Transmitter Antenna Port Conducted Emissions

Transmitter conducted emission measurements were made at RRH antenna port 4. Measurements were performed over the 9kHz to 9GHz frequency range. The RRH was operated on the Band 5 middle channel (881.5MHz) and Band 13 middle channel (751.0MHz) simultaneously with all LTE modulation types (QPSK, 16QAM, 64QAM and 256QAM) for all available LTE bandwidths (Band 5: 1.4MHz, 3MHz, 5MHz and 10MHz; Band 13: 5MHz and 10MHz). The same LTE bandwidth was used for both frequency bands when available. If the same LTE bandwidth for both bands was not available then the smallest LTE bandwidth was used.

The limit of -19dBm was used in the certification testing. The limit is adjusted to -19dBm [-13dBm -10 log (4)] per FCC KDB 662911D01 v02r01 because the BTS may operate as a 4 port MIMO transmitter. The required measurement parameters include a 100kHz bandwidth with power measured in average value (since transmitter power was measured in average value). Measurements were performed with a spectrum analyzer using a peak detector with max hold over 50 sweeps.

The limit for the 9kHz to 150kHz frequency range was adjusted to –39dBm to correct for a spectrum analyzer RBW of 1kHz versus required RBW of 100kHz [i.e.: -39dBm = -19dBm -10log(100kHz/1kHz)]. The required limit of -19dBm with a RBW of $\geq$100kHz was used for all other frequency ranges. The spectrum analyzer settings that were used for this test are summarized in the following table.

Frequency Range	RBW	VBW	Number of Data Points	Detector	Sweep Time	Max Hold over	Offset Note 1
9kHz to 150kHz	1kHz	3kHz	1001	Peak	Auto	50 Sweeps	39.9dB
150kHz to 20MHz	100kHz	300kHz	8001	Peak	Auto	50 Sweeps	39.9dB
20MHz to 350MHz	100kHz	300kHz	8001	Peak	Auto	50 Sweeps	40.2dB
350MHz to 700MHz	100kHz	300kHz	8001	Peak	Auto	50 Sweeps	40.2dB
700MHz to 1.1GHz	100kHz	300kHz	8001	Peak	Auto	50 Sweeps	40.2dB
1.1GHz to 5GHz	1MHz	3MHz	8001	Peak	Auto	50 Sweeps	23.1dB
5GHz to 9GHz	1MHz	3MHz	8001	Peak	Auto	50 Sweeps	24.1dB
Note 1: The total measurement RF path loss of the test setup (attenuators, filters and test cables) is accounted for by the spectrum analyzer reference level offset.							

A high pass filter was used to reduce measurement instrumentation noise floor for the frequency ranges above 1100MHz. The total measurement RF path loss of the test setup (attenuators, high pass filter and test cables) as shown in the table is accounted for by the spectrum analyzer reference level offset. The display line on the plots reflects the required limit.

Conducted spurious emission plots/measurements are provided in Appendix A.

Transmitter Antenna Port Conducted Emissions in 1559MHz to 1610MHz Frequency Range

Conducted emissions in the frequency range 1559MHz to 1610MHz were measured. The EIRP limit in this band is -70dBW/MHz for wideband signals and -80dBW for discrete emissions of bandwidths less than 700Hz as shown in FCC 27.53(f) and RSS-130 section 4.6.2(b). This equates to an EIRP of -40dBm/MHz for wideband emissions and -50dBm/MHz for discrete emissions.

The limit is adjusted to -46 dBm [-40 dBm -10 log (4)] for wideband signals and -56dBm [-50 dBm -10 log (4)] for discrete emissions per FCC KDB 662911D01 v02r01 because the BTS may operate as a 4 port MIMO transmitter.

Measurements were made at AHBCC antenna port 4 with carriers at maximum power. The RRH was operated on the Band 5 middle channel (881.5MHz) and Band 13 middle channel (751.0MHz) simultaneously with all LTE modulation types (QPSK, 16QAM, 64QAM and 256QAM) for all available LTE bandwidths (Band 5: 1.4MHz, 3MHz, 5MHz and 10MHz; Band 13: 5MHz and 10MHz). The same LTE bandwidth was used for both frequency bands when available. If the same LTE bandwidth for both bands was not available then the smallest LTE bandwidth was used.

