TEST SET- UP PROCEDURES

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.

1.	RF Power Output	_____X
2.	Audio Response	_____X
3.	Low Pass Filter Response	_____X
4.	Modulation Limiting	_____X
5.	Occupied Bandwidth	_____X
6.	Radiated Spurious Emissions	_____X
7.	Conducted Spurious Emissions	__N/A
8.	Frequency Stability	_____X
9.	Transient Frequency Behavior	_____X
10.	Bluetooth Measured data	_____X

MOTOROLA

FCC ID: AZ489FT4900

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

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 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 a 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)

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

Frequencies between 3 kHz and 20 kHz shall be attenuated greater than the attenuation at 1 kHz by 60 $1og_{10}$ (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(fd-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 Plantation, 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 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 antenna.

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 producing 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 = 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 +.00025% from -30 to +50 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. (See CFR Rule Part 90.213 Page 329)

*Per Applicable Rule Parts.

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 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 scope. The output of the directional coupler is mixed, via an RF combining network, with the output of a signal generator. Verify that the

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 transmitter under test, 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. Connect the test receiver's output port to the vertical input channel of the storage scope. Adjust the horizontal sweep rate on the oscilloscope to 10 msec/div and adjust the vertical amplitude to display the 1 kHz tone at

+/- 4 divisions centered on the display. Reduce the transmit attenuator by 30 dB as per step (l) so that the difference in power between the reference signal and the transmitter signal at the combiner is 50 dB when the transmitter 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 transmitter is turned on. Switch on the transmitter 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 transmitter is turned off. Switch off the transmitter and record the display (For RF Output Power OFF).

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

Method of Measurement -- Per TIA/EIA-603

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

Bluetooth Carrier Frequency Separation – Pursuant 47 CFR 15.247(a)(1)

The RF output port of the Device under Test (DUT) is directly coupled to the input of the spectrum analyzer through a specialized RF connector. A power supply is used for the supply voltage. The DUT has its hopping function enabled. The following spectrum analyzer settings are used:

Span = 5 MHz (wide enough to capture the peaks of two adjacent channels)

Resolution Bandwidth (RBW) = 100 kHz (≥ 1% of the span)

Video (or Average) Bandwidth (VBW) = 300 kHz (≥ RBW)

Sweep = auto

Detector function = peak

Trace = max hold

The trace is allowed to stabilize. The marker-delta function is used to determine the separation between the peaks of the adjacent channels. The limit is specified to be greater than the 20 dB bandwidth of the hopping channel.

Bluetooth Number of Hopping Frequencies – Pursuant 47 CFR 15.247(a) (1)(iii)

The RF output port of the DUT is directly coupled to the input of the spectrum analyzer through a specialized RF connector. A power supply is used for the supply voltage. The DUT must have its hopping function enabled. The following spectrum analyzer settings are used:

Span = 100 MHz (the frequency band of operation)

RBW = 100 kHz (≥ 1% of the span)

VBW = 100 kHz (≥ RBW)

Sweep = auto

Detector function = peak

Trace = max hold

The trace is allowed to stabilize. The limit is specified as a minimum of 15 non-overlapping channels over a total span of at least 75 MHz.

Time of Occupancy (Dwell Time) – Pursuant 47 CFR 15.247(a) (1)(iii)

The RF output port of the DUT is directly coupled to the input of the EMC analyzer through a specialized RF connector. A power supply is used for the supply voltage. The DUT has its hopping function enabled. The following spectrum analyzer settings are used:

Span = zero span, centered on a hopping channel

RBW = 1 MHz

VBW $\geq$ RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

Use the marker-delta function to determine the dwell time. Subparagraph 15.247(a)(1)(iii) states “The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.” This equates to a time period of 31.6 seconds.

A single measurement cannot be made over a 31.6 second period due to the coarse resolution in the time domain. A sweep is first made in a 4 second period. The resolution is not fine enough to capture the dwell time in each burst but the periodicity can be seen. The number of time slots occupied (40) can be extrapolated to show the number of time slots occupied within a 31.6 second period ($41 \bullet \frac{32s}{4s} = 328$).

Another sweep is made over a 5 ms period, allowing the measurement of the duration of one time-slot. This active time can be multiplied by the number of transmissions in a 31.6 second period (328) to derive the total dwell time in a 31.6 second period. The specification is 400 ms maximum dwell time.

20 dB Bandwidth – Pursuant 47 CFR 15.247(a) (1)(ii)

The RF output port of the DUT is directly coupled to the input of the spectrum analyzer through a specialized RF connector. A power supply is used for the supply voltage. The DUT must have its hopping function enabled. The following spectrum analyzer settings are used:

Span = 2 MHz (approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel)

RBW = 50 kHz (≥ 1% of the 20 dB bandwidth)

VBW = 50 kHz (≥ RBW)

Sweep = auto

Detector function = peak

Trace = max hold

The DUT transmits at its maximum data rate. The trace is allowed to stabilize. The marker-to-peak function is used to set the marker to the peak of the emission. The marker-delta function is used to measure 20 dB down one side of the emission. The marker-delta function is reset and the marker is moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The limit is specified as a maximum of 1 MHz.

Peak Output Power – Pursuant 47 CFR 15.247(b) (1)

The RF output port of the DUT is directly coupled to the input of the spectrum analyzer through a specialized RF connector. A power supply is used for the supply voltage. The DUT must have its hopping function enabled. The following spectrum analyzer settings are used:

Span = 5 MHz (approximately 5 times the 20 dB bandwidth, centered on a hopping channel)

RBW = 1 MHz (> the 20 dB bandwidth of the emission being measured)

VBW = 1 MHz (≥ RBW)

Sweep = auto

Detector function = peak

Trace = max hold

The trace is allowed to stabilize. The marker-to-peak function is used to set the marker to the peak of the emission. The indicated level is the peak output power. The maximum level is specified as 1 Watt.

Band-Edge Compliance of RF Conducted Emissions – Pursuant 47 CFR 15.247(c)

The RF output port of the DUT is directly coupled to the input of the spectrum analyzer through a specialized RF connector. A power supply is used for the supply voltage. The following spectrum analyzer settings are used:

Span = 10 MHz (wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation)

RBW = 100 kHz (≥ 1% of the span)

VBW = 100 kHz (≥ RBW)

Sweep = auto

Detector function = peak

Trace = max hold

The trace is allowed to stabilize. The marker is set on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. The marker-delta function is enabled and then the marker-to-peak function is used to move the marker to the peak of the in-band emission. The marker-delta value displayed must be greater than 20 dB.

Now, using the same instrument settings, the hopping function of the DUT is enabled. The trace is allowed to stabilize. The same procedure listed above is followed to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

Spurious RF Conducted Emissions – Pursuant 47 CFR 15.247(c)

The RF output port of the DUT is directly coupled to the input of the spectrum analyzer through a specialized RF connector. A power supply is used for the supply voltage. The following spectrum analyzer settings are used:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Several plots are required to cover this entire span.

RBW = 100 kHz

VBW = 100 kHz (≥ RBW)

Sweep = auto

Detector function = peak

Trace = max hold

BT Spurious RF Radiated Emissions - Pursuant 47 CFR 15.247(c)

Measurement was done at ACS Engineering Lab.