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**LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
User Equipment (UE) radio transmission and reception for
satellite access
(3GPP TS 36.102 version 18.5.0 Release 18)**

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Contents

Intellectual Property Rights	2
Legal Notice	2
Modal verbs terminology.....	2
Foreword.....	7
1 Scope	9
2 References	9
3 Definitions of terms, symbols and abbreviations	10
3.1 Terms.....	10
3.2 Symbols.....	10
3.3 Abbreviations	11
4 General	12
4.1 Relationship between minimum requirements and test requirements	12
4.2 Applicability of minimum requirements	12
4.3 Specification Suffix Information.....	12
5 Operating bands and channel arrangement.....	13
5.1 General	13
5.2 Operating bands.....	13
5.2A Operating bands for UE category M1.....	13
5.2B Operating bands for category NB1 and NB2.....	13
5.3 Channel bandwidth.....	14
5.3A Channel bandwidth for category M1	14
5.3B Channel bandwidth for category NB1 and NB2.....	14
5.4 Channel arrangement.....	15
5.4A Channel arrangement for category M1	15
5.4A.1 Channel spacing.....	15
5.4A.2 Channel raster, carrier frequency and EARFCN.....	16
5.4A.3 TX–RX frequency separation	16
5.4B Channel arrangement for category NB1 and NB2.....	17
5.4B.1 Channel spacing.....	17
5.4B.2 Channel raster, carrier frequency and EARFCN.....	17
5.4B.3 TX–RX frequency separation	17
6 Transmitter characteristics	17
6.1 General	17
6.2 Transmit power	17
6.2A Transmit power for category M1.....	18
6.2A.1 UE maximum output power for category M1	18
6.2A.2 UE maximum output power reduction for category M1	18
6.2A.3 UE additional maximum output power reduction for category M1 UE.....	19
6.2A.4 Configured transmitted Power for category M1	19
6.2B Transmit power for category NB1 and NB2	19
6.2B.1 UE maximum output power for category NB1 and NB2.....	19
6.2B.2 UE maximum output power reduction for category NB1 and NB2.....	20
6.2B.3 UE additional maximum output power reduction for category NB1 and NB2 UE.....	20
6.2B.4 Configured transmitted Power for category NB1 and NB2	20
6.3 Output power dynamics.....	21
6.3A Output power dynamics for category M1	21
6.3A.1 UE Minimum output power for category M1	21
6.3A.2 Transmit OFF power for category M1.....	21
6.3A.3 ON/OFF time mask for category M1	21
6.3A.4 Power control for category M1	21
6.3B Output power dynamics for category NB1 and NB2.....	21
6.3B.1 UE Minimum output power for category NB1 and NB2.....	21

