



Hearing Aid Compatibility (HAC) RF Emissions Test Report

APPLICANT : Motorola Mobility, LLC
EQUIPMENT : Mobile Cellular Phone
BRAND NAME : Motorola Mobility, LLC
MODEL NAME : 4079
FCC ID : IHDT56PK2
STANDARD : FCC 47 CFR §20.19
ANSI C63.19-2011
HAC RATING : M4

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Eric Huang / Deputy Manager

Approved by: Jones Tsai / Manager



SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.



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Revision History

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|--------------|---------|-------------------------|---------------|
| HA462024-03A | Rev. 01 | Initial issue of report | Sep. 18, 2014 |
| | | | |
| | | | |



1. Statement of Compliance

The HAC Rating of each air interface found during testing for the **Motorola Mobility, LLC, 4079** are follows:

| Band | M Rating |
|---------------|----------|
| GSM850 | M4 |
| GSM1900 | M4 |
| WCDMA Band II | M4 |
| WCDMA Band IV | M4 |
| WCDMA Band V | M4 |
| LTE Band 17 | M4 |
| LTE Band 5 | M4 |
| LTE Band 4 | M4 |
| LTE Band 2 | M4 |
| LTE Band 7 | M4 |

They are in compliance with HAC limits specified in guidelines FCC 47 CFR §20.19 and ANSI Standard ANSI C63.19.

HAC Rating = M4 (ANSI C63.19-2011)

2. Administration Data

| Testing Laboratory | |
|--------------------|---|
| Test Site | SPORTON INTERNATIONAL INC. |
| Test Site Location | No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978 |
| Applicant | |
| Company Name | Motorola Mobility, LLC |
| Address | 222 W Merchandise Mart Plaza, Suite 1800, Chicago, IL 60654, United States |
| Manufacturer | |
| Company Name | Motorola Mobility, LLC |
| Address | 222 W Merchandise Mart Plaza, Suite 1800, Chicago, IL 60654, United States |



3. General Information

3.1 Description of Equipment Under Test (EUT)

| Product Feature & Specification | |
|--|---|
| EUT Type | Mobile Cellular Phone |
| Brand Name | Motorola Mobility, LLC |
| Model Name | 4079 |
| FCC ID | IHDT56PK2 |
| Tx Frequency | GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz LTE Band 17: 706.5 MHz ~ 713.5 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 7: 2502.5 MHz ~ 2567.5 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC: 13.56 MHz |
| Antenna Type | WWAN Fixed Internal Antenna WLAN Fixed Internal Antenna Bluetooth: Fixed Internal Antenna NFC: FPC + Ferrite Antenna |
| Mode | <ul style="list-style-type: none"> • GSM/GPRS/EGPRS • RMC/AMR 12.2Kbps • HSDPA • HSUPA • DC-HSDPA • LTE: QPSK, 16QAM • 802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80 • Bluetooth v3.0+EDR , Bluetooth v4.0-LE • NFC:ASK |
| EUT Stage | Identical Prototype |
| Remark: | |
| 1. This report only assessed WCDMA B4 other frequency band tested results which refer to the Sporton FCC RF Test Report, FCC ID: IHDT56PK1, Report No: HA462024A and Appendix A. | |



3.2 Air Interface and Operating Mode

| Air Interface | Band MHz | Type | C63.19 Tested | Simultaneous Transmitter | OTT | Power Reduction |
|---------------|-----------|------|-------------------|--------------------------|-----|-----------------|
| GSM | 850 | VO | Yes | WLAN, BT | NA | No |
| | 1900 | | | WLAN, BT | NA | No |
| | GPRS/EDGE | DT | No | WLAN, BT | Yes | No |
| WCDMA | 850 | VO | No ⁽¹⁾ | WLAN, BT | NA | No |
| | 1750 | | | WLAN, BT | NA | No |
| | 1900 | | | WLAN, BT | NA | No |
| | HSPA | DT | No | WLAN, BT | Yes | No |
| LTE | Band 2 | VD | No ^(*) | WLAN, BT | NA | No |
| | Band 4 | | | WLAN, BT | | No |
| | Band 5 | | | WLAN, BT | | No |
| | Band 7 | | | WLAN, BT | | No |
| | Band 17 | | | WLAN, BT | | No |
| WLAN | 2450 | DT | No | GSM,WCDMA,LTE | Yes | No |
| | 5200 | | | GSM, WCDMA,LTE | | No |
| | 5300 | | | GSM, WCDMA,LTE | | No |
| | 5500 | | | GSM, WCDMA,LTE | | No |
| | 5800 | | | GSM, WCDMA,LTE | | No |
| BT | 2450 | DT | No | GSM, WCDMA,LTE | NA | No |

