LTE & NR Over-the-Air Performance Test Plan

Version 4.3
November 2021

Revision	Description	Summary of Revisions	Initials	Release Date
1.0	1st Release	Initial release	MK	3/31/2011
1.1	2nd Release	Modifications Table 3.1.3-1	MK	4/19/2011
2.0	3rd Release	Modifications Tables 2.1.3-1 and 3.1.3-1	MK	11/15/2011
2.1	4th Release	Modifications Tables 2.1.3-1, 3.1.3-1and 3.1.3-2	MK	5/11/2012
2.2	5th Release	Modifications Tables 2.1.2-1, 3.1.2-1, 3.1.2-2, 3.1.3-1. Added Section 1.6 for Test Channels	MK	7/24/2012
2.3		Modifications Tables 2.1.2-1, 3.1.2-1, 3.1.2-2, 3.1.3-1	MK	9/24/2012
2.4		Modified Tables 2.1.3-1 and 3.1.3-1. Also reduced the measurement uncertainty levels from +/-2.5 to +/-1.5.	MK	11/8/2012
3.0		Modified section 1.6, Included new measurement uncertainty levels are included. In order to reduce test times USCC only require 10 MHz results, unless specified otherwise.	MK	11/29/2012
3.1			MK	5/17/2013
3.2		Modified Table 2.1.2-1, TRP resource block allocations, updated table 3.1.3-2	MK	05/6/2014
3.3		Modified Tables 3.1.3-1 and 3.1.3-2. Also added roaming band requirements (band 13,17 and 25)	MK	10/16/2014
3.4		Modified Band 25 and 13 TIS limits	MK	11/25/2014
3.5		Adjusted Uplink RB allocations for Band 12,13,17 and 25 in section 3	MK	12/03/2014
3.6		Added Band 12 Mid channel, updated limits in table 2.1.3-1 and 3.1.3-1	MK	07/17/2015
3.7		Formatting cleanup. TIS & TRP reduced by 1dB. Band 17 removed. BH removed. Band 12 channel BW is now 5MHz. B2 optional with B25. CTIA spec ver. 3.6.1. Corrected BHHR case in **Error! Reference source not found.**	SM	3/6/2017
4.0		- Removed " U.S. Cellular LTE 3GPP Network Access Device Requirements" reference - Added Band 66 and 71 - Added wrist worn (WL) TRP/TIS requirements - Removed antenna type from TRP requirements - Corrected **Error! Reference source not found.** - removed HR, BHHR for devices not held up to head	SM	4/6/2018
4.1		- Changed to Combined TIS testing instead of Primary/Secondary - Updated to CTIA OTA test plan 3.8.1 - Removed conducted receiver & transmitter testing & limits - B13 BHHR TRP/TIS changed per VZW specs - 1.6.6, 2.1.6 added language for multiple Tx antennas - Added 1.6.8, 1.6.9 (wearable & non-voice devices) - Added Cat-M sections 3.1.7, 3.1.8 - Removed envelope correlation coef. 3.2, 4	SM	5/2//2019
4.2		- Section 1.2 changed B71 from 10MHz BW to 5MHz	SM	6/13/2019
4.3		- Logo & title updated, general updates to include NR - Updated to CTIA OTA 3.9.3 - Simplified Rx table, removed channels, earfcn, RBs. These are per CTIA. - Added SFF device definition and specs for LTE-M and NBIOT - Added high-power FWA - Reference measurement channels, test site config removed. Use CTIA docs.	SM	11/1/2021

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1 INTRODUCTION

U.S. Cellular requires all devices designed to operate on the U.S. Cellular LTE & NR network and on other operators networks to meet U.S. Cellular over-the-air radiated performance requirements. This document describes the procedure for verifying that these requirements have been met.

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

1.1 TEST OBJECTIVES

The objective of this document is to define the U.S. Cellular LTE and NR over-the-air radiated performance test procedures and minimum requirements for devices designed to operate on the U.S. Cellular LTE network and on other operators LTE and NR networks.

