

MEASUREMENT PROCEDURE AND TEST USED

Except where otherwise stated, all measurements are made following the Electronic Industries Association (EIA) Minimum Standard for Portable/Personal Land Mobile Communications FM or PM Equipment 25-1000 MHz-(TIA/EIA-603).

This exhibit presents a brief summary of how the measurements were made, the required limits, and the test equipment used.

The following procedures are presented with this application.

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|----|------------------------------|--------------|
| 1. | RF Power Output | <u> X</u> |
| 2. | Audio Response | <u> X</u> |
| 3. | Low Pass Filter Response | <u> X</u> |
| 4. | Modulation Limiting | <u> X</u> |
| 5. | Occupied Bandwidth | <u> X</u> |
| 6. | Radiated Spurious Emissions | <u> X</u> |
| 7. | Conducted Spurious Emissions | <u> X</u> |
| 8. | Frequency Stability | <u> X</u> |
| 9. | Transient Frequency Behavior | <u> X</u> |

TEST EQUIPMENT LIST

Pursuant To FCC Rules 2.999

1. Spectrum Analyzer
 - A. HP 8591E
 - B. HP 8566
 - C. HP35665A
2. RF Signal Generators
 - A. HP 8665
 - B. HP 8642
 - C. HP 8656
3. RF Millivoltmeter
 - A. Boonton 4200
 - B. Boonton 4210
4. RF Loads
 - A. WEINSCHEL M1418
5. Dipole Antenna Set
 - A. Singer DM-105A series
 - B. EMCO Model 3120
6. RF Power Meters
 - A. HP 436A
 - B. 8482B Power Sensor
 - C. 30 dB High Power Pad
7. Monitor Receivers
 - A. Motorola Comm Syst Analyzer
 - B. HP8901
8. Tenny Temperature Chamber
9. Frequency Counters
 - A. HP 5385A
10. Audio Analyzer
 - A. HP8903B
11. AC/DC Voltmeters
 - A. Fluke8012A Digital Multimeter
12. HP8901B Modulation Analyzer

EXHIBIT 12

RF POWER OUTPUT

Pursuant to FCC Rules 2.985 (a)

Method of Measurement

The RF power output is measured with the value of voltage and current specified in Exhibit 3 as required by 2.983(d) (5). A 50 ohm RF attenuator of proper power rating was used as a load for making these measurements. For Transmitter having an output impedance other than 50 ohm, a suitable matching network is placed between the transmitter and the load.

The power measurements are made using a Hewlett Packard series HP 436A power meter and 30 dB attenuator or a HP 437B power meter.

AUDIO FREQUENCY RESPONSE

Pursuant FCC Rules 2.987 (a)

Method of Measurement

Operate the transmitter under standard test conditions and monitor the output with a frequency deviation meter or calibrated test receiver. With 1000 Hz sine wave audio input applied through a dummy microphone circuit, adjust the audio input to give 30% of full rated system deviation. Maintaining constant deviation, vary the input frequency from 100 to 5000 Hz, and observe the level necessary to maintain a constant 30% modulation.

Minimum Standard

The audio frequency response shall not vary more than +1 or -3 dB from 300 to 3000 Hz as referenced to 1000 Hz level (with the exception of a permissible 6 dB/octave roll off from 2500 to 3000 Hz)

POST LIMITER FILTER FREQUENCY RESPONSE

Pursuant FCC Rules 2.987 (a)

Method of Measurement

Operate the transmitter under standard test conditions and monitor the output with a modulation or calibrated test receiver. Adjust the audio input frequency to 1000 Hz and the input level to 20 dB greater than that required to produce standard test modulation. Note the output level on the frequency deviation meter or a calibrated test receiver. User this output level as reference (0 dB), vary the modulating frequency from 1000 Hz to 30,000 Hz and observe the change in output while maintaining a constant input level.

FCC Limits -- Per applicable rule parts.

A. 25 to 450 MHz

Frequencies between 3 kHz and 15 kHz shall be attenuated greater than the attenuation at 1 kHz by $40 \log_{10}(f/3)$ dB. Frequencies above 15 kHz shall be attenuated 28 dB.

B. 450 to 866 MHz & VHF Marine

Frequencies between 3 kHz and 20 kHz shall be attenuated greater than the attenuation at 1 kHz by $60 \log_{10}(f/3)$ dB. Frequencies above 20 kHz shall be attenuated at least 50 dB.

