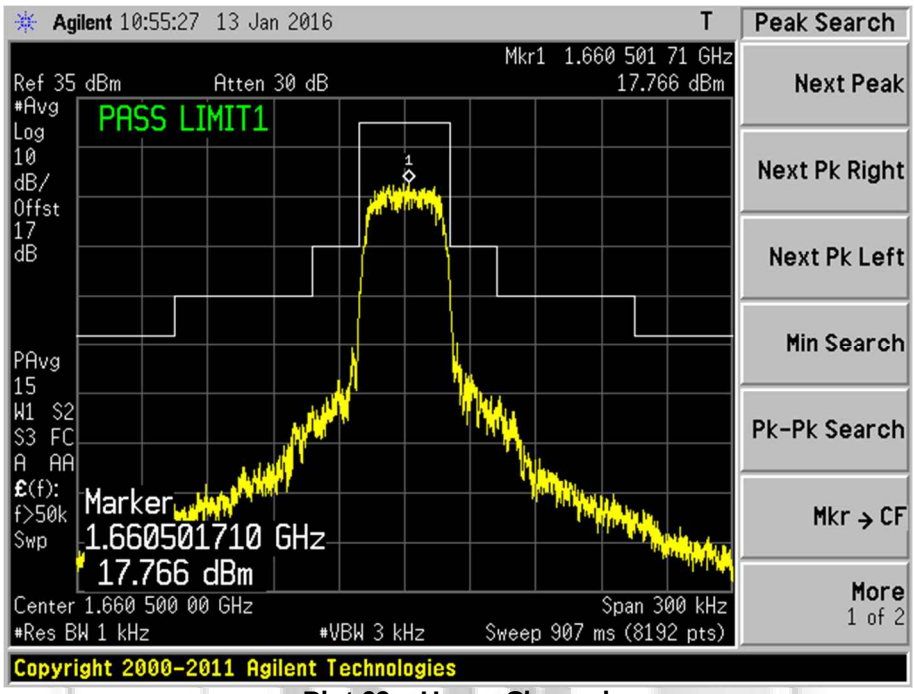
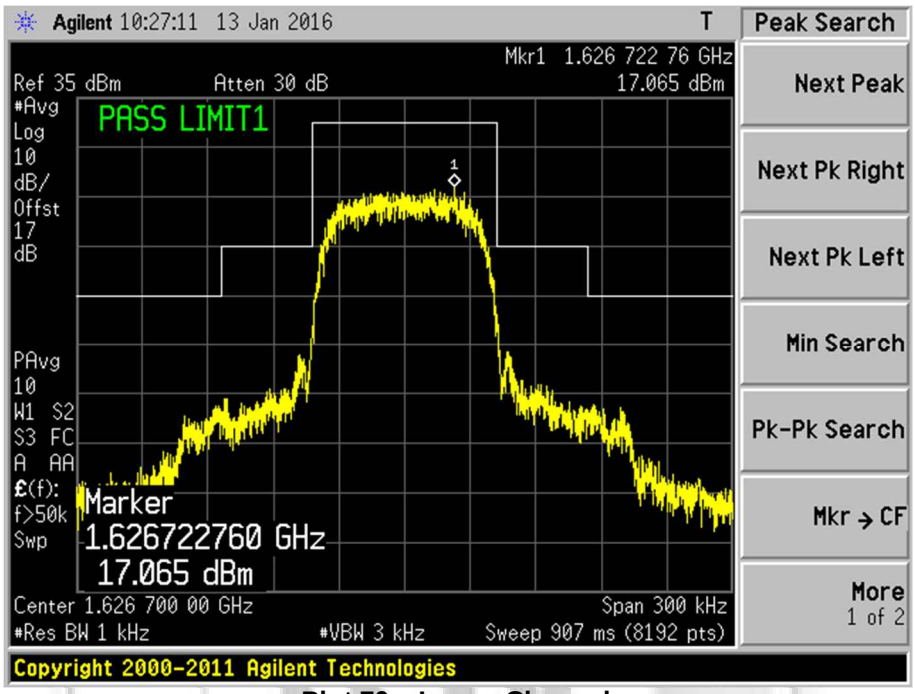
In Band Emissions Plots (Bearer Type: 1)

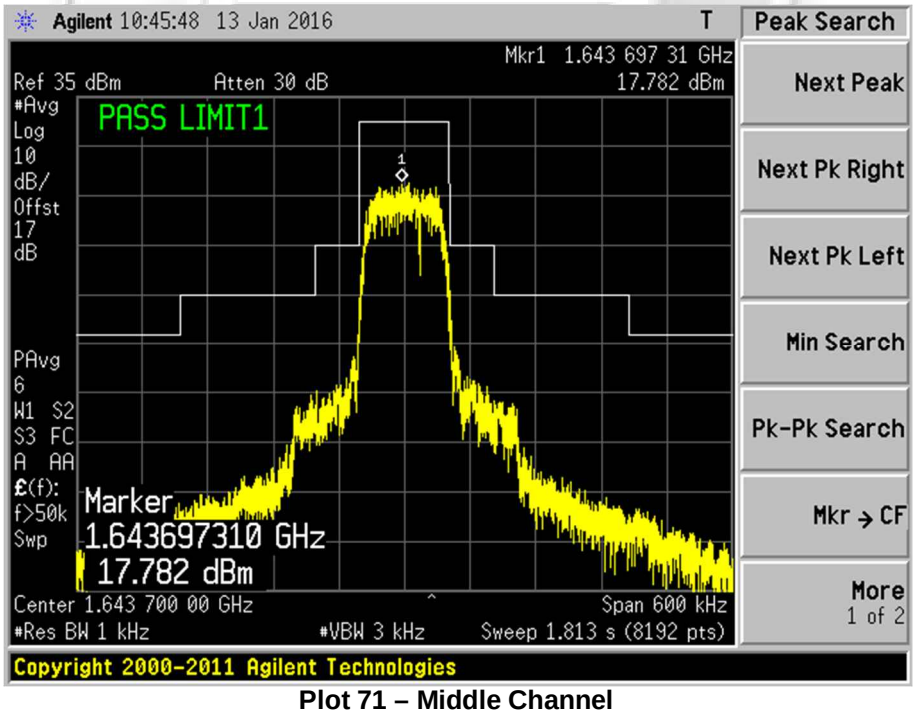


Plot 69 – Upper Channel

In Band Emissions Plots (Bearer Type: 2)

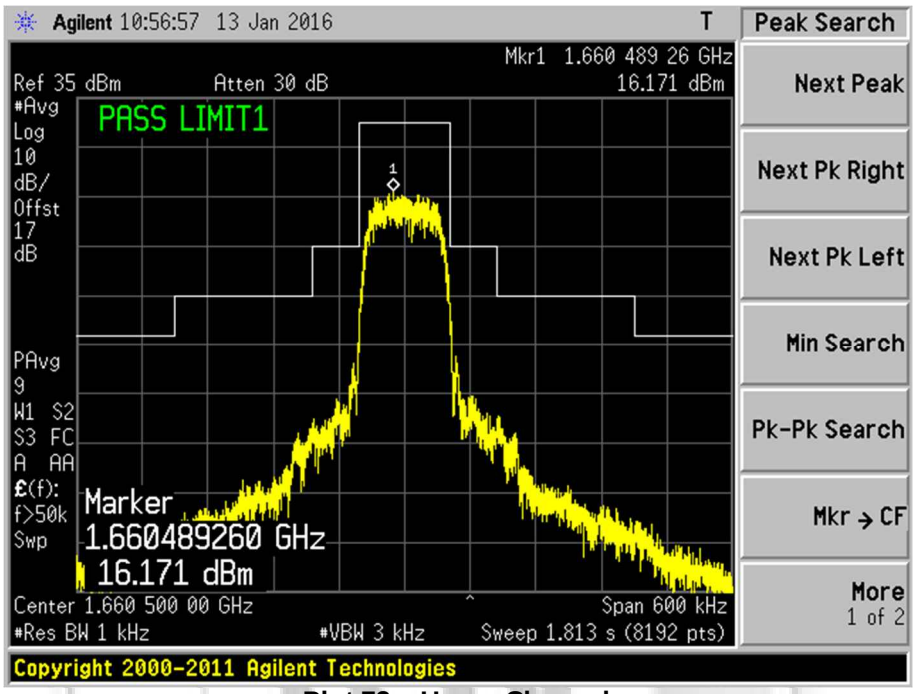


Plot 70 – Lower Channel



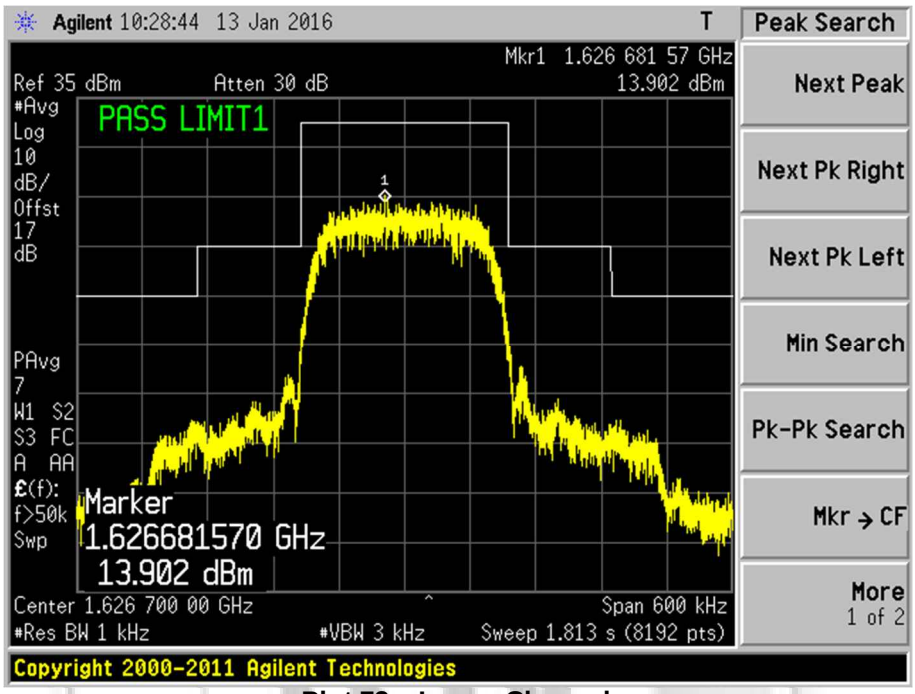
Plot 71 – Middle Channel

In Band Emissions Plots (Bearer Type: 2)

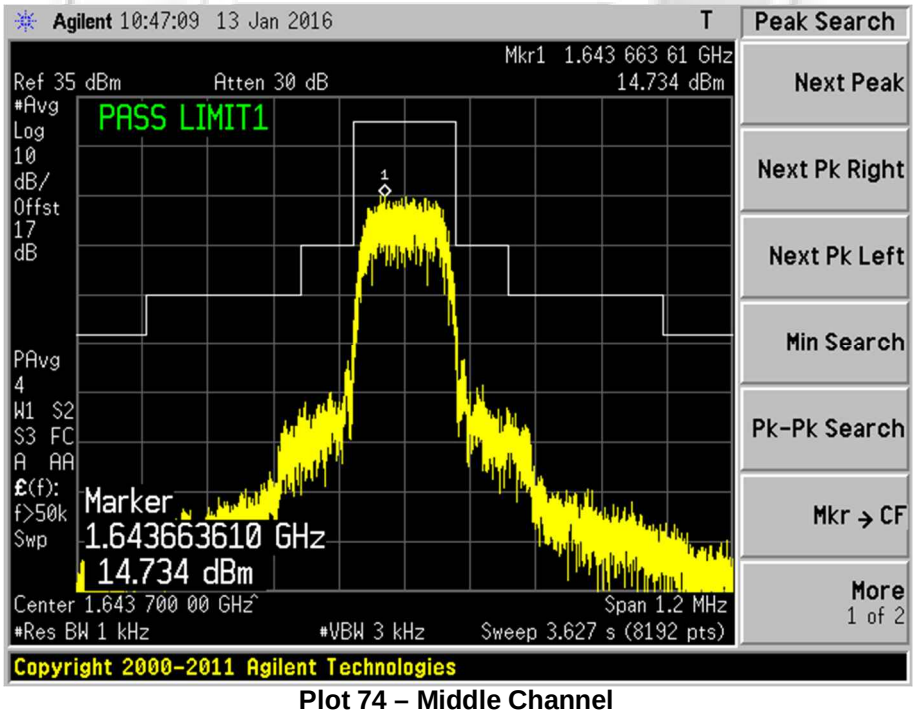


Plot 72 – Upper Channel

In Band Emissions Plots (Bearer Type: 3)

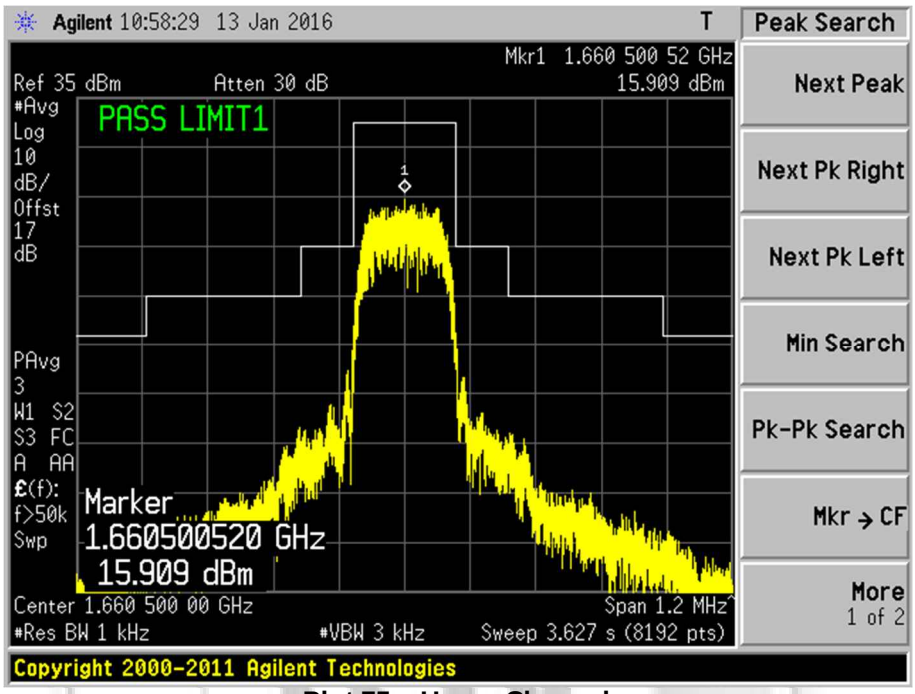


Plot 73 – Lower Channel



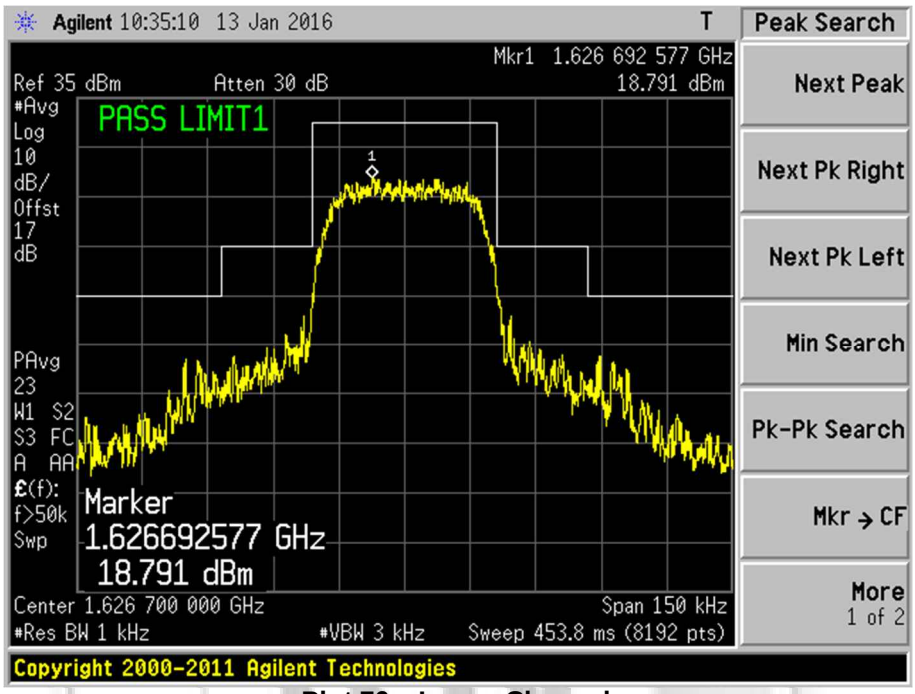
Plot 74 – Middle Channel

In Band Emissions Plots (Bearer Type: 3)

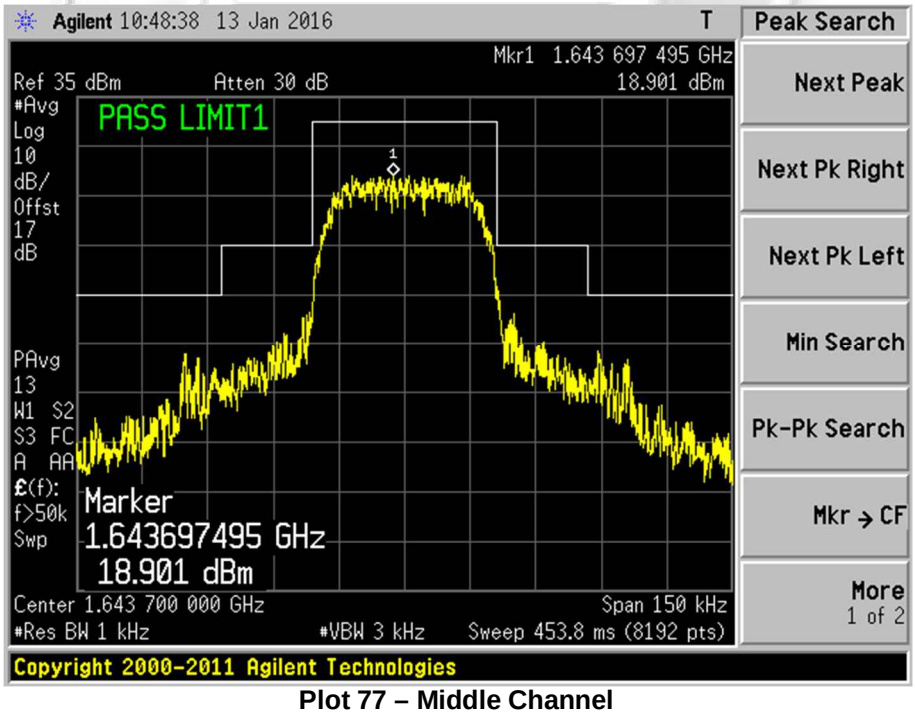


Plot 75 – Upper Channel

In Band Emissions Plots (Bearer Type: 4)

