}(P)$  dB at or below 2 490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2 495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

#### IC

- RSS-132 Issue 3

5.5, Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

(i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dB W) by at least  $43 + 10 \log_{10} p$  (watts).

(ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dB W) by at least  $43 + 10 \log_{10} p$  (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

- RSS-139 Issue 3

6.6, (i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1 % of the emission bandwidth shall be attenuated below the transmitter output power P (in dB W) by at least  $43 + 10 \log_{10} p$  (watts) dB.

(ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dB W) by at least  $43 + 10 \log_{10} p$  (watts) dB.

- RSS-199 Issue 3

4.5, In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

for base station and fixed subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dB W), by at least  $43 + 10 \log_{10} p$  for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dB W), by at least:

- i.  $40 + 10 \log_{10} p$  from the channel edges to 5 MHz away
- ii.  $43 + 10 \log_{10} p$  between 5 MHz and X MHz from the channel edges, and
- iii.  $55 + 10 \log_{10} p$  at X MHz and beyond from the channel edges

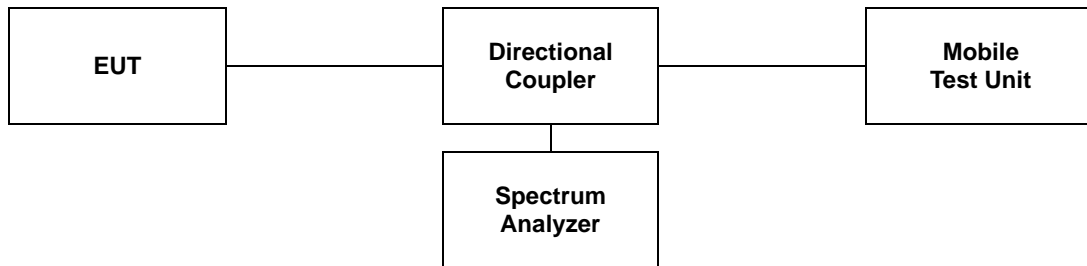
In addition, the attenuation shall not be less than  $43 + 10 \log_{10} p$  on all frequencies between 2 490.5 MHz and 2 496 MHz, and  $55 + 10 \log_{10} p$  at or below 2 490.5 MHz.

In (a) and (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

## 6.2. Test Procedure

The test follows section 5.7 of ANSI C63.26-2015.

1. Start frequency was set to 9 kHz and stop frequency was set to at least 10\* the fundamental frequency.
2. Detector = RMS.
3. Trace mode = Max hold.
4. Sweep time = Auto couple.
5. The trace was allowed to stabilize.
6. Please see notes below for RBW and VBW settings.
7. For plots showing conducted spurious emissions from 9 kHz to 28 GHz, all path loss of wide frequency range was investigated and compensated to spectrum analyzer as TDF function.



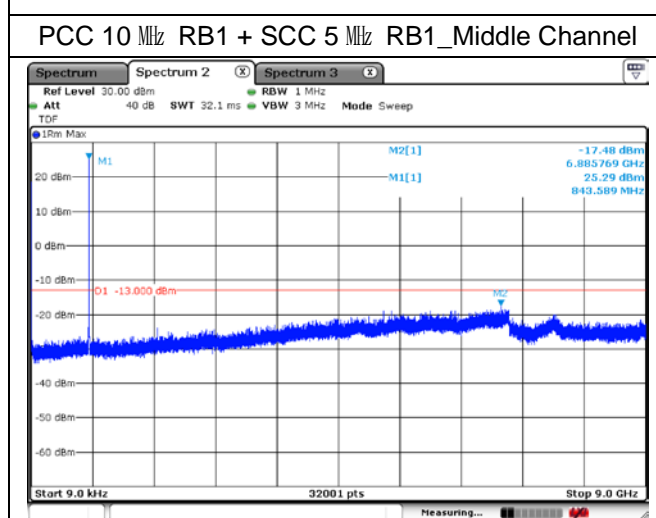
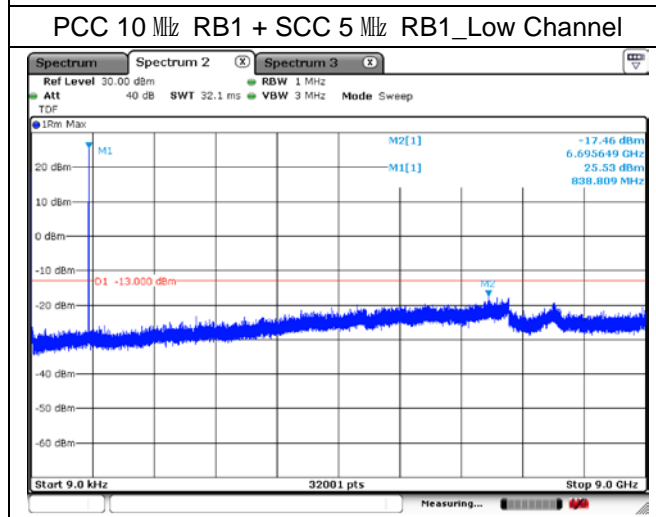
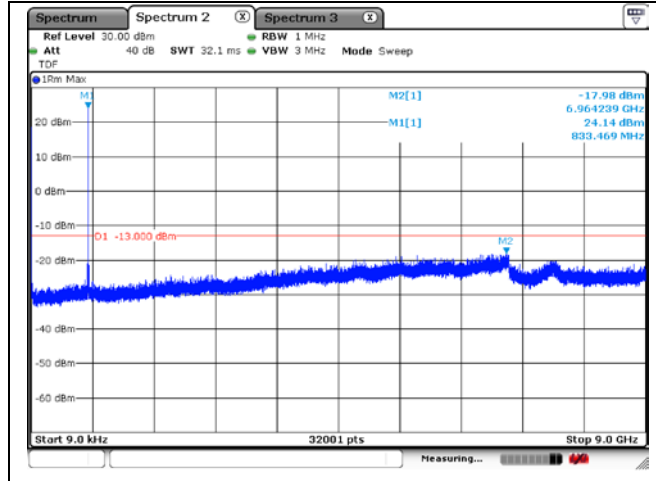
### Note;

Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for frequencies less than 1 GHz and frequencies greater than 1 GHz. 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 point, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

