9. SPURIOUS EMISSION

9.1 CONDUCTED SPURIOUS EMISSION

9.1.1 MEASUREMENT METHOD

The following steps outline the procedure used to measure the conducted emissions from the EUT.

1. The level of the carrier and the various conducted spurious and harmonic frequency is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10^{th} harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the approximate frequencies. All data rates were investigated to determine the worst case configuration.

2. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the equipment of PCS1900 band, this equates to a frequency range of 30 MHz to 19.1 GHz, data taken from 30 MHz to 20 GHz. For GSM 850, data taken from 30 MHz to 9 GHz.

3. Determine EUT transmit frequencies: the following typical channels were chosen to conducted emissions testing.

Typical Channels for testing of GSM 850	
Channel	Frequency (MHz)
128	824.2
190	836.6
251	848.8

Typical Channels for testing of PCS 1900	
Channel	Frequency (MHz)
512	1850.2
661	1880.0
810	1909.8

Typical Channels for testing of UMTS band II	
Channel	Frequency (MHz)
9663	1852.6
9800	1880
9937	1907.4

Typical Channels for testing of UMTS band V	
Channel	Frequency (MHz)
4358	826.6
4407	836.4
4457	846.4

9.1.2 PROVISIONS APPLICABLE

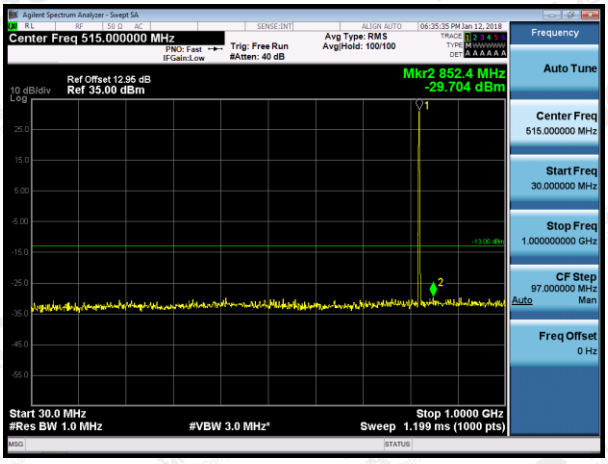
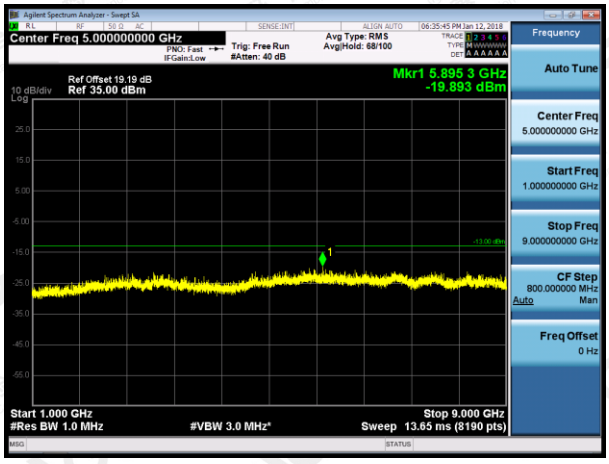
On any frequency outside frequency band of the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log(P) dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

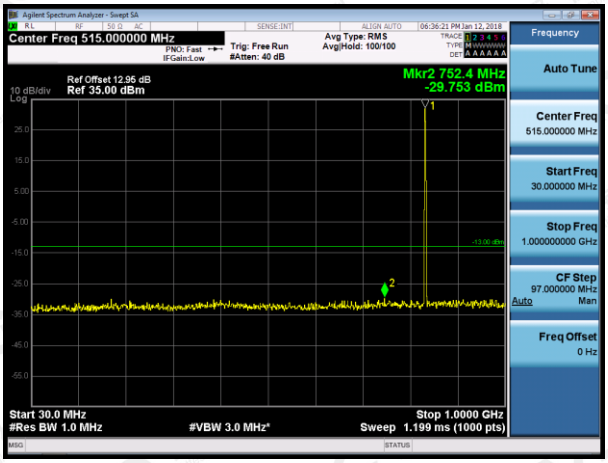
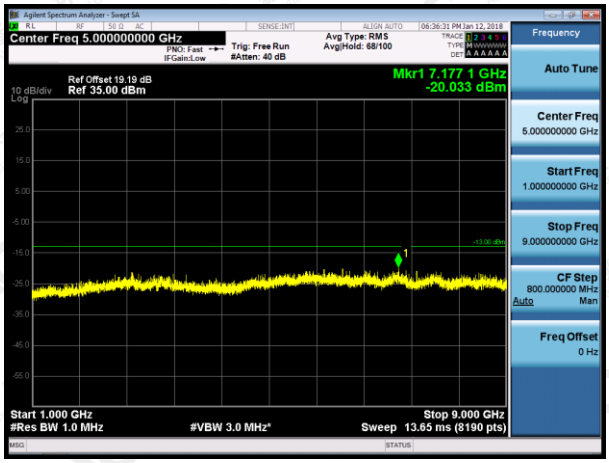
9.1.3 MEASUREMENT RESULT

Test Results

Test Band=GSM850/GSM1900

Test Mode=GSM

GSM 850-LCH-GSM	GSM 850-LCH-GSM
	

GSM 850-MCH-GSM	GSM 850-MCH-GSM
	

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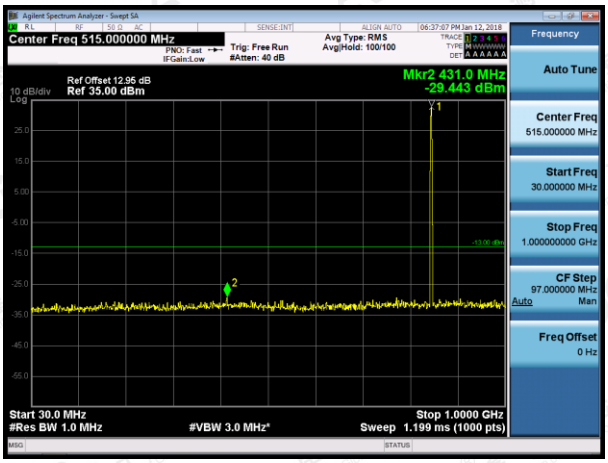	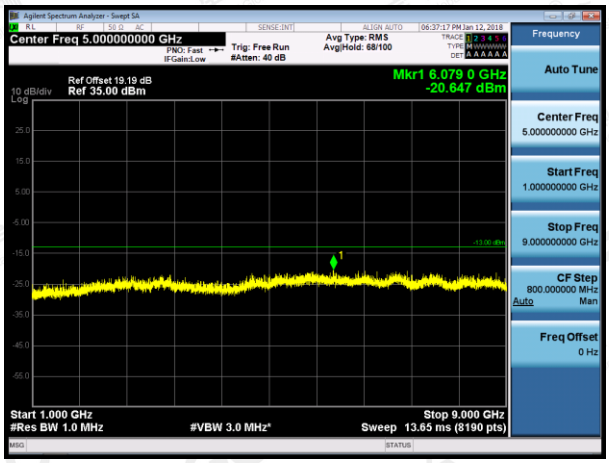