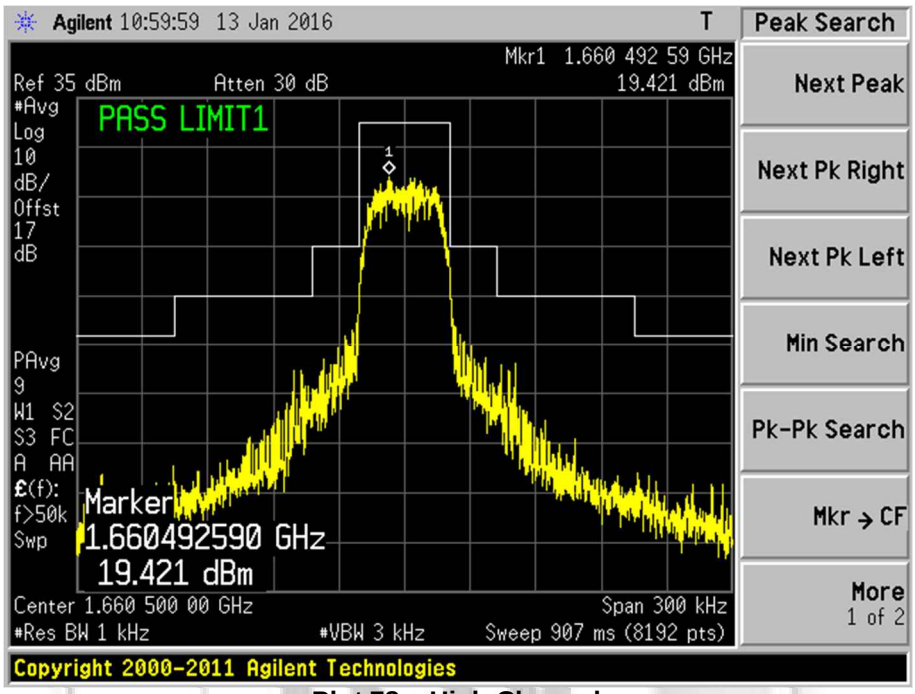


Plot 76 – Lower Channel



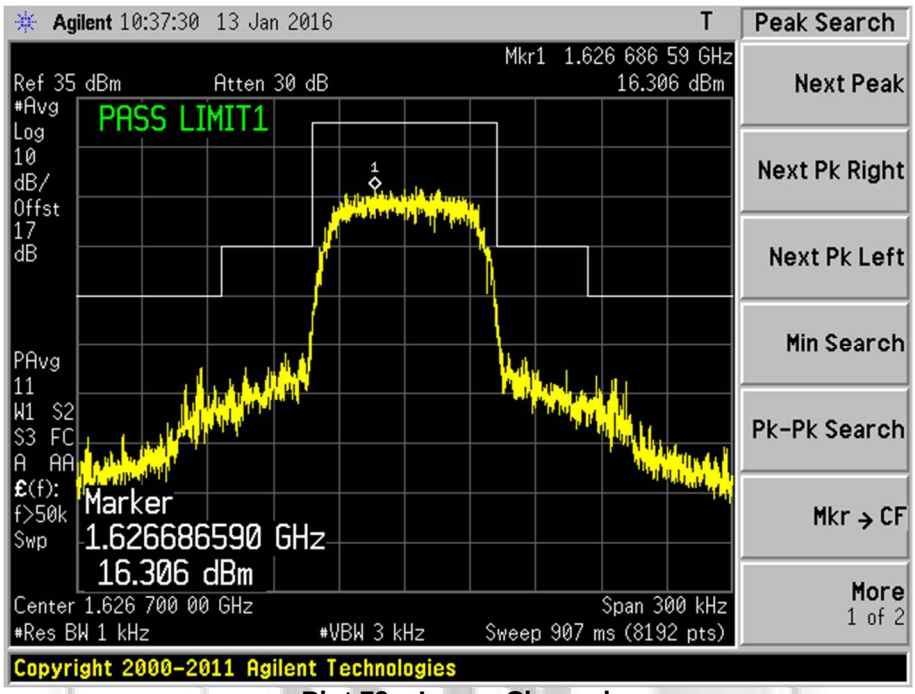
Plot 77 – Middle Channel

In Band Emissions Plots (Bearer Type: 4)

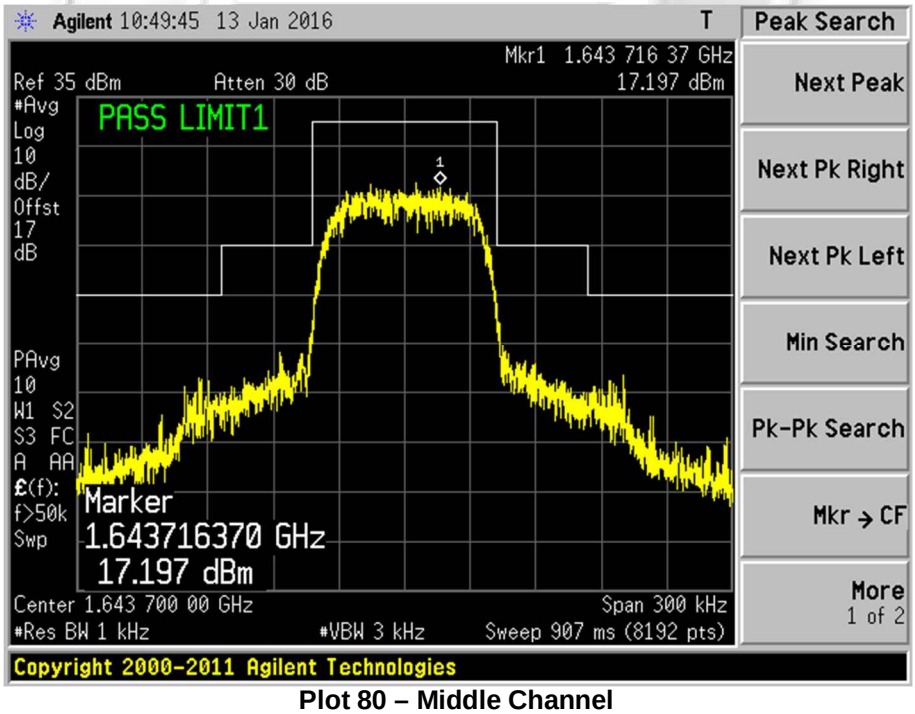


Plot 78 – High Channel

In Band Emissions Plots (Bearer Type: 5)

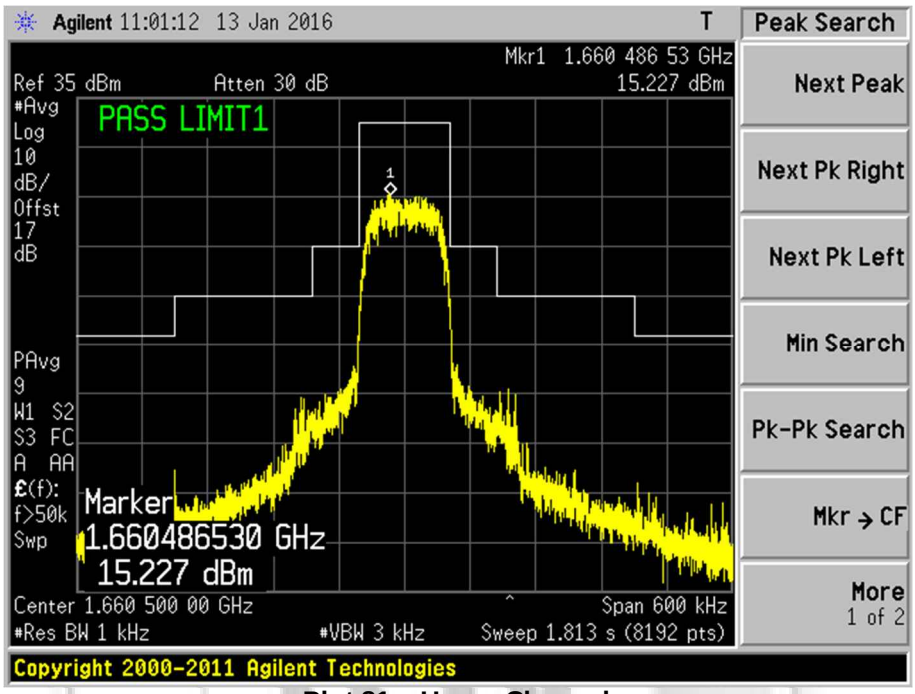


Plot 79 – Lower Channel



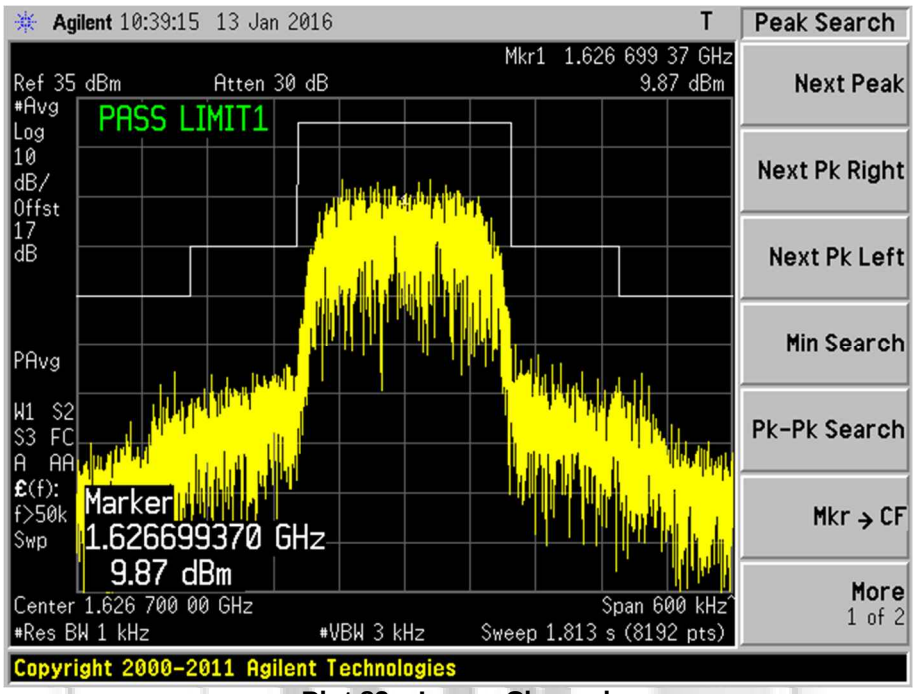
Plot 80 – Middle Channel

In Band Emissions Plots (Bearer Type: 5)

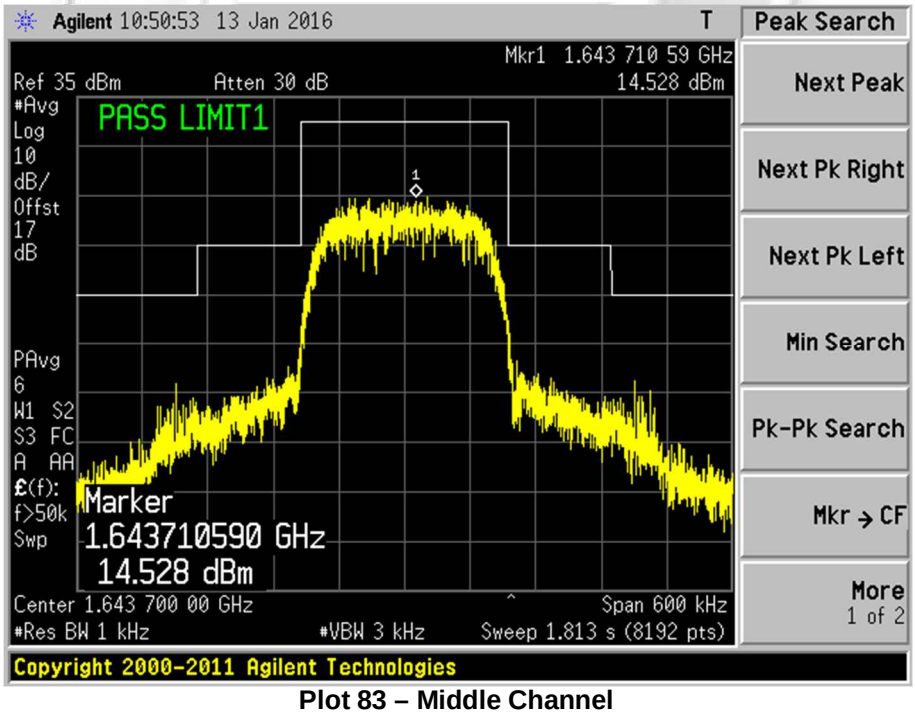


Plot 81 – Upper Channel

In Band Emissions Plots (Bearer Type: 6)

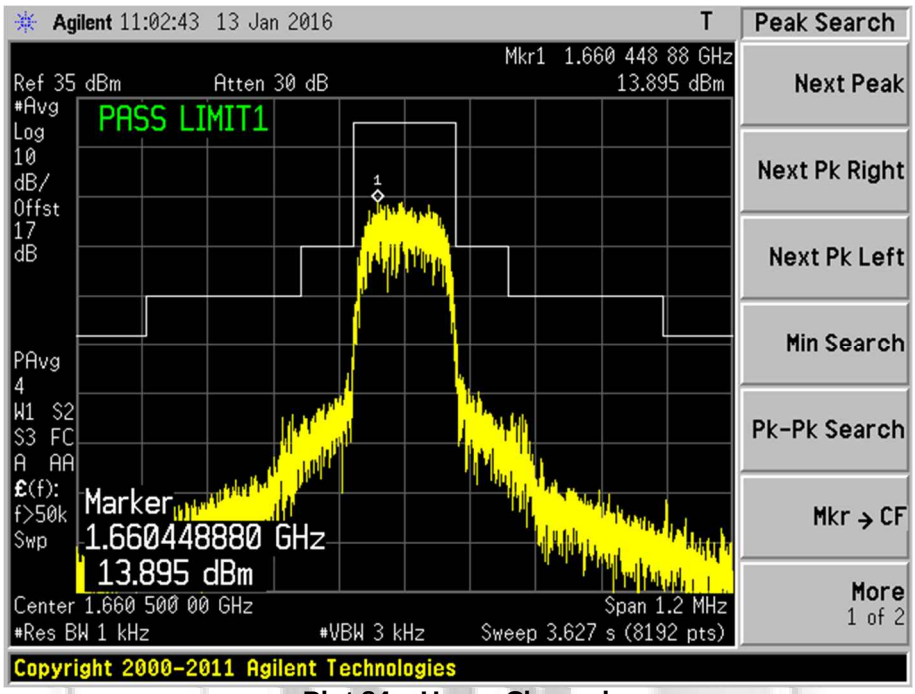


Plot 82 – Lower Channel



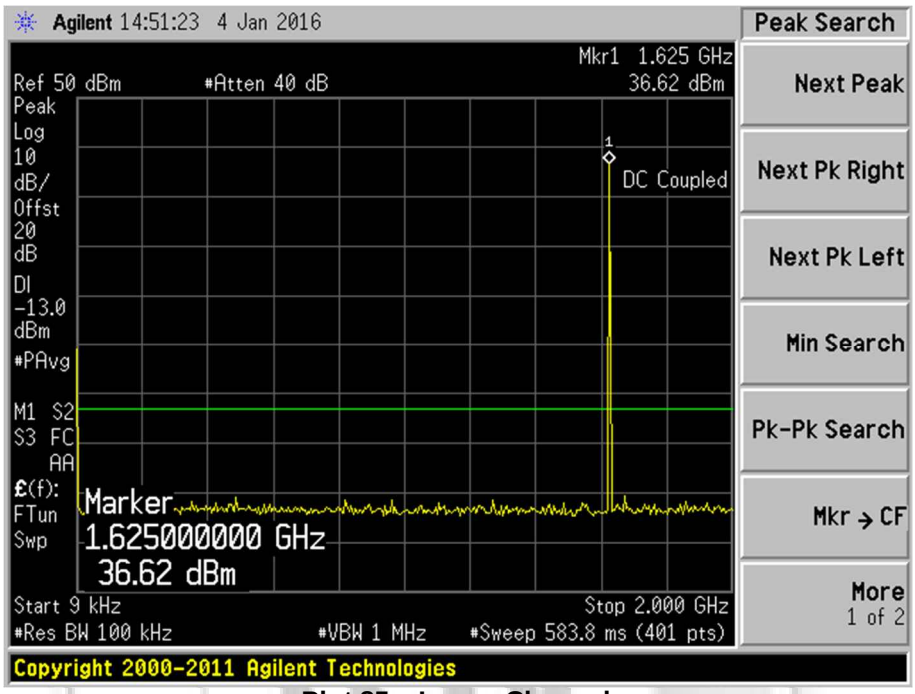
Plot 83 – Middle Channel

In Band Emissions Plots (Bearer Type: 6)

