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| 3GPP TR 37.826 V1.1.0 (2022-03) |
| Technical Report |
| 3rd Generation Partnership Project;Technical Specification Group Radio Access Networks;Rel-17 High power UE (power class 2) for EN-DC with 1 LTE band + 1 NR TDD band (Release 17) |
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Contents

Foreword 6

1 Scope 8

2 References 8

3 Definitions of terms, symbols and abbreviations 8

3.1 Terms 8

3.2 Symbols 8

3.3 Abbreviations 9

4 Background 9

4.1 TR Maintenance 9

5 High power UE (power class 2) for EN-DC with 1 LTE band + 1 NR TDD band: General Part 10

6 High power UE (power class 2) for EN-DC with 1 LTE band + 1 NR TDD band: Specific Band Combination Part 10

6.1 DC\_1A\_n78A 10

6.1.1 Transmitter Characteristics 10

6.1.1.1 Maximum Output Power 10

6.1.1.2 Co-existence study 10

6.1.2 Receiver Characteristics 10

6.1.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 10

6.2 DC\_8A\_n78A 11

6.2.1 Transmitter Characteristics 11

6.2.1.1 Maximum Output Power 11

6.2.1.2 Co-existence study 11

6.2.2 Receiver Characteristics 11

6.2.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 11

6.3 DC\_2\_n77 12

6.3.1 Transmitter Characteristics 12

6.3.1.1 Maximum Output Power 12

6.3.1.2 Configurations for EN-DC 12

6.3.1.3 Co-existence study 12

6.3.2 Receiver Characteristics 12

6.3.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 12

6.3.2.1.1 Power class 2 Case A 12

The MSD due to receiver harmonic mixing for Case A are same as PC3 DC\_2A\_n77A. 12

6.3.2.1.2 Power class 2 Case B 13

The additional MSD due to receiver harmonic mixing for Case B are defined in table 6.3.2.1.2-1 13