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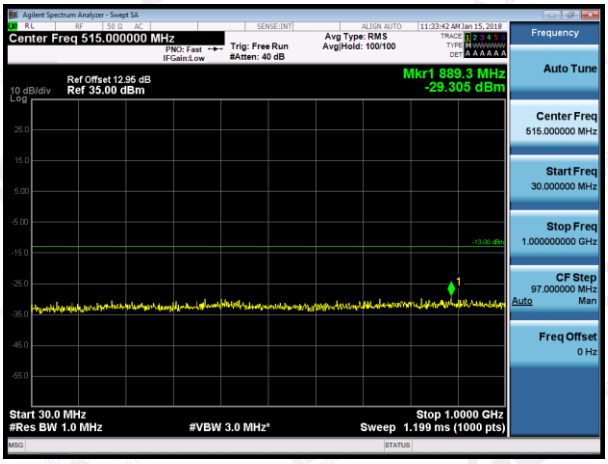	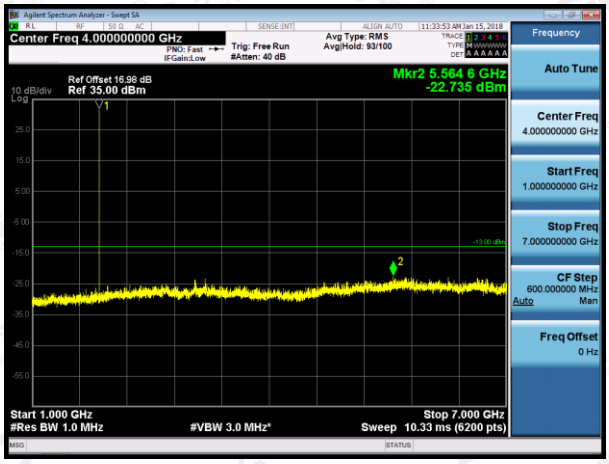

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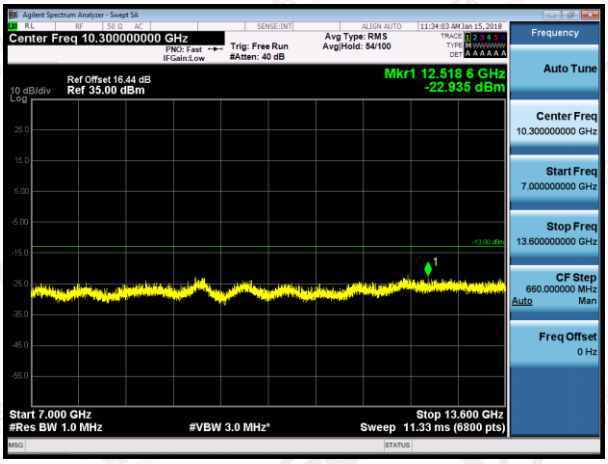	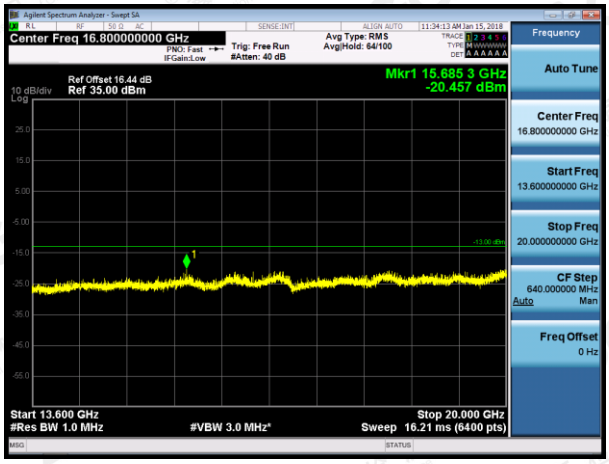

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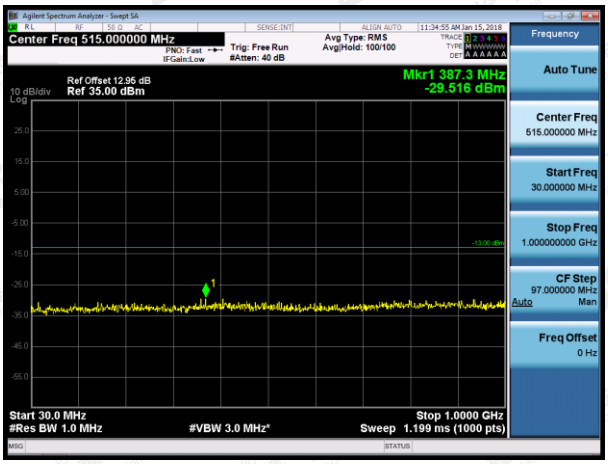	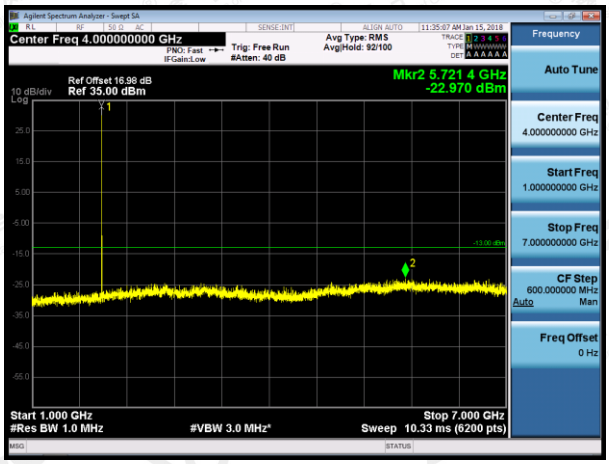

