FCC CFR47 PART 95 REQUIREMENT

CERTIFICATION REPORT

FOR

FAMILY RADIO SERVICE TRANSCEIVER

MODEL: ORB-R15F

FCC ID: PX4ORB-R15F

REPORT NUMBER: 01I0998-1

ISSUE DATE: NOVEMBER 26, 2001

Prepared for
ORBICLE CO., LTD.
3MA 201, SHIWA INDUSTRIAL COMPLEX #1374
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KOREA

Prepared by
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TEL: (408) 463-0885

LAB CODE:200065-0

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1. VERIFICATION OF COMPLIANCE

Inspection Institution: COMPLIANCE ENGINEERING SERVICES INC.
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MORGAN HILL, CA 95037, USA
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Applicant: ORBICLE CO., LTD
Manufacturer: ORBICLE CO., LTD.
Brand Name: ORBICLE
Model No/Name: ORB-R15F Serial No: OB0109-002 & OB0109-001

LAB CODE:200065-0

ITEM	TESTING ITEM	APPLIED SPECIFICATION	TESTING RESULTS	TESTING EQUIPMENT	REMARK
1	Channel Frequency	Section 95.627(a)	Complied	Note 1	
2	Type of Communication	Section 95.193	Complied	Note 1	
3	Frequency Toleration	Section 95.627(b)	Complied	Note 1	
4	Emission Type	Section 95.631(d)	Complied	Note 1	
5	Emission Bandwidth	Section 95.633(c)	Complied	Note 1	
6	Unwanted Emission	Section 95.635	Complied	Note 1	
7	Modulation Standards	Section 95.637(a)	Complied	Note 1	
8	Maximum Transmitter Power	Section 95.639(d)	Complied	Note 1	
9	Transmitter Antenna	Section 95.647	Complied	Note 1	
10	Power Capability	Section 95.649	Complied	Note 1	

Note 1: Please refer to each test section for detailed instrument list.

The above equipment was tested by Compliance Certification Services for compliance with the requirements set forth in the FCC PART 95 Subpart B FRS. The results of testing in this report apply to the product/system, which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties. **Warning** : This document reports conditions under which testing was conducted and results of tests performed. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification will constitute fraud and shall nullify the document.

Approved & Released For CCS By: Tested By:

STEVE CHENG
MANAGER OF EMC DEPARTMENT
COMPLIANCE CERTIFICATION SERVICES

KERWIN CORPUZ
ASSOCIATE EMC ENGINEER
COMPLIANCE RTIFICATION SERVICES

2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

a). Type of EUT: FRS Transceiver
b). Trade Name: N/A
c). Model No: ORB-R15F
d). FCC ID: PX4ORB-R15F
e). Working Frequency: 14 Channels within frequency band from 462.5625 ~ 467.7125 MHz.
f). Power Supply: 6 Vdc

2.2. MEASURED CHARACTERISTICS OF EUT

a). Communication Type: Voice/Tone only
b). Frequency Tolerance: 0.00017% (limit < 0.00025%)
c). Emission Type: F3E
d). Emission Bandwidth: 10.65 KHz (limit <12.5 KHz)
e). Unwanted Radiation:
1). At least 25 dB on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.
2). At least 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.
3). At least 43+10 $\log_{10}$(TP) dB on any frequency removed from the center of the authorized bandwidth by more than 250%.
f). Peak Frequency Deviation: 2.01 KHz (limit < ± 2.5 KHz)
g). Audio Frequency Response: 2.8KHz (limit < 3.125 KHz)
h). Maximum Transmitter Power: 0.193 W (limit < 0.5W)
i). Antenna Type: Fixed whip antenna solder to the EUT
j). Output power Modification: Fixed can't be change
k). Operating Frequency Range and Channels
Frequency Range: 462.5625 ~ 467.7125 MHz
Total 14 channels

CH 01---- 462.5625 MHz	CH08---- 467.5625 MHz
CH 02---- 462.5875 MHz	CH09---- 467.5875 MHz
CH 03---- 462.6125 MHz	CH10---- 467.6125 MHz
CH 04---- 462.6375 MHz	CH11---- 467.6375 MHz
CH 05---- 462.6625 MHz	CH12---- 467.6625 MHz
CH 06---- 462.6875 MHz	CH13---- 467.6875 MHz
CH 07---- 462.7125 MHz	CH14---- 467.7125 MHz

l). Effective distance: Nominal 1.86 miles, with 193mW power output.
m). Battery Endpoint: 3.85 Vdc

2.3. TEST METHODOLOGY

Both conducted and radiated testing were performed according to the procedures documented in chapter 13 of ANSI C63.4 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055 and 2.1057.

2.4. TEST FACILITY

The open area test sites and conducted measurement facilities used to collect the radiated data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

2.5. ACCREDITATION AND LISTING

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code:200065-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (reference no: 31040/SIT (1300B3) and 31040/SIT(1300F2))

2.6. MEASURING INSTRUMENT CALIBRATION

The measuring equipment which was utilized in performing the tests documented herein has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment which is traceable to recognized national standards.

3. REQUIREMENTS OF PROVISION

3.1. GENERAL TECHNICAL REQUIMENTS

a). Section 95.193 – Communication Type shall be Voice/Tone only
b). Section 95.627(b) – Frequency Tolerance less than 0.00025%
c). Section 95.631 – Emission Type shall be F3E
d). Section 95.633 – Emission Bandwidth shall be less than 12.5 KHz
e). Section 95.635 – Unwanted Radiation

According to CFR 47 section 95.635(b), the power of each unwanted emission shall be less than Transmitted Power as specified below:

1). At least 25 dB on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.

2). At least 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.

3). At least $43+10 \log_{10}(TP)$ dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

f). Section 95.637 – Peak Frequency Deviation less than ± 2.5 KHz, and Audio Frequency Response less than 3.125 KHz
g). Section 95.639 – Maximum Transmitter Power less than 0.5W
h). Section 95.647 – Antenna shall be a dedicate type
i). Section 95.649 – Output power can't be change

3.2. LABELING REQUIREMENT

Each equipment for which a type acceptance application is filed on or after May 1, 1981 shall bear an identification plate or label pursuant to section 2.925 (Identification of equipment) and section 2.926 (FCC Identifier).

3.3. USER INFORMATION

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for the compliance could void the user's authority to operate the equipment.

4. OUTPUT POWER MEASUREMENT

4.1. PROVISION APPLICABLE

According to section 95.639(d), the output power shall not exceed 500 milliwatts (ERP).

4.2. MEASUREMENT PROCEDURE

1). On a test site, the EUT shall be placed on a turntable, and in the position closest to the normal use as declared by the user.

2). The test antenna shall be oriented initially for vertical polarization located 3m from the EUT to correspond to the frequency of the transmitter.

3). The output of the test antenna shall be connected to the measuring receiver and either a peak or quasi-peak detector was used for the measurement as indicated on the report. The detector selection is based on how close the emission level was approaching the limit.

4). The transmitter shall be switched ON, if possible, without the modulation and the measurement receiver shall be tuned to the frequency of the transmitter under test.

5). The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.

6). The transmitter shall than be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.

7). The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.

8). The maximum signal level detected by the measuring receiver shall be noted.

9). The transmitter shall be replaced by a tuned dipole (substitution antenna).

10). The substitution antenna shall be oriented for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter.

11). The substitution antenna shall be connected to a calibrated signal generator.

12). If necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.

13). The test antenna shall be raised and lowered through the specified range of the height to ensure that the maximum signal is received.

14). The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuation setting of the measuring receiver.

15). The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.

16). The measurement shall be repeated with the test antenna and the substitution antenna oriented for horizontal polarization.

17). The measure of the effective radiated power is the larger of the two levels recorded, at the input to the substitution antenna, corrected for the gain of the substitution antenna if necessary.

Detector Function Setting of Test Receiver

Frequency Range (MHz)	Detector Function	Resolution Bandwidth	Video Bandwidth
30 to 1000	Quasi Peak/Peak	120 KHz/100 KHz	120 KHz/100 KHz
Above 1000	Average/ Peak	1 MHz	1 MHz

TEST SETUP:

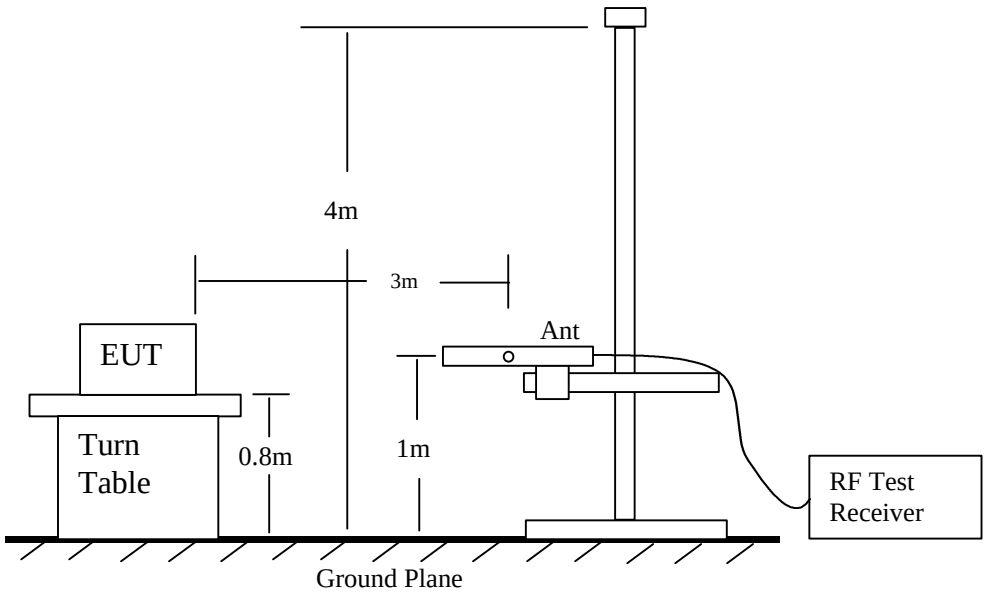


Fig 1: Radiated Emission Measurement 30 to 1000 MHz

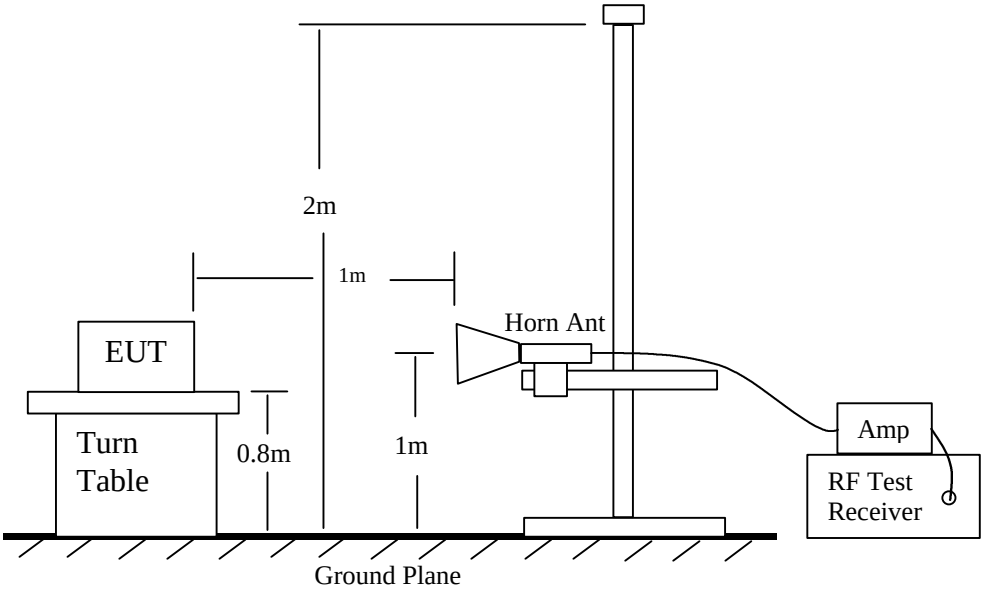


Fig 2: Radiated Emission Above 1000 MHz

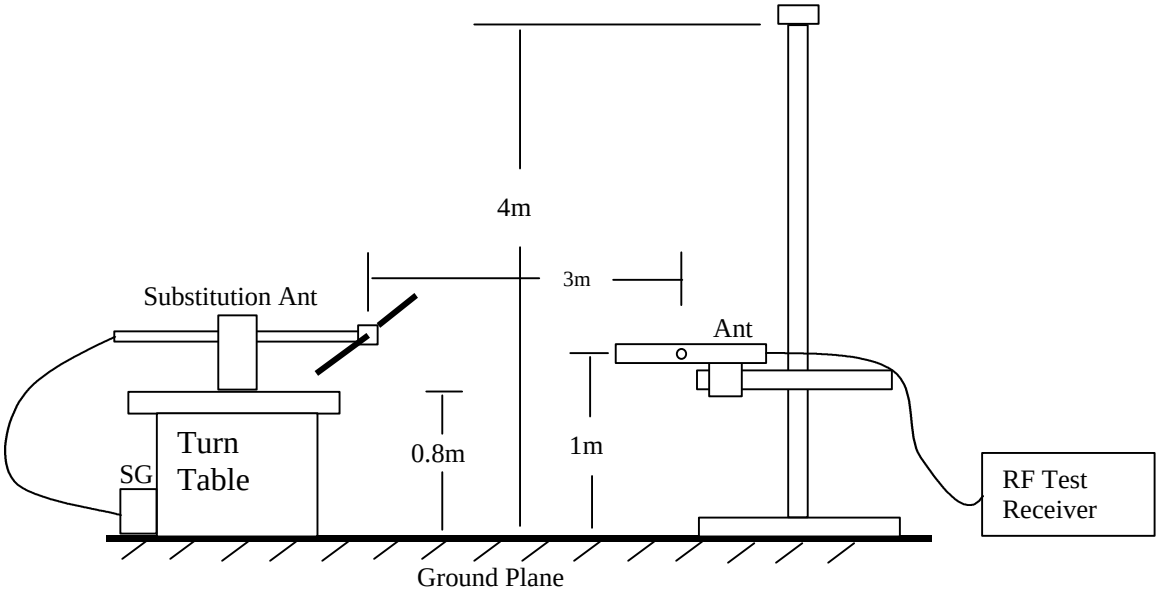
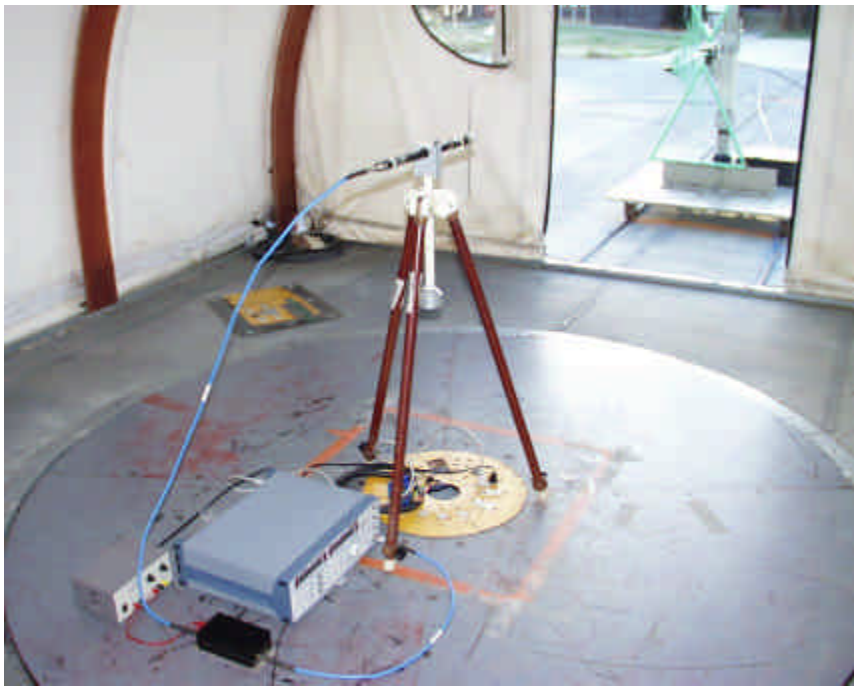


