LTE band 2 results: channels 18600, 18900, & 19199 @ 20°C maximum transmitted power

Traffic Channel Number	LTE Band 2 Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
18600	1860.0	3.6	20	13.53	0.0073
18900	1880.0	3.6	20	-4.61	-0.0025
19199	1900.0	3.6	20	7.22	0.0038

Traffic Channel Number	LTE Band 2 Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
18600	1860.0	4.1	20	8.63	0.0046
18900	1880.0	4.1	20	4.73	0.0025
19199	1900.0	4.1	20	5.69	0.0030

Traffic Channel Number	LTE Band 2 Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
18600	1860.0	4.35	20	8.71	0.0047
18900	1880.0	4.35	20	-4.51	-0.0024
19199	1900.0	4.35	20	8.74	0.0046

LTE band 2 Results: channel 18600 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
18600	1860.0	3.6	-30	**14.13**	**0.0076**
18600	1860.0	3.6	-20	11.39	0.0061
18600	1860.0	3.6	-10	9.28	0.0050
18600	1860.0	3.6	0	10.73	0.0058
18600	1860.0	3.6	10	11.10	0.0060
18600	1860.0	3.6	20	13.53	0.0073
18600	1860.0	3.6	30	8.23	0.0044
18600	1860.0	3.6	40	9.73	0.0052
18600	1860.0	3.6	50	8.24	0.0044
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
18600	1860.0	4.1	-30	10.07	0.0054
18600	1860.0	4.1	-20	8.50	0.0046
18600	1860.0	4.1	-10	8.11	0.0044
18600	1860.0	4.1	0	12.69	0.0068
18600	1860.0	4.1	10	10.64	0.0057
18600	1860.0	4.1	20	8.63	0.0046
18600	1860.0	4.1	30	9.80	0.0053
18600	1860.0	4.1	40	8.40	0.0045
18600	1860.0	4.1	50	11.77	0.0063
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
18600	1860.0	4.35	-30	12.39	0.0067
18600	1860.0	4.35	-20	8.34	0.0045
18600	1860.0	4.35	-10	8.73	0.0047
18600	1860.0	4.35	0	9.73	0.0052
18600	1860.0	4.35	10	11.57	0.0062
18600	1860.0	4.35	20	8.71	0.0047
18600	1860.0	4.35	30	9.46	0.0051
18600	1860.0	4.35	40	9.33	0.0050
18600	1860.0	4.35	50	7.94	0.0043

LTE band 2 Results: channel 18900 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
18900	1880.00	3.6	-30	-6.41	-0.0034
18900	1880.00	3.6	-20	-5.24	-0.0028
18900	1880.00	3.6	-10	-6.09	-0.0032
18900	1880.00	3.6	0	-4.33	-0.0023
18900	1880.00	3.6	10	2.98	0.0016
18900	1880.00	3.6	20	-4.61	-0.0025
18900	1880.00	3.6	30	-8.27	-0.0044
18900	1880.00	3.6	40	3.03	0.0016
18900	1880.00	3.6	50	-7.10	-0.0038
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
18900	1880.00	4.1	-30	5.94	0.0032
18900	1880.00	4.1	-20	-6.41	-0.0034
18900	1880.00	4.1	-10	-5.72	-0.0030
18900	1880.00	4.1	0	-6.02	-0.0032
18900	1880.00	4.1	10	-6.42	-0.0034
18900	1880.00	4.1	20	4.73	0.0025
18900	1880.00	4.1	30	-7.85	-0.0042
18900	1880.00	4.1	40	-6.04	-0.0032
18900	1880.00	4.1	50	-5.81	-0.0031
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
18900	1880.00	4.35	-30	-4.79	-0.0025
18900	1880.00	4.35	-20	-5.34	-0.0028
18900	1880.00	4.35	-10	-4.78	-0.0025
18900	1880.00	4.35	0	-8.05	-0.0043
18900	1880.00	4.35	10	-5.65	-0.0030
18900	1880.00	4.35	20	-4.51	-0.0024
18900	1880.00	4.35	30	-6.75	-0.0036
18900	1880.00	4.35	40	-6.19	-0.0033
18900	1880.00	4.35	50	-7.57	-0.0040

LTE band 2 Results: channel 19199 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
19199	1900.0	3.6	-30	8.41	0.0044
19199	1900.0	3.6	-20	4.98	0.0026
19199	1900.0	3.6	-10	3.36	0.0018
19199	1900.0	3.6	0	9.71	0.0051
19199	1900.0	3.6	10	8.07	0.0042
19199	1900.0	3.6	20	7.22	0.0038
19199	1900.0	3.6	30	9.68	0.0051
19199	1900.0	3.6	40	6.44	0.0034
19199	1900.0	3.6	50	7.08	0.0037
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
19199	1900.0	4.1	-30	7.60	0.0040
19199	1900.0	4.1	-20	5.16	0.0027
19199	1900.0	4.1	-10	6.74	0.0035
19199	1900.0	4.1	0	10.17	0.0054
19199	1900.0	4.1	10	-4.13	-0.0022
19199	1900.0	4.1	20	5.69	0.0030
19199	1900.0	4.1	30	8.28	0.0044
19199	1900.0	4.1	40	-5.62	-0.0030
19199	1900.0	4.1	50	-4.19	-0.0022
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
19199	1900.0	4.35	-30	6.58	0.0035
19199	1900.0	4.35	-20	6.07	0.0032
19199	1900.0	4.35	-10	8.51	0.0045
19199	1900.0	4.35	0	4.76	0.0025
19199	1900.0	4.35	10	4.75	0.0025
19199	1900.0	4.35	20	8.74	0.0046
19199	1900.0	4.35	30	4.42	0.0023
19199	1900.0	4.35	40	5.59	0.0029
19199	1900.0	4.35	50	8.57	0.0045

APPENDIX 3C – LTE Band 2 RADIATED EMISSIONS TEST DATA

Radiated Power Test Data Results

The following measurements were performed by Shiva Kumbham.
Date of Test: November 12, 2014
The environmental tests conditions were: Temperature: 25.8 °C
Relative Humidity: 37.1 %
The BlackBerry® smartphone was standalone, USB Down and LCD facing the RX antenna when the turntable is at 0 degree position.
Measurements were performed with QPSK and 16QAM modulations. The smallest test margins are reported below.
Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height.

LTE band 2, 20MHz BW, RB=1, QPSK modulation

								Substitution Method					
EUT				Rx Antenna		Spectrum Analyzer		Tracking Generator					
Type	Ch	Frequency (MHz)	Band	Type	Pol.	Reading (dBuV)	Max (V,H) (dBuV)	Pol. Tx-Rx	Reading (dBm)	Corrected Reading (dBm)	Corrected Reading (W)	Limit (dBm)	Diff to Limit (dB)
F0	18700	1860.00	2	Horn	V	-24.22	-24.22	V-V	-13.98	25.98	0.40	33.00	7.02
F0	18700	1860.00	2	Horn	H	-26.00		H-H	-13.52				
F0	18900	1880.00	2	Horn	V	-24.32	-24.32	V-V	-14.08	26.07	0.40	33.00	6.93
F0	18900	1880.00	2	Horn	H	-26.34		H-H	-13.33				
F0	19099	1899.90	2	Horn	V	-24.21	-24.21	V-V	-13.70	**26.20**	**0.42**	33.00	6.80
F0	19099	1899.90	2	Horn	H	-25.39		H-H	-13.34				

LTE band 2, 20MHz BW, RB=1, 16-QAM modulation

								Substitution Method					
EUT				Rx Antenna		Spectrum Analyzer		Tracking Generator					
Type	Ch	Frequency (MHz)	Band	Type	Pol.	Reading (dBuV)	Max (V,H) (dBuV)	Pol. Tx-Rx	Reading (dBm)	Corrected Reading (dBm)	Corrected Reading (W)	Limit (dBm)	Diff to Limit (dB)
F0	18700	1860.00	2	Horn	V	-25.03	-25.03	V-V	-14.90	25.08	0.32	33.00	7.92
F0	18700	1860.00	2	Horn	H	-27.32		H-H	-14.42				
F0	18900	1880.00	2	Horn	V	-25.12	-25.12	V-V	-14.97	**25.20**	**0.33**	33.00	7.80
F0	18900	1880.00	2	Horn	H	-27.47		H-H	-14.20				
F0	19099	1899.90	2	Horn	V	-25.46	-25.46	V-V	-14.96	24.91	0.31	33.00	8.09
F0	19099	1899.90	2	Horn	H	-26.18		H-H	-14.63				

Radiated Emissions Test Data Results

The following measurements were performed by Savtej Sandhu.

Date of Test: November 6, 2014

The environmental test conditions were: Temperature: 25.1 ºC
Relative Humidity: 15.3 %

The BlackBerry® smartphone was standalone, side button up and LCD facing the RX antenna when the turntable is at 0 degree position.

Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height, and the frequency range scanned was 30MHz – 1GHz.

Measurements were performed in LTE band 2 with QPSK and 16-QAM modulations for 15MHz BW (channel18675, 18900, 19124 with RB = 1)

All emissions were at least 25 dB below the limit.

The following measurements were performed by Kevin Guo.

Date of Test: November 7-10, 2014

The environmental test conditions were: Temperature: 25.4 ºC
Relative Humidity: 41.7 %

Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height, and a frequency range of 1 GHz to 20 GHz.

The BlackBerry® smartphone was standalone, with side button up LCD facing to the RX antenna when the turntable is at 0 degree position

Measurements were performed in LTE band 2 with QPSK and 16-QAM modulations for 15MHz BW (channel18675, 18900, 19124 with RB = 1)

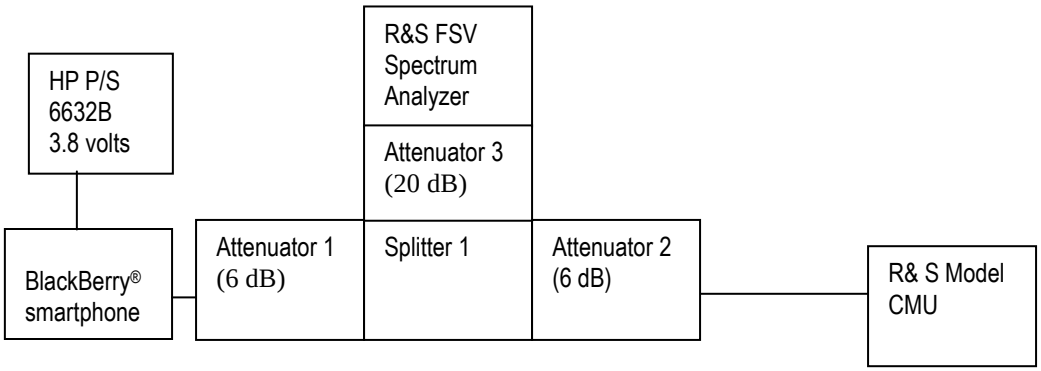
All emissions were at least 25 dB below the limit.

APPENDIX 4A– LTE Band 5 CONDUCTED RF EMISSIONS TEST DATA/PLOTS

LTE Band 5 Conducted RF Emission Test Data

This appendix contains measurement data pertaining to conducted spurious emissions, 99% power bandwidth and the channel mask.

Test Setup Diagram



A reference offset of 31.4 dB was applied to the spectrum analyzer reference level for the attenuators and coaxial cable loss in the test circuit.

UNIT	MANUFACTURER	MODEL	SERIAL NUMBER
Attenuator 1	Mini-Circuits	BW-S6W2+	0647
Attenuator 2	Mini-Circuits	BW-S6W2+	0648
Attenuator 3	Mini-Circuits	BW-S20-2W263+	1234
Splitter 1	Weinschel	1515	MES 92

Date of Test: November 12, 2014

The environmental test conditions were: Temperature: 22.5 ºC
Relative Humidity: 19.2 %

The following measurements were performed by Sijia Li.

LTE Band 5 Conducted RF Emission Test Data cont'd

Emission Designator Table

Frequency Range (MHz)	Conducted Output Power (dBm)	Emission Designator	Band	Bandwidth (MHz)	Modulation
824.7-848.2	23.00	1M08G7D	LTE B5	1.4	QPSK
824.7-848.2	21.92	1M08D7W	LTE B5	1.4	16QAM
825.5-847.5	23.88	2M69G7D	LTE B5	3	QPSK
825.5-847.5	22.59	2M68D7W	LTE B5	3	16QAM
826.5-846.4	23.14	4M47G7D	LTE B5	5	QPSK
826.5-846.4	22.47	4M47D7W	LTE B5	5	16QAM
829-844	23.10	8M93G7D	LTE B5	10	QPSK
829-844	22.74	8M92D7W	LTE B5	10	16QAM

The conducted spurious emissions – As per 47 CFR 2.1051, CFR 22.917 were measured from 30 MHz to 20 GHz.

–26 dBc Bandwidth and Occupied Bandwidth (99%)

For each 1.4MHz, 3MHz, 5MHz, 10MHz with different number of RBs as per scalable bandwidths for LTE band 5, the modulation spectrum was measured by both methods of 99% power bandwidth and –26 dBc bandwidth.

QPSK and 16-QAM modulations were applied to each of the bandwidths. Only the worst case measurements are documented in this report.

A minimum RB condition was also measured (RB = 1).

The resolution bandwidth required for out-of-band emissions in the 1 MHz bands immediately outside and adjacent to the frequency block, was determined to be at least 1% of the emission bandwidth.

The worst case –26dBc bandwidth for LTE band 5 was measured to be 9.3 MHz. Results were derived in a 100 kHz resolution bandwidth.

On any frequency outside the frequency block and outside the adjacent 1 MHz bands, a resolution bandwidth of at least 1 MHz was applied.

Test Data for LTE Band 5 selected Frequencies in 10MHz BW (RB = 50)

LTE Band 5 Frequency (MHz)	26dBc Occupied Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	
	QPSK	QPSK	16-QAM
829.0	9.28	8.97	8.97
836.5	9.25	8.94	8.94
843.9	9.3	**8.99**	8.97

Measurement Plots for LTE Band 5

See Figures 4-1a to 4-18a for the plots of the conducted spurious emissions.
See Figures 4-19a to 4-36a and 4-45a to 4-47a for the plots of 99% Occupied Bandwidth and -26 dBc Bandwidth.
See Figures 4-37a to 4-44a for the plots of the Channel mask.

LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-1a: Band 5, Spurious Conducted Emissions, Low channel, 10MHz BW (RB= 1)

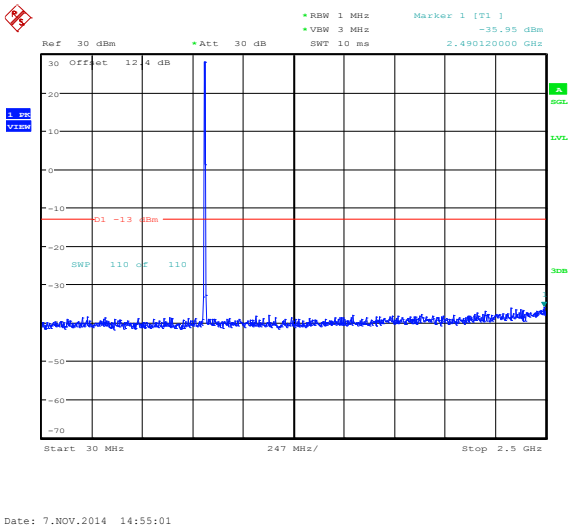


Figure 4-2a: Band 5, Spurious Conducted Emissions, Low channel, 10MHz BW (RB= 1)

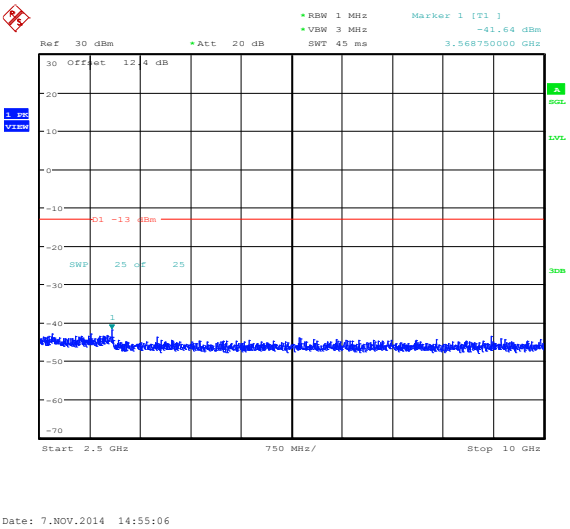


Figure 4-3a: Band 5, Spurious Conducted Emissions, Middle channel, 10MHz BW (RB= 25)

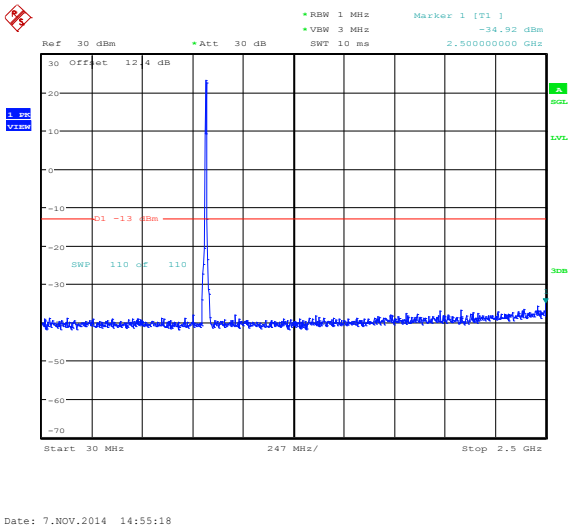
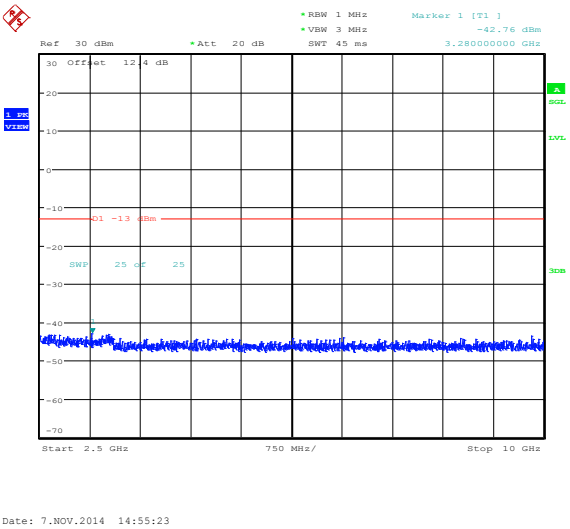


Figure 4-4a: Band 5, Spurious Conducted Emissions, Middle channel, 10MHz BW (RB= 25)



LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-5a: Band 5, Spurious Conducted Emissions, High Channel, 10MHz BW (RB= 50)

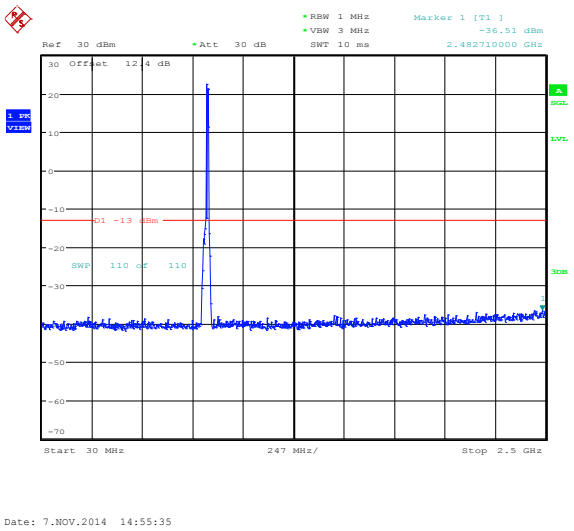


Figure 4-6a: Band 5, Spurious Conducted Emissions, High Channel, 10MHz BW (RB= 50)

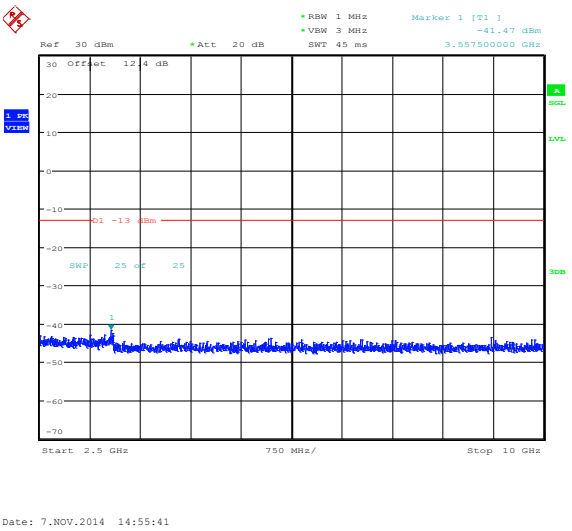


Figure 4-7a: Band 5, Spurious Conducted Emissions, Low channel, 5MHz BW (RB= 1)

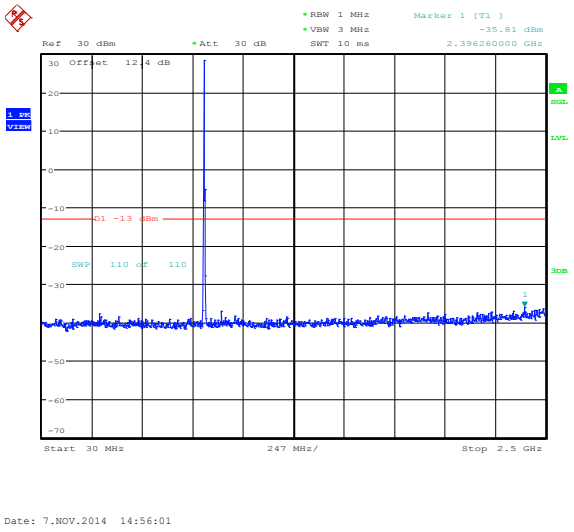
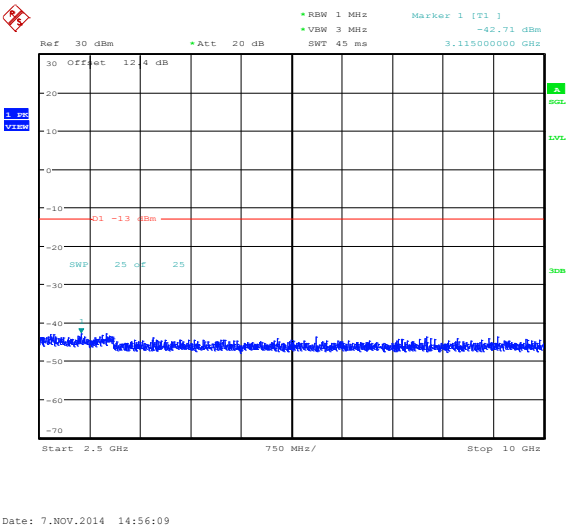
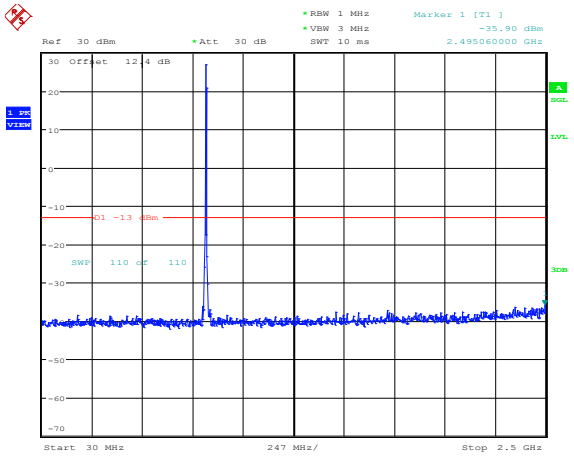


Figure 4-8a: Band 5, Spurious Conducted Emissions, Low channel, 5MHz BW (RB= 1)



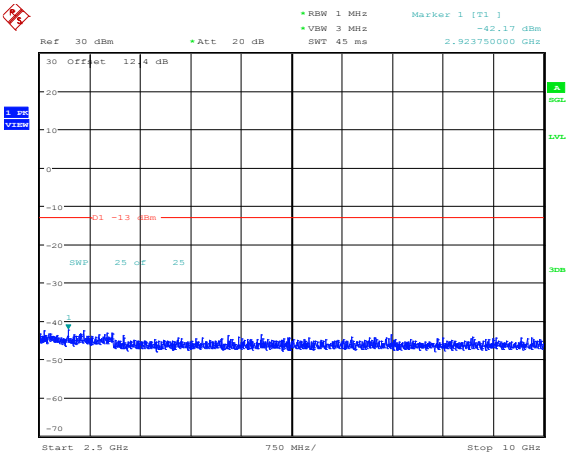
LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-9a: Band 5, Spurious Conducted Emissions, Middle Channel, 5MHz BW (RB= 15)



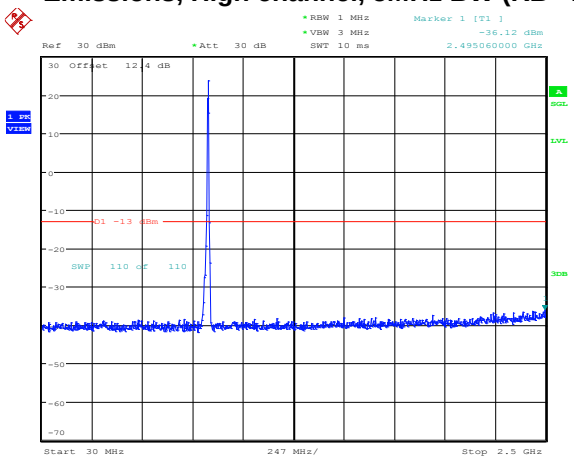
Date: 7.NOV.2014 14:56:20

Figure 4-10a: Band 5, Spurious Conducted Emissions, Middle Channel, 5MHz BW (RB= 15)



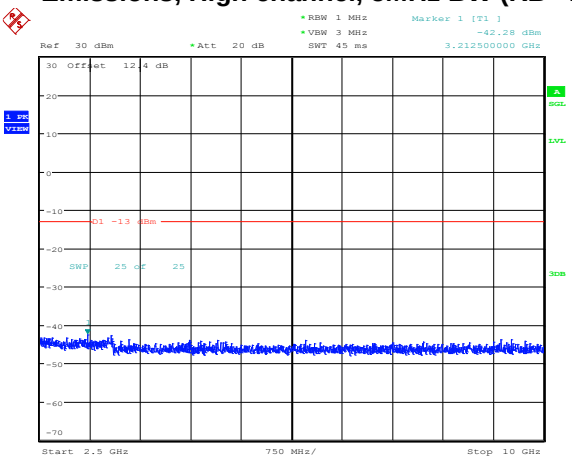
Date: 7.NOV.2014 14:56:26

Figure 4-11a: Band 5, Spurious Conducted Emissions, High channel, 5MHz BW (RB= 25)



Date: 7.NOV.2014 14:56:38

Figure 4-12a: Band 5, Spurious Conducted Emissions, High channel, 5MHz BW (RB= 25)



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LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-13a: Band 5, Spurious Conducted Emissions, Low Channel, 1.4MHz BW (RB= 1)

