# Draft ETSI TS 103 793 V1.0.0 (2025-07)

TECHNICAL SPECIFICATION

# Rail Telecommunications (RT);
# Future Railway Mobile Communication System (FRMCS);
# Radio Characteristics

Reference
DTS/RT-0089

Keywords
FRMCS, radio parameters, railways, testing

***ETSI***

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

# Contents

Intellectual Property Rights ..... 5
Foreword ..... 5
Modal verbs terminology ..... 5
1 Scope ..... 6
2 References ..... 6
2.1 Normative references ..... 6
2.2 Informative references ..... 7
3 Definition of terms, symbols and abbreviations ..... 7
3.1 Terms ..... 7
3.2 Symbols ..... 7
3.3 Abbreviations ..... 8
4 Band definitions ..... 8
4.1 n100 ..... 8
4.2 n101 ..... 8
5 Specifications for base stations ..... 9
5.1 Output power ..... 9
5.2 Spurious emissions ..... 9
5.2.0 General ..... 9
5.2.1 n100 ..... 9
5.2.2 n101 ..... 9
5.2.3 Operating band unwanted emissions ..... 9
5.3 Reference sensitivity ..... 9
5.4 Receiver intermodulation ..... 9
5.4.1 n100 ..... 9
5.4.2 n101 ..... 9
5.5 In-band blocking ..... 9
5.5.1 n100 ..... 9
5.5.2 n101 ..... 9
5.6 Out-of-band blocking ..... 10
5.6.1 n100 ..... 10
5.6.2 n101 ..... 10
6 Specifications for cab radio user equipment ..... 10
6.0 General ..... 10
6.1 Output power ..... 10
6.2 Out-of-band and spurious emissions ..... 10
6.3 NR ACLR ..... 10
6.4 Reference sensitivity ..... 10
6.5 Blocking requirements ..... 10
6.5.0 General ..... 10
6.5.1 n100 ..... 11
6.5.2 n101 ..... 11
7 Specifications for terminals other than cab radios ..... 11
7.0 General ..... 11
7.1 Output power ..... 11
7.2 Out-of-band and spurious emissions ..... 11
7.3 NR ACLR ..... 11
7.4 Reference sensitivity ..... 12
7.5 Blocking requirements ..... 12
8 Test cases for base stations ..... 12
8.1 Transmitter ..... 12
8.1.1 Output power ..... 12
8.1.2 Spurious emissions ..... 12

8.2 Receiver ..... 12
8.2.1 Reference sensitivity ..... 12
8.2.2 In-band selectivity and blocking ..... 12
8.2.3 Out-of-band blocking ..... 12
8.2.4 Receiver intermodulation ..... 12

9 Test cases for cab radio user equipment ..... 12
9.0 General ..... 12
9.1 Transmitter ..... 12
9.1.1 Output power ..... 12
9.1.2 NR ACLR ..... 13
9.1.3 Out-of-band and spurious emissions ..... 13
9.2 Receiver ..... 13
9.2.1 Reference sensitivity power level ..... 13
9.2.2 Blocking ..... 13
9.2.2.0 General Requirements ..... 13
9.2.2.1 Test purpose ..... 13
9.2.2.2 Test method #1 ..... 13
9.2.2.2.1 Test applicability ..... 13
9.2.2.2.2 Minimum conformance requirements ..... 13
9.2.2.2.3 Test description ..... 14
9.2.2.2.4 Test requirement ..... 15
9.2.2.3 Test method #2 ..... 15
9.2.2.3.1 Test applicability ..... 15
9.2.2.3.2 Minimum conformance requirements ..... 15
9.2.2.3.3 Test Description ..... 16
9.2.2.3.4 Test Requirement ..... 17

10 Test cases for terminals other than cab radios ..... 18
10.0 General ..... 18
10.1 Transmitter ..... 18
10.1.1 Output power ..... 18
10.1.2 NR ACLR ..... 18
10.1.3 Out-of-band and spurious emissions ..... 18
10.2 Receiver ..... 18
10.2.1 Reference sensitivity power level ..... 18
10.2.2 Blocking ..... 18

**Annex A (normative): European mobile bands, excluding n100 and n101 ..... 19**

History ..... 20

# Intellectual Property Rights

## Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI IPR online database.

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

## Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

**DECT™**, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™**, **LTE™** and **5G™** logo are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM**® and the GSM logo are trademarks registered and owned by the GSM Association.

# Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Railway Telecommunications (RT) and is now submitted for the combined Public Enquiry and Vote phase of the ETSI Standardisation Request deliverable Approval Procedure (SRdAP).

# Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

# 1 Scope

The present document addresses the specific RF technical characteristics and methods of measurements required by ECC Decision (20)02 [i.1] for base stations, cab radio user equipment and terminals other than cab radio intended to be used for the Future Railway Mobile Communications System (FRMCS) and operating in bands as listed in Table 1-1.