Measurements were also made on the Band 13 bottom and top channels for LTE bandwidths of 5MHz and 10MHz (The dual carrier Band 13 LTE5 case was also measured) with the Band 5 carrier at the middle channel with a 1.4MHz LTE bandwidth. The AHBCC configured for Band 13 LTE10 may operate only on the middle channel since the operational bandwidth is 10MHz wide.

Measurements were performed with the spectrum analyzer in the RMS average mode over 100 traces. A 1MHz RBW and 3MHz VBW was used for all measurements. A 1GHz high pass filter was used to block the carrier fundamental frequency to reduce the measurement instrumentation noise floor level. The total measurement RF path loss of the test setup (attenuators, filters and test cables) of 23.1dB is accounted for by the spectrum analyzer reference level offset.

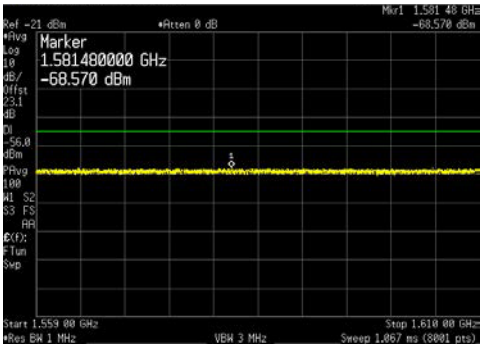
All readings were at the measurement instrumentation noise floor. The highest (worst case) emission from the measurement data was -68.119 dBm or -98.119 dBW. The results are summarized in the following table.

Channel Bandwidth & Channel Frequency Configuration		Conducted Emissions in 1559MHz to 1610MHz Frequency Range (dBm)			
Band 5	**Band 13**	**QPSK**	**16QAM**	**64QAM**	**256QAM**
LTE1.4 & MC	LTE5 & MC	-68.570	-68.546	-68.519	-68.505
LTE3 & MC	LTE5 & MC	-68.465	-68.456	-68.264	-68.500
LTE5 & MC	LTE5 & MC	-68.377	-68.202	-68.558	-68.576
LTE10 & MC	LTE10 & MC	-68.467	-68.542	-68.530	-68.425
LTE1.4 & MC	LTE5 & BC	-68.468	-68.391	-68.502	-68.301
LTE1.4 & MC	LTE5 & TC	-68.517	**-68.119**	-68.323	-68.148
LTE1.4 & MC	Dual LTE5 & BC/TC	-68.546	-68.334	-68.419	-68.451
LTE1.4 & MC	LTE10 & MC	-68.328	-68.416	-68.424	-68.454

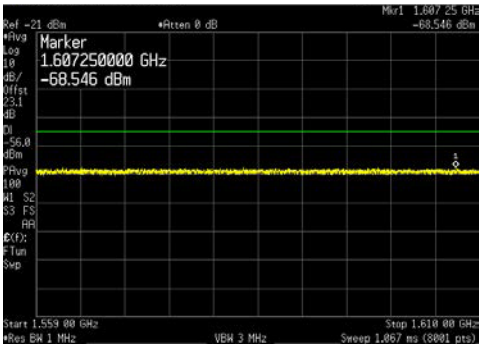
Conducted emission plots/measurements for the 1559MHz to 1610MHz frequency range are provided in the following pages. The display line on the plots reflects the required worse case limit (-56dBm).

Band 5_LTE1.4 at Middle Channel (881.5MHz) & Band 13_LTE5 at Middle Channel (751MHz):