Fig 3: Radiated Emission – Substitution Method setup

Radiated Emission Setup 30 – 1000 MHz



Radiated Emission Substitution Setup 30 – 1000 MHz

4.3. OUTPUT POWER TEST EQUIPMENT

EQUIPMENT	MANUFACTURE	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Spectrum Analyzer	HP	8566B	2140A01296	05/04/02
RF Preselector	HP	85685A	2817A00756	05/04/02
Bilog Antenna	CHASE EMC LTD	CBL6112	2049	18/02/02
Amplifier	MINI CIRCUIT	ZHL-42W-SMA	D082301-1	N/A
Dipole Antenna	COMPLIANCE DESIGN	ROBERTS	116	05/05/02
Signal Generator	ROHDE&SCHWARZ	SMY-01	DE12311	08/02/02

4.4. MEASUREMENT RESULT

Compliance Certification Services

Radiated Power (ERP) 10/23/01
95.639(d) A-Site (3 meter)
Kerwin Corpuz

ORBICLE CO., LTD.
FRS DEVICE (M/N: ORB-R15F)

***** *FUNDAMENTAL* *****

Channel	frequency (MHz)	SA reading (dBuV)	SG reading (dBm)	CL (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	462.5625	102.9	23.3	0.54	22.76	27	-4.24
2	462.5875	101	21.4	0.54	20.86	27	-6.14
3	462.6125	101	21.4	0.54	20.86	27	-6.14
4	462.6375	101.3	21.7	0.54	21.16	27	-5.84
5	462.6625	101.4	21.8	0.54	21.26	27	-5.74
6	462.6875	101.4	21.8	0.54	21.26	27	-5.74
7	462.7125	101.3	21.7	0.54	21.16	27	-5.84
8	467.5625	103	23.4	0.54	22.86	27	-4.14
9	467.5875	101.6	22	0.54	21.46	27	-5.54
10	467.6125	101.4	21.8	0.54	21.26	27	-5.74
11	467.6375	100.9	21.3	0.54	20.76	27	-6.24
12	467.6625	100.7	21.1	0.54	20.56	27	-6.44
13	467.6875	100.6	21	0.54	20.46	27	-6.54
14	467.7125	100.8	21.2	0.54	20.66	27	-6.34

NOTE: Spot Check X, Y and Z AXIS of EUT. Worse case position X axis.
SA: Spectrum Analyzer
SG: Signal Generator
CL: SMA cable loss (6ft)
EPR = SG reading with Amplifier - CL
Margin = EPR - Limit

Maximum Output Power (ERP): 22.86 dBm = 0.193 W

5. MODULATION CHARACTERISTICS

5.1. PROVISIONS APPLICABLE

According to CFR 47 section 2.1047 (a), for Voice Modulated Communication Equipment, the frequency response of the audio modulation circuit over a range of 100 to 5000 Hz shall be measured.

According to CFR 47 section 95.637 (a), a FRS unit that transmits emission type F3E must not exceed a peak frequency deviation of ± 2.5KHz, and the audio frequency response shall not exceed 3.125 KHz.

5.2. MEASUREMENT METHOD

5.2.1. Modulation Limit

1). Configure the EUT as shown in figure 4, adjust the audio input for 60% of rated system deviation at 1 KHz using this level as a reference (0 dB) and vary the input level from -20 to +20 dB. Record the frequency deviation obtained as a function of the input level.

2). Repeat step 1 with input frequency changing to 300, 1004, and 2500 Hz in sequence.

5.2.2. Audio Frequency Response

1). Configure the EUT as shown in figure 4.

2). Adjust the audio input for 20% of rated system deviation at 1 KHz using this level as a reference (0 dB).

3). Vary the Audio frequency from 100 Hz to 10 KHz and record the frequency deviation.

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

TEST SETUP:

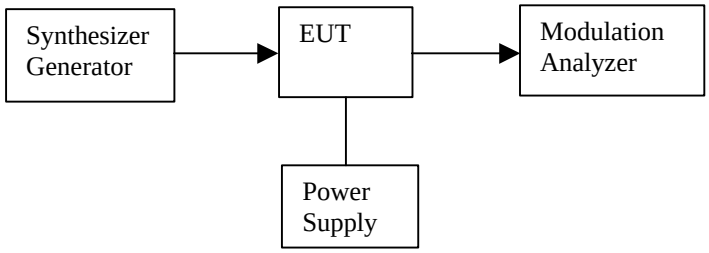
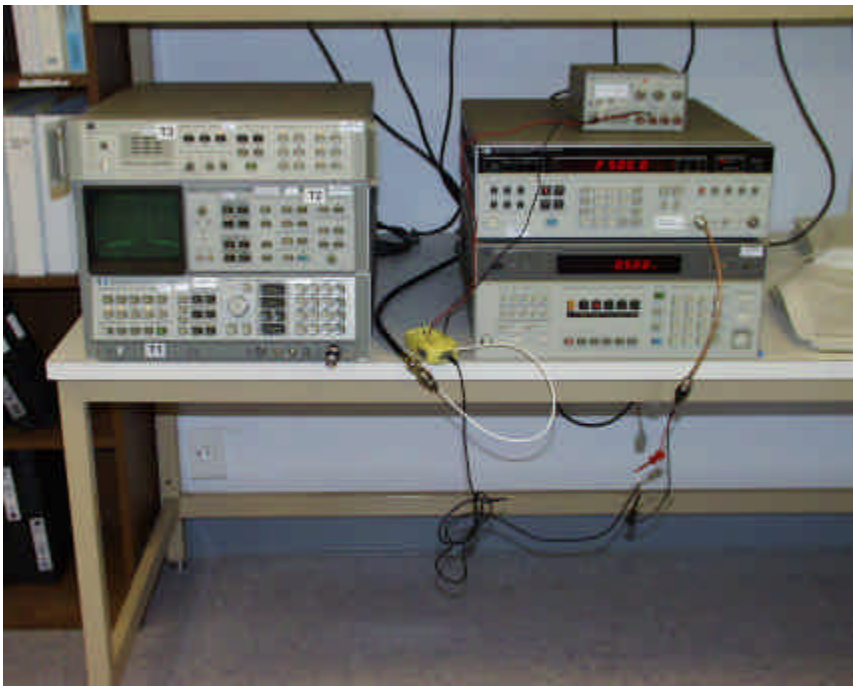


Figure 4: Modulation characteristic measurement configuration



Modulation Characteristic Setup

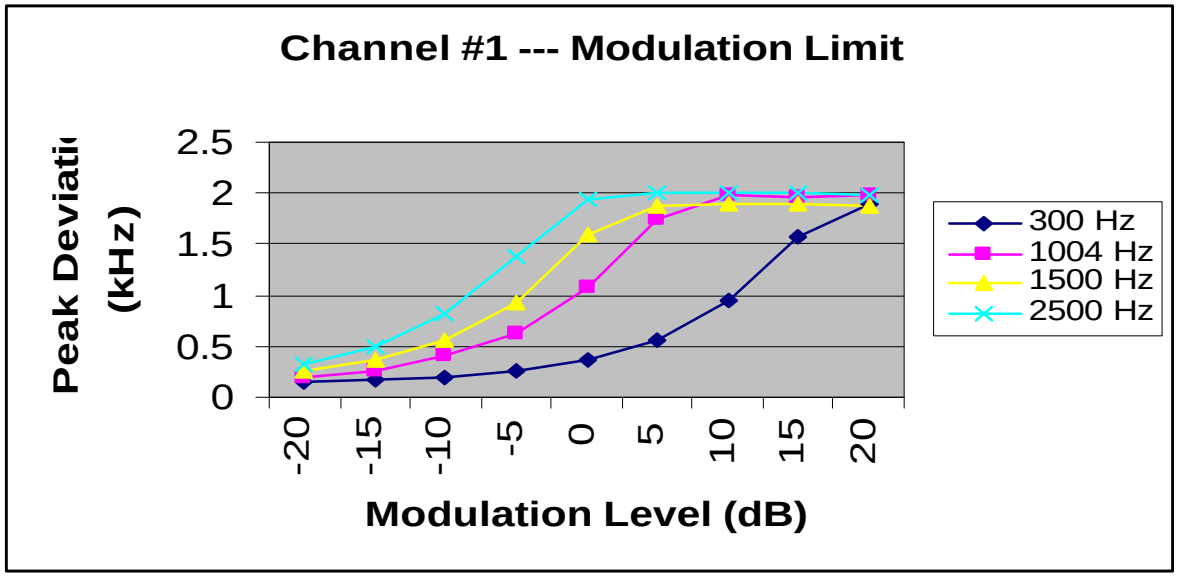
5.3. MEASUREMENT INSTRUMENT

EQUIPMENT	MANUFACTURE	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Modulation Analyzer	HP	8901B	3438A05272	05/31/02
Synthesizer Generator	HP	3325A	2652A24749	N/A
Power Supply	HP	6235A	2450A-08312	N/A

5.4. MEASUREMENT RESULT

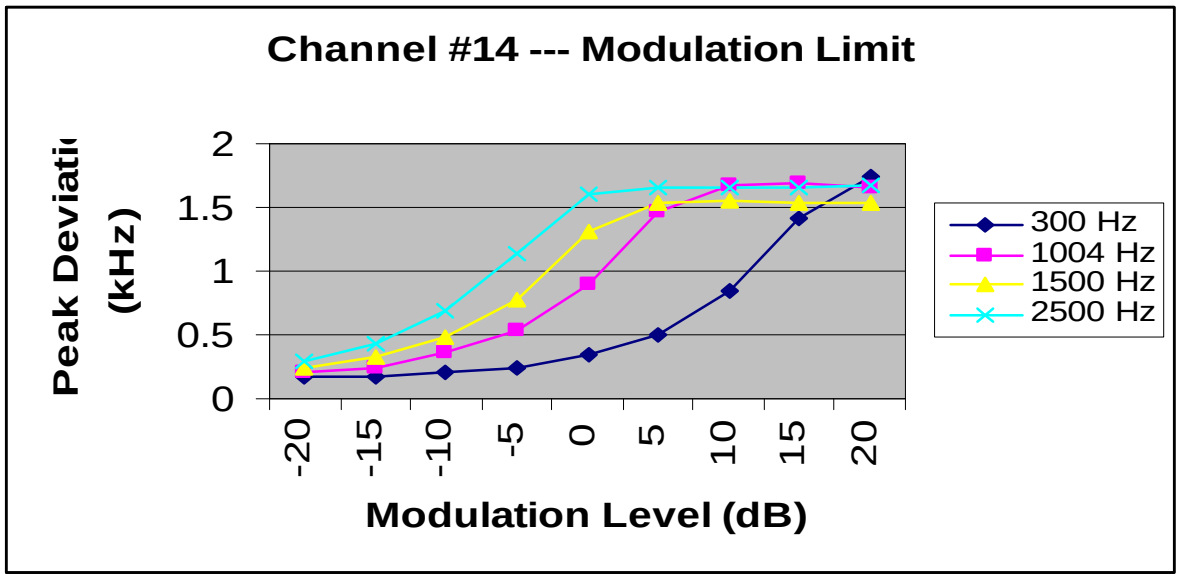
a). Modulation Limit: Channel #1 – 462.5625 MHz

Modulation Level (dB)	Peak Freq. Deviation At 300 Hz (KHz)	Peak Freq. Deviation At 1004 Hz (KHz)	Peak Freq. Deviation At 1500 Hz (KHz)	Peak Freq. Deviation At 2500 Hz (KHz)
-20	0.16	0.20	0.25	0.32
-15	0.17	0.25	0.36	0.49
-10	0.20	0.40	0.56	0.81
-5	0.26	0.63	0.92	1.37
0	0.37	1.07	1.60	1.94
+5	0.57	1.74	1.88	2.01
+10	0.95	1.98	1.89	2.01
+15	1.57	1.97	1.89	2.00
+20	1.90	1.98	1.88	1.99



b). Modulation Limit: Channel #14 – 467.7125 MHz

Modulation Level (dB)	Peak Freq. Deviation At 300 Hz (KHz)	Peak Freq. Deviation At 1004 Hz (KHz)	Peak Freq. Deviation At 1500 Hz (KHz)	Peak Freq. Deviation At 2500 Hz (KHz)
-20	0.17	0.20	0.24	0.30
-15	0.18	0.24	0.32	0.43
-10	0.20	0.36	0.48	0.69
-5	0.24	0.54	0.77	1.14
0	0.34	0.89	1.31	1.61
+5	0.50	1.46	1.54	1.66
+10	0.85	1.67	1.55	1.66
+15	1.42	1.69	1.53	1.66
+20	1.74	1.66	1.54	1.67

