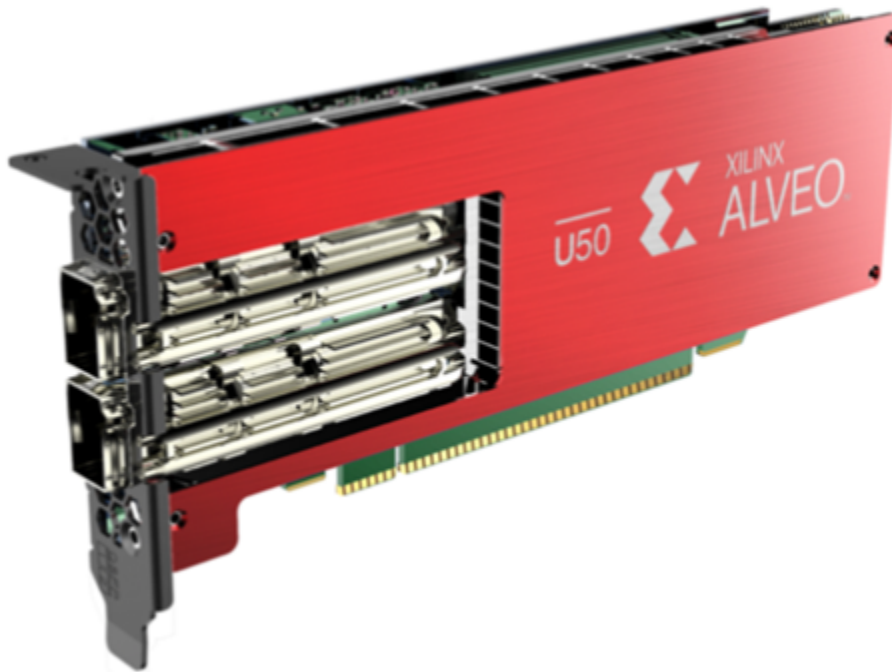


Summary

The Xilinx® Alveo™ U50 Data Center accelerator card, shown in the following figure, is a single slot, low profile form factor passively-cooled card operating up to a 75W maximum power limit. It supports PCI Express® (PCIe®) Gen3 x16 or dual Gen4 x8, is equipped with 8 GB of high-bandwidth memory (HBM2), and Ethernet networking capability. The Alveo U50 is designed to accelerate memory-bound, compute intensive applications in financial computing, machine learning, computational storage, and data search and analytics.

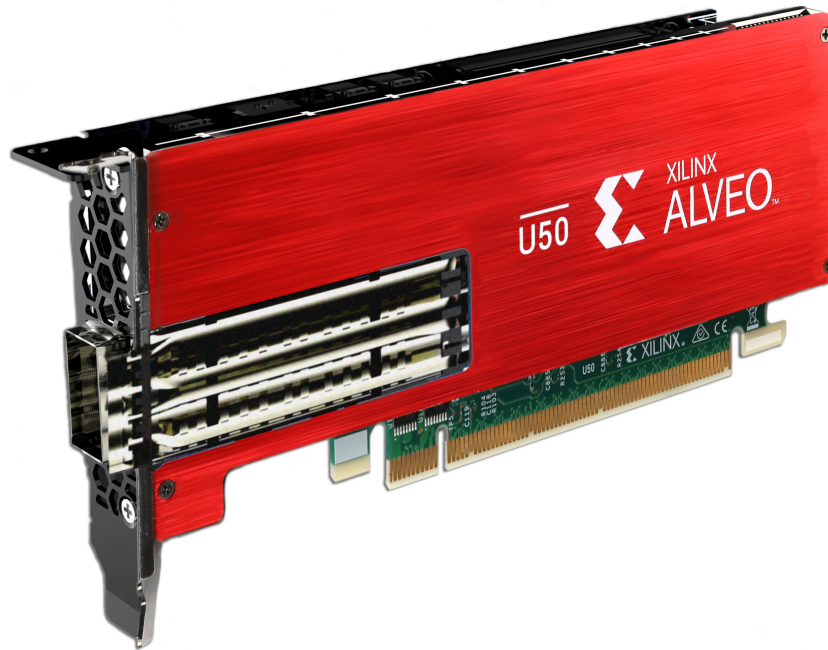
The initial U50DD ES3 card has two SFP-DD (small form factor pluggable-double density) connectors each capable of 2x25G performance.

Figure 1: Alveo U50DD ES3 Data Center Accelerator Card



The subsequent U50 production version, qualified for deployment, will have a single QSFP28 connector capable of 4x25G.

