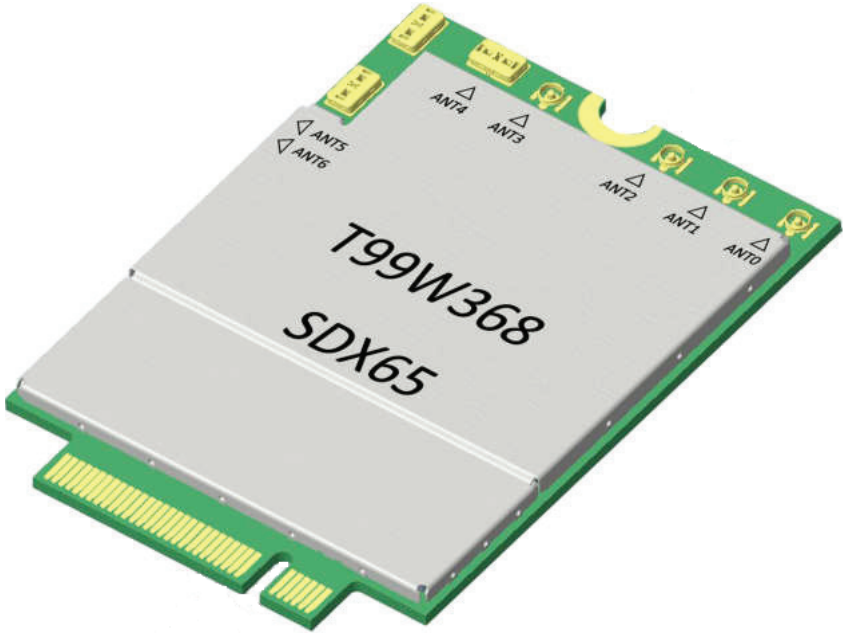
5GNR/ LTE-Advanced PCI Express M.2 Module (Sub 6G, mmWave, LTE, UMTS)

Engineering Requirements Specification



Project code: T99W368
Solution: SDX65+2x SDR735+SMR546
SKU: WW-2-5G

Reviewers

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

CONTENTS

1. General Description

T99W368 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. T99W368 is the data card solution that delivers wireless wide-area network (WWAN) connectivity for the 5GNR (Sub 6G/ mmWave), LTE, UMTS (HSDPA/HSUPA/HSPA+DC-HSPA+) and GPS/Glonass/ Beidou/ Galileo protocols in one hardware configuration.

SKU		WW-1-5G / T99W368
Carrier Support		NA: AT&T, Verizon, T-Mobile WW: Vodafone, Swisscom, Telefonica-O2 EU: Deutsche Telekom, Swisscom APAC: Telstra, Optus, Docomo, KDDI, Softbank China: CMCC/CUCC/CTCC * Carrier engagement based on real business agreement
QCT Solution		SDX65+2x SDR735+SMR546+PMX65
5G	FR1 (Sub 6G)	LB: n5/8/12/13/14/18/20/26/28/71; MB: n1/2(25)/3/66/70/75/76; HB: n7/30/38/40/41/48/53/77/78/79
	FR2 (mmWave)	n257/258/260/261 (UL 2X2+4CC or 1X1+8CC)
	4x4 MIMO	n1/2(25)/3/66/70/7/30/38/40/41/48/53/75/76/77/78/79
	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: B7/30/34/38/39/40/41/42/43/48
	4x4 MIMO	B1/25(2)/3/66(4)/7/30/40/41(38)/42/43/48
	LAA	B46 (DL only)
	LTE Cat.	ue-CategoryUL 18 (UL: 211Mbps) + ue-CategoryDL 20 (DL: 2Gbps); 7xDL CA, 2xUL CA, 5xDL CA+4X4 MIMO (Up to Cat20)
3G	WCDMA	HSPA+ Rel8 (DL/UL: up to 42/11 Mbps)
	Support Band	B1/2/4/5/8/
GNSS		Dual-Frequency GNSS: L1: GPS/Glonass/Beidou/Galileo, L5: GPS/Beidou/Galileo
eSIM		Dual SIM with eSIM on board (eSIM is option), Dual SIM Dual Active (DSDA)
Interface		USB3.1 Gen2, PCIe3 x2 Lane or PCIe 4 x1 Lane
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 × W × H): 42 mm × 30 mm × 2.6 mm, maximum height=2.75mm (add 0.15mm tolerance)
Shielding design	Shield case on board design, no additional shielding requirement
Weight	Approximately ~8g
USIM	Off-board USIM connector supported on Host through USIM1; e-SIM embedded on Module through USIM2
Operating Bands	WCDMA/HSDPA/HSUPA/HSPA+ operating bands: Band 1: 1920 to 1980 MHz (UL), 2110 to 2170 MHz (DL) 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 8: 880 to 915 MHz (UL), 925 to 960 MHz (DL)
	LTE FDD/TDD operating bands: Band 1: 1920 to 1980 MHz (UL), 2110 to 2170 MHz (DL) Band 2: 1850 to 1910 MHz (UL), 1930 to 1990 MHz (DL) Band 3: 1710 to 1785 MHz (UL), 1805 to 1880 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 8: 880 to 915 MHz (UL), 925 to 960 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 18: 815 to 830 MHz (UL), 860 to 875 MHz (DL) Band 19: 830 to 845 MHz (UL), 875 to 890 MHz (DL) Band 20: 832 to 862 MHz (UL), 791 to 821 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 28: 703 to 748 MHz (UL), 758 to 803 MHz (DL) Band 29: 717 to 728 MHz (DL) Band 30: 2305 to 2315 MHz (UL) 2350 to 2360 MHz (DL) Band 32: 1452 to 1496 MHz (DL) Band 34: 2010 to 2025 MHz (UL/DL) Band 38: 2570 to 2620 MHz (UL/DL) Band 39: 1880 to 1920 MHz (UL/DL) Band 40: 2300 to 2400 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)

