Operational Descriptions of NEN-LX3

1) Product Description

This device is a high end Tri-mode mobile phone researched and developed independently by HUAWEI based on the chipset SM6115 produced by MTK. It supports LTE/UMTS/GSM/GPRS frequency bands. It is designed in compliance with the FCC Rules and Regulations **Part24E, Part 22H , Part 27, Part 90**

2) Intended use statements

NEN-LX3 is a LTE/UMTS/GPRS/GSM Mobile Phone. It can only be work in the networks which supports the LTE/UMTS/GPRS/GSM technique. If there are no corresponding networks, the RF module of NEN-LX3 will not work and no any unwanted emission will be produced. More details about the function of this device, please refer to the document named as“User Manual”

3) Types of Emission Designator

	Air Interface	type of modulation	bandwidth	emission designator
☒	GSM/GPRS 850	GMSK	200K	G7D
☒	EDGE 850	8PSK	200K	W7D
☒	GSM/GPRS 1900	GMSK	200K	G7D
☒	EDGE 1900	8PSK	200K	W7D
☒	WCDMA 850	QPSK	5M	F9W
☒	WCDMA 1700	QPSK	5M	F9W
☒	WCDMA 1900	QPSK	5M	F9W
☐	CDMA 800	QPSK	1.25M	F9W
☐	CDMA 1700	QPSK	1.25M	F9W
☐	CDMA 1900	QPSK	1.25M	F9W
☐	CDMA 850	QPSK	1.25M	F9W
☒	LTE Band2	QPSK	1.4M	G7D
		16QAM	1.4M	W7D
		QPSK	3M	G7D
		16QAM	3M	W7D
		QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
		QPSK	15M	G7D
		16QAM	15M	W7D
		QPSK	20M	G7D
		16QAM	20M	W7D
☒	LTE Band4	QPSK	1.4M	G7D

		16QAM	1.4M	W7D
		QPSK	3M	G7D
		16QAM	3M	W7D
		QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
		QPSK	15M	G7D
		16QAM	15M	W7D
		QPSK	20M	G7D
		16QAM	20M	W7D
☒	LTE Band5	QPSK	1.4M	G7D
		16QAM	1.4M	W7D
		QPSK	3M	G7D
		16QAM	3M	W7D
		QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
☒	LTE Band7	QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
		QPSK	15M	G7D
		16QAM	15M	W7D
		QPSK	20M	G7D
		16QAM	20M	W7D
☒	LTE Band12	QPSK	1.4M	G7D
		16QAM	1.4M	W7D
		QPSK	3M	G7D
		16QAM	3M	W7D
		QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
☐	LTE Band13	QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
☒	LTE Band17	QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
☐	LTE Band25	QPSK	1.4M	G7D
		16QAM	1.4M	W7D
		QPSK	3M	G7D
		16QAM	3M	W7D
		QPSK	5M	G7D
		16QAM	5M	W7D

		QPSK	10M	G7D
		16QAM	10M	W7D
		QPSK	15M	G7D
		16QAM	15M	W7D
		QPSK	20M	G7D
		16QAM	20M	W7D
☒	LTE Band26	QPSK	1.4M	G7D
		16QAM	1.4M	W7D
		QPSK	3M	G7D
		16QAM	3M	W7D
		QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
		QPSK	15M	G7D
		16QAM	15M	W7D
☐	LTE Band30	QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
☐	LTE Band38	QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
		QPSK	15M	G7D
		16QAM	15M	W7D
		QPSK	20M	G7D
		16QAM	20M	W7D
☐	LTE Band41	QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
		QPSK	15M	G7D
		16QAM	15M	W7D
		QPSK	20M	G7D
		16QAM	20M	W7D
☒	LTE Band66	QPSK	1.4M	G7D
		16QAM	1.4M	W7D
		QPSK	3M	G7D
		16QAM	3M	W7D
		QPSK	5M	G7D
		16QAM	5M	W7D
		QPSK	10M	G7D
		16QAM	10M	W7D
		QPSK	15M	G7D
		16QAM	15M	W7D
		QPSK	20M	G7D
		16QAM	20M	W7D

