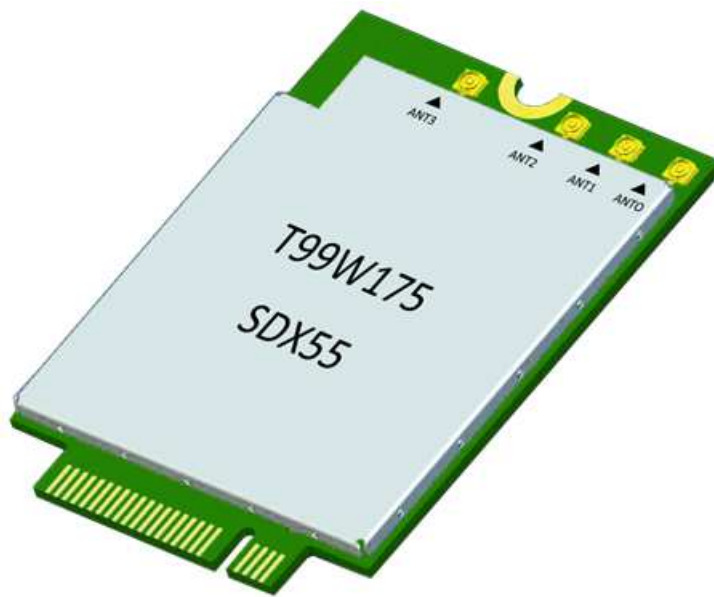


# 5GNR/ LTE-Advanced PCI Express M.2 Module (Sub 6G, LTE, UMTS)

## Engineering Requirements Specification



Project code: T99W175M  
Solution: SDX55+SDR865+PMX55  
SKU: WW-1-5G

Foxconn PN	Customer PN
T99W175.06	K1YCW
T99W175.08	JP18Y
T99W175.09	FTY9X
T99W175.30	1TFY5
T99W175.31	H75GC
T99W175.32	01PCT

Reviewers

Department	Name	Signature	Review Dates	
			* Plan	** Results
Project Manager	Ai-Ning Song			
Project Leader	Michael. Xiao			
Hardware Engineer	Lynn. Liu			

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**Modification History**

Rev	Date	Originator	Comment
R1.0	2019/5/9	Lynn. Liu	Initial release
R1.1	2019/5/20	Lynn. Liu	Update base on the customer requirements
R1.2	2019/5/28	Lynn. Liu	Update item 2.4 for antenna requirements; item 1.4.2 for USIM2
R1.3	2019/5/30	Lynn. Liu	Update Pin38/60 description and item 1.5.12 for Coexistence
R1.4	2019/7/9	Lynn. Liu	1. Remove n25/38/40& B43 support due to Qualcomm update (item1.1); 2. Remove n71& GPS L5 due to not in POR and B48 as TBD; 3. Update mmWave IF connector pin definition (item 2.4.2); 4. Update ME drawing (item3.2
R1.5	2019/7/25	Lynn. Liu	1. Update PCIe connection guideline(item1.5.4); 2. Update ME drawing (item3.2); 3. Update antenna configuration (item 2.4.2); 4. Update LTE Rx sensitivity Spec; 5. Update W_Disable# (item1.5.5)
R1.6	2019/9/12	Lynn. Liu	1. Update Pin29/31/35/37(USB3.0) to NC; 2. Need Platform side reserve USB2.0 for factory test (WinPE) (item1.4.2)
R1.7	2019/10/08	Lynn. Liu	1. Disable B48 for NA (item 1); 2. Update operating temperature (item 4.1); 3. Update antenna configuration (item 2.4.2 Figure2-2); 4. Update golden plating drawing; 5. Pin29/31/35/37 as NC and reserve with PCIe Lane 2
R1.8	2020/2/24	Lynn. Liu	1. Remove mmW for Sub6G only SKU; 2. Enable B48 for US& EU 3. Remove Reset (Pin67) requirement; 4. Update antenna configure (Item 2.4.2 Figure2-2); 5. Update HW feature (Item 2); 6. Update initial power consumption Spec (Item 4.2); 7. Update RF performance Spec (Item 5.1& 5.2) & support bandwidth; 8. Add DPS feature
R1.9	2020/3/27	Lynn. Liu	1. Add PN for Olympic MLK& Andrews; 2. Disable B40 to meet FCC requirement; 3. Update Power on/off sequence requirement (Item 1.5.13); 4. Reserve 0.1uF on Pin6(Full card power off) & Pin50 (PERST#) Item 1.5.3& 1.5.4; 5. Add n71 for new Platform POR

