



TEST REPORT

Report No.: SRMC2010-H072-E0001

Product Name: Digital Mobile Radio

Product Model: MD780

MD782

MD785

MD786

MD788

Applicant: Hytera Communications Corporation Ltd.

Manufacture: Hytera Communications Corporation Ltd.

Specification: FCC Part90, Part 2

(January 9, 2010 edition)

TIA-603-C (December, 2004 edition)

FCC ID: YAMMD78XU1

The State Radio Monitoring Center

State Radio Spectrum Monitoring and Testing Center

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1. General information

1.1 Notes of the test report

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The test results relate only to individual items of the samples which have been tested.

1.2 Information about the testing laboratory

Company: The State Radio Monitoring Center
State Radio Spectrum Monitoring and Testing Center
Address: No.80 Beilishi Road, Xicheng District, Beijing China
City: Beijing
Country or Region: China
Contacted person: Wang Junfeng
Tel: +86 10 68009181 +86 10 68009202
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Email: wangjf@srrc.org.cn

1.3 Applicant's details

Company: Hytera Communications Corporation Ltd.
Address: Hytera Tower, Hi-Tech Industrial Park North,
Nanshan District, 518057
City: Shenzhen
Country or Region: P.R.China
Grantee Code: YAM
Contacted person: Suzi Lan
Tel: +86-755-26972999
Fax: +86-755-86137130
Email: lanya@hyt.com.cn

1.4 Manufacturer's details

Company: Hytera Communications Corporation Ltd.
Address: Hytera Tower, Hi-Tech Industrial Park North,
Nanshan District, 518057
City: Shenzhen
Country or Region: P.R.China
Grantee Code: YAM
Contacted person: Suzi Lan
Tel: +86-755-26972999
Fax: +86-755-86137130
Email: lanya@hyt.com.cn

1.5 Application details

Date of reception of test sample: 1st Feb 2010
 Date of test: 1st Feb 2010 to 24th Mar 2010

1.6 Reference specification

FCC Part90, Part 2 (January 9, 2010 edition)
 TIA-603-C (December, 2004 edition)

1.7 Information of EUT

1.7.1 General information

Name of EUT	Digital Mobile Radio
FCC ID	YAMMD78XU1
Frequency range	400MHz ~ 470MHz
Rated output power	46.5dBm
Modulation type	Analog Voice: FM
	Digitized Voice/Data: 4FSK
Emission Designator	Analog Voice: 16K0F3E 11K0F3E
	Digitized Voice/Data: 7K60FXD 7K60FXW
Channel Bandwidth	Analog Voice: 25KHz 12.5kHz
	Digitized Voice/Data: 12.5kHz
Antenna type	External
Power Supply	External DC power supply
Rated Power Supply Voltage	13.6Vd.c.
Extreme Temperature	Lowest: -30°C
	Highest: +50°C
Extreme Voltage	Minimum: 10.8Vd.c. Maximum: 15.6Vd.c.
HW Version	V1.00.00.432
SW Version	MD780_P3A

Note: The product has the same digital working characters when operating in both two digitized voice/data mode (7K60FXD and 7K60FXW). So only one set of test results for digital modulation modes are provided in this test report.

1.7.2 EUT details


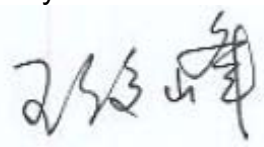
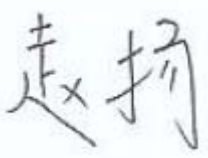
Name	Model	Serial Number
Digital Mobile Radio	MD780	10421K0002

Note: The Digital Mobile Radio MD780, MD782, MD785, MD786 and MD788 are all the same on every functional aspect. They just named differently due to the marketing purposes. Therefore, this report is just to provide the test values of MD780. And the results could represent all the features which other product models have.

2. Test information

2.1 Summary of the test results

No.	Test case	FCC reference	Verdict
1	Frequency Stability	2.1055/90.213	Pass
2	RF Power Output	2.1046/90.205(h)	Pass
3	Audio Frequency Response	2.1047(a)/TIA-603-C	Pass
4	Occupied Bandwidth	2.1049/90.209(b)(5)/90.210(b)	Pass
5	Modulation Limiting	2.1047(b)/90.210/TIA-603-C	Pass
6	Conducted Spurious Emissions	2.1051/90.210(b)(d)	Pass
7	Radiated Spurious Emissions	2.1053/90.210(b)	Pass
8	Transient Frequency Behavior	90.214	Pass

This Test Report Is Issued by: 	Checked by: 
Tested by: 	Issued date: 2010.06.15

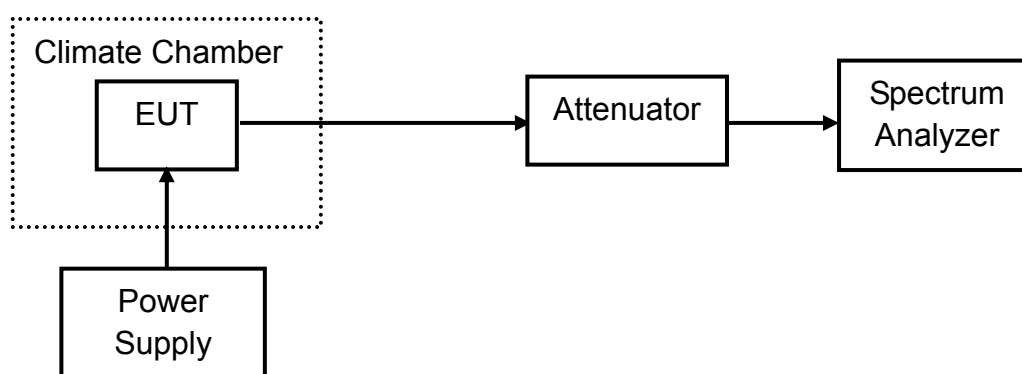
2.2 Test result

2.2.1 Frequency Stability-FCC Part2.1055/Part90.213

Ambient condition:

Temperature	Relative humidity	Pressure
23°C	46%	101.5kPa

Test Setup:



Test Procedure:

The EUT was connected to a spectrum analyzer via the main RF connector, and through an appropriate attenuator. The EUT was controlled to transmit carrier signal. Then the frequency error of the EUT can be measured by the spectrum analyzer. The temperature inside the climate chamber is varied from -30° C to +55° C in 10° C step size. And also the power supply voltage to the EUT is varied from 85 to 115 percent of the nominal value.

The measurement will be conducted at three channels, Bottom channel (400.025MHz), Middle channel (435.000MHz) and Top channel (469.975MHz)

Test result:

Modulation type: FM

Channel bandwidth: 25kHz

Test conditions		Frequency error (ppm)		
Voltage(V)	Temp(°C)	CH Bottom (400.025MHz)	CH Middle (435.000MHz)	CH Top (469.975MHz)
13.6	-30	-0.37	-0.34	-0.32
	-20	-0.64	-0.42	-0.21
	-10	-0.49	-0.26	-0.35
	0	-0.23	-0.57	-0.36
	10	-0.36	-0.48	-0.18
	20	-0.14	-0.25	-0.14
	30	-0.73	-0.29	-0.20
	40	-0.64	-0.31	-0.36
	50	-0.29	-0.34	-0.39
10.8 (85% Rated)	20	-0.38	-0.25	-0.22
15.6 (115% Rated)	20	-0.22	-0.24	-0.28
Limit		5 ppm		
Conclusion		Complies		

Modulation type: FM

Channel bandwidth: 12.5kHz

Test conditions		Frequency error (ppm)		
Voltage(V)	Temp(°C)	CH Bottom (400.025MHz)	CH Middle (435.000MHz)	CH Top (469.975MHz)
13.6	-30	0.63	0.69	0.76
	-20	0.58	0.52	0.61
	-10	0.41	0.37	0.42
	0	0.16	0.20	0.15
	10	0.11	0.12	0.09
	20	-0.08	-0.11	-0.06
	30	-0.13	-0.05	-0.10
	40	-0.35	-0.28	-0.22
	50	-0.68	-0.47	-0.39
10.8 (85% Rated)	20	-0.09	-0.11	-0.06
15.6 (115% Rated)	20	-0.08	-0.11	-0.07
Limit		2.5 ppm		
Conclusion		Complies		

Modulation type: 4FSK
 Channel bandwidth: 12.5kHz

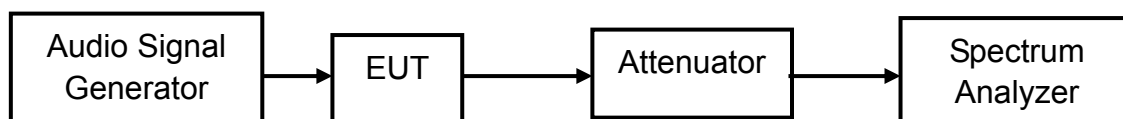
Test conditions		Frequency error (ppm)		
Voltage(V)	Temp(°C)	CH Bottom (400.025MHz)	CH Middle (435.000MHz)	CH Top (469.975MHz)
7.4	-30	-0.47	-0.43	-0.52
	-20	-0.36	-0.38	-0.49
	-10	-0.52	-0.48	-0.61
	0	-0.28	-0.30	-0.35
	10	-0.17	-0.25	-0.28
	20	-0.21	-0.20	-0.26
	30	-0.20	-0.23	-0.34
	40	-0.32	-0.38	-0.48
	50	-0.35	-0.30	-0.52
6.2 (85% Rated)	20	-0.24	-0.31	-0.30
8.4 (115% Rated)	20	-0.23	-0.27	-0.28
Limit		2.5 ppm		
Conclusion		Complies		

2.2.2 RF Power Output-FCC Part2.1046/Part90.205(h)

Ambient condition:

Temperature	Relative humidity	Pressure
23°C	46%	101.5kPa

Test Setup:



Test procedure:

The EUT was connected to the audio signal generator and the spectrum analyzer via the main RF connector, and through an appropriate attenuator. The EUT was controlled to transmit its maximum power. Then the maximum channel power of the EUT can be measured by the spectrum analyzer. The loss between the main RF connector of the EUT and the input port of the spectrum analyzer will be taken into consideration.

The measurement will be conducted at three channels, Bottom channel (400.025MHz), Middle channel (435.000MHz) and Top channel (469.975MHz)

Test result:

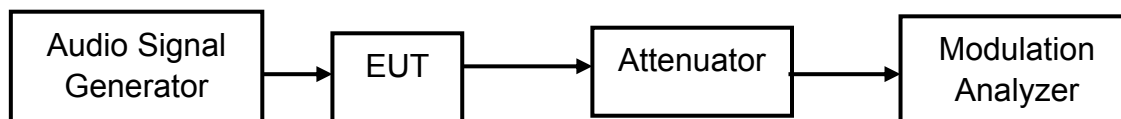
Modulation type	Channel bandwidth	Channel (Frequency)	RF Power Output (dBm)
FM	25kHz	Bottom (400.025MHz)	45.53
		Middle (435.000MHz)	45.87
		Top (469.975MHz)	45.39
	12.5kHz	Bottom (400.025MHz)	45.53
		Middle (435.000MHz)	45.83
		Top (469.975MHz)	45.33
4FSK	12.5kHz	Bottom (400.025MHz)	45.57
		Middle (435.000MHz)	45.67
		Top (469.975MHz)	45.35
Limit	The limit is dependent upon the station's antenna HAAT and required service area.		
Conclusion	Complies		

2.2.3 Audio Frequency Response-FCC Part2.1047(a)/TIA-603-C

Ambient condition:

Temperature	Relative humidity	Pressure
23°C	46%	101.5kPa

Test Setup:



Test Procedure:

The EUT was connected to the audio signal generator and the modulation analyzer via the main RF connector, and through an appropriate attenuator. Adjust the audio input for 30% of rated system deviation at 1kHz using this level as a reference (0dB). Vary the Audio frequency from 300Hz to 3kHz and record the frequency deviation.

Audio Frequency Response = $20\log_{10}$ (Deviation of test frequency/Deviation of 1 kHz reference).

The measurement will be conducted at Middle channel (435.000MHz)

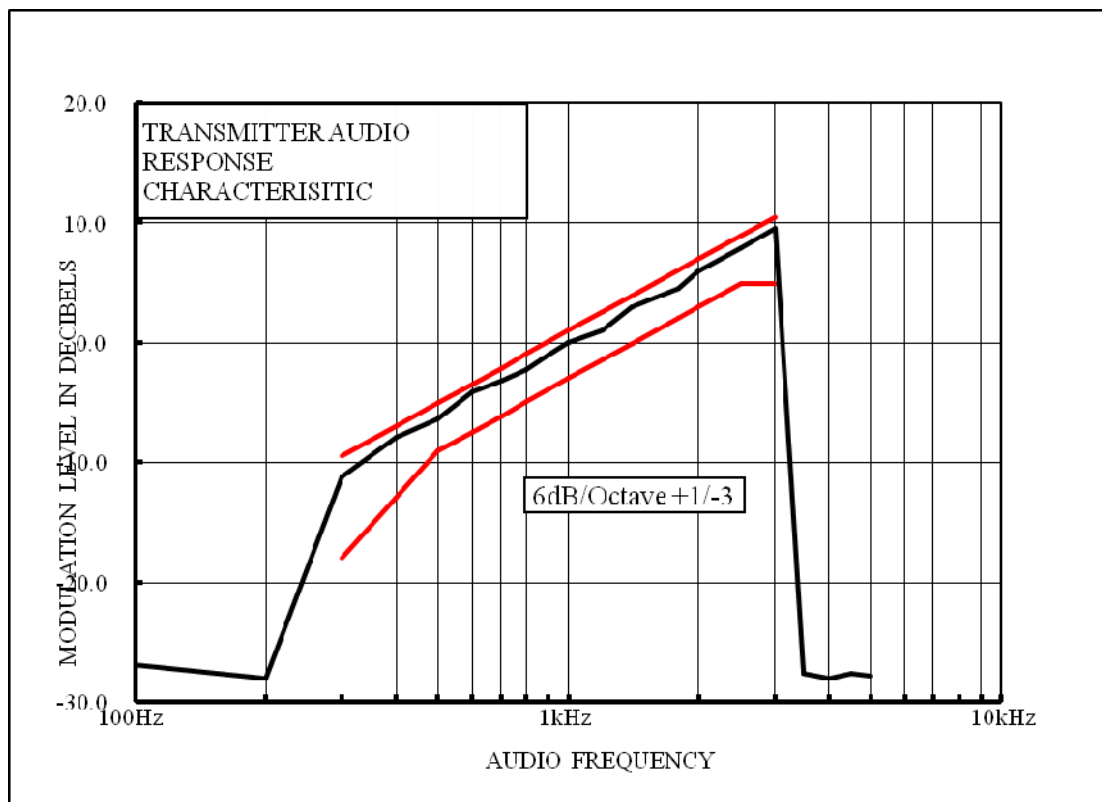
Test result:

Modulation type: FM

Channel bandwidth: 25kHz

Audio Frequency	Audio Frequency Response (dB)	Audio Frequency	Audio Frequency Response (dB)	Limit	Conclusion
	435.000MHz		435.000MHz		
100Hz	-26.9	1400Hz	3.0	1dB~ -3dB (Reference from a true 6 dB per octave pre-emphasis characteristic as referenced to the 1000Hz level)	Complies
200Hz	-28.0	1600Hz	3.8		
300Hz	-11.2	1800Hz	4.5		
400Hz	-7.9	2000Hz	6.0		
500Hz	-6.3	2500Hz	7.9		
600Hz	-4.1	3000Hz	9.6		
700Hz	-3.2	3500Hz	-27.6		
800Hz	-2.2	4000Hz	-28.0		
900Hz	-1.0	4500Hz	-27.6		
1000Hz	0	5000Hz	-27.8		
1200Hz	1.0				

