SDR845 Gigabit RF Card

Engineering Requirements Specification

Project code: T77W980T00
Solution: SDR845

Reviewers

Department	Name	Signature	Review Dates	
			* Plan	** Results
Project Manager	Choro Chung			
ProjectLeader	Jeff Guo			
Hardware Engineer	Neil Li			

Modification History

Rev	Date	Originator	Comment
V1.0	2018/01/11	Neil Li	Initial release for carrier engagement, will update it after fix hardware design
V1.1	2018/02/03	Neil Li	Update the mechanical drawing
V1.2	2018/02/06	Neil Li	Update the soldering condition
V1.3	2018/02/22	Neil Li	Update the soldering information
V1.4	2018/04/14	Neil Li	Update the Qlink information
V1.5	2018/05/22	Neil Li	Add the Qlink length information
V1.6	2018/06/13	Neil Li	Add the label information

CONTENTS

1. General Description

T77W980T00 is designed to enable wireless data connectivity for notebook computer or any other device which runs on Qualcomm Snapdragon SDM845/ SDM850, it is compatible with the LGA interface 31x31type. It delivers wireless wide-area network (WWAN) connectivity for the LTE, UMTS and GPS/GLONASS/Beidou/Galileo protocols in one hardware configuration.

Form Fact		LGA 31x31 Module
Carrier Support		North America: AT&T, Verizon, T-Mobile, Sprint, Bell, Rogers
		Europe: Vodafone, EE, DT, H3G, Orange, TEF, TIM, Swisscom
		Russia: MTS
		China: CMCC, CT, CU
		Australia: Telstra, Optus
		South Korea: SKT
		Japan: KDDI, DCM, SBM
		Carriers above is subject to biz discussion
QCT Solution		SDR845
LTE	Mode	FDD / TDD
	Band	LB:B8/12(17)/13/14/20/26(5/18/19)/28/29 /B71
		MB:B1/2(25)/3/4(66)/32/B39/B34
		HB:B7/30/40/41(38)
		3.5G:B42/43/48
		LAA/LTE-U (DL only): B46
	CA	5xDL CA (Up to 100MHz, 256QAM)
		2xUL CA (Up to 40MHz. 64QAM) -- intra-band contiguous CA
	MIMO	4X4(band plan: B1/2(25)/3/4(66)/7/30/40/41(38)/, 4X2, 2X2
	Cat (DL/UL Mbps)	ue-CategoryUL 13 (UL: 150Mbps) + ue-CategoryDL 16 (DL: 1.0Gbps) @ 2X2
		ue-CategoryUL 13 (UL: 150Mbps) + ue-CategoryDL 18 (DL: 1.2Gbps) @ 4X4
3G	WCDMA	HSPA+ Rel8 (DL/UL: up to 42/11 Mbps)
	Band	Band1/2/4/5(6/19)/8/9
GNSS		GPS/GLONASS/Beidou/Galileo
Interface		Qlink/MIPI/GRFC

1.1 System Main Feature

Feature	Description
Physical	LTE module, 31 x 31 mm, 183 pin LGA
Electrical	No single voltage supply
Dimension	Dimensions (L × W × H): 31 mm × 31 mm × 2.05 mm
Shielding design	Shield case on board design, no additional shielding requirement
Weight	4.4g
USIM	Off-board USIM connector supported
Operating Bands	WCDMA/HSDPA/HSUPA/HSPA+ operating bands: Band 2: 1850 to 1910 MHz (UL), 1930 to 1990 MHz (DL) Band 4: 1710 to 1755 MHz (UL), 2110 to 2155 MHz (DL) Band 5: 824 to 849 MHz (UL), 869 to 894 MHz (DL)
	LTE bands: Band 2: 1850 to 1910 MHz (UL), 1930 to 1990 MHz (DL) Band 4: 1710 to 1755 MHz (UL), 2110 to 2155 MHz (DL) Band 5: 824 to 849 MHz (UL), 869 to 894 MHz (DL) Band 7: 2500 to 2570 MHz (UL), 2620 to 2690 MHz (DL) Band 12: 699 to 716 MHz (UL), 729 to 746 MHz (DL) Band 13: 777 to 787 MHz (UL), 746 to 756 MHz (DL) Band 14: 788 to 798 MHz (UL), 758 to 768 MHz (DL) Band 17: 704 to 716 MHz (UL), 734 to 746 MHz (DL) Band 25: 1850 to 1915 MHz (UL), 1930 to 1995 MHz (DL)) Band 26: 814 to 849 MHz (UL), 859 to 894 MHz (DL) Band 29: 717 to 728 MHz (DL) Band 30: 2305 to 2315 MHz (UL) 2350 to 2360 MHz (DL) Band 38: 2570 to 2620 MHz (UL/DL) Band 41: 2496 to 2690 MHz (UL/DL) Band 66: 1710 to 1800 MHz (UL), 2110 to 2200 MHz (DL) Band 71:663 to 698 MHz (UL), 617 to 652 MHz (DL)
Diversity/2nd Rx	All UMTS operating bands All LTE operating bands
GNSS	GPS: L1 (1575.42MHz) GLONASS: L1 (1602MHz) Beidou (1561.098MHz) Galileo (1575.42MHz)
Antenna connectors	MAIN and AUX(supports Diversity and GPS simultaneously)
Throughput	WCDMA CS: DL 64 kbps /UL 64 kbps WCDMA PS: DL 384 kbps /UL 384 kbps

	HSPA+:DL 21.6 Mbps /UL 5.76 Mbps DC-HSPA+: DL 42 Mbps/UL 5.76 Mbps LTE Cat4: DL:150 Mbps/UL 50 Mbps LTE Cat6: DL:300 Mbps/UL 50 Mbps LTE Cat9: DL:450 Mbps/UL 50 Mbps LTE Cat11: DL:585 Mbps/UL 50 Mbps LTE Cat16: DL:1Gbps/UL 150Mbps LTE Cat18: DL:1.2Gbps/UL 150Mbps

LTE air interface

LTE Rel13

- DL – 1.2 Gbps / 12-layer / 100 MHz CA

- UL - 150 Mbps / 40 MHz CA

- 256 QAM DL / 64 QAM UL

- 4×2 MIMO 5x CA (R13)

- 4×4 MIMO 3x CA

- FDD + TDD CA

- 3.5 GHz and 600 MHz Bands

- LAA and LTE-U (up to 80 MHz of unlicens)

- Advance LTE IC + NAIC (with CRS only)

WCDMA/HSPA air interface

- R99:

