Alveo U45N Data Center Accelerator Card Data Sheet

DS1014 (v1.0) June 23, 2023 **Product Specification**

Summary

The AMD Alveo™ U45N data center accelerator card brings true convergence of network, compute, and storage acceleration to a single platform allowing data processing with maximum efficiency while avoiding unnecessary data movements and CPU processing. It enables cloud service providers to customize their own infrastructure workloads and enables the deployment of bare-metal services. The Alveo U45N is a single-slot, half-length, full-height form factor card that features an XCU26 FPGA (XCU26-L2VSVA1365E). The card is passively cooled and has two QSFP28 network connections and x16 PCIe® Gen3/Gen4 x8 interfaces. The card has a maximum electrical power limit of 150W.

Figure 1: **Alveo U45N Data Center Accelerator Card**

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Product Details

Table 1: **Alveo U45N Accelerator Card Product Details**

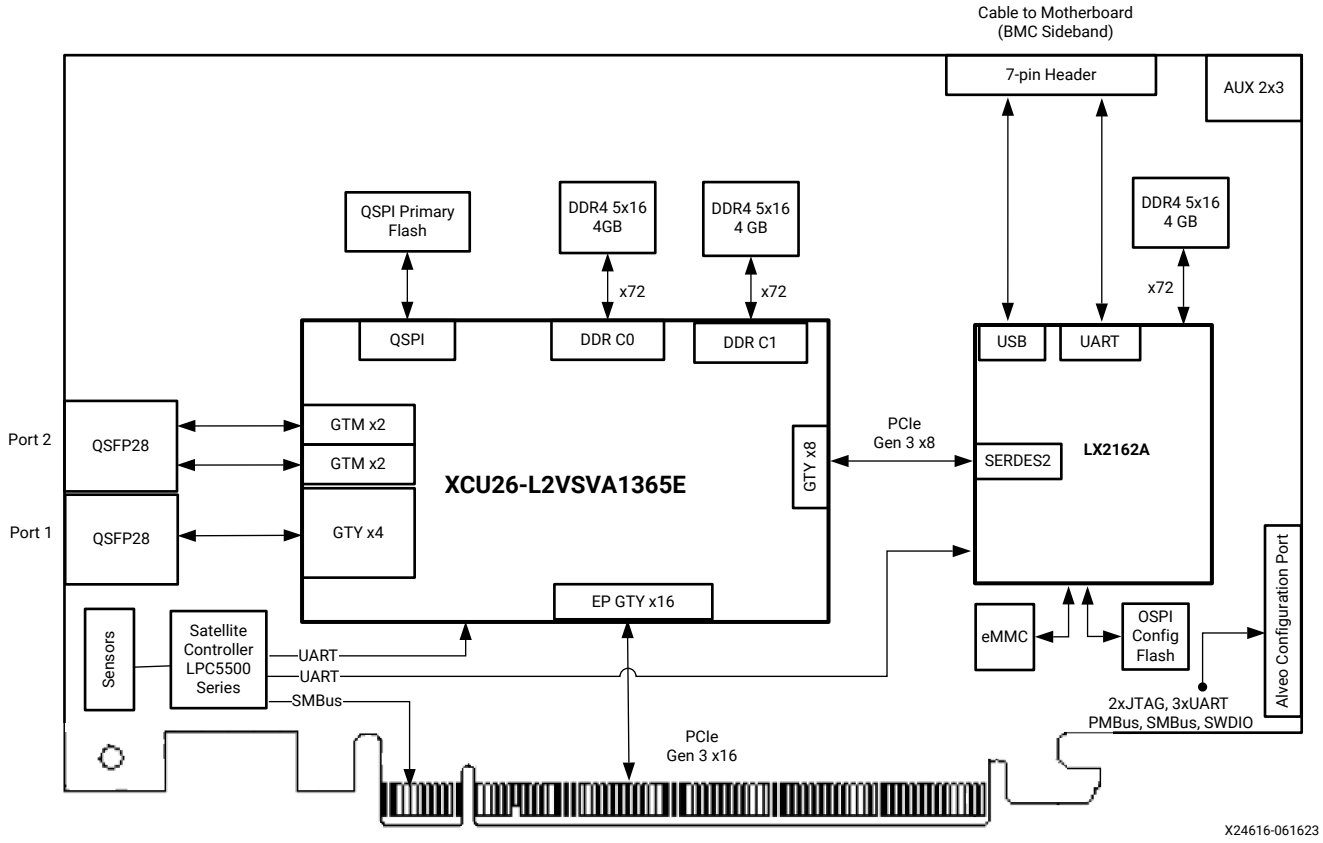
Specification	Alveo U45N Accelerator Card
Production product SKU	A-U45N-P08G-PQ-G (2x100G DC accelerator card)
Total electrical card load	• 75W (without PCIe AUX power) • 150W (with PCIe AUX power)
Thermal design power (TDP)	• 70W (without PCIe AUX power) • 115W (with PCIe AUX power)
Thermal cooling solution	Passive
Form factor	Full height, half length, single slot
Network interface	2 x QSFP28
PCIe interface	Gen 3 x16/Gen 4 x8 to host system and Gen 3 x8 to communications processor
Configuration	• 2 Gb OSPI flash memory • Configurable over ADK2 configuration port
FPGA	
FPGA DDR	Two 4 GB DDR4 component interface 72b with ECC operating at 2400 MT/s
LUTs/Registers/DSP slices	1030K/2059K/1320
Maximum distributed RAM/block Ram/UltraRAM	14.2 Mb/74.3 Mb/99 Mb
Communications Processor	
Arm processor	NXP Layerscape LX2162A
Cores	16 Arm v8 Cortex-A72 CPU cores, running up to 2.0 GHz
Cache buffer	16 MB cache
Packet buffer	2 MB packet caching buffer
Connection to FPGA	PCIe Gen 3 x8
DDR	4 GB DDR4 component x72 up to 2400 MT/s
System storage	Flash: NAND 128 Gb (16G x 8) eMMC for root file system
	Flash: NOR 512 Mb SERIAL MT35X OSPI for boot