Audio frequency response in 25kHz middle channel

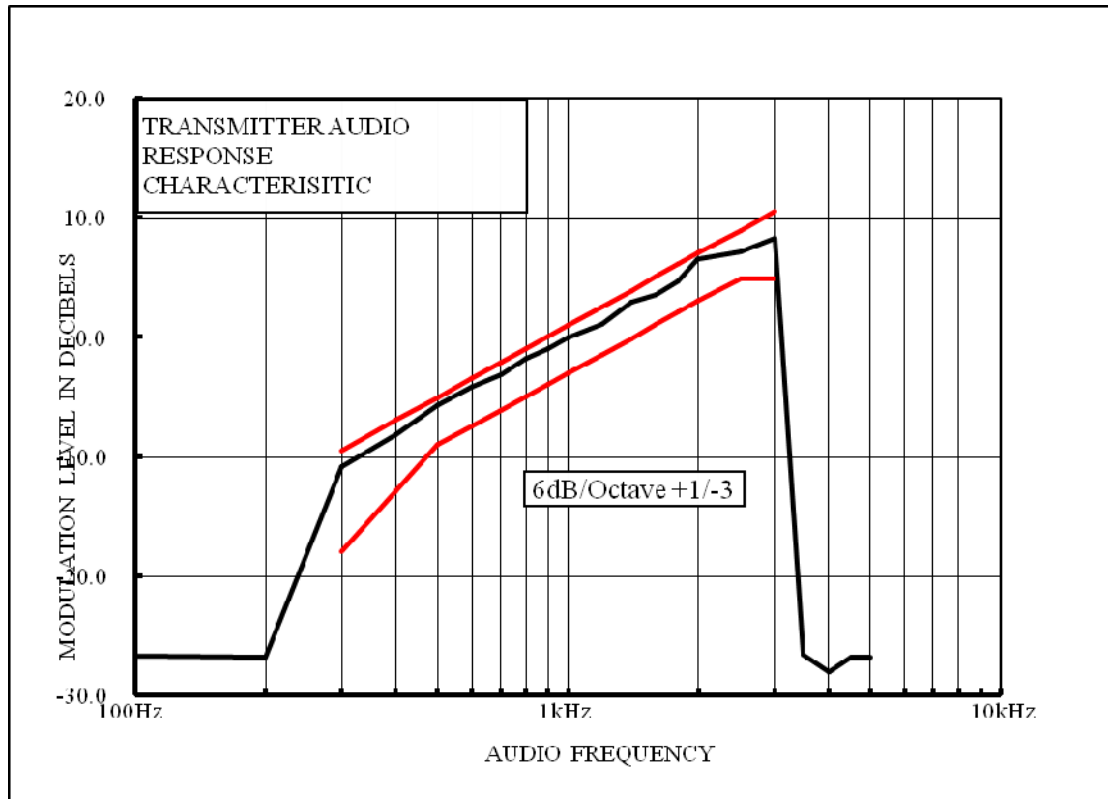


Modulation type: FM

Channel bandwidth: 12.5kHz

Audio Frequency	Audio Frequency Response (dB)	Audio Frequency	Audio Frequency Response (dB)	Limit	Conclusion
	435.000MHz		435.000MHz		
100Hz	-26.7	1400Hz	3.0	1dB~ -3dB (Reference from a true 6 dB per octave pre-emphasis characteristic as referenced to the 1000Hz level)	Complies
200Hz	-26.8	1600Hz	3.6		
300Hz	-10.8	1800Hz	4.7		
400Hz	-8.2	2000Hz	6.6		
500Hz	-5.7	2500Hz	7.2		
600Hz	-4.1	3000Hz	8.3		
700Hz	-3.1	3500Hz	-26.6		
800Hz	-1.8	4000Hz	-28.0		
900Hz	-1.0	4500Hz	-26.8		
1000Hz	0	5000Hz	-26.8		
1200Hz	1.1				

Audio frequency response in 12.5kHz middle channel



Modulation type: 4FSK
Channel bandwidth: 12.5kHz

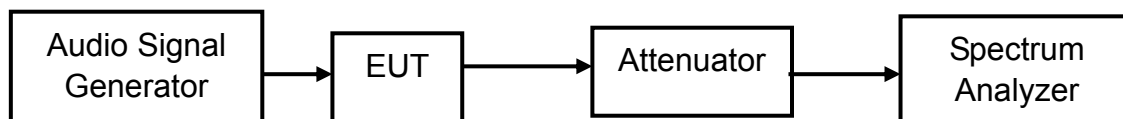
It is not applicable for devices which operate with the digitized voice/data modulation type.

2.2.4 Occupied Bandwidth-FCC Part2.1049/Part90.209(b)(5)/Part90.210(b)

Ambient condition:

Temperature	Relative humidity	Pressure
22°C	46%	101.5kPa

Test Setup:



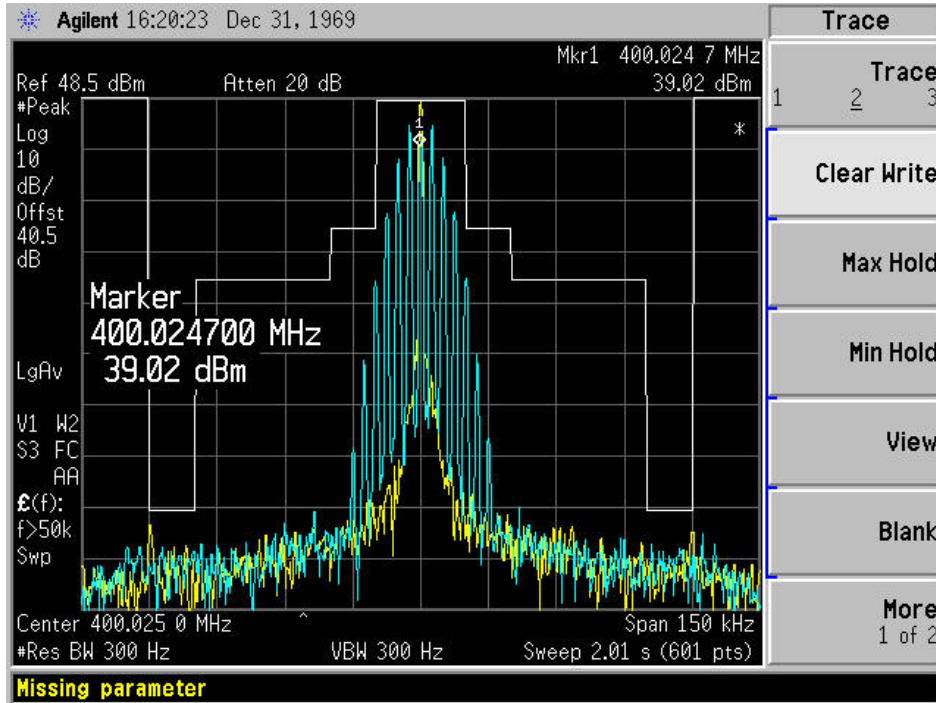
Test procedure:

- (a) Occupied Bandwidth: The EUT was connected to the audio signal generator and the spectrum analyzer via the main RF connector, and through an appropriate attenuator. The EUT was controlled to transmit its maximum power. Then the bandwidth of 99% power can be measured by the spectrum analyzer.
- (b) Emission Mask B: For transmitters that are equipped with an audio low-pass filter pursuant to §90.211(a), the power of any emission must be below the unmodulated carrier power (P) as follows:
 - (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
 - (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
 - (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.
- (c) Emission Mask D, 12.5 kHz channel bandwidth equipment: For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
 - (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
 - (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB.
 - (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.

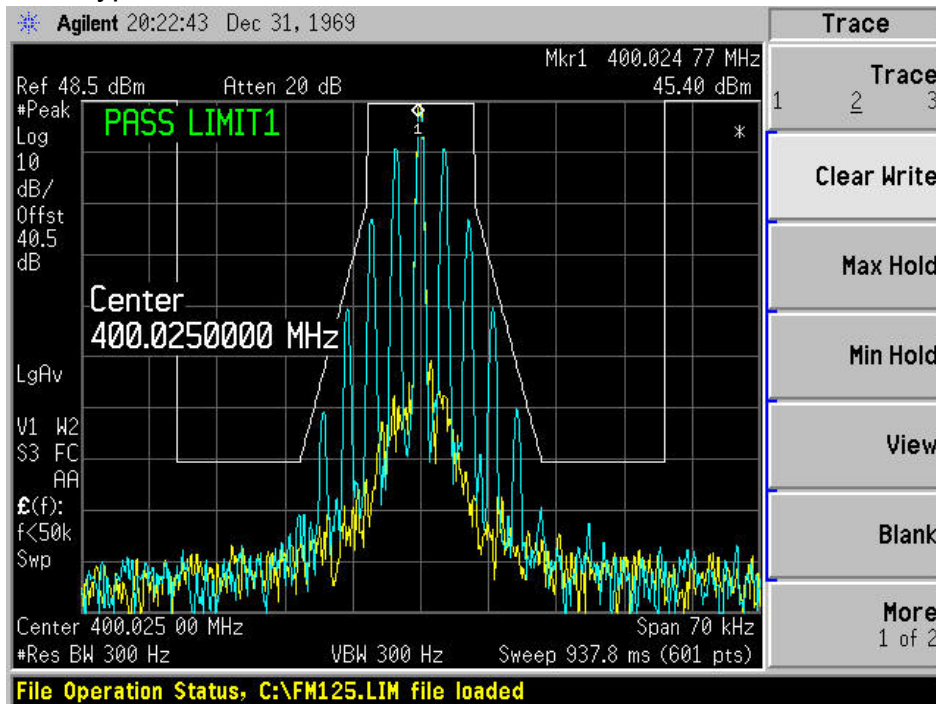
Test result:

Modulation type	Channel bandwidth	Channel (Frequency)	Occupied Bandwidth (99% Power Bandwidth) (kHz)
FM	25kHz	Bottom (400.025MHz)	12.0
		Middle (435.000MHz)	11.8
		Top (469.975MHz)	11.8
	12.5kHz	Bottom (400.025MHz)	7.9
		Middle (435.000MHz)	7.9
		Top (469.975MHz)	7.8
4FSK	12.5kHz	Bottom (400.025MHz)	7.3
		Middle (435.000MHz)	7.3
		Top (469.975MHz)	7.3
Limit	20kHz (Channel bandwidth: 25kHz)		
	11.25kHz (Channel bandwidth: 25kHz)		
Conclusion	Complies		

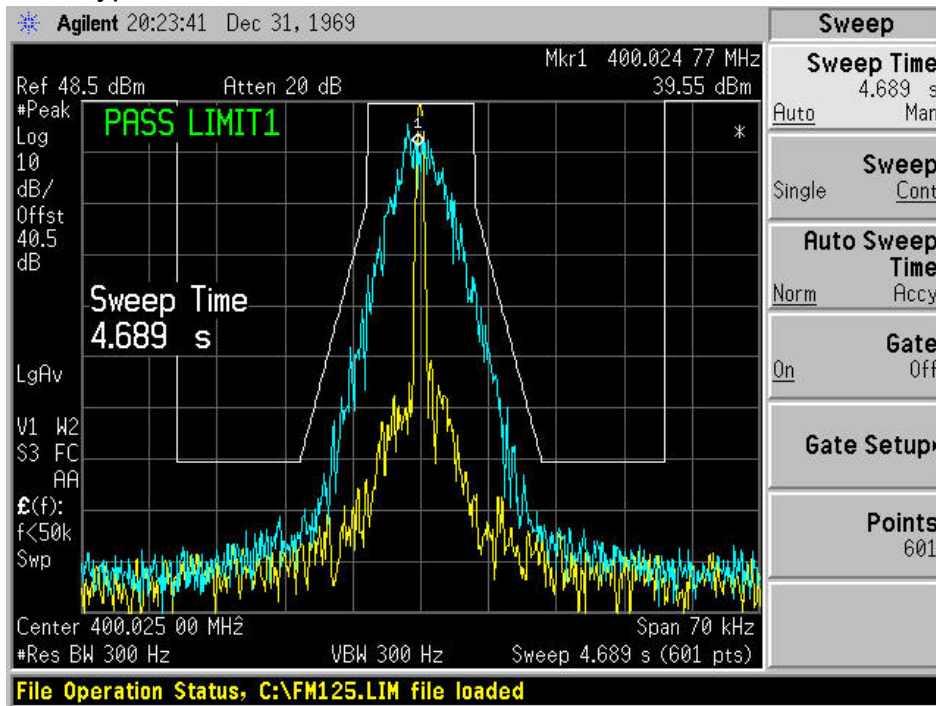
MASK B in bottom channel
 Modulation type: FM 25kHz



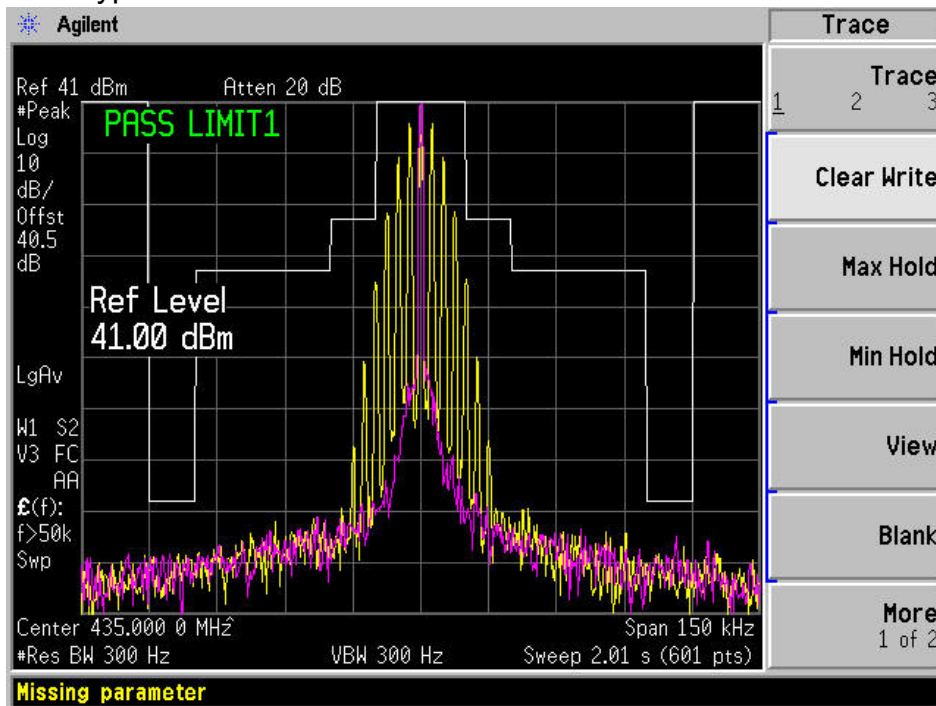
MASK D in bottom channel
 Modulation type: FM 12.5kHz



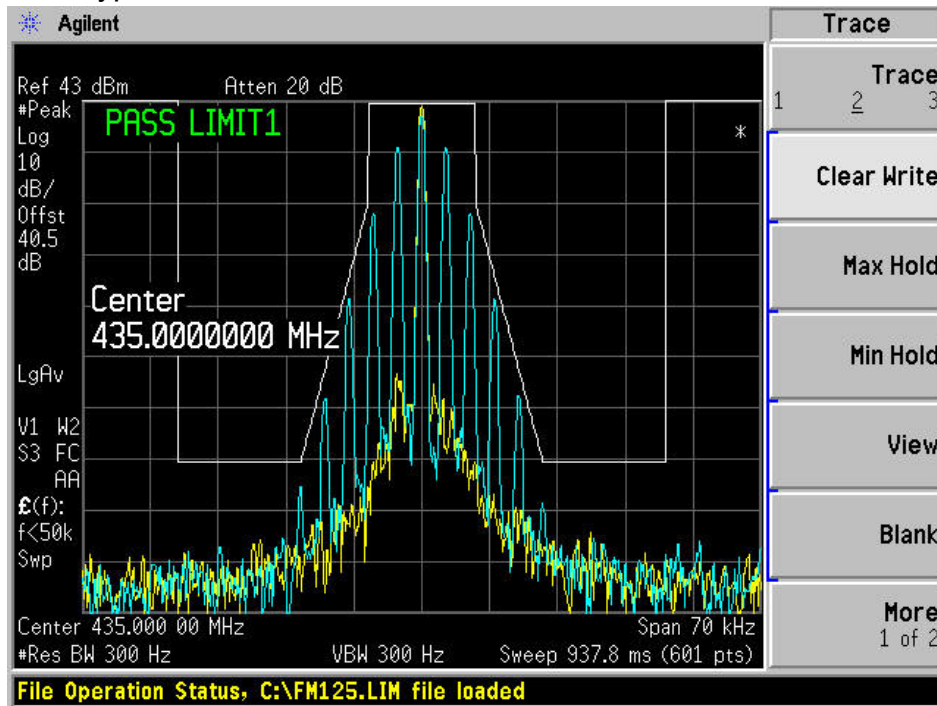
MASK D in bottom channel
 Modulation type: 4FSK 12.5kHz



