

# **THRULab & Engineering.**

RM302,BOKJO,29-15 , CHONGPA3-DONG

YONGSAN-GU, SEOUL, KOREA

81221095059F81221095056 email thrukang@kornet.net



## **Test Report**

**Product Name: GMRS/FRS Combination**

**MODEL : GMRS602**

**FCC ID: PDHGMRS602**

## **Applicant:**

**TTI Tech Co., Ltd.**

**Eundo Bldg.Room 402,737-19 Banpo-1dong  
Seocho-ku, Seoul, Korea.137-041**

**Date Receipt: 19/JAN/2005**

**Date Tested: 24/JAN/2005**

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FCC ID :PDHGMRS602

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### EXHIBITS CONTAINING:

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## GENERAL INFORMATION REQUIRED FOR CERTIFICATION

2.1033 (c) (1) (2) TTI Tech Co., Ltd. will manufacture the FCCID: PDHGMRS602 GMRS/FRS COMBINATION TRANSCEIVER in quantity, for use under FCC RULES PART 95.

TTI Tech Co., Ltd.  
Eundo Bldg.Room 402,737-19 Banpo-1dong  
Seocho-ku, Seoul, Korea.137-04

2.1033 (c) TECHNICAL DESCRIPTION

2.1033 (c) (3) Instruction book. A draft copy of the instruction manual is included as EXHIBIT 7.

2.1033 (c) (4) Type of Emission : 10K5F3E  
95.631

$B_n = 2M + 2DK$   
 $M = 3000$   
 $D = 2.25k$   
 $B_n = 2(3000) + 2(2250) = 10.5k$   
GMRS Frequency Range :20.0kHz

2.1033 (c) (5) GMRS Frequency Range:  
95.621

|              |              |
|--------------|--------------|
| 1. 462.5500  | 13. 462.7000 |
| 2. 462.5625  | 14. 462.7125 |
| 3. 462.5750  | 15. 462.7250 |
| 4. 462.5875  | 16. 467.5500 |
| 5. 462.6000  | 17. 467.5750 |
| 6. 462.6125  | 18. 467.6000 |
| 7. 462.6250  | 19. 467.6250 |
| 8. 462.6375  | 20. 467.6500 |
| 9. 462.6500  | 21. 467.6750 |
| 10. 462.6625 | 22. 467.7000 |
| 11. 462.6750 | 23. 467.7250 |
| 12. 462.6875 |              |

## FRS Authorized Bandwidth:12.5kHz

2.1033(c)(5) FRS Frequency Range:  
95.627

|             |                  |
|-------------|------------------|
| 1. 462.5625 | 8. 467.5625      |
| 2. 462.5875 | 9. 467.5875      |
| 3. 462.6125 | 10. 467.6125     |
| 4. 462.6375 | 11. 467.6375     |
| 5. 462.6625 | 12. 467.6625     |
| 6. 462.6875 | 13. 467.6875     |
| 7. 462.7125 | 14. 467.7125 MHz |

2.10311c)(6)(7) RF power is measured by the substitution method as  
2.1046(a) outlined in TIA/EIA - 603. With a nominal battery voltage of 6 V, and the transmitter properly adjusted the RF output measures:

power supply : Roket batteries (1.5VDC) 4

GMRS (HIGH) - 0.872 Watts  
GMRS (LOW) - 0.427 Watts  
FRS - 0.397 Watts

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2.1033(c)(6)(7) FRS Power Output shall not exceed 0.50 Watts effective

95.639 radiated power. There can be no provisions for

95.649 Increasing the power or varying the power.

2.1033(c)(8) DC Voltages and Current into Final Amplifier:  
FINAL AMPLIFIER ONLY

FOR GMRS HIGH POWER SETTING INPUT POWER:  $(6V)(.337A) = 2.022$  Watts

FOR GMRS LOW POWER SETTING INPUT POWER :  $(6V)(.177A) = 1.062$  Watts

FOR FRS POWER SETTING INPUT POWER :  $(6V)(.165A) = 0.99$  Watts

2.1033(c)(9) Tune-up procedure. The tune-up procedure is included as EXHIBIT # 9.

2.1033(c)(10) Complete Circuit Diagrams: The circuit diagram is included as EXHIBIT 6 of this report. The block diagrams are included as EXHIBIT 5 of this report.

2.1033(c)(11) A photograph or a drawing of the equipment identification label is included as exhibit No. 1.