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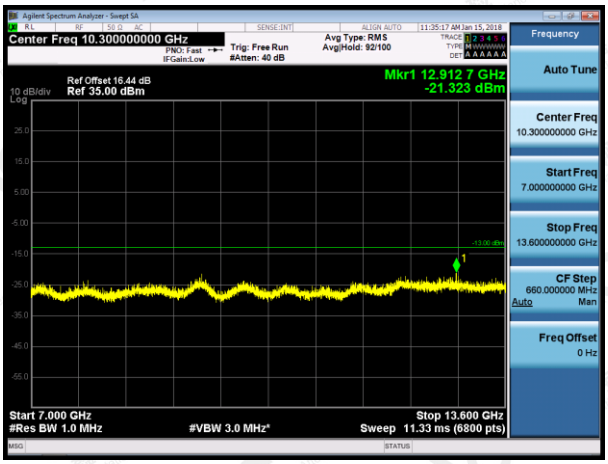
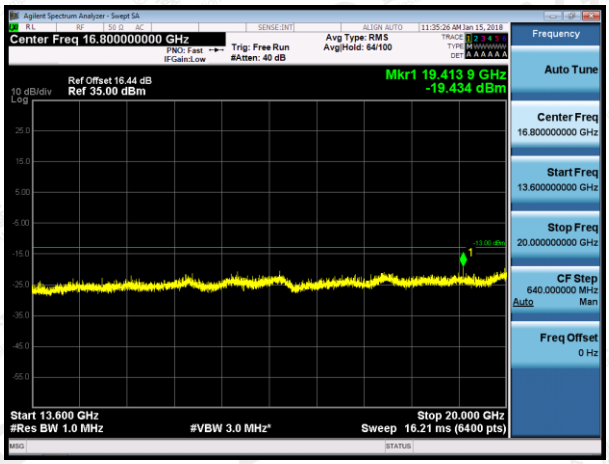
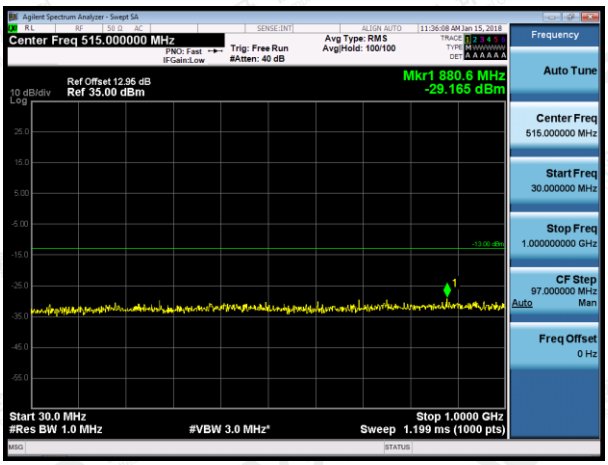
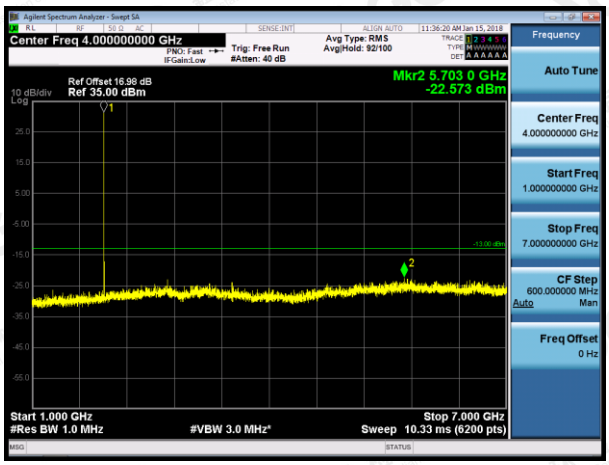
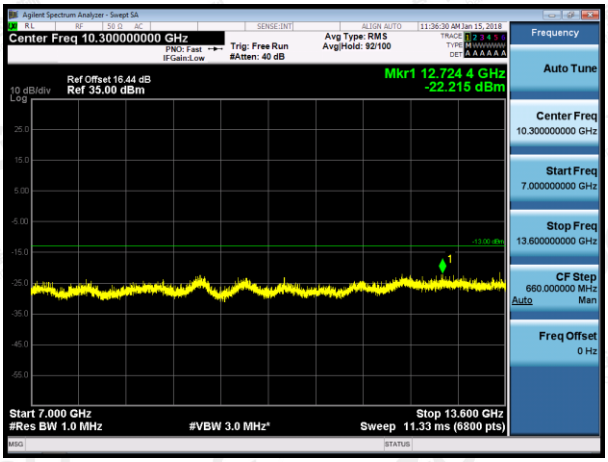
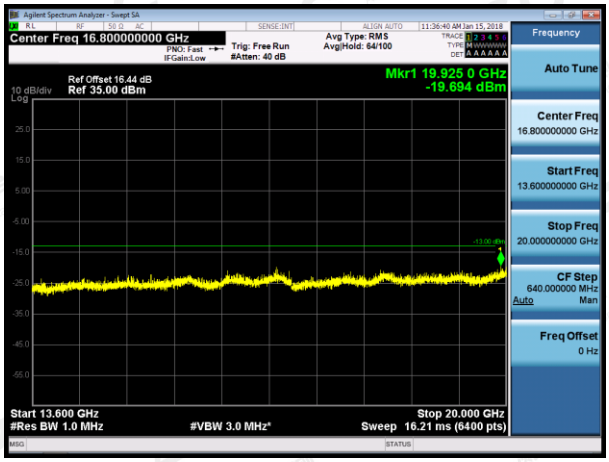
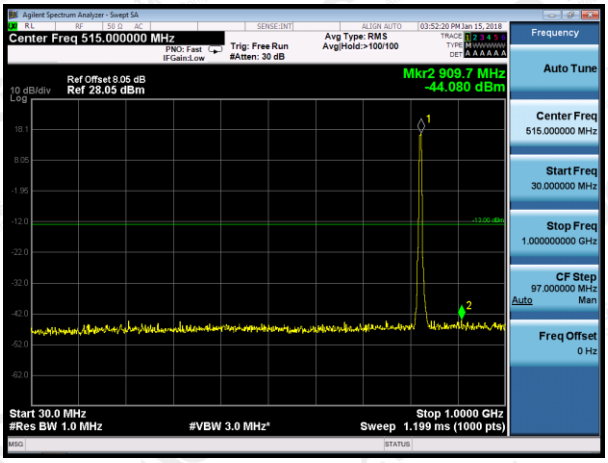
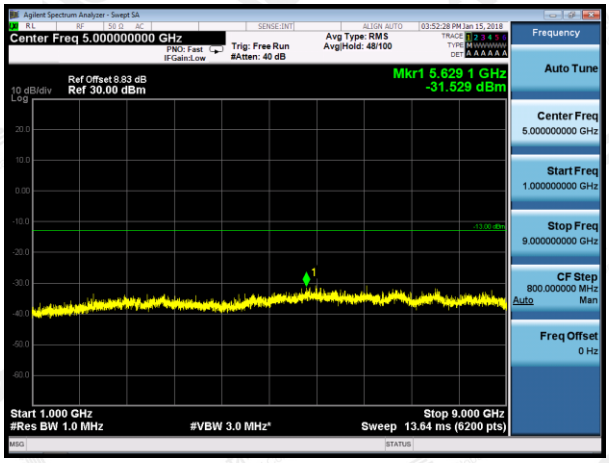
	