  All modes and data rates for WCDMA FDD

- R5 HSDPA

  PS data speeds up to 7.2 Mbps on the downlink

- R6 HSUPA

  E-DCH data rates of up to 5.76 Mbps for 2 ms TTI (UE category 6) uplink

- R7 HSPA+

  Downlink 64 QAM SISO: up to 21 Mbps

  Downlink 16 QAM 2X2 MIMO: up to 28 Mbps

  Uplink 16 QAM: up to 5.76 Mbps

- R8 DC-HSPA+

  Downlink dual carrier with 64 QAM (SISO); up to 42 Mbps

GNSS

- Customizable tracking session

  • Automatic tracking session on startup

  • Concurrent standalone GPS, GLONASS, Beidou and Galileo

• gpsOneXTRA with GPS + GLONASS + Beidou + Galileo support

1.2 Carrier aggregation combination

1.2.1. Refer to Qualcomm documents 80-P8641-123 Rev. A, Published: 2017/7/31.
Remark: T77W980 hardware design can support follow CA combination, but the Final CA combinations plan depends on carrier engagement and Qualcomm software design.
1.2.2. Qualcomm SDX20 support 5CA+256QAM (up to Cat18) and Rel13 (FDD+TDD CA) which is mandatory for AU/JP/China carriers.
Update the Carrier CA combination, please refer the document:
SDR845_CA_list_20180508 .xlsx

1.3 System Block Diagram

1. GRC is the RF only module, it doesn't include the CPU & memory. So GRC doesn't have the SW image.
2. Each GRC will have its unique QCN data, it will use the GRC SN to name it, and provide these data to one ftp server. OEM can scan the SN to get the QCN data then load it to the platform memory.

1. Just one antenna to support Tx;
2. Support 2 or 4 antennas simultaneously (2 ANTs up to Cat16: 2X2 MIMO+5CA, 4 ANTs up to Cat18: 4X4 MIMO+3CA and 2X2 MIMO+5CA)

1. Single main antenna design with Pentaplexer;
2. All the PAMiD with PA+SW+Filter+LNA+ASM.
Figure 1-3-2 RF Block Diagram-DRX

1. Single aux antenna design with Pentaplexer;
2. Add QLN2042 for 3.5GHz

1.4 Pin definition

1.4.1 LGA interface Pin sequence

1.4.2 Pin definition
Table 1-4-2 Definitions of pins on the LGA interface

PIN #	Signal Name^	Description	Comments
A3	GND	GND	
A4	GND	GND	
A5	GND	GND	
A6	GND	GND	
A7	GND	GND	
A8	GND	GND	
A9	GND	GND	
A10	GND	GND	
A11	GND	GND	
A12	GND	GND	
B3	GND	GND	
B4	GND	GND	
B5	GND	GND	
B6	GND	GND	
B7	GND	GND	
B8	GND	GND	
B9	GND	GND	
B10	GND	GND	
B11	GND	GND	
B12	GND	GND	
B13	GND	GND	
C1	GND	GND	
C2	GND	GND	
C3	GND	GND	
C4	GND	GND	
C5	GND	GND	
C6	GND	GND	
C7	GND	GND	
C8	GND	GND	
C9	GND	GND	
C10	GND	GND	
C11	GND	GND	
C12	GND	GND	
C13	GND	GND	
C14	GND	GND	
D1	GND	GND	
D2	GNSS_EN	GNSS Enable	
D3	GRFC4	Generic RF control	
D4	VREG_L12M_2P7	Power supply input	For switch, for FEM VDD
D5	VREG_L12M_2P7	Power supply input	
D6	VREG_L12M_2P7	Power supply input	
D7	VREG_L6M_1P8	VDD_1P8_DIG	For PA ,LNA, FEM VIO,for SDR845
D8	VXEG_L6M_1P8	VDD_1P8_DIG	

PIN #	Signal Name^	Description	Comments
			1P8_DIG, for ET
D9	GRFC2	Generic RF control	
D10	GND	GND	
D11	GND	GND	
D12	GND	GND	
D13	GND	GND	
D14	GND	GND	
E1	GND	GND	
E2	GND	GND	
E3	GPIO_1	HW Version check	
E4	GPIO_2	HW Version check	
E5	GRFC6	Generic RF control	
E6	GND	GND	
E7	GND	GND	
E8	GRFC7	Generic RF control	
E9	GND	GND	
E10	GND	GND	
E11	PA_THERM_2	AMUX input for 3.5G PA thermistor	It is a NTC -- 100Kohm 1% 170mW
E12	GND	GND	
E13	GND	GND	
E14	GND	GND	
F1	GND	GND	
F2	GND	GND	
F3	RFFE3_DATA	MIPI RFFE data	
F4	RFFE3_CLK	MIPI RF front end (RFFE) clock	
F5	GND	GND	
F6	RFFE4_CLK	MIPI RF front end (RFFE) clock	
F7	RFFE4_DATA	MIPI RFFE data	
F8	GND	GND	
F9	RFFE6_CLK	MIPI RF front end (RFFE) clock	
F10	GND	GND	
F11	GND	GND	
F12	GND	GND	
F13	GND	GND	
F14	GND	GND	
G1	GND	GND	
G2	GND	GND	
G3	GND	GND	
G4	GND	GND	
G5	GND	GND	
G6	GND	GND	

PIN #	Signal Name^	Description	Comments
G7	GND	GND	
G8	GND	GND	
G9	RFFE6_DATA	MIPI RFFE data	
G10	GND	GND	
G11	GRFC1	Generic RF control	
G12	GND	GND	
G13	VREG_L5M	VDD_1P8_ANA_W0	
G14	GND	GND	
H1	GND	GND	
H2	VREG_L6M_1P8	VDD_1P8_DIG	
H3	VREG_L6M_1P8	VDD_1P8_DIG	
H4	GND	GND	
H5	QLINK_REQ	QLink request from SDR845	
H6	QPHY_DL2_P	QLink downlink lane 2 – plus	
H7	QPHY_DL1_P	QLink downlink lane 1 – plus	
H8	GND	GND	
H9	GND	GND	
H10	GRFC3	Generic RF control	
H11	VREG_L1M	VDD_1P2_ANA_W0	
H12	VREG_L1M	VDD_1P2_ANA_W0	
H13	VREG_L5M	VDD_1P8_ANA_W0	
H14	GND	GND	
I1	GND	GND	
I2	VREG_L5M	VDD_1P8_ANA_W0	
I3	VREG_L5M	VDD_1P8_ANA_W0	
I4	GND	GND	
I5	QLINK_EN	QLink Enable for SDR845	
I6	QPHY_DL2_M	QLink downlink lane 2 – minus	
I7	QPHY_DL1_M	QLink downlink lane 1 – minus	
I8	GND	GND	
I9	RFFE5_CLK	MIPI RF front end (RFFE) clock	
I10	GND	GND	
I11	PA_THERM_1	AMUX input for M/HB PA thermistor	It is a NTC -- 100Kohm 1% 170mW
I12	VREG_L1M	VDD_1P2_ANA_W0	
I13	VREG_L5M	VDD_1P8_ANA_W0	
I14	GND	GND	
J1	GND	GND	
J2	VREF_DAC	Transmitter DAC voltage reference	
J3	VREF_DAC	Transmitter DAC voltage reference	
J4	GND	GND	
J5	QPHY_DL0_P	QLink downlink lane 0 – plus	