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## 1. General Description

T99W175M is designed to enable wireless data connectivity for notebook computer or any other device compatible with the PCI Express M.2 Specification 3042 type Key B slot.

T99W175M is the data card solution that delivers wireless wide-area network (WWAN) connectivity for the 5G NR (Sub 6G), LTE, UMTS (HSDPA/HSUPA/HSPA+DC-HSPA+) and GPS/Glonass/ Beidou/ Galileo protocols in one hardware configuration.

SKU		WW-1-5G / T99W175M
Carrier Support		NA: AT&T, Verizon, Sprint WW: Vodafone, Telefonica-O2 APAC: Telstra, Docomo, KDDI, Softbank * Carrier engagement based on real business agreement
QCT Solution		SDX55+SDR865+SMR526+PMX55
5G	FR1 (Sub 6G)	LB: n5/8/12/20/28/71; MB: n1/2/3/66; HB: n7/38/41/77/78/79
	FR2 (mmWave)	NA
	4x4 MIMO	n1/2/3/66/7/38/41/77/78/79
	UE Capability	UL (TBD); DL(TBD)
4G	Support Band	LB: B26(5/18/19)/8/12(17)/13/14/20/28/29/71 MB: B1/2(25)/3/4(66)/32 HB: B7/30/34/38/39/40(Disable for FCC)/41/42/48
	4x4 MIMO	B1/25(2)/3/66(4)/7/30/40/41(38)/42/48
	LAA	B46 (DL only)
	LTE Cat.	ue-CategoryUL 13 (UL: 150Mbps) + ue-CategoryDL 20 (DL: 2Gbps); 7xDL CA, 2xUL CA (Intra-band), 5xDL CA+4X4 MIMO (Up to Cat20)
3G	WCDMA	HSPA+ Rel8 (DL/UL: up to 42/11 Mbps)
	Support Band	B1/2/4/5(6/19)/8/9
GNSS		Dual-Frequency GNSS: L1 GPS/Glonass/Beidou/Galileo,
USIM		Dual SIM interface, Dual SIM Single Active (DSSA)
eSIM		eSIM Dual SIM with eSIM on board (eSIM is option), Dual SIM Single Active (DSSA)
Interface		PCIe3.0; Reserve USB2.0 for factory test (WinPE)
Form factor		3042 PCIe M.2 Key.B