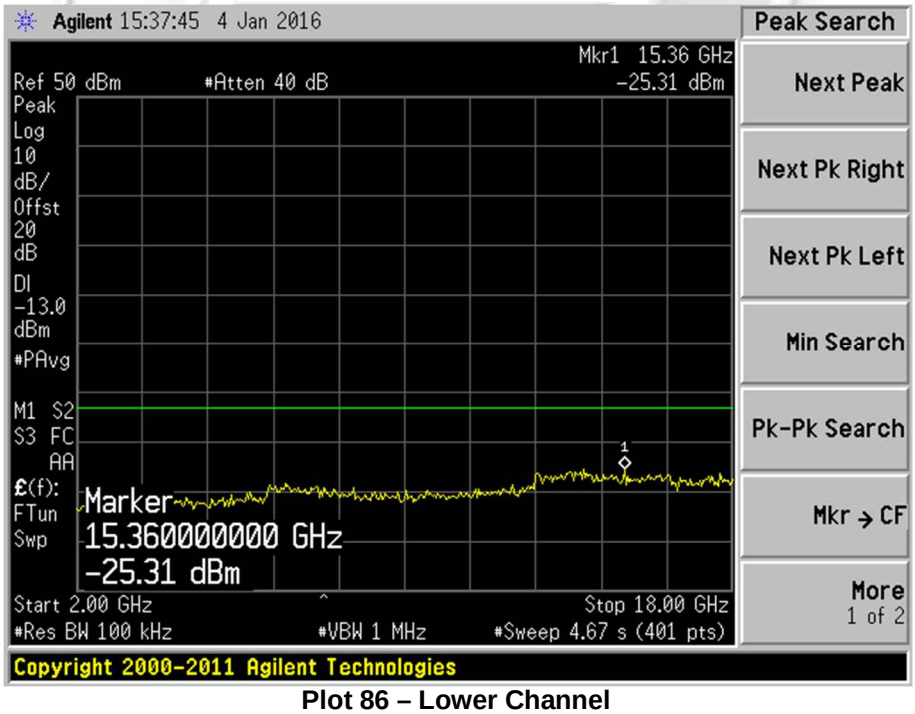


Plot 84 – Upper Channel

Out of Band Spurious Plots (Bearer Type: 0)

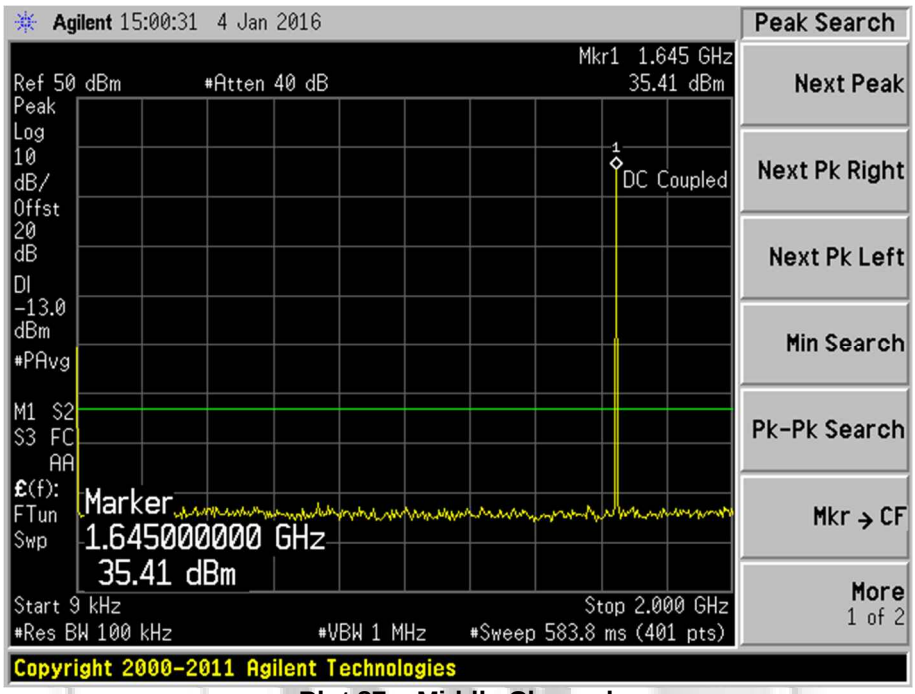


Plot 85 – Lower Channel

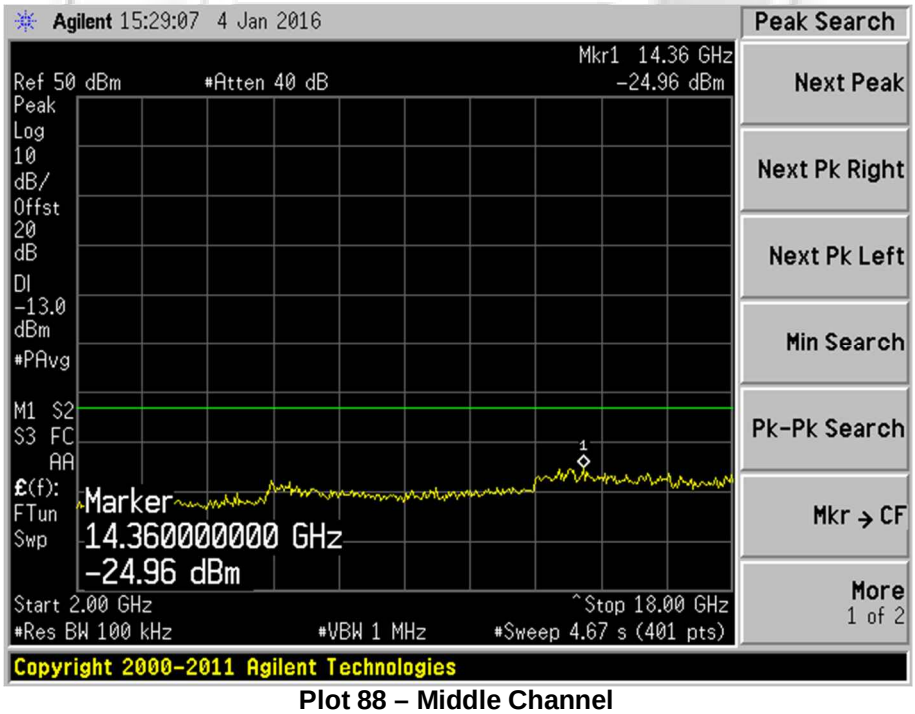


Plot 86 – Lower Channel

Out of Band Spurious Plots (Bearer Type: 0)

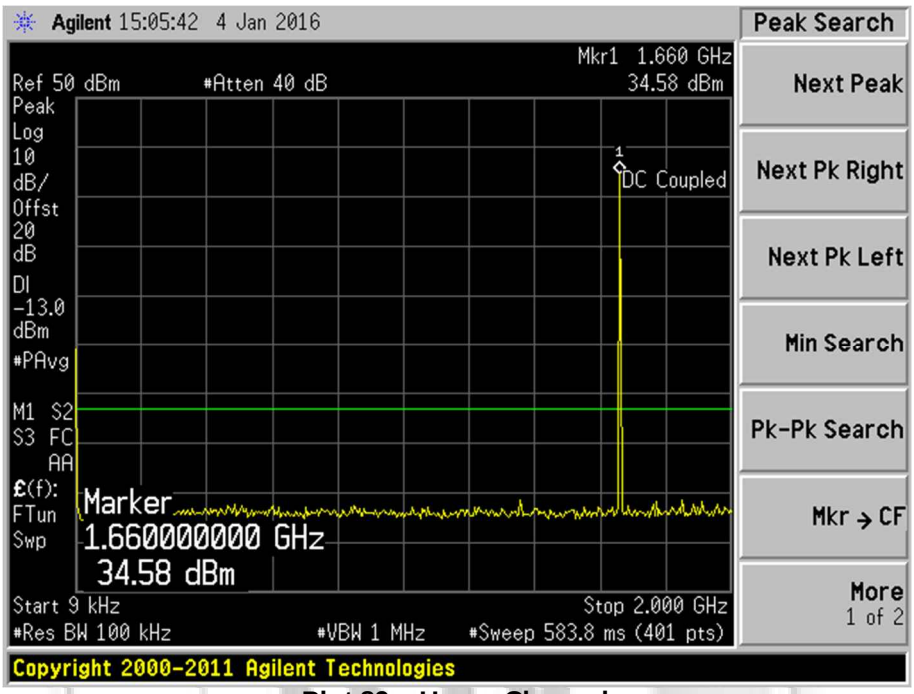


Plot 87 – Middle Channel

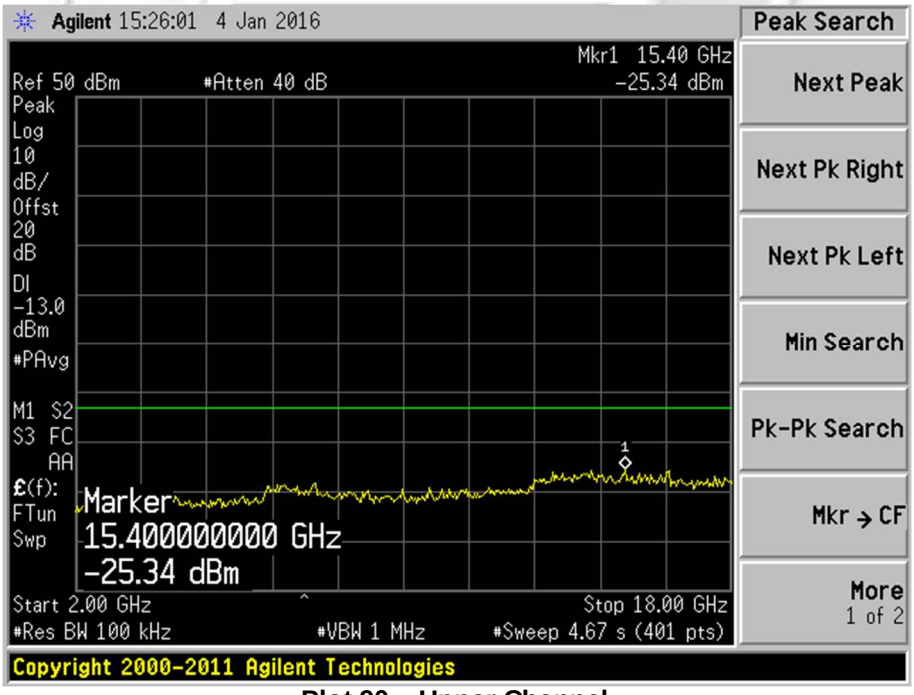


Plot 88 – Middle Channel

Out of Band Spurious Plots (Bearer Type: 0)

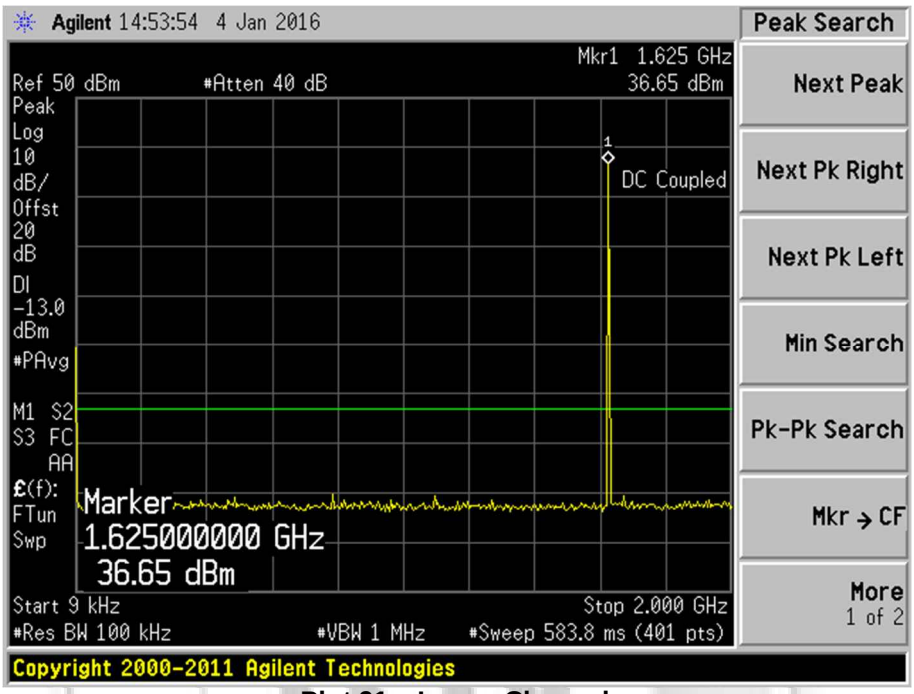


Plot 89 – Upper Channel

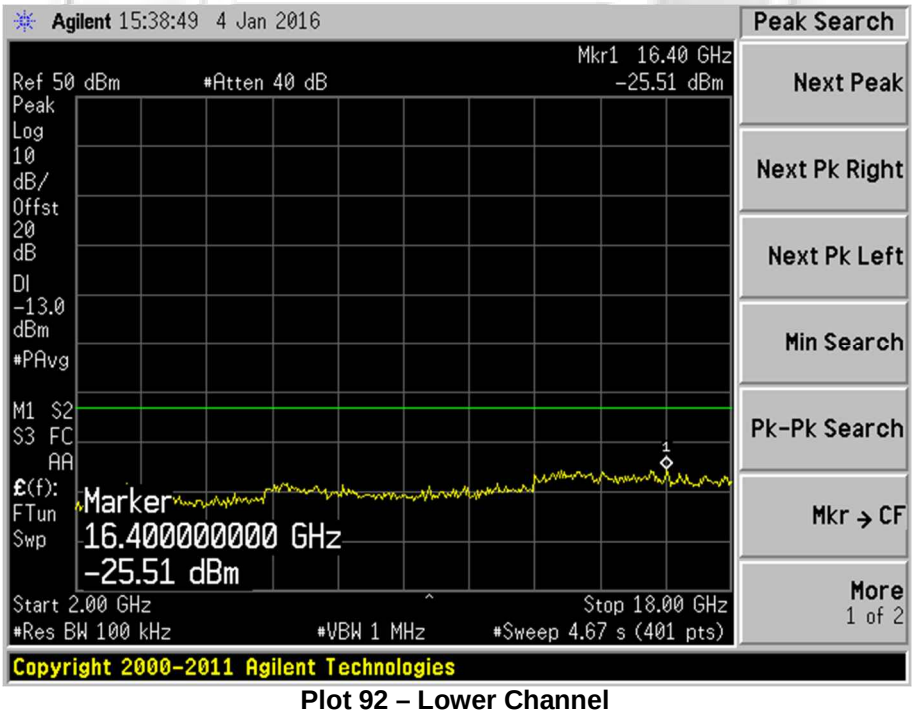


Plot 90 – Upper Channel

Out of Band Spurious Plots (Bearer Type: 1)

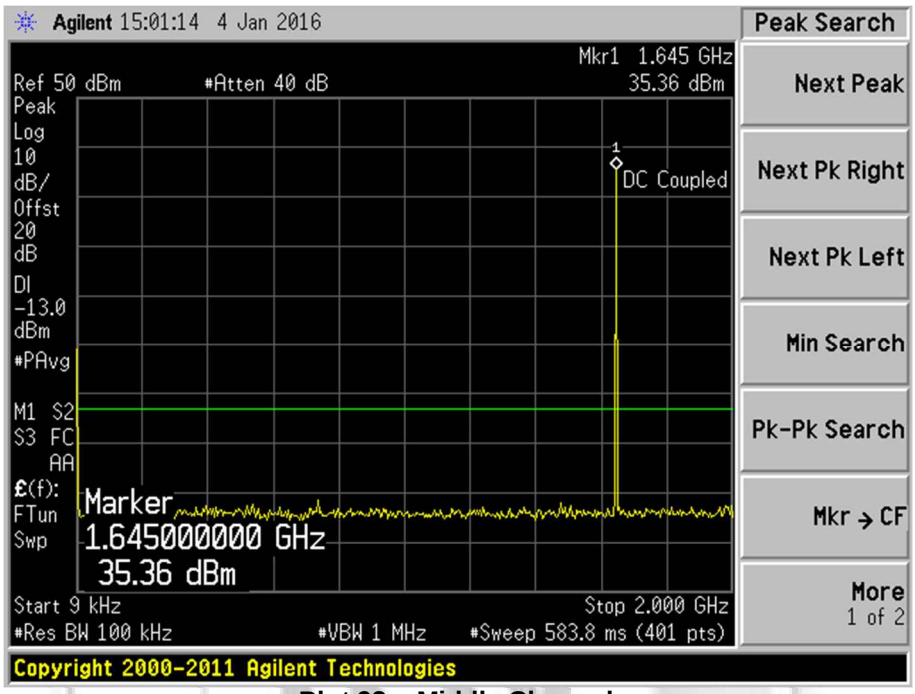


Plot 91 – Lower Channel

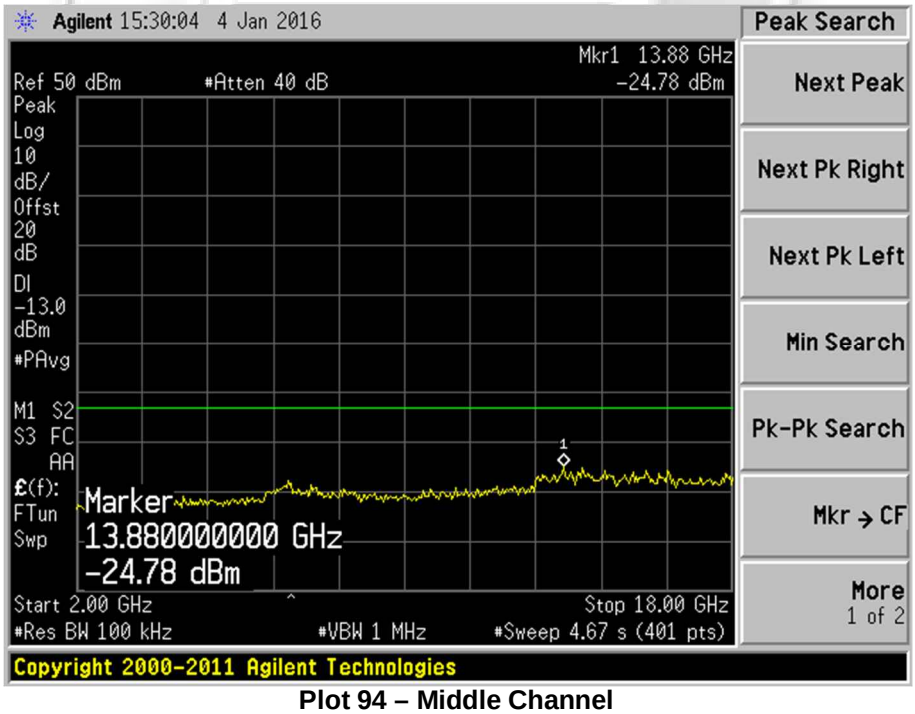


Plot 92 – Lower Channel

Out of Band Spurious Plots (Bearer Type: 1)