**Table 1-1: List of supported 3GPP bands and modes of operation**

| Band name | Uplink | Downlink | Duplex mode | RAT |
|---|---|---|---|---|
| n100 | 874,4 - 880 MHz | 919,4 - 925 MHz | FDD | 5G NR |
| n101 | 1 900 - 1 910 MHz | 1 900 - 1 910 MHz | TDD | 5G NR |

The technical characteristics and methods of measurements have been derived from, and are consistent with ECC Decision (20)02 [i.1], Commission Implementing Decision (EU) 2021/1730 [i.2], ETSI TS 138 101-1 [1], ETSI TS 138 104 [2], ETSI TS 138 141-1 [3], ETSI TS 138 508-1 [4] and ETSI TS 138 521-1 [5].

For the clauses not specifically mentioned in the present document, compliance with the above mentioned 3GPP Technical Specifications (TS) is also required for BS and UE. Only BS type 1-C characteristics in the previously mentioned specifications apply for the base station specifications given in the present document.

# 2 References

## 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found in the ETSI docbox.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 138 101-1 (V18.9.0): "5G; NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone (3GPP TS 38.101-1 version 18.9.0 Release 18)".

[2] ETSI TS 138 104 (V18.9.0): "5G; NR; Base Station (BS) radio transmission and reception (3GPP TS 38.104 version 18.9.0 Release 18)".

[3] ETSI TS 138 141-1 (V18.9.0): "5G; NR; Base Station (BS) conformance testing Part 1: Conducted conformance testing (3GPP TS 38.141-1 version 18.9.0 Release 18)".

[4] ETSI TS 138 508-1 (V18.6.0): "LTE; 5G; 5GS; User Equipment (UE) conformance specification; Part 1: Common test environment (3GPP TS 38.508-1 version 18.6.0 Release 18)".

[5] ETSI TS 138 521-1 (V18.6.0): "5G; NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 standalone (3GPP TS 38.521-1 version 18.6.0 Release 18)".

[6] ETSI EN 302 208 (V3.4.1): "Radio Frequency Identification Equipment operating in the band 865 MHz to 868 MHz with power levels up to 2 W and in the band 915 MHz to 921 MHz with power levels up to 4 W; Harmonised Standard for access to radio spectrum".

[7] ETSI TS 136 101 (V18.9.0): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (3GPP TS 36.101 version 18.9.0 Release 18)".

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

[i.1] ECC Decision (20)02: "Harmonised use of the paired frequency bands 874.4-880.0 MHz and 919.4-925.0 MHz and of the unpaired frequency band 1900-1910 MHz for Railway Mobile Radio (RMR)".

[i.2] Commission Implementing Decision (EU) 2021/1730 of 28 September 2021 on the harmonised use of the paired frequency bands 874,4-880,0 MHz and 919,4-925,0 MHz and of the unpaired frequency band 1900-1910 MHz for Railway Mobile Radio.

[i.3] ETSI TR 103 791: "Rail Telecommunications (RT); Future Railway Mobile Communication System (FRMCS); Terminology for FRMCS specifications".

# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in ETSI TR 103 791 [i.3] and the following apply:

**local area base station:** equipment class characterized by requirements derived from Pico Cell scenarios with a BS to UE minimum coupling loss equal to 45 dB

NOTE: As defined in ETSI TS 138 104 [2], clause 4.4.

**medium range base station:** equipment class characterized by requirements derived from Micro Cell scenarios with a BS to UE minimum coupling loss equals to 53 dB

NOTE: As defined in ETSI TS 138 104 [2], clause 4.4.

**$P_{CMAX\_L,f,c}$:** UE's lowest configurable maximum output power for carrier f of serving cell c in each slot

NOTE: As defined in ETSI TS 138 521-1 [5], clause 6.2.4.

**TRANSFORM_PRECODER_ENABLED:** transform precoding is enabled (DFT-s-OFDM UL waveform is configured)

NOTE: As defined in ETSI TS 138 508-1 [4], Table 4.6.3-118.

**wide area base station:** equipment class characterized by requirements derived from Macro Cell scenarios with a BS to UE minimum coupling loss equal to 70 dB

NOTE: As defined in ETSI TS 138 104 [2], clause 4.4.