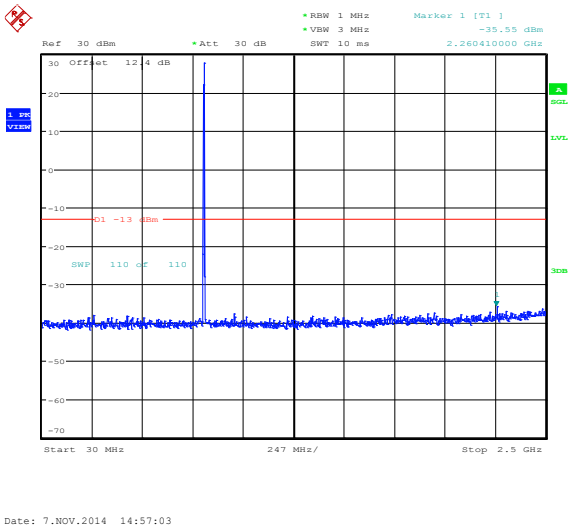

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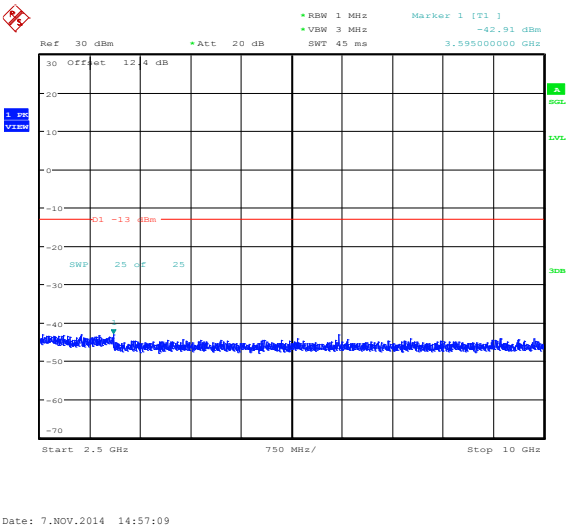
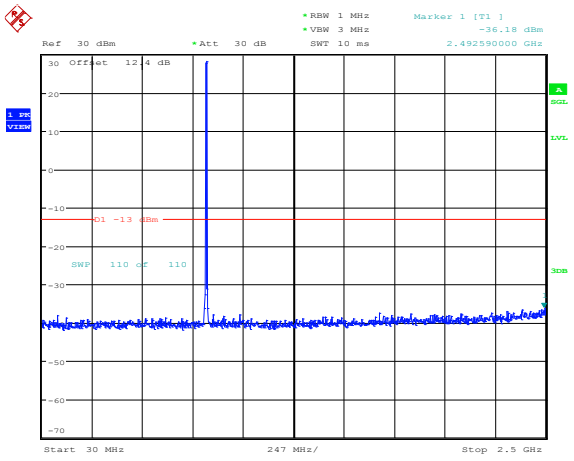
Figure 4-14a: Band 5, Spurious Conducted Emissions, Low Channel, 1.4MHz BW (RB= 1)



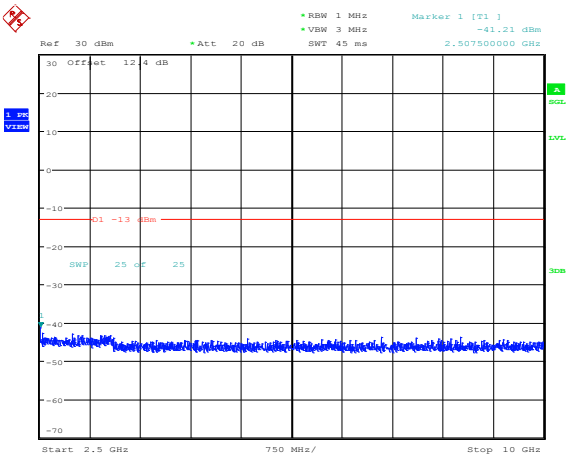
Date: 7.NOV.2014 14:57:09

Figure 4-15a: Band 5, Spurious Conducted Emissions, Middle channel, 1.4MHz BW (RB= 3)



Date: 7.NOV.2014 14:57:21

Figure 4-16a: Band 5, Spurious Conducted Emissions, Middle channel, 1.4MHz BW (RB= 3)



Date: 7.NOV.2014 14:57:26

LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-17a: Band 5, Spurious Conducted Emissions, High channel, 1.4MHz BW (RB= 6)

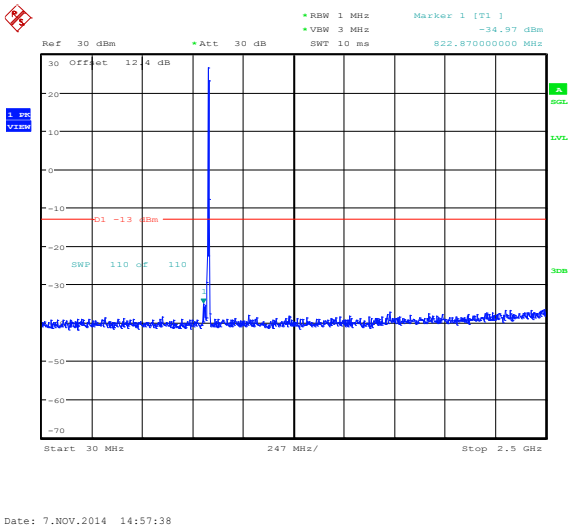
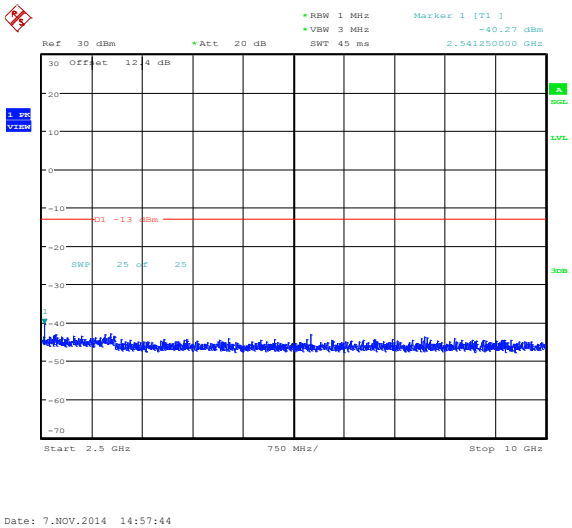


Figure 4-18a: Band 5, Spurious Conducted Emissions, High channel, 1.4MHz BW (RB= 6)



LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-19a: Occupied Bandwidth, Band 5 Low Channel, 10MHz BW, RB=50

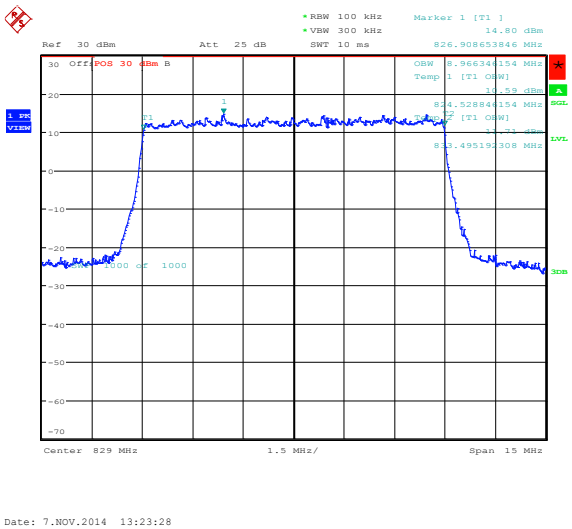


Figure 4-20a: Occupied Bandwidth, Band 5 Middle Channel, 10MHz BW, RB=50

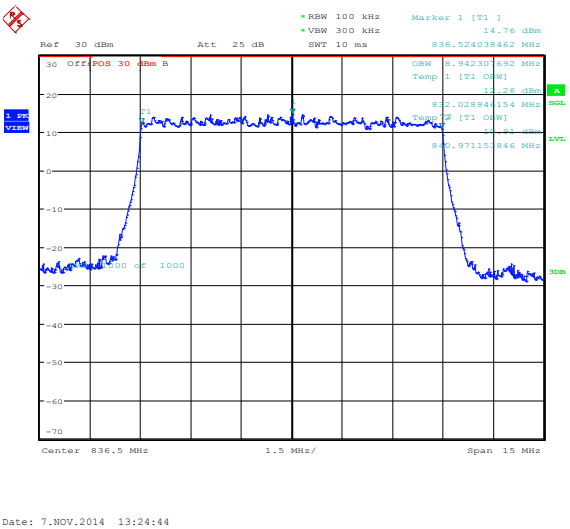
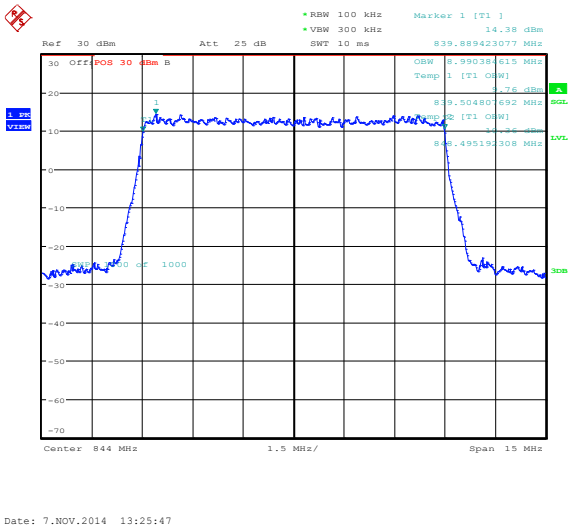
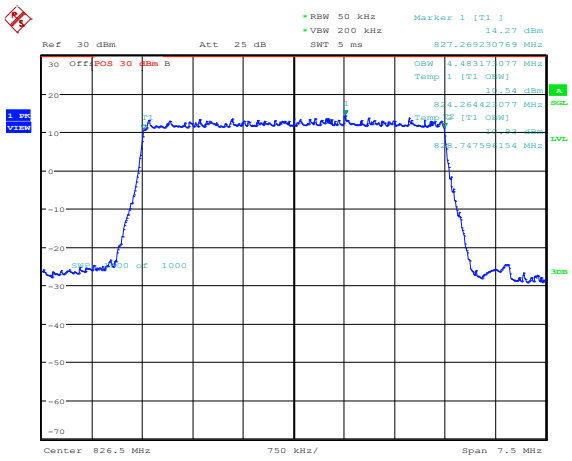


Figure 4-21a: Occupied Bandwidth, Band 5 High Channel, 10MHz BW, RB=50



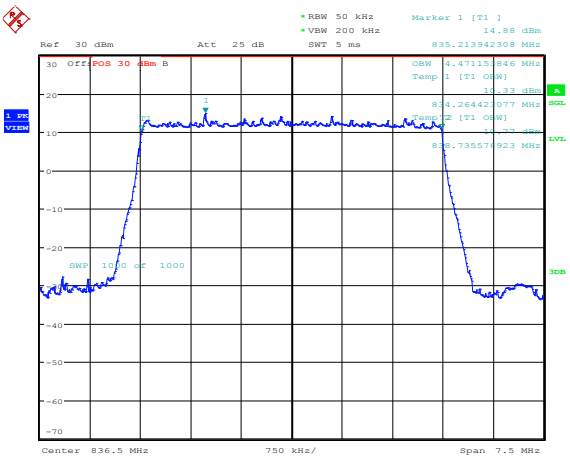
LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-22a: Occupied Bandwidth, Band 5 Low Channel, 5MHz BW, RB=25



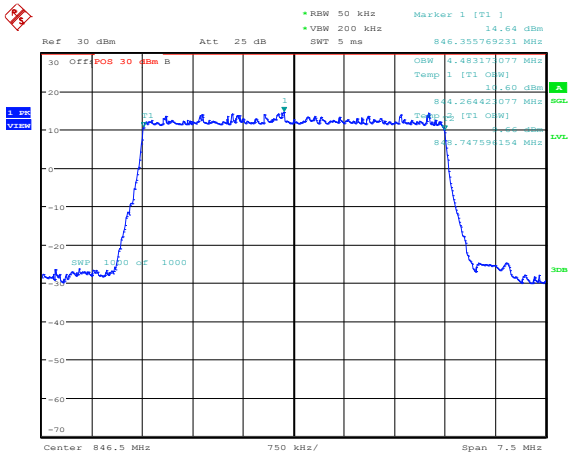
Date: 7.NOV.2014 13:29:32

Figure 4-23a: Occupied Bandwidth, Band 5 Middle Channel, 5MHz BW, RB=25



Date: 7.NOV.2014 13:30:33

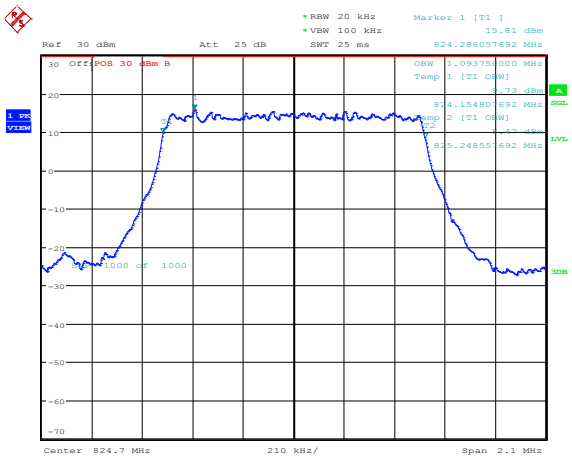
Figure 4-24a: Occupied Bandwidth, Band 5 High Channel, 5MHz BW, RB=25



Date: 7.NOV.2014 13:31:00

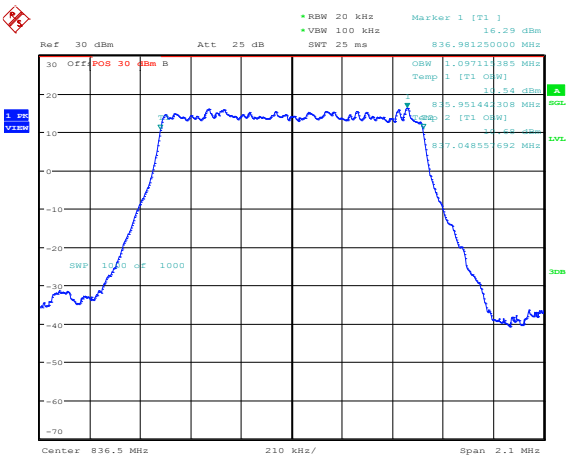
LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-25a: Occupied Bandwidth, Band 5 Low Channel, 1.4MHz BW, RB=6



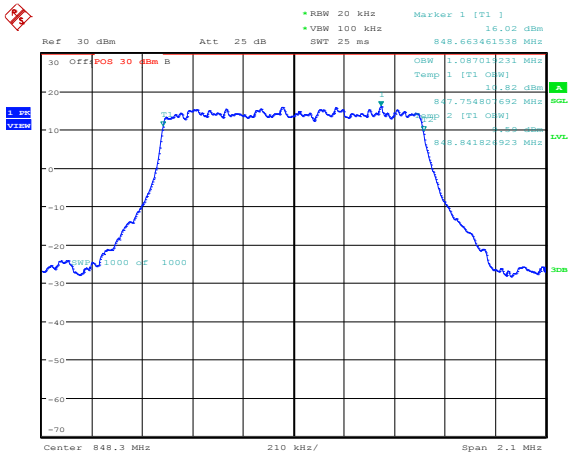
Date: 7.NOV.2014 13:37:56

Figure 4-26a: Occupied Bandwidth, Band 5 Middle Channel, 1.4MHz BW, RB=6



Date: 7.NOV.2014 13:55:59

Figure 4-27a: Occupied Bandwidth, Band 5 High Channel, 1.4MHz BW, RB=6



Date: 7.NOV.2014 13:56:36

LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-28a: -26 dBc Bandwidth, Band 5 Low Channel, 10MHz BW, RB=50

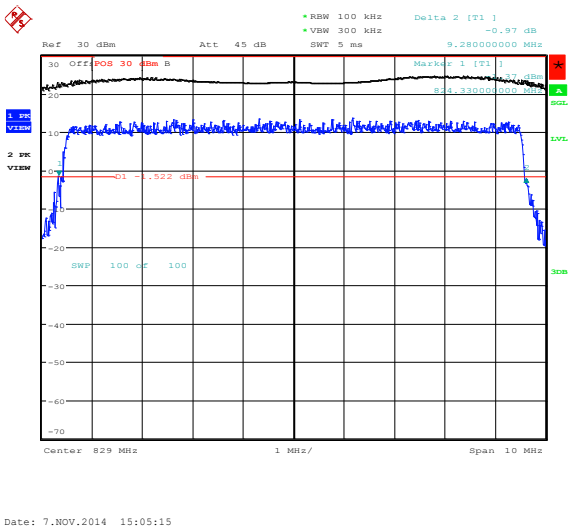


Figure 4-29a: -26 dBc Bandwidth, Band 5 Middle Channel, 10MHz BW, RB=50

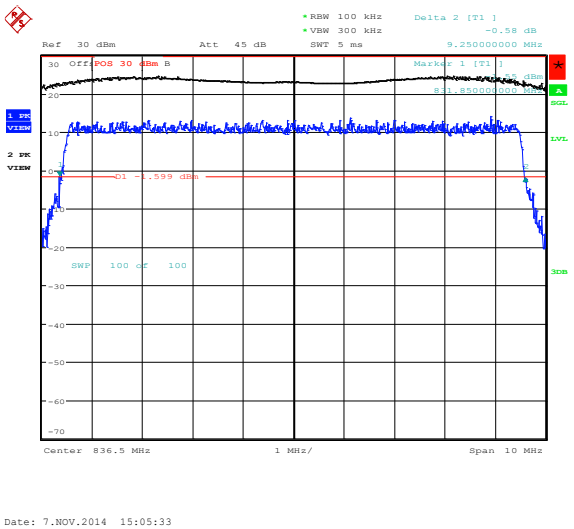


Figure 4-30a: -26 dBc Bandwidth, Band 5 High Channel, 10MHz BW, RB=50

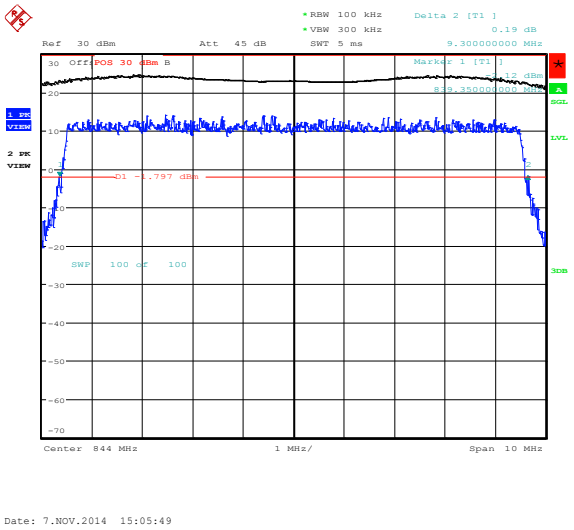
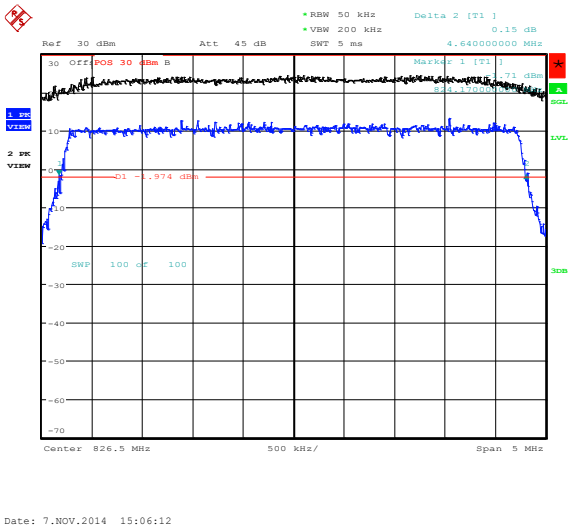


Figure 4-31a: -26 dBc Bandwidth, Band 5 Low Channel, 5MHz BW, RB=25



LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-32a: -26 dBc Bandwidth, Band 5 Middle Channel, 5MHz BW, RB=25

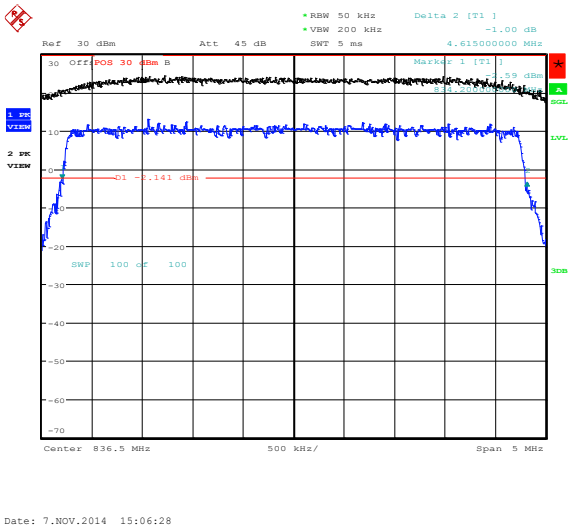


Figure 4-33a: -26 dBc Bandwidth, Band 5 High Channel, 5MHz BW, RB=25

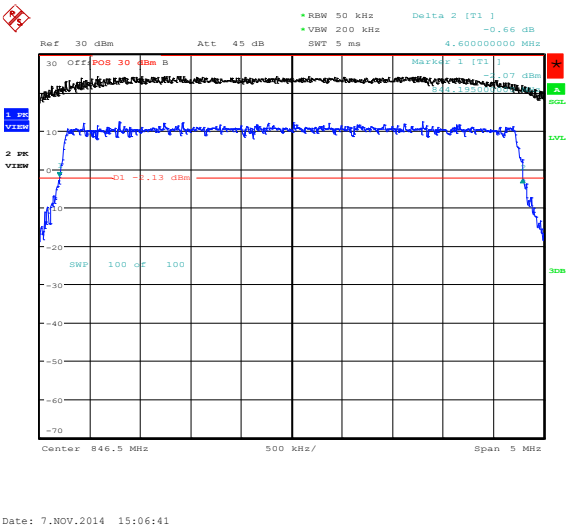


Figure 4-34a: -26 dBc Bandwidth, Band 5 Low Channel, 1.4MHz BW, RB=6

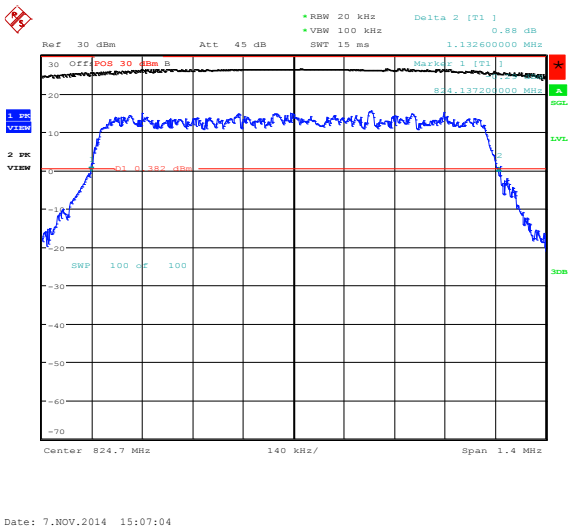
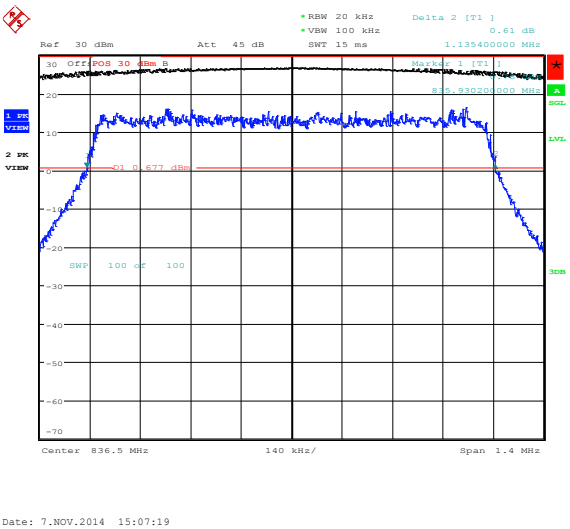


Figure 4-35a: -26 dBc Bandwidth, Band 5 Middle Channel, 1.4MHz BW, RB=6



LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-36a: -26 dBc Bandwidth, Band 5 High Channel, 1.4MHz BW, RB=6

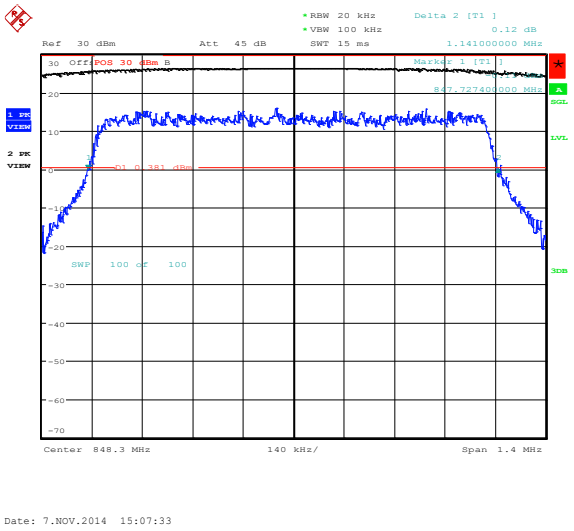


Figure 4-37a: Band 5 Low Channel Mask, 10MHz BW, RB=50

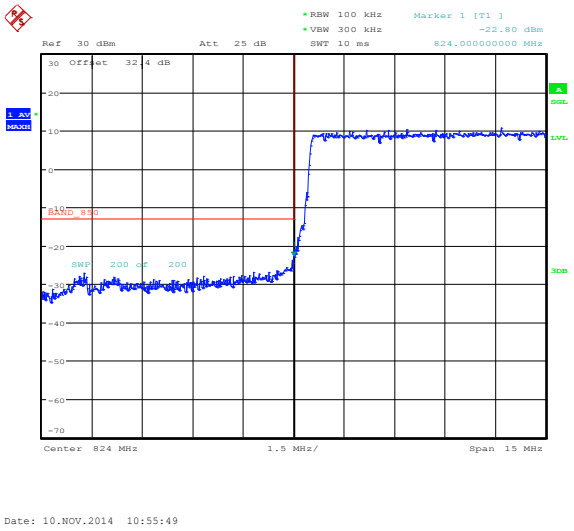
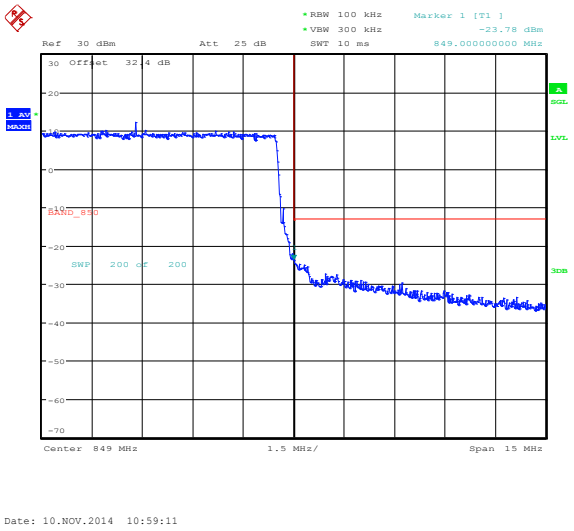


Figure 4-38a: Band 5 High Channel Mask, 10MHz BW, RB=50



LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-39a: Band 5 Low Channel Mask, 5MHz BW, RB=25

