Annex A (normative):  
Measurement channels

# A.1 General

The throughput values defined in the measurement channels specified in Annex A, are calculated and are valid per datastream (codeword). For multi-stream (more than one codeword) transmissions, the throughput referenced in the minimum requirements is the sum of throughputs of all datastreams (codewords).

The UE category entry in the definition of the reference measurement channel in Annex A is only informative and reveals the UE categories, which can support the corresponding measurement channel. Whether the measurement channel is used for testing a certain UE category or not is specified in the individual minimum requirements.

# A.2 UL reference measurement channels

## A.2.1 General

The measurement channels in the following clauses are defined to derive the requirements in clause 6 (Transmitter Characteristics) and clause 7 (Receiver Characteristics). The measurement channels represent example configurations of physical channels for different data rates.

The measurement channels in the following clauses are applicable to both FDD and TDD.

The active uplink slots for TDD configurations are specified in table A.2.1-1. TDD slot patterns defined for reference sensitivity tests will be used for TDD UL RMCs.

Table A.2.1-1: TDD active uplink slots

|  |  |
| --- | --- |
| SCS | Active Uplink slots |
| 15 kHz | 4, 9 |
| 30 kHz | 8, 9, 18, 19 |
| 60 kHz | 16, 17, 18, 19, 36, 37, 38, 39 |

## A.2.2 Reference measurement channels

### A.2.2.1 DFT-s-OFDM Pi/2-BPSK

Table A.2.2.1-1: Reference Channels for DFT-s-OFDM Pi/2-BPSK

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | DFT-s-OFDM Symbols per slot (Note 1) | Modulation | MCS Index (Note 2) | Payload size | Transport block CRC | LDPC Base Graph | Number of code blocks per slot (Note 3) | Total number of bits per slot | Total modulated symbols per slot |
| Unit |  |  |  |  | Bits | Bits |  |  | Bits |  |
|  | 1 | 11 | pi/2 BPSK | 0 | 24 | 16 | 2 | 1 | 132 | 132 |
|  | 5 | 11 | pi/2 BPSK | 0 | 160 | 16 | 2 | 1 | 660 | 660 |
|  | 9 | 11 | pi/2 BPSK | 0 | 288 | 16 | 2 | 1 | 1188 | 1188 |
|  | 10 | 11 | pi/2 BPSK | 0 | 320 | 16 | 2 | 1 | 1320 | 1320 |
|  | 12 | 11 | pi/2 BPSK | 0 | 384 | 16 | 2 | 1 | 1584 | 1584 |
|  | 15 | 11 | pi/2 BPSK | 0 | 480 | 16 | 2 | 1 | 1980 | 1980 |
|  | 18 | 11 | pi/2 BPSK | 0 | 576 | 16 | 2 | 1 | 2376 | 2376 |
|  | 24 | 11 | pi/2 BPSK | 0 | 768 | 16 | 2 | 1 | 3168 | 3168 |
|  | 25 | 11 | pi/2 BPSK | 0 | 808 | 16 | 2 | 1 | 3300 | 3300 |
|  | 30 | 11 | pi/2 BPSK | 0 | 984 | 16 | 2 | 1 | 3960 | 3960 |
|  | 32 | 11 | pi/2 BPSK | 0 | 1032 | 16 | 2 | 1 | 4224 | 4224 |
|  | 36 | 11 | pi/2 BPSK | 0 | 1128 | 16 | 2 | 1 | 4752 | 4752 |
|  | 45 | 11 | pi/2 BPSK | 0 | 1416 | 16 | 2 | 1 | 5940 | 5940 |
|  | 50 | 11 | pi/2 BPSK | 0 | 1544 | 16 | 2 | 1 | 6600 | 6600 |
|  | 60 | 11 | pi/2 BPSK | 0 | 1864 | 16 | 2 | 1 | 7920 | 7920 |
|  | 64 | 11 | pi/2 BPSK | 0 | 2024 | 16 | 2 | 1 | 8448 | 8448 |
|  | 75 | 11 | pi/2 BPSK | 0 | 2408 | 16 | 2 | 1 | 9900 | 9900 |
|  | 80 | 11 | pi/2 BPSK | 0 | 2472 | 16 | 2 | 1 | 10560 | 10560 |
|  | 81 | 11 | pi/2 BPSK | 0 | 2536 | 16 | 2 | 1 | 10692 | 10692 |
|  | 90 | 11 | pi/2 BPSK | 0 | 2792 | 16 | 2 | 1 | 11880 | 11880 |
|  | 100 | 11 | pi/2 BPSK | 0 | 3104 | 16 | 2 | 1 | 13200 | 13200 |
|  | 108 | 11 | pi/2 BPSK | 0 | 3368 | 16 | 2 | 1 | 14256 | 14256 |
|  | 120 | 11 | pi/2 BPSK | 0 | 3752 | 16 | 2 | 1 | 15840 | 15840 |
|  | 128 | 11 | pi/2 BPSK | 0 | 3976 | 24 | 2 | 2 | 16896 | 16896 |
|  | 135 | 11 | pi/2 BPSK | 0 | 4104 | 24 | 2 | 2 | 17820 | 17820 |
|  | 160 | 11 | pi/2 BPSK | 0 | 4872 | 24 | 2 | 2 | 21120 | 21120 |
|  | 162 | 11 | pi/2 BPSK | 0 | 5000 | 24 | 2 | 2 | 21384 | 21384 |
|  | 180 | 11 | pi/2 BPSK | 0 | 5512 | 24 | 2 | 2 | 23760 | 23760 |
|  | 216 | 11 | pi/2 BPSK | 0 | 6664 | 24 | 2 | 2 | 28512 | 28512 |
|  | 243 | 11 | pi/2 BPSK | 0 | 7560 | 24 | 2 | 2 | 32076 | 32076 |
|  | 270 | 11 | pi/2 BPSK | 0 | 8448 | 24 | 2 | 3 | 35640 | 35640 |
| NOTE 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data. DM-RS symbols are not counted.  NOTE 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [10].  NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  NOTE 4: The RMCs apply to all channel bandwidth where LCRB ≤ NRB. | | | | | | | | | | |

Table A.2.2.1-2: Void

Table A.2.2.1-3: Void

### A.2.2.2 DFT-s-OFDM QPSK

Table A.2.2.2-1: Reference Channels for DFT-s-OFDM QPSK

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | DFT-s-OFDM Symbols per slot (Note 1) | Modulation | MCS Index (Note 2) | Payload size | Transport block CRC | LDPC Base Graph | Number of code blocks per slot (Note 3) | Total number of bits per slot | Total modulated symbols per slot |
| Unit |  |  |  |  | Bits | Bits |  |  | Bits |  |
|  | 1 | 11 | QPSK | 2 | 48 | 16 | 2 | 1 | 264 | 132 |
|  | 5 | 11 | QPSK | 2 | 256 | 16 | 2 | 1 | 1320 | 660 |
|  | 9 | 11 | QPSK | 2 | 456 | 16 | 2 | 1 | 2376 | 1188 |
|  | 10 | 11 | QPSK | 2 | 504 | 16 | 2 | 1 | 2640 | 1320 |
|  | 12 | 11 | QPSK | 2 | 608 | 16 | 2 | 1 | 3168 | 1584 |
|  | 15 | 11 | QPSK | 2 | 768 | 16 | 2 | 1 | 3960 | 1980 |
|  | 18 | 11 | QPSK | 2 | 928 | 16 | 2 | 1 | 4752 | 2376 |
|  | 20 | 11 | QPSK | 2 | 1032 | 16 | 2 | 1 | 5280 | 2640 |
|  | 24 | 11 | QPSK | 2 | 1192 | 16 | 2 | 1 | 6336 | 3168 |
|  | 25 | 11 | QPSK | 2 | 1256 | 16 | 2 | 1 | 6600 | 3300 |
|  | 30 | 11 | QPSK | 2 | 1544 | 16 | 2 | 1 | 7920 | 3960 |
|  | 32 | 11 | QPSK | 2 | 1608 | 16 | 2 | 1 | 8448 | 4224 |
|  | 36 | 11 | QPSK | 2 | 1800 | 16 | 2 | 1 | 9504 | 4752 |
|  | 45 | 11 | QPKS | 2 | 2208 | 16 | 2 | 1 | 11880 | 5940 |
|  | 50 | 11 | QPSK | 2 | 2472 | 16 | 2 | 1 | 13200 | 6600 |
|  | 60 | 11 | QPSK | 2 | 3104 | 16 | 2 | 1 | 15840 | 7920 |
|  | 64 | 11 | QPSK | 2 | 3240 | 16 | 2 | 1 | 16896 | 8448 |
|  | 75 | 11 | QPSK | 2 | 3752 | 16 | 2 | 1 | 19800 | 9900 |
|  | 80 | 11 | QPSK | 2 | 3976 | 24 | 2 | 2 | 21120 | 10560 |
|  | 81 | 11 | QPSK | 2 | 4040 | 24 | 2 | 2 | 21384 | 10692 |
|  | 90 | 11 | QPSK | 2 | 4488 | 24 | 2 | 2 | 23760 | 11880 |
|  | 100 | 11 | QPSK | 2 | 5000 | 24 | 2 | 2 | 26400 | 13200 |
|  | 108 | 11 | QPSK | 2 | 5384 | 24 | 2 | 2 | 28512 | 14256 |
|  | 120 | 11 | QPSK | 2 | 5896 | 24 | 2 | 2 | 31680 | 15840 |
|  | 128 | 11 | QPSK | 2 | 6408 | 24 | 2 | 2 | 33792 | 16896 |
|  | 135 | 11 | QPSK | 2 | 6664 | 24 | 2 | 2 | 35640 | 17820 |
|  | 160 | 11 | QPSK | 2 | 7944 | 24 | 2 | 3 | 42240 | 21120 |
|  | 162 | 11 | QPSK | 2 | 8064 | 24 | 2 | 3 | 42768 | 21384 |
|  | 180 | 11 | QPSK | 2 | 8976 | 24 | 2 | 3 | 47520 | 23760 |
|  | 216 | 11 | QPSK | 2 | 10752 | 24 | 2 | 3 | 57024 | 28512 |
|  | 243 | 11 | QPSK | 2 | 12040 | 24 | 2 | 4 | 64152 | 32076 |
|  | 270 | 11 | QPSK | 2 | 13320 | 24 | 2 | 4 | 71280 | 35640 |
| NOTE 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data. DM-RS symbols are not counted.  NOTE 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [10].  NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  NOTE 4: The RMCs apply to all channel bandwidth where LCRB ≤ NRB. | | | | | | | | | | |

Table A.2.2.2-2: Void

Table A.2.2.2-3: Void

### A.2.2.3 DFT-s-OFDM 16QAM

Table A.2.2.3-1: Reference Channels for DFT-s-OFDM 16QAM

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | DFT-s-OFDM Symbols per slot (Note 1) | Modulation | MCS Index (Note 2) | Payload size | Transport block CRC | LDPC Base Graph | Number of code blocks per slot (Note 3) | Total number of bits per slot | Total modulated symbols per slot |
| Unit |  |  |  |  | Bits | Bits |  |  | Bits |  |
|  | 1 | 11 | 16QAM | 10 | 176 | 16 | 2 | 1 | 528 | 132 |
|  | 5 | 11 | 16QAM | 10 | 888 | 16 | 2 | 1 | 2640 | 660 |
|  | 9 | 11 | 16QAM | 10 | 1608 | 16 | 2 | 1 | 4752 | 1188 |
|  | 10 | 11 | 16QAM | 10 | 1800 | 16 | 2 | 1 | 5280 | 1320 |
|  | 12 | 11 | 16QAM | 10 | 2088 | 16 | 2 | 1 | 6336 | 1584 |
|  | 15 | 11 | 16QAM | 10 | 2664 | 16 | 2 | 1 | 7920 | 1980 |
|  | 18 | 11 | 16QAM | 10 | 3240 | 16 | 2 | 1 | 9504 | 2376 |
|  | 24 | 11 | 16QAM | 10 | 4224 | 24 | 1 | 1 | 12672 | 3168 |
|  | 25 | 11 | 16QAM | 10 | 4352 | 24 | 1 | 1 | 13200 | 3300 |
|  | 30 | 11 | 16QAM | 10 | 5248 | 24 | 1 | 1 | 15840 | 3960 |
|  | 32 | 11 | 16QAM | 10 | 5632 | 24 | 1 | 1 | 16896 | 4224 |
|  | 36 | 11 | 16QAM | 10 | 6272 | 24 | 1 | 1 | 19008 | 4752 |
|  | 45 | 11 | 16QAM | 10 | 7808 | 24 | 1 | 1 | 23760 | 5940 |
|  | 50 | 11 | 16QAM | 10 | 8712 | 24 | 1 | 2 | 26400 | 6600 |
|  | 60 | 11 | 16QAM | 10 | 10504 | 24 | 1 | 2 | 31680 | 7920 |
|  | 64 | 11 | 16QAM | 10 | 11272 | 24 | 1 | 2 | 33792 | 8448 |
|  | 75 | 11 | 16QAM | 10 | 13064 | 24 | 1 | 2 | 39600 | 9900 |
|  | 80 | 11 | 16QAM | 10 | 14088 | 24 | 1 | 2 | 42240 | 10560 |
|  | 81 | 11 | 16QAM | 10 | 14088 | 24 | 1 | 2 | 42768 | 10692 |
|  | 100 | 11 | 16QAM | 10 | 17424 | 24 | 1 | 3 | 52800 | 13200 |
|  | 108 | 11 | 16QAM | 10 | 18960 | 24 | 1 | 3 | 57024 | 14256 |
|  | 120 | 11 | 16QAM | 10 | 21000 | 24 | 1 | 3 | 63360 | 15840 |
|  | 128 | 11 | 16QAM | 10 | 22536 | 24 | 1 | 3 | 67584 | 16896 |
|  | 135 | 11 | 16QAM | 10 | 23568 | 24 | 1 | 3 | 71280 | 17820 |
|  | 160 | 11 | 16QAM | 10 | 28168 | 24 | 1 | 4 | 84480 | 21120 |
|  | 162 | 11 | 16QAM | 10 | 28168 | 24 | 1 | 4 | 85536 | 21384 |
|  | 216 | 11 | 16QAM | 10 | 37896 | 24 | 1 | 5 | 114048 | 28512 |
|  | 243 | 11 | 16QAM | 10 | 43032 | 24 | 1 | 6 | 128304 | 32076 |
|  | 270 | 11 | 16QAM | 10 | 47112 | 24 | 1 | 6 | 142560 | 35640 |
| NOTE 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data. DM-RS symbols are not counted.  NOTE 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [10].  NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  NOTE 4: The RMCs apply to all channel bandwidth where LCRB ≤ NRB. | | | | | | | | | | |

Table A.2.2.3-2: Void

Table A.2.2.3-3: Void

### A.2.2.4 DFT-s-OFDM 64QAM

Table A.2.2.4-1: Reference Channels for DFT-s-OFDM 64QAM

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | DFT-s-OFDM Symbols per slot (Note 1) | Modulation | MCS Index (Note 2) | Payload size | Transport block CRC | LDPC Base Graph | Number of code blocks per slot (Note 3) | Total number of bits per slot | Total modulated symbols per slot |
| Unit |  |  |  |  | Bits | Bits |  |  | Bits |  |
|  | 1 | 11 | 64QAM | 18 | 408 | 16 | 2 | 1 | 792 | 132 |
|  | 5 | 11 | 64QAM | 18 | 2024 | 16 | 2 | 1 | 3960 | 660 |
|  | 9 | 11 | 64QAM | 18 | 3624 | 16 | 2 | 1 | 7128 | 1188 |
|  | 10 | 11 | 64QAM | 18 | 3968 | 24 | 1 | 1 | 7920 | 1320 |
|  | 12 | 11 | 64QAM | 18 | 4736 | 24 | 1 | 1 | 9504 | 1584 |
|  | 15 | 11 | 64QAM | 18 | 6016 | 24 | 1 | 1 | 11880 | 1980 |
|  | 18 | 11 | 64QAM | 18 | 7168 | 24 | 1 | 1 | 14256 | 2376 |
|  | 24 | 11 | 64QAM | 18 | 9480 | 24 | 1 | 2 | 19008 | 3168 |
|  | 25 | 11 | 64QAM | 18 | 9992 | 24 | 1 | 2 | 19800 | 3300 |
|  | 30 | 11 | 64QAM | 18 | 12040 | 24 | 1 | 2 | 23760 | 3960 |
|  | 32 | 11 | 64QAM | 18 | 12808 | 24 | 1 | 2 | 25344 | 4224 |
|  | 36 | 11 | 64QAM | 18 | 14344 | 24 | 1 | 2 | 28512 | 4752 |
|  | 45 | 11 | 64QAM | 18 | 17928 | 24 | 1 | 3 | 35640 | 5940 |
|  | 50 | 11 | 64QAM | 18 | 19968 | 24 | 1 | 3 | 39600 | 6600 |
|  | 60 | 11 | 64QAM | 18 | 24072 | 24 | 1 | 3 | 47520 | 7920 |
|  | 64 | 11 | 64QAM | 18 | 25608 | 24 | 1 | 4 | 50688 | 8448 |
|  | 75 | 11 | 64QAM | 18 | 30216 | 24 | 1 | 4 | 59400 | 9900 |
|  | 80 | 11 | 64QAM | 18 | 31752 | 24 | 1 | 4 | 63360 | 10560 |
|  | 81 | 11 | 64QAM | 18 | 32264 | 24 | 1 | 4 | 64152 | 10692 |
|  | 90 | 11 | 64QAM | 18 | 35856 | 24 | 1 | 5 | 71280 | 11880 |
|  | 100 | 11 | 64QAM | 18 | 39936 | 24 | 1 | 5 | 79200 | 13200 |
|  | 108 | 11 | 64QAM | 18 | 43032 | 24 | 1 | 6 | 85536 | 14256 |
|  | 120 | 11 | 64QAM | 18 | 48168 | 24 | 1 | 6 | 95040 | 15840 |
|  | 128 | 11 | 64QAM | 18 | 51216 | 24 | 1 | 7 | 101376 | 16896 |
|  | 135 | 11 | 64QAM | 18 | 54296 | 24 | 1 | 7 | 106920 | 17820 |
|  | 160 | 11 | 64QAM | 18 | 63528 | 24 | 1 | 8 | 126720 | 21120 |
|  | 162 | 11 | 64QAM | 18 | 64552 | 24 | 1 | 8 | 128304 | 21384 |
|  | 180 | 11 | 64QAM | 18 | 71688 | 24 | 1 | 9 | 142560 | 23760 |
|  | 216 | 11 | 64QAM | 18 | 86040 | 24 | 1 | 11 | 171072 | 28512 |
|  | 243 | 11 | 64QAM | 18 | 96264 | 24 | 1 | 12 | 192456 | 32076 |
|  | 270 | 11 | 64QAM | 18 | 108552 | 24 | 1 | 13 | 213840 | 35640 |
| NOTE 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data. DM-RS symbols are not counted.  NOTE 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [10].  NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  NOTE 4: The RMCs apply to all channel bandwidth where LCRB ≤ NRB. | | | | | | | | | | |

Table A.2.2.4-2: Void

Table A.2.2.4-3: Void

### A.2.2.5 DFT-s-OFDM 256QAM

Table A.2.2.5-1: Reference Channels for DFT-s-OFDM 256QAM

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | DFT-s-OFDM Symbols per slot (Note 1) | Modulation | MCS Index (Note 2) | Payload size | Transport block CRC | LDPC Base Graph | Number of code blocks per slot (Note 3) | Total number of bits per slot | Total modulated symbols per slot |
| Unit |  |  |  |  | Bits | Bits |  |  | Bits |  |
|  | 1 | 11 | 256QAM | 20 | 704 | 16 | 2 | 1 | 1056 | 132 |
|  | 5 | 11 | 256QAM | 20 | 3496 | 16 | 2 | 1 | 5280 | 660 |
|  | 9 | 11 | 256QAM | 20 | 6272 | 24 | 1 | 1 | 9504 | 1188 |
|  | 10 | 11 | 256QAM | 20 | 7040 | 24 | 1 | 1 | 10560 | 1320 |
|  | 12 | 11 | 256QAM | 20 | 8456 | 24 | 1 | 2 | 12672 | 1584 |
|  | 15 | 11 | 256QAM | 20 | 10504 | 24 | 1 | 2 | 15840 | 1980 |
|  | 18 | 11 | 256QAM | 20 | 12552 | 24 | 1 | 2 | 19008 | 2376 |
|  | 24 | 11 | 256QAM | 20 | 16896 | 24 | 1 | 3 | 25344 | 3168 |
|  | 25 | 11 | 256QAM | 20 | 17424 | 24 | 1 | 3 | 26400 | 3300 |
|  | 30 | 11 | 256QAM | 20 | 21000 | 24 | 1 | 3 | 31680 | 3960 |
|  | 32 | 11 | 256QAM | 20 | 22536 | 24 | 1 | 3 | 33792 | 4224 |
|  | 36 | 11 | 256QAM | 20 | 25104 | 24 | 1 | 3 | 38016 | 4752 |
|  | 45 | 11 | 256QAM | 20 | 31752 | 24 | 1 | 4 | 47520 | 5940 |
|  | 50 | 11 | 256QAM | 20 | 34816 | 24 | 1 | 5 | 52800 | 6600 |
|  | 60 | 11 | 256QAM | 20 | 42016 | 24 | 1 | 5 | 63360 | 7920 |
|  | 64 | 11 | 256QAM | 20 | 45096 | 24 | 1 | 6 | 67584 | 8448 |
|  | 75 | 11 | 256QAM | 20 | 53288 | 24 | 1 | 7 | 79200 | 9900 |
|  | 80 | 11 | 256QAM | 20 | 56368 | 24 | 1 | 7 | 84480 | 10560 |
|  | 81 | 11 | 256QAM | 20 | 57376 | 24 | 1 | 7 | 85536 | 10692 |
|  | 90 | 11 | 256QAM | 20 | 63528 | 24 | 1 | 8 | 95040 | 11880 |
|  | 100 | 11 | 256QAM | 20 | 69672 | 24 | 1 | 9 | 105600 | 13200 |
|  | 108 | 11 | 256QAM | 20 | 75792 | 24 | 1 | 9 | 114048 | 14256 |
|  | 120 | 11 | 256QAM | 20 | 83976 | 24 | 1 | 10 | 126720 | 15840 |
|  | 128 | 11 | 256QAM | 20 | 90176 | 24 | 1 | 11 | 135168 | 16896 |
|  | 135 | 11 | 256QAM | 20 | 94248 | 24 | 1 | 12 | 142560 | 17820 |
|  | 160 | 11 | 256QAM | 20 | 112648 | 24 | 1 | 14 | 168960 | 21120 |
|  | 162 | 11 | 256QAM | 20 | 114776 | 24 | 1 | 14 | 171072 | 21384 |
|  | 180 | 11 | 256QAM | 20 | 127080 | 24 | 1 | 16 | 190080 | 23760 |
|  | 216 | 11 | 256QAM | 20 | 151608 | 24 | 1 | 18 | 228096 | 28512 |
|  | 243 | 11 | 256QAM | 20 | 172176 | 24 | 1 | 21 | 256608 | 32076 |
|  | 270 | 11 | 256QAM | 20 | 188576 | 24 | 1 | 23 | 285120 | 35640 |
| NOTE 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data. DM-RS symbols are not counted.  NOTE 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [10].  NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  NOTE 4: The RMCs apply to all channel bandwidth where LCRB ≤ NRB. | | | | | | | | | | |