VO=CMRS Voice Service
 DT=Digital Transport
 VD=CMRS IP Voice Service and Digital Transport
 (*)No Associated T-Coil measurement has been made in accordance with 285076 D02 T-Coil testing for CMRS IP

Remark:
 1. WCDMA is exempted from testing by low power exemption that its average antenna input power plus its MIF is ≤17 dBm, and is rated as M4

3.3 Applied Standards

- FCC CFR47 Part 20.19
- ANSI C63.19 2011-version
- FCC KDB 285076 D01 HAC Guidance v04
- FCC KDB 285076 D02 T Coil testing for CMRS IP v01r01



4. HAC RF Emission

FCC wireless hearing aid compatibility rules ensure that consumers with hearing loss are able to access wireless communications services through a wide selection of handsets without experiencing disabling radio frequency (RF) interference or other technical obstacles.

To define and measure the hearing aid compatibility of handsets, in CFR47 part 20.19 ANSI C63.19 is referenced. A handset is considered hearing aid-compatible for acoustic coupling if it meets a rating of at least M3 under ANSI C63.19, and A handset is considered hearing aid compatible for inductive coupling if it meets a rating of at least T3.

According to ANSI C63.19 2011 version, for acoustic coupling, the RF electric field emissions of wireless communication devices should be measured and rated according to the emission level as below.

| Emission Categories | E-field emissions | |
|---------------------|-------------------|-------------------|
| | <960Mhz | >960Mhz |
| M1 | 50 to 55 dB (V/m) | 40 to 45 dB (V/m) |
| M2 | 45 to 50 dB (V/m) | 35 to 40 dB (V/m) |
| M3 | 40 to 45 dB (V/m) | 30 to 35 dB (V/m) |
| M4 | <40 dB (V/m) | <30 dB (V/m) |

Table 4.1 Telephone near-field categories in linear units



5. Modulation Interference Factor

The HAC Standard ANSI C63.19-2011 defines a new scaling using the Modulation Interference Factor (MIF).

For any specific fixed and repeatable modulated signal, a modulation interference factor (MIF, expressed in dB) may be developed that relates its interference potential to its steady-state rms signal level or average power level. This factor is a function only of the audio-frequency amplitude modulation characteristics of the signal and is the same for field-strength and conducted power measurements. It is important to emphasize that the MIF is valid only for a specific repeatable audio-frequency amplitude modulation characteristic. Any change in modulation characteristic requires determination and application of a new MIF

The Modulation Interference factor (MIF, in dB) is added to the measured average E-field (in dBV/m) and converts it to the RF Audio Interference level (in dBV/m). This level considers the audible amplitude modulation components in the RF E-field. CW fields without amplitude modulation are assumed to not interfere with the hearing aid electronics. Modulations without time slots and low fluctuations at low frequencies have low MIF values, TDMA modulations with narrow transmission and repetition rates of few 100 Hz have high MIF values and give similar classifications as ANSI C63.19-2007.

ER3D, EF3D and EU2D E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. DASY52 is therefore using the indirect measurement method according to ANSI C63.19-2011 which is the primary method. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by PMR calibration in order to not overestimate the field reading. Probe Modulation Response (PMR) calibration linearizes the probe response over its dynamic range for specific modulations which are characterized by their UID and result in an uncertainty specified in the probe calibration certificate. The MIF is characteristic for a given waveform envelope and can be used as a constant conversion factor if the probe has been PMR calibrated.

The evaluation method for the MIF is defined in ANSI C63.19-2011 section D.7. An RMS demodulated RF signal is fed to a spectral filter (similar to an A weighting filter) and forwarded to a temporal filter acting as a quasi-peak detector. The averaged output of these filtering is scaled to a 1 kHz 80% AM signal as reference. MIF measurement requires additional instrumentation and is not well suited for evaluation by the end user with reasonable uncertainty. It may alternatively be determined through analysis and simulation, because it is constant and characteristic for a communication signal. DASY52 uses well-defined signals for PMR calibration. The MIF of these signals has been determined by simulation and it is automatically applied.