## 3.2 Symbols

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

| | |
|---|---|
| $BW_{Channel}$ | channel bandwidth |
| $N_{RB}$ | transmission bandwidth configuration, expressed in units of resource blocks |
| $P_{EIRP}$ | EIRP value |

## 3.3 Abbreviations

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

| | |
|---|---|
| ACLR | Adjacent Channel Leakage Ratio |
| BS | Base Station |
| BW | BandWidth |
| C_RNTI | Cell Radio Network Temporary Identifier |
| CP-OFDM | Cyclic Prefix Orthogonal Frequency Division Multiplexing |
| CW | Continuous Wave |
| DCI | Downlink Control Information |
| DFT-s-OFDM | Discrete Fourier Transform-spread Orthogonal Frequency Division Multiplexing |
| DL | DownLink |
| EIRP | Equivalent Isotropically Radiated Power |
| E-UTRA | Enhanced Universal Terrestrial Radio Access |
| FDD | Frequency Division Duplex |
| FRMCS | Future Railway Mobile Communications System |
| HARQ | Hybrid Automatic Repeat Request |
| ID | Identifier |
| LTE | Long Term Evolution |
| MAC | Medium Access Control |
| MU | Measurement Uncertainty |
| NR | New Radio |
| OCNG | OFDMA Channel Noise Generator |
| OFDMA | Orthogonal Frequency Division Multiple Access |
| PDCCH | Physical Downlink Control CHannel |
| PDSCH | Physical Downlink Shared CHannel |
| PUSCH | Physical Uplink Shared CHannel |
| QPSK | Quadrature Phase Shift Keying |
| RAT | Radio Access Technology |
| RB | Resource Block |
| REFSENS | Reference Sensitivity |
| RFID | Radio Frequency IDentification |
| RMC | Reference Measurement Channel |
| RRC | Radio Resource Control |
| Rx | Receiver |
| SCS | SubCarrier Spacing |
| SRD | Short Range Devices |
| SS | System Simulator |
| TDD | Time Division Duplex |
| TE | Test Equipment |
| Tx | Transmitter |
| UE | User Equipment |
| UL | UpLink |

# 4 Band definitions

## 4.1 n100

The operating band and channel arrangement specifications defined for band n100 in ETSI TS 138 101-1 [1], clause 5 shall apply.

Only 5 MHz wide channel bandwidth shall be considered for band n100.

## 4.2 n101

The operating band and channel arrangement specifications defined for band n101 in ETSI TS 138 101-1 [1], clause 5 shall apply.

# 5 Specifications for base stations

## 5.1 Output power

The specifications defined in ETSI TS 138 104 [2], clauses 6.2.1 and 6.2.4 shall apply.

## 5.2 Spurious emissions

### 5.2.0 General

The limits defined in ETSI TS 138 104 [2], Table 6.6.5.2.1-2 shall apply.

### 5.2.1 n100

In addition to the requirements defined in clause 5.2.0, for a base station transmitting in n100, the limits defined in ETSI TS 138 104 [2], Tables 6.6.5.2.3-1 and 6.6.5.2.3-13 shall apply to European frequency bands listed in Annex A.

### 5.2.2 n101

In addition to the requirements defined in clause 5.2.0, for a base station transmitting in n101, the limits defined in ETSI TS 138 104 [2], Tables 6.6.5.2.3-1 and 6.6.5.2.3-12 shall apply to European frequency bands listed in Annex A.

### 5.2.3 Operating band unwanted emissions

For wide area base stations, the limits defined in ETSI TS 138 104 [2], Table 6.6.4.2.2.2-1 shall apply. For medium range base stations, the limits defined in ETSI TS 138 104 [2], Tables 6.6.4.2.3-1 and 6.6.4.2.3-2 shall apply. For local area base stations, the limits defined in ETSI TS 138 104 [2], Table 6.6.4.2.4-1 shall apply.

## 5.3 Reference sensitivity

The specifications defined in ETSI TS 138 104 [2], clause 7.2.2 for frequency bands n100 and n101 shall apply.

## 5.4 Receiver intermodulation

### 5.4.1 n100

The specifications defined in ETSI TS 138 104 [2], clauses 7.7.2 and 7.7.3 shall apply.

### 5.4.2 n101

The specifications defined in ETSI TS 138 104 [2], clause 7.7.2 shall apply.

## 5.5 In-band blocking

### 5.5.1 n100

The specifications defined in ETSI TS 138 104 [2], clauses 7.4.2.2 and 7.4.2.5 shall apply.

### 5.5.2 n101

The specifications defined in ETSI TS 138 104 [2], clause 7.4.2.2 shall apply.

## 5.6 Out-of-band blocking

### 5.6.1 n100

The specifications defined in ETSI TS 138 104 [2], clause 7.5.2 shall apply.

### 5.6.2 n101

The specifications defined in ETSI TS 138 104 [2], clauses 7.5.2 and 7.5.5 shall apply.

# 6 Specifications for cab radio user equipment

## 6.0 General

This clause defines the specifications for cab radio user equipment, which fulfil the power class 1 category as specified in ETSI TS 138 101-1 [1], clause 6.2.

If an external antenna is present the $P_{EIRP}$ shall not exceed 33 dBm.

## 6.1 Output power

The specifications defined in ETSI TS 138 101-1 [1], clause 6.2 shall apply.

## 6.2 Out-of-band and spurious emissions

The specifications defined in ETSI TS 138 101-1 [1], clauses 6.1, 6.5.2 and 6.5.3 shall apply to European frequency bands listed in Annex A.