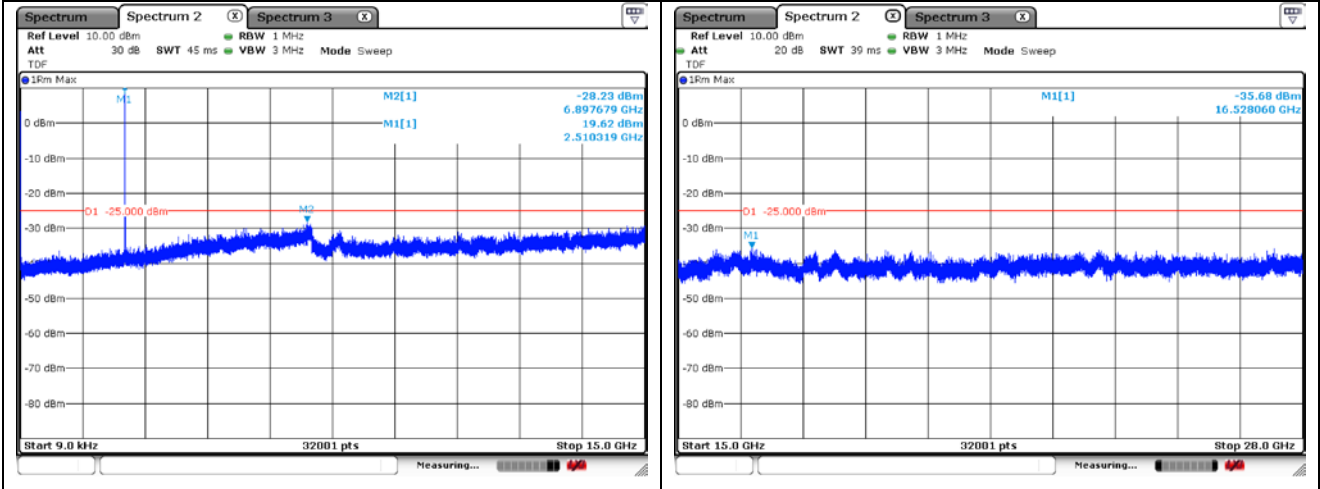
### 6.3. Test Results

Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

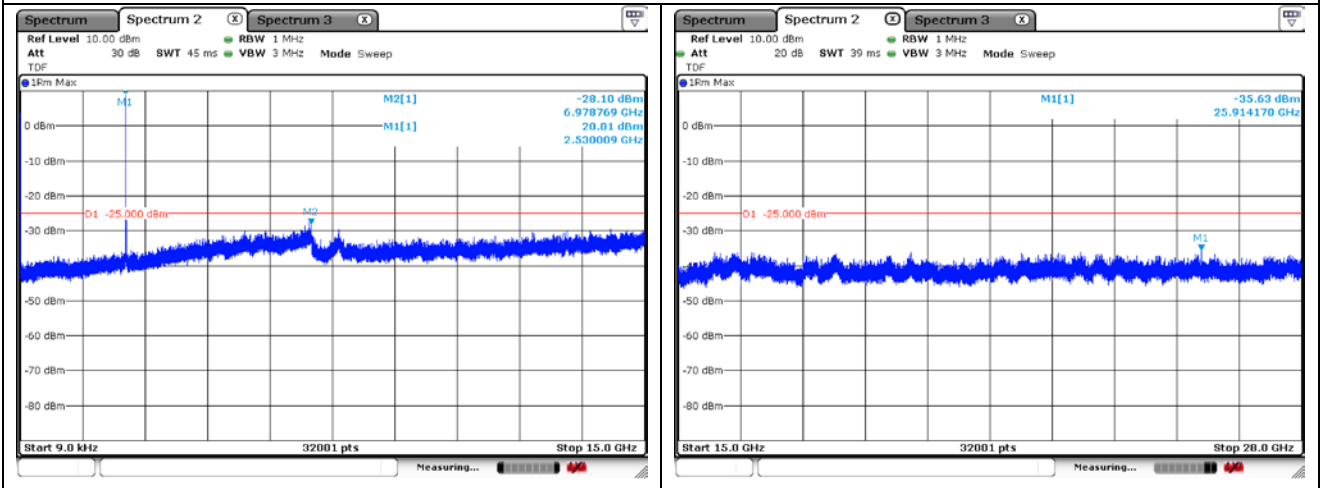
**- Test plots**  
**ULCA 5B**



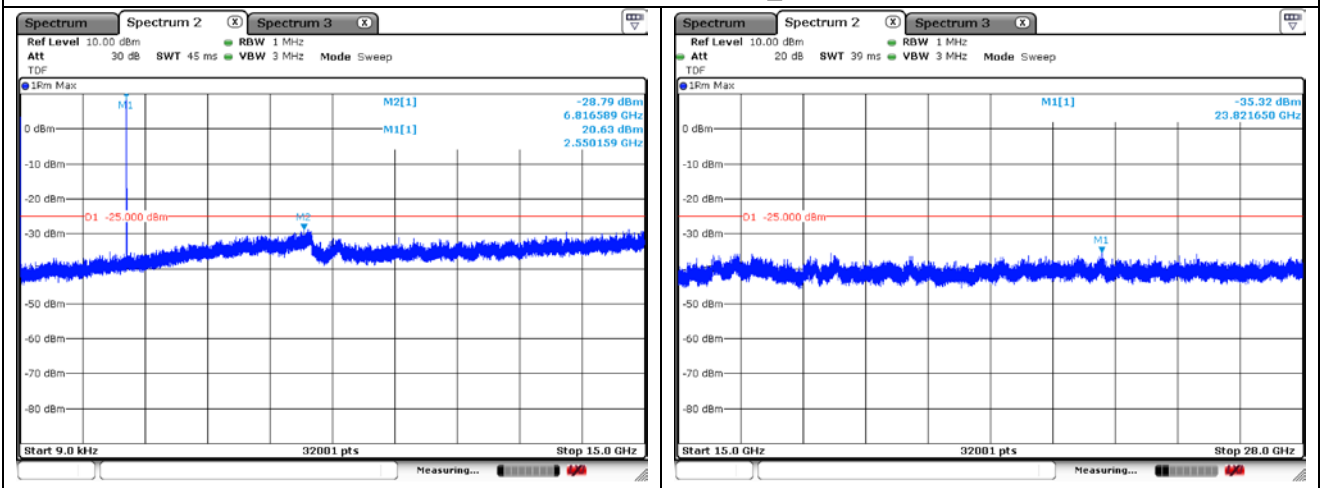
**ULCA 7C**



**PCC 10 MHz RB1 + SCC 20 MHz RB1\_Low Channel**

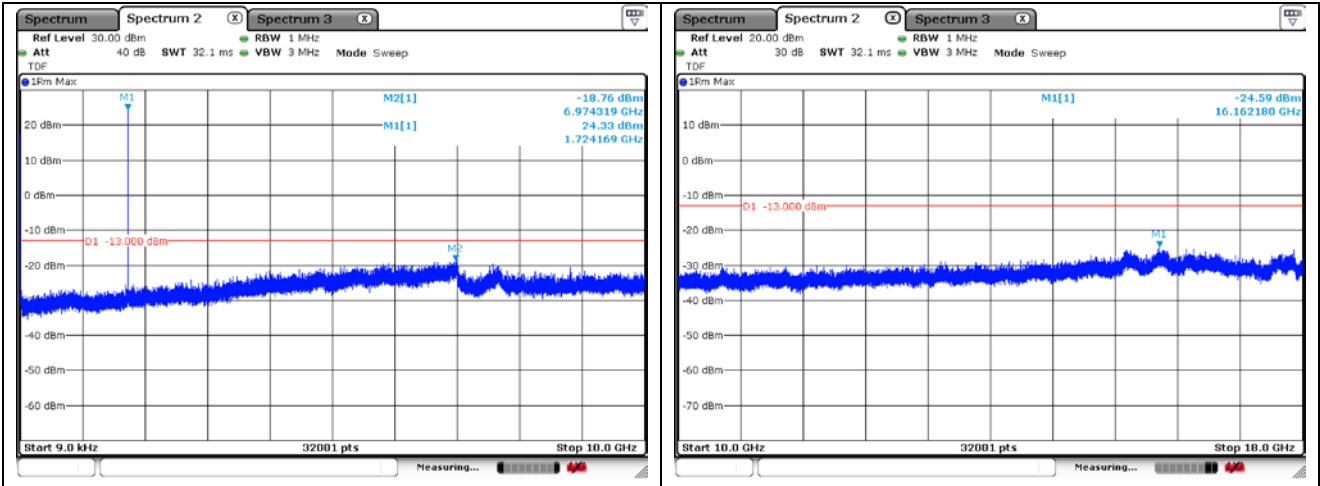


**PCC 10 MHz RB1 + SCC 20 MHz RB1\_Middle Channel**

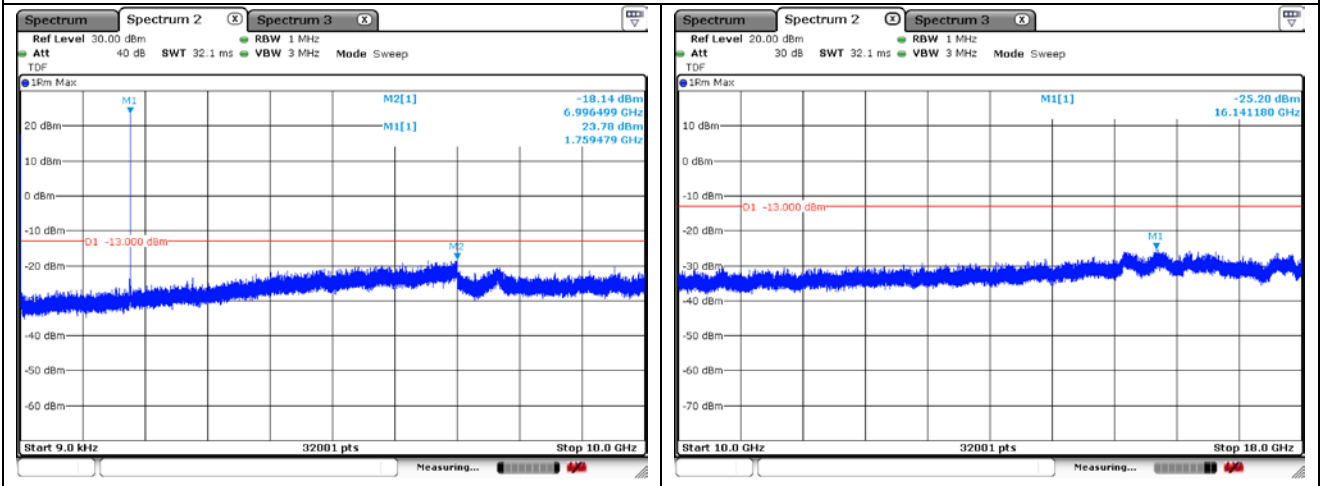


**PCC 10 MHz RB1 + SCC 20 MHz RB1\_High Channel**

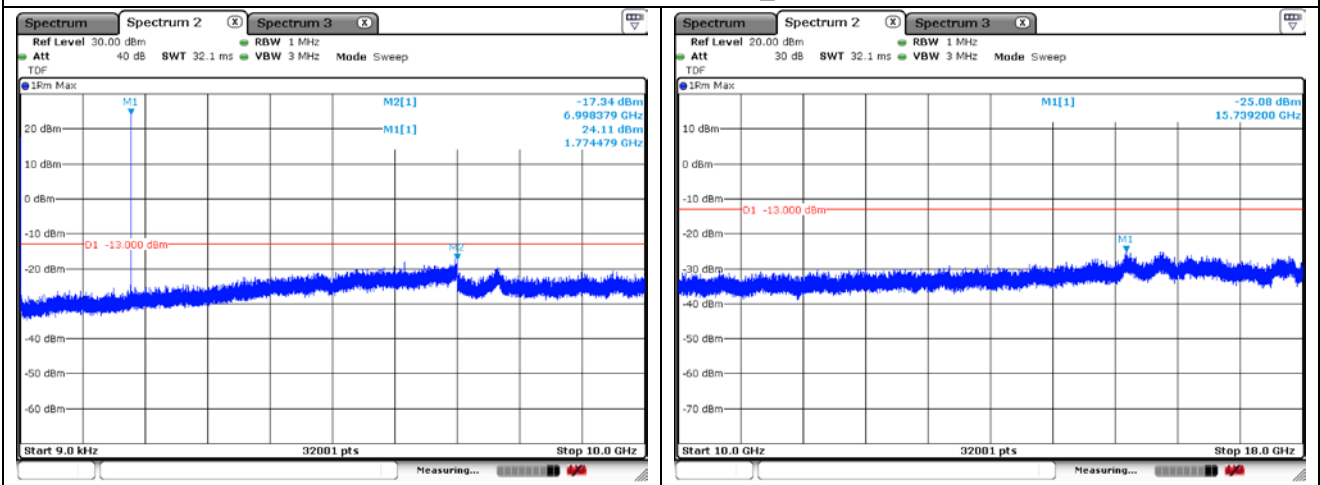