6.4 DC\_5\_n77 13

6.4.1 Transmitter Characteristics 13

6.4.1.1 Maximum Output Power 13

6.4.1.2 Configurations for EN-DC 13

6.4.1.3 Co-existence study 14

6.4.2 Receiver Characteristics 14

6.4.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 14

6.4.2.1.1 Power class 2 Case A 14

6.4.2.1.2 Power class 2 Case B 14

6.4.2.2 OOB blocking exception requirements 14

6.5 DC\_13\_n77 15

6.5.1 Transmitter Characteristics 15

6.5.1.1 Maximum Output Power 15

6.5.1.2 Configurations for EN-DC 15

6.5.1.3 Co-existence study 15

6.5.2 Receiver Characteristics 15

6.5.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 15

6.5.2.1.1 Power class 2 Case A 15

6.5.2.1.2 Power class 2 Case B 16

6.5.2.2 OOB blocking exception requirements 16

6.6 DC\_66\_n77 17

6.6.1 Transmitter Characteristics 17

6.6.1.1 Maximum Output Power 17

6.6.1.2 Configurations for EN-DC 17

6.6.1.3 Co-existence study 17

6.6.2 Receiver Characteristics 17

6.6.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 17

6.6.2.1.1 Power class 2 Case A 17

6.6.2.1.2 Power class 2 Case B 18

6.7 DC\_5A\_n78A 18

6.7.1 Transmitter Characteristics 18

6.7.1.1 Maximum Output Power 18

6.7.1.2 Co-existence study 18

6.7.2 Receiver Characteristics 18

6.7.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 18

6.8 DC\_7A\_n78A 19

6.8.1 Transmitter Characteristics 19

6.8.1.1 Maximum Output Power 19

6.8.1.2 Co-existence study 19

6.8.2 Receiver Characteristics 19

6.8.2.1 Reference sensitivity exceptions due to cross band isolation for EN-DC in NR FR1 19

6.9 DC\_2A\_n41A 20

6.9.1 Transmitter Characteristics 20

6.9.1.1 Maximum Output Power 20

6.9.1.2 Co-existence study 20

6.9.2 Receiver Characteristics 20

6.9.2.1 MSD for cross band isolation 20

6.10 DC\_66A\_n41A 20

6.10.1 Transmitter Characteristics 20

6.10.1.1 Maximum Output Power 20

6.10.1.2 Co-existence study 20

6.10.2 Receiver Characteristics 21

6.10.2.1 MSD for cross band isolation 21

6.11 DC\_14A\_n77A 21

6.11.1 Transmitter Characteristics 21

6.11.1.1 Maximum Output Power 21

6.11.1.2 Co-existence study 21

6.11.2 Receiver Characteristics 22

6.11.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 22

6.11.2.2 Reference sensitivity exceptions due to receiver harmonic mixing for PC2 EN-DC in NR FR1 22

6.12 DC\_30A\_n77A 22

6.12.1 Transmitter Characteristics 22

6.12.1.1 Maximum Output Power 22

6.12.1.2 Co-existence study 22

6.12.2 Receiver Characteristics 23

6.12.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 23

6.13 DC\_12A\_n77A 23

6.13.1 Transmitter Characteristics 23

6.13.1.1 Maximum Output Power 23

6.13.1.2 Co-existence study 23

6.13.2 Receiver Characteristics 24

6.13.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 24

6.13.2.2 Reference sensitivity exceptions due to receiver harmonic mixing for PC2 EN-DC in NR FR1 24

6.14 DC\_48\_n77 24

6.14.1 Transmitter Characteristics 24

6.14.1.1 Maximum Output Power 24

6.14.1.2 Configurations for EN-DC 24

6.14.1.3 Co-existence study 25

6.14.2 Receiver Characteristics 25

6.14.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 25

6.15 DC\_28A\_n78A 26

6.15.1 Transmitter Characteristics 26

6.15.1.1 Maximum Output Power 26

6.15.1.2 Co-existence study 26

6.15.2 Receiver Characteristics 26

6.15.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands 26

6.15.2.2 Reference sensitivity exceptions due to receiver harmonic mixing for PC2 EN-DC in NR FR1 27

Annex A (informative): Change history 28

# 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:

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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 is a technical report for High power UE (power class 2) for EN-DC with 1 LTE band + 1 NR TDD band within FR1 under Rel-17 timeframe, including both FDD+TDD and TDD+TDD EN-DC band combinations. FDD+TDD band combinations could support LTE 23dBm + NR 23dBm and LTE 23dBm + NR 26dBm, while TDD+TDD band combinations support only LTE 23dBm + NR 23dBm. Completion of PC3 for particular EN-DC combination is the prerequisite for introducing PC2 for that combination. All the PC2 EN-DC combinations are release-independent from Rel-15.

The purpose is to gather the relevant background information and studies in order to address Power Class 2 EN-DC of 1 LTE band and 1 NR TDD band for the Rel-17 band combinations in Table 1-1. The actual requirements are added to the corresponding technical specifications.

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

…

[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].

**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> <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> <Expansion>

# 4 Background

The present document is a technical report for High power UE (power class 2) for EN-DC with 1 LTE band + 1 NR TDD band within FR1 under Rel-17 timeframe. The document covers each band combination specific issues (i.e. one sub-clause defined per band combination)

## 4.1 TR Maintenance

A single company is responsible for introducing all approved TPs in the current TR, i.e. TR editor. However, it is the responsibility of the contact person of each band combination to ensure that the TPs related to the band combination have been implemented.

# 5 High power UE (power class 2) for EN-DC with 1 LTE band + 1 NR TDD band: General Part

For the EN-DC of LTE TDD band + NR TDD band, The UE is not required to support PC2 within E-UTRA or NR cell group. For the EN-DC of LTE FDD band + NR TDD band, The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group.

# 6 High power UE (power class 2) for EN-DC with 1 LTE band + 1 NR TDD band: Specific Band Combination Part

## 6.1 DC\_1A\_n78A

### 6.1.1 Transmitter Characteristics

#### 6.1.1.1 Maximum Output Power

Table 6.1.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_1A\_n78A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signaled separately by the UE. |

#### 6.1.1.2 Co-existence study

The co-existence study for PC2 DC\_1A\_n78A can be reused from the PC3 DC\_1A\_n78A captured in TR37.863-11-11, where:

- 4th intermodulation product may fall into band n1 Rx.

Therefore, additional MSD for IMD4 needs to be defined for PC2 DC\_1A\_n78A.

### 6.1.2 Receiver Characteristics

#### 6.1.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

Table 6.1.2.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD |
| --- |
| EN-DCConfiguration | EUTRA or NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL LCRB | DL Fc (MHz) | MSD (dB) | IMD order |
| DC\_1A\_n78A | 1 | 1950 | 5 | 25 | 2140 | 17.8 | IMD4 |
| n78 | 3710 | 10 | 50 | 3710 | N/A | N/A |

## 6.2 DC\_8A\_n78A

### 6.2.1 Transmitter Characteristics

#### 6.2.1.1 Maximum Output Power

Table 6.2.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_8A\_n78A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signaled separately by the UE. |

#### 6.2.1.2 Co-existence study

The co-existence study for PC2 DC\_8A\_n78A can be reused from the PC3 DC\_8A\_n78A captured in TR37.863-11-11, where:

- 4th intermodulation product may fall into band n8 Rx.

- 4th harmonic product of band n8 may fall into band n78 Rx.

For the harmonic product, due to the maximum output power of band n8 is kept unchanged, so the MSD values due to 4th harmonic product of the corresponding PC3 ENDC can be applied. Therefore, only additional MSD for IMD4 needs to be defined for PC2 DC\_8A\_n78A.

### 6.2.2 Receiver Characteristics

#### 6.2.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

Table 6.2.2.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD |
| --- |
| EN-DCConfiguration | EUTRA or NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL LCRB | DL Fc (MHz) | MSD (dB) | IMD order |
| DC\_8A\_n78A | 8 | 897.5 | 5 | 25 | 942.5 | 15.5 | IMD4 |
| n78 | 3635 | 10 | 50 | 3635 | N/A | N/A |

## 6.3 DC\_2\_n77

### 6.3.1 Transmitter Characteristics

#### 6.3.1.1 Maximum Output Power

Table 6.3.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_2A\_n77A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signalled separately by the UE. |

#### 6.3.1.2 Configurations for EN-DC

Table 6.3.1.2-1: Inter-band EN-DC configurations within FR1 (two bands)

| EN-DCconfiguration | Uplink EN-DCconfiguration(NOTE 1) |
| --- | --- |
| DC\_2A\_n77ADC\_2A-2A\_n77ADC\_2A\_n77CDC\_2A-2A\_n77C | DC\_2A\_n77A |

#### 6.3.1.3 Co-existence study

According to the PC3 DC\_2A\_n77A study, the 2nd harmonic mixing products from band 2 may fall into band n77 UL frequency range. And, the 2nd, 4th and 5th order IMD products generated by dual uplink from both band 2 and band n77 may fall into the band 2 Rx frequency range. Thus, additional MSD for IMD 2, 4 and 5 should be considered to mitigate the impact of the interference for PC2 DC\_2A\_n77A combination.