Table A.2.2.5-2: Void

Table A.2.2.5-3: Void

### A.2.2.6 CP-OFDM QPSK

Table A.2.2.6-1: Reference Channels for CP-OFDM QPSK

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | CP-OFDM Symbols per slot (Note 1) | Modulation | MCS Index (Note 2) | Payload size | Transport block CRC | LDPC Base Graph | Number of code blocks per slot (Note 3) | Total number of bits per slot | Total modulated symbols per slot |
| Unit |  |  |  |  | Bits | Bits |  |  | Bits |  |
|  | 1 | 11 | QPSK | 2 | 48 | 16 | 2 | 1 | 264 | 132 |
|  | 5 | 11 | QPSK | 2 | 256 | 16 | 2 | 1 | 1320 | 660 |
|  | 6 | 11 | QPSK | 2 | 304 | 16 | 2 | 1 | 1584 | 792 |
|  | 9 | 11 | QPSK | 2 | 456 | 16 | 2 | 1 | 2376 | 1188 |
|  | 10 | 11 | QPSK | 2 | 504 | 16 | 2 | 1 | 2640 | 1320 |
|  | 11 | 11 | QPSK | 2 | 552 | 16 | 2 | 1 | 2904 | 1452 |
|  | 12 | 11 | QPSK | 2 | 608 | 16 | 2 | 1 | 3168 | 1584 |
|  | 13 | 11 | QPSK | 2 | 672 | 16 | 2 | 1 | 3432 | 1716 |
|  | 15 | 11 | QPSK | 2 | 768 | 16 | 2 | 1 | 3960 | 1980 |
|  | 16 | 11 | QPSK | 2 | 808 | 16 | 2 | 1 | 4224 | 2112 |
|  | 18 | 11 | QPSK | 2 | 928 | 16 | 2 | 1 | 4752 | 2376 |
|  | 19 | 11 | QPSK | 2 | 984 | 16 | 2 | 1 | 5016 | 2508 |
|  | 24 | 11 | QPSK | 2 | 1192 | 16 | 2 | 1 | 6336 | 3168 |
|  | 25 | 11 | QPSK | 2 | 1256 | 16 | 2 | 1 | 6600 | 3300 |
|  | 26 | 11 | QPSK | 2 | 1288 | 16 | 2 | 1 | 6864 | 3432 |
|  | 31 | 11 | QPSK | 2 | 1544 | 16 | 2 | 1 | 8184 | 4092 |
|  | 33 | 11 | QPSK | 2 | 1672 | 16 | 2 | 1 | 8712 | 4356 |
|  | 38 | 11 | QPSK | 2 | 1928 | 16 | 2 | 1 | 10032 | 5016 |
|  | 39 | 11 | QPSK | 2 | 2024 | 16 | 2 | 1 | 10296 | 5148 |
|  | 40 | 11 | QPSK | 2 | 2024 | 16 | 2 | 1 | 10560 | 5280 |
|  | 47 | 11 | QPSK | 2 | 2408 | 16 | 2 | 1 | 12408 | 6204 |
|  | 51 | 11 | QPSK | 2 | 2536 | 16 | 2 | 1 | 13464 | 6732 |
|  | 52 | 11 | QPSK | 2 | 2600 | 16 | 2 | 1 | 13728 | 6864 |
|  | 53 | 11 | QPSK | 2 | 2664 | 16 | 2 | 1 | 13992 | 6996 |
|  | 54 | 11 | QPSK | 2 | 2664 | 16 | 2 | 1 | 14256 | 7128 |
|  | 61 | 11 | QPSK | 2 | 3104 | 16 | 2 | 1 | 16104 | 8052 |
|  | 65 | 11 | QPSK | 2 | 3240 | 16 | 2 | 1 | 17160 | 8580 |
|  | 67 | 11 | QPSK | 2 | 3368 | 16 | 2 | 1 | 17688 | 8844 |
|  | 68 | 11 | QPSK | 2 | 3368 | 16 | 2 | 1 | 17952 | 8976 |
|  | 78 | 11 | QPSK | 2 | 3848 | 24 | 2 | 2 | 20592 | 10296 |
|  | 79 | 11 | QPSK | 2 | 3912 | 24 | 2 | 2 | 20856 | 10428 |
|  | 80 | 11 | QPSK | 2 | 3976 | 24 | 2 | 2 | 21120 | 10560 |
|  | 81 | 11 | QPSK | 2 | 4040 | 24 | 2 | 2 | 21384 | 10692 |
|  | 93 | 11 | QPSK | 2 | 4616 | 24 | 2 | 2 | 24552 | 12276 |
|  | 95 | 11 | QPSK | 2 | 4744 | 24 | 2 | 2 | 25080 | 12540 |
|  | 106 | 11 | QPSK | 2 | 5256 | 24 | 2 | 2 | 27984 | 13992 |
|  | 107 | 11 | QPSK | 2 | 5256 | 24 | 2 | 2 | 28248 | 14124 |
|  | 108 | 11 | QPSK | 2 | 5384 | 24 | 2 | 2 | 28512 | 14256 |
|  | 109 | 11 | QPSK | 2 | 5384 | 24 | 2 | 2 | 28776 | 14388 |
|  | 121 | 11 | QPSK | 2 | 6024 | 24 | 2 | 2 | 31944 | 15972 |
|  | 123 | 11 | QPSK | 2 | 6152 | 24 | 2 | 2 | 32472 | 16236 |
|  | 133 | 11 | QPSK | 2 | 6664 | 24 | 2 | 2 | 35112 | 17556 |
|  | 135 | 11 | QPSK | 2 | 6664 | 24 | 2 | 2 | 35640 | 17820 |
|  | 137 | 11 | QPSK | 2 | 6792 | 24 | 2 | 2 | 36168 | 18084 |
|  | 160 | 11 | QPSK | 2 | 7944 | 24 | 2 | 3 | 42240 | 21120 |
|  | 162 | 11 | QPSK | 2 | 8064 | 24 | 2 | 3 | 42768 | 21384 |
|  | 189 | 11 | QPSK | 2 | 9480 | 24 | 2 | 3 | 49896 | 24948 |
|  | 216 | 11 | QPSK | 2 | 10752 | 24 | 2 | 3 | 57024 | 28512 |
|  | 217 | 11 | QPSK | 2 | 10752 | 24 | 2 | 3 | 57288 | 28644 |
|  | 245 | 11 | QPSK | 2 | 12296 | 24 | 2 | 4 | 64680 | 32340 |
|  | 270 | 11 | QPSK | 2 | 13320 | 24 | 2 | 4 | 71280 | 35640 |
|  | 273 | 11 | QPSK | 2 | 13576 | 24 | 2 | 4 | 72072 | 36036 |
| NOTE 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data. DM-RS symbols are not counted.  NOTE 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [10].  NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  NOTE 4: The RMCs apply to all channel bandwidth where LCRB ≤ NRB. | | | | | | | | | | |

Table A.2.2.6-2: Void

Table A.2.2.6-3: Void

### A.2.2.7 CP-OFDM 16QAM

Table A.2.2.7-1: Reference Channels for CP-OFDM 16QAM

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | CP-OFDM Symbols per slot (Note 1) | Modulation | MCS Index (Note 2) | Payload size | Transport block CRC | LDPC Base Graph | Number of code blocks per slot (Note 3) | Total number of bits per slot | Total modulated symbols per slot |
| Unit |  |  |  |  | Bits | Bits |  |  | Bits |  |
|  | 1 | 11 | 16QAM | 10 | 176 | 16 | 2 | 1 | 528 | 132 |
|  | 5 | 11 | 16QAM | 10 | 888 | 16 | 2 | 1 | 2640 | 660 |
|  | 6 | 11 | 16QAM | 10 | 1064 | 16 | 2 | 1 | 3168 | 792 |
|  | 9 | 11 | 16QAM | 10 | 1608 | 16 | 2 | 1 | 4752 | 1188 |
|  | 10 | 11 | 16QAM | 10 | 1800 | 16 | 2 | 1 | 5280 | 1320 |
|  | 11 | 11 | 16QAM | 10 | 1928 | 16 | 2 | 1 | 5808 | 1452 |
|  | 12 | 11 | 16QAM | 10 | 2088 | 16 | 2 | 1 | 6336 | 1584 |
|  | 13 | 11 | 16QAM | 10 | 2280 | 16 | 2 | 1 | 6864 | 1716 |
|  | 15 | 11 | 16QAM | 10 | 2664 | 16 | 2 | 1 | 7920 | 1980 |
|  | 16 | 11 | 16QAM | 10 | 2792 | 16 | 2 | 1 | 8448 | 2112 |
|  | 18 | 11 | 16QAM | 10 | 3240 | 16 | 2 | 1 | 9504 | 2376 |
|  | 19 | 11 | 16QAM | 10 | 3368 | 16 | 2 | 1 | 10032 | 2508 |
|  | 24 | 11 | 16QAM | 10 | 4224 | 24 | 1 | 1 | 12672 | 3168 |
|  | 25 | 11 | 16QAM | 10 | 4352 | 24 | 1 | 1 | 13200 | 3300 |
|  | 26 | 11 | 16QAM | 10 | 4480 | 24 | 1 | 1 | 13728 | 3432 |
|  | 31 | 11 | 16QAM | 10 | 5376 | 24 | 1 | 1 | 16368 | 4092 |
|  | 33 | 11 | 16QAM | 10 | 5760 | 24 | 1 | 1 | 17424 | 4356 |
|  | 38 | 11 | 16QAM | 10 | 6656 | 24 | 1 | 1 | 20064 | 5016 |
|  | 39 | 11 | 16QAM | 10 | 6784 | 24 | 1 | 1 | 20592 | 5148 |
|  | 40 | 11 | 16QAM | 10 | 7040 | 24 | 1 | 1 | 21120 | 5280 |
|  | 47 | 11 | 16QAM | 10 | 8192 | 24 | 1 | 1 | 24816 | 6204 |
|  | 51 | 11 | 16QAM | 10 | 8968 | 24 | 1 | 2 | 26928 | 6732 |
|  | 52 | 11 | 16QAM | 10 | 9224 | 24 | 1 | 2 | 27456 | 6864 |
|  | 53 | 11 | 16QAM | 10 | 9224 | 24 | 1 | 2 | 27984 | 6996 |
|  | 54 | 11 | 16QAM | 10 | 9480 | 24 | 1 | 2 | 28512 | 7128 |
|  | 61 | 11 | 16QAM | 10 | 10760 | 24 | 1 | 2 | 32208 | 8052 |
|  | 65 | 11 | 16QAM | 10 | 11272 | 24 | 1 | 2 | 34320 | 8580 |
|  | 67 | 11 | 16QAM | 10 | 11784 | 24 | 1 | 2 | 35376 | 8844 |
|  | 68 | 11 | 16QAM | 10 | 11784 | 24 | 1 | 2 | 35904 | 8976 |
|  | 78 | 11 | 16QAM | 10 | 13576 | 24 | 1 | 2 | 41184 | 10296 |
|  | 79 | 11 | 16QAM | 10 | 13832 | 24 | 1 | 2 | 41712 | 10428 |
|  | 80 | 11 | 16QAM | 10 | 14088 | 24 | 1 | 2 | 42240 | 10560 |
|  | 81 | 11 | 16QAM | 10 | 14088 | 24 | 1 | 2 | 42768 | 10692 |
|  | 93 | 11 | 16QAM | 10 | 16392 | 24 | 1 | 2 | 49404 | 12276 |
|  | 95 | 11 | 16QMA | 10 | 16392 | 24 | 1 | 2 | 50160 | 12540 |
|  | 106 | 11 | 16QAM | 10 | 18432 | 24 | 1 | 3 | 55968 | 13992 |
|  | 107 | 11 | 16QAM | 10 | 18960 | 24 | 1 | 3 | 56496 | 14124 |
|  | 108 | 11 | 16QAM | 10 | 18960 | 24 | 1 | 3 | 57024 | 14256 |
|  | 109 | 11 | 16QAM | 10 | 18960 | 24 | 1 | 3 | 57552 | 14388 |
|  | 121 | 11 | 16QAM | 10 | 21000 | 24 | 1 | 3 | 63888 | 15972 |
|  | 123 | 11 | 16QAM | 10 | 21504 | 24 | 1 | 3 | 64944 | 16236 |
|  | 133 | 11 | 16QAM | 10 | 23040 | 24 | 1 | 3 | 70224 | 17556 |
|  | 135 | 11 | 16QAM | 10 | 23568 | 24 | 1 | 3 | 71280 | 17820 |
|  | 137 | 11 | 16QAM | 10 | 24072 | 24 | 1 | 3 | 72336 | 18084 |
|  | 160 | 11 | 16QAM | 10 | 28168 | 24 | 1 | 4 | 84480 | 21120 |
|  | 162 | 11 | 16QAM | 10 | 28168 | 24 | 1 | 4 | 85536 | 21384 |
|  | 189 | 11 | 16QAM | 10 | 32776 | 24 | 1 | 4 | 99792 | 24948 |
|  | 216 | 11 | 16QAM | 10 | 37896 | 24 | 1 | 5 | 114048 | 28512 |
|  | 217 | 11 | 16QAM | 10 | 37896 | 24 | 1 | 5 | 114576 | 28644 |
|  | 245 | 11 | 16QAM | 10 | 43032 | 24 | 1 | 6 | 129360 | 32340 |
|  | 270 | 11 | 16QAM | 10 | 47112 | 24 | 1 | 6 | 142560 | 35640 |
|  | 273 | 11 | 16QAM | 10 | 48168 | 24 | 1 | 6 | 144144 | 36036 |
| NOTE 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data. DM-RS symbols are not counted.  NOTE 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [10].  NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  NOTE 4: The RMCs apply to all channel bandwidth where LCRB ≤ NRB. | | | | | | | | | | |

Table A.2.2.7-2: Void

Table A.2.2.7-3: Void

### A.2.2.8 CP-OFDM 64QAM

Table A.2.2.8-1: Reference Channels for CP-OFDM 64QAM

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | CP-OFDM Symbols per slot (Note 1) | Modulation | MCS Index (Note 2) | Payload size | Transport block CRC | LDPC Base Graph | Number of code blocks per slot (Note 3) | Total number of bits per slot | Total modulated symbols per slot |
| Unit |  |  |  |  | Bits | Bits |  |  | Bits |  |
|  | 1 | 11 | 64QAM | 19 | 408 | 16 | 2 | 1 | 792 | 132 |
|  | 5 | 11 | 64QAM | 19 | 2024 | 16 | 2 | 1 | 3960 | 660 |
|  | 9 | 11 | 64QAM | 19 | 3624 | 16 | 2 | 1 | 7128 | 1188 |
|  | 10 | 11 | 64QAM | 19 | 3968 | 24 | 1 | 1 | 7920 | 1320 |
|  | 11 | 11 | 64QAM | 19 | 4352 | 24 | 1 | 1 | 8712 | 1452 |
|  | 12 | 11 | 64QAM | 19 | 4736 | 24 | 1 | 1 | 9504 | 1584 |
|  | 13 | 11 | 64QAM | 19 | 5120 | 24 | 1 | 1 | 10296 | 1716 |
|  | 15 | 11 | 64QAM | 19 | 6016 | 24 | 1 | 1 | 11880 | 1980 |
|  | 18 | 11 | 64QAM | 19 | 7168 | 24 | 1 | 1 | 14256 | 2376 |
|  | 19 | 11 | 64QAM | 19 | 7552 | 24 | 1 |  | 15048 | 2508 |
|  | 24 | 11 | 64QAM | 19 | 9480 | 24 | 1 | 2 | 19008 | 3168 |
|  | 25 | 11 | 64QAM | 19 | 9992 | 24 | 1 | 2 | 19800 | 3300 |
|  | 26 | 11 | 64QAM | 19 | 10504 | 24 | 1 | 2 | 20592 | 3432 |
|  | 31 | 11 | 64QAM | 19 | 12296 | 24 | 1 | 2 | 24552 | 4092 |
|  | 33 | 11 | 64QAM | 19 | 13064 | 24 | 1 | 2 | 26136 | 4356 |
|  | 38 | 11 | 64QAM | 19 | 15112 | 24 | 1 | 2 | 30096 | 5016 |
|  | 39 | 11 | 64QAM | 19 | 15624 | 24 | 1 | 2 | 30888 | 5148 |
|  | 47 | 11 | 64QAM | 19 | 18960 | 24 | 1 | 3 | 37224 | 6204 |
|  | 51 | 11 | 64QAM | 19 | 20496 | 24 | 1 | 3 | 40392 | 6732 |
|  | 52 | 11 | 64QAM | 19 | 21000 | 24 | 1 | 3 | 41184 | 6864 |
|  | 53 | 11 | 64QAM | 19 | 21000 | 24 | 1 | 3 | 41976 | 6996 |
|  | 61 | 11 | 64QAM | 19 | 24567 | 24 | 1 | 3 | 48312 | 8052 |
|  | 65 | 11 | 64QAM | 19 | 26120 | 24 | 1 | 4 | 51480 | 8580 |
|  | 67 | 11 | 64QAM | 19 | 26632 | 24 | 1 | 4 | 53064 | 8844 |
|  | 78 | 11 | 64QAM | 19 | 31240 | 24 | 1 | 4 | 61776 | 10296 |
|  | 79 | 11 | 64QAM | 19 | 31752 | 24 | 1 | 4 | 62568 | 10428 |
|  | 80 | 11 | 64QAM | 19 | 31752 | 24 | 1 | 4 | 63360 | 10560 |
|  | 81 | 11 | 64QAM | 19 | 32264 | 24 | 1 | 4 | 64152 | 10692 |
|  | 93 | 11 | 64QAM | 19 | 36896 | 24 | 1 | 5 | 73656 | 12276 |
|  | 95 | 11 | 64QAM | 19 | 37896 | 24 | 1 | 5 | 75240 | 12540 |
|  | 93 | 11 | 64QAM | 19 | 36896 | 24 | 1 | 5 | 73656 | 12276 |
|  | 106 | 11 | 64QAM | 19 | 42016 | 24 | 1 | 5 | 83952 | 13992 |
|  | 107 | 11 | 64QAM | 19 | 43032 | 24 | 1 | 6 | 84744 | 14124 |
|  | 108 | 11 | 64QAM | 19 | 43032 | 24 | 1 | 6 | 85536 | 14256 |
|  | 109 | 11 | 64QAM | 19 | 44040 | 24 | 1 | 6 | 86328 | 14388 |
|  | 121 | 11 | 64QAM | 19 | 48168 | 24 | 1 | 6 | 95832 | 15972 |
|  | 123 | 11 | 64QAM | 19 | 49176 | 24 | 1 | 6 | 97416 | 16236 |
|  | 133 | 11 | 64QAM | 19 | 53288 | 24 | 1 | 7 | 105336 | 17556 |
|  | 135 | 11 | 64QAM | 19 | 54296 | 24 | 1 | 7 | 106920 | 17820 |
|  | 137 | 11 | 64QAM | 19 | 54296 | 24 | 1 | 7 | 108504 | 18084 |
|  | 160 | 11 | 64QAM | 19 | 63528 | 24 | 1 | 8 | 126720 | 21120 |
|  | 162 | 11 | 64QAM | 19 | 64552 | 24 | 1 | 8 | 128304 | 21384 |
|  | 189 | 11 | 64QAM | 19 | 75792 | 24 | 1 | 9 | 149688 | 24948 |
|  | 216 | 11 | 64QAM | 19 | 86040 | 24 | 1 | 11 | 171072 | 28512 |
|  | 217 | 11 | 64QAM | 19 | 86040 | 24 | 1 | 11 | 171864 | 28644 |
|  | 245 | 11 | 64QAM | 19 | 98376 | 24 | 1 | 12 | 194040 | 32340 |
|  | 270 | 11 | 64QAM | 19 | 108552 | 24 | 1 | 13 | 213840 | 35640 |
|  | 273 | 11 | 64QAM | 19 | 108552 | 24 | 1 | 13 | 216216 | 36036 |
| NOTE 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data. DM-RS symbols are not counted.  NOTE 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [10].  NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  NOTE 4: The RMCs apply to all channel bandwidth where LCRB ≤ NRB. | | | | | | | | | | |

Table A.2.2.8-2: Void

Table A.2.2.8-3: Void

### A.2.2.9 CP-OFDM 256QAM

Table A.2.2.9-1: Reference Channels for CP-OFDM 256QAM

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | CP-OFDM Symbols per slot (Note 1) | Modulation | MCS Index (Note 2) | Payload size | Transport block CRC | LDPC Base Graph | Number of code blocks per slot (Note 3) | Total number of bits per slot | Total modulated symbols per slot |
| Unit |  |  |  |  | Bits | Bits |  |  | Bits |  |
|  | 1 | 11 | 256QAM | 20 | 704 | 16 | 2 | 1 | 1056 | 132 |
|  | 5 | 11 | 256QAM | 20 | 3496 | 16 | 2 | 1 | 5280 | 660 |
|  | 9 | 11 | 256QAM | 20 | 6272 | 24 | 1 | 1 | 9504 | 1188 |
|  | 10 | 11 | 256QAM | 20 | 7040 | 24 | 1 | 1 | 10560 | 1320 |
|  | 11 | 11 | 256QAM | 20 | 7680 | 24 | 1 | 1 | 11616 | 1452 |
|  | 12 | 11 | 256QAM | 20 | 8456 | 24 | 1 | 2 | 12672 | 1584 |
|  | 13 | 11 | 256QAM | 20 | 9224 | 24 | 1 | 2 | 13728 | 1716 |
|  | 15 | 11 | 256QAM | 20 | 10504 | 24 | 1 | 2 | 15840 | 1980 |
|  | 18 | 11 | 256QAM | 20 | 12552 | 24 | 1 | 2 | 19008 | 2376 |
|  | 19 | 11 | 256QAM | 20 | 13320 | 24 | 1 | 2 | 20064 | 2508 |
|  | 24 | 11 | 256QAM | 20 | 16896 | 24 | 1 | 3 | 25344 | 3168 |
|  | 25 | 11 | 256QAM | 20 | 17424 | 24 | 1 | 3 | 26400 | 3300 |
|  | 26 | 11 | 256QAM | 20 | 18432 | 24 | 1 | 3 | 27456 | 3432 |
|  | 31 | 11 | 256QAM | 20 | 22032 | 24 | 1 | 3 | 32736 | 4092 |
|  | 33 | 11 | 256QAM | 20 | 23040 | 24 | 1 | 3 | 34848 | 4356 |
|  | 38 | 11 | 256QAM | 20 | 26632 | 24 | 1 | 4 | 40128 | 5016 |
|  | 39 | 11 | 256QAM | 20 | 27656 | 24 | 1 | 4 | 41184 | 5148 |
|  | 47 | 11 | 256QAM | 20 | 32776 | 24 | 1 | 4 | 49632 | 6204 |
|  | 51 | 11 | 256QAM | 20 | 35856 | 24 | 1 | 5 | 53856 | 6732 |
|  | 52 | 11 | 256QAM | 20 | 36896 | 24 | 1 | 5 | 54912 | 6864 |
|  | 53 | 11 | 256QAM | 20 | 36896 | 24 | 1 | 5 | 55968 | 6996 |
|  | 61 | 11 | 256QAM | 20 | 43032 | 24 | 1 | 6 | 64416 | 8052 |
|  | 65 | 11 | 256QAM | 20 | 46104 | 24 | 1 | 6 | 68640 | 8580 |
|  | 67 | 11 | 256QAM | 20 | 47112 | 24 | 1 | 6 | 70752 | 8844 |
|  | 78 | 11 | 256QAM | 20 | 55304 | 24 | 1 | 7 | 82368 | 10296 |
|  | 79 | 11 | 256QAM | 20 | 55304 | 24 | 1 | 7 | 83424 | 10428 |
|  | 80 | 11 | 256QAM | 20 | 56368 | 24 | 1 | 7 | 84480 | 10560 |
|  | 81 | 11 | 256QAM | 20 | 57376 | 24 | 1 | 7 | 85536 | 10692 |
|  | 93 | 11 | 256QAM | 20 | 65576 | 24 | 1 | 8 | 98208 | 12276 |
|  | 95 | 11 | 256QAM | 20 | 67584 | 24 | 1 | 8 | 100320 | 12540 |
|  | 106 | 11 | 256QAM | 20 | 73776 | 24 | 1 | 9 | 111936 | 13992 |
|  | 107 | 11 | 256QAM | 20 | 75792 | 24 | 1 | 9 | 112992 | 14124 |
|  | 108 | 11 | 256QAM | 20 | 75792 | 24 | 1 | 9 | 114048 | 14256 |
|  | 109 | 11 | 256QAM | 20 | 75792 | 24 | 1 | 9 | 115104 | 14388 |
|  | 121 | 11 | 256QAM | 20 | 86040 | 24 | 1 | 11 | 127776 | 15972 |
|  | 123 | 11 | 256QAM | 20 | 86040 | 24 | 1 | 11 | 129888 | 16236 |
|  | 133 | 11 | 256QAM | 20 | 94248 | 24 | 1 | 12 | 140448 | 17556 |
|  | 135 | 11 | 256QAM | 20 | 94248 | 24 | 1 | 12 | 142560 | 17820 |
|  | 137 | 11 | 256QAM | 20 | 96264 | 24 | 1 | 12 | 144672 | 18084 |
|  | 160 | 11 | 256QAM | 20 | 112648 | 24 | 1 | 14 | 168960 | 21120 |
|  | 162 | 11 | 256QAM | 20 | 114776 | 24 | 1 | 14 | 171072 | 21384 |
|  | 189 | 11 | 256QAM | 20 | 131176 | 24 | 1 | 16 | 199584 | 24948 |
|  | 216 | 11 | 256QAM | 20 | 151608 | 24 | 1 | 18 | 228096 | 28512 |
|  | 217 | 11 | 256QAM | 20 | 151608 | 24 | 1 | 18 | 229152 | 28644 |
|  | 245 | 11 | 256QAM | 20 | 172176 | 24 | 1 | 21 | 258720 | 32340 |
|  | 270 | 11 | 256QAM | 20 | 188576 | 24 | 1 | 23 | 285120 | 35640 |
|  | 273 | 11 | 256QAM | 20 | 192624 | 24 | 1 | 23 | 288288 | 36036 |
| NOTE 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data. DM-RS symbols are not counted.  NOTE 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [10].  NOTE 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)  NOTE 4: The RMCs apply to all channel bandwidth where LCRB ≤ NRB. | | | | | | | | | | |

Table A.2.2.9-2: Void

Table A.2.2.9-3: Void

## A.2.3 Reference measurement channels for TDD

The TDD UL RMCs are defined in clause A.2.2 with the active UL slots specified in table A.2.1-1 and TDD slot patterns as defined for reference sensitivity tests.