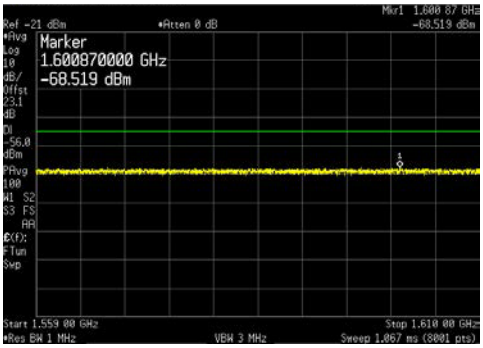
QPSK



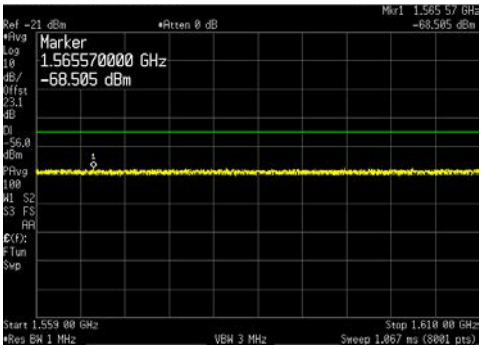
16QAM



64QAM

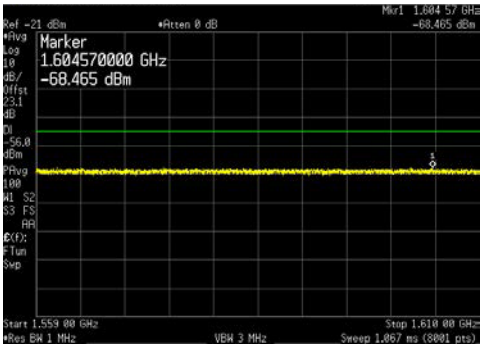


256QAM

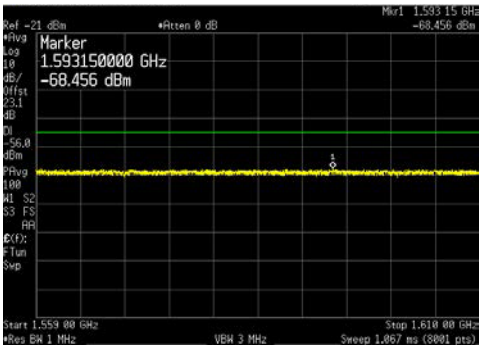


Band 5_LTE3 at Middle Channel (881.5MHz) & Band 13_LTE5 at Middle Channel (751MHz):

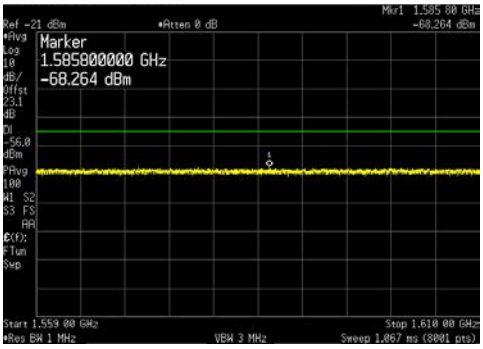
QPSK



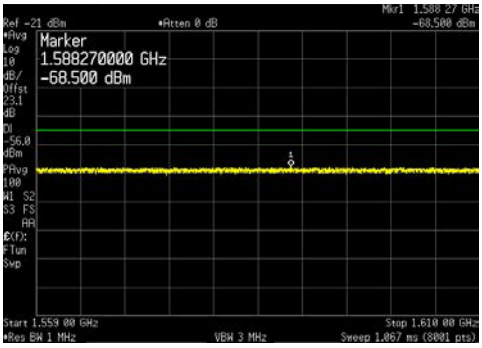
16QAM



64QAM

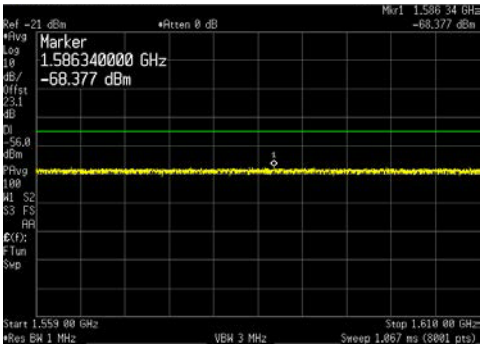


256QAM

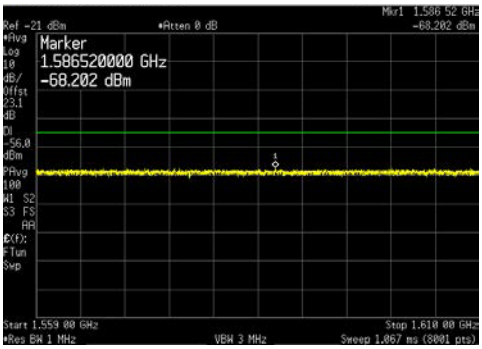


Band 5_LTE5 at Middle Channel (881.5MHz) & Band 13_LTE5 at Middle Channel (751MHz):