### 6.3.2 Receiver Characteristics

#### 6.3.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

#### 6.3.2.1.1 Power class 2 Case A

#### The MSD due to receiver harmonic mixing for Case A are same as PC3 DC\_2A\_n77A.

The additional MSD due to intermodulation for PC2 Case A DC\_2\_n77 are defined in table 6.3.2.1.1-1.

Table 6.3.2.1.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

|  |  |  |
| --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** |  |  |
| **EN-DC** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD for PC2** | **Duplex mode** | **Source of IMD** |
| **Configuration** | **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| DC\_2A\_n77ADC\_2A-2A\_n77ADC\_2A\_n77CDC\_2A-2A\_n77C | 2 | 1855 | 5 | 25 | 1935 | 32.10 | FDD | IMD2 |
| 34.852 |
| n77 | 3790 | 10 | 50 | 3790 | N/A | TDD | N/A |
| 2 | 1900 | 5 | 25 | 1980 | 19.10 | FDD | IMD41 |
| 21.852 |
| n77 | 3720 | 10 | 50 | 3720 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified.NOTE 2: Applicable only if operation with 4 antenna ports is supported in the band with carrier aggregation configured. |

#### 6.3.2.1.2 Power class 2 Case B

#### The additional MSD due to receiver harmonic mixing for Case B are defined in table 6.3.2.1.2-1

Table 6.3.2.1.2-1: MSD exceptions due to receiver harmonic mixing for EN-DC in NR FR1

|  |
| --- |
| NR Band / Channel bandwidth of the affected DL band / MSD |
| UL band | DL band | 5MHz (dB) | 10 MHz (dB) | 15 MHz(dB) | 20 MHz(dB) | 25 MHz(dB) | 40 MHz(dB) | 50 MHz(dB) | 60 MHz(dB) | 70 MHz(dB) | 80 MHz(dB) | 90 MHz(dB) | 100 MHz(dB) |
| n77 | 2 | 9.1 | 8.0 | 7.0 | 6.7 |  |  |  |  |  |  |  |  |

The additional MSD due to intermodulation for PC2 Case B DC\_2\_n77 are same as the Case A defined in table 6.3.2.1.1-1.

## 6.4 DC\_5\_n77

### 6.4.1 Transmitter Characteristics

#### 6.4.1.1 Maximum Output Power

Table 6.4.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_5A\_n77A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signalled separately by the UE. |

#### 6.4.1.2 Configurations for EN-DC

Table 6.4.1.2-1: Inter-band EN-DC configurations within FR1 (two bands)

| EN-DCconfiguration | Uplink EN-DCconfiguration(NOTE 1) |
| --- | --- |
| DC\_5A\_n77ADC\_5A\_n77C | DC\_5A\_n77A |

#### 6.4.1.3 Co-existence study

According to the PC3 DC\_5A\_n77A study, the 4th and 5th IMD products from dual uplink of band 5 and n77 may fall into the band 5 Rx frequency range. Thus, additional MSD for IMD 4 and 5 should be considered to mitigate the impact of the interference for PC2 DC\_5A\_n77A combination.

### 6.4.2 Receiver Characteristics

#### 6.4.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

#### 6.4.2.1.1 Power class 2 Case A

The additional MSD due to intermodulation for PC2 Case A DC\_5\_n77 are defined in table 6.4.2.1-1.

Table 6.4.2.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

|  |
| --- |
| **Band / Channel bandwidth / NRB / Duplex mode** |
| **NR EN-DC****Configuration** | **NR band** | **UL Fc****(MHz)** | **UL/DL BW****(MHz)** | **UL****CLRB** | **DL Fc (MHz)** | **MSD for PC2****(dB)** | **Duplex mode** | **Source of IMD** |
| DC\_5A\_n77A3DC\_5A\_n77C3 | 5 | 844 | 5 | 25 | 889 | 18.60 | FDD | IMD41 |
| n77 | 3421 | 10 | 50 | 3421 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified.NOTE 3: The MSD test points cannot be verified for the band combination in US due to the Band n77 frequency range restriction |

#### 6.4.2.1.2 Power class 2 Case B

The additional MSD due to intermodulation for PC2 Case B DC\_5\_n77 are same as the Case A defined in table 6.4.2.1-1.

#### 6.4.2.2 OOB blocking exception requirements

Since band 5 is a low band and n77 is a wide band, the OOBB exception is needed.