4) Frequency Range

GSM/GRPS/EDGE		Frequency	Transmit MHz	Receive MHz
	☒	850	824-849	869-894
	☒	1900	1850-1910	1930-1990

WCDMA		Band	Transmit MHz	Receive MHz
	☒	V	824-849	869-894
	☒	IV	1710-1755	2110-2155
	☒	II	1850-1910	1930-1990

CDMA		Band	Transmit MHz	Receive MHz
	☐	BC0 Subclass 0	824-849	869-894
	☐	BC1	1850-1910	1930-1990
	☐	BC10 Subclass 0,1,2,3	806-824	851-869
	☐	BC15	1710-1755	2110-2170

LTE	Band			FDD/TDD	Transmit MHz	Receive MHz
	☒	2	II	FDD	1850-1910	1930-1990
	☒	4	IV	FDD	1710-1755	2110-2170
	☒	5	V	FDD	824-849	869-894
	☒	7	VII	FDD	2500-2570	2620-2690
	☒	12	XII	FDD	699-716	729-746
	☐	13	XIII	FDD	777-787	746-756
	☒	17	XVII	FDD	704-716	734-746
	☐	25	XXV	FDD	1850-1915	1930-1995
	☒	26	XXVI	FDD	814-849	859-894
	☐	29	XXIX	FDD	NA	717-728
	☐	30	XXX	FDD	2305-2315	2350-2360
	☐	38	XXXVIII	TDD	2570-2620	
	☐	41	XLI	TDD	2496-2690	
	☒	66	LXVI	FDD	1710-1780	2110-2200

Frequency Band (MHz)	Active Scanning (the device can transmit a probe (beacon))		passive scanning (where the device is can listen only with no probes)		Ad Hoc Mode or Wi-Fi Direct capability		Access point capability	
2412-2462	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No
5150-5250	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No
5250-5350	☐ Yes	☒ No	☒ Yes	☐ No	☐ Yes	☒ No	☐ Yes	☒ No
5470-5725	☐ Yes	☒ No	☒ Yes	☐ No	☐ Yes	☒ No	☐ Yes	☒ No
5725-5825	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No

5825-5850	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No	☒ Yes	☐ No

Bluetooth：2402MHz to 2480MHz

5) Range of Operating Power

Please Refer to the document “22- Tune-up Info”

6) Antenna description

a) Licensed Transmitter Main Antenna 0： (2G/3G/4G 主天线)

Item	**Description**
Frequency	1850-1910，1930-1990，1710-1755，2110-2155，2500-2570，2620-2690，1710-1780，2110-2200（MHz）
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	≤-0.5dBi
Rated power	4W
Polarization	Linear
detachable	☐ Yes ☒ No

b) Licensed Transmitter Main Antenna 1： (2G/3G/4G 主天线)

Item	**Description**
Frequency	824-849，869-894，699-716, 729-746，814-849，859-894， 704-716， 734-746MHz）
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	≤-1.6dBi
Rated power	4W
Polarization	Linear
detachable	☐ Yes ☒ No

c) Licensed Transmitter Main Antenna 2： (2G/3G/4G 主天线)

Item	**Description**
Frequency	1850-1910，1930-1990，1710-1755，2110-2155，2500-2570，2620-2690，1710-1780，2110-2200（MHz）
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	≤-0.5dBi
Rated power	4W
Polarization	Linear
detachable	☐ Yes ☒ No

d) Licensed Transmitter Main Antenna 3： (2G/3G/4G 主天线)

Item	**Description**
Frequency	824-849，869-894， 699-716, 729-746，814-849，

	859-894（MHz）
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	≤-1.6dBi
Rated power	4W
Polarization	Linear
detachable	☐ Yes ☒ No

e) Licensed Transmitter Main Antenna 4： (4G 主天线)