Card Specifications

Block Diagram

The high-level block diagram for the Alveo U45N accelerator card is given in the following figure.

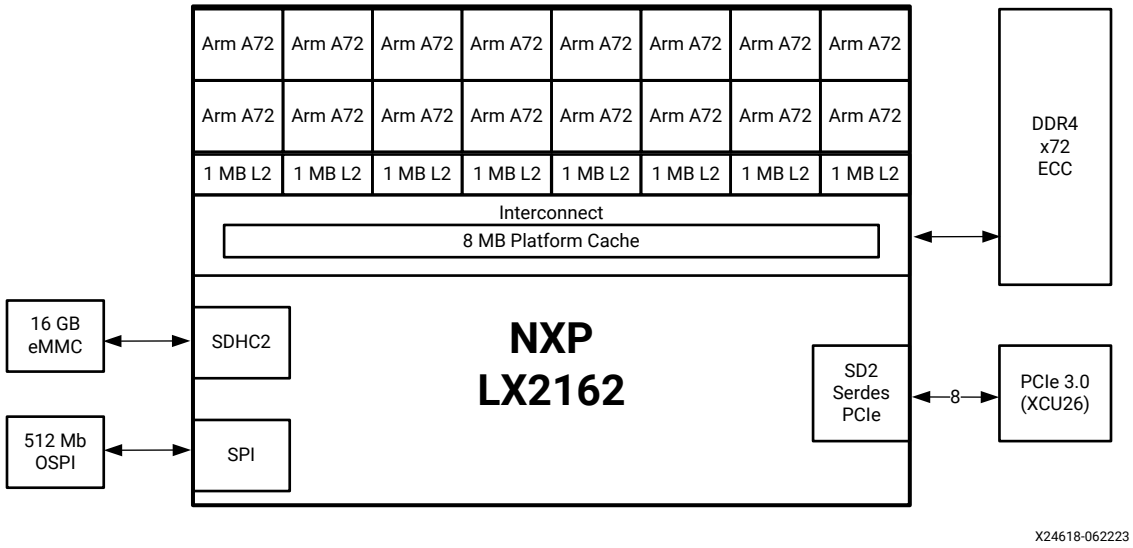
Figure 2: **Alveo U45N Accelerator Card Block Diagram**



The XCU26 is based on the 16 nm AMD UltraScale™ architecture. The programmable logic (PL) region is connected to two QSFP28 cages. The XCU26 also has two 4 GB x72 of DDR4 memory component interfaces and a PCIe CEM 3.0 compliant x16 edge-finger interface.