6.3B.2	Transmit OFF power for category NB1 and NB2.....	21
6.3B.3	ON/OFF time mask for category NB1 and NB2.....	22
6.3B.4	Power Control for category NB1 and NB2.....	22
6.4	Transmit signal quality.....	22
6.4A	Transmit signal quality for category M1.....	22
6.4A.1	Frequency error for UE category M1.....	22
6.4A.2	Transmit modulation quality for category M1.....	22
6.4B	Transmit signal quality for category NB1 and NB2.....	23
6.4B.1	Frequency error for UE category NB1 and NB2.....	23
6.4B.2	Transmit modulation quality for Category NB1 and NB2.....	23
6.5	Output RF spectrum emissions.....	23
6.5A	Output RF spectrum emissions for category M1.....	24
6.5A.1	General.....	24
6.5A.2	Occupied bandwidth for category M1.....	24
6.5A.3	Out of band emission for category M1.....	24
6.5A.3.1	General.....	24
6.5A.3.2	Spectrum emission mask.....	24
6.5A.3.3	Additional Spectrum Emission Mask for category M1.....	25
6.5A.3.4	Adjacent Channel Leakage Ratio for category M1.....	25
6.5A.4	Spurious emission for category M1.....	25
6.5A.4.1	General.....	25
6.5A.4.2	Minimum requirements.....	25
6.5A.4.3	Spurious emission band UE co-existence.....	26
6.5A.4.4	Additional spurious emissions.....	27
6.5A.4.4.1	General.....	27
6.5A.4.4.2	Minimum requirement (network signalled value "NS_02N").....	27
6.5A.4.4.3	Minimum requirement (network signalled value "NS_24").....	28
6.5A.4.4.4	Minimum requirement (network signalled value "NS_03N").....	28
6.5A.4.4.5	Minimum requirement (network signalled value "NS_04N").....	29
6.5A.4.4.6	Minimum requirement (network signalled value "NS_05N").....	29
6.5B	Output RF spectrum emissions for category NB1 and NB2.....	30
6.5B.1	General.....	30
6.5B.2	Occupied bandwidth for category NB1 and NB2.....	30
6.5B.3	Out of band emission for category NB1 and NB2.....	30
6.5B.3.1	General.....	30
6.5B.3.2	Spectrum emission mask.....	30
6.5B.3.3	Additional Spectrum Emission Mask for category NB1 and NB2.....	30
6.5B.3.4	Adjacent Channel Leakage Ratio for category NB1 and NB2.....	30
6.5B.4	Spurious emission for category NB1 and NB2.....	31
6.5B.4.1	General.....	31
6.5B.4.2	Minimum requirements.....	31
6.5B.4.3	Spurious emission band UE co-existence.....	31
6.5B.4.4	Additional spurious emissions.....	31
6.5B.4.4.1	General.....	31
6.5B.4.4.2	Minimum requirement (network signalled value "NS_02N").....	32
6.5B.4.4.3	Minimum requirement (network signalled value "NS_24").....	32
6.5B.4.4.4	Minimum requirement (network signalled value "NS_03N").....	32
6.5B.4.4.5	Minimum requirement (network signalled value "NS_04N").....	33
6.5B.4.4.6	Minimum requirement (network signalled value "NS_05N").....	33
6.6	Transmit intermodulation.....	33
6.6A	Transmit intermodulation for category M1.....	33
6.6B	Transmit intermodulation for category NB1 and NB2.....	33
7	Receiver characteristics.....	33
7.1	General.....	33
7.2	Diversity characteristics.....	33
7.3	Reference sensitivity power level.....	34
7.3A	Reference sensitivity power level for UE category M1.....	34
7.3B	Reference sensitivity power level for UE category NB1 and NB2.....	35
7.4	Maximum input level.....	35
7.4A	Maximum input level for category M1.....	35
7.4B	Maximum input level for category NB1 and NB2.....	35

7.5	Adjacent Channel Selectivity (ACS).....	36
7.5A	Adjacent Channel Selectivity for category M1	36
7.5B	Adjacent Channel Selectivity for category NB1 and NB2	37
7.6	Blocking characteristics	37
7.6A	Blocking characteristics for category M1.....	38
7.6A.1	General.....	38
7.6A.2	In-band blocking requirements for category M1	38
7.6A.3	Out-of-band blocking requirements for category M1	39
7.6A.4	Narrow band blocking for category M1.....	39
7.6B	Blocking characteristics for category NB1 and NB2	40
7.6B.1	General.....	40
7.6B.2	In-band blocking requirements for category NB1 and NB2	40
7.6B.3	Out-of-band blocking requirements for category NB1 and NB2	40
7.6B.4	Narrow band blocking for category NB1 and NB2	41
7.7	Spurious response.....	41
7.7A	Spurious response for category M1	41
7.7B	Spurious response for category NB1 and NB2.....	42
7.8	Intermodulation characteristics	42
7.8A	Intermodulation characteristics for category M1.....	42
7.8B	Intermodulation characteristics for category NB1 and NB2	42
7.9	Spurious emissions	43
8	Performance requirement	43
8.1	General	43
8.1.1	Receiver antenna capability	43
8.1.2	Applicability of requirements	43
8.1.2.1	Applicability of requirements for different channel bandwidths.....	43
8.1.2.2	Applicability of requirements for optional UE features	43
8.1.3	UE category and UE DL category	44
8.2	Demodulation performance requirements for UE category M1	44
8.2.1	FDD and half-duplex FDD	44
8.2.1.1	PDSCH.....	44
8.2.1.1.1	Single-antenna port performance	45
8.3	Demodulation performance requirements for UE category NB1 and NB2	47
8.3.1	Half-duplex FDD	47
8.3.1.1	NPDSCH demodulation requirements	47
8.3.1.1.1	Single-antenna port performance	47