MIF values applied in this test report were provided by the HAC equipment provider, SPEAG, and the values are listed below

| UID | Communication System Name | MIF(dB) |
|-------|---------------------------|---------|
| 10011 | UMTS-FDD(WCDMA) | -27.23 |

The MIF measurement uncertainty is estimated as follows, declared by HAC equipment provider SPEAG, for modulation frequencies from slotted waveforms with fundamental frequency and at least 2 harmonics within 10 kHz:

- i) 0.2 dB for MIF: -7 to +5 dB,
- ii) 0.5 dB for MIF: -13 to +11 dB
- iii) 1 dB for MIF: > -20 dB



6. RF Emissions Test Procedure

Referenced from ANSI C63.19 -2011 section 5.5.1

- a) Confirm the proper operation of the field probe, probe measurement system, and other instrumentation and the positioning system.
- b) Position the WD in its intended test position.
- c) Set the WD to transmit a fixed and repeatable combination of signal power and modulation characteristic that is representative of the worst case (highest interference potential) encountered in normal use. Transiently occurring start-up, changeover, or termination conditions, or other operations likely to occur less than 1% of the time during normal operation, may be excluded from consideration.
- d) The center sub-grid shall be centered on the T-Coil mode perpendicular measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane, refer to illustrated in Figure 8.2. If the field alignment method is used, align the probe for maximum field reception.
- e) Record the reading at the output of the measurement system.
- f) Scan the entire 50 mm by 50 mm region in equality spaced increments and record the reading at each measurement point, The distance between measurement points shall be sufficient to assure the identification of the maximum reading.
- g) Identify the five contiguous sub-grids around the center sub-grid whose maximum reading is the lowest of all available choices. This eliminates the three sub-grids with the maximum readings. Thus, the six areas to be used to determine the WD's highest emissions are identified.
- h) Identify the maximum reading within the non-excluded sub-grids identified in step g).
- i) *Indirect measurement method*
The RF audio interference level in dB (V/m) is obtained by adding the MIF (in dB) to the maximum steady-state rms field-strength reading, in dB (V/m)
- j) Compare this RF audio interference level with the categories in ANSI C63.19-2011 clause 8 and record the resulting WD category rating.
- k) For the T-Coil mode M-rating assessment, determine whether the chosen perpendicular measurement point is contained in an included sub-grid of the first scan. If so, then a second scan is not necessary. The first scan and resultant category rating may be used for the T-Coil mode M rating.

Otherwise, repeat step a) through step i), with the grid shifted so that it is centered on the perpendicular measurement point. Record the WD category rating.