2.1033(c)(12) Photographs(8"X10") of the equipment of sufficient clarity to reveal equipment construction and layout, including meters, labels for controls, including any view under shields. See exhibits 3-4.

2.1033(c)(13) Digital modulation is not allowed.

2.1033(c)(14) The data required by 2.1046 through 2.1057 is submitted below.

2.1046(a) RF power output. The test procedure used was TIA/EIA-603.

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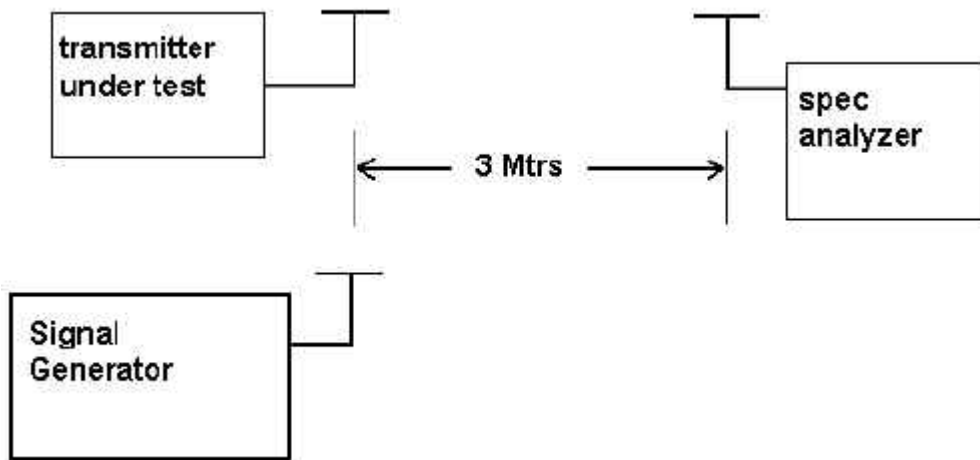
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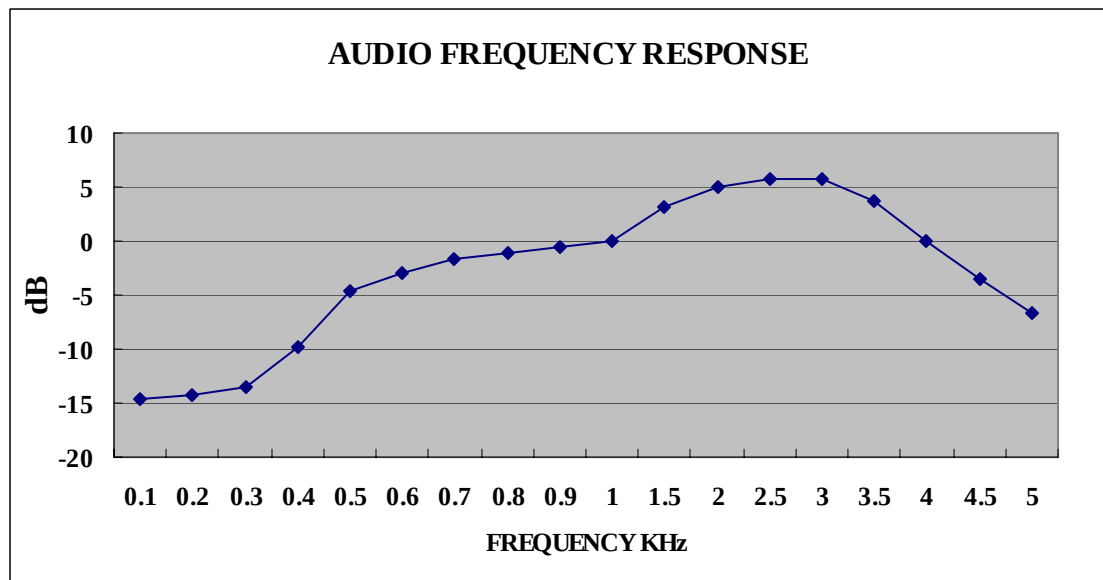
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## 2.1047 (a) (b) Modulation characteristics :

### AUDIO FREQUENCY RESPONSE

The audio frequency response was measured in accordance with TIA/EIA Specification 603. The audio frequency response curve is shown on the next page. The audio signal was fed into a dummy microphone Circuit and into the microphone connector. The Input required to produce 30 percent modulation Level was measured. See plot below.