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

Specifically, this document includes:

- UE transmitter total radiated power (TRP) test cases
- UE combined receiver total isotropic sensitivity (C-TIS) test cases
- UE transmit power EIRP and receiver sensitivity EIS for NR FR2

Wherever possible, this test plan uses standard radiated test procedures as defined in [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3 and 3GPP standard RF conformance test procedures for LTE as defined in [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, Release 13*.

For NR FR2 testing, this test plan uses test procedures defined in [7] CTIA Certification Test Plan for 5G Millimeter Wave Over the Air Performance Ver 1.0.2 and [6] 3GPP TS 38.521-3 *User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios, Release 15*

1.2 Band and Bandwidth Definition

The scope of this test plan includes the following 3GPP LTE and NR bands and channel bandwidths:

Table 1.2-1 LTE Band & Bandwidth Scope

LTE Band	Channel Bandwidth
2, 4, 5, 13, 66	10MHz
12, 25, 71	5MHz

If the device supports Band 25 and Band 2, then testing is only required to be completed in Band 25 using Band 25 channel configuration and requirement limits.

If the device supports Band 66 and Band 4, then testing is only required to be completed in Band 66 using Band 66 channel configuration and requirement limits.

Table 1.2-2 NR Band & Bandwidth Scope

NR Band	Channel Bandwidth
N260, N261	100MHz

1.3 Abbreviations and Acronyms

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)
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 106 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
USC	United States Cellular
WL	Wrist-worn Left

1.4 ENTRANCE CRITERIA

All vendors shall successfully pass this test plan per LTE & NR bands listed in section 0.

1.4.1 DEVICE CONFORMANCE TEST PROCESS

Prior to testing, U.S Cellular strongly recommends that all devices pass 3GPP standard RF conformance per [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, Release 13* and EN-DC sections of [6] 3GPP TS 38.521-3 *User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios, Release 15*

1.5 UE CONFIGURATION

1.5.1 IMS TEST MODE OPERATION

The device shall support an IMS test mode in which the IMS client is disabled. By default, this test mode shall be disabled, i.e. the IMS client is enabled. Unless indicated otherwise in the test case procedure, IMS Test Mode shall be enabled in the device for the test cases in this test plan.

1.5.2 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 [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3

1.5.3 NOTEBOOK PC'S WITH EMBEDDED LTE MODEM

Testing of notebook PC's, tablets, and ultra-mobile PC's with embedded LTE modems shall include the procedures defined in Appendix L of [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3

1.5.4 *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 during 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 U.S Cellular and the device manufacturer. If a device manufacturer believes a mechanical mode tested is invalid, the device manufacturer shall raise this concern directly to U.S Cellular. If such a concern is raised, U.S Cellular shall determine the validity of any mechanical use mode in question.

1.5.5 *UE Transmitter Configuration*

If a device supports transmitter antenna switching or transmit diversity, all transmitters and antenna selection algorithms shall be enabled and configured per the planned commercial implementation.

1.5.6 *Wrist Worn Wearable (Forearm) Devices*

Wrist worn wearable devices shall be tested per Appendix O.6 and Appendix Q of [4]CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3.

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

1.5.7 *Data-Centric Devices with No Voice Support (excluding High Power FWA)*

Data-centric devices that do not support voice operation against the head shall be tested per Appendix O.5 of CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3. This includes the applicability to devices with internal antennas, removable antennas or antennas connected via <20cm transmission line.

1.5.8 *Small-Form-Factor (SFF) Devices*

SFF IoT devices are data-centric devices that are no larger than 107mm along the longest dimension, excluding any cables or optional accessories, and operate on LTE-M or NB-IOT networks. SFF devices should not be used for critical data communication, or in underground or indoor locations due to their reduced OTA performance which will reduce coverage in such locations.

1.5.9 *High Power Fixed Wireless Access (FWA) Devices*

High-Power FWA devices are intended for permanent outdoor installation and support 5G FR2 bands with Power Class 1. These devices have directional antennas for FR2 bands and are intended to provide home internet service to the end user.

