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| 3GPP TS 38.161 V0.2.0 (2022-03) | |
| Technical Specification | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  NR;  User Equipment (UE) TRP (Total Radiated Power) and TRS (Total Radiated Sensitivity) requirements;  Range 1 Standalone and Range 1 Interworking operation with other radios  (Release 17) | |
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# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document establishes the TRP (Total Radiated Power) and TRS (Total Radiated Sensitivity) requirements for NR UEs operating on Range 1 Standalone and Range 1 Interworking operation with other radios.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 38.834: “Measurements of User Equipment (UE) Over-the-Air (OTA) performance for NR FR1; Total Radiated Power (TRP) and Total Radiated Sensitivity (TRS) test methodology”.

[3] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[4] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[5] 3GPP TS 38.521-1: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 Standalone".

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

[7] 3GPP TS 38.508-1: "5GS; User Equipment (UE) conformance specification; Part 1: Common test environment ".

…

[x] <doctype> <#>[ ([up to and including]{yyyy[-mm]|V<a[.b[.c]]>}[onwards])]: "<Title>".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Definition format (Normal)

**<defined term>:** <definition>.

**example:** text used to clarify abstract rules by applying them literally.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

Symbol format (EW)

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

Abbreviation format (EW)

NSA Non-Standalone, a mode of operation where operation of an other radio is assisted with an other radio

OTA Over The Air

SA Standalone

TRP Total Radiated Power

TRS Total Radiated Sensitivity

UE User Equipment

# 4 General

## 4.1 Relationship between minimum requirements and test requirements

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification in RAN5 will define test tolerances for FR1 TRP TRS. The test tolerances are used to relax the minimum requirements in this specification to create test requirements.

## 4.2 Applicability of minimum requirements

<Editor’s note: Detailed structure of the subclause is TBD. >

### 4.2.1 General

### The minimum requirements apply only to the primary mechanical mode of UE in the environmental conditions specified in Annex C.4.2.2 UE mechanical modes

The mechanical modes of a device under test (DUT) are declared by the manufacturer. A DUT shall have at least one mechanical mode. If only one mode is supported, then this is defined as the primary.

# 5 Frequency bands

## 5.1 General

<Editor’s note: Detailed structure of the subclause is TBD. >

## 5.2 Operating bands

<Editor’s note: Detailed structure of the subclause is TBD. >

### 5.2.1 FR1 Standalone Operating bands

The requirements defined in this specification for FR1 standalone apply to the operating bands defined in Table 5.2.1-1.

