Report No.	RA295027
Specifications Test method	FCC Part 95 Subpart G – Certification ANSI C63.4 1992
Applicant	Lightspeed Technologies Inc.
Applicant address	11509 S.W. Herman Road, Tualatin, OR, 97062 USA
Items tested Model No.	Wireless Microphone LES370T (Sample # RA2027)
Results	**Compliance** (As detailed within this report)
Date	11/22/2002 (month / day / year) (Sample received) 12/05/2002 (month / day / year) (Test)
Prepared by	Project Engineer
Authorized by	General Manager (Frank Tsai)
Issue date	*January 2, 2003* (month / day / year)
Modifications	**None**
Tested by	Training Research Co., Ltd.
Office at	No. 255, Nan-yang Street, Hsichih, Taipei Hsien 221, Taiwan
Anechoic Chamber at	No. 255, Nan-yang Street, Hsichih, Taipei Hsien 221, Taiwan

Conditions of issue:

(1) This test report shall not be reproduced except in full, without written approval of TRC. And the test result contained within this report only relate to the sample submitted for testing.

(2) This report must not be used by the client to claim product endorsement by NVLAP or nay agency of U.S. Government.

★ ***FCC ID : ORVLES370T***

Contents

Chapter 0 Application for Certification

95.651	:	Transmitters may be either crystal controlled or frequency synthesized. ☒ crystal controlled ☐ frequency synthesized
2.1033(c)(1)	:	applicant and manufacturer
2.1033(c)(2)	:	The equipment is a transmitter, wireless microphone Model No.: LES370T
2.1033(c)(3)	:	Quantity production is planned. See users manual
2.1033 (c)(4)	:	Type of emission – F3E- FM Modulation
2.1033(c)(5)	:	216.0125 ~ 216.9875MHz
2.1033(c)(6)	:	5.771mW
2.1033(c)(7)	:	Specification of 100mW is met by the equipment in the applicable Part 95.639 (e)
2.1033 (c)(8)	:	Final RF amplifier stage current : 80mA
2.1033(c)(9)	:	Description follows
2.1033(c)(10)	:	Complete circuit diagrams are included. No modification was made
2.1033(c)(11)	:	See Label, Instruction sheet to user included
2.1033(c)(12)	:	See photos.
2.1033(c)(13)	:	N/A
2.1033(c)(14)	:	Description follows.
2.1033(c)(15)	:	N/A
2.1033(c)(16)	:	N/A
2.1033(c)(17)	:	N/A

Chapter 1 GENERAL

1.1 Introduction

The following measurement report is submitted on behalf of LIGHTSPEED TECHNOLOGIES INC. In support of the wireless microphone certification in accordance with FCC Rules 2.1031, 2.1046, 2.1047, 2.1049, 2.1053, 2.1055 and subpart G of part 95

Description of EUT:

EUT	:	WIRELESS MICROPHONE
Model No.	:	LES370T
Carrier Frequency	:	216.4375MHz and 216.6125MHz
RF Power Output	:	5.771mW
Supply Voltage	:	1.5V Battery (DC Jack is disabled)
Supply Current	:	80 mA
Frequency Response	:	50Hz ~ 3kHz
Frequency Stability	:	0.005%
Operating Temperature	:	– 30 to + 50 degree centigrade

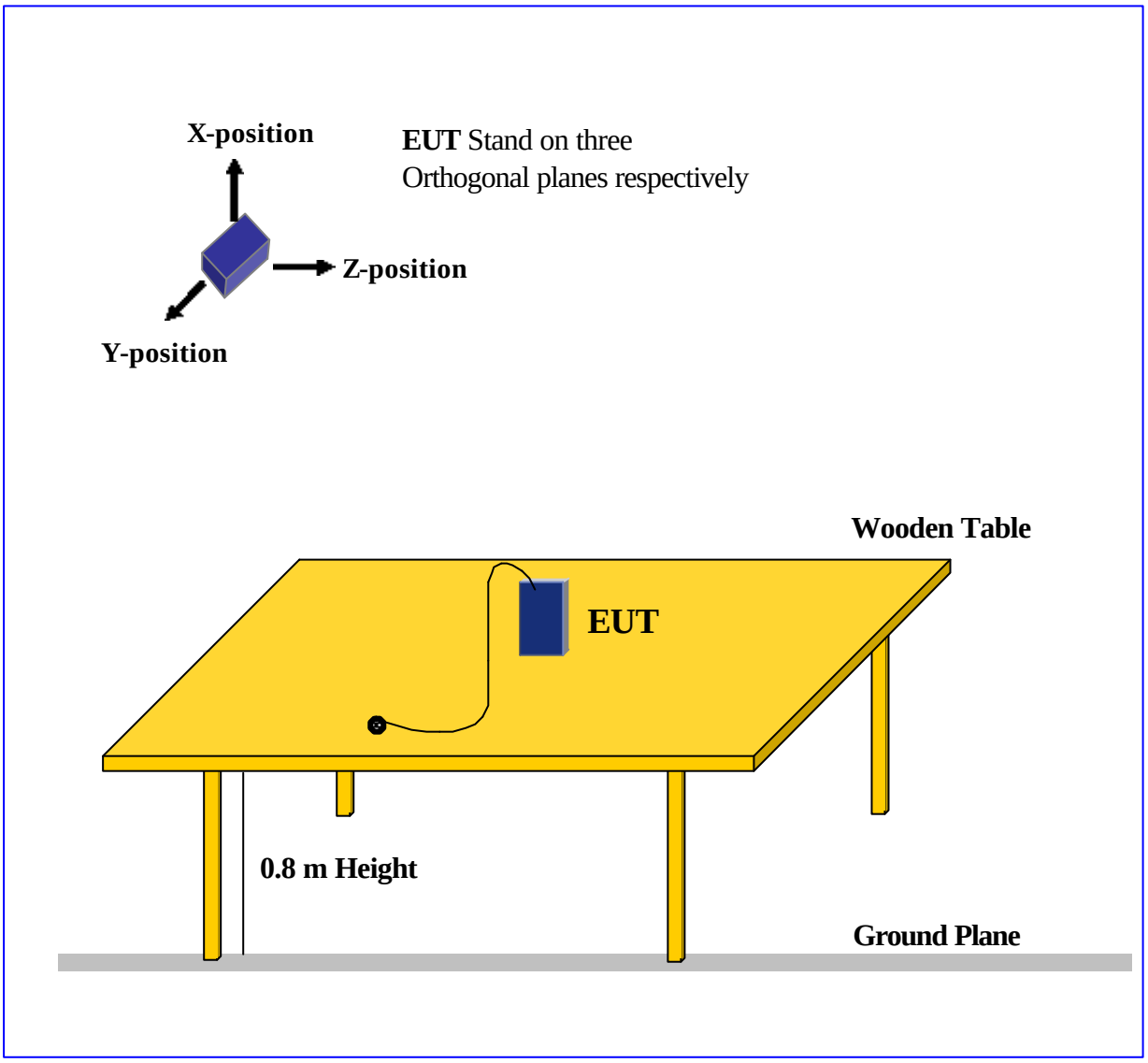
Wireless microphone is a transmitter, which operates in the frequency range of 216.0125MHz ~ 216.9875MHz. This microphone is worn by an auditory assistance communications and educational settings.

1.2 Description of Support Equipment

No support equipment

The EUT does not be connected with any product. No support equipment is requited for its normal operation.

1.3 Configuration of Test Setup



1.4 Location of the Measurement Site

The radiated emissions measurements required by the Rules were performed on the Three-meter, anechoic chamber at test site maintained by ***Training Research Co., Ltd.,*** *No. 255, Nan Yang Street, Hsichih, Taipei Hsien 221, Taiwan*. Complete description and measurement data have been placed on file with the Commission. The conducted power line Emissions tests were performed in a shielded enclosure also located at the above facility.

Training Research Co., Ltd. is listed by the FCC (Registration Number: 93906) as a facility available to do measurement work for others on a contract basis.

1.5 General Test Condition

The conditions under which the EUT operates were varied to determine their effect on the equipment's emission characteristics. The final configuration of the test system and the mode of operation used during these tests were chosen as that which produced the highest emission levels. However, only those conditions, which the EUT was considered likely to encounter in normal use were investigated.

