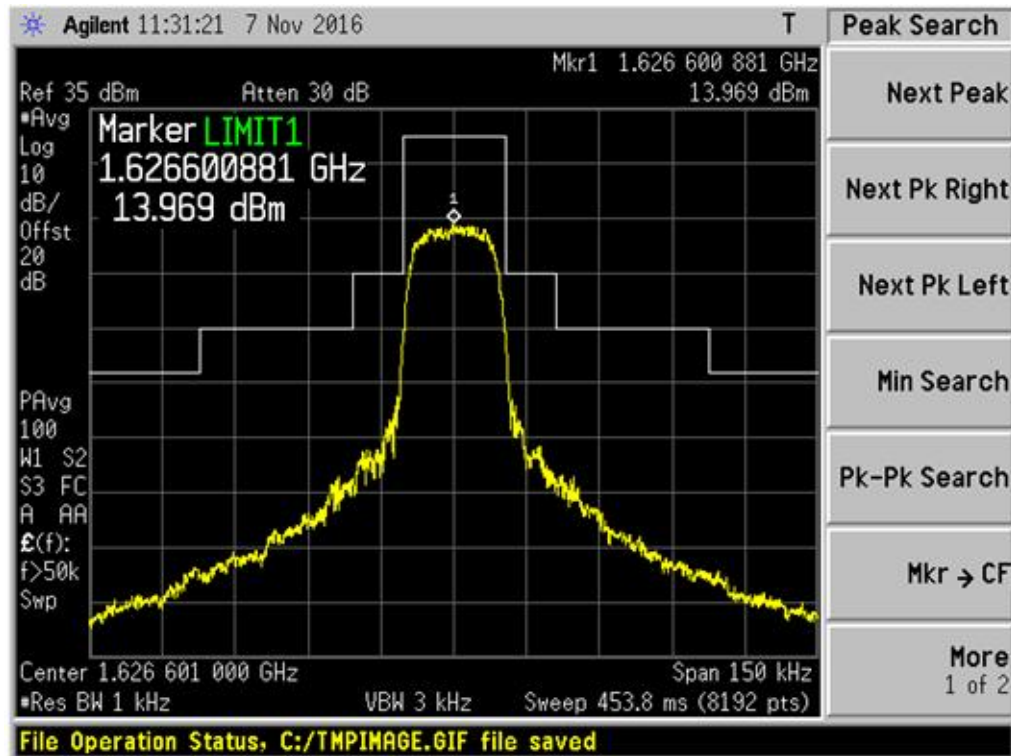
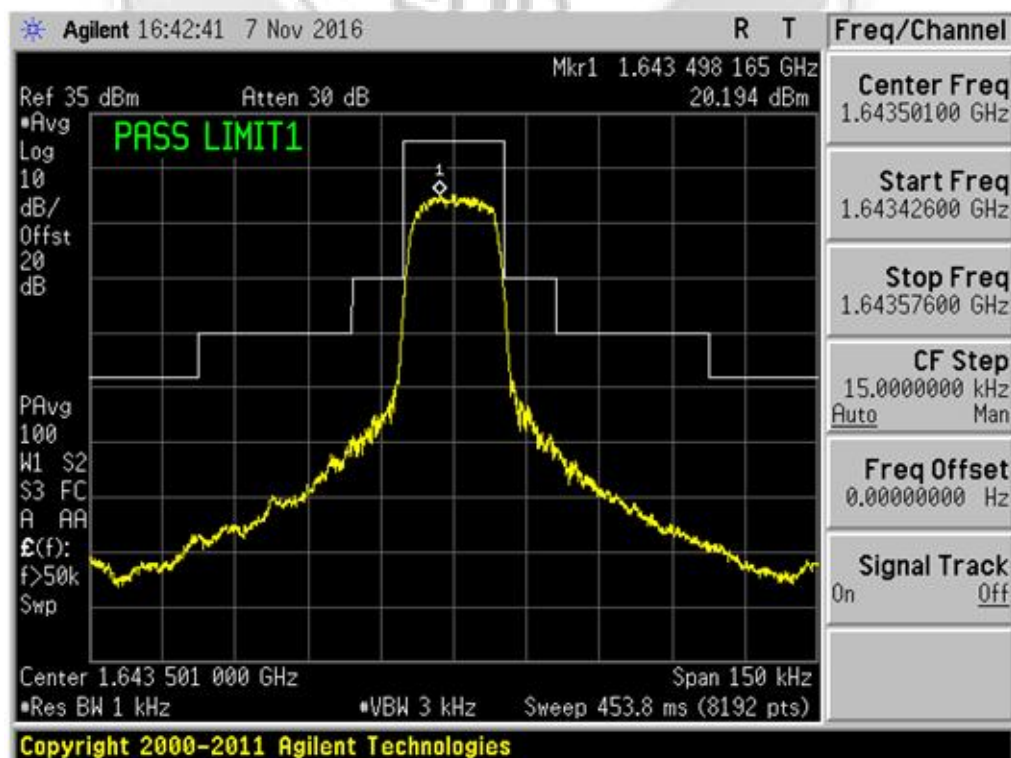


UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 0)



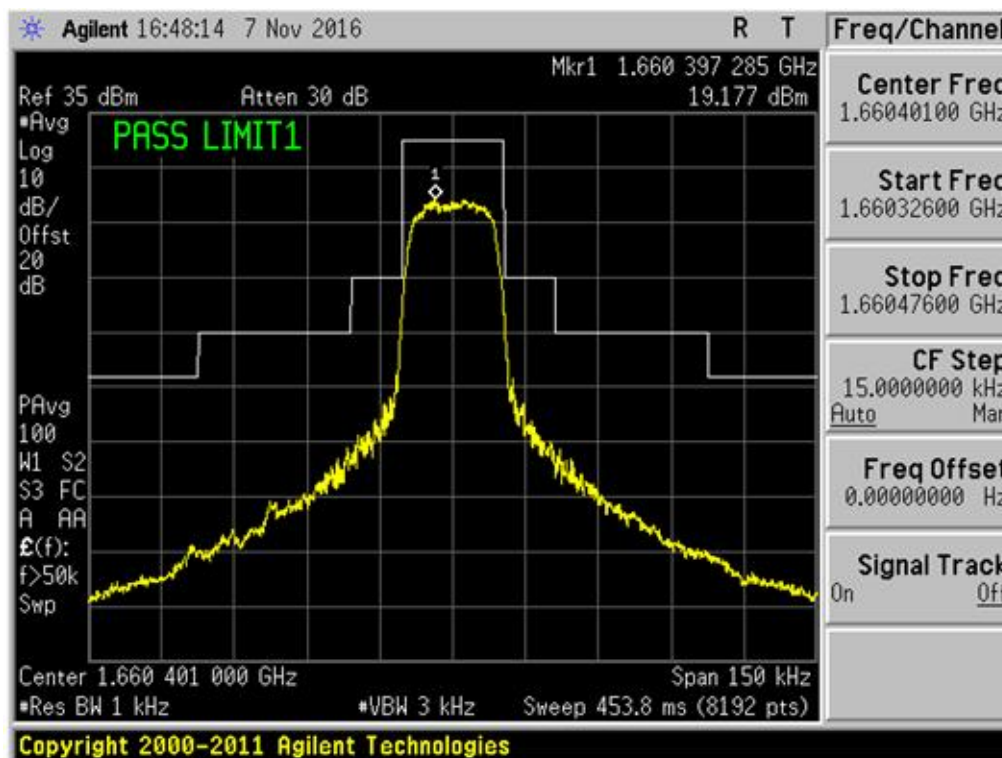
Plot 109 - Lower Channel



Plot 110 - Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

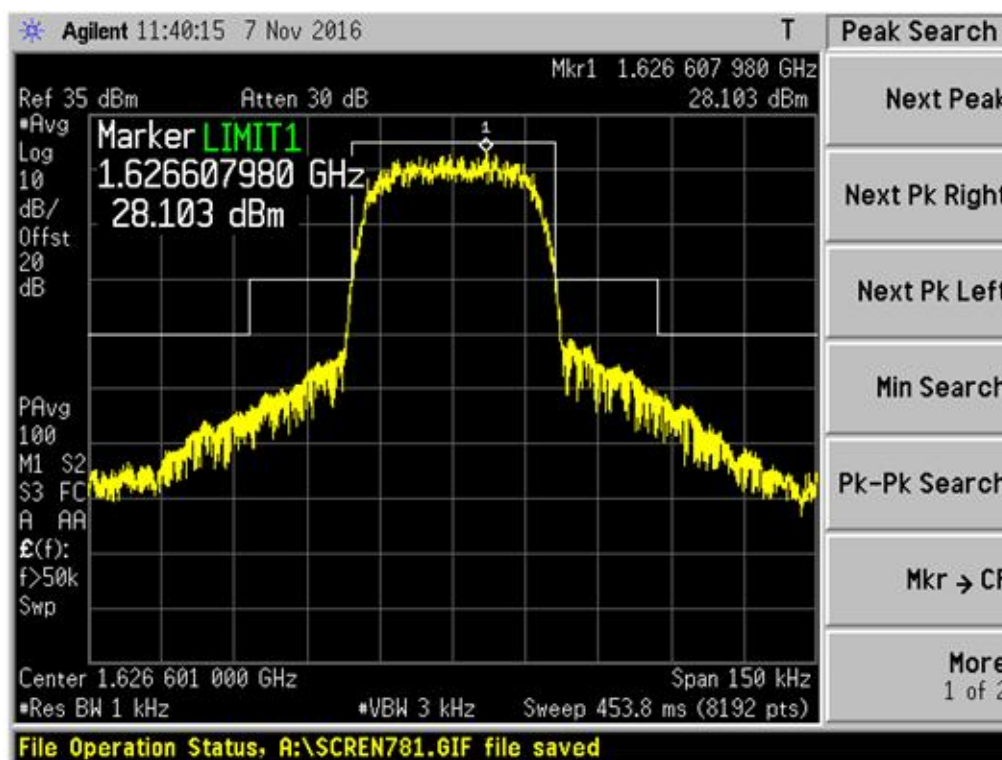
In Band Emissions Plots (Bearer Type: 0)



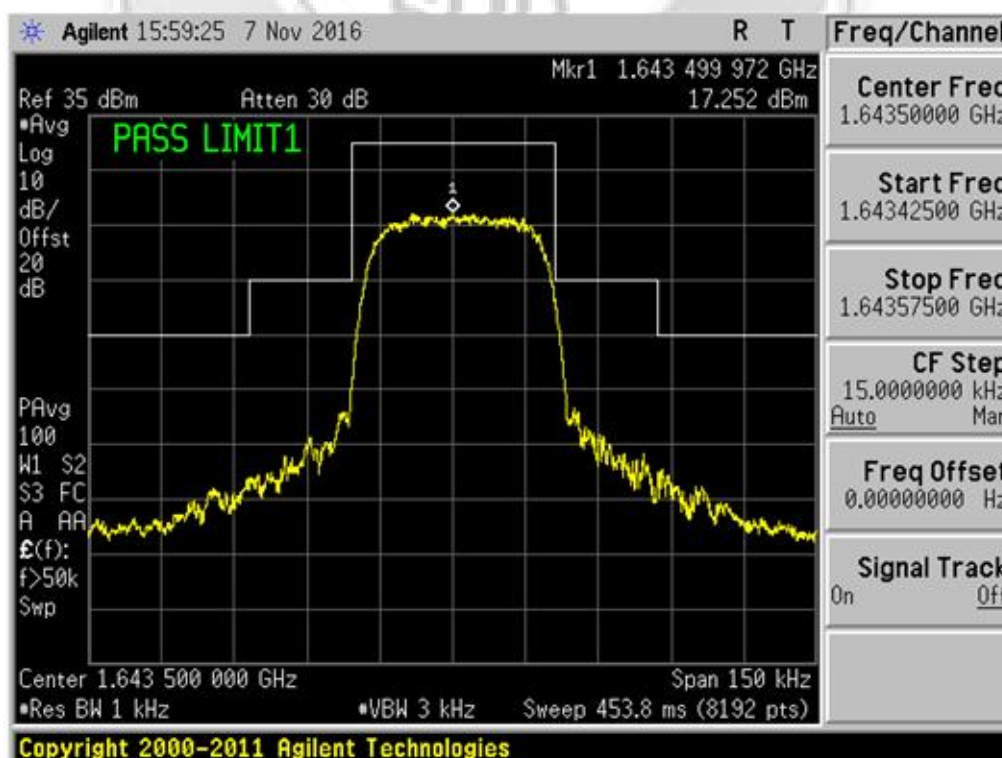
Plot 111 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 1)



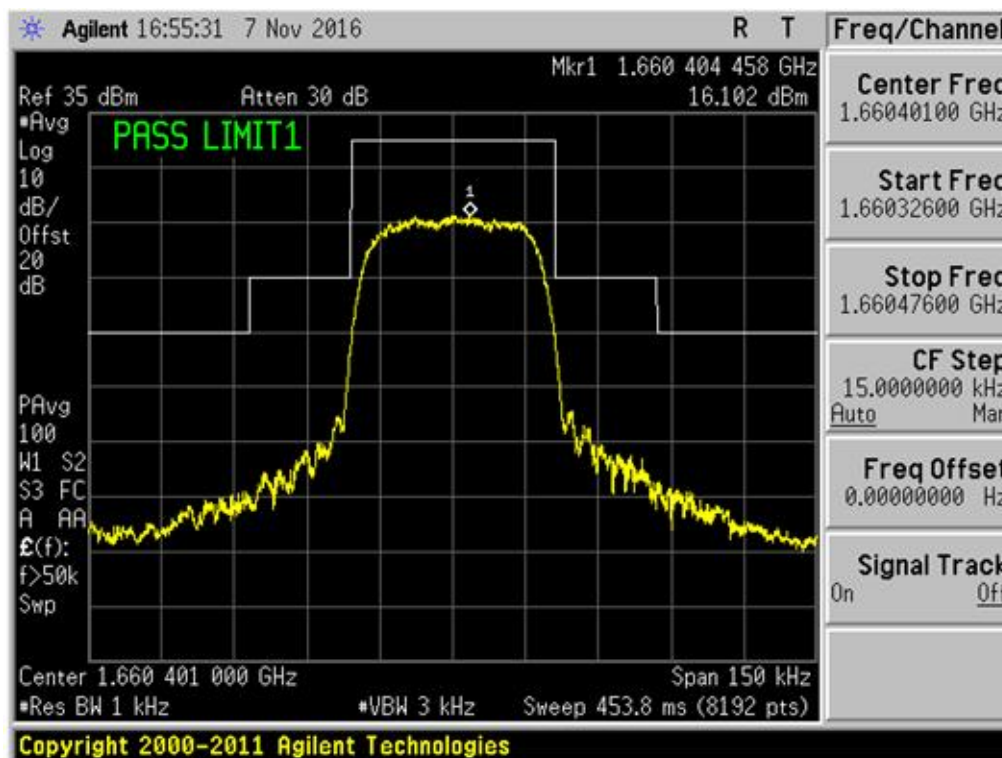
Plot 112 - Lower Channel



Plot 113 - Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

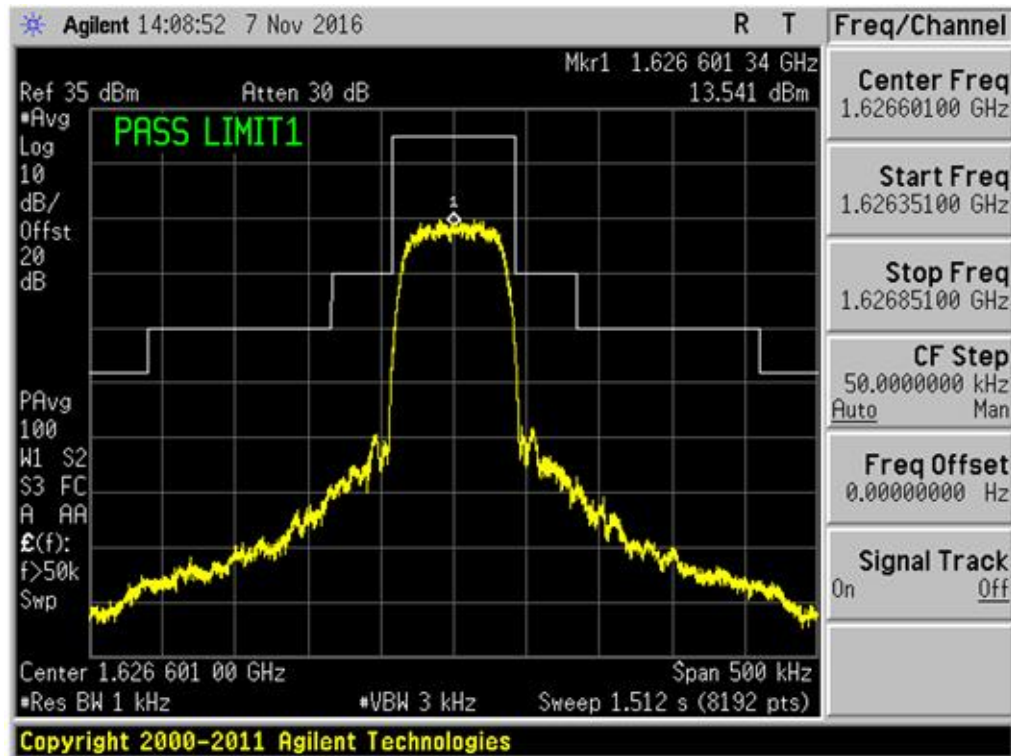
In Band Emissions Plots (Bearer Type: 1)



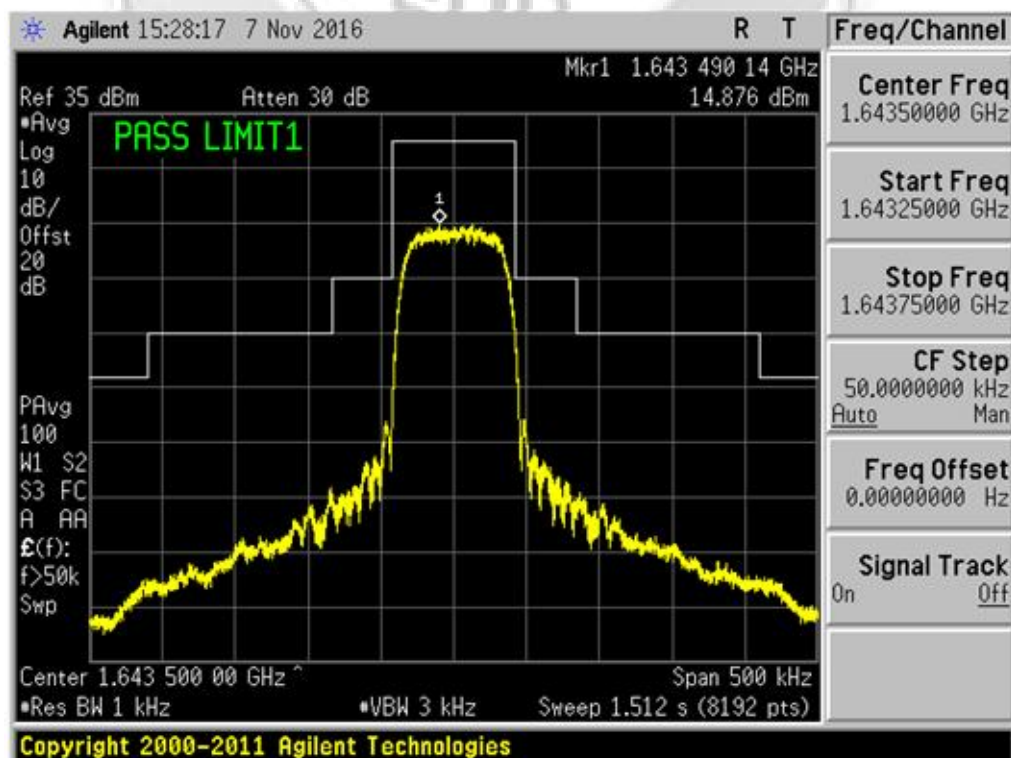
Plot 114 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 2)



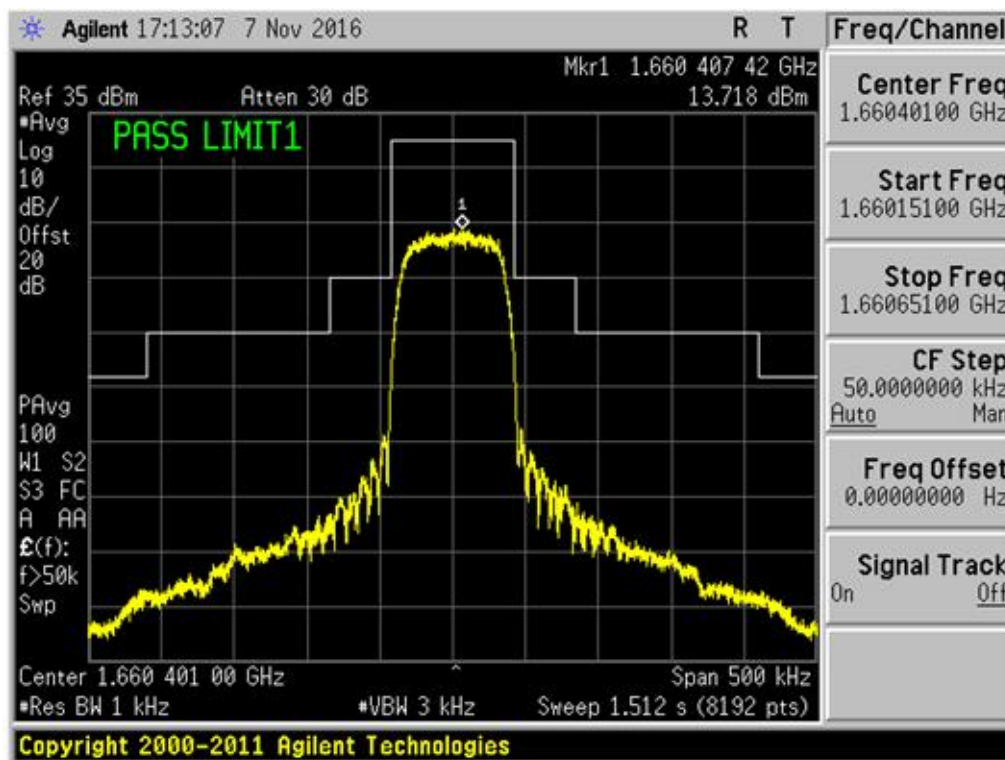
Plot 115 - Lower Channel



Plot 116 - Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

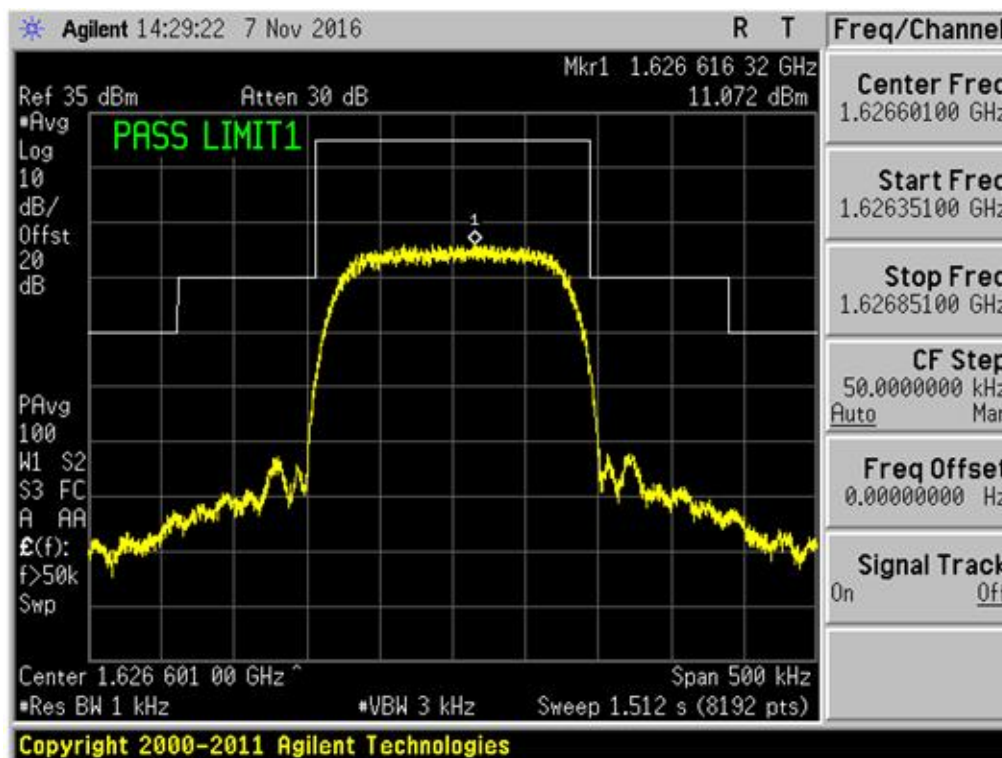
In Band Emissions Plots (Bearer Type: 2)



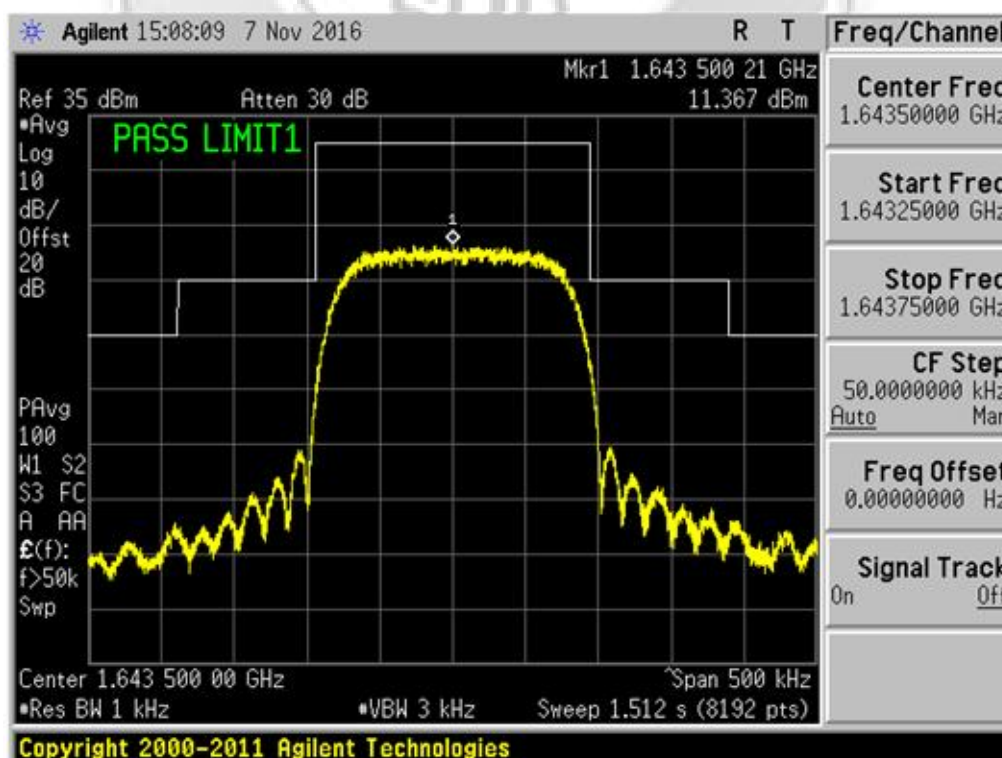
Plot 117 - Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 3)