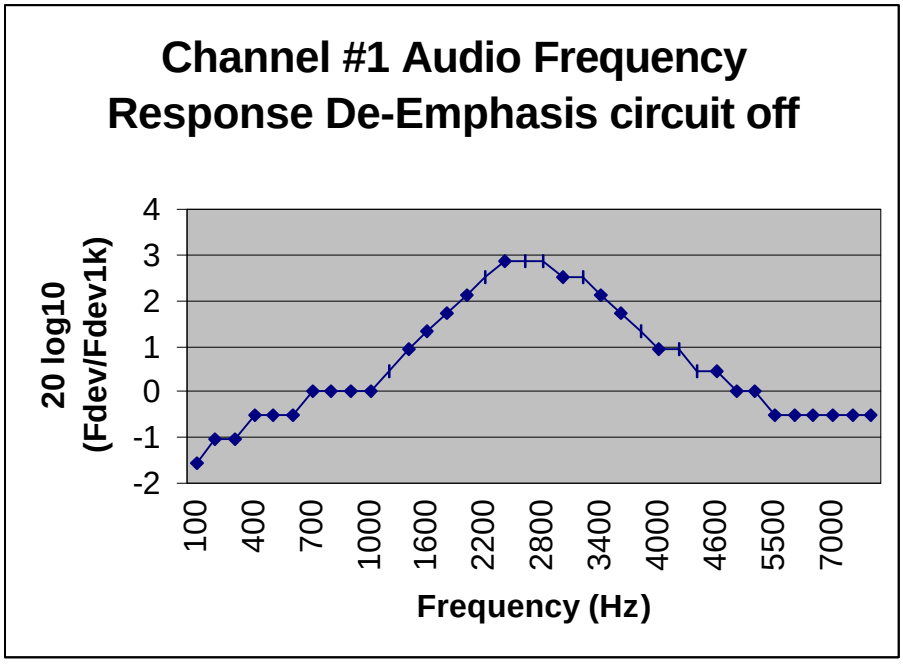


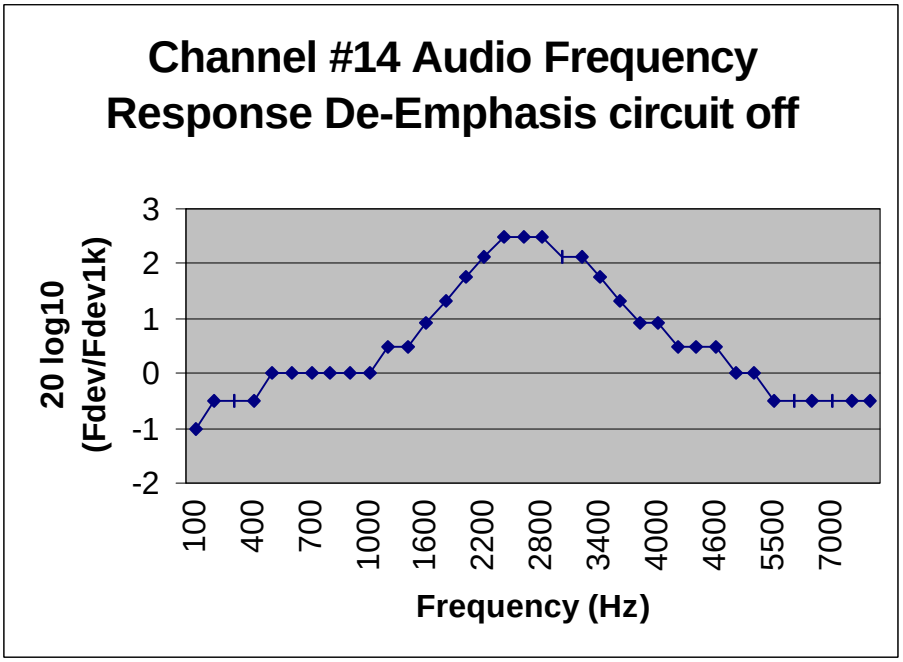
c). Audio Frequency Response: Channel #1 – 462.5625 MHz

Frequency (Hz)	Deviation (KHz)
100	0.15
200	0.16
300	0.16
400	0.17
500	0.17
600	0.17
700	0.18
800	0.18
900	0.18
1000	0.18
1200	0.19
1400	0.20
1600	0.21
1800	0.22
2000	0.23
2200	0.24
2400	0.25
2600	0.25
2800	0.25
3000	0.24
3200	0.24
3400	0.23
3600	0.22
3800	0.21
4000	0.20
4200	0.20
4400	0.19
4600	0.19
4800	0.18
5000	0.18
5500	0.17
6000	0.17
6500	0.17
7000	0.17
8500	0.17
10000	0.17

d). Audio Frequency Response: Channel #14 – 467.7125 MHz

Frequency (Hz)	Deviation (KHz)
100	0.16
200	0.17
300	0.17
400	0.17
500	0.18
600	0.18
700	0.18
800	0.18
900	0.18
1000	0.18
1200	0.19
1400	0.19
1600	0.20
1800	0.21
2000	0.22
2200	0.23
2400	0.24
2600	0.24
2800	0.24
3000	0.23
3200	0.23
3400	0.22
3600	0.21
3800	0.20
4000	0.20
4200	0.19
4400	0.19
4600	0.19
4800	0.18
5000	0.18
5500	0.17
6000	0.17
6500	0.17
7000	0.17
8500	0.17
10000	0.17





6. EMISSION BANDWIDTH

6.1. PROVISIONS APPLICABLE

According to CFR 47 section 95.633(3), the authorized bandwidth for emission type FRS unit is 12.5 KHz.

6.2. MEASUREMENT METHOD

a). Check the calibration of the measurement instrument using either an internal calibrator or a known signal from an external generator.
b). Set-up the test equipments as shown in the following Figure (5).

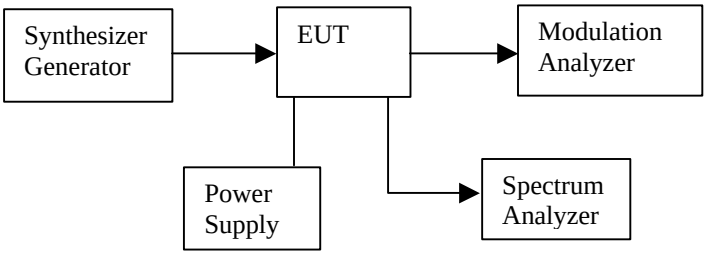
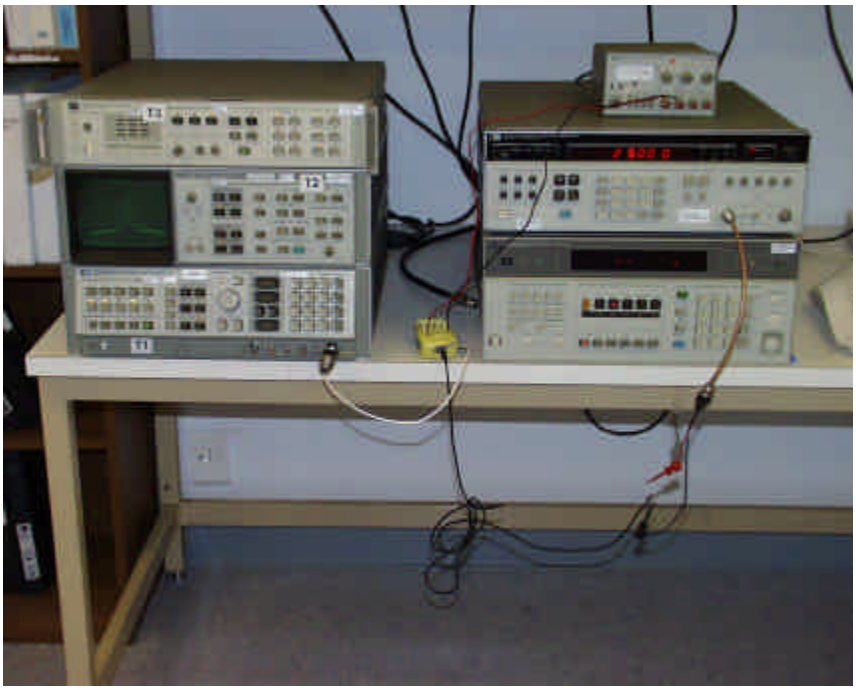


Figure 5: Emission Bandwidth measurement configuration



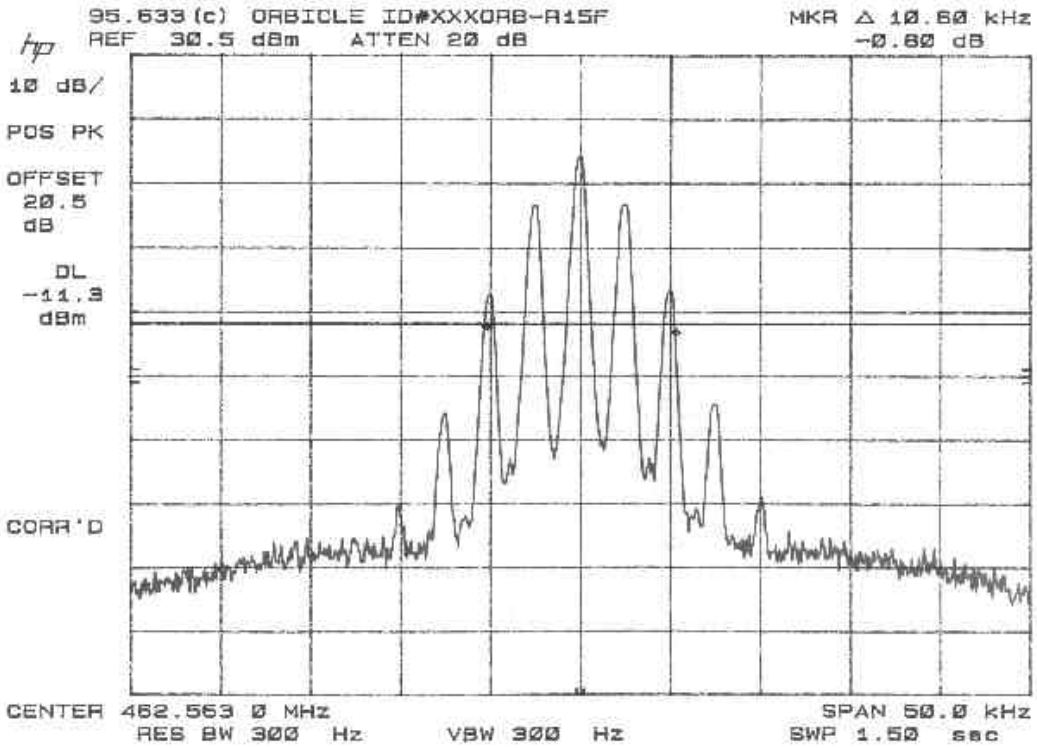
Emission Mask / Occupied Bandwidth Setup

c). Set the level of audio signal generator to obtain 16 dB greater than required for the rated 50% modulation.
d). The occupied bandwidth is measured with the spectrum analyzer set at 5 KHz/div scan and 10 dB/div.

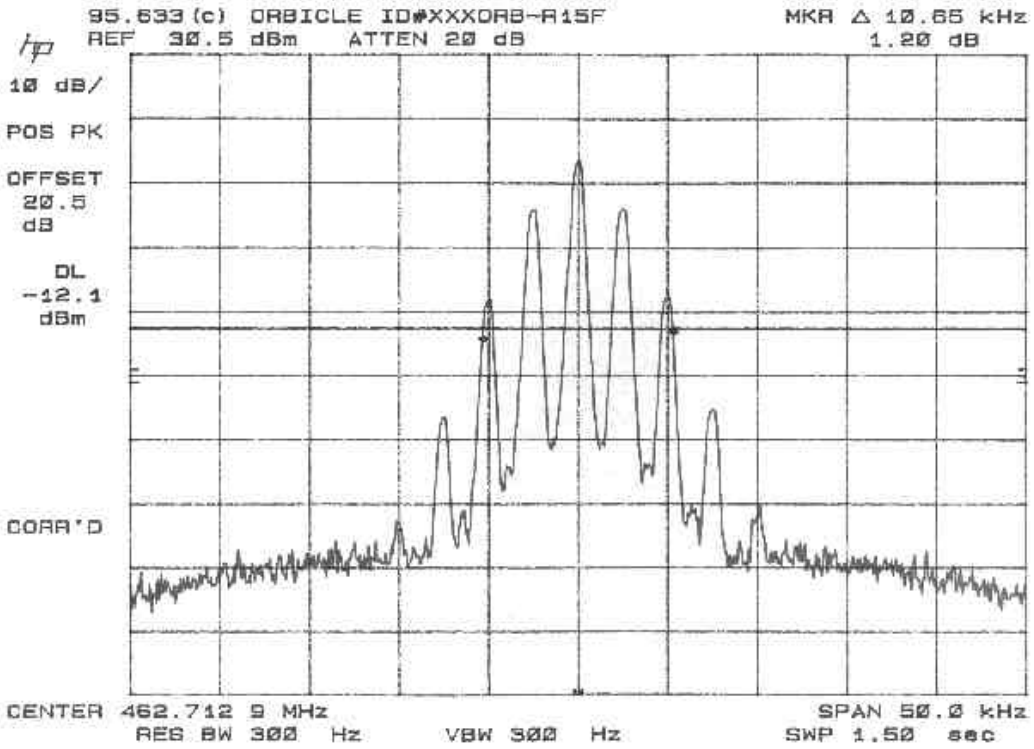
6.3. MEASUREMENT INSTRUMENT

EQUIPMENT	MANUFACTURE	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Spectrum Analyzer	HP	8566B	2140A01296	05/04/02
Modulation Analyzer	HP	8901B	3438A05272	05/31/02
Synthesizer Generator	HP	3325A	2652A24749	N/A
Power Supply	HP	6235A	2450A-08312	N/A