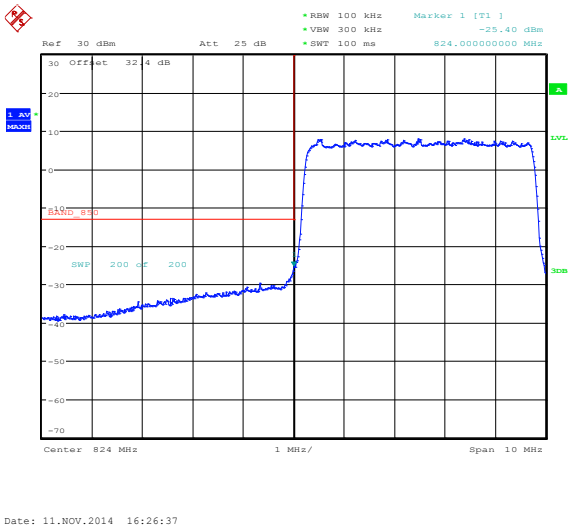


Figure 4-40a: Band 5 High Channel Mask, 5MHz BW, RB=25

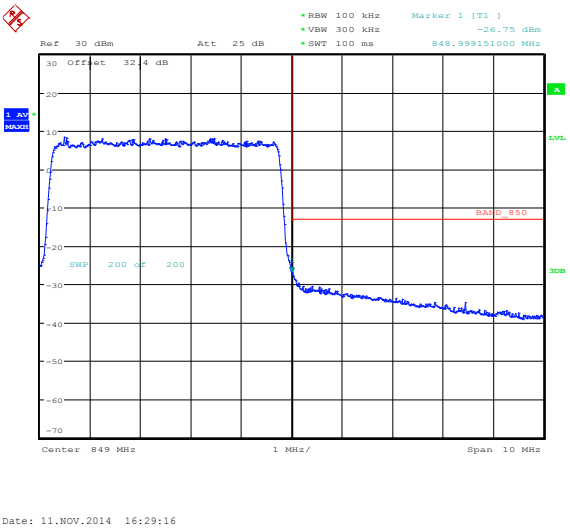


Figure 4-41a: Band 5 Low Channel Mask, 1.4MHz BW, RB=6

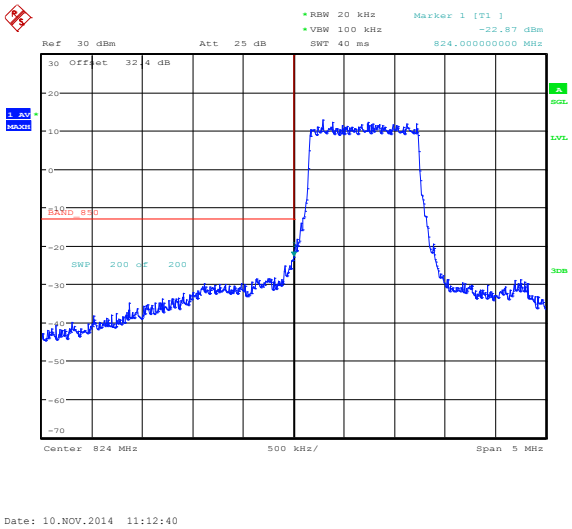
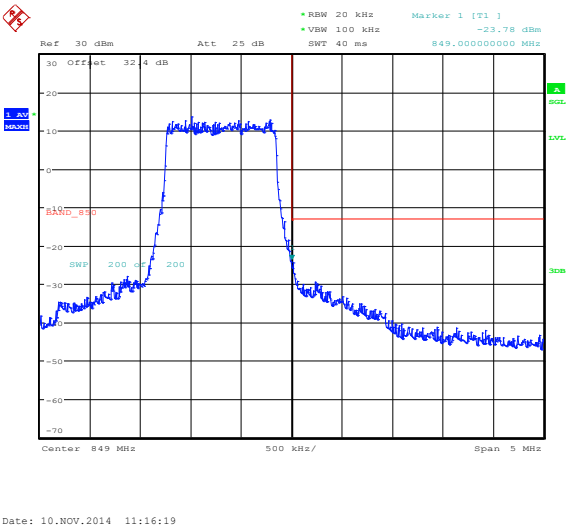


Figure 4-42a: Band 5 High Channel Mask, 1.4MHz BW, RB=6



LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 4-43d: Band 5 Low Channel Mask, 10MHz BW, RB=1

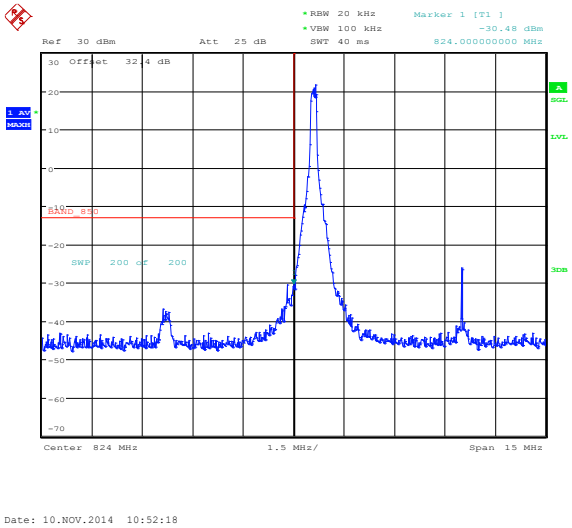
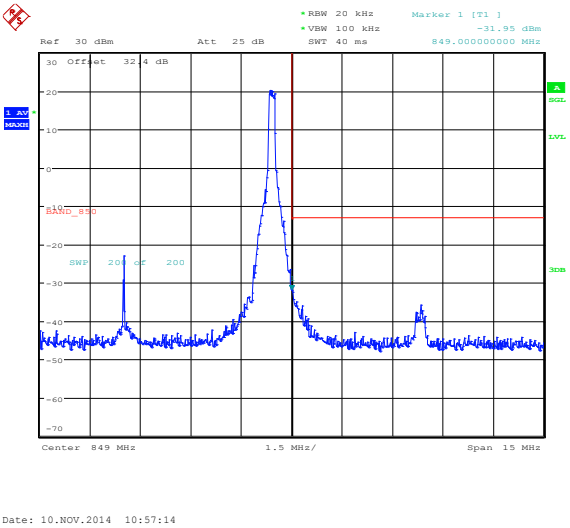


Figure 4-44a: Band 5 High Channel Mask, 10MHz BW, RB=1



LTE Band 5 Conducted RF Emission Test Data cont'd

Figure 3-45a: Occupied Bandwidth, Band 5 Low Channel, 10MHz BW (RB= 50) 16-QAM

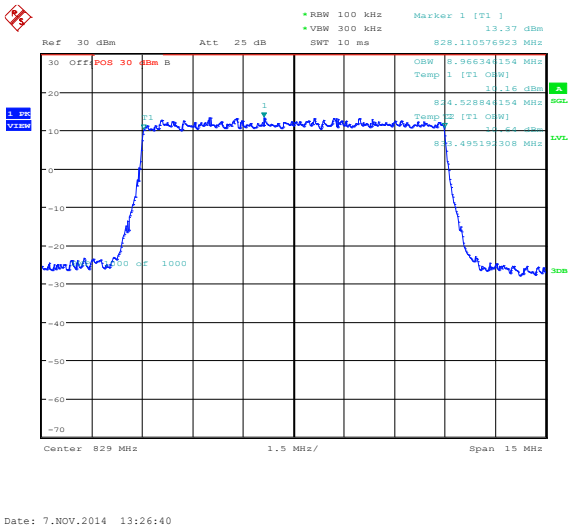


Figure 3-46a: Occupied Bandwidth, Band 5 Mid Channel, 20MHz BW (RB= 50) 16-QAM

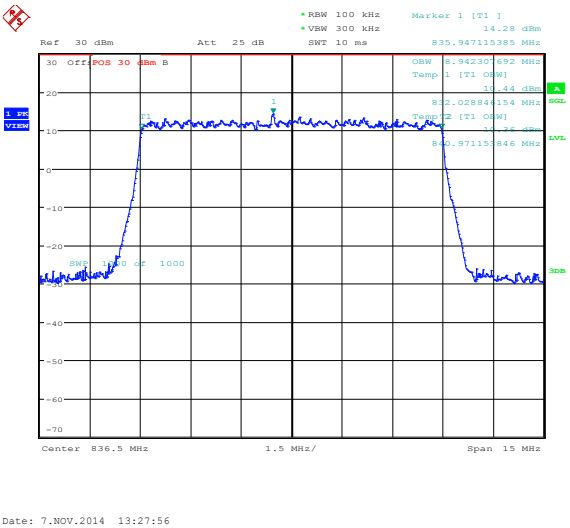
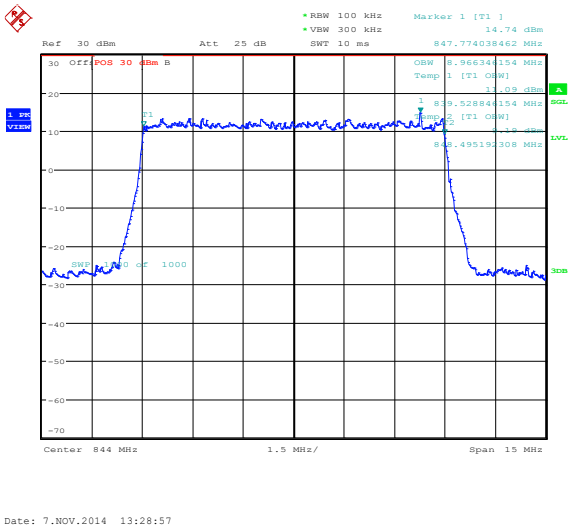
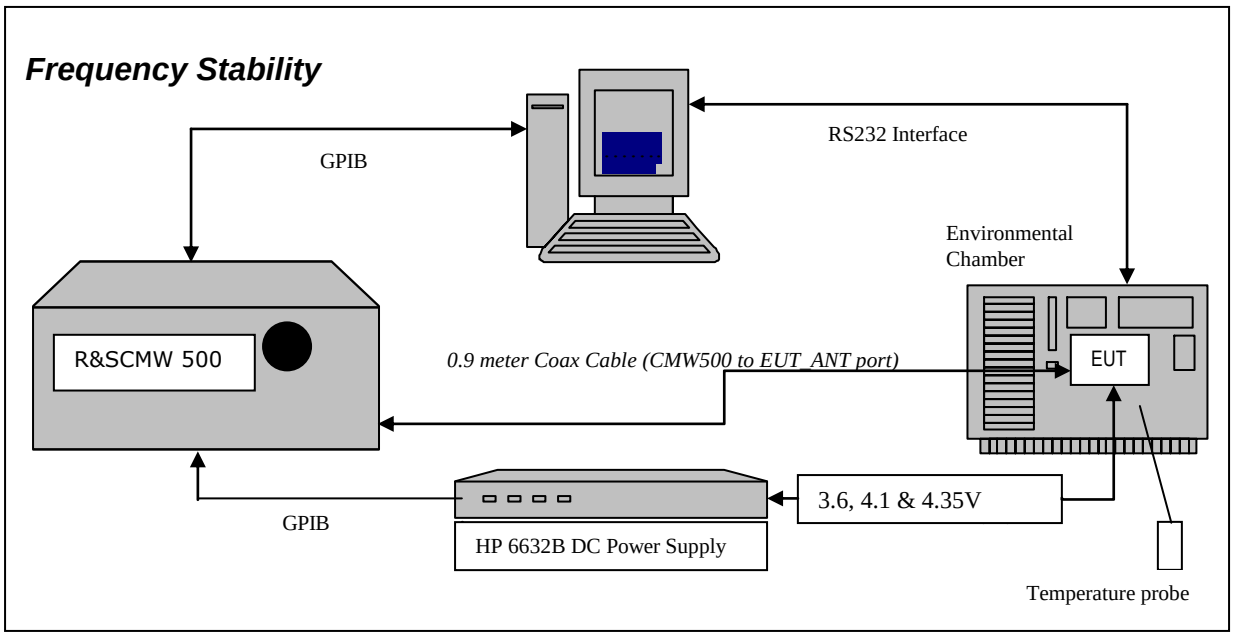


Figure 3-47a: Occupied Bandwidth, Band 5 High Channel, 10MHz BW (RB= 50) 16-QAM



APPENDIX 4B – LTE Band 5 FREQUENCY STABILITY TEST DATA

LTE Band 5 Frequency Stability Test Data



The following measurements were performed by Sijia Li.

CFR 47 Chapter 1 - Federal Communications Commission Rules

Part 2 Required Measurements
2.1055 Frequency Stability - Procedures
(a,b) Frequency Stability - Temperature Variation
(d) Frequency Stability - Voltage Variation

24.236 *Frequency Stability*.
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

The EUT meets the requirements as stated in CFR 47 chapter 1, Section 27.54, CFR 47.
Frequency Stability measurement devices were configured as presented in the block diagram recording frequency, power, data, temperatures, and stepped voltages controlled via a GPIB interface linked to the Environmental chamber, a DC power supply, and the Communications Test Set. A 0.9-metre coax cable was calibrated to characterize the insertion loss for the transmitted frequencies between the RF input/output of the CMW 500 and the EUT antenna port.

Test Setup:

The EUT was placed in the Temperature chamber and connected to CMW 500 outside as shown in the figure above. Dry air was pumped inside the temperature chamber to maintain a backpressure during the test. The EUT was kept in the off condition at all times except when the following measurements were to be made.

The chamber was switched on and the temperature was set to -30°C.
After the chamber stabilized at -30 °C there was a soak period of one hour to alleviate moisture in the chamber, the EUT voltage was enabled.
The system software recorded the frequency, power, and associated measurements.

A Computer system controlled the automated software. This application was given the command of activating all machines intrinsic to the temperature and voltage tests controlling the CMW 500 via the GPIB Bus. The Environmental Chamber was instructed through an RS-232 serial line. The EUT dialogue was passed through a serial connection.

The EUT repetitively transmitted 100 bursts for each set of programmed parameters recording temperature, voltage settings, and systematically selected frequencies. The power supply was cycled from minimum voltage 3.6 volts, 4.1 volts and to 4.35 volts maximum voltage. The frequency error was measured at a maximum output power and recorded by the automated system test software.

The EUT output power and frequency was measured at 3.6 volts, 4.1 volts and 4.35 volts. The transmit frequency was varied in 3 steps consisting of 829.0 MHz, 836.5 MHz and 844.0 MHz each was measured under 10 MHz bandwidth with maximum (50) RBs. This frequency was recorded in MHz and deviation from nominal, in Parts Per Million.

After the initial one-hour soak at the beginning of the tests, a period of thirty minutes soak was initialized between each ascending temperature step, before proceeding to the next measurement test cycle.

Procedure:

The test system software for commencing the Frequency Stability Tests carried through the following cycle.

15. Switch on the HP 6632B power supply; CMW 500 Communications test Set, and Environmental Chamber.
16. Start test program
17. Set the Temperature to –30°C and maintain a period of one- hour soak time, with the EUT supply voltage disabled.
18. Set power supply voltage to 3.6 volts.
19. Set up CMW 500 Radio Communication Tester.
20. Command the CMW 500 to switch to the low channel.
21. Enable the voltage to the EUT, and connect a link to the CMW 500 test set.
22. EUT is commanded to Transmit 100 Bursts.
23. Software logs the following data from the CMW 500, power supply and temperature chamber: Traffic Channel Number, Traffic Channel Frequency, Power Level, Chamber Temperature, Supply Voltage, Power and Frequency Error.
24. The CMW 500 commands the EUT to change frequency to the middle channel and high channel and repeats steps 7 to 9.
25. Repeat steps 5 to 10 changing the supply voltage to 4.1 Volts
26. Increase temperature by 10°C and soak for 1/2 hour.
27. Repeat steps 4 - 12 for temperatures –30°C to 60°C.
28. Repeat steps 5 to 10 changing the supply voltage to 4.35 volts

Procedure 5 to 10 was repeated at room temperature (20°C) with the power supply voltage set to 3.6, 4.1 and 4.35 volts

The maximum frequency error in the LTE Band 5 measured was **0.0059PPM**.

LTE Band 5 results: channels 20400, 20525 and 20649 @ 20°C maximum transmitted power

Traffic Channel Number	LTE Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20450	829.0	3.6	20	-3.22	-0.0039
20525	836.5	3.6	20	2.20	0.0026
20600	844.0	3.6	20	3.36	0.0040

Traffic Channel Number	LTE Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20450	829.0	4.1	20	-2.62	-0.0032
20525	836.5	4.1	20	-3.52	-0.0042
20600	844.0	4.1	20	2.72	0.0032

Traffic Channel Number	LTE Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20450	829.0	4.35	20	-1.62	-0.0019
20525	836.5	4.35	20	-2.68	-0.0032
20600	844.0	4.35	20	2.50	0.0030

LTE band 5 Results: channel 20400 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20450	829.0	3.6	-30	**4.92**	**0.0059**
20450	829.0	3.6	-20	-1.67	-0.0020
20450	829.0	3.6	-10	2.85	0.0034
20450	829.0	3.6	0	-2.42	-0.0029
20450	829.0	3.6	10	-4.08	-0.0049
20450	829.0	3.6	20	-3.22	-0.0039
20450	829.0	3.6	30	-3.83	-0.0046
20450	829.0	3.6	40	-4.05	-0.0049
20450	829.0	3.6	50	3.86	0.0047
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20450	829.0	4.1	-30	3.39	0.0041
20450	829.0	4.1	-20	-3.53	-0.0043
20450	829.0	4.1	-10	3.22	0.0039
20450	829.0	4.1	0	2.82	0.0034
20450	829.0	4.1	10	-1.93	-0.0023
20450	829.0	4.1	20	-2.62	-0.0032
20450	829.0	4.1	30	-4.25	-0.0051
20450	829.0	4.1	40	-3.68	-0.0044
20450	829.0	4.1	50	3.66	0.0044
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20450	829.0	4.35	-30	-2.35	-0.0028
20450	829.0	4.35	-20	-2.70	-0.0033
20450	829.0	4.35	-10	2.36	0.0028
20450	829.0	4.35	0	-2.15	-0.0026
20450	829.0	4.35	10	2.90	0.0035
20450	829.0	4.35	20	-1.62	-0.0019
20450	829.0	4.35	30	-3.19	-0.0038
20450	829.0	4.35	40	3.66	0.0044
20450	829.0	4.35	50	-3.96	-0.0048

LTE band 5 Results: channel 20525 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20525	836.5	3.6	-30	-2.45	-0.0029
20525	836.5	3.6	-20	2.26	0.0027
20525	836.5	3.6	-10	2.82	0.0034
20525	836.5	3.6	0	2.50	0.0030
20525	836.5	3.6	10	-2.72	-0.0032
20525	836.5	3.6	20	2.20	0.0026
20525	836.5	3.6	30	-4.51	-0.0054
20525	836.5	3.6	40	-4.51	-0.0054
20525	836.5	3.6	50	1.39	0.0017
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20525	836.5	4.1	-30	-4.22	-0.0050
20525	836.5	4.1	-20	2.90	0.0035
20525	836.5	4.1	-10	-2.76	-0.0033
20525	836.5	4.1	0	-3.72	-0.0044
20525	836.5	4.1	10	-4.12	-0.0049
20525	836.5	4.1	20	-3.52	-0.0042
20525	836.5	4.1	30	-4.85	-0.0058
20525	836.5	4.1	40	-3.09	-0.0037
20525	836.5	4.1	50	-3.45	-0.0041
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20525	836.5	4.35	-30	-2.59	-0.0031
20525	836.5	4.35	-20	-2.82	-0.0034
20525	836.5	4.35	-10	-3.00	-0.0036
20525	836.5	4.35	0	-3.81	-0.0045
20525	836.5	4.35	10	2.30	0.0028
20525	836.5	4.35	20	-2.68	-0.0032
20525	836.5	4.35	30	-2.72	-0.0032
20525	836.5	4.35	40	-2.55	-0.0030
20525	836.5	4.35	50	-4.68	-0.0056

LTE band 5 Results: channel 20649 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20600	844.0	3.6	-30	-2.82	-0.0033
20600	844.0	3.6	-20	-2.52	-0.0030
20600	844.0	3.6	-10	3.92	0.0046
20600	844.0	3.6	0	2.37	0.0028
20600	844.0	3.6	10	2.30	0.0027
20600	844.0	3.6	20	3.36	0.0040
20600	844.0	3.6	30	-3.93	-0.0047
20600	844.0	3.6	40	-3.42	-0.0041
20600	844.0	3.6	50	1.86	0.0022
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20600	844.0	4.1	-30	-1.93	-0.0023
20600	844.0	4.1	-20	-3.38	-0.0040
20600	844.0	4.1	-10	3.06	0.0036
20600	844.0	4.1	0	2.22	0.0026
20600	844.0	4.1	10	1.60	0.0019
20600	844.0	4.1	20	2.72	0.0032
20600	844.0	4.1	30	-2.60	-0.0031
20600	844.0	4.1	40	-3.28	-0.0039
20600	844.0	4.1	50	-4.03	-0.0048
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20600	844.0	4.35	-30	2.62	0.0031
20600	844.0	4.35	-20	2.39	0.0028
20600	844.0	4.35	-10	1.90	0.0023
20600	844.0	4.35	0	-2.90	-0.0034
20600	844.0	4.35	10	-2.69	-0.0032
20600	844.0	4.35	20	2.50	0.0030
20600	844.0	4.35	30	-2.72	-0.0032
20600	844.0	4.35	40	-3.85	-0.0046
20600	844.0	4.35	50	-2.73	-0.0032

APPENDIX 4C – LTE Band 5 RADIATED EMISSIONS TEST DATA

Radiated Power Test Data Results

The following measurements were performed by Shiva Kumbham.
Date of Test: November 11, 2014
The environmental tests conditions were: Temperature: 25.0 °C
Relative Humidity: 29.5 %
The BlackBerry® smartphone was standalone horizontal Down and LCD Screen pointing to the RX antenna when the turntable is at 0 degree position.
Measurements were performed with QPSK and 16QAM modulations. The smallest test margins are reported below.
Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height.

LTE band 5, 10MHz BW, RB=1, QPSK modulation

								Substitution Method					
EUT				Rx Antenna		Spectrum Analyzer		Tracking Generator					
Type	Ch	Frequency (MHz)	Band	Type	Pol.	Reading (dBuV)	Max (V,H) (dBuV)	Pol. Tx-Rx	Reading (dBm)	Corrected Reading (relative to Dipole) (dBm)	(W)	Limit (dBm)	Diff to Limit (dB)
F0	20500	834.00	5	Dipole	V	-39.92	-30.52	V-V	5.42	**23.23**	0.21	38.50	15.27
F0	20500	834.00	5	Dipole	H	-30.52		H-H	2.79				
F0	20525	836.50	5	Dipole	V	-39.54	-31.36	V-V	5.23	22.92	0.20	38.50	15.58
F0	20525	836.50	5	Dipole	H	-31.36		H-H	2.56				
F0	20549	838.90	5	Dipole	V	-40.07	-33.34	V-V	2.34	20.09	0.10	38.50	18.41
F0	20549	838.90	5	Dipole	H	-33.34		H-H	2.14				

LTE band 5, 10MHz BW, RB=1, 16-QAM modulation

								Substitution Method					
EUT				Rx Antenna		Spectrum Analyzer		Tracking Generator					
Type	Ch	Frequency (MHz)	Band	Type	Pol.	Reading (dBuV)	Max (V,H) (dBuV)	Pol. Tx-Rx	Reading (dBm)	Corrected Reading (relative to Dipole) (dBm)	(W)	Limit (dBm)	Diff to Limit (dB)
F0	20500	834.00	5	Dipole	V	-39.12	-30.55	V-V	5.41	**23.22**	0.21	38.50	15.28
F0	20500	834.00	5	Dipole	H	-30.55		H-H	2.78				
F0	20525	836.50	5	Dipole	V	-39.29	-31.36	V-V	5.23	22.92	0.20	38.50	15.58
F0	20525	836.50	5	Dipole	H	-31.36		H-H	2.56				
F0	20549	838.90	5	Dipole	V	-40.03	-33.30	V-V	2.38	20.13	0.10	38.50	18.37
F0	20549	838.90	5	Dipole	H	-33.30		H-H	2.20				

Radiated Emissions Test Data Results cont'd

The following measurements were performed by Savtej.

Date of Test: November 6, 2014

The environmental test conditions were: Temperature: 25.3 ºC
Relative Humidity: 18.3 %

The BlackBerry® smartphone was standalone horizontally with LCD facing down and top pointing to the RX antenna when the turntable is at 0 degree position

Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height, and the frequency range scanned was 30MHz – 1GHz.

Measurements were performed in LTE band 5 with QPSK and 16-QAM modulation for 3MHz BW (channel 20415, 20525 and 20634 with RB = 6).

All emissions were at least 25 dB below the limit.

The following measurements were performed by Masud Attayi

Date of Test: November 7-11, 2014

The environmental test conditions were: Temperature: 25.5 ºC
Relative Humidity: 21.6 %

Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height, and a frequency range of 1 GHz to 10 GHz.

The BlackBerry® smartphone was standalone, with horizontally and top pointing to the RX antenna when the turntable is at 0 degree position

Measurements were performed in LTE band 5 with QPSK and 16-QAM modulation for 3MHz BW (channel 20415, 20525 and 20634 with RB = 6).

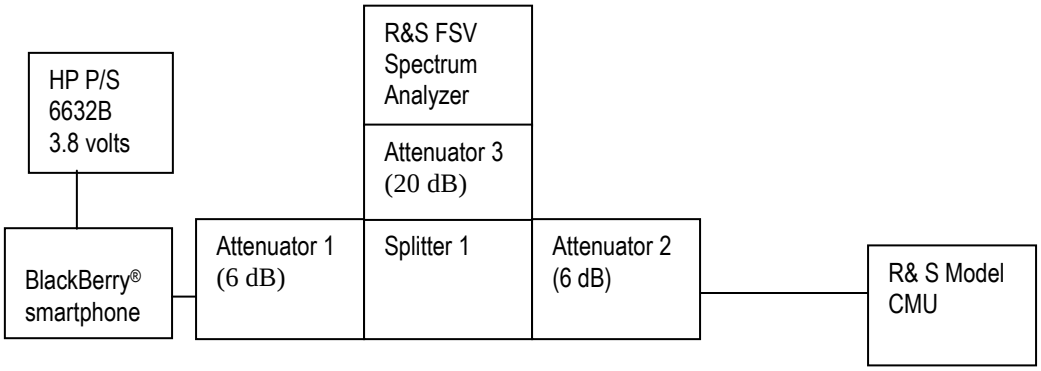
All emissions were at least 25 dB below the limit.

APPENDIX 5A– LTE Band 4 CONDUCTED RF EMISSIONS TEST DATA/PLOTS

LTE Band 4 Conducted RF Emission Test Data

This appendix contains measurement data pertaining to conducted spurious emissions, 99% power bandwidth and the channel mask.

Test Setup Diagram



A reference offset of 31.4 dB was applied to the spectrum analyzer reference level for the attenuators and coaxial cable loss in the test circuit.

UNIT	MANUFACTURER	MODEL	SERIAL NUMBER
Attenuator 1	Mini-Circuits	BW-S6W2+	0647
Attenuator 2	Mini-Circuits	BW-S6W2+	0648
Attenuator 3	Mini-Circuits	BW-S20-2W263+	1234
Splitter 1	Weinschel	1515	MES 92

Date of Test: November 12, 2014

The environmental test conditions were: Temperature: 23.2ºC
Relative Humidity: 21.1 %

The following measurements were performed by Sijia Li.

LTE Band 4 Conducted RF Emission Test Data cont'd

Emission Designator Table

Frequency Range (MHz)	Conducted Output Power (dBm)	Emission Designator	Band	Bandwidth (MHz)	Modulation
1710.7-1754.3	21.80	1M08G7D	LTE B4	1.4	QPSK
1710.7-1754.3	20.50	1M08D7W	LTE B4	1.4	16QAM
1711.5-1753.5	21.70	2M69G7D	LTE B4	3	QPSK
1711.5-1753.5	21.30	2M69D7W	LTE B4	3	16QAM
1712.5-1752.5	21.90	4M48G7D	LTE B4	5	QPSK
1712.5-1752.5	21.40	4M47D7W	LTE B4	5	16QAM
1715-1750	21.70	8M95G7D	LTE B4	10	QPSK
1715-1750	21.30	8M95D7W	LTE B4	10	16QAM
1717.5-1747.5	21.70	13M4G7D	LTE B4	15	QPSK
1717.5-1747.5	21.40	13M4D7W	LTE B4	15	16QAM
1720-1745	21.90	17M9G7D	LTE B4	20	QPSK
1720-1745	21.50	17M9D7W	LTE B4	20	16QAM

The conducted spurious emissions – As per 47 CFR 2.1051, CFR 27.53 were measured from 30 MHz to 20 GHz.