Annex A (normative): Measurement channels.....49

A.1	DL reference measurement channels	49
A.1.1	Reference measurement channels for NPDSCH performance requirements.....	49
A.1.1.1	Standalone.....	49
A.1.2	Reference measurement channels for PDSCH performance requirements	50
A.1.2.1	Single-antenna transmission (Common Reference Symbols).....	50
A.2	OFDMA Channel Noise Generator (OCNG).....	50
A.2.1	OCNG Patterns for Narrowband IoT	50
A.2.1.1	Narrowband IoT OCNG pattern 1.....	51
A.2.2	OCNG Patterns for FDD	51
A.2.2.1	OCNG FDD Pattern 1: Two sided dynamic OCNG FDD pattern	52
A.3	Testing related to Satellite Access.....	52
A.3.1	General	52
A.3.2	Test condition for transmitter characteristics	52
A.3.3	Test condition for receiver characteristics.....	52
A.3.4	Test condition for performance requirements.....	53
A.4	UL reference measurement channels	53
A.4.1	General	53
A.4.1.1	Applicability and common parameters	53
A.4.1.2	Determination of payload size	53
A.4.1.3	Overview of UL reference measurement channels	54
A.4.2	Reference measurement channels for FDD.....	55

A.4.2.1	Full RB allocation.....	55
A.4.2.1.1	QPSK	55
A.4.2.1.2	16-QAM.....	56
A.4.2.2	Partial RB allocation.....	56
A.4.2.2.1	QPSK	56
A.4.2.2.2	16-QAM.....	57
A.4.2.3	subPRB allocation	57
A.4.3	Reference measurement channels for category NB1.....	58
Annex B (normative): Downlink physical channels.....		59
B.1	General	59
B.2	Set-up	59
B.3	Connection	59
B.3.1	Measurement of Receiver Characteristics	59
B.3.2	Measurement of Performance requirements	60
B.3.3	Measurement of Receiver Characteristics for Narrowband IoT	61
Annex C (normative): Environment conditions		62
C.1	General	62
C.2	Environmental	62
C.2.1	Temperature	62
C.2.2	Voltage	62
C.2.3	Vibration.....	63
Annex D (normative): Propagation conditions.....		64
D.1	Multi-path fading propagation conditions	64
D.1.1	Delay profiles	64
D.1.2	Combinations of channel model parameters	64
Annex E (informative): Change history		66
History		67

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

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

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

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- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

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

- can** indicates that something is possible
- cannot** indicates that something is impossible

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

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

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

In addition:

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

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

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

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1 Scope

The present document establishes the minimum RF characteristics and minimum performance requirements for E-UTRA User Equipment (UE) operating satellite access.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
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- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 36.108: "Evolved Universal Terrestrial Radio Access (E-UTRA); Satellite Access Node (SAN) radio transmission and reception".
- [3] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".
- [4] ITU-R Recommendation M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".
- [5] 3GPP TS 36.307: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements on User Equipments (UEs) supporting a release-independent frequency band".
- [6] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".
- [7] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception"
- [8] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".
- [9] ITU-R Recommendation SM.329-10, "Unwanted emissions in the spurious domain"
- [10] [ANSI C63.26-2015, American National standard for Compliance Testing of Transmitters Used in Licensed Radio Services, Accredited Standards Committee C63 – Electromagnetic compatibility]
- [11] 3GPP TS 36.306: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities".
- [12] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".
- [13] 3GPP TR 38.811: "Study on New Radio (NR) to support non-terrestrial networks"
- [14] 3GPP TS 36.508: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing".
- [15] 3GPP TS 36.212: " Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

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

Channel edge: The lowest and highest frequency of the carrier, separated by the channel bandwidth.

Channel bandwidth: The RF bandwidth supporting a single E-UTRA RF carrier with the transmission bandwidth configured in the uplink or downlink of a cell. The channel bandwidth is measured in MHz and is used as a reference for transmitter and receiver RF requirements.

Category NB1/NB2 stand-alone operation: category NB1/NB2 is operating standalone when it utilizes its own spectrum, for example the spectrum used by GERAN systems as a replacement of one or more GSM carriers, as well as scattered spectrum for potential IoT deployment.

Category NB1/NB2 guard band operation: category NB1/NB2 is operating in guard band when it utilizes the unused resource block(s) within a E-UTRA carrier's guard-band.

Category NB1/NB2 in-band operation: category NB1/NB2 is operating in-band when it utilizes the resource block(s) within a normal E-UTRA carrier or within a normal NR carrier plus 15 kHz at each edge (and not within NR minimum guard band).