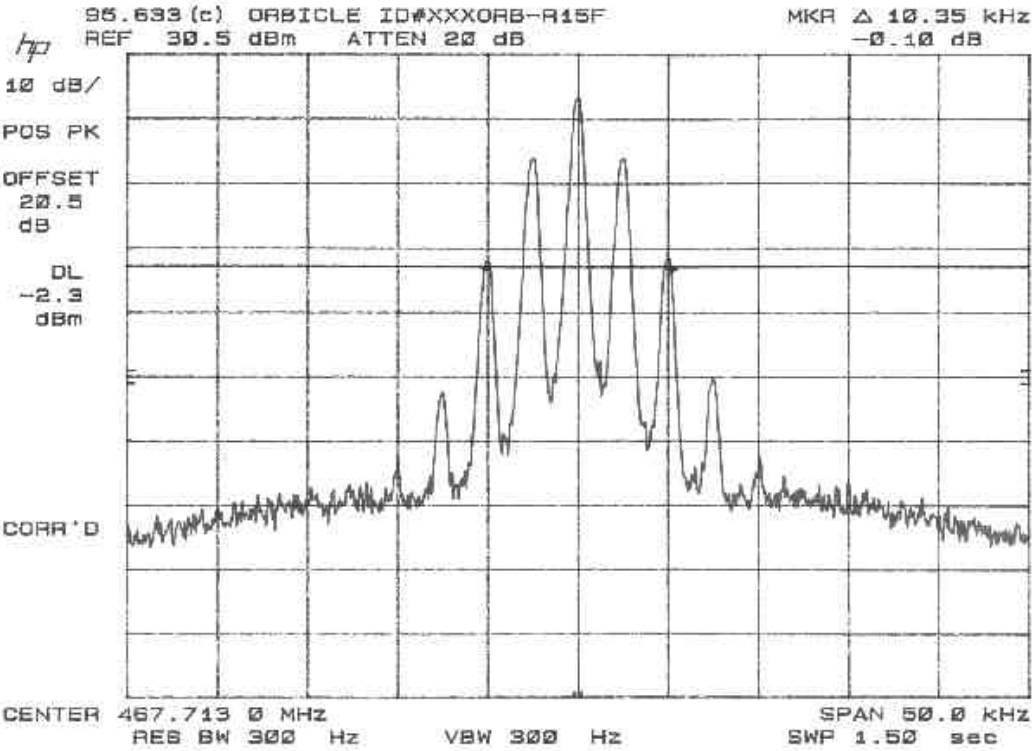
6.4. MEASUREMENT RESULT



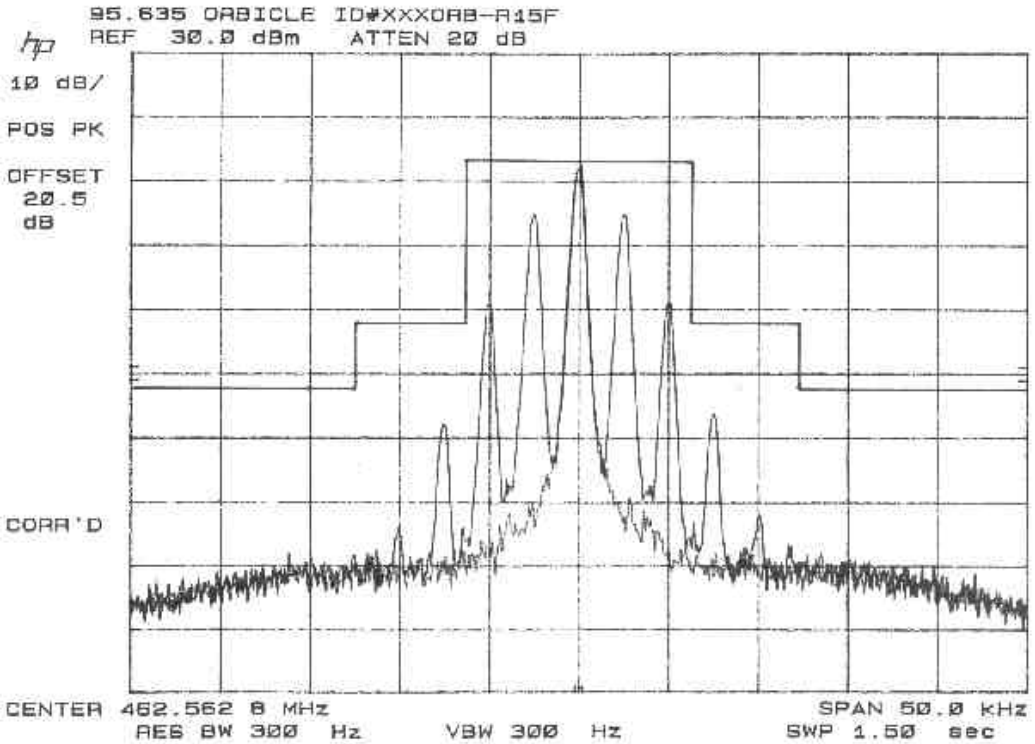
CHANNEL 1 OCCUPIED BANDWIDTH



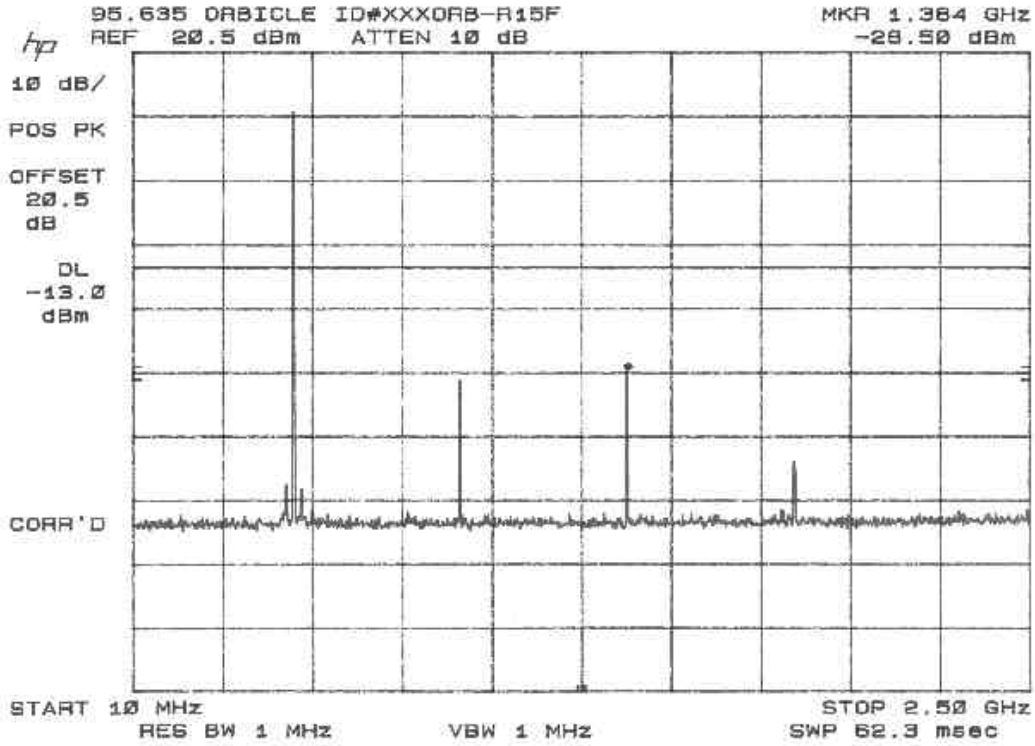
CHANNEL 7 OCCUPIED BANDWIDTH



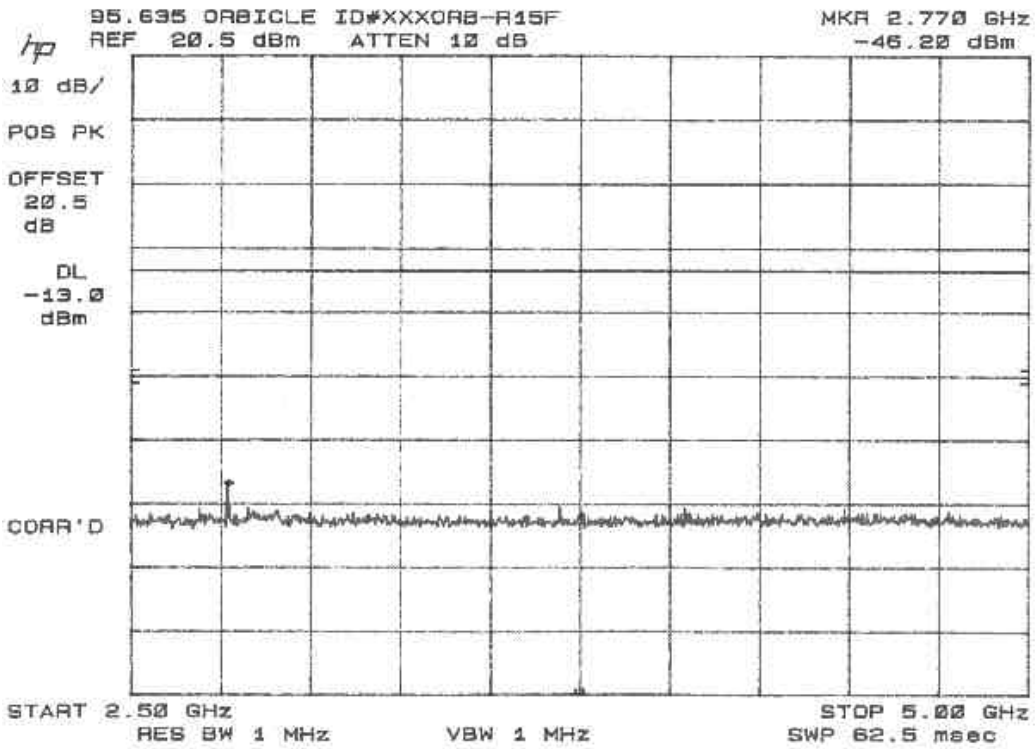
CHANNEL 14 OCCUPIED BANDWIDTH



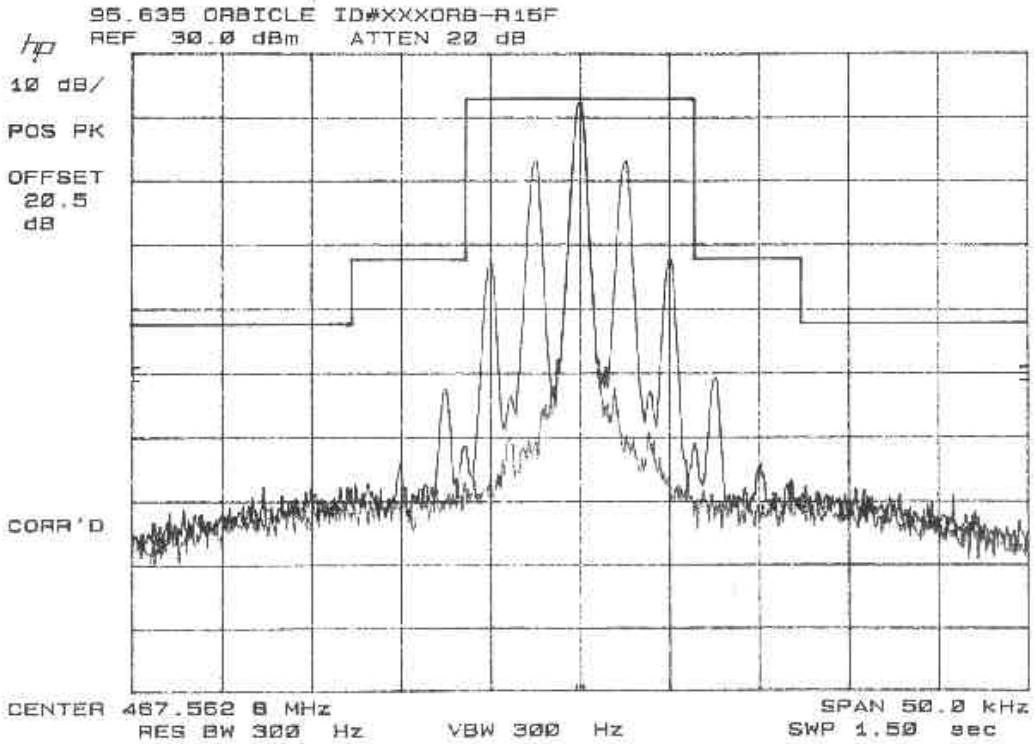
CHANNEL 1 EMISSION MASK



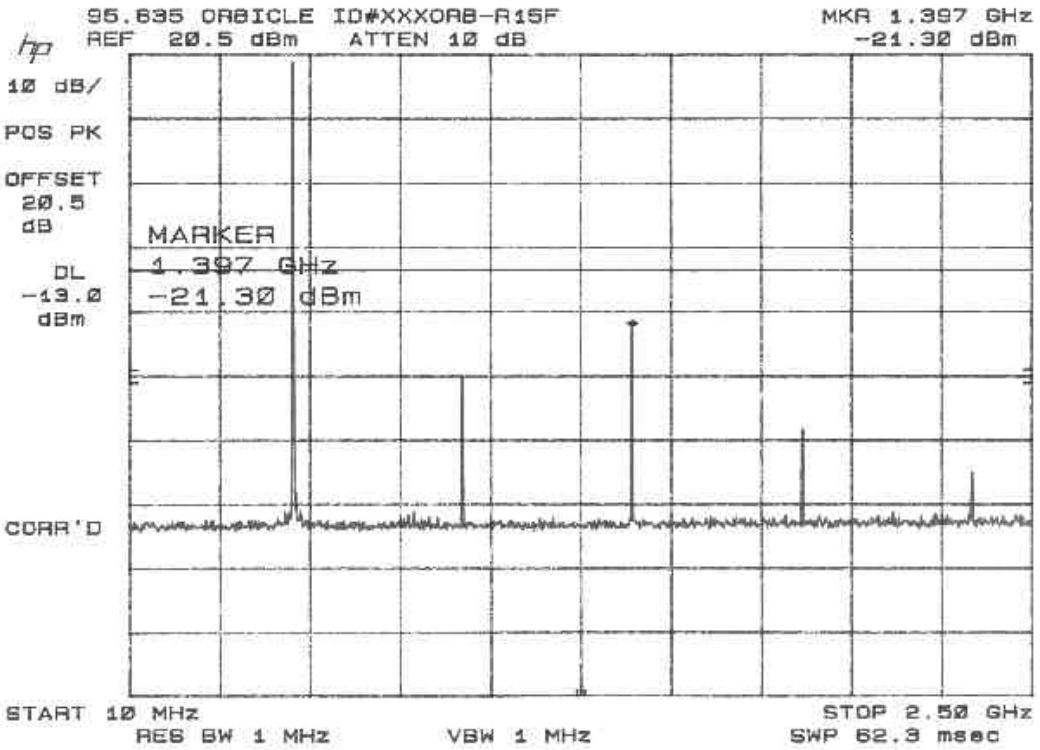
CHANNEL 1 OUT OF BAND 10 – 2500 MHz



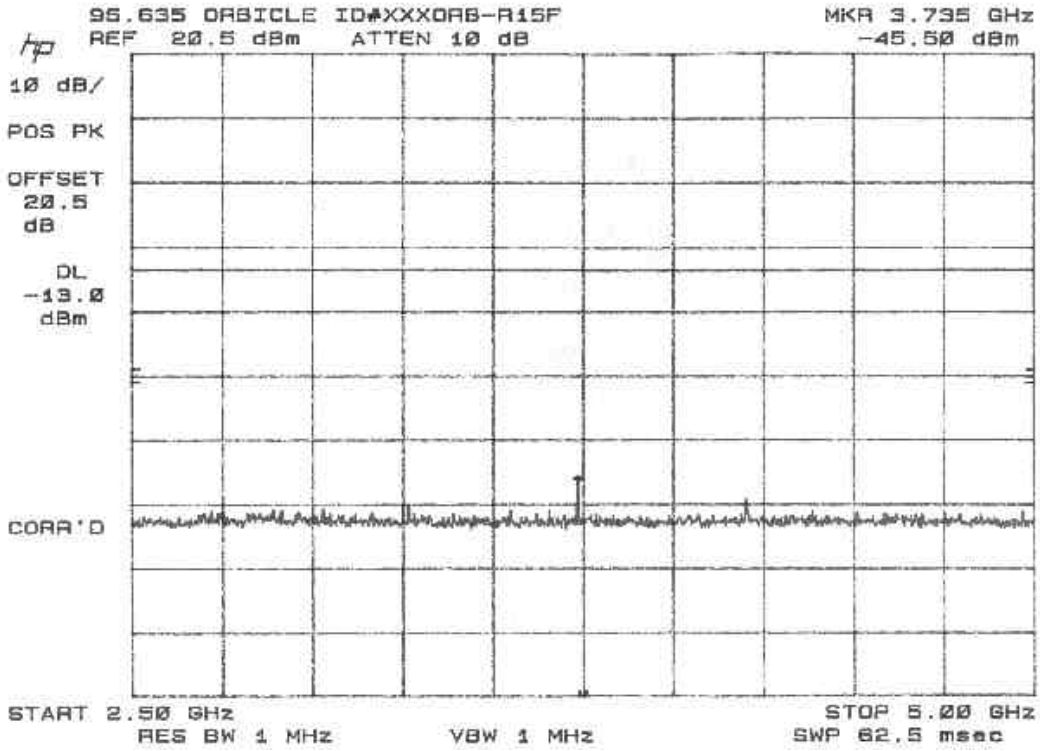
CHANNEL 1 OUT OF BAND 2.5 – 5 GHz



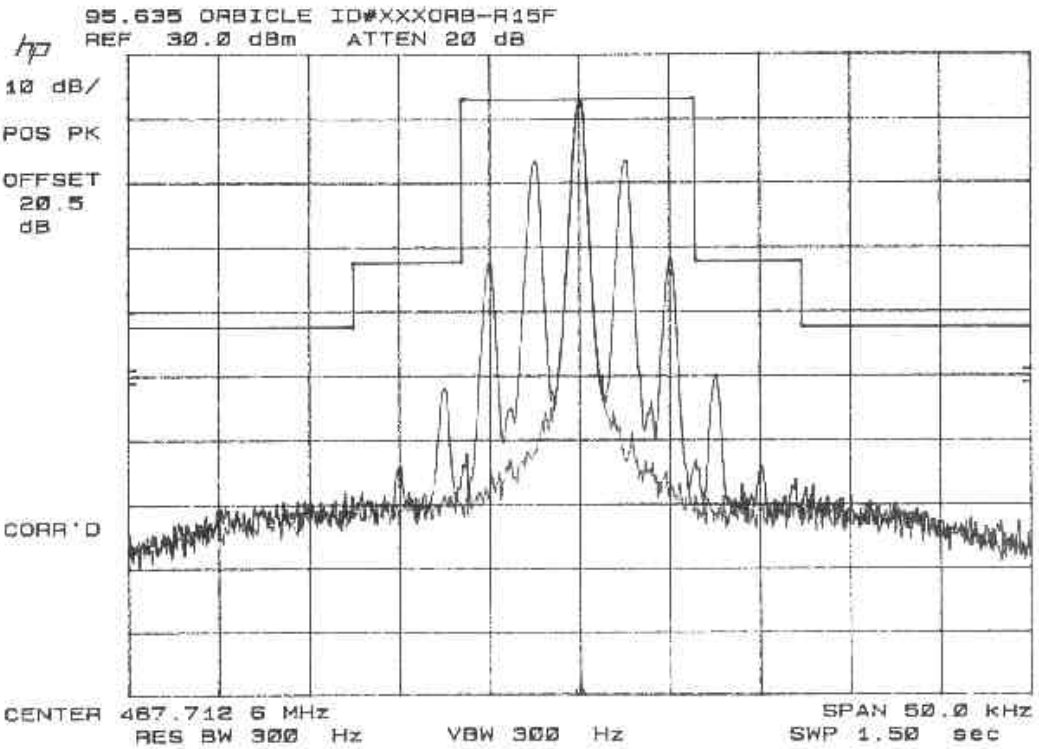
CHANNEL 8 EMISSION MASK



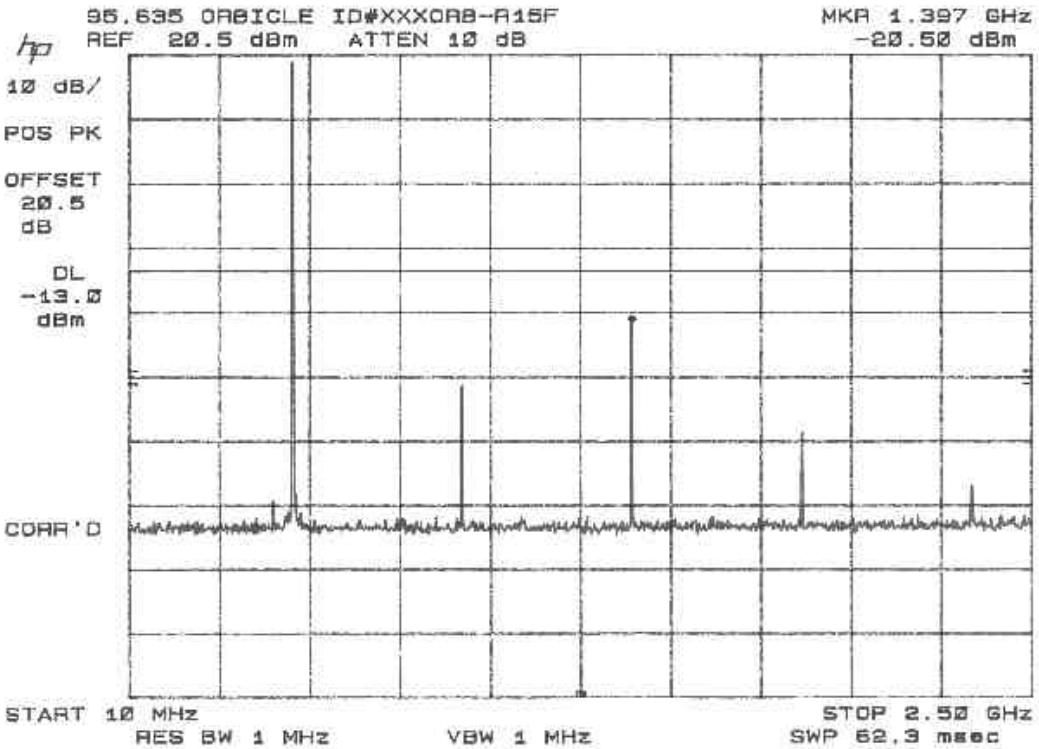
CHANNEL 8 OUT OF BAND 10 – 2500 MHz



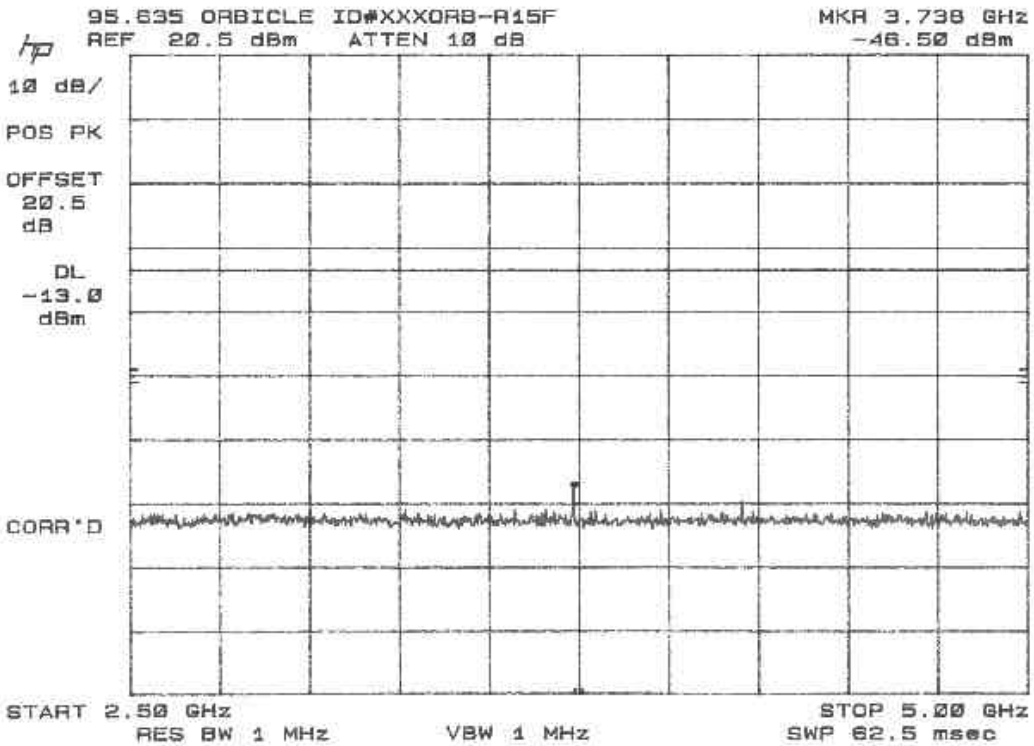
CHANNEL 8 OUT OF BAND 2.5 – 5 GHz



CHANNEL 14 EMISSION MASK



CHANNEL 14 OUT OF BAND 10 – 2500 MHz



CHANNEL 14 OUT OF BAND 2.5 – 5 GHz

7. FIELD STRENTH OF SPURIOUS EMISSION

7.1. PROVISIONS APPLICABLE

According to CFR47 section 2.1053(a), Measurement shall be made to detect spurious emission that may be radiated directly from the cabinet, control circuits, power leads or intermediate circuit element under normal condition of installation and operation. Information submitted shall include the relative radiated power of spurious emission with reference to the rated power output of the transmitter,

According to CFR 47 section 95.635(b), the power of each unwanted emission shall be less than Transmitted Power as specified below:
1). At least 25 dB on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.
2). At least 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.
3). At least $43+10 \log_{10}(TP)$ dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

7.2. MEASUREMENT PROCEDURE

--- For Frequency Range From 30 to 1000 MHz ---

1). On a test site, the EUT shall be placed on a turntable, and in the position closest to the normal use as declared by the user.