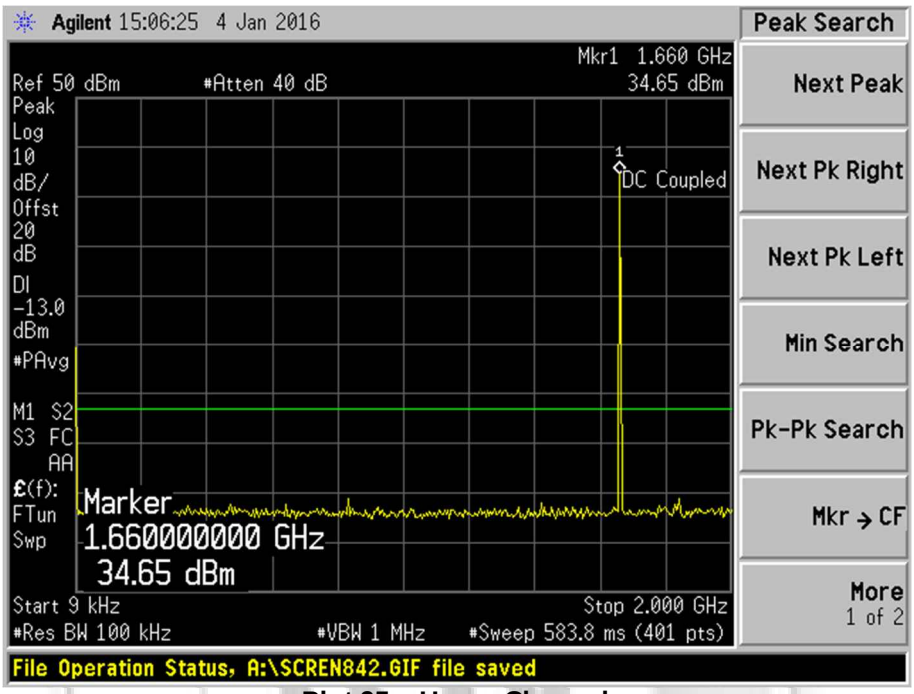


Plot 93 – Middle Channel

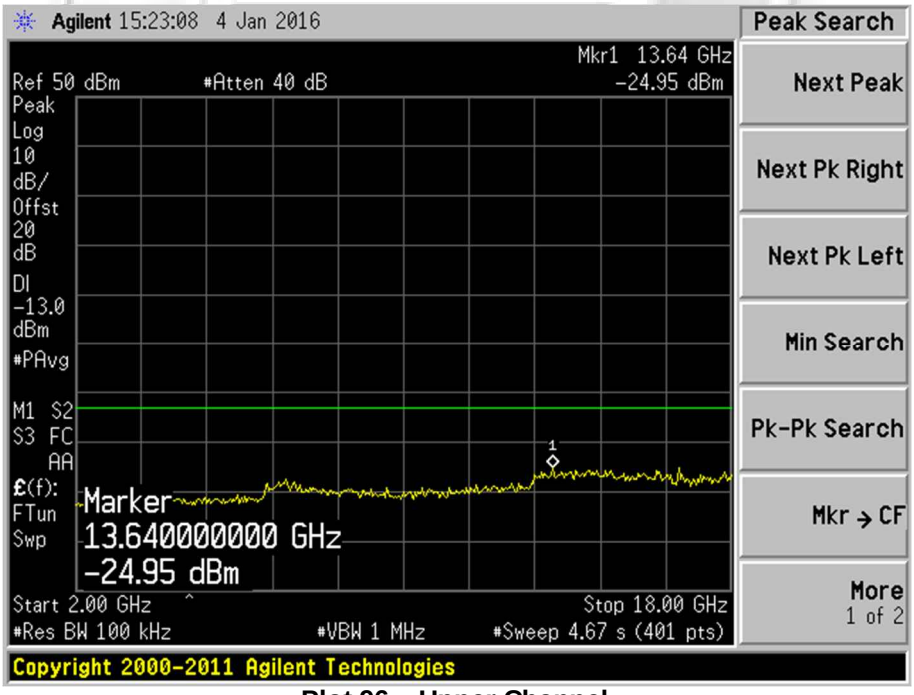


Plot 94 – Middle Channel

Out of Band Spurious Plots (Bearer Type: 1)

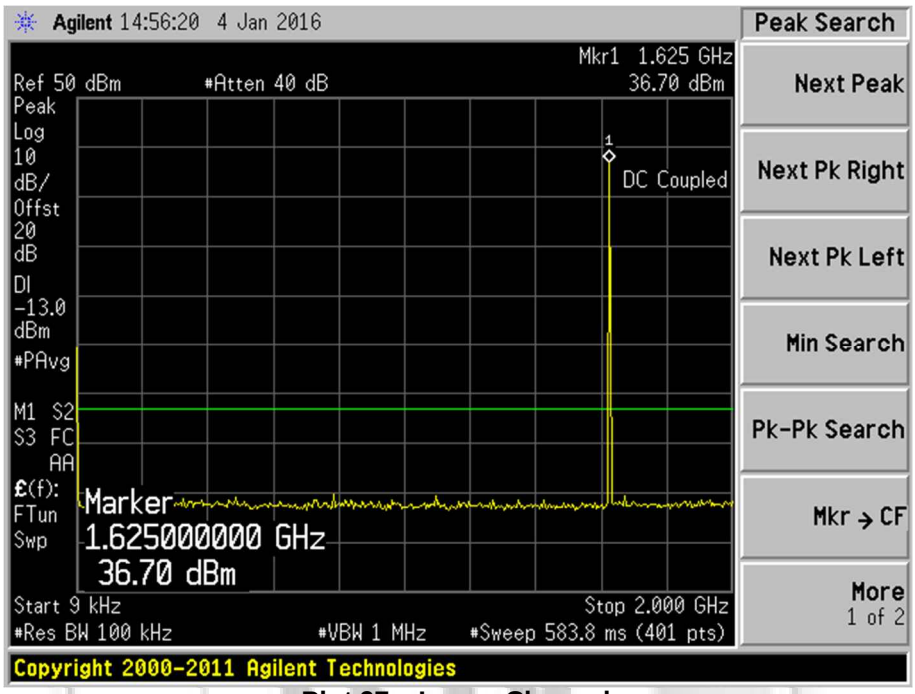


Plot 95 – Upper Channel

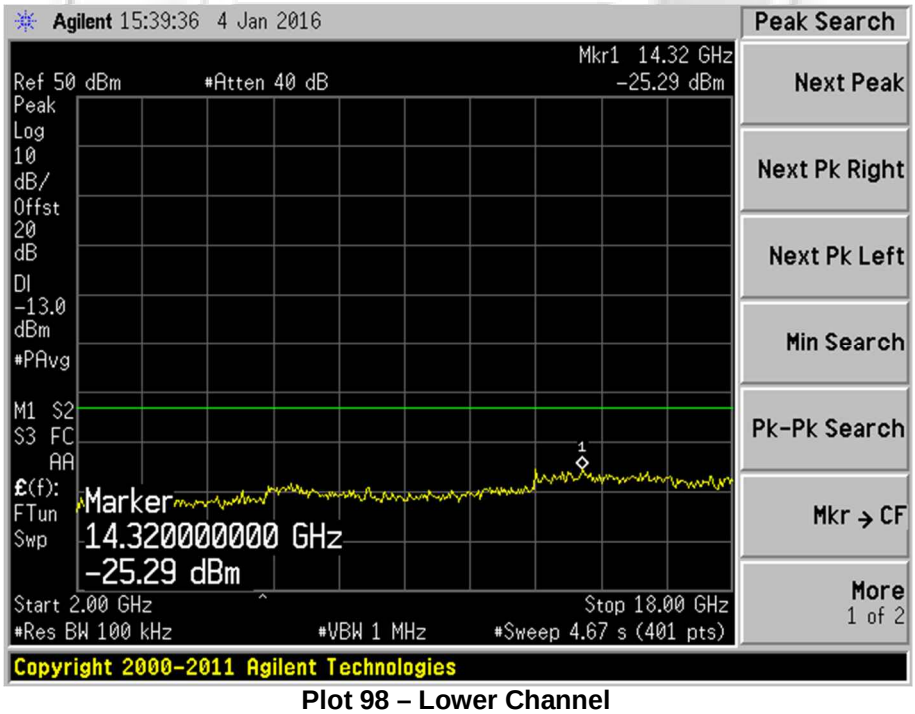


Plot 96 – Upper Channel

Out of Band Spurious Plots (Bearer Type: 2)

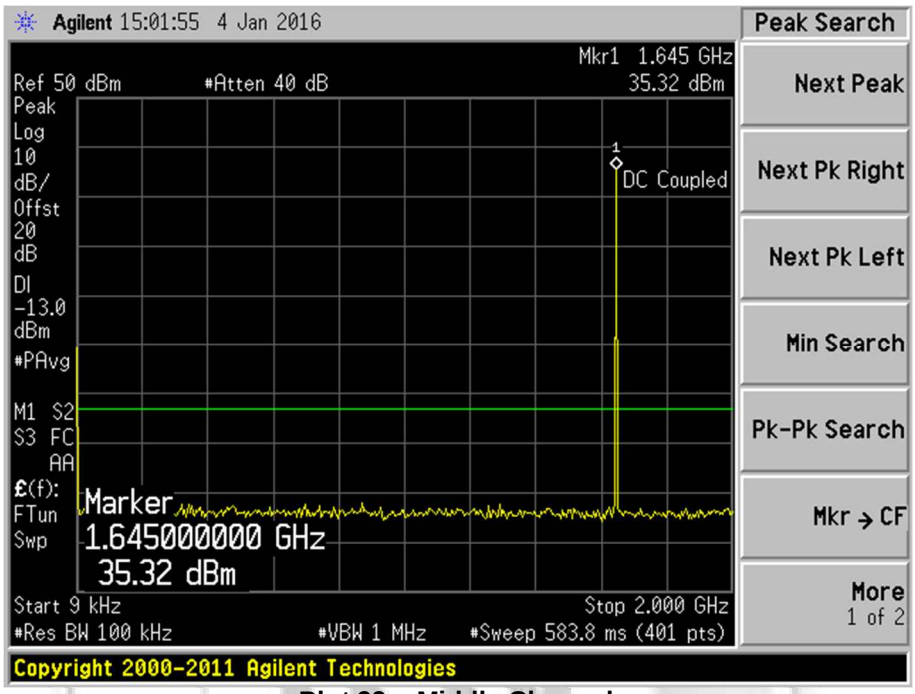


Plot 97 – Lower Channel

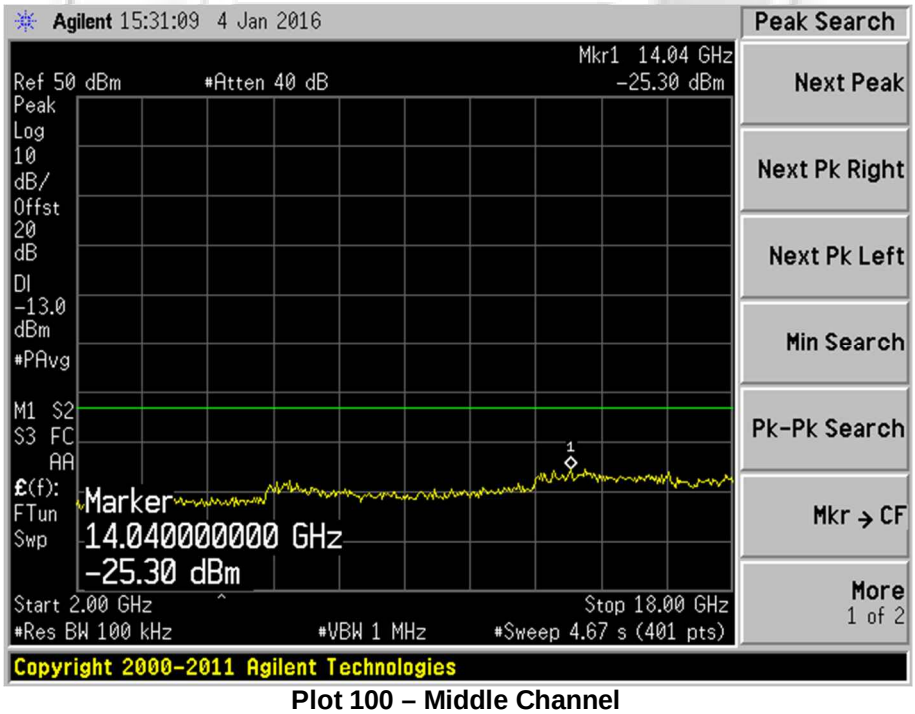


Plot 98 – Lower Channel

Out of Band Spurious Plots (Bearer Type: 2)

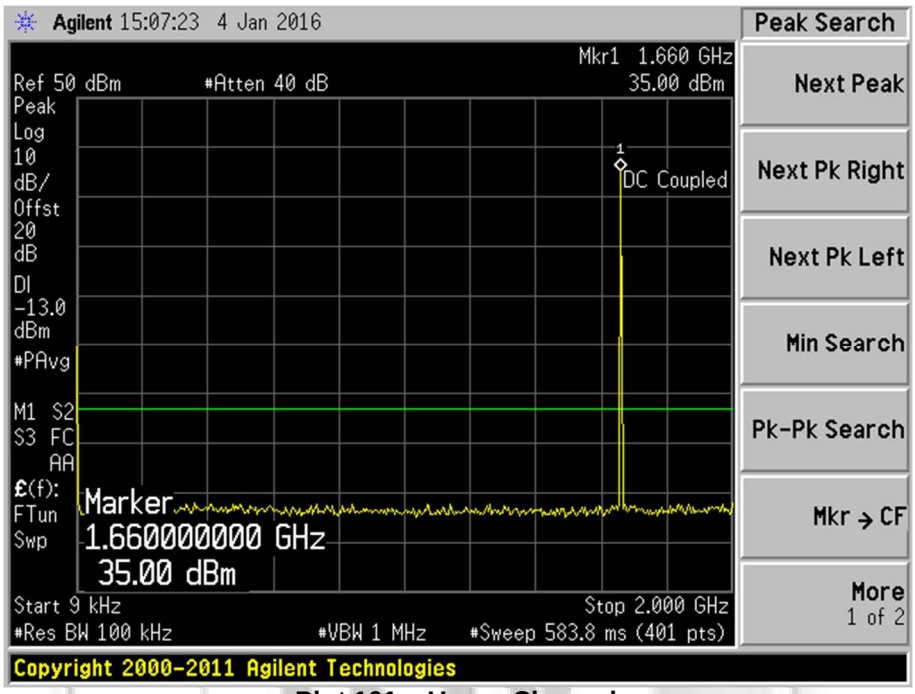


Plot 99 – Middle Channel

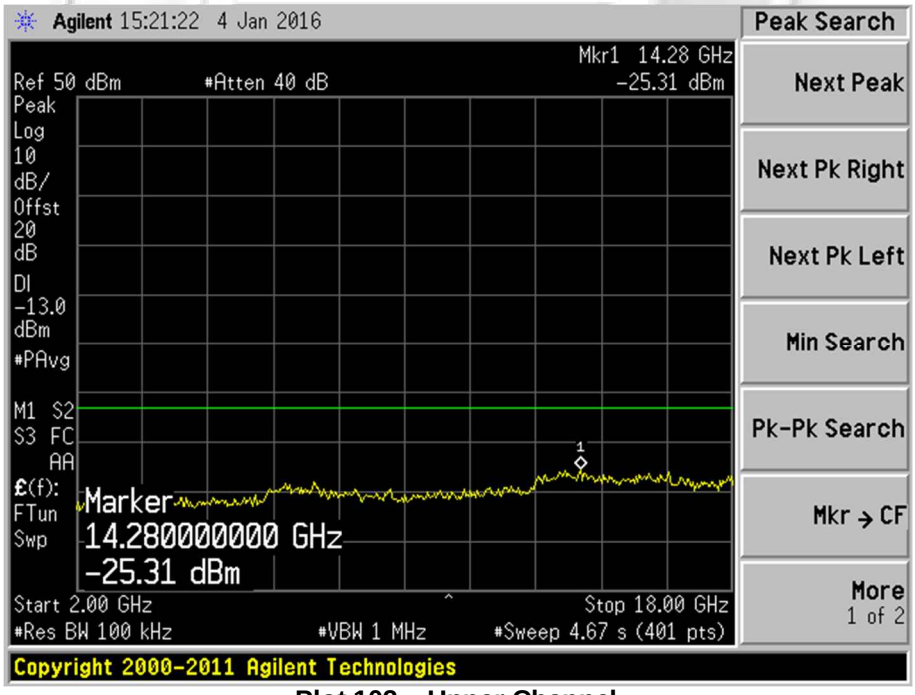


Plot 100 – Middle Channel

Out of Band Spurious Plots (Bearer Type: 2)

