



## Test Plan

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Revision History

Rev.	Author	Description of Changes	Date
1.0	Verizon Wireless	Initial release.	September 2009
2.0	Verizon Wireless	Version 2.0 Updates/Clarifications/Additions to the following sections: 1.5.10, 1.5.11, 2.1.3, 3.1.2, 3.1.3, 5.2.2, 5.2.3, 5.2.4, 5.2.5, 6	November 2009
3.0	Verizon Wireless	Version 3.0 Updates/Clarifications/Additions to the following sections: 1.4, 1.5, 6 Updates to sections 2.1.2, 3.1.2 based on changes in the September 2009 version of 3GPP TS 36.521-1	December 2009
4.0	Verizon Wireless	Version 4.0 Updates/Clarifications/Additions to the following sections: 1.4, 1.5, 1.5.6, 1.5.12, 3.1.2, 5.2.2, 5.2.3, 5.2.4, 6	March 2010

5.0	Verizon Wireless	Version 5.0 Updates/Clarifications/Additions to the following sections: 1.4, 2.1.3, 3.1.2, 3.1.3.2, 3.1.3.3, 5.2.1, 5.2.2, 6	June 2010
6.0	Verizon Wireless	Version 6.0 Updates/Clarifications/Additions to the following sections: 3.1.2	September 2010
7.0	Verizon Wireless	Version 7.0 Updates/Clarifications/Additions to the following sections: 1.3, 1.5.3, 3.1.2 Update to Release 9 throughout document	December 2010
8.0	Verizon Wireless	Version 8.0 Updates/Clarifications/Additions to the following sections: 1.5.1, 1.5.3, 1.5.4, 3.1.2, 3.1.3, 5.2.3, 5.2.4 Updated CTIA Test Plan for Mobile Station Over the Air Performance references to v3.1	March 2011
9.0	Verizon Wireless	Version 9.0	December 2011

		Updates/Clarifications/Additions to the following sections:  1.5.3	
10.0	Verizon Wireless	Version 10.0  Updates/Clarifications/Additions to the following sections:  1.5.9, 2.1.3, 3.1.3.2, 3.1.3.3, 3.2.3, 4.1.1, 5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.2.5	April 2012
11.0	Verizon Wireless	Version 11.0  Updates/Clarifications/Additions to the following sections:  1.5.3, 4.1.2	July 2012
12.0	Verizon Wireless	Version 12.0  Updates/Clarifications/Additions:  Corrected TRP Test 2 RB allocation RBstart  Removed 6 RB test cases for TIS	October 2012
13.0	Verizon Wireless	Version 13.0  Updates/Clarifications/Additions:  Updated section 1.5.9.1  Updated CTIA Test Plan for Mobile Station Over	February 2013

		the Air Performance references to v3.2	
14.0	Verizon Wireless	Version 14.0 Updates/Clarifications/Additions to the following sections: 1.5.9.1, 3.1.2, 5.2.1  Updated CTIA Test Plan for Mobile Station Over the Air Performance references to v3.2.1	June 2013
15.0	Verizon Wireless	Version 15.0 Clarification on primary vs. secondary receive antenna declaration.	June 2014
16.0	Verizon Wireless	Version 16.0 Corrected Tx ordering - 2.3 and 2.4 interchanged to follow the 36.521 test standard. Error created in June release.	October 2014
17.0	Verizon Wireless	Version 17.0 Updated "CTIA Test Plan for Wireless Device Over the Air Performance" references throughout the document.	February 2015
18.0	Verizon Wireless	Version 18.0 Added clarifications and CTIA references for CA test cases	October 2015
19.0	Verizon Wireless	Version 19.0	February 2016

		Added MIMO OTA Added Wearable (Forearm) device TRP/TIS limits	
20.0	Verizon Wireless	Version 20.0 Added CTIA wide grip hand phantom Added Wearable (Forearm) device TRP/TIS OEM trade-off options between FS versus forearm performance.	June 2016
21.0	Verizon Wireless	Version 21.0 Updates to phantom testing for devices that support voice operation against the head	October 2016
22.0	Verizon Wireless	Version 22.0 Added details on wrist-worn wearable testing requirements. Updated MIMO OTA pass/fail criteria. Added notes on retirement of ECC. Added test tolerance for TRP and TIS.	February 2017
23.0	Verizon Wireless	Version 23.0 Added Cat M1. Added pointers to the CTIA OTA Test Plan for TRP and TIS test procedures. Removed ECC.	June 2017
24.0	Verizon Wireless	Version 24.0	October 2017