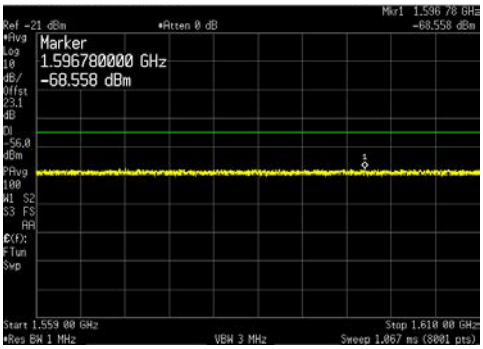
QPSK



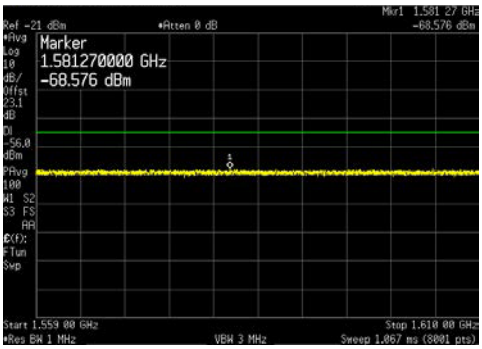
16QAM



64QAM

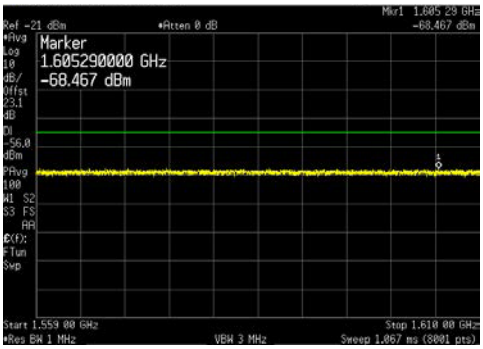


256QAM

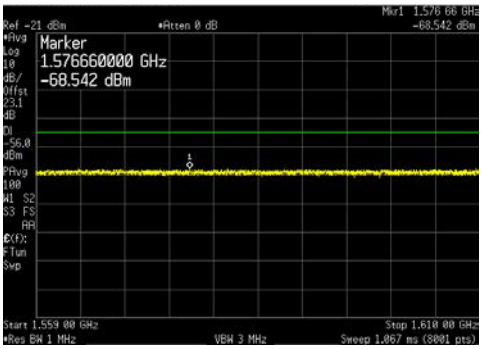


Band 5_LTE10 at Middle Channel (881.5MHz) & Band 13_LTE10 at Middle Channel (751MHz):

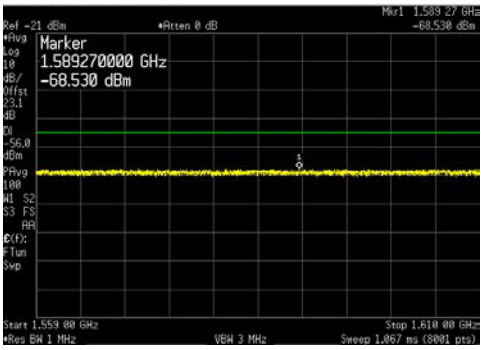
QPSK



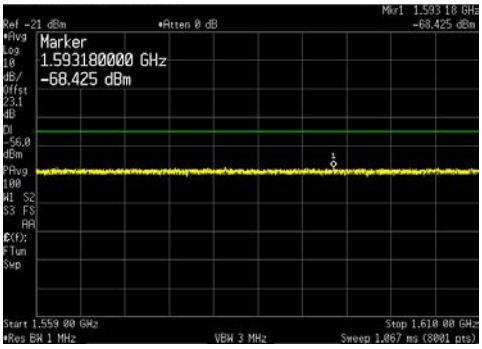
16QAM



64QAM

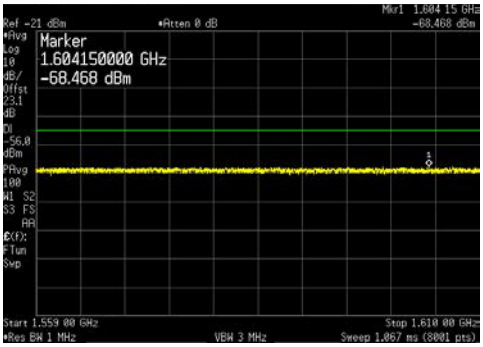


256QAM

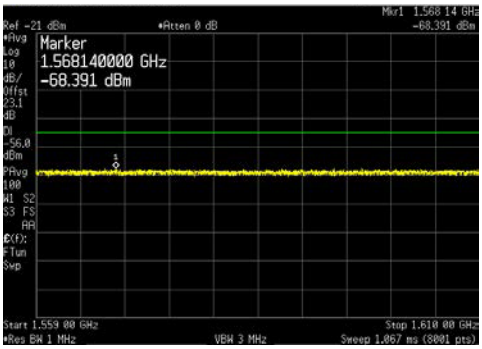


Band 5_LTE1.4 at Middle Channel (881.5MHz) & Band 13_LTE5 at Bottom Channel (748.5MHz):