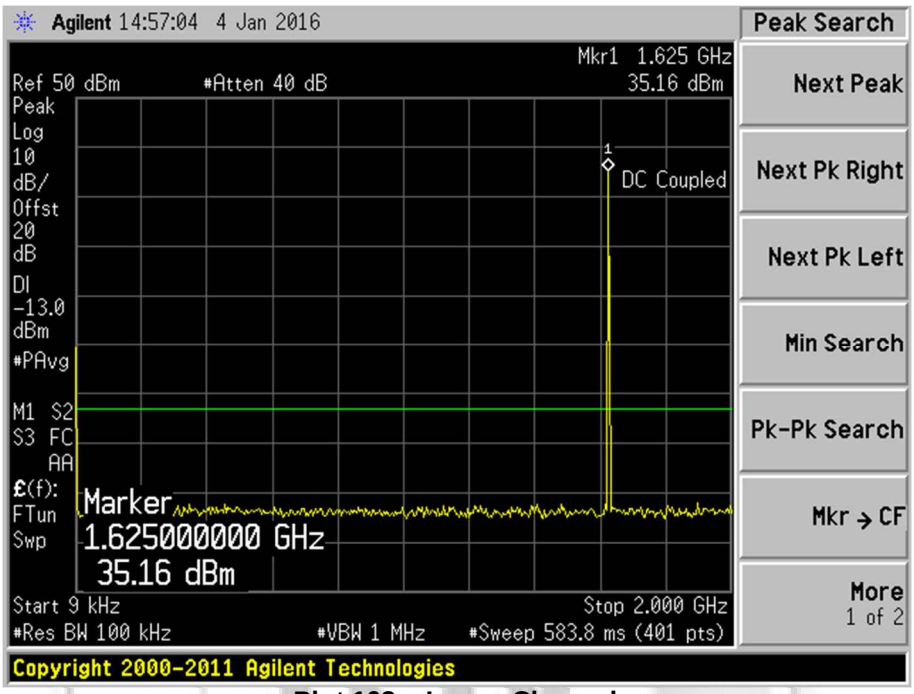


Plot 101 – Upper Channel

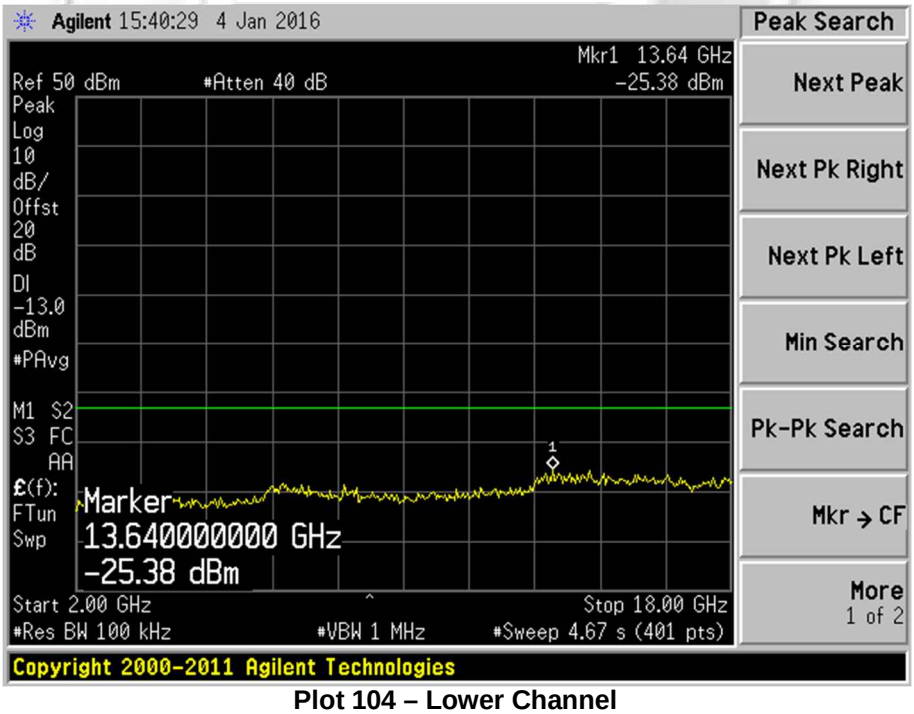


Plot 102 – Upper Channel

Out of Band Spurious Plots (Bearer Type: 3)

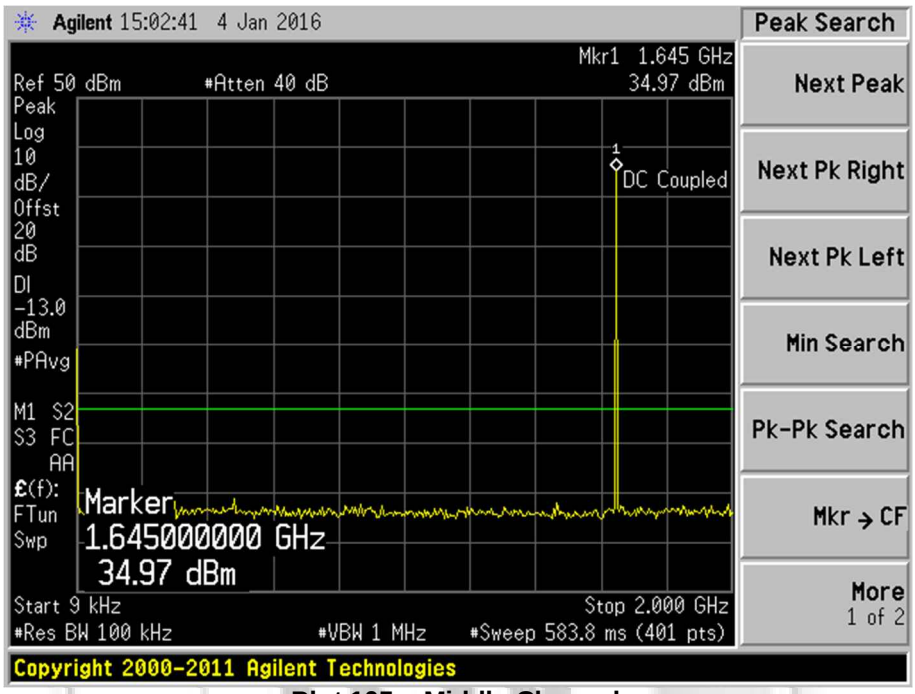


Plot 103 – Lower Channel

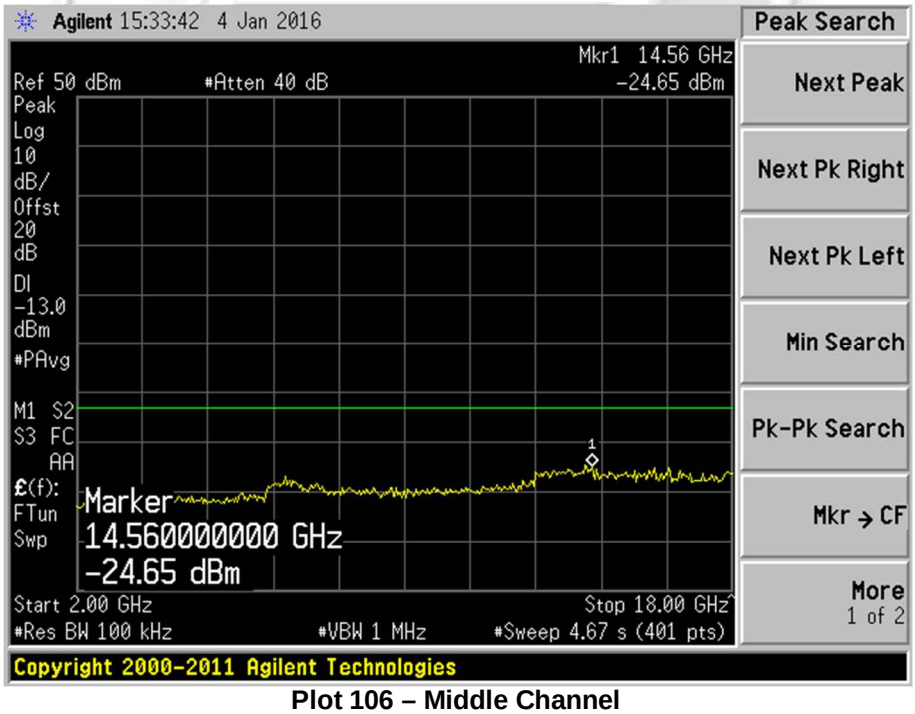


Plot 104 – Lower Channel

Out of Band Spurious Plots (Bearer Type: 3)

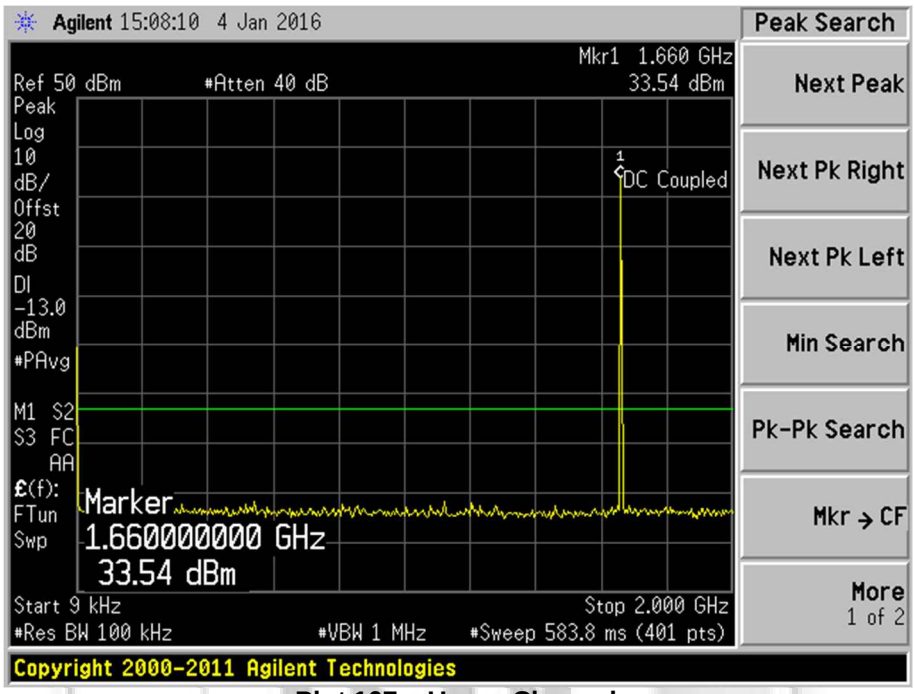


Plot 105 – Middle Channel

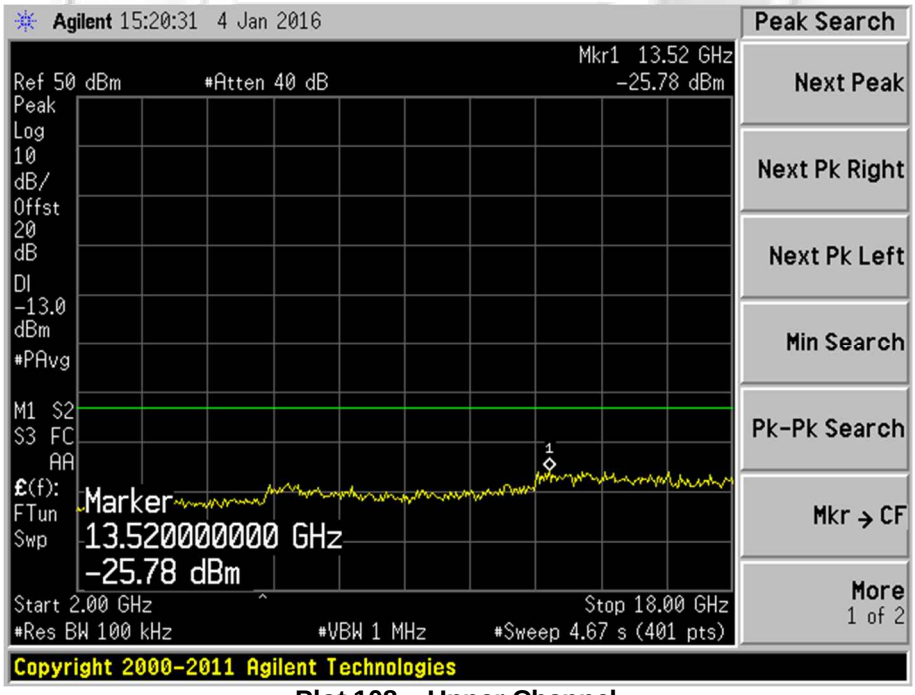


Plot 106 – Middle Channel

Out of Band Spurious Plots (Bearer Type: 3)

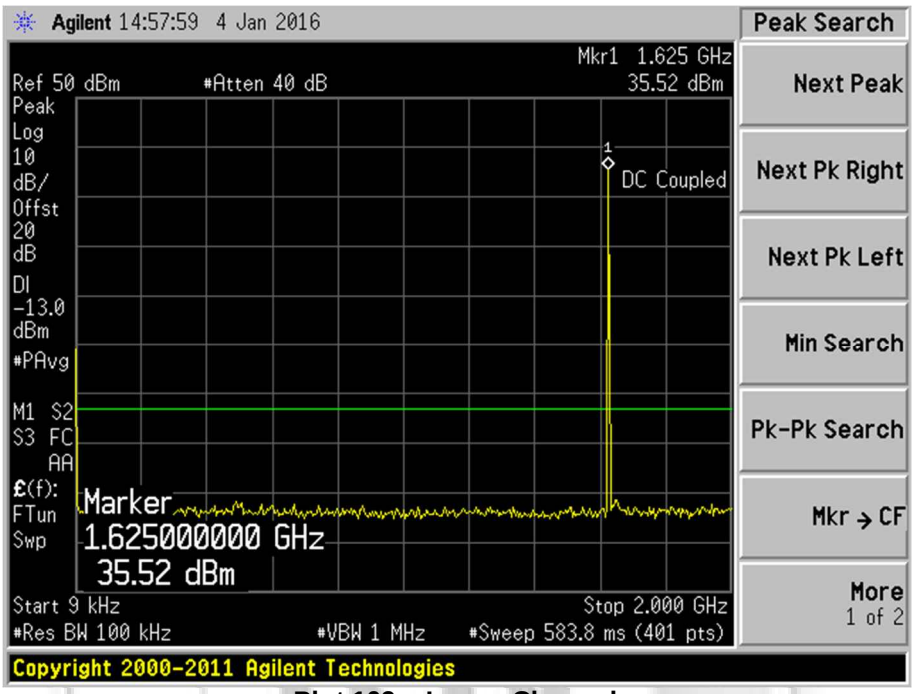


Plot 107 – Upper Channel

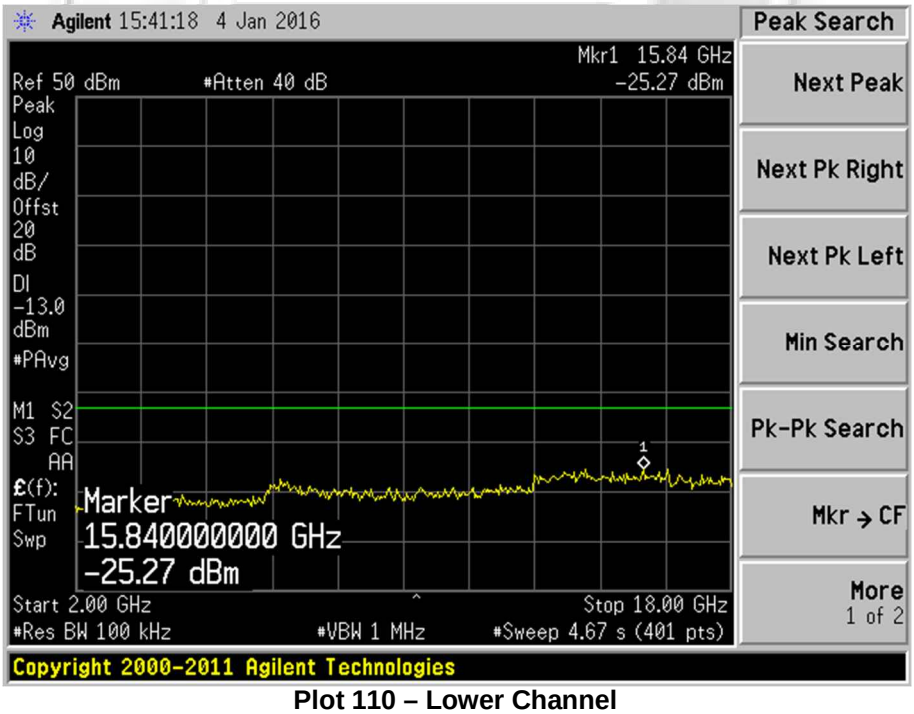


Plot 108 – Upper Channel

Out of Band Spurious Plots (Bearer Type: 4)