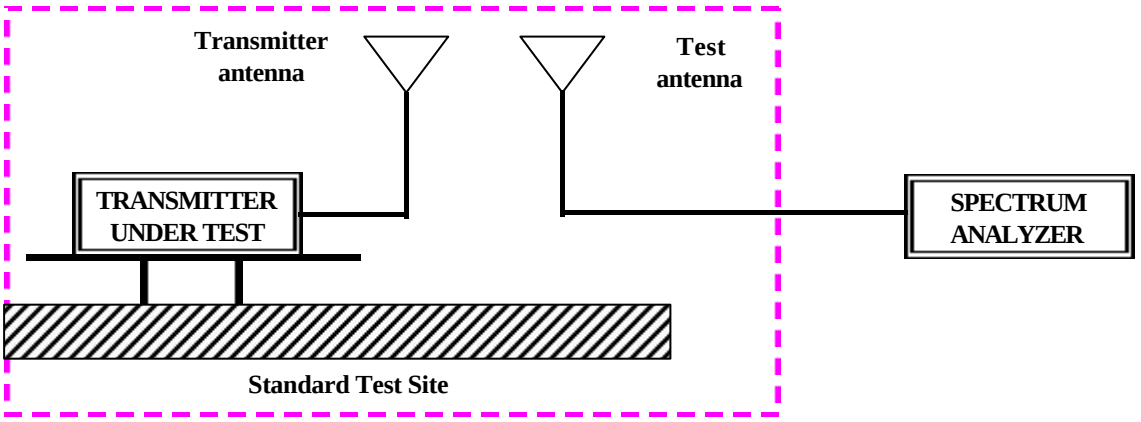
Chapter 2 Power Output Measurement

2.1 Rules and Specification Limits

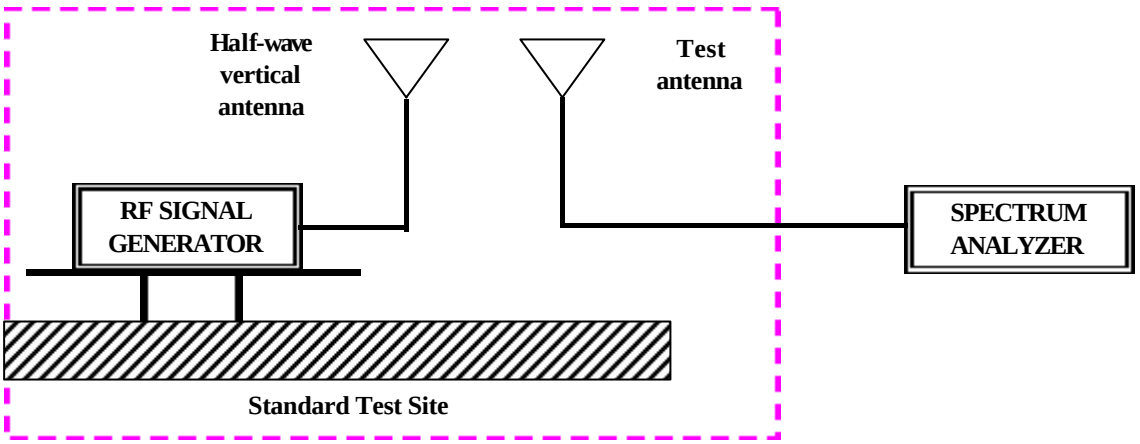
2.1046(a), ANSI/ TIA/ EIA-603-1992, Paragraph 2.2.1.

95.639 (e) : The maximum transmitter output power authorized for LPRS stations is 100 mW.

2.2 Test condition and setup



1. Measurement was made on anechoic chamber. The EUT system was placed on non-conductive turntable which is 0.8 meters height, top surface 1.0 X 1.5 meter. The EUT was placed in three direction of the space in order to obtain maximum emission.
2. Connect the equipment as illustrated. Place the transmitter to be tested on the turntable in the standard test site.
3. Raise and lower the test antenna from 1m to 4m with the transmitter facing the antenna and record the highest received signal.
4. Repeat step (3) for seven additional readings at 45 interval positions of the turn-table.



5. Replace the transmitter under test with a half-wave vertically polarized antenna. The center of the antenna should be at the same location as the transmitter under test. Connect the antenna to a signal generator with a known output and record value.

6. FI_a(dBm) = FI_r (dBm) + Corrected (dB)
   Corrected (dB) = AF(dB) + [CL(dB) – Amplitude Gain]
   FI_a : Actual Field Intensity
   FI_r : Reading of the Field Intensity
   AF : Antenna Factor
   CL : Cable Loss

7. The field intensity in Watt can then be determined by the following equation:
   P (watt) = FI^2(Volt) X d^2 (meter) / 49.2
   P : Power in Watt
   D : Measurement Distance (3 m)

2.3 Test condition and setup

				Calibration Date	
Instrument Name	Model No.	Brand	Serial No.	Last time	Next time
EMI Receiver	8546A	H P	3520A00242	06/28/02	06/28/03
RF Filter Section	85460A	H P	3448A00217	06/28/02	06/28/03
Small Biconical Antenna and Balun	BBVU9135 UBAA9114	Schwarzeck	127	05/07/02	05/07/03
Switch/Control Unit (> 30MHz)	3488A	HP	N/A	11/20/02	11/20/03
Auto Switch Box (> 30MHz)	ASB-01	TRC	9904-01	11/20/02	11/20/03
Spectrum Analyzer	8564E	HP	US36433002	08/01/02	08/01/03
Microwave Preamplifier	83051A	HP	3232A00347	08/01/02	08/01/03
Horn Antenna	3115	EMCO	9704 – 5178	08/01/02	08/01/03
Anechoic Chamber (cable calibrated together)				05/20/02	05/20/03

The level of confidence of 95%, the uncertainty of measurement of radiated emission is ± 3.44 dB.

2.4 Measurement Result

Frequency: 216.6125 MHz

The maximum field measured is 7.61dBm

FI (Volt) = $10^{104.99/20}$ X 10^{-6}
= 0.17762 V

FI (W) = $(0.17762 \text{ X } 3)^2 / 49.2$
= $5.771 \text{ x } 10^{-3}$ W

Angle of Turn Table (°)	Spectrum Reading (dBm)	Corrected (dB)	Actually Value (dBm)	E. R. P. (mW)	Average (W)
0°	-6.36	1.58	-4.78	0.33289	$3.160\text{x } 10^{-3}$
45°	2.85	1.58	4.43	2.77524	
90°	5.77	1.58	7.35	5.43626	
135°	4.95	1.58	6.53	4.50091	
180°	-0.99	1.58	0.59	1.14630	
225°	-2.44	1.58	-0.86	0.82092	
270°	5.97	1.58	7.55	5.69246	
315°	5.02	1.58	6.60	4.57404	

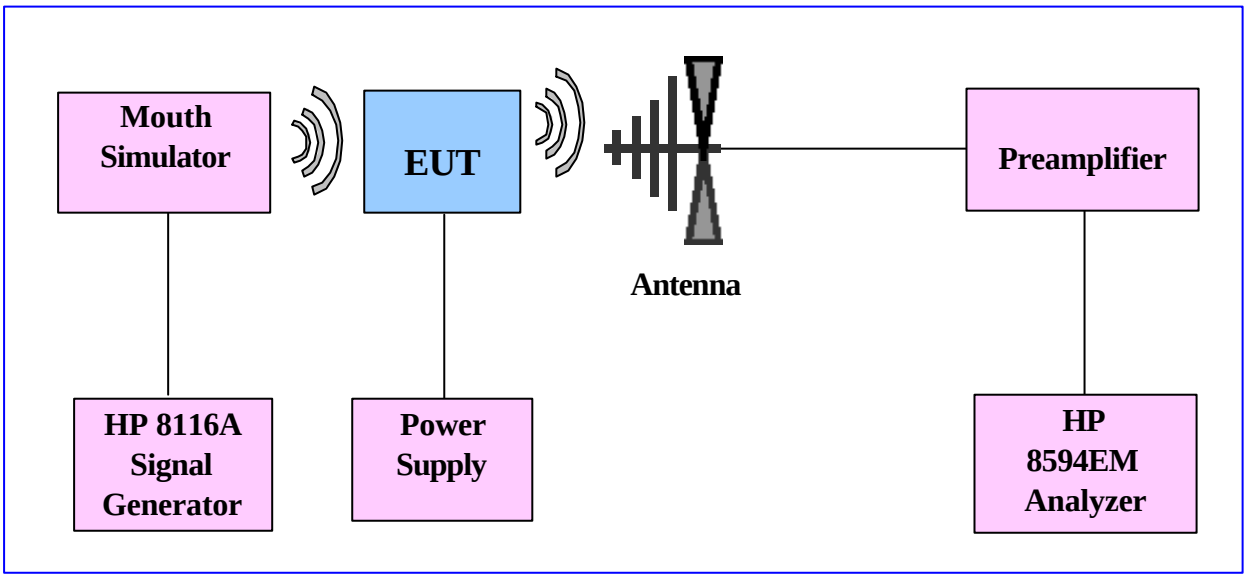
Chapter 3 Modulation Characteristics Measurement

3.1 Rules and Specification Limits

2.1047 (a), ANSI/ TIA/ EIA-603-1992, Paragraph 2.2.6.
Voice modulated communication equipment

2.1047 (b), ANSI/ TIA/ EIA-603-1992, Paragraph 2.2.3.
Equipment which employs modulation limiting

3.2 Test Configuration & List of Test Instruments



3.3 List of test instrument

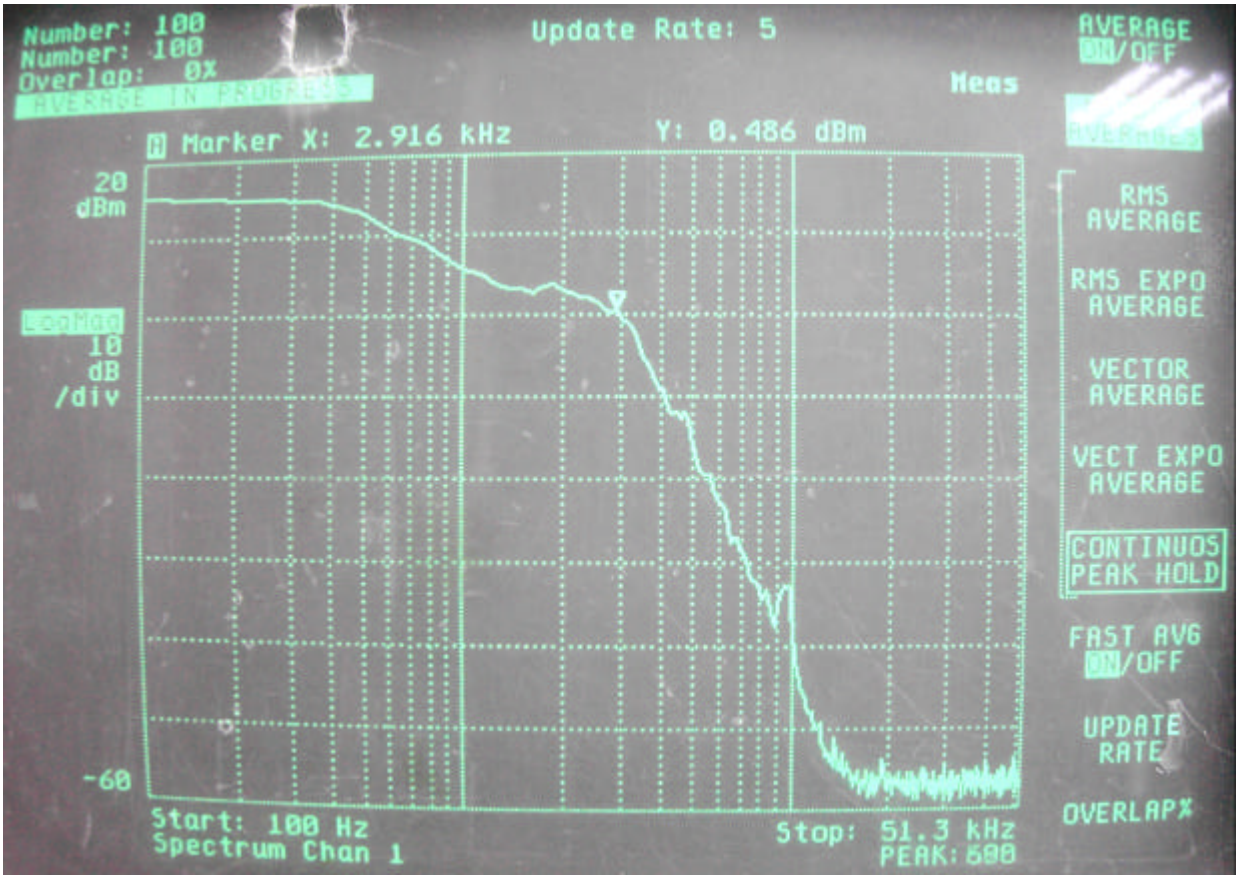
Manufacturer	Device	Model No.	Input Impedance
HP	Dynamic Signal Analyzer	HP35660A	50
HP	Signal Generator 50 MHz	HP8116A	50
SCHAFFNER	Bi-log Antenna	CBL6141A	50
Farnell	Modulation Meter	AMM2000	50
TRC	Preamplifier	TRC001	50