Item	**Description**
Frequency	2500-2570，2620-2690（MHz）
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	≤-0.5dBi
Rated power	4W
Polarization	Linear
detachable	☐ Yes ☒ No

***如果有 2 根主天线，请再增加一个表格。

f) Licensed Transmitter Main Antenna 5 (BT/Wi-Fi 天线)

Item	**Description**
Frequency	2400MHz to 2483.5MHz，5150-5250 MHz 5250-5350 MHz 5470-5725 MHz 5725-5825 MHz
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	≤-1.5dBi
Rated power	20mW
Polarization	Linear
detachable	☐ Yes ☒ No

g) Licensed Transmitter Main Antenna 6 (GPS 天线)

Item	**Description**
Frequency	1575.4 MHz
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	≤-0.5dBi
Rated power	20mW
Polarization	Linear
detachable	☐ Yes ☒ No

7) Applied voltages

Normal Voltage: 3.87V

Low Voltage: 3.6V
High Voltage: 4.43V

Complete bill of material
Refer to other attachment

Complete Circuit Diagrams
Refer to other attachment

Instruction/Installation Manual
Refer to other attachment

8) Means for Frequency Stabilization

The Voltage Controlled Temperature Compensated Crystal Oscillator (VCTCXO) provides the reference frequency for all SM6115 RF parts synthesizers as well as clock generation functions within the IC. The oscillator frequency is controlled by the SM6115.

9) Means for Limiting Modulation

Air Interface	Modulation
GSM	GMSK, 8PSK
WCDMA	QPSK
CDMA	QPSK,HPSK
LTE	QPSK,16QAM
Bluetooth	GFSK, π/4-DQPSK,8DPSK
Bluetooth Low Energy	GFSK
Wi-Fi	DBPSK/DQPSK/CCK(DSS), BPSK/QPSK/16QAM/64QAM(OFDM)

10) Description of Digital Modulation Techniques

a) **GSM** is a digital system, so speech which is inherently analog, has to be digitized. The method employed by ISDN, and by current telephone systems for multiplexing voice lines over high speed trunks and optical fiber lines, is Pulse Coded Modulation (PCM). The output stream from PCM is 64 kbps, too high a rate to be feasible over a radio link. The 64 kbps signal, although simple to implement, contains much redundancy. The GSM group studied several speech coding algorithms on the basis of subjective speech quality and complexity (which is related to cost, processing delay, and power consumption once implemented) before arriving at the choice of a Regular Pulse Excited -- Linear Predictive Coder (RPE--LPC) with a Long Term Predictor loop. Basically, information from previous samples, which does not change very quickly, is used to predict the current sample. The coefficients of the linear combination of the previous samples, plus an encoded form of the residual, the difference between the predicted and actual sample, represent the signal. Speech is divided into 20 millisecond samples, each of which is encoded as 260 bits, giving a total bit rate of 13 kbps. This is the so-called Full-Rate speech coding. Recently, an Enhanced Full-Rate (EFR) speech coding algorithm has been implemented by some North American GSM1900 operators. This is said to provide improved speech quality using the existing 13 kbps bit rate.

Because of natural and man-made electromagnetic interference, the encoded speech or data signal transmitted over the radio interface must be protected from errors. GSM uses convolutional encoding and block interleaving to achieve this protection. The exact algorithms used differ for speech and for different data rates. The method used for speech blocks will be described below.

Recall that the speech codec produces a 260 bit block for every 20 ms speech sample. From subjective testing, it was found that some bits of this block were more important for perceived speech quality than others. The bits are thus divided into three classes:

Class Ia 50 bits - most sensitive to bit errors
Class Ib 132 bits - moderately sensitive to bit errors
Class II 78 bits - least sensitive to bit errors

Class Ia bits have a 3 bit Cyclic Redundancy Code added for error detection. If an error is detected, the frame is judged too damaged to be comprehensible and it is discarded. It is replaced by a slightly attenuated version of the previous correctly received frame. These 53 bits, together with the 132 Class b bits and a 4 bit tail sequence (a total of 189 bits), are input into a 1/2 rate convolutional encoder of constraint length 4. Each input bit is encoded as two output bits, based on a combination of the previous 4 input bits. The convolutional encoder thus outputs 378 bits, to which are added the 78 remaining Class II bits, which are unprotected. Thus every 20 ms speech sample is encoded as 456 bits, giving a bit rate of 22.8 kbps.