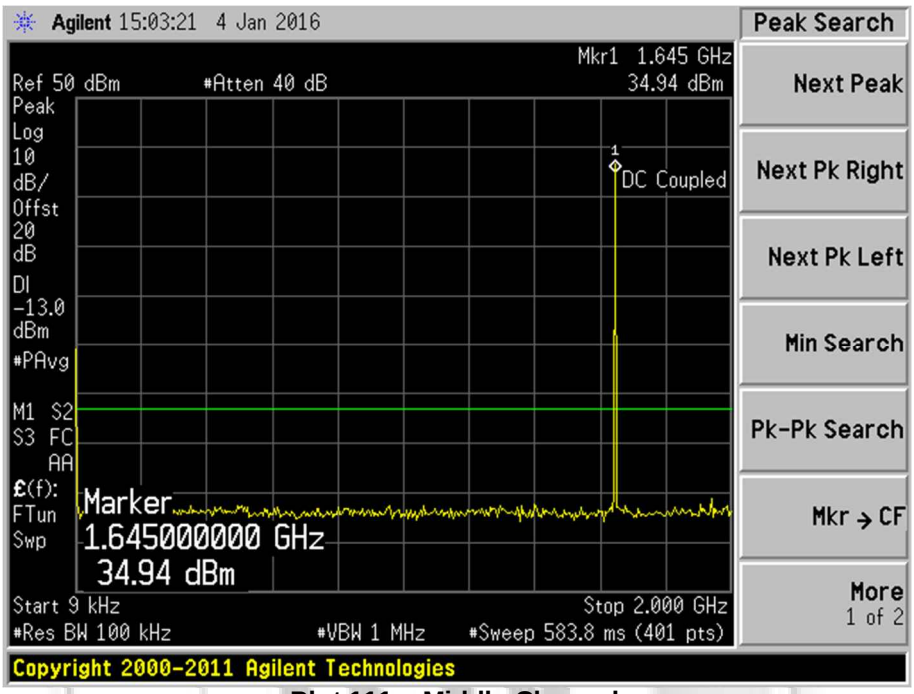


Plot 109 – Lower Channel

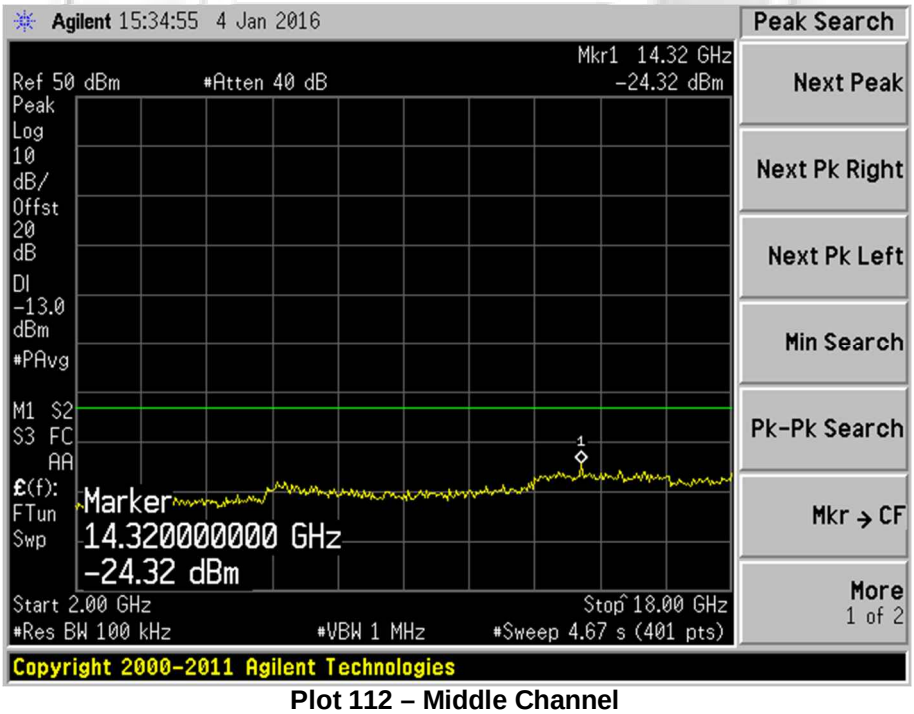


Plot 110 – Lower Channel

Out of Band Spurious Plots (Bearer Type: 4)

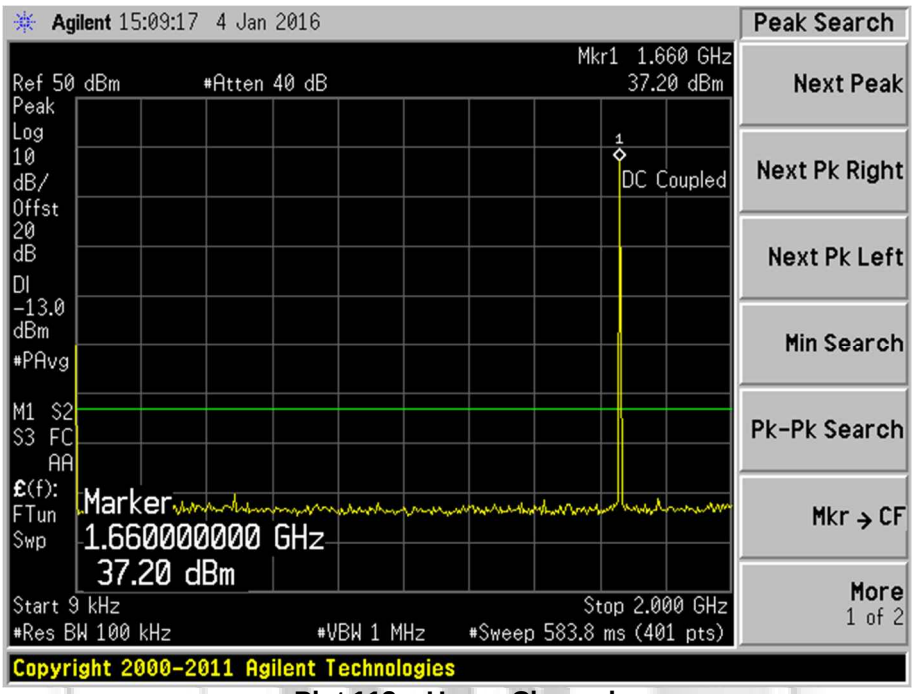


Plot 111 – Middle Channel

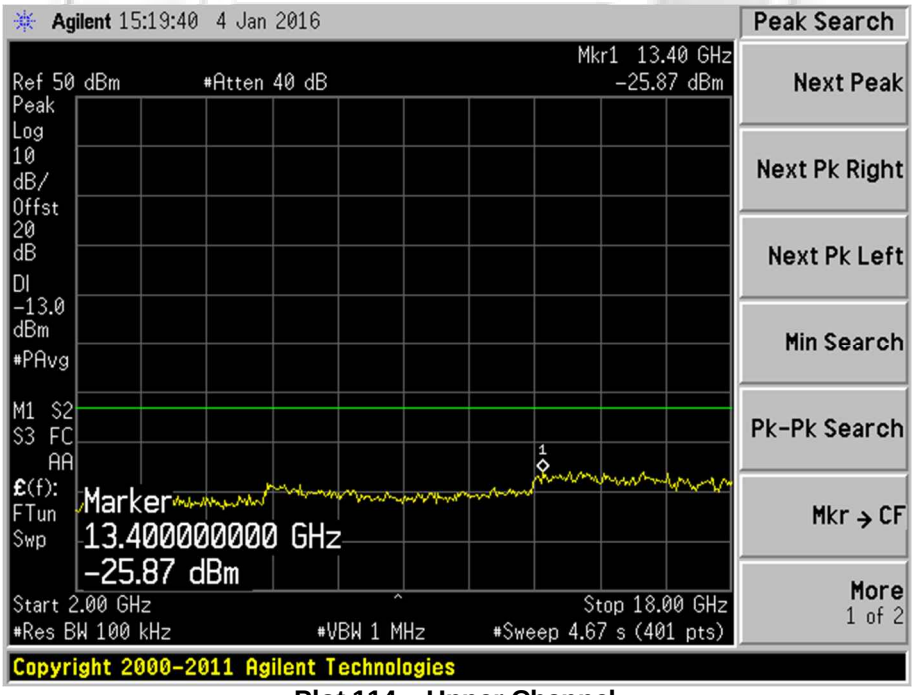


Plot 112 – Middle Channel

Out of Band Spurious Plots (Bearer Type: 4)

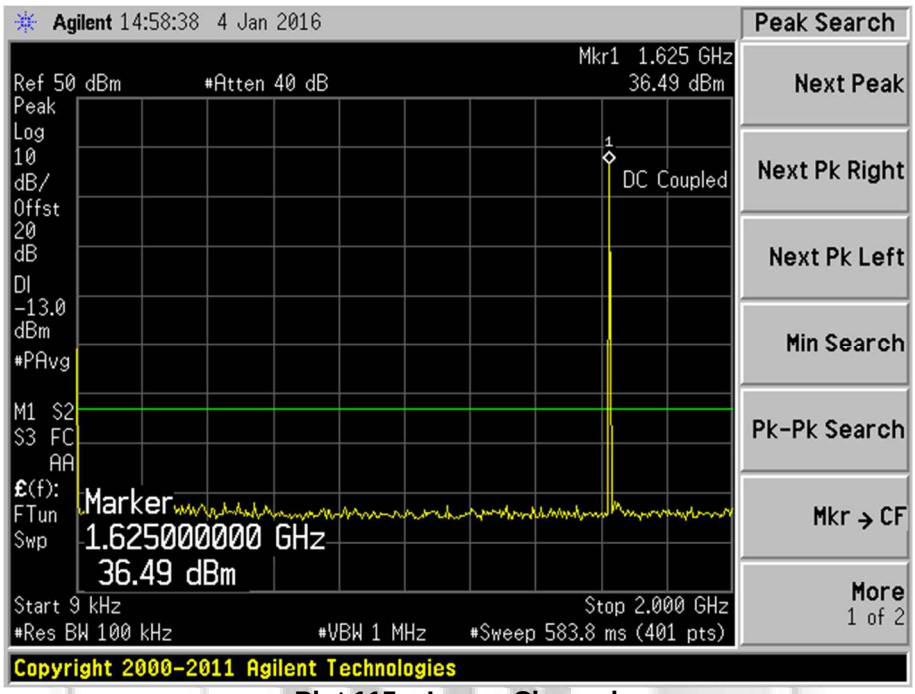


Plot 113 – Upper Channel

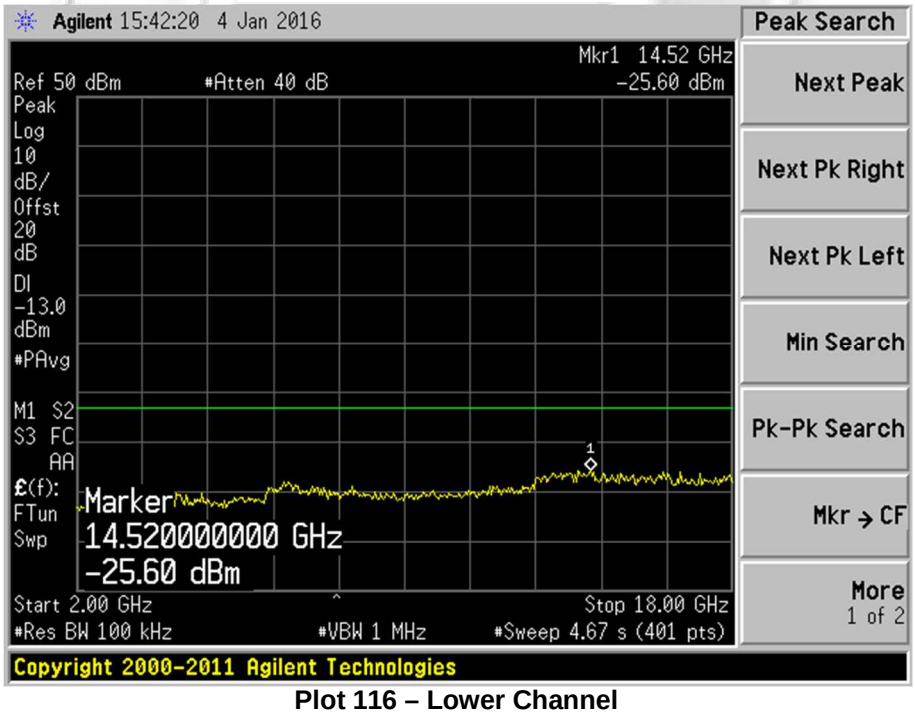


Plot 114 – Upper Channel

Out of Band Spurious Plots (Bearer Type: 5)

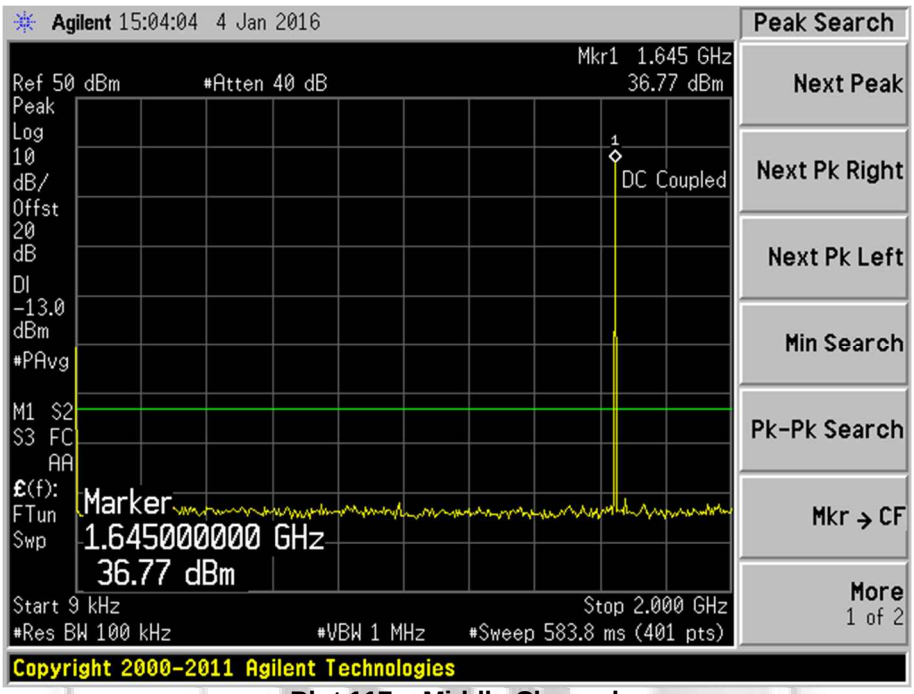


Plot 115 – Lower Channel

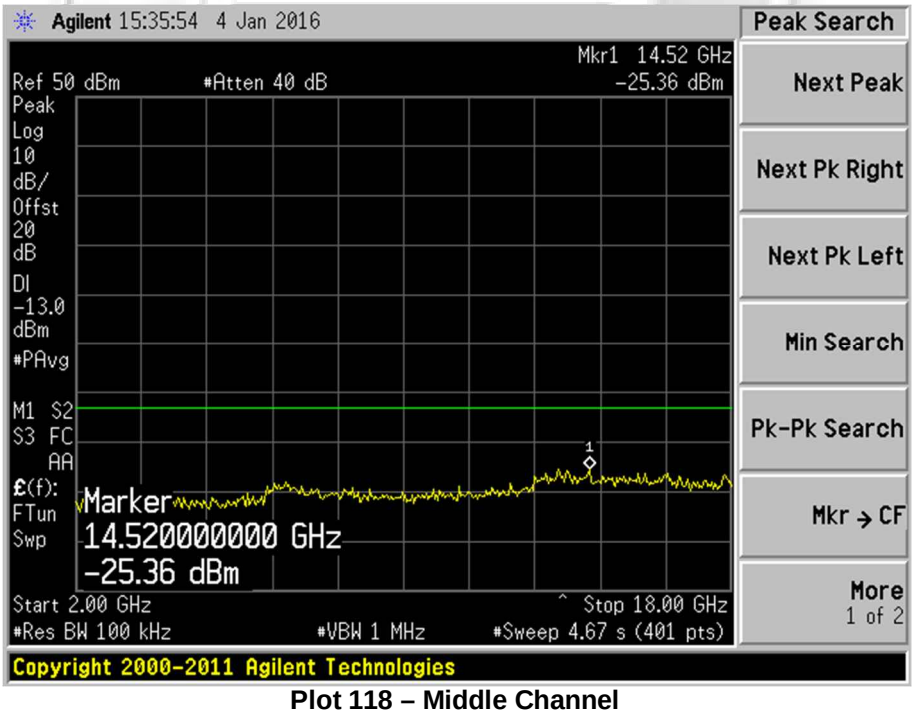


Plot 116 – Lower Channel

Out of Band Spurious Plots (Bearer Type: 5)

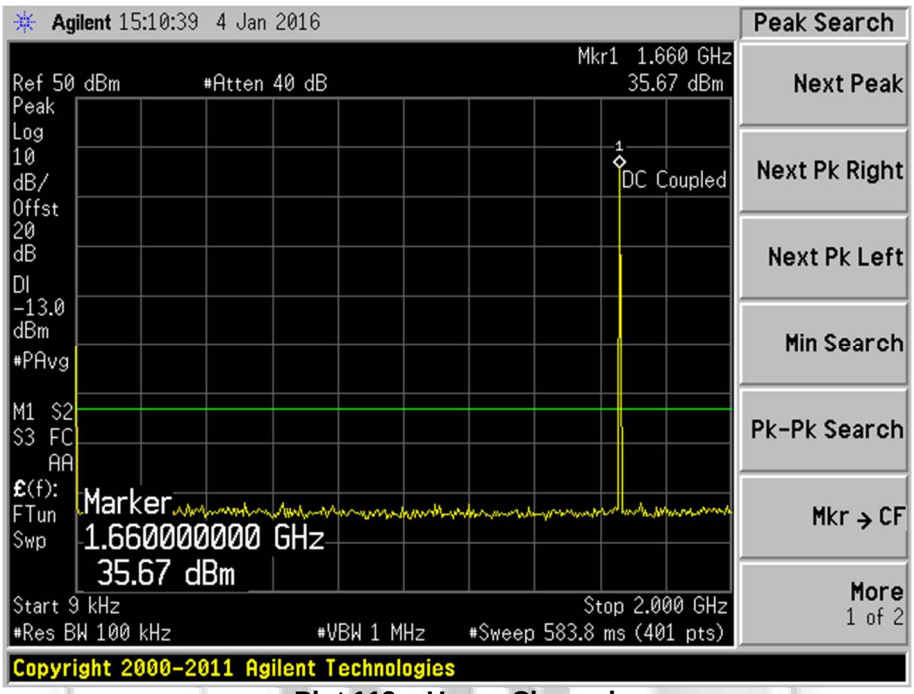


Plot 117 – Middle Channel

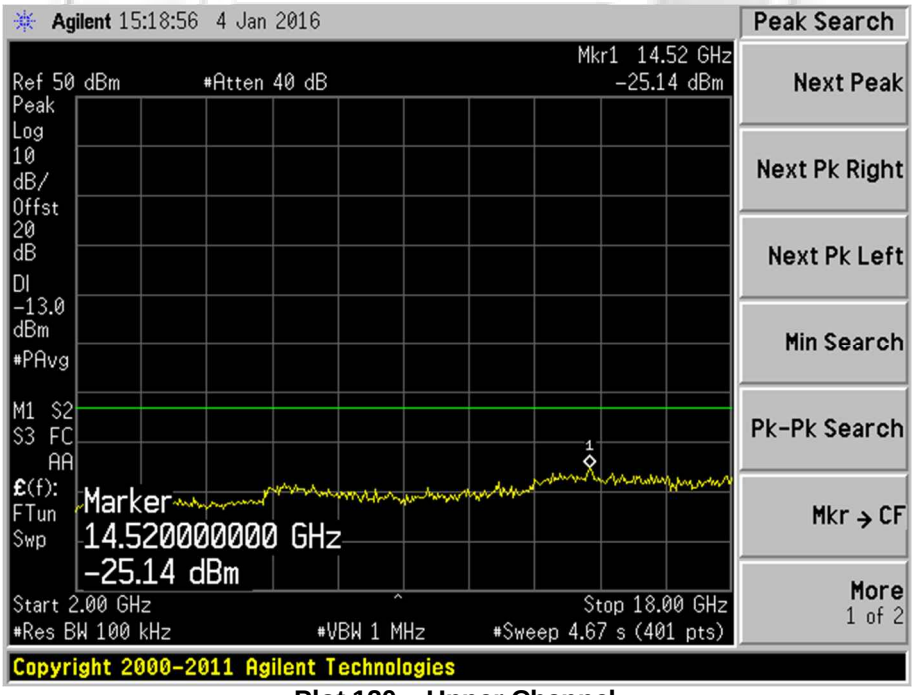


Plot 118 – Middle Channel

Out of Band Spurious Plots (Bearer Type: 5)