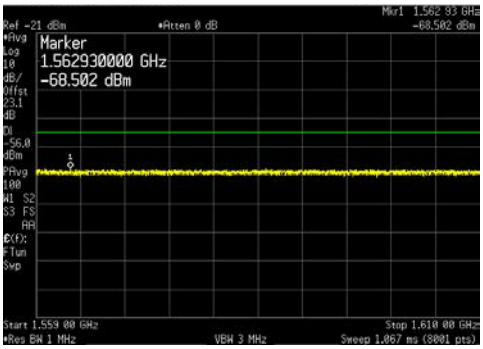
QPSK



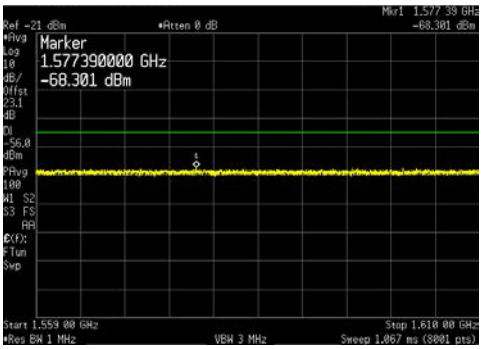
16QAM



64QAM

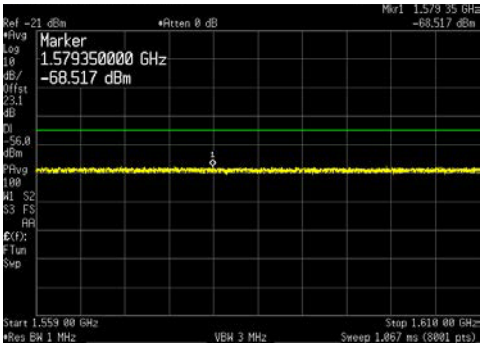


256QAM

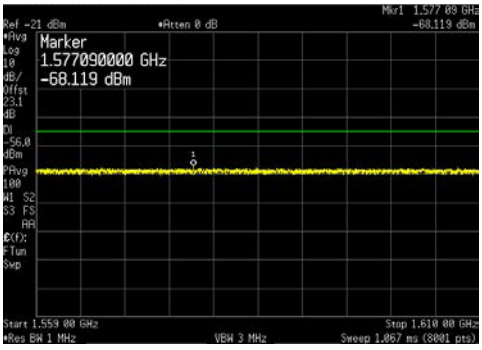


Band 5_LTE1.4 at Middle Channel (881.5MHz) & Band 13_LTE5 at Top Channel (753.5MHz):