2). The test antenna shall be oriented initially for vertical polarization located 3m from the EUT to correspond to the frequency of the transmitter.

3). The output of the test antenna shall be connected to the measuring receiver and either a peak or quasi-peak detector was used for the measurement as indicated on the report. The detector selection is based on how close the emission level was approaching the limit.

4). The transmitter shall be switched on, if possible, without the modulation and the measurement receiver shall be tuned to the frequency of the transmitter under test.

5). The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.

6). The transmitter shall than be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.

7). The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.

8). The maximum signal level detected by the measuring receiver shall be noted.

9). The measurement shall be repeated with the test antenna set to horizontal polarization.

--- For Frequency Above 1000 MHz ---

10). Repeat procedures 1 to 9 with a proper Antenna (i.e. Horn antenna for 1 to 26 GHz)

11). After down with step 10. Replace the transmitter with a proper Antenna (substitution antenna).

12). The substitution antenna shall be oriented for vertical polarization and, if necessary, the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter.

13). The substitution antenna shall be connected to a calibrated signal generator.

14). If necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.

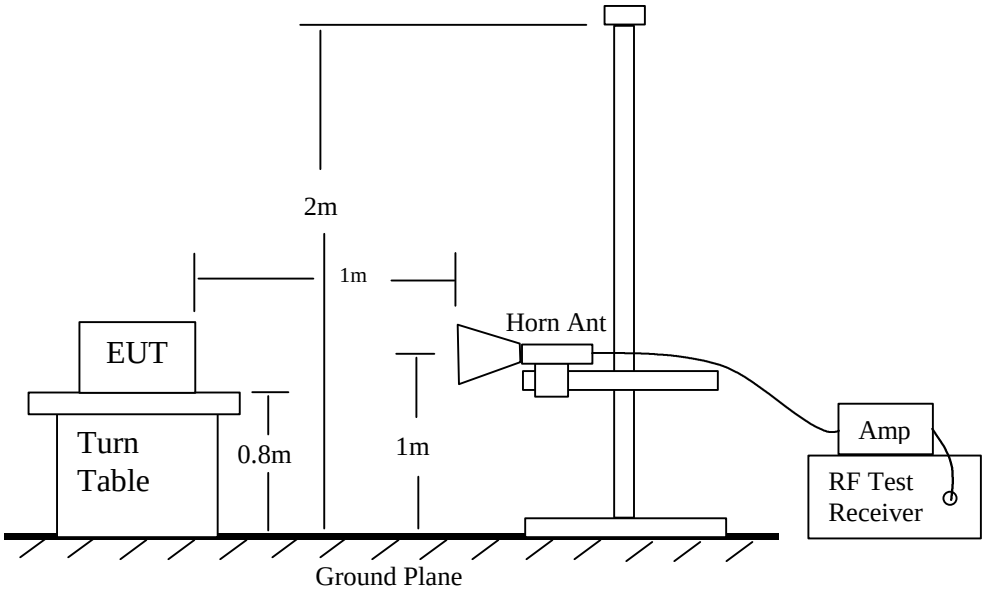
15). The test antenna shall be raised and lowered through the specified range of the height to ensure that the maximum signal is received.

16). The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the transmitter radiated power was measured in step 10, corrected for the change of input attenuation setting of the measuring receiver.