		Removed FS for wrist-worn wearables. Updates to align with the CTIA OTA test plan.	
25.0	Verizon Wireless	Version 25.0 Replaced TIS with C-TIS. Updates to align with v3.8 of the CTIA OTA test plan.	October 2018
26.0	Verizon Wireless	Version 26.0 Updates to address foldable devices and small form factor devices. Added LTE Category M1 power class 5 TRP limits.	February 2020
27.0	Verizon Wireless	Version 27.0 Added note on LTE Category 1bis TIS limits in the C-TIS table.	June 2020
28.0	Verizon Wireless	Version 28.0 Updated Band 13 TRP limits. Added NB-IoT.	October 2020
29.0	Verizon Wireless	Version 29.0 Updates to wearable TRP limits.	February 2022
30.0	Verizon Wireless	Version 30.0 Added limits for FWA.	June 2022
31.0	Verizon Wireless	Version 31.0 Added chest worn wearable devices. Added wall/window/table mount devices. Added criteria for devices that do not require RF OTA testing.	June 2023

32.0	Verizon Wireless	Version 32.0 Updates on measurement grids and TRP reporting requirements.	October 2023
33.0	Verizon Wireless	Version 33.0 Added test platform criteria for suspect C-TIS measurements.	February 2024
34.0	Verizon Wireless	Version 34.0 Added clarification to suspect measurement definition.	June 2024

## Introduction

Verizon Wireless requires all devices designed to operate on the Verizon Wireless LTE 3GPP Band 13 network to meet Verizon Wireless over-the-air radiated performance requirements as detailed in the *Verizon Wireless-Specific LTE 3GPP Band 13 RF Performance Requirements* section of the Verizon Wireless LTE 3GPP Band 13 Network Access Device Requirements. This document describes the procedure for verifying that these requirements have been met. Verizon Wireless over-the-air radiated performance requirements and testing are in addition to standard 3GPP LTE RF minimum performance requirements and conformance testing defined in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* and 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*, respectively.

This publication is part of Verizon Wireless compliance with the FCCs rules for 700 MHz C Block (47 C.F.R. § 27.16), as explained in the FCCs Second Report and Order in WT Docket No. 06-150, "Service Rules for the 698-746, 747-762 and 777-792 MHz Bands" released on August 10, 2007.

In this document, the terms LTE (Long Term Evolution) and E-UTRA (Evolved Universal Terrestrial Radio Access) are considered equivalent.

## Test Objectives

The objective of this document is to define the Verizon Wireless LTE over-the-air radiated performance test procedures for devices designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.

This document will be used by employees of device manufacturers, test labs, and Verizon Wireless to guide the execution of Verizon Wireless LTE over-the-air radiated performance testing. This document will also be used to define the Verizon Wireless LTE over-the-air radiated performance test procedures for test automation development.

Specifically, this document includes:

- UE transmitter total radiated power (TRP) test cases
- UE receiver total isotropic sensitivity (TIS) test cases
- UE MIMO measurements

Wherever possible, this test plan uses standard radiated test procedures as defined in the CTIA Test Plan for Wireless Device Over the Air Performance, and 3GPP standard RF conformance test procedures for LTE as defined in 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*.

## Definitions

The following terms are used in this document:

Acronym/Term	Definition
3GPP	3rd Generation Partnership Project, manages GSM, EDGE, UMTS, HSPA, and LTE standards
A-MPR	Additional Maximum Power Reduction
BH	Beside Head (head phantom only)
BHHR	Beside Head and Hand Right Side (head and hand phantom)
BHL	Beside Head Left Side (head phantom only)
BHR	Beside Head Right Side (head phantom only)
DL	Downlink
EIRP	Effective Isotropic Radiated Power
EIS	Effective Isotropic Sensitivity
E-UTRA	Evolved Universal Terrestrial Radio Access
FFS	For Future Study
FS	Free Space

HR	Hand Right (hand phantom only)
LTE	Long Term Evolution
MHz	Mega-Hertz (1 x 10 <sup>6</sup> cycles per second)
MIMO	Multiple Input-Multiple Output
MPR	Maximum Power Reduction
N/A	Not Applicable
RB	Resource Block
RBstart	RB number where a RB allocation begins within the channel
REFSENS	Reference Sensitivity
RS	Reference Symbol
TIS	Total Isotropic Sensitivity
TRP	Total Radiated Power
USB	Universal Serial Bus
UE	User Equipment
UL	Uplink

VZW	Verizon Wireless
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**CTIA Test Plan for Wireless Device Over the Air Performance**

All references to the CTIA Test Plan for Wireless Device Over the Air Performance in this document shall refer to the latest "in force" version of the CTIA test plan unless indicated otherwise.