3.4 Frequency Response of Audio Modulation Circuit and Low Pass Filter Measurement Condition & Setup

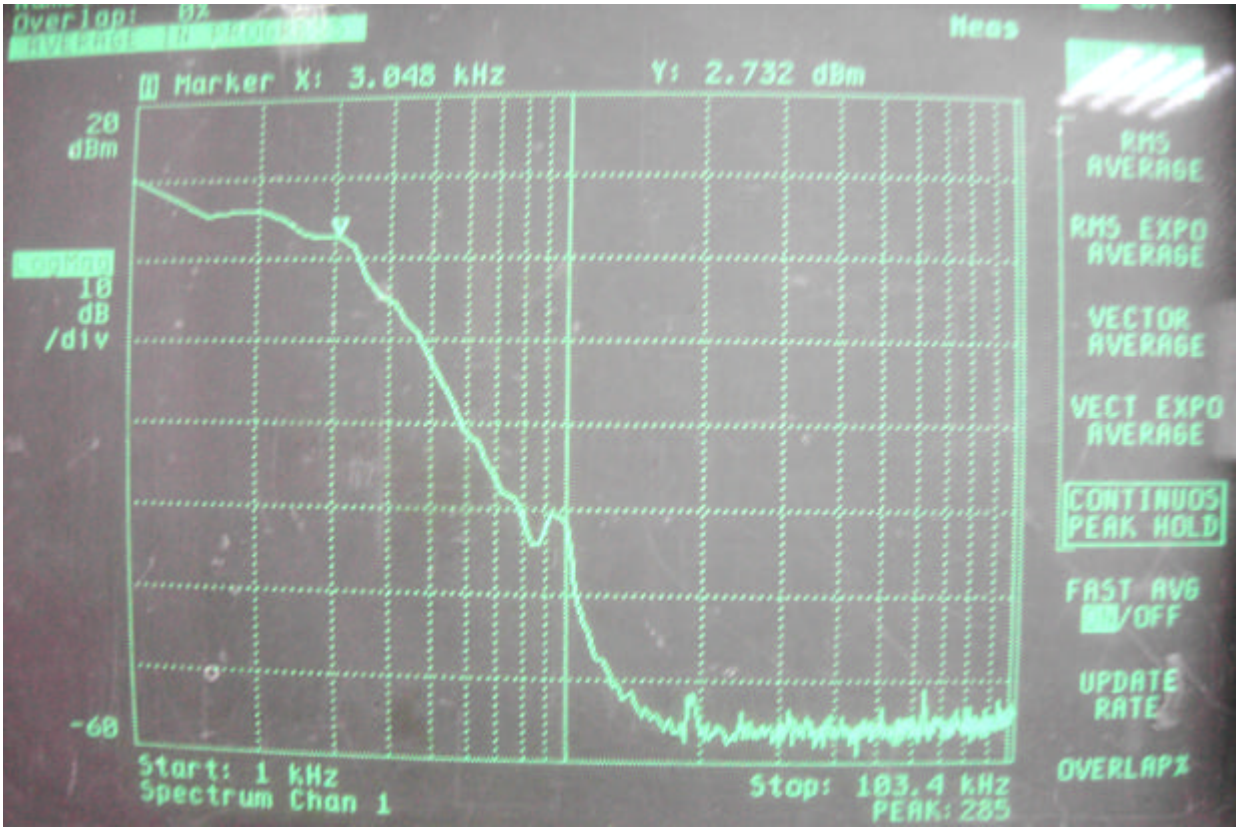
2.1047 (a)

1. The EUT and test equipment were set up as shown on the Section 3.2.
2. The Plus/Function generator was connected to the microphone of EUT, via an artificial mouth simulator.
3. The audio signal input was adjusted to obtain 50% modulation at 1kHz.
4. With input levels held constant and below limiting at all frequencies, the generator was varied from 100Hz to 51.3kHz, 1kHz to 103.4kHz
5. The response in dBm relative to 1kHz was then measured, using the HP 35660A Dynamic Signal Analyzer as follow page.

100Hz to 51.3kHz



1kHz to 103.4kHz



3.5 Modulation Limiting Measurement Condition & Setup

2.1047 (b)

1. The Plus/Function generator was connected to the microphone of EUT, via an artificial mouth simulator.
2. The modulation response was measured for each of following frequencies: 300Hz, 1kHz, 1.8kHz, and 2.916kHz.
3. The input level was varied from 30% modulation to at least 20dB higher than the saturation point.
4. Measurements were performed for both negative and positive modulation and the respective results were recorded.
5. Measurement results as Chart 3.1 and Chart 3.2

Chart 3.1 Modulation Limiting Measuerment Negative

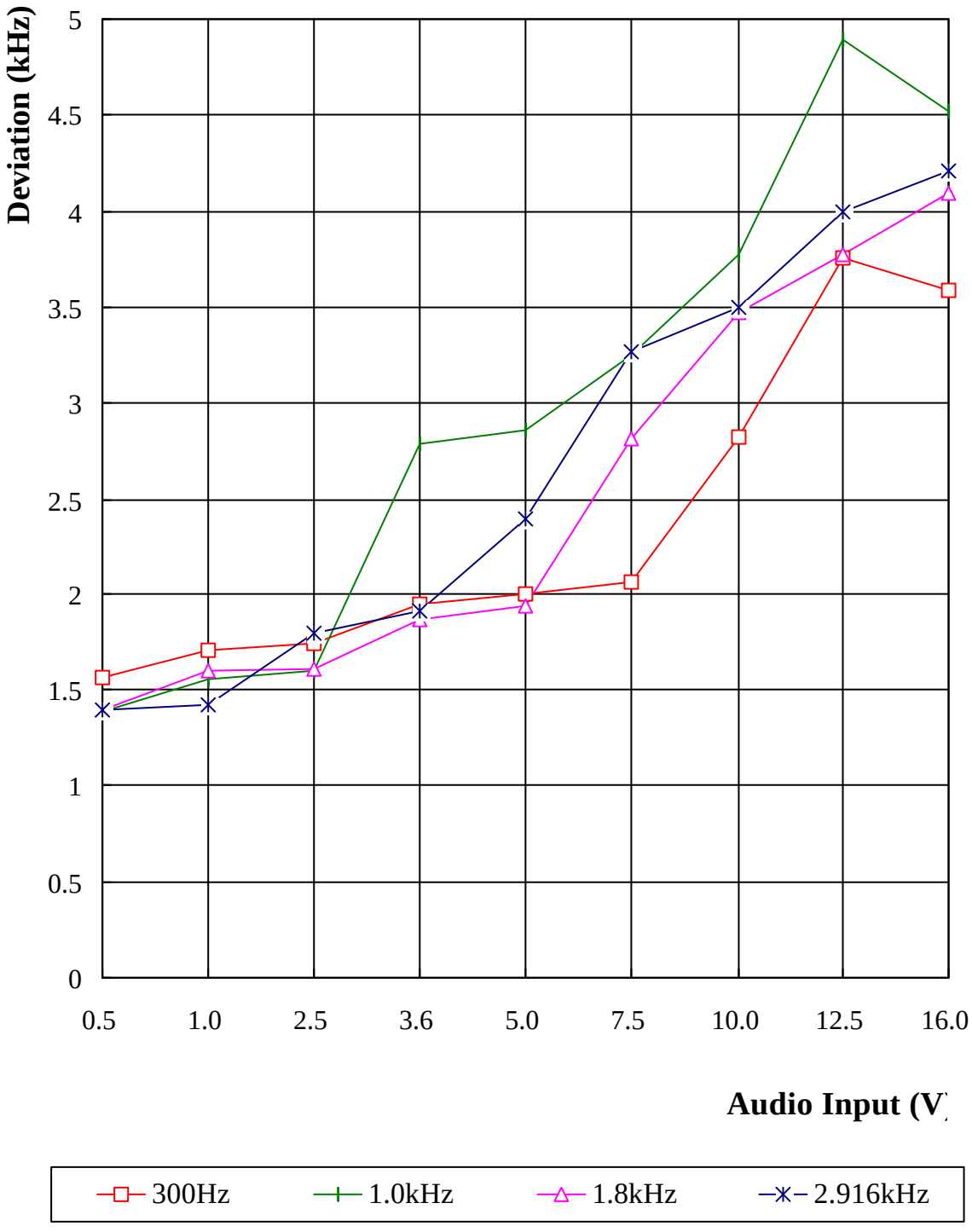
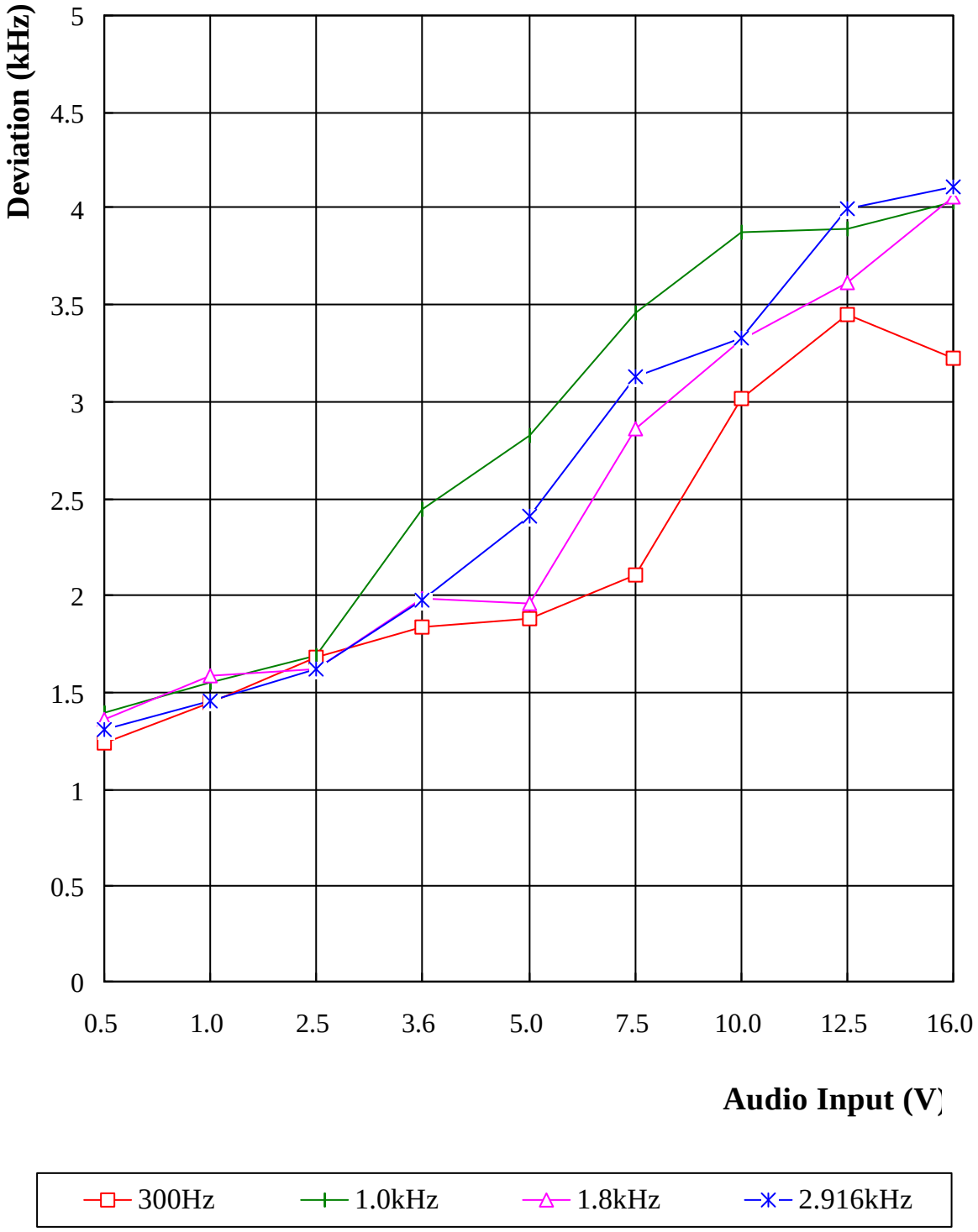