PIN #	Signal Name^	Description	Comments
J6	QPHY_CLK_M	QLink clock – minus	
J7	QPHY_UL0_P	QLink uplink lane 0 – plus	
J8	GND	GND	
J9	RFFE5_DATA	MIPI RFFE data	
J10	GND	GND	
J11	VREG_L8M	VDD_1P0_DIG_W0	For SDR845
J12	VREG_L6M_1P8	VDD_1P8_DIG	
J13	GND	GND	
J14	GND	GND	
K1	GND	GND	
K2	WMSS_RESET	Reset functionality for the digital sections inside the transceiver	
K3	VREF_DAC	Transmitter DAC voltage reference	
K4	GND	GND	
K5	QPHY_DL0_M	QLink downlink lane 0 – minus	
K6	QPHY_CLK_P	QLink clock – plus	
K7	QPHY_UL0_M	QLink uplink lane 0 – minus	
K8	GND	GND	
K9	GND	GND	
K10	VREG_L8M	VDD_1P0_DIG_W0	
K11	VREG_L8M	VDD_1P0_DIG_W0	
K12	VREG_L6M_1P8	VDD_1P8_DIG	
K13	VPH_QFE	Power supply input for RF	
K14	GND	GND	
L1	GND	GND	
L2	GND	GND	
L3	GRFC5	Generic RF control	
L4	GND	GND	
L5	GND	GND	
L6	GND	GND	
L7	GND	GND	
L8	GND	GND	
L9	GND	GND	
L10	VREG_L3M	VDD_1P0_ANA_W0	For SDR845
L11	VREG_L6M_1P8	VDD_1P8_DIG	
L12	VPH_QFE	Power supply input for RF -- 3.3V~4.4V	
L13	VPH_QFE	Power supply input for RF -- 3.3V~4.4V	
L14	GND	GND	
M2	GND	GND	
M3	GND	GND	
M4	RF_CLK1	38.4 MHz reference input forPLLs and other circuits	
M5	GND	GND	

PIN #	Signal Name^	Description	Comments
M6	RFFE1_CLK	MIPI RF front end (RFFE) clock	
M7	RFFE1_DATA	MIPI RFFE data	
M8	GND	GND	
M9	VREG_L3M	VDD_1P0_ANA_W0	
M10	VREG_L3M	VDD_1P0_ANA_W0	
M11	VPH_QFE	Power supply input for RF -- 3.3V~4.4V	
M12	VPH_QFE	Power supply input for RF -- 3.3V~4.4V	
M13	GND	GND	
N3	GND	GND	
N4	GND	GND	
N5	GND	GND	
N6	GND	GND	
N7	GND	GND	
N8	GND	GND	
N9	GND	GND	
N10	GND	GND	
N11	GND	GND	
N12	GND	GND	

1.5 Platform connection design

1.5.1 For signal line impedance control

Metrics		Guidance	Comments
Total channel bus length		<=60mm	Maximun PCB bus routing length for entire channel between SDM845 to GRC
Impedance	Diff Z0 min/max	Field route	85 Ω +/- 10 Ω	Differential PCB routing Z0
Length Match	Intrapair match	0.7mm	Length match between P and N side of differntial pair, need to include the GRC internal trace length

For Qlink signal line:

For Qlink line, shall shielding well for themself, difference control for each pair lines.

Please refer Qualcomm document: 80-P6348-3 Rev. A

1.5.2 For GRC mother board layout suggestion

a: Please put the Q-link signals routing on the first priority, Q-link signal frequency will be up to 6GHz. If GRC module mounts on the mother board top side, that on the mother board PCB top layer, please don't have the other signal trace during the position of these Q-link signals. Detail location please see the below pictures.

b: For Q-link signal lines' upper and lower layers must be GND, they should be wrapped up in GND well. GRC also have the MIPI line, suggest to route by differential.

If GRC module mounts on the mother board top side, please reserve the relative position clearance on the back side. We need to consider the thermal, reserve the location for future thermal solution. So it is better that don't put the components on the GRC module back side.

Please refer the below picture, suggest to reserve the red dotted line location (31L * 25H mm).
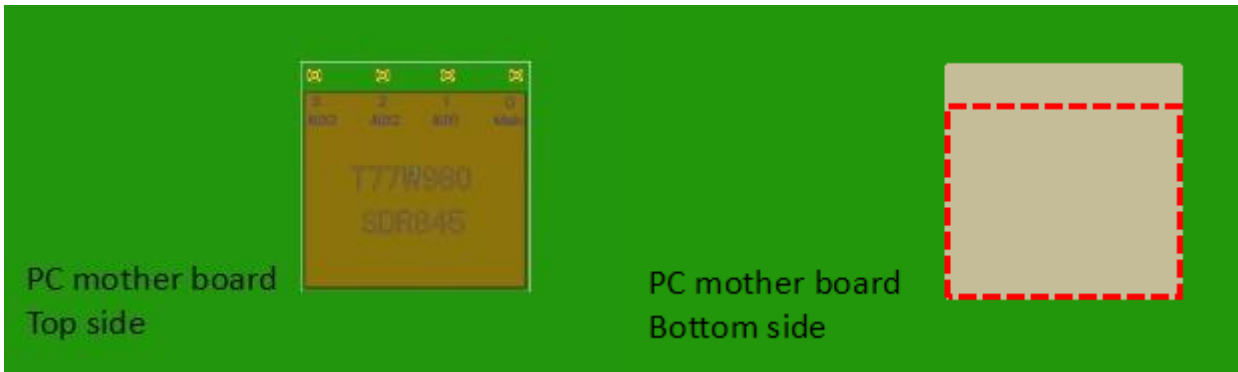
Figure 1-5-2PC mother board (Top/bottom view)

2. Hardware features

T77W980T00 consists of the following key engine components, in addition to the required front-end RF and other discrete components.

Modem engine

■ RF: SDR845

Connectivity engine

■ Antenna: connectors for the off board antennas

2.1 RF transceiver

The SDR845 device is a highly-integrated multimode, multiband RF CMOS transceiver IC that interfaces with the SDX20 device through QLink. The SDR845 is the first integrated single-chip RFIC for LTE downlink carrier aggregation (CA) up to 100 MHz BW supporting 5DL CA (two of the carriers must be contiguous). It also supports LTE uplink carrier aggregation up to 20 MHz + 20 MHz for interband and 40 MHz for contiguous intraband.