–26 dBc Bandwidth and Occupied Bandwidth (99%)

The modulation spectrum was measured by both methods of 99% power bandwidth and –26 dBc bandwidth For each 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz and 20MHz with different number of RBs for LTE band 4,.

QPSK and 16-QAM modulations were applied to each of the bandwidths. Only the worst case measurements are documented in this report.

A minimum RB condition was also measured (RB = 1).

The resolution bandwidth required for out-of-band emissions in the 1 MHz bands immediately outside and adjacent to the frequency block, was determined to be at least 1% of the emission bandwidth.

The worst case –26dBc bandwidth for LTE band 4 was measured to be 18.56 MHz. Results were derived in a 200 kHz resolution bandwidth.

On any frequency outside the frequency block and outside the adjacent 1 MHz bands, a resolution bandwidth of at least 1 MHz was applied.

Test Data for LTE Band 4 selected Frequencies in 20MHz BW (RB = 100)

LTE Band 4 Frequency (MHz)	26dBc Occupied Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	
	QPSK	QPSK	16-QAM
1720.0	18.48	17.84	17.88
1732.5	18.52	17.84	17.88
1745.0	18.56	**17.93**	17.88

Peak to Average Ratio (PAR)

For each 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz and 20MHz with different number of RBs as per scalable bandwidths for LTE band 4, the peak to average ratio was measured on the low, middle and high channels with QPSK modulation.

On any frequency outside the frequency block and outside the adjacent 1 MHz bands, a resolution bandwidth of at least 1 MHz was applied.

The worst case measured was 11.32 dB in 10MHz bandwidth with 50 RBs.

Measurement Plots for LTE Band 4

See Figures 5-1a to 5-18a for the plots of the conducted spurious emissions.

See Figures 5-19a to 5-34a and 5-51a to 5-53a for the plots of 99% Occupied Bandwidth and -26 dBc Bandwidth.

See Figures 5-35a to 5-44a for the plots of the Channel mask.

See Figures 5-45a to 5-50a for the plots of the Peak to Average Ratios.

LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-1a: Band 4, Spurious Conducted Emissions, Low channel, 20MHz BW (RB= 1)

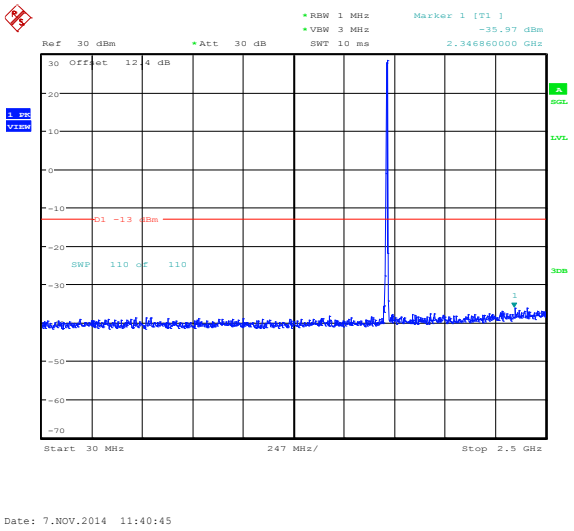


Figure 5-2a: Band 4, Spurious Conducted Emissions, Low channel, 20MHz BW (RB= 1)

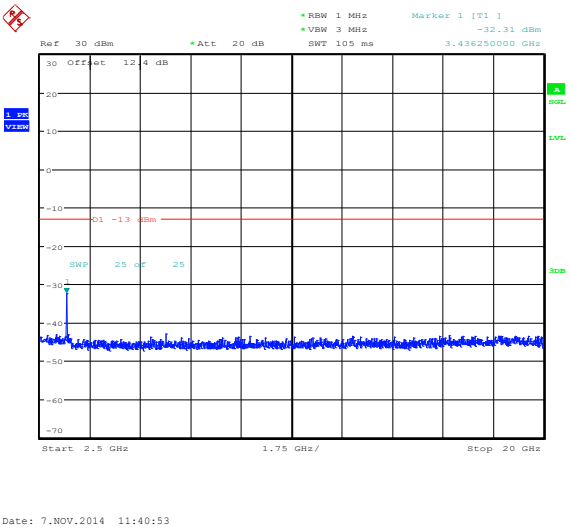


Figure 5-3a: Band 4, Spurious Conducted Emissions, Middle channel, 20MHz BW (RB= 50)

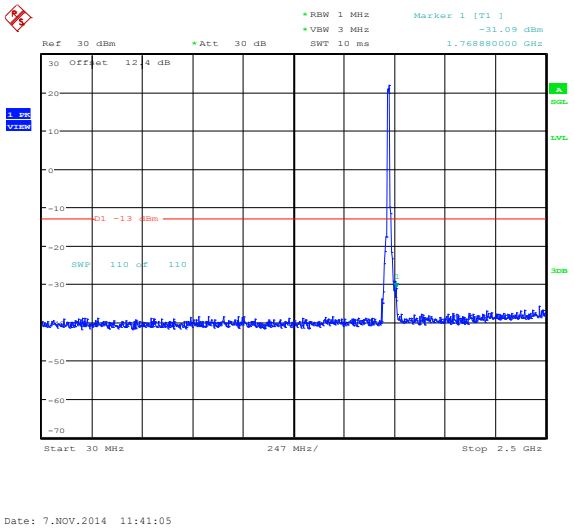
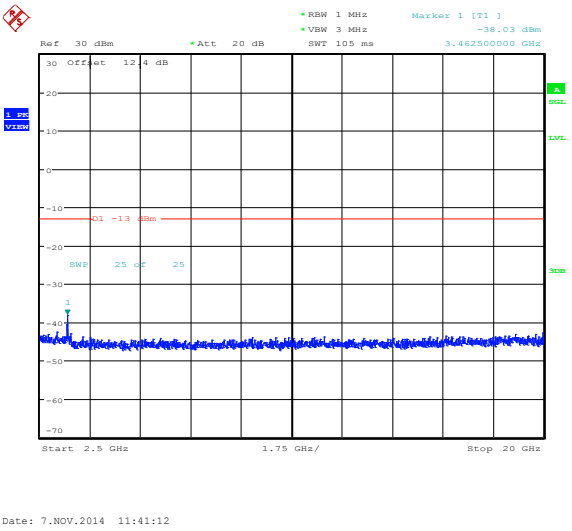


Figure 5-4a: Band 4, Spurious Conducted Emissions, Middle channel, 20MHz BW (RB= 50)



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-5a: Band 4, Spurious Conducted Emissions, High Channel, 20MHz BW (RB= 100)

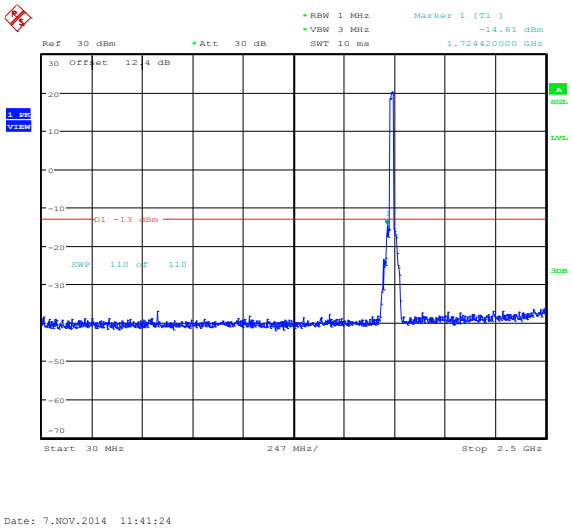


Figure 5-6a: Band 4, Spurious Conducted Emissions, High Channel, 20MHz BW (RB= 100)

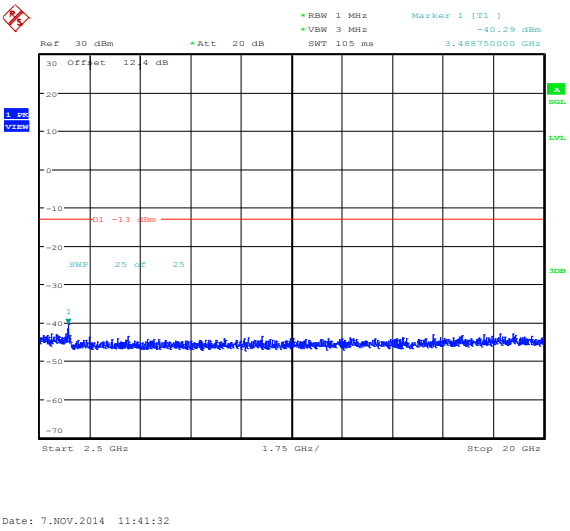


Figure 5-7a: Band 4, Spurious Conducted Emissions, Low channel, 10MHz BW (RB= 1)

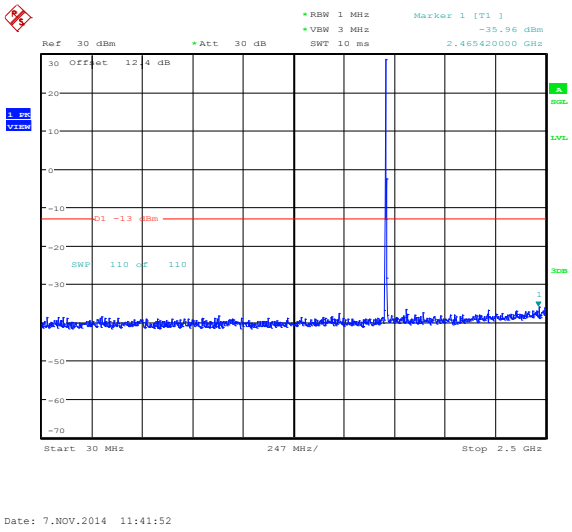
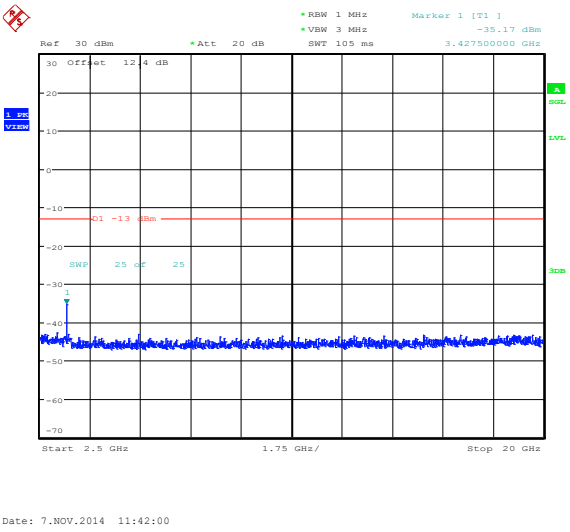


Figure 5-8a: Band 4, Spurious Conducted Emissions, Low channel, 10MHz BW (RB= 1)



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-9a: Band 4, Spurious Conducted Emissions, Middle Channel, 10MHz BW (RB= 25)

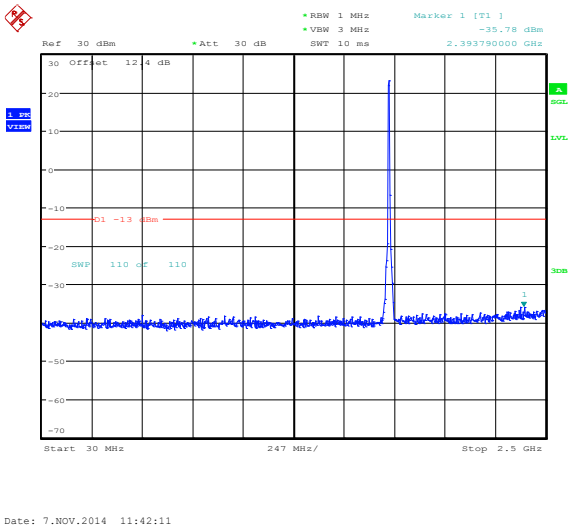


Figure 5-10a: Band 4, Spurious Conducted Emissions, Middle Channel, 10MHz BW (RB= 25)

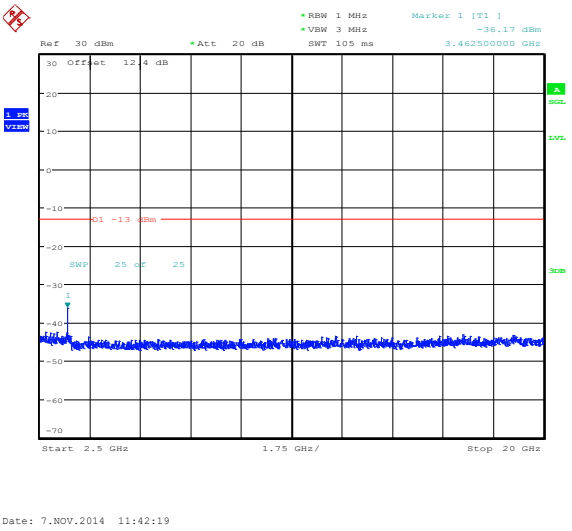


Figure 5-11a: Band 4, Spurious Conducted Emissions, High channel, 10MHz BW (RB= 50)

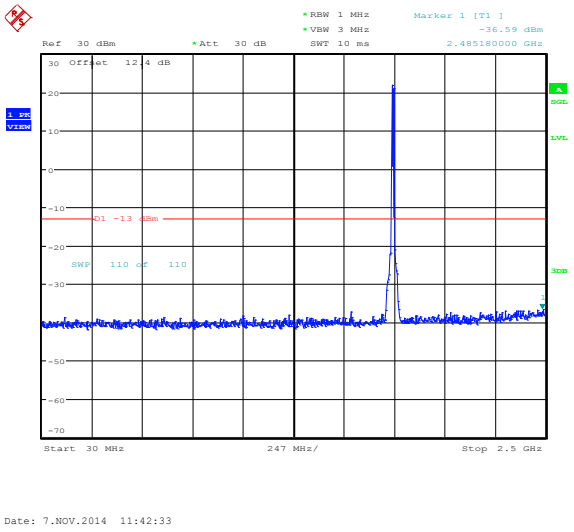
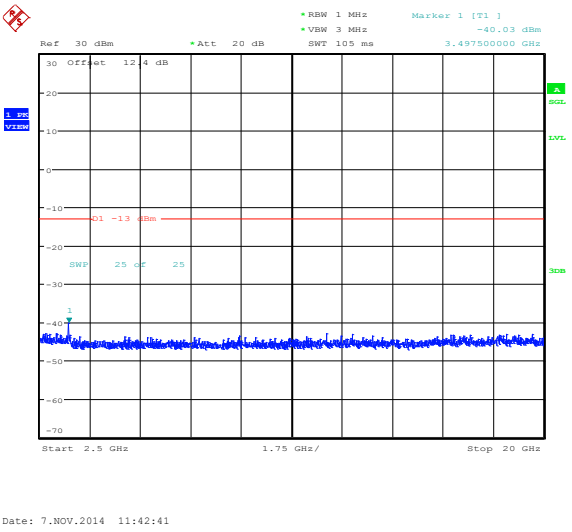


Figure 5-12a: Band 4, Spurious Conducted Emissions, High channel, 10MHz BW (RB= 50)



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-13a: Band 4, Spurious Conducted Emissions, Low Channel, 1.4MHz BW (RB= 1)

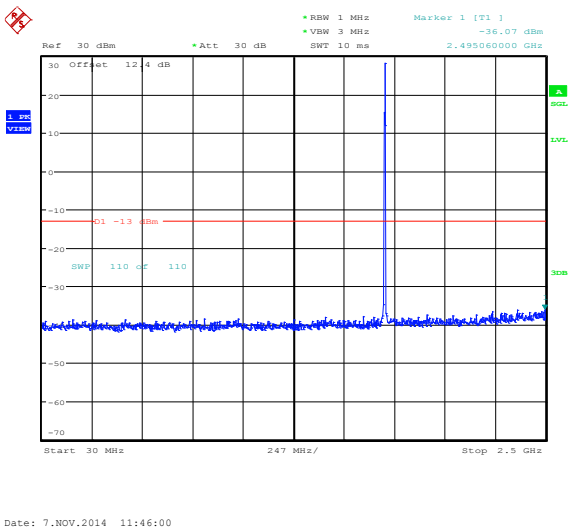


Figure 5-14a: Band 4, Spurious Conducted Emissions, Low Channel, 1.4MHz BW (RB= 1)

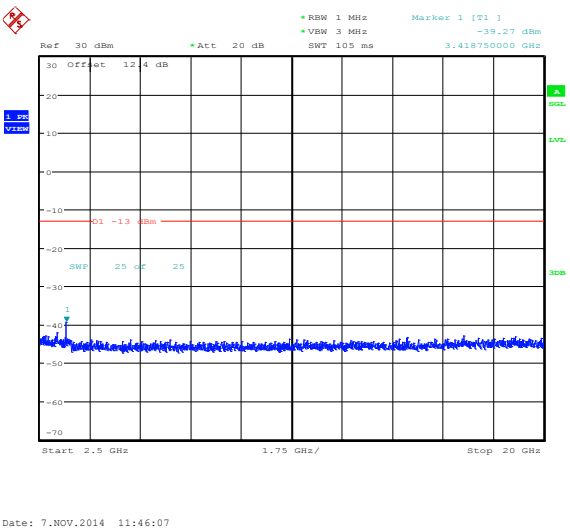


Figure 5-15a: Band 4, Spurious Conducted Emissions, Middle channel, 1.4MHz BW (RB= 3)

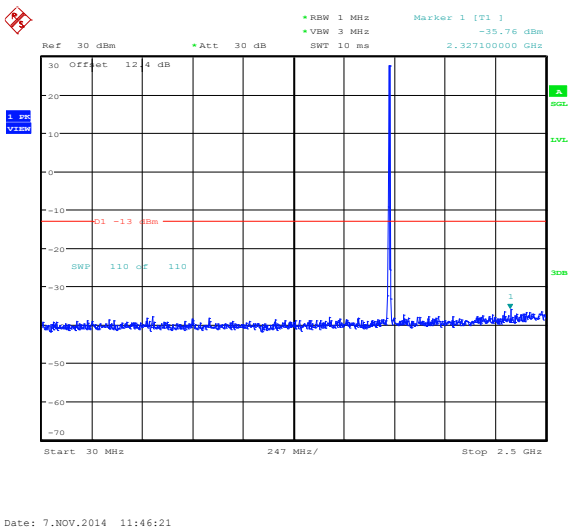
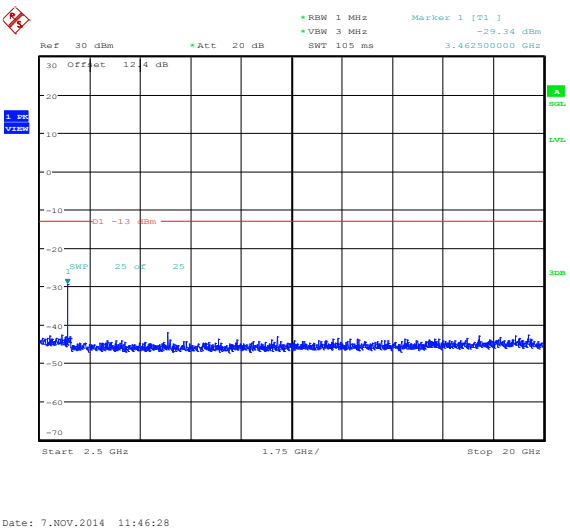


Figure 5-16a: Band 4, Spurious Conducted Emissions, Middle channel, 1.4MHz BW (RB= 3)



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-17a: Band 4, Spurious Conducted Emissions, High channel, 1.4MHz BW (RB= 6)

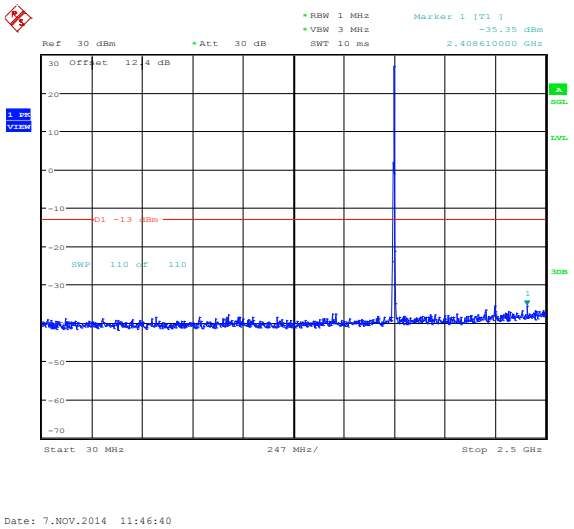
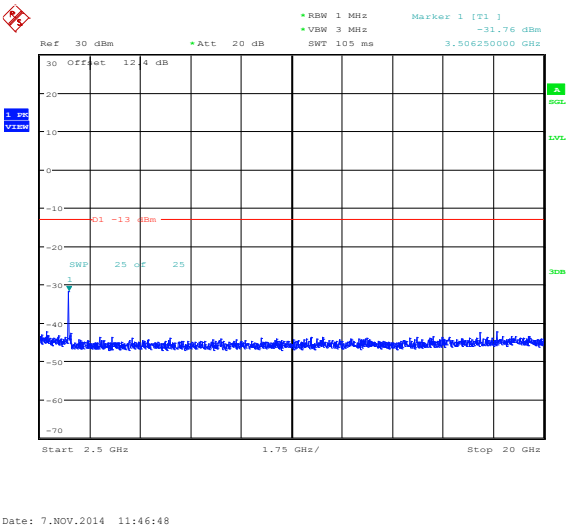


Figure 5-18a: Band 4, Spurious Conducted Emissions, High channel, 1.4MHz BW (RB= 6)



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-19a: Occupied Bandwidth, Band 4 Low Channel, 20MHz BW, RB=100

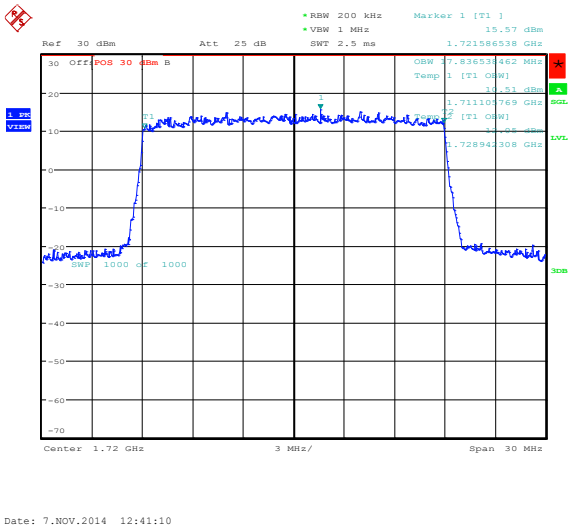


Figure 5-20a: Occupied Bandwidth, Band 4 Middle Channel, 20MHz BW, RB=100

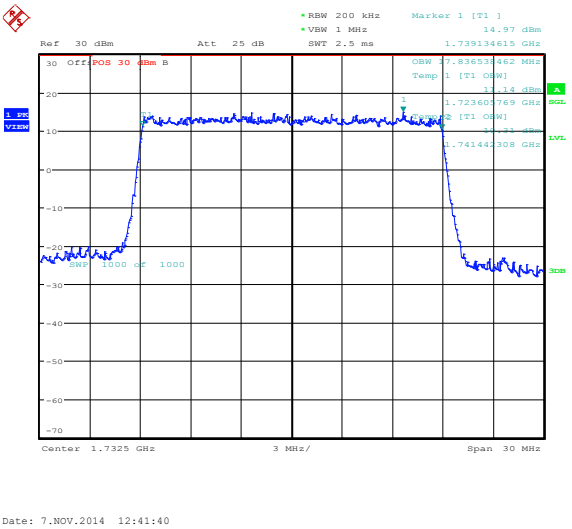
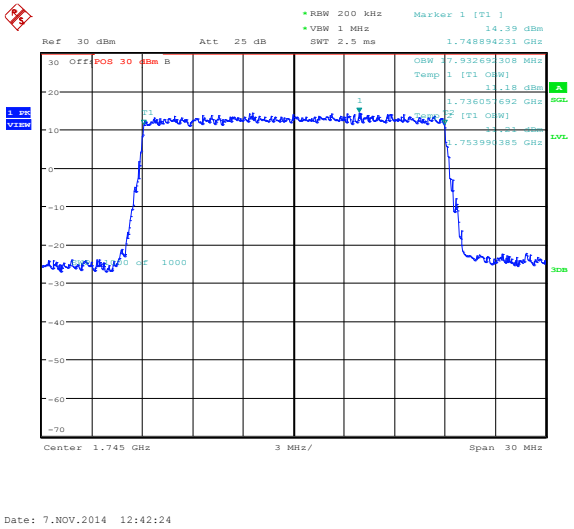


Figure 5-21a: Occupied Bandwidth, Band 4 High Channel, 20MHz BW, RB=100



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-22a: Occupied Bandwidth, Band 4 Low Channel, 10MHz BW, RB=50

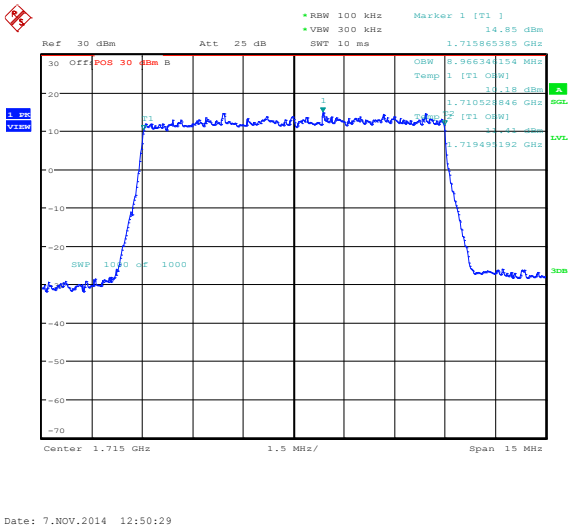


Figure 5-23a: Occupied Bandwidth, Band Middle Channel, 10MHz BW, RB=50

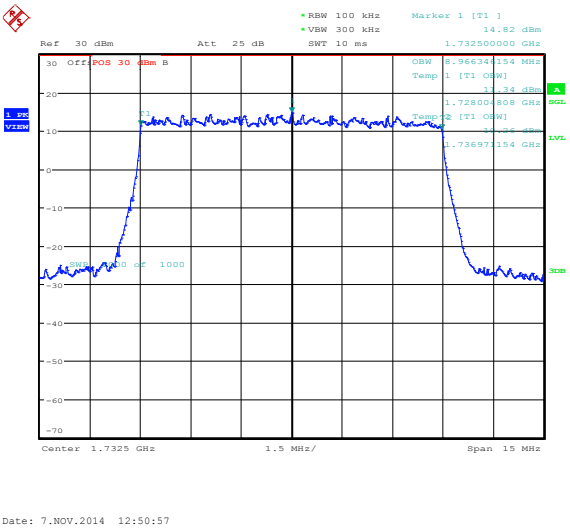
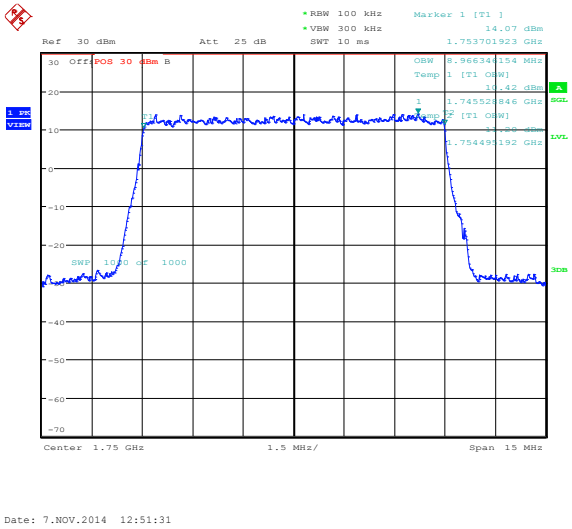