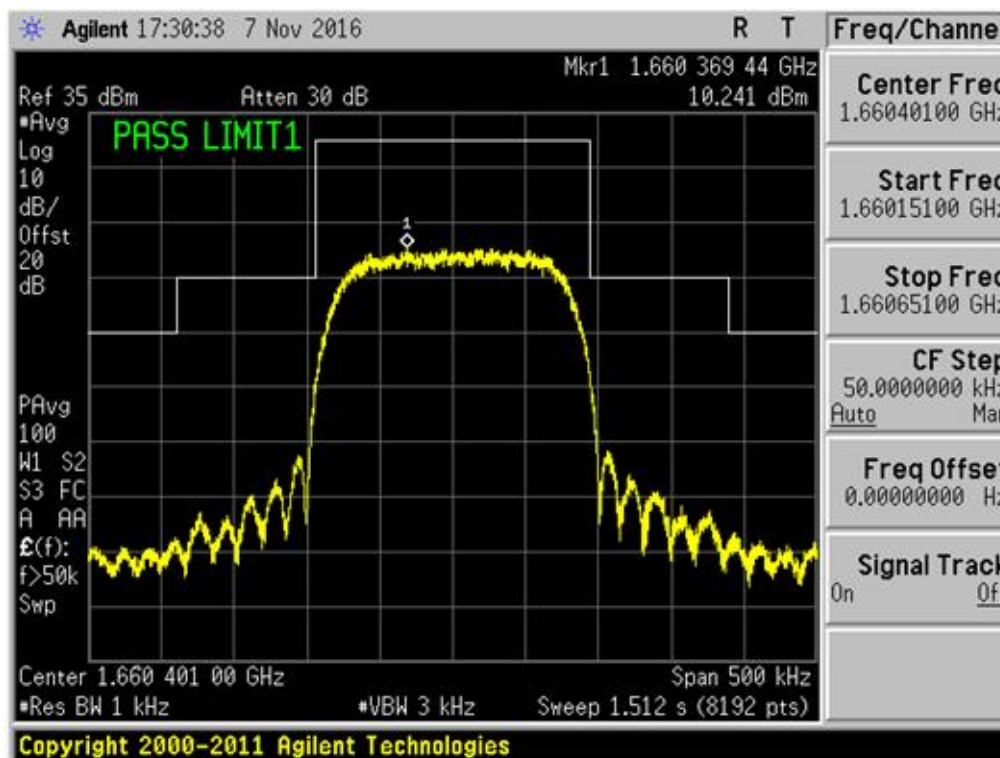
Plot 118 - Lower Channel



Plot 119 - Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

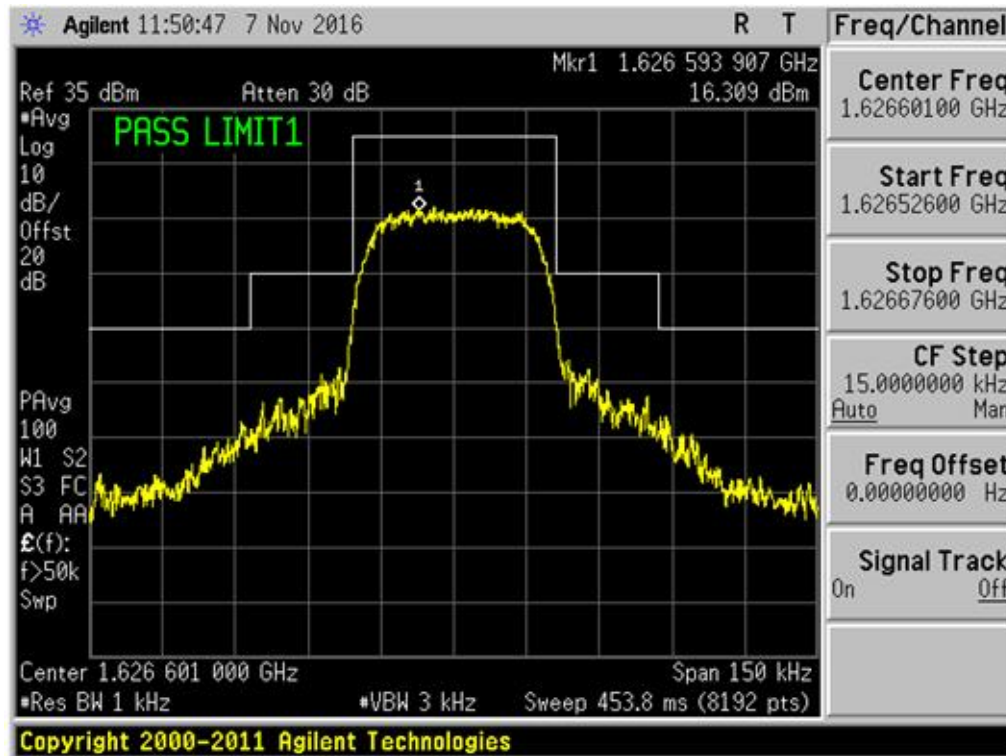
In Band Emissions Plots (Bearer Type: 3)



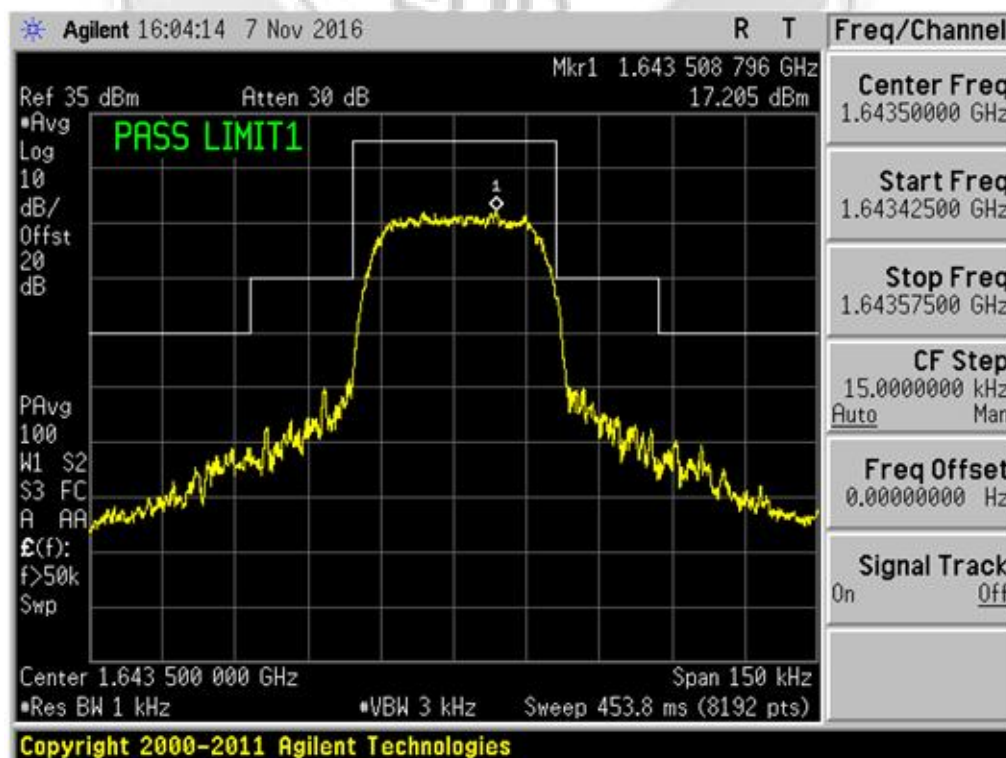
Plot 120 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 4)



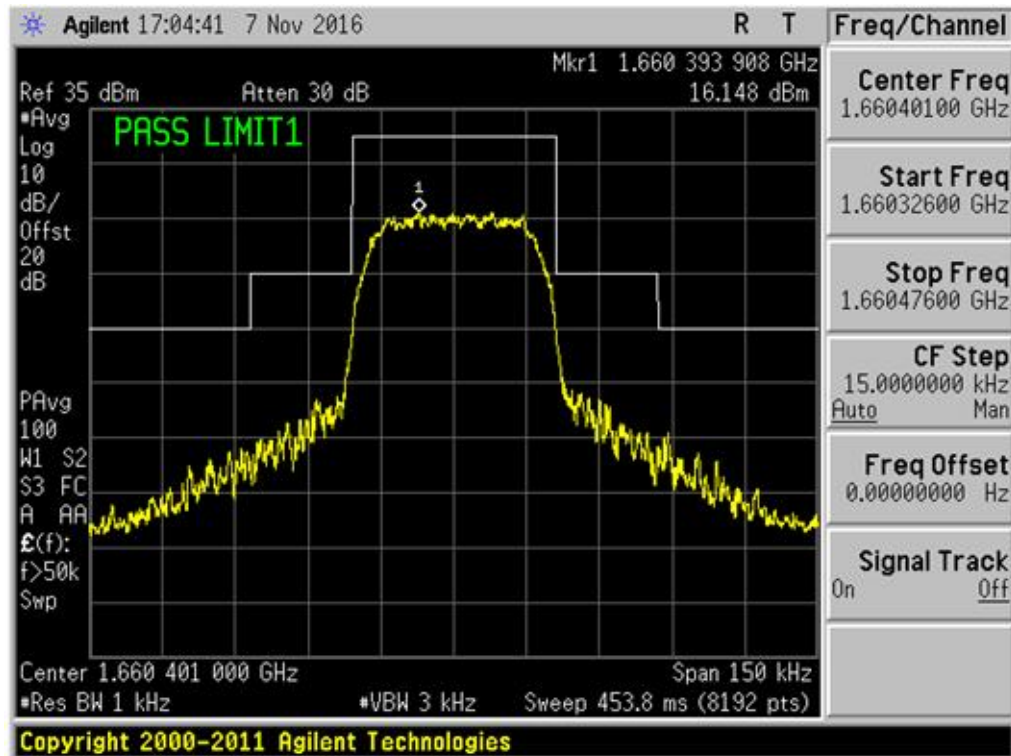
Plot 121 - Lower Channel



Plot 122 - Middle Channel

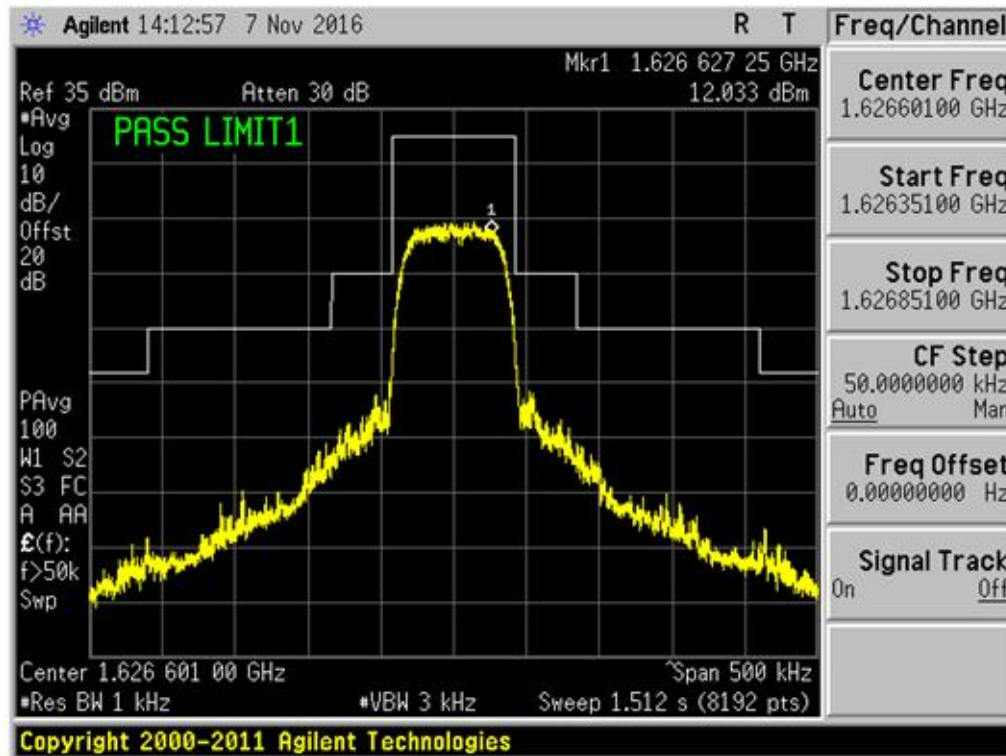
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 4)

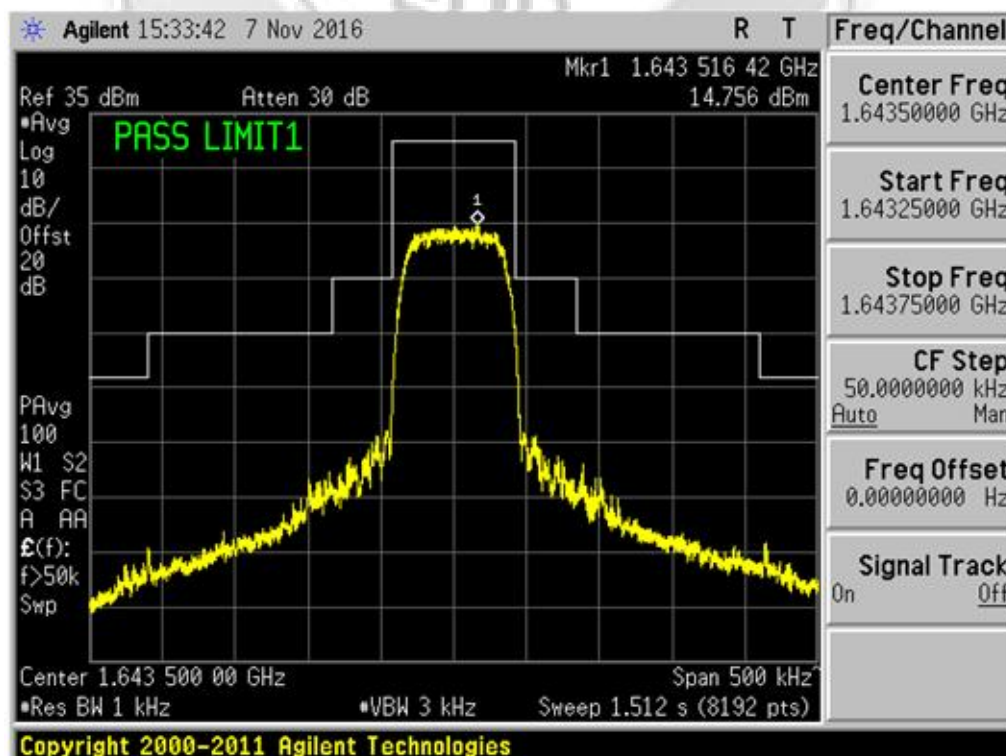


UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 5)



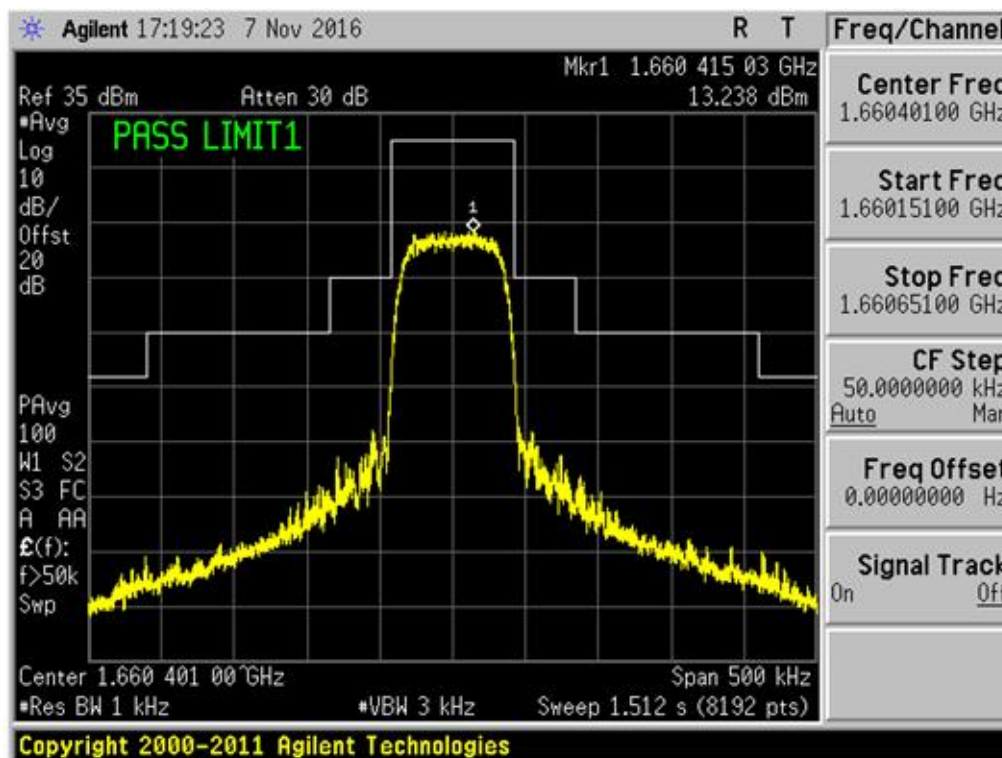
Plot 124 - Lower Channel



Plot 125 - Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

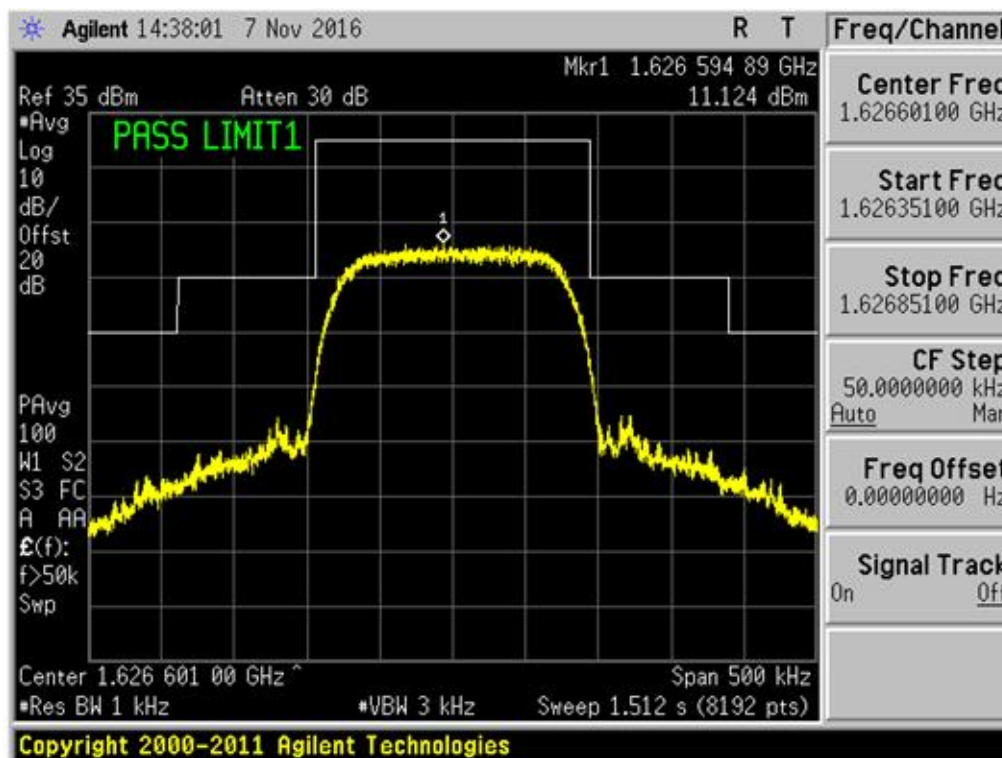
In Band Emissions Plots (Bearer Type: 5)



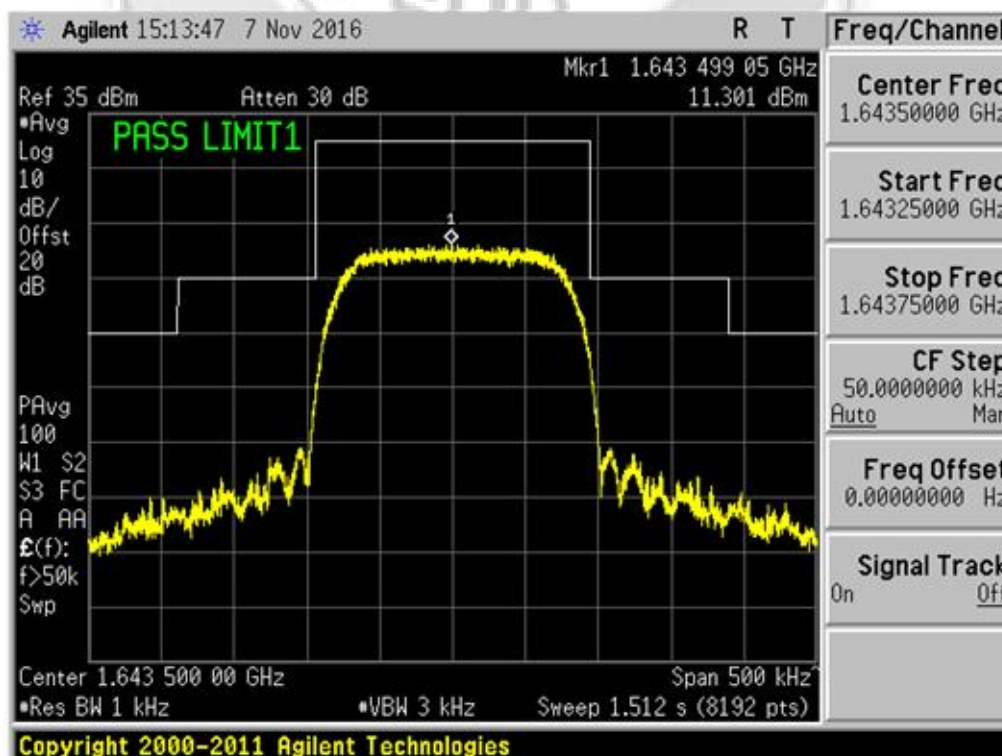
Plot 126 - Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 6)



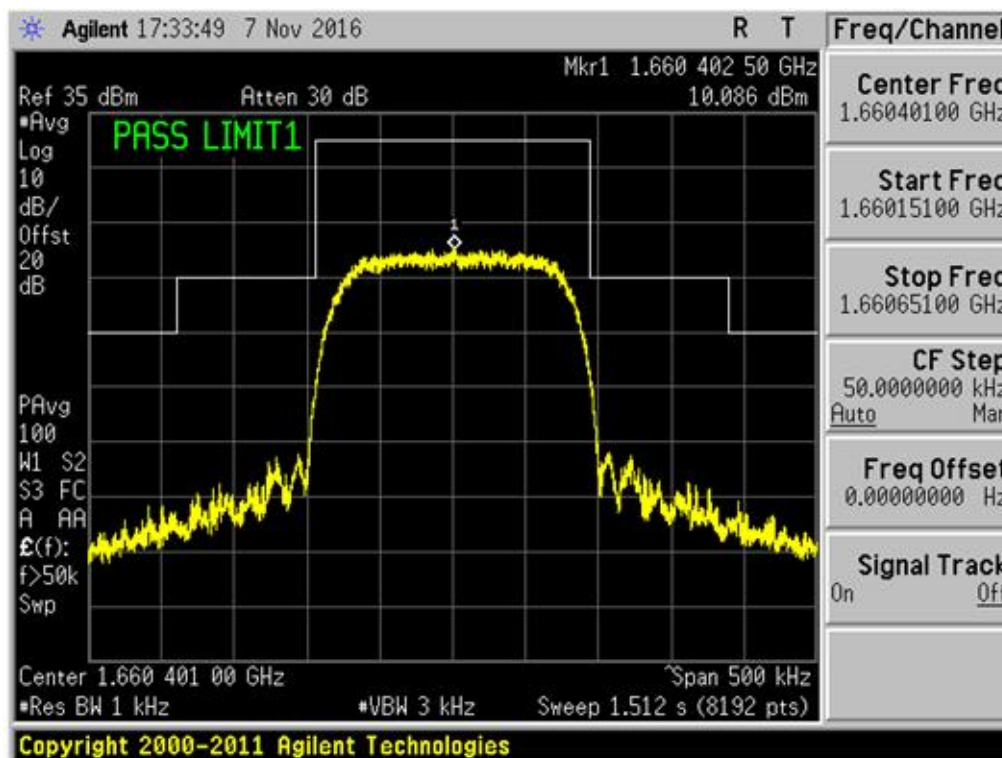
Plot 127 - Lower Channel



Plot 128 - Middle Channel

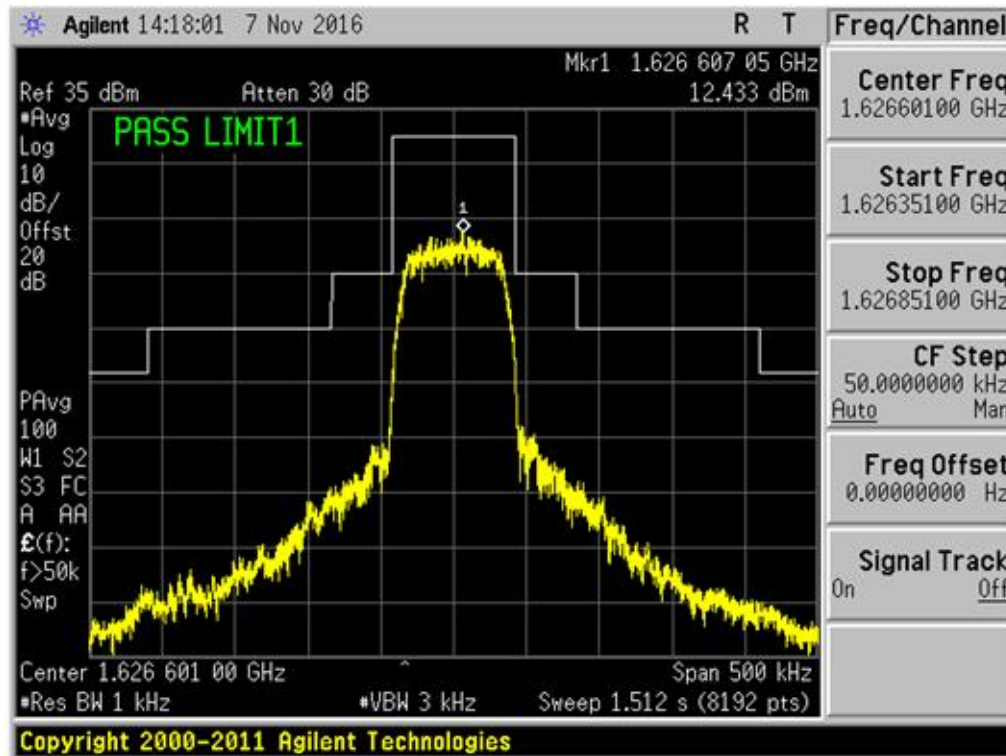
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 6)

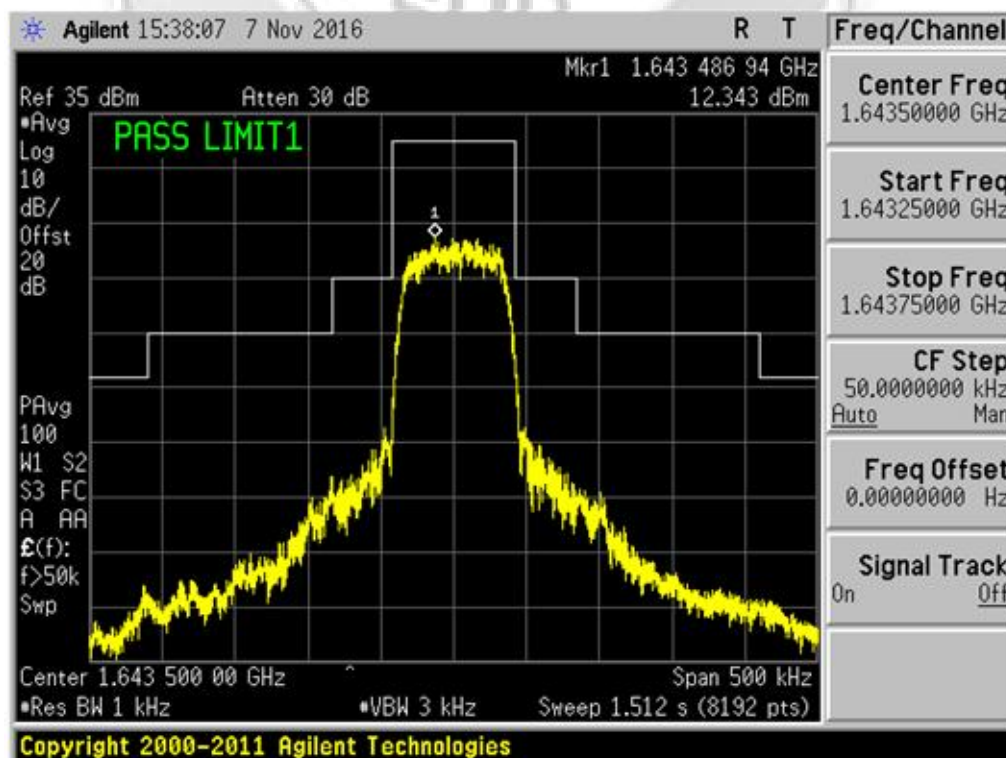


UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 7)