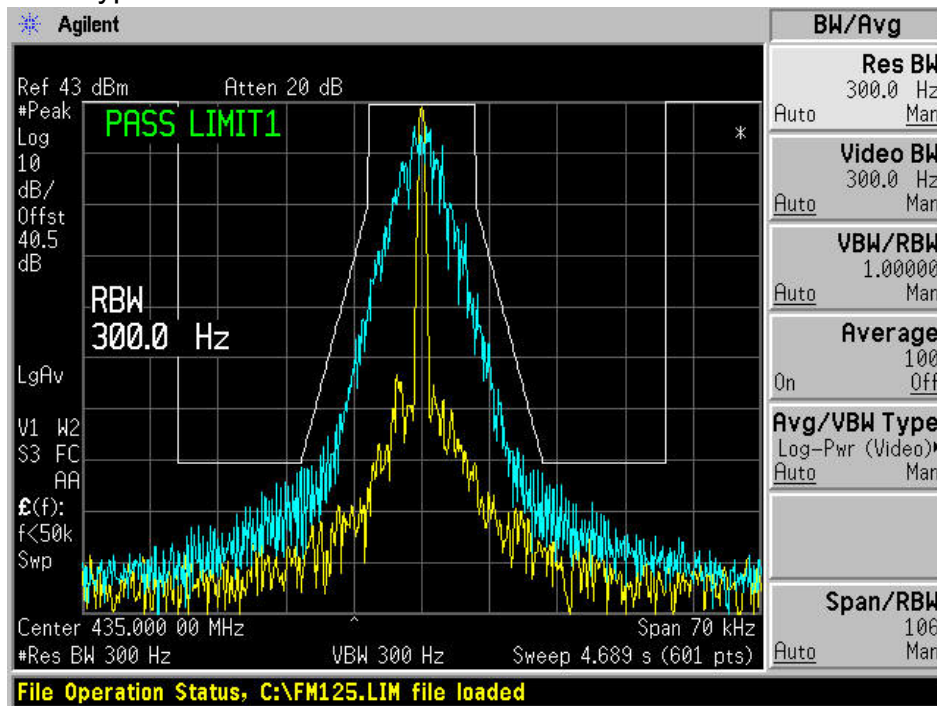
MASK B in middle channel
 Modulation type: FM 25kHz



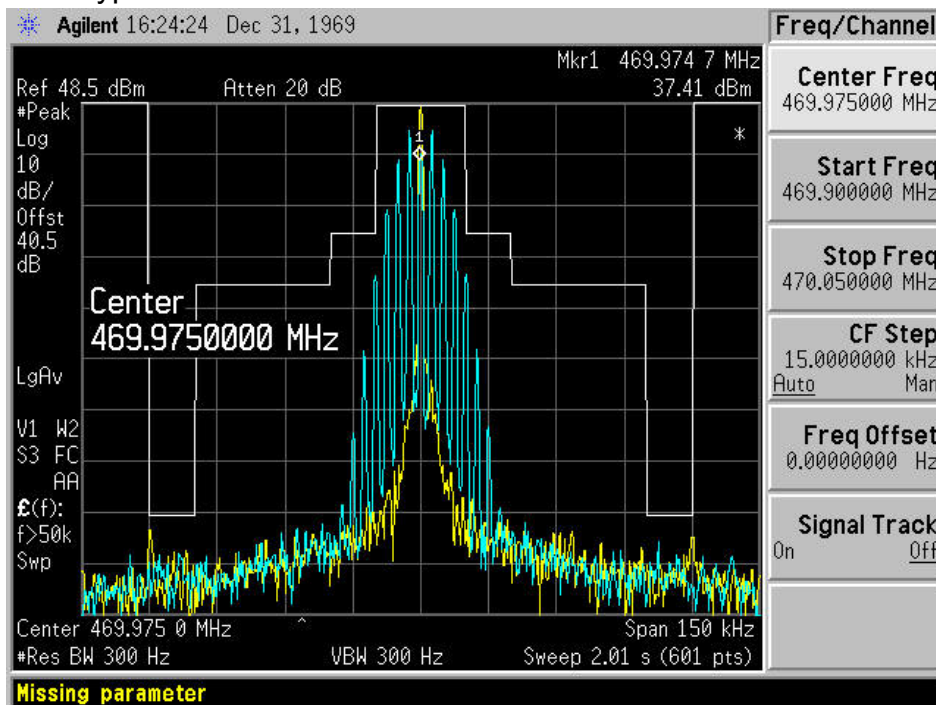
MASK D in middle channel
 Modulation type: FM 12.5kHz



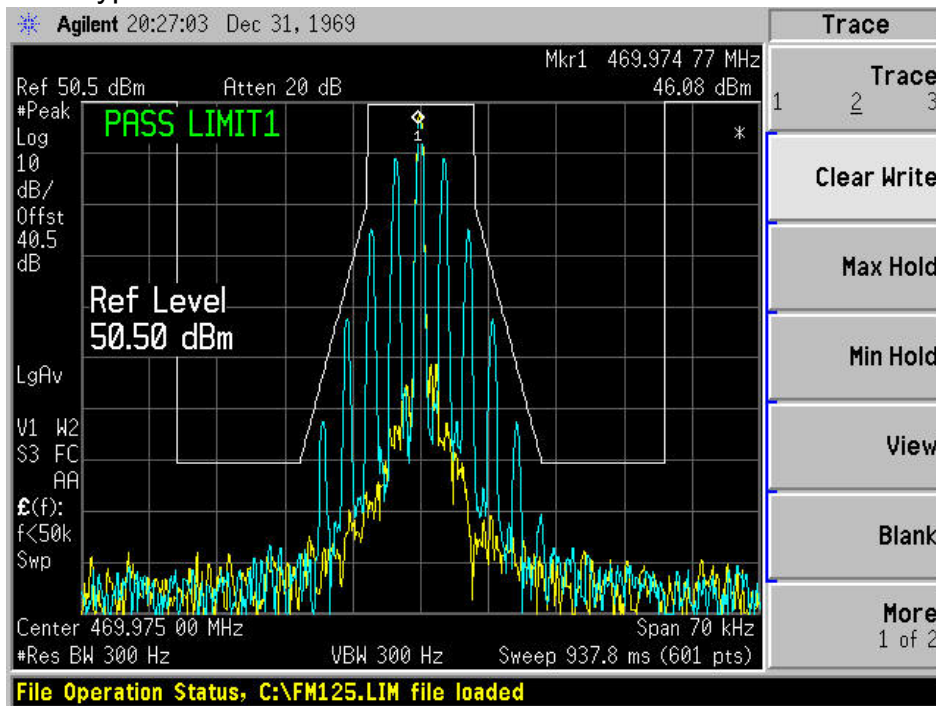
MASK D in middle channel
 Modulation type: 4FSK 12.5kHz



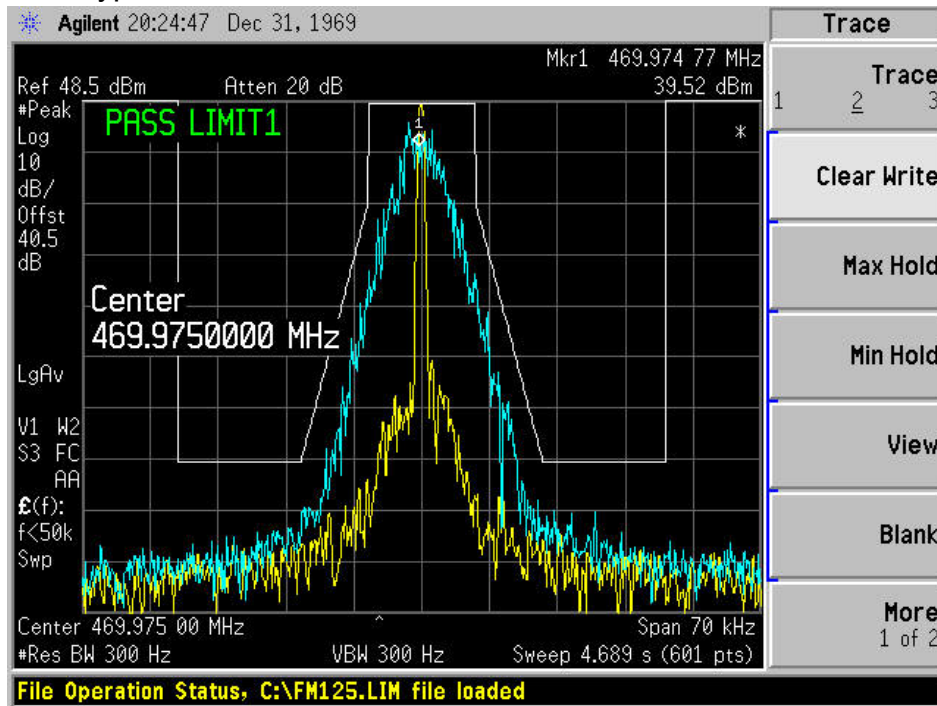
MASK B in top channel
 Modulation type: FM 25kHz



MASK D in top channel
 Modulation type: FM 12.5kHz



MASK D in top channel
Modulation type: 4FSK 12.5kHz

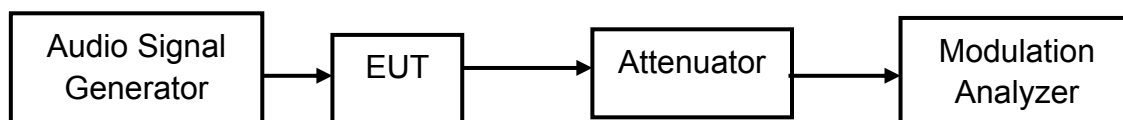


2.2.5 Modulation Limiting-FCC Part2.1047(b)/Part90.210/TIA-603-C

Ambient condition:

Temperature	Relative humidity	Pressure
22°C	46%	101.5kPa

Test Setup:



Test Procedure:

The EUT was connected to the audio signal generator and the modulation analyzer via the main RF connector, and through an appropriate attenuator. The carrier frequency deviation was measured with the tone input signal level varied from 0 Vp to audio input rating level 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 kHz. The maximum deviation was recorded at each test condition. The measurement will be conducted at Middle channel (435.000MHz).

Test result:

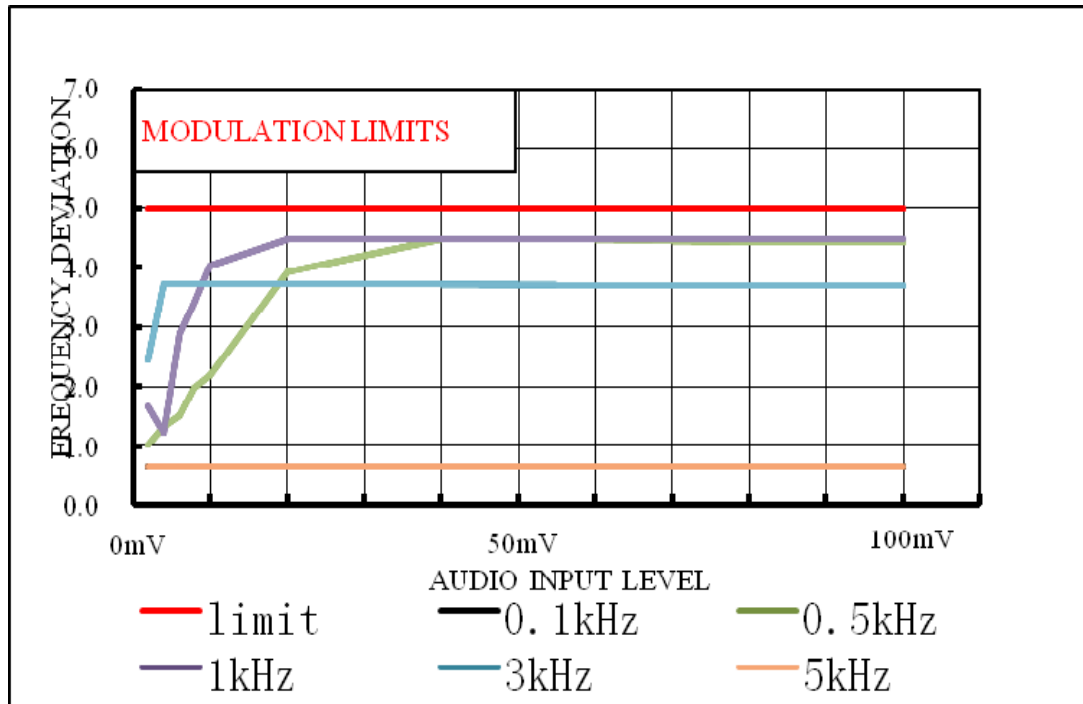
Modulation type: FM

Channel bandwidth: 25kHz

MODULATING SIGNAL LEVEL (mvrms)	PEAK FREQUENCY DEVIATION (kHz) (At the following modulation frequencies)					MAXIMUM LIMIT (kHz)
	0.1kHz	0.5kHz	1.0kHz	3.0kHz	5.0kHz	
2	0.65	1.02	1.68	2.44	0.66	5
4	0.65	1.33	1.22	3.72	0.65	5
6	0.65	1.52	2.88	3.71	0.65	5
8	0.65	1.99	3.42	3.71	0.66	5
10	0.65	2.20	4.03	3.71	0.65	5
20	0.66	3.93	4.47	3.72	0.66	5
40	0.66	4.47	4.47	3.72	0.66	5
60	0.66	4.47	4.47	3.68	0.66	5
80	0.66	4.42	4.47	3.69	0.65	5
100	0.66	4.42	4.47	3.69	0.66	5

Modulation type: FM

Channel bandwidth: 25kHz



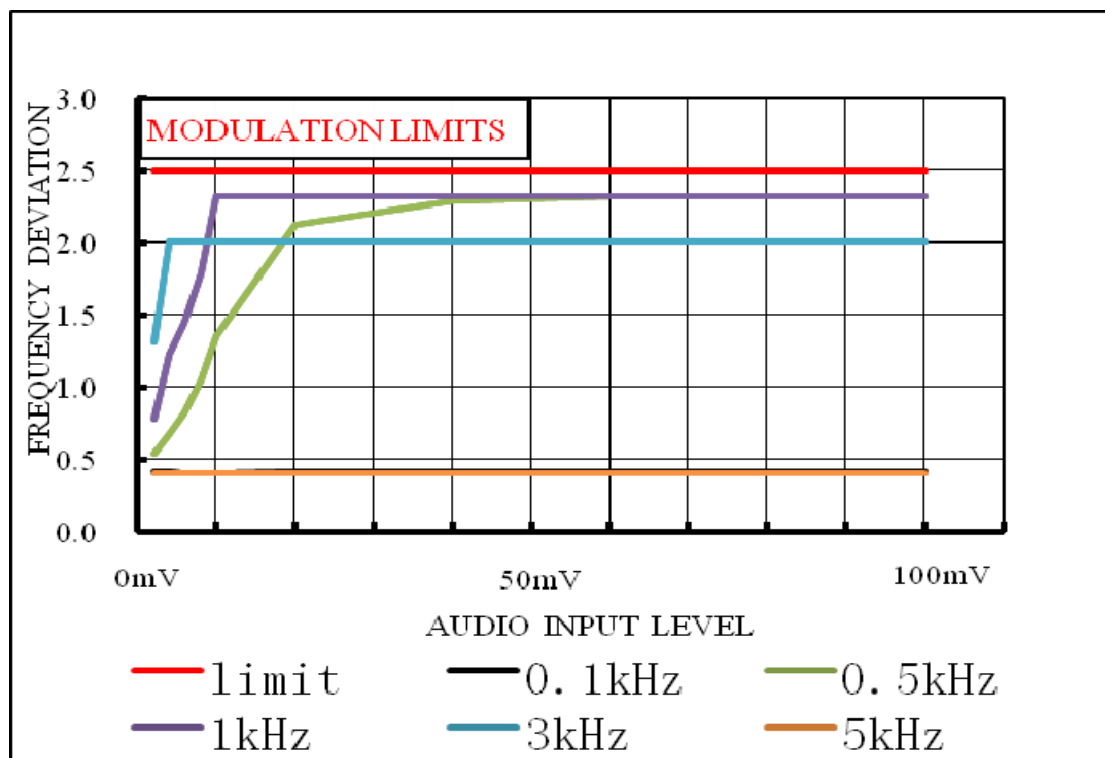
$$\begin{aligned}
 \text{Voice Signal Input Level} &= \text{STD MOD Level} + 16 \text{ dB} \\
 &= 22.39 \text{ dB (mVrms)} + 16 \text{ dB} \\
 &= 38.39 \text{ dB (mVrms)} \\
 &= 83.10 \text{ mVrms}
 \end{aligned}$$