Table 6.4.2.4-1: EN-DC band combination with exceptions allowed

|  |
| --- |
| EN-DC band combination |
| DC\_5\_n77 |

## 6.5 DC\_13\_n77

### 6.5.1 Transmitter Characteristics

#### 6.5.1.1 Maximum Output Power

Table 6.5.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_13A\_n77A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signalled separately by the UE. |

#### 6.5.1.2 Configurations for EN-DC

Table 6.5.1.2-1: Inter-band EN-DC configurations within FR1 (two bands)

| EN-DCconfiguration | Uplink EN-DCconfiguration(NOTE 1) |
| --- | --- |
| DC\_13A\_n77ADC\_13A\_n77C | DC\_13A\_n77A |

#### 6.5.1.3 Co-existence study

According to the PC3 DC\_13A\_n77A study, the 5th harmonic mixing products from band 13 may fall into band n77 UL frequency range. And, the 5th IMD products generated from dual uplinks of band 13 and n77 UL may fall into the band 13 Rx frequency range. Thus, addition MSD for IMD 5 should be considered to mitigate the impact of the interference for PC2 DC\_13A\_n77A combination.

### 6.5.2 Receiver Characteristics

#### 6.5.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

#### 6.5.2.1.1 Power class 2 Case A

The MSD due to receiver harmonic mixing for the PC2 Case A are same as PC3 DC\_13A\_n77A.

The additional MSD due to intermodulation for PC2 DC\_13\_n77 are defined in table 6.5.2.1.1-1.

Table 6.5.2.1.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD |
| --- |
| EN-DC Configuration | EUTRA or NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL LCRB | DL Fc (MHz) | **MSD for PC2** | IMD order |
| DC\_13A\_n77ADC\_13A\_n77C | 13 | 782 | 5 | 20 | 751 | 15.37  | IMD5 |
| n77 | 3879 | 10 | 50 | 3879 | N/A | N/A |

#### 6.5.2.1.2 Power class 2 Case B

The additional MSD due to receiver harmonic mixing for the PC2 Case B DC\_13\_n77 are defined in table 6.5.2.1.2-1.

Table 6.5.2.1.2-1: MSD exceptions (MSD) due to receiver harmonic mixing for EN-DC in NR FR1

|  |
| --- |
| **E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD** |
| **UL band** | **DL band** | **5** **MHz** | **10** **MHz** | **15** **MHz** | **20** **MHz** | **25** **MHz** | **40** **MHz** | **50** **MHz** | **60** **MHz** | **70** **MHz** | **80** **MHz** | **100** **MHz** |
| **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** |
| n77 | 132 | 34 | 31 |  |  |  |  |  |  |  |  |  |
| NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (high) band (superscript HB) such that in MHz and  with carrier frequency in the victim (lower) band in MHz and  the channel bandwidth configured in the higher band. |

The additional MSD due to intermodulation for PC2 Case B DC\_13\_n77 are same as the Case A defined in table 6.5.2.1.1-1.

#### 6.5.2.2 OOB blocking exception requirements

Since band 13 is a low band and n77 is a wide band, the OOBB exception is needed.

Table 6.5.2.2-1: EN-DC band combination with exceptions allowed

|  |
| --- |
| EN-DC band combination |
| DC\_13\_n77 |

## 6.6 DC\_66\_n77

### 6.6.1 Transmitter Characteristics

#### 6.6.1.1 Maximum Output Power

Table 6.6.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_66A\_n77A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signalled separately by the UE. |

#### 6.6.1.2 Configurations for EN-DC

Table 6.6.1.2-1: Inter-band EN-DC configurations within FR1 (two bands)

| EN-DCconfiguration | Uplink EN-DCconfiguration(NOTE 1) |
| --- | --- |
| DC\_66A\_n77ADC\_66A-66A\_n77ADC\_66A-66A-66A\_n77ADC\_66A\_n77CDC\_66A-66A\_n77CDC\_66A-66A-66A\_n77C | DC\_66A\_n77A |

#### 6.6.1.3 Co-existence study

According to the PC3 DC\_66A\_n77A study, the 2nd and 5th order IMD products generated from dual uplinks of band 66 and n77 may fall into the band 66 Rx frequency range. Thus additional MSD should be considered to mitigate the impact of the interference for the PC2 DC\_66A\_n77A combination.

### 6.6.2 Receiver Characteristics

#### 6.6.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

#### 6.6.2.1.1 Power class 2 Case A

The additional MSD due to intermodulation for PC2 Case A DC\_66\_n77 are defined in table 6.6.2.1.1-1.

Table 6.6.2.1.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

|  |  |  |
| --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** |  |  |
| **EN-DC** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD for PC2** | **Duplex mode** | **Source of IMD** |
| **Configuration** | **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| DC\_66A\_n77ADC\_66A-66A\_n77ADC\_66A-66A-66A\_n77ADC\_66A\_n77CDC\_66A-66A\_n77CDC\_66A-66A-66A\_n77C | 66 | 1775 | 5 | 25 | 2175 | 34.33 | FDD | IMD2 |
| n77 | 3950 | 10 | 50 | 3950 | N/A | TDD | N/A |
| 66 | 1760 | 5 | 25 | 2160 | 11.27 | FDD | IMD5 |
| n77 | 3720 | 10 | 50 | 3720 | N/A | TDD | N/A |

#### 6.6.2.1.2 Power class 2 Case B

The additional MSD due to intermodulation for PC2 Case B DC\_66\_n77 are same as the Case A defined in table 6.6.2.1.1-1.