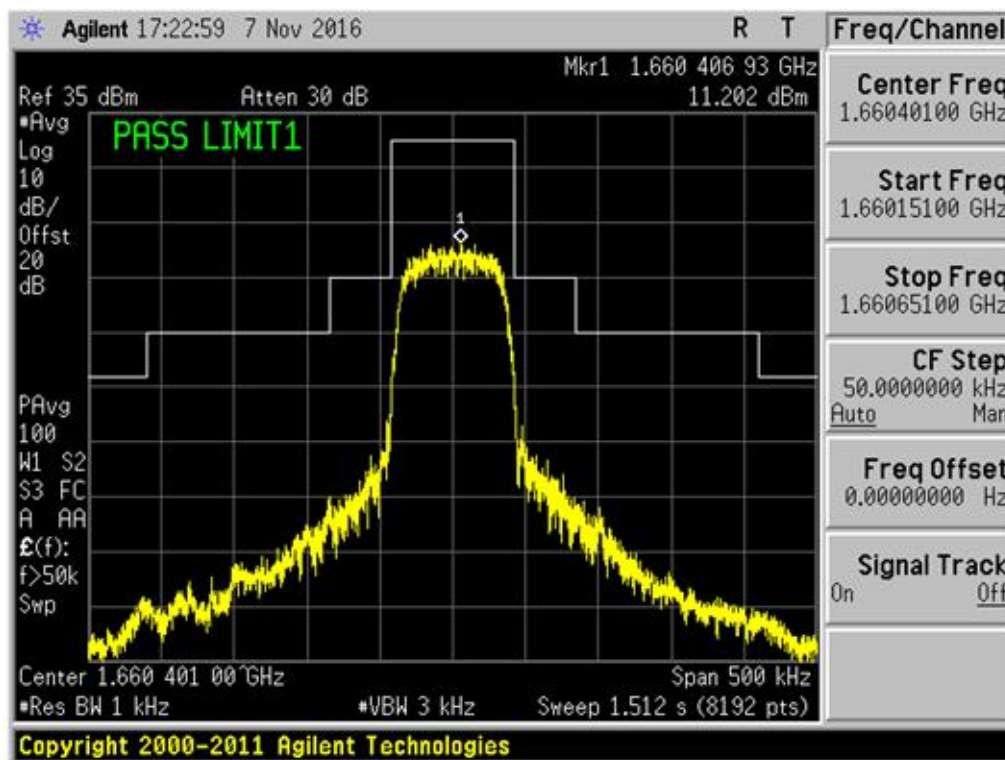
Plot 130 - Lower Channel



Plot 131 - Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

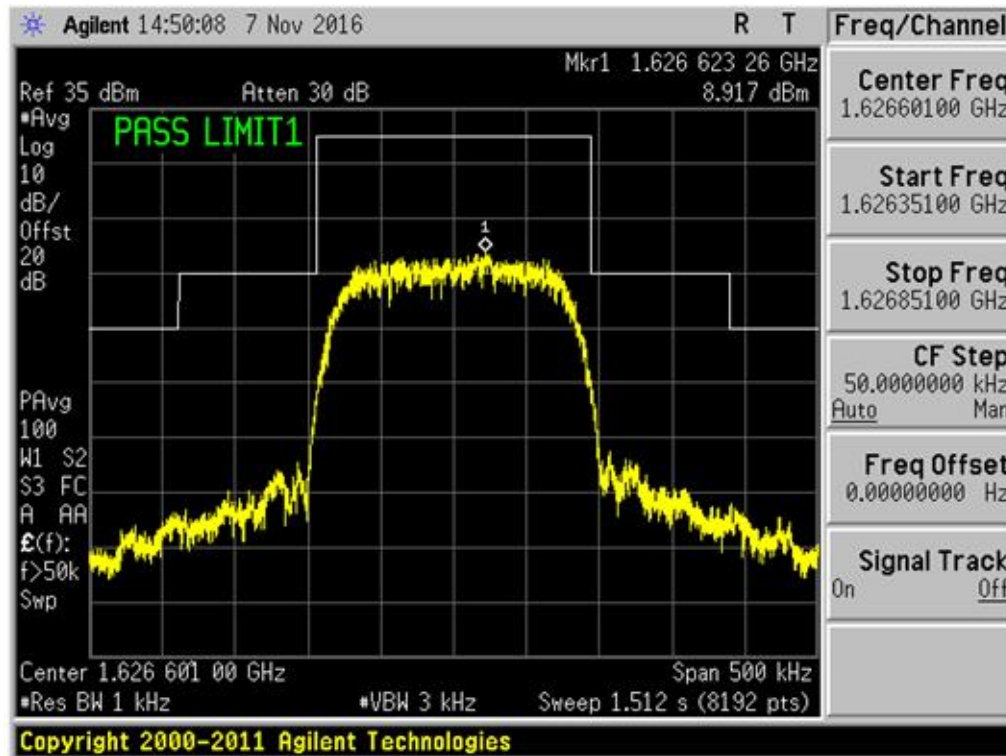
In Band Emissions Plots (Bearer Type: 7)



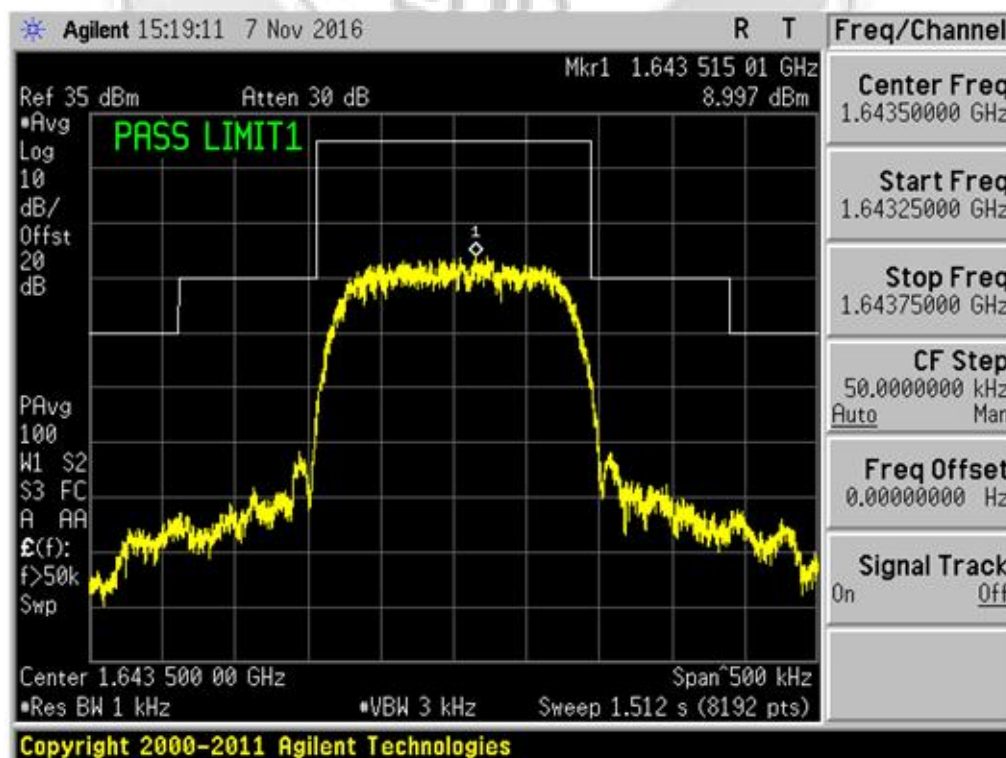
Plot 132 - Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 8)



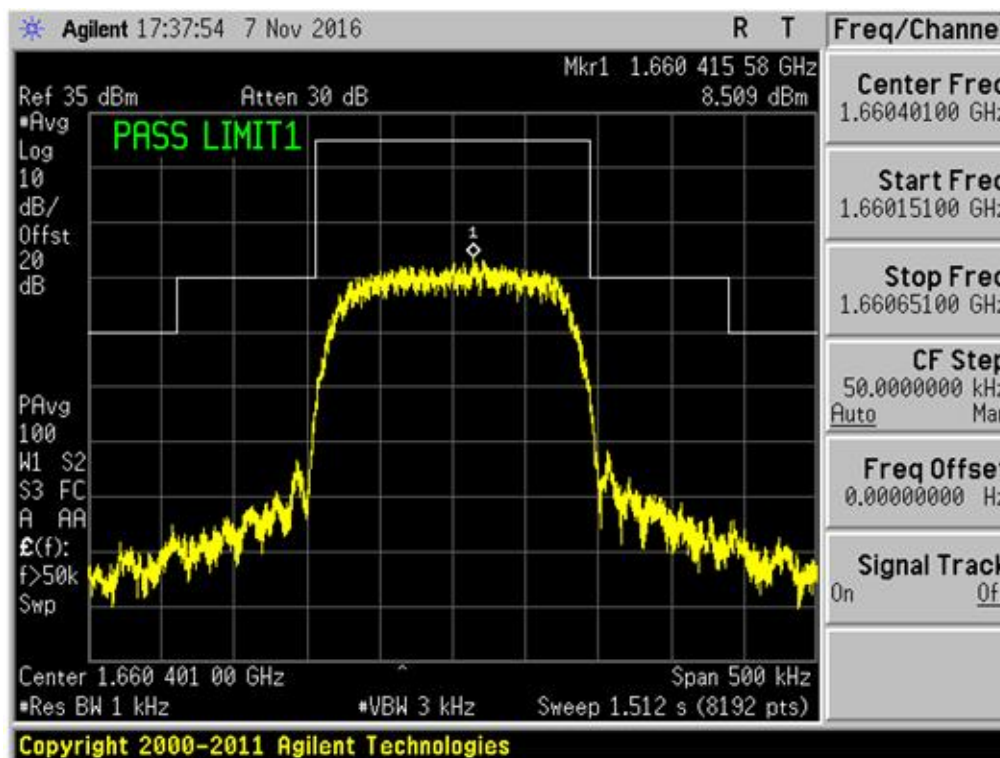
Plot 133 - Lower Channel



Plot 134 - Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

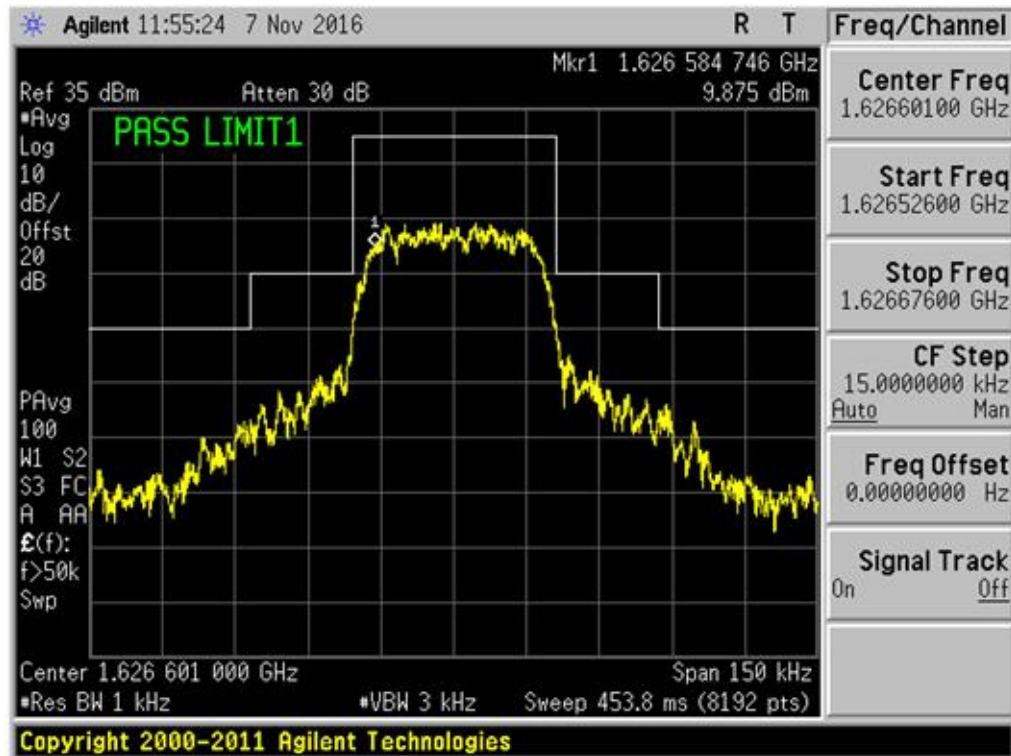
In Band Emissions Plots (Bearer Type: 8)



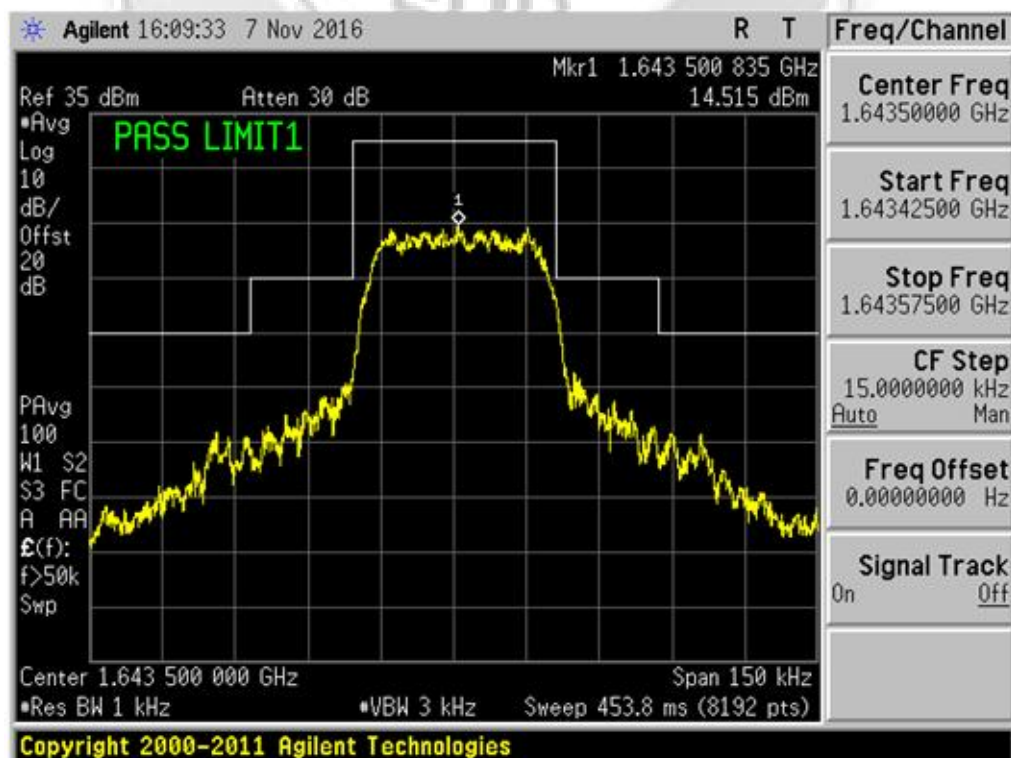
Plot 135 - Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 9)



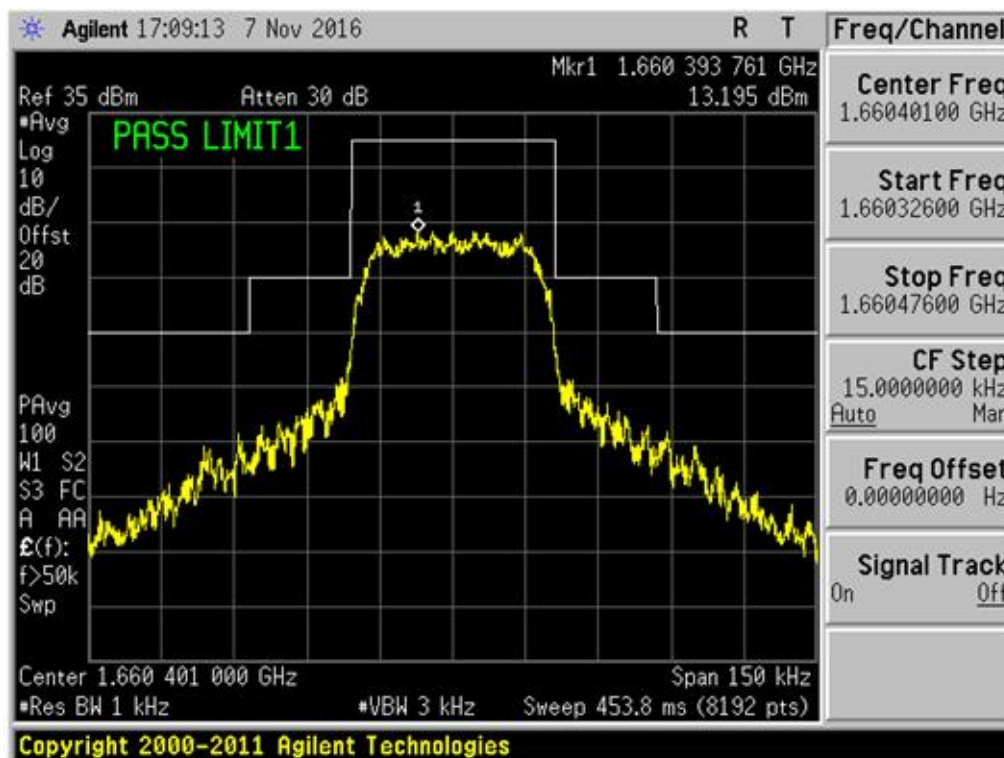
Plot 136 - Lower Channel



Plot 137 - Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

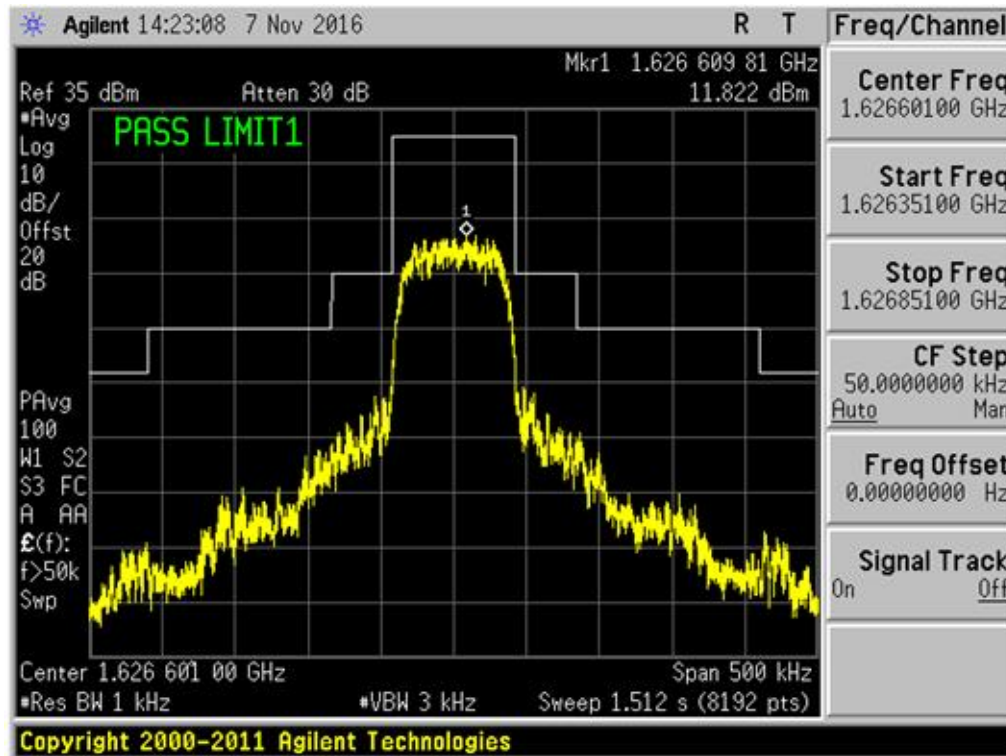
In Band Emissions Plots (Bearer Type: 9)



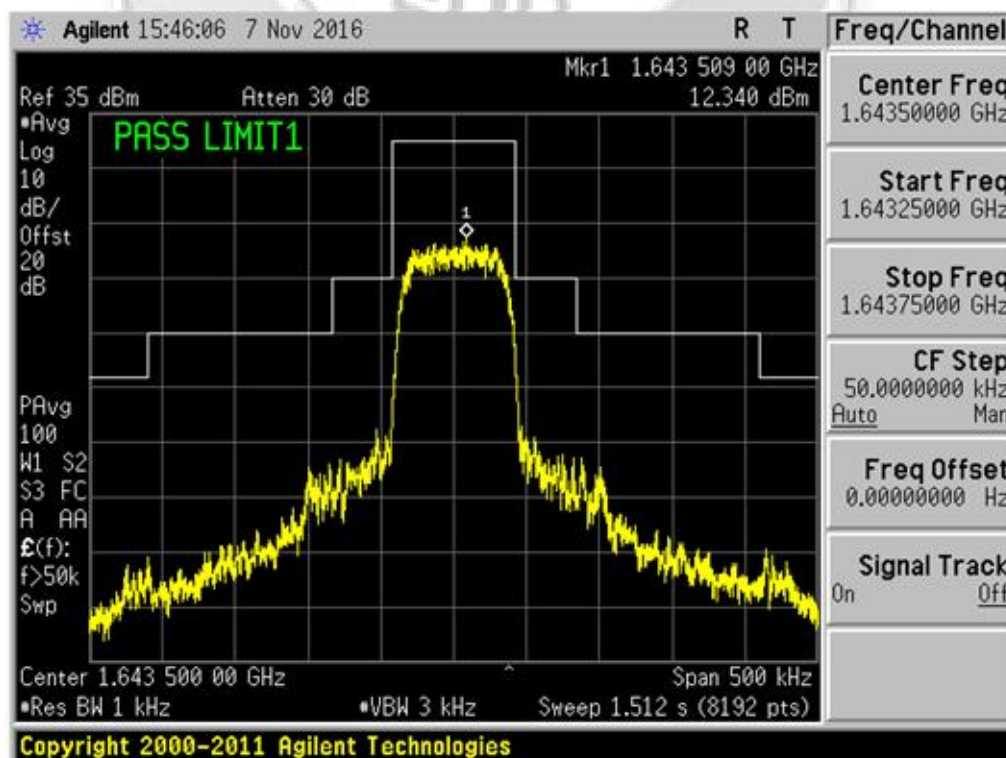
Plot 138 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 10)



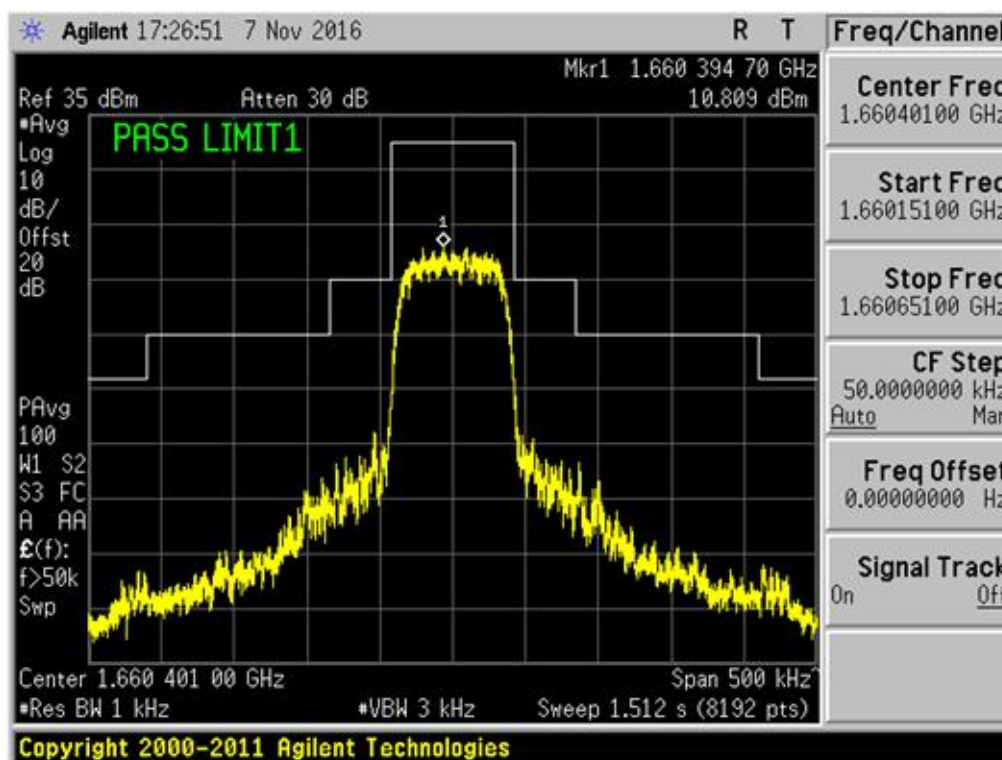
Plot 139 - Lower Channel



Plot 140 - Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

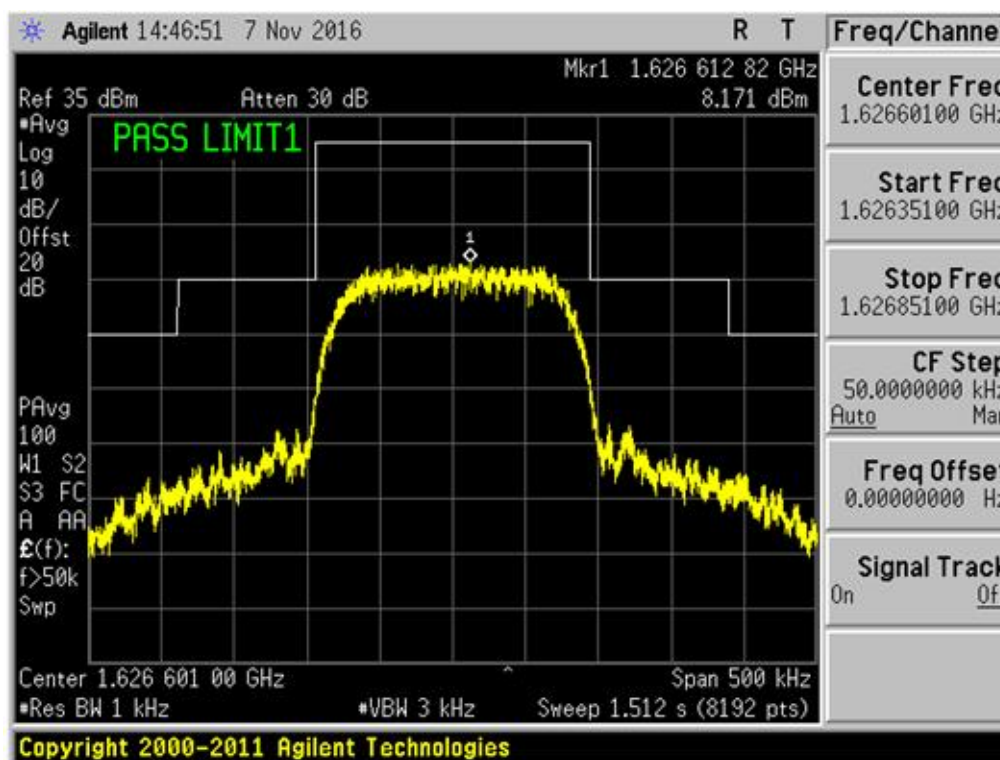
In Band Emissions Plots (Bearer Type: 10)



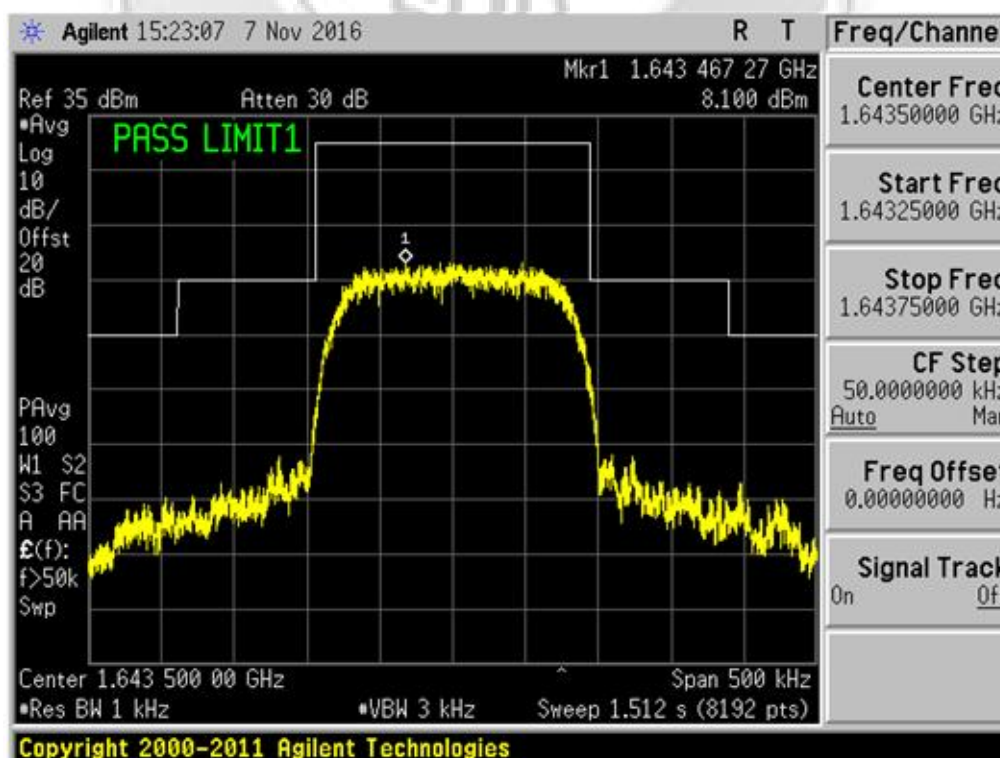
Plot 141 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

In Band Emissions Plots (Bearer Type: 11)