**Test Site Characteristics and Calibration**

Test site characteristics and calibration shall be per the CTIA Test Plan for Wireless Device Over the Air Performance.

**Data Card Testing**

Data cards that are tethered to a laptop in normal operation shall be tested using a reference laptop. Devices that connect to the USB port of the laptop shall be connected directly to a USB port on the left or right side of the laptop. A USB cable shall not be used to connect the device to the laptop unless the use of a cable is consistent with the mechanical use case(s) of the device. In the case where the use of a cable is consistent with the mechanical use case(s) of the device, the cable shall be as short as possible, preferably less than 6 inches. The laptop shall be configured as per section L.4 of Appendix L of the CTIA Test Plan for Wireless Device Over the Air Performance. When testing mechanical use cases which require a cable, the complete test setup (i.e. laptop, USB cable, and device) shall be centered in the quiet zone (no parts of the test setup shall exceed the quiet zone). *Additional details on the VZW-approved reference laptops (e.g. manufacturer, make, model, CPU, etc.) are FFS and will be included in a future release of this document.*

**Notebook PCs with Embedded LTE Modem Testing**

Testing of notebook PCs, tablets, and ultra-mobile PCs with embedded LTE modems shall include the procedures defined in Appendix L of the CTIA Test Plan for Wireless Device Over the Air Performance.

### Wrist Worn Wearable (Forearm) Devices

Verizon Wireless requires all wearable devices network to meet Verizon Wireless over-the-air radiated performance requirements as detailed in the *Verizon Wireless-Specific LTE 3GPP Band 13 RF Performance Requirements* section of the Verizon Wireless LTE 3GPP Band 13 Network Access Device Requirements. Wrist worn wearable devices shall be tested per Appendix O.6 and Appendix Q of version 3.8 (or later) of the CTIA Test Plan for Wireless Device Over the Air Performance.

**NOTE:** For wrist worn wearable devices, no spacer shall be used between the device and the forearm phantom.

### Chest Worn Wearable Devices

Chest worn wearable devices shall be tested per *CTIA 01.01* and *CTIA 01.72* of version 6.0 (or later) of the CTIA Test Plan for Wireless Device Over the Air Performance. **NOTE:** For chest worn wearable devices, no spacer shall be used between the device and the chest phantom.

### Wall/Window/Table Mount Devices

For a device that is designed to be mounted on a wall or window or sit on a table, the device is only required to be tested over a hemisphere created by a full 360 degrees in azimuth and 90 degrees in elevation such that the hemisphere points away from the wall/window/table and the wall/window/table is the bottom plane of the hemisphere.).

### Mechanical Modes

The test cases in this test plan shall be repeated for all valid mechanical modes of the device and for the antenna retracted and extended for devices with retractable antennas. Pass/fail criteria apply to all valid mechanical modes of the device and for the antenna retracted and extended for devices with retractable antennas.

Valid mechanical modes comprise all the mechanical use modes for the device that an end user would be expected to encounter in the course of normal operation of the device. If a test lab is uncertain about the validity of a mechanical mode, the test lab shall raise this concern to both Verizon Wireless and the device manufacturer. If a device manufacturer believes a mechanical mode tested is invalid, the device

manufacturer shall raise this concern directly to Verizon Wireless. If such a concern is raised, Verizon Wireless shall determine the validity of any mechanical use mode in question.

## Temperature and Voltage Requirements

### Ambient Temperature

The ambient temperature shall be per the normal conditions as defined in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* and 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing*.

### UE Power Supply/Battery Voltage

The UE power supply/battery voltage shall be per the normal operating conditions as defined by the device manufacturer, 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*, and 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing*.

## Devices which Support Voice Operation Against the Head for One or More Modes of Operation

Devices that support voice operation against the head shall be tested per Appendix O.3 of version 3.8 (or later) of the CTIA Test Plan for Wireless Device Over the Air Performance.

**NOTE 1:** If the device supports voice operation against the head in a given mechanical mode and is wider than 72mm (and less than or equal to 92 mm), then the device shall be tested using the CTIA wide grip hand phantom, and the BHHR/BHHL and HR/HL limits in this document shall apply. Per the CTIA Test Plan for Wireless Device Over the Air Performance, only free space is required for devices that supports voice operation against the head in a given mechanical mode and is wider than 92mm.