## 6.3 NR ACLR

The specifications defined in ETSI TS 138 101-1 [1], clause 6.5.2.4.1 shall apply.

## 6.4 Reference sensitivity

The specifications defined in ETSI TS 138 101-1 [1], clause 7.3.2 for frequency band n100 and n101 shall apply.

## 6.5 Blocking requirements

### 6.5.0 General

The following Tables define the tolerable interfering signals that need to be taken into account for the cab radio user equipment.

The frequency ranges for the interfering signals shall be considered edge-to-edge, including any guard band within the carrier as defined in the respective standard of the interfering signal as shown in Tables 6.5.1-1 and 6.5.2-1.

### 6.5.1 n100

For n100, the blocking signals identified in Table 6.5.1-1 shall be considered.

**Table 6.5.1-1: n100 cab radio blocking characteristics**

| Frequency range (edge to edge) | Interfering signal type | Power level for interfering signal | Level of wanted signal | Corresponding test case in clause 9.2.2 |
|---|---|---|---|---|
| 880 - 915 MHz | 5 MHz LTE, according to ETSI TS 136 101 [7], clause 5.6 | -26 dBm | REFSENS + 3 dB | Test method #1 |
| 915 - 918,9 MHz | 400 kHz SRD / RFID, according to ETSI EN 302 208 [6], clause 4.2 | -26 dBm | | Test method #1 |
| 925,6 - 927 MHz | CW | -13 dBm | | Test method #2 |
| 927 - 960 MHz | CW | -10 dBm | | Test method #2 |
| 925,1 - 930,1 MHz | 5 MHz LTE, according to ETSI TS 136 101 [7], clause 5.6 | -13 dBm | | Test method #1 |

### 6.5.2 n101

For n101, the blocking signals identified in Table 6.5.2-1 shall be considered.

**Table 6.5.2-1: n101 cab radio blocking characteristics**

| Frequency range (edge to edge) | Interfering signal type | Power level for interfering signal | Level of wanted signal | Corresponding test case in clause 9.2.2 |
|---|---|---|---|---|
| 1 805 - 1 880 MHz | 5 MHz LTE, according to ETSI TS 136 101 [7], clause 5.6 | -13 dBm | REFSENS + 3 dB | Test method #1 |
| 1 920 - 1 980 MHz | 5 MHz LTE, according to ETSI TS 136 101 [7], clause 5.6 | -39 dBm | | Test method #1 |

# 7 Specifications for terminals other than cab radios

## 7.0 General

This clause defines the specifications for terminals other than cab radios, which fulfil the power class 3 category as specified in ETSI TS 138 101-1 [1], clause 6.2.

## 7.1 Output power

The specifications defined in ETSI TS 138 101-1 [1], clause 6.2 shall apply.

## 7.2 Out-of-band and spurious emissions

The specifications defined in ETSI TS 138 101-1 [1], clauses 6.1, 6.5.2 and 6.5.3 shall apply to European frequency bands listed in Annex A.

## 7.3 NR ACLR

The specifications defined in ETSI TS 138 101-1 [1], clause 6.5.2.4.1 shall apply.

## 7.4 Reference sensitivity

The specifications defined in ETSI TS 138 101-1 [1], clause 7.3.2 for frequency bands n100 and n101 shall apply.

## 7.5 Blocking requirements

The specifications defined in ETSI TS 138 101-1 [1], clause 7.6 shall apply.

# 8 Test cases for base stations

## 8.1 Transmitter

### 8.1.1 Output power

The test case defined in ETSI TS 138 141-1 [3], clause 6.2 shall apply.

### 8.1.2 Spurious emissions

The test cases defined in ETSI TS 138 141-1 [3], clause 6.6 shall apply.

## 8.2 Receiver

### 8.2.1 Reference sensitivity

The test case defined in ETSI TS 138 141-1 [3], clause 7.2 shall apply.

### 8.2.2 In-band selectivity and blocking

The test cases defined in ETSI TS 138 141-1 [3], clause 7.4 shall apply.

### 8.2.3 Out-of-band blocking

The test case defined in ETSI TS 138 141-1 [3], clause 7.5 shall apply.

### 8.2.4 Receiver intermodulation

The test case defined in ETSI TS 138 141-1 [3], clause 7.7 shall apply.

# 9 Test cases for cab radio user equipment

## 9.0 General

This clause defines the test cases for cab radio user equipment, which fulfil the power class 1 category as specified in ETSI TS 138 101-1 [1], clause 6.2.

## 9.1 Transmitter

### 9.1.1 Output power

The test cases defined in ETSI TS 138 521-1 [5], clause 6.2 shall apply.

### 9.1.2 NR ACLR

The test case defined in ETSI TS 138 521-1 [5], clause 6.5.2.4.1 shall apply.

### 9.1.3 Out-of-band and spurious emissions

The test cases defined in ETSI TS 138 521-1 [5], clauses 6.5.2 and 6.5.3 shall apply.