2.1.1 For Key features of SDR845

● Qualcomm Technologies, Inc. (QTI) 28 nm RF CMOS device with an integrated modem subsystem in a PSP package (0.35 mm pitch)

● Integrating RF receive, transmit, and the QLink controller

● First QTI single-chip RF device to support three-carrier

● 4×4 MIMO (where two carriers are contiguous)

● First QTI single-chip RF device to have dedicated MIMO inputs

● SDR845 is the first QTI RF transceiver to support 12-layer DL MIMO

2.1.1 For Key benefits of SDR845

● First QTI single-chip RF device to support three-carrier 4×4 MIMO (where two carriers are contiguous)

● This device is also capable of supporting two-carrier 4×4 MIMO and two-carrier 4x HORxD

● First QTI single-chip RF device to have dedicated MIMO inputs

● SDR845 is the first QTI RF transceiver to support 12-layer DL MIMO

● QTI RF device that supports high-speed digital interface (QLink) between SDR845 and

● SDX20/SDM845

● QTI RF device supporting external GRFCs that can be used for RF front-end communication and general-purpose functions

● QTI single-chip RF transceiver with integrated LTE-unlicensed (LTE-U)/LAA support

● QTI RF device that supports B42, B43, B46, and B48

- QTI single-chip RF device that supports uplink carrier aggregation (using two Tx chains)
- QTI single-chip RF device that supports the integrated envelope tracking (ET) feature for both Tx chains (ETDAC0 and ETDAC1)
- QTI single-chip RF transceiver that supports up to five downlink (DL) carrier aggregation
- One independent differential low noise amplifier (LNA) port, supporting Tx feedback for all WAN bands (UL)
- Most highly integrated RF transceiver
- Up to 10 receivers running concurrently
- Simplified DC power requirements for this highly integrated RFIC with built-in microprocessor

2.2 Antenna Design

The antenna elements are typically integrated into the notebook/ultrabook /tablet and connected to T77W980T00module via flexible RF coaxial cables. T77W980T00 provides four RF connectors (MHF4 type), one for the primary transmitter/receiver port and one for the diversity receiver and GNSS the others for the 4*4 MIMO. To ensure customer has a clear knowledge of the four antennas, check below product picture.
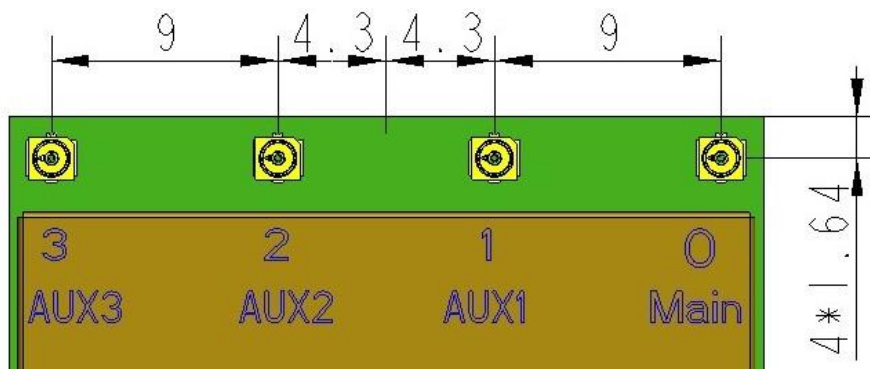
Antenna	Interface	Frequencies [MHz]
0	WWANMain	600~6000
1	WWAN MIMO 1	1700~2700
2	WWAN MIMO 2	1700~2700
3	WWAN Aux/GPS	600~6000

Figure 2-2-1 Antenna connector location and type

3.1 commended operating conditions

Parameter	Min	Type	Max	Units
Storage temperature	-30	+25	+85	°C
Recommend operating temperature (3GPP compliant with mitigation plan) (*1)	-30	+25	+70	°C
Extendable (with limited performance) Temperature measure on T77W980 module(*2)	-40		+85	°C

Table 4-1 Recommended operating conditions

3.2 Storage Requirement

The module must be stored and sealed properly in vacuum package under a temperature below 40°C and the relative humidity less than 90% in order to ensure the weldability within 12 months.

3.3 Crystal material

For T77W980T00 OEM main board crystal , please OEM choose the same material TXC -OW38477001, when mount the GRC on the mother board, for OEM just redo the XO_Calibration, and leverage the RF QCN parameter.

OEM vendor needs to set up a RF calibration station for crystal, Using IQXStream or 8820C to re-calirbate the XO then rewrite the XO NV.
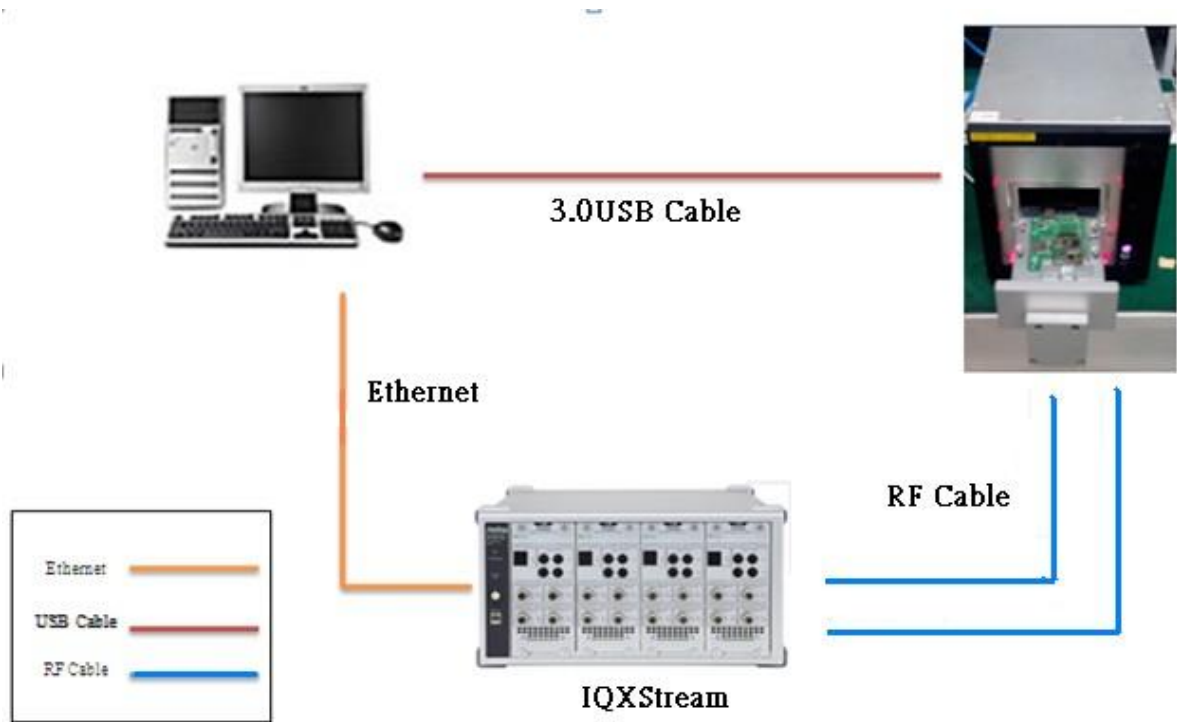
NV items list will provide later.