Figure 5-24a: Occupied Bandwidth, Band 4 High Channel, 10MHz BW, RB=50



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-25a: Occupied Bandwidth, Band 4 Low Channel, 1.4MHz BW, RB=6

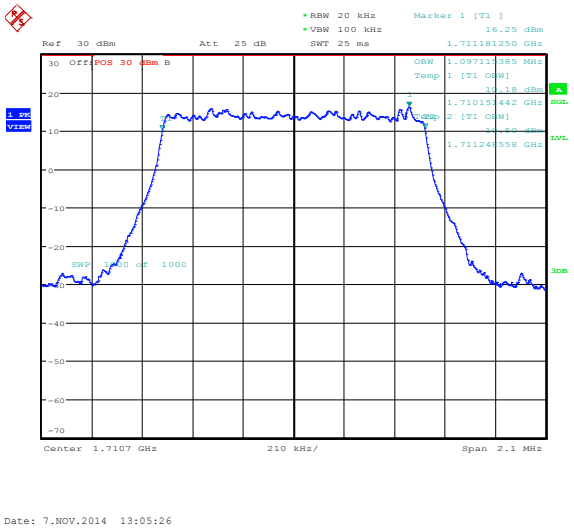


Figure 5-26a: Occupied Bandwidth, Band 4 Middle Channel, 1.4MHz BW, RB=6

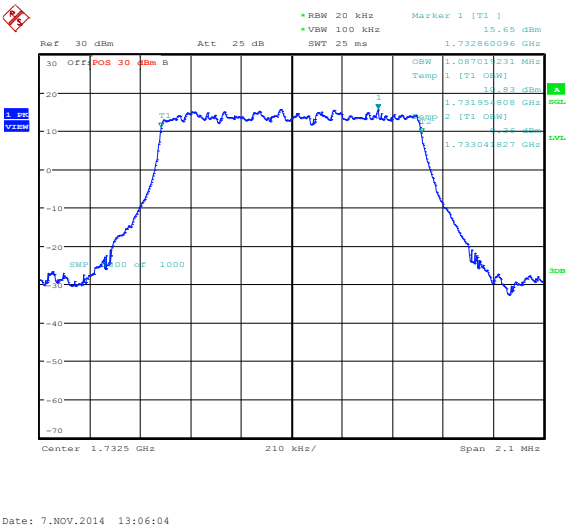
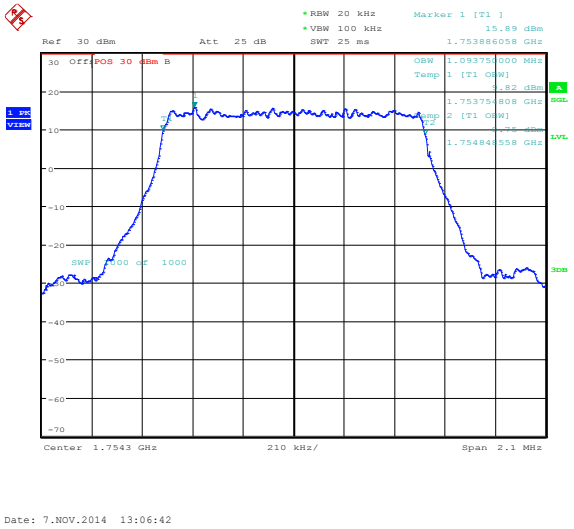


Figure 5-27a: Occupied Bandwidth, Band 4 High Channel, 1.4MHz BW, RB=6



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-28a: -26 dBc Bandwidth, Band 4 Low Channel, 20MHz BW, RB=100

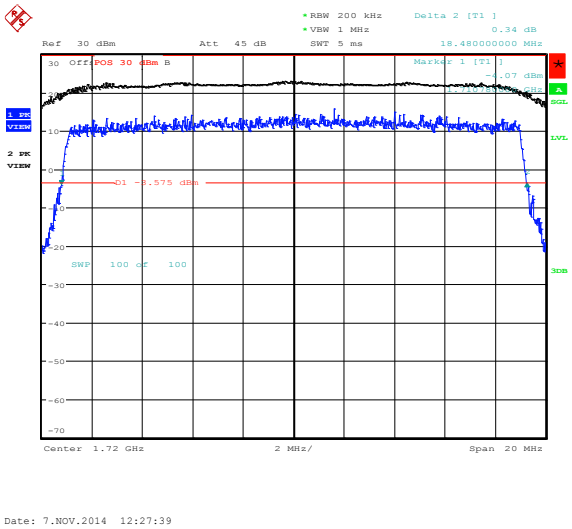


Figure 5-29a: -26 dBc Bandwidth, Band 4 Middle Channel, 20MHz BW, RB=100

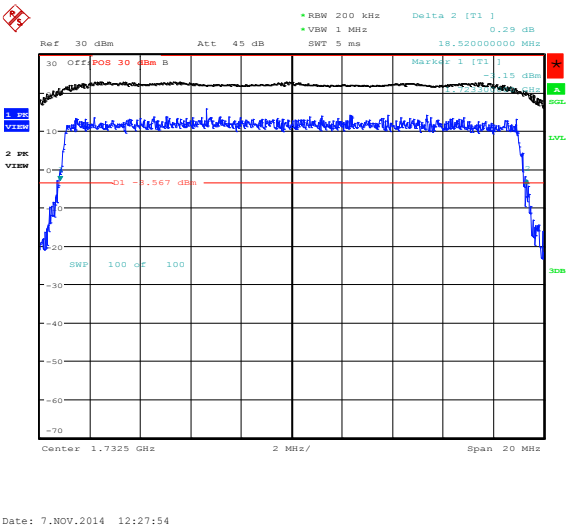


Figure 5-30a: -26 dBc Bandwidth, Band 4 High Channel, 20MHz BW, RB=100

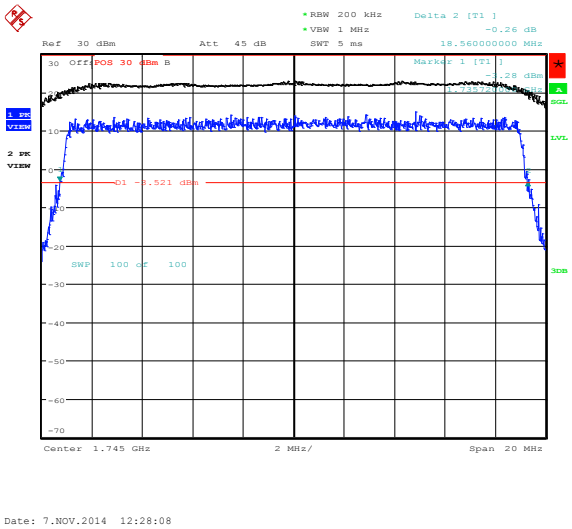
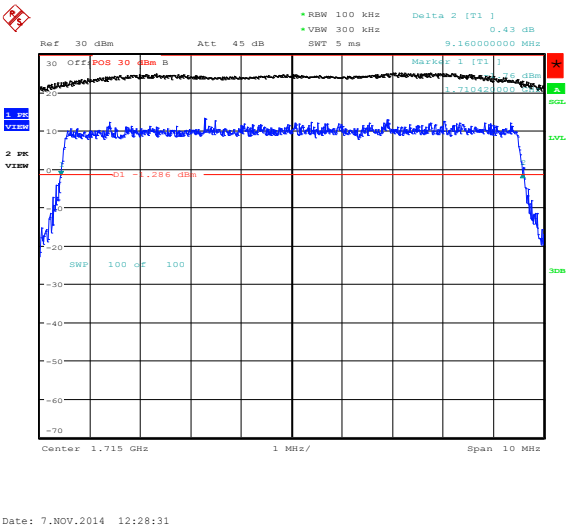


Figure 5-31a: -26 dBc Bandwidth, Band 4 Low Channel, 10MHz BW, RB=50



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-32a: -26 dBc Bandwidth, Band 4 Middle Channel, 10MHz BW, RB=50

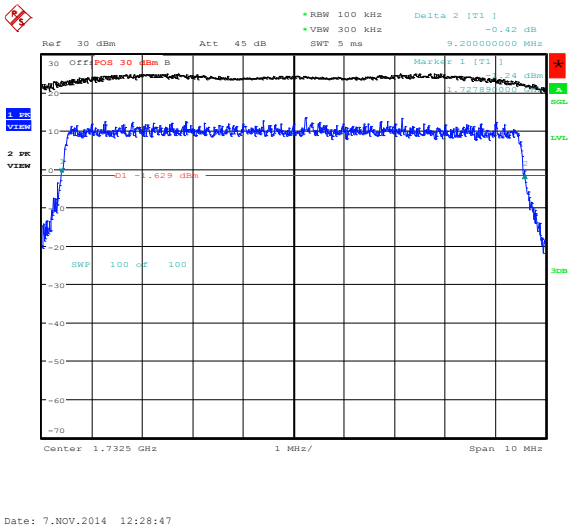


Figure 5-33a: -26 dBc Bandwidth, Band 4 High Channel, 10MHz BW, RB=50

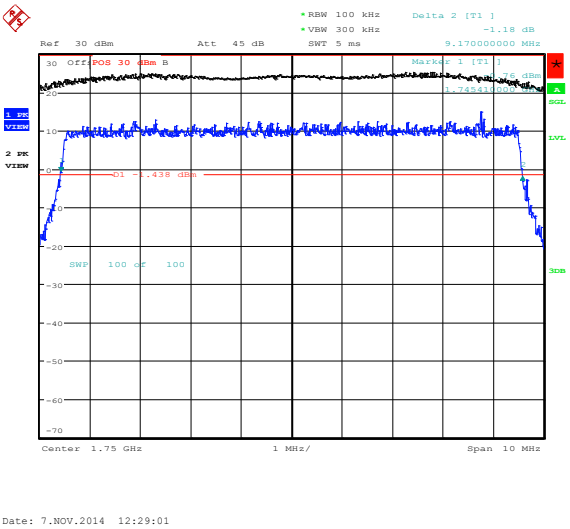


Figure 5-34a: -26 dBc Bandwidth, Band 4 Low Channel, 1.4MHz BW, RB=6

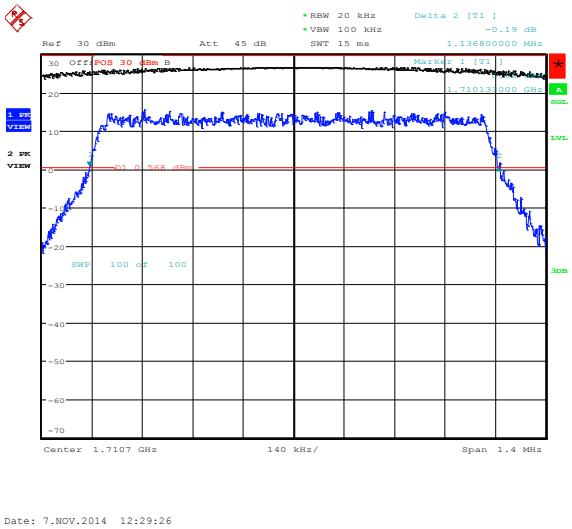
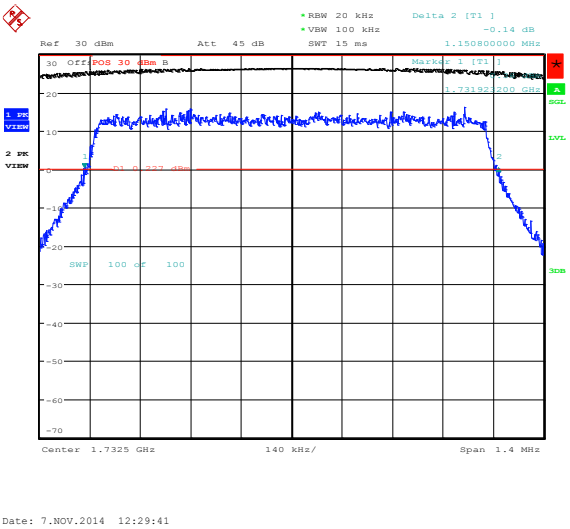


Figure 5-35a: -26 dBc Bandwidth, Band 4 Middle Channel, 1.4MHz BW, RB=6



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-36a: -26 dBc Bandwidth, Band 4 High Channel, 1.4MHz BW, RB=6

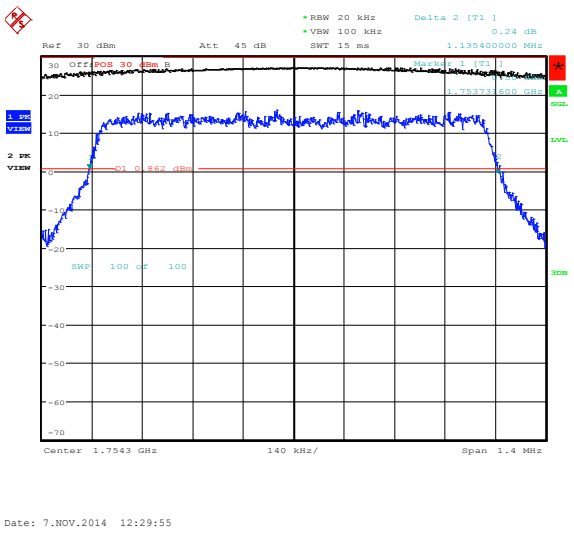


Figure 5-37a: Band 4 Low Channel Mask, 20MHz BW, RB=100

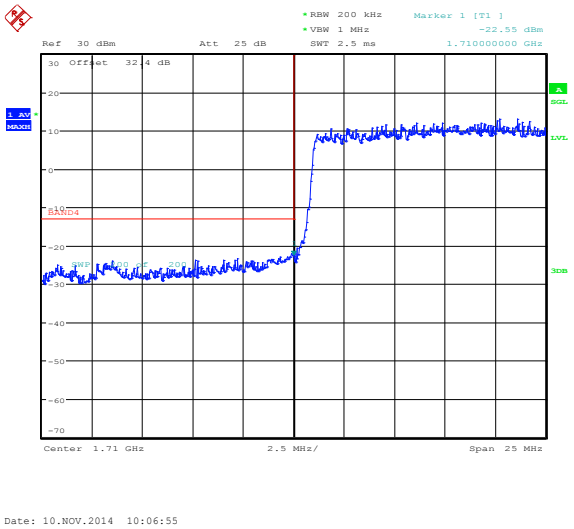
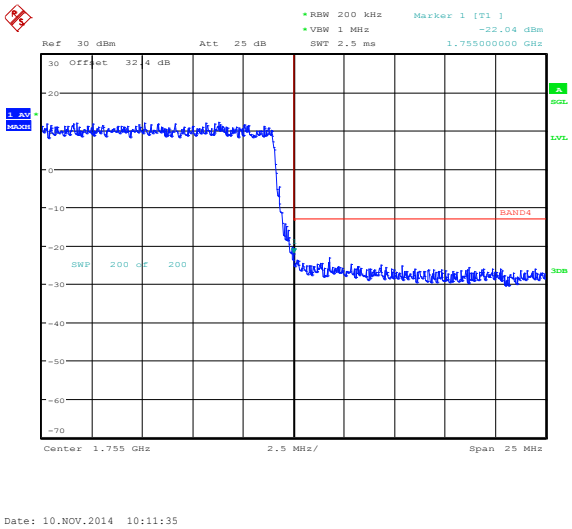


Figure 5-38a: Band 4 High Channel Mask, 20MHz BW, RB=100



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-39a: Band 4 Low Channel Mask, 10MHz BW, RB=50

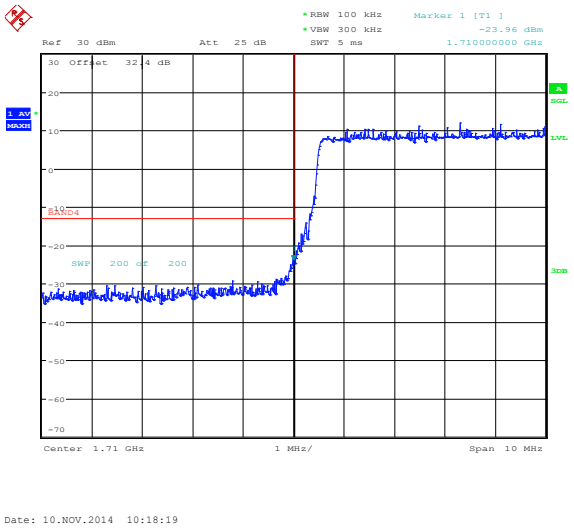


Figure 5-40a: Band 4 High Channel Mask, 10MHz BW, RB=50

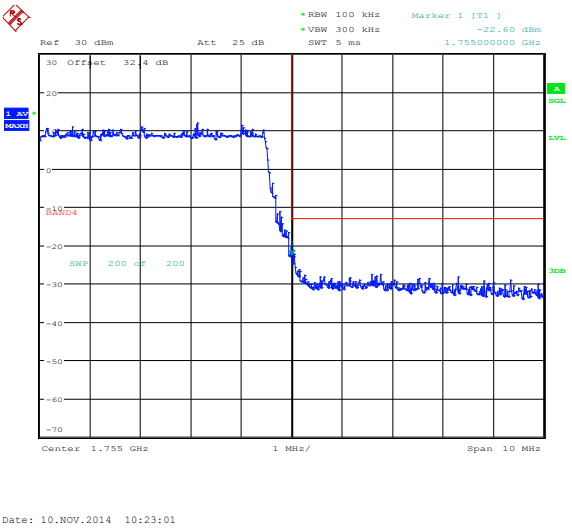


Figure 5-41a: Band 4 Low Channel Mask, 1.4MHz BW, RB=6

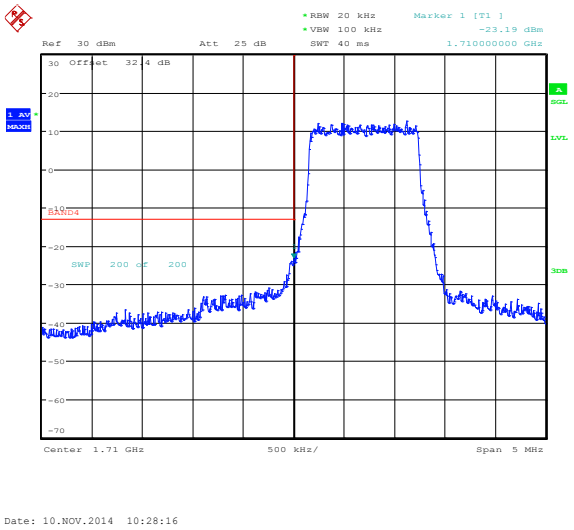
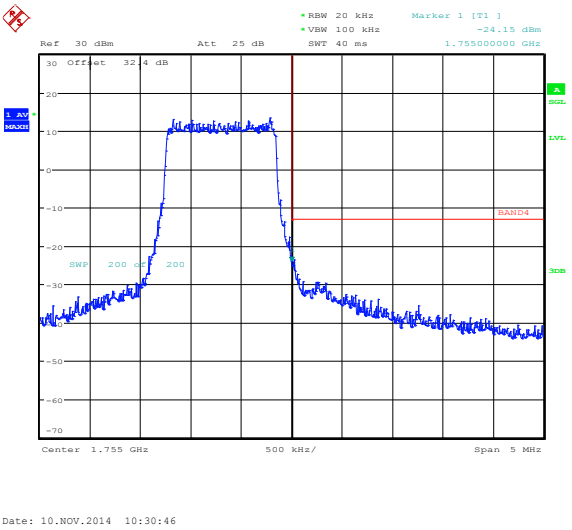
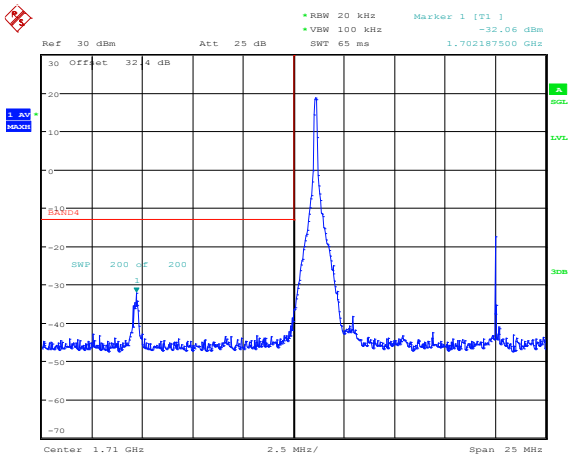


Figure 5-42a: Band 4 High Channel Mask, 1.4MHz BW, RB=6



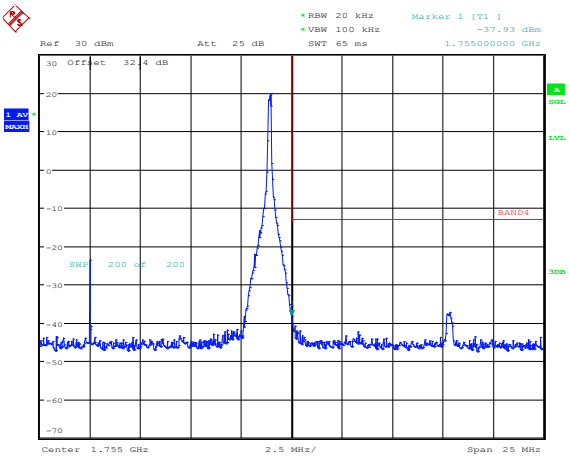
LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-43a: Band 4 Low Channel Mask, 20MHz BW, RB=1



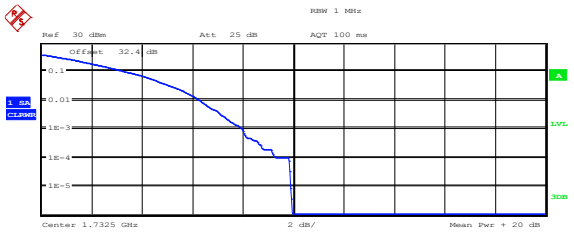
Date: 10.NOV.2014 10:04:28

Figure 5-44a: Band 4 High Channel Mask, 20MHz BW, RB=1



Date: 10.NOV.2014 10:09:56

Figure 5-45a: Band 4 Mid Channel PAR, 20MHz BW, RB=50, QPSK

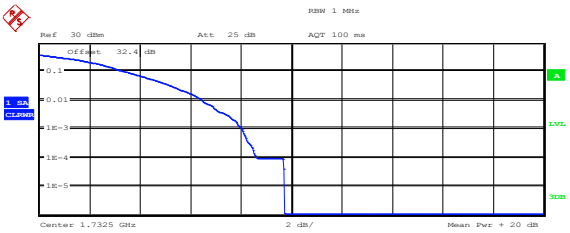


Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	6.02 dBm
Peak	15.97 dBm
Crest	9.94 dB
10 %	3.33 dB
1 %	6.25 dB
.1 %	7.98 dB
.01 %	9.81 dB

Date: 10.NOV.2014 12:21:59

Figure 5-46a: Band 4 Middle Channel Mask, 20MHz BW, RB=100, 16-QAM



Complementary Cumulative Distribution Function (100000 samples)

	Trace 1
Mean	8.43 dBm
Peak	18.15 dBm
Crest	9.72 dB
10 %	3.43 dB
1 %	6.44 dB
.1 %	8.01 dB
.01 %	9.65 dB

Date: 10.NOV.2014 12:22:28

LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-47a: Band 4 Mid Channel PAR, 10MHz BW, RB=25, QPSK

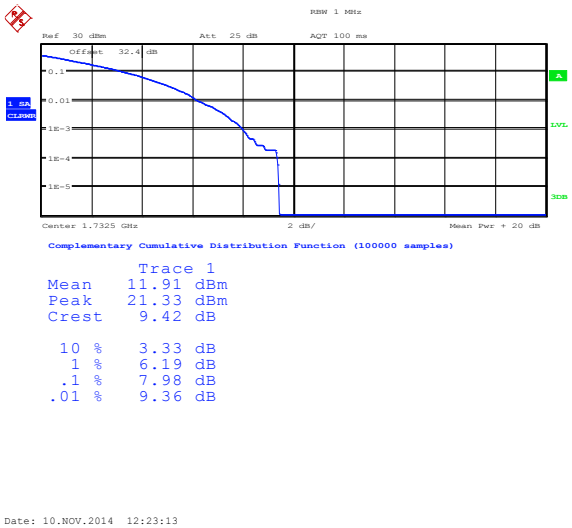


Figure 5-48a: Band 4 Mid Channel PAR, 10MHz BW, RB=50, 16-QAM

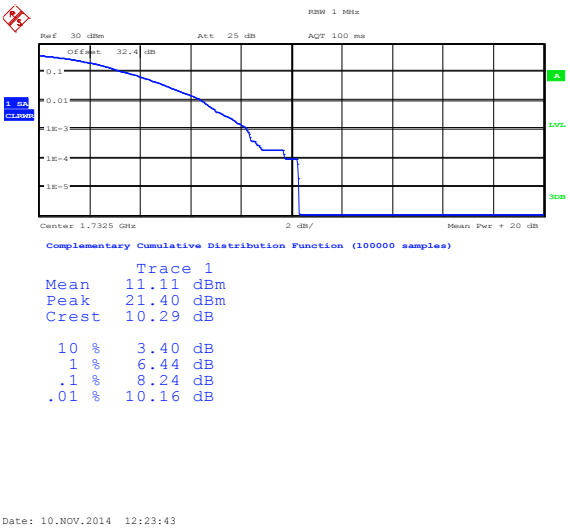


Figure 5-49a: Band 4 Mid Channel PAR, 1.4MHz BW, RB=3, QPSK

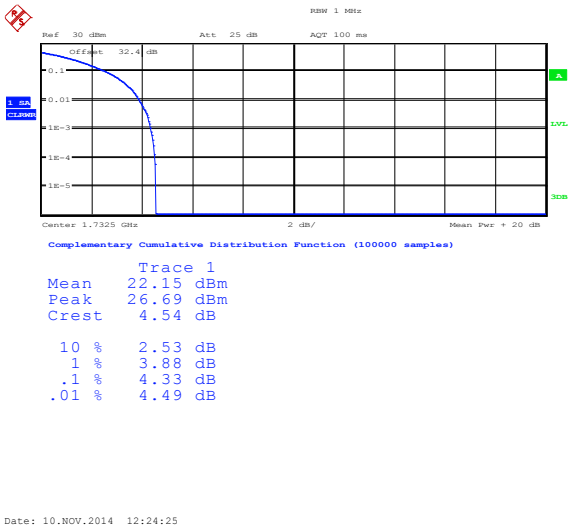
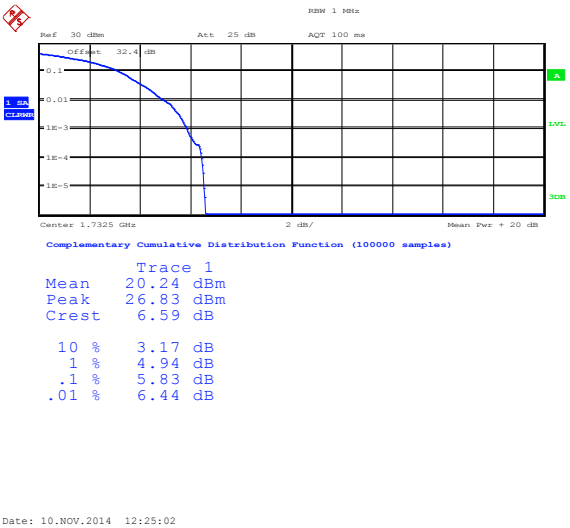