GSM 1900-HCH-GSM	GSM 1900-HCH-GSM
	

GSM 1900-HCH-GSM	GSM 1900-HCH-GSM
	

Test Band=WCDMA850 /WCDMA1900

Test Mode=UMTS

WCDMA 850-LCH	WCDMA 850-LCH
	

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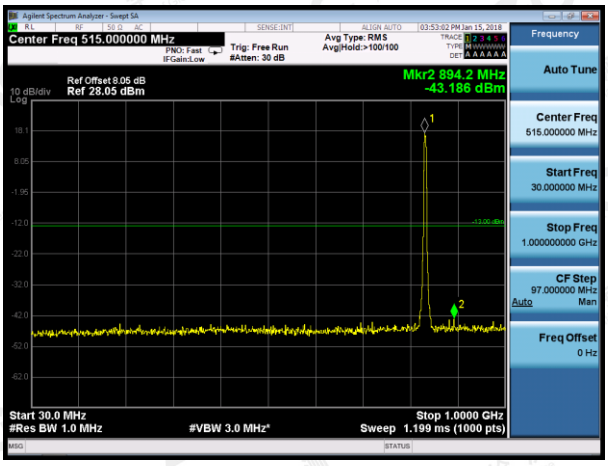	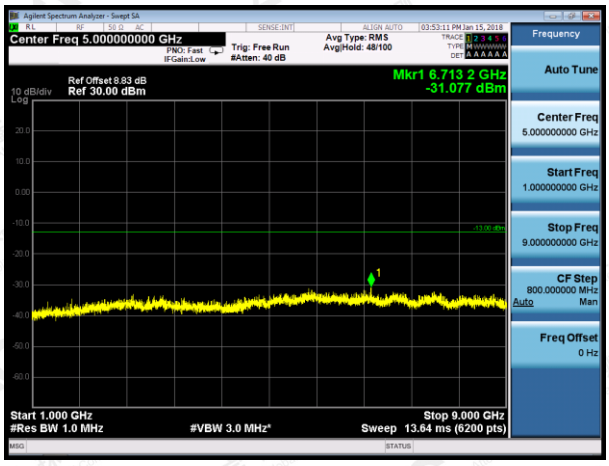

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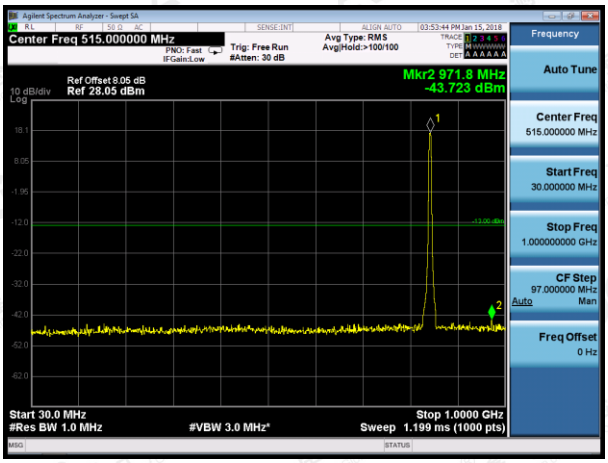	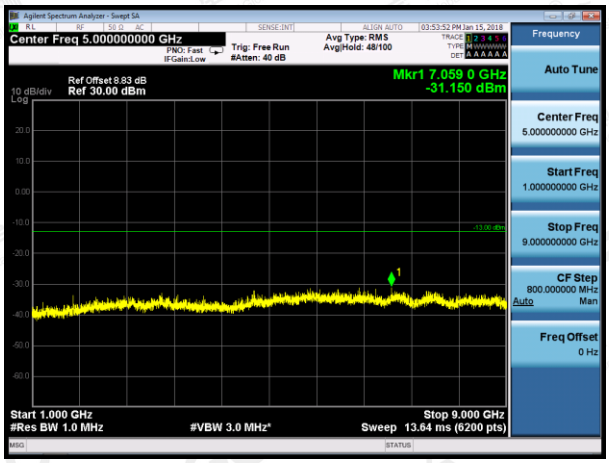

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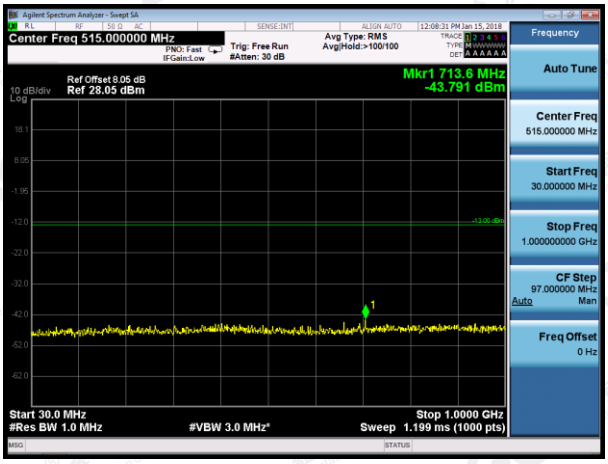	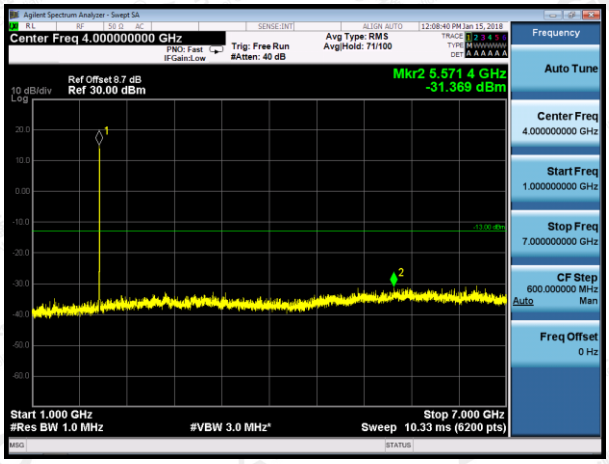

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	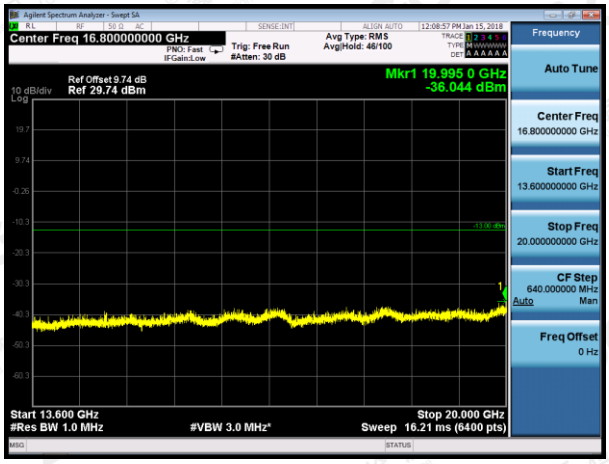