Modulating Frequency (kHz)	Peak Frequency Deviation (kHz)	Maximum Limit (kHz)
0.1	0.66	5
0.2	0.73	5
0.4	4.37	5
0.6	4.37	5
0.8	4.41	5
1.0	4.45	5
2.0	4.47	5
4.0	0.66	5
6.0	0.66	5
8.0	0.66	5
10.0	0.66	5

Modulation type: FM
 Channel bandwidth: 12.5kHz

MODULATING SIGNAL LEVEL (mvrms)	PEAK FREQUENCY DEVIATION (kHz) (At the following modulation frequencies)					MAXIMUM LIMIT (kHz)
	0.1kHz	0.5kHz	1.0kHz	3.0kHz	5.0kHz	
2	0.42	0.54	0.78	1.31	0.41	2.5
4	0.42	0.68	1.23	2.01	0.41	2.5
6	0.41	0.82	1.45	2.01	0.41	2.5
8	0.41	1.05	1.79	2.01	0.41	2.5
10	0.41	1.35	2.32	2.01	0.41	2.5
20	0.42	2.12	2.32	2.01	0.41	2.5
40	0.42	2.29	2.32	2.01	0.41	2.5
60	0.42	2.32	2.32	2.01	0.41	2.5
80	0.42	2.32	2.32	2.01	0.41	2.5
100	0.42	2.32	2.32	2.01	0.41	2.5

Modulation type: FM
 Channel bandwidth: 12.5kHz



$$\begin{aligned}\text{Voice Signal Input Level} &= \text{STD MOD Level} + 16 \text{ dB} \\ &= 22.39 \text{ dB (mVrms)} + 16 \text{ dB} \\ &= 38.39 \text{ dB (mVrms)} \\ &= 83.10 \text{ mVrms}\end{aligned}$$

Modulating Frequency (kHz)	Peak Frequency Deviation (kHz)	Maximum Limit (kHz)
0.1	0.42	2.5
0.2	0.42	2.5
0.4	2.31	2.5
0.6	2.31	2.5
0.8	2.32	2.5
1.0	2.32	2.5
2.0	2.20	2.5
4.0	0.41	2.5
6.0	0.41	2.5
8.0	0.41	2.5
10.0	0.41	2.5

Modulation type: 4FSK
Channel bandwidth: 12.5kHz

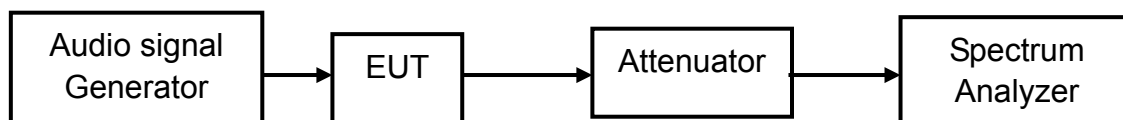
It is not applicable for devices which operate with the digitized voice/data modulation type.

2.2.6 Conducted Spurious Emissions-FCC Part2.1051/90.210(b)(d)

Ambient condition:

Temperature	Relative humidity	Pressure
23°C	45%	101.3kPa

Test Setup:



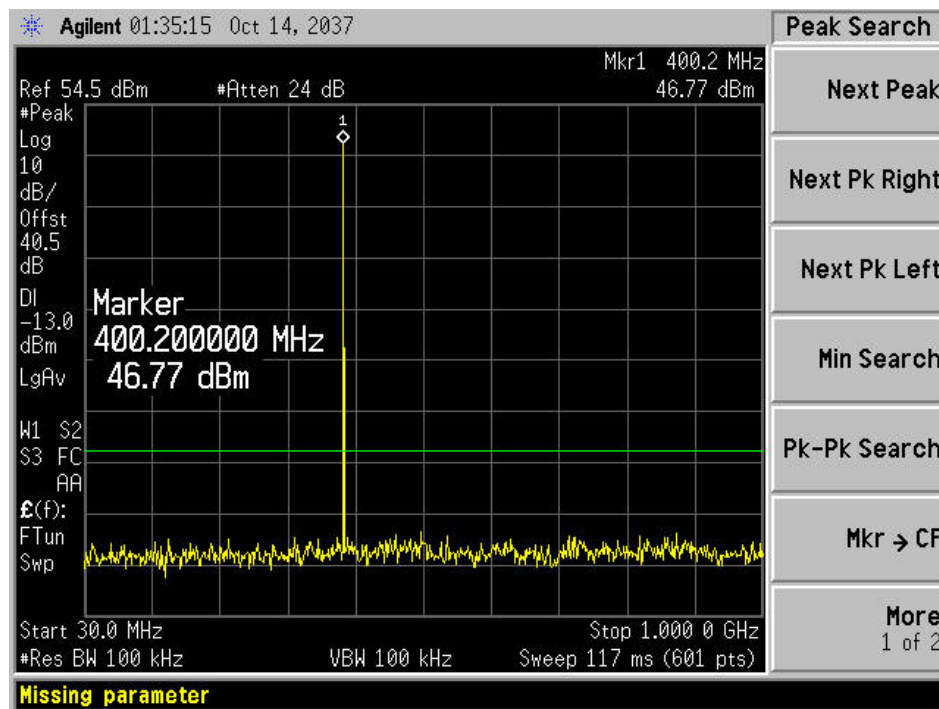
Test procedure:

The EUT was connected to the audio signal generator and the modulation analyzer via the main RF connector, and through an appropriate attenuator. The EUT was controlled to transmit its maximum power. Then the maximum unwanted emissions of the EUT can be measured by the spectrum analyzer. The measurement will be conducted at three channels, Bottom channel (400.025MHz), Middle channel (435.000MHz) and Top channel (469.975MHz)

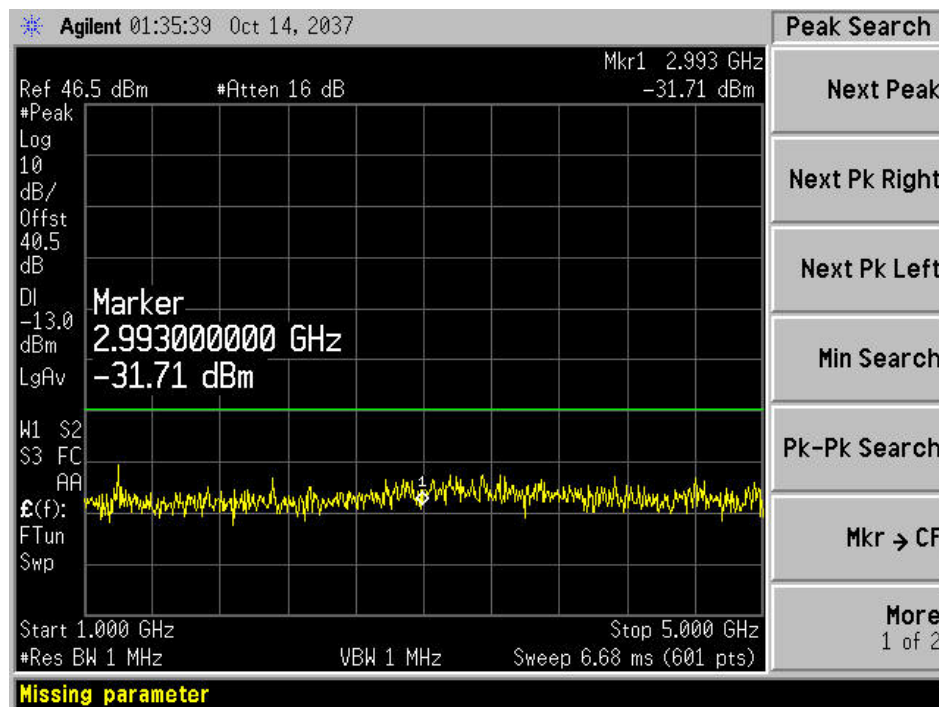
Test result:

Modulation type	Channel bandwidth	Channel (Frequency)	Conducted Spurious Emissions
FM	25kHz	Bottom (400.025MHz)	Refer to test plots
		Middle (435.000MHz)	Refer to test plots
		Top (469.975MHz)	Refer to test plots
	12.5kHz	Bottom (400.025MHz)	Refer to test plots
		Middle (435.000MHz)	Refer to test plots
		Top (469.975MHz)	Refer to test plots
4FSK	12.5kHz	Bottom (400.025MHz)	Refer to test plots
		Middle (435.000MHz)	Refer to test plots
		Top (469.975MHz)	Refer to test plots
Limit	43 + 10 log (P) or -13dBm, whichever is less (Channel bandwidth: 25kHz)		
	50 + 10 log (P) or -20dBm or 70dBc, whichever is less (Channel bandwidth: 12.5kHz)		
Conclusion	Complies		

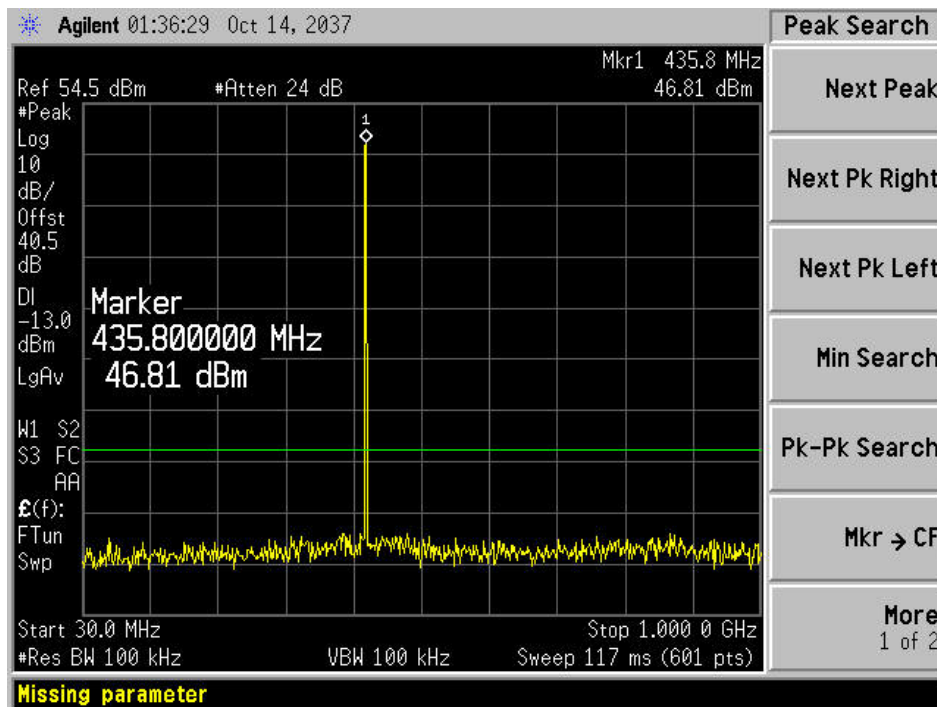
Test plots:
 Modulation type: FM
 Channel bandwidth: 25kHz



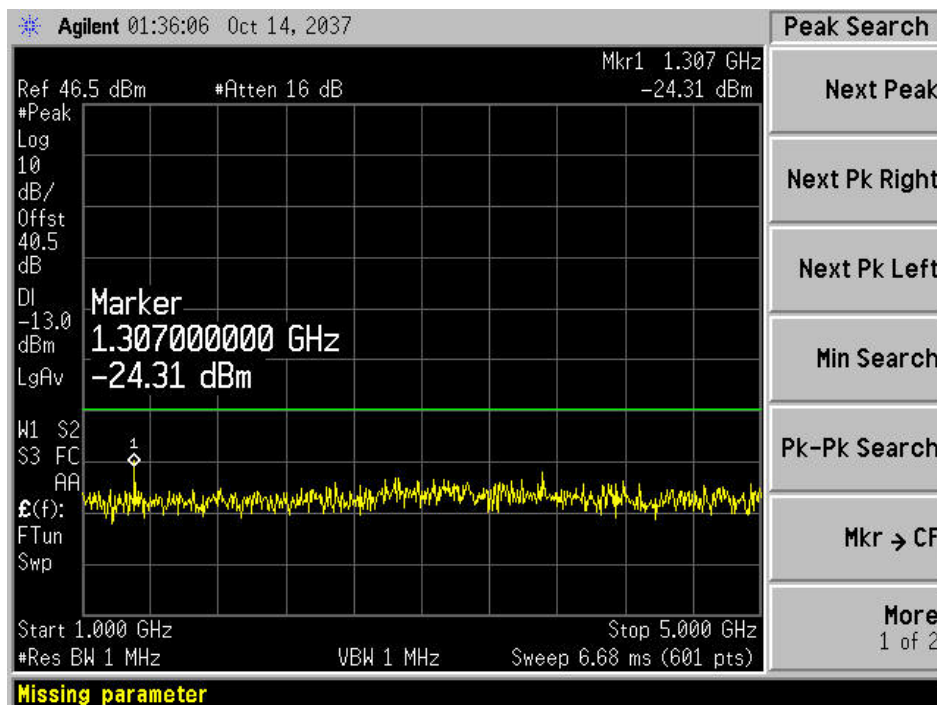
30MHz ~ 1GHz Conducted Spurious Emissions on Bottom channel
 Note: The signal beyond the limit is carrier.



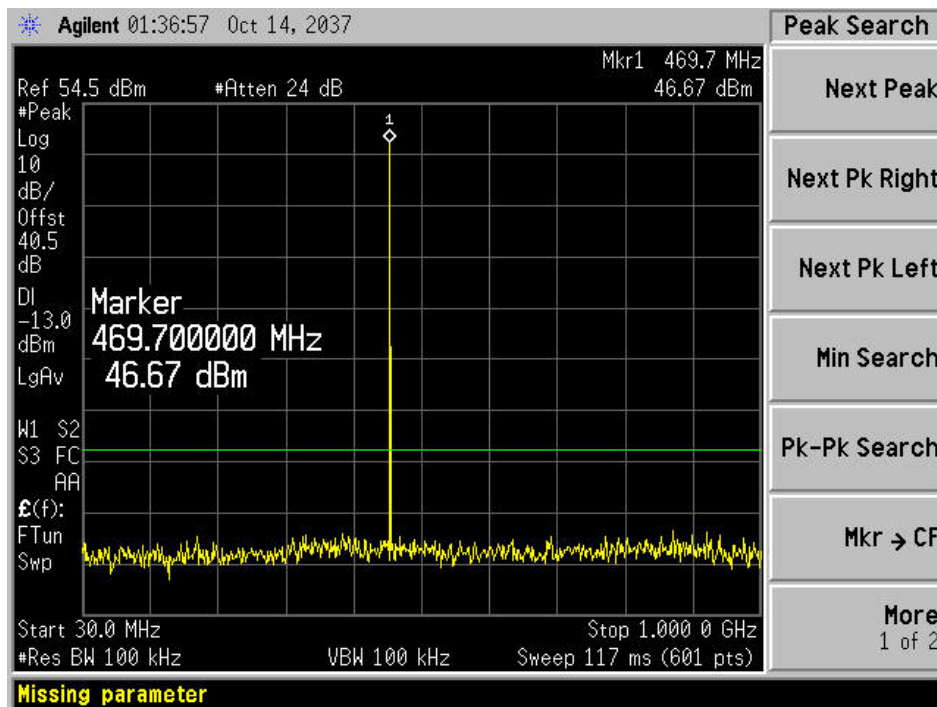
1GHz ~ 5GHz Conducted Spurious Emissions on Bottom channel



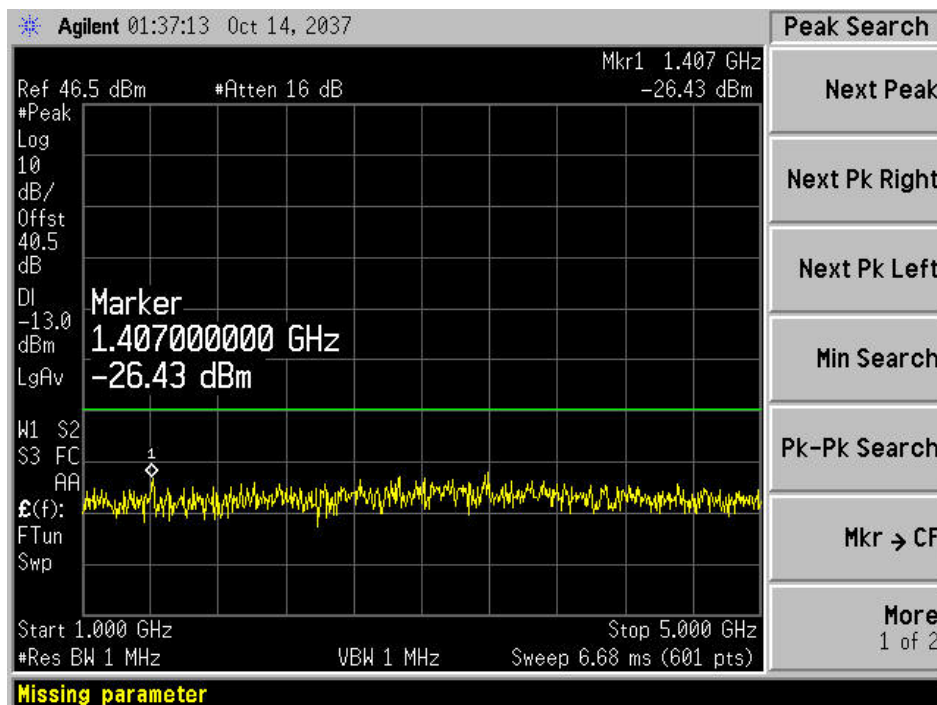
30MHz ~ 1GHz Conducted Spurious Emissions on Middle channel
 Note: The signal beyond the limit is carrier.