### A.2.3.1 DFT-s-OFDM Pi/2-BPSK

Table A.2.3.1-1: Void

Table A.2.3.1-2: Void

Table A.2.3.1-3: Void

### A.2.3.2 DFT-s-OFDM QPSK

Table A.2.3.2-1: Void

Table A.2.3.2-2: Void

Table A.2.3.2-3: Void

### A.2.3.3 DFT-s-OFDM 16QAM

Table A.2.3.3-1: Void

Table A.2.3.3-2: Void

Table A.2.3.3-3: Void

### A.2.3.4 DFT-s-OFDM 64QAM

Table A.2.3.4-1: Void

Table A.2.3.4-2: Void

Table A.2.3.4-3: Void

### A.2.3.5 DFT-s-OFDM 256QAM

Table A.2.3.5-1: Void

Table A.2.3.5-2: Void

Table A.2.3.5-3: Void

### A.2.3.6 CP-OFDM QPSK

Table A.2.3.6-1: Void

Table A.2.3.6-2: Void

Table A.2.3.6-3: Void

### A.2.3.7 CP-OFDM 16QAM

Table A.2.3.7-1: Void

Table A.2.3.7-2: Void

Table A.2.3.7-3: Void

### A.2.3.8 CP-OFDM 64QAM

Table A.2.3.8-1: Void

Table A.2.3.8-2: Void

Table A.2.3.8-3: Void

### A.2.3.9 CP-OFDM 256QAM

Table A.2.3.9-1: Void

Table A.2.3.9-2: Void

Table A.2.3.9-3: Void

# A.3 DL reference measurement channels

## A.3.1 General

Unless otherwise stated, Tables A.3.2.2-1, A.3.2.2-2, A.3.2.2-3, A.3.3.2-1, A.3.3.2-2 and A.3.3.2-3 are applicable for measurements of the Receiver Characteristics (clause 7) with the exception of clauses 7.4 (Maximum input level).

Unless otherwise stated, Tables A.3.2.3-1, A.3.2.3-2, A.3.2.3-3, A.3.3.3-1, A.3.3.3-2 and A.3.3.3-3 are applicable for clauses 7.4 (Maximum input level) and for UE not supporting PDSCH 256QAM,

Unless otherwise stated, Tables A.3.2.4-1, A.3.2.4-2, A.3.2.4-3, A.3.3.4-1, A.3.3.4-2 and A.3.3.4-3 are applicable for clauses 7.4 (Maximum input level) and for UE supporting PDSCH 256QAM,

Unless otherwise stated, Tables A.3.2.2-1, A.3.2.2-2, A.3.2.2-3, A.3.3.2-1, A.3.3.2-2 and A.3.3.2-3 also apply for the modulated interferer used in Clauses 7.5, 7.6 and 7.8 with test specific bandwidths.

Table A.3.1-1. Common reference channel parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| CORESET frequency domain allocation | |  | Full BW |
| CORESET time domain allocation | |  | 2 OFDM symbols at the begin of each slot |
| PDSCH mapping type | |  | Type A |
| PDSCH start symbol index (S) | |  | 2 |
| Number of consecutive PDSCH symbols (L) | |  | 12 |
| PDSCH PRB bundling | | PRBs | 2 |
| Dynamic PRB bundling | |  | false |
|  | |  |  |
| Overhead value for TBS determination | |  | 0 |
| First DMRS position for Type A PDSCH mapping | |  | 2 |
| DMRS type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| FDM between DMRS and PDSCH | |  | Disable |
| CSI‑RS for tracking | First subcarrier index in the PRB used for CSI-RS (k0) |  | 0 for CSI-RS resource 1,2,3,4 |
|  | OFDM symbols in the PRB used for CSI‑RS |  | l0 = 6 for CSI-RS resource 1 and 3  l0 = 10 for CSI-RS resource 2 and 4 |
|  | Number of CSI-RS ports |  | 1 for CSI-RS resource 1,2,3,4 |
|  | CDM Type |  | 'No CDM' for CSI-RS resource 1,2,3,4 |
|  | Density (ρ) |  | 3 for CSI-RS resource 1,2,3,4 |
|  | CSI‑RS periodicity | Slots | 15 kHz SCS: 20 for CSI-RS resource 1,2,3,4  30 kHz SCS: 40 for CSI-RS resource 1,2,3,4  60 kHz SCS: 80 for CSI-RS resource 1,2,3,4 |
|  | CSI‑RS offset | Slots | 15 kHz SCS:  0 for CSI-RS resource 1 and 2  1 for CSI-RS resource 3 and 4  30 kHz SCS:  1 for CSI-RS resource 1 and 2  2 for CSI-RS resource 3 and 4  60 kHz SCS:  2 for CSI-RS resource 1 and 2  3 for CSI-RS resource 3 and 4 |
|  | Frequency Occupation |  | Start PRB 0  Number of PRB = BWP size |
|  | QCL info |  | TCI state #0 |
| PTRS configuration | |  | PTRS is not configured |

## A.3.2 DL reference measurement channels for FDD

### A.3.2.1 General

Table A.3.2.1-1 Additional reference channels parameters for FDD

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Number of HARQ Processes |  | 4 |
| K1 value |  | 2 for all slots |

### A.3.2.2 FRC for receiver requirements for QPSK

Table A.3.2.2-1 Fixed reference channel for receiver requirements (SCS 15 kHz, FDD, QPSK 1/3)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Subcarrier spacing configuration |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Allocated resource blocks |  | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| MCS Index |  | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination | 64QAM | | | | | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate |  | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,3,4,5,6,7,8,9 | Bits | 1672 | 3368 | 5120 | 6912 | 8712 | 10504 | 14088 | 17424 |
| Transport block CRC | Bits | 16 | 16 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,3,4,5,6,7,8,9 | CBs | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,3,4,5,6,7,8,9 | Bits | 5400 | 11232 | 17064 | 22896 | 28728 | 34560 | 46656 | 58320 |
| Max. Throughput averaged over 1 frame | Mbps | 1.338 | 2.694 | 4.096 | 5.530 | 6.970 | 8.403 | 11.270 | 13.9392 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | | | | | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 80 | 90 | 100 |
| Subcarrier spacing configuration |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated resource blocks |  | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 217 | 245 | 273 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 |
| MCS Index |  | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination | 64QAM | | | | | | | | | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate |  | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 3,…,19 | Bits | 736 | 1608 | 2472 | 3368 | 4224 | 4992 | 6912 | 8712 | 10504 | 14088 | 15880 | 17928 |
| Transport block CRC | Bits | 16 | 16 | 16 | 16 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 3,…,19 | CBs | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 3,…,19 | Bits | 2376 | 5184 | 8208 | 11016 | 14040 | 16848 | 22896 | 28728 | 34992 | 46872 | 52920 | 58968 |
| Max. Throughput averaged over 1 frame | Mbps | 1.251 | 2.734 | 4.202 | 5.726 | 7.181 | 8.486 | 11.750 | 14.810 | 17.857 | 23.950 | 26.996 | 30.478 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | | | |

Table A.3.2.2-2 Fixed reference channel for receiver requirements (SCS 30 kHz, FDD, QPSK 1/3)

### A.3.2.3 FRC for maximum input level for 64QAM

Table A.3.2.3-1 Fixed reference channel for maximum input level receiver requirements (SCS 15 kHz, FDD, 64QAM)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Subcarrier spacing configuration |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Allocated resource blocks |  | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| MCS Index |  | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination | 64QAM | | | | | | | | |
| Modulation |  | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM |
| Target Coding Rate |  | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,3,4,5,6,7,8,9 | Bits | 12296 | 25608 | 38936 | 52224 | 64552 | 77896 | 106576 | 131176 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |
| For Slot 0,1 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,3,4,5,6,7,8,9 | CBs | 2 | 4 | 5 | 7 | 8 | 10 | 13 | 16 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |
| For Slot 0,1 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,3,4,5,6,7,8,9 | Bits | 16200 | 33696 | 51192 | 68688 | 86184 | 103680 | 139968 | 174960 |
| Max. Throughput averaged over 1 frame | Mbps | 9.837 | 20.486 | 31.149 | 41.779 | 51.642 | 62.317 | 85.261 | 104.941 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot 0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | |

Table A.3.2.3-2 Fixed reference channel for maximum input level receiver requirements (SCS 30 kHz, FDD, 64QAM)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | | | | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 80 | 100 |
| Subcarrier spacing configuration |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated resource blocks |  | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 217 | 273 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 |
| MCS Index |  | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination |  | 64QAM | | | | | | | | | | |
| Modulation |  | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM |
| Target Coding Rate |  | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 3,…,19 | Bits | 5376 | 11784 | 18432 | 25104 | 31752 | 37896 | 52224 | 64552 | 79896 | 106576 | 135296 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slot2 0,1,2 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 3,…,19 | CBs | 1 | 2 | 3 | 3 | 4 | 5 | 7 | 8 | 10 | 13 | 17 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 3,…,19 | Bits | 7128 | 15552 | 24624 | 33048 | 42120 | 50544 | 68688 | 86184 | 104976 | 140616 | 176904 |
| Max. Throughput averaged over 1 frame | Mbps | 9.139 | 20.033 | 31.334 | 42.677 | 53.978 | 64.423 | 88.781 | 109.738 | 135.823 | 181.179 | 230.003 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot 0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | | |

Table A.3.2.3-3 Fixed Reference Channel for Maximum input level receiver requirements (SCS 60 kHz, FDD, 64QAM)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | | | | |
| Channel bandwidth | MHz | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 80 | 100 |
| Subcarrier spacing configuration |  | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Allocated resource blocks |  | 11 | 18 | 24 | 31 | 38 | 51 | 65 | 79 | 107 | 135 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| MCS Index |  | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination |  | 64QAM | | | | | | | | | |
| Modulation |  | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM |
| Target Coding Rate |  | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 4,…,39 | Bits | 5376 | 8712 | 11784 | 15112 | 18432 | 25104 | 31752 | 38936 | 52224 | 65576 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 4,…,39 | CBs | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 5 | 7 | 8 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 4,…,39 | Bits | 7128 | 11664 | 15552 | 20088 | 24624 | 33048 | 42120 | 51192 | 69336 | 87480 |
| Max. Throughput averaged over 1 frame | Mbps | 19.354 | 31.363 | 42.422 | 54.403 | 66.355 | 90.374 | 114.307 | 140.170 | 188.006 | 236.074 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | |

### A.3.2.4 FRC for maximum input level for 256 QAM

Table A.3.2.4-1 Fixed reference channel for maximum input level receiver requirements (SCS 15 kHz, FDD, 256QAM)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Subcarrier spacing configuration |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Allocated resource blocks |  | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| MCS Index |  | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination |  | 256QAM | | | | | | | |
| Modulation |  | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM |
| Target Coding Rate |  | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,3,4,5,6,7,8,9 | Bits | 16896 | 34816 | 53288 | 71688 | 90176 | 108552 | 143400 | 180376 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |
| For Slot 0,1 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,3,4,5,6,7,8,9 | CBs | 3 | 5 | 7 | 9 | 12 | 14 | 18 | 23 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,3,4,5,6,7,8,9 | Bits | 21600 | 44928 | 68256 | 91584 | 114912 | 138240 | 186624 | 233280 |
| Max. Throughput averaged over 1 frame | Mbps | 13.517 | 27.853 | 42.630 | 57.350 | 72.141 | 86.842 | 114.720 | 144.310 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot 0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | |

Table A.3.2.4-2 Fixed reference channel for maximum input level receiver requirements (SCS 30 kHz, FDD, 256QAM)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | | | | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 80 | 100 |
| Subcarrier spacing configuration |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated resource blocks |  | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 217 | 273 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 |
| MCS Index |  | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination |  | 256QAM | | | | | | | | | | |
| Modulation |  | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM |
| Target Coding Rate |  | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 3,…,19 | Bits | 7424 | 16136 | 25608 | 33816 | 44040 | 52224 | 71688 | 90176 | 108552 | 147576 | 184424 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 3,…,19 | CBs | 1 | 3 | 4 | 5 | 6 | 7 | 9 | 12 | 14 | 19 | 23 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 3,…,19 | Bits | 9504 | 20736 | 32832 | 44064 | 56160 | 67392 | 91584 | 114912 | 139968 | 187488 | 235872 |
| Max. Throughput averaged over 1 frame | Mbps | 12.621 | 27.431 | 43.534 | 57.487 | 74.868 | 88.781 | 121.870 | 153.299 | 184.538 | 250.879 | 313.521 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot 0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | | |

Table A.3.2.4-3 Fixed reference channel for maximum input level receiver requirements (SCS 60 kHz, FDD, 256QAM)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | | | | |
| Channel bandwidth | MHz | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 80 | 100 |
| Subcarrier spacing configuration |  | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Allocated resource blocks |  | 11 | 18 | 24 | 31 | 38 | 51 | 65 | 79 | 107 | 135 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| MCS Index |  | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination |  | 256QAM | | | | | | | | | |
| Modulation |  | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM |
| Target Coding Rate |  | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 4,…,39 | Bits | 7424 | 12040 | 16136 | 21000 | 25608 | 33816 | 44040 | 53288 | 71688 | 90176 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 4,…,39 | CBs | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 9 | 12 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |
| For Slot 0,1,2,3 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 4,…,39 | Bits | 9504 | 15552 | 20736 | 26784 | 32832 | 44064 | 56160 | 68256 | 92448 | 116640 |
| Max. Throughput averaged over 1 frame | Mbps | 26.726 | 43.344 | 58.090 | 75.600 | 92.189 | 121.738 | 158.544 | 191.837 | 258.077 | 324.634 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | |

## A.3.3 DL reference measurement channels for TDD

### A.3.3.1 General

Table A.3.3.1-1 Additional reference channels parameters for TDD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Value | | |
|  | | SCS 15 kHz (µ=0) | SCS 30 kHz (µ=1) | SCS 60 kHz (µ=2) |
| TDD Slot Configuration pattern (Note 1) | | DDDSU | 7DS2U | 14DS1S24U |
| Special Slot Configuration (Note 2) | | 10D+2G+2U | 6D+4G+4U | S1=12D+2G, S2=6G+8U |
| referenceSubcarrierSpacing | | 15 kHz | 30 kHz | 60 kHz |
| UL-DL configuration | *dl-UL-TransmissionPeriodicity* | 5 ms | 5 ms | 5 ms |
|  | *nrofDownlinkSlots* | 3 | 7 | 14 |
|  | *nrofDownlinkSymbols* | 10 | 6 | 12 |
|  | *nrofUplinkSlot* | 1 | 2 | 4 |
|  | *nrofUplinkSymbols* | 2 | 4 | 8 |
| Number of HARQ Processes | | 8 | 8 | 16 |
| The number of slots between PDSCH and corresponding HARQ-ACK information (Note 3) | | K1 = 4 if mod(i,5) = 0 K1 = 3 if mod(i,5) = 1 K1 = 2 if mod(i,5) = 2 where i is slot index per frame; i = {0,…,9} | K1 = 8 if mod(i,10) = 0 K1 = 7 if mod(i,10) = 1 K1 = 6 if mod(i,10) = 2 K1 = 5 if mod(i,10) = 3 K1 = 4 if mod(i,10) = 4 K1 = 3 if mod(i,10) = 5 K1 = 2 if mod(i,10) = 6 where i is slot index per frame; i = {0,…,19} | K1 = 13 if mod(i,20) = 2  K1 = 12 if mod(i,20) = 3  K1 = 11 if mod(i,20) = 4  K1 = 10 if mod(i,20) = 5  K1 = 9 if mod(i,20) = 6  K1 = 8 if mod(i,20) = 7  K1 = 7 if mod(i,20) = 8  K1 = 6 if mod(i,20) = 9 K1 = 6 if mod(i,20) = 10  K1 = 6 if mod(i,20) = 11  K1 = 6 if mod(i,20) = 12 K1 = 6 if mod(i,20) = 13 where i is slot index per frame; i = {0,…,39} |
| NOTE 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.  NOTE 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information.  NOTE 3: i is the slot index per frame.  NOTE 4: A -2ms or +3ms time offset to the NR configuration pattern relative to the E-UTRA UL-DL configuration must be apply in the TDD intra-band EN-DC. | | | | |

### A.3.3.2 FRC for receiver requirements for QPSK

Table A.3.3.2-1 Fixed reference channel for receiver requirements (SCS 15 kHz, TDD, QPSK 1/3)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | | | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Subcarrier spacing configuration |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Allocated resource blocks |  | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| MCS Index |  | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination |  | 64QAM | | | | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate |  | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,3,4,8,9 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,5,6,7 | Bits | 1672 | 3368 | 5120 | 6912 | 8712 | 10504 | 14088 | 17424 |
| Transport block CRC | Bits | 16 | 16 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,3,4,8,9 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,5,6,7 | CBs | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,3,4,8,9 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,5,6,7 | Bits | 5400 | 11232 | 17064 | 22896 | 28728 | 34560 | 46656 | 58320 |
| Max. Throughput averaged over 1 frame | Mbps | 0.669 | 1.347 | 2.048 | 2.765 | 3.485 | 4.202 | 5.635 | 6.970 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot 0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | |

Table A.3.3.2-2 Fixed reference channel for receiver requirements (SCS 30 kHz, TDD, QPSK 1/3)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit |  | Value | | | | | | | | | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 100 |
| Subcarrier spacing configuration |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated resource blocks |  | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 162 | 217 | 273 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 13 | 11 | 11 |
| MCS Index |  | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination |  | 64QAM | | | | | | | | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate |  | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,19} | Bits | 736 | 1608 | 2472 | 3368 | 4224 | 4992 | 6912 | 8712 | 10504 | 12296 | 14088 | 17928 |
| Transport block CRC | Bits | 16 | 16 | 16 | 16 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19} | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,19} | CBs | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,19} | Bits | 2376 | 5184 | 8208 | 11016 | 14040 | 16848 | 22896 | 28728 | 34992 | 40824 | 46872 | 58968 |
| Max. Throughput averaged over 1 frame | Mbps | 0.810 | 2.1.769 | 2.719 | 3.705 | 4.646 | 5.491 | 7.603 | 9.583 | 11.554 | 13.526 | 15.497 | 19.721 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | | | |

Table A.3.3.2-3 Fixed reference channel for receiver requirements (SCS 60 kHz, TDD, QPSK 1/3)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit |  | Value | | | | | | | | | |
| Channel bandwidth | MHz | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 100 |
| Subcarrier spacing configuration |  | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Allocated resource blocks |  | 11 | 18 | 24 | 31 | 38 | 51 | 65 | 79 | 93 | 107 | 135 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 26 | 24 | 24 |
| MCS Index |  | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination |  | 64QAM | | | | | | | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate |  | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 and Slot i, if mod(i, 20) = {14,15,16,17,18,19} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 20) = {0,…, 13} for i from {4,…,39} | Bits | 736 | 1192 | 1608 | 2024 | 2472 | 3368 | 4224 | 5120 | 6016 | 6912 | 8712 |
| Transport block CRC | Bits | 16 | 16 | 16 | 16 | 16 | 16 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 and Slot i, if mod(i, 20) = {14,15,16,17,18,19} for i from {0,…,39} | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 20) = {0,…, 13} for i from {4,…,39} | CBs | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 and Slot i, if mod(i, 20) = {14,15,16,17,18,19} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 20) = {0,…,13} for i from {4,…,39} | Bits | 2376 | 3888 | 5184 | 6696 | 8208 | 11016 | 14040 | 17064 | 20088 | 23112 | 29160 |
| Max. Throughput averaged over 1 frame | Mbps | 1.766 | 3.2.861 | 3.859 | 4.858 | 5.933 | 8.083 | 10.138 | 12.288 | 14.438 | 16.589 | 20.909 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | | |

### A.3.3.3 FRC for maximum input level for 64QAM

Table A.3.3.3-1 Fixed reference channel for maximum input level receiver requirements (SCS 15 kHz, TDD, 64QAM)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | | | | |
| **Channel bandwidth** | **MHz** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Subcarrier spacing configuration |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Allocated resource blocks |  | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| MCS Index |  | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination |  | 64QAM | | | | | | | |
| Modulation |  | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM |
| Target Coding Rate |  | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,3,4,8,9 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,5,6,7 | Bits | 12296 | 25608 | 38936 | 52224 | 64552 | 77896 | 106576 | 131176 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,3,4,8,9 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,5,6,7 | CBs | 2 | 4 | 5 | 7 | 8 | 10 | 13 | 16 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,3,4,8,9 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,5,6,7 | Bits | 16200 | 33696 | 51192 | 68688 | 86184 | 103680 | 139968 | 174960 |
| Max. Throughput averaged over 1 frame | Mbps | 4.918 | 10.243 | 15.574 | 20.890 | 20.890 | 31.158 | 42.630 | 52.470 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot 0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | |

Table A.3.3.3-2 Fixed reference channel for maximum input level receiver requirements (SCS 30 kHz, TDD, 64QAM)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** |  | **Value** | | | | | | | | | | |
| **Channel bandwidth** | **MHz** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **70** | **80** | **100** |
| Subcarrier spacing configuration |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated resource blocks |  | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 189 | 217 | 273 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 13 | 11 | 11 |
| MCS Index |  | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination |  | 64QAM | | | | | | | | | | | |
| Modulation |  | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM |
| Target Coding Rate |  | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,19} | Bits | 5376 | 11784 | 18432 | 25104 | 31752 | 37896 | 52224 | 64552 | 79896 | 92200 | 106576 | 135296 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19} | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,19} | CBs | 1 | 2 | 3 | 3 | 4 | 5 | 7 | 8 | 10 | 11 | 13 | 17 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,19} | Bits | 7128 | 15552 | 24624 | 33048 | 42120 | 50544 | 68688 | 86184 | 104976 | 122472 | 140616 | 176904 |
| Max. Throughput averaged over 1 frame | Mbps | 5.914 | 12.962 | 20.275 | 27.614 | 34.927 | 41.686 | 57.446 | 71.007 | 87.886 | 101.42 | 117.234 | 148.826 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | | | |

Table A.3.3.3-3. Fixed reference channel for maximum input level receiver requirements (SCS 60 kHz, TDD, 64QAM)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** |  | **Value** | | | | | | | | | |
| **Channel bandwidth** | **MHz** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **70** | **80** | **100** |
| Subcarrier spacing configuration |  | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Allocated resource blocks |  | 11 | 18 | 24 | 31 | 38 | 51 | 65 | 79 | 93 | 107 | 135 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 26 | 24 | 24 |
| MCS Index |  | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination |  | 64QAM | | | | | | | | | | |
| Modulation |  | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM | 64 QAM |
| Target Coding Rate |  | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 and Slot i, if mod(i, 20) = {14,15,16,17,18,19} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 20) = {0,…, 13} for i from {4,…,39} | Bits | 5376 | 8712 | 11784 | 15112 | 18432 | 25104 | 31752 | 38936 | 45096 | 52224 | 65576 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 and Slot i, if mod(i, 20) = {14,15,16,17,18,19} for i from {0,…,39} | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 20) = {0,…, 13} for i from {4,…,39} | CBs | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 and Slot i, if mod(i, 20) = {14,15,16,17,18,19} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 20) = {0,…, 13} for i from {4,…,39} | Bits | 7128 | 11664 | 15552 | 20088 | 24624 | 33048 | 42120 | 51192 | 60264 | 69336 | 87480 |
| Max. Throughput averaged over 1 frame | Mbps | 12.902 | 20.909 | 28.282 | 36.269 | 44.237 | 60.250 | 76.205 | 93.446 | 108.23 | 125.338 | 157.382 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | | |

### A.3.3.4 FRC for maximum input level for 256 QAM

Table A.3.3.4-1 Fixed reference channel for maximum input level receiver requirements (SCS 15 kHz, TDD, 256QAM)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | | | | |
| **Channel bandwidth** | **MHz** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Subcarrier spacing configuration |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Allocated resource blocks |  | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| MCS Index |  | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| MCS table for TBS determination |  | 256QAM | | | | | | | |
| Modulation |  | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM |
| Target Coding Rate |  | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,3,4,8,9 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,5,6,7 | Bits | 16896 | 34816 | 53288 | 71688 | 90176 | 108552 | 143400 | 180376 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,3,4,8,9 | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,5,6,7 | CBs | 3 | 5 | 7 | 9 | 12 | 14 | 18 | 23 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,3,4,8,9 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slots 2,5,6,7 | Bits | 21600 | 44928 | 68256 | 91584 | 114912 | 138240 | 186624 | 233280 |
| Max. Throughput averaged over 1 frame | Mbps | 6.758 | 13.926 | 21.315 | 28.675 | 36.070 | 43.421 | 57.360 | 72.150 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot 0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | |

Table A.3.3.4-2 Fixed Reference channel for maximum input level receiver requirements (SCS 30 kHz, TDD, 256QAM)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | **Unit** |  | **Value** | | | | | | | | | | |
| Channel bandwidth | | MHz | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 100 |
| Subcarrier spacing configuration | |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated resource blocks | |  | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 189 | 217 | 273 |
| Subcarriers per resource block | |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame | |  | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 13 | 11 | 11 |
| MCS Index | |  | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination | |  | 256QAM | | | | | | | | | | | |
| Modulation | |  | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM |
| Target Coding Rate | |  | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 |
| Maximum number of HARQ transmissions | |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19} | | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,19} | | Bits | 7424 | 16136 | 25608 | 33816 | 44040 | 52224 | 71688 | 90176 | 108552 | 127080 | 147576 | 184424 |
| Transport block CRC | | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph | |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19} | | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,19} | | CBs | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 |
| Binary Channel Bits per Slot | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19} | | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,19} | | Bits | 9504 | 20736 | 32832 | 44064 | 56160 | 67392 | 91584 | 114912 | 139968 | 163296 | 187488 | 235872 |
| Max. Throughput averaged over 1 frame | | Mbps | 8.166 | 17.750 | 28.169 | 37.198 | 48.444 | 57.446 | 78.857 | 99.194 | 119.407 | 139.788 | 162.334 | 202.866 |
|  | NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | | | |

Table A.3.3.4-3 Fixed reference channel for maximum input level receiver requirements (SCS 60 kHz, TDD, 256QAM)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** |  | **Value** | | | | | | | | | |
| Channel bandwidth | MHz | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 100 |
| Subcarrier spacing configuration |  | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Allocated resource blocks |  | 11 | 18 | 24 | 31 | 38 | 51 | 65 | 79 | 93 | 107 | 135 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per Frame |  | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 26 | 24 | 24 |
| MCS Index |  | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination |  | 256QAM | | | | | | | | | | |
| Modulation |  | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM | 256 QAM |
| Target Coding Rate |  | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 and Slot i, if mod(i, 20) = {14,15,16,17,18,19} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 20) = {0,…, 13} for i from {4,…,39} | Bits | 7424 | 12040 | 16136 | 21000 | 25608 | 33816 | 44040 | 53288 | 62504 | 71688 | 90176 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 and Slot i, if mod(i, 20) = {14,15,16,17,18,19} for i from {0,…,39} | CBs | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 20) = {0,…, 13} for i from {4,…,39} | CBs | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 12 |
| Binary Channel Bits per Slot |  |  |  |  |  |  |  |  |  |  |  |  |
| For Slots 0,1,2,3 and Slot i, if mod(i, 20) = {14,15,16,17,18,19} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 20) = {0,…, 13} for i from {4,…,39} | Bits | 9504 | 15552 | 20736 | 26784 | 32832 | 44064 | 56160 | 68256 | 80352 | 92448 | 116640 |
| Max. Throughput averaged over 1 frame | Mbps | 17.818 | 28.896 | 38.726 | 50.400 | 61.459 | 81.158 | 105.696 | 127.891 | 150.010 | 172.051 | 216.422 |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.  NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame  NOTE 4: Slot i is slot index per frame | | | | | | | | | | | | |

# A.4 CSI reference measurement channels

# A.5 OFDMA Channel Noise Generator (OCNG)

## A.5.1 OCNG Patterns for FDD

### A.5.1.1 OCNG FDD pattern 1: Generic OCNG FDD Pattern for all unused REs

Table A.5.1.1-1: OP.1 FDD: Generic OCNG FDD Pattern for all unused REs

|  |  |  |
| --- | --- | --- |
| OCNG Appliance  OCNG Parameters | Control Region  (Core Set) | Data Region |
| Resources allocated | All unused REs (Note 1) | All unused REs (Note 2) |
| Structure | PDCCH | PDSCH |
| Content | Uncorrelated pseudo random QPSK modulated data | Uncorrelated pseudo random QPSK modulated data |
| Transmission scheme for multiple  antennas ports transmission | Single Tx port transmission | Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH |
| Subcarrier Spacing | Same as for RMC PDCCH in the active BWP | Same as for RMC PDSCH in the active BWP |
| Power Level | Same as for RMC PDCCH | Same as for RMC PDSCH |
| NOTE 1: All unused REs in the active CORESETS appointed by the search spaces in use.  NOTE 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals in channel bandwidth. | | |

## A.5.2 OCNG Patterns for TDD

### A.5.2.1 OCNG TDD pattern 1: Generic OCNG TDD Pattern for all unused REs

Table A.5.2.1-1: OP.1 TDD: Generic OCNG TDD Pattern for all unused REs

|  |  |  |
| --- | --- | --- |
| OCNG Appliance  OCNG Parameters | Control Region  (Core Set) | Data Region |
| Resources allocated | All unused REs (Note 1) | All unused REs (Note 2) |
| Structure | PDCCH | PDSCH |
| Content | Uncorrelated pseudo random QPSK modulated data | Uncorrelated pseudo random QPSK modulated data |
| Transmission scheme for multiple  antennas ports transmission | Single Tx port transmission | Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH |
| Subcarrier Spacing | Same as for RMC PDCCH in the active BWP | Same as for RMC PDSCH in the active BWP |
| Power Level | Same as for RMC PDCCH | Same as for RMC PDSCH |
| NOTE 1: All unused REs in the active CORESETS appointed by the search spaces in use.  NOTE 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals in channel bandwidth. | | |

# A.6 Void

# A.7 V2X reference measurement channels

## A.7.1 General

The algorithm for determining the payload size A is as follows; given a desired coding rate R and radio block allocation NRB

1. Calculate the RE number of 2nd stage SCI Q\_SCI2^' that can be transmitted in a given sub-frame, where in order to make sure that the code-rate of 2-A is approximate to SCI 1-A, a beta offset is selected based on MCS, and vacant resource elements γ value is determined based on NRB and DMRS frequency density.

2. Transport Block Size is determined according to clause 8.1.3.2 of TS 38.214 [13] based on Table A.7.1-1.

3. Calculate Binary Channel Bits per Slot for PSSCH as below

Binary Channel Bits per Slot = (NRB\* Subcarriers per resource block\*CP-OFDM symbols per slot – DMRS resource REs – PSCCH resource Res - Q\_SCI2^') \* Qm

Where Qm is the modulation order corresponding to MCS.

In Table A.7.1-1 Common reference channel parameters are listed the Sidelink reference measurement channels specified in annexes A.7.2 to A.7.6.

Table A.7.1-1: Common reference channel parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | remark |
| Number of HARQ Processes | 1 |  |
| Channel state | AWGN |  |
| Subcarriers per resource block | 12 |  |
| sl-PSSCH-DMRS-TimePatternList | 2 | symbol4 and symbol 10 in each slot  FDMed with PSSCH within DMRS symbol  Frequency density is ½ |
| CP-OFDM symbols per slot (Note1) | 12 for all slots | Excluding the first OFDM symbol in one SL slot used for AGC |
| PSCCH resource | 10 PRBs, 3 symbols in time domain |  |
| Slot number in 10ms |  | for 15kHz, 30kHz, 60kHz |
| PT-RS | disable |  |
| CSI-RS | disable |  |
| x-overhead | 0 |  |
| PSFCH period | 0 |  |
| 2nd stage SCI payload size | 59 | 35bits SCI-2A + 24bits CRC |
| Redundancy Version | RV0 | For channel coding |
| Alpha value for SCI-2 | 1 |  |

## A.7.2 FRC for V2X receiver requirements for QPSK

For V2X transmission over PC5, Table A.7.2-1, Table A.7.2-2 and Table A.7.2-3 are applicable for measurements on the Receiver Characteristics with the exception of Maximum input level.

Table A.7.2-1: Fixed reference channel for V2X receiver requirements (SCS 15 kHz, QPSK)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 |
| Subchannel size |  | 10 | 15 | 10 | 12 |
| Allocated resource blocks |  | 50 | 105 | 160 | 216 |
| MCS Index |  | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK |
| Transport Block Size |  | 3624 | 7936 | 12296 | 16896 |
| Transport block CRC | Bits | 16 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 1 | 1 | 2 | 3 |
| Beta offset for 2nd stage SCI |  | 2.25 | 2.25 | 2.25 | 2.25 |
| value when 2nd stage SCI rate match |  | 1 | 1 | 1 | 1 |
| Binary Channel Bits per Slot |  | 12036 | 26556 | 41076 | 55860 |
| Max. Throughput averaged over 100ms | Mbps | 0.3624 | 0.7936 | 1.2296 | 1.6896 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | |

Table A.7.2-2: Fixed reference channel for V2X receiver requirements (SCS 30 kHz, QPSK)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |
| Subchannel size |  | 12 | 10 | 15 | 15 |
| Allocated resource blocks |  | 24 | 50 | 75 | 105 |
| MCS Index |  | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK |
| Transport Block Size |  | 1608 | 3624 | 5632 | 7936 |
| Transport block CRC | Bits | 16 | 16 | 24 | 24 |
| LDPC base graph |  | 2 | 2 | 1 | 1 |
| Number of Code Blocks per Slot |  | 1 | 1 | 1 | 1 |
| Beta offset for 2nd stage SCI |  | 2.25 | 2.25 | 2.25 | 2.25 |
| value when 2nd stage SCI rate match |  | 7 | 1 | 1 | 1 |
| Binary Channel Bits per Slot |  | 5160 | 12036 | 18636 | 26556 |
| Max. Throughput averaged over 100ms | Mbps | 0.3216 | 0.7248 | 1.1264 | 1.5872 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | |

Table A.7.2-3: Fixed reference channel for V2X receiver requirements (SCS 60 kHz, QPSK)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 60 | 60 | 60 | 60 |
| Subchannel size |  | 10 | 12 | 12 | 10 |
| Allocated resource blocks |  | 10 | 24 | 36 | 50 |
| MCS Index |  | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK |
| Transport Block Size |  | 456 | 1608 | 2536 | 3624 |
| Transport block CRC | Bits | 16 | 16 | 16 | 16 |
| LDPC base graph |  | 2 | 2 | 2 | 2 |
| Number of Code Blocks per Slot |  | 1 | 1 | 1 | 1 |
| Beta offset for 2nd stage SCI |  | 2.25 | 2.25 | 2.25 | 2.25 |
| value when 2nd stage SCI rate match |  | 7 | 7 | 7 | 1 |
| Binary Channel Bits per Slot |  | 1464 | 5160 | 8328 | 12036 |
| Max. Throughput averaged over 100ms | Mbps | 0.1824 | 0.6432 | 1.0144 | 1.4496 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | |

## A.7.3 FRC for maximum input level for 64QAM

For V2X transmission over PC5, Table A.7.3-1, Table A.7.3-2 and TableA.7.3-3 are applicable for Maximum input level when the maximum modulation order is 64QAM.

Table A.7.3-1: Fixed reference channel for V2X receiver requirements (SCS 15 kHz, 64QAM)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 |
| Subchannel size |  | 10 | 15 | 10 | 12 |
| Allocated resource blocks |  | 50 | 105 | 160 | 216 |
| MCS Index |  | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM |
| Transport Block Size |  | 27144 | 60456 | 92200 | 127080 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 4 | 8 | 11 | 16 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 1 | 1 | 1 | 1 |
| Binary Channel Bits per Slot |  | 35964 | 79524 | 123084 | 167436 |
| Max. Throughput averaged over 100ms | Mbps | 2.7144 | 6.0456 | 9.22 | 12.708 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | |

Table A.7.3-2: Fixed reference channel for V2X receiver requirements (SCS 30 kHz, 64QAM)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |
| Subchannel size |  | 12 | 10 | 15 | 15 |
| Allocated resource blocks |  | 24 | 50 | 75 | 105 |
| MCS Index |  | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM |
| Transport Block Size |  | 11528 | 27144 | 42016 | 60456 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 2 | 4 | 5 | 8 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 7 | 1 | 1 | 1 |
| Binary Channel Bits per Slot |  | 15336 | 35964 | 55764 | 79524 |
| Max. Throughput averaged over 100ms | Mbps | 2.3056 | 5.4288 | 8.4032 | 12.091 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | |

TableA.7.3-3: Fixed reference channel for V2X receiver requirements (SCS 60 kHz, 64QAM)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 60 | 60 | 60 | 60 |
| Subchannel size |  | 10 | 12 | 12 | 10 |
| Allocated resource blocks |  | 10 | 24 | 36 | 50 |
| MCS Index |  | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM |
| Transport Block Size |  | 3240 | 11528 | 18960 | 27144 |
| Transport block CRC | Bits | 16 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 1 | 2 | 3 | 4 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 7 | 7 | 7 | 1 |
| Binary Channel Bits per Slot |  | 4248 | 15336 | 24840 | 35964 |
| Max. Throughput averaged over 100ms | Mbps | 1.296 | 4.6112 | 7.584 | 10.858 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | |

## A.7.4 FRC for maximum input level for 256QAM

For V2X transmission over PC5, Table A.7.4-1, Table A.7.4-2 and Table A.7.4-3 are applicable for Maximum input level when the 256QAM is supported.

Table A.7.4-1: Fixed reference channel for V2X receiver requirements (SCS 15 kHz, 256QAM)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 |
| Subchannel size |  | 10 | 15 | 10 | 12 |
| Allocated resource blocks |  | 50 | 105 | 160 | 216 |
| MCS Index |  | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination | 256QAM | | | | |
| Modulation |  | 256QAM | 256QAM | 256QAM | 256QAM |
| Transport Block Size |  | 36896 | 81976 | 127080 | 172176 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 5 | 10 | 16 | 21 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 3 | 3 | 3 | 3 |
| Binary Channel Bits per Slot |  | 48000 | 106080 | 164160 | 223296 |
| Max. Throughput averaged over 100ms | Mbps | 3.6896 | 8.1976 | 12.708 | 17.218 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | |

Table A.7.4-2: Fixed reference channel for V2X receiver requirements (SCS 30 kHz, 256QAM)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |
| Subchannel size |  | 12 | 10 | 15 | 15 |
| Allocated resource blocks |  | 24 | 50 | 75 | 105 |
| MCS Index |  | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination | 256QAM | | | | |
| Modulation |  | 256QAM | 256QAM | 256QAM | 256QAM |
| Transport Block Size |  | 15880 | 36896 | 58384 | 81976 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 2 | 5 | 7 | 10 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 3 | 3 | 3 | 3 |
| Binary Channel Bits per Slot |  | 20544 | 48000 | 74400 | 106080 |
| Max. Throughput averaged over 100ms | Mbps | 3.176 | 7.3792 | 11.677 | 16.395 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | |

Table A.7.4-3: Fixed reference channel for V2X receiver requirements (SCS 60kHz, 256QAM)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 60 | 60 | 60 | 60 |
| Subchannel size |  | 10 | 12 | 12 | 10 |
| Allocated resource blocks |  | 10 | 24 | 36 | 50 |
| MCS Index |  | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination | 256QAM | | | | |
| Modulation |  | 256QAM | 256QAM | 256QAM | 256QAM |
| Transport Block Size |  | 4480 | 15880 | 25608 | 36896 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 1 | 2 | 4 | 5 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 3 | 3 | 3 | 3 |
| Binary Channel Bits per Slot |  | 5760 | 20544 | 33216 | 48000 |
| Max. Throughput averaged over 100ms | Mbps | 1.792 | 6.352 | 10.243 | 14.758 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | |

Annex B (informative): Void

Annex C (informative):  
Downlink physical channels

# C.1 General

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

# C.2 Setup

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

Table C.2-1: Downlink Physical Channels required  
for connection set-up

|  |
| --- |
| Physical Channel |
| PBCH |
| SSS |
| PSS |
| PDCCH |
| PDSCH |
| PBCH DMRS |
| PDCCH DMRS |
| PDSCH DMRS |
| CSI-RS |

# C.3 Connection

## C.3.1 Measurement of Receiver Characteristics

Unless otherwise stated, Table C.3.1-1 is applicable for measurements on the Receiver Characteristics (clause 7).

Table C.3.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| SSS transmit power | W | Test specific |
| EPRE ratio of PSS to SSS | dB | 0 |
| EPRE ratio of PBCH to SSS | dB | 0 |
| EPRE ratio of PBCH to PBCH DMRS | dB | 0 |
| EPRE ratio of PDCCH to SSS | dB | 0 |
| EPRE ratio of PDCCH to PDCCH DMRS | dB | 0 |
| EPRE ratio of PDSCH to SSS | dB | 0 |
| EPRE ratio of PDSCH to PDSCH DMRS (Note 1) | dB | -3 |
| EPRE ratio of CSI-RS to SSS | dB | 0 |
| EPRE ratio of PTRS to PDSCH | dB | Test specific |
| EPRE ratio of OCNG DMRS to SSS | dB | 0 |
| EPRE ratio of OCNG to OCNG DMRS (Note 1) | dB | 0 |
| NOTE 1: No boosting is applied to any of the channels except PDSCH DMRS. For PDSCH DMRS, 3 dB power boosting is applied assuming DMRS Type 1 configuration when DMRS and PDSCH are TDM'ed and only half of the DMRS REs are occupied.  NOTE 2: Number of DMRS CDM groups without data for PDSCH DMRS configuration for OCNG is set to 1. | | |

Annex D (normative):  
Characteristics of the interfering signal

# D.1 General

Some RF performance requirements for the NR UE receiver are defined with interfering signals present in addition to the wanted signal.

For NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz, a modulated 5 MHz full bandwidth NR down link signal, and in some cases an additional CW signal, are used as interfering signal. For intra-band contiguous CA bandwidth class B and C, a modulated 5 MHz NR downlink signal is used. And for some cases an additional CW signal is used.

For NR bands with FDL\_low ≥ 3300 MHz and FUL\_low ≥ 3300 MHz, a modulated NR downlink signal which equals to channel bandwidth of the wanted signal for single carrier and inter-band CA cases is used as interfering signal. For intra-band contiguous CA bandwidth Class C, a modulated NR downlink signal which equals to the aggregated channel bandwidth of the wanted signal is used. For intra-band contiguous CA bandwidth class D and E cases, a modulated 50 MHz NR downlink signal is used. And for some cases an additional CW signal is used.

# D.2 Interference signals

Table D.2-1 and Table D.2-4 describes the modulated interferer for different channel bandwidth options for NR band lower than 2700MHz.

Table D.2-1: Description of modulated NR interferer for NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Channel bandwidth** | | | | | |
|  | 5 MHz | 10MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz |
| RB | NOTE 1 | | | | | |
| BWInterferer | 5 MHz | | | | | |
|  | Channel bandwidth | | | | | |
|  | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| RB | NOTE 1 | | | | | |
| BWInterferer | 5 MHz | | | | | |
| NOTE 1: The RB configured for interfering signal is the same as maximum RB number defined in Table 5.3.2-1 for each sub-carrier spacing. | | | | | | |

Table D.2-2 and Table D.2-3 describe the modulated interferer for different channel bandwidth options for NR band higher than 3300MHz.

Table D.2-2: Description of modulated NR interferer for NR bands with FDL\_low ≥ 3300 MHz and FUL\_low ≥ 3300 MHz

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Channel bandwidth** | | | | | | | | |
|  | 10 MHz | 15 MHz | 20 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| RB | NOTE 1 | | | | | | | | |
| BWInterferer | 10 MHz | 15 MHz | 20 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| NOTE 1: The RB configured for interfering signal is the same as maximum RB number defined in Table 5.3.2-1 for each sub-carrier spacing. | | | | | | | | | |

Table D.2-3: Description of modulated NR interferer for NR bands with FDL\_low≥ 3300 MHz and FUL\_low≥ 3300 MHz for Intra-band contiguous CA

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Aggregated Channel bandwidth of Bandwdith Class C | | | | | | | | Bandwidth Class D/E |
|  | 110 MHz | 120 MHz | 130 MHz | 140 MHz | 150 MHz | 160 MHz | 180 MHz | 200 MHz |
| RB(SCS=30 kHz) | NOTE 1 | | | | | | | | 133 |
| RB(SCS=60 kHz) | NOTE 1 | | | | | | | | 65 |
| BWInterferer | 110 MHz | 120 MHz | 130 MHz | 140 MHz | 150 MHz | 160 MHz | 180 MHz | **200 MHz** | 50MHz |
| NOTE 1: The interfering signal shall be configured in the same way as the aggregated bandwidth of the wanted signal. The RB configurations for each component carrier are defined in Table 5.3.2-1 for each sub-carrier spacing. | | | | | | | | | |

Table D.2-4: Description of modulated NR interferer for NR bands with FDL\_low < 2700 MHz and FUL\_low < 2700 MHz for Intra-band contiguous CA

|  |  |  |
| --- | --- | --- |
|  | Bandwidth Class B | Bandwidth Class C |
| RB | NOTE 1 | NOTE 1 |
| BWInterferer | 5 MHz | 5 MHz |
| NOTE 1: The RB configured for interfering signal is the same as maximum RB number defined in Table 5.3.2-1 for each sub-carrier spacing. | | |

Annex E (normative):   
Environmental conditions

# E.1 General

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

# E.2 Environmental

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

## E.2.1 Temperature

The UE shall fulfil all the requirements in the full temperature range of:

Table E.2.1-1: Temperature conditions

|  |  |
| --- | --- |
| +15°C to +35°C | For normal conditions (with relative humidity of 25 % to 75 %) |
| -10°C to +55°C | For extreme conditions (see IEC publications 68‑2‑1 and 68‑2‑2) |

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 for extreme operation.

## E.2.2 Voltage

The UE shall fulfil all the requirements in the full voltage range, i.e. the voltage range between the extreme voltages.

The manufacturer shall declare the lower and higher extreme voltages and the approximate shutdown voltage. For the equipment that can be operated from one or more of the power sources listed below, the lower extreme voltage shall not be higher, and the higher extreme voltage shall not be lower than that specified below.

Table E.2.2-1: Voltage conditions

|  |  |  |  |
| --- | --- | --- | --- |
| Power source | Lower extreme  voltage | Higher extreme  voltage | Normal conditions  voltage |
| AC mains | 0,9 \* nominal | 1,1 \* nominal | nominal |
| Regulated lead acid battery | 0,9 \* nominal | 1,3 \* nominal | 1,1 \* nominal |
| Non regulated batteries:  Leclanché  Lithium  Mercury/nickel & cadmium | 0,85 \* nominal  0,95 \* nominal  0,90 \* nominal | Nominal  1,1 \* Nominal | Nominal  1,1 \* Nominal  Nominal |

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

## E.2.3 Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes.

Table E.2.3-1: Vibration conditions

|  |  |
| --- | --- |
| Frequency | ASD (Acceleration Spectral Density) random vibration |
| 5 Hz to 20 Hz | 0.96 m2/s3 |
| 20 Hz to 500 Hz | 0.96 m2/s3 at 20 Hz, thereafter –3 dB/Octave |

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1 for extreme operation.

Annex F (normative):   
Transmit modulation

# F.0 General

While measuring the transmit modulation quality of carriers, an existence of the carrier leakage needs to be taken into account indicated by the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE.

# F.1 Measurement Point

Figure F.1-1 shows the measurement point for the unwanted emission falling into non-allocated RB(s) and the EVM for the allocated RB(s).

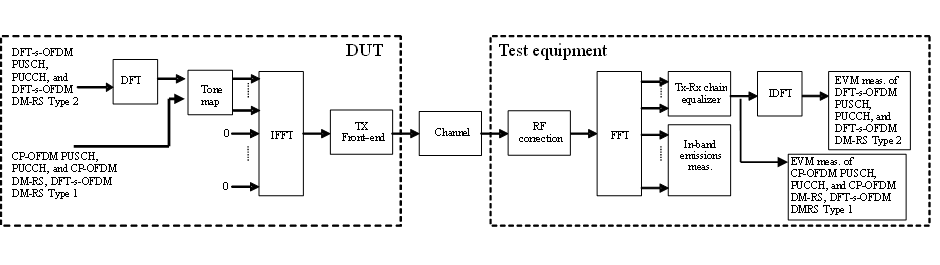


Figure F.1-1: EVM measurement points

# F.2 Basic Error Vector Magnitude measurement

The EVM is the difference between the ideal waveform and the measured waveform for the allocated RB(s)

,

where

is a set of  modulation symbols with the considered modulation scheme being active within the measurement period,

 are the samples of the signal evaluated for the EVM,

 is the ideal signal reconstructed by the measurement equipment, and

 is the average power of the ideal signal. For normalized modulation symbols  is equal to 1.

The basic EVM measurement interval is defined over one slot in the time domain for PUCCH and PUSCH and over one preamble sequence for the PRACH.

# F.3 Basic in-band emissions measurement

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks. The in-band emission requirement is evaluated for PUCCH and PUSCH transmissions. The in-band emission requirement is not evaluated for PRACH transmissions.

The in-band emissions are measured as follows

,

where

is a set of OFDM symbols with the considered modulation scheme being active within the measurement period,

 is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB),

 (resp. ) is the lower (resp. upper) edge of the UL UE channel bandwidth,

 and  are the lower and upper edge of the allocated BW, and

 is the frequency domain signal evaluated for in-band emissions as defined in the clause (ii)

The relative in-band emissions are, given by



where

 is the number of allocated RBs

The basic in-band emissions measurement interval is defined over one slot in the time domain. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the in-band emissions measurement interval is reduced by one OFDM symbol, accordingly.

In the evaluation of in-band emissions, the timing is set according to , where sample time offsets  and  are defined in clause F.4.

# F.4 Modified signal under test

Implicit in the definition of EVM is an assumption that the receiver is able to compensate a number of transmitter impairments.