## 9.2 Receiver

### 9.2.1 Reference sensitivity power level

The test case defined in ETSI TS 138 521-1 [5], clause 7.3 shall apply.

### 9.2.2 Blocking

#### 9.2.2.0 General Requirements

The test procedures specified in the present clause shall be carried out using the defined characteristics (in Tables 6.5.1-1 and 6.5.2-1) for testing RF blocking with FRMCS cab radio user equipment.

#### 9.2.2.1 Test purpose

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit.

#### 9.2.2.2 Test method #1

##### 9.2.2.2.1 Test applicability

This test method applies to all FRMCS cab radio user equipment. It is used for testing RF blocking with interfering signals of type other than CW (see Tables 6.5.1-1 and 6.5.2-1).

##### 9.2.2.2.2 Minimum conformance requirements

The throughput of the wanted signal shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in ETSI TS 138 521-1 [5], clauses A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL signal as described in ETSI TS 138 521-1 [5], clause A.5) with parameters specified in Tables 9.2.2.2.2-1 and 9.2.2.2.3.1-1.

**Table 9.2.2.2.2-1: Test parameter table**

| Rx parameter | Units | Channel bandwidth (MHz) |
|---|---|---|
| | | 5, 10 |
| Power in transmission bandwidth configuration | dBm | REFSENS + 3 dB |
| $BW_{interferer}$ | MHz | As defined in Tables 6.5.1-1 and 6.5.2-1 |
| NOTE: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in ETSI TS 138 521-1 [5], Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in ETSI TS 138 521-1 [5], clause 6.2.4. | | |

#### 9.2.2.2.3 Test description

##### 9.2.2.2.3.1 Initial conditions

Initial conditions are a set of test configurations in which the cab radio UE needs to be tested in and the steps for the SS to take with the cab radio UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions based on NR operating bands specified in ETSI TS 138 521-1 [5], Table 5.3.5-1. The details of the uplink and downlink Reference Measurement Channels (RMC) are specified in ETSI TS 138 521-1 [5], clauses A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in ETSI TS 138 521-1 [5], clause C.2.

**Table 9.2.2.2.3.1-1: Test configuration table**

| **Default Conditions** | | | | |
|---|---|---|---|---|
| Test Environment as specified in ETSI TS 138 508-1 [4], clause 4.1 | Normal | | | |
| Test Frequencies for wanted and unwanted signals | Low, Mid, High | | | |
| Test Channel Bandwidths | 5 MHz for band n100, 10 MHz for band n101 | | | |
| Test SCS for the wanted signal | 15 kHz for band n100, 30 kHz for band n101 | | | |
| **Test Parameters** | | | | |
| | **Downlink Configuration** | | **Uplink Configuration** | |
| **Test ID** | **Modulation** | **RB allocation** | **Modulation** | **RB allocation** |
| 1 | CP-OFDM QPSK | Note 1 | DFT-s-OFDM QPSK | Note 1 |
| NOTE 1: The specific configuration of uplink and downlink are defined in ETSI TS 138 521-1 [5], Table 7.3.2.4.1-1. | | | | |
| NOTE 2: In a band where cab radio UE supports 4Rx, the test shall be performed only with 4Rx antennas ports connected and 4Rx REFSENS requirement (ETSI TS 138 521-1 [5], Table 7.3.2.5-2) is used in the test requirements. | | | | |
| NOTE 3: The test frequencies shall be the lowest, the middle and the highest frequency available within the given frequency band with the specified configuration, for both wanted and unwanted signals. In specific cases, there are either one or two possible test frequencies. All combinations of possible wanted and unwanted frequencies shall be tested. | | | | |

1) Connect the SS to the cab radio UE antenna connectors as shown in ETSI TS 138 508-1 [4], Annex A, in Figure A.3.1.4.1 for TE diagram and clause A.3.2 for UE diagram.

2) The parameter settings for the cell are set up according to ETSI TS 138 508-1 [4], clause 4.4.3.

3) Downlink signals are initially set up according to ETSI TS 138 521-1 [5], clauses C.0, C.1, C.2 and C.3.1, and uplink signals according to ETSI TS 138 521-1 [5], clauses G.0, G.1, G.2 and G.3.1.

4) The DL and UL Reference Measurement channels are set according to Table 9.2.2.2.3.1-1.

5) Propagation conditions are set according to ETSI TS 138 521-1 [5], clause B.0.

6) Ensure the cab radio UE is in state RRC_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to ETSI TS 138 508-1 [4], clause 4.5. Message contents are defined in clause 9.2.2.2.3.3.

##### 9.2.2.2.3.2 Test procedure

1) SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 9.2.2.2.3.1-1. The SS sends downlink MAC padding bits on the DL RMC.

2) SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 9.2.2.2.3.1-1. Since the UL has no payload and no loopback data to send the cab radio UE sends uplink MAC padding bits on the UL RMC.

3) Set the parameters of the signal generator for an interfering signal according to Table 9.2.2.2.2-1.

4) Set the downlink signal level according to Table 6.5.1-1 or 6.5.2-1. Send uplink power control commands to the cab radio UE using 1 dB power step size to ensure that the cab radio UE output power measured by the test system is within the Uplink power control window, defined as -MU to -(MU + Uplink power control window size) dB of the target power level in Table 9.2.2.2.2-1 for at least the duration of the Throughput measurement, where:

   - MU is the test system uplink power measurement uncertainty and is specified in ETSI TS 138 521-1 [5], Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW.

   - Uplink power control window size = 1 dB (cab radio UE power step size) + 0,7 dB (cab radio UE power step tolerance) + (Test system relative power measurement uncertainty), where, the cab radio UE power step tolerance is specified in ETSI TS 138 101-1 [1], Table 6.3.4.3-1 and is 0,7 dB for 1 dB power step size, and the Test system relative power measurement uncertainty is specified for test case 6.3.4.3 in ETSI TS 138 521-1 [5], Table F.1.2-1.

   - For cab radio UEs supporting Tx diversity, the transmit power is measured as the sum of the output power from both cab radio UE antenna connectors.

5) Measure the average throughput for a duration sufficient to achieve statistical significance according to ETSI TS 138 521-1 [5], Annex H.

NOTE: The purpose of the Uplink power control window is to ensure that the actual cab radio UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual cab radio UE Uplink power window is illustrated in ETSI TS 138 521-1 [5], clause F.4.3.

#### 9.2.2.2.3.3 Message contents

Message contents are according to ETSI TS 138 508-1 [4], clause 4.6 with TRANSFORM_PRECODER_ENABLED condition in Table 4.6.3-118 PUSCH-Config.

### 9.2.2.2.4 Test requirement

The throughput measurement derived in test procedure shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in ETSI TS 138 521-1 [5], clauses A.2.2, A.2.3 and A.3.2 with parameters specified in Tables 9.2.2.2.2-1 and 9.2.2.2.3.1-1.

## 9.2.2.3 Test method #2

### 9.2.2.3.1 Test applicability

This test method applies to all FRMCS cab radio user equipment. It is used for testing RF blocking with interfering signals of type CW (see Table 6.5.1-1).

### 9.2.2.3.2 Minimum conformance requirements

The throughput of the wanted signal shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in ETSI TS 138 521-1 [5], clauses A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in ETSI TS 138 521-1 [5], clauses A.5.1.1 and A.5.2.1) with parameters specified in Tables 9.2.2.3.2-1 and 9.2.2.3.3.1-1.

**Table 9.2.2.3.2-1: Test parameter table**

| Channel bandwidth | Power in transmission bandwidth configuration [dBm] |
|---|---|
| 5, 10 MHz | REFSENS + 3 dB |
| NOTE: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in ETSI TS 138 521-1 [5], Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in ETSI TS 138 521-1 [5], clause 6.2.4. | |

For interferer frequencies in Table 6.5.1-1, a maximum of:

$$\lfloor max\{24{,}6 \cdot \lceil n \cdot N_{RB}/6 \rceil\}/min\{\lfloor n \cdot N_{RB}/10 \rfloor, 5\}\rfloor$$

exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a step size of $min(\lfloor BW_{channel}/2 \rfloor, 5)$ MHz with $N_{RB}$ the number of resource blocks in the downlink transmission bandwidth configuration, $BW_{Channel}$ is the bandwidth of the frequency channel in MHz and n = 1,2 for SCS = 15,30 kHz, respectively. For these exceptions, the requirements in ETSI TS 138 521-1 [5], clause 7.7 apply.

### 9.2.2.3.3 Test Description

#### 9.2.2.3.3.1 Initial Conditions

Initial conditions are a set of test configurations in which the cab radio UE needs to be tested in and the steps for the SS to take with the cab radio UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions based on NR operating bands specified in ETSI TS 138 521-1 [5], Table 5.3.5-1. All of these configurations for wanted and unwanted frequencies shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, and are shown in Table 9.2.2.3.3.1-1. The details of the uplink and downlink Reference Measurement Channels (RMCs) are specified in ETSI TS 138 521-1 [5], clauses A.2 and A.3 respectively. The details of the OCNG patterns used are specified in ETSI TS 138 521-1 [5], clause A.5. Configurations of PDSCH and PDCCH before measurement are specified in ETSI TS 138 521-1 [5], clause C.3.