1GHz ~ 5GHz Conducted Spurious Emissions on Middle channel

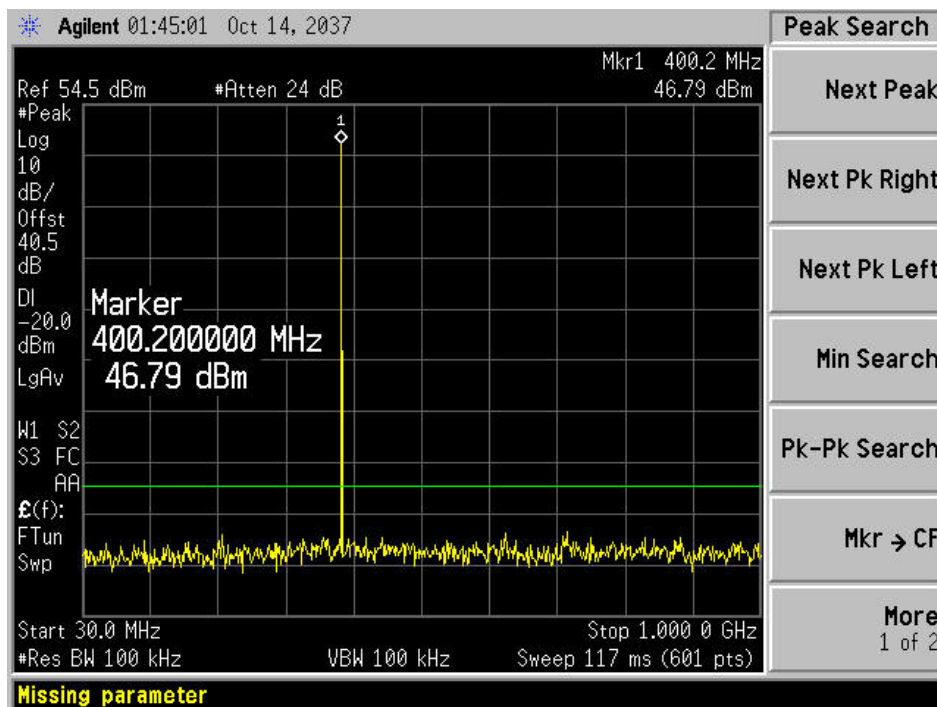


30MHz ~ 1GHz Conducted Spurious Emissions on Top channel
 Note: The signal beyond the limit is carrier.

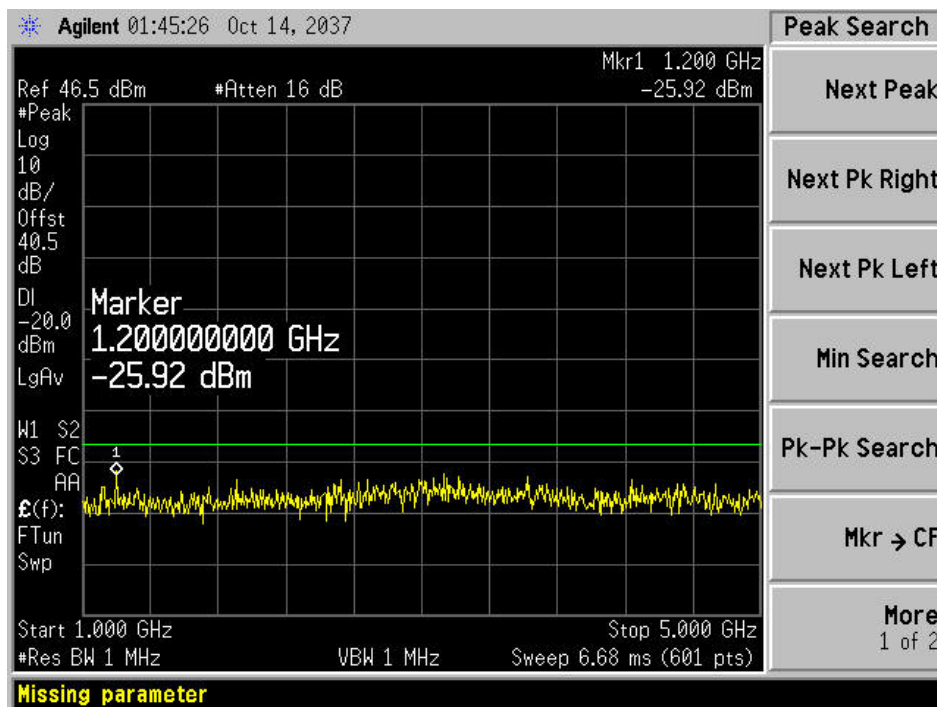


1GHz ~ 5GHz Conducted Spurious Emissions on Top channel

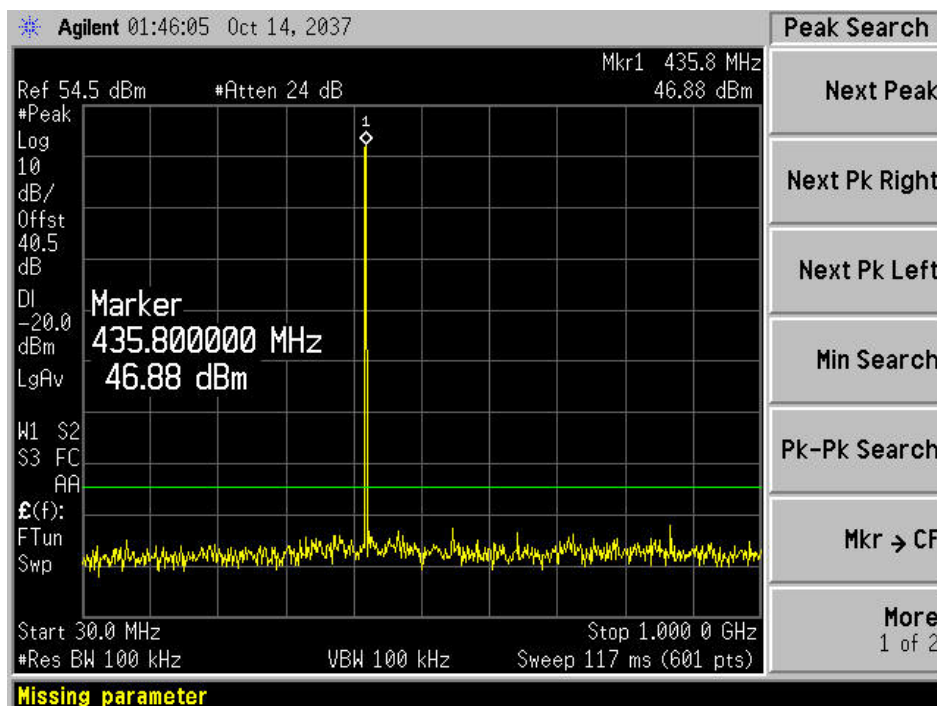
Modulation type: FM
 Channel bandwidth: 12.5kHz



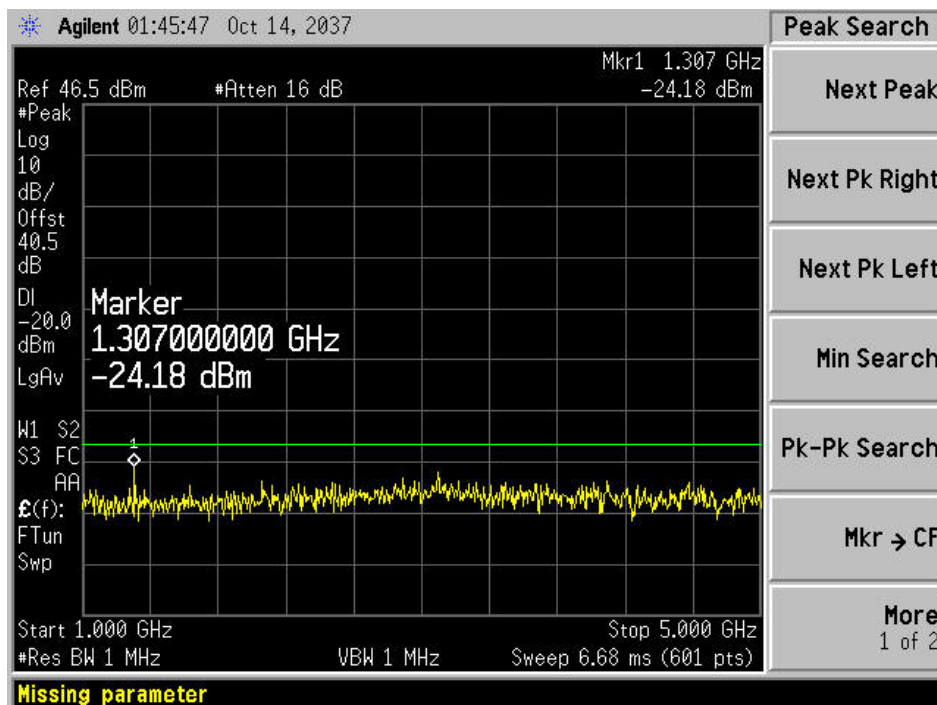
30MHz ~ 1GHz Conducted Spurious Emissions on Bottom channel
 Note: The signal beyond the limit is carrier.



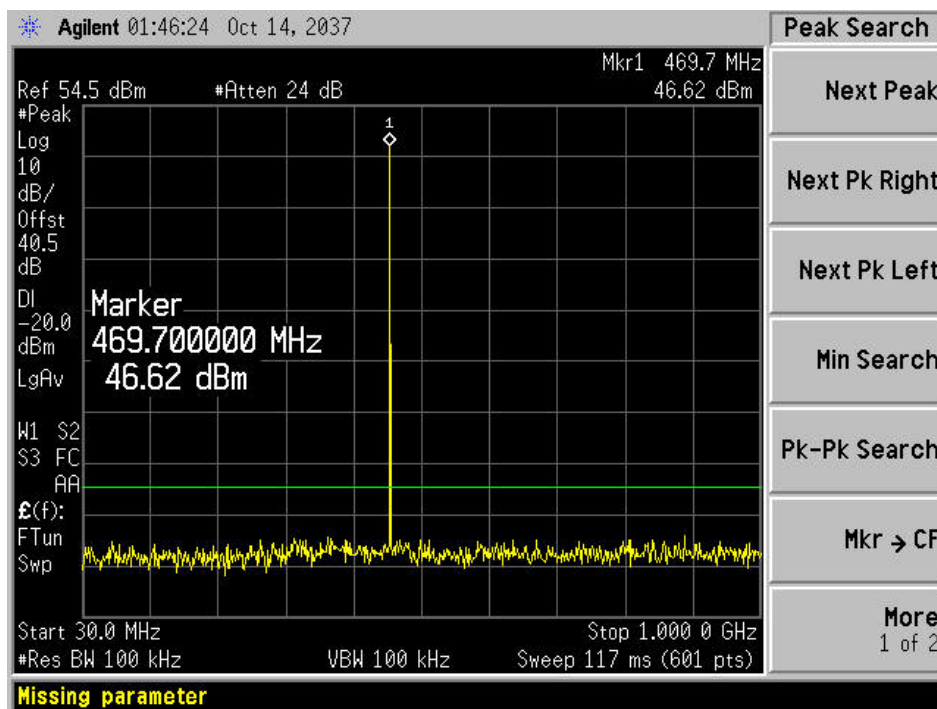
1GHz ~ 5GHz Conducted Spurious Emissions on Bottom channel



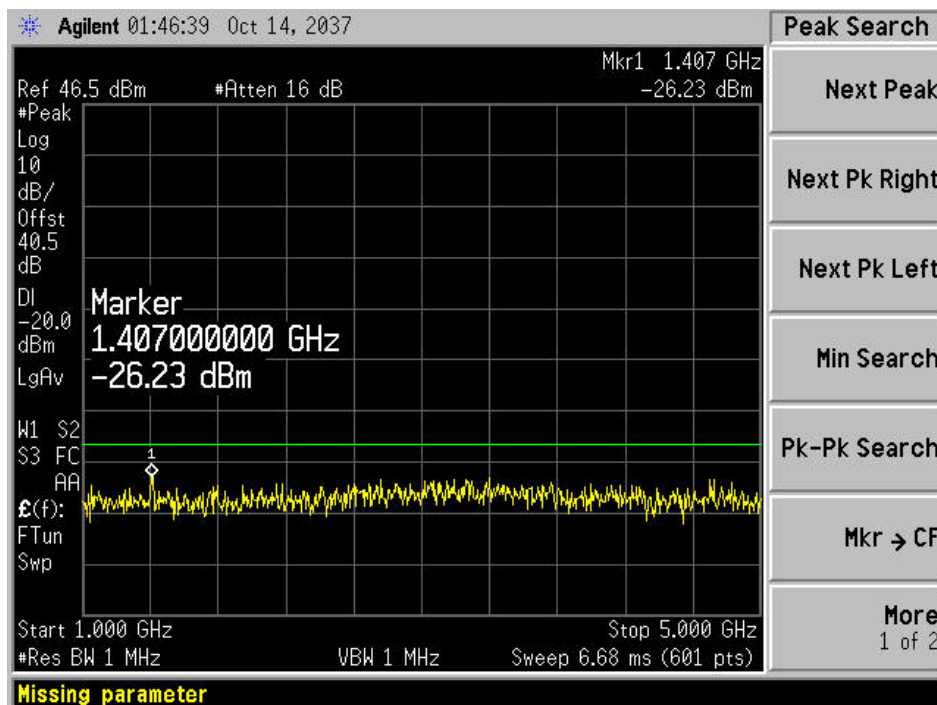
30MHz ~ 1GHz Conducted Spurious Emissions on Middle channel
 Note: The signal beyond the limit is carrier.



1GHz ~ 5GHz Conducted Spurious Emissions on Middle channel

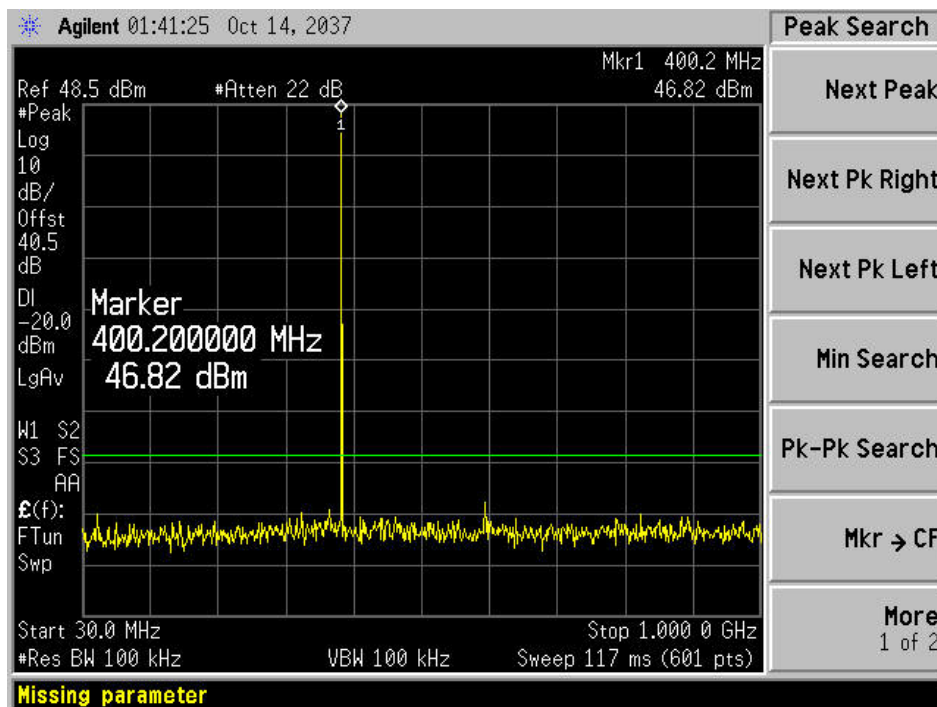


30MHz ~ 1GHz Conducted Spurious Emissions on Top channel
 Note: The signal beyond the limit is carrier.