Table 5.2.1-1 NR operating bands in FR1 standalone

|  |  |  |  |
| --- | --- | --- | --- |
| NR operating band | Uplink (UL) *operating band* BS receive / UE transmit  FUL\_low  – FUL\_high | Downlink (DL) *operating band* BS transmit / UE receive  FDL\_low – FDL\_high | Duplex Mode |
| n1 | 1920 MHz – 1980 MHz | 2110 MHz – 2170 MHz | FDD |
| n2 | 1850 MHz – 1910 MHz | 1930 MHz – 1990 MHz | FDD |
| n3 | 1710 MHz – 1785 MHz | 1805 MHz – 1880 MHz | FDD |
| n5 | 824 MHz – 849 MHz | 869 MHz – 894 MHz | FDD |
| n7 | 2500 MHz – 2570 MHz | 2620 MHz – 2690 MHz | FDD |
| n8 | 880 MHz – 915 MHz | 925 MHz – 960 MHz | FDD |
| n12 | 699 MHz – 716 MHz | 729 MHz – 746 MHz | FDD |
| n14 | 788 MHz – 798 MHz | 758 MHz – 768 MHz | FDD |
| n20 | 832 MHz – 862 MHz | 791 MHz – 821 MHz | FDD |
| n25 | 1850 MHz – 1915 MHz | 1930 MHz – 1995 MHz | FDD |
| n26 | 814 MHz – 849 MHz | 859 MHz – 894 MHz | FDD |
| n28 | 703 MHz – 748 MHz | 758 MHz – 803 MHz | FDD |
| n30 | 2305 MHz – 2315 MHz | 2350 MHz – 2360 MHz | FDD |
| n34 | 2010 MHz – 2025 MHz | 2010 MHz – 2025 MHz | TDD |
| n38 | 2570 MHz – 2620 MHz | 2570 MHz – 2620 MHz | TDD |
| n39 | 1880 MHz – 1920 MHz | 1880 MHz – 1920 MHz | TDD |
| n40 | 2300 MHz – 2400 MHz | 2300 MHz – 2400 MHz | TDD |
| n41 | 2496 MHz – 2690 MHz | 2496 MHz – 2690 MHz | TDD |
| n48 | 3550 MHz – 3700 MHz | 3550 MHz – 3700 MHz | TDD |
| n50 | 1432 MHz – 1517 MHz | 1432 MHz – 1517 MHz | TDD1 |
| n51 | 1427 MHz – 1432 MHz | 1427 MHz – 1432 MHz | TDD |
| n53 | 2483.5 MHz – 2495 MHz | 2483.5 MHz – 2495 MHz | TDD |
| n65 | 1920 MHz – 2010 MHz | 2110 MHz – 2200 MHz | FDD4 |
| n66 | 1710 MHz – 1780 MHz | 2110 MHz – 2200 MHz | FDD |
| n70 | 1695 MHz – 1710 MHz | 1995 MHz – 2020 MHz | FDD |
| n71 | 663 MHz – 698 MHz | 617 MHz – 652 MHz | FDD |
| n74 | 1427 MHz – 1470 MHz | 1475 MHz – 1518 MHz | FDD |
| n75 | N/A | 1432 MHz – 1517 MHz | SDL |
| n76 | N/A | 1427 MHz – 1432 MHz | SDL |
| n7712 | 3300 MHz – 4200 MHz | 3300 MHz – 4200 MHz | TDD |
| n78 | 3300 MHz – 3800 MHz | 3300 MHz – 3800 MHz | TDD |
| n79 | 4400 MHz – 5000 MHz | 4400 MHz – 5000 MHz | TDD |
| n80 | 1710 MHz – 1785 MHz | N/A | SUL |
| n81 | 880 MHz – 915 MHz | N/A | SUL |
| n82 | 832 MHz – 862 MHz | N/A | SUL |
| n83 | 703 MHz – 748 MHz | N/A | SUL |
| n84 | 1920 MHz – 1980 MHz | N/A | SUL |
| n86 | 1710 MHz – 1780 MHz | N/A | SUL |
| n95 | 2010 MHz – 2025 MHz | N/A | SUL |

Other operating bands may be considered in future releases.

### 5.2.2 FR1 EN-DC band combinations

*<Editor’s note: Example EN-DC combinations can be added. >*

Principle of EN-DC band combinations selection for FR1 TRP TRS OTA testing:

1) Focus on the performance of the NR carrier and do not consider multiple permutations between different LTE bands and NR band under test, i.e., for each NR band, only select one EN-DC band combination.

2) For UE supporting multiple EN-DC band combinations for the same NR band, consider only those EN-DC configurations which have no MSD impact on either LTE or NR, i.e., the selected EN-DC combination should be no MSD issue identified in TS 38.101-3 Section 7.3B.2.3 (Inter-band EN-DC within FR1).

Table 5.2.2-1 Measurement parameters for example inter-band EN-DC band combinations (two bands)

| EN-DC  configuration | E-UTRA configurations | NR configurations |
| --- | --- | --- |
| DC\_3A\_n28A | Note1 | Note2 |
| DC\_2A\_n41A | Note1 | Note2 |
| DC\_1A\_n78A | Note1 | Note2 |
| DC\_1A\_n79A | Note1 | Note2 |
| Note 1: As per TR 37.902 [10], Section 6.4 (Measurement frequencies).  Note 2: As per Table 4.3.3-1 and Table 4.3.3-2 in TR 38.834. | | |

# 6 FR1 TRP requirements

## 6.1 General

<Editor’s note: Detailed structure of the subclause is TBD>

## 6.2 Minimum requirement

### 6.2.1 Minimum requirement for handheld UE

The average measured total radiated power (TRP) of low, mid and high channel for handheld UE shall be higher than the average TRP requirement specified in subclauses 6.2.1.1 and 6.2.1.2. The averaging shall be done in linear scale for the TRP results of both right and left side of the phantom head in case of beside the head and hand phantom positions. For the hand phantom browsing mode position the averaging shall be done in linear scale for the TRP results of both right and left hand phantom measurements.

EN-DC test methodology is defined in TR38.834 [1] clause 9.

<Editor's note: an agreement is needed on the applicability of EN-DC mode requirements>

#### 6.2.1.1 Hand phantom browsing mode

Hand phantom browsing mode positions are defined in TR38.834 [1] subclause 6.3.