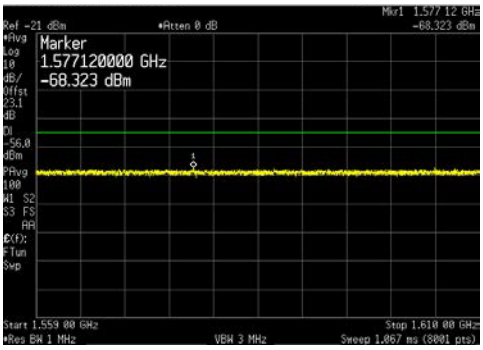
QPSK



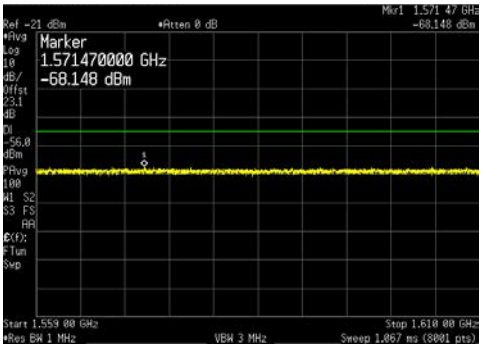
16QAM



64QAM

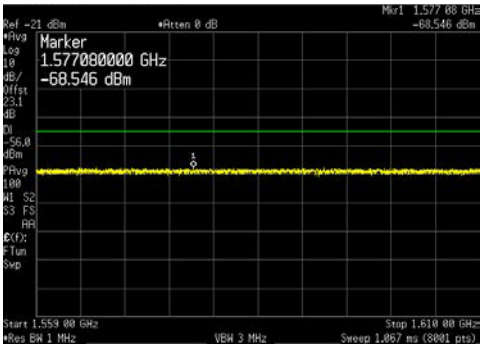


256QAM

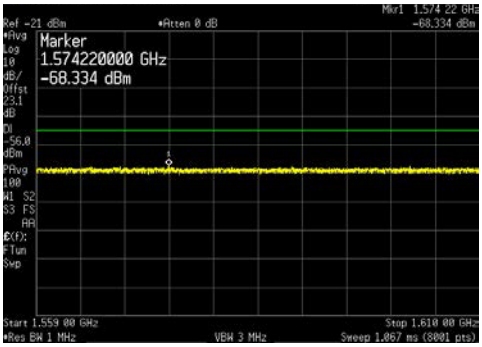


Band 5_LTE1.4 at Middle Channel (881.5MHz) & Band 13_Dual LTE5 (748.5MHz and 753.5MHz):

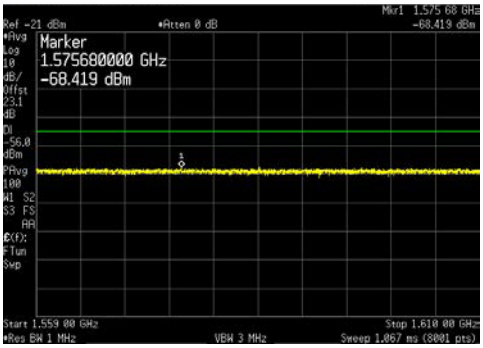
QPSK



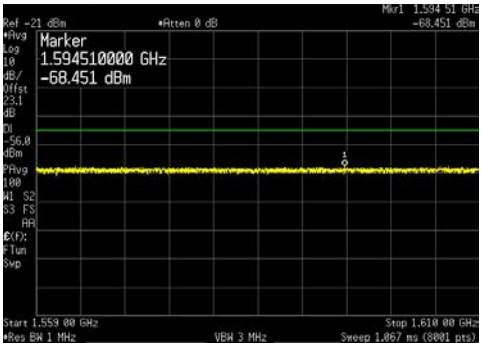
16QAM



64QAM

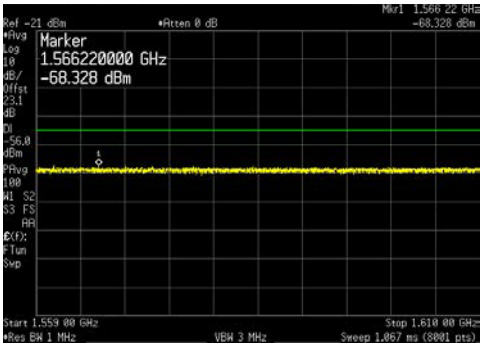


256QAM

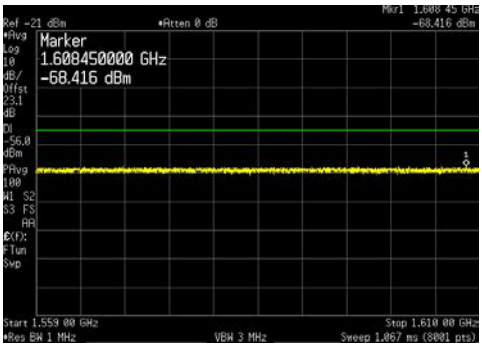


Band 5_LTE1.4 at Middle Channel (881.5MHz) & Band 13_LTE10 at Middle Channel (751MHz):