1.6 TEST EQUIPMENT CONFIGURATION

1.6.1 TEST APPLICATION SUPPORT

To enable the radiated receiver performance testing in this test plan, the test platform shall communicate with a test application on the device. This test application shall provide complex antenna pattern (i.e. RSSI and phase) from device as per section 6.16.4.1[4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3. The test application shall also be capable of storing complex antenna pattern data (i.e. both magnitude and phase) on the device for both antennas used in the reception of LTE signals in the format specified in section 6.16.4.1 [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3. The device vendor shall provide a PC client to download the stored antenna pattern data into a .csv file on the PC (for downloading, the device shall be tethered to a PC via a USB connection) after test completion.

1.6.2 AMBIENT TEMPERATURE

The ambient temperature shall be per the normal conditions as defined in [1] 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception, Release 13* and [2] 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 13*.

1.6.3 UE POWER SUPPLY/BATTERY VOLTAGE

The UE power supply/battery voltage shall be per the normal operating conditions as defined by the device manufacturer, [1] 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception, Release 13*, and [2] 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 13*.

1.7 LTE MEASUREMENT UNCERTAINTY

The results of the calculations for expanded uncertainty for both LTE TRP and TIS measurements shall be reported, along with full documentation to support the resulting values. The expanded LTE TRP and TIS uncertainties must not exceed the values in below table at a 95% confidence level.

Table 1.7-1 Measurement Uncertainty maximum limits

Expected Uncertainty		
Test Configuration	**TRP**	**TIS**
Free Space	2	2.3
Beside Head and Hand Right	2.4	2.6
Beside Head and Hand Left	2.4	2.6
Hand Right	2.2	2.4

2 TRANSMITTER TESTS

2.1 LTE TOTAL RADIATED POWER (TRP)

2.1.1 DEFINITION

This test verifies that the UE meets U.S Cellular requirements for UE maximum radiated transmit output power for uplink RB allocations. OEM's must provide results for all bands supported by the device.

2.1.2 TRACEABILITY

- [1] 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception, Release 13*, section 6.2.2
- [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, Release 13*, section 6.2.2
- [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3

2.1.3 APPLICABILITY

This test case applies to all UE's designed to operate on LTE networks on bands defined in section 0.

"FS" (free space) DUT conditions apply to all voice-centric and data-centric device form factors that have integrated antennas, except for wrist-worn devices. Additional "HR" and "BHHR" DUT conditions only apply if the device supports a mode of operation against the head.

"WL" (wrist-worn left) DUT condition applies to devices whose primary mode of operation is on the users wrist. These devices need to be tested only in the "WL" condition. See [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3 for details.

2.1.4 MAXIMUM POWER REDUCTION

Maximum Power Reduction (MPR) and Additional Maximum Power Reduction (A-MPR) algorithms shall be disabled for all transmitter testing.

2.1.5 TEST PROCEDURE

The test procedure for Total Radiated Power procedure shall be per the CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3 section 5.8, 5.15 (LTE-M1) and 5.16 (NB-IOT) for all EUTRA bands listed in section 0 of this document, all applicable mechanical modes in section 1.5 of this document and the applicable DUT conditions such as FS, BHHR, HR and/or WL.

2.1.6 TRP MINIMUM REQUIREMENTS

The requirements below apply to all power class 3 devices, including Cat-M1 and Cat-NB (NB-IOT).

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

For devices with multiple transmit antennas, at least one of the transmit antennas must meet the following requirements for each band defined in section 0.

Table 2.1-1 TRP Minimum Requirements – LTE, LTE Cat-M, NB-IOT

Device worn on the body (Yes/No)	Device held up to Head (Yes/No)	Power Class 3 TRP Requirement (dBm) Bands 2,4,5,12,25,66				
		DUT Condition				
		FS	HR	BHHR	WL	Small FF
No	Yes	18	13	11	NA	NA
No	No	18	NA	NA	NA	10
Yes	No	NA	NA	NA	8	NA
		Band 71				
No	Yes	17	12	10	NA	NA
No	No	17	NA	NA	NA	NA
		Band 13				
No	Yes	17	15	10	NA	NA
No	No	18	NA	NA	NA	10