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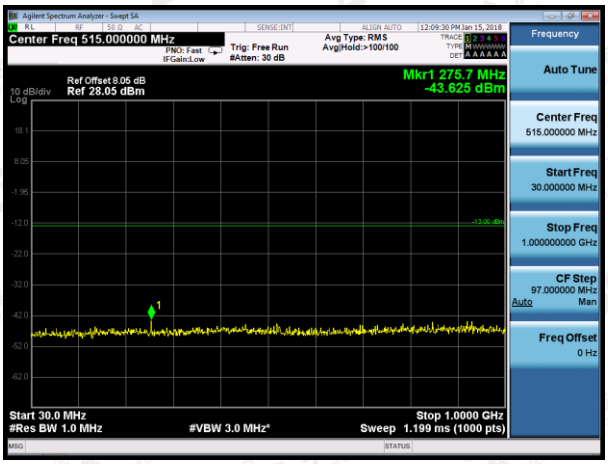
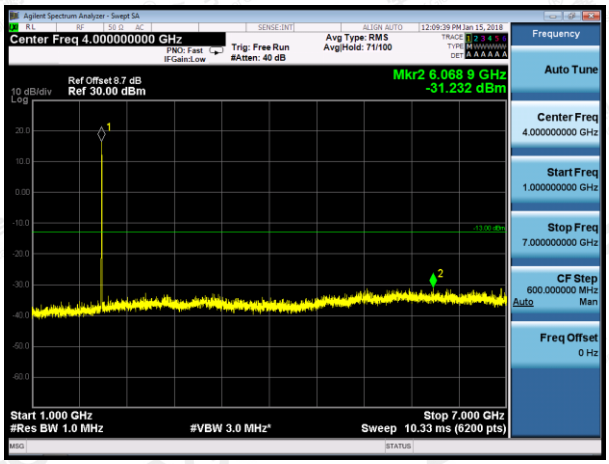
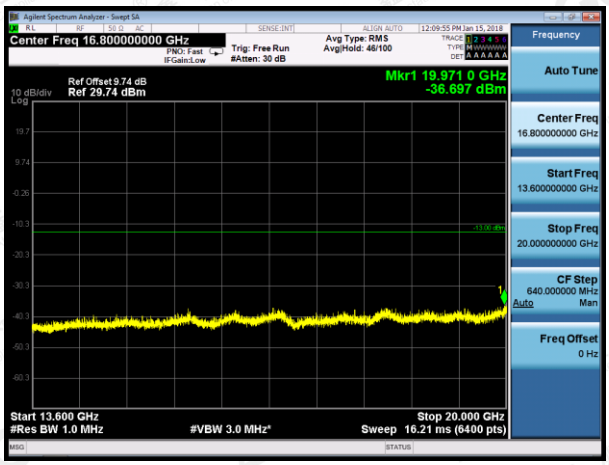
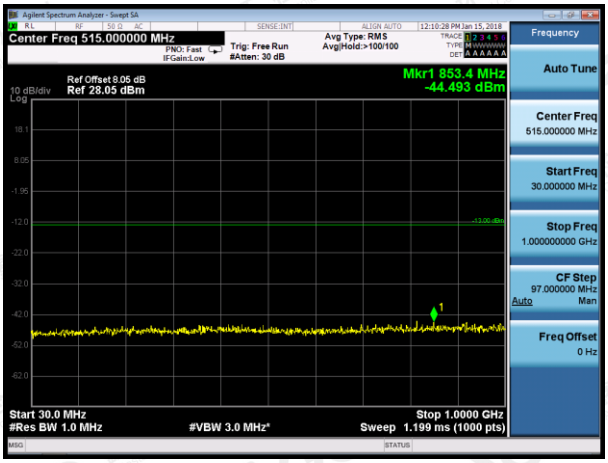
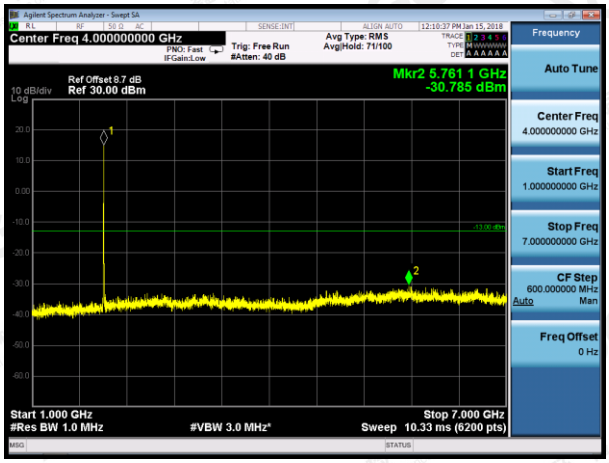
	

WCDMA 1900-MCH	WCDMA 1900-MCH
	

WCDMA 1900-HCH	WCDMA 1900-HCH
	

WCDMA 1900-HCH	WCDMA 1900-HCH
	

Note: 1. Below 30MHZ no Spurious found and Above is the worst mode data.

2. As no emission found in standby or receive mode, no recording in this report.

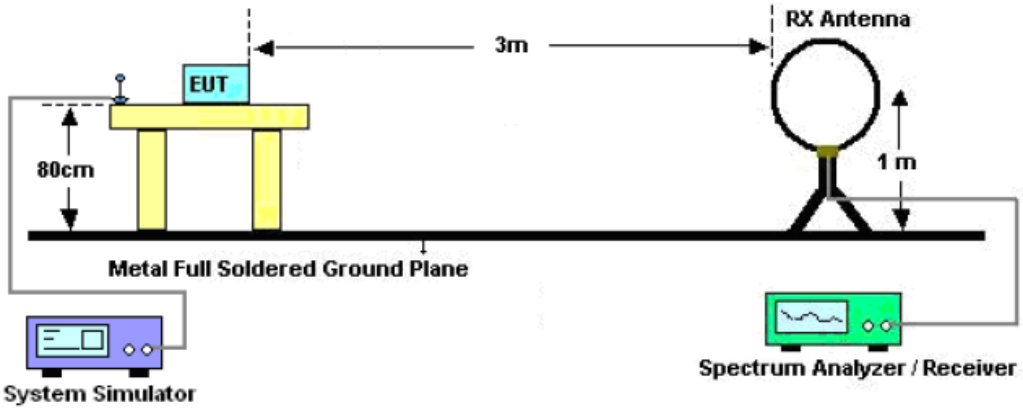
9.2 RADIATED SPURIOUS EMISSION

9.2.1 MEASUREMENT METHOD

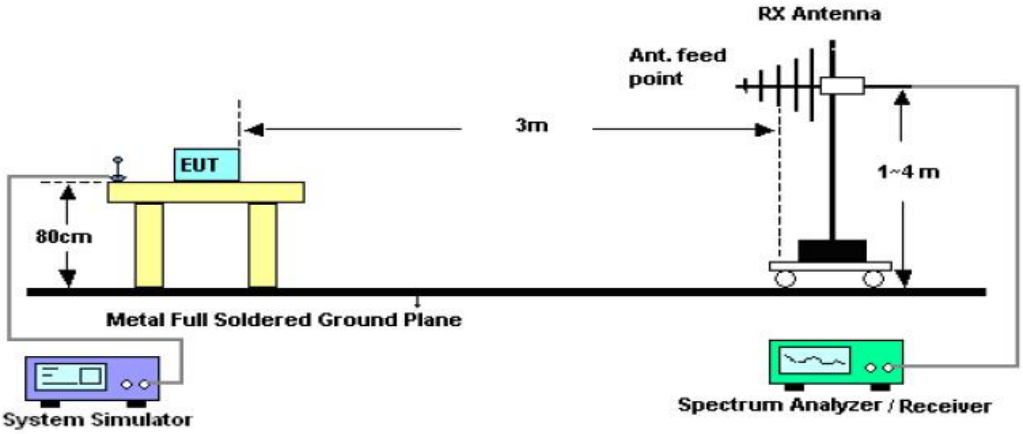
1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