**ULCA 66B**



**PCC 15 MHz RB1 + SCC 5 MHz RB1\_Low Channel**

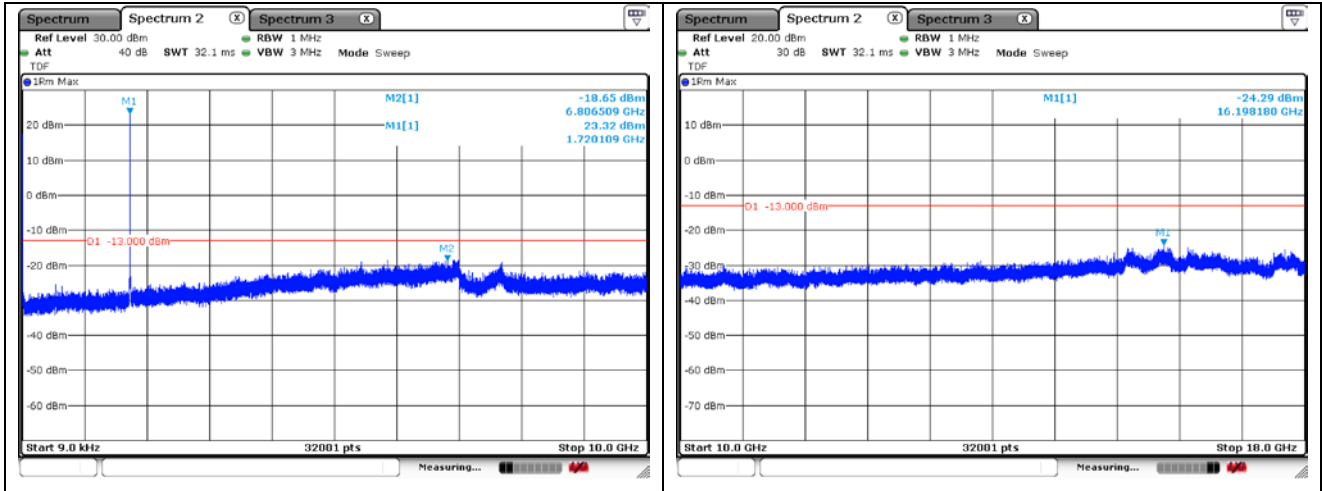


**PCC 15 MHz RB1 + SCC 5 MHz RB1\_Middle Channel**

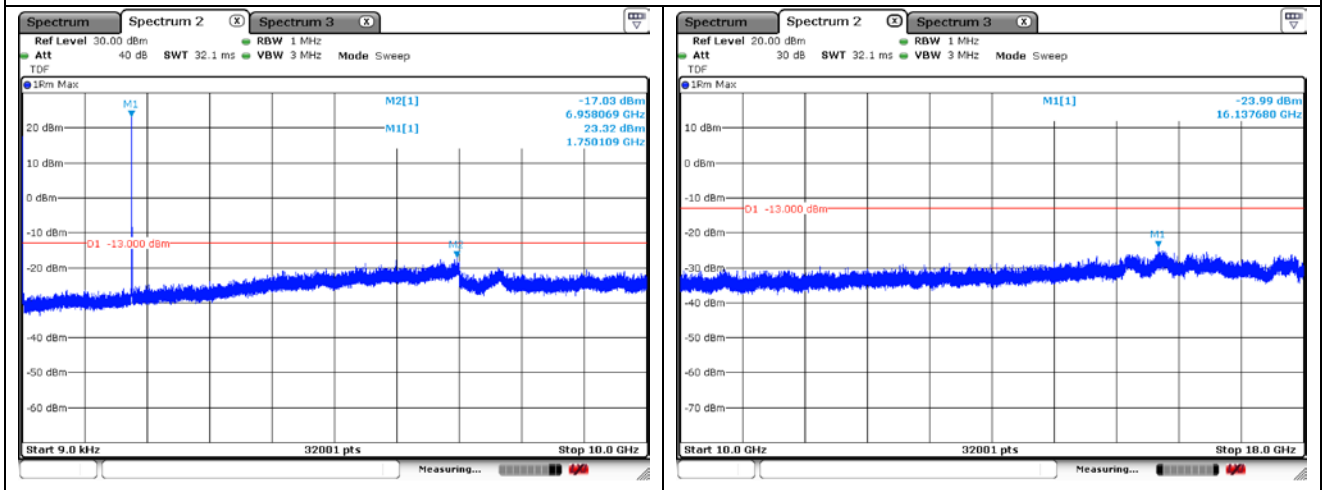


**PCC 15 MHz RB1 + SCC 5 MHz RB1\_High Channel**

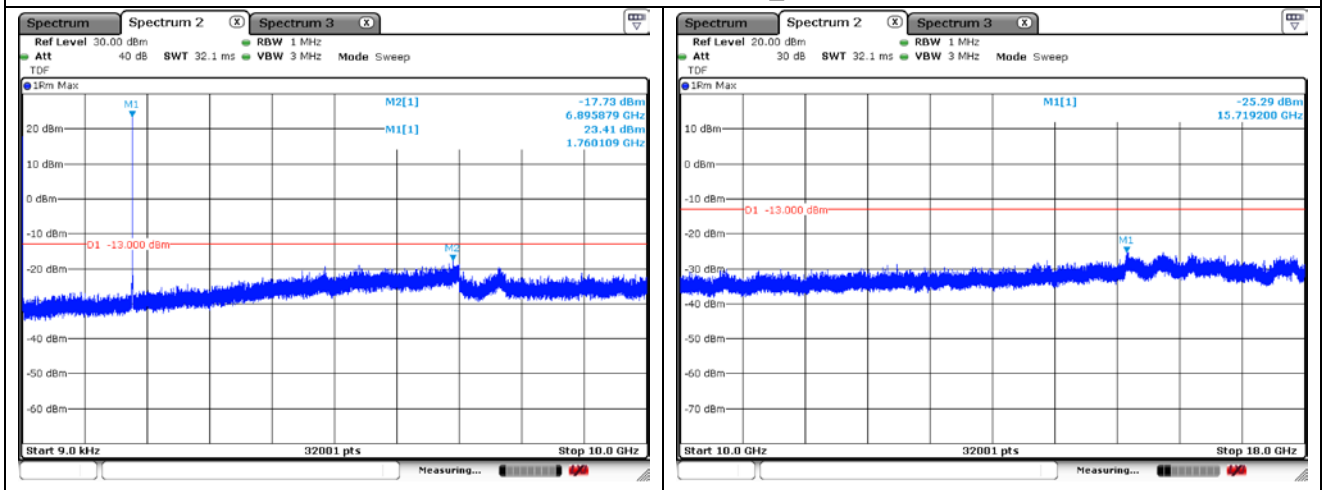
**ULCA 66C**



**PCC 10 MHz RB1 + SCC 20 MHz RB1\_Low Channel**



**PCC 10 MHz RB1 + SCC 20 MHz RB1\_Middle Channel**



**PCC 10 MHz RB1 + SCC 20 MHz RB1\_High Channel**



## 7. Band Edge and Emission Mask

### 7.1. Limit

#### FCC

- §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  $43 + 10\log(P)$  dB.