Figure 4-2 RF calibration station

4. Electrostatic Discharge

The module is not protected against Electrostatic Discharge (ESD) in general. Consequently, it is subject to ESD handling precautions that typically apply to ESD sensitive components.
Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates a T77W980T00 LTE module.

The remaining interfaces of T77W980T00 LTE module are not accessible to the user of the final product (since they are installed within the device) and are therefore only protected according to the JEDEC JESD22-A114D requirements.
T77W980T00 LTE module has been tested according to the following standards. Electrostatic values can be gathered from the following table.

Table 4-5: Electrostatic values

Specification / Requirements	Contact discharge	Air discharge
JEDEC JESD22-A114D		
All SMT interfaces	± 1kV Human Body Model	n.a.
ETSI EN 301 489-1/7		
All antenna interfaces (LTE/WCDMA/GPS)	± 4kV	± 8kV
BATT+	± 4kV	± 8kV

Note: Please note that the values may vary with the individual application design. For example, it matters whether or not the application platform is grounded over external devices like a computer or other equipment

5. Mechanics, Mounting and Packaging

5.1 Mechanics

5.1.1 Overview

The T77W980T00 LTE module uses the 183-pin LGA as their external interface. For details about the module and dimensions, see 5.1.2 Dimensions and Interfaces (Tolerance:+/-0.10).

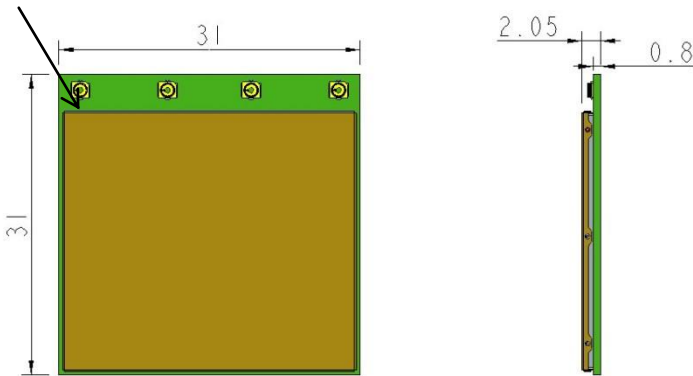Typical module dimension (W x L): 31mmx31mm. Max Z-height is 2.15mm

Pin1

Figure 5-1-1Top & side view

5.1.2 Dimensions and Interfaces

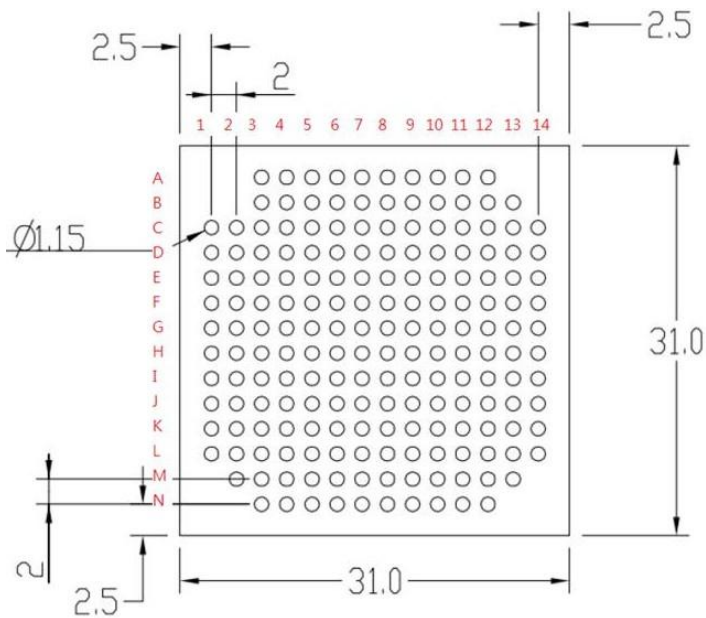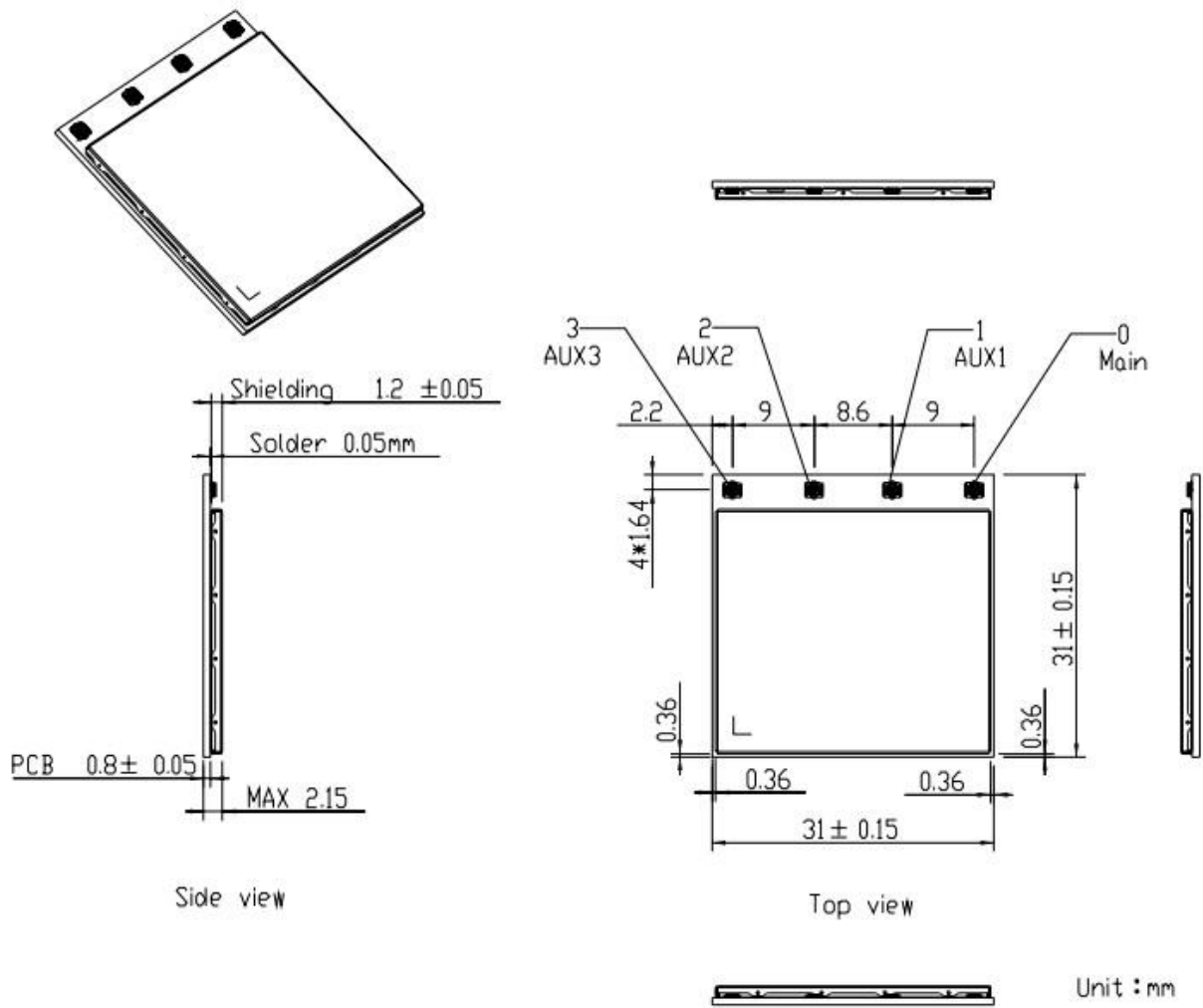Figure 5-1-2 shows the dimensions in details.