To further protect against the burst errors common to the radio interface, each sample is interleaved. The 456 bits output by the convolutional encoder are divided into 8 blocks of 57 bits, and these blocks are transmitted in eight consecutive time-slot bursts. Since each time-slot burst can carry two 57 bit blocks, each burst carries traffic from two different speech samples.

Recall that each time-slot burst is transmitted at a gross bit rate of 270.833 kbps. This digital signal is modulated onto the analog carrier frequency using Gaussian-filtered Minimum Shift Keying (GMSK). GMSK was selected over other modulation schemes as a compromise between spectral efficiency, complexity of the transmitter, and limited spurious emissions. The complexity of the transmitter is related to power consumption, which should be minimized for the mobile station. The spurious radio emissions, outside of the allotted bandwidth, must be strictly controlled so as to limit adjacent channel interference.

b) **WCDMA or UMTS** – as it is called throughout Europe – is a standard which has been developed to accommodate higher data rates to allow features like internet surfing, video telephony or video download. Even though WCDMA is focusing on high data rates it still supports simple features like a plain voice call or sending of SMS.WCDMA is a CDMA system. CDMA stands for code division multiple access. This means that the available frequency channel is broken down by different code sequences that are multiplied by the user signals of the individual subscribers. All subscribers transmit on the same frequency and at the same time.

For WCDMA different base stations are distinguished by a different scrambling code, which makes cell planning a lot easier, since neighboring cells can re-use the same frequency! (However, the occupied "SNR" – or Signal to Noise Ratio is the limiting factor and characteristic for CDMA)

The data rate used by a terminal depends on spreading factor assigned to this particular terminal. If several terminals use the same spreading factor, the signals are distinguished through different code channels. At present the maximum data rate is 384 kbps. In the future it will be possible to combine several code channels to a multi-code link, allowing data rates up to 2 Mbps. However, when this is used the capacity of this frequency channel is used up, i.e. no other terminal can operate on this frequency channel. The reason for this is that there is no more "SNR" left for additional connections. This is the capacity issue indicated above.

In order to address higher data rates high speed downlink packet access (DC-HSDPA) has been introduced into Release 8 of the DC-HSDPA(3GPP) standard. DC-HSDPA allows data rates of up to 43.2Mbps and is based on 64-QAM modulation. As the name suggests DC-HSDPA is only available in the downlink direction, i.e. ideal for loading large Emails, surf the web or download videos.

c) **LTE,** known as Long-Term Evolution, targets more complex spectrum situations and has fewer restrictions on backwards compatibility. The radio interface is purely optimized for IP transmissions not having to support ISDN traffic: that is, there is no requirement for support of GSM circuit-switch services, a requirement that WCDMA had. For spectrum flexibility, LTE is therefore targeted to operate in spectrum allocations from roughly 1 to 20MHz. Furthermore, when going to the data rates that LTE is targeting, achieving low delay and high data rates at the cell edges are more important requirements than the peak data rate.

The multiple access scheme for the LTE physical layer is based on Orthogonal Frequency Division Multiplexing (OFDM) with a cyclic prefix (CP) in the downlink, and on Single-Carrier Frequency Division Multiple Access (SC-FDMA) with a cyclic prefix in the uplink.

The Layer 1 is defined in a bandwidth agnostic way based on resource blocks, allowing the LTE Layer 1 to adapt to various spectrum allocations. A resource block spans either 12 sub-carriers with a sub-carrier bandwidth of 15kHz or 24 sub-carriers with a sub-carrier bandwidth of 7.5kHz each over a slot duration of 0.5ms.