Figure 2: Alveo U50 Production Data Center Accelerator Card



The card can be used with the Xilinx® SDAccel™ software and deployment shell that simplifies the design process and allows for high level languages such as C, C++ and OpenCL™ to be used. A deployment shell enables the card to be configured from onboard flash memory and upgraded through PCI Express. For experienced programmable logic developers, the card can be used with the Vivado® Design Suite where the full resources of the programmable logic device are made available for development. See the *Alveo U50 Data Center Accelerator Card User Guide* ([UG1371](#)) for more information.

Alveo Product Details

Table 1: Alveo U50 Accelerator Card Product Details

Specification	U50DD ES3 ¹	U50 Production
Product SKU	A-U50DD-P00G-ES3-G	A-U50-P00G-PQ-G
Total electrical card load	75W	75W
Thermal cooling solution	Passive	Passive
Weight	278g – 287g	300g – 325g
Form factor	Half height, half width	Half height, half width
Network interface	2x SFP-DD	1x QSFP28
PCIe interface ^{2,3}	Gen3 x16, Gen4 x8, CCIX	Gen3 x16, Gen4 x8, CCIX
HBM2 total capacity	8 GB	8 GB
Look-up tables (LUTs)	872K	872K
Registers	1,743K	1,743K
DSP slices	5,952	5,952

Table 1: Alveo U50 Accelerator Card Product Details (cont'd)

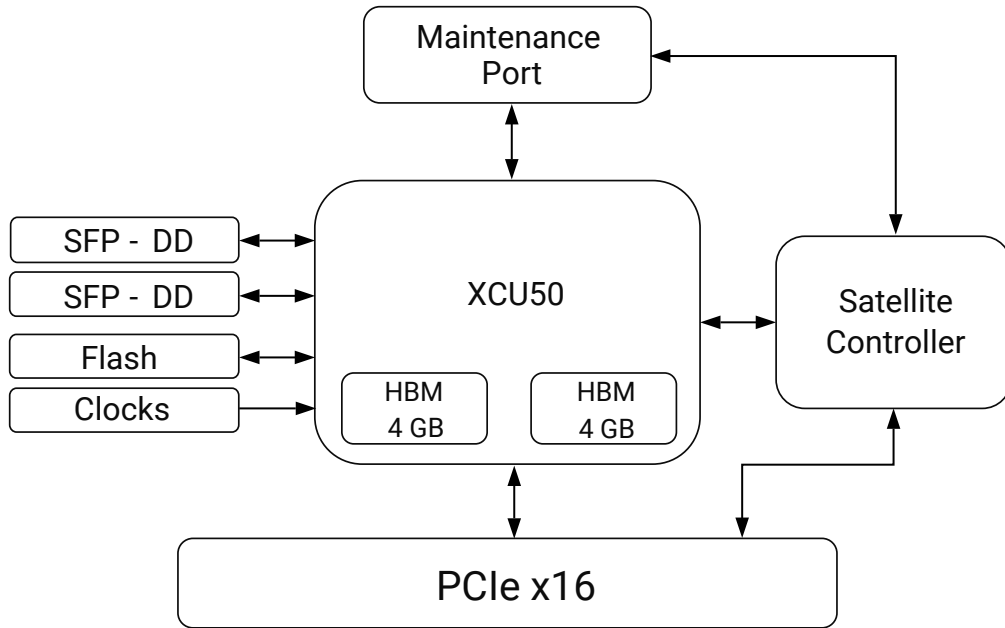
Specification	U50DD ES3 ¹	U50 Production
Max. Dist. RAM	24.6 Mb	24.6 Mb
36 Kb block RAM	1344 (47.3 Mb)	1344 (47.3 Mb)
288 Kb UltraRAM	640 (180.0 Mb)	640 (180.0 Mb)
GTY transceivers	20	20
Qualified for deployment	No	Yes

Notes:

1. Alveo™ U50DD cards with the SFP-DD interface (A-U50DD-P00G-ES3-G) are not recommended for production. Alveo U50 cards with QSFP28 (A-U50-P00G-PQ-G) will be qualified for production.
2. The PCIe interface can be configured to support a variety of link widths and speeds. The maximum is Gen3 (8 GT/s) x16, Gen4 (16 GT/s) x8 or CCIX operating at 16 GT/s x8. The PCIe interface can also be configured into dual x8 interfaces and connected to hosts that support PCIe bifurcation.
3. This block operates in compatibility mode for 16.0 GT/s (Gen4) operation. Refer to *UltraScale+ Devices Integrated Block for PCI Express LogiCORE IP Product Guide (PG213)* for details on compatibility mode.