Figure 5-1-2 Dimensions Top view (Unit: mm)

Shielding   1.2 ±0.05

Solder 0.05mm

PCB   0.8± 0.05

MAX 2.15

Side view

3 AUX3   2 AUX2   1 AUX1   0 Main

2.2   9   8.6   9

4*1.64

31 ± 0.15

0.36

0.36   0.36

31 ± 0.15

Top view

Unit : mm

5.1.2 Recommended LGA Land Pattern(bottom view), unit:mm

6.5   6.5

2.5   2.5   2   2   2.5   2.5

6.5   6.5

2   2

Ø1.15

2   2

2.5   2.5   2   2   2.5   2.5

6.5   6.5

6.5   6.5
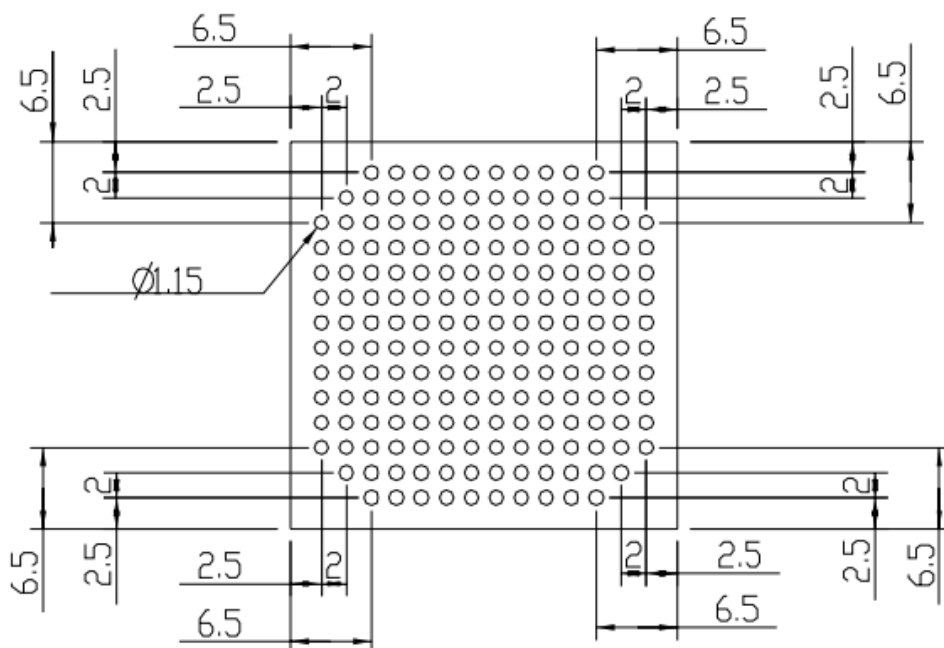
5.1.3PCB stacking

10 Layers, HDI, thickness:0.8mm +/-0.05mm

layer name	layer type	Raw_Thk (um)	Finished (μm)	tolerance (um)
mask top	Solder mask	20	20	+/-10
layer 1	Copper	12	25	+/-7
	prepreg 0106	66	58	+15/-10
layer 2	Copper	12	20	+/-7
	prepreg 0106	66	58	+15/-10
layer 3	Copper	12	20	+/-7
	prepreg 0106	66	58	+15/-10
layer 4	Copper	12	20	+/-7
	prepreg 0106	66	58	+15/-10
layer 5	Copper	12	20	+/-7
	laminate	75	75	+/-15
layer 6	Copper	12	20	+/-7
	prepreg 0106	66	58	+15/-10
layer 7	Copper	12	20	+/-7
	prepreg 0106	66	58	+15/-10
layer 8	Copper	12	20	+/-7
	prepreg 0106	66	58	+15/-10
layer 9	Copper	12	20	+/-7
	prepreg 0106	66	58	+15/-10
layer 10	Copper	12	25	+/-7
mask bot	Solder mask	20	20	+/-10

5.1.4 label information

3   2   1   0
Aux3 Aux2   Aux1 Main

SN: 980xxxxxxxx
Part NO.: T77W980T00
MO: 1234567890-VVSS
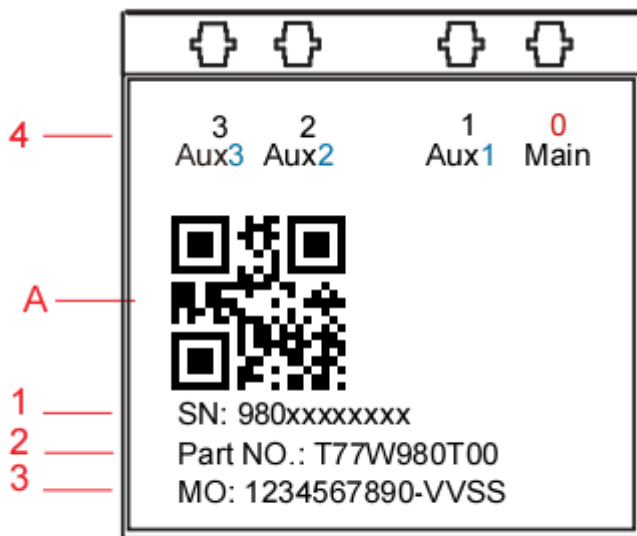
SCALE:1:1

一.Human readable(可讀部分)：

1.SN digital range (total 11digital)：
  SN(11 digits) =980xxxxxxxx
  980 Fixed
  4th-11th digits - serial number (00000000-99999999) managed by FXN

2. Part NO.: T77W980T00 (Fixed)
3. MO:MO-VVSS
  a. The first MO is the text
  b. The second MO is Foxconn MO,follow Foxconn standard.
  c. VV:the engineering version
     (refer to Foxconn label Rev column in the cover of the MFG document)
  d. SS:the version of A300/A400 product
     (refer to Doc Rev. in the cover of MFG document)

4.   3   2   1   0   (Fixed)
    Aux3 Aux2   Aux1 Main

All of the font:

Font 0:Keyence Standard
Height(字符高度): 1.4mm
Width(字符宽度): 0.7mm
Space(字符间隔):0.8mm

5.2Mounting onto the Application Platform

This section describes how to mount T77W980T00 LTE Module onto the PCBs (=printed circuit boards), includingland pattern and stencil design, board-level characterization, soldering conditions, durabilityand mechanical handling.