##### 6.2.1.1.1 NR FR1

Handheld UE TRP minimum performance requirement for NR FR1 bands in the hand phantom browsing position and the primary mechanical mode are defined in Tables 6.2.1.1.1-1 and 6.2.1.1.1-2.

Table 6.2.1.1.1-1 Handheld PC3 UE TRP minimum performance requirement for NR FR1 bands in the hand phantom browsing position and the primary mechanical mode

|  |  |  |
| --- | --- | --- |
| NR Band | Power Class 3 | |
| Average TRP (dBm) | |
| UE width ≤ 72mm | UE width > 72mm |
| n28 |  |  |
| n41 |  |  |
| n78 |  |  |
| n79 |  |  |

Table 6.2.1.1-2 Handheld PC2 UE TRP minimum performance requirement for NR FR1 bands in the hand phantom browsing position and the primary mechanical mode

|  |  |  |
| --- | --- | --- |
| NR Band | Power Class 2 | |
| Average TRP (dBm) | |
| UE width ≤ 72mm | UE width > 72mm |
| n28 |  |  |
| n41 |  |  |
| n78 |  |  |
| n79 |  |  |

##### 6.2.1.1.2 NR FR1 in EN-DC mode

Handheld UE TRP minimum performance requirement for NR FR1 bands (in EN-DC mode) in the hand phantom browsing position and the primary mechanical mode are defined in Tables 6.2.1.1.2-1 and 6.2.1.1.2-2.

Table 6.2.1.1.2-1 Handheld PC3 UE TRP minimum performance requirement for NR FR1 bands (in EN-DC mode) in the hand phantom browsing position and the primary mechanical mode

|  |  |  |
| --- | --- | --- |
| NR Band | Power Class 3 | |
| Average TRP (dBm) | |
| UE width ≤ 72mm | UE width > 72mm |
| n28 |  |  |
| n41 |  |  |
| n78 |  |  |
| n79 |  |  |

Table 6.2.1.1.2-2 Handheld PC2 UE TRP minimum performance requirement for NR FR1 bands (in EN-DC mode) in the hand phantom browsing position and the primary mechanical mode

|  |  |  |
| --- | --- | --- |
| NR Band | Power Class 2 | |
| Average TRP (dBm) | |
| UE width ≤ 72mm | UE width > 72mm |
| n28 |  |  |
| n41 |  |  |
| n78 |  |  |
| n79 |  |  |

#### 6.2.1.2 Beside the head and hand phantom position

Beside the head and hand phantom mode positions are defined in TR38.834 [1] subclause 6.4.

##### 6.2.1.2.1 NR FR1

Handheld UE TRP minimum performance requirement for NR FR1 bands in the beside head and hand phantom position and the primary mechanical mode are defined in Tables 6.2.1.2.1-1 and 6.2.1.2.1-2.

Table 6.2.1.2.1-1 Handheld PC3 UE TRP minimum performance requirement for NR FR1 bands in the beside head and hand phantom position and the primary mechanical mode

|  |  |  |
| --- | --- | --- |
| NR Band | Power Class 3 | |
| Average TRP (dBm) | |
| UE width ≤ 72mm | UE width > 72mm |
| n28 |  |  |
| n41 |  |  |
| n78 |  |  |
| n79 |  |  |

Table 6.2.1.2.1-2 Handheld PC2 UE TRP minimum performance requirement for NR FR1 bands in the beside head and hand phantom position and the primary mechanical mode

|  |  |  |
| --- | --- | --- |
| NR Band | Power Class 2 | |
| Average TRP (dBm) | |
| UE width ≤ 72mm | UE width > 72mm |
| n28 |  |  |
| n41 |  |  |
| n78 |  |  |
| n79 |  |  |

##### 6.2.1.2.2 NR FR1 in EN-DC mode

Handheld UE TRP minimum performance requirement for NR FR1 bands (in EN-DC mode) in the beside head and hand phantom position and the primary mechanical mode are defined in Tables 6.2.1.2.2-1 and 6.2.1.2.2-2.