**Table 9.2.2.3.3.1-1: Test configuration table**

| **Default Conditions** | | | | |
|---|---|---|---|---|
| Test Environment as specified in ETSI TS 138 508-1 [4], clause 4.1 | Normal | | | |
| Test Frequencies for wanted and unwanted signals | Low, Mid, High | | | |
| Test Channel Bandwidths | 5 MHz for band n100, 10 MHz for band n101 | | | |
| Test SCS for the wanted signal | 15 kHz for band n100, 30 kHz for band n101 | | | |
| Test Parameters | | | | |
| | **Downlink Configuration** | | **Uplink Configuration** | |
| **Test ID** | **Modulation** | **RB allocation** | **Modulation** | **RB allocation** |
| 1 | CP-OFDM QPSK | Note 1 | DFT-s-OFDM QPSK | Note 1 |
| NOTE 1: The specific configuration of uplink and downlink are defined in ETSI TS 138 521-1 [5], Table 7.3.2.4.1-1. | | | | |
| NOTE 2: In a band where cab radio UE supports 4Rx but does not support 8Rx, the test shall be performed only with 4Rx antennas ports connected and 4Rx REFSENS requirement (ETSI TS 138 521-1 [5], Tables 7.3.2.5-2a and 7.3.2.5-2b) is used in the test requirements. In a band where cab radio UE supports 8Rx, the test shall be performed only with 8Rx antennas ports connected and 8Rx REFSENS requirement (ETSI TS 138 521-1 [5], Tables 7.3.2.5-2e and 7.3.2.5-2f) is used in the test requirements. Otherwise, the UE shall be verified with two Rx antenna ports. | | | | |
| NOTE 3: The test frequencies shall be the lowest, the middle and the highest frequency available within the given frequency band with the specified configuration, for both wanted and unwanted signals. In specific cases, there are either one or two possible test frequencies. All combinations of possible wanted and unwanted frequencies shall be tested. | | | | |

1) Connect the SS to the cab radio UE antenna connectors as shown in ETSI TS 138 508-1 [4], Annex A, in Figure A.3.1.4.2 for TE diagram and clause A.3.2 for UE diagram.

2) The parameter settings for the cell are set up according to ETSI TS 138 508-1 [4], clause 4.4.3.

3) Downlink signals are initially set up according to ETSI TS 138 521-1 [5], clauses C.0, C.1, C.2 and C.3.1, and uplink signals according to ETSI TS 138 521-1 [5], clauses G.0, G.1, G.2 and G.3.1.

4) The UL and DL Reference Measurement channels are set according to Table 9.2.2.3.3.1-1.

5) Propagation conditions are set according to ETSI TS 138 521-1 [5], clause B.0.

6) Ensure the cab radio UE is in State RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release On, Test Mode On and Test Loop Function On according to ETSI TS 138 508-1 [4], clause 4.5. Message contents are defined in clause 9.2.2.3.3.3.

#### 9.2.2.3.3.2 Test Procedure

1) SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 9.2.2.3.3.1-1. The SS sends downlink MAC padding bits on the DL RMC.

2) SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 9.2.2.3.3.1-1. Since the cab radio UE has no payload data to send, the cab radio UE transmits uplink MAC padding bits on the UL RMC.

3) Set the parameters of the CW signal generator for an interfering signal below the wanted signal according to Table 6.5.1-1. The frequency step size is $min(\lfloor BW_{channel}/2 \rfloor, 5)$ MHz.

4) Set the downlink signal level according to the Table 6.5.1-1. Send uplink power control commands to the cab radio UE using 1 dB power step size to ensure that the cab radio UE output power measured by the test system is within the Uplink power control window, defined as -MU to -(MU + Uplink power control window size) dB of the target power level in Table 9.2.2.3.2-1 for at least the duration of the Throughput measurement, where:

   - MU is the test system uplink power measurement uncertainty and is specified in ETSI TS 138 521-1 [5], Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW.

   - Uplink power control window size = 1 dB (cab radio UE power step size) + 0,7 dB (cab radio UE power step tolerance) + (Test system relative power measurement uncertainty), where, the cab radio UE power step tolerance is specified in ETSI TS 138 101-1 [1], Table 6.3.4.3-1 and is 0,7 dB for 1 dB power step size, and the Test system relative power measurement uncertainty is specified for test case 6.3.4.3 in ETSI TS 138 521-1 [5], Table F.1.2-1.

   - For cab radio UEs supporting Tx diversity, the transmit power is measured as the sum of the output power from both cab radio UE antenna connectors.

5) Measure the average throughput for a duration sufficient to achieve statistical significance according to ETSI TS 138 521-1 [5], Annex H.

6) Record the frequencies for which the throughput does not meet the requirements.

7) Repeat steps from 3 to 6, using an interfering signal above the wanted signal at step 3.

NOTE: The purpose of the Uplink power control window is to ensure that the actual cab radio UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual cab radio UE Uplink power window is illustrated in ETSI TS 138 521-1 [5], clause F.4.3.

#### 9.2.2.3.3.3 Message Contents

Message contents are according to ETSI TS 138 508-1 [4], clause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED.