- §27.53(h)(1), for operations in the 1 695-1 710 MHz, 1 710-1 755 MHz, 1 755-1 780 MHz, 1 915-1 920 MHz, 1 995-2 000 MHz, 2 000-2 020 MHz, 2 110-2 155 MHz, 2 155-2 180 MHz, and 2 180-2 200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10} (P)$  dB.

- §27.53(m)(4), for mobile digital stations, the attenuation factor shall be not less than  $40 + 10 \log_{10} (P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log_{10} (P)$  dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and  $55 + 10 \log_{10} (P)$  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. In addition, the attenuation factor shall not be less than  $43 + 10 \log_{10} (P)$  dB on all frequencies between 2 490.5 MHz and 2 496 MHz and  $55 + 10 \log_{10} (P)$  dB at or below 2 490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2 495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

#### IC

- RSS-132 Issue 3

5.5, Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

(i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dB W) by at least  $43 + 10 \log_{10} p$  (watts).

(ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dB W) by at least  $43 + 10 \log_{10} p$  (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

- RSS-139 Issue 3

6.6, (i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1 % of the emission bandwidth shall be attenuated below the transmitter output power P (in dB W) by at least  $43 + 10 \log_{10} p$  (watts) dB.

(ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dB W) by at least  $43 + 10 \log_{10} p$  (watts) dB.

- RSS-199 Issue 3

4.5, In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

for base station and fixed subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dB W), by at least  $43 + 10 \log_{10} p$  for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dB W), by at least:

- i.  $40 + 10 \log_{10} p$  from the channel edges to 5 MHz away
- ii.  $43 + 10 \log_{10} p$  between 5 MHz and X MHz from the channel edges, and
- iii.  $55 + 10 \log_{10} p$  at X MHz and beyond from the channel edges

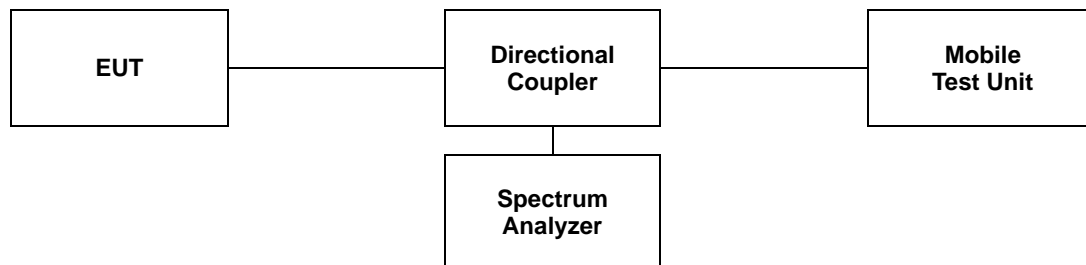
In addition, the attenuation shall not be less than  $43 + 10 \log_{10} p$  on all frequencies between 2 490.5 MHz and 2 496 MHz, and  $55 + 10 \log_{10} p$  at or below 2 490.5 MHz.

In (a) and (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

## 7.2. Test Procedure

The test follows section 5.7 of ANSI C63.26-2015.

- a. Span was set large enough so as to capture all out of band emissions near the band edge.
- b. RBW  $\geq$  1 % of OBW
- c. VBW  $\geq$  3 x RBW.
- d. Detector = RMS.
- e. Trace mode = Average.
- f. Sweep time = Auto.
- g. The trace was allowed to stabilize.
- h. All path loss of frequency range was investigated and compensated to spectrum analyzer as TDF function.