Test Instructions

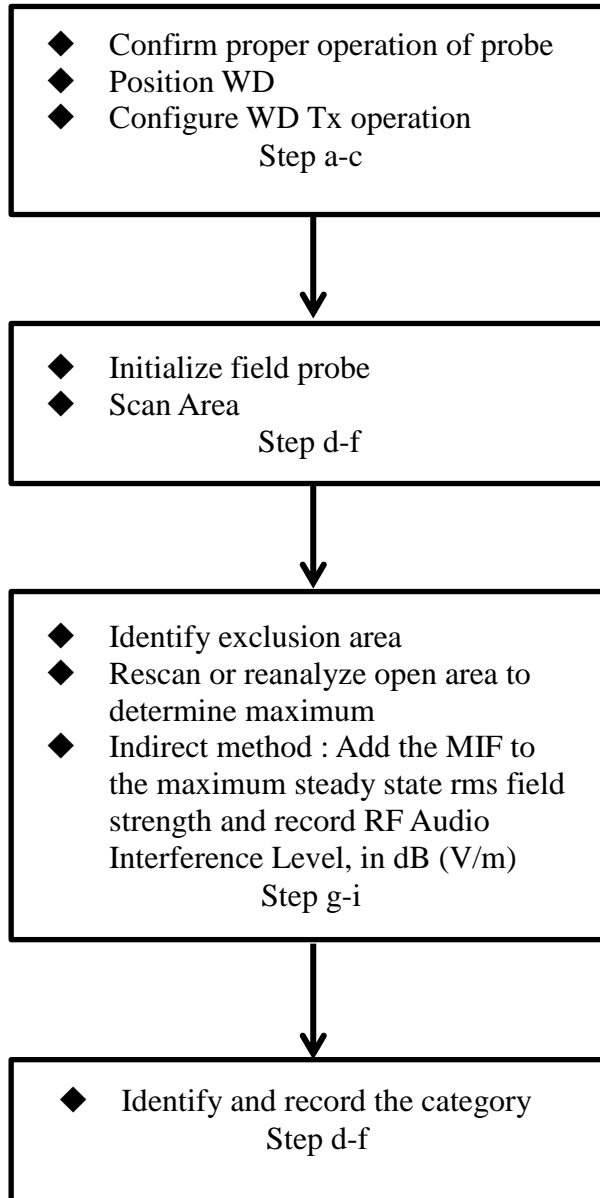


Fig 8.1 Flow Chart of HAC RF Emission



Fig 8.2 EUT reference and plane for HAC RF emission measurements

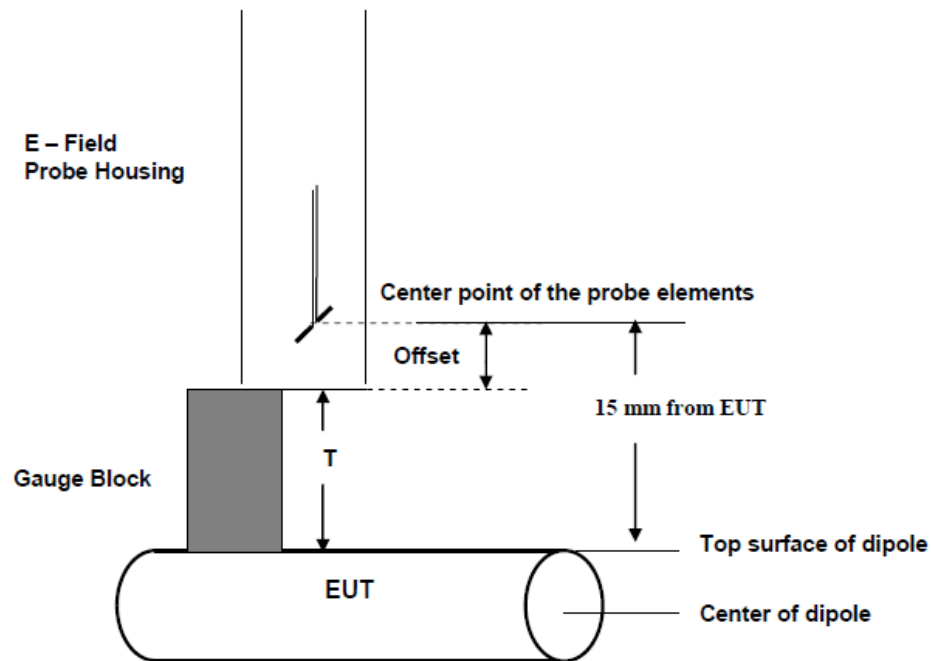


Fig. 8.3 Gauge block with E-field probe



7. Conducted RF Output Power (Unit: dBm)

| Air Interface | WCDMA Band V | | |
|----------------------------------|--------------|--------|--------|
| Channel | 1312 | 1413 | 1513 |
| Frequency (MHz) | 1712.4 | 1732.6 | 1752.6 |
| Average Antenna Input Power(dBm) | 23.97 | 23.71 | 23.92 |

8. Low-power Exemption

According to ANSI C63.19 2011-version, an RF air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤ 17 dBm for any of its operating modes.

| Air Interface | Operating Mode | Average Antenna Input Power (dBm) | MIF (dB) | Power + MIF(dB) | C63.19 test required |
|---------------|----------------|-----------------------------------|----------|-----------------|----------------------|
| WCDMA IV | RMC 12.2Kbps | 23.97 | -27.23 | -3.26 | No |

Conclusion: HAC RF rating is M4 for the air interface which meets the low power exemption.

9. References

- [1] ANSI C63.19-2011, "American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids", 27 May 2011
- [2] SPEAG DASY System Handbook