## 6.7 DC\_5A\_n78A

### 6.7.1 Transmitter Characteristics

#### 6.7.1.1 Maximum Output Power

Table 6.7.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_5A\_n78A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signalled separately by the UE. |

#### 6.7.1.2 Co-existence study

According to the PC3 DC\_5A\_n78A study, the 4th IMD products from dual uplink of band 5 and n78 may fall into the band 5 Rx frequency range. Thus, additional MSD for IMD 4 should be considered to mitigate the impact of the interference for PC2 DC\_5A\_n78A combination.

### 6.7.2 Receiver Characteristics

#### 6.7.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

MSD values are provided from a previous contribution [yy] and a new test result (33dBm for PA forward and 65 dB for PCB isolation), the proposed MSD levels are merged in Table 6.7.2.1-1.

Table 6.7.2.1-1: Proposed MSD levels from interested companies for PC2 DC\_5\_n78

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **DC bands** | **UL DC** | **IMD** | **LGE** | **SKT, Murata** | **Qualcomm** | **MSD (dB)** |
| DC\_5A\_n78A | 5 | IMD4 | |3\*fB5 -fn78| | 17.7 [yy] | 17.9 | 17 | 17.5 |
| n78 |

Based on the merged MSD Table, the test points and required MSD levels are proposed in Table 6.7.2.1-2.

Table 6.7.2.1-2: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD |
| --- |
| EN-DCConfiguration | EUTRA or NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL LCRB | DL Fc (MHz) | MSD (dB) | IMD order |
| DC\_5A\_n78A | 5 | 844 | 5 | 25 | 889 | 17.5 | IMD4 |
| n78 | 3421 | 10 | 52 | 3421 | N/A | N/A |

## 6.8 DC\_7A\_n78A

### 6.8.1 Transmitter Characteristics

#### 6.8.1.1 Maximum Output Power

Table 6.8.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_7A\_n78A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signalled separately by the UE. |

#### 6.8.1.2 Co-existence study

According to the PC3 DC\_7A\_n78A study, there was no IMD impacts by dual uplink transmission into the own RX frequency bands for DC\_7A-n78A UE. However, there exists a cross band issue for DC\_7A\_n78A, which requires the reference sensitivity exceptions as seen in Table 6.8.2.1-1 (23dBm + 26dBm) [yy].

### 6.8.2 Receiver Characteristics

#### 6.8.2.1 Reference sensitivity exceptions due to cross band isolation for EN-DC in NR FR1

Table 6.8.2.1-1: Proposed MSD levels from interested companies for PC2 DC\_7\_n78

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **DC bands** | **UL** | **DL** | **LGE** | **Qualcomm** | **MSD (dB)** |
| DC\_7A\_n78A | n78 | 7 | 6.5 [yy] | 6.2 | 6.4 |

Table 6.8.2.1-2: Reference sensitivity exceptions (MSD) due to cross band isolation for PC2 EN-DC in NR FR1

|  |  |
| --- | --- |
|  | E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD |
| UL band | DL band | 5 MHz(dB) | 10 MHz(dB) | 15 MHz(dB) | 20 MHz(dB) |
| n78 | 7 | 6.4 | 6.4 | 6.4 | 6.4 |

## 6.9 DC\_2A\_n41A

### 6.9.1 Transmitter Characteristics

#### 6.9.1.1 Maximum Output Power

Table 6.9.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_2A\_n41A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signaled separately by the UE. |

#### 6.9.1.2 Co-existence study

The co-existence study for PC2 DC\_2A\_n41A can be reused from the PC3 DC\_2A\_n41A captured in TR37.716-11-11, where:

- MSD due to cross band isolation into B2 Rx.

Therefore, additional MSD for cross band isolation needs to be defined for PC2 DC\_2A\_n41A.

### 6.9.2 Receiver Characteristics

#### 6.9.2.1 MSD for cross band isolation

The MSD due to cross band isolation for DC\_2A\_n41A in PC3 was 0.6 dB. 1.1 dB MSD was calculated for PC2 by calculating the interferer power for PC3, and adding 3 dB, then calculating the new MSD.

**Table 6.9.2.1 Reference sensitivity exceptions (MSD) due to cross band isolation for PC2 EN-DC in NR FR1**

|  |  |
| --- | --- |
|  | **E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD** |
| **UL band** | **DL band** | **5 MHz****(dB)** | **10 MHz****(dB)** | **15 MHz****(dB)** | **20 MHz****(dB)** | **25 MHz****(dB)** | **30 MHz****(dB)** | **40 MHz****(dB)** | **50 MHz****(dB)** | **60 MHz****(dB)** | **80 MHz****(dB)** | **90 MHz****(dB)** | **100 MHz****(dB)** |
| n41 | 2 | 1.6 | 1.6 | 1.6 | 1.6 |  |  |  |  |  |  |  |  |

## 6.10 DC\_66A\_n41A

### 6.10.1 Transmitter Characteristics

#### 6.10.1.1 Maximum Output Power

Table 6.10.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_66A\_n41A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signaled separately by the UE. |

#### 6.10.1.2 Co-existence study

The co-existence study for PC2 DC\_66A\_n41A can be reused from the PC3 DC\_66A\_n41A captured in TR37.716-11-11, where:

- MSD due to cross band isolation into B66 Rx.