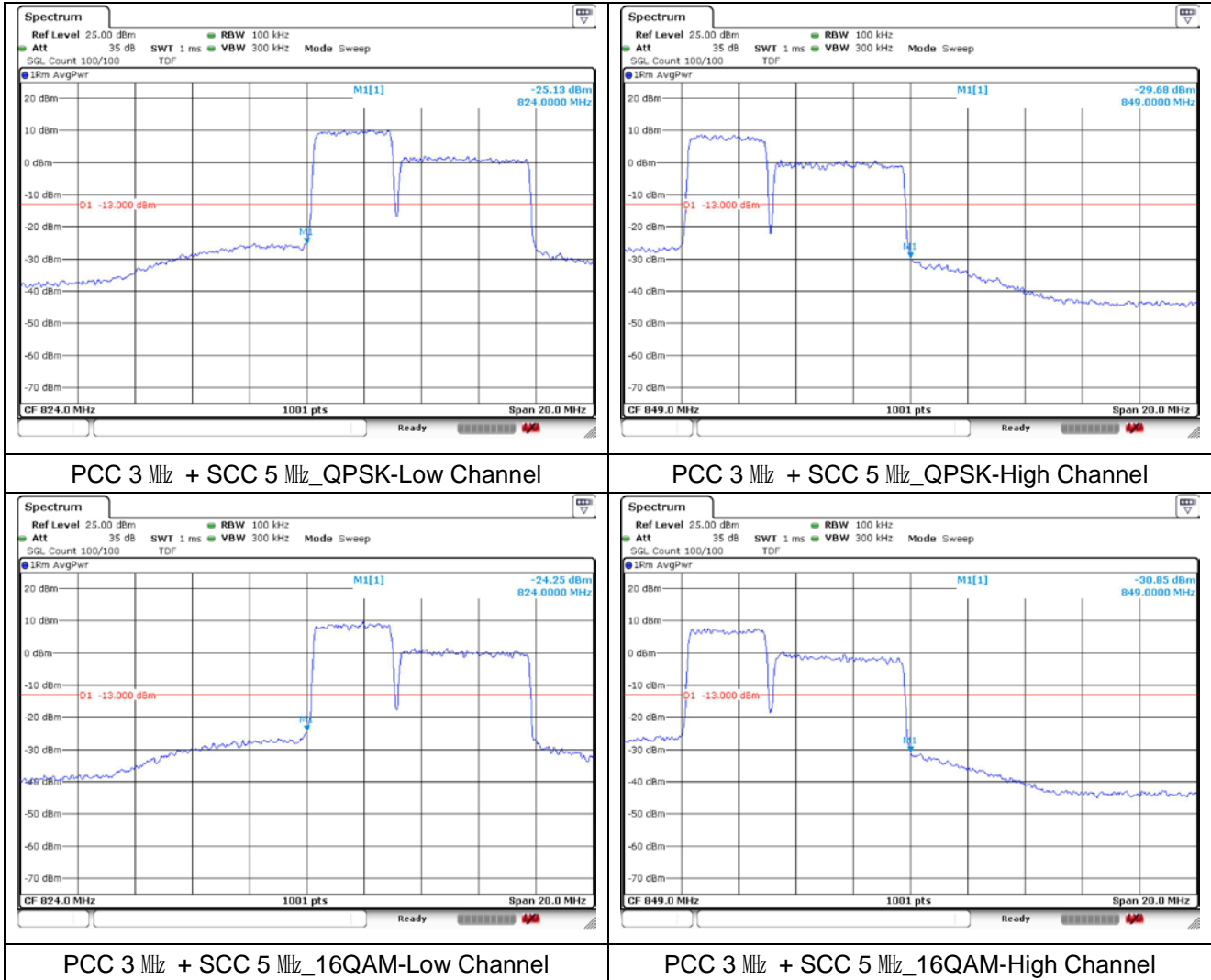


### 7.3. Test Results

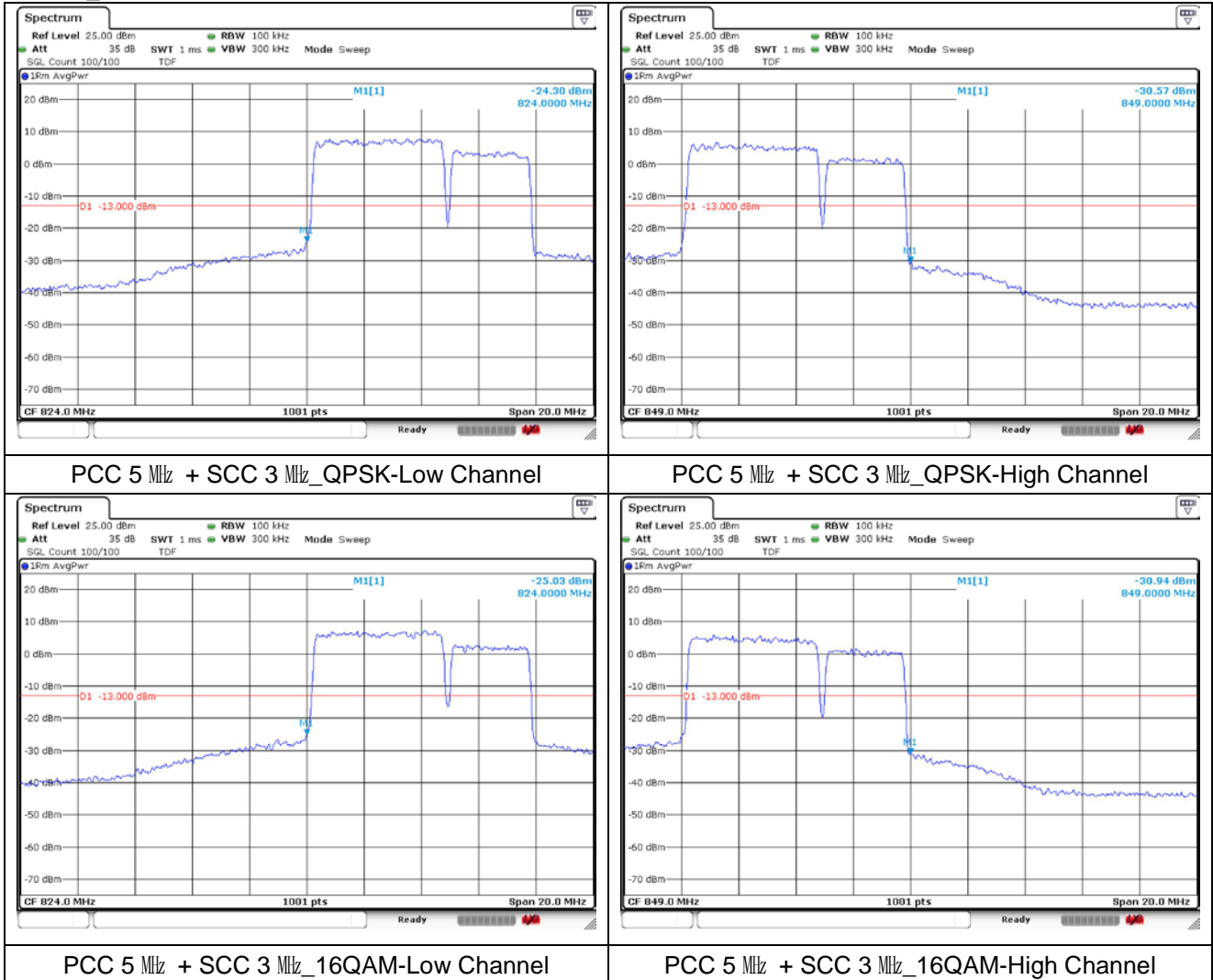
Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

#### - Test plots

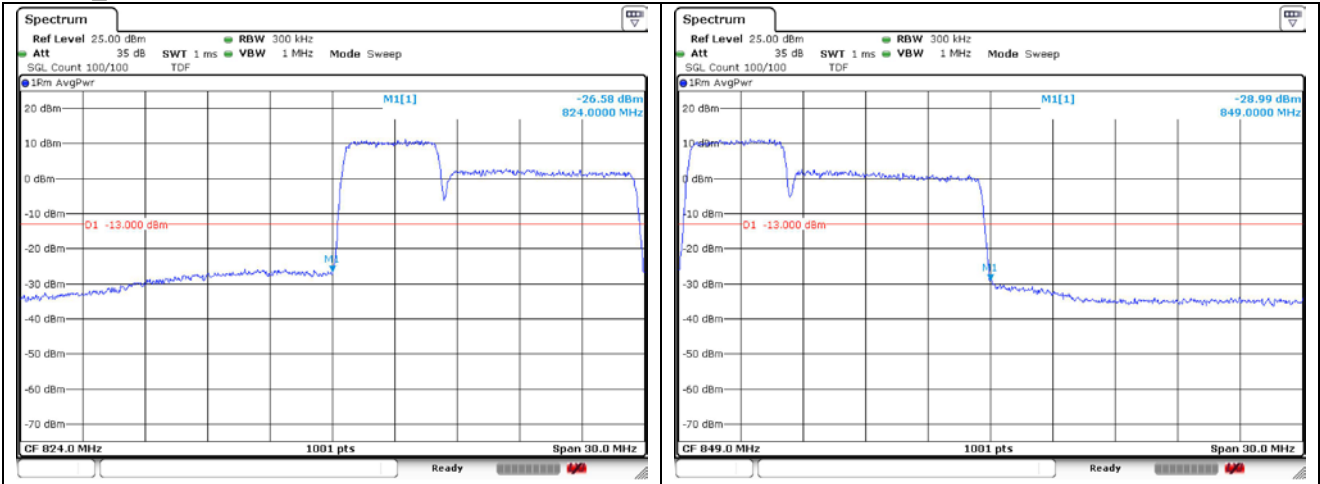
##### ULCA\_5B



**ULCA\_5B**

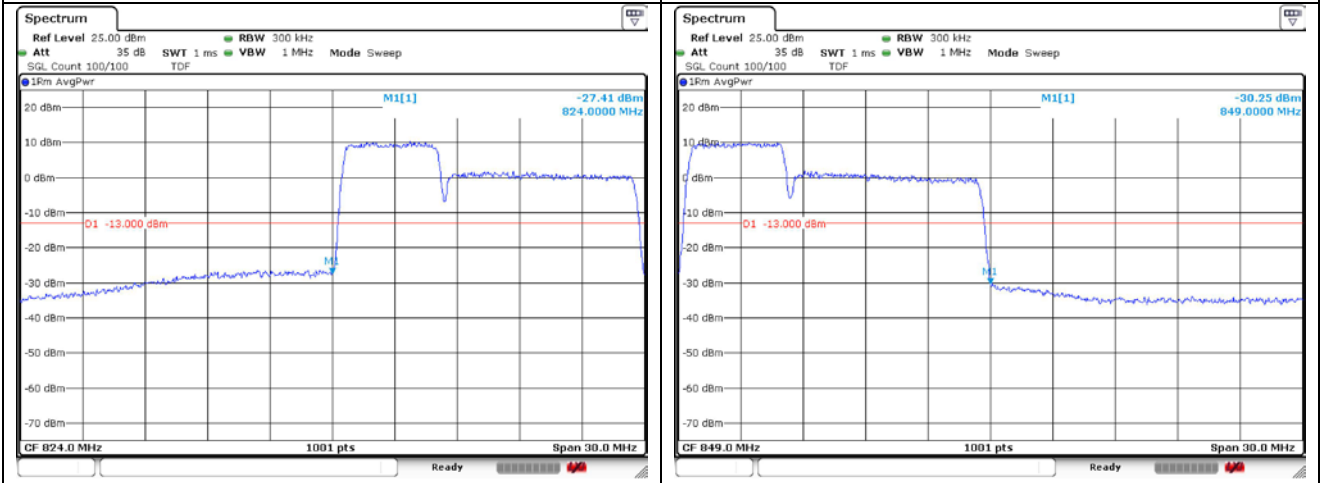


**ULCA\_5B**



PCC 5 MHz + SCC 10 MHz\_QPSK-Low Channel

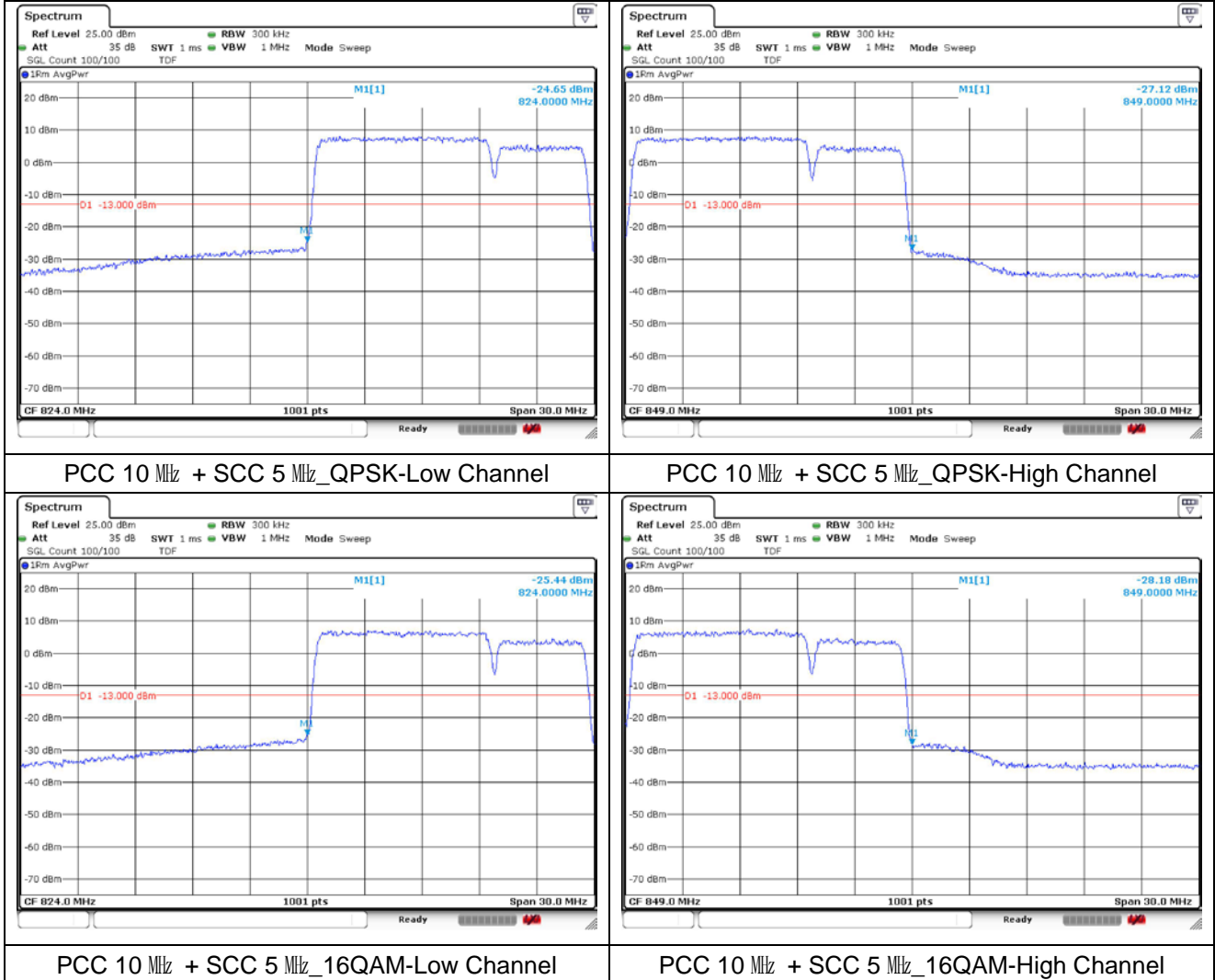
PCC 5 MHz + SCC 10 MHz\_QPSK-High Channel



