

**3rd Generation Partnership Project;  
Technical Specification Group Radio Access Network;  
NR;  
Study on enhanced test methods for FR2 NR UEs;  
(Release 16)**



**3GPP**

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*For definitive guidance on drafting 3GPP TSs and TRs, see [3GPP TS 21.801](http://www.3gpp.org/specifications-groups/delegates-corner/writing-a-new-spec) supplemented by the 3GPP web page <http://www.3gpp.org/specifications-groups/delegates-corner/writing-a-new-spec>.*

*Ensure all blue guidance text is removed before submitting the TS/TR to the TSG for approval.*

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## Foreword

This Technical Report 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 drafting the TS/TR, pay particular attention to the use of modal auxiliary verbs! TRs shall not contain any normative provisions.*

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

- |                  |                                                         |
|------------------|---------------------------------------------------------|
| <b>shall</b>     | indicates a mandatory requirement to do something       |
| <b>shall not</b> | 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.

- |                   |                                                |
|-------------------|------------------------------------------------|
| <b>should</b>     | indicates a recommendation to do something     |
| <b>should not</b> | indicates a recommendation not to do something |
| <b>may</b>        | indicates permission to do something           |
| <b>need not</b>   | 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.

- |               |                                        |
|---------------|----------------------------------------|
| <b>can</b>    | indicates that something is possible   |
| <b>cannot</b> | indicates that something is impossible |

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

<b>will</b>	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
<b>will not</b>	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
<b>might</b>	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
<b>might not</b>	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:

<b>is</b>	(or any other verb in the indicative mood) indicates a statement of fact
<b>is not</b>	(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 objectives of this study are to enhance the FR2 RF testing methodology and to quantify the impact of the enhancements on the UE performance, as related to the polarization basis mismatch between the test equipment and UE and to add support for testing under extreme temperature conditions.

The development of testing methodology enhancements proceeds within the following scope:

- In general
  - Target the testing and calibration aspects of the permitted methods for FR2 UE RF testing and the preliminary assessment of measurement uncertainty (Clause 5.2 and Annex B of TR38.810)
  - The test methodologies and procedures shall be applicable for different device types and power classes with DUT size defined in the TR 38.810. Prioritize the study to PC3 for aspects related to DUT size, and limit the study to free space conditions
  - The study item outcomes shall capture the efficacy of the enhancements
  - Objectives related to regulatory test cases shall be prioritized

The detailed objectives are:

1. Define test methodology for high DL power and low UL power test cases
  - Considering path loss reduction, measurement antenna gain improvement, DUT positioning improvement, and MU improvement
  - Considering NTF (defined in Clause 5.2 of TR38.810) and direct near field test methodologies as possible alternative methods
  - Other approaches are not precluded
  - Study preliminary assessment of measurement uncertainty of new alternative methods
2. Define solutions to minimize the impact of polarization basis mismatch between the TE and DUT on the RF testing
  - Considering polarization basis mismatch between the test equipment and UE and UE implementations which may be impacted by this mismatch
  - Study EIS test metric which can apply to different UE RF implementations considering downlink polarization sweep enhancement
  - Limit the study of this objective to the permitted UE RF methods defined in Clause 5.2 of TR38.810
  - Possible enhancements may be described as
    - Downlink polarization sweeping by the test equipment (i.e. introducing an additional degree of freedom for polarization alignment of the measurement antenna)
    - The use of circular polarization to perform measurements
    - Coherent combining and demodulation of orthogonally polarized received signals in the test equipment
    - Uplink polarization sweeping by the test equipment to search for the optimal polarization angle to receive and demodulate the signal transmitted by the UE
    - Considering NTF (defined in Clause 5.2 of TR38.810) test methodology for EIS measurement
    - Other approaches are not precluded
3. Study testability enhancements to support the verification of RF requirements for inter-band (FR2+FR2) CA
  - Work on inter-band DL CA is prioritized