Frame structure type 2 is applicable to TDD. Each radio frame of length 10ms consists of two half-frames of length 5ms each. Each half-frame consists of five subframes of length1ms. According to different UL-DL subframe configuration, the number of subframes allocated to uplink and downlink can be adjusted flexibility.

LTE has 5 terminal categories. For TDD category 4 and 20MHz bandwidth, the downlink allows data rate up to 110Mbps and is based on 64QAM modulation, the he uplink allows data rate up to 8Mbps and is based on 16QAM modulation

d) Bluetooth, The Bluetooth SIG had completed the Bluetooth Core Specification version 4.1 . It includes Classic Bluetooth, Bluetooth high speed and Bluetooth low energy protocols. Bluetooth high speed is based on Wi-Fi, and Classic Bluetooth consists of legacy Bluetooth protocols. Bluetooth transceivers operate in the 2.4GHz ISM band. The frequency range is 2400MHz to 2483.5MHz (in most countries).The channel spacing is 1MHz,with an upper and lower guard band. Output power is also specified, Bluetooth uses GFSK (Gaussian Frequency Shift Keying), π/4-DQPSK and 8DPSK as its modulation. The corresponding symbol rate is 1Mbps, 2Mbps and 3Mbps. The 2.4GHz band is part of the ISM（Industrial, Scientific, and Medical）license-free radio bands. Both Bluetooth and 802.11 operate within the band. Additional frequencies of the ISM band include the 900MHz band, and 5.8GHz band. The un-licensed ISM band also means that devices need to short range so they do not interfere with other devices which may also be using the band.

e) WLAN transceivers operate in the 2.4GHz ISM band. The frequency range is 2400MHz to 2483.5MHz (in most countries).The channel spacing is 22MHz, with an upper and lower guard band. Output power is also specified, WLAN uses DQPSK/CCK、DQPSK、DBPSK、OFDM/CCK and OFDM as its modulation. DQPSK/CCK corresponding symbol rate is 33 or 22 or 11or 5.5Mbps, DQPSK corresponding symbol rate is 2Mbps,DBPSK corresponding symbol rate is 1Mbps,OFDM/CCK corresponding symbol rate is 6 or 9or 12 or 18 or 24 or 36 or 54 Mbps, OFDM corresponding symbol rate is 6 or 9or 12 or 18 or 24 or 36 or 48 or 54 Mbps.
The 2.4GHz band is part of the ISM（Industrial, Scientific, and Medical）license-free radio bands. Both Bluetooth and 802.11 operate with in the band.

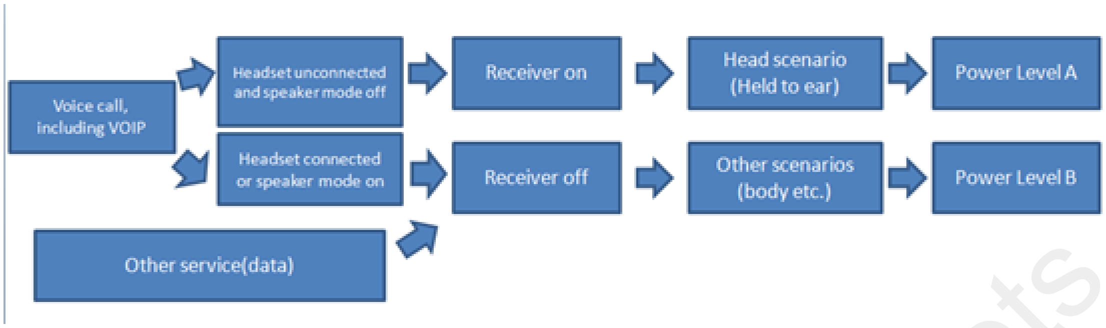
11)Description of Power Reduction(请根据实际情况选择相应内容，不涉及请删除，若有其它未包含的请自行增加)

a) spot Reduction: A fixed level power reduction is applied for some frequency bands when hotspot mode becomes active. When the hotspot is disabled, the power value will be recovered.