AUDIO FRQUENCY RESPONSE PLOT GOES HERE



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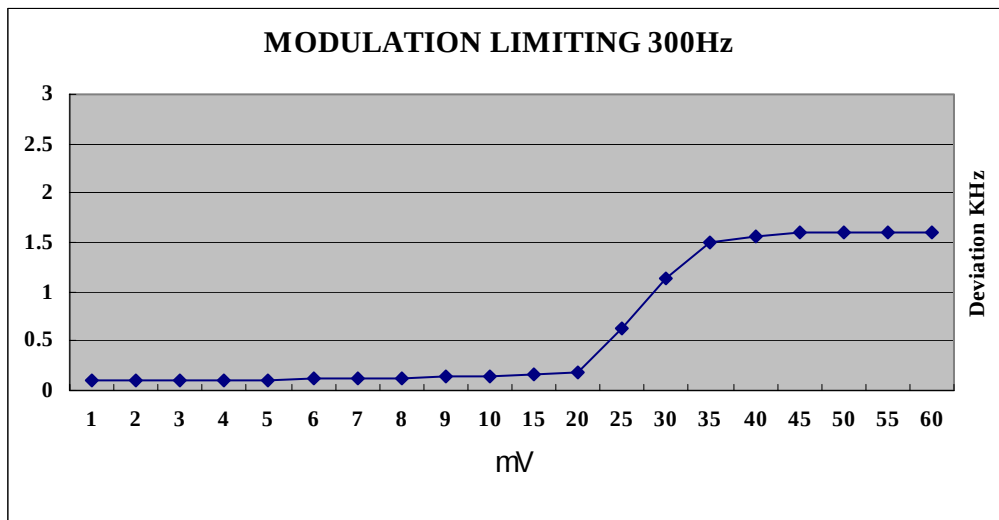
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2.1047 (b)

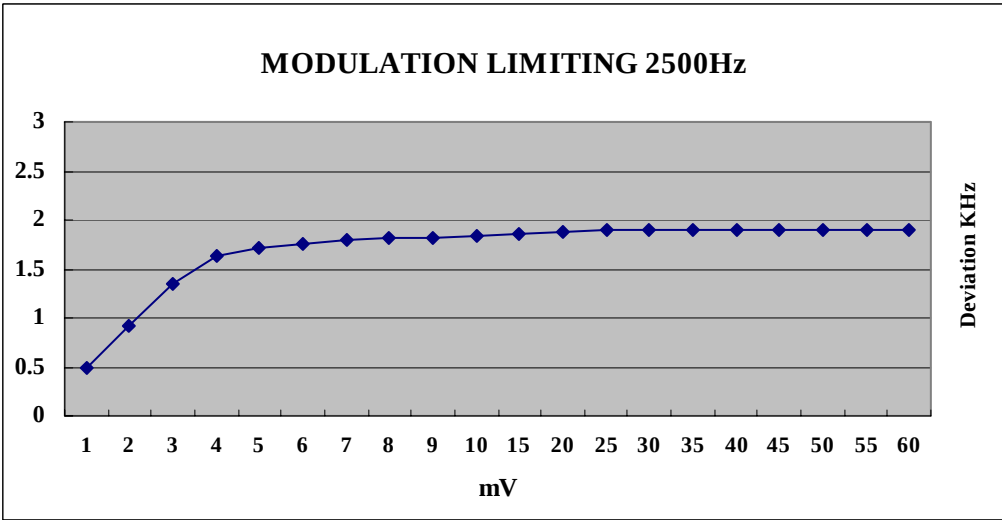
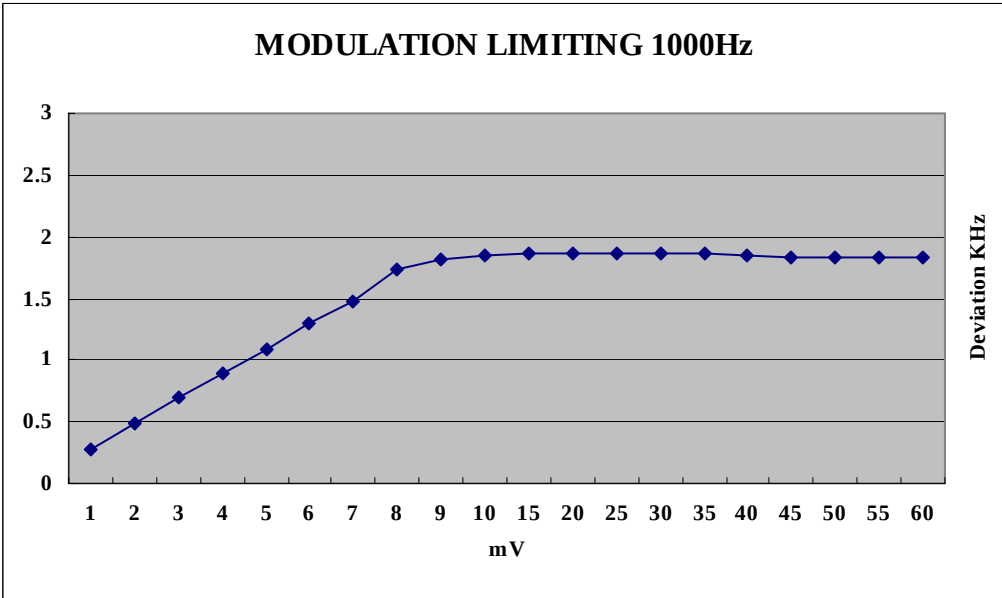
Audio input versus modulation