Therefore, additional MSD for cross band isolation needs to be defined for PC2 DC\_66A\_n41A.

### 6.10.2 Receiver Characteristics

#### 6.10.2.1 MSD for cross band isolation

The MSD due to cross band isolation for DC\_66A\_n41A in PC3 was 3.5 dB. 5.4 dB was calculated for PC2 by calculating the interferer power for PC3, and adding 3 dB, then calculating the new MSD.

**Table 6.10.2.1 Reference sensitivity exceptions (MSD) due to cross band isolation for PC2 EN-DC in NR FR1**

|  |  |
| --- | --- |
|  | **E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD** |
| **UL band** | **DL band** | **5 MHz****(dB)** | **10 MHz****(dB)** | **15 MHz****(dB)** | **20 MHz****(dB)** | **25 MHz****(dB)** | **30 MHz****(dB)** | **40 MHz****(dB)** | **50 MHz****(dB)** | **60 MHz****(dB)** | **80 MHz****(dB)** | **90 MHz****(dB)** | **100 MHz****(dB)** |
| n41 | 66 | 5.4 | 5.4 | 5.4 | 5.4 |  |  |  |  |  |  |  |  |

## 6.11 DC\_14A\_n77A

### 6.11.1 Transmitter Characteristics

#### 6.11.1.1 Maximum Output Power

Table 6.11.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| EN-DC combination | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_14A\_n77A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signaled separately by the UE. |

#### 6.11.1.2 Co-existence study

The co-existence study for PC2 DC\_14A\_n77A can be reused from the PC3 DC\_14A\_n77A captured in TR 37.717-11-11, where:

- 5th order harmonic of band 14 UL may fall into own Rx frequencies of band n77.

- band n77 UL might affect band 14 DL via 5th order harmonic mixing

- 5th order IMD products may fall into own Rx frequencies of band 14.

For the 5th order harmonic of band 14 UL, the MSD values due to 5th order harmonic product of the corresponding PC3 ENDC can be applied since the maximum output power of band 14 is unchanged.

Therefore, additional MSD values for IMD5 and for 5th order harmonic mixing need to be defined for PC2 DC\_14A\_n77A.

### 6.11.2 Receiver Characteristics

#### 6.11.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

Table 6.11.2.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD |
| --- |
| EN-DCConfiguration | EUTRA or NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL LCRB | DL Fc (MHz) | MSD (dB) | IMD order |
| DC\_14A\_n77A | 14 | 795.5 | 5 | 15 | 765.5 | 11.7 | IMD5 |
| n77 | 3947.5 | 10 | 50 | 3947.5 | N/A | N/A |

#### 6.11.2.2 Reference sensitivity exceptions due to receiver harmonic mixing for PC2 EN-DC in NR FR1

Table 6.11.2.2-1: Reference sensitivity exceptions (MSD) due to receiver harmonic mixing for PC2 EN-DC in NR FR1

|  |
| --- |
| E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD |
| UL band | DL band | 5MHz(dB) | 10 MHz(dB) | 15 MHz(dB) | 20 MHz(dB) | 25 MHz(dB) | 40 MHz(dB) | 50 MHz(dB) | 60 MHz(dB) | 80 MHz(dB) | 90 MHz(dB) | 100 MHz(dB) |
| n77 | 14zz | 34 | 31 |  |  |  |  |  |  |  |  |  |
| NOTE ZZ: The requirements should be verified for DL EARFCN of the victim (lower) band (superscript LB) such that  with  the DL carrier frequency in the lower band and $f\_{UL}^{HB}$ the UL carrier frequency in the higher band, both in MHz. |

## 6.12 DC\_30A\_n77A

### 6.12.1 Transmitter Characteristics

#### 6.12.1.1 Maximum Output Power

Table 6.12.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| EN-DC combination | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_30A\_n77A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signaled separately by the UE. |

#### 6.12.1.2 Co-existence study

The co-existence study for PC2 DC\_30A\_n77A can be reused from the PC3 DC\_30A\_n77A captured in TR 37.717-11-11, where:

- 4th order IMD products may fall into own Rx frequencies of band 30.

Therefore, additional MSD for IMD4 needs to be defined for PC2 DC\_30A\_n77A.

### 6.12.2 Receiver Characteristics

#### 6.12.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

Table 6.12.2.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD |
| --- |
| EN-DCConfiguration | EUTRA or NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL LCRB | DL Fc (MHz) | MSD (dB) | IMD order |
| DC\_30A\_n77A | 30 | 2310 | 5 | 25 | 2355 | 17.6 | IMD4 |
| n77 | 3487.5 | 10 | 50 | 3487.5 | N/A | N/A |

## 6.13 DC\_12A\_n77A

### 6.13.1 Transmitter Characteristics

#### 6.13.1.1 Maximum Output Power

Table 6.13.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| EN-DC combination | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_12A\_n77A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signaled separately by the UE. |

#### 6.13.1.2 Co-existence study

The co-existence study for PC2 DC\_12A\_n77A can be reused from the PC3 DC\_12A\_n77A captured in TR 37.717-11-11, where:

- 5th order harmonic of band 12 UL may fall into own Rx frequencies of band n77.