- Whether the test setup shall be restricted to emulating the signal from the same direction for the aggregated bands shall be aligned with the UE RF architecture assumption taken in the work item on NR RF Requirement Enhancements for FR2 [UID 830189]
4. Support extreme temperature conditions for all applicable FR2 UE RF test cases
    - Considering beam peak search, spherical coverage, and total radiated power procedures
    - Limit the study of this objective to the permitted UE RF methods defined in Clause 5.2 of TR38.810
    - Study preliminary impacts on system measurement uncertainty under extreme temperature conditions
  5. Study testability enhancements to support the verification of RF requirements for FR2 DL 256QAM
  6. Study testability enhancements to reduce test time
    - Including RF test method enhancement with reduced test time, and possible test time saving approach for UE Demodulation test and RRM test

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## 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 TS 38.101-2: "User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone". |
| [3] | 3GPP TR 38.810: " Study on test methods ".                                                            |
| ... |                                                                                                       |
| [x] | <doctype> <#>[ ([up to and including]{yyyy[-mm] V<a[.b[.c]]>}[onwards])]: "<Title>".                  |

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## 3 Definitions of terms, symbols and abbreviations

*This clause and its three subclauses are mandatory. The contents shall be shown as "void" if the TS/TR does not define any terms, symbols, or 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)*

<ABBREVIATION>    <Expansion>



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## 4 General

*Editor's note: general aspects related to the scope of the study or common study outcomes can be captured in this clause.*

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## 5 UE RF testing methodology enhancements

*Editor's note: testing and calibration aspects of the permitted methods for FR2 UE RF testing and the preliminary assessment of measurement uncertainty (Clause 5.2 and Annex B of TR38.810) define the baseline UE RF methodology for the purpose of this study.*

### 5.1 High DL power and low UL power

*Editor's note: outcome of SI Objective 1 is captured in this clause. Because this objective targets both the permitted methods and may potentially define alternative methods, the sub-clauses can be organized accordingly*

### 5.2 Polarization basis mismatch between the UE and DUT

*Editor's note: outcome of SI Objective 2 is captured in this clause. Because this objective targets both the permitted methods and may potentially consider NTF for EIS, the sub-clauses can be organized accordingly*

### 5.3 Inter-band (FR2+FR2) CA

*Editor's note: outcome of SI Objective 3 is captured in this clause*

### 5.4 Extreme temperature conditions

*Editor's note: outcome of SI Objective 4 is captured in this clause*

### 5.5 FR2 DL 256QAM

*Editor's note: outcome of SI Objective 5 is captured in this clause*

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## 6 Test time reduction

*Editor's note: outcome of SI Objective 6 is captured in this clause. This objective may potentially impact RF, RRM, and demodulation test setups.*

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## Annex A: Environment conditions

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### A.1 Operating voltage

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### A.2 Temperature

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## Annex B: Measurement uncertainty

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### B.1 Measurement uncertainty budget for UE RF testing methodology

*Editor's note: collect the MU elements which are impacted by the enhancements in Clauses 5 and 6 in this clause; if impact on the MU budget of the RRM and/or demodulation setups is identified, the corresponding clauses can be added. Organize the Annex to mirror the TR38.810 structure*

## Annex <X>: Change history

*This is the last annex for TS/TSS which details the change history using the following table.*

*This table is to be used for recording progress during the WG drafting process till TSG approval of this TS/TR.*

*For TRs under change control, use one line per approved Change Request*

*Date: use format YYYY-MM*

*CR: four digits, leading zeros as necessary*

*Rev: blank, or number (max two digits)*

*Cat: use one of the letters A, B, C, D, F*

*Subject/Comment: for TSs under change control, include full text of the subject field of the Change Request cover*

*New vers: use format [n]n.[n]n.[n]n*

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2019-10	R4#92bis	R4-1913071				Initial skeleton	0.0.1