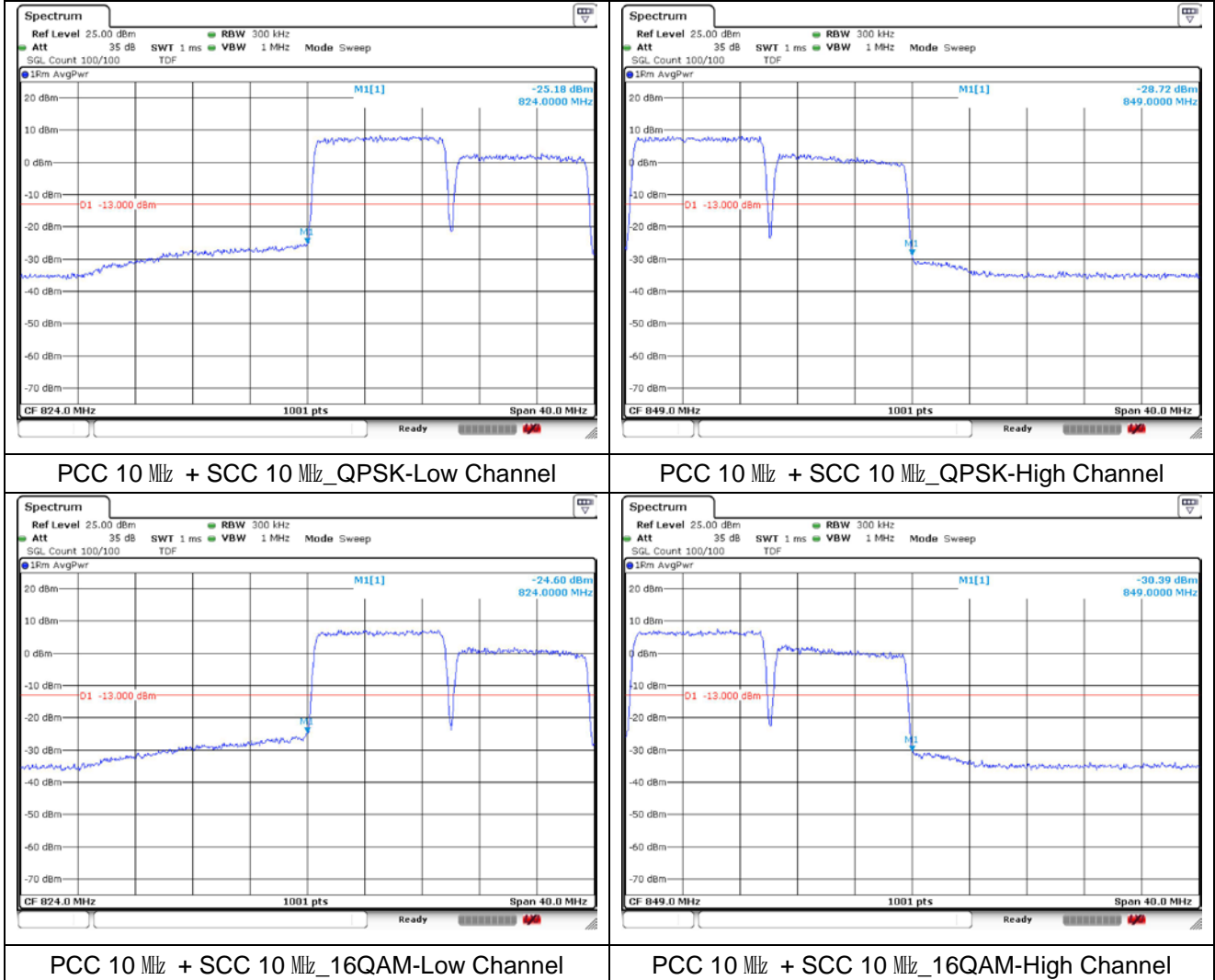
PCC 5 MHz + SCC 10 MHz\_16QAM-Low Channel