The following figure shows the components within an Alveo U50DD ES3 accelerator card.

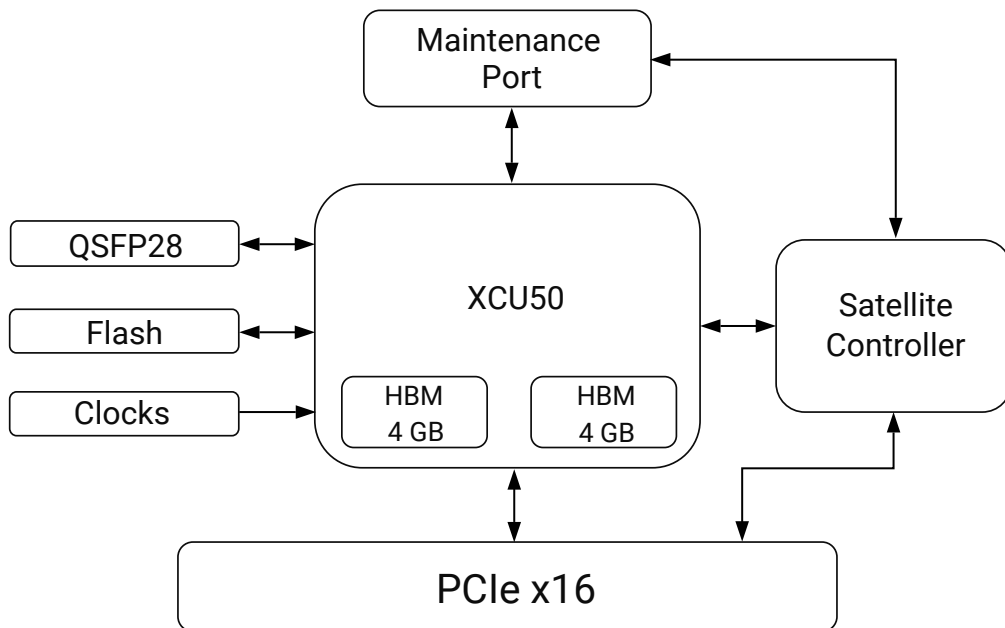
Figure 3: U50DD ES3 Block Diagram



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The following figure shows the components within an Alveo U50 production accelerator card.

Figure 4: U50 Production Block Diagram



X22940-080119

Card Specifications

Dimensions

The U50DD ES3 and U50 production cards are compliant with the PCIe CEM rev.3.0 Specification as single slot, half height, half width cards.

Table 2: Card Dimensions

Parameter	Dimension
Height	2.54 inch (64.40 mm)
PCB thickness (+/- 0.13 mm (0.005 inch))	0.62 inch (1.57 mm)
Primary side width	0.570 inch (14.47 mm)
Secondary side width	0.105 inch (2.67 mm)
Length	6.60 inch (167.65 mm)

PCIe Connector/Data Rates

The Alveo U50 accelerator card uses an UltraScale+™ FPGA containing a PCIE4C block. The PCIE4C block is compliant to the PCI Express Base Specification v3.1 supporting up to 8.0 GT/s (Gen3 x16) and compatible with PCI Express Base Specification v4.0 supporting up to 16.0 GT/s (Gen4 x8). The PCIE4C block is also compliant with CCIX Base Specification Revision 1.0 v0.9, supporting speeds up to 16.0 GT/s.

Table 3: PCI Express Data Transfer Rate Performance

PCI Express Generation	Performance
Gen 1	2.5 GigaTransfers per second (GT/s)
Gen 2	5.0 GT/s
Gen 3	8.0 GT/s
Gen 4 ¹	16.0 GT/s

Notes:

- The Gen4 (16.0 GT/s) line rate is currently not supported in the deployment shell. Xilinx IP that supports PCIe operating at the Gen4 rate is available in Vivado. For a list of limitations when operating at the Gen4 rate, see *UltraScale+ Devices Integrated Block for PCI Express LogiCORE IP Product Guide (PG213)*.

Network Interfaces

The Alveo U50DD ES3 accelerator cards host two SFP-DD pluggable connectors. Each connector can support 2x25G or 2x10G speeds using optical modules or cables. A 161.1328125 MHz clock is provided to the SFP-DD or QSFP28 interface such that different Ethernet IPs can be enabled. Each connector is housed within a single SFP-DD cage assembly located at the I/O bracket.