The DFT-s-OFDM modulated signals or PRACH signal under test is modified and, in the case of DFT-s-OFDM modulated signals, decoded according to:



where

 is the time domain samples of the signal under test.

The CP-OFDM modulated signals or PUSCH demodulation reference signal or PUCCH data signal under test is equalised and, in the case of CP-OFDM modulated signals decoded according to:



where

 is the time domain samples of the signal under test.

To minimize the error, the signal under test should be modified with respect to a set of parameters following the procedure explained below.

Notation:

 is the sample timing difference between the FFT processing window in relation to nominal timing of the ideal signal.

 is the RF frequency offset.

 is the phase response of the TX chain.

 is the amplitude response of the TX chain.

In the following  represents the middle sample of the EVM window of length  (defined in the next clauses) or the last sample of the first window half if is even.

The EVM analyser shall

- detect the start of each slot and estimate  and ,

- determine  so that the EVM window of length  is centred

- on the time interval determined by the measured cyclic prefix minus 16κ samples of the considered OFDM symbol for symbol l for subcarrier spacing configuration µ in a subframe, with l = 0 or l = 7\*2^µ for normal CP, i.e. the first 16κ samples of the CP should not be taken into account for this step. In the determination of the number of excluded samples, a sampling rate of 1/Tc is assumed. If a different sampling rate is used, the number of excluded samples is scaled linearly.

- on the measured cyclic prefix of the considered OFDM symbol symbol for all other symbols for normal CP and for symbol 0 to 11 for extended CP.

- on the measured preamble cyclic prefix for the PRACH

To determine the other parameters a sample timing offset equal to  is corrected from the signal under test. The EVM analyser shall then

- correct the RF frequency offset for each time slot, and

- apply an FFT of appropriate size. The chosen FFT size shall ensure that in the case of an ideal signal under test, there is no measured inter-subcarrier interference.

The carrier leakage shall be removed from the evaluated signal before calculating the EVM and the in-band emissions; however, the removed relative carrier leakage power also has to satisfy the applicable requirement.

At this stage the allocated RBs shall be separated from the non-allocated RBs. In the case of PUCCH and PUSCH EVM, the signal on the non-allocated RB(s), , is used to evaluate the in-band emissions.

Moreover, the following procedure applies only to the signal on the allocated RB(s).

- In the case of PUCCH and PUSCH, the UL EVM analyzer shall estimate the TX chain equalizer coefficients and  used by the ZF equalizer for all subcarriers by time averaging at each signal subcarrier of the amplitude and phase of the reference and data symbols. The time-averaging length is 1 slot. This process creates an average amplitude and phase for each signal subcarrier used by the ZF equalizer. The knowledge of data modulation symbols may be required in this step because the determination of symbols by demodulation is not reliable before signal equalization.

- In the case of PRACH, the UL EVM analyzer shall estimate the TX chain coefficients and  used for phase and amplitude correction and are seleted so as to minimize the resulting EVM. The TX chain coefficients are not dependent on frequency, i.e.  and . The TX chain coefficient are chosen independently for each preamble transmission and for each .

At this stage estimates of , ,  and  are available.  is one of the extremities of the window , i.e. can be  or , where  if  is odd and  if is even. The EVM analyser shall then

- calculate EVMl with  set to ,

- calculate EVMh with  set to .

For the EVM calculation on the symbols with a transient period when the UE signals a transient period capability (tp) of 2, 4 or 7usec, is is given below.

- calculate EVMl\_tp with set to, where is 1/Tc the sampling rate

- calculate EVMh\_tp with set to, where 1/Tc is the sampling rate and the CP is the cyclic prefix of the symbol on which EVM is calculated (e.g. long CP for the first symbol of the slot) in seconds

A pictorial representation of the EVM measurement windows is given in Figure F.4-1.



Figure F.4-1: EVM measurement window

# F.5 Window length

## F.5.1 Timing offset

As a result of using a cyclic prefix, there is a range of, which, at least in the case of perfect Tx signal quality, would give close to minimum error vector magnitude. As a first order approximation, that range should be equal to the length of the cyclic prefix. Any time domain windowing or FIR pulse shaping applied by the transmitter reduces the  range within which the error vector is close to its minimum.

## F.5.2 Window length

The window length *W* affects the measured EVM and is expressed as a function of the configured cyclic prefix length. In the case where equalization is present, as with frequency domain EVM computation, the effect of FIR is reduced. This is because the equalization can correct most of the linear distortion introduced by the FIR. However, the time domain windowing effect can't be removed.

## F.5.3 Window length for normal CP

Table F.5.3-1, F.5.3-2, F.5.3-3 below specify the EVM window length (*W*) for normal CP.

Table F.5.3-1: EVM window length for normal CP for NR, FR1, 15 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth (MHz) | FFT size | Cyclic prefix length for symbols 1‑6 and 8-13 in FFT samples | EVM window length *W* | Ratio of *W* to total CP length for symbols 1‑6 and 8-131 (%) |
| 5 | 512 | 36 | 18 | 50 |
| 10 | 1024 | 72 | 36 | 50 |
| 15 | 1536 | 108 | 54 | 50 |
| 20 | 2048 | 144 | 72 | 50 |
| 25 | 2048 | 144 | 72 | 50 |
| 30 | 3072 | 216 | 108 | 50 |
| 40 | 4096 | 288 | 144 | 50 |
| 50 | 4096 | 288 | 144 | 50 |
| NOTE 1: These percentages are informative and apply to a slot's symbols 1 to 6 and 8 to 13. Symbols 0 and 7 have a longer CP and therefore a lower percentage. | | | | |

Table F.5.3-2: EVM window length for normal CP for NR, FR1, 30 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth (MHz) | FFT size | Cyclic prefix length for symbols 1‑13 in FFT samples | EVM window length *W* | Ratio of *W* to total CP length for symbols 1‑131 (%) |
| 5 | 256 | 18 | 9 | 50 |
| 10 | 512 | 36 | 18 | 50 |
| 15 | 768 | 54 | 27 | 50 |
| 20 | 1024 | 72 | 36 | 50 |
| 25 | 1024 | 72 | 36 | 50 |
| 30 | 1536 | 108 | 54 | 50 |
| 40 | 2048 | 144 | 72 | 50 |
| 50 | 2048 | 144 | 72 | 50 |
| 60 | 3072 | 216 | 108 | 50 |
| 70 | 3072 | 216 | 108 | 50 |
| 80 | 4096 | 288 | 144 | 50 |
| 90 | 4096 | 288 | 144 | 50 |
| 100 | 4096 | 288 | 144 | 50 |
| NOTE 1: These percentages are informative and apply to a slot's symbols 1 through 13. Symbol 0 has a longer CP and therefore a lower percentage. | | | | |

Table F.5.3-3: EVM window length for normal CP for NR (60 kHz SCS)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth (MHz) | FFT size | Cyclic prefix length for symbols in FFT samples | EVM window length *W* | Ratio of *W* to total CP length 1 (%) |
| 10 | 256 | 18 | 9 | 50 |
| 15 | 384 | 27 | 14 | 50 |
| 20 | 512 | 36 | 18 | 50 |
| 25 | 512 | 36 | 18 | 50 |
| 30 | 768 | 54 | 27 | 50 |
| 40 | 1024 | 72 | 36 | 50 |
| 50 | 1024 | 72 | 36 | 50 |
| 60 | 1536 | 108 | 54 | 50 |
| 70 | 1536 | 108 | 54 | 50 |
| 80 | 2048 | 144 | 72 | 50 |
| 90 | 2048 | 144 | 72 | 50 |
| 100 | 2048 | 144 | 72 | 50 |
| NOTE 1: These percentages are informative and apply to all OFDM symbols within subframe except for symbol 0 of slot 0 and slot 2. Symbol 0 of slot 0 and slot 2 may have a longer CP and therefore a lower percentage. | | | | |

## F.5.4 Window length for Extended CP

Table F.5.4-1 below specifies the EVM window length (*W*) for extended CP. The number of CP samples excluded from the EVM window is the same as for normal CP length.

Table F.5.4-1: EVM window length for extended CP for NR, FR1, 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth (MHz) | FFT size | Cyclic prefix length in FFT samples | EVM window length *W* | Ratio of *W* to total CP length1 (%) |
| 10 | 256 | 64 | 54 | 84.4 |
| 15 | 384 | 96 | 80 | 83.3 |
| 20 | 512 | 128 | 106 | 82.8 |
| 25 | 512 | 128 | 110 | 85.9 |
| 30 | 768 | 192 | 164 | 85.4 |
| 40 | 1024 | 256 | 220 | 85.9 |
| 50 | 1024 | 256 | 220 | 85.9 |
| 60 | 1536 | 384 | 330 | 85.9 |
| 70 | 1536 | 384 | 330 | 85.9 |
| 80 | 2048 | 512 | 440 | 85.9 |
| 90 | 2048 | 512 | 440 | 85.9 |
| 100 | 2048 | 512 | 440 | 85.9 |
| NOTE 1: These percentages are informative. | | | | |

## F.5.5 Window length for PRACH

The table below specifies the EVM window length for PRACH preamble formats for *LRA*= 839 and .

Table F.5.5-1 EVM window length for PRACH formats for  *LRA*= 839

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Preamble format | Cyclic prefix length *NCP* | Nominal FFT size1 | EVM window length *W* in FFT samples | Ratio of *W* to CP2 |
| 0 | 3168 | 24576 | 2307 | 72.8% |
| 1 | 21024 | 24576 | 20163 | 95.9% |
| 2 | 4688 | 24576 | 3827 | 81.6% |
| 3 | 3168 | 6144 | 2952 | 93.2% |
| NOTE 1: The use of other FFT sizes is possible as long as appropriate scaling of the window length is applied  NOTE 2: These percentages are informative | | | | |

The table below specifies the EVM window length for PRACH preamble formats for  *LRA*= 139 and  where.

Table F.5.5-2 EVM window length for PRACH formats for  *LRA*= 139

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Preamble format | Cyclic prefix length  *NCP* | Nominal FFT size1 | EVM window length *W* in FFT samples | Ratio of *W* to CP2 |
| A1 | 2882*-* | 20482*-* | 1442*-* | 50.0% |
| A2 | 5762*-* | 20482*-* | 4322*-* | 75.0% |
| A3 | 8642*-* | 20482*-* | 7202*-* | 83.3% |
| B1 | 2162*-* | 20482*-* | 722*-* | 33.3% |
| B2 | 3602*-* | 20482*-* | 2162*-* | 60.0% |
| B3 | 5042*-* | 20482*-* | 3602*-* | 71.4% |
| B4 | 9362*-* | 20482*-* | 7922*-* | 84.6% |
| C0 | 12402*-* | 20482*-* | 10962*-* | 88.4% |
| C2 | 20482*-* | 20482*-* | 19042*-* | 93.0% |
| NOTE 1: The use of other FFT sizes is possible as long as appropriate scaling of the window length is applied  NOTE 2: These percentages are informative | | | | |

# F.6 Averaged EVM

The general EVM is averaged over basic EVM measurements for n slots in the time domain.

,

where n is

for PUCCH, PUSCH.

The EVM requirements shall be tested against the maximum of the RMS average at the window W extremities of the EVM measurements:

Thus is calculated using in the expressions above and is calculated using .

Thus we get:



The calculation of the EVM for the demodulation reference signal, , follows the same procedure as calculating the general EVM, with the exception that the modulation symbol set  defined in clause F.2 is restricted to symbols containing uplink demodulation reference signals.

The basic  measurements are first averaged over n slots in the time domain to obtain an intermediate average .

In the determination of each , the timing is set to  if , and it is set to  otherwise, where  and  are the general average EVM values calculated in the same n slots over which the intermediate average  is calculated. Note that in some cases, the general average EVM may be calculated only for the purpose of timing selection for the demodulation reference signal EVM.

Then the results are further averaged to get the EVM for the demodulation reference signal, ,



The PRACH EVM, , is averaged over 2 preamble sequence measurements for long preamble formats as defined in table 6.3.3.1-1 in [6] and averaged over 10 preamble sequence measurements for short preamble formats as defined in table 6.3.3.1-2 in [6].

The EVM requirements shall be tested against the maximum of the RMS average at the window *W* extremities of the EVM measurements:

Thus is calculated using  and is calculated using .

Thus we get:



# F.7 Spectrum Flatness

The data shall be taken from FFT coded data symbols and the demodulation reference symbols of the allocated resource block.

# F.8

# F.9

# F.10 EVM for UL MIMO

## F10.1 General

EVM for UL MIMO is measured per layer. A zero-forcing (ZF) MIMO receiver architecture is used so that dual layer transmissions by the UE can be demodulated by the test equipment receiver.

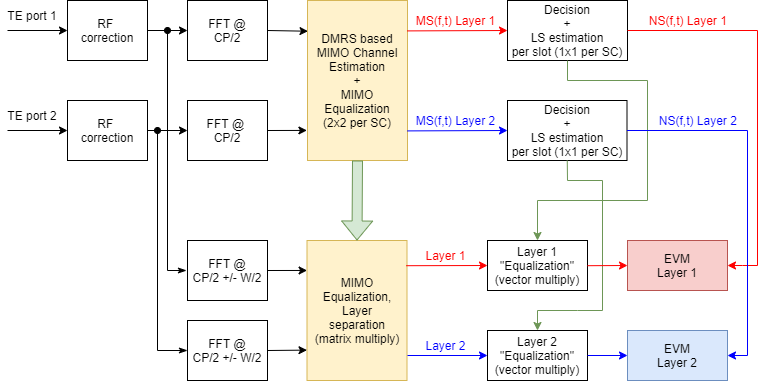


Figure F.10.1-1: EVM calculation block diagram for 2-Layer UL MIMO

The TE receives signals from 2 different ports which are connected to two antenna connectors in the test system.

For UL MIMO measurements a MIMO equalization step as described in section F.10.2 is performed to separate the layers.

Each layer is then processed as described in section F.10.3 to receive the measurement results for each individual layer.

## F10.2 MIMO Equalization

The MIMO equalization is based only on reference signals (DMRS) without using any data symbols. In order to obtain comparable EVM results independent of the number of DMRS symbols per slot, only the first DMRS symbol in each slot is used.

The effective 2x2 channel matrix is estimated using reference signals of different subcarriers, e.g. in case of DMRS antenna ports 0 and 2. In case that same subcarriers are used, e.g. DMRS antenna ports 0 and 1, a channel decomposition is necessary taking advantage of the orthogonal codes *wf* and *wt* and assuming identical channel coefficients for adjacent subcarriers of same CDM group.

Effective channel including the precoding matrix *P* is:

with

where *y* denotes the received symbol on port index *n* and *r* the reference signal for layer index *ν*.

Since reference signals of a specific layer are transmitted only on subcarriers of one CDM group channel, interpolation is needed in order to obtain channel coefficients for all subcarriers. Channel interpolation is done using the channel coefficients of active CDM group in all other CDM groups.

The channel coefficients used to calculate the equalizer coefficients are obtained after channel smoothing in frequency domain by computing the moving average of interpolated channel coefficients. The moving average window size is 7. For subcarriers at or near the edge of allocation the window size is reduced accordingly.

The ZF equalizer coefficients are calculated as the inverse of the effective channel matrix, in general:

## F10.3 Layer processing

After performing the MIMO equalization as described in section F.10.2 each layer is processed using the existing procedure as defined in Annex E of TS 38.521-1 [4].

Since the channel estimation is calculated only on first DMRS symbol an averaging including all 14 symbols of one slot, i.e. data and reference signals, is needed in order to minimize EVM. The averaging is achieved by the least square (LS) equalization method described for single layer in Annex E.3. of TS 38.521-1 [4].

*MS(f,t)* and *NS(f,t)* are processed with a LS estimator, to derive one equalizer coefficient per time slot and per allocated subcarrier. *EC(f)* is defined for each layer as:

With \* denoting complex conjugation. *EC(f)* are used to equalize layer data symbols.

EVM equalizer spectral flatness is derived from equalizer coefficients for each layer as follows:

Annex G (normative):

Difference of relative phase and power errors

# G.0 General

This annex gives further information needed for understanding and implementing 6.4D.4. The following terms should be understood as follows:

Relative phase error: refers to the phase difference between signals at different antenna connectors, which should be ideally 0. It should be understood as for a slot i.e. (slot) relative phase. It is calculated based on DMRS symbols of that slot or on SRS symbols.

Difference of relative phase error: refers to the difference between the relative phase error determined per slot and the relative phase error determined based on the SRS transmitted.

# G.1 Measurement Point

Figure G.1-1 shows the measurement point for the difference of relative phase and power errors.



Figure G.1-1 - Measurement point for difference of relative phase/power error for UL coherent MIMO

# G.2 Relative Phase Error Measurement

Here are listed the different aspects that may lead to different interpretations.

## G.2.1 Symbols and subcarriers used

Phase error is determined based on DMRS REs (DMRS mapping type A with 3 DMRS symbols per slot, the REs corresponding to the odd subcarriers and DMRS symbols are non-allocated for data or DMRS.) and SRS REs (with 4 SRS symbols in the SRS slot, same SRS resource mapping is used for non-codebook-based and codebook-based precoding).

For the DMRS and SRS to occupy identical SCs and maximimize their frequency density, DMRS configuration type 1 and SRS comb2 configuration are used.

UL RMC described in Annex A.2 is used.

## G.2.2 CFO (carrier frequency offset) correction

The TE performs a CFO correction on a slot-by-slot basis using a common frequency correction at the two uplink antenna connectors.

## G.2.3 Steps of the measurement method

Below are detailed the steps necessary to obtain the maximum difference of relative phase error during the 20ms time window.

1 Determination for each subcarrier and at each antenna, the SRS relative phase error based on the last SRS transmitted on Ant1 and Ant2, that relative phase error serves as a reference for the calculation of the difference of relative phase error for each slot inside the 20 ms time window.

The output is the “SRS relative phase error” vector for the last SRS transmitted: .

2 Calculation for the last SRS transmitted, for each RB of the SRS relative phase errors based on the arithmetic mean of the subcarrier SRS relative phase errors determined in previous step.

The output is the “SRS relative phase error” vector for the last SRS transmitted: .

3 CFO correction on slot-by-slot basis using a common frequency correction for both antenna outputs. 4 Determination for each subcarrier and at each antenna, the phase over the slot being analyzed. The phase is extracted from the channel estimate derived from the 3 DMRS symbols of the slot using the LSE technique.

The output is one vector of dimension for each antenna.

5 Calculation for a slot for each subcarrier of the relative phase error (difference between the vectors determined in the previous step).

The output is subcarrier relative phase errors of a slot: .

6 Calculation for a slot, for each RB of the relative phase errors based on the arithmetic mean of the subcarrier relative phase errors determined in previous step.

The output is a “slot relative phase error” vector for a slot:.

7 Calculation for a slot of the difference of relative phase errors based on the “SRS relative phase error” (reference) determined in step 2 and the “slot relative phase error” determined in previous step.

The output is a “difference of relative phase error” vector for a slot:.

8 Calculation for a slot of the arithmetic mean value of the “difference of relative phase error” vector determined in previous step, this value corresponds to an RB.

The output is a “difference of relative phase error” value for a slot:

9 Perform for each slot of the 20ms time window, steps 3 to 8.

The output is a “difference of relative phase error” vector: .

10 Calculation of the maximum value of the “difference of relative phase error”.

The output is the “difference of relative phase error” that should be verified as complying with the 40° maximum allowable difference of relative phase error requirement: .

Annex H (informative): Void

Annex I (informative): Void

Annex J (informative): Void

Annex K (informative): Void

Annex L (normative):  
ModifiedMPR-Behavior

# L.1 Indication of modified MPR behavior

This annex contains the definitions of the bits in the field *modifiedMPR-Behavior* indicated per supported NR band in the IE *RF-Parameters* [7] by a UE supporting an MPR or A-MPR modified in a given version of this specification. A modified MPR or A-MPR behaviour can apply to a supported NR band in stand-alone operation (including CA and NN-DC operation) or in non-standalone operation with the said NR band as part of an EN-DC or NE-DC band combination.

NOTE 1: In the present release, the *modifiedMPR-Behavior* is indicated [7] by an 8-bit bitmap per supported NR band.

Table L.1-1: Definitions of the bits in the field *modifiedMPR-Behavior*

|  |  |  |  |
| --- | --- | --- | --- |
| NR Band | Index of field  (bit number) | Definition  (description of the supported functionality if indicator set to one) | Notes |
| n41 | 0 (leftmost bit) | - EN-DC contiguous intraband MPR as defined in clause 6.2B.2.1 of 38.101-3 v15.5.0 | - This bit shall be set to 1 by a UE supporting DC\_(n)41AA UE EN-DC |
|  | 1 | - EN-DC non-contiguous intraband MPR as defined in clause 6.2B.2.2 of 38.101-3 v15.5.0 | - This bit shall be set to 1 by a UE supporting DC\_41A\_n41A EN-DC |
|  | 2 | - EN-DC contiguous and non-contiguous intraband MPR and A-MPR as defined in 38.101-3 v16.4.0. If this bit is not set the UE uses Rel-15 MPR or A-MPR for EN-DC contiguous and non-contiguous intraband MPR and A-MPR | -This bit may be set to 1 by a UE supporting DC\_(n)41AA or DC\_41A\_n41A EN-DC |
| n71 | 0 (leftmost bit) | - EN-DC contiguous intraband MPR as defined in clause 6.2B.2.1 of 38.101-3 v15.5.0 | - This bit shall be set to 1 by a UE supporting DC\_(n)71AA UE EN-DC |