### 1.1 System Main Feature

Feature	Description
Physical	PCI express M.2 module, size 3042, Key.B,75Pin golden finger
Electrical	Single VCC supply (3.135V~3.63V)
Dimension	Dimensions (L x W x H): 42 mm x 30 mm x 2.5 mm, maximum height=2.6mm (add PCB tolerance=0.1mm)
Shielding design	Shield case on board design, no additional shielding requirement
Weight	Approximately ~8g
USIM	Off-board USIM connector supported on Host through USIM1/USIM2
Operating Bands	<p>WCDMA/HSDPA/HSUPA/HSPA+ operating bands:</p> <ul style="list-style-type: none"> <li>Band 1: 1920 to 1980 MHz (UL), 2110 to 2170 MHz (DL)</li> <li>Band 2: 1850 to 1910 MHz (UL), 1930 to 1990 MHz (DL)</li> <li>Band 4: 1710 to 1755 MHz (UL), 2110 to 2155 MHz (DL)</li> <li>Band 5: 824 to 849 MHz (UL), 869 to 894 MHz (DL)</li> <li>Band 6: 830 to 840 MHz (UL), 875 to 885 MHz (DL)</li> <li>Band 8: 880 to 915 MHz (UL), 925 to 960 MHz (DL)</li> <li>Band 9: 1750 to 1785 MHz (UL), 1845to 1880 MHz (DL)</li> <li>Band 19: 830 to 845 MHz (UL), 875 to 890 MHz (DL)</li> </ul>
	<p>LTE FDD/TDD operating bands:</p> <ul style="list-style-type: none"> <li>Band 1: 1920 to 1980 MHz (UL), 2110 to 2170 MHz (DL)</li> <li>Band 2: 1850 to 1910 MHz (UL), 1930 to 1990 MHz (DL)</li> <li>Band 3: 1710 to 1785 MHz (UL), 1805 to 1880 MHz (DL)</li> <li>Band 4: 1710 to 1755 MHz (UL), 2110 to 2155 MHz (DL)</li> <li>Band 5: 824 to 849 MHz (UL), 869 to 894 MHz (DL)</li> <li>Band 7: 2500 to 2570 MHz (UL), 2620 to 2690 MHz (DL)</li> <li>Band 8: 880 to 915 MHz (UL), 925 to 960 MHz (DL)</li> <li>Band 12: 699 to 716 MHz (UL), 729 to 746 MHz (DL)</li> <li>Band 13: 777 to 787 MHz (UL), 746 to 756 MHz (DL)</li> <li>Band 14: 788 to 798 MHz (UL), 758 to 768 MHz (DL)</li> <li>Band 17: 704 to 716 MHz (UL), 734 to 746 MHz (DL)</li> <li>Band 18: 815 to 830 MHz (UL), 860 to 875 MHz (DL)</li> <li>Band 19: 830 to 845 MHz (UL), 875 to 890 MHz (DL)</li> <li>Band 20: 832 to 862 MHz (UL), 791 to 821 MHz (DL)</li> <li>Band 25: 1850 to 1915 MHz (UL), 1930 to 1995 MHz (DL)</li> <li>Band 26: 814 to 849 MHz (UL), 859 to 894 MHz (DL)</li> <li>Band 28: 703 to 748 MHz (UL), 758 to 803 MHz (DL)</li> <li>Band 29: 717 to 728 MHz (DL)</li> <li>Band 30: 2305 to 2315 MHz (UL) 2350 to 2360 MHz (DL)</li> <li>Band 32: 1452 to 1496 MHz (DL)</li> <li>Band 34: 2010 to 2025 MHz (UL/DL)</li> <li>Band 38: 2570 to 2620 MHz (UL/DL)</li> <li>Band 39: 1880 to 1920 MHz (UL/DL)</li> <li>Band 40: 2300 to 2400 MHz (UL/DL)</li> <li>Band 41: 2496 to 2690 MHz (UL/DL)</li> <li>Band 66: 1710 to 1800 MHz (UL), 2110 to 2200 MHz (DL)</li> <li>Band 71: 663 to 698 MHz (UL), 617 to 652 MHz (DL)</li> </ul>

Operating Bands	LTE 3.5G Band 42: 3400 to 3600 MHz (UL/DL) Band 48: 3550 to 3700 MHz (UL/DL)
	LAA Band 46: 5150 to 5925 MHz (DL)
	5G NR Sub 6GHz n1: 1920 to 1980 MHz (UL), 2110 to 2170 MHz (DL) n2: 1850 to 1910 MHz (UL), 1930 to 1990 MHz (DL) n3: 1710 to 1785 MHz (UL), 1805 to 1880 MHz (DL) n5: 824 to 849 MHz (UL), 869 to 894 MHz (DL) n7: 2500 to 2570 MHz (UL), 2620 to 2690 MHz (DL) n8: 880 to 915 MHz (UL), 925 to 960 MHz (DL) n12: 699 to 716 MHz (UL), 729 to 746 MHz (DL) n20: 832 to 862 MHz (UL), 791 to 821 MHz (DL) n28: 703 to 748 MHz (UL), 758 to 803 MHz (DL) n38: 2570 to 2620 MHz (UL/DL) n41: 2496 to 2690 MHz (UL/DL) n66: 1710 to 1800 MHz (UL), 2110 to 2200 MHz (DL) n71: 663 to 698 MHz (UL), 617 to 652 MHz (DL) n77: 3300 to 4200 MHz (UL/DL) n78: 3300 to 3800 MHz (UL/DL) n79: 4400 to 5000 MHz (UL/DL)
	5G NR mmWave NA
Diversity/2nd Rx	All UMTS operating bands All LTE operating bands
4x4 MIMO Rx	LTE-B1/25(2)/3/66(4)/7/30/40/41(38)/42/48 5G NR-n1/2/3/66/7/41/77/78/79
GNSS	GPS: L1 (1575.42MHz); GLONASS: L1 (1602MHz) BeidouB1(1561.098MHz) Galileo E1 (1575.42);
USIM Voltage	Support 1.8V and 2.85V, and auto detects follow SIM card type
Antenna connectors	ANT0: Support all 5G NR Sub 6G& LTE& UMTS bands ANT1: Support 5G NR Sub 6G& LTE M/H/UHB& UMTS bands ANT2: Support 5G NR Sub 6G& LTE M/H/UHB& UMTS bands ANT3: Support all 5G NR Sub 6G& LTE& UMTS bands and GPS L1 simultaneously ANT4/5/6: NA