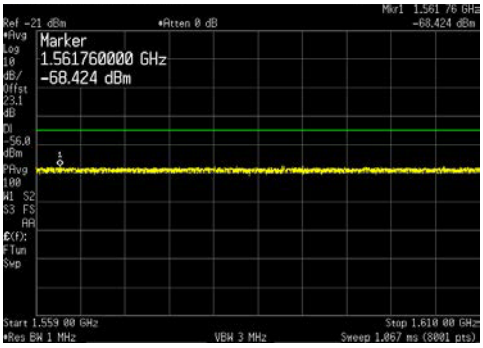
QPSK



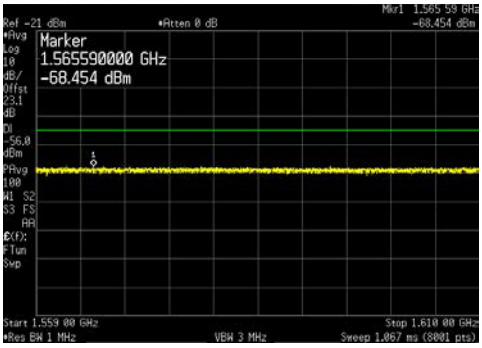
16QAM



64QAM

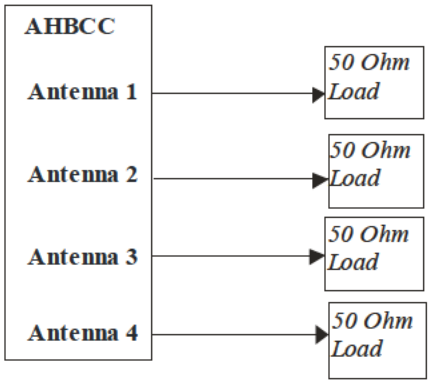


256QAM



Transmitter Radiated Spurious Emissions

During radiated emission testing all antenna ports of the base station were terminated with 50ohm termination blocks as shown in the diagram below.



Based on antenna port conducted spurious emissions tests results, preliminary scans for radiated spurious emissions were performed in 30MHz – 9GHz frequency range. One radiated emission test configuration (with the external cooling fan) is needed to prove compliance for both 3GPP Band 5 and the 3GPP Band 13 frequency bands. The 3GPP Band 5 and the 3GPP Band 13 transmitters were enabled simultaneously at maximum power (40 watts per carrier and 80 watts per port) on all four ports for this test. The bottom, middle and top frequency channels for each band were enabled. The AHBCC band 13 configured for LTE10 may operate only on the middle channel since the operational bandwidth is 10MHz wide (The band 13 carrier covers the entire downlink band). The carrier configurations for the radiated emission testing are provided below. Final maximized radiated emissions were measured in these modes.

Frequency Band	Antenna Port	RF Bandwidth	EARFCN	Transmit Frequency
Band 5	1	1.4 MHz	2407 (Bottom Channel)	869.7 MHz
Band 5	2	1.4 MHz	2525 (Middle Channel)	881.5 MHz
Band 5	3	1.4 MHz	2525 (Middle Channel)	881.5 MHz
Band 5	4	1.4 MHz	2643 (Top Channel)	893.3 MHz
Band 13	1	10 MHz	5230 (Middle Channel)	751.0 MHz
Band 13	2	10 MHz	5230 (Middle Channel)	751.0 MHz
Band 13	3	10 MHz	5230 (Middle Channel)	751.0 MHz
Band 13	4	10 MHz	5230 (Middle Channel)	751.0 MHz

Band 5 & Band 13 Carriers Enabled Simultaneously at Maximum Power

Radiated spurious emission results are provided in Appendix A.

Frequency Stability/Accuracy

Carrier frequency stability of the EUT at extreme temperatures and voltages was measured. The frequency error was measured as follows:

(1) EUT transmitting in 5MHz-QPSK-LTE mode at center channel (751.0MHz) on port 4.
(2) The EUT temperature was stabilized at each temperature step (for a minimum of 30 minutes) prior to frequency accuracy measurement.

Nominal operating voltage of the product is declared as 48VDC.

Frequency error results are listed below for extreme voltages and temperatures.

Extreme Voltages:

Percentage of Rated Supply	DC Voltage (VDC)	Frequency Error (Hz) at 20°C
85%	40.8	1.01
100%	48.0	1.01
115%	55.2	0.94

Extreme Temperatures:

Temperature	Frequency Error (Hz) at 48VDC
-30 °C	1.20
-20 °C	1.15
-10 °C	1.23
0 °C	0.88
10 °C	**1.26**
20 °C	1.01
30 °C	1.07
40 °C	1.01
50 °C	1.01

Based on the results above, highest recorded frequency error (1.26Hz or ~0.0016 ppm) ensures that the transmitted signal remains in its authorized frequency block at extreme voltages and temperatures.

The results above are deemed sufficient to demonstrate carrier frequency stability for all other channel bandwidth modes and modulations since all carriers are controlled by the same frequency stabilization circuitry that was subjected to the extreme conditions under this test.