**NOTE 2:** Foldable devices with a vertical or horizontal hinge that support voice operation against the head shall be tested per Appendix O.3 of version 3.8 (or later) of the CTIA Test Plan for Wireless Device Over the Air Performance and as follows:

- **Open Mechanical Use Case:** FS, HR/HL (if the device fits in the hand phantom in the open mechanical use case), BHHR/BHHL (if the device supports voice against the head in the open mechanical use case and fits in the hand phantom in the open mechanical use case)
- **Closed Mechanical Use Case:** FS, HR/HL (if the device fits in the hand phantom in the closed mechanical use case), BHHR/BHHL (if the device supports voice against the head in the closed mechanical use case and fits in the hand phantom in the closed mechanical use case)

### Data-Centric Devices with No Voice Support

Data-centric devices that do not support voice operation against the head shall be tested per Appendix O.5 of version 3.8 (or later) of the CTIA Test Plan for Wireless Device Over the Air Performance.

### Small Factor Devices (Category M1)

A “Small Form Factor” device is a Category M1 device with no surfaces that individually exceed 2500 mm<sup>2</sup> in area.

### IMS Test Mode Operation

Unless indicated otherwise in the test case procedure, IMS Test Mode shall be enabled for IMS-capable devices for the test cases in this test plan. IMS Test Mode operation is per the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements.

### TRP Testing for Devices with Tx Antenna Switching

TRP testing of devices that support Tx antenna switching shall be per CTIA guidelines as defined in the CTIA Test Plan for Wireless Device Over the Air Performance. For a given phantom, at least one Tx antenna must meet the TRP limit in this test plan for the test to be considered passing.

### Test Tolerance for TRP, TIS, and MARSS

A test tolerance of 0.7 dB is allowed for TRP, TIS, and MARSS. As result, the pass/fail limits for TRP, TIS, and MARSS in this test plan may be relaxed by 0.7 dB to account for the allowed test tolerance. No additional test tolerance shall be applied.

### Measurement Uncertainty

The measurement uncertainty of the radiated performance test solution shall not exceed the values defined in the CTIA Test Plan for Wireless Device Over the Air Performance. Measurement uncertainty calculations shall be per the CTIA Test Plan for Wireless Device Over the Air Performance.

### Devices Not Requiring RF OTA Testing

Per *CTIA 01.01 Test Scope, Requirements, and Applicability* Section 2.1.4 (of the CTIA Test Plan for Wireless Device Over the Air Performance), RF over the air performance testing is not required for the following devices:

*"Integrated Devices with a removable antenna that is connected to the device through an RF transmission line (such as a coaxial cable) greater than 20 cm in length and not physically attached to the host device."*

For these devices, Verizon Wireless requires conducted RF testing at the antenna connectors of the host device. Please consult Verizon Wireless for additional details on the testing required.

### Measurement Grids

TRP and C-TIS testing shall use the measurement grids in Tables 1.1-1 and 1.1-2 below. Tables 1.1-1 and 1.1-2 shall supersede Tables 3.1-2 and 4.1-1 of *CTIA 01.20*, respectively. Any deviation from Tables 1.1-1 and 1.1-2 requires the permission of Verizon Wireless prior to testing.

For TRP test results, TRP shall be calculated and reported four ways:

1. Using the 15 degree (elevation)/15 degree (azimuth) grid per Table 1.1-1 below. This result shall be used for determining pass/fail.
2. Using a 15 degree (elevation)/30 degree (azimuth) grid. This result shall be reported for informational purposes only.
3. Using a 30 degree (elevation)/30 degree (azimuth) grid. This result shall be reported for informational purposes only.
4. Using a 30 degree (elevation)/30 degree (azimuth) grid with a 15 degree shift in both elevation and azimuth compared to item 3 above. This result shall be reported for informational purposes only.