The audio input level needed for a particular percentage of modulation was measured in accordance with TIA/EIA Specification 603. The audio input curves versus modulation are on the following pages. Curves are provided for audio input frequencies of 300, 1000, and 2500 Hz. See Pages 6 and 7 of report.



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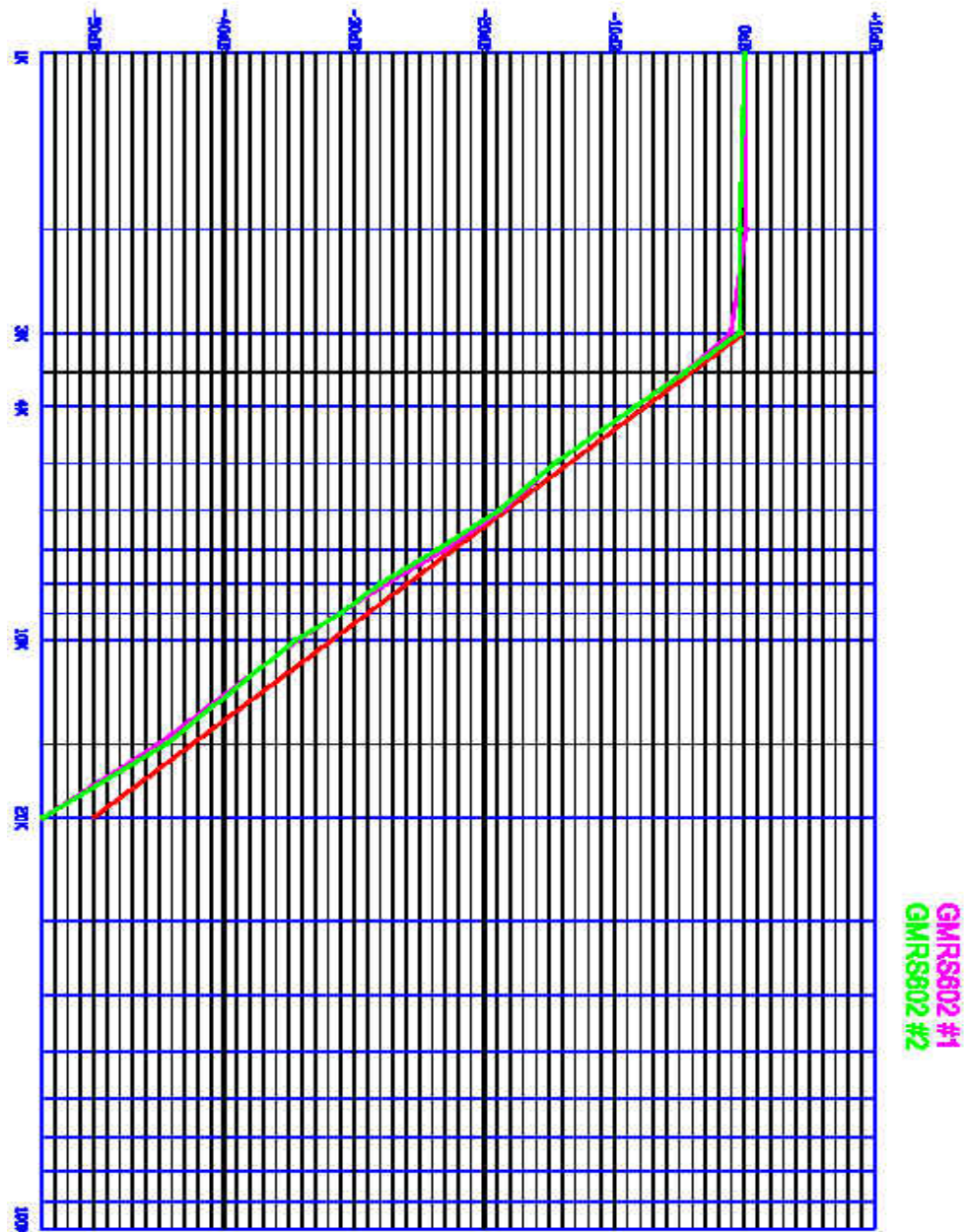
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## AUDIO LOW PASS FILTER GRAPH