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 Cat20: DL:2Gbps/UL 150 Mbps 5G NR Sub 6G: DL: TBD/UL (TBD) 5G NR mmWave: NA
ENDC DPS	Support NSA mode ENDC Dynamic Power Sharing feature

### 5G NR Air Interface

- 3GPP Rel15 5G NR Sub-6  
Sub-6G
- Modulation UL: 256 QAM; DL: 256 QAM
- Waveform UL: CP-OFDM and DFT-S-OFDM; DL: CP-OFDM
- Sub-Carrier Spacing (SCS): 15 KHz, 30 KHz
- Duplex mode: FDD and TDD
- Operation mode: Standalone mode (SA) and Non-Standalone mode (NSA)
- CA capability: DLCA
- MIMO DL: 4 × 4 MIMO;
- EN-DC: LTE and NR sub-6 GHz dual connectivity

### LTE Air Interface

#### LTE Rel15

- 20 layers and 2 Gbps downlink (DL) throughput – 4 × 4 MIMO across 5x CA
- 150 Mbps uplink (UL) throughput – 40 MHz ULCA and 256 QAM
- LAA (Licensed assist access) across 80 MHz
- CA capability:
  - DLCA
    - Inter-band DLCA
    - Intra band contiguous CA
    - Intra band non contiguous
  - ULCA
    - Inter band ULCA (Depend on Customer requirements)
    - Intra band contiguous CA
- Modulation UL: 256 QAM; DL: 256 QAM
- 4 × 2 MIMO 7x CA (R15)
- 4 × 4 MIMO 5x CA (R15)
- FDD + TDD CA



#### 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
- R8 DC-HSPA+  
Downlink dual carrier with 64 QAM (SISO); up to 42 Mbps

#### GNSS

- GPS, GLONASS, Galileo, and BeiDou support
- Two GNSS paths to support simultaneous L1
- Customizable tracking session
  - Automatic tracking session on startup
  - Concurrent standalone GPS, GLONASS , BeiDou and Galileo
  - gpsOneXTRA with GPS + GLONASS + BeiDou+ Galileo support

## 1.2 EUTRA -NR- Dual Connectivity & Carrier Aggregation Combination

TBD

For US SKU Spec.

Feature	Description
Physical	PCI express M.2 module, size 3042,Key.B,75Pin golden finger
Electrical	5Vdc ( Host Equipment ) 3.135Vdc~3.63Vdc ( Module )
Shielding design	Shield case on board design, no additional shielding requirement
Operating Bands	<p>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)            Band 6 (cover by B5): 830 to 840 MHz (UL), 875 to 885 MHz (DL)            Band 19 (cover by B5): 830 to 845 MHz (UL), 875 to 890 MHz (DL)</p> <p>LTE FDD/TDD 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)            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 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)</p>
Operating Bands	<p>LTE 3.5G            Band 48: 3550 to 3700 MHz (UL/DL)</p>