Chart 3.2 Modulation Limiting Measuerment Positive



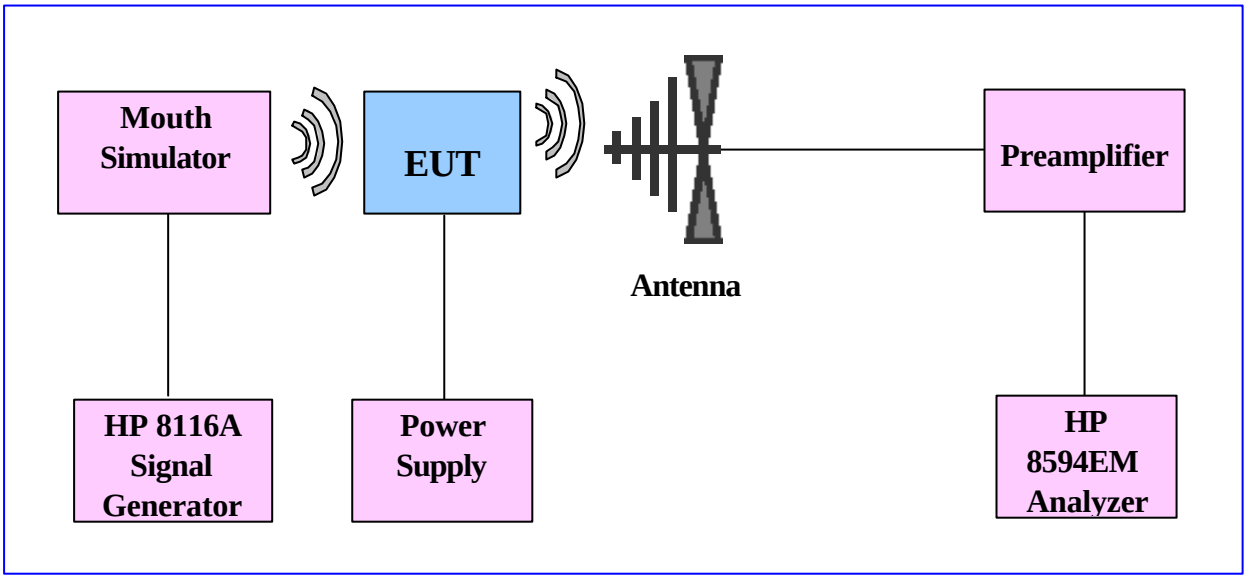
Chapter 4 Occupied Bandwidth Measurement

4.1 Rules and Specification Limits

2.1049(c)(1): ANSI/ TIA / EIA-603-1992, Paragraph 2.2.11.

95.633(d)(2): The channel bandwidth for standard band frequencies is 25kHz.

4.2 Test Configuration & List of Test Instruments



4.3 List of test Instrument

Instrument Name	Model No.	Brand	Input Impedance
Spectrum analyzer (9K~1.8GHz)	8594EM	HP	50
Preamplifier (30MHz~1GHz)	TRC001	TRC	50
Signal Generator 50 MHz	HP8116A	HP	50
Bi-log Antenna	CBL6141A	SCHAFFNER	50

4.4 Measurement Procedure

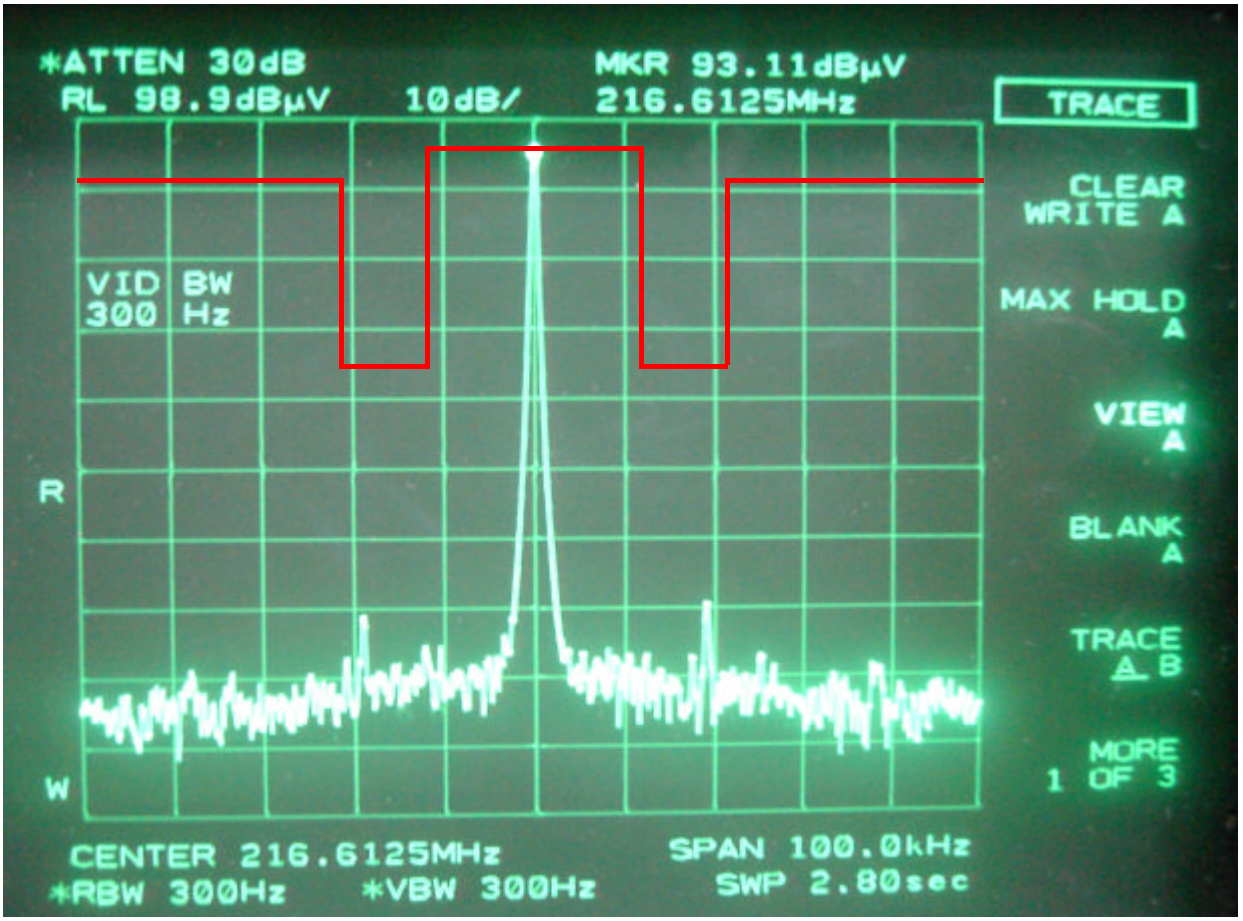
1. Connect the EUT as Section 4.2 .
2. Plot the unmodulated chart shows on spectrum.
3. Set the output of the signal generator to 300Hz, 1.0kHz, 1.8kHz, and 2.916kHz. Increase the amplitude of the signal, while monitoring the modulation meter. Until modulation is maximum measure the bandwidth under 26 dB compared to the unmodulated fundamental carrier peak level of the modulated signal displayed on the spectrum analyzer.
4. The occupied Bandwidth was measured as follow pages.