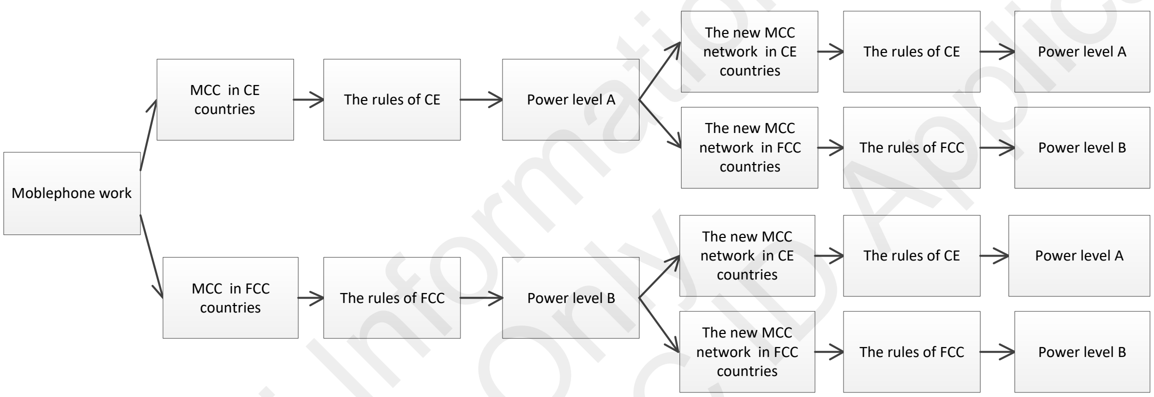
Simultaneous Reduction:

b) For the model CHW-LX3, it can transmit from either Main Antenna or Second Antenna, but they cannot transmit simultaneously. Main Antenna or Second Antenna transmits simultaneously with Wi-Fi. A fixed level power reduction is applied for some frequency bands when simultaneously transmitting with the other antennas in certain simultaneous transmission conditions.

c) Receiver on power reduction:
This device uses the receiver to indicate whether the user is making a voice call in head scenario or not. The selection between head and body power levels is based on the receiver detection mechanism. A fixed level power reduction is applied for some frequency bands when the audio receiver is on.
The receiver on detection is accomplished by voice call from the modem as figure below shows:



d) Country code detection：
This device uses the mobile country code (MCC) to indicate whether the users in CE countries or FCC countries. The selection between CE countries and FCC countries power levels is based on the country code detection mechanism. It can determine the countries where users are and set the relevant power level for each antenna accordingly
The countries on detection is accomplished by operator network as figure below shows:



The software of the device has information of CE and FCC countries so that to detect where the users are. If the users are in CE countries, the power level A is applied. If the users are in FCC countries, the power level B is applied.
The default status when the device doesn't know the MCC information will be set to the Lower Power Level between A and B. That is when the phone is first turned on, its power level can meet US compliant.

12)Description of two antennas switch （若支持主天线切换，请增加此段描述，标黄部分请根据实际情况填写）

NEN-LX3 have two antennas, two antennas support the same frequency bands, Choose which antenna is based on the antennas RSSI (Received Signal Strength Indication) comparison and Switch Algorithm. The antenna switching threshold is set to a fixed value(3 dB). The software will choose the Antenna with better RSSI as the main operating Tx antenna by comparing the RSSI between Ant1 and Ant 2. When the RSSI of Ant2 is 3 dB higher than Ant1, then the Ant2 will be chosen as the main operating Tx antenna.
The antenna1 support FDD: B2/B4/B5/B7/B12/B17/B26/B66 WCDMA：B2/B4/B5 GSM B2/B5 bands, the antenna2 support FDD: B2/B4/B5/B7/B12/ B17/B26/B66 WCDMA： B2/B4/B5 GSM B2/B5

bands.