2.1.7 *EXPECTED RESULTS*

The UE TRP shall meet or exceed the requirements in Table 2.1-1 for all applicable test conditions and UE configurations. Measurement uncertainty calculation shall be per [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3

The conducted output power of the device submitted for USCC 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 USCC 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 USCC TRP testing exceeds the conducted output power of devices submitted for FCC SAR testing, USCC will adjust the TRP results downward as follows before determining compliance to USCC TRP requirements:

The highest conducted output power of all RB allocations used in FCC SAR testing (per the copy of the device's FCC SAR compliance filing) shall be recorded as $P_{out,peak}$. If the conducted output power of the device for any RB allocation used in USCC TRP testing exceeds $P_{out,peak}$, the difference the conducted output power and $P_{out,peak}$ 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.

2.2 TRANSMIT POWER FOR FWA DEVICES

2.2.1 DEFINITION

This test verifies that the Power Class 1 FWA UE meets U.S Cellular requirements for maximum radiated transmit output power in NR FR2 bands.

2.2.2 TRACEABILITY

- [5] 3GPP TS 38.101-2 *NR User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone, Release 15*
- [7] CTIA Certification Test Plan for 5G Millimeter Wave Over the Air Performance Ver 1.0.2

2.2.3 APPLICABILITY

This test case applies to all Power Class 1 FWA devices defined in 1.5.9.

2.2.4 MAXIMUM POWER REDUCTION

Maximum Power Reduction (MPR) shall be disabled for all transmitter testing.

2.2.5 TEST PROCEDURE

The test procedure for FR2 transmit output power shall be per [7] CTIA Certification Test Plan for 5G Millimeter Wave Over the Air Performance Ver 1.0.2, section 5. This test procedure implies that the UE is operating in EN-DC mode. Any supported LTE anchor band can be used for this testing.

2.2.6 PEAK EIRP MINIMUM REQUIREMENTS

The following requirement is sourced from section 6.2.1.1 of [5]. The Min EIRP requirement has been adjusted by 5dB to reflect existing product performance.

The following requirements define the maximum output power radiated by the UE for any transmission bandwidth within the channel bandwidth for non-CA configuration, unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). The minimum output power values for EIRP are found in Table 2.2-1. The requirement is verified with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 2.2-1 UE minimum peak EIRP for power class 1

Operating band	Min peak EIRP (dBm)
n260	43.0
n261	45.0
NOTE 1: Minimum peak EIRP is defined as the lower limit without tolerance	

2.2.7 EIRP & TRP MAXIMUM REQUIREMENTS

The following requirement is sourced from section 6.2.1.1 of [5]

The maximum output power values for TRP and EIRP are found in Table 2.2-2 below. The maximum allowed EIRP is derived from regulatory requirements [8]. The requirements are

verified with the test metrics of TRP (Link=TX beam peak direction, Meas=TRP grid) in beam locked mode and EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 2.2-2 UE maximum output power limits for power class 1

Operating band	Max TRP (dBm)	Max EIRP (dBm)
n260	35	55
n261	35	55

2.2.8 *EIRP MINIMUM SPHERICAL COVERAGE*

The following requirement is sourced from section 6.2.1.1 of [5]. The Min EIRP requirement has been adjusted by 5dB to reflect existing product performance.

The minimum EIRP at the 85th percentile of the distribution of radiated power measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 2.2-3 below. The requirement is verified with the test metric of EIRP (Link=Spherical coverage grid, Meas=Link angle).

Table 2.2-3 UE spherical coverage for power class 1

Operating band	Min EIRP at 85 %-tile CDF (dBm)
n260	35.0
n261	37.0
NOTE 1: Minimum EIRP at 85 %-tile CDF is defined as the lower limit without tolerance NOTE 2: The requirements in this table are verified only under normal temperature conditions as defined in Annex E.2.1.	

