Introduction

NTN-LX3 is a middle and high three end mobile phone researched and developed independently by HONOR based on the chipset SM6115 produced by Qualcomm. It supports LTE/WCDMA/GSM/GPRS/EDGE frequency bands and Bluetooth/Wi-Fi. It is designed in compliance with the FCC Rules and Regulations Part24 and Part 22 and Part 27 and Part 15.

Intended use statements

NTN-LX3 is a Smart Phone. It can only be work in the networks which supports the LTE/WCDMA/GSM/GPRS/EDGE technique. If there are no corresponding networks, the RF module of NTN-LX3 will not work and no any unwanted emission will be produced.

Types of Emission

For this mobile phone, the emission designators are :

GSM850	247KGXW; 247KG7W
GSM1900	247KGXW; 244KG7W
UMTS Band II	4M17F9W;
UMTS Band IV	4M15F9W;
UMTS Band V	4M16F9W;
LTE Band 2	1M10G7D;1M09W7D; 2M70G7D;2M69W7D; 4M48G7D;4M50W7D; 8M93G7D;8M93W7D; 13M5G7D;13M5W7D; 17M9G7D;17M9W7D;
LTE Band 4	1M09G7D;1M09W7D; 2M70G7D;2M69W7D; 4M48G7D;4M50W7D; 8M93G7D;8M93W7D; 13M5G7D;13M5W7D; 17M9G7D;17M9W7D;
LTE Band 5	1M09G7D;1M09W7D; 2M70G7D;2M69W7D; 4M48G7D;4M49W7D; 8M95G7D;8M93W7D;
LTE Band 7	4M48G7D;4M49W7D; 8M93G7D;8M95W7D; 13M5G7D;13M5W7D; 17M9G7D;17M9W7D;

LTE Band 12	1M09G7D;1M09W7D; 2M70G7D;2M69W7D; 4M48G7D;4M49W7D; 8M95G7D;8M95W7D;
LTE Band 17	4M48G7D;4M49W7D; 8M95G7D;8M95W7D;
LTE Band 26 （814-824）	1M09G7D;1M09W7D; 2M70G7D;2M69W7D; 4M48G7D;4M50W7D; 8M91G7D;8M93W7D;
LTE Band 26 （824-849）	1M10G7D;1M09W7D; 2M70G7D;2M69W7D; 4M48G7D;4M49W7D; 8M93G7D;8M93W7D; 13M5G7D;13M5W7D;
LTE Band 66	1M09G7D;1M09W7D; 2M70G7D;2M69W7D; 4M48G7D;4M50W7D; 8M93G7D;8M93W7D; 13M5G7D;13M5W7D; 17M9G7D;17M9W7D;
Bluetooth	GFSK π/4DQPSK 8DPSK
BLE	GFSK
2.4G Wi-Fi	DSSS OFDM
5G Wi-Fi	OFDM

Frequency Range

LTE FDD Band 2: 1850-1910 MHz (UL), 1930-1990 MHz (DL)
LTE FDD Band 4: 1710-1755 MHz (UL), 2110-2155 MHz (DL)
LTE FDD Band 5: 824-849 MHz (UL), 869-894 MHz (DL)
LTE FDD Band 7: 2500-2570 MHz (UL), 2620-2690 MHz (DL)
LTE FDD Band 12: 699-716 MHz (UL), 729-746 MHz (DL)
LTE FDD Band 17: 704-716 MHz (UL), 734-746 MHz (DL)
LTE FDD Band 26: 814-849 MHz (UL), 859-894 MHz (DL)
LTE TDD Band 66: 1710-1780 MHz (UL), 1710-1780 MHz (DL)
WCDMA Band 2: 1850-1910 MHz (UL), 1930-1990 MHz (DL)
WCDMA Band 4: 1710-1755 MHz (UL), 2110-2155 MHz (DL)

WCDMA Band 5: 824-849 MHz (UL), 869-894 MHz (DL)
EGSM (GSM 850): 824-849 MHz (UL), 869-894 MHz (DL)
DCS (GSM 1900): 1850-1910 MHz (UL), 1930-1990 MHz (DL)
BT: 2402MHz-2480MHz
Wi-Fi 2.4G: 2412MHz-2462MHz
5G Wi-Fi: 5150~5250MHz，5250~5350MHz，5470~5725MHz, 5725~5850MHz
FM: 87.5 MHz to 108MHz
GPS: 1575.42MHz