Figure 5-50a: Band 4 Middle Channel Mask, 5MHz BW, RB=6, 16-QAM



LTE Band 4 Conducted RF Emission Test Data cont'd

Figure 5-51a: Occupied Bandwidth, Band 4 Low Channel, 20MHz BW (RB= 100) 16-QAM

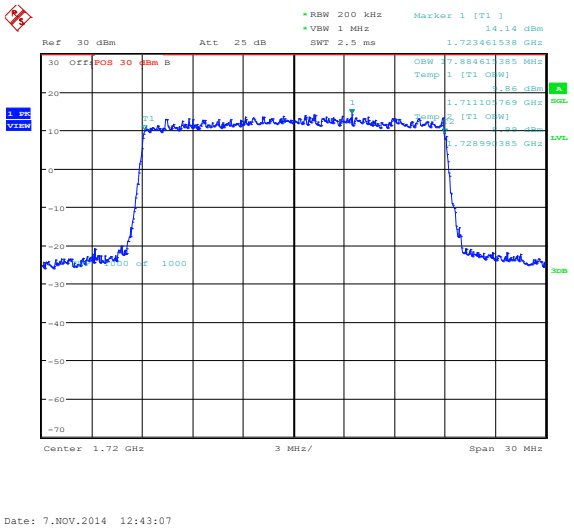


Figure 5-52a: Occupied Bandwidth, Band 4 Mid Channel, 20MHz BW (RB= 100) 16-QAM

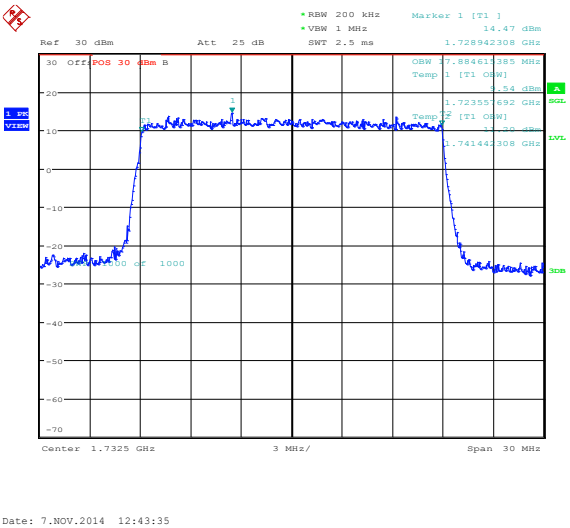
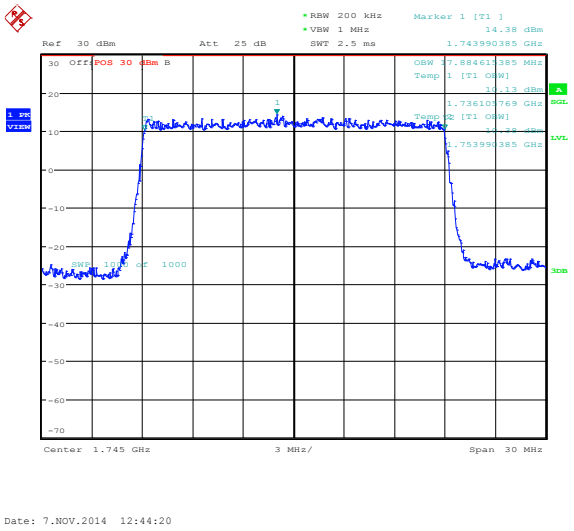
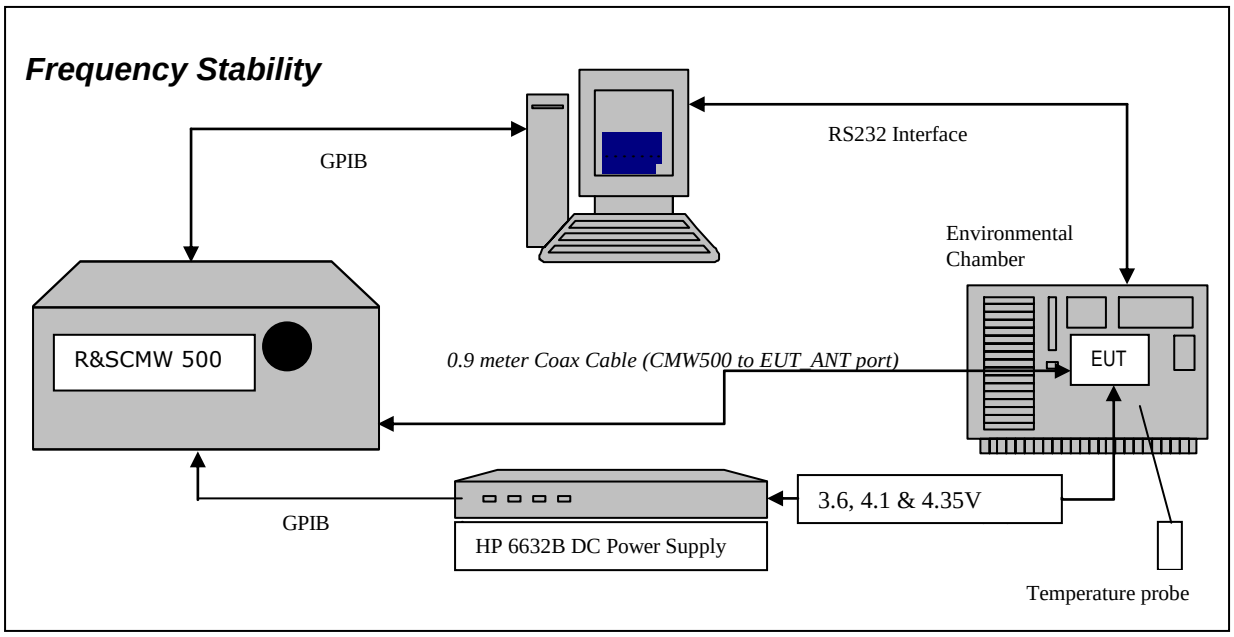


Figure 5-53a: Occupied Bandwidth, Band 4 High Channel, 20MHz BW (RB= 100) 16-QAM



APPENDIX 5B – LTE Band 4 FREQUENCY STABILITY TEST DATA

LTE Band 4 Frequency Stability Test Data



The following measurements were performed by Sijia Li.

CFR 47 Chapter 1 - Federal Communications Commission Rules

Part 2 Required Measurements
2.1055 Frequency Stability - Procedures
(a,b) Frequency Stability - Temperature Variation
(d) Frequency Stability - Voltage Variation

The EUT meets the requirements as stated in CFR 47 chapter 1, Section 27.54, CFR 47.
Frequency Stability measurement devices were configured as presented in the block diagram recording frequency, power, data, temperatures, and stepped voltages controlled via a GPIB interface linked to the Environmental chamber, a DC power supply, and the Communications Test Set. A 0.9-metre coax cable was calibrated to characterize the insertion loss for the transmitted frequencies between the RF input/output of the CMW 500 and the EUT antenna port.

Test Setup:

The EUT was placed in the Temperature chamber and connected to CMW 500 outside as shown in the figure above. Dry air was pumped inside the temperature chamber to maintain a backpressure during the test. The EUT was kept in the off condition at all times except when the following measurements were to be made.

The chamber was switched on and the temperature was set to -30°C.
After the chamber stabilized at -30 °C there was a soak period of one hour to alleviate moisture in the chamber, the EUT voltage was enabled.
The system software recorded the frequency, power, and associated measurements.

A Computer system controlled the automated software. This application was given the command of activating all machines intrinsic to the temperature and voltage tests controlling the CMW 500 via the GPIB Bus. The Environmental Chamber was instructed through an RS-232 serial line. The EUT dialogue was passed through a serial connection.

The EUT repetitively transmitted 100 bursts for each set of programmed parameters recording temperature, voltage settings, and systematically selected frequencies. The power supply was cycled from minimum voltage 3.6 volts, to 4.1 volts and to 4.35 volts maximum voltage. The frequency error was measured at a maximum output power and recorded by the automated system test software.

The EUT output power and frequency was measured at 3.6 volts, 4.1 volts and 4.35 volts. The transmit frequency was varied in 3 steps consisting of 1720.0 MHz, 1732.5 MHz and 1745.0 MHz each was measured under 20 MHz bandwidth with maximum (100) RBs. This frequency was recorded in MHz and deviation from nominal, in Parts Per Million.

After the initial one-hour soak at the beginning of the tests, a period of thirty minutes soak was initialized between each ascending temperature step, before proceeding to the next measurement test cycle.

Procedure:

The test system software for commencing the Frequency Stability Tests carried through the following cycle.

29. Switch on the HP 6632B power supply; CMW 500 Communications test Set, and Environmental Chamber.
30. Start test program
31. Set the Temperature to –30°C and maintain a period of one- hour soak time, with the EUT supply voltage disabled.
32. Set power supply voltage to 3.6 volts.
33. Set up CMW 500 Radio Communication Tester.
34. Command the CMW 500 to switch to the low channel.
35. Enable the voltage to the EUT, and connect a link to the CMW 500 test set.
36. EUT is commanded to Transmit 100 Bursts.
37. Software logs the following data from the CMW 500, power supply and temperature chamber: Traffic Channel Number, Traffic Channel Frequency, Power Level, Chamber Temperature, Supply Voltage, Power and Frequency Error.
38. The CMW 500 commands the EUT to change frequency to the middle channel and high channel and repeats steps 7 to 9.
39. Repeat steps 5 to 10 changing the supply voltage to 4.1 Volts
40. Increase temperature by 10°C and soak for 1/2 hour.
41. Repeat steps 4 - 12 for temperatures –30°C to 60°C.
42. Repeat steps 5 to 10 changing the supply voltage to 4.35 volts

Procedure 5 to 10 was repeated at room temperature (20°C) with the power supply voltage set to 3.6, 4.1 and 4.35 volts

The maximum frequency error in the LTE band 4 measured was **-0.0074PPM**.

LTE Band 4 results: channels 20050, 20175 and 20300 @ 20°C maximum transmitted power

Traffic Channel Number	LTE Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20050	1720.0	3.6	20	6.54	0.0038
20175	1732.5	3.6	20	-4.43	-0.0026
20300	1745.0	3.6	20	4.06	0.0023

Traffic Channel Number	LTE Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20050	1720.0	4.1	20	7.54	0.0044
20175	1732.5	4.1	20	4.43	0.0026
20300	1745.0	4.1	20	-4.48	-0.0026

Traffic Channel Number	LTE Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20050	1720.0	4.35	20	7.47	0.0043
20175	1732.5	4.35	20	-5.22	-0.0030
20300	1745.0	4.35	20	7.34	0.0042

LTE band 4 Results: channel 20050 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20050	1720.0	3.6	-30	6.17	0.0036
20050	1720.0	3.6	-20	**12.72**	**0.0074**
20050	1720.0	3.6	-10	8.60	0.0050
20050	1720.0	3.6	0	6.90	0.0040
20050	1720.0	3.6	10	5.92	0.0034
20050	1720.0	3.6	20	6.54	0.0038
20050	1720.0	3.6	30	7.31	0.0042
20050	1720.0	3.6	40	7.38	0.0043
20050	1720.0	3.6	50	7.11	0.0041
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20050	1720.0	4.1	-30	10.19	0.0059
20050	1720.0	4.1	-20	11.57	0.0067
20050	1720.0	4.1	-10	5.15	0.0030
20050	1720.0	4.1	0	4.98	0.0029
20050	1720.0	4.1	10	7.60	0.0044
20050	1720.0	4.1	20	7.54	0.0044
20050	1720.0	4.1	30	7.65	0.0044
20050	1720.0	4.1	40	4.79	0.0028
20050	1720.0	4.1	50	4.08	0.0024
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20050	1720.0	4.35	-30	6.72	0.0039
20050	1720.0	4.35	-20	4.72	0.0027
20050	1720.0	4.35	-10	6.59	0.0038
20050	1720.0	4.35	0	7.94	0.0046
20050	1720.0	4.35	10	8.71	0.0051
20050	1720.0	4.35	20	7.47	0.0043
20050	1720.0	4.35	30	6.52	0.0038
20050	1720.0	4.35	40	7.45	0.0043
20050	1720.0	4.35	50	6.04	0.0035

LTE band 4 Results: channel 20175 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20175	1732.5	3.6	-30	6.19	0.0036
20175	1732.5	3.6	-20	-7.22	-0.0042
20175	1732.5	3.6	-10	2.46	0.0014
20175	1732.5	3.6	0	-3.65	-0.0021
20175	1732.5	3.6	10	-8.11	-0.0047
20175	1732.5	3.6	20	-4.43	-0.0026
20175	1732.5	3.6	30	-5.78	-0.0033
20175	1732.5	3.6	40	-3.53	-0.0020
20175	1732.5	3.6	50	-6.08	-0.0035
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20175	1732.5	4.1	-30	4.72	0.0027
20175	1732.5	4.1	-20	-5.85	-0.0034
20175	1732.5	4.1	-10	-4.94	-0.0028
20175	1732.5	4.1	0	-3.55	-0.0020
20175	1732.5	4.1	10	-3.88	-0.0022
20175	1732.5	4.1	20	4.43	0.0026
20175	1732.5	4.1	30	9.40	0.0054
20175	1732.5	4.1	40	-7.24	-0.0042
20175	1732.5	4.1	50	-6.09	-0.0035
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20175	1732.5	4.35	-30	-7.84	-0.0045
20175	1732.5	4.35	-20	5.64	0.0033
20175	1732.5	4.35	-10	-6.17	-0.0036
20175	1732.5	4.35	0	-5.79	-0.0033
20175	1732.5	4.35	10	-6.12	-0.0035
20175	1732.5	4.35	20	-5.22	-0.0030
20175	1732.5	4.35	30	-7.70	-0.0044
20175	1732.5	4.35	40	-4.22	-0.0024
20175	1732.5	4.35	50	-3.02	-0.0017

LTE band 4 Results: channel 20300 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
20300	1745.0	3.6	-30	8.40	0.0048
20300	1745.0	3.6	-20	8.96	0.0051
20300	1745.0	3.6	-10	-3.59	-0.0021
20300	1745.0	3.6	0	-3.28	-0.0019
20300	1745.0	3.6	10	3.92	0.0022
20300	1745.0	3.6	20	4.06	0.0023
20300	1745.0	3.6	30	3.75	0.0021
20300	1745.0	3.6	40	4.52	0.0026
20300	1745.0	3.6	50	-4.41	-0.0025
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20300	1745.0	4.1	-30	6.21	0.0036
20300	1745.0	4.1	-20	4.22	0.0024
20300	1745.0	4.1	-10	2.89	0.0017
20300	1745.0	4.1	0	6.48	0.0037
20300	1745.0	4.1	10	8.61	0.0049
20300	1745.0	4.1	20	-4.48	-0.0026
20300	1745.0	4.1	30	4.31	0.0025
20300	1745.0	4.1	40	4.95	0.0028
20300	1745.0	4.1	50	-6.78	-0.0039
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
20300	1745.0	4.35	-30	7.80	0.0045
20300	1745.0	4.35	-20	5.32	0.0030
20300	1745.0	4.35	-10	5.26	0.0030
20300	1745.0	4.35	0	6.25	0.0036
20300	1745.0	4.35	10	8.53	0.0049
20300	1745.0	4.35	20	7.34	0.0042
20300	1745.0	4.35	30	-6.87	-0.0039
20300	1745.0	4.35	40	-5.79	-0.0033
20300	1745.0	4.35	50	5.41	0.0031

APPENDIX 5C – LTE Band 4 RADIATED EMISSIONS TEST DATA

Radiated Power Test Data Results

The following measurements were performed by Shiva Kumbham.
Date of Test: November 12, 2014
The environmental tests conditions were: Temperature: 25.0 °C
Relative Humidity: 29.5 %
The BlackBerry® smartphone was standalone, side button pointing down with the LCD facing to the RX antenna when the turntable is at 0 degree position.
Measurements were performed with QPSK and 16QAM modulations. The smallest test margins are reported below.
Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height.

LTE band 4, 20MHz BW, RB=1, QPSK modulation

								Substitution Method					
EUT				Rx Antenna		Spectrum Analyzer		Tracking Generator					
Type	Ch	Frequency (MHz)	Band	Type	Pol.	Reading (dBuV)	Max (V,H) (dBuV)	Pol. Tx-Rx	Reading (dBm)	Corrected Reading (relative to Isotropic Radiator) (dBm)	(W)	Limit (dBm)	Diff to Limit (dB)
F0	20050	1720.00	4	Horn	V	-21.15	-21.15	V-V	-10.13	**28.51**	0.71	30.00	1.49
F0	20050	1720.00	4	Horn	H	-26.20		H-H	-10.92				
F0	20175	1732.50	4	Horn	V	-21.97	-21.97	V-V	-11.50	27.29	0.54	30.00	2.71
F0	20175	1732.50	4	Horn	H	-25.81		H-H	-11.88				
F0	20299	1744.90	4	Horn	V	-22.69	-22.69	V-V	-12.72	25.95	0.39	30.00	4.05
F0	20299	1744.90	4	Horn	H	-25.01		H-H	-12.65				

LTE band 4, 20MHz BW, RB=1, 16-QAM modulation

								Substitution Method					
EUT				Rx Antenna		Spectrum Analyzer		Tracking Generator					
Type	Ch	Frequency (MHz)	Band	Type	Pol.	Reading (dBuV)	Max (V,H) (dBuV)	Pol. Tx-Rx	Reading (dBm)	Corrected Reading (relative to Isotropic Radiator) (dBm)	(W)	Limit (dBm)	Diff to Limit (dB)
F0	20050	1720.00	4	Horn	V	-22.67	-22.67	V-V	-11.66	**26.98**	0.50	30.00	3.02
F0	20050	1720.00	4	Horn	H	-27.40		H-H	-12.43				
F0	20175	1732.50	4	Horn	V	-22.85	-22.85	V-V	-12.41	26.38	0.43	30.00	3.62
F0	20175	1732.50	4	Horn	H	-26.60		H-H	-12.78				
F0	20299	1744.90	4	Horn	V	-22.93	-22.93	V-V	-12.93	25.76	0.38	30.00	4.24
F0	20299	1744.90	4	Horn	H	-34.98		H-H	-12.84				

Radiated Emissions Test Data Results cont'd

The following measurements were performed by Savtej Sandhu.

Date of Test: November 6, 2014

The environmental test conditions were: Temperature: 26.4 ºC
Relative Humidity: 17.3 %

The BlackBerry® smartphone was standalone, side button point up with LCD facing to the RX antenna when the turntable is at 0 degree position

Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height, and the frequency range scanned was 30MHz – 1GHz.

Measurements were performed in LTE band 4 with QPSK and 16-QAM modulations for 5MHz BW (channel 19975, 20175 and 20374 with RB = 1).

All emissions were at least 25.0 dB below the limit.

The following measurements were performed by Kevin Guo

Date of Test: November 7-11, 2014

The environmental test conditions were: Temperature: 29.5 ºC
Relative Humidity: 30.4 %

Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height, and a frequency range of 1 GHz to 20 GHz.

The BlackBerry® smartphone was standalone, side button point up with LCD facing to the RX antenna when the turntable is at 0 degree position

Measurements were performed in LTE band 4 with QPSK and 16-QAM modulations for 5MHz BW (channel 19975, 20175 and 20374 with RB = 1).

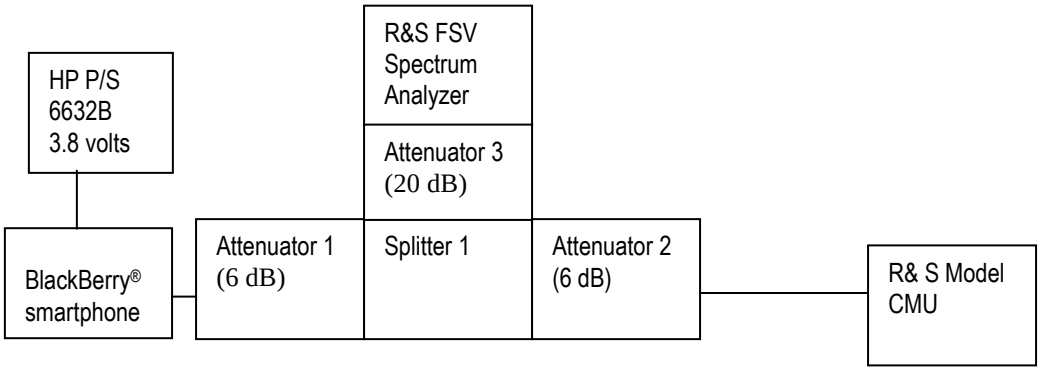
All emissions were at least 25.0 dB below the limit.

APPENDIX 6A– LTE Band 17 CONDUCTED RF EMISSIONS TEST DATA/PLOTS

LTE Band 17 Conducted RF Emission Test Data

This appendix contains measurement data pertaining to conducted spurious emissions, 99% power bandwidth and the channel mask.

Test Setup Diagram



A reference offset of 31.4 dB was applied to the spectrum analyzer reference level for the attenuators and coaxial cable loss in the test circuit.

UNIT	MANUFACTURER	MODEL	SERIAL NUMBER
Attenuator 1	Mini-Circuits	BW-S6W2+	0647
Attenuator 2	Mini-Circuits	BW-S6W2+	0648
Attenuator 3	Mini-Circuits	BW-S20-2W263+	1234
Splitter 1	Weinschel	1515	MES 92

Date of Test: November 12, 2014.

The environmental test conditions were: Temperature: 21.8 – 22.5ºC
Relative Humidity: 19 – 19.2 %

The following measurements were performed by Sijia Li.

LTE Band 17 Conducted RF Emission Test Data cont'd

Emission Designator Table

Frequency Range (MHz)	Conducted Output Power (dBm)	Emission Designator	Band	Bandwidth (MHz)	Modulation
706.5-713.5	23.22	4M48G7D	LTE B17	5	QPSK
706.5-713.5	22.47	4M47D7W	LTE B17	5	16QAM
709-711	23.34	8M95G7D	LTE B17	10	QPSK
709-711	22.80	8M93D7W	LTE B17	10	16QAM

The conducted spurious emissions – As per 47 CFR 2.202, CFR 2.1046, CFR 27.53 CFR 27.54, CFR 27.50, were measured from 30 MHz to 20 GHz.

–26 dBc Bandwidth and Occupied Bandwidth (99%)

the modulation spectrum was measured by both methods of 99% power bandwidth and –26 dBc bandwidth for each 5MHz and 10MHz with different number of RBs for LTE band 17.
QPSK and 16-QAM modulations were applied to each of the bandwidths. Only the worst case measurements are documented in this report.
A minimum RB condition was also measured (RB = 1).
The resolution bandwidth required for out-of-band emissions in the 1 MHz bands immediately outside and adjacent to the frequency block, was determined to be at least 1% of the emission bandwidth.
The worst case –26dBc bandwidth for LTE band 17 was measured to be 9.3 MHz. Results were derived in a 100 kHz resolution bandwidth.
On any frequency outside the frequency block and outside the adjacent 1 MHz bands, a resolution bandwidth of at least 1 MHz was applied.

Test Data for LTE Band 17 selected Frequencies in 10MHz BW (RB = 50)

LTE Band 17 Frequency (MHz)	26dBc Occupied Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	
	QPSK	QPSK	16-QAM
709.0	9.27	**8.966**	8.990
710.0	9.22	**8.966**	8.966
711.0	**9.3**	**8.966**	8.966

Peak to Average Ratio (PAR)

For each 5MHz and 10MHz with different number of RBs as per scalable bandwidths for LTE band 17, the peak to average ratio was measured on the low, middle and high channels with QPSK modulation.

On any frequency outside the frequency block and outside the adjacent 1 MHz bands, a resolution bandwidth of at least 1 MHz was applied.

The worst case measured was 10.48 dB on in 10MHz bandwidth with 50 RBs.

Measurement Plots for LTE Band 17

See Figures 6-1a to 6-12a for the plots of the conducted spurious emissions.

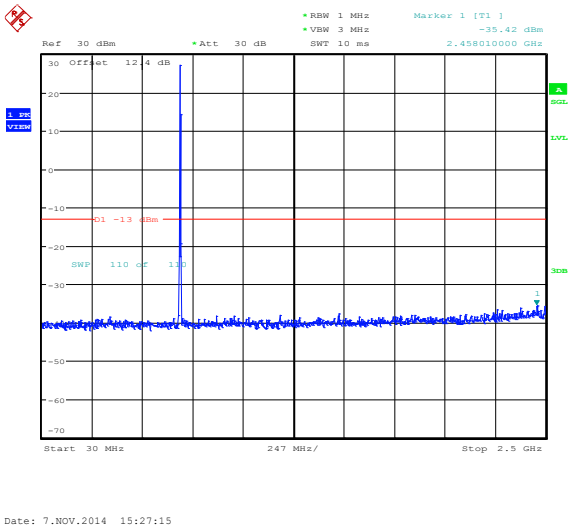
See Figures 6-19a to 6-24a and 6-37a to 6-39a for the plots of 99% Occupied Bandwidth and -26 dBc Bandwidth.

See Figures 6-25a to 6-32a for the plots of the Channel mask.

See Figures 6-33a to 6-36a for the plots of the Peak to Average Ratio.