9.2.2 TEST SETUP

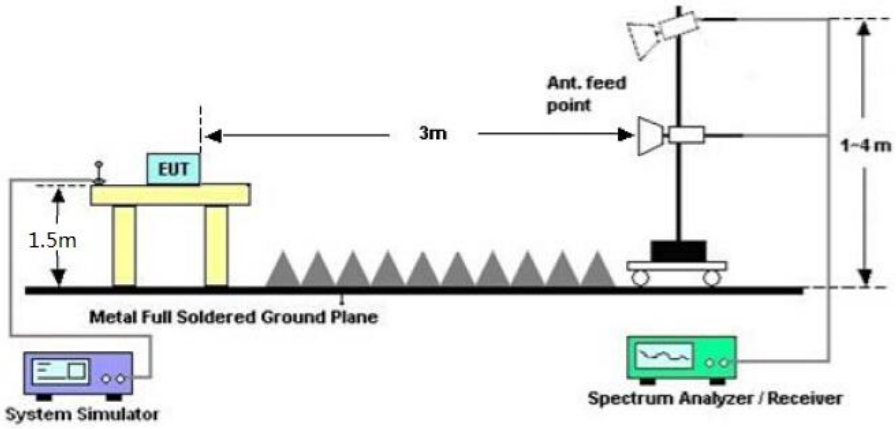
Radiated Emission Test-Setup Frequency Below 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



9.2.3 PROVISIONS APPLICABLE

(a) On any frequency outside a licensee's frequency block (e.g. A, D, B, etc.) within the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log(P) dB. The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

Note: only result the worst condition of each test mode:

9.2.4 MEASUREMENT RESULT

GSM 850:

The Worst Test Results for Channel 251/848.8 MHz				
Frequency	Emission Level	Limits	Margin	Comment
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	
1697.66	-49.43	-13.00	-36.43	Horizontal
3395.27	-34.75	-13.00	-21.75	Horizontal
6790.46	-28.05	-13.00	-15.05	Horizontal
1697.63	-48.61	-13.00	-35.61	Vertical
3395.18	-36.34	-13.00	-23.34	Vertical
6790.42	-27.51	-13.00	-14.51	Vertical

PCS 1900:

The Worst Test Results for Channel 810/1909.8MHz				
Frequency	Emission Level	Limits	Margin	Comment
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	
1847.65	-48.85	-13.00	-35.85	Horizontal
3819.68	-37.98	-13.00	-24.98	Horizontal
7639.47	-25.36	-13.00	-12.36	Horizontal
1887.51	-48.11	-13.00	-35.11	Vertical
3819.63	-36.85	-13.00	-23.85	Vertical
7639.51	-26.24	-13.00	-13.24	Vertical

HSPA band II:

The Worst Test Results for Channel 9938/1907.4MHz				
Frequency	Emission Level	Limits	Margin	Comment
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	
1879.54	-48.87	-13.00	-35.87	Horizontal
3814.86	-38.15	-13.00	-25.15	Horizontal
7629.65	-25.71	-13.00	-12.71	Horizontal
1881.47	-49.63	-13.00	-36.63	Vertical
3814.87	-38.04	-13.00	-25.04	Vertical
7629.69	-26.81	-13.00	-13.81	Vertical

HSPA band V:

The Worst Test Results for Channel 4458/846.4MHz				
Frequency	Emission Level	Limits	Margin	Comment
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	
1692.84	-47.02	-13.00	-34.02	Horizontal
3385.67	-34.27	-13.00	-21.27	Horizontal
6771.22	-26.83	-13.00	-13.83	Horizontal
1692.79	-47.86	-13.00	-34.86	Vertical
3385.57	-35.92	-13.00	-22.92	Vertical
6771.58	-26.90	-13.00	-13.90	Vertical

RESULT: PASS

Note:

1. Margin = Emission Leve - Limit
2. Below 30MHZ no Spurious found and Above is the worst mode data.

10. FREQUENCY STABILITY

10.1 MEASUREMENT METHOD

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of R&S CMU200 DIGITAL RADIO COMMUNICATION TESTER.

1 Measure the carrier frequency at room temperature.

2 Subject the EUT to overnight soak at -10℃.

3 With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on channel 661 for PCS 1900 band , channel 190 for GSM 850 band, channel 9400 for UMTS band II and channel 4175 for UMTS band V measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.

4 Repeat the above measurements at 10℃ increments from -10℃ to +55℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.

5 Re-measure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments re-measuring carrier frequency at each voltage. Pause at nominal voltage for 1 1/2 hours unpowered, to allow any self-heating to stabilize, before continuing.

6 Subject the EUT to overnight soak at +55℃.

7 With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on the centre channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.

8 Repeat the above measurements at 10℃ increments from +55℃ to -10℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.

9 At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

10.2 PROVISIONS APPLICABLE

10.2.1 For Hand carried battery powered equipment

According to the ANSI/TIA-603-D-2010，the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. As this transceiver is considered "Hand carried, battery powered equipment" Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of between 3.4VDC and 4.2VDC, with a nominal voltage of 3.7VDC. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress. These voltages represent a tolerance of -10 % and +12.5 %. For the purposes of measuring frequency stability these voltage limits are to be used.

10.2.2 For equipment powered by primary supply voltage

According to the ANSI/TIA-603-D-2010，the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. For this EUT section 2.1055(d)(1) applies. This requires varying primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment, the normal environment temperature is 20^{o}C.