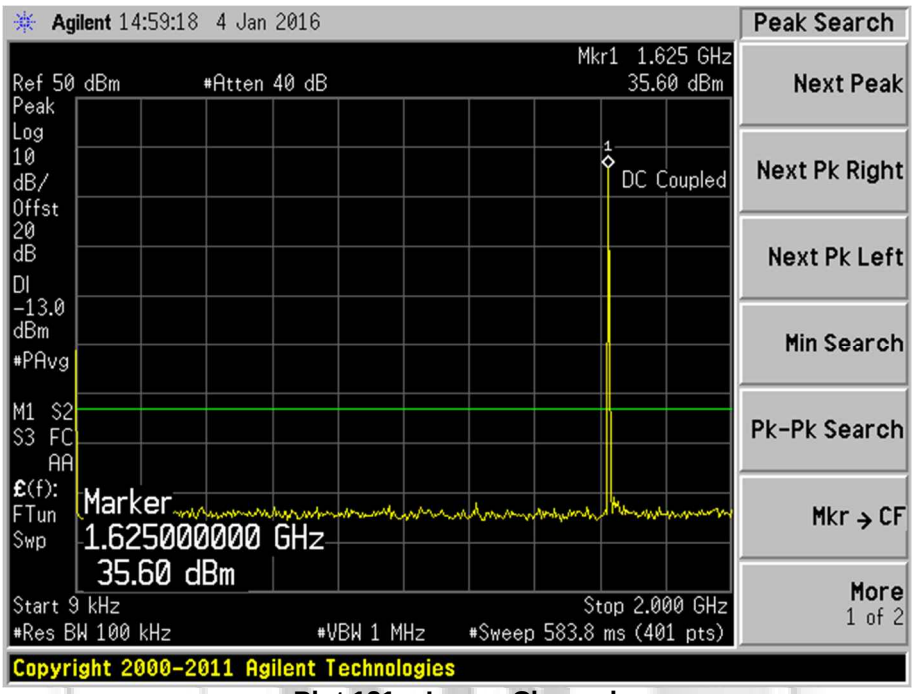


Plot 119 – Upper Channel

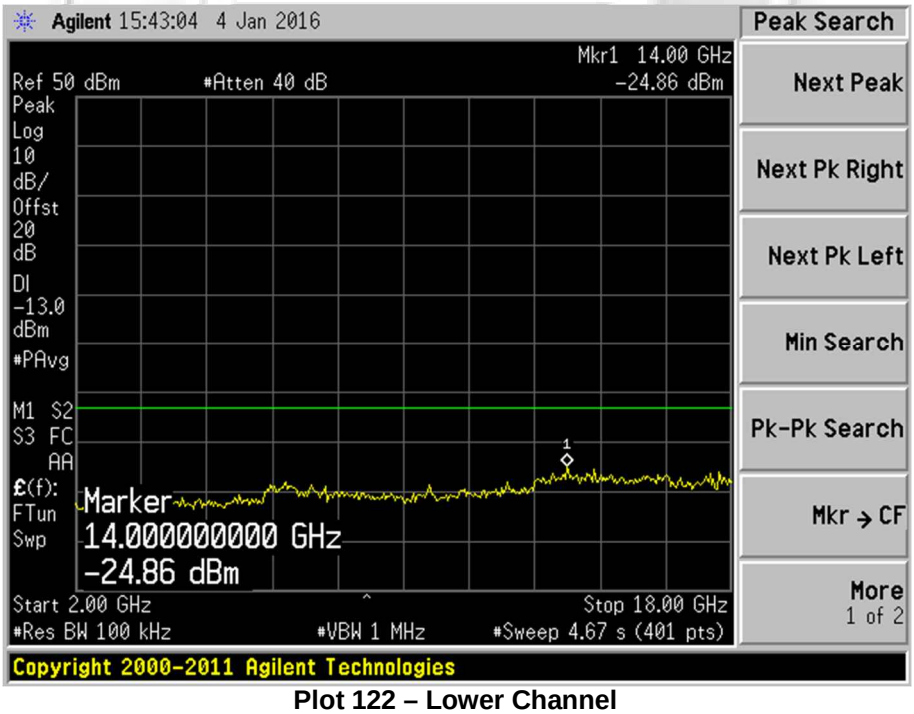


Plot 120 – Upper Channel

Out of Band Spurious Plots (Bearer Type: 6)

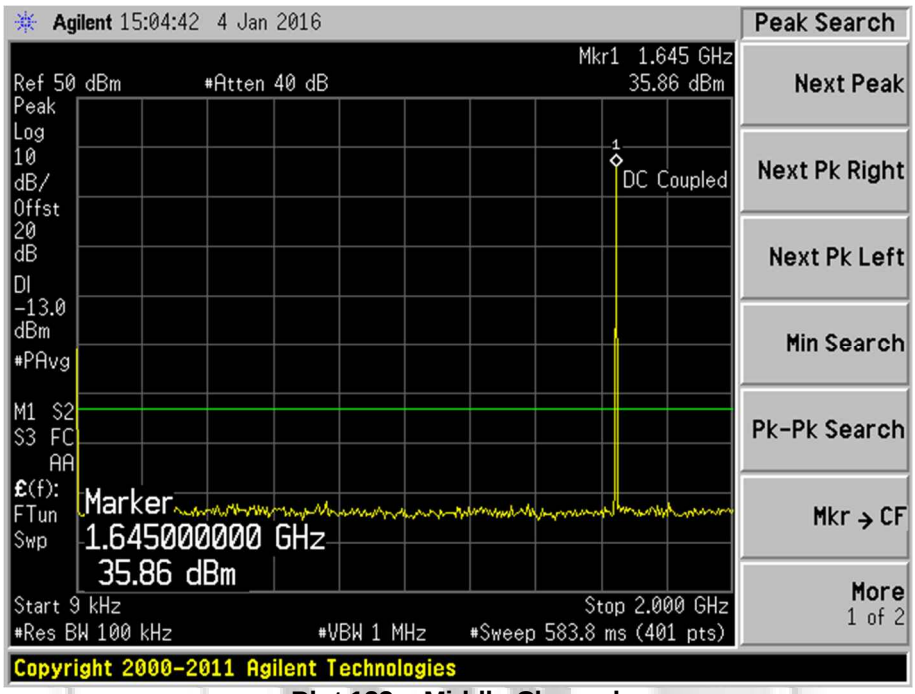


Plot 121 – Lower Channel

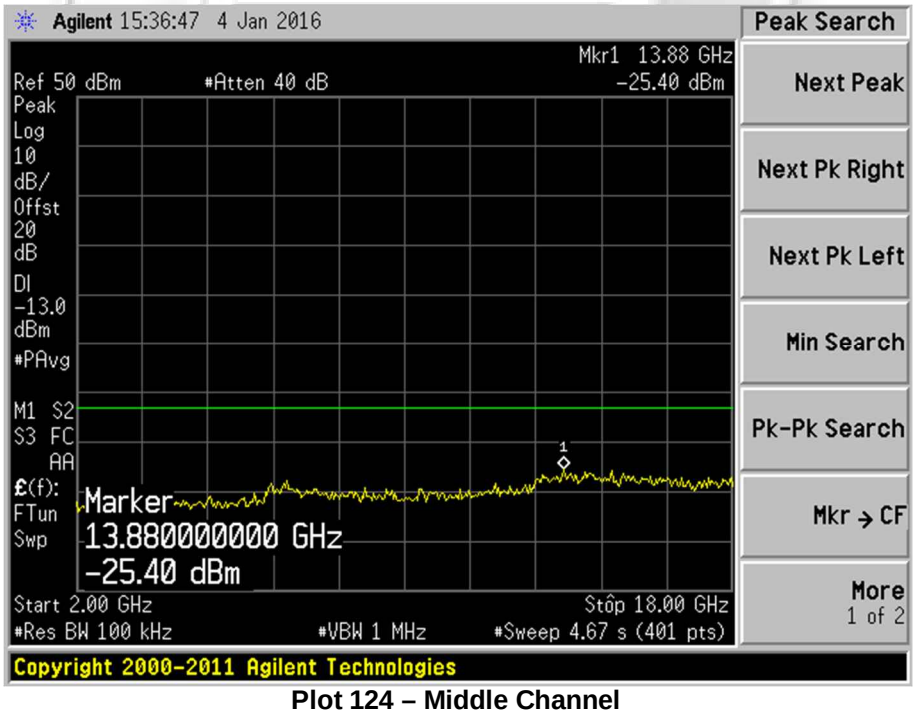


Plot 122 – Lower Channel

Out of Band Spurious Plots (Bearer Type: 6)

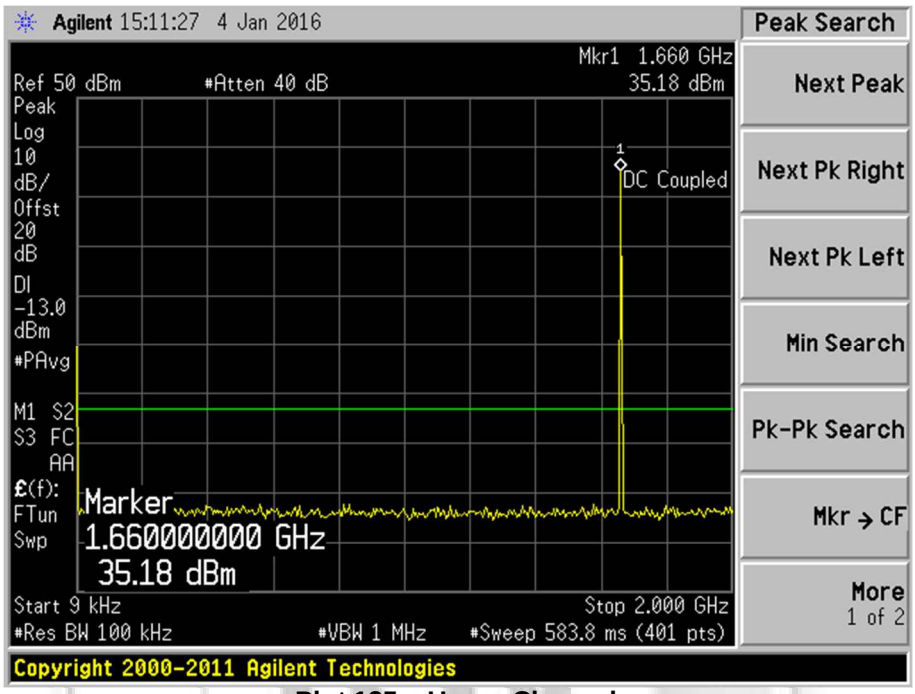


Plot 123 – Middle Channel

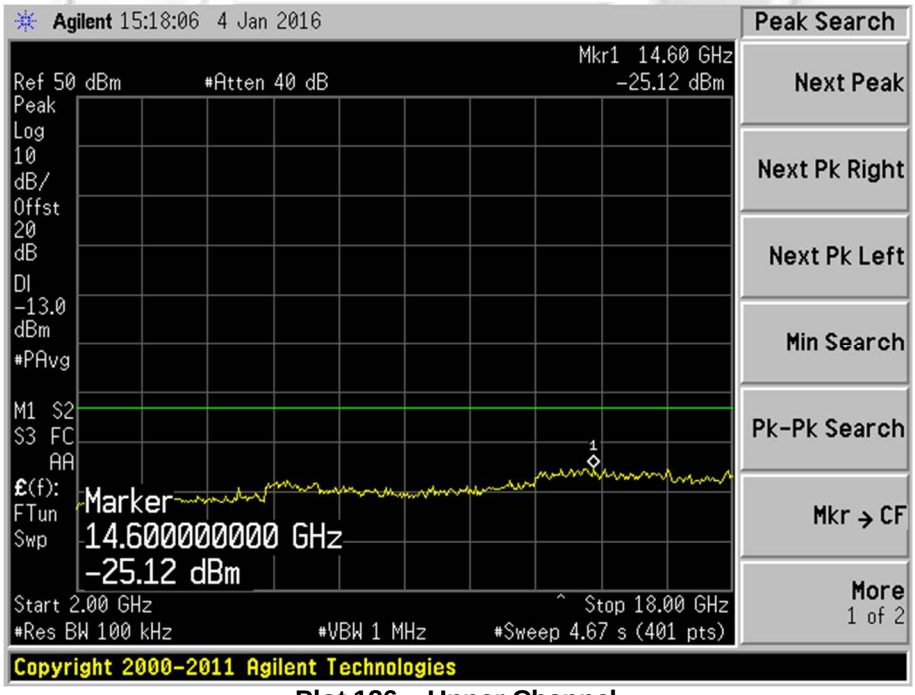


Plot 124 – Middle Channel

Out of Band Spurious Plots (Bearer Type: 6)



Plot 125 – Upper Channel



Plot 126 – Upper Channel

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
Agilent Spectrum Analyzer	E7405A	MY45106084	01 Aug 2016
Schaffner Bilog Antenna –(30MHz-2GHz) BL4	CBL6112B	2593	13 Dec 2016
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441056	15 Aug 2016
Toyo Preamplifier	TPA0118036	00000005	16 Oct 2016
EMCO Horn Antenna (1GHz-18GHz)	3115	9901-5671	13 Mar 2017
K&L Microwave Tunable Band Reject Filter	3TNF-1000/2000-N/N	436	Output Monitor

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 360º 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 10^{th} 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.

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

Operating Mode	Continuous Satellite Transmission	Temperature	28°C
Test Input Power	12Vdc	Relative Humidity	59%
Test Distance	3m	Atmospheric Pressure	1030mbar
Type Bearer	0 (Worst Bearer)	Tested By	Lim Kay Tak

30MHz – 1GHz

Lower Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
93.9330	-59.1	-13.0
113.6280	-62.5	-13.0
187.4840	-61.7	-13.0
785.7190	-62.0	-13.0
864.4990	-62.6	-13.0
953.1270	-60.2	-13.0

Middle Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
93.6810	-59.1	-13.0
181.8540	-63.0	-13.0
189.2010	-62.2	-13.0
500.2560	-62.7	-13.0
865.1940	-62.4	-13.0
950.9180	-60.3	-13.0

Upper Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
93.6810	-59.0	-13.0
113.2750	-63.5	-13.0
189.2010	-62.7	-13.0
500.2560	-63.4	-13.0
865.1940	-61.9	-13.0
950.9180	-59.8	-13.0

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

Operating Mode	Continuous Satellite Transmission	Temperature	28°C
Test Input Power	12Vdc	Relative Humidity	59%
Test Distance	3m	Atmospheric Pressure	1030mbar
Type Bearer	0 (Worst Bearer)	Tested By	Lim Kay Tak

1GHz – 17GHz

Lower Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
1023.7830	-55.1	-13.0
1118.9130	-59.1	-13.0
2603.1720	-51.5	-13.0
4828.9930	-47.0	-13.0
7231.0320	-36.2	-13.0
11725.9370	-46.5	-13.0

Middle Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
1010.1200	-53.6	-13.0
2537.0740	-42.7	-13.0
3600.9020	-44.0	-13.0
4876.0520	-38.4	-13.0
5402.3050	-44.8	-13.0
5948.7980	-43.5	-13.0

Upper Channel

Frequency (MHz)	Amplitude (dBm)	Limit (dBm)
1023.7830	-53.8	-13.0
2550.7370	-51.4	-13.0
4924.1230	-46.3	-13.0
7397.5100	-35.9	-13.0
9847.1140	-44.1	-13.0
12320.5010	-44.7	-13.0

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 10log10 [(used RBW) / 4kHz].
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 ±4.0dB.

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
Agilent Spectrum Analyzer	E7405A	MY45106084	01 Aug 2016
Schaffner Bilog Antenna –(30MHz-2GHz) BL4	CBL6112B	2593	13 Dec 2016
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441056	15 Aug 2016
Toyo Preamplifier	TPA0118036	00000005	16 Oct 2016
EMCO Horn Antenna (1GHz-18GHz)	3115	9901-5671	13 Mar 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).