PCC 5 MHz + SCC 10 MHz\_16QAM-High Channel

**ULCA\_5B**

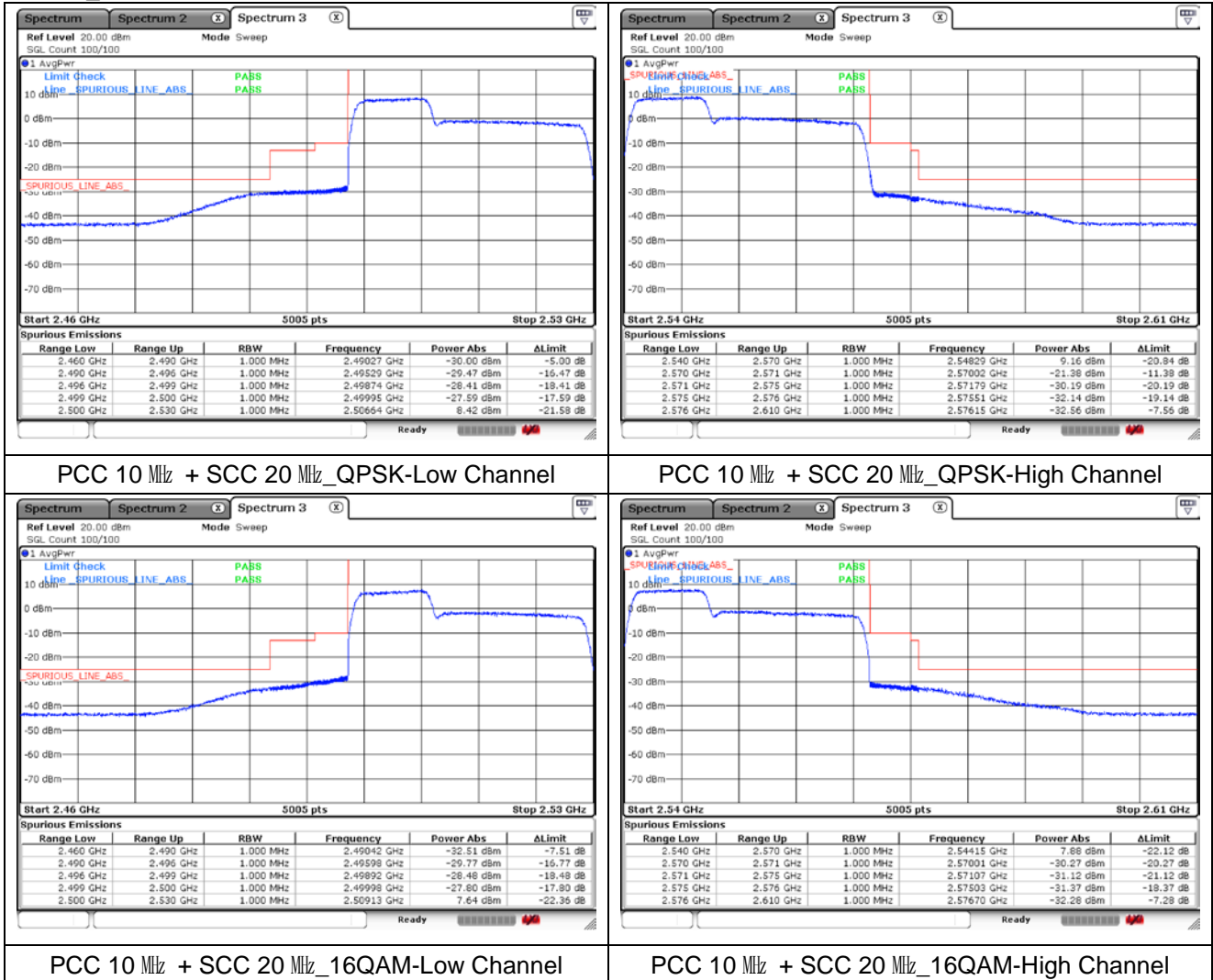


**ULCA\_5B**

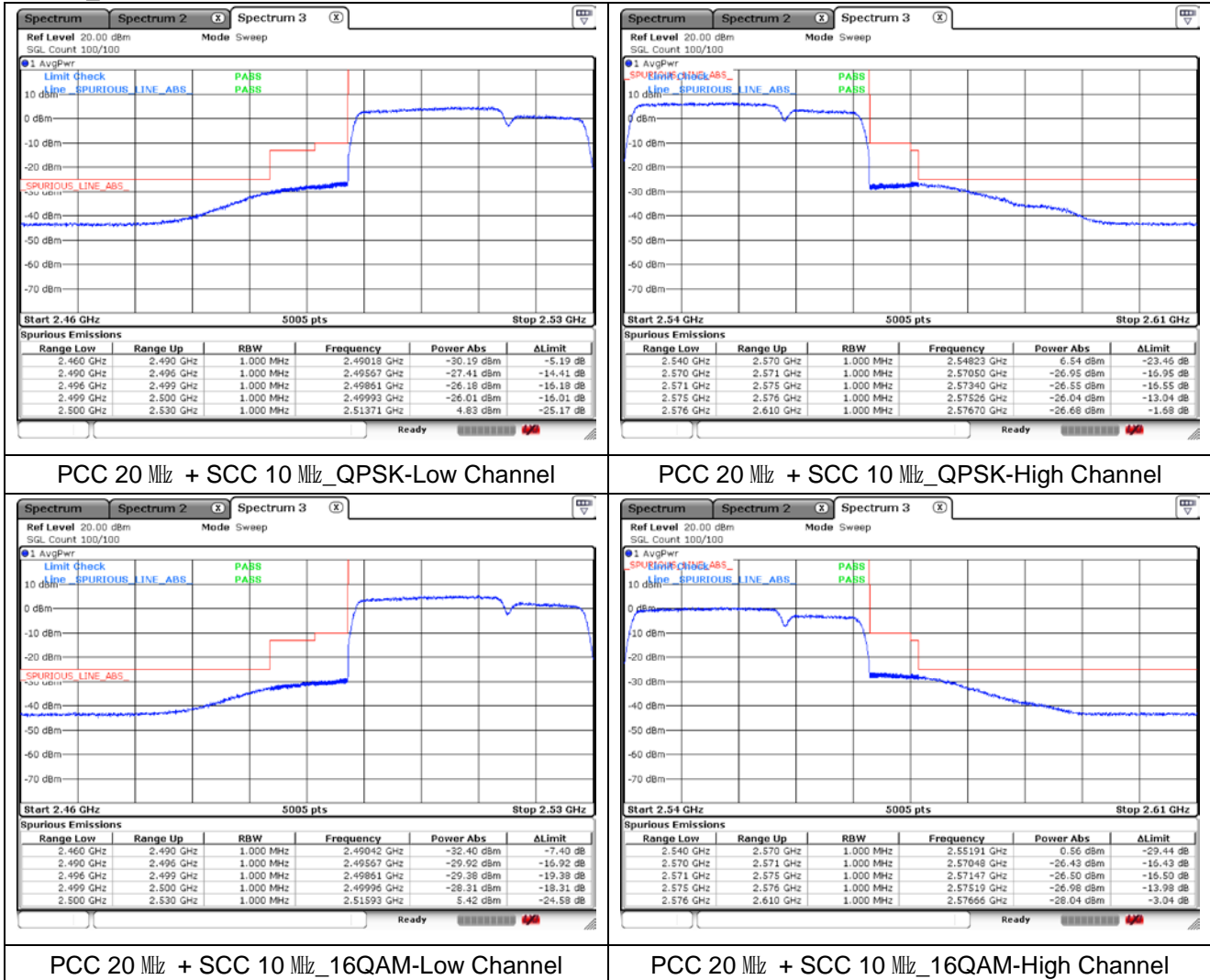




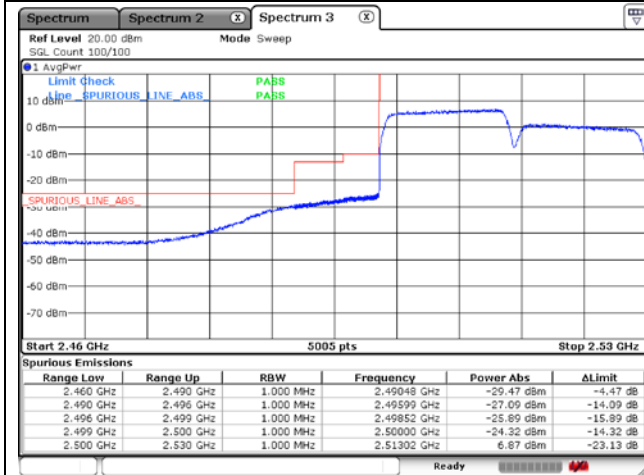
**ULCA\_7C**



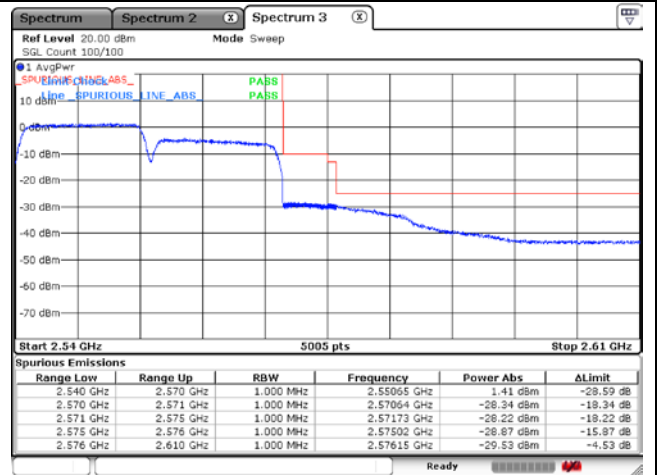
**ULCA\_7C**



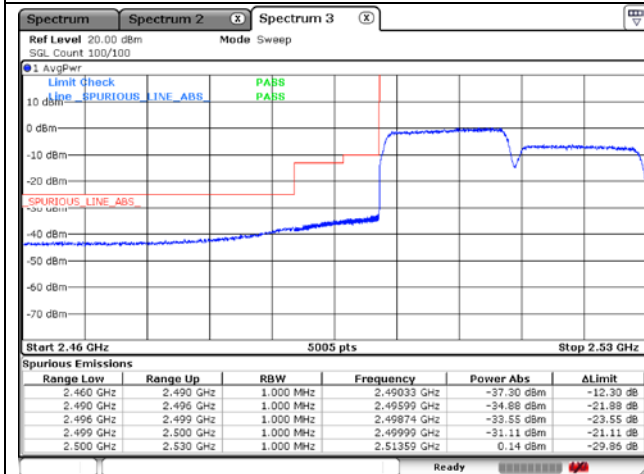
**ULCA\_7C**



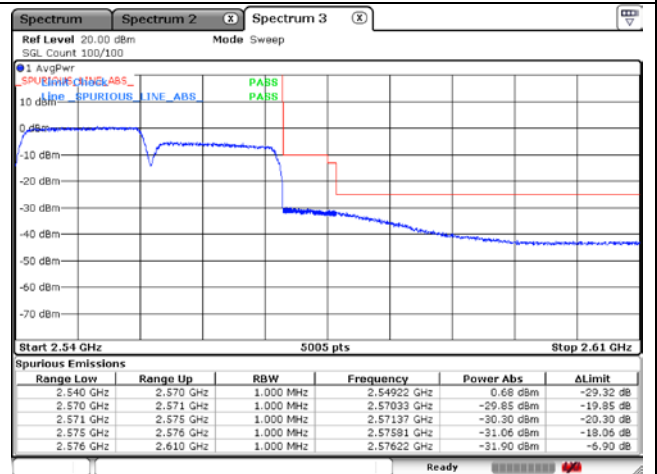
PCC 15 MHz + SCC 15 MHz\_QPSK-Low Channel