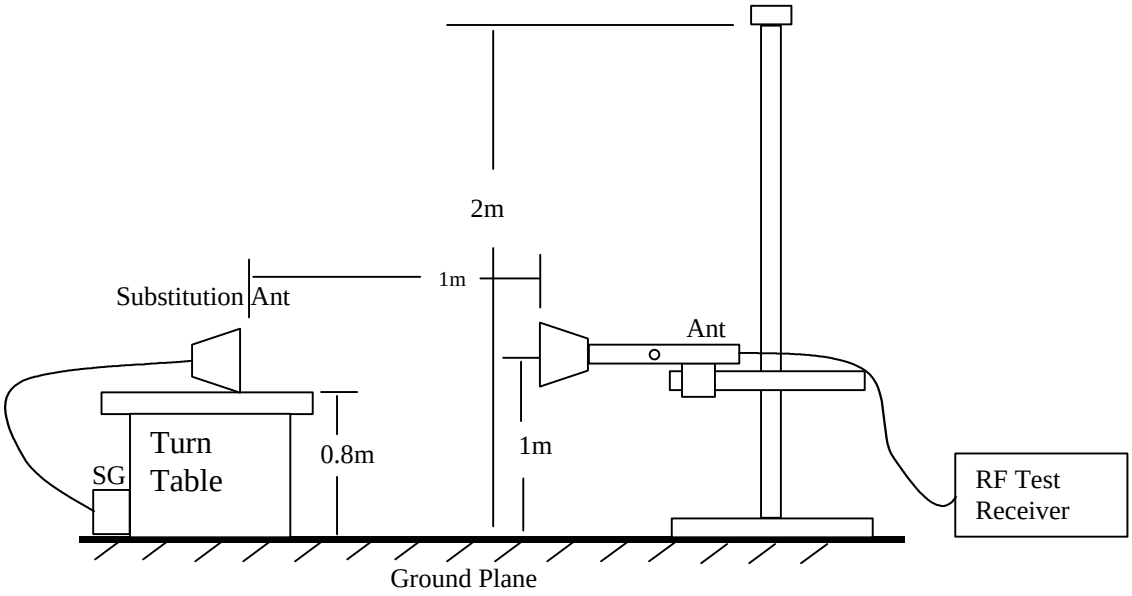
17). The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.

18). The measurement shall be repeated with the test antenna and the substitution antenna oriented for horizontal polarization.

TEST SETUP:



Radiated Emission Above 1000 MHz



Radiated Emission – Substitution Method setup

Radiated Emission above 1 GHz measurement setup

Above 1 GHz Substitution Method Setup

7.3. MEASUREMENT INSTRUMENT

EQUIPMENT	MANUFACTURE	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Spectrum Analyzer	HP	8566B	2140A01296	05/04/02
Amplifier	MITEQ	NSP2600-44	646456	04/12/02
Horn Antenna	EMCO	3115	9001-3245	06/20/02
Horn Antenna	EMCO	3115	2238	06/20/02
Signal Generator	HP	83732B	US34490599	03/21/02

Detector Function Setting of Test Receiver

Frequency Range (MHz)	Detector Function	Resolution Bandwidth	Video Bandwidth
30 to 1000	Quasi Peak/Peak	120 KHz/100 KHz	120 KHz/100 KHz
Above 1000	Average/ Peak	1 MHz	1 MHz

7.4. MEASUREMENT RESULT

Compliance Certification Services

Out of Band Emissions 10/23/01
95.639(d) A-Site
Kerwin Corpuz

ORBICLE CO., LTD.
FRS DEVICE (M/N: ORB-R15F)

***** Channel 1 (462.5625 MHz) Harmonic *****

frequency (MHz)	SA reading (dBuV)	SG reading (dBm)	CL (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)	Note measured
925.12V	50.3	-26	0.24	7.2	-19.04	-13	-6.04	at 3meter
925.12H	53.4	-23	0.24	7.2	-16.04	-13	-3.04	at 3meter
1387.68V	95.6	-22	0.3	6.1	-16.2	-13	-3.2	at 1meter
1387.68H	97.5	-21	0.3	6.1	-15.2	-13	-2.2	at 1meter
1850.24V	87.6	-26	0.36	6.9	-19.46	-13	-6.46	at 1meter
1850.24H	94.9	-22	0.36	6.9	-15.46	-13	-2.46	at 1meter
2312.80V	90.6	-24	0.4	6.7	-17.7	-13	-4.7	at 1meter
2312.80H	93.3	-22	0.4	6.7	-15.7	-13	-2.7	at 1meter
2775.36V	92.8	-21	0.42	6.8	-14.62	-13	-1.62	at 1meter
2775.36H	91	-23	0.42	6.8	-16.62	-13	-3.62	at 1meter
3237.92V	82	-29	0.44	6.2	-23.24	-13	-10.24	at 1meter
3237.92H	74.8	-37	0.44	6.2	-31.24	-13	-18.24	at 1meter
3700.48V	77	-33	0.52	6.8	-26.72	-13	-13.72	at 1meter
3700.48H	79.7	-32	0.52	6.8	-25.72	-13	-12.72	at 1meter
4163.04V	72.5	-38	0.56	8	-30.56	-13	-17.56	at 1meter
4163.04H	78.9	-33	0.56	8	-25.56	-13	-12.56	at 1meter
4625.60V	78.2	-32	0.6	8.5	-24.1	-13	-11.1	at 1meter
4625.60H	80.5	-31	0.6	8.5	-23.1	-13	-10.1	at 1meter

NOTE: Spot Check X, Y and Z AXIS of EUT. Worse case position X axis.
SA: Spectrum Analyzer
SG: Signal Generator
CL: SMA cable loss (6ft)
Gain (dBi): TX antenna
EPR = SG reading with Amplifier - CL + Gain (dBi)
Margin = EPR - Limit

Compliance Certification Services

Out of Band Emissions 10/23/01
95.639(d) A-Site
Kerwin Corpuz

ORBICLE CO., LTD.
FRS DEVICE (M/N: ORB-R15F)

***** *Channel 14 (467.7125 MHz) Harmonic* *****

frequency (MHz)	SA reading (dBuV)	SG reading (dBm)	CL (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)	Note measured
935.42V	50.9	-25	0.24	7.2	-18.04	-13	-5.04	at 3meter
935.42H	54.7	-22	0.24	7.2	-15.04	-13	-2.04	at 3meter
1403.13V	94.6	-24	0.3	6.1	-18.2	-13	-5.2	at 1meter
1403.13H	99.9	-20	0.3	6.1	-14.2	-13	-1.2	at 1meter
1870.84V	97.4	-20	0.36	6.9	-13.46	-13	-0.46	at 1meter
1870.84H	90.3	-27	0.36	6.9	-20.46	-13	-7.46	at 1meter
2338.55V	82.8	-30	0.4	6.7	-23.7	-13	-10.7	at 1meter
2338.55H	94.1	-25	0.4	6.7	-18.7	-13	-5.7	at 1meter
2806.26V	79.2	-32	0.42	6.8	-25.62	-13	-12.62	at 1meter
2806.26H	94	-24	0.42	6.8	-17.62	-13	-4.62	at 1meter
3273.97V	78	-33	0.44	6.2	-27.24	-13	-14.24	at 1meter
3273.97H	78.9	-33	0.44	6.2	-27.24	-13	-14.24	at 1meter
3741.68V	84.2	-25	0.52	6.8	-18.72	-13	-5.72	at 1meter
3741.68H	82.6	-31	0.52	6.8	-24.72	-13	-11.72	at 1meter
4209.39V	75.6	-35	0.56	8	-27.56	-13	-14.56	at 1meter
4209.39H	77.9	-34	0.56	8	-26.56	-13	-13.56	at 1meter
4677.10V	76.4	-35	0.6	8.5	-27.1	-13	-14.1	at 1meter
4677.10H	79.3	-33	0.6	8.5	-25.1	-13	-12.1	at 1meter

NOTE: Spot Check X, Y and Z AXIS of EUT. Worse case position X axis.
SA: Spectrum Analyzer
SG: Signal Generator
CL: SMA cable loss (6ft)
Gain (dBi): TX antenna
EPR = SG reading with Amplifier - CL + Gain (dBi)
Margin = EPR - Limit

8. FREQUENCY STABILITY MEASUREMENT

8.1. PROVISIONS APPLICABLE

a). According to CFR 47 section 1055(a)(1), the frequency stability shall be measured with variation of ambient temperature from –30°C to +50°C centigrade.
b). According to CFR 47 section 1055(d)(2), for hand carried battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacture.
c). According to CFR 47 section 95.267(b), the FRS unit must be maintained within a frequency tolerance of 0.00025%.

8.2. MEASUREMENT METHOD

8.2.1. Frequency stability versus environmental temperature

1). Setup the configuration per figure 6 for frequencies measurement inside an environmental chamber. Install new battery in the EUT.

2). Turn on EUT and set SA center frequency to the EUT radiated frequency. Set SA Resolution Bandwidth to 10 KHz and Video Resolution Bandwidth to 100 KHz and Frequency Span to 100 KHz. Record this frequency as reference frequency.

3). Set the temperature of chamber to 50°C. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the chamber, turn the EUT on and measure the EUT operating frequency.

4). Repeat step 2 with a 10°C decreased per stage until the lowest temperature -30°C is measured, record all measured frequencies on each temperature step.

8.2.2. Frequency stability versus input voltage

1). Setup the configuration per figure 6 for frequencies measured at temperature if it is within 15°C to 25°C. Otherwise, an environmental chamber set for a temperature of 20°C shall be used. Install new battery in the EUT.

2). Set SA center frequency to the EUT radiated frequency. Set SA Resolution Bandwidth to 10 KHz and Video Resolution Bandwidth to 100 KHz and Frequency Span to 100 KHz. Record this frequency as reference frequency.

3). For battery operated only device, supply the EUT primary voltage at the operating end point which is specified by manufacturer and record the frequency.

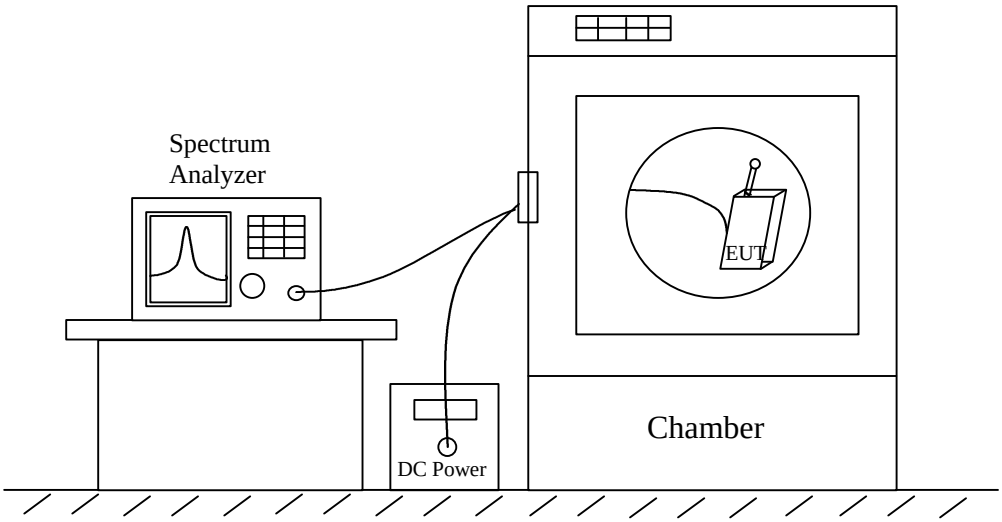
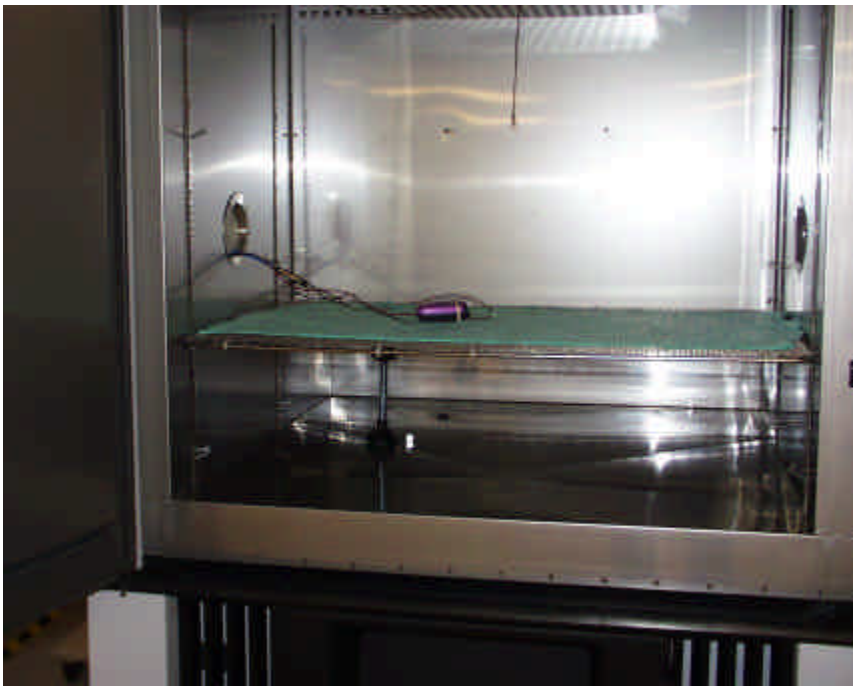
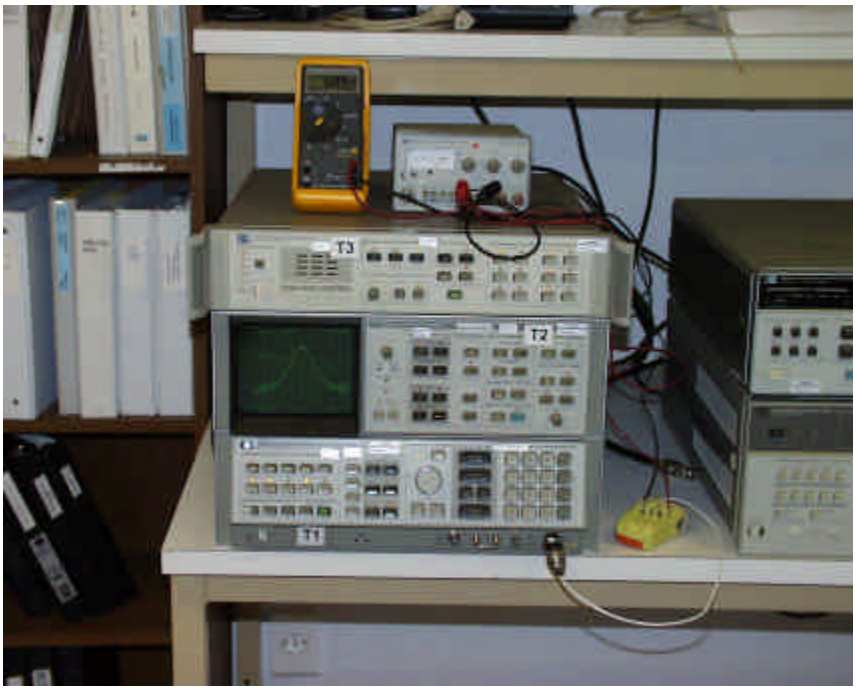


Figure 6: Frequency stability measurement configuration



Frequency Stability VS Environment Temperature Setup



Frequency Stability VS Input Voltage Setup

8.3. MEASUREMENT INSTRUMENT

EQUIPMENT	MANUFACTURE	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Spectrum Analyzer	HP	8566B	2140A01296	05/04/02
Environmental Chamber	THERMOTRON	SE-600-10-10	29800	03/23/02
Power Supply	HP	6235A	2450A-08312	N/A

8.4. MEASUREMENT RESULT

a). Frequency stability versus environment temperature.