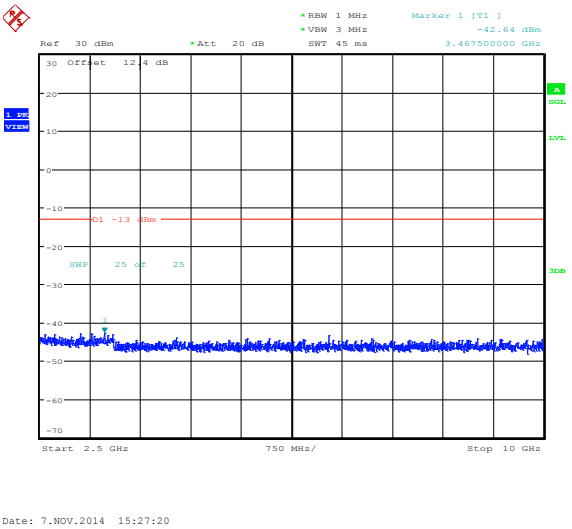
LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-1a: Band 17, Spurious Conducted Emissions, Low channel, 10MHz BW (RB= 1)



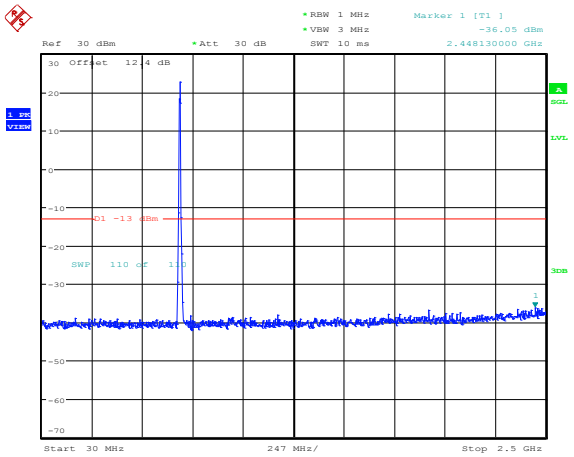
Date: 7.NOV.2014 15:27:15

Figure 6-2a: Band 17, Spurious Conducted Emissions, Low channel, 10MHz BW (RB= 1)



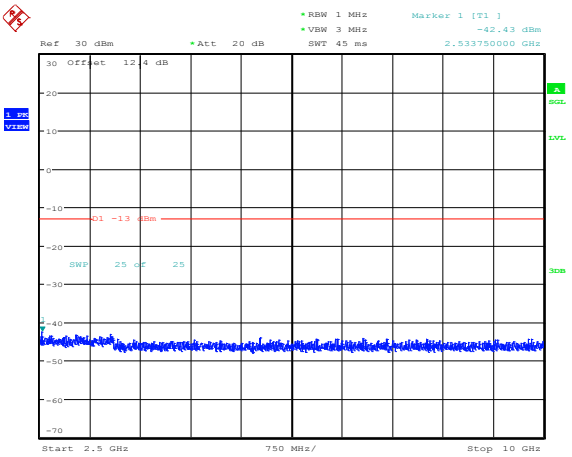
Date: 7.NOV.2014 15:27:20

Figure 6-3a: Band 17, Spurious Conducted Emissions, Middle channel, 10MHz BW (RB= 25)



Date: 7.NOV.2014 15:27:34

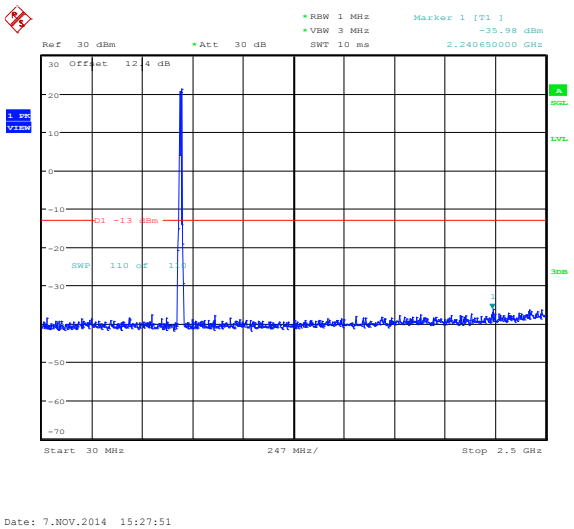
Figure 6-4a: Band 17, Spurious Conducted Emissions, Middle channel, 10MHz BW (RB= 25)



Date: 7.NOV.2014 15:27:39

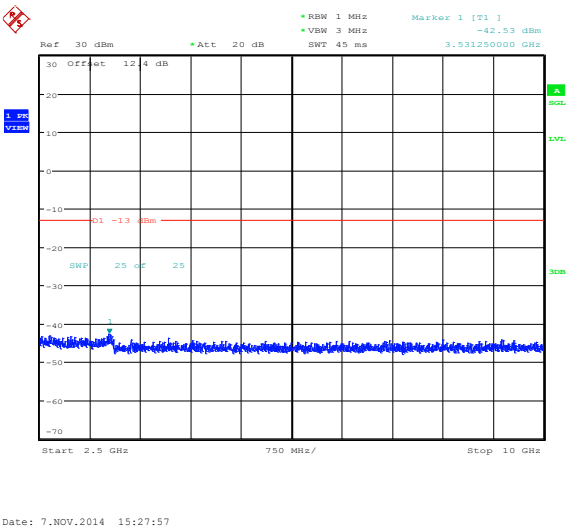
LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-5a: Band 17, Spurious Conducted Emissions, High Channel, 10MHz BW (RB= 50)



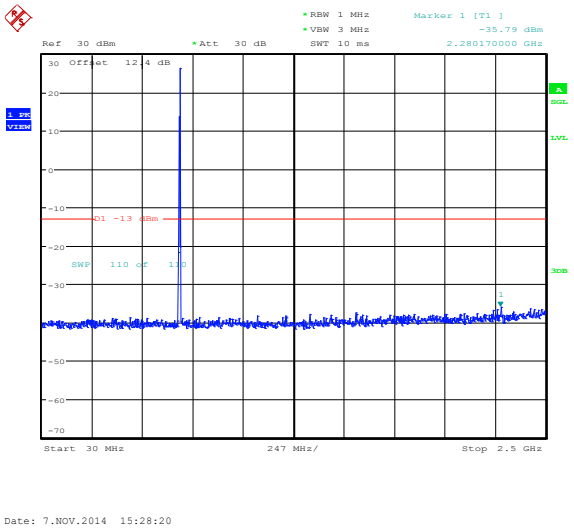
Date: 7.NOV.2014 15:27:51

Figure 6-6a: Band 17, Spurious Conducted Emissions, High Channel, 10MHz BW (RB= 50)



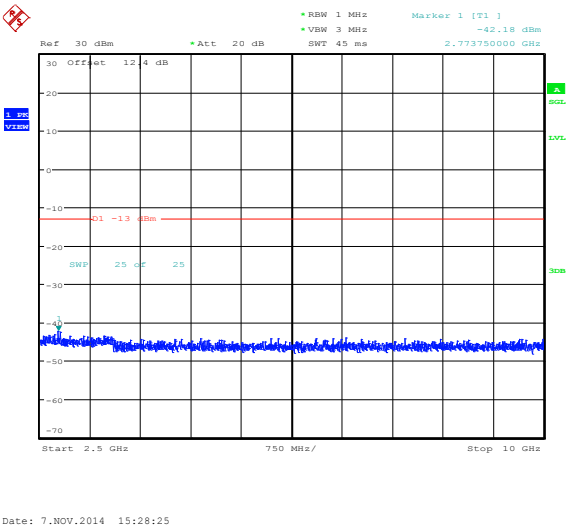
Date: 7.NOV.2014 15:27:57

Figure 6-7a: Band 17, Spurious Conducted Emissions, Low channel, 5MHz BW (RB= 1)



Date: 7.NOV.2014 15:28:20

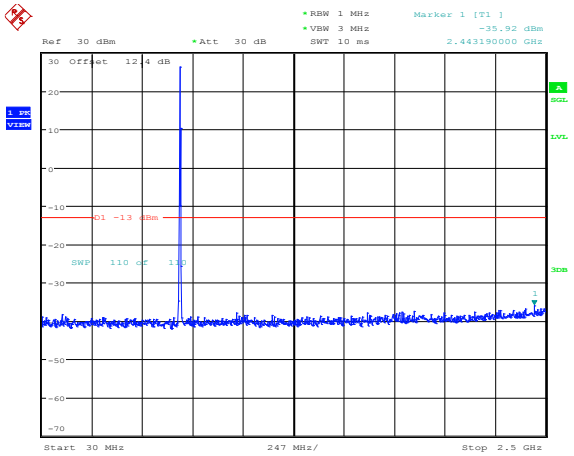
Figure 6-8a: Band 17, Spurious Conducted Emissions, Low channel, 5MHz BW (RB= 1)



Date: 7.NOV.2014 15:28:25

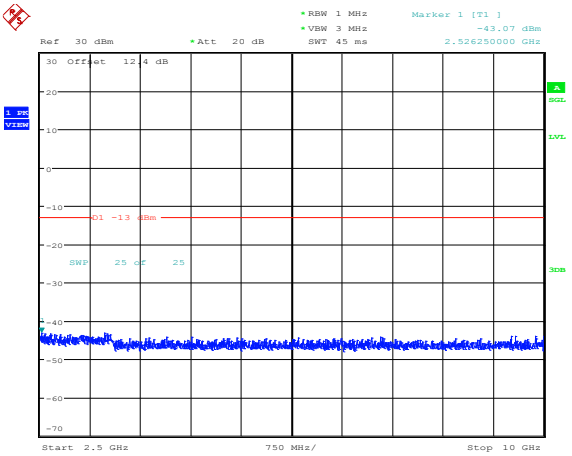
LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-9a: Band 17, Spurious Conducted Emissions, Middle Channel, 5MHz BW (RB= 15)



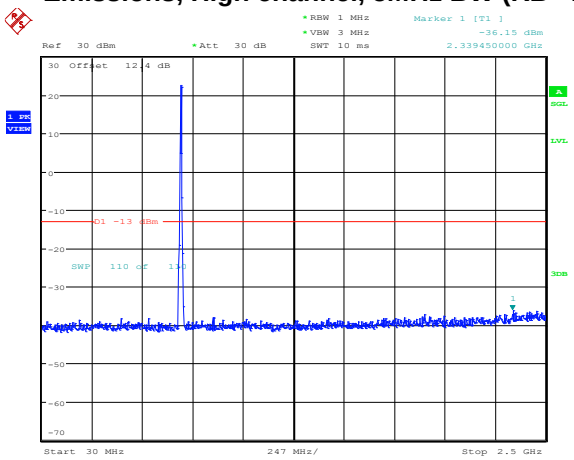
Date: 7.NOV.2014 15:28:37

Figure 6-10a: Band 17, Spurious Conducted Emissions, High Channel, 5MHz BW (RB= 15)



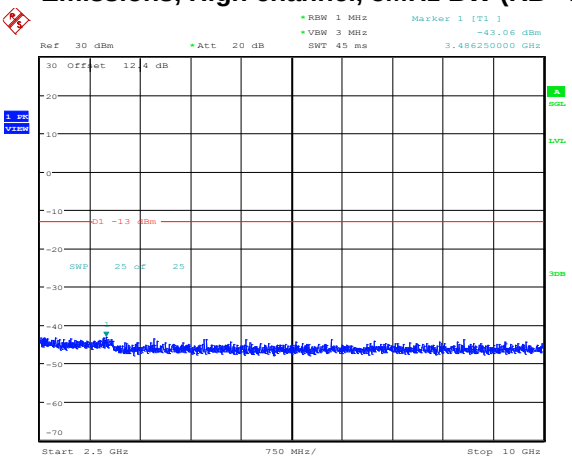
Date: 7.NOV.2014 15:28:42

Figure 6-11a: Band 17, Spurious Conducted Emissions, High channel, 5MHz BW (RB= 25)



Date: 7.NOV.2014 15:28:54

Figure 6-12a: Band 17, Spurious Conducted Emissions, High channel, 5MHz BW (RB= 25)



Date: 7.NOV.2014 15:29:00

LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-13a: Occupied Bandwidth, Band 17 Low Channel, 10MHz BW, RB=50

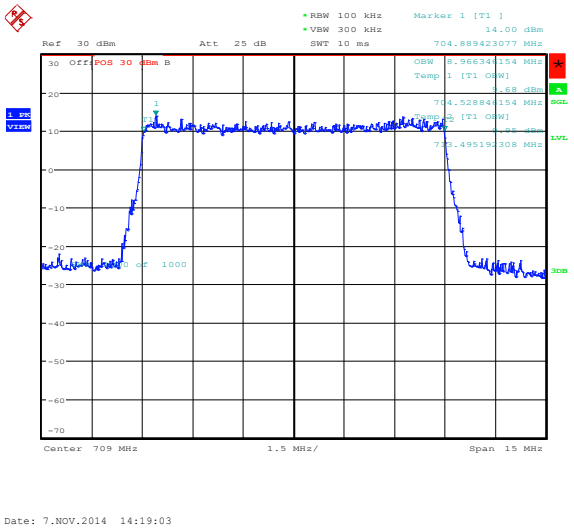


Figure 6-14a: Occupied Bandwidth, Band 17 Middle Channel, 10MHz BW, RB=50

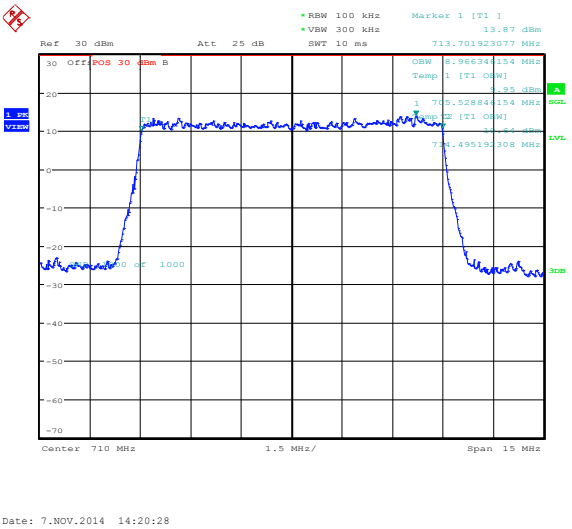
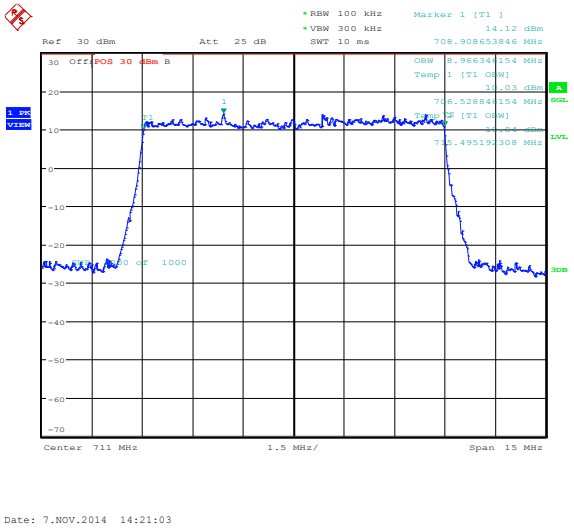


Figure 6-15a: Occupied Bandwidth, Band 17 High Channel, 10MHz BW, RB=50



LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-16a: Occupied Bandwidth, Band 5 Low Channel, 5MHz BW, RB=25

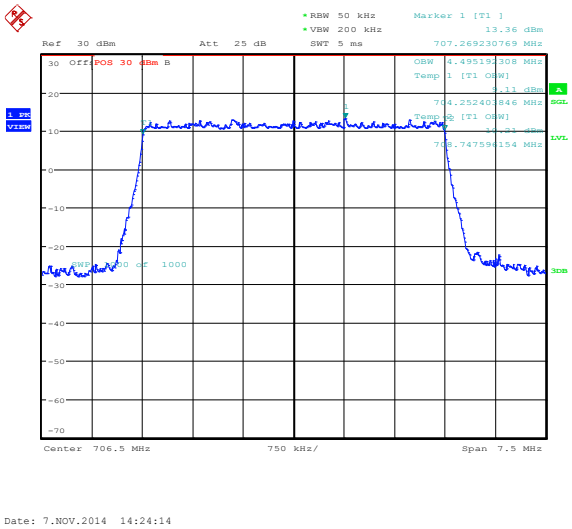


Figure 6-17a: Occupied Bandwidth, Band 5 Middle Channel, 5MHz BW, RB=25

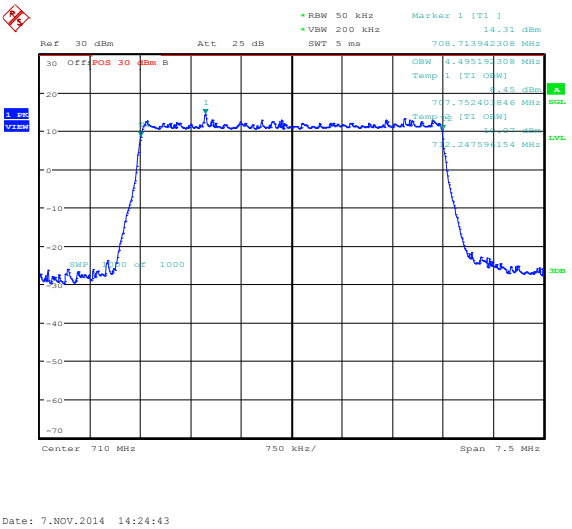
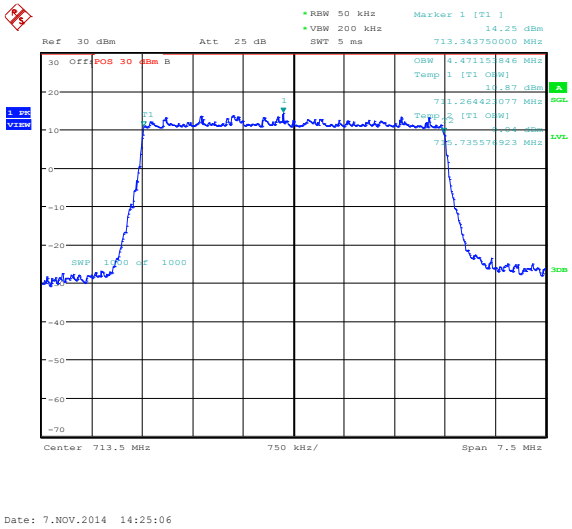


Figure 6-18a: Occupied Bandwidth, Band 5 High Channel, 5MHz BW, RB=25



LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-19a: -26 dBc Bandwidth, Band 17 Low Channel, 10MHz BW, RB=50

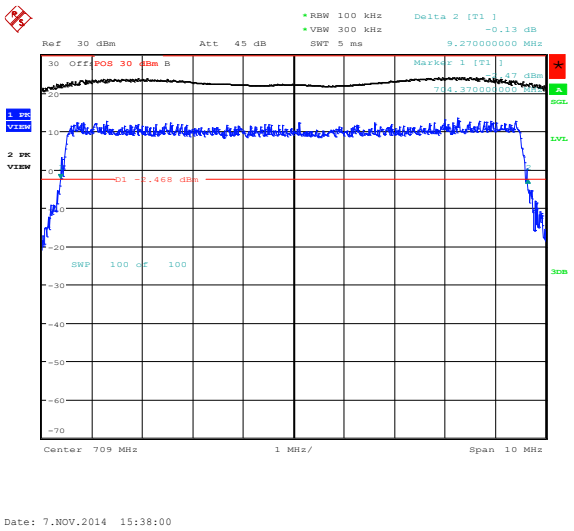


Figure 6-20a: -26 dBc Bandwidth, Band 17 Middle Channel, 10MHz BW, RB=50

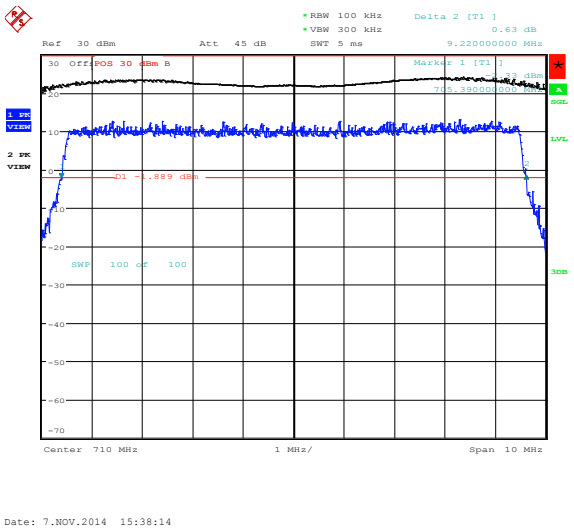


Figure 6-21a: -26 dBc Bandwidth, Band 17 High Channel, 10MHz BW, RB=50

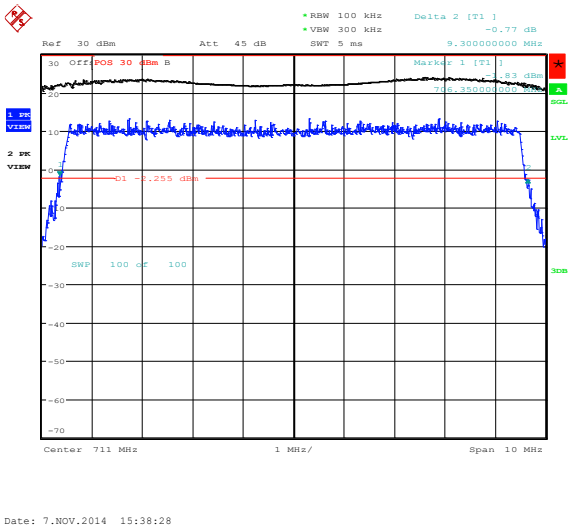
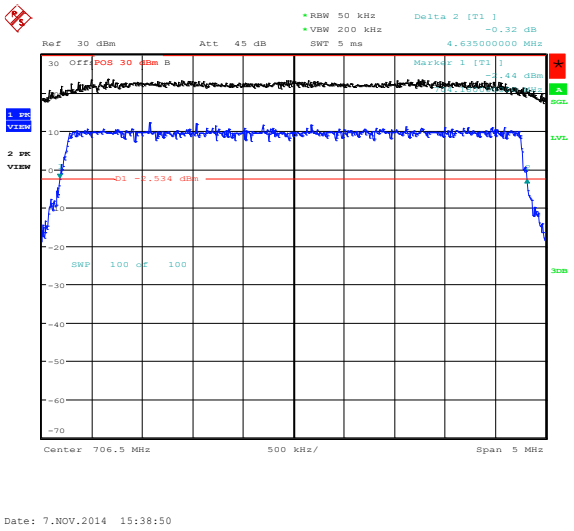


Figure 6-22a: -26 dBc Bandwidth, Band 17 Low Channel, 5MHz BW, RB=25



LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-23a: -26 dBc Bandwidth, Band 17 Middle Channel, 5MHz BW, RB=25

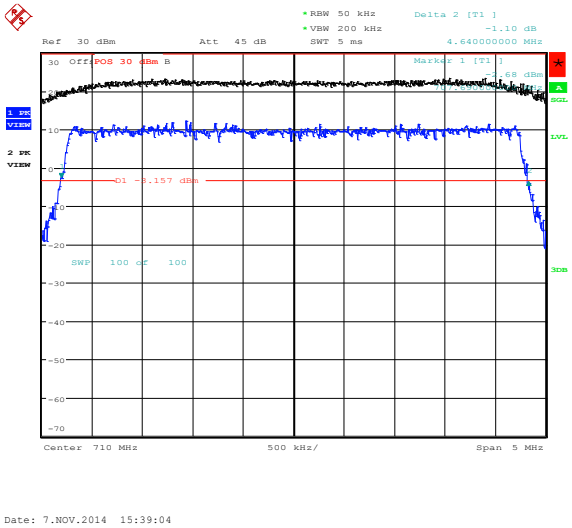


Figure 6-24a: -26 dBc Bandwidth, Band 17 High Channel, 5MHz BW, RB=25

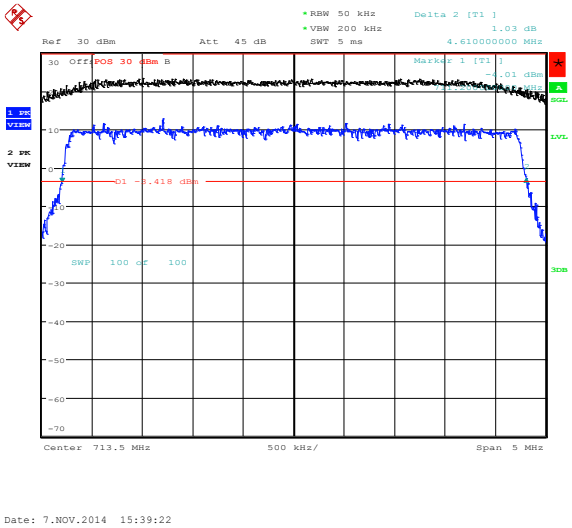


Figure 6-25a: Band 17 Low Channel Mask, 10MHz BW, RB=50

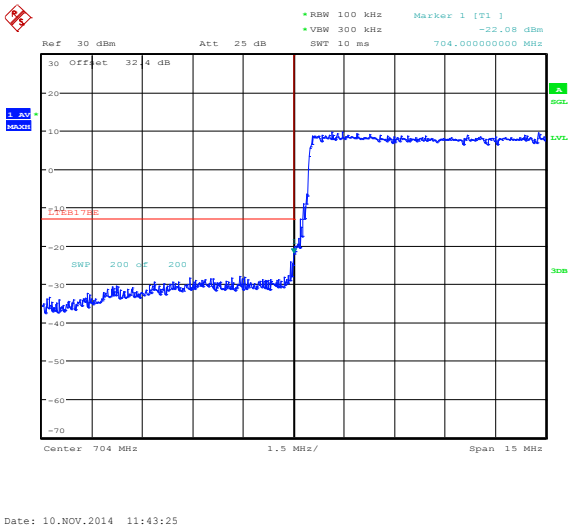
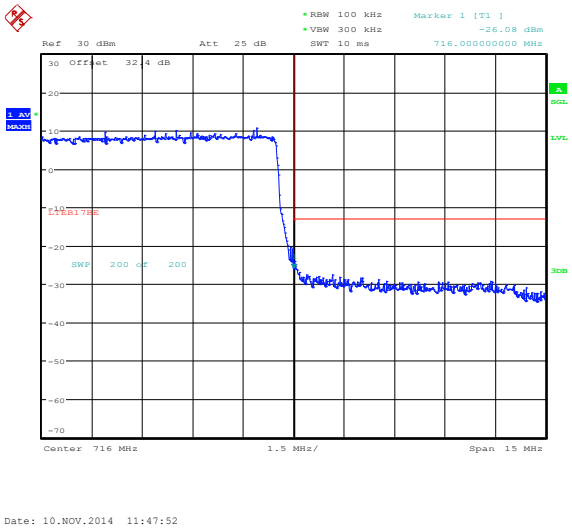


Figure 6-26a: Band 17 High Channel Mask, 10MHz BW, RB=50



LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-27a: Band 17 Low Channel Mask, 10MHz BW, RB=1

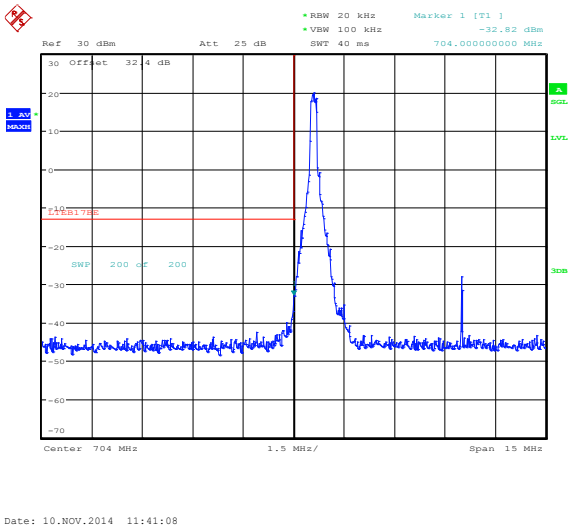


Figure 6-28a: Band 17 High Channel Mask,10MHz BW, RB=1

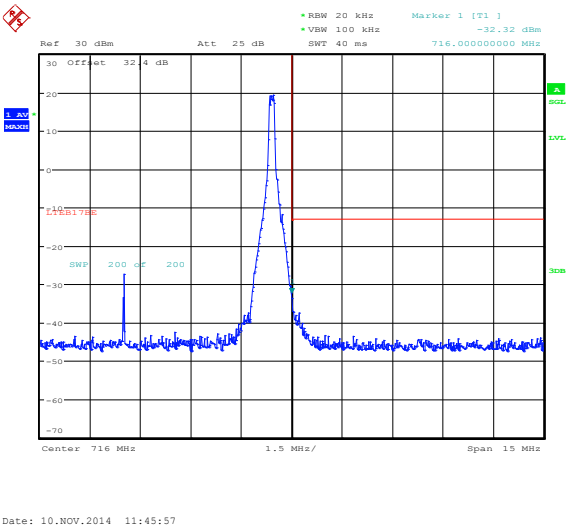


Figure 6-29a: Band 17 Low Channel Mask, 5MHz BW, RB=25

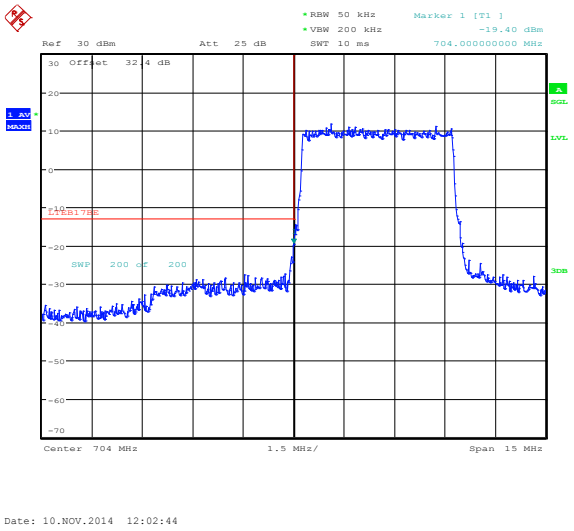
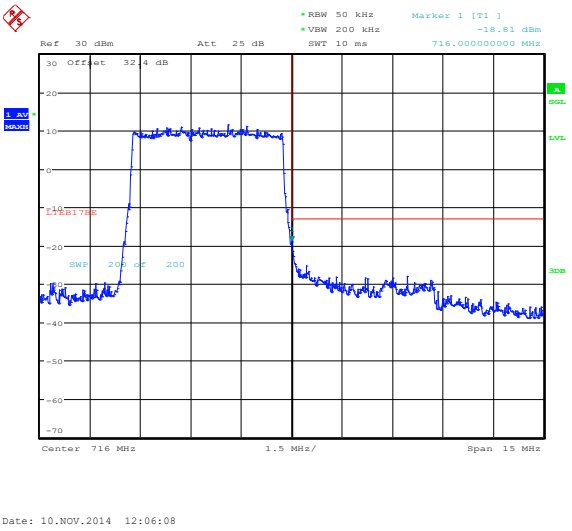