Geosynchronous Earth Orbit: Earth-centred orbit at approximately 35786 kilometres above Earth's surface and synchronised with Earth's rotation. A geostationary orbit is a non-inclined geosynchronous orbit, i.e. in the Earth's equator plane.

Low Earth Orbit: Orbit around the Earth with an altitude between 300 km, and 1500 km.

Satellite: A space-borne vehicle embarking a bent pipe payload or a regenerative payload telecommunication transmitter, placed into Low-Earth Orbit (LEO), Medium-Earth Orbit (MEO), or Geosynchronous Earth Orbit (GEO).

Satellite Access Node: see definition in TS 36.108 [2].

sTTI: A transmission time interval (TTI) of either one slot or one subslot as defined in TS 36.211 [3] on either uplink or downlink.

3.2 Symbols

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

ΔF_{Raster}	Band dependent channel raster granularity
BW_{Channel}	Channel bandwidth
F	Frequency
$F_{\text{Interferer}} \text{ (offset)}$	Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured)
$F_{\text{Interferer}}$	Frequency of the interferer
F_{offset}	Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)
F_C	Frequency of the carrier centre frequency
$F_{\text{DL_low}}$	The lowest frequency of the downlink operating band
$F_{\text{DL_high}}$	The highest frequency of the downlink operating band
$F_{\text{UL_low}}$	The lowest frequency of the uplink operating band
$F_{\text{UL_high}}$	The highest frequency of the uplink operating band
F_{OOB}	The boundary between the E-UTRA out of band emission and spurious emission domains.
L_{Ctone}	Transmission bandwidth which represents the length of a contiguous sub-carrier allocation expressed in units of tones
N_{DL}	Downlink EARFCN
$N_{\text{Offs-DL}}$	Offset used for calculating downlink EARFCN
$N_{\text{Offs-UL}}$	Offset used for calculating uplink EARFCN

N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
N_{RB_alloc}	Total number of simultaneously transmitted resource blocks in Channel bandwidth or Aggregated Channel Bandwidth.
N_{tone}	Transmission bandwidth configuration for category NB1 and NB2, expressed in units of tones.
$N_{tone\ 3.75kHz}$	Transmission bandwidth configuration for category NB1 and NB2 with 3.75 kHz sub-carrier spacing, expressed in units of tones.
$N_{tone\ 15kHz}$	Transmission bandwidth configuration for category NB1 and NB2 with 15 kHz sub-carrier spacing, expressed in units of tones.
N_{UL}	Uplink EARFCN.
P_{CMAX}	The configured maximum UE output power.
$P_{Interferer}$	Modulated mean power of the interferer
$P_{PowerClass}$	$P_{PowerClass}$ is the nominal UE power (i.e., no tolerance).
$P_{PowerClass_Default}$	$P_{PowerClass_Default}$ is the default nominal UE power (i.e., no tolerance) for the band.
P_{UMAX}	The measured configured maximum UE output power.
P_{uw}	Power of an unwanted DL signal
P_w	Power of a wanted DL signal
Δf_{OOB}	Δ Frequency of Out Of Band emission

3.3 Abbreviations

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

ACLR	Adjacent Channel Leakage Ratio
ACS	Adjacent Channel Selectivity
A-MPR	Additional Maximum Power Reduction
AWGN	Additive White Gaussian Noise
BW	Bandwidth
CW	Continuous Wave
DL	Downlink
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
E-UTRA	Evolved UMTS Terrestrial Radio Access
EUTRAN	Evolved UMTS Terrestrial Radio Access Network
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
GEO	Geostationary Earth Orbit
GSO	Geosynchronous Orbit
ITU-R	Radiocommunication Sector of the International Telecommunication Union
LEO	Low Earth Orbit
HD-FDD	Half- Duplex FDD
MEO	Medium Earth Orbit
MPR	Maximum Power Reduction
NGSO	Non-Geosynchronous Orbit
OCNG	OFDMA Channel Noise Generator
OFDMA	Orthogonal Frequency Division Multiple Access
OOB	Out-of-band
QAM	Quadrature Amplitude Modulation
RAN	Radio Access Network
RE	Resource Element
REFSENS	Reference Sensitivity power level
RF	Radio Frequency
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4 General

4.1 Relationship between minimum requirements and test requirements

The present document is a Single-RAT specification for satellite NR UE, covering RF characteristics and minimum performance requirements.