- band n77 UL might affect band 12 DL via 5th order harmonic mixing

- 5th order IMD products may fall into own Rx frequencies of band 12.

For the 5th order harmonic of band 12 UL, the MSD values due to 5th order harmonic product of the corresponding PC3 ENDC can be applied since the maximum output power of band 12 is unchanged.

Therefore, additional MSD values for IMD5 and for 5th order harmonic mixing need to be defined for PC2 DC\_12A\_n77A.

### 6.13.2 Receiver Characteristics

#### 6.13.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

Table 6.13.2.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD |
| --- |
| EN-DCConfiguration | EUTRA or NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL LCRB | DL Fc (MHz) | MSD (dB) | IMD order |
| DC\_12A\_n77A | 12 | 701.5 | 5 | 20 | 737 | 11.7 | IMD5 |
| n77 | 3543 | 10 | 50 | 3543 | N/A | N/A |

#### 6.13.2.2 Reference sensitivity exceptions due to receiver harmonic mixing for PC2 EN-DC in NR FR1

Table 6.13.2.2-1: Reference sensitivity exceptions (MSD) due to receiver harmonic mixing for PC2 EN-DC in NR FR1

|  |
| --- |
| E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD |
| UL band | DL band | 5MHz(dB) | 10 MHz(dB) | 15 MHz(dB) | 20 MHz(dB) | 25 MHz(dB) | 40 MHz(dB) | 50 MHz(dB) | 60 MHz(dB) | 80 MHz(dB) | 90 MHz(dB) | 100 MHz(dB) |
| n77 | 12zz | 34 | 31 |  |  |  |  |  |  |  |  |  |
| NOTE ZZ: The requirements should be verified for DL EARFCN of the victim (lower) band (superscript LB) such that  with  the DL carrier frequency in the lower band and $f\_{UL}^{HB}$ the UL carrier frequency in the higher band, both in MHz. |

## 6.14 DC\_48\_n77

### 6.14.1 Transmitter Characteristics

#### 6.14.1.1 Maximum Output Power

Table 6.14.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| **EN-DC combination** | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| N/A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signalled separately by the UE. |

#### 6.14.1.2 Configurations for EN-DC

This combination is not used alone, and no uplink inter-band EN-DC is specified for the configuration

Table 6.14.1.2-1: Inter-band EN-DC configurations within FR1 (two bands)

| EN-DCconfiguration | Uplink EN-DCconfiguration(NOTE 1) |
| --- | --- |
| DC\_48A\_n77A3,4, 9, 11DC\_48A\_n77C3,4, 9, 11DC\_48C\_n77A3,4, 9, 11DC\_48C\_n77C3,4, 9, 11DC\_48D\_n77A3,4, 9, 11DC\_48D\_n77C3,4, 9, 11DC\_48E\_n77A3,4, 9, 11 | N/A |
| NOTE 3: The minimum requirements apply only when there is non-simultaneous Tx/Rx operation between E-UTRA and NR carriers. This restriction applies also for these carriers when applicable EN-DC configuration is part of a higher order EN-DC configuration.NOTE 4: The minimum requirements for intra-band non-contiguous EN-DC apply. When UE capability *interBandContiguousMRDC* is indicated, the minimum requirements for intra-band-contiguous EN-DC also should be met in addtion to intra-band non-contiguous EN-DC*.* The intra-band requirements also apply for these carriers when applicable EN-DC configuration is a subset of a higher order EN-DC configuration.NOTE 9: The combination is not used alone as fall back mode of other band combinations in which UL in Band 42 or Band 48 is not used.NOTE 11: The minimum requirements for inter-band EN-DC apply when the maximum power spectral density imbalance between downlink carriers is within 6 dB. The power spectral density imbalance condition also applies for these carriers when applicable EN-DC configuration is a subset of a higher order EN-DC configuration. |

#### 6.14.1.3 Co-existence study

There is no uplink inter-band EN-DC is specified for the configuration above, thus no coexistence issue is identified.

### 6.14.2 Receiver Characteristics

#### 6.14.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

There is no MSD identified for both Case A and B.

## 6.15 DC\_28A\_n78A

### 6.15.1 Transmitter Characteristics

#### 6.15.1.1 Maximum Output Power

Table 6.15.1.1-1: Maximum output power for inter-band EN-DC (two bands)

| EN-DC combination | Power class 2 (dBm) | Tolerance (dB) |
| --- | --- | --- |
| DC\_28A\_n78A | 266 | +2/-3 |
| NOTE 6: The UE supports PC3 within E-UTRA cell group, and supports either PC3 or PC2 within NR cell group. Power class support within each individual cell group is signaled separately by the UE. |

#### 6.15.1.2 Co-existence study

The co-existence study for PC2 DC\_28A\_n78A can be reused from the PC2 DC\_14A\_n77A captured in TR 37.826, where:

- 5th order harmonic of band 28 UL may fall into own Rx frequencies of band n78.

- band n78 UL might affect band 28 DL via 5th order harmonic mixing

- 5th order IMD products may fall into own Rx frequencies of band 28.

For the 5th order harmonic of band 28 UL, the MSD values due to 5th order harmonic product of the corresponding PC3 ENDC can be applied since the maximum output power of band 28 is unchanged.