95.637

Post Limiter Filter Each GMRS transmitter, except a Mobile station transmitter with a power of 2.5Watts or less, must be equipped with an audio low pass filter. At any frequency between 3 & 20 kHz the filter must have an attenuation of  $60\log(f/3)$  greater than the attenuation at 1KHz. See below.



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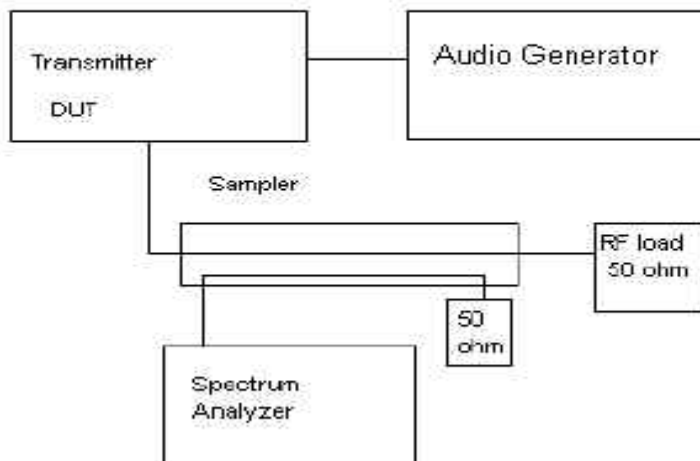
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2.1049 Occupied bandwidth :

95.635 (b) (1) (3) (7)

At least 25dB on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth. At least 35dB on any frequency removed from the center of the authorized BW by more than 100% up to and including 250% of the authorized BW. At least  $43 + \log_{10}(TP)$  dB on any frequency removed from the center of the authorized bandwidth by more than 250%. See plots on the next 2 pages.

Occupied BW Test Equipment Setup



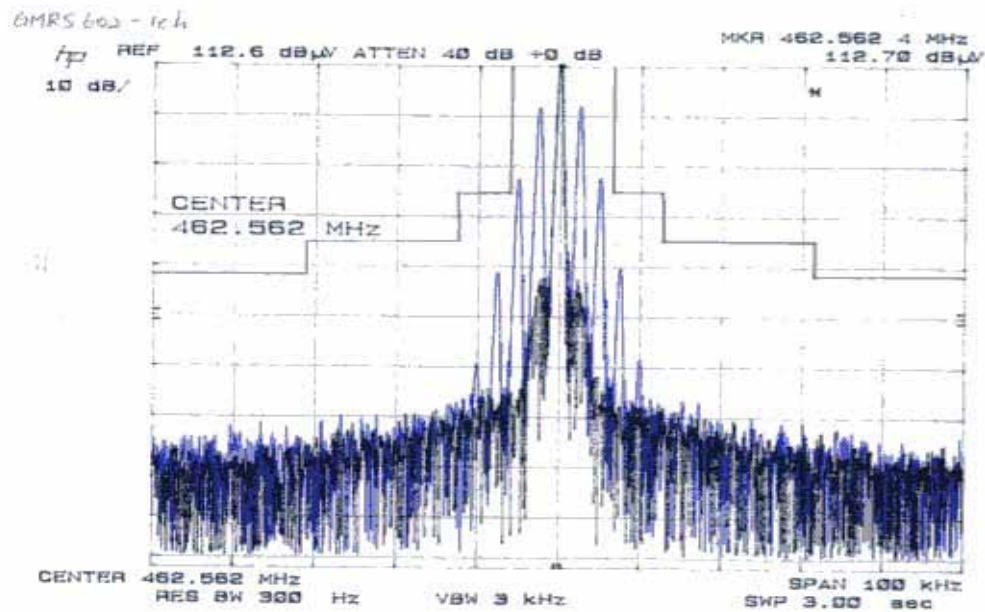
# THRUlab & Engineering.