Multiple I/O brackets are shipped with the U50 card and the correct bracket can be attached to the card to match the panel interface size of the server slot.

Satellite Controller

A TI MSP432 satellite controller resides on the U50 to control and monitor voltages, currents and temperatures. When used in conjunction the Xilinx provided deployment shell, you can easily monitor for any abnormal operating conditions and react accordingly. If you are not using the deployment shell, Xilinx provides a Card Management Solution IP allowing you to quickly develop and interact with the satellite controller from the FPGA. See the *Card Management Solution Subsystem Product Guide (PG348)* for more information.

Maintenance Port

The maintenance port is a 30-pin connector that allows access to a number of different features and signals including JTAG, UARTs, PMBus, resets and more. Xilinx has developed a Debug and Maintenance Board (DMB) that attaches to the Maintenance Port allowing easy access to the ports and these features. (See the *Alveo U50 Debug and Maintenance Board User Guide (UG1377)* for more information.)

Validated Servers

The following is a preliminary list of servers and desktops intended to be validated to enable developers to use the U50.

Table 4: List of Servers

Manufacturer	Model/Platform
Dell EMC	PowerEdge R640
Dell EMC	PowerEdge R740
HPE	ProLiant DL380 G10
SuperMicro	SYS-7049GP-TRT Workstation

Operating System Compatibility

The following operating systems are supported:

- CentOS 7.4/7.5/7.6
- RHEL 7.4/7.5
- Ubuntu 16.04
- Ubuntu 18.04

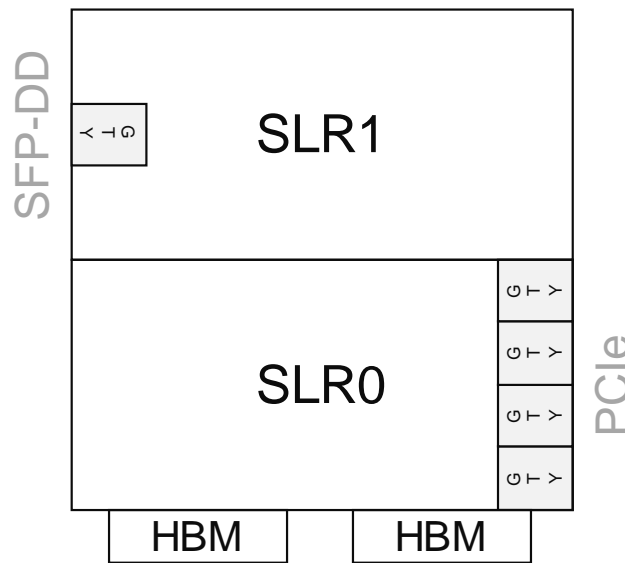
See the *Alveo U50 Data Center Accelerator Card Installation Guide (UG1370)* for more information.

FPGA Resource Information

The Xilinx Alveo U50 accelerator card is a custom-built UltraScale+ FPGA that runs optimally (and exclusively) on Alveo architecture. The Alveo U50 card features the XCU50 FPGA, which uses Xilinx stacked silicon interconnect (SSI) technology to deliver breakthrough FPGA capacity, bandwidth, and power efficiency. This technology allows for increased density by combining multiple super logic regions (SLRs). The XCU50 comprises two SLRs with the bottom SLR (SLR0) integrating an HBM controller to interface with the adjacent 8 GB HBM2 memory.

The following figure shows the two SLR regions along with the connections for PCIe and SFP-DD. The HBM is co-located on the XCU50 device and connects directly to SLR0.

Figure 5: Floorplan of the XCU50 Device



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For customers using the SDAccel flow, a shell is created that manages the PCIe interface, data transfers, and card status information. It also remotely loads kernels and performs a number of other functions. This shell is part of the static region (an area of the FPGA that is not reconfigurable). This shell consumes resources from the available resources listed in [Table 1](#). The specific amount of resources depends on which shell, and even which version of a shell is used. This information is available in the *Alveo U50 Data Center Accelerator Card User Guide (UG1371)*.

For developing applications, refer to the *SDAccel Environment User Guide (UG1023)*.

Thermal Specification

Ambient Conditions

The ambient conditions are detailed in the following sections.

