T1 Telco Accelerator Card Data Sheet

DS999 (v1.0) December 17, 2021 **Product Specification**

Summary

The Xilinx® T1 Telco accelerator card is built for deployment at 5G mobile edge virtualized baseband units (vBBUs) and O-RAN compliant distributed units (O-DUs) for baseband and fronthaul acceleration. It is a single-slot, full-height, half-length (FHHL) card and features the 16 nm ZU19EG Zynq® UltraScale+™ MPSoC and ZU21DR Zynq® UltraScale+™ RFSoC devices.

The Zynq UltraScale+ MPSoC ZU19EG device on the T1 card manages the fronthaul optical connections between the radio units (RRUs) and the distributed unit (5G base stations). The Zynq UltraScale+ RFSoC ZU21DR device integrates a standard cell ASIC block, Soft-Decision Forward Error Correction (SD-FEC), which supports Low Density Parity Check (LDPC) decode and encode in a power-efficient, high-performance, and cost-effective manner.

The T1 card has a bifurcated PCIe® Gen3 x16 interface, providing x8 links from the host to each Zynq UltraScale+ MPSoC and Zynq UltraScale+ RFSoC device. The card is passively cooled, has two SFP28 network connections, and a maximum electrical power limit of 75W.

Target applications for the T1 card include the following:

- 5G fronthaul termination
- 5G layer 1 (L1) function lookaside acceleration (L1 offload)
- Optional use of fronthaul ports for a midhaul (F1) interface between distributed and centralized units (DU and CU)

Xilinx programmable logic devices and SoCs provide the most suitable environment for accelerating these functions in lookaside or inline modes of operation in conjunction with x86 or Arm®-based CPUs. The T1 Telco accelerator card enables Telco service providers to maximize CPU savings by offloading compute intensive radio access network (RAN) workloads to the card, enabling high-performance virtualized RAN.