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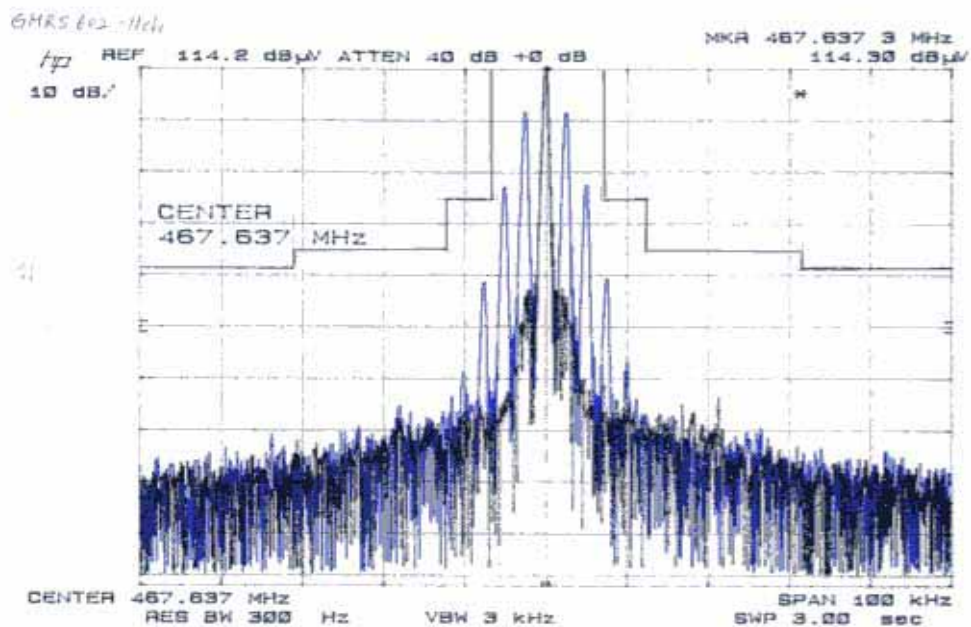
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1ch



11ch



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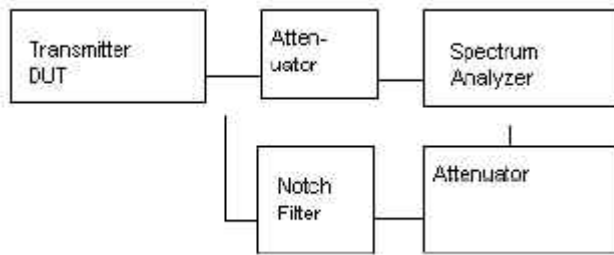
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2.1051 Spurious emissions at antenna terminals (conducted) :

The following data shows the level of conducted spurious responses at the antenna terminal. The test procedure used was TIS/EIA 603 S2.2.13 with the exception that the emissions were recorded in dBc. The spectrum was the fundamental.

spurious Emission at  
antenna Terminals



Method of Measuring Conducted Spurious Emissions

2.1051 Spurious emissions at the Antenna Terminals

NAME OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

2.1051 Not Applicable, no antenna terminal allowed.

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2.1053

## UNWANTED RADIATION

95.635 (b) (7)

The tabulated Data shows the results of the radiated Field strength emissions test. The spectrum was Scanned from 30 MHz to at least the 10<sup>th</sup> harmonic of The fundamental. This test was conducted per ANSI C63.4 - 1992