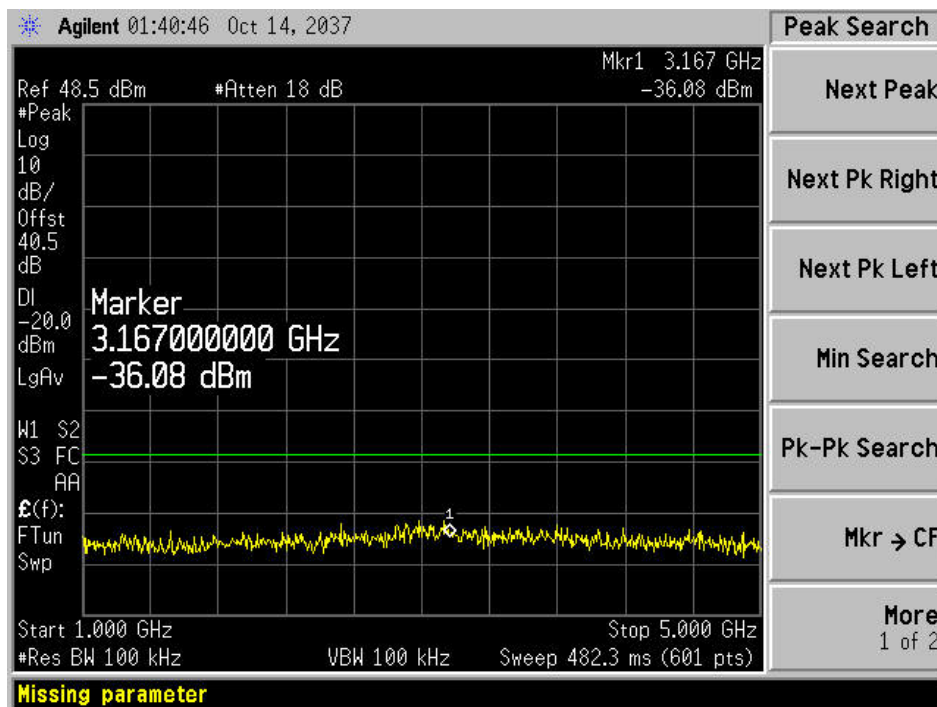


1GHz ~ 5GHz Conducted Spurious Emissions on Top channel

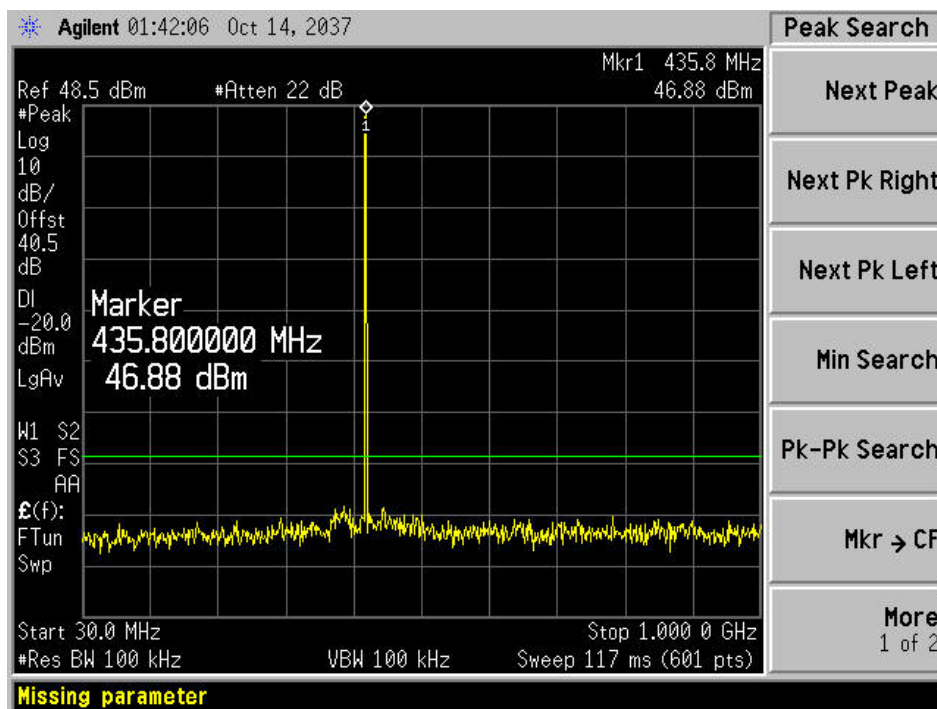
Modulation type: 4FSK
 Channel bandwidth: 12.5kHz



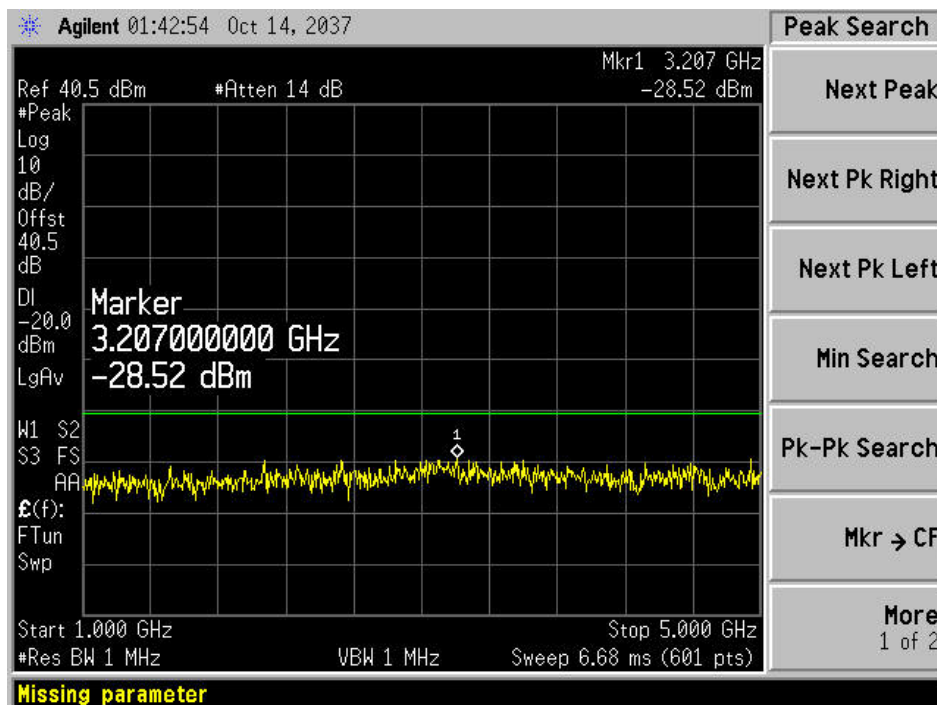
30MHz ~ 1GHz Conducted Spurious Emissions on Bottom channel
 Note: The signal beyond the limit is carrier.



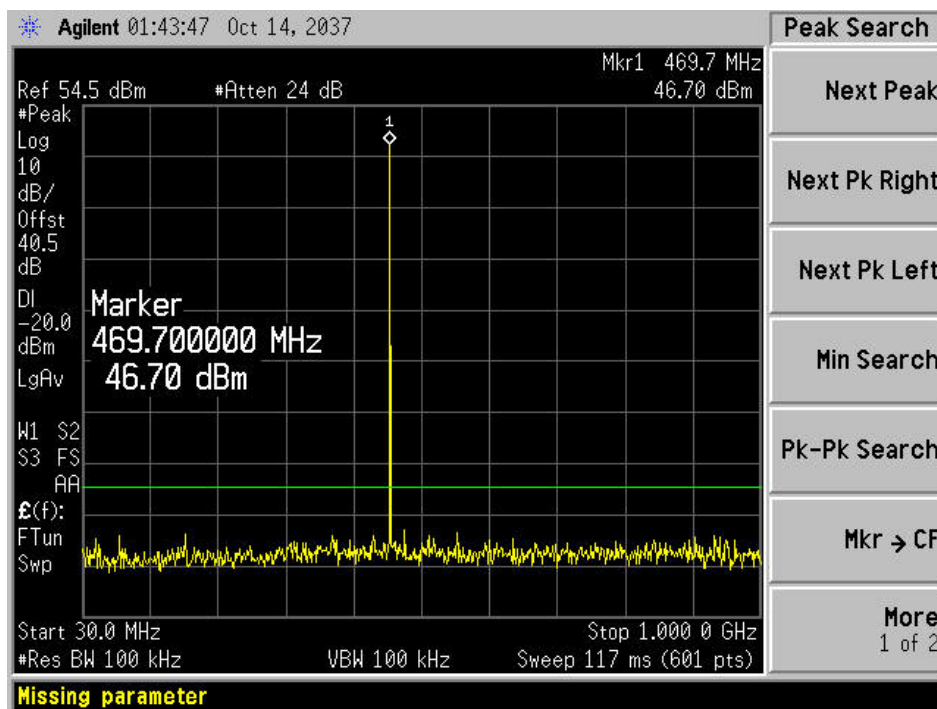
1GHz ~ 5GHz Conducted Spurious Emissions on Bottom channel



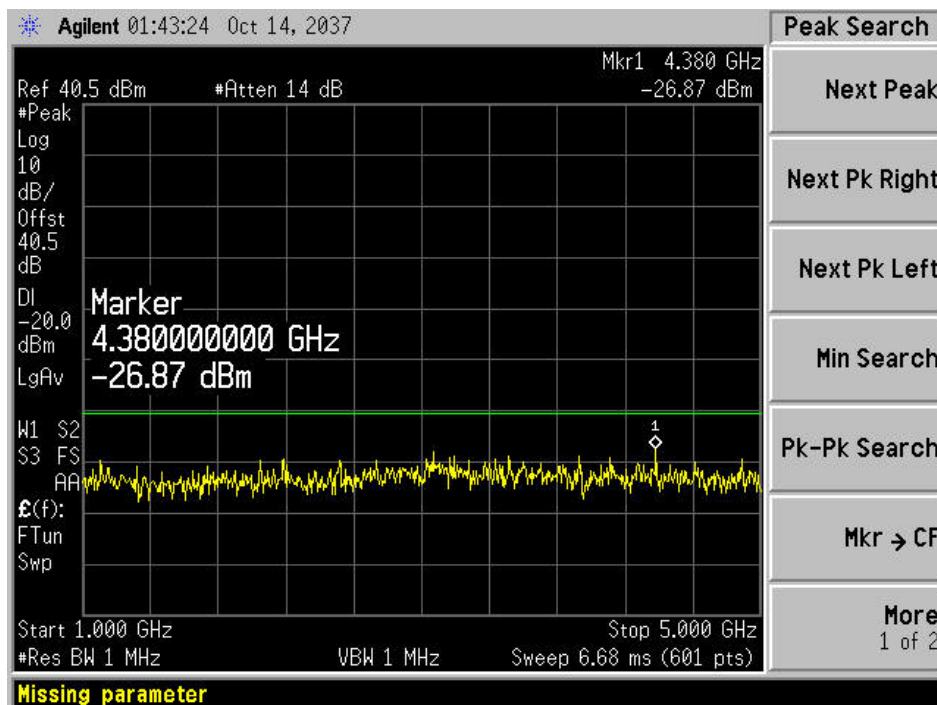
30MHz ~ 1GHz Conducted Spurious Emissions on Middle channel
 Note: The signal beyond the limit is carrier.



1GHz ~ 5GHz Conducted Spurious Emissions on Middle channel



30MHz ~ 1GHz Conducted Spurious Emissions on Top channel
 Note: The signal beyond the limit is carrier.



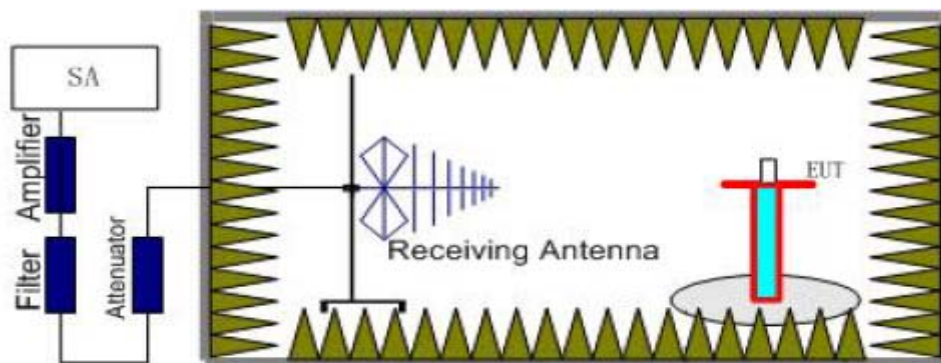
1GHz ~ 5GHz Conducted Spurious Emissions on Top channel

2.2.7 Radiated Spurious Emissions-FCC Part2.1053/Part90.210(b)

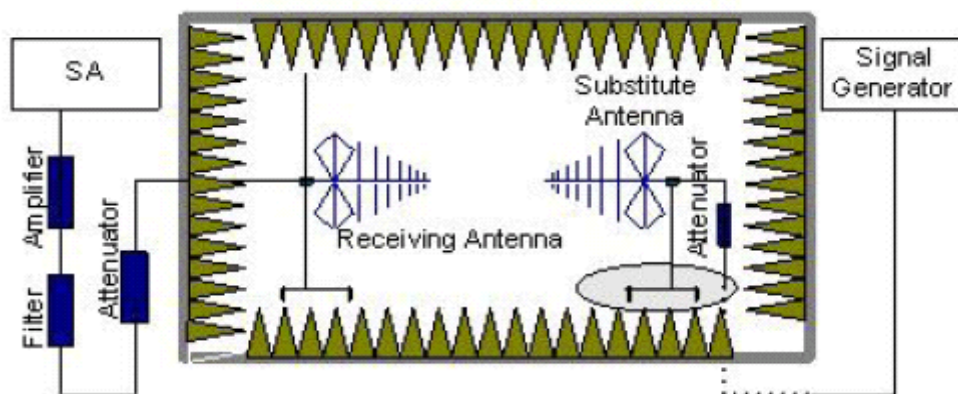
Ambient condition

Temperature	Relative humidity	Pressure
23°C	44%	101.0kPa

Test Setup:



Step 1



Step 2

Test procedure:

Step 1:

The measurement is carried out in the fully anechoic chamber. EUT was placed on a 2.4 meter high non-conductive table at a 3 meter test distance from the test receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT. The height of receiving antenna is 2.4m and varies in certain range to find the maximum power value. The EUT was controlled to transmit its maximum power. The measurement is carried out using a spectrum analyzer or receiver. Then the antenna height and turn table rotation is adjusted till the maximum power value is founded on spectrum analyzer or receiver. A notch filter is necessary in the band near to the carrier frequency. A high pass filter is needed to avoid the distortion of the testing

equipment in the band above the carrier frequency.

Step 2:

A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.

Calculation procedure:

The data of cable loss, antenna gain and air loss has been calibrated in full testing frequency range before the testing.