2.2.9 *EXPECTED RESULTS*

The UE shall meet or exceed the transmit power requirements defined in Table 2.2-1, Table 2.2-2 and Table 2.2-3 for all applicable test conditions and UE configurations. Measurement uncertainty and templates for reporting of results shall be per [7] CTIA Certification Test Plan for 5G Millimeter Wave Over the Air Performance Ver 1.0.2

3 RECEIVER TESTS

3.1 LTE TOTAL ISOTROPIC SENSITIVITY (TIS)

3.1.1 DEFINITION

This test verifies that the UE meets U.S Cellular requirements for UE receiver radiated sensitivity. OEM's must provide results for all bands supported by the device.

3.1.2 TRACEABILITY

- [1] 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception, Release 13*, section 7.3
- [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, Release 13*, section 7.3
- [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3

3.1.3 APPLICABILITY

This test case applies to all UE's designed to operate on LTE networks on bands defined in section 0.

"FS" (free space) DUT conditions apply to all voice-centric and data-centric device form factors that have integrated antennas, except for wrist-worn devices. Additional "HR" and "BHHR" DUT conditions only apply if the device supports a mode of operation against the head.

"WL" (wrist-worn left) DUT condition applies to devices whose primary mode of operation is on the users wrist. These devices need to be tested only in the "WL" condition. See [4] "CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3" for details.

3.1.4 TEST PROCEDURE FOR LTE CATEGORY 1 OR HIGHER DEVICES

The C-TIS test procedure shall be per the CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3 for all EUTRA bands listed in section 0 of this document, all applicable mechanical modes in section 1.5 of this document and the applicable DUT conditions such as FS, BHHR, HR and/or WL.

3.1.5 COMBINED RECEIVER TIS (C-TIS) REQUIREMENTS FOR LTE CATEGORY 1 OR HIGHER DEVICES

For a device supporting multiple LTE receivers, all receivers and antenna tuning algorithms shall be enabled and configured per the planned commercial implementation.

Table 3.1-1 TIS Requirements for LTE Cat-1 or higher

EUTRA Band	Channel Bandwidth	C-TIS Requirement (dBm)			
		DUT Condition			
		FS	HR	BHHR	WL
Band 2, 25	10MHz	-93	-89	-86	-83
Band 4, 66	10MHz	-93	-89	-86	-83
Band 5	10MHz	-92	-88	-84	-80
Band 12	5MHz	-95	-91	-87	-83
Band 13	10MHz	-93.5	-88.5	-82.5	-80
Band 71	5MHz	-92	-88	-84	-80

3.1.6 *MAXIMUM THROUGHPUT FOR REFERENCE MEASUREMENT CHANNELS FOR REFERENCE SENSITIVITY FOR LTE CATEGORY 1 OR HIGHER DEVICES*

Table 3.1-2 Maximum Throughput for TIS Measurement

Maximum Throughput Averaged over 1 Frame (kbps)
3952.8

* Above throughput values are for 10MHz Channel Bandwidth. For 5MHz Channel Bandwidth, the throughput values shall be half of these values.

* As per Annex A.3.2 [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, Release 13*

3.1.7 *TEST PROCEDURE FOR LTE CAT- M1 DEVICES*

The TIS test procedure shall be per [4]CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3 or later, section 6.20.

3.1.8 *TIS REQUIREMENTS FOR LTE CAT- M1 DEVICES*

Table 3.1-3 Cat-M1 TIS Requirements

EUTRA Band	Macro Channel Bandwidth	LTE-M C-TIS (dBm) Freespace	LTE-M Small-Form-Factor C-TIS (dBm) Freespace
Band 2	10MHz	-96	-88
Band 4	10MHz	-96	-88
Band 5	10MHz	-93	-85
Band 12	5MHz	-93	-85

NOTE: Macro Channel Bandwidth refers to the full LTE 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 REFSENS 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, Release 13* section 7.3EA.5.

3.1.9 *Test Procedure for NB-IOT Devices*

The TIS test procedure shall be per [4]CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3 or later, section 6.22.