The XCU26 is connected to an NXP Layerscape LX2162A Arm processor through a PCIe 3.0 compliant x8 interface. The LX2162A supports 16 Cortex-A72 cores, a 46 Gb/s security engine and an 88 Gb/s data compression engine. For system applications, the LX2162A has a dedicated DDR4 memory interface with 4 GB x72 DDR4, a dedicated 16 GB eMMC NAND, and a 512 Mb OSPI NOR flash. The Arm processor on the U45N accelerator card helps to increase the server CPU efficiency and lower total costs by offloading workloads from the host. For more information on utilizing the LX2162A, contact AMD sales representative.

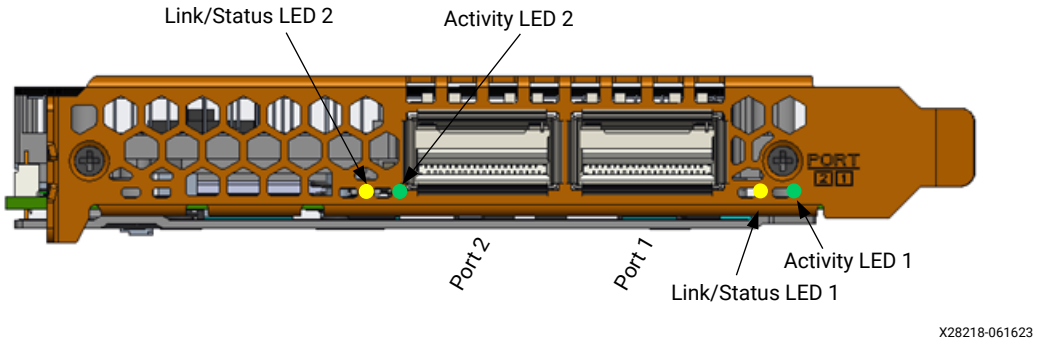
Figure 3: **XCU26 Communication Processor Floorplan**



Network Interfaces

The following figure shows the QSFP28 port location and number along with the activity and link/status LEDs associated with each port.

Figure 4: **Network Port and LED Locations**



The following table provides the QSFP port to GT Quad mapping.

Table 2: **QSFP Port to GT Quad Mapping**

QSFP Port	QSFP GT Quad
1	GTM 233 (lanes 3 and 4) and GTM 234 (lanes 1 and 2)
2	GTY 231

Network LEDs

The following table list the two LEDs present for each QSFP port. The LEDs are visible through the I/O bracket as shown in Figure 4. In addition, it provides recommended operation along with the source control logic.

Table 3: **QSFP LEDs**

LED	Colors	Recommended Operation	Control
Link/Status	Yellow/Green	Green when physical link is present and operating at the highest supported link rate. Yellow when operating at lower rates. Off in the absence of physical link.	FPGA
Activity	Green	LED illuminated or blinking green to show link activity. Off when there is no activity.	FPGA

Network MAC Addresses

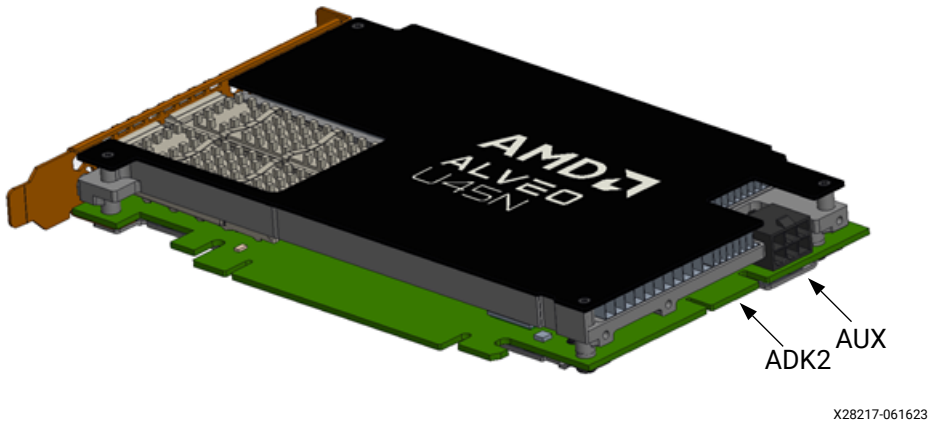
Sixteen contiguous MAC addresses are available. First and last addresses are listed on the MAC address label on the card in addition to the manufacturing and IPMI EEPROMs.