Therefore, additional MSD values for IMD5 and for 5th order harmonic mixing need to be defined for PC2 DC\_28A\_n78A.

### 6.15.2 Receiver Characteristics

#### 6.15.2.1 MSD test points for intermodulation interference due to dual uplink operation for PC2 EN-DC in NR FR1 involving two bands

MSD value for band 28 is reused from DC\_14\_n77 PC2.

Table 6.15.2.1-1: MSD test points for PCell due to dual uplink operation for PC2 EN-DC in NR FR1 (two bands)

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD |
| --- |
| EN-DCConfiguration | EUTRA or NR band | UL Fc (MHz) | UL/DL BW (MHz) | UL LCRB | DL Fc (MHz) | MSD (dB) | IMD order |
| DC\_28A\_n78A | 28 | 705.5 | 5 | 25 | 760.5 | 11.7 | IMD5 |
| n78 | 3582.5 | 10 | 50 | 3582.5 | N/A | N/A |

#### 6.15.2.2 Reference sensitivity exceptions due to receiver harmonic mixing for PC2 EN-DC in NR FR1

Table 6.15.2.2-1: MSD exceptions (MSD) due to receiver harmonic mixing for PC2 EN-DC in NR FR1

|  |
| --- |
| E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD |
| UL band | DL band | 5MHz(dB) | 10 MHz(dB) | 15 MHz(dB) | 20 MHz(dB) | 25 MHz(dB) | 40 MHz(dB) | 50 MHz(dB) | 60 MHz(dB) | 80 MHz(dB) | 90 MHz(dB) | 100 MHz(dB) |
| n78 | 282 | 31 | 28 | 26.2 | 25 |  |  |  |  |  |  |  |
| NOTE 2: The requirements should be verified for DL EARFCN of the victim (lower) band (superscript LB) such that  with  the DL carrier frequency in the lower band and the UL carrier frequency in the higher band, both in MHz. |

**Table 6.15.2.2-2: Uplink configuration for reference sensitivity exceptions due to receiver harmonic mixing for EN-DC in NR FR1**

|  |
| --- |
| **E-UTRA or NR Band / SCS / Channel bandwidth of the affected DL band / UL RB allocation of the agressor band** |
| **UL band** | **DL band** | **SCS of UL band****(kHz)** | **5 MHz****(LCRB)** | **10 MHz****(LCRB)** | **15 MHz****(LCRB)** | **20 MHz****(LCRB)** | **25 MHz****(LCRB)** | **40 MHz****(LCRB)** | **50 MHz****(LCRB)** | **60 MHz****(LCRB)** | **80 MHz****(LCRB)** | **90 MHz****(LCRB)** | **100 MHz****(LCRB)** |
| n78 | 28 | 15 | 25 | 50 | 75 | 100 |  |  |  |  |  |  |  |

# Annex A (informative): Change history

|  |
| --- |
| **Change history** |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2020-11 | RAN4-97e | R4-2014649 |  |  |  | Initial TR skeleton | 0.0.1 |
| 2020-11 | RAN4-97e | R4-2017840 |  |  |  | Included TPs/pCRs:R4-2016856 PC2 for DC\_1A\_n78AR4-2016857 PC2 for DC\_8A\_n78A | 0.1.0 |
| 2021-02 | RAN4-98e | R4-2100084 |  |  |  | Included TPs/pCRs:R4-2103175 PC2 for DC\_2A\_n77AR4-2103176 PC2 for DC\_5A\_n77AR4-2103177 PC2 for DC\_13A\_n77AR4-2103178 PC2 for DC\_66A\_n77A | 0.2.0 |
| 2021-04 | RAN4-98-bis-e | R4-2106288 |  |  |  | Included TPs/pCRs:R4-2105347 PC2 for DC\_5A\_n78AR4-2105348 PC2 for DC\_7A\_n78AR4-2105349 PC2 for DC\_2A\_n41AR4-2107332 PC2 for DC\_66A\_n41A | 0.3.0 |
| 2021-08 | RAN4-100-e | R4-2112472 |  |  |  | Included TPs/pCRs:R4-2111818 PC2 for DC\_14A\_n77AR4-2111819 PC2 for DC\_30A\_n77AR4-2114939 PC2 for DC\_12A\_n77A | 0.4.0 |
| 2021-11 | RAN4-101e | R4-2118152 |  |  |  | Included TPs/pCRs:R4-2119900 PC2 TP for DC\_2\_n77R4-2117111 PC2 TP for DC\_5\_n77R4-2117112 PC2 TP for DC\_13\_n77R4-2119942 PC2 TP for DC\_66\_n77 | 0.5.0 |
| 2021-12 | RAN #94e | RP-212894 |  |  |  | provided for information to RAN (wtith wrong version) | 0.6.0 |
| 2021-12 | RAN #94e | RP-213193 |  |  |  | provided for information to RAN (missing presentation cover and missing update of history table) | 1.0.0 |
| 2021-12 | RAN #94e | RP-213468 |  |  |  | provided for information to RAN | 1.0.1 |
| 2022-03 | RAN4-102e | R4-2204168 |  |  |  | Included TPs/pCRs:R4-2200305 TP for TR 37.826 for DL DC\_48\_n77R4-2206272 TP for TR 37.826 to add DC\_28\_n78 | 1.1.0 |