4.5 Measurement Result

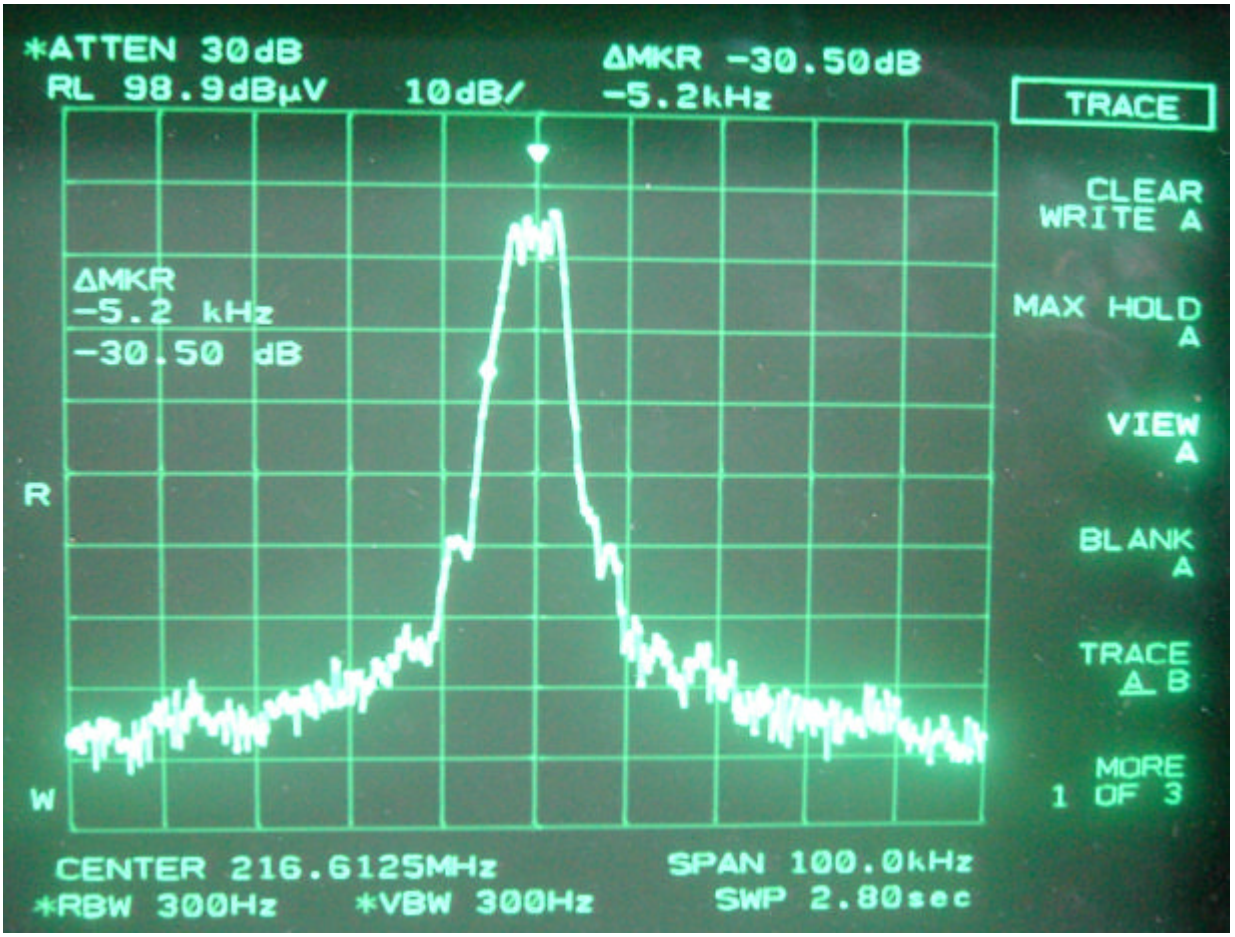
The occupied bandwidth's plot is presented on following pager, which illustrates compliance with the rules.

Calculation of Necessary Bandwidth (Bn)
Bn = 2M + 2D
M = Max. Modulation Frequency = 2.916 kHz
D = Peak Frequency Deviation = 4.897 kHz (Chart 3-1, Page20)
K = 1
Bn = 15.626 kHz