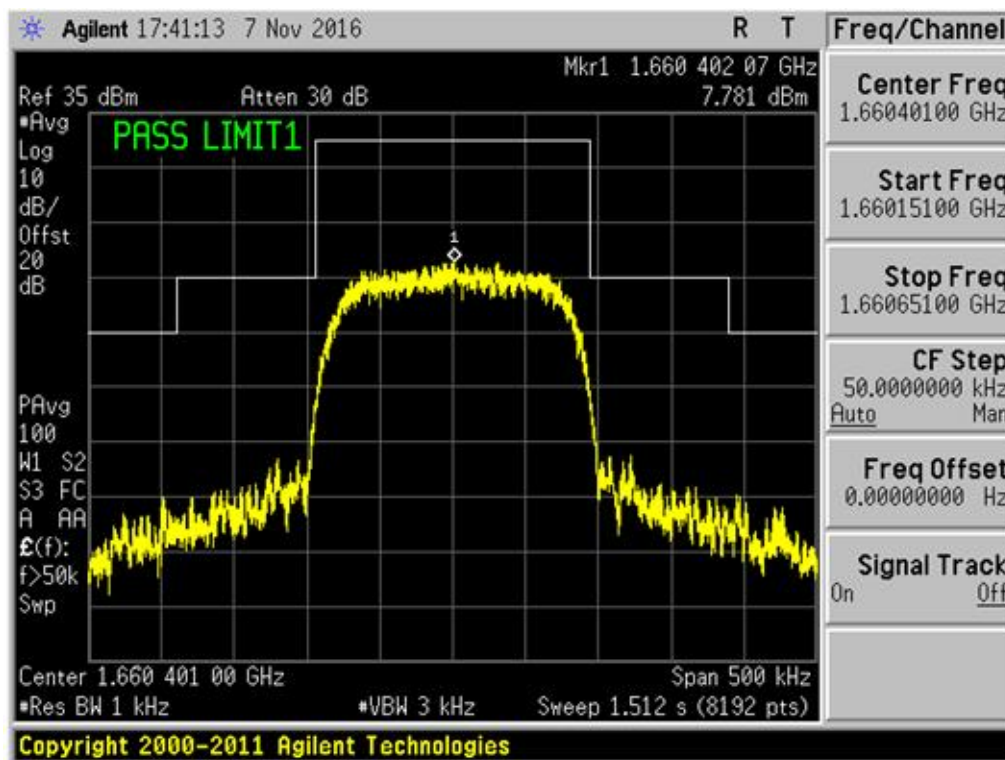
Plot 142 – Lower Channel



Plot 143 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

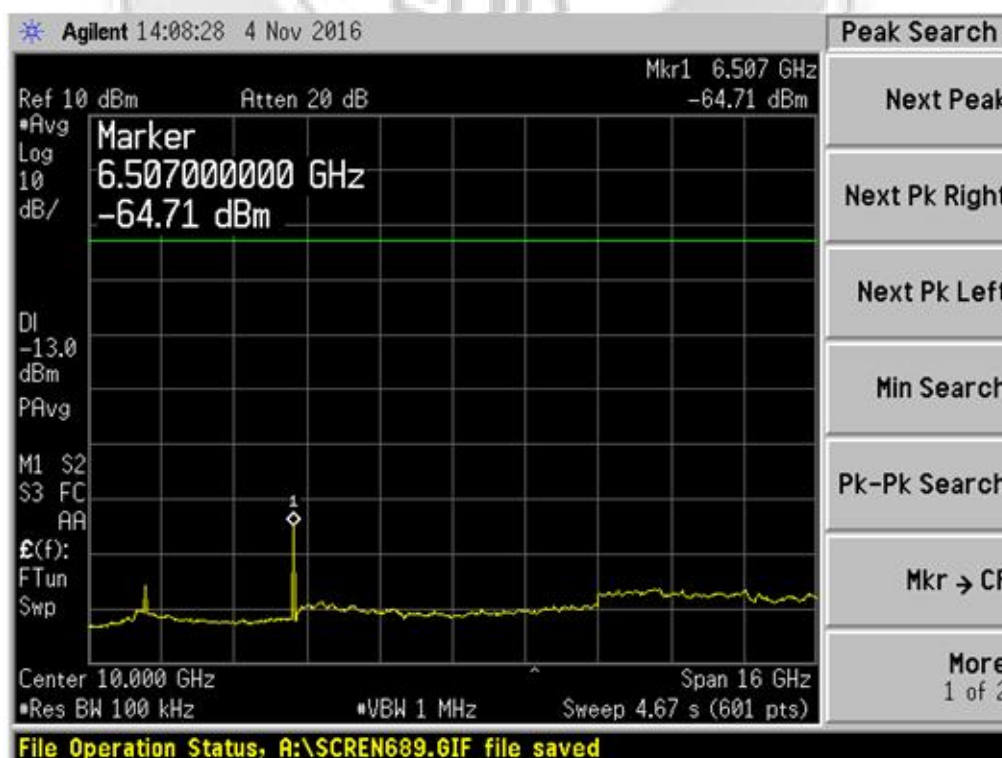
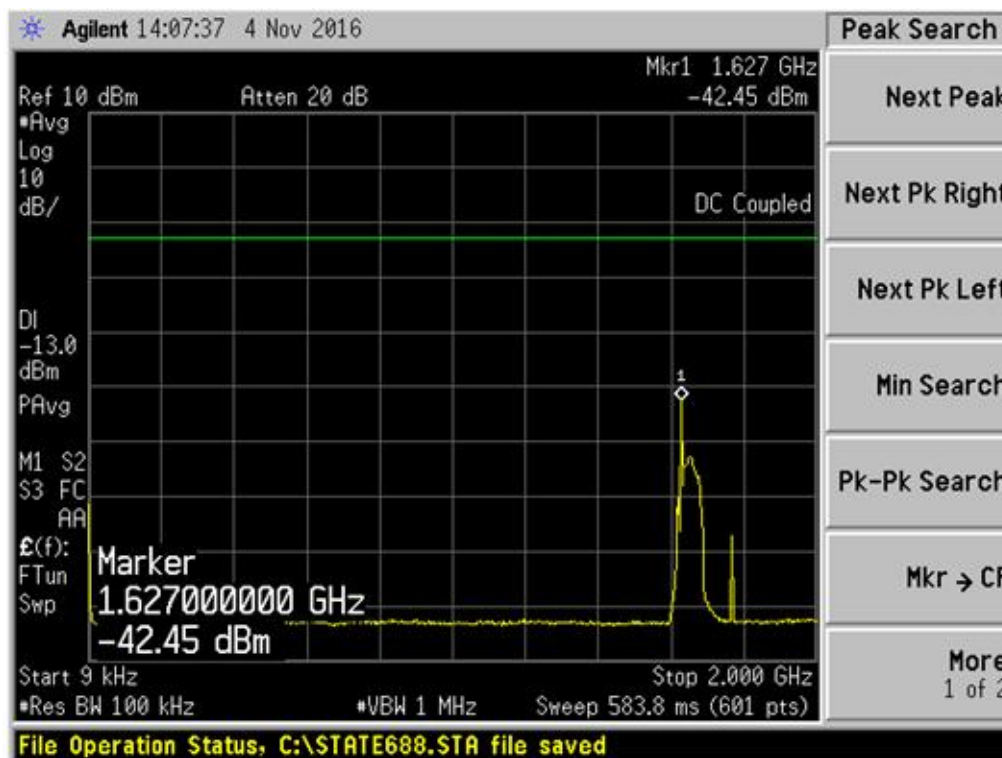
In Band Emissions Plots (Bearer Type: 11)



Plot 144 – High Channel

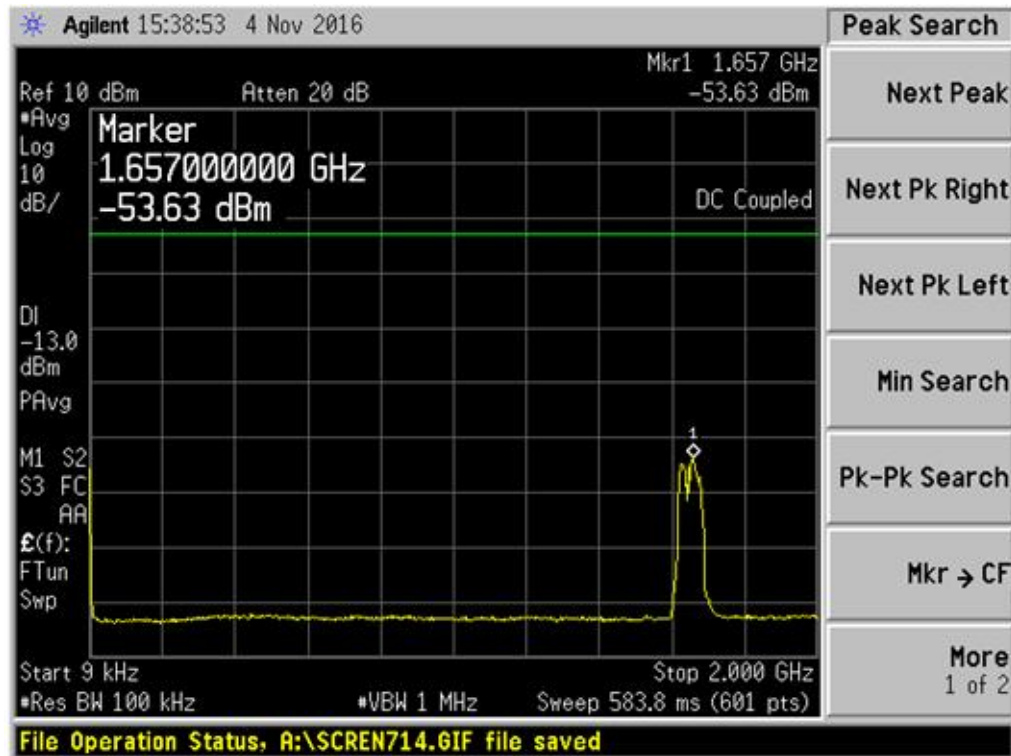
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 0)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 0)



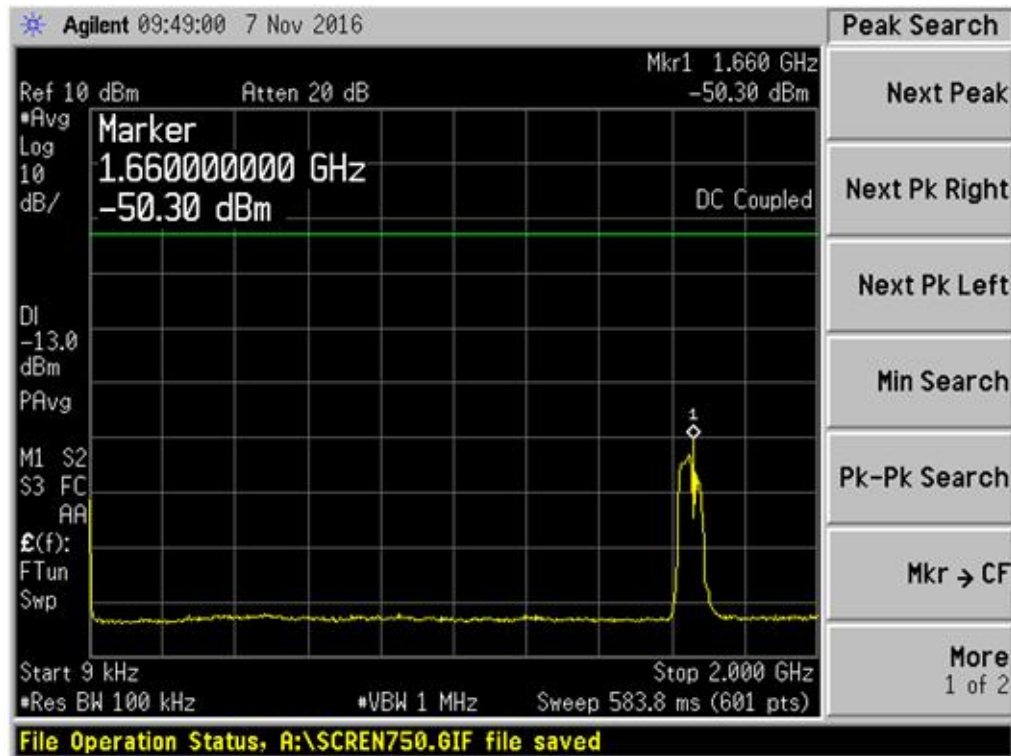
Plot 147 – Middle Channel



Plot 148 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 0)



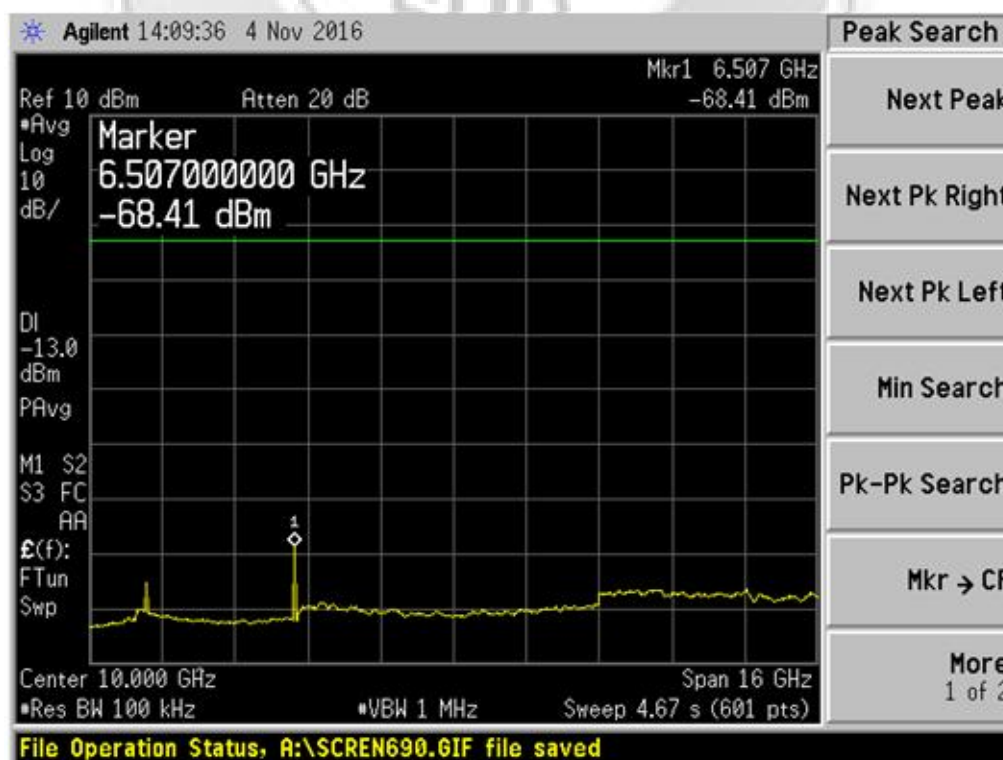
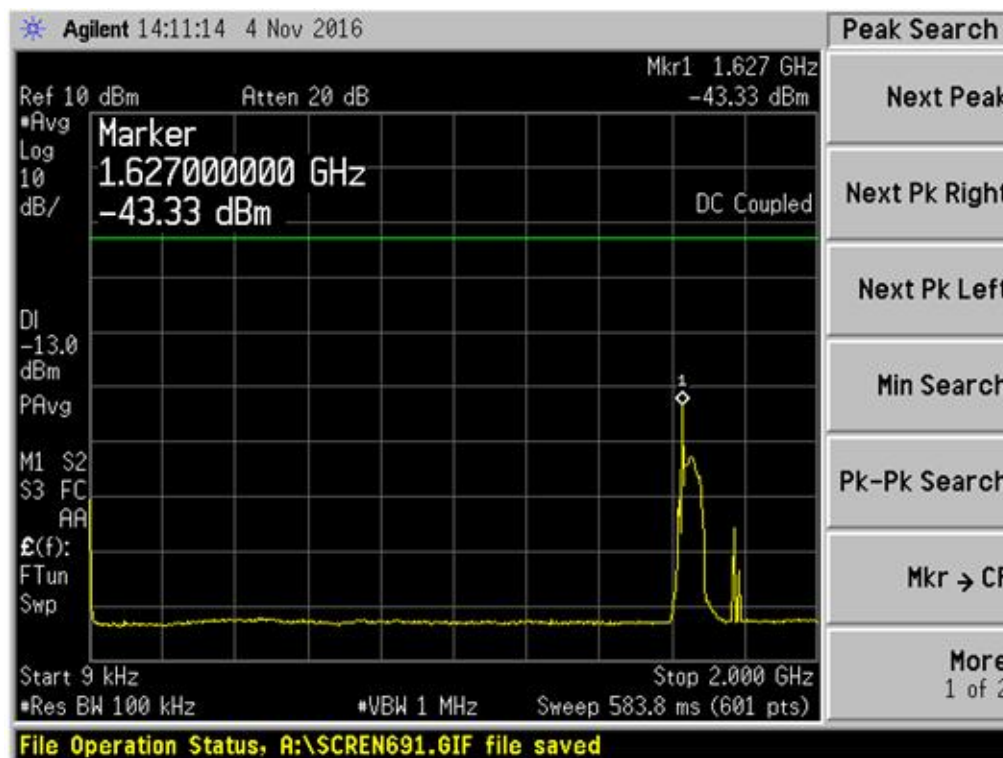
Plot 149 – Upper Channel



Plot 150 – Upper Channel

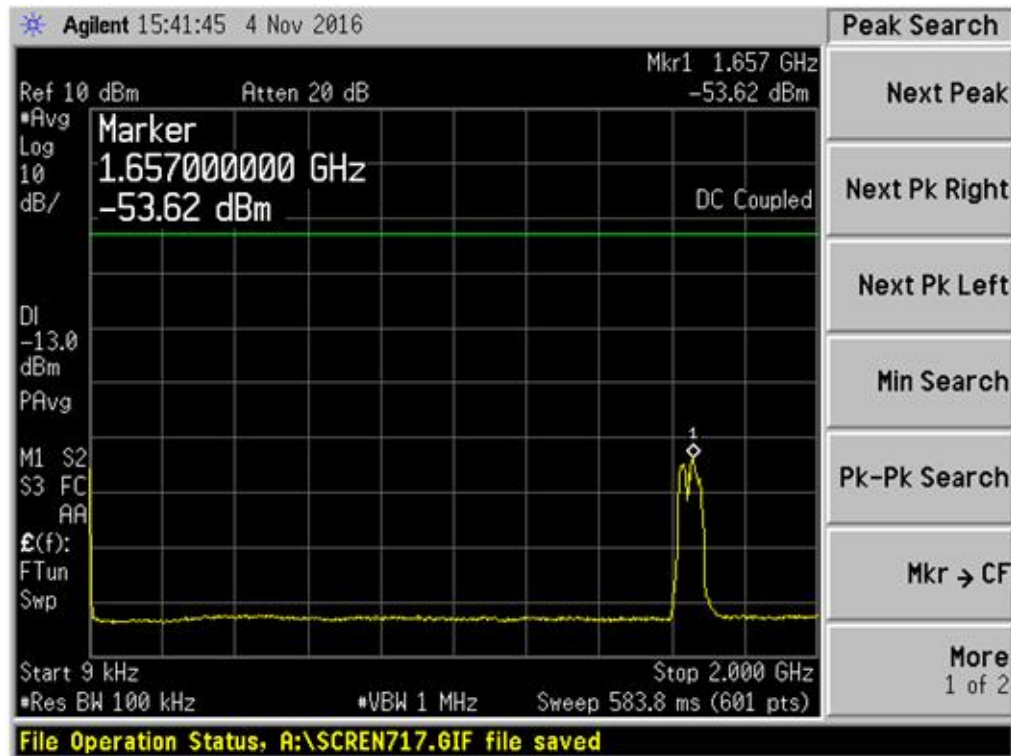
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 1)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 1)



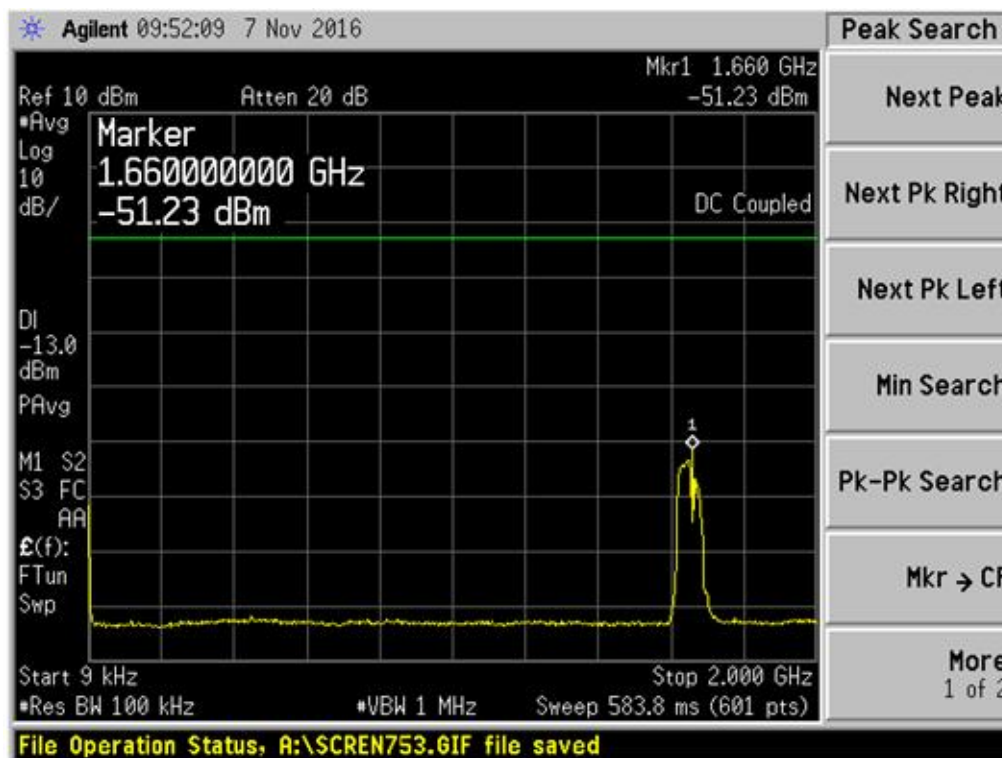
Plot 153 – Middle Channel



Plot 154 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 1)



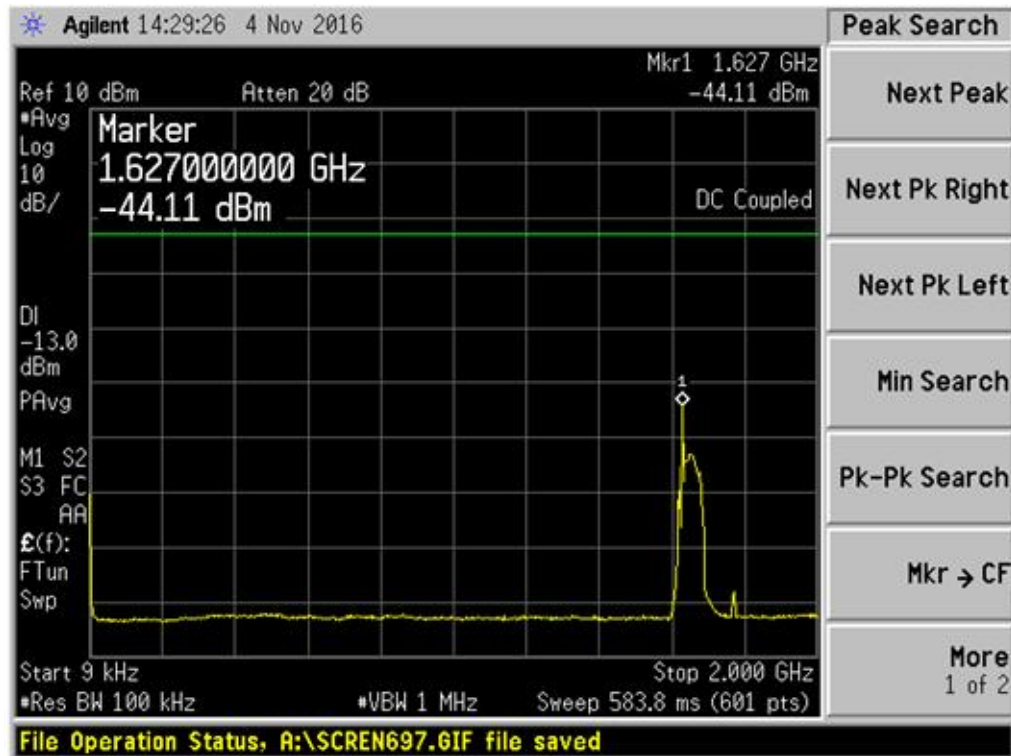
Plot 155 – Upper Channel



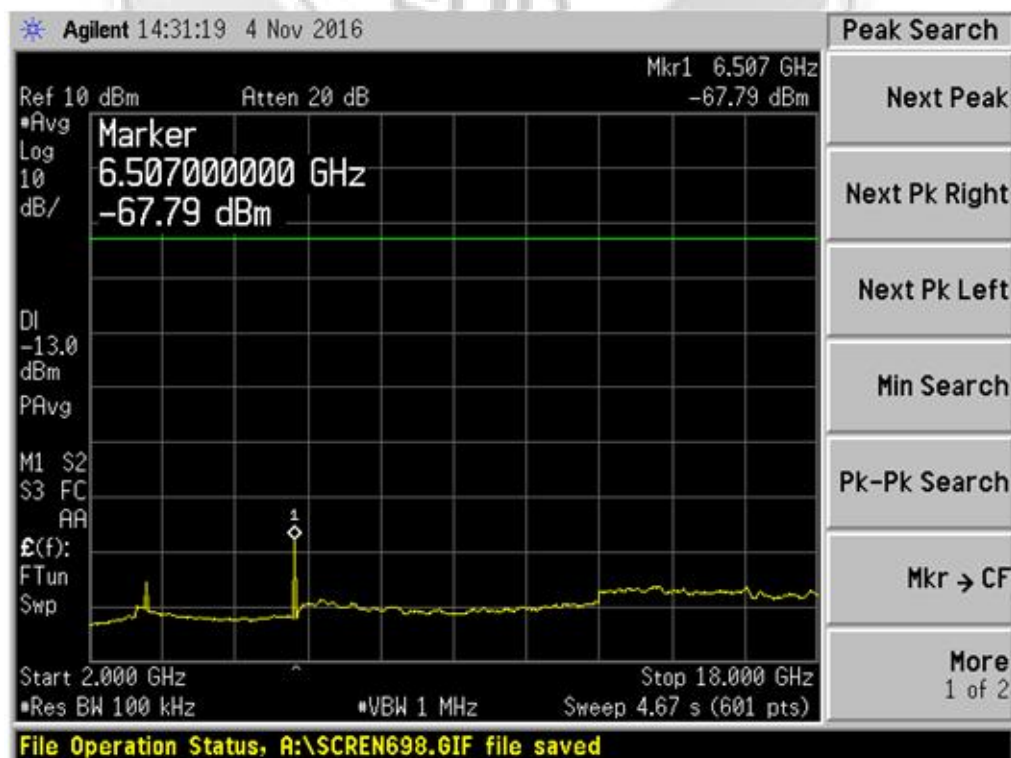
Plot 156 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 2)



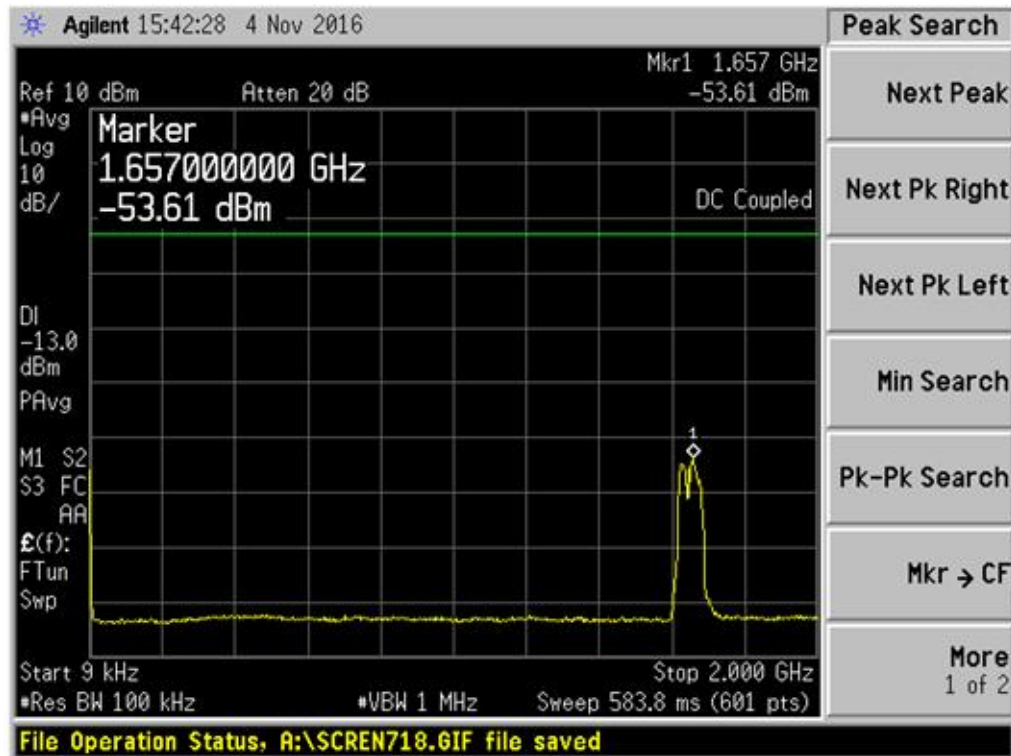
Plot 157 – Lower Channel



Plot 158 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 2)



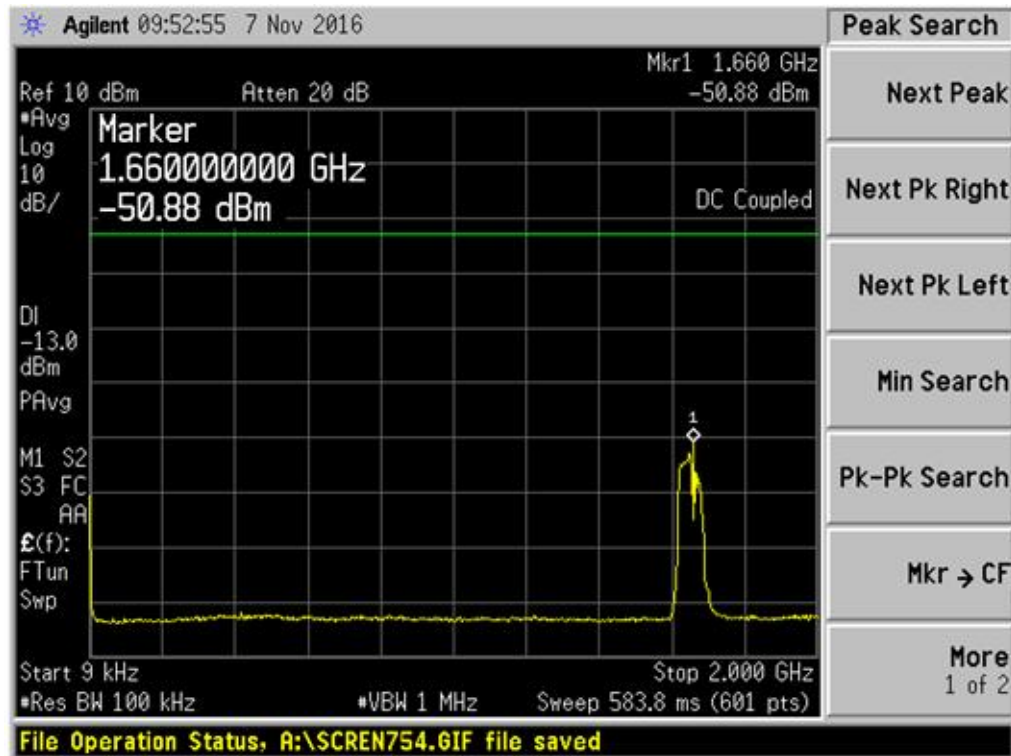
Plot 159 – Middle Channel



Plot 160 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 2)