PCC 15 MHz + SCC 15 MHz\_QPSK-High Channel

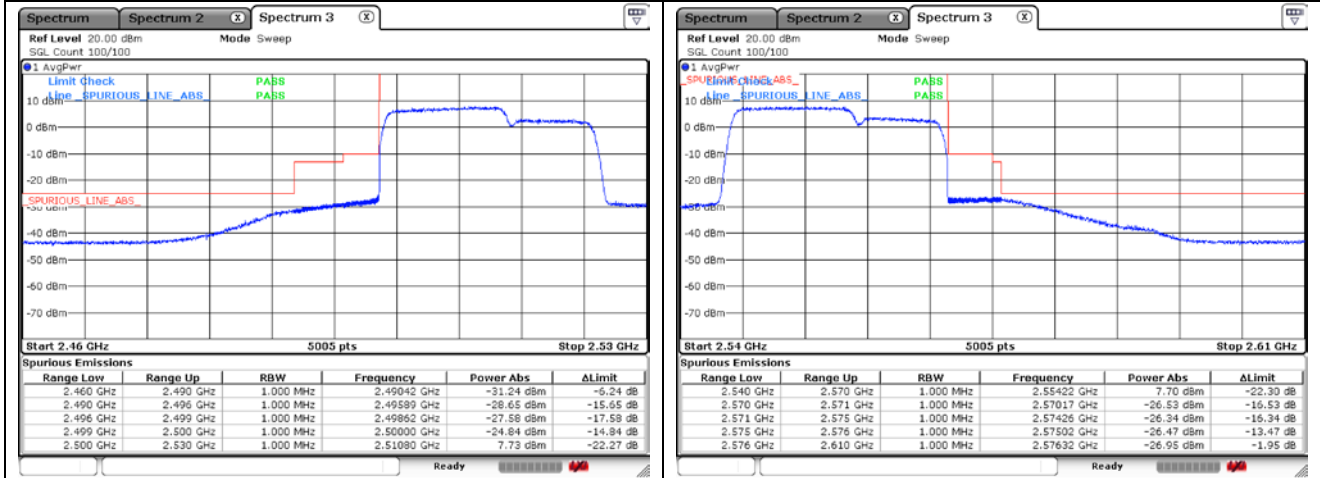


PCC 15 MHz + SCC 15 MHz\_16QAM-Low Channel



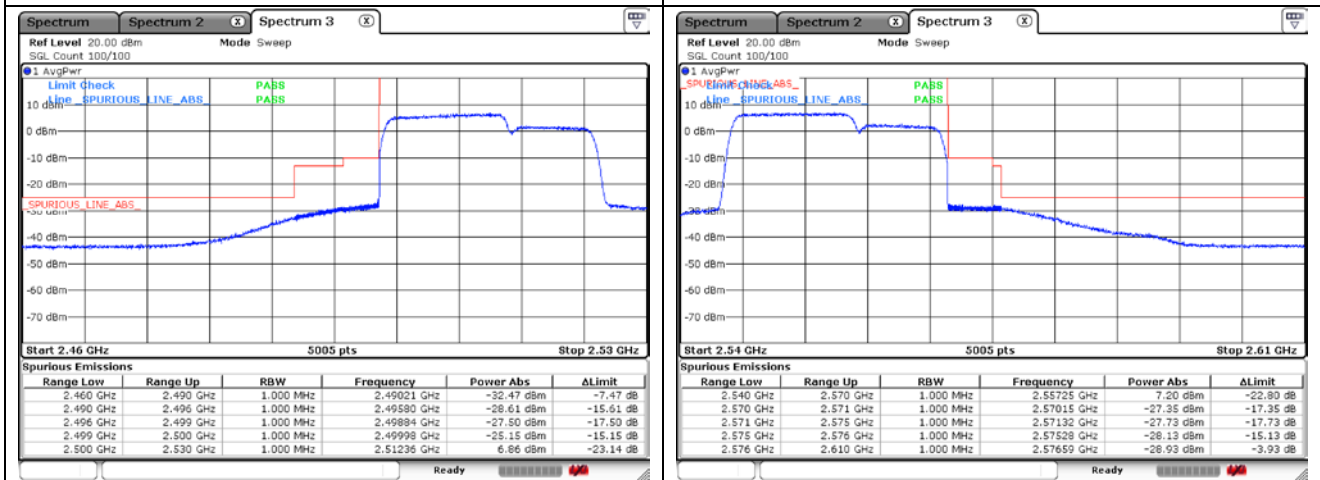
PCC 15 MHz + SCC 15 MHz\_16QAM-High Channel

**ULCA\_7C**



PCC 15 MHz + SCC 10 MHz\_QPSK-Low Channel

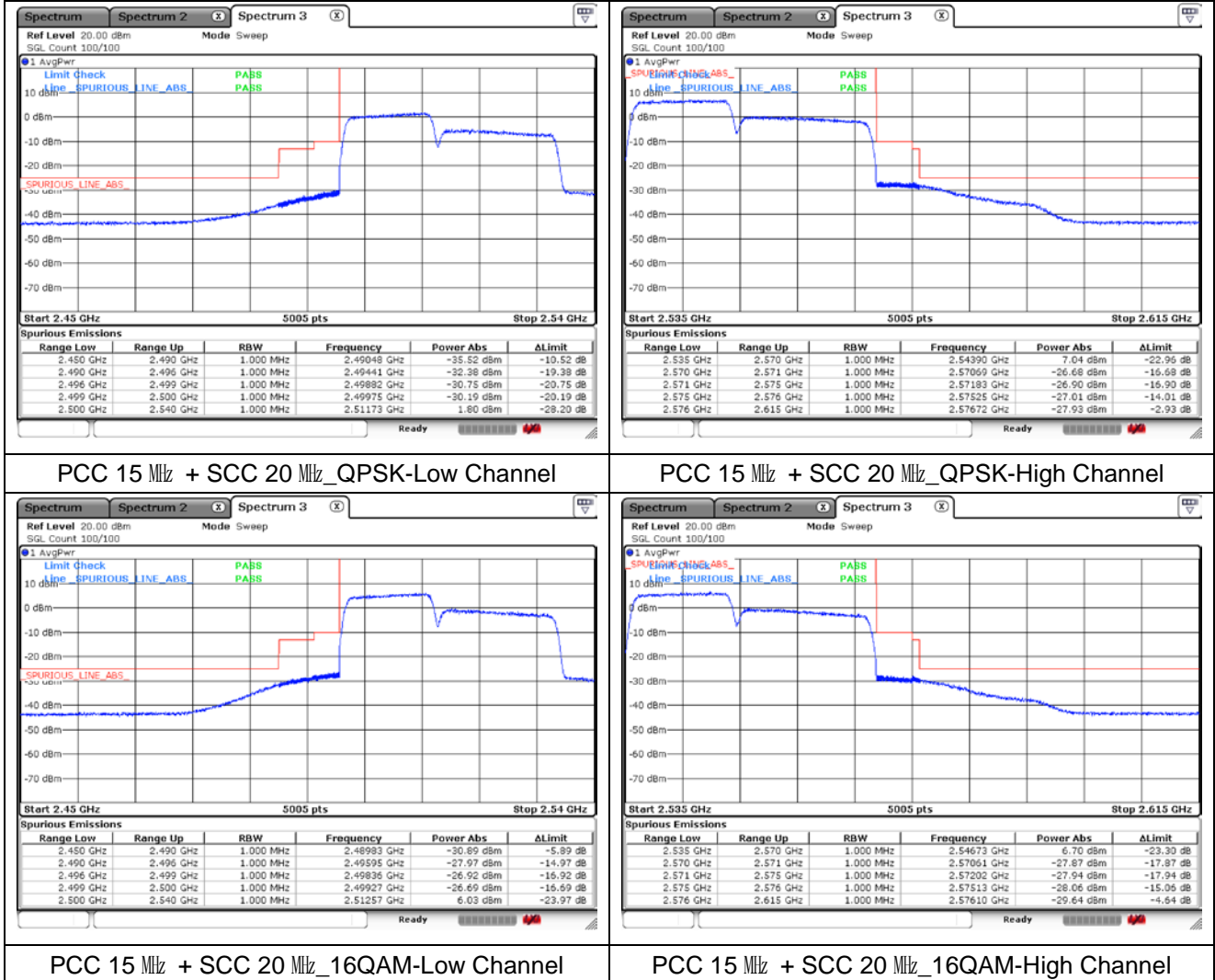
PCC 15 MHz + SCC 10 MHz\_QPSK-High Channel



PCC 15 MHz + SCC 10 MHz\_16QAM-Low Channel

PCC 15 MHz + SCC 10 MHz\_16QAM-High Channel

**ULCA\_7C**



**ULCA\_7C**