Figure 1: **T1 Telco Accelerator Card**

Product Details

Table 1: **T1 Telco Accelerator Card Specifications**

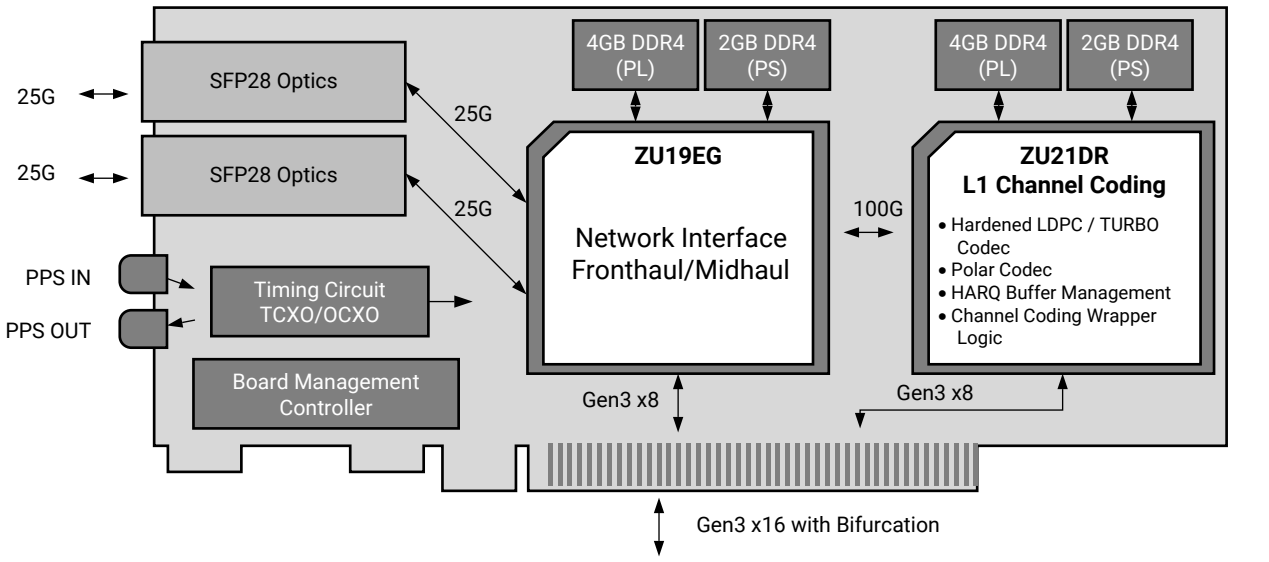
Specification	T1 Telco Accelerator Card	
Production product SKU	TA-T1-P12G-PQ-EV (encryption enabled) TA-T1-P12G-PQ-DV (encryption disabled)	
PCIe® lanes	Gen3 x16 bifurcated to 2x Gen3 x8	
Total thermal design power	70W	
Thermal cooling solution	Passive	
Weight	580 g	
Onboard memory	Programmable logic (PL): 1x bank of 4 GB x72 (64-bit + 8-bit ECC) Processing system (PS): 1x bank of 2 GB x 40 (32-bit + 8-bit ECC) Total capacity 4 GB in PL in each Zynq UltraScale+ MPSoC and Zynq UltraScale+ RFSoC device Total capacity 2 GB in PS in each Zynq UltraScale+ MPSoC and Zynq UltraScale+ RFSoC device	
Form factor	FHHL	
Network interfaces	2x SFP28	
Power	75W – supplied through the PCIe connector, composed of 3A max on the 3.3V rail and 5.5A max on the 12V rail	
Clocking	IEEE 1588-v2 network synchronizer timing circuit with PPS In/Out connectors	
SOC resources	XCZU19EG-L2FFVD1760E	XCZU21DR-L2FSVD1156E4947
Application processing unit (APU)	Quad-core Arm® Cortex®-A53 MPCore up to 1.5 GHz	Quad-core Arm Cortex-A53 MPCore up to 1.3 GHz
Real-time processing unit (RPU)	Dual-core Arm® Cortex®-R5F MPCore up to 600 MHz	Dual-core Arm Cortex-R5F MPCore up to 533 MHz
CLB lookup tables (LUTs) (K)	523	425
System logic cells (K)	1143	930

Table 1: **T1 Telco Accelerator Card Specifications** *(cont'd)*

Specification	T1 Telco Accelerator Card	
DSP slices	1,968	4,272
Maximum distributed RAM (Mb)	9.8	13
Total block RAM (Mb)	34.6	38
UltraRAM (Mb)	36	22.5

The Zynq UltraScale+ MPSoC and Zynq UltraScale+ RFSoC devices are at the core of the T1 card architecture. See the Zynq UltraScale+ MPSoC Product Selection Guide and the Zynq UltraScale+ RFSoC Product Selection Guide for more details about these devices.

Figure 2: **T1 Card High-Level Block Diagram**



PCIe Connector/Data Rates

The T1 card is compliant to the PCI Express Base Specification Revision 3.1 (registration required) supporting up to 8.0 GT/s (Gen3) per lane data rates. The PCI Express fingers support 16 lanes (x16) which are bifurcated into two x8 PCIe interfaces. Each x8 interface goes to each of the ZU19EG Zynq UltraScale+ MPSoC and ZU21DR Zynq UltraScale+ RFSoC devices. Servers must support bifurcation and have bifurcation enabled for the slot where the T1 card is inserted to enable host connectivity to both devices.

Network Interfaces

The Zynq® UltraScale+™ MPSoC ZU19EG device in the T1 card is connected to two SFP28 cages allowing for two 25 GbE ports (the total supported T1 bandwidth is 50 Gb).

Satellite Controller

A satellite controller resides on the T1 card to control and monitor voltages, currents, and temperatures. The host server board management controller (BMC) can interact with the satellite controller to monitor and control the T1 card through out-of-band communication. Xilinx supports the PLDM protocol over MCTP over SMBUS, complying with DMTF standards.