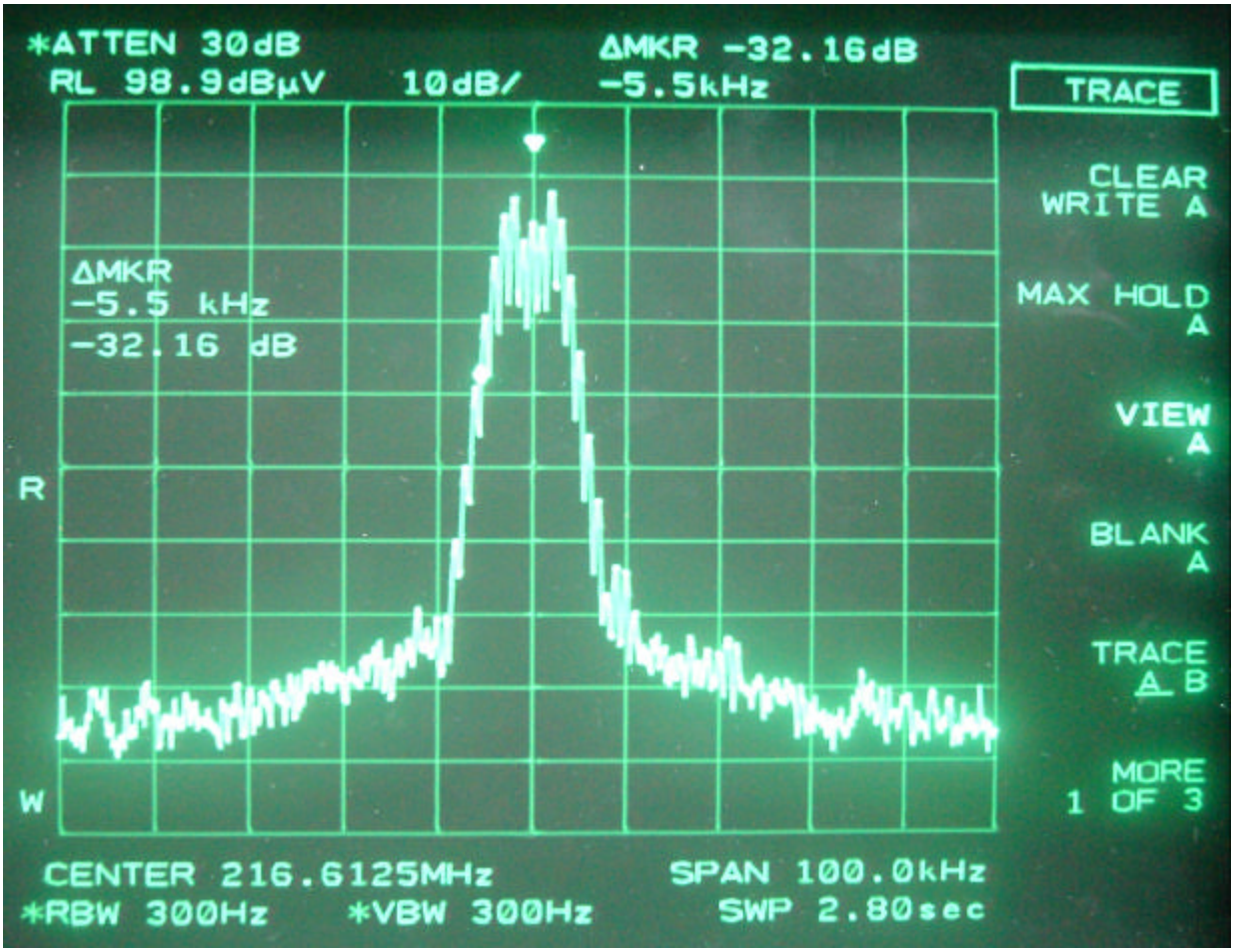
unmodulation



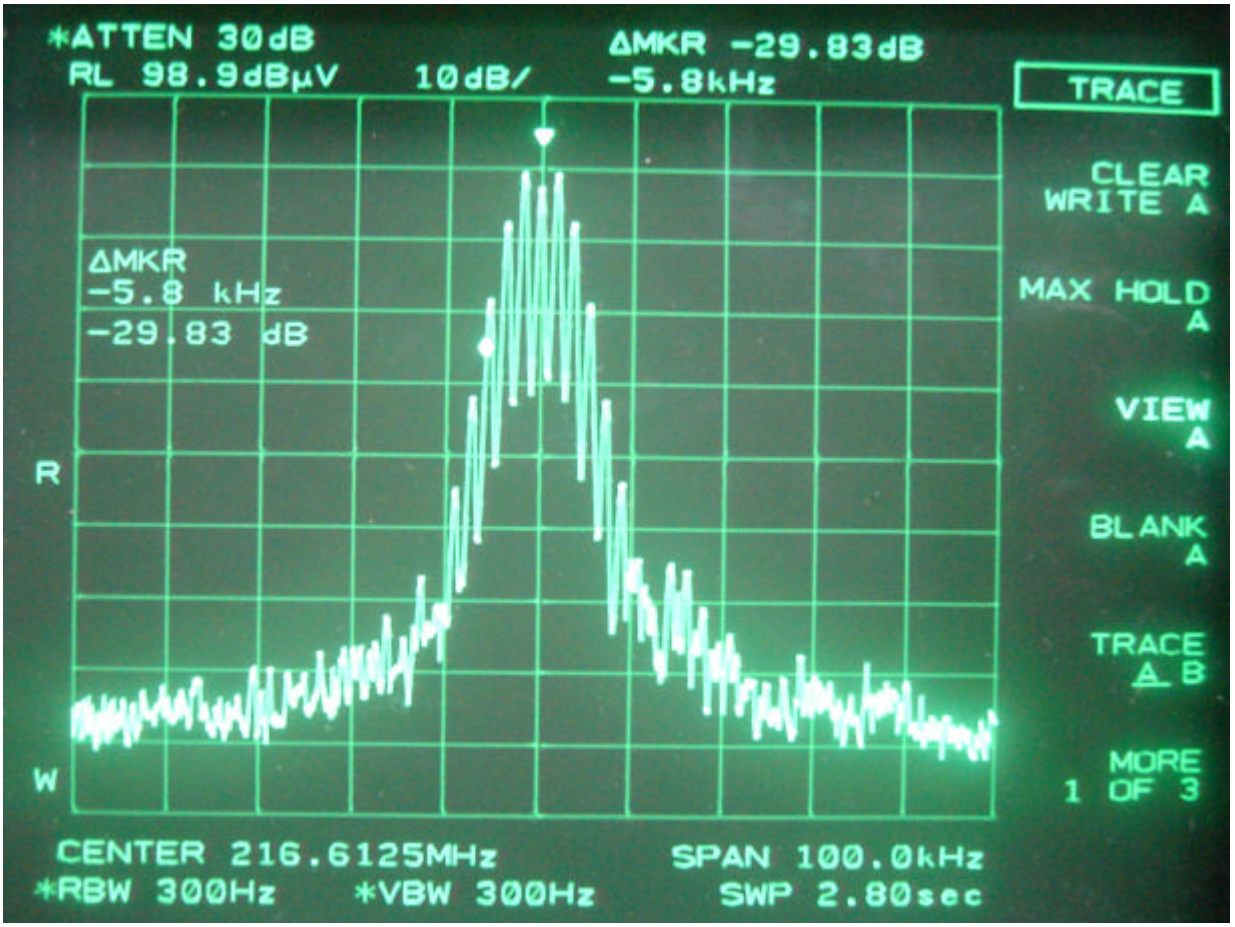
300Hz modulation



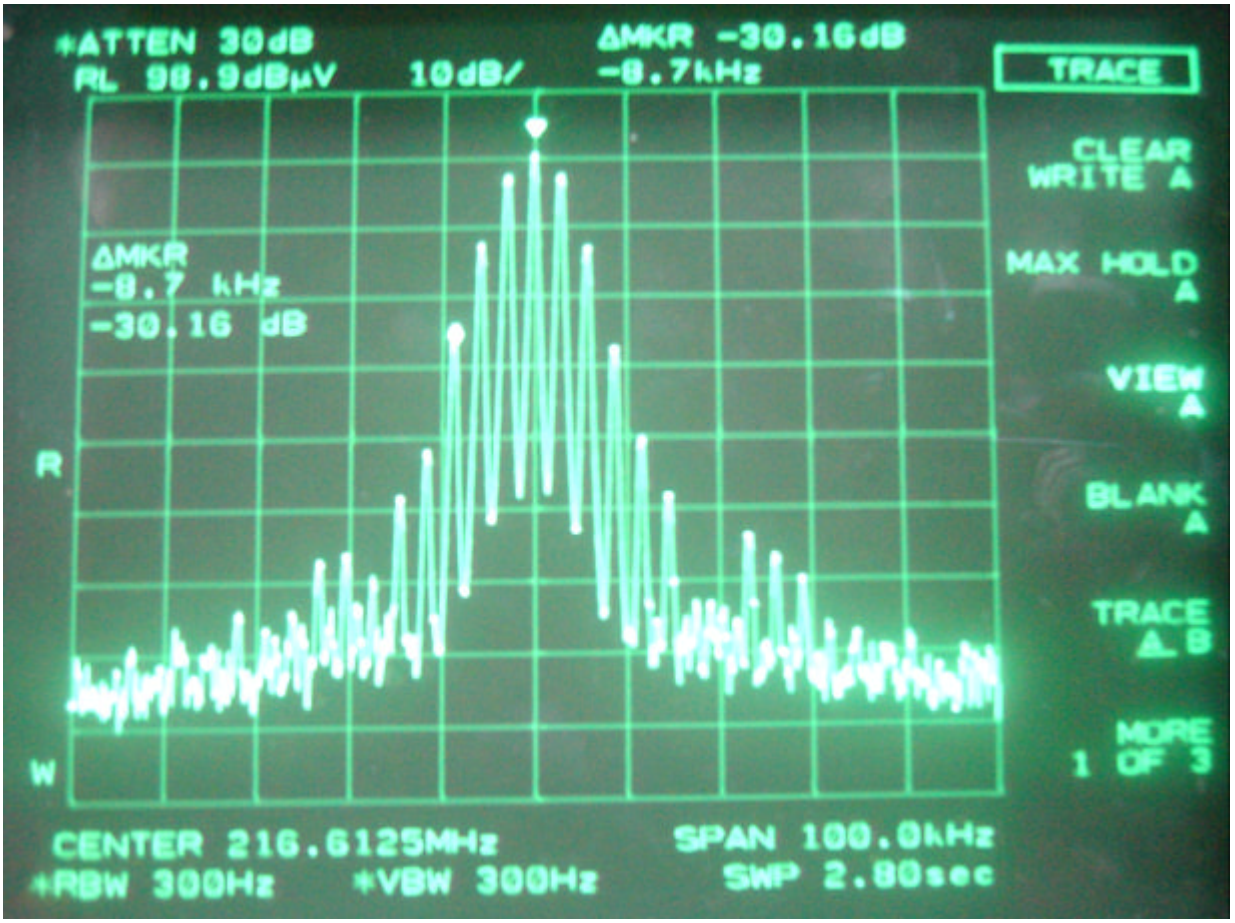
1.0kHz modulation



1.8kHz modulation



2.916kHz modulation



Chapter 5 Field Strength of Spurious Radiation Measurement

5.1 Rules and Specification Limits

2.1053(a): ANSI/ TIA/ EIA-603-1992, Paragraph 2.2.12

Measurements 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.

95.635(c): For transmitters designed to operate in the LPRS, emissions shall be attenuated in accordance with the following:

95.635(1): Emission for LPRS transmitters operating on standard band channels (25 KHz) shall be attenuated below the unmodulated carrier in accordance with the following :

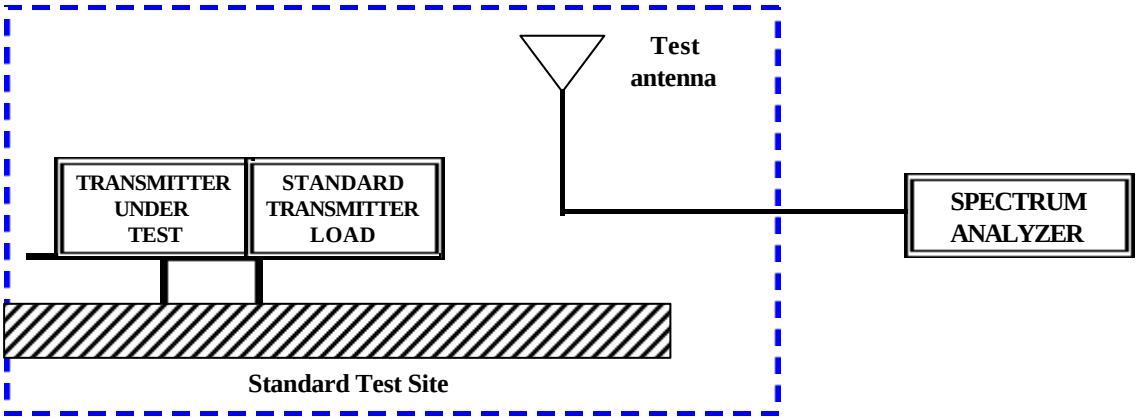
95.635(1)(i): Emission 12.5 kHz to 22.5 kHz away from the channel center frequency: at least 30 dB; and

95.635(1)(ii): Emission more than 22.5kHz away form the channel center frequency: at least 43 + 10 log (carrier powering watts) dB below the Carrier peak

2.1057:

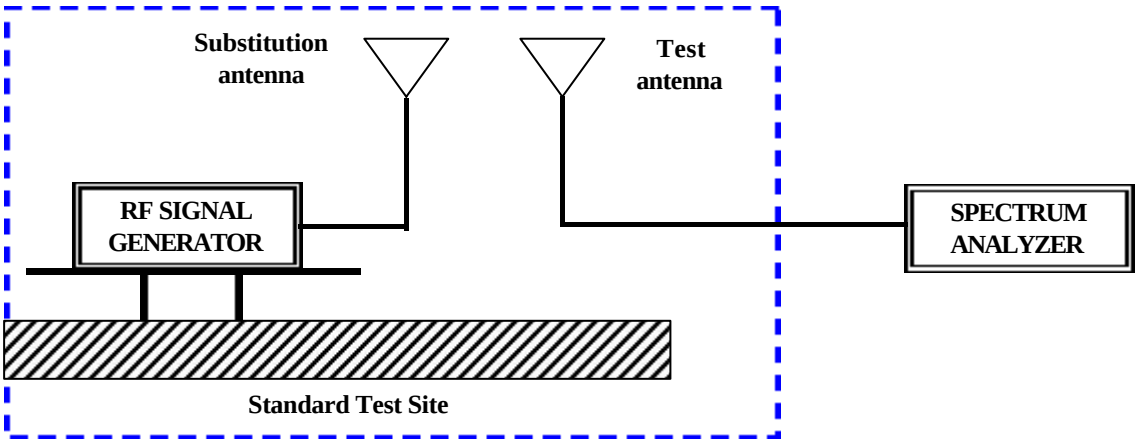
In all measurements set forth, the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency.