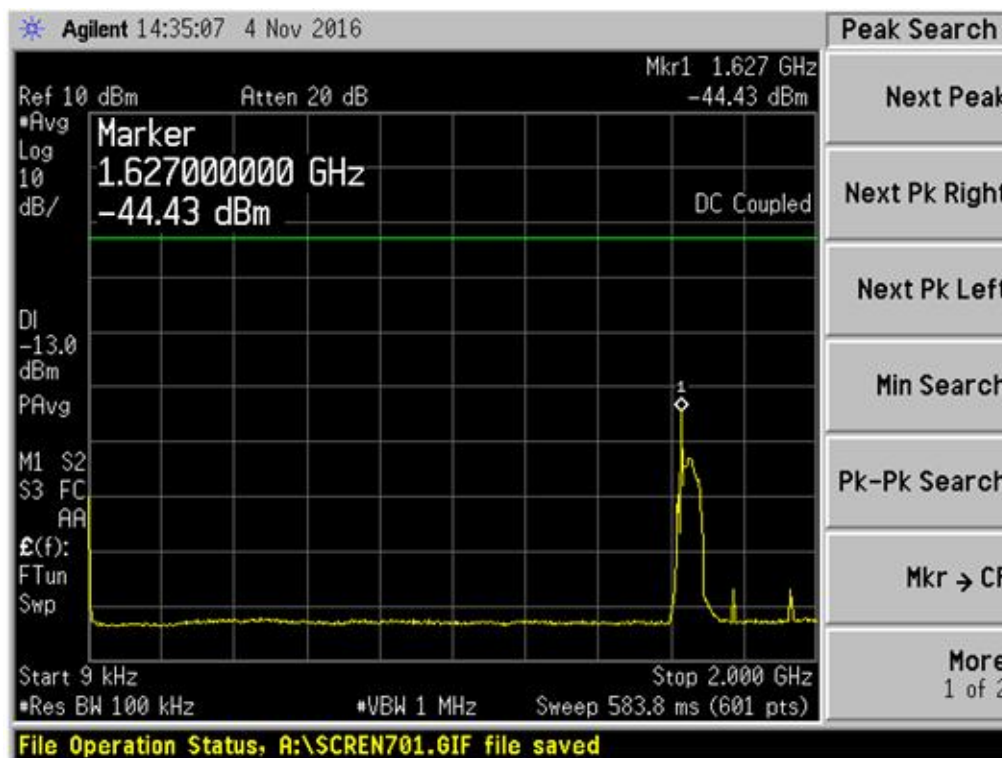
Plot 161 – Upper Channel



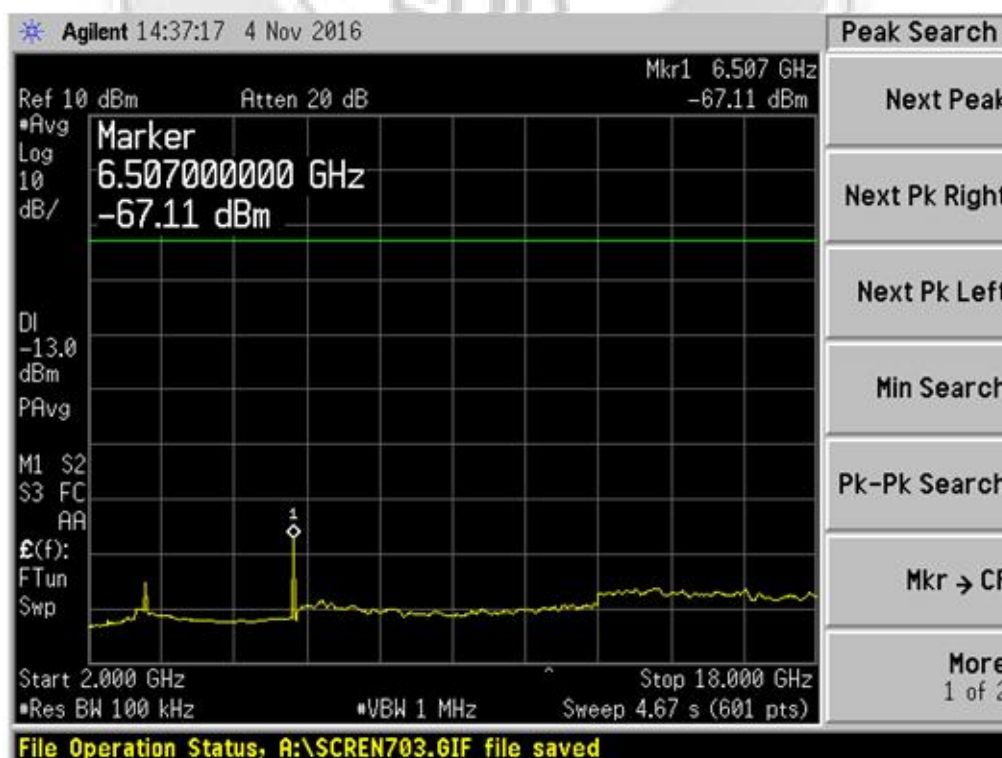
Plot 162 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 3)



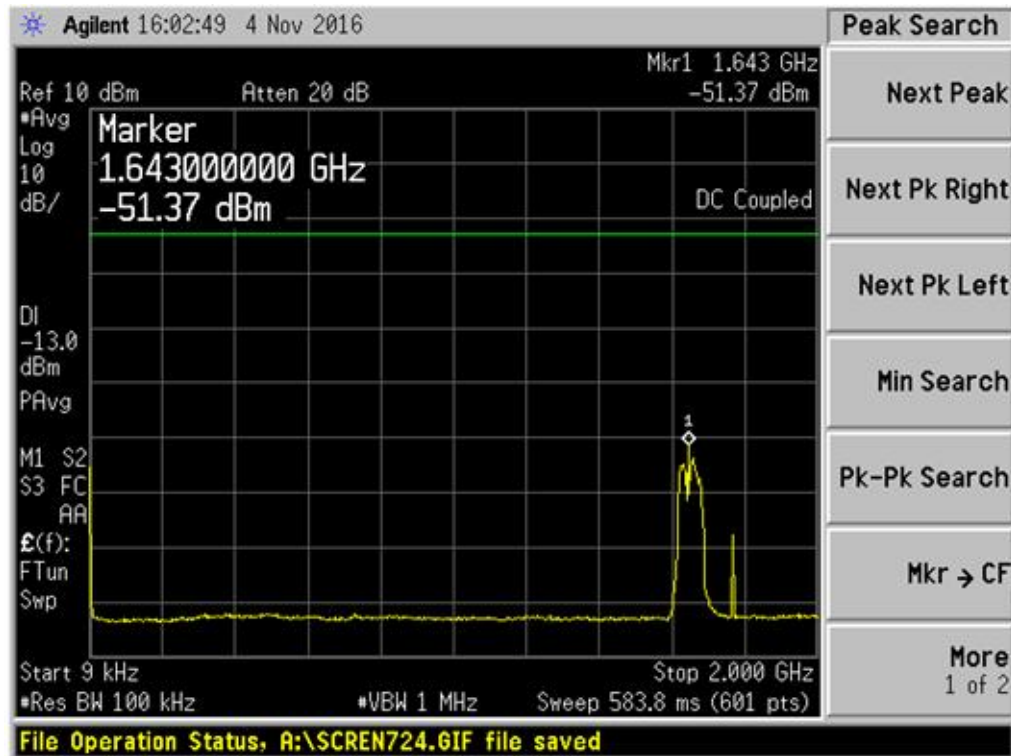
Plot 163 – Lower Channel



Plot 164 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 3)



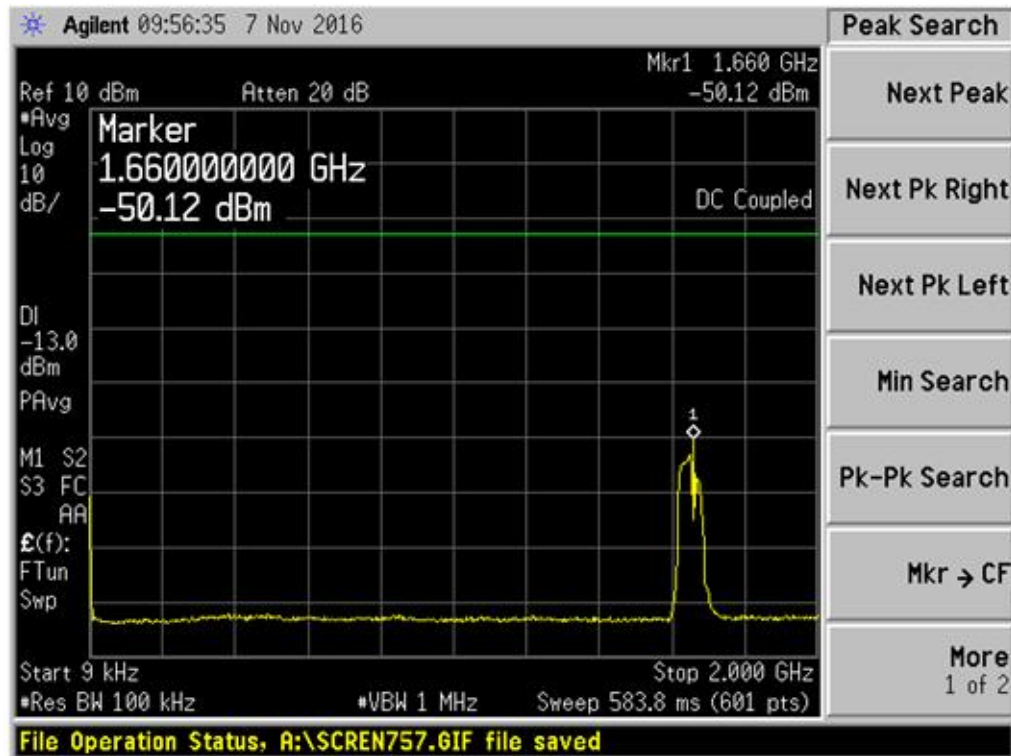
Plot 165 – Middle Channel



Plot 166 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 3)



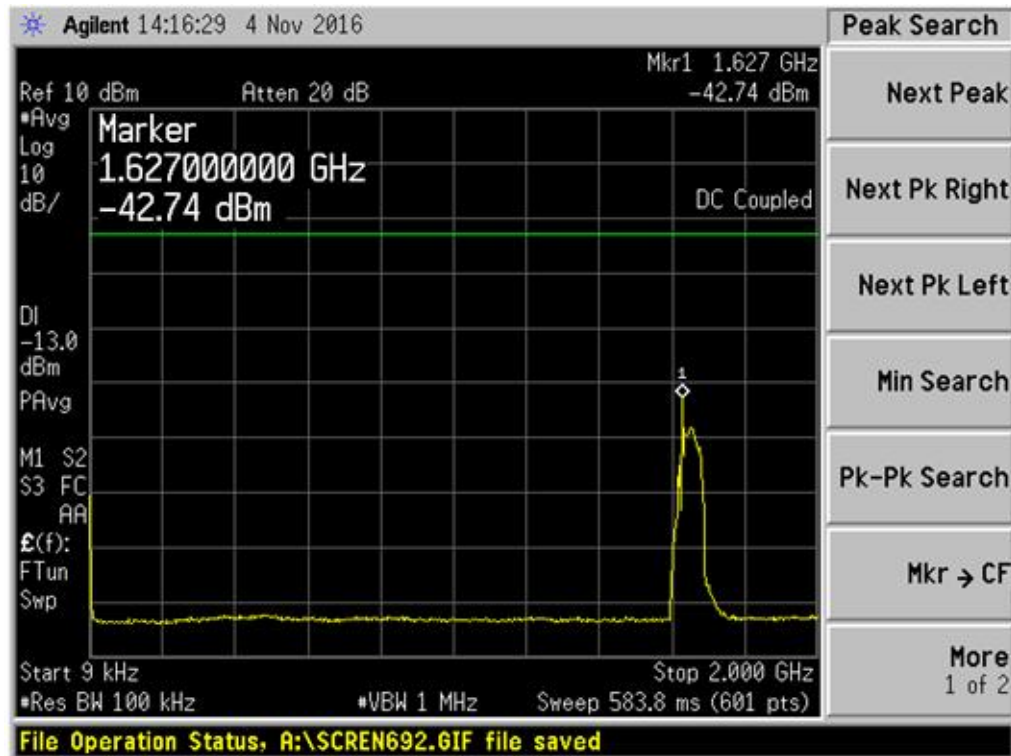
Plot 167 – Upper Channel



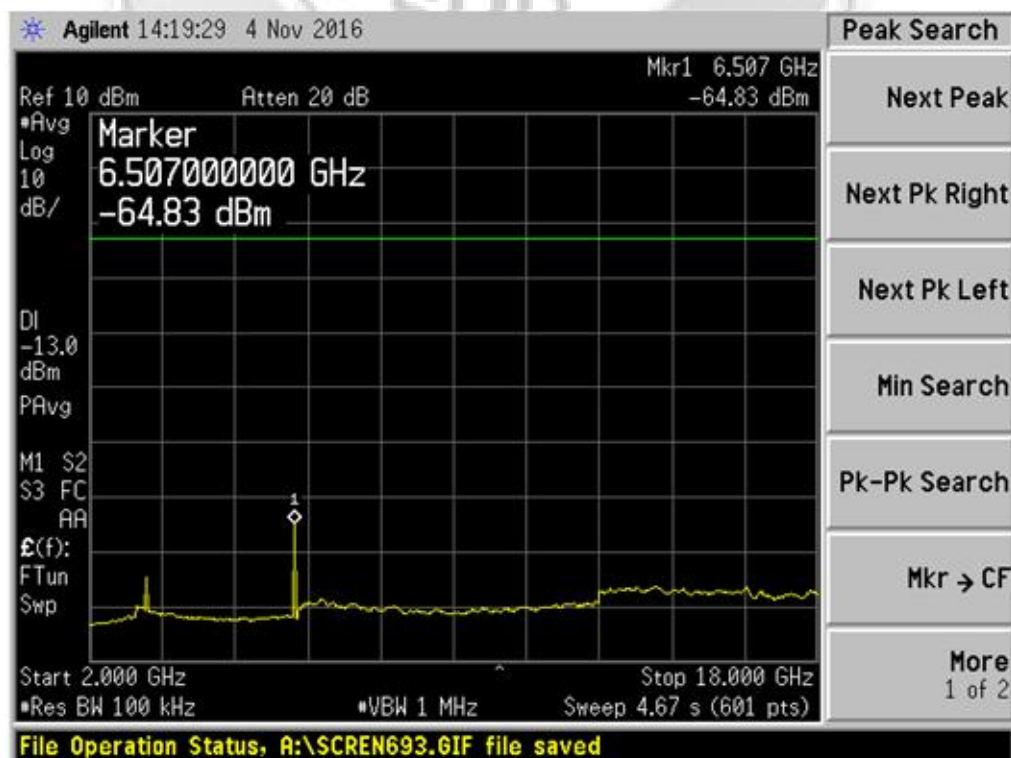
Plot 168 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 4)



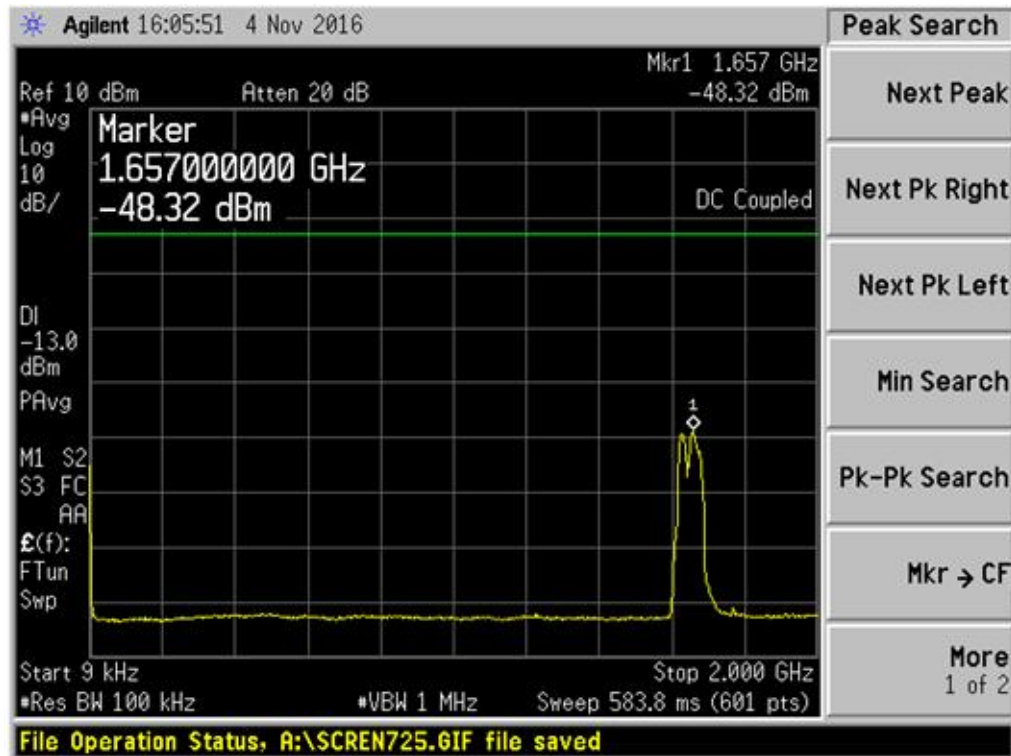
Plot 169 – Lower Channel



Plot 170 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 4)



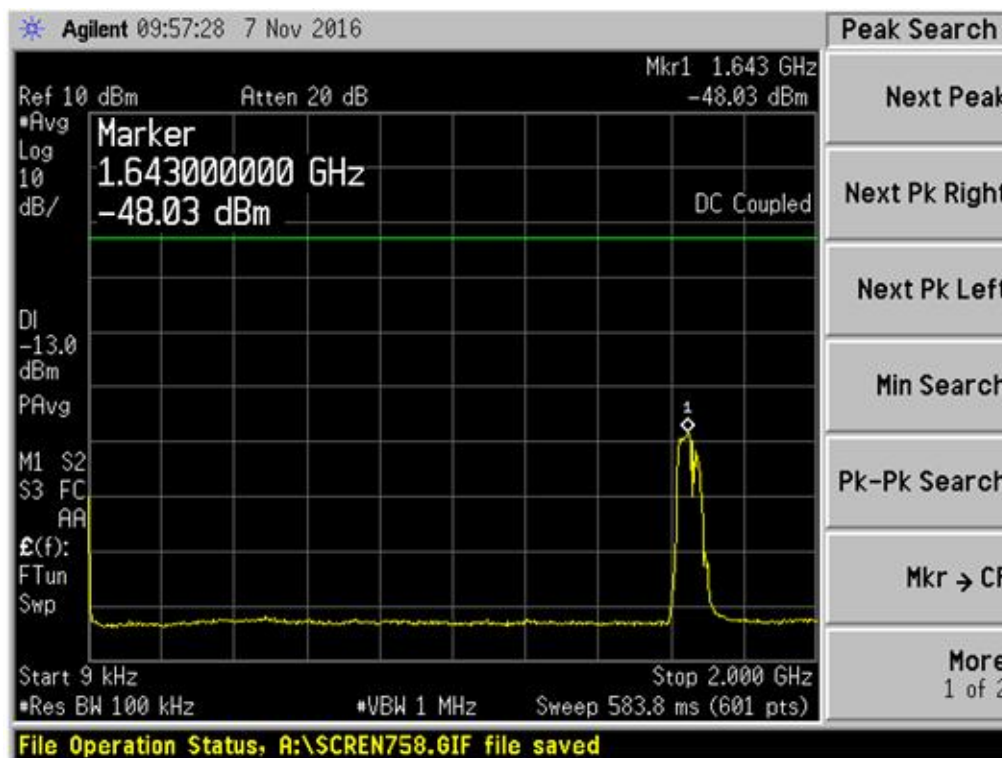
Plot 171 – Middle Channel



Plot 172 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 4)



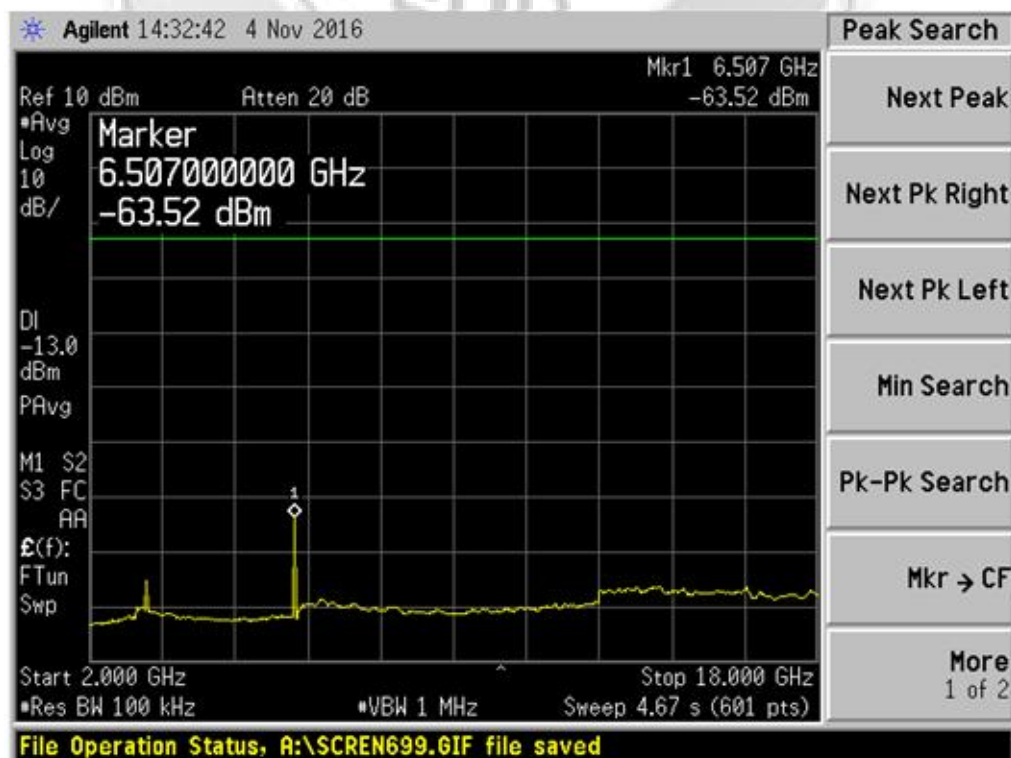
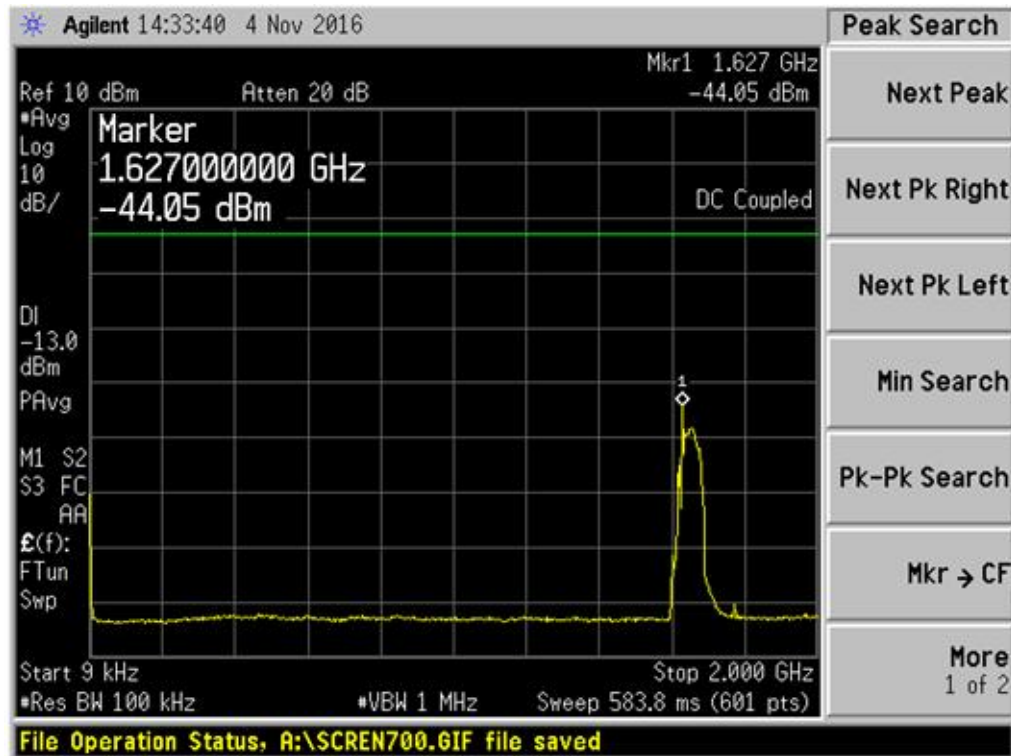
Plot 173 – Upper Channel



Plot 174 – Upper Channel

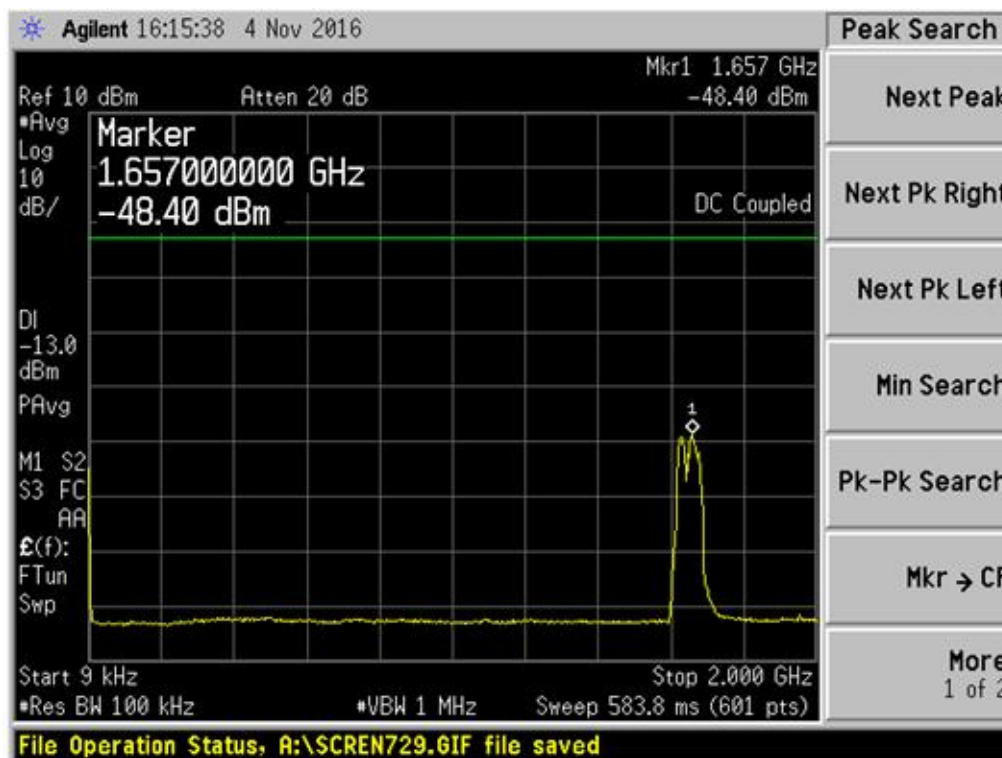
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 5)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 5)



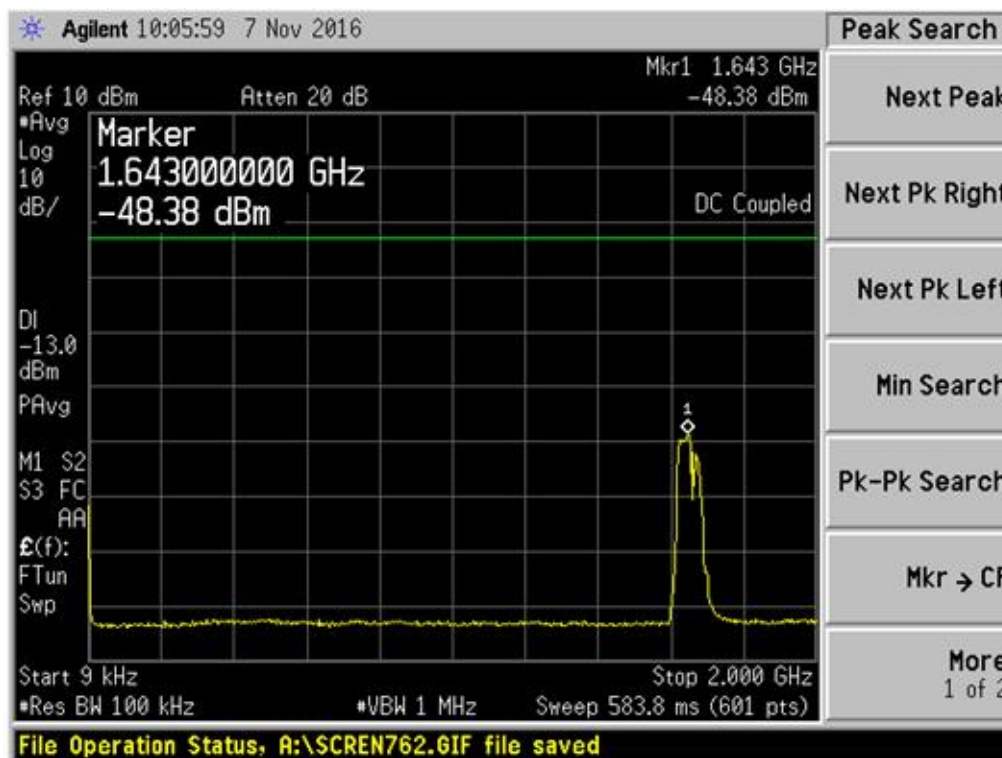
Plot 177 – Middle Channel



Plot 178 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 5)