Reference Frequency: 462.562768 MHz				Limit: 0.00025 % (1.156 kHz)
Environment Temperature (°C)	Power Supplied (Vdc)	Frequency deviation measured with time		
		10 minutes		
		New frequency (MHz)	Ä frequency (Hz)	%
50	6	462.562678	90	0.00002
40	6	462.562533	235	0.00005
30	6	462.562668	100	0.00002
20	6	reference	0	0.00000
10	6	462.562833	65	0.00001
0	6	462.563123	355	0.00008
-10	6	462.563283	515	0.00011
-20	6	462.563538	770	0.00017

b). Frequency stability versus input voltage (battery operation end point voltage is 3.85 Vdc)

Channel	Reference Frequency (MHz)	Frequency measured at end point voltage	Frequency Deviation (%)	Limit (%)
1	462.562913	462.562850	0.000014	0.00025
14	467.712788	467.712750	0.000008	0.00025

9. APPENDIX

EXHIBIT 1: **EUT External / Internal Photos**

EXHIBIT 2: **Proposed FCC ID Labeling**

EXHIBIT 3: **Request for Confidentiality**

EXHIBIT 4: **Theory of Operation**

EXHIBIT 5: **Part List**

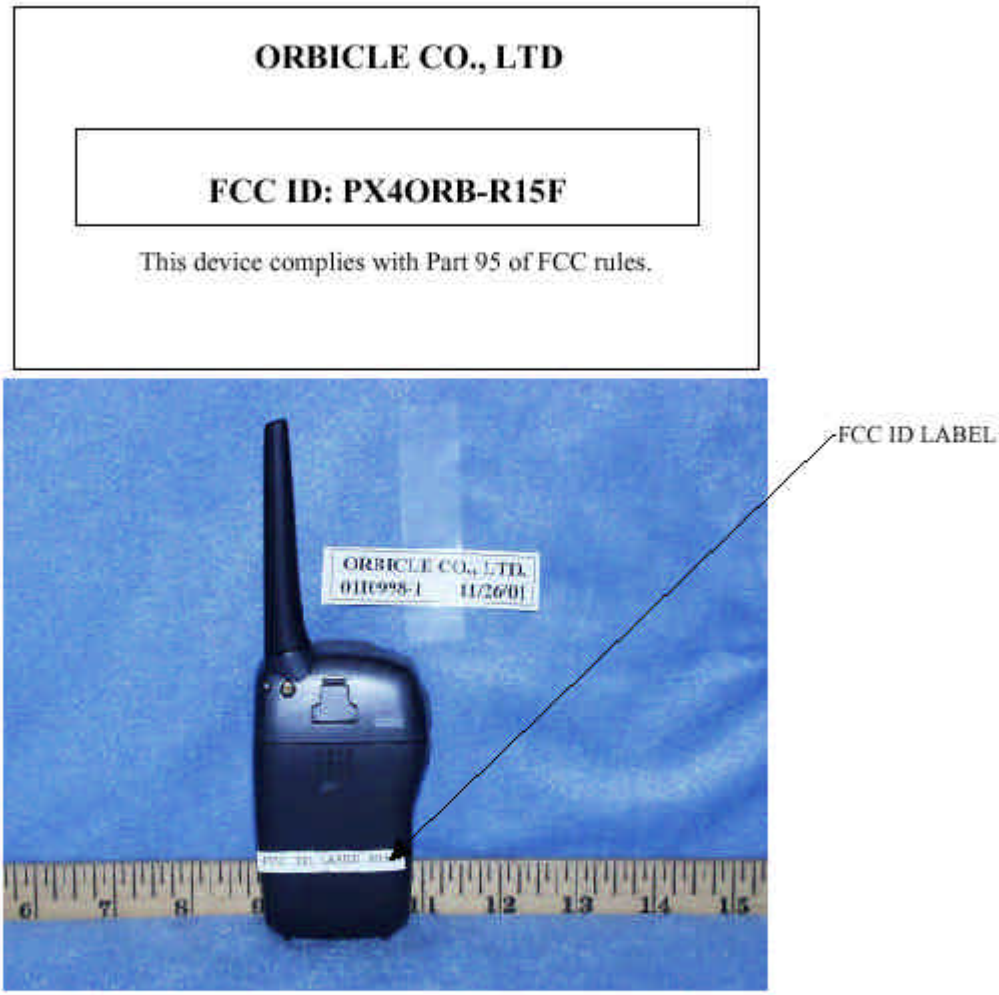
EXHIBIT 6: **Tune-Up Procedure**

EXHIBIT 7: **Schematic & Block Diagram**

EUT External/Internal Photos

Proposed FCC ID Labeling

PROPOSED FCC ID LABEL AND LOCATION



Request For Confidentiality

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To : CCS
Denise Teng / Scott Wang
Tel No : 1-408-463-0885
Fax No : 1-408-463-0888

Date : Oct. 8, 2001
DOC #: OBC0110-018
From : J. H. Hor / Manager
Pages : 1 page incl. cover page

Subject : Request your Confidentiality for our FRS – FCC Approval

Dear sir,

We, Orbicle, request you to manage our schematics and block diagram of ORB-R15F FRS with confidentiality.

Thanks for your kind co-operation.

Your Sincerely,

Jung-Hoon Hor
/ Manager
/ORBICLE

Theory of Operation

Theory of Operation

1. PLL Frequency Synthesizer

PLL Frequency synthesizer is composed with X2 which is crystal oscillator, VCO which is voltage control oscillator, Phase Comparer, Pre-scaler, U1 (PLL IC) which is embedded programmable divider, and RC LPF(low-pass filter). This PLL Frequency synthesizer is designed to generate the setting frequency according to the control of CPU.

1-1) X-TAL Oscillator

The frequency of X2(X-TAL Oscillator) is used for the reference frequency of U1(PLL IC), also is used for the local frequency of U2(IF IC).

1-2) PLL IC

PLL IC(U1) is controlled by CPU, and receives the transmitting/receiving frequency data per each channel which is memorized to EEPROM through CPU.

U1 divide the VCO oscillation frequency which is received in Pin 16 of U1 by Prescaler and Programmable Divider, and then compares the phase with reference frequency, at this time the frequency is determined. The output detected from the internal Phase Comparer, via Pin14 of U1, is transmitted to the "C53, R35, C54, R36, and C55"that is PLL LPF, and finally generates DC voltage to adjust the VCO output frequency wanted.

1-3) PLL Lock Detector

Internal Phase Comparer of PLL IC(U1) compares the frequency and phase which is loaded from the Reference signal and the signal from VCO, and via the Pin14 of U1, output the differential DC voltage which is the difference of two signal. This DC voltage is loaded to the VCO, and finally the VCO frequency is changed. Above series of operation is repeated continuously and the frequency is to be set to the frequency wanted.

The frequency stability at this time, is to be same with the stability of X2, and this status is called as "Locked".

1-4) Voltage Control Oscillator (VCO)

VCO has the "transmitting/receiving Voltage Control Oscillator" which is adjusted by the DC voltage that comes from PLL LPF.

Local Oscillation Frequency is determined by C58, C60, L16, C65, C66, D8, and VC2, and transmitting / receiving is switched by Q10.

The frequency is oscillated and amplified at Q8, and Q9, when receiving, the receiving local oscillation frequency is loaded to the Mixer Q6, and when transmitting, the transmitting return frequency is loaded to the Q4 (TX amplification Driver)

2. Receiving Part

2-1. Transmitting/Receiving change switching circuit

The signal received from the antenna, via the LPF(low pass filter) composed with L1~L3, C1, C2, C3, C4 and C5, is loaded to the "Transmitting/Receiving change switching circuit". By the D1 (transmitting change switching Diode) is to be off, via L19, received signal is transmitted to the foregoing Band-Pass-Filter which is located before the receiving part.

2-2. Front-End

Front-End is composed two SAW (Surface Acoustic Wave) Filter and one LNA (Low Noise Amplifier).

2-3. **1st Mixer**

Mixer Q6 is "RF AMP TR", add the VCO local signal with the received signal which is received from input BASE, load the added signal to the EMITTER, enforce the non-linear operation of amplifier, generate co-modulation frequency between the receiving signal frequency of COLLECTOR and Local signal frequency, and the one of them is the 1st medium frequency signal (21.7 MHz).

2-4. MCF (Monolithic Crystal Filter)

MCF is a input/output matching circuit of FL3, is the BPF which have high selectivity. MCF has very narrow band-pass width of 3.75, and the function that eliminating the ripple among the band-pass width, also MCF meet the attenuation characteristic of Stop Band.

Among various signal generated from 1st Mixer, MCF select IF 21.7 MHz signal, and suppress other signal unwanted.

2-5. **IF Amp**

Q7 amplifies the amount that the loss of MCF and the Gain which is needed afterward circuit, and load the 21.7 MHz IF Signal to the Mixer Input Pin16 of the narrow-band Fm IF IC U2.

2-6. IF IC

2nd Mixer, IF AMP, Osc., FM Detection, Noise Squelch, and RSSI circuit is embedded on the IF IC U2. By the mixing with "1st IF signal 21.7 MHz of internal 2nd Mixer in IF IC" and "2nd local frequency 21.25 MHz of X2 that is connected to Pin1", IF IC generates 2nd IF signal 450 kHz.

Via Pin3, this 450 kHz signal is loaded to 450 kHz Ceramic Filter FL4, filtered, and then is loaded again to the 2nd IF AMP(450 kHz) PIN 5, and then finally this 450 KHz signal is amplified.

450 KHz IF AMP transmit the signal that have sufficient Gain to the internal Detector circuit, and demodulate the signal. The demodulation type is a quadrature detector type, the demodulation is conducted by Resonator X3 that is connected to the IC Pin8, and the Audio Signal is transmitted to the Pin9 through internal LPF.

Among the detected output, first the noise ingredient is loaded to the Pin8 (which is Internal Filter input terminal) of U2.

By R29, R28, R27, C38, C39, and C37, this loaded Noise is amplified and frequency bandwidth is limited. The Squelch Operation is controlled by the changing of noise quantity in "Noise Comparer Section" of U2.

If the Squelch is in open status, SQ Detector terminal Pin13 of U2 is loaded to CPU with the Logic High State, and make the CPU output the signal that release the Signal Mute and Audio Mute.

If the Squelch is in close status, SQ Detector terminal Pin13 of U2 is loaded to CPU with the Logic Low State, and make the CPU can not output the signal that release the Signal Mute and Audio Mute.

2-7. **Audio High-pass Bandwidth Filter and Audio Amplifier**

Demodulated Audio signal is passed the De-Emphasis circuit which has -6 dB/OCT characteristic, and the high-pass bandwidth is attenuated that is emphasized at TX, and finally the signal is changed to flat frequency response characteristic.

The Audio Signal is loaded to Pin17 of U5, and is adjusted with appropriate level, and is transmitted to the Audio last AMP U7 Pin 2. The amplified Audio signal is outputted to U7 Pin5, and then via External Speaker Jack J2A, and drive the internal Speaker. (Nominal output is larger than 0.25)

Belonging to the varying of the voltage of Pin6 in U7 by Q19, and Q20, the Audio Mute is controlled. That is, if the voltage of Pin6 in U7 is High, the Audio signal is passed, but if the voltage of Pin6 in U7 is Low, the Audio signal is muted. Audio output is controlled by VOLUME UP/DOWN KEY.

3. Transmission Part

Transmission Part is composed with Driver AMP High-Frequency RF Power IC. When starting the transmission by pressing the PTT SW, the output of VCO is amplified through Q4,Q3,Q2,and Q1, and via LPF, the output is transmitted to the ANT.

3-1) **PTT Detector and CPU Control**

By pressing the PTT SW1, the Pin46 of U3 is changed with LOW, then the CPU starts the transmission. When in VOX MODE status, the value of MIC Level is amplified by Q23, depending on the Setting Value of VOX Level, U1 recognize the PTT.

The CPU that recognized the PTT signal, decodes the Frequency Data of that channel and other Option Data which is registered in EEPROM, controls the other Option control circuit, and transmit the Data to the PLL IC, also send the Low signal to TX Enable(U3 pin38) that controls the TX voltage.

The CPU monitor the Lock Port of PLL, and once find that if the PLL is stable, send the Low signal to the TX LED(U3 pin22) control terminal. These operations are maintained while pressing the PTT SW.

3-2). **Mic AMP and modulation**

The Audio signal which is made by internal condenser MIC or external MIC, is amplified by U5 and U6, and have the characteristic of Pre Emphasis 6dB/OCT.

U5 has the -36dB/OCT for frequency more than 3.6 kHz, the Audio signal which is filtered through Limiting circuit, is transmitted to the Maximum deviation adjuster VR1, and limits the maximum modulation deviation, and finally the audio signal is loaded to VCO, and then the Audio signal FM modulated.

3-3) **Power AMP and LPF**

TX RF signal that generated at TX VCO, is loaded to Drive AMP Q4, Q3, and Q2, and is amplified by the input level that Q1 requires, and then is loaded to Q1, finally is changed to the output of more than 0.5W. This signal is supplied to the LPF and ANT Connector, and is radiated via ANT.

If there isn't enough size of input or Bias voltage, the output isn't made. The LPF is designed with 3rd stage for the purpose that eliminating the High-Frequency ingredient and making better the TX Spurious characteristic.