Annex M (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Change history | | | | | | | |
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2017-08 | RAN4#84 | R4-1708909 |  |  |  | Initial Skeleton | 0.0.1 |
| 2017-10 | RAN4#84Bis | R4-1709958 |  |  |  | Added approved TPs in RAN4-NR-AH#3  R4-1709948, TP for TS 38.101-1: minimum output power, Huawei  R4-1709454, TP for TS 38.101-1:UE Tx spurious emission for range 1, ZTE Corporation | 0.1.0 |
| 2017-10 | RAN4#84Bis | R4-1711978 |  |  |  | Embedded approved TPs in RAN4#84Bis  R4-1711556, "TP to TS 38.101: Draft CR to Transmitter power clause", Nokia  R4-1710962, "TP to TS 38.101-1: Draft CR to Output RF spectrum emissions" Nokia  R4-1711608, "TP for TS38.101-1 on conducted UE transmitter intermodulation for FR1(section 6.5)" ZTE Corporation  Number of TPs by editors | 0.2.0 |
| 2017-12 | RAN4#85 | R4-1713805 |  |  |  | Approved TPs in RAN4#85  R4-1713204, TP on general parts for 38.101-1 NR FR1, Ericsson  R4-1714047, WF on MPR for sub6GHz, NTT DOCOMO, INC.  R4-1714052, TP for TS 38.101-1 introduction of band n71 for transmitter characteristics, T-Mobile USA Inc.  R4-1714162, TP to 38.101-1: ACS, Ericsson  R4-1714163, TP to 36.101-1: In-band blocking, Ericsson  R4-1714446, TP to 36.101-1: Out-of-band blocking and exceptions for spurious response, Ericsson  R4-1714369, TP for NBB requirement for FR1, Intel Corporation  R4-1714529, TP on introducing operating bands for NR-LTE DC including SUL band combinations in 38.101-1, Huawei  R4-1714097, TP for TS 38.101-1: UE RF requirements for standalone SUL, Huawei  R4-1714536, TP for TS 38.101-1: Channel Bandwidth Definition, Qualcomm Incorporated (Note, this TP was further discussed and edited in the reflector)  R4-1714114, TP for TS 38.101-1: Channel Arrangement, Qualcomm Incorporated (Note, this TP was further discussed and edited in the reflector)  R4-1714029, Sub6 Reference Sensitivity, Qualcomm Incorporated  R4-1714329, TP to TR 38.101-01 v0.2.0: ON/OFF mask design for NR UE transmissions for FR1, Ericsson  Band list according to R4-1714542, List of bands and band combinations to be introduced into RAN4 NR core requirements by December 2017, RAN4 Chairmen  Input from:  R4-1714479, TP for TR 38.817-01 NR channel bandwidth, Huawei, HiSilicon | 0.3.0 |
| 2017-12 | RAN4#85 | R4-1714569 |  |  |  | Further corrections and alignments with 38.104 after email review | 0.4.0 |
| 2017-12 | RAN#78 | RP-172475 |  |  |  | v1.0.0 submitted for plenary approval. Contents same as 0.4.0 | 1.0.0 |
| 2017-12 | RAN#78 |  |  |  |  | Approved by plenary – Rel-15 spec under change control | 15.0.0 |
| 2018-03 | RAN#79 | RP-180264 | 0003 |  | F | Implementation of endorced CRs to 38.101-1  Endorsed draft CRs  F: R4-1800400, Editorial corrections for 38.101-1, Qualcomm  B: R4-1801102, Draft CR for 30 MHz CBW support, Huawei  F: R4-1800032, 38.101-1 n71 draft CR for section 6.2.3 - UE A-MPR - NS values, T-Mobile USA Inc.  B: R4-1801121, Draft pCR for TS 38.101-1 version 15.0.0: Remaining ON/OFF masks for FR1 NR UE transmissions, Ericsson  F: R4-1800417, Correction of NR SEM table and additional requirements table, vivo  F: R4-1800033, 38.101-1 n71 draft CR for section 6.5.3.2 Spurious emissions for UE co-existence, T-Mobile USA Inc.  F: R4-1801114, Proposal on protected band numbering in UE specs, Sprint Corporation  F: R4-1800407, Draft CR for TS 38.101-1: Mandatory 4Rx antenna performance for NR UE, Vodafone Group Plc  F: R4-1800451 Draft CR for TS 38.101-1: Clarification of 4Rx NR bands, Huawei, HiSilicon  F: R4-1801136, Draft CR for TS 38.101-1: REFSENS for NR bands, Huawei, HiSilicon  F: R4-1801137, Draft CR: n71 REFSENS, Dish Network  F: R4-1800395, Draft CR to 38.101-1: corrections to ACS and in-band blocking, Ericsson  F: R4-1800396, Draft CR to 38.101-1: corrections to out-of-band blocking, Ericsson  F: R4-1800397, Draft CR to 38.101-1: corrections to spurious response, Ericsson  F: R4-1800305, Draft CR for NR FR1 wide band intermodulation requirements, MediaTek Inc.  F: R4-1800320, Draft CR to 38.101-1: Rx Spurious emission for NR FR1 (section 7.9), ZTE Corporation  F: R4-1800473, Draft CR on UE RF requirements for SUL in TS 38.101-1, Huawei  F: R4-1800965, Draft CR to TS 38.101-1: Asymmetric CH BW operation, Dish Network  F: R4-1800882, Draft CR for correction of UE channel bandwidth for Bands n77 and n78 for TS 38.101-1, Orange UK  F: R4-1801012, Draft CR to 38.101-1: Clarifications to UE spectrum utilization section 5.3, Ericsson  F: R4-1800030, 38.101-1 n71 draft CR for section 5.4.4 - TX–RX frequency separation, T-Mobile USA Inc  F: R4-1801228, Draft CR to 38.101-1: Channel spacing for CA for NR FR1(section 5.4.1.2), ZTE Corporation  F: R4-1801231, Correction CR for channel spacing:38.101-1, Samsung  F: R4-1801235, Draft CR to TS 38.101-1: Corrections on channel raster calculation in section 5.4.2, ZTE Corporation  F: R4-1801318, Draft CR on synchronization raster, Huawei  RAN4#86:  R4-1803053, Draft CR for new spec structure of 38.101-1, Ericsson  R4-1801479, Draft CR to 38.101-1: Default Tx-RX frequency separation for NR FR1(section 5.4.4), ZTE  R4-1801581, Draft CR for TS 38.101-1 update of 4Rx bands, Huawei Technologies France  R4-1802211, draft CR TS 38.101-1 Uplink configuration for FR1 NR REFSENS, Skyworks Solutions Inc.  R4-1802342, Draft CR for NR FR1 ACS case 2 transmitter power setting correction (Note 1), MediaTek Inc.  R4-1802509, Draft CR on 38.101-1 v15.0.0: Remaining ON/OFF masks for FR1 NR UE transmissions, Ericsson  R4-1802566, Draft CR to TS 38.101-1: Clarification of mixed numerology guardband size, Ericsson  R4-1802978, Draft CR to TS 38.101-1: Corrections on channel raster in Section 5.4.2.3, Intel Corporation  R4-1803064, Draft CR for 38.101-1: Correction of errors, Sprint Corporation  R4-1803065, Draft CR for 38.101-1 Introduction of n41requirements, Sprint Corporation  R4-1803242, Draft CR to 38.101-1: Corrections to n66, Dish Network  R4-1803285, Draft CR to 38.101-1: Correction to CH BWs without symmetric uplink Dish Network, Skyworks Solutions Inc.  R4-1803436, Introduction of UL subcarrier alignment for additional bands, AT&T  R4-1803456, Draft CR for 38.101-1: Spurious Emissions for UE Coexistence, Sprint Corporation  R4-1803461, CR on configured transmitted power for TS 38.101-1, Huawei  R4-1803452, draft CR for introduction of completed band combinations from 37.865-01-01 into 38.101-1, Ericsson  R4-1803567, Draft CR for TS 38.101-1: Sync raster offset in re-farming bands (5.4.3), Ericsson  R4-1803365, CR to introduce MPR for PC2 and PC3 and A-MPR for UTRA protection, Nokia | 15.1.0 |
| 2018-06 | RAN#80 | RP-181262 | 0011 |  | F | CR to TS 38.101-1: Implementation of endorsed draft CRs from RAN4 #86bis and RAN4 #87  R4-1803900, Draft CR into TS 38.101-1 Introduction of band combinations for SUL, Huawei  R4-1804021 CR for clarifications for NR FR1 CA BW Classes Nokia, Nokia Shanghai Bell  R4-1804140 CR for Narrow Band Blocking requirement for FR1 Intel Corporation  R4-1804219 Draft CR for 38.101-1: n41 SEM and additional spurious emissions SPRINT Corporation  R4-1804266 Draft CR to 38.101-1 MPR channel bandwidth criteria Skyworks Solutions Inc.  R4-1804267 Draft CR to 38.101-1 n3,n5,n8 REFSENS levels Skyworks Solutions Inc.  R4-1804268 Draft CR to 38.101-1: Corrrection to n41 uplink configuration for reference sensitivity Skyworks Solutions Inc.  R4-1804370 Draft CR to add missing NR inter-band DL CA in FR1 for TS 38.101-1 NTT DOCOMO, INC.  R4-1804581 Draft CR to 38.101-1: On EVM Wording Qualcomm, Inc.  R4-1804948 Corrections to 5.3.3 in TS 38.101-1 Nokia, Nokia Shanghai Bell  R4-1804877 draft CR introduction completed band combinations 37.865-01-01 -> 38.101-1 Ericsson  R4-1805444 Draft CR to TS 38.101-1: Asymmetric CH BW operation Dish Network  R4-1805447 drfat CR for including SRS antenna switching in configured output power Qualcomm Incorporated  R4-1805462 Editorial corrections to UE RF requirements in 38.101-1 Qualcomm Incorporated  R4-1805659 Draft CR for CBW for n50 for 38.101-1 Huawei  R4-1805664 Draft CR to 38.101-1: Addition of Annex F Rohde & Schwarz  R4-1805665 Correction to inner and outer definitions for MPR Qualcomm Incorporated  R4-1805684 Draft CR to TS38.101-1: Channel Raster to Resource Element Mapping (Section 5.4.2.2) and RB alignment with different numerologies (Section 5.3.4) ZTE Corporation  R4-1805698 Draft CR for 38.101-1 for Rx(Ch7) of Band n77, n78 and n79 RF requirements CMCC  R4-1805699 Draft CR to 38.101-1:introduction of Tx/Rx requirements for inter-band CA ZTE Corporation  R4-1805751 Draft CR on UE-to-UE coexistence requirements to protect band 29 from NR band 71 LG Electronics France  R4-1805783 Draft CR for 38.101-1 for Tx(Ch6) of Band n77, n78 and n79 RF requirements CMCC  R4-1805902 Draft CR into TS 38.101-1 Correction on SUL\_n78-n80 Huawei, HiSilicon  R4-1805904 Draft CR into TS 38.101-1 Introduction of new band combinations for SUL Huawei, HiSilicon  R4-1805921 Draft CR on NR UE REFSENS SNR FRC for FR1 Intel Corporation  R4-1805981 Draft CR for TS38.101-1:Sync raster Samsung  R4-1804548 Draft CR for CA BW class for FR1 NTT DOCOMO, INC.  R4-1806170 Draft CR on frequency error for TS 38.101-1 ZTE Corporation  R4-1806481 Draft CR for Environmental conditions in TS 38.101-1 Annex NTT DOCOMO, INC.  R4-1806657 Draft CR to 38.101-1: Measurement BW for min and off power Skyworks Solutions Inc.  R4-1806669 Draft CR to TS38.101-1\_introduction of completed band combinations for inter-band 2UL CA ZTE Corporation  R4-1806673 Draft CR to TS38.101-1\_Remove brackets from Tx and Rx spurious emission table ZTE Corporation  R4-1806677 Draft CR on including CA bandwidth class and band combinations for intra-band CA LG Electronics France  R4-1806719 Introduction of 7.5 kHz frequency shift for Band n71 Ericsson, T-Mobile  R4-1806844 Draft CR for 38.101-1 for Tx(Ch6): missing maximum power requirements for n1 and n8 SoftBank Corp.  R4-1806945 Draft CR for TS 38.101-1: Channel raster and NR-ARFCN clarification (5.4.2) Ericsson  R4-1807039 Intra-band CA terminology for UE ZTE Corporation  R4-1807178 Corrections to n70 TX/RX frequency separation Dish Network  R4-1807181 Corrections to spurious emissions UE co-existence table Dish Network  R4-1807234 Draft CR into TS 38.101-1 Some Corrections for SUL Huawei, HiSilicon  R4-1807269 Corrections to Wide band intermodulation table <2700MHz Dish Network  R4-1807392 to remove the brackets for SU in 38.101-1 Huawei, HiSilicon  R4-1807647 Draft CR to TS 38.101-1: Correction to Asymmetric CH BW operation Dish Network  R4-1807680 Draft CR on 38.101-1 on channel raster to achieve alignment of data and SSB subcarrier grids Nokia, Nokia Shanghai Bell, Ericsson  R4-1807705 CR for TS 38.101-1 A-MPR for n51 Huawei, Hisilicon  R4-1807814 Draft CR for 38.101-1: SEM correction for n41 Sprint Corporation  R4-1807851 Draft CR for 38.101-1: UE spurious emission protection requirements for n5 Sprint Corporation  R4-1807920 General requirements for downlink inter-band CA Qualcomm Incorporated  R4-1807923 Resolution bandwidth for ACLR Qualcomm Incorporated  R4-1808084 Introduction of n12 into TS 38.101-1 Nokia  R4-1808087 Draft CR 38.101-1: Introduction of n2, n25, n66 and n70 Sprint Corporation, Dishnetwork  R4-1808090 Draft CR to TS 38.101-1: Inclusion of Simultaneous RxTx UE capability for some band combinations Ericsson, Vodafone, Orange  R4-1808107 Draft CR to TS38.101-1\_corrections on UE coexistence ZTE Corporation  R4-1808111 TP to TS38.101-1 - UE ON/OFF masks Ericsson  R4-1808116 Draft CR to 38.101-1: introduction of Band n34,n39 and n40 RF requirements ZTE Corporation,CMCC  R4-1808136 Draft CR to 38.101-1: FR1 UE Power Control Qualcomm Incorporated  R4-1808141 Correction to MPR for PC2 and spectrum emission mask measurement bandwidth Qualcomm Incorporated  R4-1808142 Draft CR for 38.101-1 n41 A-MPR Sprint Corporation, Nokia, Nokia Shanghai Bell, Ericsson  R4-1808143 Draft CR for TS 38.101-1 A-MPR for n20 Huawei, HiSilicon  R4-1808155 Draft CR for TS 38.101-1: to correct reqirements for n71 Samsung  R4-1808178 Addition parameters about n50 & n51 in TS 38.101-1 Huawei, Hisilicon, Etisalat (editors note: n50 not implemented per chairmans aggreement)  R4-1808182 Draft CR for TS 38.101-1 A-MPR for n28 Huawei, HiSilicon  R4-1808187 CR for RF requirements for Coherent UL MIMO for FR1 Qualcomm Austria RFFE GmbH  R4-1808207 Draft CR to 38.101-1: On EVM Averaging Length, Wording , Qualcomm  R4-1808209 Draft CR for 38.101-1 for Tx (Ch6) of HPUE Qualcomm  R4-1808466 Draft CR on UL RMC and OCNG pattern for FDD REFSENS tests RD session  R4-1808493 Draft CR for TS 38.101-1: Channel and sync raster corrections (5.4) Ericsson  R4-1808507 Draft CR for TS38.101-1 on addition of new 90MHz UE CBW for n41/n78 LG Electronics Inc., LG Uplus, Samsung  R4-1808176, Draft CR for 38.101-1 : Introduction of A-MPR for n8, SoftBank  R4-1808201, Draft CR for 38.101-1 : Introduction of A-MPR for n1, SoftBank  R4-1807101, draft CR introduction completed band combinations 37.865-01-01 -> 38.101-1, Ericsson | 15.2.0 |
| 2018-09 | RAN#81 | RP-181896 | 0025 |  | F | Big CR for 38.101-1  Endorced draft CRs from RAN4#NR-AH-1807  R4-1809335, Draft CR on UL RMC for FR1 RF tests , Qualcomm Incorporated  R4-1809337, Draft CR on NR UE REFSENS SNR FRC for FR1, Intel Corporation  R4-1809339, Draft CR on measurement of receiver characteristics for FR1 RF Tests, Qualcomm Incorporated  R4-1809396, Draft CR on NR UE maximum input level FRC for FR1, Intel  R4-1809567, Draft CR on OCNG pattern for FR1 REFSENS tests, Qualcomm Incorporated, Rohde & Schwarz  Endorced draft CRs from RAN4#88  R4-1809714, Draft CR to correct in-band blocking parameters for FR1, Anritsu Corporation  R4-1809784, Draft CR to 38.101-1: Corrections on CA bandwidth classes for FR1, ZTE Corporation  R4-1809785, Draft CR to TS 38.101-1 for Corrections on UE transmitter power, ZTE Corporation  R4-1809793, Draft CR to 38.101-1: Corrections on additional spectrum emission mask, ZTE Corporation  R4-1809919, Correction on UE receiver requirement for FR1, CATT  R4-1810091, Draft CR TS 38.101-1 - UE ON-OFF mask clean up, Ericsson  R4-1810210, Draft CR for TS 38.101-1: MPR inner and outer RB allocations formula correction, MediaTek, Inc.  R4-1810229, Draft CR for TS 38.101-1: Spurious emission for UE coexistence table corrections, MediaTek, Inc.  R4-1810230, Draft CR for TS38.101-1 to correct 90MHz UE CBW, LG Electronics, Inc.  R4-1810232, Draft CR for TS 38.101-1: Table 7.3.2-1 n77 reference sensitivity corrections, MediaTek, Inc.  R4-1810369, Draft CR to 38.101-1: Corrections on symbols and abbreviations in section 3, ZTE Corporation  R4-1810376, Draft CR: General corrections to n71 requirements, Dish Network  R4-1810428, Draft CR on TS38.101-1 for UE maximum output power for UL MIMO, OPPO  R4-1810552, Correction of reference tables, OPPO  R4-1810729, Draft CR for introduction of Band n74 for TS 38.101-1, NTT DOCOMO, Inc.  R4-1810862, Draft CR to 38.101-1: Updates to Transmit Modulation Annex, Rohde & Schwarz  R4-1810892, CR to update Table 6.2D.1-2 for FR1, Qualcomm Incorporated  R4-1810961, CR on ACS minimum requirement, Intel Corporation  R4-1810965, CR on Out-of-Band Blocking minimum requirement, Intel Corporation  R4-1810967, CR on Rx Intermodulation characteristics for CA, Intel Corporation  R4-1810974, Annex lettering change for 38.101-1, Qualcomm Incorporated  R4-1811189, CR to add more details to Coherent UL MIMO spec for FR1, Qualcomm Incorporated  R4-1811280, Corrections of NR receiver characteristics titles, Vivo  R4-1811455, Draft CR on DL Physical Channel for FR1 RF tests, Qualcomm Europe Inc. (Spain)  R4-1811457, NS numbering, Qualcomm Incorporated  R4-1811459, Correction on UE transmitter requirement for FR1, CATT  R4-1811463, Draft CR for 38.101-1: Addition of missing NR CA configurations n8-n75 and n28-n75, VodafoneItalia SpA  R4-1811472, Addition parameters about n51 in TS 38.101-1, Huawei, Hisilicon, Etisalat  R4-1811474, CR CP- OFDM almost contiguous allocation, Nokia, Nokia Shanghai Bell  R4-1811477, Draft CR to 38.101-1: FR1 Power Control, Qualcomm Incorporated  R4-1811478, A-MPR correction for n20 and n28, Huawei, HiSilicon  R4-1811490, Draft CR to 38.101-1: Addition of Carrier Leakage table, Rohde & Schwarz  R4-1811491, Draft CR for TS38.101-1 on transmit signal quality, OPPO  R4-1811493, CR to TS 38.101-1: pi/2 BPSK with Spectrum Shaping, Indian Institute of Tech (M),Indian Institute of Tech (H), CEWiT, Nokia  R4-1811513, A proposal on 2UL co-ex table modification, SoftBank Corp.  R4-1811514, Draft CR to TS 38.101-1: Clarification on OCNG, Keysight Technologies UK Ltd  R4-1811516, Draft CR on NR DL FRCs for FR1 UE RF requirements, Intel Corporation  R4-1811550, Draft CR to TS 38.101-1 on channel bandwidth and spacing descriptions, Ericsson  R4-1811553, Draft CR to 38.101-1: Corrections on description of channel raster entries, ZTE Corporation  R4-1811783, Measurement period of PRACH time mask, CATT  R4-1811792, Draft CR for A-MPR revision for n1, NTT DOCOMO, INC.  R4-1811798, Draft CR for Pcmax for FR1, Qualcomm Incorporated  R4-1811799, Pcmax for inter-band NR CA FR1 draft CR, InterDigital, Inc.  R4-1811812, Draft CR to 38.101-1: On FR1 AMPR Band n41 NS\_04, Qualcomm Incorporated  R4-1811816, CR to update the definition of Long and Short subslot for FR1, Qualcomm  R4-1811894, Addition parameters about n50 in TS 38.101-1, Huawei  R4-1811896, Draft CR for TS 38.101-1: n41 GSCN range modification, MediaTek Inc.  R4-1811285, Draft CR TS 38.101-1: NS\_04 A-MPR' and spurious emisison corrections, Sprint | 15.3.0 |
| 2018-12 | RAN#82 | RP-182836 | 0029 | 1 | F | Endorced draft CRs from RAN4#88Bis:  R4-1812050, CR Simplification of NR NS\_08, Nokia  R4-1812054, Correction for Inter-band CA operating bands table in TS 38.101-1, Nokia.  R4-1812079, draft CR to introduce asymmetric UL DL channel BW combinations for n71, T-Mobile USA Inc.  R4-1812121, Draft CR on Note1 Corrections in 38.101 RX tests, Qualcomm  R4-1812128, draftCR on 256QAM UL power requirement, Intel Corporation  R4-1812200, Draft CR to TS 38.101-1 Add clarification note to PC3 MPR table, Intel Corporation  R4-1812217, Draft CR to 38.101-1: Corrections on the descriptions of UE channel bandwidth for CA, ZTE Corporation  R4-1812319, Draft CR for TS 38.101-1: REFSENS UL configuration corrections, MediaTek Inc.  R4-1812320, Draft CR for TS 38.101-1: Out-of-band blocking exceptions for CA, MediaTek Inc.  R4-1812322, Draft CR for TS 38.101-1: Blocking characteristics for SUL, MediaTek Inc.  R4-1812397, Clarification for almost contiguous CP-OFDM, Qualcomm Incorporated  R4-1812508, Draft CR to 38.101-1: Corrections on channel raster & SS raster for operating bands, ZTE Corporation  R4-1812611, Draft CR to 38.101-1: Some corrections for inter-band CA combinations, ZTE Corporation  R4-1813459, Draft CR for TS 38.101-1: Support 4Rx for n38, Huawei  R4-1813469, draftCR on applicability of TDD configuratiin for CA in TS 38.101-1, Huawei  R4-1813521, Addition of ?TC,c for single carrier Pcmax for FR1, vivo  R4-1813798, Draft CR to 38.101-1: Corrections on UE additional maximum output power reduction, ZTE Corporation  R4-1813811, Draft CR to 38.101-1: Corrrection to n12 reference sensitivity power levels, Skyworks Solutions Inc.  R4-1813812, Band n41 spurious emission limits , Qualcomm Incorporated  R4-1813813, Draft CR for TS 38.101-1: P-Max for 5G NR HPUE, CMCC  R4-1814158, CR on Spurious emissions for UE co-existence, Intel Corporation  R4-1814159, Draft CR for CA ACS/IBB for Bandwidth class C, Qualcomm  R4-1813843, Draft CR to 38.101-1: Update of Annex F, Rohde & Schwarz  R4-1813845, Correction for PI/2 PBSK requriements, Nokia  Endorsed draft CR's from RAN4#89  R4-1815950, dCR on TS38.101-1 merging draft CRs from RAN4#88Bis, Qualcomm Incorporated  R4-1814752, DraftCR to TS 38.101-1 pi/2 BPSK in n41, CMCC  R4-1814824, n50 A-MPR, Qualcomm Incorporated  R4-1814959, Changes to Max input power UL and DL configuratgions in FR1, OPPO  R4-1814970, NR FR1 relative power tolerance CR, Nokia  R4-1814972, A-MPR for NS\_03 and NS\_03U and re-formulation of NS\_100, Nokia  R4-1815060, draft CR for adding note about the fallback of NR CA in FR1 for TS 38.101-1, NTT DOCOMO, INC.  R4-1815392, Draft CR to 38.101-1: Update to NS\_04 requirements, Rohde & Schwarz  R4-1815563, Draft CR to 38.101-1 on Clarification on 7.5 KHz raster shift in NR re-farmed bands, Ericsson  R4-1815863, Draft CR for 38.101-1: Nominal carrier spacing for 30 kHz raster, SPRINT Corporation  R4-1815898, draft CR on CA configuration on bandwidth class F, Huawei  R4-1815917, draftCR on DL RMC for TS 38.101-1, Huawei  R4-1816162, Draft CR on introduction of SRS switch IL in FR1, OPPO  R4-1816199, Draft CR on FR1-FR2 UE-to-UE coexistence for TS38.101-1, LG Electronics France  R4-1816200, Draft CR to 38.101-1 on intra-band contiguous CA configurations for FR1, ZTE Corporation  R4-1816240, Transient period for SRS Antenna Switching for FR1, Qualcomm  R4-1816243, Draft CR to TS38.101-1\_Clarifications on MSD and UL configuration tables for inter-band CA, ZTE Corporation  R4-1816466, Draft CR on some changes for SUL band combinations to TS 38.101-1, Huawei  R4-1816468, Support of 7.5 kHz carrier shift for additional operating bands, Ericsson  R4-1816604, TDD configuration for UE Tx test in FR1, Ericsson  R4-1816663, Draft CR to 38.101-1 (5.3.4) RB alignment, Huawei  R4-1816755, CR to 38.101-1: ACS and IBB intra-band contiguous CA, Intel Corporation  Further changes in RAN#82  - 7.5 kHz frequency shift is specified for all FDD bands in clause 5.4.2.1 | 15.4.0 |
| 2018-12 | RAN#82 | RP-182814 | 0030 | 2 | F | Company CR on 2Rx exception for NR vehicular UE at FR1 | 15.4.0 |