5.2 Measurement Condition & Setup



1. Connect the equipment as illustrated.
2. Adjust the spectrum analyzer for the following setting:
   a) Resolution Bandwidth ≦ 3kHz
   b) Video Bandwidth ≧ 10kHz
   c) Sweep Speed ≦ 2000Hz /second
   d) Detector mode = Positive Peak

3. Place the transmitter to be tested on the turntable in the standard test site. The transmitter is transmitting into a non-radiating load, which is placed on the turntable. The RF cable to this load should be of minimum length.
4. For each spurious measurement the test antenna should be adjusted to the correct length for the frequency involved. The length may be determined form a calibration ruler supplied with the equipment. Measurements shall be made form the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to ±the test bandwidth (see section 1.3.4.4)
5. For each spurious frequency, raise and lower the test antenna from 1m to 4m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Then the turntable should be rotated 360º to determine the maximum reading. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
6. Repeat step (5) for each spurious frequency with the test antenna polarized vertically.



7. Reconnect the equipment as illustrated.
8. Keep the spectrum analyzer adjusted as in step (2)

9. Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3m above the ground.

10. Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.

11. Repeat step (10) with both antennas vertically polarized for each spurious frequency.

12. Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps (10) and (11) by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to and ideal half-wave dipole antenna.

13. The levels record in step (12) are the absolute levels of radiated spurious emissions in dBm. The radiated spurious emissions in dB can be calculated by the following:

    Radiated spurious emissions (dB) =

    $$10 \log_{10} \left[\frac{\text{TX power in watts}}{0.001} \right] - \text{the levels in step (12)}$$

5.3 List of Measurement Instruments

				Calibration Date	
Instrument Name	Model No.	Brand	Serial No.	Last time	Next time
EMI Receiver	8546A	H P	3520A00242	06/28/02	06/28/03
RF Filter Section	85460A	H P	3448A00217	06/28/02	06/28/03
Small Biconical Antenna and Balun	BBVU9135 UBAA9114	Schwarzeck	127	05/07/02	05/07/03
Switch/Control Unit (> 30MHz)	3488A	HP	N/A	11/20/02	11/20/03
Auto Switch Box (> 30MHz)	ASB-01	TRC	9904-01	11/20/02	11/20/03
Spectrum Analyzer	8564E	HP	US36433002	08/01/02	08/01/03
Microwave Preamplifier	83051A	HP	3232A00347	08/01/02	08/01/03
Horn Antenna	3115	EMCO	9704 – 5178	08/01/02	08/01/03
Anechoic Chamber (cable calibrated together)				05/20/02	05/20/03

The level of confidence of 95% , the uncertainty of measurement of radiated emission is ± 3.44 dB .

5.4 Measurement Result:

Test Conditions:

Testing room : Temperature : 25 °C Humidity : 70 % RH

Test mode: Antenna polarity – horizontal, 30MHz ~ 3GHz, A-channel

Frequency	*Reading Amplitude*	*Ant. Height*	*Table*	*Correction Factors*	*Corrected Power*	*Attenuated below the mean power*	*Minimum Attenuation limit*
MHz	**dBm**	**m**	**degree**	**dB**	**dBm**	**dBc**	**dBc**
145.19	-76.83	1.00	297	2.06	-74.77	82.38	20.61
193.69	-74.68	1.00	294	1.70	-72.98	80.59	
242.79	-73.52	1.00	290	1.60	-71.92	79.53	
433.76	-76.68	1.00	71	6.57	-70.11	77.72	
866.62	-78.92	1.00	284	21.66	-57.26	64.87	
1082.50	-40.30	1.00	231	0.91	-39.39	47.00	
1299.37	-46.64	1.00	59	0.80	-45.84	53.45	
1515.00	-44.14	1.00	208	0.05	-44.09	51.70	
1731.25	-46.47	1.00	154	0.62	-45.85	53.46	
1948.12	-51.14	1.00	29	3.62	-47.52	55.13	
2164.37	-51.30	1.00	220	5.19	-46.11	53.72	
2380.62	-47.31	1.00	39	6.27	-41.04	48.65	

Note:

1. **Corrected Amplitude = Reading Amplitude + Correction Factors**
2. **The maximum field measured is 7.61dBm**
   Attenuated below the mean power = Power – Corrected Power
   { For example: 7.61 – (-74.77) = 82.38 dBc }
3. **Attenuation required = 43 + 10 log (5.771 x 10^{-3} W) = 20.61**

Test mode: Antenna polarity -- vertical, 30MHz ~ 3GHz, A-channel

Frequency	*Reading Amplitude*	*Ant. Height*	*Table*	*Correction Factors*	*Corrected Power*	*Attenuated below the mean power*	*Minimum Attenuation limit*
MHz	**dBm**	**m**	**degree**	**dB**	**dBm**	**dBc**	**dBc**
145.19	-77.81	1.00	77	2.06	-75.75	83.36	20.61
193.69	-74.65	1.00	261	1.70	-72.95	80.56	
242.19	-75.91	1.00	270	1.62	-74.29	81.90	
289.48	-77.75	1.00	230	2.05	-75.70	83.31	
433.76	-76.43	1.00	47	6.57	-69.86	77.47	
650.19	-77.57	1.00	221	15.44	-62.13	69.74	
866.62	-78.45	1.00	266	21.66	-56.79	64.40	
1082.50	-36.30	1.00	109	0.91	-35.39	43.00	
1299.37	-42.81	1.00	64	0.80	-42.01	49.62	
1515.00	-39.64	1.00	89	0.05	-39.59	47.20	
1730.62	-47.48	1.00	116	0.62	-46.86	54.47	
1948.12	-46.14	1.00	349	3.62	-42.52	50.13	
2164.37	-52.14	1.00	9	5.19	-46.95	54.56	
2380.62	-45.31	1.00	207	6.27	-39.04	46.65	

Note:

1. **Corrected Amplitude = Reading Amplitude + Correction Factors**
2. **The maximum field measured is 7.61dBm**
   Attenuated below the mean power = Power – Corrected Power
   { For example: 7.61 – (-74.77) = 82.38 dBc }
3. **Attenuation required = 43 + 10 log (5.771 x 10^{-3} W) = 20.61**

Chapter 6 Frequency Stability Tolerance Measurement

6.1 Rules and Specification Limits

2.1055, ANSI/ TIA/ EIA-603-1992, Paragraph 2.2.2 .

95.629(b)(2): The frequency tolerance of the transmitter shall be 0.005 percent (50 ppm).

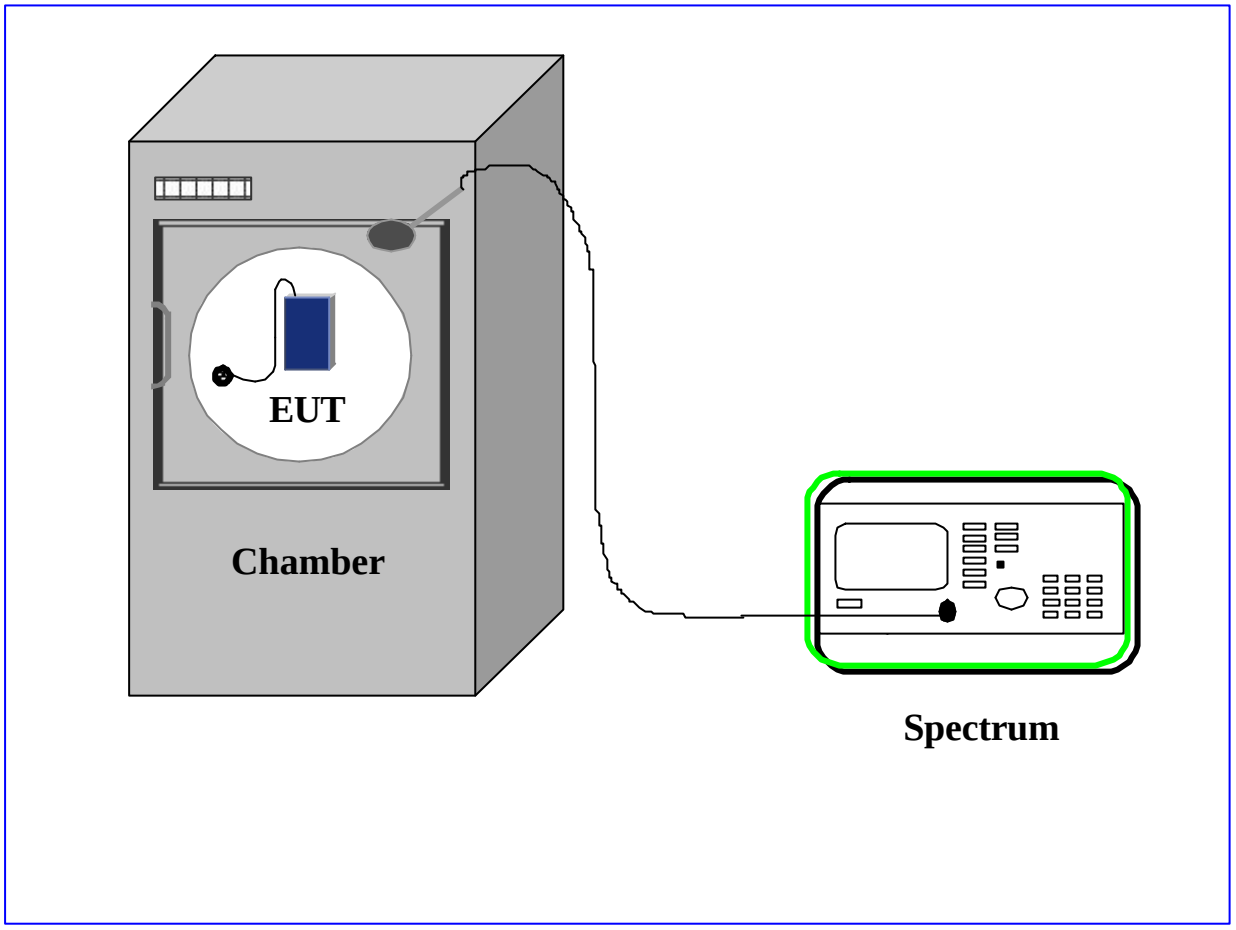
6.2 Measurement Condition & Setup with Temperature Variation

1. Place the EUT in the chamber, powered in its normal operation.
2. Set the temperature of the chamber -30 degree Centigrade. Allow the equipment to stabilize at that temperature.
3. Measured the carrier frequency using preamplifier and frequency counter.
4. Repeated procedures 1 to 3 from -20 to 50 degree Centigrade at internals of 10 degree.