**REQUIREMENTS: GMRS (HIGH) :  $43 + 10\log(0.872) = 42.40516\text{dB}$**

**(LOW) :  $43 + 10\log(0.427) = 39.30427\text{dB}$**

| Test Data :        | GMRS-    | High Power |  | Test Data :        | GMRS -   | Low Power |
|--------------------|----------|------------|--|--------------------|----------|-----------|
| Emission Frequency | ATTN dBc | Margin dB  |  | Emission Frequency | ATTN dBc | Margin dB |
| 462.56             | 0.00     | 0.00       |  | 462.56             | 0.00     | 0.00      |
| 925.13             | 44.26    | 1.85       |  | 925.13             | 44.56    | 5.25      |
| 1387.69            | 51.80    | 9.40       |  | 1387.69            | 62.80    | 23.50     |
| 1850.25            | 60.77    | 18.36      |  | 1850.25            | 73.97    | 34.66     |
| 2312.81            | 62.55    | 20.15      |  | 2312.81            | 64.55    | 25.25     |
| 2775.38            | 59.17    | 16.77      |  | 2775.38            | 64.57    | 25.27     |
| 3237.94            | 54.20    | 11.79      |  | 3237.94            | 64.70    | 25.39     |
| 3700.50            | 48.96    | 6.56       |  | 3700.50            | 63.76    | 24.46     |
| 4163.06            | 50.59    | 8.18       |  | 4163.06            | 62.09    | 22.78     |
| 4625.63            | 55.21    | 12.81      |  | 4625.63            | 60.81    | 21.51     |

METHOD OF MEASUREMENT : The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA/EIA STANDARD 603 using the substitution method. Measurements were made at the open field test site of ThruLab & ENGINEERING. located at RM302, BOKJO B/D 29-15, CHONGPA3-DONG YONGSAN-GU, SEOUL, KOREA.

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2.1053

UNWANTED RADIATION:

95.635 (b) (7)

The tabulated Data shows the results of the radiated Field strength emissions test. The spectrum was Scanned from 30 MHz to at least the 10<sup>th</sup> harmonic of The fundamental. This test was conducted per ANSI C63.4 - 1992

**REQUIREMENTS: FRS:  $43 + 10\log(0.397) = 38.98790\text{dB}$**

| Test Data :        | FRS      |           |
|--------------------|----------|-----------|
|                    |          |           |
| Emission Frequency | ATTN dBc | Margin dB |
| 467.64             | 0.00     | 0.00      |
| 935.28             | 49.47    | 10.48     |
| 1402.91            | 65.66    | 26.67     |
| 1870.55            | 74.55    | 35.56     |
| 2338.19            | 65.61    | 26.62     |
| 2805.83            | 64.93    | 25.94     |
| 3273.46            | 62.45    | 23.46     |
| 3741.10            | 62.22    | 23.23     |
| 4208.74            | 61.03    | 22.04     |
| 4676.38            | 59.82    | 20.83     |

METHOD OF MEASUREMENT : The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA/EIA STANDARD 603 using the substitution method. Measurements were made at the open field test site of ThruLab & ENGINEERING. located at RM302, BOKJO B/D 29-15, CHONGPA3-DONG YONGSAN-GU, SEOUL, KOREA.

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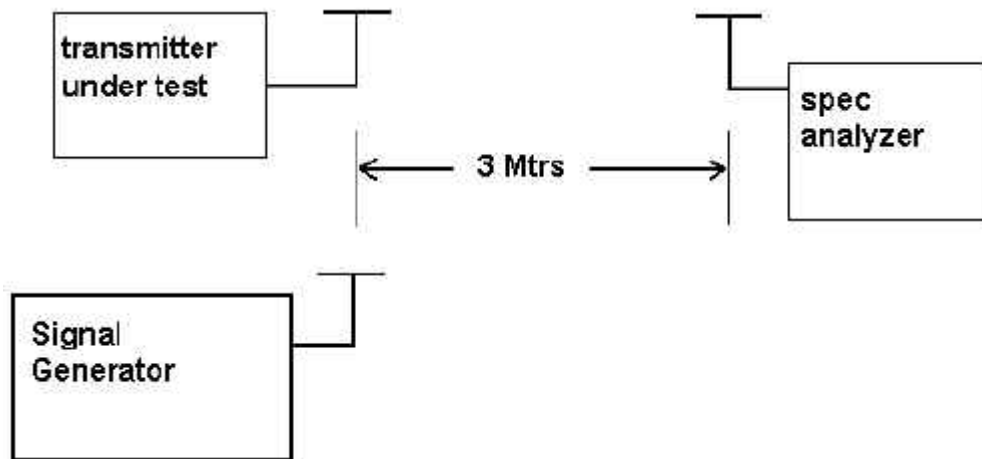
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## Method of Measuring Radiated Spurious Emissions



Equipment placed 80 cm above ground

on a rotatable platform.

\* Appropriate antenna raised from 1 to 4 M.