The power of the Radiated Spurious Emissions is calculated by adding the cable loss, antenna gain and air loss. The basic equation with a sample calculation is as followed:

$$P = P_R + L_C + L_A - G$$

Where

P: Power of the Radiated Spurious Emissions (dBm)

P_R: reading of the receiver (dBm)

L_C: Cable Lose (dB)

L_A: Air loss (dB)

G: Antenna Gain (dBi)

Assumed the reading of the receiver is -60dBm. A cable lose of 10dB, an air lose of 30dB and an antenna gain of 11dBi are added.

$$P = P_R + L_C + L_A - G = -60 + 10 + 30 - 11 = -31 \text{dBm}$$

The measurement will be conducted at Middle channel (435.000MHz)

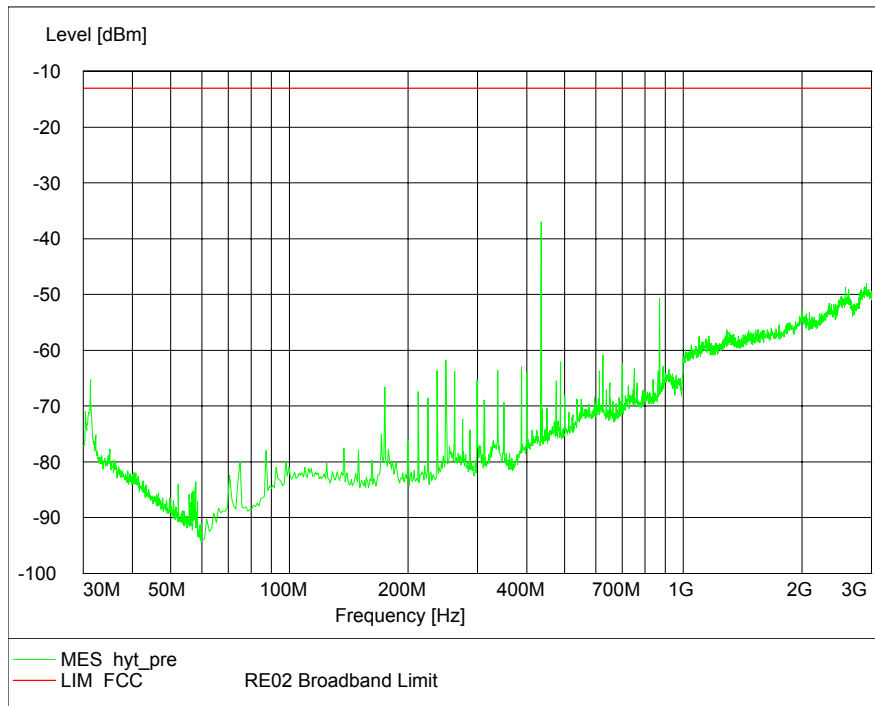
Test result:

Modulation type	Channel bandwidth	Frequency by plot range	Radiated Spurious Emissions
FM	25kHz	30MHz ~ 3GHz	Refer to test plots
		3GHz ~ 6GHz	Refer to test plots
	12.5kHz	30MHz ~ 3GHz	Refer to test plots
		3GHz ~ 6GHz	Refer to test plots
4FSK	12.5kHz	30MHz ~ 3GHz	Refer to test plots
		3GHz ~ 6GHz	Refer to test plots
Limit	43 + 10 log (P) or -13dBm, whichever is less (Channel bandwidth: 25kHz)		
	50 + 10 log (P) or -20dBm or 70dBc, whichever is less (Channel bandwidth: 12.5kHz)		
Conclusion	Complies		

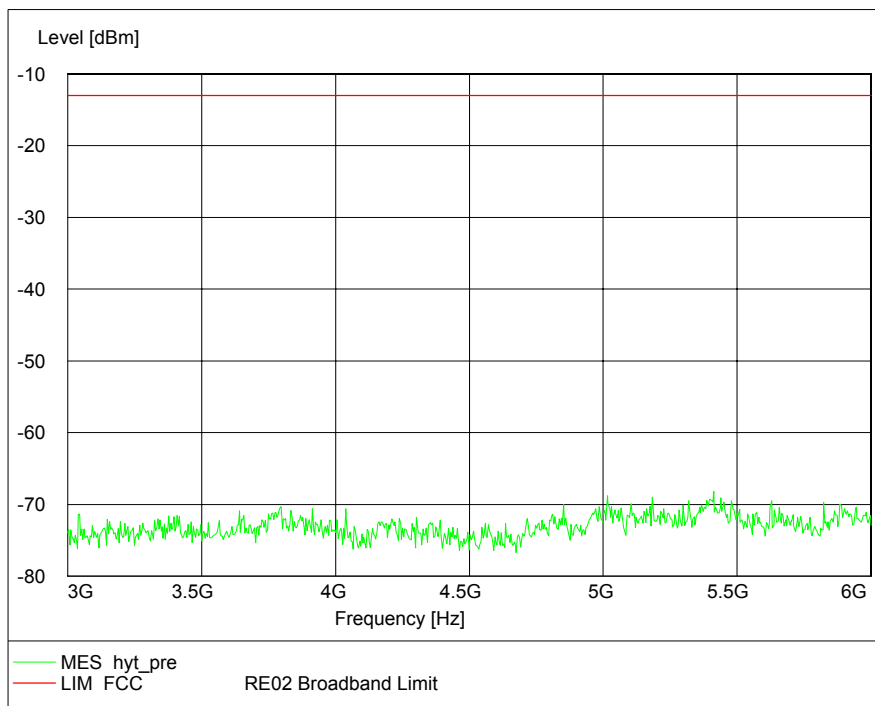
Test plots:

Modulation type: FM

Channel bandwidth: 25kHz

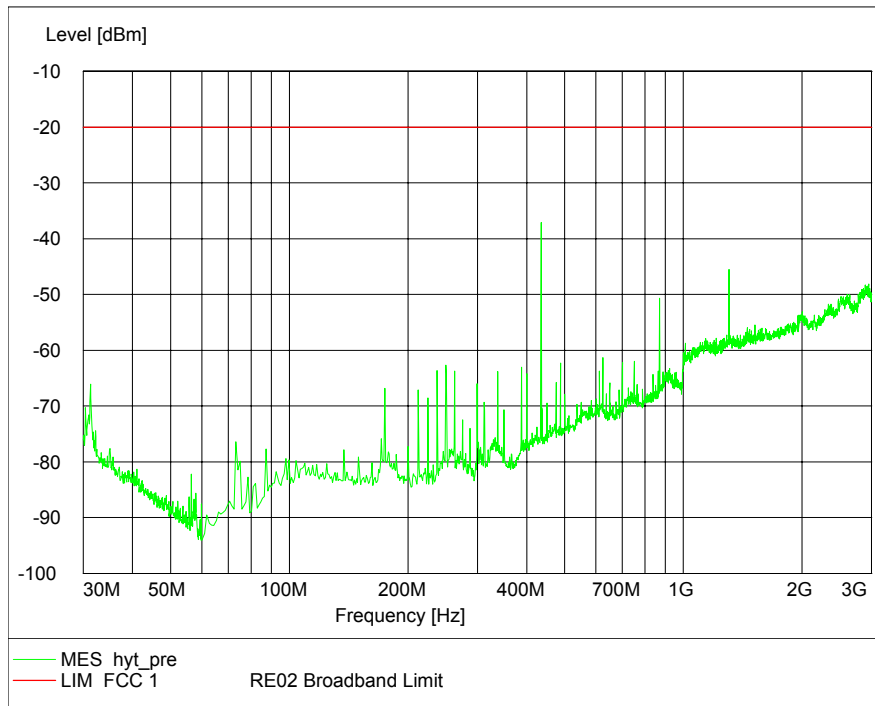


30MHz ~ 3GHz Radiated Spurious Emissions on CH Middle

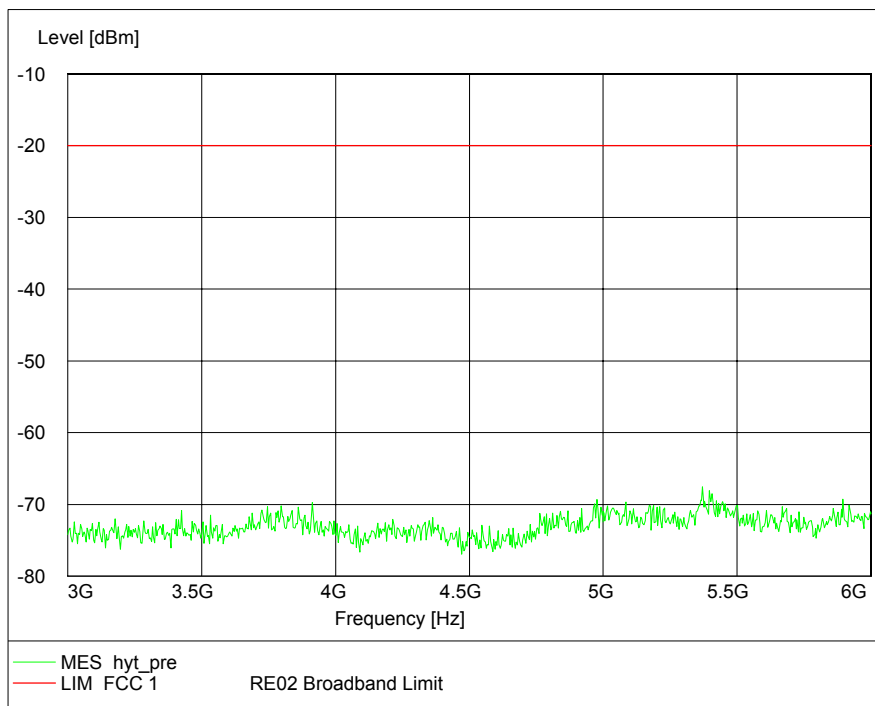


3GHz ~ 6GHz Radiated Spurious Emissions on CH Middle

Modulation type: FM
Channel bandwidth: 12.5kHz

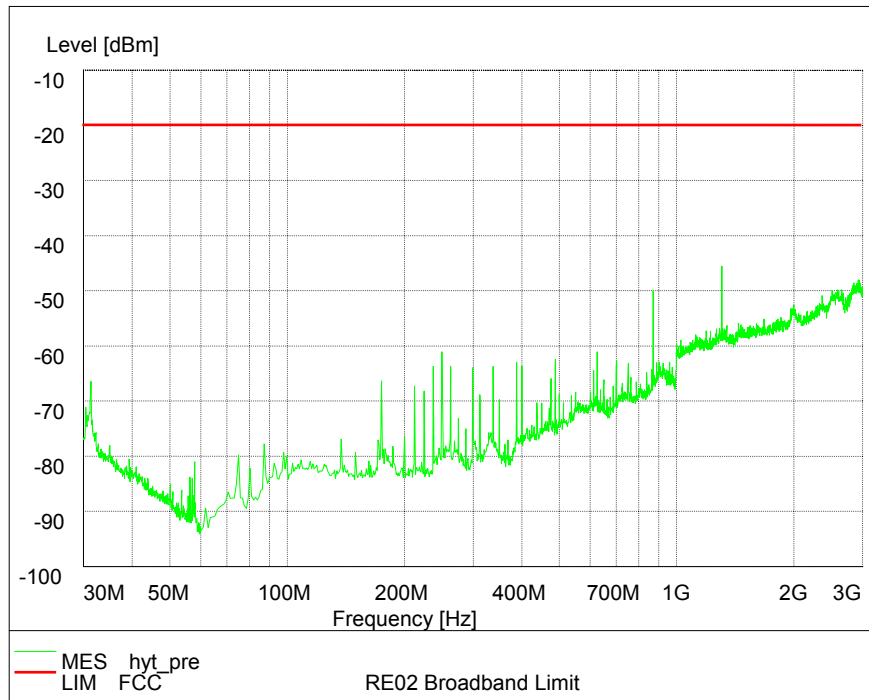


30MHz ~ 3GHz Radiated Spurious Emissions on CH Middle

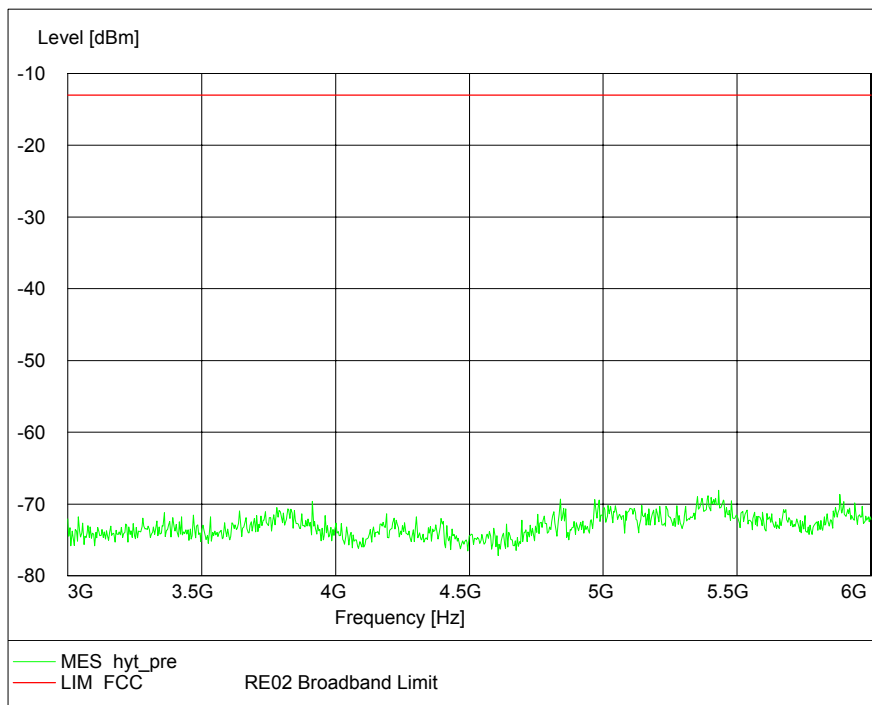


3GHz ~ 6GHz Radiated Spurious Emissions on CH Middle

Modulation type: 4FSK
Channel bandwidth: 12.5kHz



30MHz ~ 3GHz Radiated Spurious Emissions on CH Middle



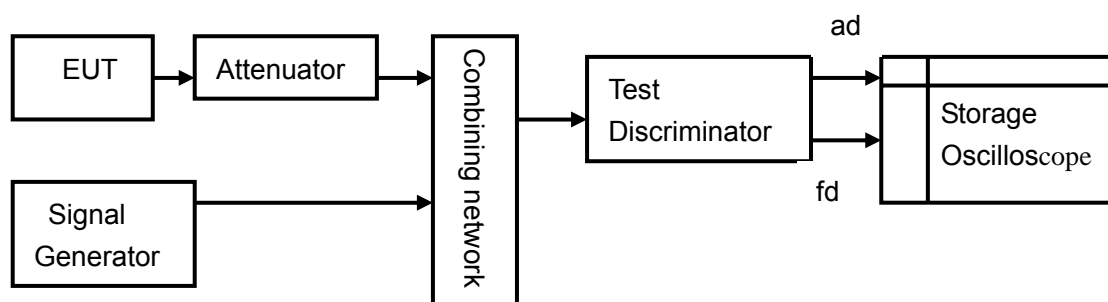
3GHz ~ 6GHz Radiated Spurious Emissions on CH Middle

2.2.8 Transient Frequency Behavior-FCC Part90.214

Ambient condition

Temperature	Relative humidity	Pressure
23°C	44%	101.0kPa

Test Setup:



Test Procedure:

Two signals shall be connected to the test discriminator via a combining network, The transmitter shall be connected to a 50 Ohm power attenuator. The test signal was modulated by a frequency of 1 kHz with a deviation equal to \pm the value of the relevant channel. And level of the test signal shall be adjusted to correspond to 0,1 % of the power of the transmitter under test measured at the input of the test discriminator. The amplitude difference (ad) and the frequency difference (fd) output of the test discriminator were connected to the storage oscilloscope. The storage oscilloscope was set to display the channel corresponding to the (fd) input up to ± 1 channel frequency difference, corresponding to the relevant channel separation, from the nominal frequency. And then which was set to trigger on the channel corresponding to the amplitude difference (ad) input at a low input level, rising. The transmitter shall then be switched on, without modulation, to produce the trigger pulse and a picture on the display. The result of the change in the ratio of power between the test signal and the transmitter output will, due to the capture ratio of the test discriminator, produce two separate sides on the picture, one showing the 1 kHz test signal, the other the frequency difference of the transmitter versus time.