	5G NR Sub 6GHz ( STA Mode ) n38: 2570 to 2620 MHz (UL/DL)  5G NR FR1 EN_DC <table border="1"> <thead> <tr> <th rowspan="2">5G NR</th> <th colspan="3">FCC 5G FR1</th> <th rowspan="2">ENDC</th> </tr> <tr> <th>Band</th> <th>SCS</th> <th>Bandwidth (MHz)</th> </tr> </thead> <tbody> <tr> <td>n2</td> <td>15kHz</td> <td>5/10/15/20</td> <td>Band 5/12/13/30/48/66</td> </tr> <tr> <td>n5</td> <td>15kHz</td> <td>5/10/15/20</td> <td>Band 2/7/12/48/66</td> </tr> <tr> <td>n7</td> <td>15kHz</td> <td>5/10/15/20</td> <td>Band 5/12</td> </tr> <tr> <td>n12</td> <td>15kHz</td> <td>5/10/15</td> <td>Band 2/66</td> </tr> <tr> <td>n41</td> <td>30kHz</td> <td>20/40/50/60/80/90/100</td> <td>Band 2/25/26/66/41</td> </tr> <tr> <td>n66</td> <td>15kHz</td> <td>5/10/15/20</td> <td>Band 5/12/13/30/48/71</td> </tr> <tr> <td>n71</td> <td>15kHz</td> <td>5/10/15/20</td> <td>Band 2/7/66</td> </tr> </tbody> </table>	5G NR	FCC 5G FR1			ENDC	Band	SCS	Bandwidth (MHz)	n2	15kHz	5/10/15/20	Band 5/12/13/30/48/66	n5	15kHz	5/10/15/20	Band 2/7/12/48/66	n7	15kHz	5/10/15/20	Band 5/12	n12	15kHz	5/10/15	Band 2/66	n41	30kHz	20/40/50/60/80/90/100	Band 2/25/26/66/41	n66	15kHz	5/10/15/20	Band 5/12/13/30/48/71	n71	15kHz	5/10/15/20	Band 2/7/66
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n7	15kHz	5/10/15/20	Band 5/12																																		
n12	15kHz	5/10/15	Band 2/66																																		
n41	30kHz	20/40/50/60/80/90/100	Band 2/25/26/66/41																																		
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#### 5G NR Air Interface

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Sub-6G
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- Waveform UL: CP-OFDM and DFT-S-OFDM; DL: CP-OFDM
- Sub-Carrier Spacing (SCS): 15 KHz, 30 KHz
- Duplex mode: FDD and TDD
- Operation mode: Standalone mode (SA) and Non-Standalone mode (NSA)
- CA capability: DLCA
- EN-DC: LTE and NR sub-6 GHz dual connectivity
- **MIMO: 1 TX × 4 RX**

#### LTE Air Interface

##### LTE Rel14

- 20 layers and 2 Gbps downlink (DL) throughput – **4 RX MIMO** across 5x CA
- 200 Mbps uplink (UL) throughput – 40 MHz ULCA and 256 QAM
- LAA (Licensed assist access) across 80 MHz
- CA capability:

#### DLCA

- Inter-band DLCA
- Intra band contiguous CA
- Intra band non contiguous

#### ULCA

- Intra band contiguous CA

- Modulation UL: 256 QAM; DL: 1024 QAM
- FDD + TDD CA
- **MIMO: 1 TX × 4 RX**

#### 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
- R8 DC-HSPA+  
Downlink dual carrier with 64 QAM (SISO); up to 42 Mbps
- **MIMO: 1 TX × 4 RX**

#### GNSS

- GPS, GLONASS, Galileo, and BeiDou support
- Two GNSS paths to support simultaneous L1 and /L5
- Customizable tracking session
  - Automatic tracking session on startup
  - Concurrent standalone GPS, GLONASS , BeiDou and Galileo
  - gpsOneXTRA with GPS + GLONASS + BeiDou+ Galileo support

### 1.3 Host integration instructions

Install module through golden finger.

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#### 1.4 Host product testing guidance

HOST must follow section 3 of KDB 996369 D04 Module Integration Guide v01, to verify that the host product meets all the applicable FCC rules.

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