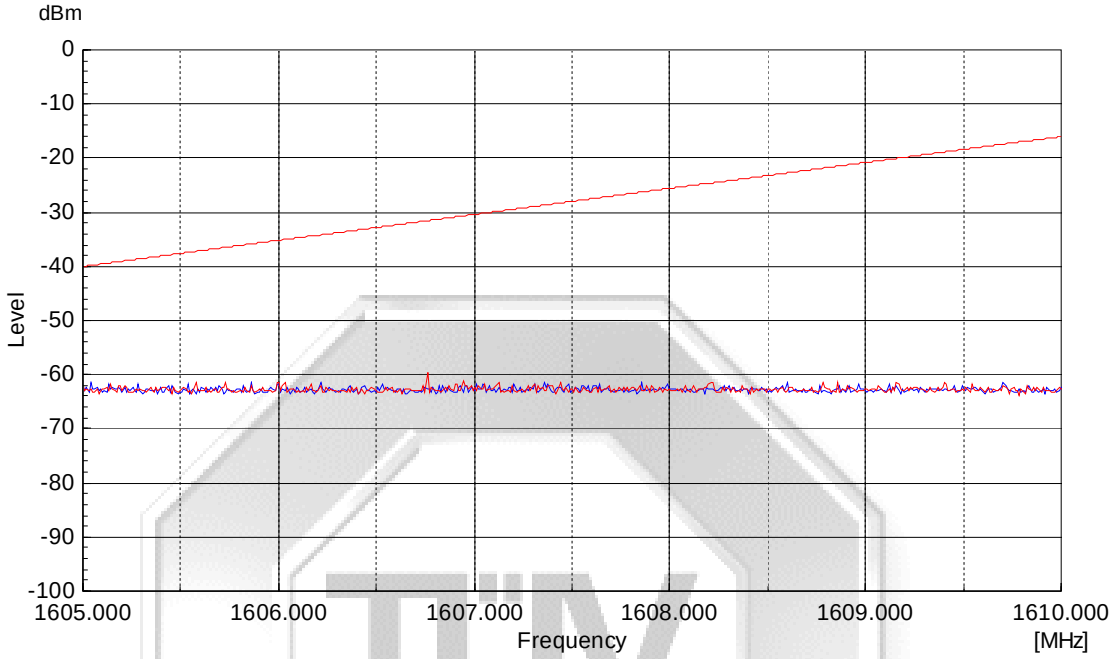
PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE TEST

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

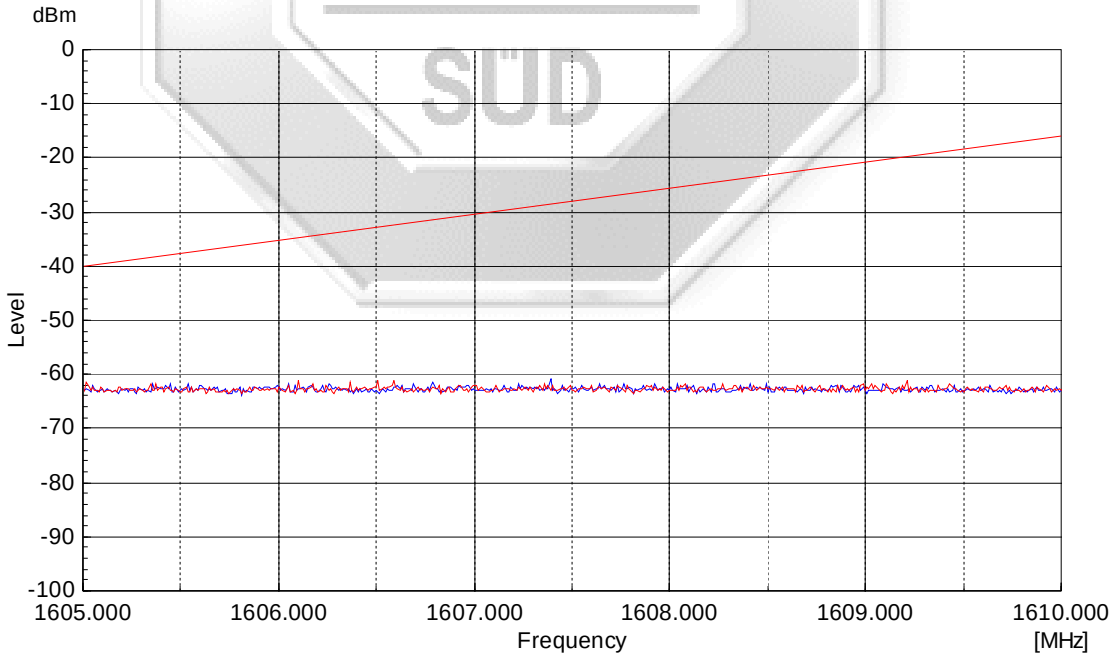
Operating Mode	Continuous Satellite Transmission	Temperature	28°C
Test Input Power	12Vdc	Relative Humidity	59%
Test Distance	3m	Atmospheric Pressure	1030mbar
Type Bearer	0 (worst bearer)	Tested By	Lim Kay Tak
Attached Plots	127 – 132		

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

Type Bearer: 0 - Transmitter On

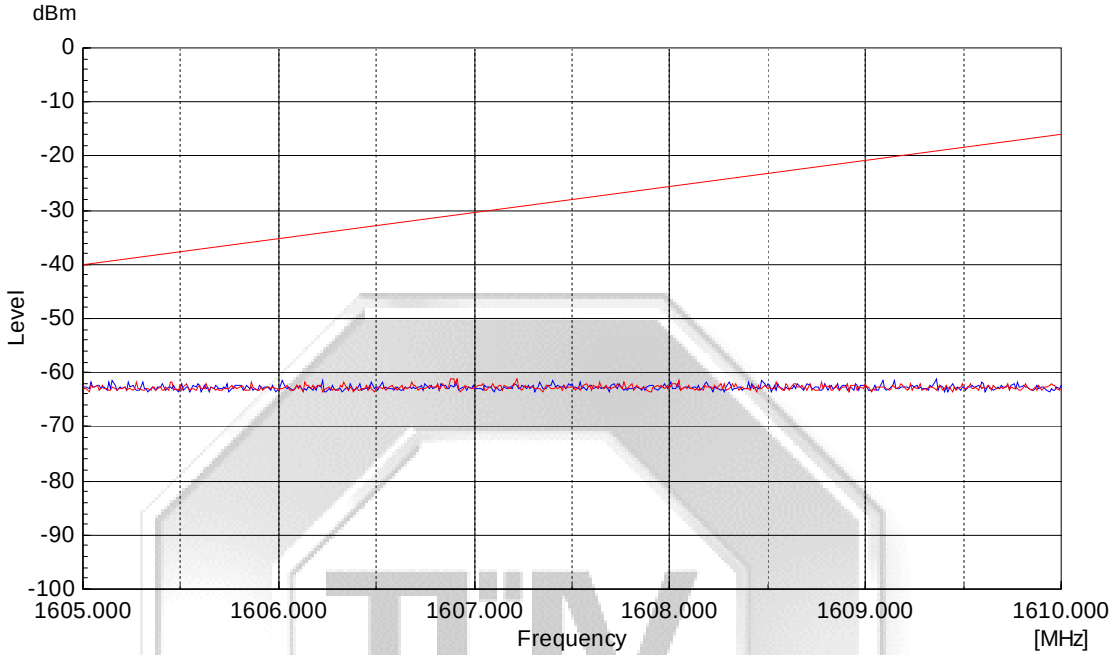


Plot 127 – Lower Channel



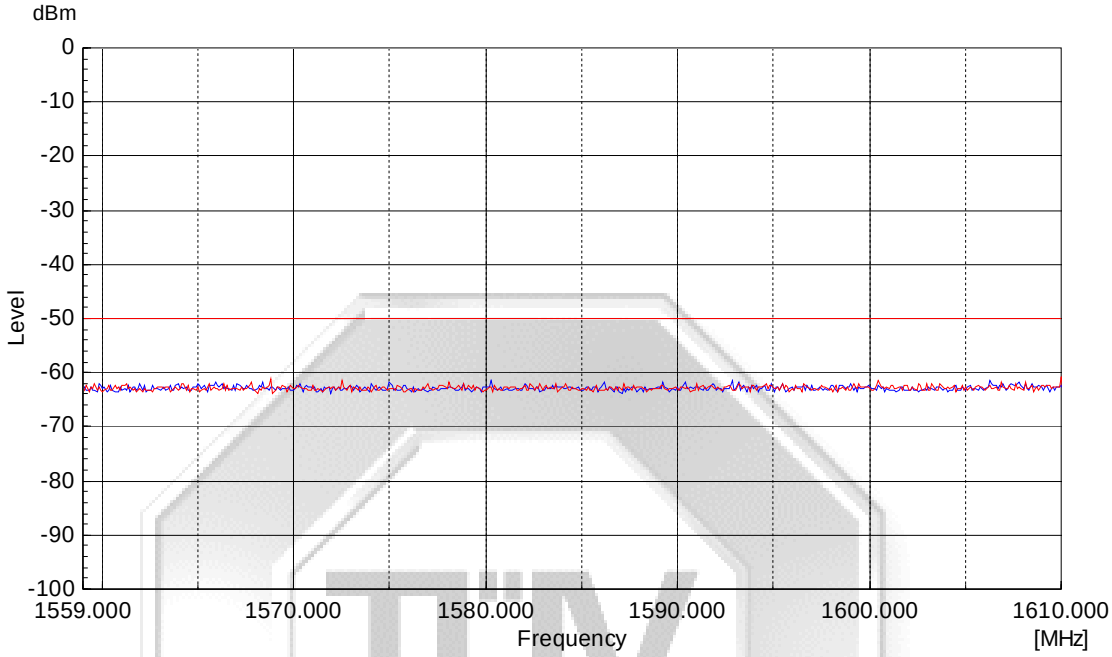
Plot 128 – Middle Channel

Type Bearer: 0 - Transmitter On

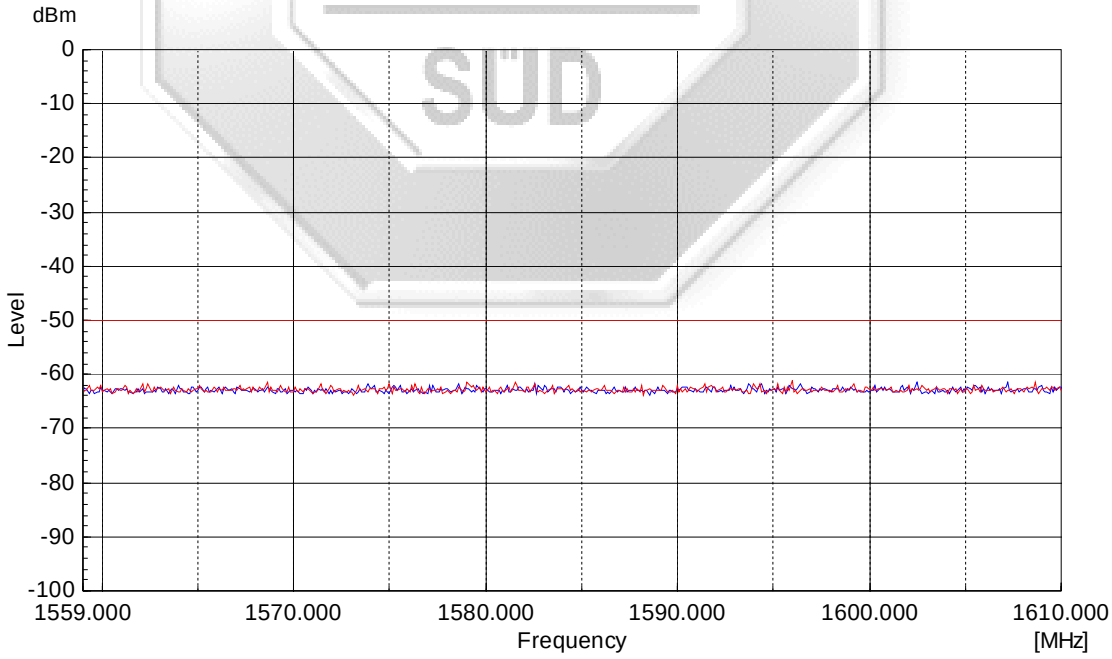


Plot 129 – Upper Channel

Carrier Off

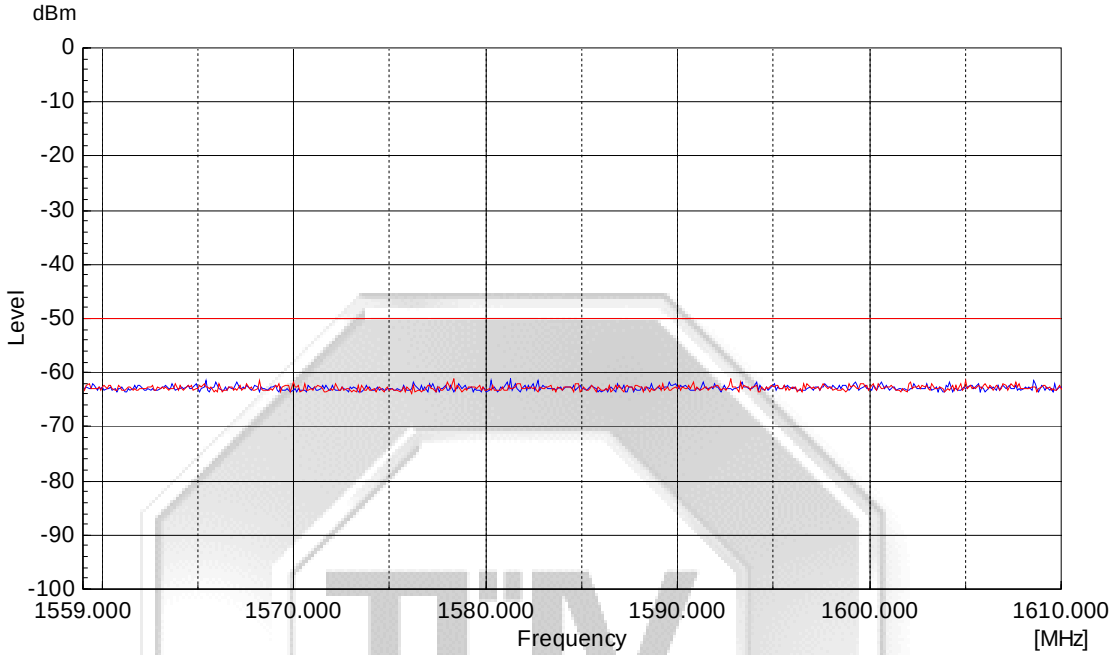


Plot 130 – Lower Channel



Plot 131 – Middle Channel

Carrier Off



Plot 132 – Upper Channel

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
Agilent Universal Counter	53132A	3736A0628	25 May 2017
Mini-Circuits Precision Fixed Attenuator	BW-S20W5+	Nil	Output Monitor
Instock Wireless Components Combiner	PD7120	Nil	Output Monitor
Kikusui Regulated DC Power Supply	PAD 35-10L	1540254	Output Monitor

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.

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	59%
		Atmospheric Pressure	1030mbar
		Tested By	Lim Poh Huat

Lower Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
-30	1.6266014063	1.626600000	1406	+/-16266
-20	1.6266013706	1.626600000	1371	+/-16266
-10	1.6266013475	1.626600000	1348	+/-16266
0	1.6266013542	1.626600000	1354	+/-16266
10	1.6266014207	1.626600000	1421	+/-16266
20	1.6266014271	1.626600000	1427	+/-16266
30	1.6266014370	1.626600000	1437	+/-16266
40	1.6266014479	1.626600000	1448	+/-16266
50	1.6266014790	1.626600000	1479	+/-16266

Middle Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
-30	1.6435014587	1.643500000	1459	+/-16435
-20	1.6435014211	1.643500000	1421	+/-16435
-10	1.6435013953	1.643500000	1395	+/-16435
0	1.6435014010	1.643500000	1401	+/-16435
10	1.6435014693	1.643500000	1469	+/-16435
20	1.6435014753	1.643500000	1475	+/-16435
30	1.6435014870	1.643500000	1487	+/-16435
40	1.6435014987	1.643500000	1499	+/-16435
50	1.6435015331	1.643500000	1533	+/-16435

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

Upper Channel

Temperature (°C)	Measured Frequency (GHz)	Reference Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
-30	1.6604014359	1.660400000	1436	+/-16604
-20	1.6604013957	1.660400000	1396	+/-16604
-10	1.6604013682	1.660400000	1368	+/-16604
0	1.6604013731	1.660400000	1373	+/-16604
10	1.6604014315	1.660400000	1431	+/-16604
20	1.6604014499	1.660400000	1450	+/-16604
30	1.6604014609	1.660400000	1461	+/-16604
40	1.6604014740	1.660400000	1474	+/-16604
50	1.6604015116	1.660400000	1512	+/-16604

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
Agilent Universal Counter	53132A	3736A0628	25 May 2017
Mini-Circuits Precision Fixed Attenuator	BW-S20W5+	Nil	Output Monitor
Instock Wireless Components Combiner	PD7120	Nil	Output Monitor
Kikusui Regulated DC Power Supply	PAD 35-10L	1540254	Output Monitor

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.

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	59%
		Atmospheric Pressure	1030mbar
		Tested By	Lim Poh Huat

Lower Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
10.2	1.6266013452	1.626600000	1345	+/-16266
24.0 (Worst)	1.6266013498	1.626600000	1350	+/-16266
27.6	1.6266013510	1.626600000	1351	+/-16266

Middle Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
10.2	1.6435013932	1.643500000	1393	+/-16435
24.0 (Worst)	1.6435013963	1.643500000	1396	+/-16435
27.6	1.6435014001	1.643500000	1400	+/-16435

Upper Channel

Voltage (V)	Measured Frequency (GHz)	Nominal Channel Frequency (GHz)	Deviation (Hz)	Limit (Hz)
10.2	1.6604013667	1.660400000	1367	+/-16604
24.0 (Worst)	1.6604013681	1.660400000	1368	+/-16604
27.6	1.6604013735	1.660400000	1373	+/-16604

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:

$S = (30GP) / (377d^2)$

where S = Power density in W/m^2
P = 4.5709W
d = Test distance at 0.2m
G = Numerical isotropic gain, 10.00 (10.0dBi)

Substituting the relevant parameters into the formula:

$d = \sqrt{[(30GP) / 377S]}$
$= 0.603m$

∴ The EUT shall maintain at least at 0.61m from operators to comply with MPE criteria.

Max MPE Ratio for TNB transmitter at 1m< 0.364
Max MPE Ratio for DTS transmitter at 1m< 0.02161
Total MPE Ratios at 1m <1.
So the EUT complies with MPT criteria at 1m distance.

PSB Singapore

Please note that this Report is issued under the following terms :

1. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.

2. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.

3. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.

4. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.

5. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

July 2011