10.3 MEASUREMENT RESULT

Test Results

Frequency Error vs. Voltage:

Test Band	Test Mode	Test Channel	Test Temp.	Test Volt.(V)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
GSM850	GSM	LCH	TN	VL	-3.29	-0.00	±2.5	PASS
			TN	VN	-2.39	-0.00	±2.5	PASS
			TN	VH	-2.71	-0.00	±2.5	PASS
		MCH	TN	VL	-1.55	-0.00	±2.5	PASS
			TN	VN	-0.26	-0.00	±2.5	PASS
			TN	VH	-2.65	-0.00	±2.5	PASS
		HCH	TN	VL	-1.03	-0.00	±2.5	PASS
			TN	VN	-0.77	-0.00	±2.5	PASS
			TN	VH	-2.07	-0.00	±2.5	PASS

Test Band	Test Mode	Test Channel	Test Temp.	Test Volt.(V)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
GSM 1900	GSM	LCH	TN	VL	-2.97	-0.00	±2.5	PASS
			TN	VN	-4.00	-0.00	±2.5	PASS
			TN	VH	-4.91	-0.00	±2.5	PASS
		MCH	TN	VL	-4.33	-0.00	±2.5	PASS
			TN	VN	-5.29	-0.00	±2.5	PASS
			TN	VH	-5.04	-0.00	±2.5	PASS
		HCH	TN	VL	-12.01	-0.01	±2.5	PASS
			TN	VN	-13.95	-0.01	±2.5	PASS
			TN	VH	-14.53	-0.01	±2.5	PASS

Frequency Error vs. Temperature:

Test Band	Test Mode	Test Channel	Test Volt.	Test Temp.	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
GSM850	GSM	LCH	VN	-10	-0.39	-0.00	±2.5	PASS
			VN	0	-0.58	-0.00	±2.5	PASS
			VN	10	-0.45	-0.00	±2.5	PASS
			VN	20	-0.97	-0.00	±2.5	PASS
			VN	30	-2.20	-0.00	±2.5	PASS
			VN	40	-0.52	-0.00	±2.5	PASS
			VN	50	-0.13	-0.00	±2.5	PASS
GSM850	GSM	MCH	VN	-10	-1.94	-0.00	±2.5	PASS
			VN	0	-2.13	-0.00	±2.5	PASS
			VN	10	-3.62	-0.00	±2.5	PASS
			VN	20	-1.49	-0.00	±2.5	PASS
			VN	30	-1.16	-0.00	±2.5	PASS
			VN	40	-1.61	-0.00	±2.5	PASS
			VN	50	-3.55	-0.00	±2.5	PASS
GSM850	GSM	HCH	VN	-10	-1.94	-0.00	±2.5	PASS
			VN	0	-1.55	-0.00	±2.5	PASS
			VN	10	-2.58	-0.00	±2.5	PASS
			VN	20	-2.13	-0.00	±2.5	PASS
			VN	30	-2.58	-0.00	±2.5	PASS
			VN	40	-2.39	-0.00	±2.5	PASS
			VN	50	-2.26	-0.00	±2.5	PASS

Test Band	Test Mode	Test Channel	Test Volt.(V)	Test Temp.	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
GSM 1900	GSM	LCH	VN	-10	-3.94	-0.00	±2.5	PASS
			VN	0	-5.36	-0.00	±2.5	PASS
			VN	10	-2.26	-0.00	±2.5	PASS
			VN	20	-6.72	-0.00	±2.5	PASS
			VN	30	-3.81	-0.00	±2.5	PASS
			VN	40	-5.75	-0.00	±2.5	PASS
			VN	50	-4.46	-0.00	±2.5	PASS
GSM 1900	GSM	MCH	VN	-10	-4.65	-0.00	±2.5	PASS
			VN	0	-6.91	-0.00	±2.5	PASS
			VN	10	-7.68	-0.00	±2.5	PASS
			VN	20	-7.62	-0.00	±2.5	PASS
			VN	30	-7.88	-0.00	±2.5	PASS
			VN	40	-7.88	-0.00	±2.5	PASS
			VN	50	-8.01	-0.00	±2.5	PASS
GSM 1900	GSM	HCH	VN	-10	-12.40	-0.01	±2.5	PASS
			VN	0	-4.58	-0.00	±2.5	PASS
			VN	10	-2.84	-0.00	±2.5	PASS
			VN	20	-4.84	-0.00	±2.5	PASS
			VN	30	-12.40	-0.01	±2.5	PASS
			VN	40	-10.78	-0.01	±2.5	PASS
			VN	50	-13.82	-0.01	±2.5	PASS

Frequency Error vs. Voltage:

Test Band	Test Mode	Test Channel	Test Temp.	Test Volt.(V)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
WCDMA850	UMTS	LCH	TN	VL	-0.15	0.00	±2.5	PASS
			TN	VN	-0.18	0.00	±2.5	PASS
			TN	VH	0.87	0.00	±2.5	PASS
		MCH	TN	VL	-3.97	0.00	±2.5	PASS
			TN	VN	-1.83	0.00	±2.5	PASS
			TN	VH	1.14	0.00	±2.5	PASS
		HCH	TN	VL	0.47	0.00	±2.5	PASS
			TN	VN	0.69	0.00	±2.5	PASS
			TN	VH	2.87	0.00	±2.5	PASS

Test Band	Test Mode	Test Channel	Test Temp.	Test Volt.(V)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
WCDMA1900	UMTS	LCH	TN	VL	-1.74	0.00	±2.5	PASS
			TN	VN	-4.94	0.00	±2.5	PASS
			TN	VH	-1.92	0.00	±2.5	PASS
		MCH	TN	VL	0.46	0.00	±2.5	PASS
			TN	VN	2.98	0.00	±2.5	PASS
			TN	VH	5.36	0.00	±2.5	PASS
		HCH	TN	VL	-10.25	-0.01	±2.5	PASS
			TN	VN	-9.98	-0.01	±2.5	PASS
			TN	VH	-2.56	0.00	±2.5	PASS

Frequency Error vs. Temperature:

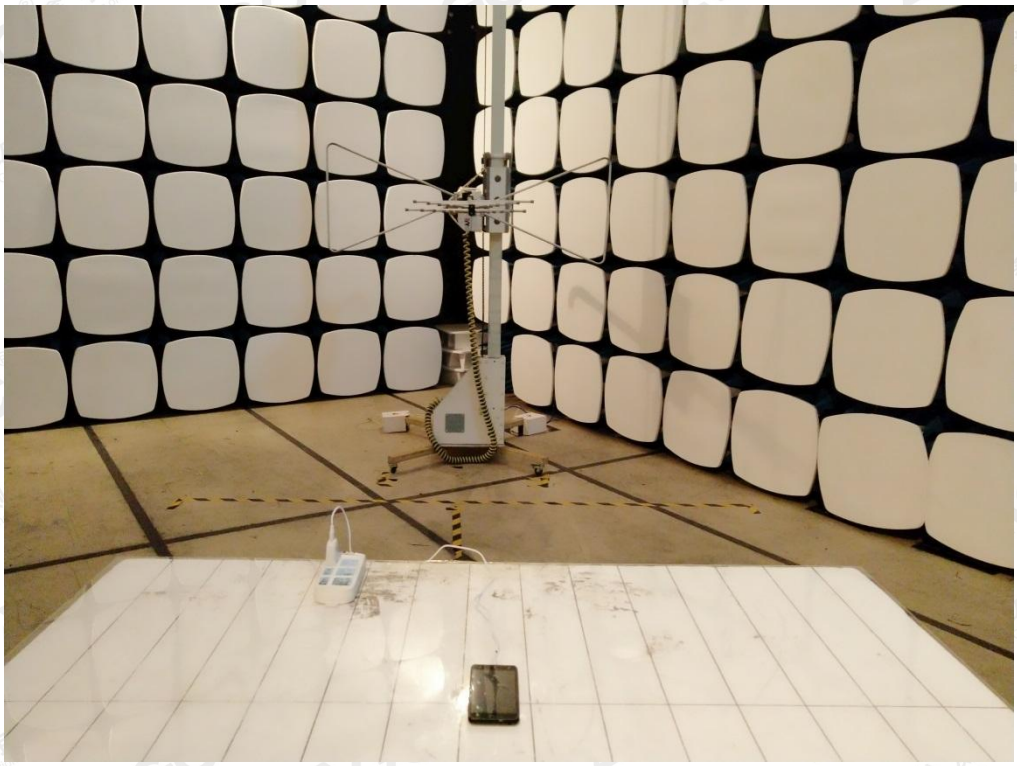
Test Band	Test Mode	Test Channel	Test Volt.(V)	Test Temp.	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
WCDMA850	UMTS	LCH	VN	-10	4.71	0.01	±2.5	PASS
			VN	0	4.30	0.01	±2.5	PASS
			VN	10	2.01	0.00	±2.5	PASS
			VN	20	0.64	0.00	±2.5	PASS
			VN	30	0.00	0.00	±2.5	PASS
			VN	40	-1.05	0.00	±2.5	PASS
			VN	50	-0.43	0.00	±2.5	PASS
WCDMA850	UMTS	MCH	VN	-10	0.08	0.00	±2.5	PASS
			VN	0	-1.95	0.00	±2.5	PASS
			VN	10	-2.11	0.00	±2.5	PASS
			VN	20	-3.98	0.00	±2.5	PASS
			VN	30	-1.30	0.00	±2.5	PASS
			VN	40	-1.14	0.00	±2.5	PASS
			VN	50	-0.90	0.00	±2.5	PASS
WCDMA850	UMTS	HCH	VN	-10	2.79	0.00	±2.5	PASS
			VN	0	1.14	0.00	±2.5	PASS
			VN	10	-1.56	0.00	±2.5	PASS
			VN	20	-5.48	-0.01	±2.5	PASS
			VN	30	-1.53	0.00	±2.5	PASS
			VN	40	0.96	0.00	±2.5	PASS
			VN	50	-1.14	0.00	±2.5	PASS

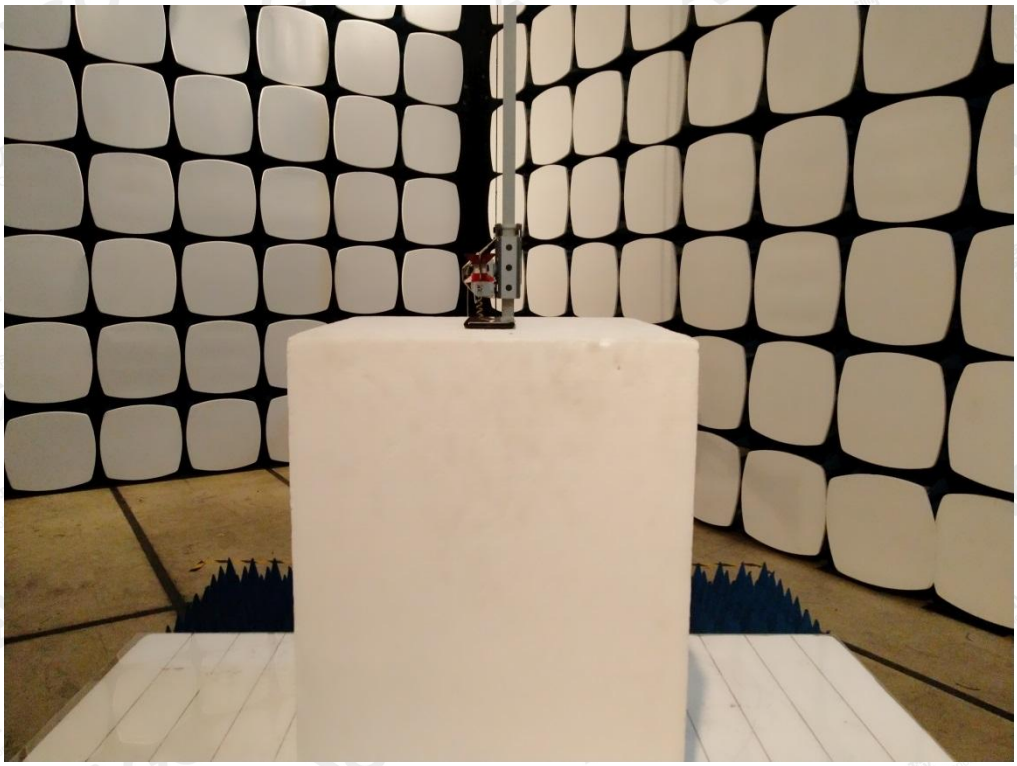
Test Band	Test Mode	Test Channel	Test Volt.	Test Temp.	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
WCDMA1900	UMTS	LCH	VN	-10	13.47	0.01	±2.5	PASS
			VN	0	6.87	0.00	±2.5	PASS
			VN	10	7.17	0.00	±2.5	PASS
			VN	20	3.98	0.00	±2.5	PASS
			VN	30	-6.70	0.00	±2.5	PASS
			VN	40	-3.20	0.00	±2.5	PASS
			VN	50	-8.38	0.00	±2.5	PASS
WCDMA1900	UMTS	MCH	VN	-10	4.58	0.00	±2.5	PASS
			VN	0	6.30	0.00	±2.5	PASS
			VN	10	8.09	0.00	±2.5	PASS
			VN	20	7.64	0.00	±2.5	PASS
			VN	30	4.87	0.00	±2.5	PASS
			VN	40	6.90	0.00	±2.5	PASS
			VN	50	7.35	0.00	±2.5	PASS
WCDMA1900	UMTS	HCH	VN	-10	-2.37	0.00	±2.5	PASS
			VN	0	-6.32	0.00	±2.5	PASS
			VN	10	-6.06	0.00	±2.5	PASS
			VN	20	-6.41	0.00	±2.5	PASS
			VN	30	-8.82	0.00	±2.5	PASS
			VN	40	-9.89	-0.01	±2.5	PASS
			VN	50	-5.71	0.00	±2.5	PASS

PHOTOGRAPHS OF TEST SETUP

CONDUCTED EMISSION

RADIATED SPURIOUS EMISSION





CONDUCTED MEASUREMENTS

----END OF REPORT----