Table 6.2.1.2.2-1 Handheld PC3 UE TRP minimum performance requirement for NR FR1 bands (in EN-DC mode) in the beside head and hand phantom position and the primary mechanical mode

|  |  |  |
| --- | --- | --- |
| NR Band | Power Class 3 | |
| Average TRP (dBm) | |
| UE width ≤ 72mm | UE width > 72mm |
| n28 |  |  |
| n41 |  |  |
| n78 |  |  |
| n79 |  |  |

Table 6.2.1.2.2-2 Handheld PC2 UE TRP minimum performance requirement for NR FR1 bands (in EN-DC mode) in the beside head and hand phantom position and the primary mechanical mode

|  |  |  |
| --- | --- | --- |
| NR Band | Power Class 2 | |
| Average TRP (dBm) | |
| UE width ≤ 72mm | UE width > 72mm |
| n28 |  |  |
| n41 |  |  |
| n78 |  |  |
| n79 |  |  |

# 7 FR1 TRS requirements

## 7.1 General

<Editor’s note: Detailed structure of the subclause is TBD. >

## 7.2 Minimum requirement

<Editor’s note: Detailed structure of the subclause is TBD. SA and EN-DC>

Annex A (normative):  
<Test methodology>

<Editor’s note: normative information of test methods, e.g., test configuration, minimum range length, antenna setting. Detailed structure of the subclause is TBD >

## A.1 Test configuration

### A.1.1 TRP Test configuration

For Standalone, the NR System Simulator (SS) and DUT shall be configured per TS 38.521-1 [5], section 6.2.1 (UE maximum output power) using the default settings specified in TS 38.521-1 [5] and TS 38.508-1 [7] as applicable. The measurement should be carried out based on the detailed test parameters for each band, as defined in TR 38.834 Table 4.3.3-1.

For EN-DC, the SS and DUT shall be configured per TS 38.521-3 [6], Section 6.2B.1 (UE Maximum Output Power for EN-DC) using the default settings specified in TS 38.521-3 [6] and TS 38.508 [7] as applicable. The measurement should be carried out based on the detailed test parameters for each band, as defined in TR 38.834 Table 4.3.3-3. The UL output power of LTE carrier should be set as a constant power of 10dBm, while measuring NR at maximum output power, i.e., with fixed p-MaxEUTRA-r15=10 dBm, and p-NR-FR1 not configured.

### A.1.2 TRS Test configuration

For Standalone, the NR System Simulator (SS) and DUT shall be configured per section 7.3.2 (Reference sensitivity power level) of TS 38.521-1 [5] using the defaults specified in TS 38.521-1 [5] and TS 38.508-1 [7] as applicable. The measurement should be carried out based on the detailed test parameters for each band, as defined in TR 38.834 Table 4.3.3-2.

For EN-DC, the EN-DC SS and DUT shall be configured per section 7.3B.2 (Reference Sensitivity for EN-DC) of TS 38.521-3 [6], using the defaults specified in TS 38.521-3 [6] and TS 38.508 [7], as applicable. The measurement should be carried out based on the detailed test parameters for each band, as defined in TR 38.834 Table 4.3.3-3. The UL power configuration for LTE and NR is 50%-50% power splitting, i.e.,

- For PC3, p-MaxEUTRA-r15=20 dBm, and p-NR-FR1= 20dBm;

- For PC2, p-MaxEUTRA-r15=23 dBm, and p-NR-FR1= 23dBm.

Annex B (normative):  
<Phantoms definition and Positioning>

<Editor’s note: normative requirement of Selected phantom and positioning forUE requirements. Detailed structure of the subclause is TBD>

Annex C (normative):  
<Environmental requirements>

# E.1 General

This normative annex specifies the environmental requirements of the UE. Within these limits the requirements of the present documents shall be fulfilled.

# E.2 Environmental

The requirements in this clause apply to all types of UE(s).

## E.2.1 Temperature

All the test cases defined in this technical specification should be measured in room temperature e.g. 25°C.

## E.2.2 Voltage

All test cases shall be performed with the DUT operated in stand-alone battery powered mode. It is preferable if the UE is fully charged in the beginning of the test.

Annex D (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2021-11 | RAN4#101-e | R4-2120687 |  |  |  | Initial Skeleton | 0.0.1 |
| 2022-01 | RAN4#101-bis-e | R4-2200971 |  |  |  | R4-2200974 TP to TS 38.161 on requirement applicability | 0.1.0 |
| 2022-03 | RAN4#102-e | R4-2204952 |  |  |  | R4-2205174 TP to 38.161 on general aspects  R4-2207315 Text proposal on environmental requirements for 38.161  R4-2207323 TP to 38.161 on TRP aspects  R4-2207316 TP to TS 38.161 on frequency bands  R4-2207322 TP to TS 38.161 on Annex A: Test methodology | 0.2.0 |