Power and Electrical

Board power is estimated based on the fronthaul and layer 1 offload reference design (contact your Xilinx sales representative for more information). All components are assumed to be at maximum process and running at the maximum supported bitrate in a 5G NR O-RAN compliant distributed unit deployment.

Programmable logic designers creating their own workloads are encouraged to follow Xilinx power estimation practices as documented in *Xilinx Power Estimator User Guide* (UG440).

Table 2: **Summary: Fronthaul and Layer 1 Primary Use Mode**

T_j Conditions	ZU19EG Zynq® UltraScale+™ MPSoC	ZU21DR Zynq® UltraScale+™ RFSoC	Components	Total
Typical power at 100°C (W)	20.7	20.7	26.3	67.7
Maximum power at 100°C (W)	23.5	23	26.3	72.8
Maximum power at 90°C (W)	21.6	21.3	26.3	69.2
Maximum power at 80°C (W)	20.2	20	26.3	66.5

Card Specifications

Dimensions

The T1 card is compliant with the PCI Express® Card Electromechanical Specification Revision 3.0 (registration required) as a single-slot, full-height, half-length card.

Table 3: **Card Dimensions**

Parameter	Dimension
Height	0.72 inch (18.3 mm)
Width	4.38 inch (111.15 mm)
Length	6.59 inch (167.5 mm)
Weight	581g

Thermal Specifications

Airflow Requirements

The T1 card supports airflow in either direction. The following table shows the thermal specification for T1 cards operating at sea level.

Table 4: **Airflow Requirements**

Specification	Requirements
Inlet temperature	≤ 55°C
Inlet air speed	≥ 600 LFM uniform velocity
Minimum velocity air pressure	0.8 inAq
QSFP case temperature for airflow entering PCIe bracket	QSFP(≤ 2.5W) case should be rated 70°C
QSFP case temperature for airflow exiting PCIe bracket	QSFP (≤ 2.5W) case should be rated 85°C
Airflow entering PCIe bracket area	104.6 mm x 13.2 mm
Airflow exiting PCIe bracket area	98.4 mm x 20.3 mm
Total thermal design power	70W

Notes:

1. The T1 card is targeted to operate in compliance with the NEBS-Gr63 environment specification and the ETS 300 019 specification with an inlet ambient from -5°C to 55°C. For more information, contact your Xilinx sales representative.

Inlet Temperature versus Airflow Requirement in Server

The following tables provide the required airflow rate and airflow speed to the T1 Telco accelerator card under various operating conditions.

T1 Normal Flow Specification for SFP Rated 85°C

Table 5: **Normal Flow (Exhaust Air from I/O Bracket) at Sea Level**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (98.4 mm x 20.33 mm) between Sea Level and 61m below Sea Level for 70W Total Card Power						
Inlet Temperature to the Card	With SFP (85°C, 1.5W)			Without SFP (85°C, 1.5W)[1]		
	CFM	LFM	Static Pressure	CFM	LFM	Static Pressure
-5 ~ 25	1.5	70	0.04	1.5	70	0.04
30	1.8	90	0.05	1.8	90	0.05
35	2.2	110	0.06	2.2	110	0.06
40	2.8	140	0.08	2.8	130	0.08
45	3.8	180	0.12	3.7	180	0.11
50	5.4	260	0.19	5.4	250	0.19
55	8.8	410	0.38	8.7	410	0.37

Notes:

1. A card without SFP allocates more power in the FPGA than one with SFP.

Table 6: **Normal Flow (Exhaust Air from I/O Bracket) at 1800m above Sea Level**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (98.4 mm x 20.33 mm) at 1800m above Sea Level for 70W Total Card Power						
Inlet Temperature to the Card	With SFP (85°C, 1.5W)			Without SFP (85°C, 1.5W)[1]		
	CFM	LFM	Static Pressure	CFM	LFM	Static Pressure
-5 ~ 25	1.7	80	0.04	1.6	80	0.04
30	2	100	0.05	2	100	0.05
35	2.5	120	0.07	2.4	120	0.06
40	3.1	150	0.09	3.1	150	0.08
45	4.2	200	0.13	4.2	200	0.12
50	6.1	290	0.22	6	280	0.2
55	9.9	460	0.45	9.8	460	0.42

Notes:

1. A card without SFP allocates more power in the FPGA than one with SFP.

T1 Normal Flow Specification for SFP Rated 70°C

Table 7: **Normal Flow (Exhaust Air from I/O Bracket) at Sea Level**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (98.4 mm x 20.33 mm) between Sea Level and 61m below Sea Level for 70W Total Card Power						
Inlet Temperature to the Card	With SFP (70°C, 1.5W)			Without SFP (70°C, 1.5W)[1]		
	CFM	LFM	Static Pressure	CFM	LFM	Static Pressure
-5 ~ 25	3.5	170	0.11	2.7	130	0.07
30	4	190	0.13	3	150	0.08
35	4.6	220	0.15	3.4	160	0.09
40	5.5	260	0.19	4	190	0.11
45	6.8	320	0.26	4.6	220	0.14
50	8.8	410	0.38	5.4	260	0.18
55	12.5	590	0.66	6.5	310	0.23

Notes:

1. A card without SFP allocates more power in the FPGA than one with SFP.

Table 8: **Normal Flow (Exhaust Air from I/O Bracket) at 1800m above Sea Level**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (98.4 mm x 20.33 mm) at 1800m above Sea Level for 70W Total Card Power						
Inlet Temperature to the Card	With SFP (70°C, 1.5W)			Without SFP (70°C, 1.5W)[1]		
	CFM	LFM	Static Pressure	CFM	LFM	Static Pressure
-5 ~ 25	3.9	190	0.12	3	140	0.08
30	4.5	210	0.15	3.4	160	0.09
35	5.2	250	0.18	3.8	180	0.11
40	6.2	290	0.23	4.4	210	0.13
45	7.6	360	0.31	5.2	250	0.16

Table 8: **Normal Flow (Exhaust Air from I/O Bracket) at 1800m above Sea Level** *(cont'd)*

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (98.4 mm x 20.33 mm) at 1800m above Sea Level for 70W Total Card Power						
Inlet Temperature to the Card	**With SFP (70°C, 1.5W)**			**Without SFP (70°C, 1.5W)[1]**		
	CFM	**LFM**	**Static Pressure**	**CFM**	**LFM**	**Static Pressure**
50	9.9	460	0.45	6.1	290	0.21
55	14.1	660	0.79	7.3	350	0.27

Notes:

1. A card without SFP allocates more power in the FPGA than one with SFP.

T1 Reverse Flow Specification for SFP Rated 70°C or 85°C

Table 9: **Reverse Flow (Inlet Air from I/O Bracket) at Sea Level**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (104.57 mm x 13.18 mm) between Sea Level and 61m below Sea Level for 70W Total Card Power						
Inlet Temperature to the Card	**With SFP (70°C, 1.5W)**			**Without SFP (70°C, 1.5W)[1]**		
	CFM	**LFM**	**Static Pressure**	**CFM**	**LFM**	**Static Pressure**
-5 ~ 25	2	140	0.07	1.8	120	0.04
30	2.3	160	0.08	2	140	0.05
35	2.6	180	0.09	2.3	160	0.06
40	3	200	0.12	2.7	190	0.08
45	3.4	240	0.15	3.2	220	0.1
50	4	280	0.19	3.9	270	0.13
55	4.8	330	0.25	4.8	330	0.19

Notes:

1. A card without SFP allocates more power in the FPGA than one with SFP.

Table 10: **Reverse Flow (Inlet Air from I/O Bracket) at 1800m Above Sea Level**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (104.57 mm x 13.18 mm) at 1800m above Sea Level for 70W Total Card Power						
Inlet Temperature to the Card	**With SFP (70°C, 1.5W)**			**Without SFP (70°C, 1.5W)[1]**		
	CFM	**LFM**	**Static Pressure**	**CFM**	**LFM**	**Static Pressure**
-5 ~ 25	2.1	150	0.07	1.9	130	0.04
30	2.4	170	0.09	2.2	150	0.05
35	2.8	190	0.11	2.5	170	0.07
40	3.2	220	0.13	2.9	200	0.09
45	3.7	250	0.16	3.5	240	0.11
50	4.4	300	0.21	4.2	290	0.15
55	5.2	360	0.28	5.1	350	0.21

Notes:

1. A card without SFP allocates more power in the FPGA than one with SFP.

Operating and Storage Conditions

Table 11: **Operating and Storage Environmental Conditions**

Specification	Requirements
Storage temperature	–40°C to 75°C
Storage humidity, non-condensing	5% to 95%
Operating temperature	–5°C to 55°C[1]
Operating humidity, non-condensing	8% to 90%, and a dew point of –12°C

Notes:

1. Complies to Telcordia GR63 environmental conditions. Power and thermal simulations should be done to ensure the card is within limits for a given server, load, and airflow.

References

These documents provide supplemental material useful with this guide:

1. *Xilinx Power Estimator User Guide* (UG440)
2. PCI Express® Card Electromechanical Specification Revision 3.0 (registration required)
3. PCI Express Base Specification Revision 3.1 (registration required)

Regulatory Compliance Statements

FCC Class A Products

The products referred to in this document are listed below:

- TA-T1-P12G-PQ-EV (encryption enabled)
- TA-T1-P12G-PQ-DV (encryption disabled)

***Note*:** These devices are for use with UL Listed Servers or I.T.E.

Regulatory compliance statements are valid for the production version of this product; not for engineering sample (ES) products.

***Note*:** These products are currently certified for use in Japan only.

Safety

The following safety standards apply to all products listed in this document.

IEC 62368-1, 2nd Edition, 2014/A11:2017, *Information technology equipment – Safety, Part 1: General requirements*

EN 62368-1, 2nd Edition, 2014/A11:2017, *Information technology equipment – Safety, Part 1: General requirements*

UL 62368-1, 2nd Edition, 2014-12-01, *Information technology equipment – Safety, Part 1: General requirements*

CSA C22.2 No. 62368-1-14, 2nd Edition, 2014-12-01, *Information Technology Equipment – Safety, Part 1: General Requirements*

EMC Compliance

Class A Products

The following standards apply:

- FCC Part 15 – Radiated & Conducted Emissions (USA)
- CISPR 32 – Radiated & Conducted Emissions (International)
- VCCI (Class A)– Radiated & Conducted Emissions (Japan)

Regulatory Compliance Markings

When required, these products are provided with the following product certification markings:

- VCCI marking

FCC Class A User Information

The Class A products listed above comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

CAUTION! *This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. 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. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their own expense.*

ATTENTION! *Cet équipement a été testé et jugé conforme à la Class A digital device, conformément à la règle 15 du standard FCC. Ces limites sont conçues pour fournir des protections contre des interférences nuisibles lorsque l'équipement est utilisé dans un environnement commercial. Cet équipement génère, utilise et peut émettre des énergies de radio-fréquence et, s'il n'est pas installé et utilisé conformément aux instructions, peut nuire aux communications radio. L'exploitation de cet équipement dans une zone résidentielle est susceptible de causer des interférences nuisibles, auquel cas l'utilisateur peut être tenu de prendre des mesures adéquates à ses propres frais.*

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Revision History

The following table shows the revision history for this document.

Section	Revision Summary
12/17/2021 Version 1.0	
Initial release.	N/A

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