MODULATION LIMITING

Pursuant FCC Rules 2.987 (a)

Method of Measurement

The transmitter shall be adjusted for full rated system deviation. Adjust the audio input for 60% of rated system deviation at 1000 Hz. Using this level as a reference (0 dB) vary the audio input level from the reference to a level 20 dB above it for modulation frequencies of 300, 1000 and 3000 Hz. Record the system deviation obtained as a function of the input level.

FCC Limits

Minimum Standard - The transmitter modulation must not exceed rated system deviation at any audio frequency input or reasonable change in input level.

OCCUPIED BANDWIDTH

Pursuant to FCC Rules 2.989

Method of Measurement

Data on occupied bandwidth is presented in the form of a spectrum analyzer photograph which illustrates the transmitter sidebands. A photograph is taken of the unmodulated carrier, for reference, to which is superimposed the sideband display generated by modulating the carrier with a 2500 Hz tone at a level 16 dB greater than that required to produce 50 percent modulation. If tone or digital coded squelch is indicated, photographs using both the 2500 Hz tone and the indicated squelch signal are used to modulate the transmitter. During these measurements, the instantaneous Deviation Control is set for a maximum of +2.5 kHz.

FCC Limits - Per Applicable Rule Parts.

Measured Data: . On any frequency removed from the assigned frequency up to 5.625 kHz, the spec is 0 dB. On any frequency removed from the assigned frequency from 5.625 kHz up to and including 12.5 kHz, the spec is at least 7.27(f_d-2.88 kHz) dB down. On any frequency removed from the assigned frequency by more than 12.5 kHz, the spec is at least 50+10log(P) dB (mean output power in watts) or 70 decibels, whichever is the lesser attenuation.

RADIATED SPURIOUS EMISSIONS

Pursuant to FCC Rules 2.993

Test Site:

The site, located at Boynton Beach, Florida in a region which is reasonably free from RF interference and has been approved by the Commission for Spurious Measurements.

The equipment is placed on the turntable and then placed in normal operation using the intended power source. A broadband receiving antenna located 15 ft. from the transmitter picks up any signal radiated from the transmitter and its operation accessories. The antenna is adjustable in height and can be horizontally and vertically polarized. A spectrum analyzer covering the necessary frequency range is used to detect and measure any radiation picked up by the antenna.

Method of Measurement:

The equipment is adjusted to obtain peak reading of received signals wherever they occur in the spectrum by:

1. Rotating the transmitter under test.
2. Adjusting the antenna height.

The testing procedure is repeated for both horizontal and vertical polarization of the receiving antenna. Relative signal strength is indicated on the spectrum analyzer connected to this antenna. All measurements recorded are relative to the fundamental and shown on the attached graphs.

FCC Limits -- Per Applicable Rule Parts.

Radiated spurious emissions shall be attenuated below the maximum level of emission of the carrier frequency in accordance with the following formula:

Spurious attenuation in dB = 50 + 10 log₁₀ (Power output in watts)

CONDUCTED SPURIOUS EMISSIONS

Pursuant to FCC Rule 2.991

Method of Measurement:

The transmitter is terminated into a 50 ohm load and interfaced with a spectrum analyzer which allows the spurious emission level relative to the carrier level to be measured directly. Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of rated system deviation at 1000 Hz. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier or as high as the state of the art permits except for that region close to the carrier equal to $\pm 250\%$ of the authorized bandwidth.

FCC Limits: Per Applicable Rule Parts.

Conducted spurious emissions shall be attenuated below the maximum level of emission of the carrier frequency in accordance with the following formula:

Spurious attenuation in dB = $50 + 10 \log_{10}$ (Power output in watts) or 70 dB, whichever is less.

FREQUENCY STABILITY

Pursuant to FCC Rule 2.995

Method of Measurement:

- A. Temperature (Non-heated type crystals oscillators):
Frequency measurements are made at the extremes of the temperature range -30 to +50 degrees centigrade and at intervals of not more than 10 degrees centigrade through out the range. Sufficient time is allowed prior to each measurement for the circuit components to stabilize.
- B. Power Supply Voltage:
The primary voltage was varied from 80% to 120% of the normal supply voltage. Voltage is measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

FCC Limits -- Per 2.995 (1) & (2) and Applicable Rule Parts.

Temperature - Frequency Stability of $\pm .00025\%$ from -30 to +50 degrees centigrade (-20 to + 50 degrees centigrade Maritime parts 81 & 83).

Power Supply Voltage - Frequency Stability of $\pm .0005\%$ from 85% to 115% of nominal voltage. (See CFR Rule Part 90.213 Page 329)

*Per Applicable Rule Parts.

EXHIBIT 12