Range of Operating Power

LTE Band B2/B4/B5/B7/B12/B17/B26//B66: 23dBm [+/-2dBm]
UMTS Band I/VIII: 24dBm [+1/-3dBm]
GSM/GPRS 850: 32.5dBm [+/-1.5dBm]
GSM/GPRS 1900: 29.5dBm[+/-1.5dBm]
Bluetooth：<20 dBm
WIFI：<20 dBm

Antenna description

Technical parameters of the NTN-LX3 Mobile Phone antenna:

Item	Description
Frequency	LTE FDD Band 2: 1850-1910 MHz (UL), 1930-1990 MHz (DL) LTE FDD Band 4: 1710-1755 MHz (UL), 2110-2155 MHz (DL) LTE FDD Band 5: 824-849 MHz (UL), 869-894 MHz (DL) LTE FDD Band 7: 2500-2570 MHz (UL), 2620-2690 MHz (DL) LTE FDD Band 12: 699-716 MHz (UL), 729-746 MHz (DL) LTE FDD Band 17: 704-716 MHz (UL), 734-746 MHz (DL) LTE FDD Band 26: 814-849 MHz (UL), 859-894 MHz (DL) LTE TDD Band 66: 1710-1780 MHz (UL), 1710-1780 MHz (DL) WCDMA Band 2: 1850-1910 MHz (UL), 1930-1990 MHz (DL) WCDMA Band 4: 1710-1755 MHz (UL), 2110-2155 MHz (DL) WCDMA Band 5: 824-849 MHz (UL),

	869-894 MHz (DL) EGSM (GSM 850): 824-849 MHz (UL), 869-894 MHz (DL) DCS (GSM 1900): 1850-1910 MHz (UL), 1930-1990 MHz (DL)
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	≤ 3dBi
Rated power	2W
Polarization	Linear

Technical parameters of the NTN-LX3 Mobile Phone main WLAN antenna:

Item	**Description**
Frequency	2.4G Wi-Fi: 2412-2462MHz 5G Wi-Fi: 5150~5250MHz， 5250~5350MHz， 5470~5725MHz, 5725-5850 MHz
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	-2dBi
Rated power	40mW
Polarization	Linear

Technical parameters of the NTN-LX3 Mobile Phone Bluetooth antenna:

Item	**Description**
Frequency	2.400G-2.483.5GHz
Input impedance	50 Ohm
VSWR	≤ 3
Peak gain	-2dBi
Rated power	4mW
Polarization	Linear

Applied voltages

Normal Voltage: 3.87V

Low Voltage: 3.6V

High Voltage: 4.48V

Complete bill of material

Attachment

Complete Circuit Diagrams

Attachment

Instruction/Installation Manual

Attachment

Means for Frequency Stabilization

The Voltage Controlled Temperature Compensated Crystal Oscillator provides the reference frequency for all WTR3925 RF parts synthesizers as well as clock generation functions within the WTR3925 IC. The oscillator frequency is controlled by the WTR3925 TRK_LO_ADJ pulse density modulated signal

Means for Limiting Modulation

In a GSM system, the input signal (voice for example) is sampled and coded in a vocoder, after channel coding, The digital signal is modulated onto the analog carrier frequency using Gaussian-filtered Minimum Shift Keying (GMSK). The modulation scheme is gaussian MSK (GMSK) with BT = 0,3. The modulation rate is 1 625/6 kbit/s (270,83 kbit/s). GMSK was selected over other modulation schemes as a compromise between spectral efficiency, complexity of the transmitter, and limited spurious emissions.

The modulation standard selected for WCDMA is QPSK. QPSK was selected over other modulation schemes as a compromise between spectral efficiency, complexity of the transmitter, and limited spurious emissions.

The LTE downlink channel is modulated by the QPSK, 16QAM, 64QAM. The uplink modulation is the QPSK and 16QAM.

Description of Digital Modulation Techniques

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.

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.

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

WLAN transceivers operate in the 2.4GHz+5GHz 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+5GHz band is part of the ISM（Industrial, Scientific, and Medical）license-free radio bands. Both Bluetooth and 802.11 operate with in 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.

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 with in 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.