MEASUREMENT PROCEDURE AND TEST EQUIPMENT 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-(EIA/TIA-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.

1.	Test Equipment List	x
2.	RF Power Output	x
3.	Audio Response	x
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TEST EQUIPMENT LIST

Pursuant To FCC Rules 2.999

1. HP 8568B/8560E Spectrum Analyzer.
2. HP 8657B RF Signal Generator.
3. Antenna Set:

   A. UHF whip B. UHF helical.
4. HP 437B RF Power Meter.
5. HP 8901B Modulation Analyzer.
6. Heraeus (HT 4002) Temperature Chamber.
7. HP 6623A Power Supply.
8. HP 89441A Vector Signal Analyzer
9. HP 8903B Audio Analyzer.
10. Fluke 8010A Digital Multimeter.
11. Tektronics TDS-540B

RF POWER OUTPUT

Pursuant to FCC Rules 2.985 (a)

Method of Measurement

The RF power output is measured with the transmitter adjusted in accordance with the tune-up procedure outlined in Exhibit 7 to give the value of voltage and current as specified in Exhibit 4 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 437B 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 20% of full rated system deviation Maintaining a constant input voltage, vary the input frequency from 300 to 3000 Hz, and observe the deviation.

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 of the post limiter low-pass filter with an audio spectrum analyzer or AC voltmeter. 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 audio spectrum analyzer or AC voltmeter. User this output dB level as reference (LEVREF), vary the modulating frequency from 3000 Hz to the upper low pass filter limit and record the dB level on the audio spectrum analyzer or AC voltmeter as LEVFRE while maintaining a constant input level. The audio frequency response of the low-pass filter in accordance with the following formula:

Low-Pass Filter Response = LEVFREQ-LEVREF

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 869 MHz & VHF Marine.

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

Frequencies above 20 kHz shall be attenuated at least 50 dB.

C. 896-901 MHz or 935-940 MHz

Frequencies between 3 kHz and 20 kHz shall be attenuated greater than the attenuation at 1 kHz by 100log10(f/3) 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 +5 kHz.

FCC Limits - Per Applicable Rule Parts.

Measured Data: At least +25 dB down on any frequency removed from the assigned frequency by more than 50 % and up to and including 100% of the authorized bandwidth. At least +35 dB

down on any frequency removed from the assigned frequency by more than 100% up to and including 250% of the authorized bandwidth; at least 43 plus 10 log $_{10}$ (mean output power in watts) decibels or 80 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, connected to a dummy RF load and then placed in normal operation using the intended power source. A broadband receiving antenna, located 3 meters from the transmitter-under-test (TUT), picks up any signals radiated from the transmitter and its operation accessories. The antenna is adjustable in height and can by horizontally and vertically polarized. A spectrum analyzer covering the necessary frequency range is used to detect and measure any radiation picked up by the above mentioned receiving 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 the receiving antenna. To obtain actual radiated signal strength for each spurious and harmonic frequency observed, a standard signal generator with calibrated output is connected to a dipole antenna adjusted to that particular frequency. This dipole antenna is substituted for the transmitter under test. The signal generator is adjusted in output level until a reading identical to that obtained with the actual transmitter is observed on the spectrum analyzer. Signal strength is then read directly from the generator. Actual measurements are recorded 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 = 43 + 10 $\log_{10}$(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 ± 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 = 43 + 10 log $_{10}$ (Power output in watts) for 25 kHz Channelization.
Spurious attenuation in dB = 50 + 10 log $_{10}$ (Power output in watts) for 12.5 kHz Channelization.

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 +60 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 85% to 115% 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 +.0005% from -30 to +60 degrees centigrade (-20 to + 50 degrees centigrade Maritime parts 81 & 83).
Power Supply Voltage - Frequency Stability of ± .0005% from 85% to 115% of nominal voltage.

TRANSIENT FREQUENCY BEHAVIOR

Pursuant to FCC Rule 90.214

Transient frequency behavior is a measure of the difference, as a function in time, of the actual transmitter frequency to the assigned transmitter frequency when the transmitted RF output power is switched on or off.

Setup -- Per TIA/EIA 603, Section 2.2.19

Connect the output port of the transmitter under test (TUT) to an attenuator, and this to a directional coupler. Connect an RF peak detector to the coupled output of the directional coupler, and connect the output of the RF peak detector to the external trigger on a storage oscilloscope. The output of the directional coupler is mixed, via an RF combining network, with the output of a signal generator. Verify that the TUT signal level present at the combining network output is approximately 40 dB below the maximum input level of the test receiver as per step (f). Set the

signal generator at the same frequency as the TUT, modulated with a 1 kHz tone, with an FM deviation equal to the assigned channel spacing (+25 kHz). Following step (h), adjust the signal generator to provide 20 dB less power at the combiner output than the level set in step (f). Connect the output of the RF combiner to a test receiver, and the test receiver's output port to a vertical input channel of the storage scope. Adjust the horizontal sweep rate on the oscilloscope to 10 msec/div, and the vertical amplitude to display the 1 kHz tone over +/- 4 divisions centered on the display. Reduce the transmit attenuation by 30 dB as per step (l) so that the difference in the power between the reference signal and the TUT signal at the combiner is 50 dB when the TUT is turned on. Following step (k), adjust the oscilloscope to trigger on an increasing signal from the RF detector at one division from the left side of the display when the TUT is turned on. Switch on the TUT and record the display (for RF Output Power ON). Following step (q), adjust the oscilloscope trigger controls to trigger on a decreasing signal from the RF peak detector, at 1 division from the right side of the display when the TUT is turned off. Switch off the transmitter and record the display (for RF Output Power OFF).

* Steps (f), (h), (k), (l), and (q) - section 2.2.19 of the TIA/EIA 603 were followed.

Method of Measurement -- Per TIA/EIA-603-2.2.19.

For RF Output Power ON: Turn the transmitter ON. Once the demodulator output has been captured by the transmitter power, the 1 kHz test signal will be completely suppressed. This point in time is named T-on. The display will then show the frequency difference from the assigned frequency to the actual transmitter frequency versus time. Two time intervals will be measured following T-on: T-1 and T-2.
So, the RF ON time intervals are as follows: T-on --------> T-1 ----------> T-2

For RF Output Power OFF: Turn the transmitter OFF. The display will show the transmitter frequency difference versus time, and when the 1 kHz test signal starts to rise, it indicates total absence of the transmitter output at the specified frequency. This point is named T-off. Time interval T-3 precedes T-off.
So, the RF OFF time intervals are as follows: T-3 --------> T-off.

FCC Limits -- Per 90.214.

	Frequency Range (MHz)		
Time Interval	30 to 300	300 to 500	500 to 1000
T-1	5.0 ms	10.0 ms	20.0 ms
T-2	20.0 ms	25.0 ms	50.0 ms
T-3	5.0 ms	10.0 ms	10.0 ms

*Per Applicable Rule Parts.

MODEL NUMBERS

H24SDC9PW5ANM1 No Display and no Key-pad
H24SDF9PW5ANM2 Full Display with partial Keypad
H24SDH9PW7ANM3 Full Display with full Keypad