| 2019-03 | RAN#83 | RP-190403 | 0034 |  | F | CR to TS 38.101-1: Implementation of endorsed draft CRs from RAN4#90  Endorced draft CR from Ran4#90  R4-1900032, Editorial corrections for 38.101-1, Qualcomm Incorporated  R4-1900031, draftCR on SRS IL for CA, Qualcomm Incorporated  R4-1900161, CR on Relative power tolerance, Intel Corporation  R4-1900162, CR on Minimum output power, Intel Corporation  R4-1900274, Draft CR to TS 38.101-1 on NR general spectrum emission mask, ZTE Corporation  R4-1900275, Draft CR to TS 38.101-1 on spurious emisssion for network signalled value NS\_40, NS\_41 and NS\_42, ZTE Corporation  R4-1900424, Correction of table references and other typos, Ericsson  R4-1900508, Draft CR to TS 38.101-1 on UE transmitter power and some other editorial corrections, ZTE Corporation  R4-1900723, Draft CR on editorial error of TS38.101-1, LG Electronics Inc.  R4-1900727, Update to PRACH EVM window length for FR1, Rohde & Schwarz  R4-1900840, Draft CR for 38.101-1 modification of Transmit intermodulation requirement, Huawei  R4-1900848, [RAN5 LS]Draft CR for 38.101-1: adding note for inter-band CA spurious emissions, Huawei  R4-1901033, Alignment of Foob related description for 38.101-1, vivo  R4-1901273, Correction of HARQ-ACK transmission timing for DL RMC for FR1 TDD SCS=60kHz, Ericsson  R4-1901766, draft\_CR TS 38.101-1 Correction to UL configuration for reference sensitivity, Skyworks Solutions Inc.  R4-1901823, draft CR on spurious requirment for TS 38.101-1, Huawei, HiSilicon  R4-1901835, draftCR on MSD for CA\_n41-n78 for TS 38.101-1, Huawei  R4-1901847, Draft CR for 38.101-1: Addition of default power class, Sprint Corporation R4-1901873, Receiver requirement RMC references, Qualcomm Incorporated  R4-1901925, Draft CR to 38.101-1 to update and clarify Rx wide band intermod and spurious requirments for BW class C, D, E, Qualcomm Incorporated  R4-1901992, Draft CR to 38.101-1. Correct FR1 NS\_41 AMPR for n50 , Huawei  R4-1902001, Draft CR to 38.101-1 on n41 – B40 coexistence, Qualcomm Incorporated  R4-1902150, Draft CR to TS38.101-1\_Clarifications on MSD and UL configuration tables for inter-band CA, ZTE Corporation  R4-1902166, Tx ON/OFF time mask for FR1, Qualcomm Inc  R4-1902174, Draft CR to 38.101-1: On FR1 A-MPR NS\_08 for n8, Qualcomm Incorporated  R4-1902175, Draft CR on AMPR requirements for NS\_05U and NS\_08U to TS 38.101-1, Huawei  R4-1902194, [41 DL]Draft CR for 38.101-1 adding DL intra-band CA requirements for frequency less than 2700MHz, Huawei  R4-1902196, Draft CR for 7.9A Spurious emissions for CA, CMCC  R4-1902223, UE optional bandwidth for FR1, Nokia  R4-1902225, CR to 38.101-1 on CA BW Classes fallback groups, Intel Corporation  R4-1902233, Draft CR to 38.101-1: SUL clarifications, Nokia  R4-1902339, Draft CR to TS 38.101-1 on FR1 extension, Ericsson  R4-1902455, Completion of the Pcmax specification: additional P-max and P\_NR, Ericsson  R4-1902468, Draft CR: Introduction of Annex on Characteristics of the Interfering Signal, Samsung  R4-1902479, Draft CR on some errors to TS 38.101-1, Huawei  R4-1902480, Draft CR for 38.101-1 modification of requirements for network signalled value NS\_04, Huawei  R4-1902655, CR to 38.101-1 on NR Uplink RBs location, Intel Corporation  R4-1901610, Draft CR for 38.101-1 REFSENS for UL MIMO , Huawei  Editorial changes after RAN#83  To align the annex numbering with other specifications (TS 38.101-x series), annexes J and K were added and Change history was numbered as annex L. | 15.5.0 |
| 2019-06 | RAN#84 | RP-191240 | 0047 |  | F | CR to TS 38.101-1: Implementation of endorsed draft CRs from RAN4#90bis and RAN4#91  Endorced draft CRs from RAN4#90Bis  R4-1902826, Draft CR for 38.101-1 modification of ACS test parameters case 2 for intra-band contiguous CA , Huawei  R4-1902926, Draft CR to TS 38.101-1 Correction to Pcmax, Intel Corporation  R4-1902975, Draft CR on PRACH and PUCCH format description for EVM in FR1, Anritsu corporation  R4-1903032, Draft CR on editorial error of TS38.101-1, LG Electronics France  R4-1903120, Draft CR on DL power allocation for TS 38.101-1, Intel Corporation  R4-1903124, Draft CR on b41-n40 coexistence, Intel Corporation  R4-1903151, Draft CR to TS38.101-1\_removing DC sections, ZTE Corporation  R4-1903195, Draft CR for 38.101-1: remove the bracket of UE capability "powerBoosting-pi2BPSK", Huawei  R4-1903392, Draft CR for TS 38.101-1: Corrections to EVM equalizer spectrum flatness requirements, MediaTek Inc.  R4-1903473, Draft CR on FREF,Shift, CMCC  R4-1903508, Draft CR to TS 38.101-1 on spurious emissions for UE co-existence, ZTE Corporation  R4-1904335, DraftCR TS 38.101 Corrections to NS\_100 UTRA ACLR frequency band list, Skyworks Solutions Inc.  R4-1904460, Draft CR for 38.101-1 CA Pcmax, Huawei  R4-1904537, Draft CR for TR 38.101-1 correction of A-MPR for NS\_04, Huawei  R4-1904554, Draft CR to 38.101-1: FR1 power dynamics DTX removal, Qualcomm Incorporated  R4-1904927, Draft CR to clarify frequency of carrier leakage in RBs for FR1, Anritsu corporation  R4-1904928, Draft CR to TS 38.101-1 on description of UE additional output power reduction, ZTE Corporation  R4-1904929, draft Rel-15 CR for editorial corrections in 38.101-1, Ericsson  R4-1904941, draft CR to 38.101-1 Correction to Pi/2 BPSK power boosting, Intel Corporation  R4-1904957, Draft CR for TR38.101-1 – Update to EVM averaging, Rohde & Schwarz  R4-1904958, Draft CR for TR38.101-1 – Update to spectrum flatness, Rohde & Schwarz  R4-1904967, Draft CR for 38.101-1 definition of Maximum input level for intra-band contiguous CA, Huawei  R4-1904969, Draft CR for 38.101-1: editoral correction, Huawei  R4-1904987, Draft CR for correction on TS38.101-1, CATT  Endorced draft CRs from RAN4#91  R4-1905339 removal of A-MPR brackets in FR1 Nokia  R4-1905503 Change description 4.2(d) in Applicability of minimum requirements for TS 38.101-1 vivo  R4-1905524 [Rx]Draft CR for 38.101-1 Removing the brackets in Rx requirements Huawei  R4-1905526 [Rx]Draft CR for 38.101-1 defining NBB requirements<2.7GHz Huawei  R4-1905772 Draft CR to TS38.101-1 Almost contiguous MPR Intel Corporation  R4-1905795 Correction to a description of PRB for in-band emission in FR1 Anritsu Corporation  R4-1905797 Correction to power control in FR1 Anritsu Corporation  R4-1906140 draft CR for TS 38.101-1 Rx requirement for CA Huawei  R4-1906153 Draft CR for TS 38.101-1: Editorial corrections to intra-band contiguous CA ACS and in-band blocking requirements MediaTek Inc.  R4-1906154 Draft CR for TS 38.101-1: Adding symbol definitions for intra-band contiguous CA Rx maximum input level and ACS requirements MediaTek Inc.  R4-1906871 Draft CR for TS 38.101-1 UE optional bandwidth for FR1 Huawei  R4-1907131 Draft CR to 38.101-1. Clarification to FR1 NS\_43 AMPR frequency ranges Qualcomm Incorporated  R4-1907135 Draft CR to 38.101-1 rel. 15 to fix missing Exceptions for Out-of-band Blocking Apple  R4-1907419 Draft CR for TS 38.101-1: Editorial improvement to EVM equalizer spectrum flatness requirements for Pi/2 BPSK MediaTek Inc.  R4-1907429 Draft CR to TS38.101-1 A-MPR for Inter-band CA Intel Corporation  R4-1907434 [Rx]Draft CR for 38.101-1 modifying characteristics of the interfering signal in Annex D Huawei  R4-1907435 Draft CR to TS38.101-1\_introduction of n41C and corrections on Rx requirements for NR intra-band contiguous CA ZTE Corporation  R4-1907439 Draft CR to TS 38.101-1 on CA bandwidth class description ZTE Corporation  R4-1907471 Draft CR to 38.101-1. Clarify all RB reference so transmission BW applies for all SCS Qualcomm Incorporated  R4-1907474 Draft CR for TS 38.101-1 Correction of channel bandwidth set for NR CA Huawei  R4-1907477 Draft CR to TS 38.101-1 on maximum aggregated bandwidth for NR CA configurations ZTE Corporation  R4-1907481 Correction of RefSens exceptions due to UL harmonic interference for NR CA in 38.101-1 vivo  R4-1907687 Correction to CA carrier spacing Ericsson | 15.6.0 |
| 2019-06 | RAN#84 | RP-191248 | 0037 | 1 | B | Introduction of n48 in to TS 38.101-1 | 16.0.0 |
| 2019-06 | RAN#84 | RP-191241 | 0040 |  | B | CR to REL-16 TS 38.101-1: Implementation of endorsed draft CRs on NR combinations and dual Connectivity combinations | 16.0.0 |
| 2019-06 | RAN#84 | RP-191242 | 0041 | 1 | B | CR to TS 38.101-1: Introduction of band n14 – Endorsed R4-1904008 in RAN4#90b | 16.0.0 |
| 2019-06 | RAN#84 | RP-191246 | 0042 | 1 | B | CR to TS 38.101-1: Introduction of band n30 + editorial in table 7.6.2-2 | 16.0.0 |
| 2019-06 | RAN#84 | RP-191244 | 0043 | 1 | B | CR to introduce n18 to TS 38.101-1 | 16.0.0 |
| 2019-06 | RAN#84 | RP-191250 | 0044 | 1 | B | n65 introduction to 38.101-1 | 16.0.0 |
| 2019-06 | RAN#84 | RP-191251 | 0045 |  | B | Addition channel bandwidth of 30MHz for n50 in TS 38.101-1 | 16.0.0 |
| 2019-06 | RAN#84 | RP-191252 | 0046 | 1 | B | Introduction of a new NR band for LTE/NR spectrum sharing in Band 41/n41 | 16.0.0 |
| 2019-06 | RAN#84 | RP-191241 | 0048 |  | B | CR on introducing NR inter-band CA of 3DL Bands and 1UL band | 16.0.0 |
| 2019-06 | RAN#84 | RP-191241 | 0049 |  | B | CR to reflect the completed NR inter-band CA/DC combinations into Rel16 TS38.101-1 | 16.0.0 |
| 2019-06 | RAN#84 | RP-191241 | 0050 |  | B | CR to reflect the completed NR inter-band CA/DC combinations for 3 bands DL with 2 bands UL into Rel16 TS38.101-1 | 16.0.0 |
| 2019-06 | RAN#84 | RP-191241 | 0051 |  | B | CR introduction completed band combinations 38.716-01-01 -> 38.101-1 | 16.0.0 |
| 2019-09 | RAN#85 | RP-192038 | 0052 |  | F | Correction to FR1 ASEM NS\_27 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192032 | 0053 |  | B | Addition of NS information on 30MHz support for n41 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192031 | 0054 | 1 | B | Addition of new channel bandwidths for n7 into TS 38.101-1 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192027 | 0055 |  | B | CR on introducing NR intra-band CA for 3DL Bands and 1UL band | 16.1.0 |
| 2019-09 | RAN#85 | RP-192027 | 0057 | 1 | F | Minor corrections of intra-band non-contiguous CA operating bands in TS 38.101-1 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192027 | 0058 | 1 | F | Adding DeltaFHD for CA\_n1-n77 refersense requirments | 16.1.0 |
| 2019-09 | RAN#85 | RP-192032 | 0060 |  | B | CR to introduce 30MHz bandwidth of n41 into TS 38.101-1 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192026 | 0061 | 1 | B | Characteristics of Interfering signal for Contiguous Intra-band CA Class B | 16.1.0 |
| 2019-09 | RAN#85 | RP-192027 | 0062 | 1 | F | Correction Inter-band CA configurations | 16.1.0 |
| 2019-09 | RAN#85 | RP-192027 | 0063 | 1 | F | Finalizing Generic Intra-band Contiguous CA Class B requirements | 16.1.0 |
| 2019-09 | RAN#85 | RP-192034 | 0064 | 1 | B | n29 introduction to 38.101 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192027 | 0065 |  | F | [SUL] CR on SUL band combinations into Rel-16 TS 38.101-1 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192029 | 0066 |  | B | CR on Introduction of SUL band n89 into Rel-16 TS 38.101-1 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192046 | 0068 | 2 | F | Correction to Band n66 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192026 | 0070 | 1 | F | CR to 38.101-1. Revamp CA ACS and IBB tables to differentiate by band numbers and not frequency | 16.1.0 |
| 2019-09 | RAN#85 | RP-192038 | 0071 |  | F | CR to 38.101-1. Add missing AMPR to NS27 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192026 | 0072 |  | B | CR for 38.101-1 Rx requirement for NR intra-band non-contiguous CA | 16.1.0 |
| 2019-09 | RAN#85 | RP-192036 | 0073 |  | F | CR for 38.101-1: Correction to the Spurious Emission for UE Coexistence table for n14 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192037 | 0074 |  | F | CR for 38.101-1: Correction to the Spurious Emission for UE Coexistence table for n30 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192027 | 0075 |  | B | CR introduction completed band combinations 38.716-01-01 -> 38.101-1 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192027 | 0076 |  | B | CR to reflect the completed NR inter band CA DC combinations for 2 bands DL with up to 2 bands UL into Rel16 TS 38.101-1 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192027 | 0077 |  | B | CR to reflect the completed NR inter band CA DC combinations for 3 bands DL with 2 bands UL into Rel16 TS 38.101-1 | 16.1.0 |
| 2019-09 | RAN#85 | RP-192049 | 0079 |  | A | CR to TS 38.101-1: Implementation of endorsed draft CRs from RAN4#92 (Rel-16)  - Mirrors changes in R4-1910350 (of RAN4#92) for Rel-15 TS 38.101-1 | 16.1.0 |
| 2019-12 | RAN#86 | RP-193022 | 0097 |  | F | CR to align NS27 AMPR to CA\_NS\_10 AMPR for 40MHz BW at the center of band 48. | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0099 |  | A | CR for 38.101- RX Out-of-Band Blocking for B38 and B41 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0103 |  | A | CR for 38.101-1 n39 AMPR | 16.2.0 |
| 2019-12 | RAN#86 | RP-193013 | 0105 | 1 | B | Introduction of 2010-2025MHz SUL band into Rel-16 TS 38.101-1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193015 | 0110 |  | B | Addition of 25, 30 and 40 MHz to NR band n25 in TS 38.101-1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0112 |  | A | Sync raster to SSB resource element mapping | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0114 |  | A | CR to TS 38.101-1 Almost contiguous A-MPR (R16) | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0118 |  | A | CR to 38.101-1 (Rel-16) to clarify measurement interval and observation window on frequency error | 16.2.0 |
| 2019-12 | RAN#86 | RP-193020 | 0119 |  | D | Format misalignment on NS\_47 protection requirement table | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0121 |  | A | CR to TS 38.101-1: Replace CBW with symbols defined in the specification | 16.2.0 |
| 2019-12 | RAN#86 | RP-193012 | 0124 |  | B | CR to reflect the completed NR inter band CA DC combinations for 2 bands DL with up to 2 bands UL into Rel16 TS 38.101-1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193012 | 0125 |  | B | CR to reflect the completed NR inter band CA DC combinations for 3 bands DL with 2 bands UL into Rel16 TS 38.101-1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193012 | 0126 |  | F | CR to remove square brackets for n90 in TS38.101-1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0128 |  | A | CR for TS38.101-1, Clarification and Editorial corrections | 16.2.0 |
| 2019-12 | RAN#86 | RP-193012 | 0132 |  | B | Introducing NR inter-band CA for 3DL Bands and 1UL band for 38.101-1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193029 | 0133 |  | B | Adding band n71 and n28 to 4 Rx antenna ports support in 38.101-1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0137 |  | A | CR for TS 38.101-1: Editorial correction for n2 uplink configuration note index in Table 7.3.2-3 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0138 |  | A | CR to TS 38.101-1 on A-MPR table cleanup (Rel-16) | 16.2.0 |
| 2019-12 | RAN#86 | RP-193029 | 0140 |  | A | CR for TS 38.101-1: Removing CA configurations for CA\_n77D/E, CA\_n78D/E, and CA\_n79D/E | 16.2.0 |
| 2019-12 | RAN#86 | RP-193029 | 0144 |  | A | CR for TS 38.101-1: Fix out-of-band blocking issue for n50 and n75 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193029 | 0146 |  | A | CR to TS 38.101-1 on corrections to channel raster entries for NR band (Rel-16) | 16.2.0 |
| 2019-12 | RAN#86 | RP-193029 | 0150 |  | A | CR to transmit modulation quality in FR1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193012 | 0151 |  | F | Corrections Intra-band CA simultaneous TX/RX requirements | 16.2.0 |
| 2019-12 | RAN#86 | RP-193029 | 0153 |  | F | Removal of brackets from reciever requirements in 38.101-1 REL-16 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193012 | 0155 |  | B | Extension of CA BW class B | 16.2.0 |
| 2019-12 | RAN#86 | RP-193029 | 0157 |  | A | CR to 38.101-1: Editorial correction of UL RMCs | 16.2.0 |
| 2019-12 | RAN#86 | RP-193012 | 0164 |  | B | CR for 38.101-1 introduce SUL band combination CA\_n78(2A)\_SUL\_n78A-n86A | 16.2.0 |
| 2019-12 | RAN#86 | RP-193010 | 0165 |  | F | CR for 38.101-1: add BCS1 configurations for CA\_n78(2A) | 16.2.0 |
| 2019-12 | RAN#86 | RP-193017 | 0166 |  | B | CR to 38.101-1 - Band n75 - wider CBW | 16.2.0 |
| 2019-12 | RAN#86 | RP-193018 | 0167 |  | B | CR for TS 38.101: adding wider channel bandwidths | 16.2.0 |
| 2019-12 | RAN#86 | RP-193016 | 0168 |  | B | CR to 38.101-1: Addition of channel bandwidth for band n38 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193012 | 0169 |  | B | CR introduction completed band combinations 38.716-01-01 -> 38.101-1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193012 | 0170 |  | B | CR introduction completed band combinations 38.716-04-01 -> 38.101-1 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193021 | 0171 |  | C | CR for 38.101-1: Making 90 MHz channel bandwidth mandatory for n41, n78 and n90 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193020 | 0172 |  | B | CR for 38.101-1: adding 30 MHz CHBW to NS\_04 for n41 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193029 | 0174 |  | A | CR to 38.101-1-g10 Corrections to Transient Time Masks | 16.2.0 |
| 2019-12 | RAN#86 | RP-193010 | 0176 | 1 | F | CR for intra-band DL contiguous CA RF requirements | 16.2.0 |
| 2019-12 | RAN#86 | RP-193010 | 0179 |  | B | Introduction of almost contiguous MPR for PC2 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193029 | 0180 |  | A | CR for asynchronous operation for NR CA n78-n79 | 16.2.0 |
| 2019-12 | RAN#86 | RP-193028 | 0182 |  | A | CR to 38.101-1: DMRS Exceptions | 16.2.0 |
| 2020-03 | RAN#87 | RP-200408 | 0191 |  | F | Corrections to n65 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200377 | 0201 | 1 | F | CR for 38.101-1 to introduce BCS1 for CA\_n77C and CA\_n78C | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0203 |  | A | CR to TS 38.101-1 on corrections to network signalling value (Rel-16) | 16.3.0 |
| 2020-03 | RAN#87 | RP-200484 | 0208 |  | A | CR for 38.101- n39 NS flag change due to conflict | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0210 |  | A | Mirror CR for 38.101-1: n41 and n25 corrections | 16.3.0 |
| 2020-03 | RAN#87 | RP-200380 | 0211 | 2 | F | CR for 38.101-1: Corrections to intra-band CA tables | 16.3.0 |
| 2020-03 | RAN#87 | RP-200387 | 0212 |  | F | CR for 38.101-1: Missing 70 MHz for NS\_01 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200381 | 0215 |  | B | CR for 38.101-1: Introduction of n26 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200380 | 0216 |  | F | CR to TS 38.101-1: Corrections on MSD tables for CA\_n20-n78 and CA\_n66-n78 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0218 |  | A | CR to TS 38.101-1: corrections on ACS for intra-band contiguous CA | 16.3.0 |
| 2020-03 | RAN#87 | RP-200380 | 0219 | 1 | F | CR to TS 38.101-1: Improvement on NR 3DL inter-band CA combination | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0221 |  | A | CR to TS 38.101-1: Replace CBW with symbols defined in the specification.  NOTE: The CR is based on something else than the latest version of the specification and therefore it is not implemented, e.g. Tables 6.2.3.1-1, 7.6.2-2 and Table 7.6.2-4 in CR0221 are different compared to those in 38.101-1 v16.2.0. | 16.3.0 |
| 2020-03 | RAN#87 | RP-200380 | 0222 |  | B | CR to reflect the completed NR inter band CA DC combinations for 2 bands DL with up to 2 bands UL into Rel16 TS 38.101-1 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200380 | 0223 |  | B | CR to reflect the completed NR inter band CA DC combinations for 3 bands DL with 2 bands UL into Rel16 TS 38.101-1 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0224 | 1 | B | Introduction of n53 into TS 38.101-1 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0229 |  | A | CR for TS38.101-1, Remove notes for UE channel bandwidth | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0231 |  | A | CR for TS38.101-1, Correction of IE RF-Parameters name of maxUplinkDutyCycle | 16.3.0 |
| 2020-03 | RAN#87 | RP-200380 | 0234 | 1 | B | Introducing NR inter-band CA for 3DL Bands and 1UL band for 38.101-1 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200377 | 0239 | 1 | F | CR for TS 38.101-1: Corrections for n48 receiver requirements | 16.3.0 |
| 2020-03 | RAN#87 | RP-200386 | 0240 | 1 | B | CR for TS 38.101: adding wider channel bandwidths for n66 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200392 | 0241 | 1 | F | Maintenance on the UE BW for n92 and n94 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200392 | 0242 |  | F | Maintenance on the Rx-Tx separation terms | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0244 |  | A | CR for 38.101-1: to remove fallback group 1 in table 5.5A.1-1 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200389 | 0247 |  | F | CR for 38.101-1: to correct CA\_n8A-n75A REFSENS | 16.3.0 |
| 2020-03 | RAN#87 | RP-200384 | 0249 | 1 | B | CR for 38.101-1: to introduce UE RF requirements for adding wider channel bandwidth in band n28 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200383 | 0250 | 1 | B | CR to 38.101-1 Band n1 - wider CBW - Additional Channel BW | 16.3.0 |
| 2020-03 | RAN#87 | RP-200385 | 0252 | 1 | B | CR to 38.101-1 Band n38 - wider CBW - Additional Channel BW | 16.3.0 |
| 2020-03 | RAN#87 | RP-200380 | 0260 | 1 | F | Editorial corrections | 16.3.0 |
| 2020-03 | RAN#87 | RP-200377 | 0263 |  | F | CR for alomost contiguous allocation applicability | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0265 | 1 | A | CR for inter-band CA Tx requirement | 16.3.0 |
| 2020-03 | RAN#87 | RP-200377 | 0266 | 1 | F | CR for intra-band CA configuration and DL RF requirements | 16.3.0 |
| 2020-03 | RAN#87 | RP-200391 | 0273 |  | F | CR for 38.101-1: Mandatory support for n41 by UEs that support n90 | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0275 |  | A | CR for [agreed] asynchronous operation for NR CA n78-n79  NOTE: The CR is based on something else than the latest version of the specification and therefore it is not implemented, e.g. Tables 6.2A.4.2.3-1, Table 7.3A.6-1, 7.3A.6.2 and table notes are different compared to those in 38.101-1 v16.2.0. | 16.3.0 |
| 2020-03 | RAN#87 | RP-200380 | 0280 |  | F | CR for 38.101-1: delta Tib corrections | 16.3.0 |
| 2020-03 | RAN#87 | RP-200394 | 0281 |  | A | Removal of unnecessary definition of offsetmax,IMD3 from Table 6.2.3.2-1 | 16.3.0 |
| 2020-06 | RAN#88 | RP-201338 | 0293 | 4 | B | CR to TS 38.101-1: Switching time mask between two uplink carriers in UL CA and SUL | 16.4.0 |