Operating Bands	LTE 3.5G Band 42: 3400 to 3600 MHZ (UL/DL) Band 43: 3600 to 3800 MHZ (UL/DL) Band 48: 3550 to 3700 MHZ (UL/DL)
	LAA Band 46: 5150 to 5925 MHZ (DL)
	5GNR 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) n13: 777 to 787 MHz (UL), 746 to 756 MHz (DL) n14: 788 to 798 MHz (UL), 758 to 768 MHz (DL) n18: 788 to 798 MHz (UL), 758 to 768 MHz (DL) n20: 832 to 862 MHz (UL), 791 to 821 MHz (DL) n25: 1850 to 1915 MHz (UL), 1930 to 1995 MHz (DL) n26: 814 to 849 MHz (UL), 859 to 894 MHz (DL) n28: 703 to 748 MHz (UL), 758 to 803 MHz (DL) n30: 2305 to 2315 MHz (UL) 2350 to 2360 MHz (DL) n38: 2570 to 2620 MHz (UL/DL) n40: 2300 to 2400 MHz (UL/DL) n41: 2496 to 2690 MHz (UL/DL) n48: 3550 to 3700 MHZ (UL/DL) n53: 2483.5 to 2495 MHz (UL/DL) n66: 1710 to 1800 MHz (UL), 2110 to 2200 MHz (DL) n70: 1695 to 1710 MHz (UL), 1995 to 2020 MHz (DL) n71: 663 to 698 MHz (UL), 617 to 652 MHz (DL) n75: 1432 to 1517 MHz (DL) n76: 1427 to 1432 MHz (DL) n77: 3300 to 4200 MHz (UL/DL) n78: 3300 to 3800 MHz (UL/DL) n79: 4400 to 5000 MHz (UL/DL)
	5GNR mmWave n257: 26500 to 29500 MHz (UL/DL) n258: 24250 to 27500 MHz (UL/DL) n260: 37000 to 40000 MHz (UL/DL) n261: 27500 to 28350 MHz (UL/DL)
Diversity/2nd Rx	All operating bands
4x4 MIMO Rx	LTE-B1/25(2)/3/66(4)/7/30/40/41(38)/42/43/48 5GNR-n1/2(25)/3/7/30/38/40/41/48/53/66/70/75/76/77/78/79

GNSS	GPS: L1 (1575.42MHz); L5 (1176MHz) GLONASS: G1 (1602MHz) BeidouB1(1561.098MHz) Galileo E1 (1575.42); E5a (1176MHz)
USIM Voltage	Support 1.8V and 2.85V, and auto detects follow SIM card type
Antenna connectors	ANT0: Support all 5GNR Sub 6G& LTE& UMTS bands ANT1: Support 5GNR Sub 6G& LTE M/H/UHB& UMTS bands ANT2: Support 5GNR Sub 6G& LTE M/H/UHB& UMTS bands ANT3: Support all 5GNR Sub 6G& LTE& UMTS bands and GPS L1/L5 simultaneously ANT4/5/6: Support mmWave IF
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 211 Mbps 5GNR Sub 6G: DL: 6.2Gbps/UL 900Mbps 5GNR mmWave: DL: 10Gbps/UL 3.4Gbps

5GNR Air Interface

- 3GPP Rel16 5G NR sub-6&mmWave
  mmWave
- mmWave IF chip with integrated QLink in the 14 nm process and pairing with QTM545 to support the 3GPP Release 16 5G-NR mmWave standard
- 64 QAM uplink/downlink in mmWaveTDD
- Supports mmWave bands: n257 (28 GHz), n258 (26 GHz), n260 (39 GHz), and n261 (28 GHz)
  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; UL: 2 × 2 MIMO on n41/n77/n78/n79
- 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
- 211 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 and /L5
- Customizable tracking session
  - Automatic tracking session on startup
  - Concurrent standalone GPS, GLONASS , BeiDou and Galileo
  - gpsOneXTRA with GPS + GLONASS + BeiDou+ Galileo support

2 Power consumption

Test condition	Estimated Power Range (Typical)	Estimated Power Range (Max.)	Remark
WCDMA (Tx=23.5dBm)	<1000 mA	<1200 mA	
LTE (Tx=23dBm)	<1300 mA	<1500 mA	
LTE 5CA mode 4x4, Tx=23dBm	<1700 mA	<2000 mA	
5G NR Sub-6 DLCA mode 4x4, NR Tx=23dBm	<1500 mA	<2000 mA	
5G NR Sub-6 ENDC mode 4x4, LTE&NR Tx=23dBm	<1700 mA	<2000 mA	
GNSS tracking	<150 mA	<300 mA	