

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

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Reviewers

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CONTENTS

1.	GENERAL DESCRIPTION.....	5
1.1	SYSTEM MAIN FEATURE.....	6
2.	POWER CONSUMPTION.....	10



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 5G NR (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)/3/66/70/73/30/38/40/41/48/53/75/76/77/78/79
	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)
	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) 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)
	5G NR 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 5G NR-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	