Note: All SMT module pads need to be soldered to the application's PCB. Not only must all supply pads and signals be connected appropriately, but all pads denoted as "Do not use" will alsohave to be soldered (but not electrically connected) in order to ensure the best possible mechanical stability.

5.2.1SMT PCB Assembly

5.2.1.1Land Pattern and Stencil
Recommended design of the solder pads on customers' PCBs (Unit: mm)
Non Solder Mask Defined (NSMD) is recommended. In addition, the solder mask of the NSMD pad design is larger than the pad so the reliability of the solder joint can be improved.
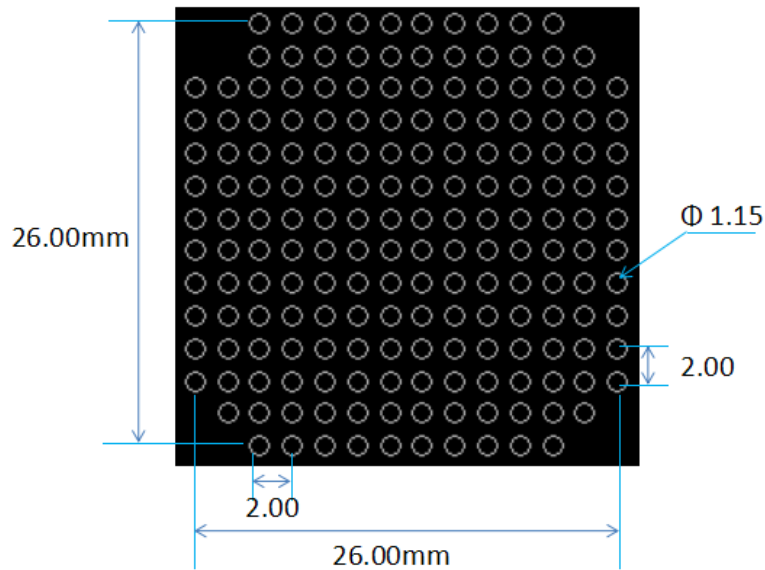
Figure 5-2-1Land pattern (top view)

It is recommended that the stencil for the LGA module be at least 0.15 mm in thickness. For the recommended stencil aperture design, refer figure 5-2-1.（Unit: mm）
The solder paste dosage(0.1587g/pcs) is a theoretical value for reference.

5.2.1.2Board Level Characterization

Board level characterization issues should also be taken into account if devising an SMT process. Characterization tests should attempt to optimize the SMT process with regard to board levelreliability. This can be done by performing the following physical tests on sample boards: Peeltest, bend test, tensile pull test, drop shock test and temperature cycling.

It is recommended to characterize land patterns before an actual PCB production, taking individual processes, materials, equipment, stencil design, and reflow profile into account. For landand stencil pattern design recommendations see also Section 5.2.1.1. Optimizing the solderstencil pattern design and print process is necessary to ensure print uniformity, to decrease solder voids, and to increase board level reliability.

Generally, solder paste manufacturer recommendations for screen printing process parameters and reflow profile conditions should be followed. Maximum ratings are described in Section5.2.3.

5.2.2Moisture Sensitivity Level

T77W980T00 LTE Module comprises components that are susceptible to damage induced by absorbed moisture.

T77W980T00 LTE Module complies with the latest revision of the IPC/JEDEC J-STD-020 Standard for moisture sensitive surface mount devices and is classified as MSL 4.For additional MSL (=moisture sensitivity level) related information see Section 5.2.4 and Section 5.3.2.

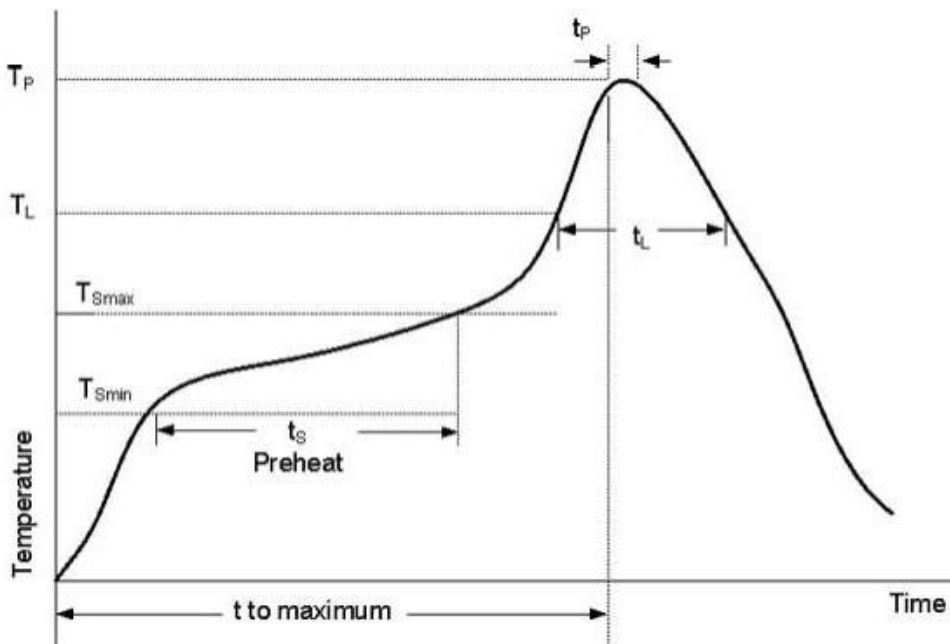## 5.2.3Soldering Conditions and Temperature

5.2.3.1Reflow Profile

Figure 5-2-3:   Reflow Profile

Table 5-2:   Reflow temperature ratings

Profile Feature	Pb-Free Assembly
Preheat & Soak Temperature Minimum (T_{Smin}) Temperature Maximum (T_{Smax}) Time (t_{Smin} to t S_{max}) (ts)	150℃ 180℃ 60~120 seconds
Average ramp up rate (T_{Smax} to T_P)	3 K/second max
Liquidous temperature (T_L) Time at liquidous (t_L)	217℃ 50~90 seconds
Peak package body temperature (T_P)	240~250℃
Time (t_P) within 5 ℃ of the peak package body temperature (T_P)	30 seconds max.
Average ramp-down rate (T_P to T_{Smax})	3 K/second max.
Time 25℃ to maximum temperature	8 minutes max.