Table 1.1-1: Applicability of TRP Measurement Grids

APPLICABILITY CONDITION	MEASUREMENT GRID STEP SIZE DQ (DEGREES)	UNIQUE NUMBER OF MEASUREMENT POINTS WITH CONSTANT ANGULAR STEP SIZE, SECTION 3.1.1 OF CTIA <i>01.90</i> DQ=DF (DEGREES)	UNIQUE NUMBER OF MEASUREMENT POINTS WITH THETA DEPENDENT PHI OPTIMIZATION, SECTION 2.7 AND SECTION 3.1.2 OF CTIA <i>01.90</i>
Below 3 GHz and Device Size $\leq$ 30 cm	15	266	182
Below 3 GHz and Device Size > 30 cm	15	266	182
Above 3 GHz	15	266	182

Table 1.1-2: Applicability of TIS Measurement Grids

APPLICABILITY CONDITION	MEASUREMENT GRID STEP SIZE DQ (DEGREES)	UNIQUE NUMBER OF MEASUREMENT POINTS WITH CONSTANT ANGULAR STEP SIZE, SECTION 3.1.1 OF CTIA <i>01.90</i> DQ=DF (DEGREES)	UNIQUE NUMBER OF MEASUREMENT POINTS WITH THETA DEPENDENT PHI OPTIMIZATION, SECTION 2.7 AND SECTION 3.1.2 OF CTIA <i>01.90</i>
Below 3 GHz and	30	62	46

APPLICABILITY CONDITION	MEASUREMENT GRID STEP SIZE DQ (DEGREES)	UNIQUE NUMBER OF MEASUREMENT POINTS WITH CONSTANT ANGULAR STEP SIZE, SECTION 3.1.1 OF <i>CTIA 01.90</i> DQ=DF (DEGREES)	UNIQUE NUMBER OF MEASUREMENT POINTS WITH THETA DEPENDENT PHI OPTIMIZATION, SECTION 2.7 AND SECTION 3.1.2 OF <i>CTIA 01.90</i>
Device Size $\leq$ 30 cm			
Below 3 GHz and Device Size > 30 cm	30	62	46
Above 3 GHz	30	62	46

### Suspect Measurements

The test platform shall flag "suspect measurements" during C-TIS testing. The test platform shall provide a count and percentage of suspect measurements. The test platform shall fail a test if  $\geq$  [10%] of the measurements are suspect measurements. The test platform shall consider the following as suspect measurements:

1. No measurement (for the given test point).
2. Measurements at the test platform's maximum transmit output power, including: maximum transmit output power of the equipment, starting transmit output power for the C-TIS test (if the test platform cannot go above the starting transmit output power), any case where the test platform stopped and was not able to achieve the 5% NACK threshold.
3. Measurement is  $\geq$  [20 dB] above or below the average of all measurement values.

**NOTE:** For the determination of suspect measurements, the test platform shall evaluate the sum of both polarizations at each spatial angle.



**2.1 TOTAL RADIATED POWER (TRP) NO MPR OR A-MPR** VZ\_TC\_OTARADPERF\_1448

**Definition**

This test verifies that the UE meets Verizon Wireless requirements for UE maximum radiated transmit output power for uplink RB allocations when MPR and A-MPR are both 0 dB.

**Traceability**

- Verizon Wireless LTE 3GPP Band 13 Network Access Device Requirements, Section *Verizon Wireless-Specific LTE 3GPP Band 13 RF Performance Requirements*
- 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*, section 6.2.2
- 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*, section 6.2.2
- CTIA Test Plan for Wireless Device Over the Air Performance

**Applicability**

This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.

Design Steps
Step Name
Step 1
Pre-Conditions
Procedures
<p><b>Test Procedure - Cat 1 and Higher</b> The TRP test procedure shall be per the CTIA Test Plan for Wireless Device Over the Air Performance.</p> <p><b>Test Procedure - Cat M1</b> The TRP test procedure shall be per v3.8 (or later) of the CTIA Test Plan for Wireless Device Over the Air Performance.</p> <p><b>Test Procedure - NB-IoT</b> The TRP test procedure shall be per v3.9 (or later) of the CTIA Test Plan for Wireless Device Over the Air Performance.</p>
Expected Results
The UE TRP shall meet or exceed the requirements in the tables below.

The conducted output power of the device submitted for Verizon Wireless TRP testing shall not exceed the conducted output power of devices submitted for FCC SAR testing. The device manufacturer shall submit a copy of the FCC SAR compliance filing to confirm that the conducted output power of the device submitted for Verizon Wireless TRP testing does not exceed the conducted output power of devices submitted for FCC SAR testing. If the conducted output power of the device submitted for Verizon Wireless TRP testing exceeds the conducted output power of devices submitted for FCC SAR testing, Verizon Wireless will adjust the TRP results downward as follows before determining compliance to Verizon Wireless TRP requirements:

- The highest conducted output power of all RB allocations used in FCC SAR testing (per the copy of the devices FCC SAR compliance filing) shall be recorded as Pout,peak.
- If the conducted output power of the device for any RB allocation used in Verizon Wireless TRP testing exceeds Pout,peak, the difference the conducted output power and Pout,peak will be subtracted from the final TRP result for the given RB allocation.
- TRP criteria shall be applied to the modified TRP value to determine compliance.

