**3GPP TSG-RAN WG4 Meeting #116bis R4-251xxxx**

**Prague, Czech Republic, Oct. 13-17, 2025**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** | **1** | **Current version:** | **19.0.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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| ***Title:***  | Draft CR on 38.191 for A-loT device testing |
|  |  |
| ***Source to WG:*** | CMCC |
| ***Source to TSG:*** | RAN4 |
|  |  |
| ***Work item code:*** | Ambient\_IoT\_Solutions-Core |  | ***Date:*** | 2025-09-23 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***Release:*** | Rel-19 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
|  |  |
| ***Reason for change:*** | There are brackets and TBD in clause 8.4.3.RF core requirement reference clause for backscatter power measurement is clause 6 rather than clasue 7.RF core requirement reference clause for unwanted emission measurement is clause 6.3 rather than 6.2 when adding 6.1 for general part. |
|  |  |
| ***Summary of change:*** | For sub-clause 8.4.3, 1)Delete brackets in clause 8.4.3. 2)add missing value of the CW incident power at the device antenna, i.e.10dB higher than the receiver sensitivity requirement.For sub-clause 8.4.2, RF core requirement reference clause for backscatter power measurement is updated as clause 6.For sub-clause 8.4.4, RF core requirement reference clause for unwanted emission measurement is updated as clause 6.3. |
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| ***Consequences if not approved:*** | The OTA testing procedure is not complete. |
|  |  |
| ***Clauses affected:*** |  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | Revised from R4-2513360 |

# 8 OTA test characteristics

## 8.1 General

### 8.1.1 Testing bands

The testing bands are based on operating bands as specified in sub-clause 5.2. The frequency ranges to be tested will be all low, middle and high frequency ranges. The detailed testing parameters as the channel bandwidth, D2R and R2D configuration for each band is defined by RAN5.

## 8.2 Performance metrics

### 8.2.1 Performance metric of Tx requirements

Transmitter power measurements shall be performed using the Effective Isotropic Radiated Power (EIRP) as the measurement metric.

The EIRP is combined from θ and ϕ polarizations:

$$EIRP\left(θ,ϕ\right)=EIRP\_{θ}\left(θ,ϕ\right)|\_{cw\_{θ}\left(θ,ϕ\right)}+EIRP\_{ϕ}\left(θ,ϕ\right)|\_{cw\_{θ}\left(θ,ϕ\right)}+EIRP\_{θ}\left(θ,ϕ\right)|\_{cw\_{ϕ}\left(θ,ϕ\right)}+EIRP\_{ϕ}\left(θ,ϕ\right)|\_{cw\_{ϕ}\left(θ,ϕ\right)}$$

Where $EIRP\_{θ}$ and $EIRP\_{ϕ}$ are the EIRP in the corresponding θ and ϕ polarizations, $CW\_{θ}$ and $CW\_{ϕ}$ are the incident CW in the corresponding θ and ϕ polarizations,

For backscatter power measurement, the EIRP only contains the power of 1st sidebands within D2R channel bandwidth and excludes power of CW.

### 8.2.2 Performance metric of Rx requirements

Receiver sensitivity measurements shall be performed using successful detection rate of R2D as the measurement metric. The DUT’s receiver sensitivity corresponds to the minimum R2D signal power required to provide a successful detection rate no less than 90% under the fixed reference channel (FRC) specified in Annex B.

The effective isotropic sensitivity (EIS) is defined as the minimum power level at which the successful detection rate no less than 90% under the specified FRC, at each given test point.

The EIS is combined from θ and ϕ polarizations:

 $EIS\left(θ,ϕ\right)=\frac{1}{(\frac{1}{EIS\_{θ}\left(θ,ϕ\right)}+\frac{1}{EIS\_{ϕ}\left(θ,ϕ\right)})}$

Where EISθ and EISϕ are the EIS in the corresponding θ and ϕ polarizations.

The EIS partial sphere coverage metric is defined as the maximum R2D EIS radiated in the Theta and Phi range from partial surface within ±45° angular width degrees.



Figure 8.2.2-1: Visualization of Partial sphere within ±45° angular range

## 8.3 Device positioning guidelines

### 8.3.1 Free space

For Free space configuration, the centre of the reference coordinate system shall be aligned with the geometric centre of the DUT in order to minimize the offset between antenna arrays integrated at any position of the device and the centre of the quiet zone.

Table 8.3.1-1: Device positioning for Free space

|  |  |  |
| --- | --- | --- |
| Test condition | DUTorientation | Diagram |
| Free spaceDUT | α = 0º;β = -90º;γ = 0º |  |

For Ambient IoT device, if the device has a rectangular shape, the DUT orientation in Table 8.3.1-1 is applied. The front and back side of device is based on device declaration. Otherwise, the device positioning is based on device declaration.

## 8.4 Anechoic Chamber method

### 8.4.1 General

Test frequency band in clause 8.1.1 is used for tests described in this clause. A device shall be positioned according to the positioning guideline in clause 8.3. Device manufacturers shall declare direction of maximum backscattering to enable efficient measurement as this eliminates the need for spherical scan to find the direction of maximum backscattering.

During tests, device is placed on a platform with either combined axis or distributed axis at the origin of a Cartesian coordinate. Test antenna with two linear orthogonal polarizations supports both CW and Reader, namely CW and Reader share the same antenna with CW and Reader using both polarizations.