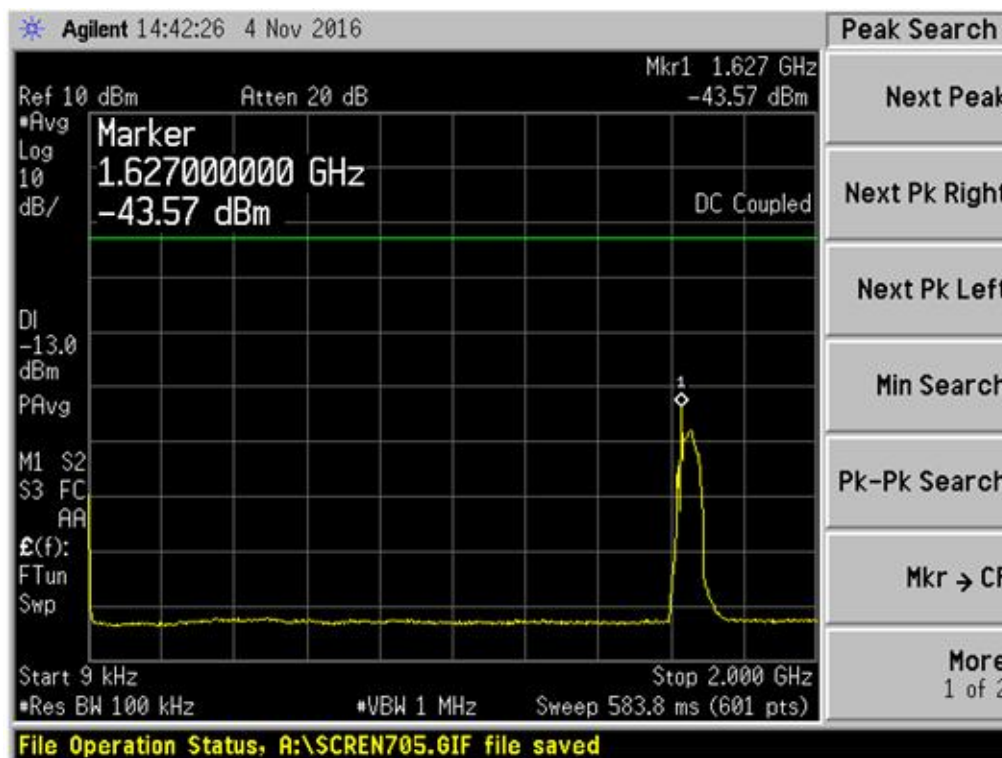
Plot 179 – Upper Channel



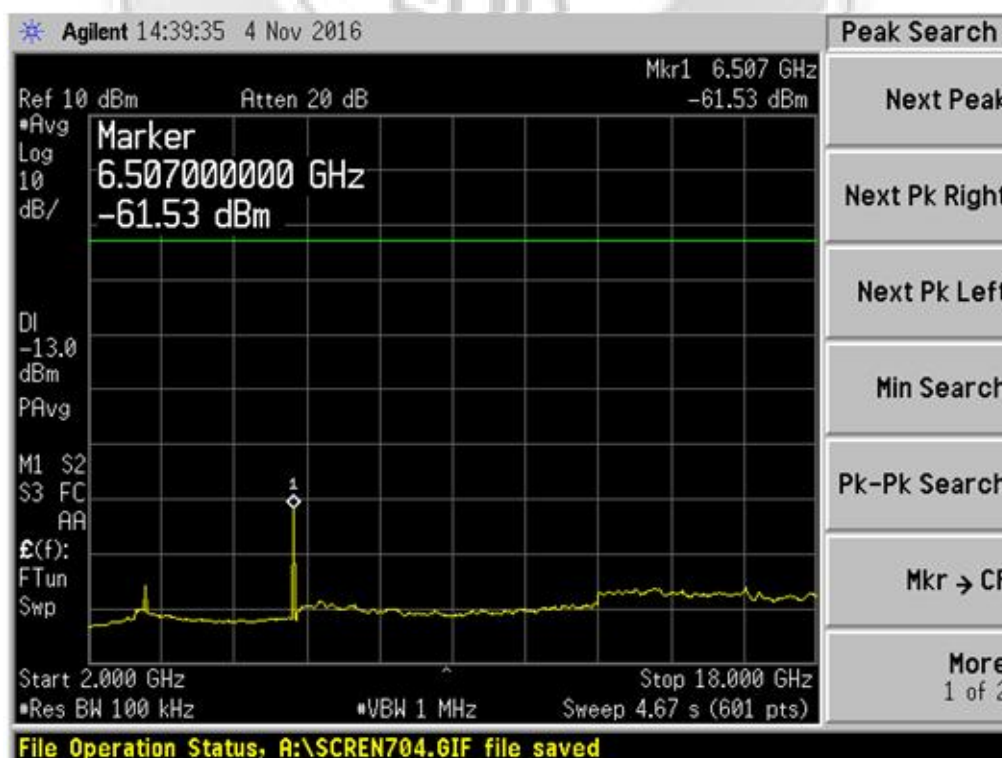
Plot 180 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 6)



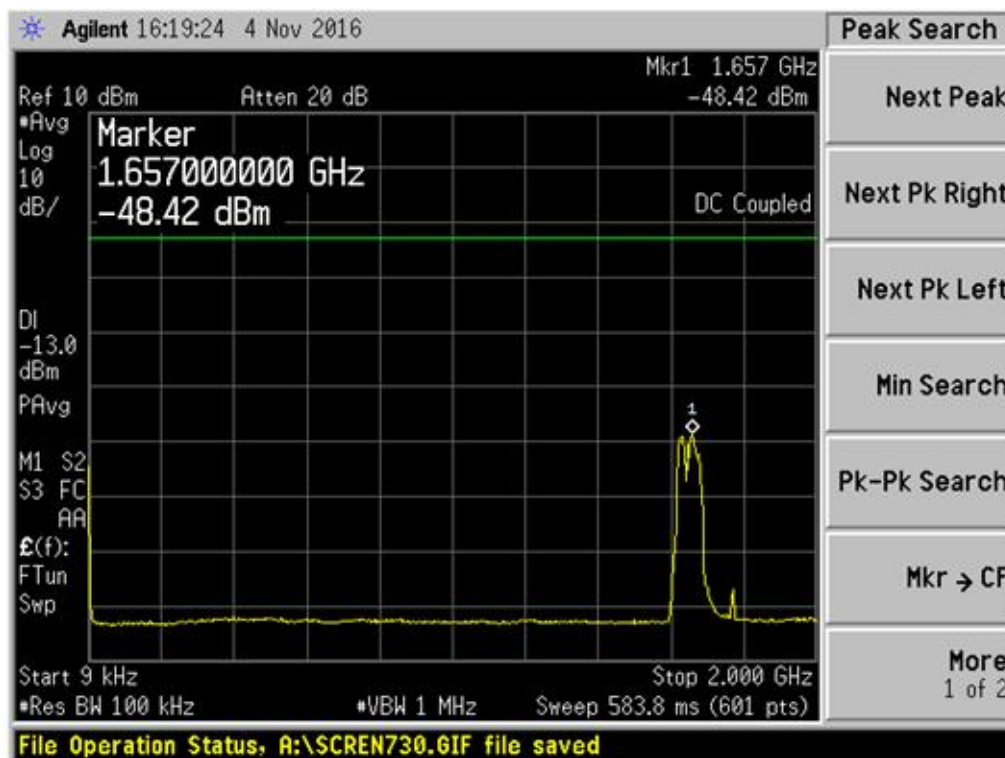
Plot 181 – Lower Channel



Plot 182 – Lower Channel

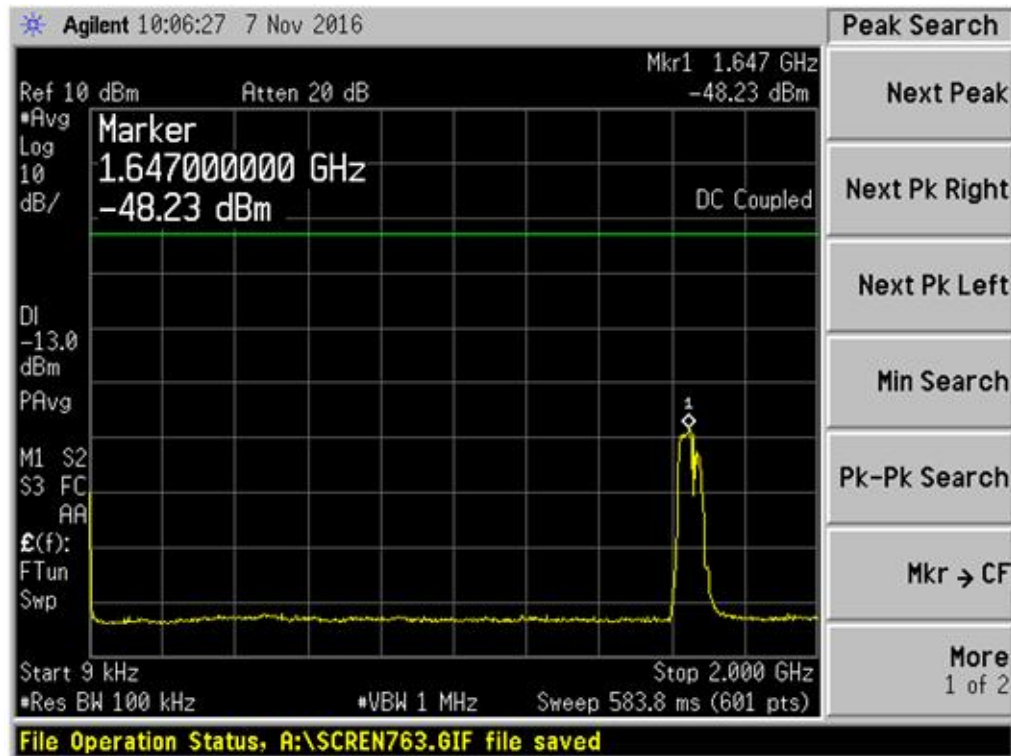
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 6)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 6)



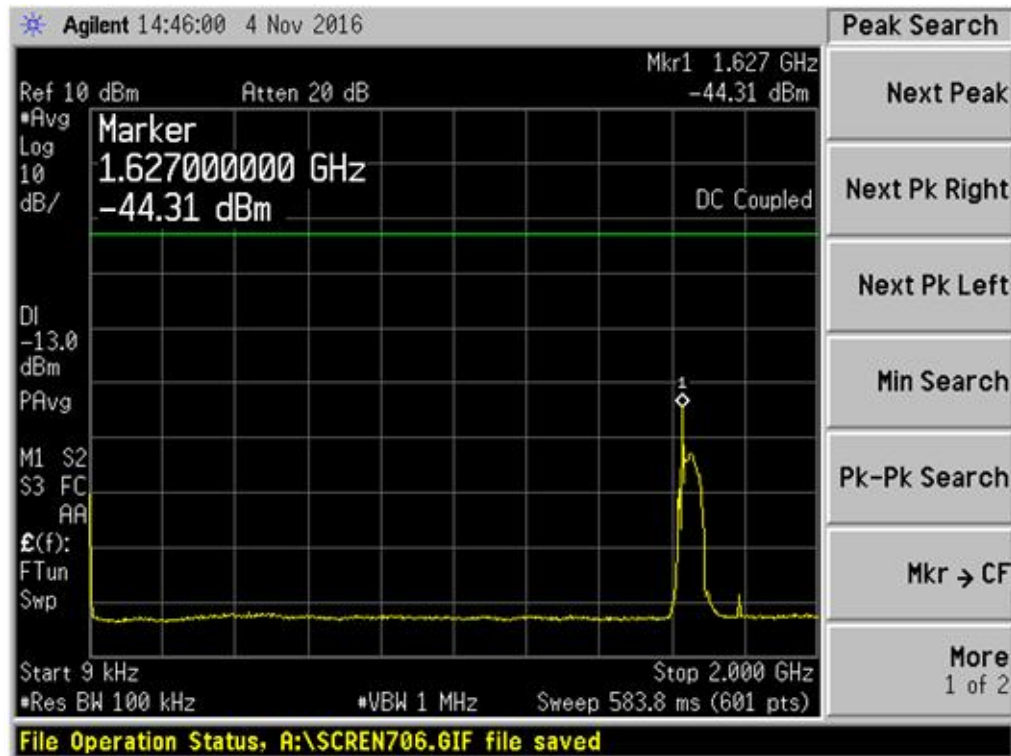
Plot 185 – Upper Channel



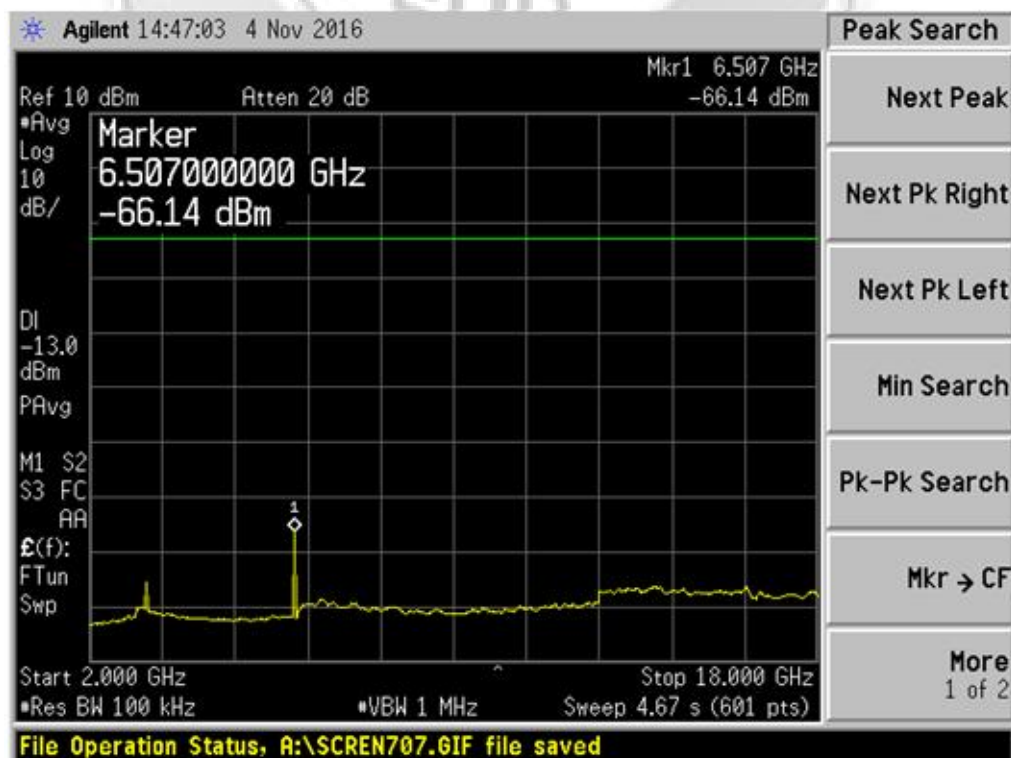
Plot 186 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 7)



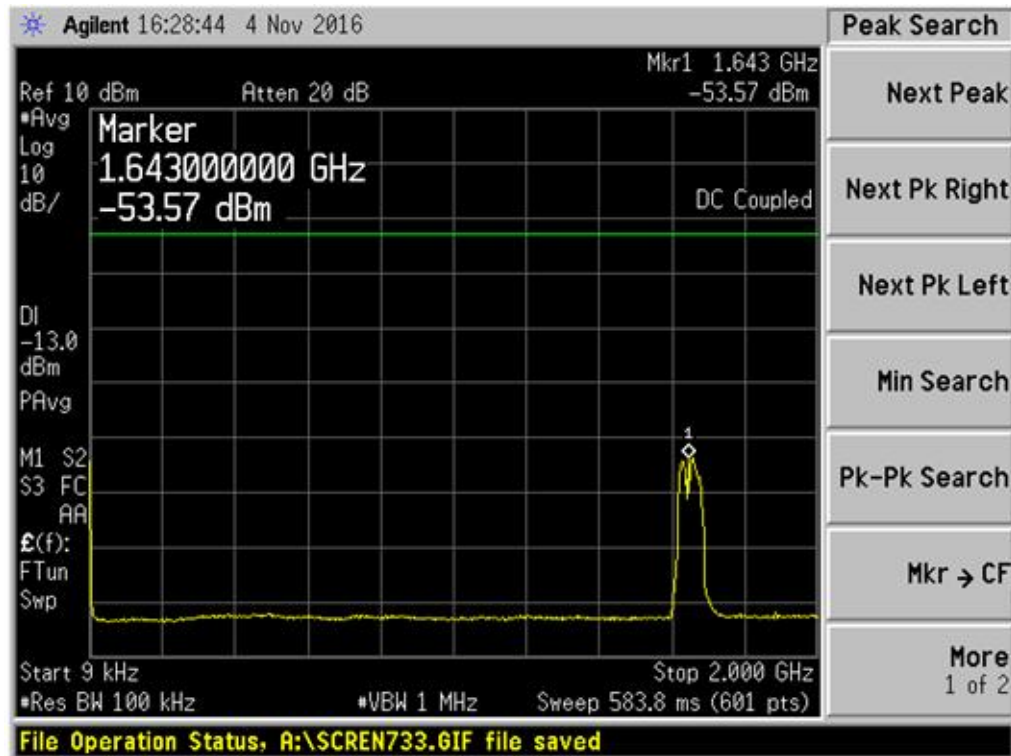
Plot 187 – Lower Channel



Plot 188 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 7)



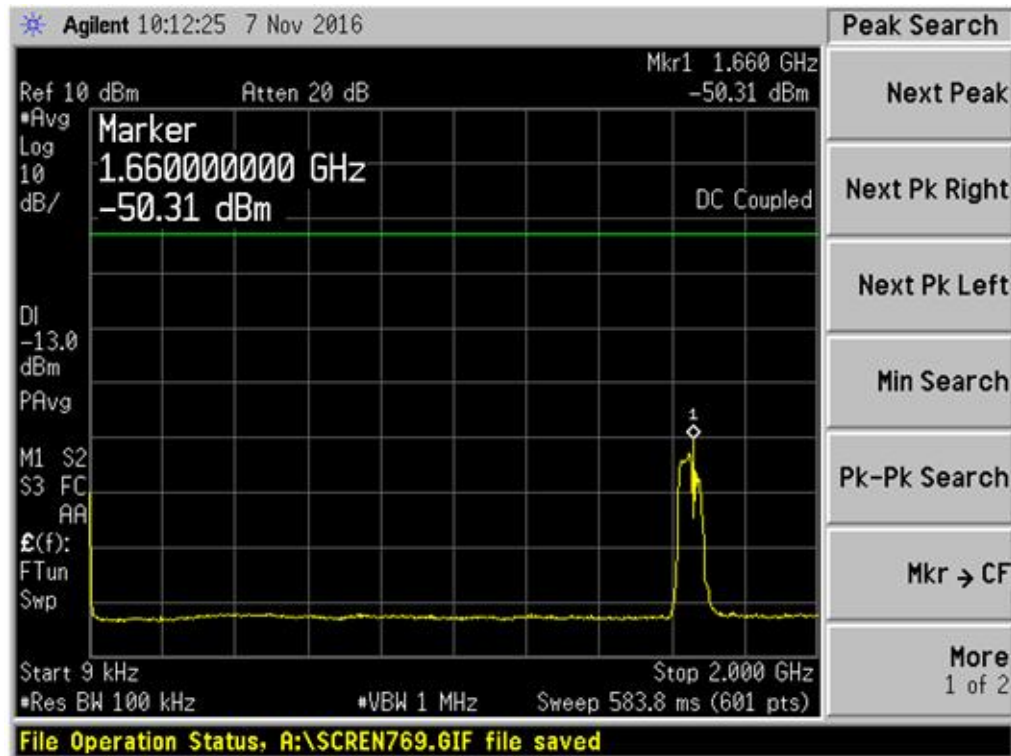
Plot 189 – Middle Channel



Plot 190 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 7)



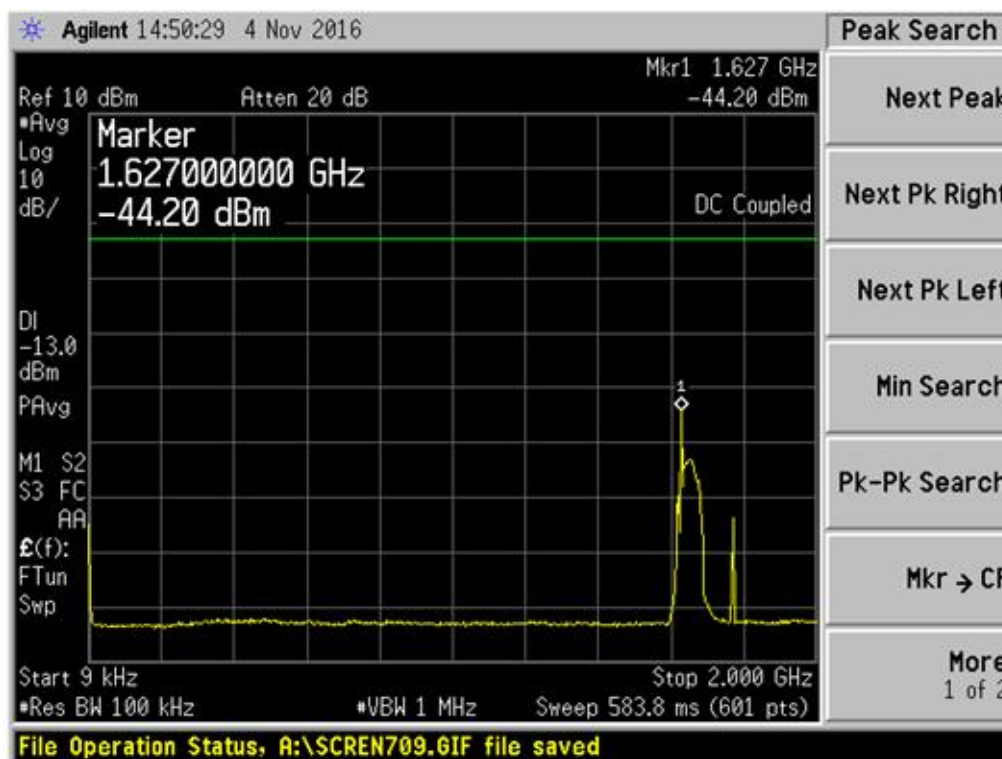
Plot 191 – Upper Channel



Plot 192 – Upper Channel

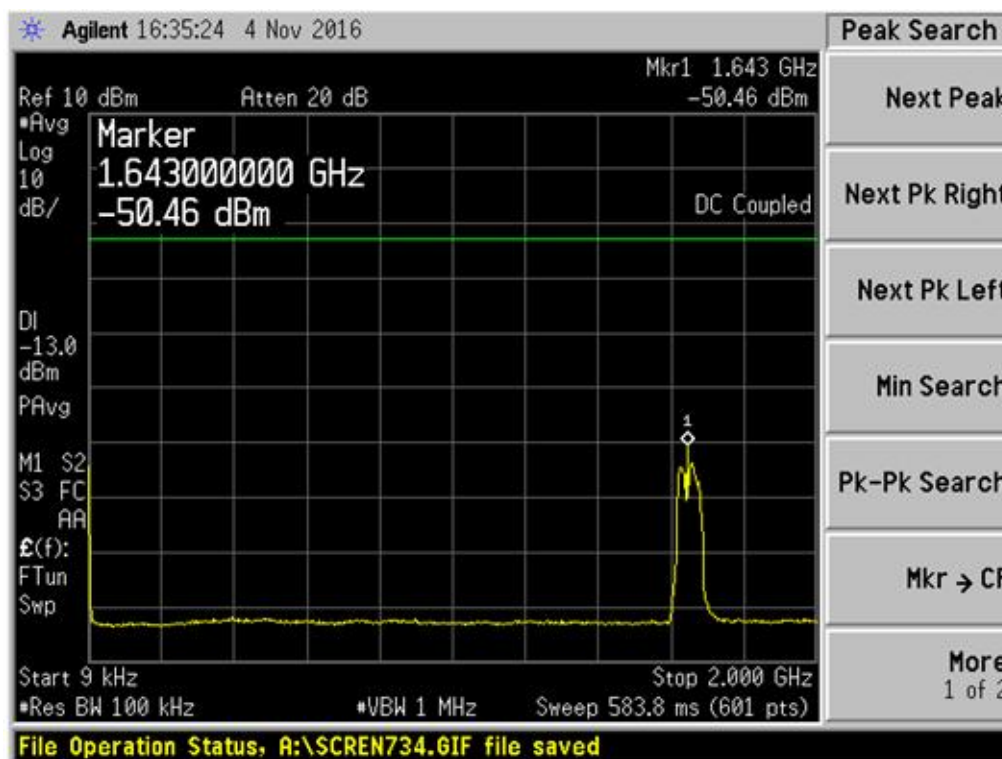
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 8)



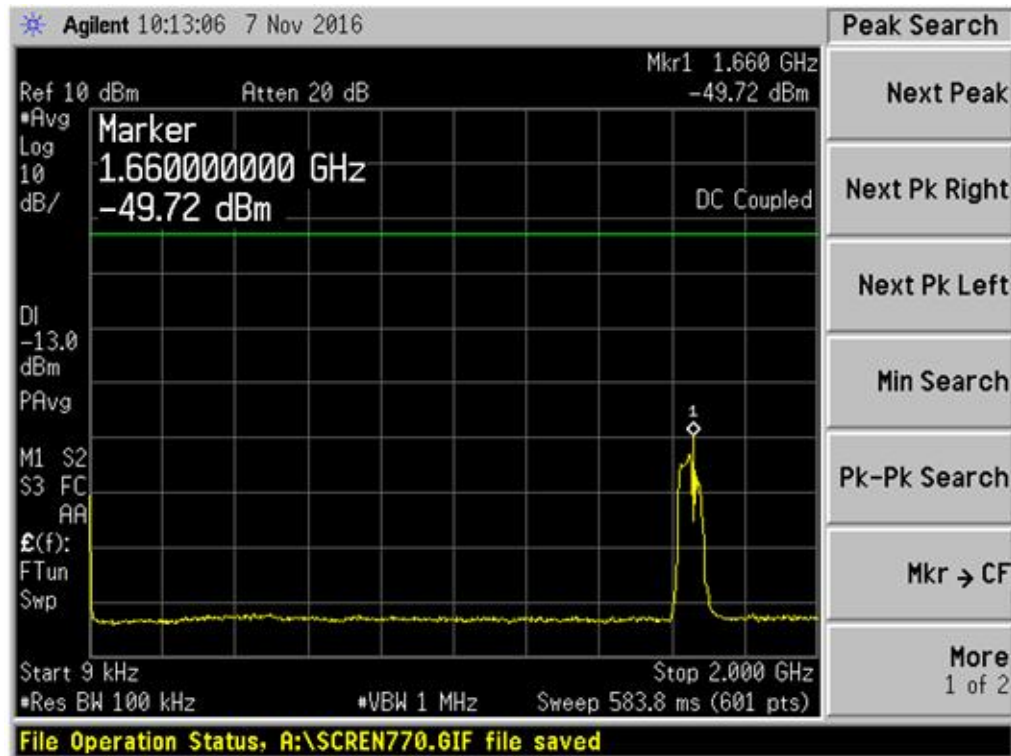
UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 8)



UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 8)