**All Devices that are LTE Category 1 and Higher except Wearable Devices:**

Device Held Up to Head (Yes/No)	Antenna Type	3GPP Band 13 TRP dBm (Minimum)			
		FS	BHR/BHL	BHHR/BHHL	HR/HL
Yes (1)	Embedded	+17	+15	+10	+15
	Stub or Retractable	+19	+16	+11	+13
No (2) - Mobility	All	+18	N/A		
No (2) - FWA	All	+21	N/A		

(1) "Yes" applies if the device supports a mode of operation against the head.

(2) "No" would be applicable to data centric devices that are not held up to the head, e.g. data cards,

USB dongles, embedded laptop modules, etc.		
<p><b>Wearable Devices that are LTE Category 1 and Higher:</b></p>		
Use Case	3GPP Band 13 TRP dBm (Minimum)	
FS (1)	+17	
WR/WL (2)	+8	
ChW (3)	+10	
<p>(1) For wrist worn wearable devices where the forearm phantom is the primary use case, free space testing is not required. <u>For chest worn wearable devices where the chest phantom is the primary use case, free space testing is not required.</u></p> <p>(2) For wrist worn wearable devices, no spacer shall be used between the device and the forearm phantom.</p> <p>(3) <u>For chest worn wearable devices, no spacer shall be used between the device and the chest phantom.</u></p>		
<p><b>LTE Category M1 Devices:</b></p>		
Use Case	3GPP Band 13 TRP dBm (Minimum)	
	Power Class 3	Power Class 5
FS (1)	+18	+15

FS - Small Form Factor (3)	+10	+7
WR/WL (2)	+8	+5
ChW (4)	+10	+7
<p>(1) For wrist worn wearable devices where the forearm phantom is the primary use case, free space testing is not required. <u>For chest worn wearable devices where the chest phantom is the primary use case, free space testing is not required.</u></p> <p>(2) For wrist worn wearable devices, no spacer shall be used between the device and the forearm phantom.</p> <p>(3) A “Small Form Factor” device is a device with no surfaces that individually exceed 2500 mm<sup>2</sup> in area.</p> <p><u>(4) For chest worn wearable devices, no spacer shall be used between the device and the chest phantom.</u></p>		
<p>LTE NB-IoT Devices:</p>		
Use Case	3GPP Band 13 TRP	
	dBm (Minimum)	
	Power Class 3	Power Class 5
FS	+18	+15
FS - Small Form	+10	+7

Factor (1)		
(1) A “Small Form Factor” device is a device with no surfaces that individually exceed 2500 mm <sup>2</sup> in area.		

**3.1 TOTAL ISOTROPIC SENSITIVITY (TIS)** VZ\_TC\_OTARADPERF\_1449

**Definition**

This test verifies that the UE meets Verizon Wireless requirements for UE receiver radiated sensitivity.

**Traceability**

- Verizon Wireless LTE 3GPP Band 13 Network Access Device Requirements, Section *Verizon Wireless-Specific LTE 3GPP Band 13 RF Performance Requirements*
- 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*, section 7.3
- 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*, section 7.3
- CTIA Test Plan for Wireless Device Over the Air Performance

**Applicability**

This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.

<b>Design Steps</b>
<b>Step Name</b>
Step 1
<b>Pre-Conditions</b>
<b>Procedures</b>
<p><b>Test Procedure - Category 1 and higher</b> The C-TIS test procedure shall be per the CTIA Test Plan for Wireless Device Over the Air Performance.</p> <p><b>Test Procedure - Category M1</b> The TIS test procedure shall be per v3.8 (or later) of the CTIA Test Plan for Wireless Device Over the Air Performance.</p> <p><b>Test Procedure - NB-IoT</b> The TIS test procedure shall be per v3.9 (or later) of the CTIA Test Plan for Wireless Device Over the Air Performance. Only testing on the low and high channels is required.</p>
<b>Expected Results</b>
All Devices that are LTE Category 1 and Higher except Wearable Devices:

Device Held Up to Head (Yes/No)	Antenna Type	3GPP Band 13 C-TIS, 10 MHz Channel Bandwidth (3) dBm (Maximum)			
		FS	BHR/BHL	BHHR/BHHL	HR/HL
Yes (1)	Embedded	-93.5	-88.5	-82.5	-88.5
	Stub or Retractable	-93.5	-90.5	-84.5	-90.5
No (2) - Mobility	All	-93.5	N/A		
No (2) - FWA	All	-93.5	N/A		

(1) "Yes" applies if the device supports a mode of operation against the head.