Part List

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NO.	NAME & DESCRIPTION	VENDOR CODE	VENDOR	Component Number	QTY
1	RES. CHIP 10 Ω ±5% 1/16W 0603	CR 1/16 100 JT	EDKA Trade	R20,29,70	3
2	RES. CHIP 10 Ω ±5% 1/16W 0603	CR 1/16 100 JT	EDKA Trade	R34,50,124	3
3	RES. CHIP 100 Ω ±5% 1/16W 0603	CR 1/16 101 JT	EDKA Trade	R10,14,48	3
4	RES. CHIP 1 KΩ ±5% 1/16W 0603	CR 1/16 102 JT	EDKA Trade	R3,71,90	3
5	RES. CHIP 10 KΩ ±5% 1/16W 0603	CR 1/16 103 JT	EDKA Trade	R1,7,8,12,16,18,26,21,37,42,65,67,68,69,81,84,87,97,107	19
6	RES. CHIP 100 KΩ ±5% 1/16W 0603	CR 1/16 104 JT	EDKA Trade	R33,66,63,64,65,86,100	6
7	RES. CHIP 1 MΩ ±5% 1/16W 0603	CR 1/16 105 JT	EDKA Trade	R23,61,98	4
8	RES. CHIP 12 KΩ ±5% 1/16W 0603	CR 1/16 123 JT	EDKA Trade	R73	1
9	RES. CHIP 150 KΩ ±5% 1/16W 0603	CR 1/16 154 JT	EDKA Trade	R62,99	2
10	RES. CHIP 22 Ω ±5% 1/16W 0603	CR 1/16 220 JT	EDKA Trade	R5,9,25,59,40	6
11	RES. CHIP 220 Ω ±5% 1/16W 0603	CR 1/16 221 JT	EDKA Trade	R52,45	2
12	RES. CHIP 2.2 KΩ ±5% 1/16W 0603	CR 1/16 222 JT	EDKA Trade	R2,16,23,91	4
13	RES. CHIP 22 KΩ ±5% 1/16W 0603	CR 1/16 223 JT	EDKA Trade	R47,61,88,79,92	4
14	RES. CHIP 220 KΩ ±5% 1/16W 0603	CR 1/16 224 JT	EDKA Trade	R54	1
15	RES. CHIP 2.7 KΩ ±5% 1/16W 0603	CR 1/16 272 JT	EDKA Trade	R43	1
16	RES. CHIP 27 KΩ ±5% 1/16W 0603	CR 1/16 273 JT	EDKA Trade	R38	1
17	RES. CHIP 270 KΩ ±5% 1/16W 0603	CR 1/16 274 JT	EDKA Trade	R95	1
18	RES. CHIP 330 Ω ±5% 1/16W 0603	CR 1/16 331 JT	EDKA Trade	R11,72,85	3
19	RES. CHIP 3.3 KΩ ±5% 1/16W 0603	CR 1/16 332 JT	EDKA Trade		
20	RES. CHIP 33 KΩ ±5% 1/16W 0603	CR 1/16 333 JT	EDKA Trade		
21	RES. CHIP 330 KΩ ±5% 1/16W 0603	CR 1/16 334 JT	EDKA Trade	R103	1
22	RES. CHIP 470 Ω ±5% 1/16W 0603	CR 1/16 471 JT	EDKA Trade	R7,21	1
23	RES. CHIP 4.7 KΩ ±5% 1/16W 0603	CR 1/16 472 JT	EDKA Trade	R13,17,33,36,40,41,44,49,58,63,77,78,79,80,89,91,105,106	18
24	RES. CHIP 47 KΩ ±5% 1/16W 0603	CR 1/16 473 JT	EDKA Trade	R35,36	2
25	RES. CHIP 470 KΩ ±5% 1/16W 0603	CR 1/16 474 JT	EDKA Trade	R31,56,62	3
26	RES. CHIP 5.6 KΩ ±5% 1/16W 0603	CR 1/16 562 JT	EDKA Trade	R28,27	2
27	RES. CHIP 6.8 KΩ ±5% 1/16W 0603	CR 1/16 682 JT	EDKA Trade	R44	1
28	RES. CHIP 680 KΩ ±5% 1/16W 0603	CR 1/16 684 JT	EDKA Trade	R25	1
29	RES. CHIP 8.2 KΩ ±5% 1/16W 0603	CR 1/16 822 JT	EDKA Trade	R9	1
30	RES. CHIP 10 ohm ±5% 1/2W 1206	RC21 1/2W 101 JT	EDKA Trade	R38	1
31	RES. SEMI-FIXED CHIP 10 KΩ 3EVA	EVM3ESX50B14	MAT'SUSH	VR1	1
32	CAP. TRIMMER CHIP 6pF NPO (BROWN)	[illegible]	MAT'SUSH	VC2	1
33	CAP. TRIMMER CHIP 10pF NARO (WHITE)	[illegible]	MAT'SUSH	VC1	1
34	CAP. TANTAL 10uF/16V +-20% SIZE B	TA-B16TCMS100M-B2L	KMM IL	C85,173	2
35	CAP. TANTAL 3.3uF +-20% SIZE A	TA-A10TCMS1R0M-AL	KMM IL	C54	1
36	CAP. TANTAL 22uF/10V +-20% SIZE A	TA-A10TCMS220M-A	KMM IL	C38,82,102,113,114,117,118	7
37	CAP. ELECT 220 uF/6.3V +-20% 6.3x7	[illegible]	SAM YOUNG	C81	1
38	CAP. CERAMIC CHIP 1 uF ±10% 0603	0603 CS 105K 000-M	EDKA Trade	C28,92	2
39	CAP. CERAMIC CHIP 2.2 uF ±10% 0603	0603 CS 225K 000-M	EDKA Trade	C60	1
40	CAP. CERAMIC CHIP 3 uF ±10% 0603	0603 CS 030C 000-M	EDKA Trade	C70,88,70	3
41	CAP. CERAMIC CHIP 5 uF ±10% 0603	0603 CS 050C 000-M	EDKA Trade	C2,15,19	3
42	CAP. CERAMIC CHIP 6 uF ±10% 0603	0603 CS 060C 000-M	EDKA Trade	C29,31	2

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[illegible]	NAME & DESCRIPTION	VENDOR CODE	VENDOR	Component number	QT
41	CAP CERAMIC CHIP 7 pF ±5% 0603	0603 CG 070C 9B8-H	ESNA Trade	C80	1
14	CAP CERAMIC CHIP 8 pF ±5% 0603 NTS	0603 UJ 080C 9B8-H	ESNA Trade	C85	1
45	CAP CERAMIC CHIP 10 pF ±5% 0603	0603 CG 100J 9B8—	ESNA Trade	C5,12,72,101,420	5
44	CAP CERAMIC CHIP 100 pF ±5% 0603	0603 CG 101J 9B8—	ESNA Trade	C30,41,45,46,47,48,50,88,91,100,130,150	12
47	CAP CERAMIC CHIP 1000 pF ±5% 0603	0603 2R 102J 9B8—	ESNA Trade	C1,7,16,19,17,19,23,27,38,85,86,87,59,89,71,73,79,84,115,116,129,192	22
49	CAP CERAMIC CHIP 0.01 µF ±5% 0603	0603 2R 103J 9B8—	ESNA Trade	C21,29,80,101,107,121,122,124	8
48	CAP CERAMIC CHIP 0.1 µF ±80% 0603	0603 2F 104Z 9B8—	ESNA Trade	C11,18,22,33,39,47,75,76,77,78,80,85,88,92,93,94,96,99,100,103,104,105,106,108,111,107,123,127	24
54	CAP CERAMIC CHIP 1 µF ±80% 0603	0603 2F 105Z 7B8—	ESNA Trade	C40,43,44,74,128	5
51	CAP CERAMIC CHIP 11 pF ±5% 0603	0603 CG 110J 9B8—	ESNA Trade	C90	1
52	CAP CERAMIC CHIP 12 pF ±5% 0603	0603 CG 120J 9B8—	ESNA Trade	C3,6,117	2
53	CAP CERAMIC CHIP 15 pF ±5% 0603	0603 CG 150J 9B8—	ESNA Trade	C19	1
56	CAP CERAMIC CHIP 18 pF ±5% 0603	0603 CG 180J 9B8—	ESNA Trade		
58	CAP CERAMIC CHIP 1500 pF ±5% 0603	0603 2R 152K 9B8—	ESNA Trade	C47	1
59	CAP CERAMIC CHIP 22 pF ±5% 0603	0603 CG 220J 9B8—	ESNA Trade	C8,61	1
57	CAP CERAMIC CHIP 220 pF ±5% 0603	0603 CG 221J 9B8—	ESNA Trade	C27,81	2
58	CAP CERAMIC CHIP 0.022 µF ±5% 0603	0603 2R 223J 9B8—	ESNA Trade	C52,95	2
57	CAP CERAMIC CHIP 0.22 µF ±80% 0603	0603 2F 224Z 9B8—	ESNA Trade	C53	1
60	CAP CERAMIC CHIP 39 pF ±5% 0603	0603 CG 390J 9B8—	ESNA Trade		
61	CAP CERAMIC CHIP 3900 pF ±5% 0603	0603 2R 392K 9B8—	ESNA Trade	C31	1
62	CAP CERAMIC CHIP 47 pF ±5% 0603	0603 CG 470J 9B8—	ESNA Trade	C29,82	2
63	CAP CERAMIC CHIP 56 pF ±5% 0603	0603 CG 560J 9B8—	ESNA Trade	C80	1
64	CAP CERAMIC CHIP 5 pF ±5% 0603 NTS	0603 UJ 5R0C 9B8-H	ESNA Trade	C45	1
65	CAP CERAMIC CHIP 82 pF ±5% 0603	0603 CG 820J 9B8—	ESNA Trade	C70	1
66	CAP CERAMIC CHIP 330 pF ±5% 0603	0603 2R 331J 9B8—	ESNA Trade	C87	1
67	IC [illegible] SSOP-28	[illegible]	ESTEC	U1	1
68	IC EEPROM 1.8-5.5V [illegible]	[illegible]	ARC	U8	1
69	IC AUDIO AMP 500mW [illegible]	[illegible]-TE	SIN MYUNG	U6	1
70	IC [illegible] SSOP-14	[illegible]-TE	SIN MYUNG	U5	1
71	IC PLL DUAL	TB31202FN	SC Trading	U7	1
72	IC LPS	[illegible]	HITACHI	U4	1
73	IC [illegible]	[illegible]	[illegible] SEMICONDUCTOR	U2	1
74	IC REGULATOR LOW DROP [illegible]	[illegible]	ARC	U9	1
75	TR RF NPN [illegible]	[illegible]	[illegible]	Q8	1
76	TR RF NPN [illegible]	[illegible]	[illegible]	Q2,5,6,9,22,27	6
77	TR RF NPN	[illegible]	HP	Q1	1
78	TR FET	[illegible]	DONG YOUNG	Q12,21	2
79	TR RF NPN [illegible]	[illegible]	DONG YOUNG	Q7	1
80	TR [illegible] SMALL [illegible]	[illegible]	DONG YOUNG	Q4,19	2
81	DST [illegible]	[illegible]	DONG YOUNG	Q16,17,23	3
82	DST [illegible]	[illegible]	DONG YOUNG	Q3,11,13,14,15,18,28	7
83	DIODE [illegible]	[illegible]	DONG YOUNG	D1,4,35	3

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[illegible]	NAME & DESCRIPTION	[illegible]	[illegible]	[illegible]	[illegible]
84	DIODE SWITCHING DUAL SOT-323 [illegible]	[illegible]	DONG YOUNG	D5	1
85	DIODE SWITCHING	[illegible]	DONG YOUNG	D2,7,8	[illegible]
86	DIODE SWITCHING DUAL SOT-23 [illegible]	[illegible]	DONG YOUNG	D10	1
87	DIODE SWITCHING DUAL SOT-23 [illegible]	[illegible]	DONG YOUNG	D3,4	2
88	DIODE VARICAP [illegible]	[illegible]	[illegible]	D6	1
89	RED LED	[illegible]	[illegible]	D11	1
90	GREEN LED	[illegible]	[illegible]	D12	1
91	CHIP LED	[illegible]	[illegible]	D15	1
92	SEG-TYPE LCD	[illegible]	[illegible]	LCD1	1
93	CERAMIC RESONATOR	[illegible]	[illegible]	X1	1
94	DISCRIMINATOR [illegible]	[illegible]	K.C. INTER.	BPF1	1
95	X-TAL 21.25MHz [illegible]	[illegible]	[illegible]	X2	1
96	FILTER X-TAL [illegible]	[illegible]	K.C. INTER.	FL3	1
97	FILTER CERAMIC [illegible]	[illegible]	K.C. INTER.	FL4	1
[illegible]	FILTER SAW [illegible]	[illegible]	[illegible]	FL2	1
[illegible]	Inductor Spring [illegible]	[illegible]	[illegible]	[illegible]	2
[illegible]	Inductor Spring [illegible]		[illegible]	L1,3,5,16	4
[illegible]	Inductor Spring [illegible]	[illegible]	[illegible]	L6	1
[illegible]	INDUCTOR CHIP CERAMIC [illegible]	[illegible]	[illegible]	L7	1
[illegible]	INDUCTOR CHIP CERAMIC [illegible]	[illegible]	[illegible]	L9	1
[illegible]	INDUCTOR CHIP CERAMIC [illegible]	[illegible]	[illegible]	L13	1
[illegible]	INDUCTOR CHIP CERAMIC [illegible]	[illegible]	[illegible]	L10,11,17	[illegible]
[illegible]	INDUCTOR CHIP CERAMIC [illegible]	[illegible]	[illegible]	L14	1
[illegible]	INDUCTOR CHIP [illegible]	[illegible]	[illegible]	L18	[illegible]
[illegible]	INDUCTOR CHIP CERAMIC [illegible]	[illegible]	[illegible]	L4,12,15	[illegible]
[illegible]	INDUCTOR CHIP [illegible]	[illegible]	[illegible]	L8	1
[illegible]	SPEAKER	[illegible]	[illegible]	SP1	1
[illegible]	MIC	[illegible]	[illegible]	MIC1	1
[illegible]	TACT-SW	MON	[illegible]	[illegible]	1
[illegible]	TACT-SW	PTT	[illegible]	[illegible]	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1
[illegible]	[illegible]	[illegible]	[illegible]	J1	1
[illegible]	[illegible]	[illegible]	[illegible]		1

Tune-Up Procedure

Tune-up Procedure

1. PLL VCO Part

Connect Voltage meter to the TP terminal(C54+), adjust VC2 that receiving voltage is to be 1.0V at 1st channel (462.5625 MHz). At this time, the transmitting Voltage should be in 1.0 ~ 1.5V range.

2. Receiving Part (Measurement Frequency : 462.5625MHz)

1) Set the SSG with "the channel frequency to be 462 467MHz, Signal Voltage of 1mV, 1KHz to be 1.5 KHz FM modulation", and then connect the SSG to the Antenna Jack.
2) Connect Oscilloscope to the DET terminal of J2, check that Vp-p is the maximum status, and then up and down the "Volume Adjust Knob", make the wave to be the square wave(0.5~ 0.7V)

3. Transmitting Part (Measurement Frequency : 462.5625MHz)

1) Adjust finely the VC1 that the frequency is to be accurate transmitting frequency.
2) Set the VR1 to the maximum position(counter clockwise), load 1.0 KHz, -20dBm (which don't have the tone) to the MIC+ terminal, and then adjust VR1, make the frequency deviation to be 2.1 KHz.
3) Load TONE 67Hz(CTCSS), check that the frequency deviation is below than 0.6 ~ 0.7KHz.
4) When modulating "the 1KHz Audio signal and the signal which has tone", check that the value is less than 2.5KHz.

Schematic & Block Diagram