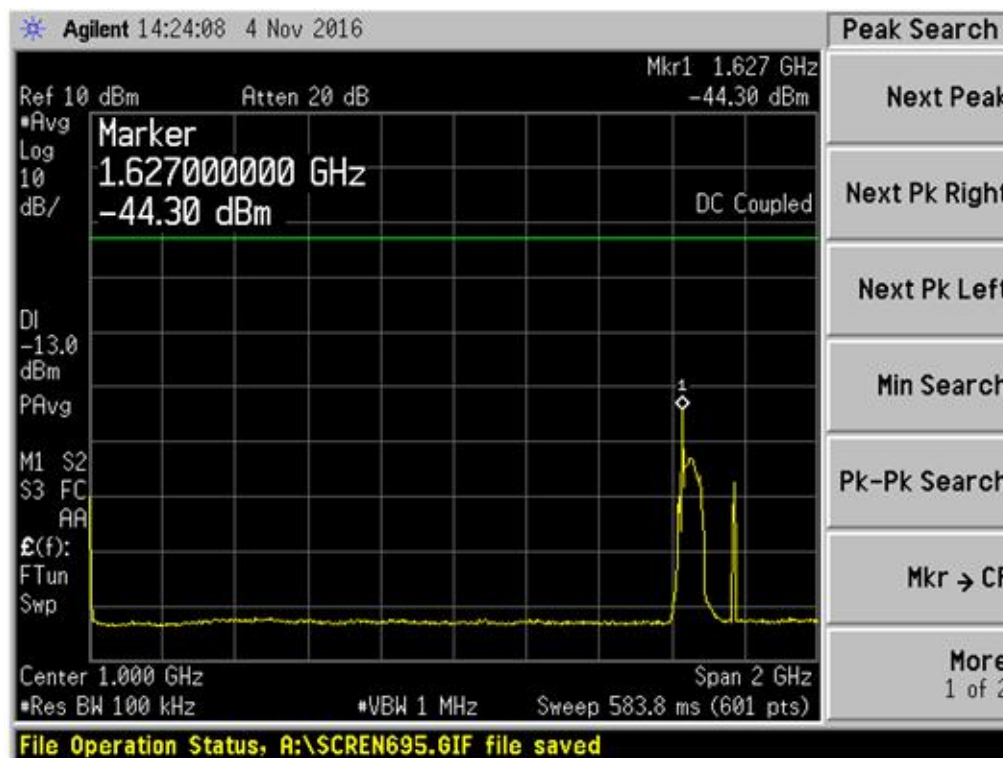
Plot 197 – Upper Channel



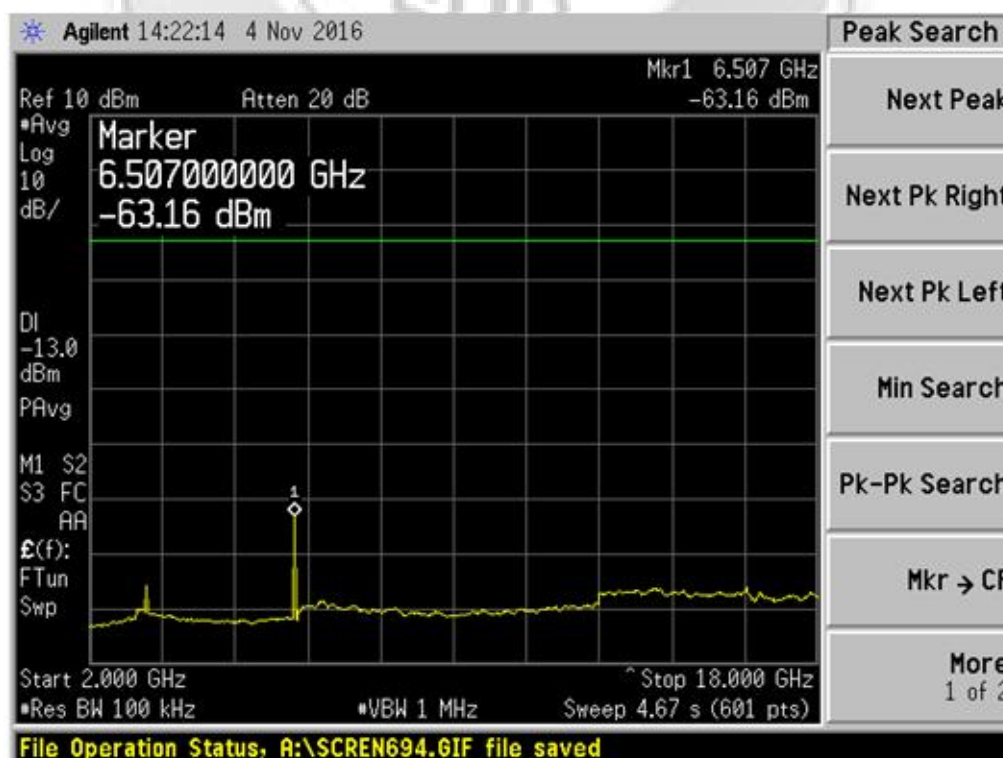
Plot 198 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 9)



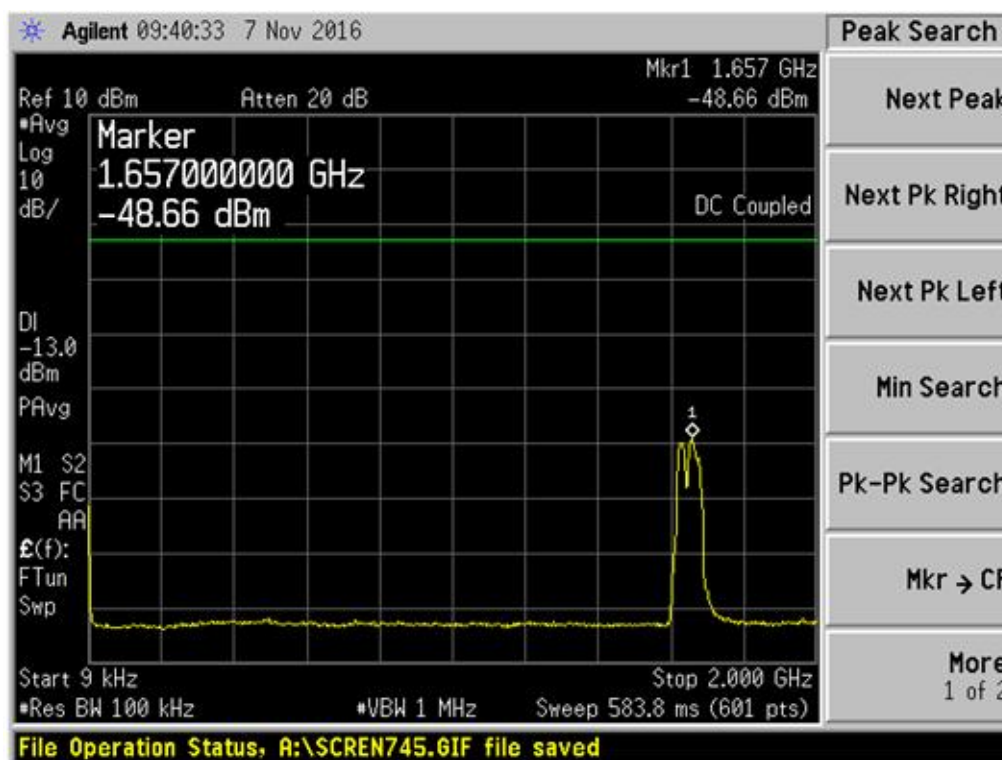
Plot 199 – Lower Channel



Plot 200 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 9)



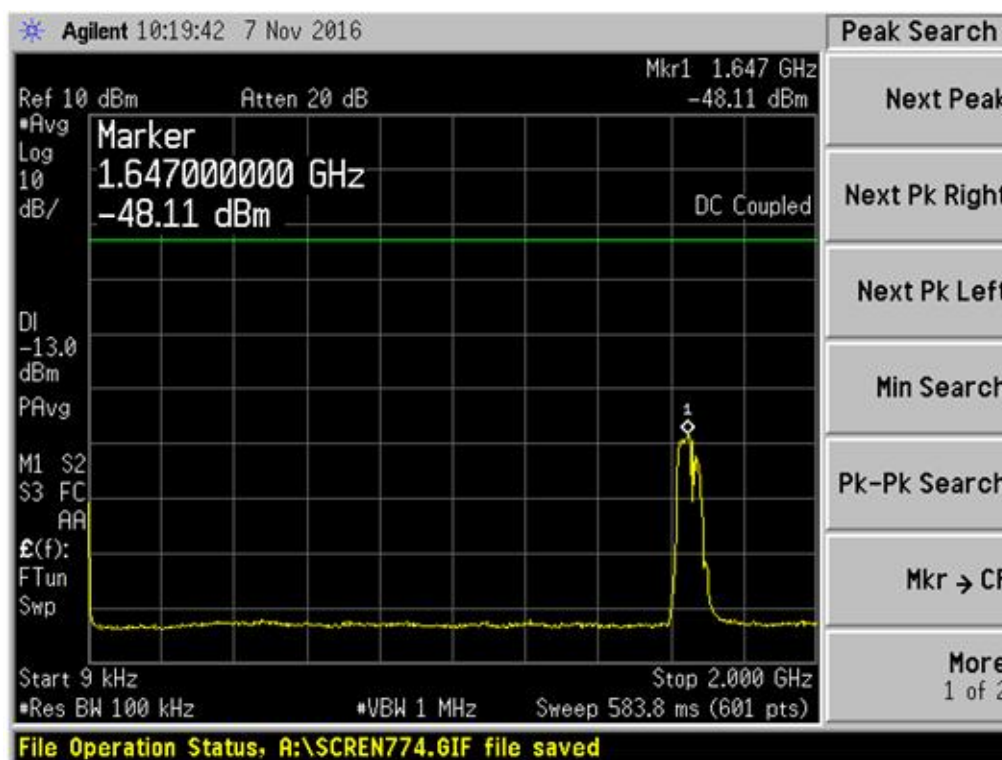
Plot 201 – Middle Channel



Plot 202 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 9)



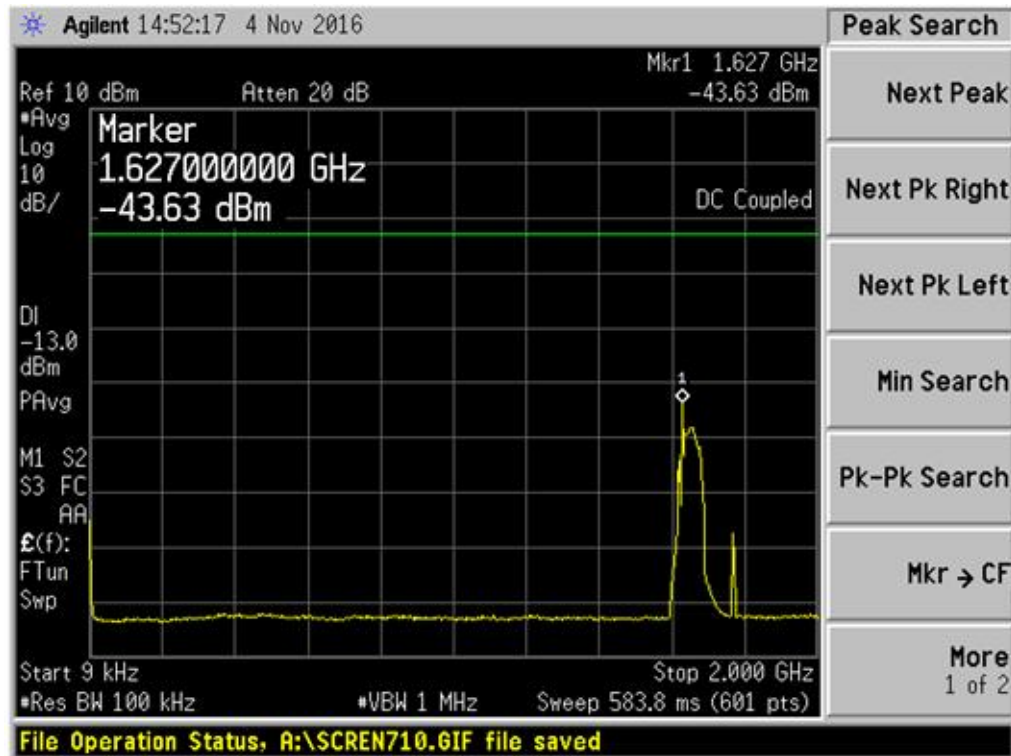
Plot 203 – Upper Channel



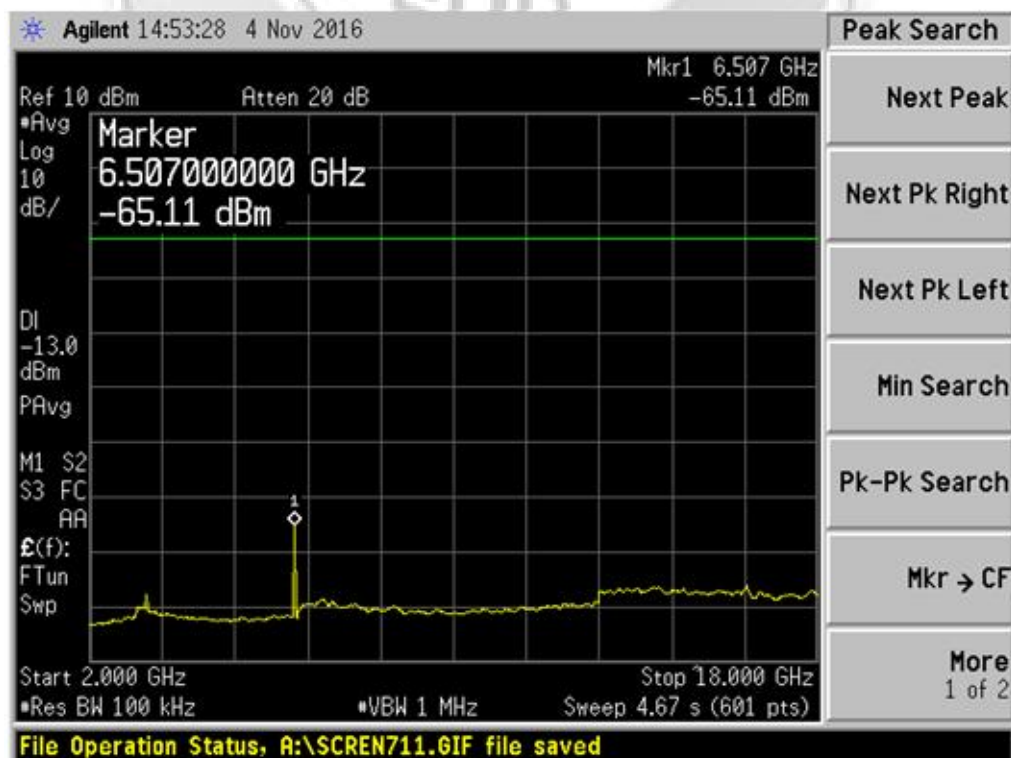
Plot 204 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 10)



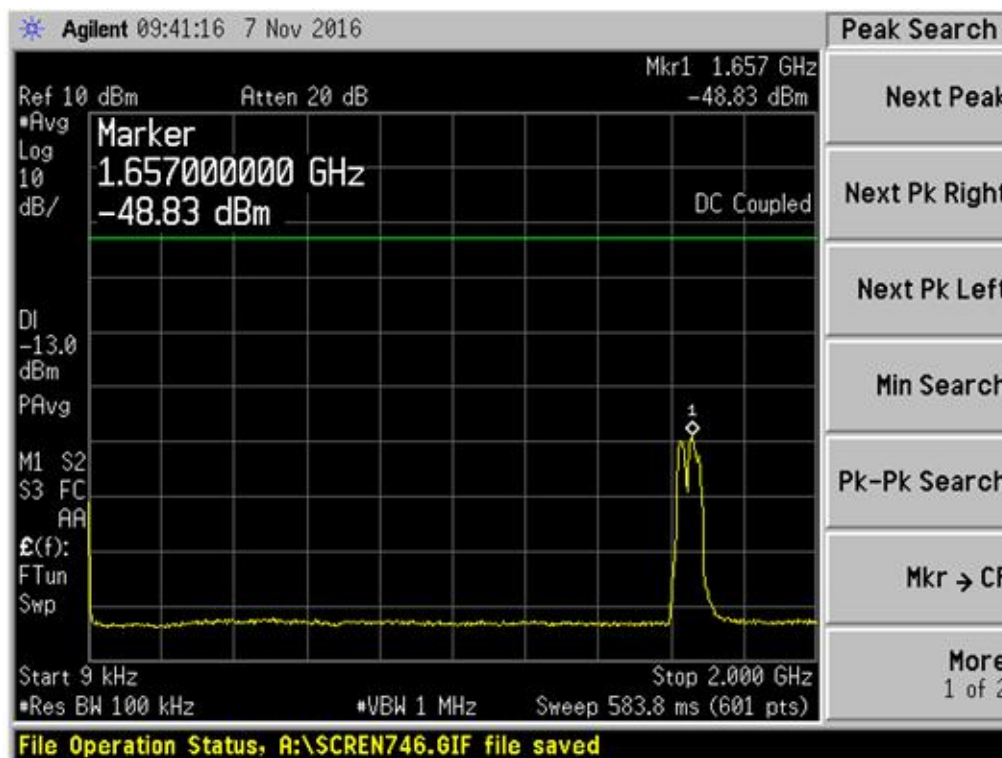
Plot 205 – Lower Channel



Plot 206 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 10)



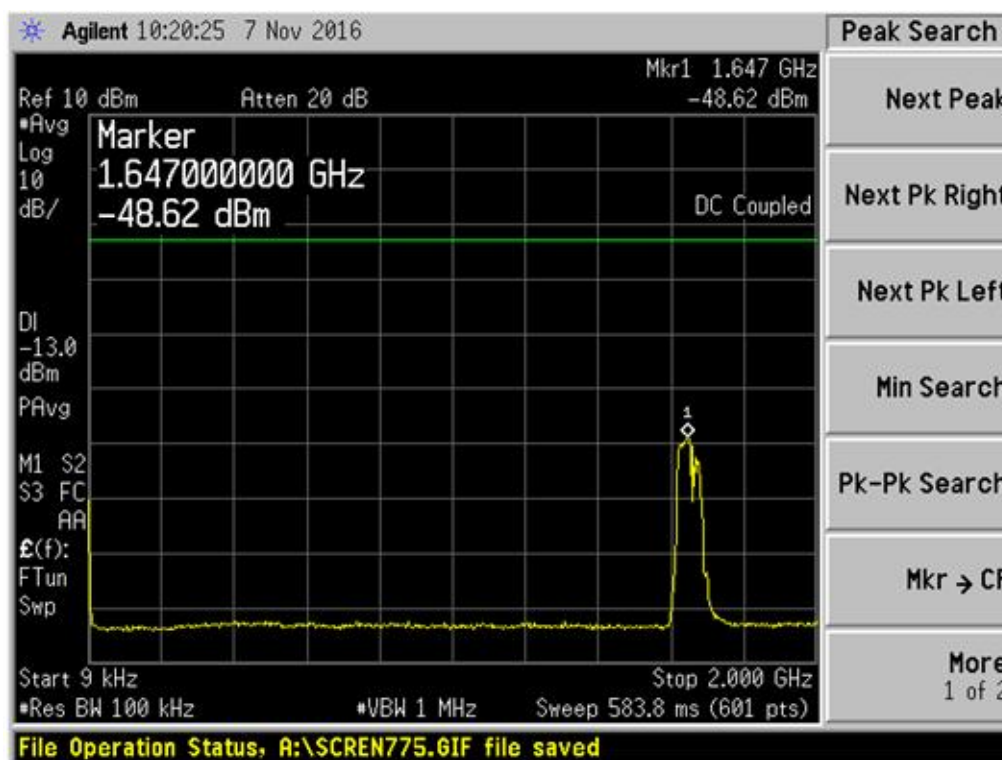
Plot 207 – Middle Channel



Plot 208 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 10)



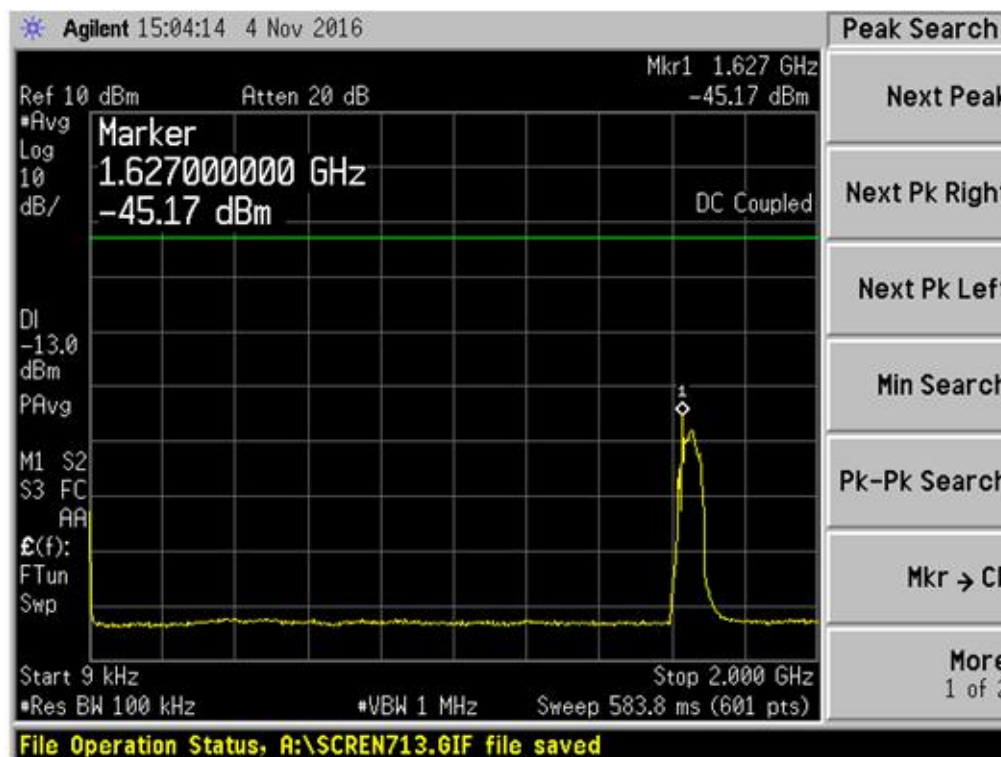
Plot 209 – Upper Channel



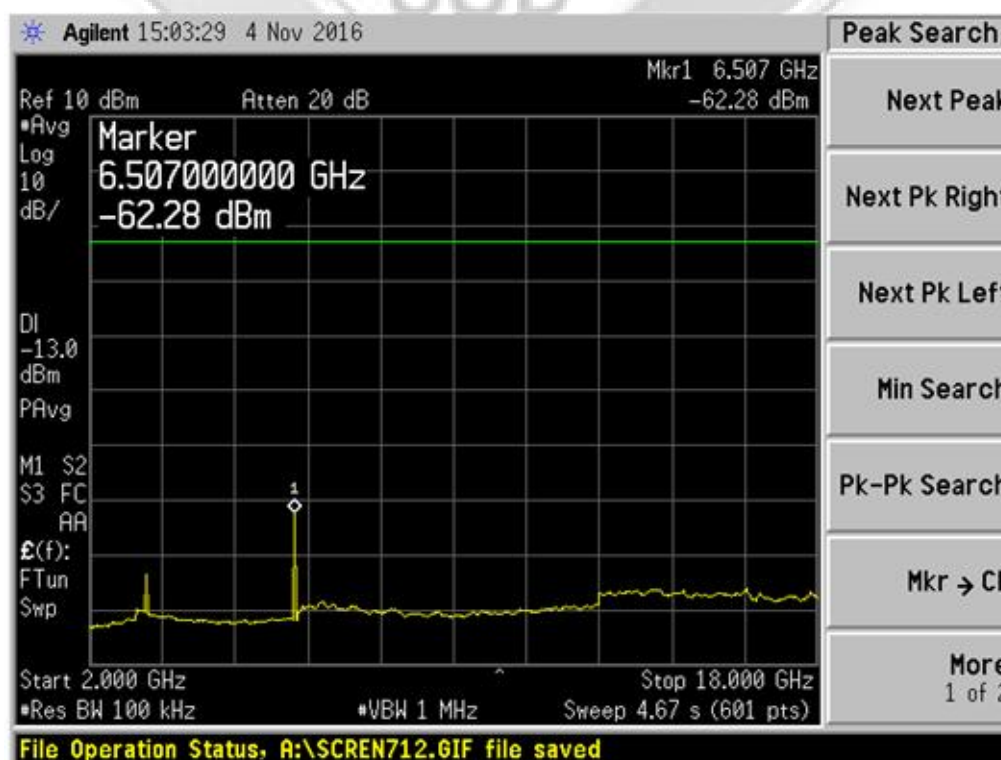
Plot 210 – Upper Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 11)



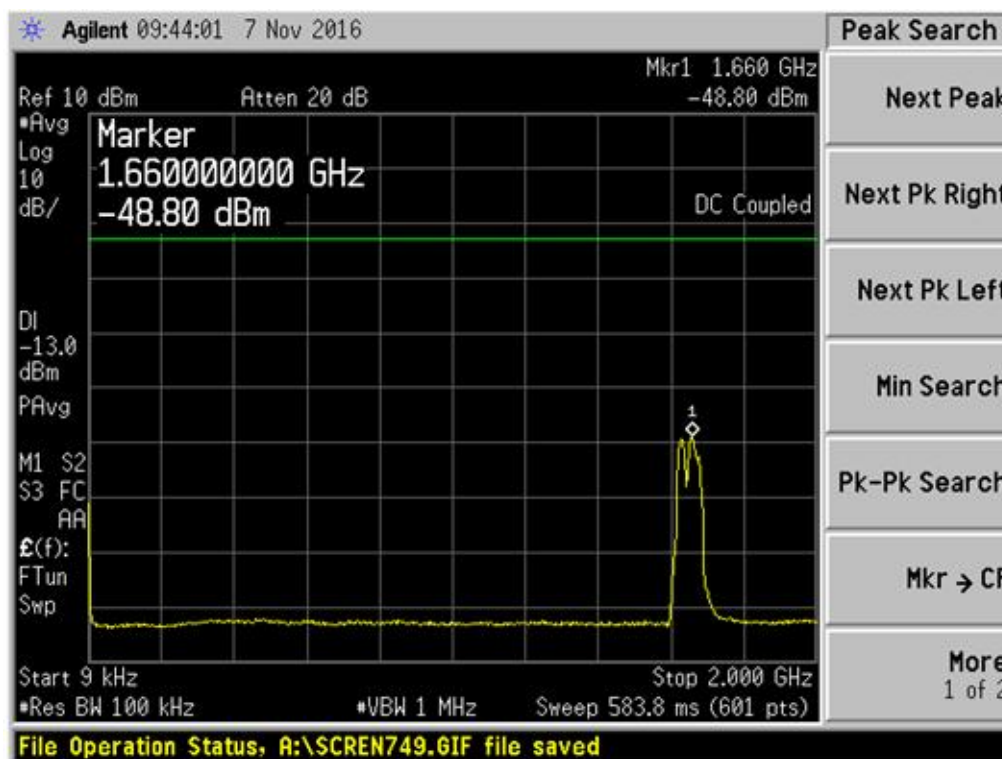
Plot 211 – Lower Channel



Plot 212 – Lower Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 11)



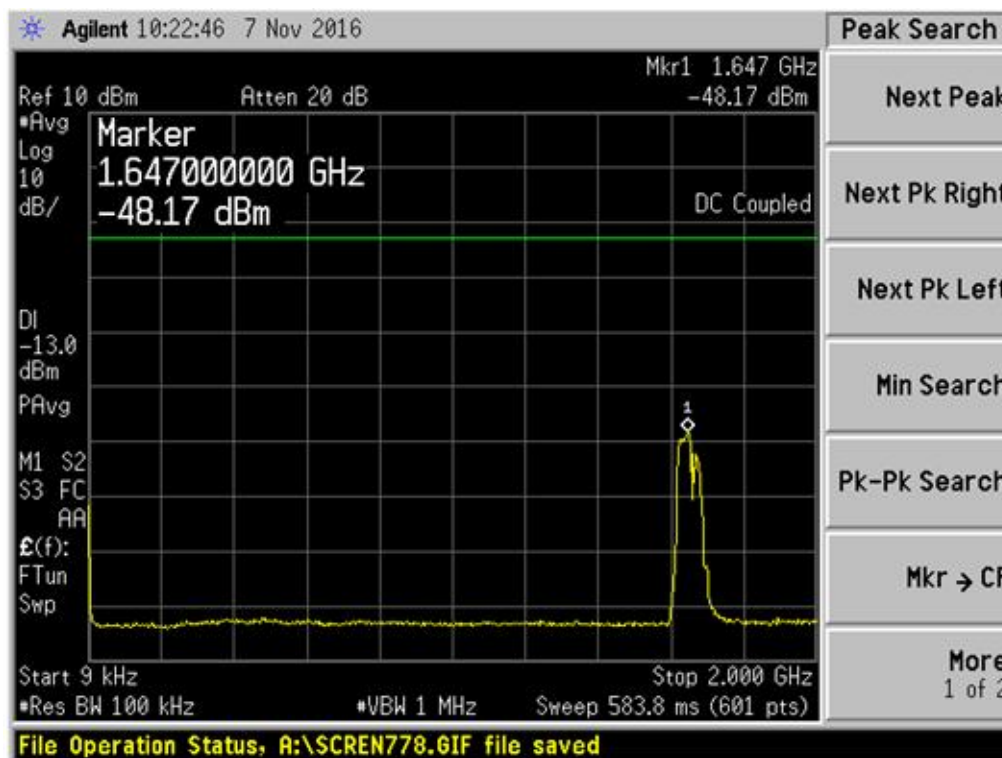
Plot 213 – Middle Channel



Plot 214 – Middle Channel

UNWANTED EMISSIONS AT ANTENNA TERMINAL TEST

Out of Band Spurious Plots (Bearer Type: 11)



RADIATED SPURIOUS EMISSION TEST

47 CFR FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Limits

1. 25.202 Emissions Limitations
 - (f) The mean power of the emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:
 - (1) In any 4kHz band, the center frequency of which is removed from the assigned frequency by more than 50% up to and including 100% of the authorized bandwidth: 25 decibels;
 - (2) In any 4kHz band, the center frequency of which is removed from the assigned frequency by more than 100% up to and including 250% of the authorized bandwidth: 35 decibels;
 - (3) In any 4kHz band, the center frequency of which is removed from the assigned frequency by more than 250% of the authorized bandwidth: an amount equal to 43 decibels plus 10 times logarithm (to the base 10) of the transmitter power in watts.
2. 2.1053 Measurements Required: Field Strength of Spurious Emissions
 - (a) Measurement shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of 2.1049, as appropriate. For equipment operating on frequencies below 890MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.
 - (b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
 - (1) Those in which the spurious emission are required to be 60dB or more below the mean power of the transmitter.
 - (2) All equipment operating on frequencies higher than 25MHz.
 - (3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
 - (4) Other types of equipment as required, when deemed necessary by the Commission.