(2) "No" would be applicable to data centric devices that are not held up to the head, e.g. data cards, USB dongles, embedded laptop modules, etc.

(3) There is no antenna imbalance limit.

(4) For LTE Category 1bis, the single receiver TIS values are equal to the C-TIS values above plus 2.5 dB.

**Wearable Devices that are LTE Category 1 and Higher:**

Number of Receive Antennas	Use Case	3GPP Band 13 C-TIS, 10 MHz Channel Bandwidth (3) dBm (Maximum)	
1	FS (1)	-91	

	WR/WL (2)	-80
	<u>ChW (4)</u>	<u>-80.5</u>
>=2	FS (1)	-93
	WR/WL (2)	-82
	<u>ChW (4)</u>	<u>-82.5</u>
<p>(1) For wrist worn wearable devices where the forearm phantom is the primary use case, free space testing is not required. <u>For chest worn wearable devices where the chest phantom is the primary use case, free space testing is not required.</u></p> <p>(2) For wrist worn wearable devices, no spacer shall be used between the device and the forearm phantom.</p> <p>(3) There is no antenna imbalance limit.</p> <p><u>(4) For chest worn wearable devices, no spacer shall be used between the device and the chest phantom.</u></p>		
<p><b>LTE Category M1 Devices:</b></p>		
Use Case	3GPP Band 13 TIS, 10 MHz Channel Bandwidth (3) dBm (Maximum)	
FS (1)	-97	
FS - Small Form Factor (4)	-88	
WR/WL (2)	-86	
<u>ChW (5)</u>	<u>-86.5</u>	

(1) For wrist worn wearable devices where the forearm phantom is the primary use case, free space testing is not required. For chest worn wearable devices where the chest phantom is the primary use case, free space testing is not required.

(2) For wrist worn wearable devices, no spacer shall be used between the device and the forearm phantom.

(3) 10 MHz refers to the macro channel bandwidth. The TIS values are calculated based on the 6 RB's that compose the LTE Category M1 narrowband index. This is equivalent to the definition of REFSSENS in 3GPP TS 36.521-1 section 7.3EA.5.

(4) A "Small Form Factor" device is a device with no surfaces that individually exceed 2500 mm<sup>2</sup> in area.

(5) For chest worn wearable devices, no spacer shall be used between the device and the chest phantom.

**LTE NB-IoT Devices:**

Use Case	3GPP Band 13 TIS dBm (Maximum)
FS	-105
FS - Small Form Factor (1)	-96

(1) A "Small Form Factor" device is a device with no surfaces that individually exceed 2500 mm<sup>2</sup> in

area.

## 3.2 RECEIVER ENVELOPE CORRELATION COEFFICIENT AND MIMO PERFORMANCE VZ\_TC\_OTARADPERF\_1450

### Definition

This test verifies that the UE meets Verizon Wireless requirements for UE receiver envelope correlation coefficient (ECC)/MIMO.

### Traceability

- Verizon Wireless LTE 3GPP Band 13 Network Access Device Requirements, Section *Verizon Wireless-Specific LTE 3GPP Band 13 RF Performance Requirements*
- 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*, section 7.3
- 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*, section 7.3
- CTIA Test Plan for Wireless Device Over the Air Performance
- CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance

### Applicability

This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.

Design Steps
Step Name
Step 1
Pre-Conditions
Procedures
<p>The device shall perform MIMO open-loop spatial multiplexing (TM<sub>3</sub>) testing as defined in the latest "in force" version of the CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance for Band 13. In addition, the following apply:</p> <ul style="list-style-type: none"> <li>• The device shall be tested in all applicable free space device orientations defined in Appendix D of the CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance.</li> <li>• The device vendor may provide results from ANY OTA chamber that is CTIA approved for the latest "in force" version of the CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance. <b>NOTE:</b> This ONLY applies to MIMO OTA testing.</li> <li>• All test results shall be provided using the test results reporting defined in Appendix C.1 of the CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance.</li> <li>• If the device supports 4 receiver operation, then MIMO OTA testing shall be performed with all 4 receivers enabled.</li> </ul>
Expected Results
Expected Result

For each free space device orientation:

- The device shall meet 70% of the theoretical maximum throughput in all 12 azimuthal orientations. Otherwise, the test for the given free space device orientation shall be considered as failed.
- The device shall meet 90% of the theoretical maximum throughput in at least 10 of the 12 azimuthal orientations. Otherwise, the test for the given free space device orientation shall be considered as failed.
- The device shall meet 95% of the theoretical maximum throughput in at least 10 of the 12 azimuthal orientations. Otherwise, the test for the given free space device orientation shall be considered as failed.
- The MARSS spatially averaged values for DL SIR are to be reported for 70%, 90%, and 95% of the theoretical maximum throughput. The MARSS value for the 70% outage point shall not exceed 23.5 dB. The MARSS values for the 90% and 95% outage points shall not exceed 26 dB. **NOTE:** A test tolerance of 0.7 dB is allowed for MARSS. As result, the pass/fail limits for MARSS may be relaxed by 0.7 dB to account for the allowed test tolerance. No additional test tolerance shall be applied.

## References VZ\_TC\_OTARADPERF\_1354266

### <Industry Standards References>

Change requests may cause modification to the specifications listed below. Please refer to [www.3gpp.org](http://www.3gpp.org) for the latest version of the 3GPP specifications. Verizon Wireless LTE 3GPP Band 13 specifications are available at [opennetwork.verizonwireless.com](http://opennetwork.verizonwireless.com).

3GPP TS 36.101: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception, Release 9

3GPP TS 36.508: Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing, Release 9

3GPP TS 36.521-1: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing, Release 9

CTIA Test Plan for Over the Air Performance

### <Verizon Specific Documentation References>

"Verizon Wireless LTE 3GPP Band 13 Test Equipment List"

"Verizon Wireless LTE 3GPP Band 13 Network Access Device Requirements"

"Verizon Wireless LTE 3GPP Band 13 Supplementary RF Conformance Test Plan"

"Verizon Wireless LTE 3GPP Band 13 Device Conformance Test Process"

"Verizon Wireless LTE 3GPP Band 13 Lab Conformance Test Plan"

"Verizon Wireless LTE 3GPP Band 13 Data Throughput Test Plan"

### <Other Applicable References>

## Requirement Coverage For Test Plan

### 2.1 TOTAL RADIATED POWER (TRP) NO MPR OR A-MPR VZ\_TC\_OTARADPERF\_1448

Requirement Name	Requirement Plan Id	Created By	Created Date
MAXIMUM RADIATED OUTPUT POWER	LTEB13NAC	Admin User	11-07-0013 14:27:34

### 3.1 TOTAL ISOTROPIC SENSITIVITY (TIS) VZ\_TC\_OTARADPERF\_1449

Requirement Name	Requirement Plan Id	Created By	Created Date
Antenna Configuration Request Message	LTEB13NAC	Admin User	11-07-0013 14:25:02
Antenna Configuration Status Request Message	LTEB13NAC	Admin User	11-07-0013 14:25:05
Antenna Configuration Status Response Message	LTEB13NAC	Admin User	11-07-0013 14:25:07
Antenna Error Response Message	LTEB13NAC	Admin User	11-07-0013 14:25:04
Antenna Information Request Message	LTEB13NAC	Admin User	11-07-0013 14:24:59
Antenna Information Response Message	LTEB13NAC	Admin User	11-07-0013 14:25:01

LTE Test Application for Antenna Testing Requirements	LTEB <sub>13</sub> NAC	Admin User	11-07-0013 14:24:58
MIMO ANTENNA REQUIREMENTS	LTEB <sub>13</sub> NAC	Admin User	11-07-0013 14:24:35
RADIATED SENSITIVITY	LTEB <sub>13</sub> NAC	Admin User	11-07-0013 14:27:46
RADIATED SENSITIVITY - Primary Receiver	LTEB <sub>13</sub> NAC	Admin User	11-07-0013 14:27:48
RADIATED SENSITIVITY - Secondary MIMO Receiver	LTEB <sub>13</sub> NAC	Admin User	11-07-0013 14:27:49
RSSI and Relative Phase Measurements, Accuracy, and Averaging	LTEB <sub>13</sub> NAC	Admin User	11-07-0013 14:25:08

3.2 RECEIVER ENVELOPE CORRELATION COEFFICIENT AND MIMO PERFORMANCE VZ\_TC\_OTARADPERF\_1450

Requirement Name	Requirement Plan Id	Created By	Created Date
MIMO Antenna Envelope Correlation Coefficient	LTEB <sub>13</sub> NAC	Admin User	11-07-0013 14:27:51