6.3 List of Measurement Instruments with Temperature Variation List of test Instrument

Instrument Name	Model No.	Brand	Remark
Spectrum Analyzer	8591A	H P	1.8GHz
Temperature Chamber	THS-MV2	King Son	
Near field Probe	7405-901	EMCO	
Power Supply	GPR-6030	Good Will	
Auto Transformer	Powerstat	Supprior Elec. Co.	

6.4 Measurement Configuration of Temperature Variation Test



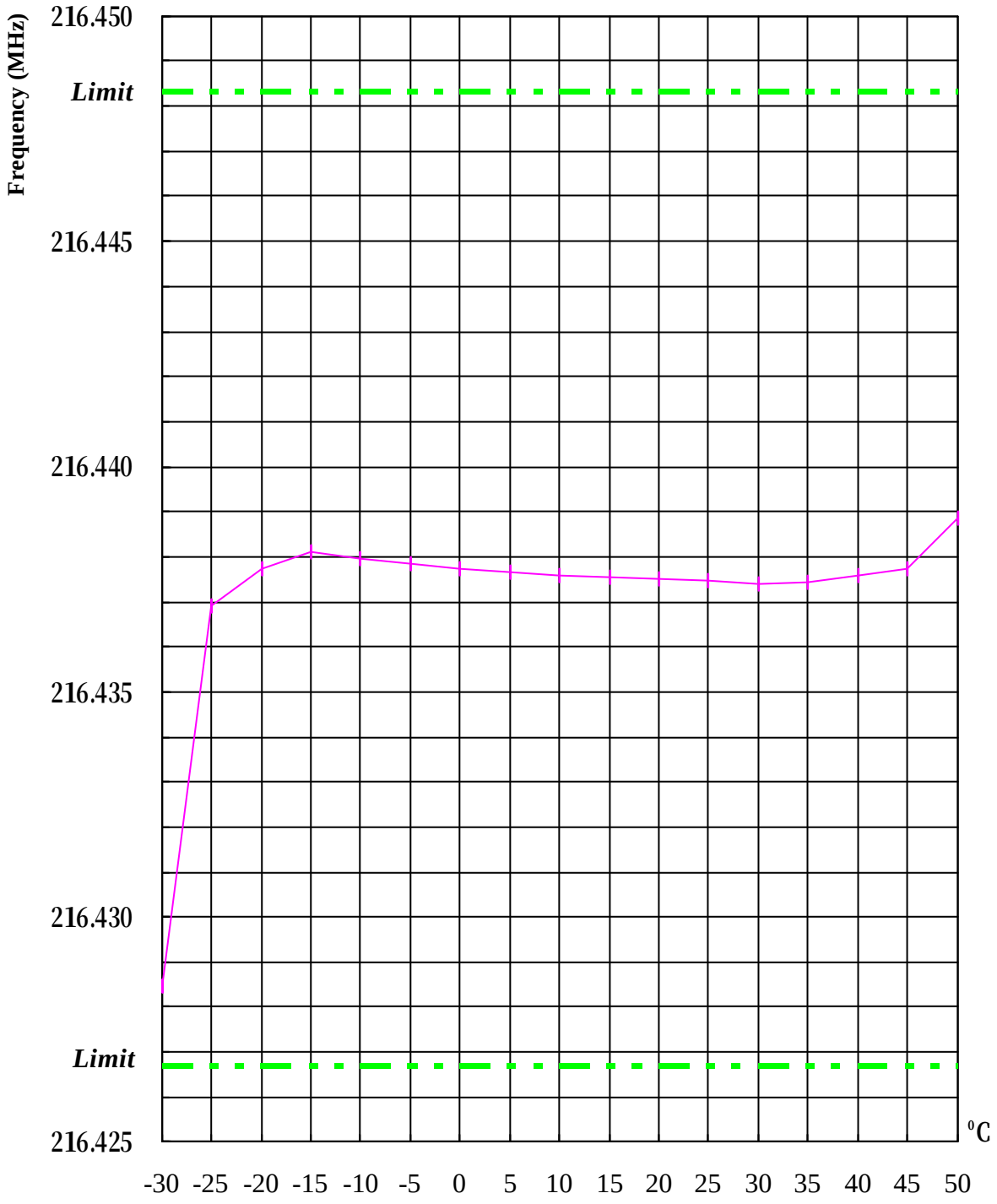
6.5 Measurement Result with Temperature Variation

A plot and table is presented which illustrates compliance with the rule where the center frequency is 216.4375 MHz.

Temperature Variation Table

Temperature (Centigrade)	***Frequency (MHz)***	***Tolerance (MHz)***
-30	216.42847	216.42668 To 216.44832
-25	216.43692	
-20	216.43773	
-15	216.43812	
-10	216.43796	
-5	216.43784	
0	216.43775	
5	216.43767	
10	216.43759	
15	216.43755	
20	216.43751	
25	216.43747	
30	216.43739	
35	216.43742	
40	216.43757	
45	216.43772	
50	216.43884	

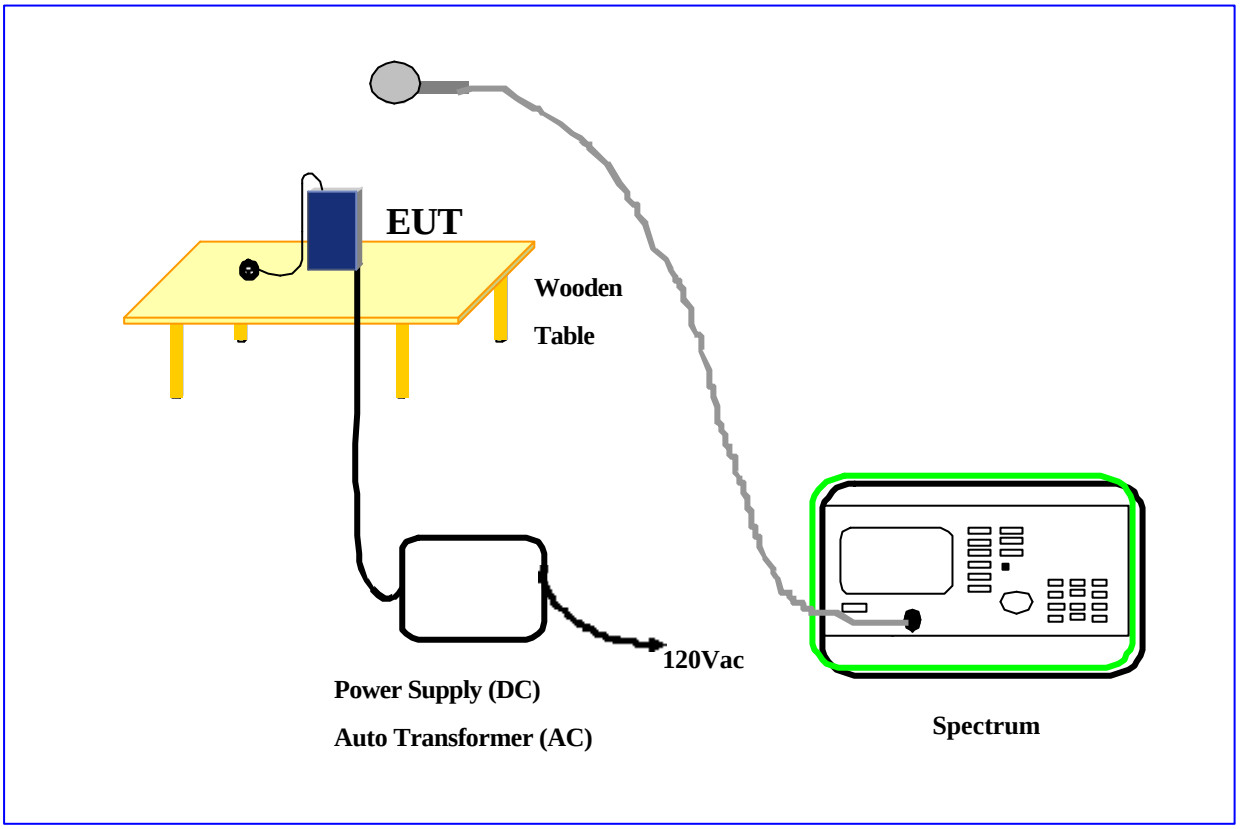
Chart 6.1 Temperatuer Variation Vs. Frequency



6.6 Measurement Condition & Setup with Voltage Variation

1. Attached the power line of the power supply to the battery position of the EUT.
2. Tuned the output power level to battery end point, 85 %, 100%, 115% of the normal operation power of EUT.
3. Recorded the frequency with a frequency counter.

6.7 Configuration of Voltage Variation Test



6.8 Measurement Result with Voltage Variation

Frequency Stability of Voltage Variation Measurement Table

Supply Voltage (Volt)	*Frequency (MHz)*	*Tolerance (MHz)*
1.275 (85%)	216.43749	216.42668 To 216.44832
1.500 (100%)	216.43747	
1.725 (115%)	216.43739	
Endpoint Voltage (Volt)		
0.72	216.42965	

Chart 6.2 Voltage Variation Vs. Frequency