| 2020-06 | RAN#88 | RP-200959 | 0294 |  | F | Corrections to CA n48 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0300 |  | A | CR to asymmetric CBW operation in FR1 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0302 |  | A | CR on ACLR MBW definition in FR1 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200959 | 0305 |  | B | Introducing NR inter-band CA for 3DL Bands and 1UL band for 38.101-1 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200959 | 0307 |  | F | CR Coexistence cleanup for 38101-1 Rel16 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0310 |  | A | CR to TS 38.101-1 R16: corrections on ACS for intra-band contiguous CA | 16.4.0 |
| 2020-06 | RAN#88 | RP-200966 | 0311 |  | F | CR for TS 38.101-1: UL harmonic MSD and OOBB exception | 16.4.0 |
| 2020-06 | RAN#88 | RP-200981 | 0315 |  | F | Update 4Rx Requirement for Band n30 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200958 | 0317 |  | B | CR on NR V2X UE RF requirements for single carrier in TS38.101-1 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0327 |  | A | Maintenance CR to 38101-1 on relative power tolerance R16 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200974 | 0329 |  | F | Endorsed CR on default AMPR signaling for n91 n92 n93 and n94 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0331 |  | A | Update of CSI-RS definition for FR1 DL RMCs | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0335 |  | A | Correction to FR1 QPSK UL RMC | 16.4.0 |
| 2020-06 | RAN#88 | RP-200966 | 0336 |  | B | CR to TS38.101-1: Introduction of NR DC(Clauses 3 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0338 |  | A | CR to TS 38.101-1: Correction on the CA nominal channel spacing | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0340 |  | A | CR to TS 38.101-1: Replace CBW with symbols defined in the specification. | 16.4.0 |
| 2020-06 | RAN#88 | RP-200959 | 0341 |  | B | CR to reflect the completed NR inter band CA DC combinations for 2 bands DL with up to 2 bands UL into Rel16 TS 38.101-1 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0345 |  | A | 30k SSB SCS for n50 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0347 |  | A | Addition of 30k SSB SCS for Band n38 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0354 |  | A | IBE measurements for Pi/2 BPSK with spectrum shaping | 16.4.0 |
| 2020-06 | RAN#88 | RP-200959 | 0357 |  | B | CR to reflect the completed NR inter band CA DC combinations for 3 bands DL with 2 bands UL into Rel16 TS 38.101-1 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200959 | 0360 |  | B | CR introduction completed band combinations 38.716-01-01 - | 16.4.0 |
| 2020-06 | RAN#88 | RP-200959 | 0361 |  | B | CR introduction completed band combinations 38.716-04-01 - | 16.4.0 |
| 2020-06 | RAN#88 | RP-200959 | 0364 |  | B | CR on Introduction of completed SUL band combinations into TS 38.101-1 | 16.4.0 |
| 2020-06 | RAN#88 | RP-201045 | 0365 |  | F | CR for 38.101-1 to introduce BCS2 for CA\_n78(2A). | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0367 |  | A | CR for 38.101-1 to remove the NR CA configuration for REFSENS exception due to cross band isolation for CA (mirror CR) | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0369 |  | A | CR for 38.101-1 to add the REFSENS exception for inter band CA with SDL (mirror CR) | 16.4.0 |
| 2020-06 | RAN#88 | RP-200979 | 0373 |  | F | CR on introduce delta-MPR for inter-band CA in band n28 and review value with brackets | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0379 |  | A | IBE requirement for almost contiguous allocations | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0385 |  | A | OOB blocking for n70 adjacent to n25 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0394 |  | F | CR for TS 38.101-1 UE co-existence correction (R16) | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0396 |  | F | CR for 38.101-1 RFC corrections (R16) | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0400 |  | A | TS38.101-1 CR on 30KHz SSB SCS for n40(Rel-16) | 16.4.0 |
| 2020-06 | RAN#88 | RP-200959 | 0318 | 1 | F | CR to add simultaneous RXTX capability for CA\_n41-n79 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0404 |  | A | CR for 38.101-1: to add some missing sub-clause title for NR inter-band CA | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0343 | 1 | A | CR for [agreed] asynchronous operation for NR CA n78-n79 | 16.4.0 |
| 2020-06 | RAN#88 | RP-201045 | 0387 | 1 | B | CR on FR1 UL contiguous CA requirement | 16.4.0 |
| 2020-06 | RAN#88 | RP-200974 | 0325 | 1 | F | CR on blocking requirements for n91 n92 n93 and n94 | 16.4.0 |
| 2020-06 | RAN#88 | RP-201045 | 0380 | 1 | B | Addition of mutual UE coexistence between US bands and NR Band n77 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200977 | 0356 | 1 | B | CR for TS 38.101: adding 50 MHz CBW for n1 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200980 | 0358 | 1 | B | CR to TS 38.101-1 - Add 40 MHz CBW in band n3 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200982 | 0359 | 1 | B | CR to TS 38.101-1 - Add 50 MHz CBW in band n65 | 16.4.0 |
| 2020-06 | RAN#88 | RP-200985 | 0405 |  | F | Corrections of UE co-ex tables for Japan-related bands (R16) | 16.4.0 |
| 2020-06 | RAN#88 | RP-201045 | 0320 | 2 | B | CR to 38.101-1: Introduce an operating band list and NR bands to UL MIMO | 16.4.0 |
| 2020-06 | RAN#88 | RP-200966 | 0362 | 1 | B | CR to 38.101-1 for Introduction of requirements for NR-DC | 16.4.0 |
| 2020-09 | RAN#89 | RP-201495 | 0407 | 1 | F | Correction to FR1 UL contiguous CA MPR regions | 16.5.0 |
| 2020-09 | RAN#89 | RP-201506 | 0409 |  | F | CR for n26 AMPR for 256QAM | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0411 |  | A | OOB blocking for Inter-band CA | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0416 | 1 | F | Correction to ASEM for NS\_27 | 16.5.0 |
| 2020-09 | RAN#89 | RP-201507 | 0419 |  | F | Introduction of UE PC2 for NR band n40 | 16.5.0 |
| 2020-09 | RAN#89 | RP-201502 | 0422 | 1 | B | Introduction of LTE/NR spectrum sharing in band 48/n48 frequency range | 16.5.0 |
| 2020-09 | RAN#89 | RP-201507 | 0423 |  | F | Coexistence cleanup for 38101-1 Rel16 | 16.5.0 |
| 2020-09 | RAN#89 | RP-201506 | 0424 |  | D | CR Editorial cleanup of band combination tables for 38101-1 Rel16 | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0426 |  | A | CR to TS 38.101-1: corrections on narrow band blocking for intra-band contiguous CA | 16.5.0 |
| 2020-09 | RAN#89 | RP-201492 | 0428 | 1 | F | CR for TS 38.101-1: Removal of table 6.5E.3.4.3-1 and table 6.5E.3.4.3-2 | 16.5.0 |
| 2020-09 | RAN#89 | RP-201503 | 0432 | 1 | B | CR for 38.101-1: Introduction of Power Class 1.5 | 16.5.0 |
| 2020-09 | RAN#89 | RP-201488 | 0433 | 1 | B | CR to TS38.101-1 on introduction of Uplink Full Power Transmission | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0435 |  | A | Corrections of Japan-related CA co-ex tables for REL-15 combo | 16.5.0 |
| 2020-09 | RAN#89 | RP-201492 | 0437 | 1 | F | Correction on 5G V2X UE RF requirements in rel-16 | 16.5.0 |
| 2020-09 | RAN#89 | RP-201495 | 0438 | 2 | B | A-MPR definition for CA\_n48B, CA\_n41B and CA\_n41C | 16.5.0 |
| 2020-09 | RAN#89 | RP-201495 | 0439 |  | F | CR Restoring the clause structure of NR FR1 uplink contiguous intraband CA | 16.5.0 |
| 2020-09 | RAN#89 | RP-201492 | 0440 | 1 | F | CR on TS38.101-1 for NR V2X | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0442 |  | A | 30k SSB SCS for Band n34 and n39 | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0444 |  | F | Correction for 5 MHz channel bandwidth for n50 and introduction of Annex H | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0458 |  | A | CR for 38.101-1 FRC corrections (R16) | 16.5.0 |
| 2020-09 | RAN#89 | RP-201506 | 0459 | 1 | F | CR for 38.101-1 to remove PHS system and 860~890 protection for NR CA band combination with band n1 and band n8 | 16.5.0 |
| 2020-09 | RAN#89 | RP-201506 | 0460 | 1 | F | CR for 38.101-1 to add the missing region for NS\_18 and maintenance the ?mprc | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0462 |  | A | CR for 38.101-1 to add the missing MSD for CA\_n41A-n78A | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0465 |  | A | Correction to configured power with allowance for SRS switching | 16.5.0 |
| 2020-09 | RAN#89 | RP-202117 | 0466 |  | B | Introduce UE NR-U requirements to 38.101-1 including Band n46 (5 GHz) and Band n96 (6 GHz) | 16.5.0 |
| 2020-09 | RAN#89 | RP-201495 | 0468 | 1 | F | CR for intra-band UL CA non-contiguous CA requirement | 16.5.0 |
| 2020-09 | RAN#89 | RP-201495 | 0469 | 1 | F | CR for correction on intra-band UL CA contiguous CA requirement | 16.5.0 |
| 2020-09 | RAN#89 | RP-201495 | 0470 | 1 | F | CR for intra-band UL contiguous CA DC location | 16.5.0 |
| 2020-09 | RAN#89 | RP-201495 | 0471 | 1 | B | CR for intra-band UL CA non-contiguous CA requirement | 16.5.0 |
| 2020-09 | RAN#89 | RP-201507 | 0480 | 1 | F | CR to 38.101-1 - Correction to CA BCS and cross band isolation MSD tables | 16.5.0 |
| 2020-09 | RAN#89 | RP-201512 | 0483 |  | A | Correction of applicability of 2Rx requirements | 16.5.0 |
| 2020-09 | RAN#89 | RP-201488 | 0486 | 2 | B | CR to add PC3 Pi/2 BPSK DMRS for IE powerBoostPi2BPSK = 0 | 16.5.0 |
| 2020-09 | RAN#89 | RP-202098 | 0499 | 1 | C | 7.5 kHz UL shift for LTE/NR spectrum sharing in Band 38/n38 | 16.5.0 |
| 2020-12 | RAN#90 | RP-202440 | 0492 | 1 | F | CR CatF n7 NS\_46 AMPR and coexistence | 16.6.0 |
| 2020-12 | RAN#90 | RP-202427 | 0498 | 1 | F | Correction on 5G V2X UE RF requirements in TS38.101-1 in rel-16 | 16.6.0 |
| 2020-12 | RAN#90 | RP-202438 | 0506 |  | F | n53 bracket removal | 16.6.0 |
| 2020-12 | RAN#90 | RP-202442 | 0507 | 2 | F | A-MPR definition for CA\_n7B, CA\_n48B, CA\_n41B and CA\_n41C | 16.6.0 |
| 2020-12 | RAN#90 | RP-202485 | 0512 |  | A | CR to TS38.101-1 on DC location correction | 16.6.0 |
| 2020-12 | RAN#90 | RP-202509 | 0518 |  | F | Coexistence cleanup for 38.101-1 Rel16 | 16.6.0 |
| 2020-12 | RAN#90 | RP-202509 | 0524 | 1 | F | CR to TS 38.101-1 on simplification for inter-band CA configuration | 16.6.0 |
| 2020-12 | RAN#90 | RP-202427 | 0525 |  | F | CR on TS38.101-1 for NR V2X | 16.6.0 |
| 2020-12 | RAN#90 | RP-202485 | 0527 |  | A | CR to TS 38.101-1[R16]: Clarification of non-simultaneous Rx/Tx operation for CA\_n77-n79 and CA\_n78-n79 in TS 38.101-1. | 16.6.0 |
| 2020-12 | RAN#90 | RP-202442 | 0533 | 1 | F | CR to 38.101-1 Add requirement on the UL CA configurations with no DL interruption | 16.6.0 |
| 2020-12 | RAN#90 | RP-202509 | 0534 |  | F | Editorial correction on section 5.2C to 38.101-1 R16 | 16.6.0 |
| 2020-12 | RAN#90 | RP-202427 | 0535 | 1 | F | CR on V2X bands reference table | 16.6.0 |
| 2020-12 | RAN#90 | RP-202509 | 0536 | 1 | F | CR on sum of power for multiple transmit connectors | 16.6.0 |
| 2020-12 | RAN#90 | RP-202428 | 0540 |  | F | CR for 38.101-1 to correct the notation of SUL band combinations in order to be aligned with 38.101-3 | 16.6.0 |
| 2020-12 | RAN#90 | RP-202485 | 0542 |  | A | CR for 38.101-1 to adjust the structure of NR CA REFSENS (Rel-16) | 16.6.0 |
| 2020-12 | RAN#90 | RP-202509 | 0544 |  | F | Reference measurement channels for 70 MHz CBW | 16.6.0 |
| 2020-12 | RAN#90 | RP-202428 | 0547 |  | F | Correction to supported channel bandwidths per SUL\_n41A-n81A | 16.6.0 |
| 2020-12 | RAN#90 | RP-202414 | 0550 | 3 | F | Correction to the intra-cell guard band definition for wideband operation | 16.6.0 |
| 2020-12 | RAN#90 | RP-202414 | 0552 | 1 | F | Correction to receiver requirements for shared spectrum channel access | 16.6.0 |
| 2020-12 | RAN#90 | RP-202442 | 0556 |  | F | CR Correction to NS\_27 and Band 10 protection 38101-1 Rel16 | 16.6.0 |
| 2020-12 | RAN#90 | RP-202428 | 0557 | 1 | F | CR for editorial corrections 38.101-1 | 16.6.0 |
| 2020-12 | RAN#90 | RP-202414 | 0558 | 2 | F | Removal of square brackets for 38.101-1 NR-U | 16.6.0 |
| 2020-12 | RAN#90 | RP-202509 | 0562 |  | F | CR to for 38.101-1: CA uplink power clarification | 16.6.0 |
| 2020-12 | RAN#90 | RP-202509 | 0563 |  | D | CR for 38.101-1: Editorial corrections | 16.6.0 |
| 2020-12 | RAN#90 | RP-202427 | 0566 | 1 | F | CR for 38.101-1 NR V2X FRC | 16.6.0 |
| 2020-12 | RAN#90 | RP-202485 | 0571 |  | A | CR for TS 38.101-1: correction of delta Tib for UE supporting multiple band combinations (R16) | 16.6.0 |
| 2020-12 | RAN#90 | RP-202442 | 0574 | 1 | B | CR for intra-band UL CA non-contiguous CA requirement | 16.6.0 |
| 2020-12 | RAN#90 | RP-202485 | 0581 |  | A | CR for 38.101-1 on corrections for AMPR-Rel-16 | 16.6.0 |
| 2020-12 | RAN#90 | RP-202485 | 0584 |  | A | CR to DMRS position in UL RMC for FR1 | 16.6.0 |
| 2021-03 | RAN#91 | RP-210190 | 0588 | 2 | F | PC1 and PC3 Updates for Band n14 | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0593 | 1 | F | 38.101 Void clean up R16 | 16.7.0 |
| 2021-03 | RAN#91 | RP-210082 | 0600 |  | F | CA\_n7B\_REFSENS\_CatF\_CR | 16.7.0 |
| 2021-03 | RAN#91 | RP-210072 | 0605 | 1 | F | CR on editorial correction on V2X operation in TS38.101-1 in Rel-16 | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0611 |  | A | CR for TS38 101-1 Rel-16 Correction for definition of P-MPR | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0613 | 2 | F | CR for TS38 101-1 Rel-16 Correction of condition for MPR and delta MPR | 16.7.0 |
| 2021-03 | RAN#91 | RP-210082 | 0629 |  | F | CR for TS 38.101-1: Correction on 1Tx-2Tx switching between two uplink carriers (Rel-16) | 16.7.0 |
| 2021-03 | RAN#91 | RP-210091 | 0632 |  | F | CR for 38.101-1: Update of missing fallback NR-DC combinations Rel-16 | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0637 | 1 | F | CR for 38.101-1 Rel16 corrections on exception requirements on out-of-band blocking for inter-band CA | 16.7.0 |
| 2021-03 | RAN#91 | RP-210091 | 0641 | 1 | B | CR on introduction of shorter Transient Period Capability | 16.7.0 |
| 2021-03 | RAN#91 | RP-210091 | 0659 |  | F | CR for 38.101-1 to add missing spurious emissions for band n38 UE co-existence (Rel-16) | 16.7.0 |
| 2021-03 | RAN#91 | RP-210084 | 0662 | 1 | F | CR to TS 38.101-1: system parameters maintenance for NR-U | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0664 |  | A | Simplification of n70 | 16.7.0 |
| 2021-03 | RAN#91 | RP-210074 | 0668 |  | F | CR for 38.101-1: Add CA\_n25A-n41(2A)-n71A which was missing in the CR implementation | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0673 |  | A | CR to TS38.101-1: Correction on applicability of minimum requirements | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0676 |  | A | CR to TS38.101-1: Correction on the Aggregated Channel Bandwidth | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0678 |  | F | CR to TS38.101-1: Correction on configured transmitted power requiremen | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0689 | 1 | D | Missing parent clause for NR-DC PCMAX | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0691 | 1 | F | Corrections to PCMAX for UL CA | 16.7.0 |
| 2021-03 | RAN#91 | RP-210117 | 0698 |  | A | CR for TS 38.101-1: Correction to FR1 time mask for SRS antenna switching | 16.7.0 |
| 2021-03 | RAN#91 | RP-210082 | 0700 | 1 | F | CR for TS 38.101-1: Corrections to intra-band UL NC CA requirements | 16.7.0 |
| 2021-03 | RAN#91 | RP-210091 | 0702 |  | F | CR for TS 38.101-1: Cleanup for spurious emissions for UE co-existence table | 16.7.0 |
| 2021-03 | RAN#91 | RP-210091 | 0710 |  | F | CR on TS 38.101-1 NS\_49 | 16.7.0 |
| 2021-06 | RAN#92 | RP-211084 | 0735 |  | A | Update of FR1 UL RMC tables | 16.8.0 |
| 2021-06 | RAN#92 | RP-211104 | 0737 |  | F | CR Removal of square brackets from n48 NS\_27 R16 CAT F | 16.8.0 |
| 2021-06 | RAN#92 | RP-211114 | 0739 | 1 | F | CR TDD Intraband CA REFSENS requirement issue R16 | 16.8.0 |
| 2021-06 | RAN#92 | RP-211118 | 0744 | 1 | F | CR on PC1.5 HPUE SAR issue into Rel-16 TS 38.101-1 | 16.8.0 |
| 2021-06 | RAN#92 | RP-211102 | 0749 | 1 | F | CR on spurious emission between n40 and n41 into Rel-16 TS 38.101-1 | 16.8.0 |
| 2021-06 | RAN#92 | RP-211080 | 0759 | 1 | F | Correction of an improper usage of band edge relaxation for MOP | 16.8.0 |
| 2021-06 | RAN#92 | RP-211085 | 0764 |  | A | CR to TS38.101-1[R16]: Addition of UE co-existence requirements for n40 | 16.8.0 |
| 2021-06 | RAN#92 | RP-211115 | 0767 |  | F | Correction on supported channel bandwidth for CA\_n39-n41-n79 | 16.8.0 |
| 2021-06 | RAN#92 | RP-211114 | 0774 | 1 | F | CR for correction of Rel-16 NR inter-band CA DC configuration for 2DL with up to 2 bands UL | 16.8.0 |
| 2021-06 | RAN#92 | RP-211077 | 0778 | 1 | F | Cleanup for UE co-existence 38.101-1 Rel-16 | 16.8.0 |
| 2021-06 | RAN#92 | RP-211105 | 0782 |  | F | UL MIMO coherence for Tx switching between two carriers (Rel-16) | 16.8.0 |
| 2021-06 | RAN#92 | RP-211077 | 0785 |  | F | CR to 38.101-1 for missing MSD due to receiver harmonic mixing for combos with n46 | 16.8.0 |
| 2021-06 | RAN#92 | RP-211077 | 0791 | 1 | F | CR for updating the note of mandatory simultaneous Rx/Tx capability for FR1 NR-CA combinations | 16.8.0 |
| 2021-06 | RAN#92 | RP-211077 | 0799 | 1 | F | Correction to MPR for serving cells of intra-band UL CA | 16.8.0 |
| 2021-06 | RAN#92 | RP-211095 | 0801 | 1 | F | Corrections to BCS for n46 | 16.8.0 |
| 2021-06 | RAN#92 | RP-211095 | 0803 | 1 | F | Applicability of minimum requirements for shared spectrum access | 16.8.0 |
| 2021-06 | RAN#92 | RP-211095 | 0810 |  | F | CR to 38.101-1 with correction of NR-U 60 MHz and 80 MHz channels | 16.8.0 |
| 2021-06 | RAN#92 | RP-211086 | 0813 |  | F | CR for Rel-16 38.101-1 to correct some errors in Delta TIB and Delta RIB table | 16.8.0 |
| 2021-06 | RAN#92 | RP-211086 | 0815 |  | F | CR for 38.101-1 Rel16 corrections on power tolerance for intra-band contiguous CA | 16.8.0 |
| 2021-06 | RAN#92 | RP-211101 | 0820 | 1 | F | CR for 38.101-1 to correct AMPR value for NR V2X NS\_52(Rel-16) | 16.8.0 |
| 2021-06 | RAN#92 | RP-211107 | 0822 |  | F | CR to TS38.101-1: Correction on configured transmitted power for NR non-contiguous CA | 16.8.0 |
| 2021-06 | RAN#92 | RP-211115 | 0824 |  | F | CR to TS38.101-1: Add missing CA\_n1A-n3A-n78A | 16.8.0 |
| 2021-06 | RAN#92 | RP-211095 | 0835 |  | F | Applicability of requirements for intra-band contiguous CA | 16.8.0 |
| 2021-06 | RAN#92 | RP-211102 | 0837 | 1 | F | Correction to Band n48 reference sensitivity | 16.8.0 |
| 2021-06 | RAN#92 | RP-211114 | 0846 | 1 | F | Rel-16 CR 38101-1-g70 corrections | 16.8.0 |
| 2021-06 | RAN#92 | RP-211101 | 0863 | 2 | F | CR for TS 38.101-1 update configured transmitted power for V2X (R16) | 16.8.0 |
| 2021-06 | RAN#92 | RP-211080 | 0867 | 1 | F | CR for 38.101-1-g70: Corrections to intra-band non-contiguous CA REFSENS | 16.8.0 |
| 2021-06 | RAN#92 | RP-211116 | 0869 |  | F | CR for 38.101-1-g70: Corrections to NS\_12, NS\_13, NS\_14, NS\_15 | 16.8.0 |
| 2021-09 | RAN#93 | RP-211910 | 0910 | 1 | B | Introduction of the UL 7.5kHz shift for NR TDD band n34 and n39 | 16.9.0 |
| 2021-09 | RAN#93 | RP-211921 | 0920 |  | F | Big CR for TS 38.101-1 Maintenance part1 (Rel-16) | 16.9.0 |
| 2021-09 | RAN#93 | RP-211907 | 0922 |  | F | Big CR for TS 38.101-1 Maintenance part2 (Rel-16) | 16.9.0 |
| 2021-09 | RAN#93 | RP-212599 | 0926 | 2 | C | Introduction of NS value for distinguishing support of extended n77 | 16.9.0 |
| 2021-12 | RAN#94 | RP-212847 | 0976 |  | F | CR to remove LO exceptions | 16.10.0 |
| 2021-12 | RAN#94 | RP-212853 | 0982 |  | F | Big CR for TS 38.101-1 Maintenance (Rel-16) | 16.10.0 |
| 2022-03 | RAN#95 | RP-220337 | 1036 |  | F | Big CR for TS 38.101-1 Maintenance Part-1 (Rel-16) | 16.11.0 |
| 2022-03 | RAN#95 | RP-220337 | 1038 |  | F | Big CR for TS 38.101-1 Maintenance Part-2 (Rel-16) | 16.11.0 |
| 2022-06 | RAN#96 | RP-221666 | 1052 |  | F | CR for 38.101-1-gb0: Correction for n7 A-MPR (NS\_46) | 16.12.0 |
| 2022-06 | RAN#96 | RP-221668 | 1056 |  | F | CR for 38.101-1 Rel16 Minor AMPR Corrections for n65 to account for SCS | 16.12.0 |
| 2022-06 | RAN#96 | RP-221661 | 1115 | 1 | F | CR to R16 TS38.101-1 on transient period capability | 16.12.0 |
| 2022-06 | RAN#96 | RP-221655 | 1120 |  | F | Big CR for TS 38.101-1 Maintenance Part-1 (Rel-16) | 16.12.0 |
| 2022-06 | RAN#96 | RP-221066 | 1125 |  | F | CR for updating the note of mandatory simultaneous Rx/Tx capability for FR1 NR-CA combinations | 16.12.1 |
| 2022-09 | RAN#97 | RP-222035 | 1189 |  | F | CR for TS 38.101-1, Correction of configured transmitted power for V2X | 16.13.0 |
| 2022-09 | RAN#97 | RP-222023 | 1191 |  | F | Big CR for 38.101-1 maintenance part1 (Rel-16) | 16.13.0 |
| 2022-09 | RAN#97 | RP-222023 | 1193 |  | F | Big CR for 38.101-1 maintenance part2 (Rel-16) | 16.13.0 |
| 2022-09 | RAN#97 | RP-222682 | 1195 | 2 | C | Extension of operation in the n77 frequency range in US [n77 US] | 16.13.0 |
| 2022-12 | RAN#98-e | RP-223290 | 1209 |  | A | Addition of FR1 UL MIMO EVM measurement description | 16.14.0 |
| 2022-12 | RAN#98-e | RP-223290 | 1212 |  | A | Addition of FR2 UL MIMO EVM measurement description  Note: The CR was not implementable and therefore was not implemented in the specification. | 16.14.0 |
| 2022-12 | RAN#98-e | RP-223295 | 1219 | 2 | F | Addition of CA\_n77-n78 to CA Band table R16 | 16.14.0 |
| 2022-12 | RAN#98-e | RP-223297 | 1221 |  | F | Correction to n91,n92,n93 and n94 co-ex R16 | 16.14.0 |
| 2022-12 | RAN#98-e | RP-223296 | 1224 |  | F | CR for TS 38.101-1 Rel-16: Correcting critical error with co-existence for band CA\_n8-n40 | 16.14.0 |
| 2022-12 | RAN#98-e | RP-223296 | 1243 |  | F | CR to R16 TS38.101-1 maintenance for UE co-ex requirements for UL CA | 16.14.0 |
| 2022-12 | RAN#98-e | RP-223296 | 1252 | 2 | F | CR to 38.101-1 on removing ambiguity in CA MPR definition | 16.14.0 |
| 2022-12 | RAN#98-e | RP-223291 | 1266 |  | A | CR on ‘Annex G Difference of relative phase and power errors’ for FR1 UL coherent MIMO | 16.14.0 |
| 2022-12 | RAN#98-e | RP-223291 | 1269 |  | A | CR on TDD RMC for Intra-band EN-DC - TS 38.101-1 | 16.14.0 |
| 2022-12 | RAN#98-e | RP-223480 | 1277 | 2 | F | Clarification of the CA\_NS indication the values for n77 in the US [n77 US] | 16.14.0 |