Figure 6-30a: Band 17 High Channel Mask, 5MHz BW, RB=25



LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-31a: Band 17 Low Channel Mask, 5MHz BW, RB=1

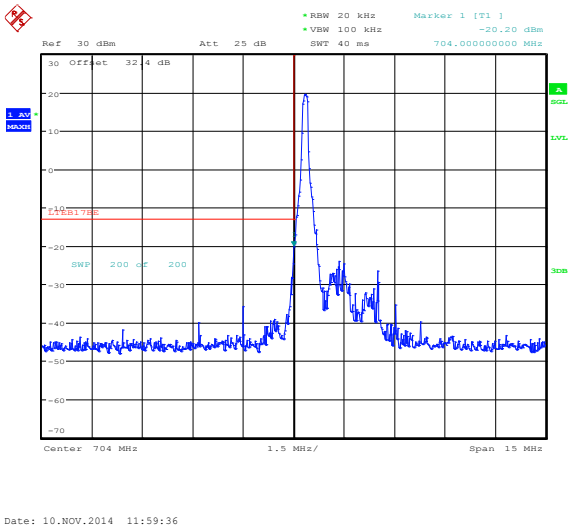


Figure 6-32a: Band 17 High Channel Mask, 5MHz BW, RB=1

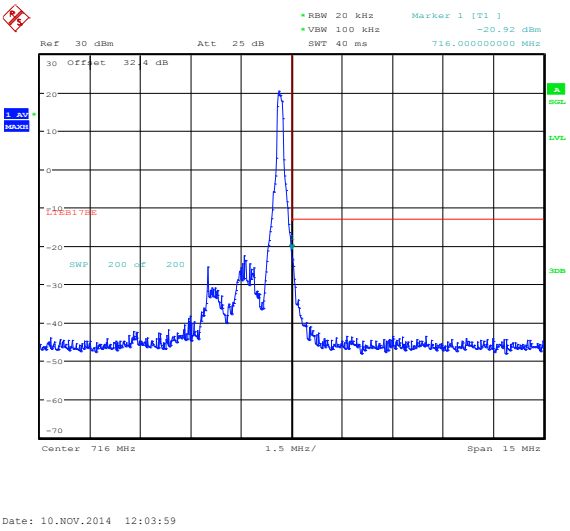


Figure 6-33a: Band 17 Mid Channel PAR, 10MHz BW, RB=25

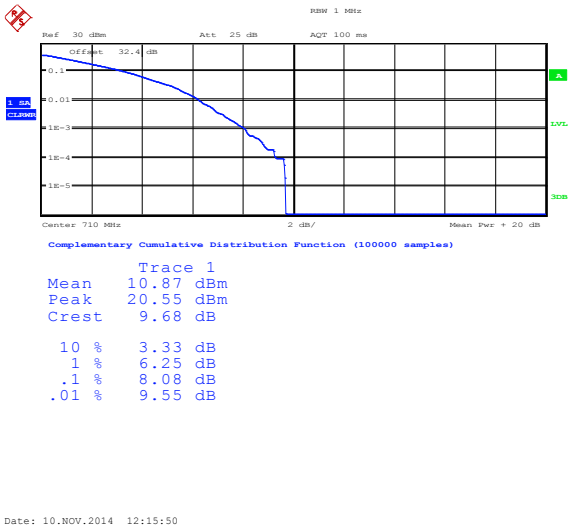
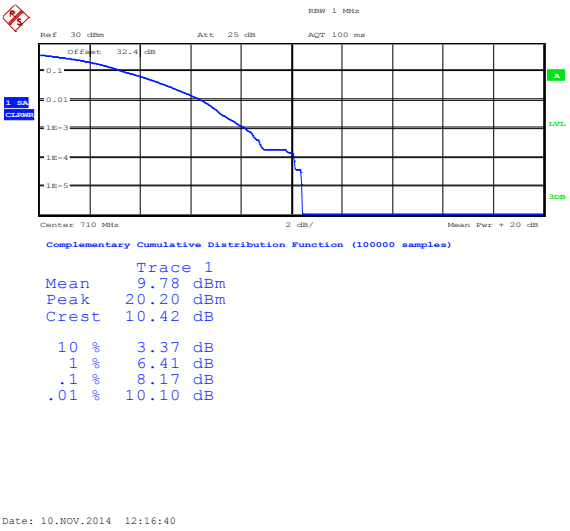


Figure 6-34a: Band 17 Middle Channel PAR, 10MHz BW, RB=50



LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-35a: Band 17 Mid Channel PAR, 5MHz BW, RB=15

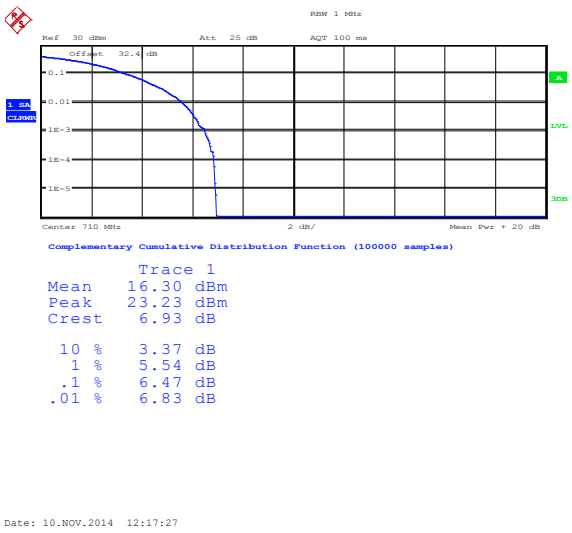
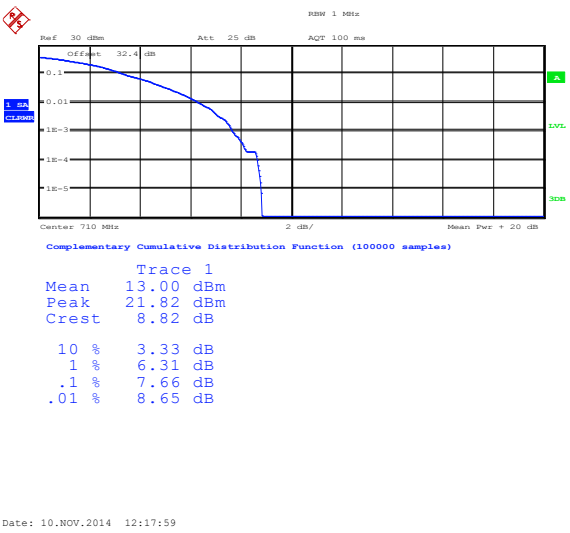
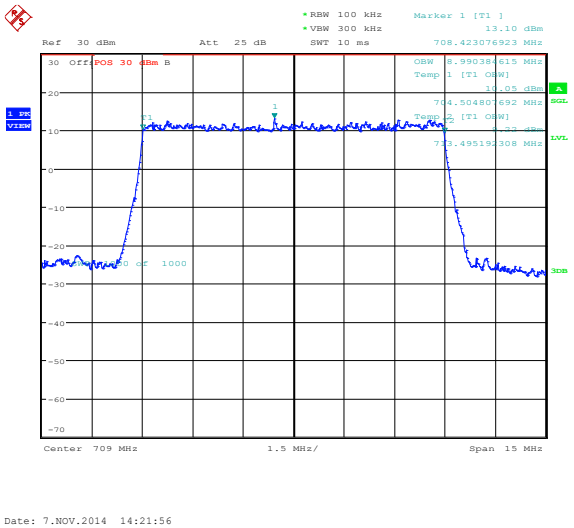


Figure 6-36a: Band 17 Mid Channel PAR, 5MHz BW, RB=25



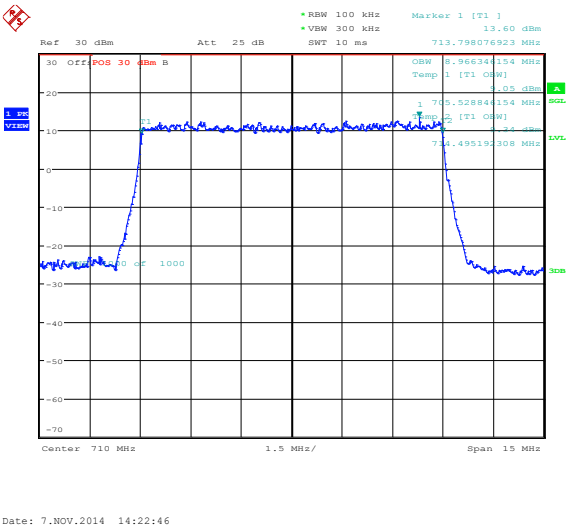
LTE Band 17 Conducted RF Emission Test Data cont'd

Figure 6-37a: Occupied Bandwidth, Band 17 Low Channel, 20MHz BW (RB= 100) 16-QAM



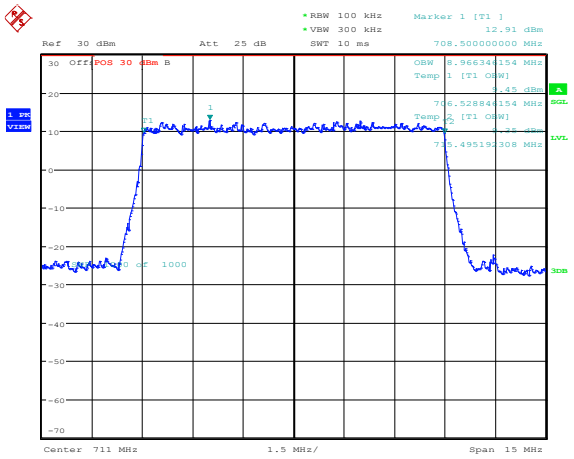
Date: 7.NOV.2014 14:21:56

Figure 6-38a: Occupied Bandwidth, Band 17 Mid Channel, 20MHz BW (RB= 100) 16-QAM



Date: 7.NOV.2014 14:22:46

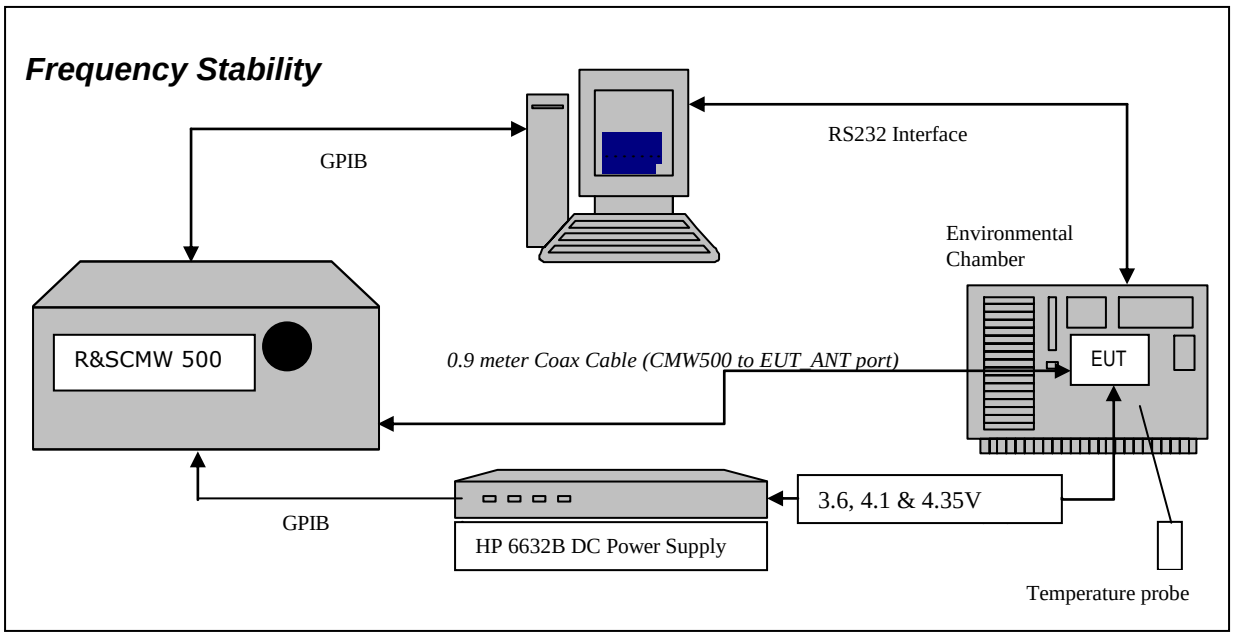
Figure 6-39a: Occupied Bandwidth, Band 17 High Channel, 20MHz BW (RB= 100) 16-QAM



Date: 7.NOV.2014 14:23:20

APPENDIX 6B – LTE Band 17 FREQUENCY STABILITY TEST DATA

LTE Band 17 Frequency Stability Test Data



The following measurements were performed by Sijia Li.

CFR 47 Chapter 1 - Federal Communications Commission Rules

Part 2 Required Measurements
2.1055 Frequency Stability - Procedures
(a,b) Frequency Stability - Temperature Variation
(d) Frequency Stability - Voltage Variation

The EUT meets the requirements as stated in CFR 47 chapter 1, Section 27.54, CFR 47.
Frequency Stability measurement devices were configured as presented in the block diagram recording frequency, power, data, temperatures, and stepped voltages controlled via a GPIB interface linked to the Environmental chamber, a DC power supply, and the Communications Test Set. A 0.9-metre coax cable was calibrated to characterize the insertion loss for the transmitted frequencies between the RF input/output of the CMW 500 and the EUT antenna port.

Test Setup:

The EUT was placed in the Temperature chamber and connected to CMW 500 outside as shown in the figure above. Dry air was pumped inside the temperature chamber to maintain a backpressure during the test. The EUT was kept in the off condition at all times except when the following measurements were to be made.

The chamber was switched on and the temperature was set to -30°C.
After the chamber stabilized at -30 °C there was a soak period of one hour to alleviate moisture in the chamber, the EUT voltage was enabled.
The system software recorded the frequency, power, and associated measurements.

A Computer system controlled the automated software. This application was given the command of activating all machines intrinsic to the temperature and voltage tests controlling the CMW 500 via the GPIB Bus. The Environmental Chamber was instructed through an RS-232 serial line. The EUT dialogue was passed through a serial connection.

The EUT repetitively transmitted 100 bursts for each set of programmed parameters recording temperature, voltage settings, and systematically selected frequencies. The power supply was cycled from minimum voltage 3.6 volts, to 4.1 volts and to 4.35 volts maximum voltage. The frequency error was measured at a maximum output power and recorded by the automated system test software.

The EUT output power and frequency was measured at 3.6 volts, 4.1 volts and 4.35 volts. The transmit frequency was varied in 3 steps consisting of 709.0 MHz, 710.0 MHz and 711.0 MHz each was measured under 10 MHz bandwidth with maximum (50) RBs. This frequency was recorded in MHz and deviation from nominal, in Parts Per Million.

After the initial one-hour soak at the beginning of the tests, a period of thirty minutes soak was initialized between each ascending temperature step, before proceeding to the next measurement test cycle.

Procedure:

The test system software for commencing the Frequency Stability Tests carried through the following cycle.

43. Switch on the HP 6632B power supply; CMW 500 Communications test Set, and Environmental Chamber.
44. Start test program
45. Set the Temperature to –30°C and maintain a period of one- hour soak time, with the EUT supply voltage disabled.
46. Set power supply voltage to 3.6 volts.
47. Set up CMW 500 Radio Communication Tester.
48. Command the CMW 500 to switch to the low channel.
49. Enable the voltage to the EUT, and connect a link to the CMW 500 test set.
50. EUT is commanded to Transmit 100 Bursts.
51. Software logs the following data from the CMW 500, power supply and temperature chamber: Traffic Channel Number, Traffic Channel Frequency, Power Level, Chamber Temperature, Supply Voltage, Power and Frequency Error.
52. The CMW 500 commands the EUT to change frequency to the middle channel and high channel and repeats steps 7 to 9.
53. Repeat steps 5 to 10 changing the supply voltage to 4.1 Volts
54. Increase temperature by 10°C and soak for 1/2 hour.
55. Repeat steps 4 - 12 for temperatures –30°C to 60°C.
56. Repeat steps 5 to 10 changing the supply voltage to 4.35 volts

Procedure 5 to 10 was repeated at room temperature (20°C) with the power supply voltage set to 3.6, 4.1 and 4.35 volts

The maximum frequency error in the LTE band 17 measured was **0.0087PPM**.

LTE Band 17 results: channels 23780, 23790 and 23800 @ 20°C maximum transmitted power

Traffic Channel Number	LTE Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
23780	709.0	3.6	20	-3.35	-0.0047
23790	710.0	3.6	20	-1.52	-0.0021
23800	711.0	3.6	20	-2.92	-0.0041

Traffic Channel Number	LTE Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
23780	709.0	4.1	20	-3.48	-0.0049
23790	710.0	4.1	20	3.68	0.0052
23800	711.0	4.1	20	3.40	0.0048

Traffic Channel Number	LTE Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
23780	709.0	4.35	20	-2.40	-0.0034
23790	710.0	4.35	20	3.68	0.0052
23800	711.0	4.35	20	2.75	0.0039

LTE band 17 Results: channel 23780 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
23780	709.0	3.6	-30	-2.76	-0.0039
23780	709.0	3.6	-20	-2.60	-0.0037
23780	709.0	3.6	-10	4.42	0.0062
23780	709.0	3.6	0	-3.02	-0.0043
23780	709.0	3.6	10	-2.40	-0.0034
23780	709.0	3.6	20	-3.35	-0.0047
23780	709.0	3.6	30	-2.98	-0.0042
23780	709.0	3.6	40	-4.35	-0.0061
23780	709.0	3.6	50	-3.85	-0.0054
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
23780	709.0	4.1	-30	-2.37	-0.0033
23780	709.0	4.1	-20	-1.83	-0.0026
23780	709.0	4.1	-10	3.28	0.0046
23780	709.0	4.1	0	-3.73	-0.0053
23780	709.0	4.1	10	-2.56	-0.0036
23780	709.0	4.1	20	-3.48	-0.0049
23780	709.0	4.1	30	-3.49	-0.0049
23780	709.0	4.1	40	-2.83	-0.0040
23780	709.0	4.1	50	-2.12	-0.0030
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
23780	709.0	4.35	-30	2.65	0.0037
23780	709.0	4.35	-20	-3.45	-0.0049
23780	709.0	4.35	-10	2.70	0.0038
23780	709.0	4.35	0	2.83	0.0040
23780	709.0	4.35	10	-2.29	-0.0032
23780	709.0	4.35	20	-2.40	-0.0034
23780	709.0	4.35	30	-2.43	-0.0034
23780	709.0	4.35	40	-4.42	-0.0062
23780	709.0	4.35	50	-3.29	-0.0046

LTE band 5 Results: channel 23790 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
23790	710.0	3.6	-30	**6.15**	**0.0087**
23790	710.0	3.6	-20	1.93	0.0027
23790	710.0	3.6	-10	2.95	0.0042
23790	710.0	3.6	0	3.50	0.0049
23790	710.0	3.6	10	3.40	0.0048
23790	710.0	3.6	20	-1.52	-0.0021
23790	710.0	3.6	30	-2.50	-0.0035
23790	710.0	3.6	40	-2.50	-0.0035
23790	710.0	3.6	50	1.86	0.0026
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
23790	710.0	4.1	-30	3.23	0.0046
23790	710.0	4.1	-20	2.19	0.0031
23790	710.0	4.1	-10	2.06	0.0029
23790	710.0	4.1	0	3.58	0.0050
23790	710.0	4.1	10	-2.37	-0.0033
23790	710.0	4.1	20	3.68	0.0052
23790	710.0	4.1	30	-2.62	-0.0037
23790	710.0	4.1	40	1.95	0.0027
23790	710.0	4.1	50	2.65	0.0037
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
23790	710.0	4.35	-30	3.36	0.0047
23790	710.0	4.35	-20	4.38	0.0062
23790	710.0	4.35	-10	2.16	0.0030
23790	710.0	4.35	0	2.16	0.0030
23790	710.0	4.35	10	3.60	0.0051
23790	710.0	4.35	20	3.68	0.0052
23790	710.0	4.35	30	2.50	0.0035
23790	710.0	4.35	40	2.55	0.0036
23790	710.0	4.35	50	-1.69	-0.0024

LTE band 17 Results: channel 23800 @ maximum transmitted power

Traffic Channel Number	Frequency (MHz)	Voltage (Volts)	Temperature (Celsius)	Frequency Error (Hz)	PPM
23800	711.0	3.6	-30	-3.15	-0.0044
23800	711.0	3.6	-20	2.37	0.0033
23800	711.0	3.6	-10	4.02	0.0057
23800	711.0	3.6	0	1.85	0.0026
23800	711.0	3.6	10	-3.62	-0.0051
23800	711.0	3.6	20	-2.92	-0.0041
23800	711.0	3.6	30	-4.55	-0.0064
23800	711.0	3.6	40	-3.48	-0.0049
23800	711.0	3.6	50	3.18	0.0045
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
23800	711.0	4.1	-30	1.54	0.0022
23800	711.0	4.1	-20	3.68	0.0052
23800	711.0	4.1	-10	-2.20	-0.0031
23800	711.0	4.1	0	4.65	0.0065
23800	711.0	4.1	10	2.69	0.0038
23800	711.0	4.1	20	3.40	0.0048
23800	711.0	4.1	30	-2.63	-0.0037
23800	711.0	4.1	40	1.92	0.0027
23800	711.0	4.1	50	-1.85	-0.0026
Traffic Channel Number	**Frequency (MHz)**	**Voltage (Volts)**	**Temperature (Celsius)**	**Frequency Error (Hz)**	**PPM**
23800	711.0	4.35	-30	-2.60	-0.0037
23800	711.0	4.35	-20	3.05	0.0043
23800	711.0	4.35	-10	3.56	0.0050
23800	711.0	4.35	0	2.69	0.0038
23800	711.0	4.35	10	2.20	0.0031
23800	711.0	4.35	20	2.75	0.0039
23800	711.0	4.35	30	-3.56	-0.0050
23800	711.0	4.35	40	-4.52	-0.0064
23800	711.0	4.35	50	-3.82	-0.0054

APPENDIX 6C – LTE Band 17 RADIATED EMISSIONS TEST DATA

Radiated Power Test Data Results

Date of Test: November 11, 2014
The following measurements were performed by Shiva Kumbham.
The environmental tests conditions were: Temperature: 25.0 °C
Relative Humidity: 29.5 %

The BlackBerry® smartphone was standalone, vertically with LCD facing the RX antenna when the turntable is at 0 degree position.
Measurements were performed with QPSK and 16QAM modulations. The smallest test margins are reported below.
Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height.

LTE band 17, 10MHz BW, RB=1, QPSK modulation

EUT				Rx Antenna		Spectrum Analyzer		Substitution Method / Tracking Generator					
Type	Ch	Frequency (MHz)	Band	Type	Pol.	Reading (dBm)	Max (V,H) (dBm)	Pol. Tx-Rx	Reading (dBm)	Corrected Reading (relative to Dipole) (dBm)	Corrected Reading (relative to Dipole) (W)	Limit (dBm)	Diff. To Limit (dB)
F0	23780	709.00	17	Dipole	V	-43.37	-31.03	V-V	4.26	22.55	0.18	35.00	12.45
F0	23780	709.00	17	Dipole	H	-31.03		H-H	-0.24				
F0	23790	710.00	17	Dipole	V	-43.19	-30.70	V-V	4.51	**22.83**	0.19	35.00	12.17
F0	23790	710.00	17	Dipole	H	-30.70		H-H	-0.14				
F0	23799	710.90	17	Dipole	V	-43.95	-30.92	V-V	4.12	22.38	0.17	35.00	12.62
F0	23799	710.90	17	Dipole	H	-30.92		H-H	-0.53				

LTE band 17, 10MHz BW, RB=1, 16-QAM modulation

EUT				Rx Antenna		Spectrum Analyzer		Substitution Method / Tracking Generator					
Type	Ch	Frequency (MHz)	Band	Type	Pol.	Reading (dBm)	Max (V,H) (dBm)	Pol. Tx-Rx	Reading (dBm)	Corrected Reading (relative to Dipole) (dBm)	Corrected Reading (relative to Dipole) (W)	Limit (dBm)	Diff. To Limit (dB)
F0	23780	709.00	17	Dipole	V	-43.11	-30.77	V-V	4.47	**22.76**	0.19	35.0	12.24
F0	23780	709.00	17	Dipole	H	-30.77		H-H	0.04				
F0	23790	710.00	17	Dipole	V	-43.55	-30.93	V-V	4.28	22.60	0.18	35.0	12.40
F0	23790	710.00	17	Dipole	H	-30.93		H-H	-0.38				
F0	23799	710.90	17	Dipole	V	-44.00	-30.92	V-V	4.12	22.38	0.17	35.0	12.62
F0	23799	710.90	17	Dipole	H	-30.92		H-H	-0.53				

Radiated Emissions Test Data Results cont'd

The following measurements were performed by Savtej Sandhu.

Date of Test: November 12, 2014

The environmental test conditions were: Temperature: 25.7 ºC
Relative Humidity: 17.9 %

The BlackBerry® smartphone was standalone, vertically with LCD facing the RX antenna when the turntable is at 0 degree position.

Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height, and the frequency range scanned was 30MHz – 1GHz.

Measurements were performed in LTE band 17 with QPSK and 16-QAM modulations for 10MHz BW (channel 23780, 23790, 23800 with RB = 1).

All emissions were at least 25.0 dB below the limit.

The following measurements were performed by Kevin Guo

Date of Test: November 7-11, 2014

The environmental test conditions were: Temperature: 23.6 – 25.7 ºC
Relative Humidity: 17.2 – 19.8 %

Test Distance was 3.0 meters with the RX antenna height scans between 1-4 meters height, and a frequency range of 1 GHz to 10 GHz.

The BlackBerry® smartphone was standalone, horizontally with LCD facing up and the top pointing to the RX antenna when the turntable is at 0 degree position

Measurements were performed in LTE band 17 with QPSK and 16-QAM modulations for 10MHz BW (channel 23780, 23790, 23800 with RB = 1).

All emissions were at least 25.0 dB below the limit.