5.2.3.2Maximum Temperature and Duration

The following limits are recommended for the SMT board-level soldering process to attach the module:

· A maximum module temperature of 245℃. This specifies the temperature as measured atthe module's top side.

· A maximum duration of 30 seconds at this temperature.

Please note that while the solder paste manufacturers' recommendations for best temperature and duration for solder reflow should generally be followed, the limits listed above must not be exceeded.

T77W980T00 LTE Module is specified for one soldering cycle only.Once T77W980T00 LTE module is removed from the application, themodule will very likely be destroyed and cannot be soldered onto another application.

5.2.4Durability and Mechanical Handling

5.2.4.1Storage Life

T77W980T00 LTE modules, as delivered in tape and reel (TBD) carriers, must be stored in sealed, moisture barrieranti-static bags. The shelf life in a sealed moisture bag is an estimated 12 month. However, sucha life span requires a non-condensing atmospheric environment, ambient temperatures below

40℃ and a relative humidity below 90%. Additional storage conditions are listed in Table 3-1.

5.2.4.2Processing Life

T77W980T00 LTE module must be soldered to an application within 72 hours after opening the MBB (=moisturebarrier bag) it was stored in.As specified in the IPC/JEDEC J-STD-033 Standard, the manufacturing site processing themodules should have ambient temperatures below 30℃ and a relative humidity below 60%.

5.2.4.3 Baking

Baking conditions are specified on the moisture sensitivity label attached to each MBB (see Figure 49 for details):

· It is not necessary to bake T77W980T00 LTE module , if the conditions specified in Section 5.2.4.1 and Section5.2.4.2 were not exceeded.

• It is necessary to bake T77W980T00 LTE module , if any condition specified in Section 5.2.4.1 and Section 5.2.4.2 was exceeded.

If baking is necessary, the modules must be put into trays that can be baked to at least 125℃. Devices should not be baked in tape and reel carriers at any temperature.

5.2.4.4 Electrostatic Discharge

ESD (=electrostatic discharge) may lead to irreversible damage for the module. It is thereforeadvisable to develop measures and methods to counter ESD and to use these to control the electrostatic environment at manufacturing sites.
Please refer to Section 4.5 for further information on electrostatic discharge.

5.3Packaging

5.3.1Tape and Reel(TBD)

The single-feed tape carrier for T77W980T00 LTE is illustrated in Figure 45. The figure also shows the proper part orientation.
5.3.1.1 Orientation

Figure 5-3-1: Carrier tape

Figure 5-3-2: Roll direction

5.3.1.2Barcode Label

A barcode label provides detailed information on the tape and its contents. It is attached to thereel.

Figure 5-3-3: Barcode label on tape reel

5.3.2Shipping Materials

T77W980T00 LTE module is distributed in tape and reel carriers. The tape and reel carriers used to distribute T77W980T00 LTE module are packed as described below, including the following required shipping materials:

- Moisture barrier bag, including desiccant and humidity indicator card
- Transportation bag

5.3.2.1Moisture Barrier Bag

The tape reels are stored inside an MBB (=moisture barrier bag), together with a humidity indicator card and desiccant pouches - see Figure 48. The bag is ESD protected and delimits moisture transmission. It is vacuum-sealed and should be handled carefully to avoid puncturing ortearing. The bag protects the T77W980T00 LTE modules from moisture exposure. It should not be openeduntil the devices are ready to be soldered onto the application.

Figure 5-3-4: Moisture barrier bag (MBB) with imprint

The label shown in Figure 5-3-5 summarizes requirements regarding moisture sensitivity, including shelf life and baking requirements. It is attached to the outside of the moisture barrier bag.

Figure 5-3-5: Moisture Sensitivity Label

MBBs contain one or more desiccant pouches to absorb moisture that may be in the bag. Thehumidity indicator card described below should be used to determine whether the enclosedcomponents have absorbed an excessive amount of moisture.
The desiccant pouches should not be baked or reused once removed from the MBB.
The humidity indicator card is a moisture indicator and is included in the MBB to show the approximate relative humidity level within the bag. Sample humidity cards are shown in Figure 5-3-6.If the components have been exposed to moisture above the recommended limits, the units willhave to be rebaked.

Figure 5-3-6:   Humidity Indicator Card - HIC

A baking is required if the humidity indicator inside the bag indicates 10% RH or more.

5.3.2.2Transportation Box

Tape and reel carriers are distributed in a box, marked with a barcode label for identificationpurposes. A box contains 2 reels with 500 modules each.

3. Sample Application

TBD

Host integration instructions
Install module through golden finger.

The End Host information:
MT code : 81JL
Marketing name : Lenovo YOGA C630-13Q50

Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.   These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.   If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
This device is intended only for OEM integrators under the following conditions:

The antenna must be installed such that 20 cm is maintained between the antenna and users, and
The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required.

However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed

IMPORTANT NOTE: In the event that these conditions <u>can not be met</u> (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID <u>can not</u> be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling
This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID:MCLT77W980". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End User
The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.
The end user manual shall include all required regulatory information/warning as show in this manual.

Radiation Exposure Statement:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Antenna spec:

Antenna No.	Antenna Gain(dBi)	Frequency range (MHz)	Antenna Type	Connecter Type	Cable Length
1	Please refer to below table	699~803	PIFA	i-pex(MHF)	100mm
2	Please refer to below table	791~960 1447.9~1606	PIFA	i-pex(MHF)	100mm
3	Please refer to below table	1710~2170 2500~2690	PIFA	i-pex(MHF)	100mm
4	Please refer to below table	5110~5925 (for LAA RX)	PIFA	i-pex(MHF)	100mm
5	Please refer to below table	2305~2315	Dipole	i-pex(MHF)	80mm

Antenna gain list			
Antenna No.	Band	Freq. Range (MHz)	Gain (dBi)
3	WCDMA II (B2)	1850~1910	4.92
3	WCDMA IV (B4)	1710~1755	5.99
2	WCDMA V (B5)	824~849	2.68
3	LTE Band (2)	1850~1910	4.92
3	LTE Band (4)	1710~1755	5.99
2	LTE Band (5)	824~849	2.68
3	LTE Band (7)	2500~2570	5.2
1	LTE Band (12)	698~716	4.17
1	LTE Band (13)	777~787	3.05
1	LTE Band (14)	788~798	2.87
1	LTE Band (17)	704~716	4.17
3	LTE Band (25)	1850~1915	4.92
2	LTE Band (26)	814~849	2.92
5	LTE Band (30)	2305~2315	3.02
3	LTE Band (38)	2570~2620	4.82
3	LTE Band (41)	2496~2690	5.38
3	LTE Band (66)	1710~1780	5.99
1	LTE Band (71)	663~698	3.83