PCIe AUX Power

The Alveo accelerator card has a 2x3 PCIe AUX power connector which can provide 75W additional power. While the card will operate with or without AUX power, application power requirements identified by the application designer will dictate the need for AUX power. The location of the PCIe AUX power connector is shown in the following figure.

***Note*:** The PCIe AUX 6-pin connector is not compatible with an ATX12V/EPS12V power cable source. Ensure that the appropriate PCIe auxiliary power source is available, and not an ATX12V/EPS12V power source.

Figure 5: **AUX Power Connector Location**



The following table shows the maximum electrical power available with and without AUX 2x3 power cable connected. At a minimum, the 75W PCIe slot power is always used.

Table 4: **Power Availability**

AUX Power Configuration	Maximum Electrical Power Available AUX 2x4
No AUX power cable connected	75W
2x3 AUX power cable connected	150W[1]

Notes:
1. Maximum card power is limited by the TDP given in Table 1.

Card Thermal and Electrical Protections

Built-in shutdown logic protects the card from damage by removing power to the device when either electrical or thermal limits (given in the following table) reach or exceed their respective card shutdown thresholds. Thermal management is implemented in the RPU which monitors the external inlet, outlet, and FPGA temperature sensors while the voltage regulator module (VRM) monitors the VCCINT current and temperature. When any of the thresholds are exceeded, card power is removed. A cold reboot of the server hosting the card is subsequently necessary to reload the device configuration and re-enumerate the card in the server.

Note: When card shutdown occurs, the card is pulled off the PCIe bus and consequently is not seen by the host. No AXI firewall trip is issued. A cold reboot of the server is required to recover.

The following table lists the card shutdown thermal and electrical thresholds. The thresholds apply equally with and without AUX power connected.

Table 5: **Thermal and Electrical Protection Thresholds**

Sensor Description	Card Shutdown Threshold
VCCINT Current	• 60A (no PCIe AUX power) • 180A (2x3 PCIe AUX power)
VCCINT Temperature	125°C
FPGA Temperature	100°C

Mechanical

The Alveo U45N accelerator card is compliant with the PCIe CEM rev. 3.0 specification as single slot, full height, half length cards. The dimensions in the following table do not include the bracket.

Table 6: **Card Dimensions**

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

Management Control

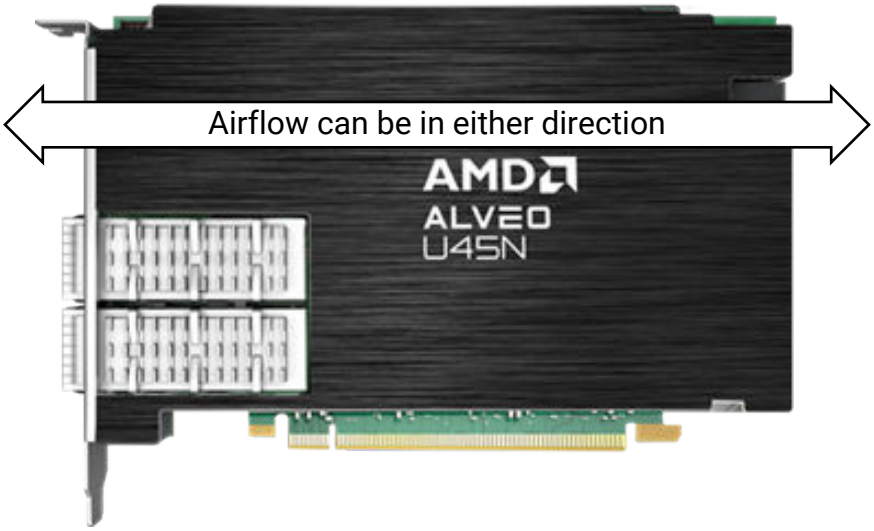
Alveo U45N accelerator card supports both in-band and out-of-band communication with the host. In-band communication is provided by PCIe bus with sixteen lanes allocated to the XCU26. In addition, in-band communication with the management subsystem, particularly reading any sensor values, is done via the satellite microcontroller on board the U45N card.