The measurement will be conducted at Middle channel (435.000MHz)

Limits:

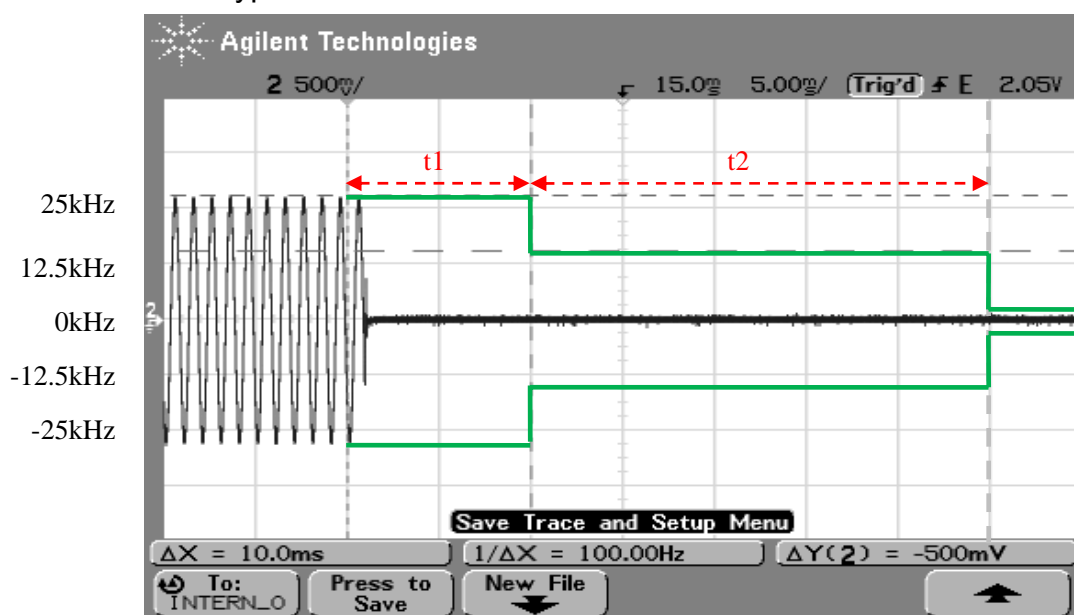
Frequency Range	Channel Separation	t1 (ms)	t2 (ms)	t3 (ms)
421MHz~512MHz	25kHz	10.0	25.0	10.0
421MHz~512MHz	12.5kHz	10.0	25.0	10.0

Where t1 and t2 are times immediately following when the transmitter is turned on, and t3 is the time from when the transmitter is turned off.

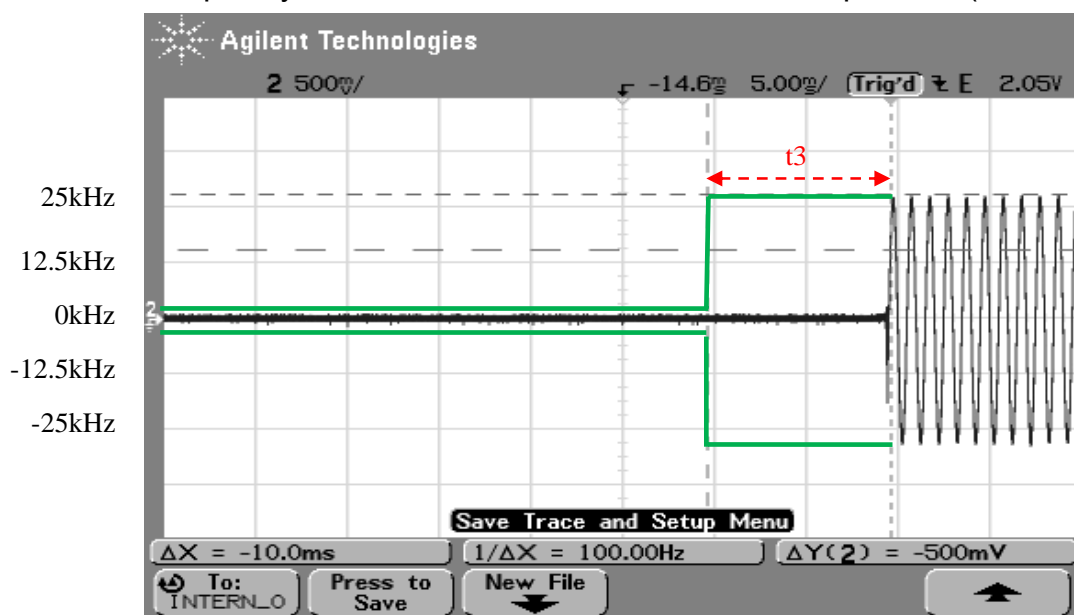
During the time from the end of t2 to the beginning of t3, the frequency difference must not exceed the limits specified in §90.213.

Test result: Refer to the following figures.

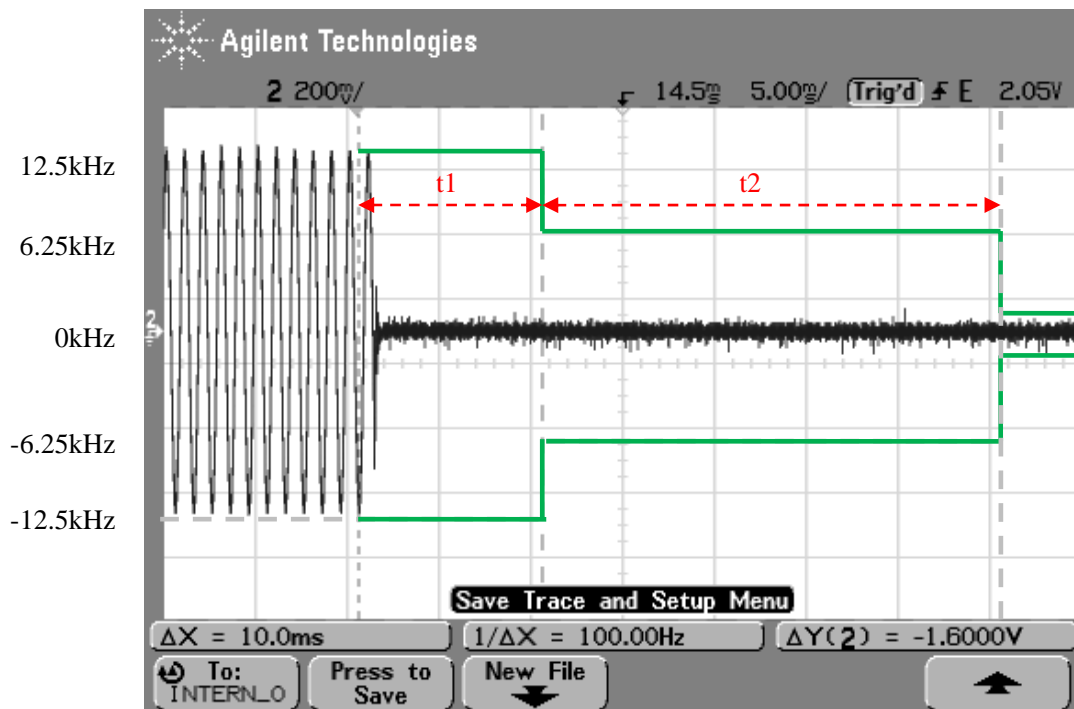
Modulation type: FM



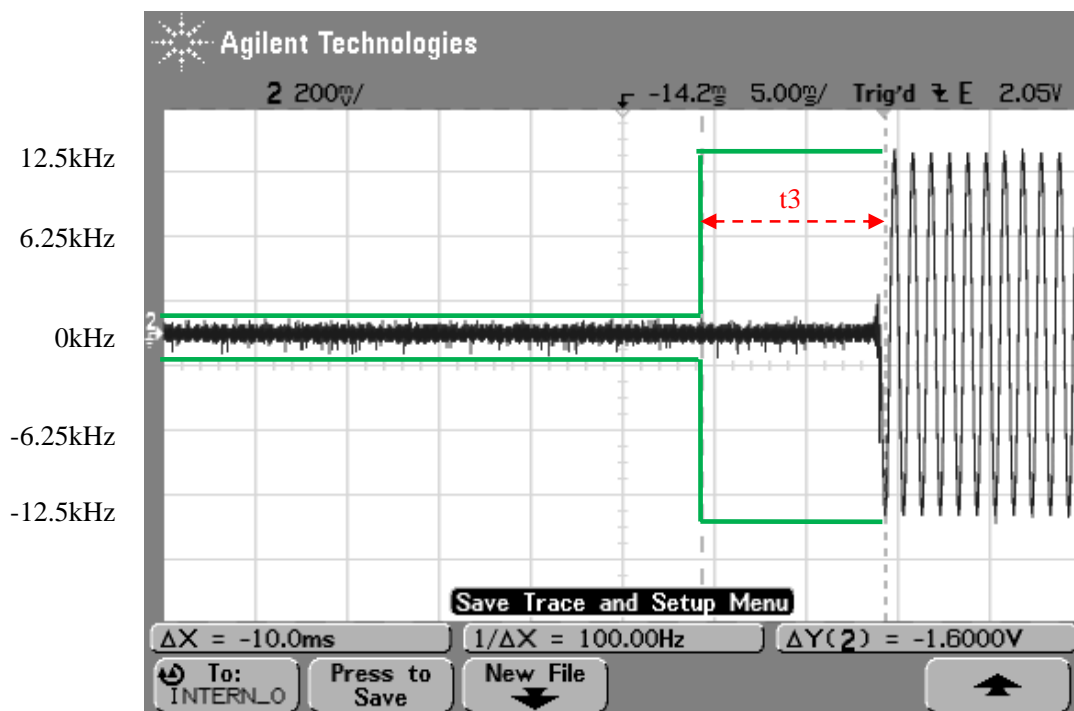
Frequency Transient Behavior, 25kHz channel separation (On-Off)



Frequency Transient Behavior, 25kHz channel separation (Off-On)

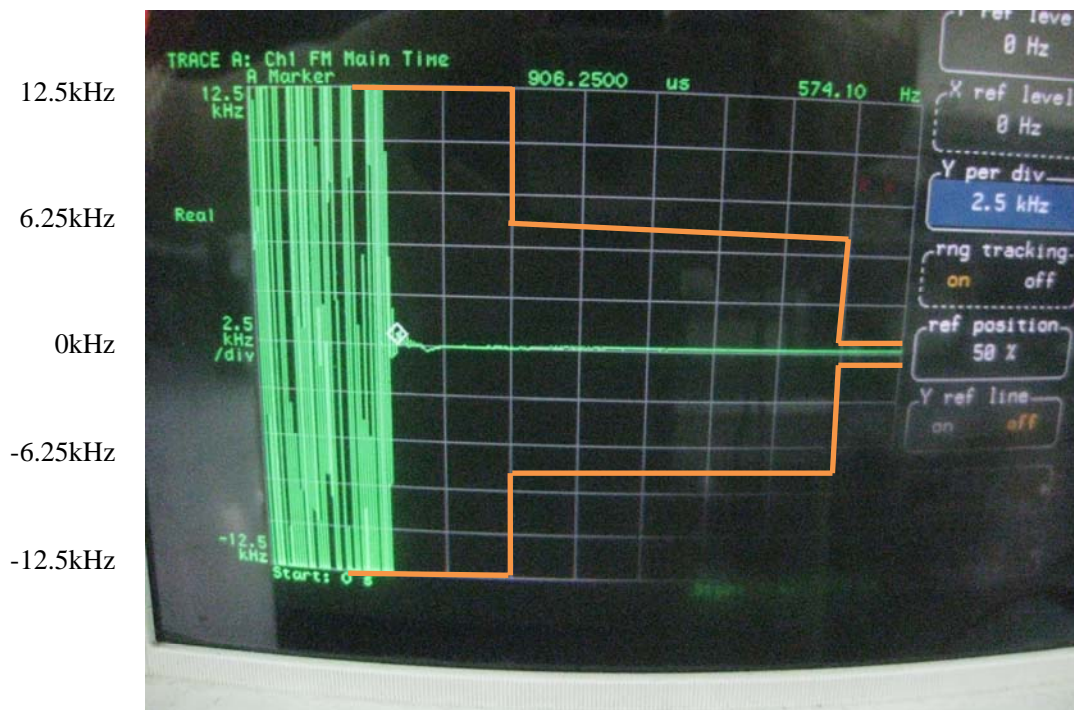


Frequency Transient Behavior, 12.5kHz channel separation (On-Off)

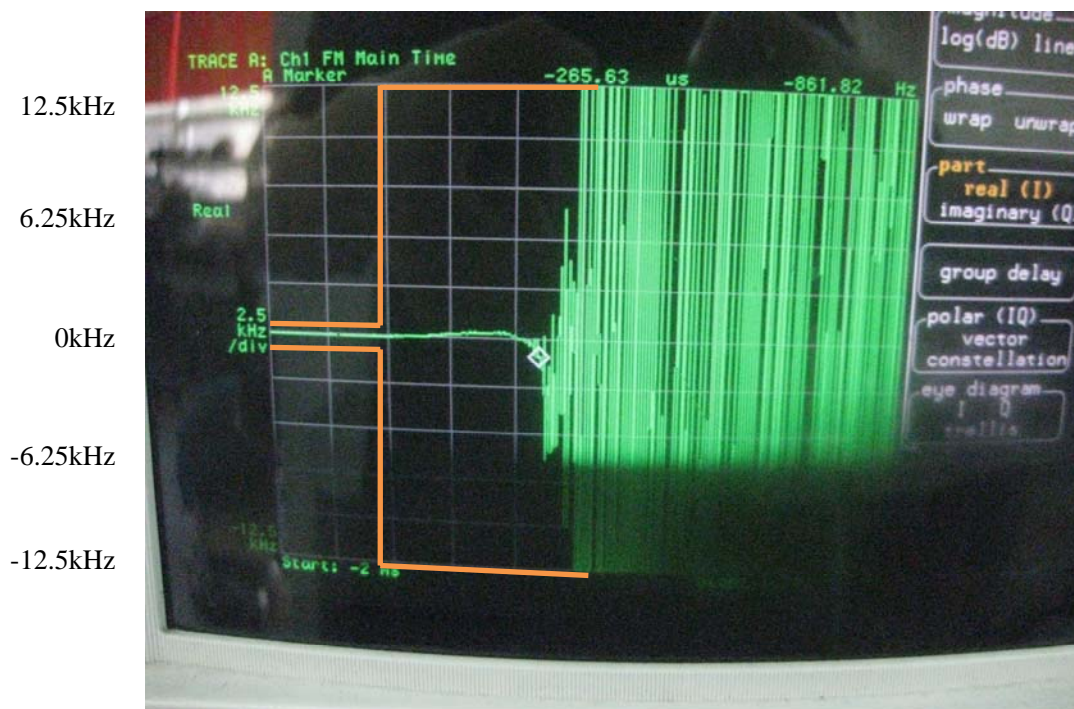


Frequency Transient Behavior, 12.5kHz channel separation (Off-On)

Modulation type: 4FSK



Frequency Transient Behavior, 12.5kHz channel separation (On-Off)



Frequency Transient Behavior, 12.5kHz channel separation (Off-On)

2.3. List of test equipments

No.	Name/Model	Manufacturer	S/N	Calibration Due Date
1	PSA E4440A Spectrum Analyzer	Agilent	MY41000183	Mar. 2011
2	66-30-33 Power Attenuator	Aeroflex / Weinschel	BV7049	Sep. 2010
3	SEWTH-Z-08 Climatic Chamber	ESPEC	7020030020	Aug. 2010
4	9.080m×5.255m×3.525m Shielding room	FRANKONIA	-----	Aug. 2010
5	ESI 40 EMI test receiver	R&S	100015	Aug. 2010
6	SMR 20 Signal generator	R&S	100086	Aug. 2010
7	12.65m*8.03m*7.50m Fully-Anechoic Chamber	FRANKONIA	-----	Aug. 2010
8	HL562 Ultra log test antenna	R&S	100016	Aug. 2010
9	ESH3-Z2 Pulse limiter	R&S	10002	Aug. 2010
10	ESH3-Z5 Attenuator	R&S	100020	Aug. 2010
11	HF 906 Double-Ridged Waveguide Horn Antenna	R&S	100030	Aug. 2010
12	MA260 Antenna Master	FRANKONIA	-----	Aug. 2010
13	E4438C Signal generator	Agilent	MY47270108	Aug. 2010
14	HP 8920A RF communication test set	HP	3345U01384	Mar.2011
15	54622A Oscilloscope	Agilent	MY40010227	Mar.2011

Appendix

Appendix1 Test Setup