### 9.2.2.3.4 Test Requirement

The throughput measurement derived in test procedure shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in ETSI TS 138 521-1 [5], clauses A.3.2 and A.3.3 with parameters specified in Tables 9.2.2.3.2-1 and 9.2.2.3.3.1-1.

# 10 Test cases for terminals other than cab radios

## 10.0 General

This clause defines the test cases for terminals other than cab radios, which fulfil the power class 3 category as specified in ETSI TS 138 101-1 [1], clause 6.2.

## 10.1 Transmitter

### 10.1.1 Output power

The test cases defined in ETSI TS 138 521-1 [5], clause 6.2 shall apply.

### 10.1.2 NR ACLR

The test case defined in ETSI TS 138 521-1 [5], clause 6.5.2.4.1 shall apply.

### 10.1.3 Out-of-band and spurious emissions

The test cases defined in ETSI TS 138 521-1 [5], clauses 6.5.2 and 6.5.3 shall apply.

## 10.2 Receiver

### 10.2.1 Reference sensitivity power level

The test case defined in ETSI TS 138 521-1 [5], clause 7.3 shall apply.

### 10.2.2 Blocking

The test cases defined in ETSI TS 138 521-1 [5], clause 7.6 shall apply.

# Annex A (normative): European mobile bands, excluding n100 and n101

**Table A-1: List of European mobile bands, excluding n100 and n101**

| Protected system | Frequency range for co-existence requirement |
|---|---|
| GSM900 | 921 MHz to 960 MHz |
| | 876 MHz to 915 MHz |
| DCS1800 | 1 805 MHz to 1 880 MHz |
| | 1 710 MHz to 1 785 MHz |
| UTRA FDD Band I or | 2 110 MHz to 2 170 MHz |
| E-UTRA Band 1 or NR Band n1 | 1 920 MHz to 1 980 MHz |
| UTRA FDD Band III or | 1 805 MHz to 1 880 MHz |
| E-UTRA Band 3 or NR Band n3 | 1 710 MHz to 1 785 MHz |
| UTRA FDD Band VII or | 2 620 MHz to 2 690 MHz |
| E-UTRA Band 7 or NR Band n7 | 2 500 MHz to 2 570 MHz |
| UTRA FDD Band VIII or | 925 MHz to 960 MHz |
| E-UTRA Band 8 or NR Band n8 | 880 MHz to 915 MHz |
| UTRA FDD Band XX or E-UTRA Band 20 or NR Band n20 | 791 MHz to 821 MHz |
| | 832 MHz to 862 MHz |
| E-UTRA Band 28 or NR Band n28 | 758 MHz to 803 MHz |
| | 703 MHz to 748 MHz |
| UTRA TDD Band d) or E-UTRA Band 38 or NR Band n38 | 2 570 MHz to 2 620 MHz |
| UTRA TDD Band e) or E-UTRA Band 40 or NR Band n40 | 2 300 MHz to 2 400 MHz |
| E-UTRA Band 41 or NR Band n41 | 2 496 MHz to 2 690 MHz |
| E-UTRA Band 50 or NR band n50 | 1 432 MHz to 1 517 MHz |
| E-UTRA Band 51 or NR Band n51 | 1 427 MHz to 1 432 MHz |
| E-UTRA Band 65 or NR Band n65 | 2 110 MHz to 2 200 MHz |
| | 1 920 MHz to 2 010 MHz |
| E-UTRA Band 75 or NR Band n75 | 1 432 MHz to 1 517 MHz |
| E-UTRA Band 76 or NR Band n76 | 1 427 MHz to 1 432 MHz |
| NR Band n77 | 3 300 MHz to 4 200 MHz |
| NR Band n78 | 3 300 MHz to 3 800 MHz |
| NR band 80 | 1 710 MHz to 1 785 MHz |
| NR band 81 | 880 MHz to 915 MHz |
| NR band 82 | 832 MHz to 862 MHz |
| NR band 83 | 703 MHz to 748 MHz |
| NR band 84 | 1 920 MHz to 1 980 MHz |
| E-UTRA Band 87 | 420 MHz to 425 MHz |
| | 410 MHz to 415 MHz |
| E-UTRA Band 88 | 422 MHz to 427 MHz |
| | 412 MHz to 417 MHz |
| NR Band n91 | 1 427 MHz to 1 432 MHz |
| | 832 MHz to 862 MHz |
| NR Band n92 | 1 432 MHz to 1 517 MHz |
| | 832 MHz to 862 MHz |
| NR Band n93 | 1 427 MHz to 1 432 MHz |
| | 880 MHz to 915 MHz |
| NR Band n94 | 1 432 MHz to 1 517 MHz |
| | 880 MHz to 915 MHz |

# History

| Version | Date | Status |
|---|---|---|
| V1.0.0 | July 2025 | SRdAP process EV 20251008: 2025-07-10 to 2025-10-08 |
| | | |
| | | |
| | | |
| | | |