The Minimum Requirements given in this specification make no allowance for measurement uncertainty.

The measurement results returned by the test system are compared - without any modification - against the test requirements as defined by the shared risk principle.

The shared risk principle is defined in Recommendation ITU-R M.1545 [4].

4.2 Applicability of minimum requirements

- a) Minimum requirements are mandated to be met in all scenarios by UEs supporting the applicable UE category(ies) for which that requirement is specified. In the present document, only minimum requirements for UE categories of M1, NB1, and NB2 are specified.
- b) For UE category M1, the applicable minimum requirements in clauses 5, 6 or 7 are specified in the suffix A subclause where they differ from the requirements in the main subclause. Where suffix A does not exist for a requirement, the minimum requirement in the main subclause shall apply.
- c) For UE category NB1 and NB2, the applicable minimum requirements in clauses 5, 6 or 7 are specified in the Suffix B subclause, where they differ from the requirements in the main subclause. Where suffix B does not exist for a requirement, the minimum requirement in the main subclause shall apply.
- d) The reference sensitivity power levels defined in subclause 7.3 are valid for the specified reference measurement channels.
- e) NOTE: Receiver sensitivity degradation may occur when:
 - 1) The UE simultaneously transmits and receives with bandwidth allocations less than the transmission bandwidth configuration (see Figure 5.3A-1 and Figure 5.3B-1), and
 - 2) Any part of the downlink transmission bandwidth is within an uplink transmission bandwidth from the downlink center subcarrier.
- f) The spurious emissions power requirements are for the long-term average of the power. For the purpose of reducing measurement uncertainty it is acceptable to average the measured power over a period of time sufficient to reduce the uncertainty due to the statistical nature of the signal.
- g) The requirements related to subslot TTI and/or slot TTI shall apply only if UE supports multiple TTI patterns. And these requirements only apply to subslot and/or slot TTI configurations
- h) TS36.307 [5] specifies which minimum requirements in the present document are applicable to UEs that conform to an earlier specification Release, and from which Release those requirements apply.

4.3 Specification Suffix Information

The following suffixes are defined at 2nd level for clauses 5, 6 and 7, as shown in Table 4.3-1.

Table 4.3-1: Definition of suffixes

Clause suffix	Variant
A	Cat-M1
B	NB1, NB2

The suffixes shall apply as defined in clause 4.2.

5 Operating bands and channel arrangement

5.1 General

The channel arrangements presented in this clause are based on the operating bands and channel bandwidths defined in the present release of specifications.

NOTE: Other operating bands and channel bandwidths may be considered in future releases.

5.2 Operating bands

E-UTRA satellite access is designed to operate in the operating bands defined in Table 5.2-1.

Table 5.2-1 E-UTRA operating bands for satellite access

E-UTRA Operating Band	Uplink (UL) operating band BS receive UE transmit	Downlink (DL) operating band BS transmit UE receive	Duplex Mode
	F _{UL_low} – F _{UL_high}	F _{DL_low} – F _{DL_high}	
256	1980 MHz – 2010 MHz	2170 MHz – 2200 MHz	FDD
255	1626.5 MHz – 1660.5 MHz	1525 MHz – 1559 MHz	FDD
254	1610 MHz – 1626.5 MHz	2483.5 MHz – 2500 MHz	FDD
253 ²	1668 MHz – 1675 MHz	1518 MHz – 1525 MHz	FDD
NOTE 1: Satellite bands are numbered in descending order from 256 NOTE 2: UE assigned to channels and allocated frequency resources in the lower portion of Band 253 may experience blocking or harmful interference from terrestrial networks in adjacent or nearby frequencies when operating in the proximity with terrestrial base stations.			

5.2A Operating bands for UE category M1

UE category M1 is designed to operate in the E-UTRA satellite access operating bands defined in Table 5.2-1 in both half duplex FDD mode and full-duplex FDD mode.

5.2B Operating bands for category NB1 and NB2

Category NB1 and NB2 UE are designed to operate in the E-UTRA satellite access operating bands defined in Table 5.2-1.

Category NB1 and NB2 UE operate in HD-FDD duplex mode.

For operation in Band 255 in USA and Canada when NS_02N is signalled, only channels positions which guarantee at least 90 kHz guard band from RF channel edge to the lower and upper limit of the band shall be used.