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## 2.1055 Frequency stability

### 95.621 (b)

Temperature and voltage tests were performed to verify that The frequency remains within the 0.0005%, 5 ppm specification limit. The test was conducted as follows : The transmitter was placed in the temperature chamber at 25 degrees C and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which four frequency readings were recorded at 15 second intervals. The worse case number was taken for temperature plotting. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to - 30 degrees C after which the transmitter was again allowed to stabilize for one hour. The transmitter was keyed ON for one minute, and again frequency readings were noted at 15 second intervals. The worst case number was recorded for temperature plotting. This procedure was repeated in 10 degree increments up to + 50 degrees C.

Reading were also taken at battery end point 6 V/dc

#### MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 462.6375

| TEMPERATURE                    | FREQUENCY(MHz) | ppm   | LIMIT(ppm) |
|--------------------------------|----------------|-------|------------|
| REFERENCE                      | 462.6375       | 0     |            |
| -30                            | 462.6366       | -1.95 | 5.0        |
| -20                            | 462.6374       | -0.22 | 2.5        |
| -10                            | 462.63811      | 1.32  | 2.5        |
| 0                              | 462.63834      | 1.82  | 2.5        |
| 10                             | 462.63814      | 1.38  | 2.5        |
| 20                             | 462.63735      | -0.32 | 2.5        |
| 30                             | 462.63738      | -0.26 | 2.5        |
| 40                             | 462.63681      | -1.49 | 2.5        |
| 50                             | 462.63642      | -2.33 | 2.5        |
| BATT voltage variation<br>+15% | 462.63732      | -0.39 | 2.5        |
| BATT voltage variation<br>-15% | 462.63741      | -0.19 | 2.5        |

Note: This EUT meets the frequency stability requirement for a FRS: +/-2.5ppm over temp range of -20 degrees C to + 50 degrees C. It also meets the GMRS frequency stability requirements : +/- 5ppm over the temp range -30 degrees C to +50 degrees C.

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## EMC Equipment List

| DEVICE                  | MODEL        | MFGR            | SERNO          | DUE . CAL   |
|-------------------------|--------------|-----------------|----------------|-------------|
| EMI Test Receiver       | ESVS 10      | Rohde & Schwarz | 830489/001     | 2005.04.07. |
| Spectrum Analyzer       | 8566B        | Hewlett Packard | 2311A02394     | 2005.04.07. |
| Spectrum Display        | 85662A       | Hewlett Packard | 2542A12429     | 2005.04.07. |
| Quasi-Peak Adapter      | 85650A       | Hewlett Packard | 2521A00887     | 2005.04.07. |
| RF Preselector          | 85685A       | Hewlett Packard | 2648A00504     | 2005.04.07. |
| Pre-Amplifier           | 8449B        | Hewlett Packard | 3008A00375     | 2005.04.07. |
| Pre-Amplifier           | 8447F        | Hewlett Packard | 3113A05367     | 2005.04.07. |
| Spectrum Monitor        | EZM          | Rohde & Schwarz | 862304/007     | 2005.04.07. |
| Bico-Antenna            | 94455-1      | Eaton           | 977            | 2005.03.17. |
| Log-Periodic<br>Antenna | 3146         | EMCO            | 2051           | 2005.03.17. |
| Dipole Antenna          | TDA25/1/2    | Electro Metrics | 176/200/200    | 2005.03.17. |
| Horn Antenna            | SAS-571      | A.H Systems     | 414            | 2005.03.17. |
| Spectrum Analyzer       | R3261C       | Advantest       | 71720189       | 2005.04.07. |
| LISN                    | KNW-242      | Kyoritsu        | 8-923-2        | 2004.07.17. |
| LISN                    | 8012-50-R-24 | Solar           | 8379121        | 2004.07.17. |
| Loop Ant                | 6507         | EMCO            | 1435           | 2004.10.06. |
| Signal Generator        | SMS          | Rohde & Schwarz | 872165/100     | 2005.04.07. |
| Modulation<br>Analyzer  | 8901B        | Hewlett Packard | 3438A05094     | 2005.04.07. |
| Frequency Counter       | CMC251       | Tektronic       | CMC-251TW52489 | 2005.04.07. |
| ModulationAnalyzer      | HP 8901B     | Hewlett Packard | -              | 2005.07.05  |
| Audio Generatior        | Ken AG203    | Kenwood         | -              | 2005.07.05  |
| AC Volt Meter           | Ldr LMV-182  | Leader          | -              | 2005.07.05  |

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