3.1.10 *TIS Requirements for NB-IOT Devices*

Table 3.1-4 – NB-IOT TIS Requirements

EUTRA Band	NB-IOT C-TIS (dBm) Freespace	NB-IOT Small-Form-Factor C-TIS (dBm) Freespace
Band 2	-105	-97
Band 4	-105	-97
Band 5	-103	-95
Band 12	-103	-95

3.1.11 *Expected Result*

The UE TIS shall meet or exceed the applicable requirements in Table 3.1-1, Table 3.1-3 and Table 3.1-4 for all applicable test conditions and UE configurations. Measurement uncertainty calculation shall be per [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3.

3.2 Receiver Sensitivity for FWA Devices

3.2.1 *Definition*

This test verifies that the Power Class 1 FWA UE meets U.S Cellular requirements for receiver sensitivity in FR2 bands.

3.2.2 *Traceability*

- [5] 3GPP TS 38.101-2 *NR User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone, Release 15*
- [7] [7]CTIA Certification Test Plan for 5G Millimeter Wave Over the Air Performance Ver 1.0.2

3.2.3 *Applicability*

This test case applies to all Power Class 1 FWA devices defined in 1.5.9.

3.2.4 *Test Procedure*

The test procedure for FR2 receiver sensitivity shall be per [7] CTIA Certification Test Plan for 5G Millimeter Wave Over the Air Performance Ver 1.0.2, section 6. This test procedure implies that the UE is operating in EN-DC mode. Any supported LTE anchor band can be used for this testing.

3.2.5 Peak EIS Receiver Sensitivity Requirements

The following requirement is sourced from section 7.3.2.1 of [5]. The Min EIRP requirement has been adjusted by 5dB to reflect existing product performance.

The peak EIS reference sensitivity power level for Power Class 1 FWA device shall be according to section 7.3.2.1 [5] 3GPP TS 38.101-2 *NR User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone, Release 15*

Table 3.2-1 Reference sensitivity for power class 1

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n260	-99.5	-96.5	-93.5	-90.5
n261	-102.5	-99.5	-96.5	-93.5
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in clause 6.2.4				

3.2.6 Spherical EIS Receiver Sensitivity Requirements

The following requirement is sourced from section 7.3.4.1 of [5]. The Min EIRP requirement has been adjusted by 5dB to reflect existing product performance.

The EIS spherical coverage receiver sensitivity for Power Class 1 FWA device shall be according to section 7.3.4.1 [5] 3GPP TS 38.101-2 *NR User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone, Release 15*

Table 3.2-2 EIS spherical coverage for power class 1

Operating band	EIS at 85th %-tile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n260	-91.5	-88.5	-85.5	-82.5
n261	-94.5	-91.5	-88.5	-85.5
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in clause 6.2.4 NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1.				

3.2.7 *Expected Results*

The UE shall meet or exceed the receiver sensitivity requirements defined in Table 3.2-1 and Table 3.2-2 for all applicable test conditions and UE configurations. Measurement uncertainty and templates for reporting of results shall be per [7] CTIA Certification Test Plan for 5G Millimeter Wave Over the Air Performance Ver 1.0.2

4 RESULTS REPORTING

Reporting of test results shall be per Appendix B of [4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3

Reporting of results for section 2.2 Transmit Power for FWA Devices and 3.2 Receiver Sensitivity for FWA Devices shall be per Appendix E of [7] CTIA Certification Test Plan for 5G Millimeter Wave Over the Air Performance Ver 1.0.2

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5 REFERENCES

Change requests may cause modification to the specifications listed below. Please refer to www.3gpp.org for the latest version of the 3GPP specifications.

[1] 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception, Release 13*

[2] 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 13*

[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, Release 13*

[4] CTIA Certification Test Plan for SISO Over the Air Performance, v3.9.3

[5] 3GPP TS 38.101-2 *NR User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone, Release 15*

[6] 3GPP TS 38.521-3 *User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios, Release 15*

[7] CTIA Certification Test Plan for 5G Millimeter Wave Over the Air Performance Ver 1.0.2

[8] 47 CFR Part 30, "UPPER MICROWAVE FLEXIBLE USE SERVICE, §30.202 Power limits", FCC.