The card satellite controller (SC) provides independent supervisory and card management functions including power and temperature monitoring. The host server board management controller (BMC) can interact with the satellite controller to monitor and control the card through out-of-band communication. The card supports the PLDM protocol over MCTP over SMBUS, complying with the DMTF standards. Refer to the *Alveo Card Out-of-Band Management Specification for Server BMC* (XD038).

Thermal

The Alveo U45N accelerator card support airflow in either direction.

Figure 6: **Airflow Direction for U45N Accelerator Card**



The following table shows requirements for the Alveo U45N accelerator card that are dependent on airflow direction.

Table 7: **Airflow Direction Dependent Requirements**

Specification	Requirements
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

Inlet Temperature versus Airflow Requirement in Server

The following tables provide the required airflow rate and airflow speed to the U45N accelerator card under various operating conditions.

***Note*:** These are early estimates that might change when more accurate details on TDP and power allocation among devices become available.

Table 8: **Normal Flow at Sea Level**

Inlet Temperature vs Airflow Requirement of PCIe Card Slot (98.4 mm x 20.33 mm) at Sea Level for 115W Total Card Power						
Inlet Temperature to the Card (°C)	**With QSFP (85°C)**			**Without QSFP[1]**		
	CFM	**LFM**	**Static Pressure**	**CFM**	**LFM**	**Static Pressure**
25	7.7	359	0.26	5.9	274	0.16
30	9.1	423	0.34	6.7	313	0.20
35	11.0	510	0.46	7.8	362	0.25
40	13.6	632	0.65	9.1	425	0.32
45	17.6	816	1.00	10.9	508	0.43
50	24.0	1115	1.73	13.4	622	0.60
55	35.9	1666	3.57	16.9	787	0.91

Notes:

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

Table 9: **Normal Flow at 1200m Above Sea Level**

Inlet Temperature vs Airflow Requirement of PCIe Card Slot (98.4 mm x 20.33 mm) at 1200m Above Sea Level for 115W Total Card Power						
Inlet Temperature to the Card (°C)	**With QSFP (85°C)**			**Without QSFP[1]**		
	CFM	**LFM**	**Static Pressure**	**CFM**	**LFM**	**Static Pressure**
25	8.2	382	0.29	6.3	294	0.18
30	9.7	450	0.38	7.2	336	0.22
35	11.7	543	0.51	8.4	389	0.28
40	14.5	673	0.72	9.8	457	0.36
45	18.7	869	1.12	11.8	547	0.49
50	25.6	1187	1.93	14.4	671	0.69
55	38.2	1774	4.01	18.3	849	1.04

Notes:

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

Table 10: **Reverse Flow at Sea Level**

Inlet Temperature vs Airflow Requirement of PCIe Card Slot (104.57 mm x 13.18 mm) at Sea Level for 115W Total Card Power						
Inlet Temperature to the Card (°C)	**With QSFP (85°C)**			**Without QSFP[1]**		
	CFM	**LFM**	**Static Pressure**	**CFM**	**LFM**	**Static Pressure**
25	6.3	295	0.43	7.3	341	0.36
30	7.3	340	0.54	8.5	393	0.46
35	8.5	397	0.71	9.9	460	0.60
40	10.2	472	0.96	11.8	546	0.82
45	12.3	572	1.35	14.3	663	1.15
50	15.3	711	2.00	17.8	825	1.71
55	19.7	915	3.18	22.9	1062	2.72

Notes:

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

Table 11: **Reverse Flow at 1200m Above Sea Level**

Inlet Temperature vs Airflow Requirement of PCIe Card Slot (104.57 mm x 13.18 mm) at 1200m Above Sea Level for 115W Total Card Power						
Inlet Temperature to the Card (°C)	**With QSFP (85°C)**			**Without QSFP[1]**		
	CFM	**LFM**	**Static Pressure**	**CFM**	**LFM**	**Static Pressure**
25	6.8	316	0.48	7.9	365	0.41
30	7.8	364	0.61	9.1	422	0.52
35	9.2	426	0.80	10.6	494	0.68
40	10.9	507	1.09	12.6	587	0.93
45	13.3	616	1.54	15.4	713	1.31
50	16.5	767	2.29	19.1	889	1.96
55	21.3	987	3.66	24.7	1146	3.13

Notes:

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

Operating and Storage Conditions

Table 12: **Operating and Storage Environmental Conditions**

Specification	Requirements
Storage temperature	–40°C to 75°C
Storage humidity, non-condensing	5% to 95%
Operating temperature gradient	15°C/hour
Operating temperature	≤ 30°C

Table 12: **Operating and Storage Environmental Conditions** *(cont'd)*

Specification	Requirements
Operating humidity, non-condensing	8% to 90%, and a dew point of –12°C

Notes:

1. The above operating conditions are based on preliminary data. The U45N accelerator card is targeted to operate between an inlet ambient from 5°C to 55°C. For more information, contact your AMD sales representative.

Regulatory Compliance Statements

FCC Class A Products

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

Safety Compliance

The following safety standards apply to all products listed above.

- IEC 62368-1:2014 +A11:2017
- EU LVD Directive 2014/35/EU

EMC Compliance

Class A Products

The following standards apply:

- FCC Part 15 – Radiated & Conducted Emissions (USA)
- CAN ICES-3(A)/NMB-3(A) – Radiated & Conducted Emissions (Canada)
- CISPR 32 – Radiated & Conducted Emissions (International)
- EN55032: 2015 – Radiated & Conducted Emissions (European Union)
- EN55035:2017 – Immunity (European Union)
- EMC Directive 2014/30/EU
- VCCI (Class A)– Radiated & Conducted Emissions (Japan)
- CNS13438 – Radiated & Conducted Emissions (Taiwan)
- CNS 15663 - RoHS (Taiwan)
- AS/NZS CISPR 32 – Radiated and Conducted Emissions (Australia/New Zealand)
- Article 58-2 of Radio Waves Act, Clause 3 (Korea)

Regulatory Compliance Markings

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

- UL Listed Accessories Mark for the USA and Canada
- CE mark
- UKCA mark
- FCC markings
- VCCI marking
- Australian RCM mark
- Korea MSIP mark
- Taiwan BSMI mark
- German GS mark

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.

IMPORTANT! *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 his or her own expense.*

IMPORTANT! *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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ATTENTION! *Si l'appareil est modifié sans l'autorisation de AMD, l'utilisateur peut annuler son abilité à utiliser l'équipement.*

VORSICHT! *Wenn das Gerät ohne Erlaubnis von AMD geändert wird, kann der Benutzer seine Berechtigung zum Betrieb des Geräts verlieren.*

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CAN ICES-3(A)/NMB-3(A)

China RoHS Compliance

- SJ/T 11363-2006, 11364-2006, and GB/T 26572-2011
- RoHS 3 directive 2015/863
- EU 2015/863

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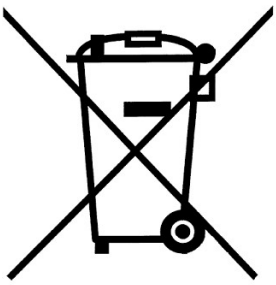

Manufacturer Declaration European Community

Manufacturer Declaration

AMD declares that the equipment described in this document is in conformance with the requirements of the European Council Directive listed below:

- Low Voltage Directive 2014/35/EU
- EMC Directive 2014/30/EU

These products follow the provisions of the European Directive 2014/53/EU.

Dette produkt er i overensstemmelse med det europæiske direktiv 2014/53/EU.

Dit product is in navolging van de bepalingen van Europees Directief 2014/53/EU.

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Dette produktet er i henhold til bestemmelsene i det europeiske direktivet 2014/53/EU.

Este produto cumpre com as normas da Diretiva Européia 2014/53/EU.

Este producto cumple con las normas del Directivo Europeo 2014/53/EU.

Denna produkt har tillverkats i enlighet med EG-direktiv 2014/53/EU.

This declaration is based upon compliance of the Class A products listed above to the following standards:

EN 55032 (CISPR 32 Class A) RF Emissions Control.

EN 55024:2010 (CISPR 24) Immunity to Electromagnetic Disturbance.

IEC 62368-1:2014 +A11:2017 Information Technology Equipment- Safety-Part 1: General Requirements.

EN 50581:2012 - Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.

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Responsible Party

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United States of America
Phone: (408) 559-7778

Revision History

The following table shows the revision history for this document.

Section	Revision Summary
06/23/2023 Version 1.0	
Initial release.	N/A

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