47 CFR FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver (20Hz –26.5GHz) – ESM11(Ref)	ESMI	849182/003 848926/007	22 Apr 2017
Schaffner Bilog Antenna –(30MHz-2GHz) BL3 (Ref)	CBL6112D	2549	11 Feb 2017
EMCO Horn Antenna(1GHz-18GHz)	3115	0003-6088	20 Apr 2017
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	11 Mar 2017
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441056	22 Jul 2017
K&L Microwave Tunable Band Reject Filter	3TNF-1000/2000-N/N	436	13 Aug 2017

RADIATED SPURIOUS EMISSION TEST

47 CFR FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant antenna was set at the required test distance away from the EUT and supporting equipment boundary

47 CFR FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Test Method

1. The EUT was set to transmit at the maximum power at the lower channel with the modulation on at normal test condition.
2. The receiving antenna (test antenna) was set at vertical polarization with the height of 1m.
3. With the spectrum analyser was set to max hold enabled (peak detector mode), the spurious emissions were searched and recorded. For EUT which is a portable device, the spurious emission search was carried out by rotating the EUT through three orthogonal axes to determine which attitude and equipment arrangement produces worst emissions.
4. For each spurious emission found, the test antenna was raised or lowered through the specified range of heights (1m – 4m) until a maximum signal level was detected on the test receiver.
5. The EUT was then rotated through 360° in the horizontal plane until the maximum signal was received. The maximum received signal level was recorded as A (in dBm).
6. The EUT was replaced with the substitution antenna with the antenna input was connected to the signal generator via a 10dB attenuator (if required).
7. The signal generator was set to the found spurious frequency. The output level of the signal generator was adjusted until the test receiver was at least 20dB above the level when the signal generator was switched off.
8. The test antenna was raised and lowered through the specified range of heights (1m – 4m) until the maximum signal level was received on the test receiver.
9. The substitution antenna was rotated until the maximum level was detected on the test receiver.
10. The output level of the signal generator was adjusted until the received signal level at the test receiver was equal to the level recorded in step 5 (A dBm). The signal generator output level was recorded as B (in dBm).
11. The spurious emission level, P (e.i.r.p) was computed as followed:
$$P(e.i.r.p) = B - C - D + E$$

where C = cable loss between the signal generator and the substitution
D = attenuation level if attenuator is used
E = substitution antenna gain
12. The steps 2 to 11 were repeated with the receiving antenna was set to horizontal polarization.
13. Comparison was made on both measured results with vertical and horizontal polarizations. The highest value out of vertical and horizontal polarizations was recorded.
14. The steps 2 to 13 were repeated until all the spurious emissions (up to 10th harmonics of the carrier frequency) were measured.
15. The steps 1 to 14 were repeated with the EUT was set to operate at the middle and upper channels respectively.

RADIATED SPURIOUS EMISSION TEST

47 CFR FCC Parts 2.1053 and 25.202(f) Radiated Spurious Emission Results

Operating Mode	Continuous Satellite Transmission	Temperature	24°C
Test Input Power	12Vdc	Relative Humidity	60%
Test Distance	3m	Atmospheric Pressure	1030mbar
Type Bearer	6 – 20T45X (Worst)	Tested By	Chang Wai Kit

30MHz – 1GHz

Lower Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
30.0000	-53.4	-13.0
39.7970	-59.6	-13.0
46.3280	-63.2	-13.0
51.7710	-67.7	-13.0
250.9770	-69.2	-13.0
351.1240	-66.6	-13.0

Middle Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
30.2210	-62.07	-13.0
37.9460	-72.97	-13.0
88.3040	-75.17	-13.0
92.3940	-75.77	-13.0
149.9740	-75.87	-13.0
249.9860	-68.37	-13.0

Upper Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
30.0000	-53.4	-13.0
36.5310	-58.2	-13.0
40.8860	-63.2	-13.0
50.6830	-71.9	-13.0
250.9770	-69.2	-13.0
351.1240	-66.7	-13.0

RADIATED SPURIOUS EMISSION TEST

1GHz – 17GHz

Lower Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
1897.7780	-58.0	-13.0
3255.6670	-56.1	-13.0
4815.5560	-46.4	-13.0
4877.2780	-55.8	-13.0
5657.2230	-58.0	-13.0
9797.6000	-55.3	-13.0

Middle Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
1746.2780	-60.5	-13.0
1813.6110	-60.1	-13.0
1864.1110	-59.2	-13.0
1920.2220	-56.4	-13.0
1993.1670	-57.6	-13.0
2335.4450	-60.8	-13.0

Upper Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
1246.8890	-58.9	-13.0
1331.0560	-55.5	-13.0
1914.6110	-55.5	-13.0
1942.6670	-54.6	-13.0
1993.1670	-57.1	-13.0
2593.5560	-57.4	-13.0

RADIATED SPURIOUS EMISSION TEST

Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured. All other emissions were relatively insignificant.
2. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
3. The Resolution Bandwidth (RBW) was corrected from 4kHz by $10\log_{10}[(\text{used RBW}) / 4\text{kHz}]$.
4. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
30MHz - 20GHz
RBW: 100kHz VBW: 300kHz
5. Emission limits are computed based on following:
 - a. Emissions Limits (dBm) (50% - 100% authorised bandwidth) = $P - 25 + CF$
 - b. Emissions Limits (dBm) (100% - 250% authorised bandwidth) = $P - 35 + CF$
 - c. Emissions Limits (dBm) (> 250% authorised bandwidth) = $P - [43 + 10 \log_{10} P_w] + 30 + CF$where
 P = Measured mean power in dBm
 P_w = Measured mean power in W
 CF = RBW correction factor (see Note 4)
6. Radiated Spurious Emissions Measurement Uncertainty
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz is $\pm 4.0\text{dB}$.

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

47 CFR FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Limits

25.216(h)(i)(j) Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service

- (h) Mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FC 03-283 (from November 6, 2003) with assigned uplink frequencies in the 1626.5MHz - 1660.5MHz band shall suppress the power density of emissions in the 1605MHz - 1610MHz band-segment to an extent determined by linear interoperation from -70dBW/MHz at 1605MHz to -46dBW/MHz at 1610MHz, averaged over any 2ms active transmission interval. The e.i.r.p of discrete emissions of less than 700Hz bandwidth from such stations shall not exceed a level determined by linear interoperation from -80dBW at 1605MHz to -56dBW at 1610MHz, averaged over any 2ms active transmission interval.
- (i) The e.i.r.p density of carrier-off state emissions from mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03-283 with assigned uplink frequencies between 1GHz and 3GHz shall not exceed -80dBW/MHz in the 1559MHz - 1610MHz band averaged over any 2ms interval.
- (j) A Root-Mean-Square detector shall be used for all power density measurements.

47 CFR FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver (20Hz –26.5GHz) – ESMI1(Ref)	ESMI	849182/003 848926/007	22 Apr 2017
Schaffner Bilog Antenna –(30MHz-2GHz) BL3 (Ref)	CBL6112D	2549	11 Feb 2017
EMCO Horn Antenna(1GHz-18GHz)	3115	0003-6088	20 Apr 2017
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	11 Mar 2017
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441056	22 Jul 2017

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

47 CFR FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant antenna was set at the required test distance away from the EUT and supporting equipment boundary

47 CFR FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Test Method

1. The EUT was set to transmit at the maximum power at the lower channel with the modulation on at normal test condition.
2. The receiving antenna (test antenna) was set at vertical polarization with the height of 1m.
3. A prescan was carried out in the frequency range under investigations with the EMI receiver set to max hold mode. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which attitude and equipment arrangement produces such emissions.
4. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
5. The maximized emissions were plotted with inclusion of corrector factor of measured radiated emissions to EIRP.
6. The steps 1 to 5 were repeated with the EUT was set to operate at the middle and upper channels respectively.
7. The measurements were repeated with the EUT in carrier off state (standby).

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

47 CFR FCC Part 25.216(h)(i)(j) Protection of Aeronautical Radio Navigation Satellite Service Results

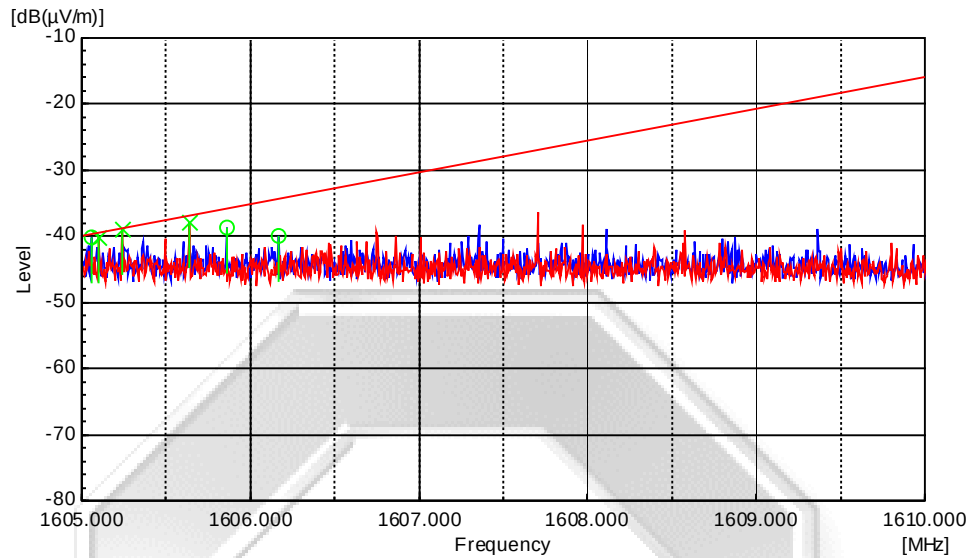
Operating Mode	Continuous Satellite Transmission	Temperature	24°C
Test Input Power	12Vdc	Relative Humidity	60%
Test Distance	3m	Atmospheric Pressure	1030mbar
Type Bearer	6 – 20T45X (Worst)	Tested By	Chang Wai Kit
Attached Plots	217 – 219 (Transmit) 220 – 222 (Standby)		

All spurious signals found were below the specified limit. Please refer to the attached plots.

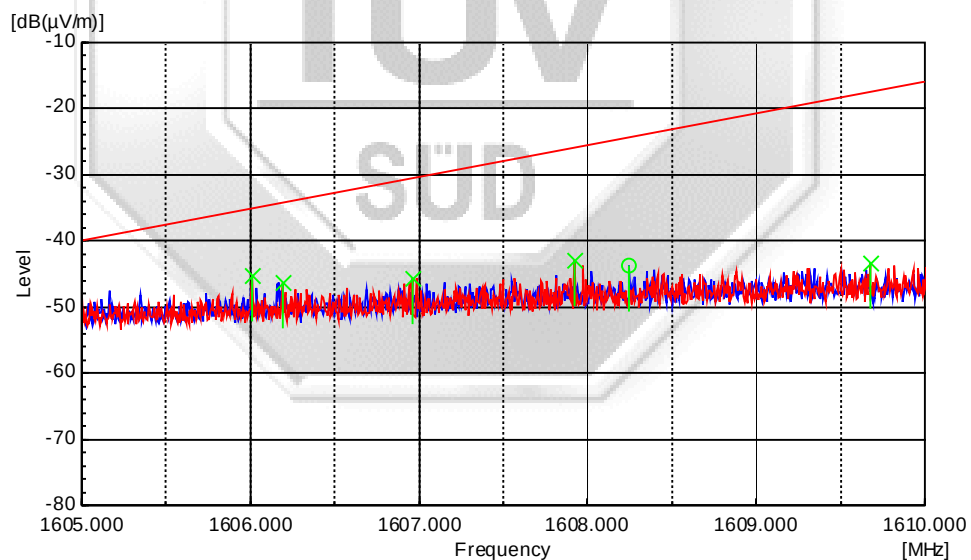


PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 6 – 20T45X (Worst) - Transmitter On



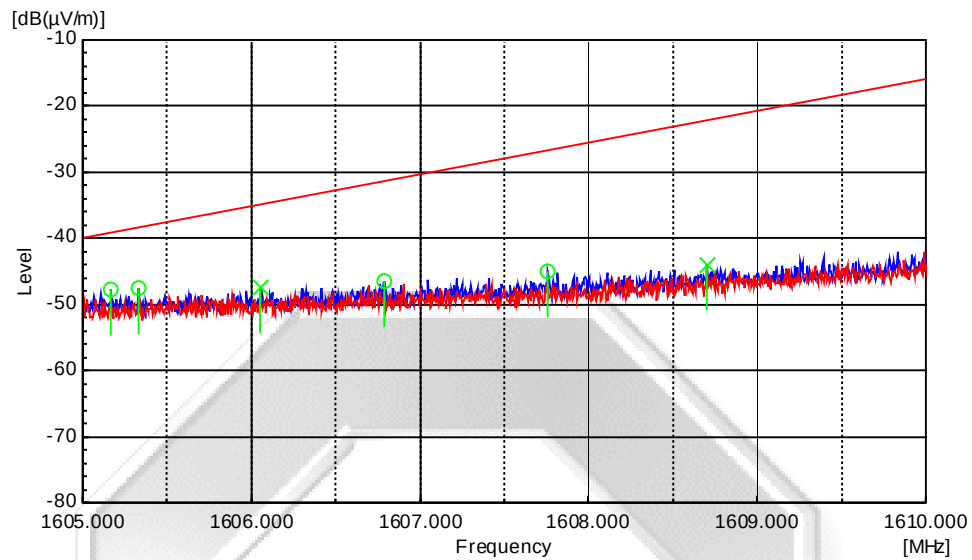
Plot 217 – Lower Channel



Plot 218 – Middle Channel

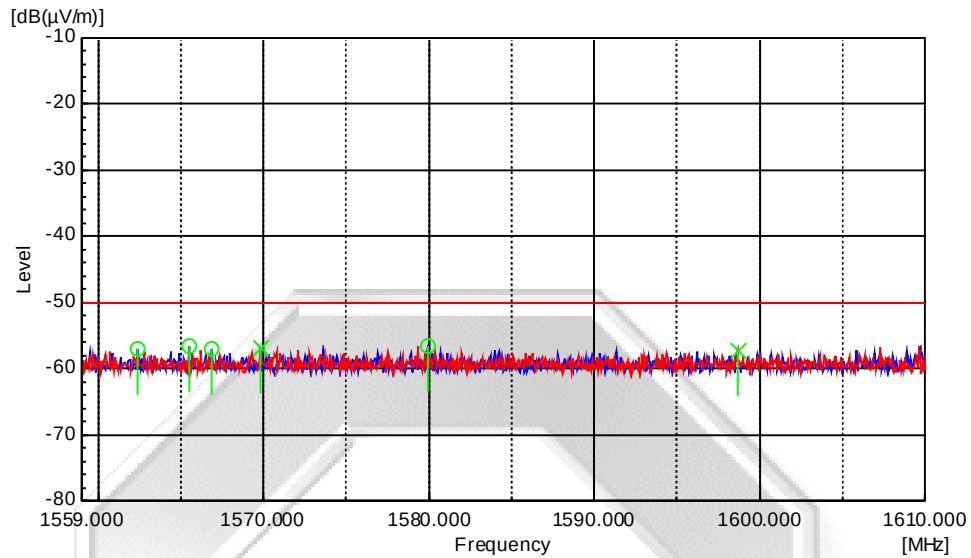
PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Type Bearer: 6 – 20T45X (Worst) - Transmitter On

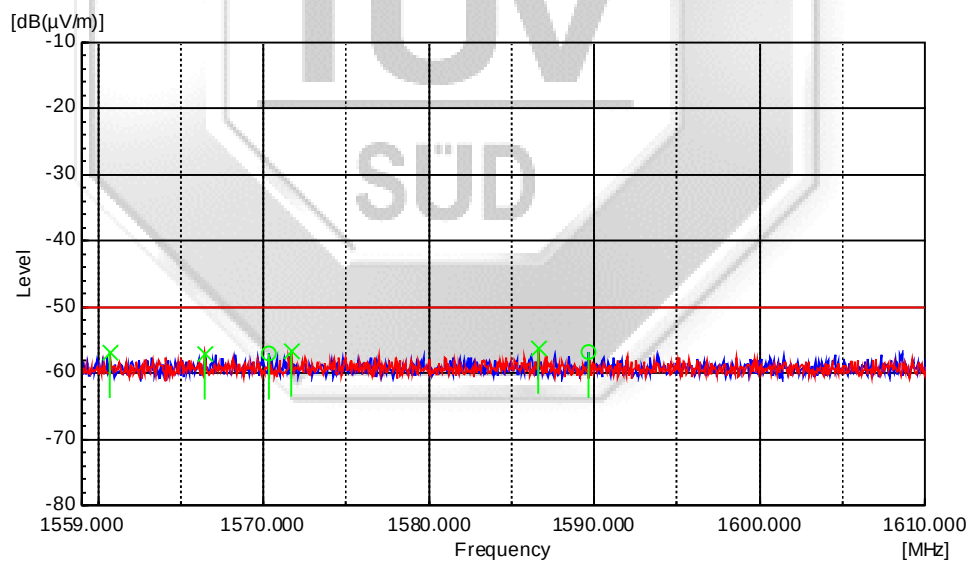


PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Carrier Off



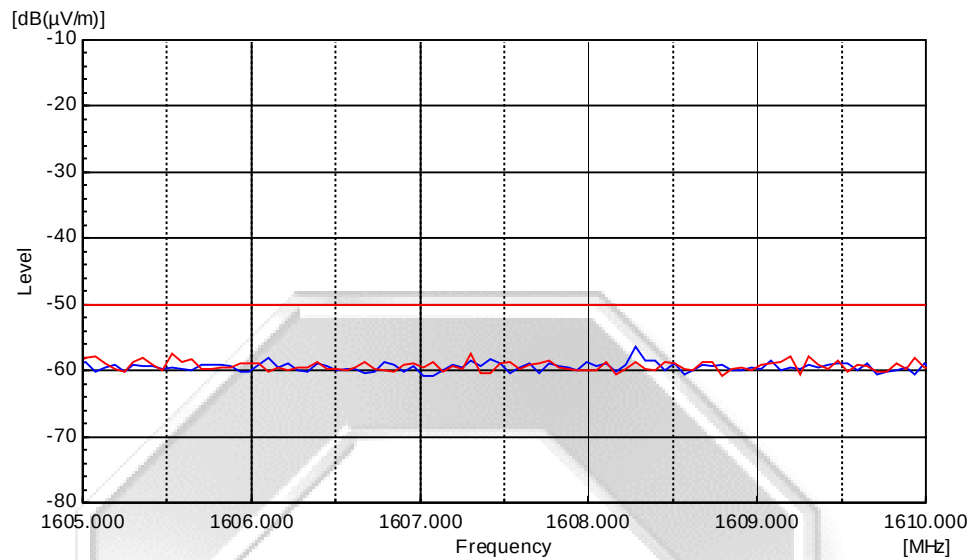
Plot 220 – Lower Channel



Plot 221 – Middle Channel

PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

Carrier Off



FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Test Limits

1. 25.202(d) Frequency Tolerance, Earth Stations
The carrier frequency of each earth station transmitter authorised in these services shall be maintained within 0.001% (10ppm) of the reference frequency.
2. 2.1055 Measurements Required: Frequency Stability
 - (a) The frequency stability shall be measured with variation of ambient temperature as follows:
 - (1) From -30°C to +50°C for all equipment except that specified in paragraphs (a)(2) and (3) of this section.
 - (b) Frequency measurements shall be made at the extremes of the specified temperature range and at interval of not more than 10°C throughout the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion of portions of the transmitter containing the frequency determining and stabilizing circuitry need to be subjected to the temperature variation test.
 - (d) The frequency stability shall be measured with variation of primary supply voltage as follows:
 - (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
 - (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
 - (3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Universal Counter	53132A	3736A06236	05 Apr 2017
Kikusui Regulated DC Power Supply	PAD 35-10L	1540254	Output Monitor
Cincinnati Sub-Zero Products, INC. Temperature & Humidity Chamber	ZH-8-1-1-H/AC	ZF9722653	28 Dec 2016

FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Test Setup

1. The EUT and supporting equipment were set up as shown in the test setup photo. A temperature-controlled chamber was used.
2. The EUT was connected to an appropriate power source while all other supporting equipment were powered separately from another power source.
3. The RF antenna connector of the EUT was connected to the spectrum analyser via a RF attenuator and a low-loss coaxial cable.

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Test Method

1. The temperature chamber was set at 20°C and permitted to stabilize. The EUT was set to transmit at lower channel without modulation. The carrier frequency was measured as the reference frequency.
2. With the EUT power removed, the temperature of the temperature chamber was set to -30°C and permitted to stabilize.
3. The EUT was turned on and set to operate at lower channel without modulation. The maximum change in the carrier frequency was recorded within a minute.
4. The EUT was powered off and the temperature was raised to -20°C.
5. The EUT was left stabilized for at least an hour before next measurement was taken as described in step 3.
6. The steps 4 and 5 were repeated with increment of temperature in 10°C step until the temperature reached 50°C.
7. The steps 1 to 6 were repeated with the EUT was set to operate at the middle and upper channels respectively.

FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Temperature Variation) Results

Operating Mode	Continuous Satellite Transmission	Temperature	See table below
Test Input Power	12Vdc	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

Lower Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
-30	1.6266004204	1.6266000000	420.400000	+/-16266
-20	1.6266004180	1.6266000000	418.000000	+/-16266
-10	1.6266005256	1.6266000000	525.600000	+/-16266
0	1.6266007834	1.6266000000	783.400000	+/-16266
10	1.6266010180	1.6266000000	1018.000000	+/-16266
20	1.6266009207	1.6266000000	920.700000	+/-16266
30	1.6266010145	1.6266000000	1014.500000	+/-16266
40	1.6266010647	1.6266000000	1064.700000	+/-16266
50	1.6266010989	1.6266000000	1098.900000	+/-16266

Middle Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
-30	1.6435004911	1.6435000000	491.100000	+/-16435
-20	1.6435004964	1.6435000000	496.400000	+/-16435
-10	1.6435006141	1.6435000000	614.100000	+/-16435
0	1.6435008945	1.6435000000	894.500000	+/-16435
10	1.6435010304	1.6435000000	1030.400000	+/-16435
20	1.6435009510	1.6435000000	951.000000	+/-16435
30	1.6435010631	1.6435000000	1063.100000	+/-16435
40	1.6435011195	1.6435000000	1119.500000	+/-16435
50	1.6435011521	1.6435000000	1152.100000	+/-16435



FREQUENCY STABILITY (TEMPERATURE VARIATION) TEST

Upper Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
-30	1.6604004581	1.660400000	458.100000	+/-16604
-20	1.6604004621	1.660400000	462.100000	+/-16604
-10	1.6604006188	1.660400000	618.800000	+/-16604
0	1.6604009025	1.660400000	902.500000	+/-16604
10	1.6604009844	1.660400000	984.400000	+/-16604
20	1.6604009230	1.660400000	923.000000	+/-16604
30	1.6604010336	1.660400000	1033.600000	+/-16604
40	1.6604010949	1.660400000	1094.900000	+/-16604
50	1.6604011285	1.660400000	1128.500000	+/-16604



FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Test Limits

1. 25.202(d) Frequency Tolerance, Earth Stations
The carrier frequency of each earth station transmitter authorised in these services shall be maintained within 0.001% (10ppm) of the reference frequency.
2. 2.1055 Measurements Required: Frequency Stability
 - (a) The frequency stability shall be measured with variation of ambient temperature as follows:
 - (1) From -30°C to +50°C for all equipment except that specified in paragraphs (a)(2) and (3) of this section.
 - (b) Frequency measurements shall be made at the extremes of the specified temperature range and at interval of not more than 10°C throughout the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion of portions of the transmitter containing the frequency determining and stabilizing circuitry need to be subjected to the temperature variation test.
 - (d) The frequency stability shall be measured with variation of primary supply voltage as follows:
 - (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
 - (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
 - (3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Universal Counter	53132A	3736A06236	05 Apr 2017
Kikusui Regulated DC Power Supply	PAD 35-10L	1540254	Output Monitor
Cincinnati Sub-Zero Products, INC. Temperature & Humidity Chamber	ZH-8-1-1-H/AC	ZF9722653	28 Dec 2016

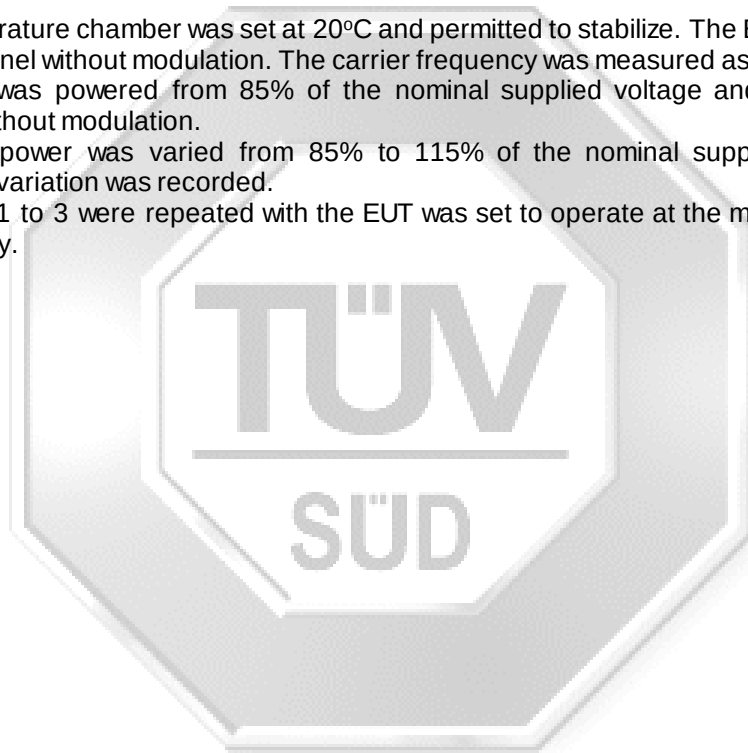
FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Test Setup

1. The EUT and supporting equipment were set up as shown in the test setup photo. A temperature-controlled chamber was used.
2. The EUT was connected to an appropriate power source while all other supporting equipment were powered separately from another power source.
3. The RF antenna connector of the EUT was connected to the spectrum analyser via a RF attenuator and a low-loss coaxial cable.

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Test Method

1. The temperature chamber was set at 20°C and permitted to stabilize. The EUT was set to transmit at lower channel without modulation. The carrier frequency was measured as the reference frequency.
2. The EUT was powered from 85% of the nominal supplied voltage and set to operate at lower channel without modulation.
3. The EUT power was varied from 85% to 115% of the nominal supplied voltage. The carrier frequency variation was recorded.
4. The steps 1 to 3 were repeated with the EUT was set to operate at the middle and upper channels respectively.



FREQUENCY STABILITY (VOLTAGE VARIATION) TEST

47 CFR FCC Parts 2.1055 and 25.202(d) Frequency Stability (Voltage Variation) Results

Operating Mode	Continuous Satellite Transmission	Temperature	20°C
Test Input Power	See table below	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

Lower Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
10.2	1.6266008947	1.6266000000	894.700000	+/-16266
12.0	1.6266009207	1.6266000000	920.700000	+/-16266
13.8	1.6266009248	1.6266000000	924.800000	+/-16266

Middle Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
10.2	1.6435009796	1.6435000000	979.600000	+/-16435
12.0	1.6435009510	1.6435000000	951.000000	+/-16435
13.8	1.6435009747	1.6435000000	974.700000	+/-16435

Upper Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
10.2	1.6604009209	1.6604000000	920.900000	+/-16435
12.0	1.6604009230	1.6604000000	923.000000	+/-16435
13.8	1.6604009272	1.6604000000	927.200000	+/-16435

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Limits

The EUT shows compliance to the requirements of this section, which states the MPE limits for general population / uncontrolled exposure are as shown below:

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (min)
0.3 - 1.34	614	1.63	100 ^{Note 2}	30
1.34 - 30	824 / f	2.19 / f	180 / f ² ^{Note 2}	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f / 1500	30
1500 - 100000	-	-	1.0	30
Notes				
1. f = frequency in MHz				
2. Plane wave equivalent power density				

47 CFR FCC Part 1.1310 Maximum Permissible Exposure Computation

The power density at 20cm distance was computed from the following formula:

$$\begin{aligned}
 \text{where } S &= (30GP) / (377d^2) \\
 S &= 10W/m^2 \\
 P &= 7.244W \text{ (maximum peak measured from Maximum Peak Power)} \\
 d &= \text{Test distance (m)} \\
 G &= \text{Numerical isotropic gain, 15.8 (12.0dBi)}
 \end{aligned}$$

Substituting the relevant parameters into the formula:

$$\begin{aligned}
 d &= \sqrt{[(30GP) / 377S]} \\
 &= 0.95m
 \end{aligned}$$

∴ The EUT shall maintain at least at 1.00m from operators to comply with MPE criteria.



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