Declaration of maximum backscattering direction by device manufacturers can only made in 15-degree step size in both $θ$- and $ϕ$-direction in the coordinate system with reference to (0º, 0º) shown in Table 8.3.1-1 of clause 8.3.

### 8.4.2 Backscattering measurement procedure

Backscattered power is only measured at the direction of maximum backscattering declared by device manufacturers with two CW incident power levels.

The measurement procedure includes the following steps:

1) Place the DUT inside the QZ following the UE positioning guidelines defined in clause 8.3.

2) Position the measurement antenna such that the DUT direction of maximum backscattering faces the measurement antenna according to the declaration from device manufacturers.

3) DUT must be fully charged before the measurement according to device declaration on the required energy conditions.

4) Set the signal generator (i.e., R2D signal) and the CW generator to transmit at the target test frequency with θ-polarization. The transmit power of the signal generator shall be set such that the received power at DUT’s antenna is larger than minimum reference sensitivity requirement of the DUT. The transmit power of the CW generator shall be such that the CW incident power at the device antenna is -27dBm as given in clause 6.

5) Measure the power received in both θ-polarization and ϕ-polarization, either simultaneously or sequentially, and calculate $EIRP\_{DUT}(Pol\_{CW}=θ)$ by adding the composite loss of the entire transmission path, then summing up the power received in θ-polarization and ϕ-polarization.

6) Repeat step 4) and 5) setting the signal generator and the CW generator to transmit in ϕ-polarization and calculate $EIRP\_{DUT}(Pol\_{CW}=ϕ)$ by adding the composite loss of the entire transmission path, then summing up the power received in θ-polarization and ϕ-polarization.

7) Calculate the backscattered power at the direction declared by device manufacturers as:

 $P\_{backscatter}=\left(EIRP\_{DUT}\left(Pol\_{CW}=θ\right)\right)+\left(EIRP\_{DUT}\left(Pol\_{CW}=ϕ\right)\right)$,

where $EIRP\_{DUT}(Pol\_{CW}=θ)$ and $EIRP\_{DUT}(Pol\_{CW}=ϕ)$ are measured backscatter power at the device antenna when incident CW power is in θ-polarization and the ϕ-polarization, respectively.

8) Repeat step 4) to 7) with the CW incident power at the device antenna set to -10dBm as given in clause 6.

### 8.4.3 Sensitivity measurement procedure

Sensitivity is measured at 4 edge points of a partial sphere of 45º degrees in elevation or θ-direction, namely ($θ$=45º, $ϕ$=0º), ($θ$=45º, $ϕ$=90º), ($θ$=45º, $ϕ$=180º), ($θ$=45º, $ϕ$=270º).

The measurement procedure includes the following steps:

1) Place DUT inside the QZ following the UE positioning guidelines defined in clause 8.3.

2) DUT must be fully charged before the measurement according to device declaration on the required energy conditions.

3) Set the CW generator to transmit at the target test frequency with θ-polarization. The transmit power of the CW generator shall be set such that the CW incident power at the device antenna is 10dB higher than the receiver sensitivity requirement.

4) Set the signal generator (i.e., R2D signal) to transmit at the target test frequency with θ-polarization. The transmit power of the signal generator shall be set such that the received power at DUT’s antenna is at least 10dB above minimum reference sensitivity requirement of the DUT.

5) Confirm that the DUT can send correct response in D2R channel within correct timing relationship and the test equipment is able to decode the responses by measuring the power received in both θ-polarization and ϕ-polarization either simultaneously or sequentially.

6) Determine $EIS\_{DUT}(Pol\_{Meas}=θ;Pol\_{CW}=θ)$, i.e., by sweeping the transmit power level for the signal generator (i.e., R2D signal), until 90% response decode success rate is achieved, determined by whether DUT can send correct response in D2R channel within correct timing relationship and the test equipment is able to decode 90% of the responses.

7) Repeat step 5) for all grid points and record $EIS\_{DUT}(Pol\_{Meas}=θ;Pol\_{CW}=θ)$.

8) Switch the signal generator (i.e., R2D signal) to transmit at the target test frequency with ϕ-polarization.

9) Calculate the EIS at every grid point using linear values:

 $EIS\_{total}(Pol\_{CW}=θ)=\left[\frac{1}{EIS\_{DUT}(Pol\_{Meas}=θ;Pol\_{CW}=θ)}+\frac{1}{EIS\_{DUT}(Pol\_{Meas}=ϕ;Pol\_{CW}=θ)}\right]^{-1}$

10) Switch the CW generator to transmit at the target test frequency with ϕ-polarization and repeat step 4) to 8), and calculate the EIS under CW with ϕ-polarization

 $EIS\_{total}(Pol\_{CW}=ϕ)=\left[\frac{1}{EIS\_{DUT}(Pol\_{Meas}=θ;Pol\_{CW}=ϕ)}+\frac{1}{EIS\_{DUT}(Pol\_{Meas}=ϕ;Pol\_{CW}=ϕ)}\right]^{-1}$

11) For each grid point, select the minimum $EIS\_{total}$:

 $EIS\_{total}\left(θ,ϕ\right)=min\left\{EIS\_{total}\left(θ,ϕ,Pol\_{CW}=θ\right),EIS\_{total}\left(θ,ϕ,Pol\_{CW}=ϕ\right)\right\} $

12) Select the worst result from all grid points and compare with the core requirement in clause 7.2.

The sensitivity at peak direction is measured at the first position of the measurement antenna in the maximum performance direction declared by device manufacturers, then use the above test procedure without step 7).