Operating and Storage Temperature Conditions

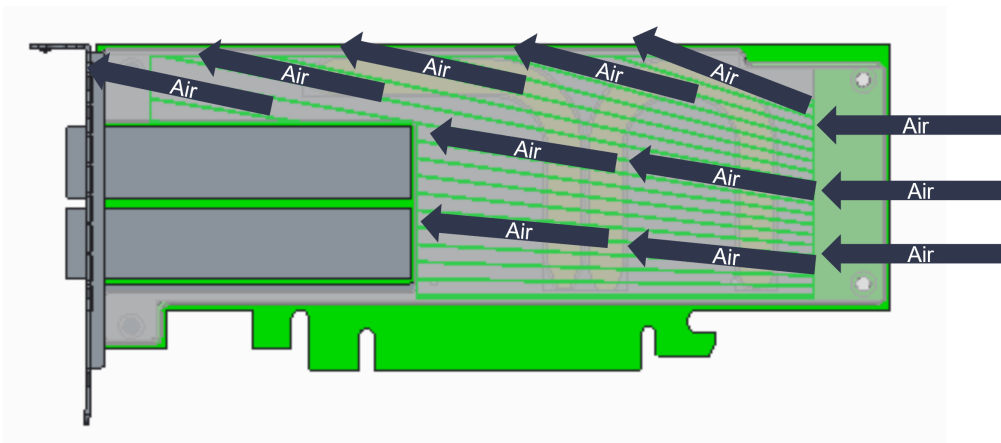
Table 5: Operating and Storage Temperatures and Humidity Conditions

Specification	Condition
Operating temperature	0°C to 55°C
Storage temperature	-40°C to 75°C
Operating humidity, non-condensing	8% to 90%
Storage humidity, non-condensing	5% to 95%

Airflow Direction Support

Forced airflow is required when the card is powered at all times. The Alveo U50 cards support front-to-back airflow. The following figure illustrates this supported airflow.

Figure 6: Airflow Direction for Passively Cooled Cards



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Operating Conditions

Inlet Temperature versus Airflow Requirement in Server

The following table states the required airflow rate and airflow speed to the U50 card under different operating conditions.

Table 6: Initial Specification for the U50 Card at Sea Level

Local PCIe Inlet Temperature (°C)	Optical Case Card (50W and 85°C SFP)	
	Inlet Speed LFM	Pressure Head (Inch of Water)
5	160	0.066
10	170	0.070
15	180	0.076
20	235	0.109
25	260	0.125

Table 6: Initial Specification for the U50 Card at Sea Level (cont'd)

Local PCIe Inlet Temperature (°C)	Optical Case Card (50W and 85°C SFP)	
	Inlet Speed LFM	Pressure Head (Inch of Water)
30	290	0.146
35	330	0.174
40	375	0.211
45	435	0.261
50	410	0.332
55	600	0.432

Notes:

1. Anticipated draft specification for the final product under the specified conditions.
2. **Disclaimer:** For any ES, this card should be used at an inlet ambient of 30°C and inlet flow of 600 LFM for thermal load of 50W/card.

Temperature Gradient

The Alveo accelerator card and its thermal management device should be able to operate at a temperature/time gradient of 15°C/hour in its ambient surroundings. The thermal management device is the heat sink, shroud, backplate, top plate, and fan (for active solutions).

Humidity

The Alveo accelerator card and its thermal management device should be able to operate in a RH (relative humidity) range of 8% to 85% and a dew point of -12°C DP without condensation.

Storage and Non-Operating Conditions

The Alveo accelerator card and its thermal management device should be stored or maintained in non-operating conditions in a RH range of 5% to 90% without condensation and an ambient temperature range of -40°C to 75°C.

Regulatory Compliance Statements

Note: The following sections contain information in languages other than English. This is required for regulatory compliance.

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.

- UL 60950-1, 2nd Edition, 2014-10-14 (Information Technology Equipment - Safety - Part 1: General Requirements)

- CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10-14 (Information Technology Equipment - Safety - Part 1: General Requirements)
- EN 60950-1:2006+A11:2009+A1:2012+A12:2011+A2:2013 (European Union)
- IEC 60950-1:2005 (2nd Edition); Am 1:2009 (International)
- EU LVD Directive 2014/35/EC

EMC Compliance

The following standards apply.

Class A Products

- 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)
- EN55024: 2010 +A1:2001+A2:2003 – Immunity (European Union)
- EMC Directive 2014/30/EC
- 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
- FCC markings
- VCCI marking
- Australian C-Tick mark
- Korea MSIP mark
- Taiwan BSMI 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.*

WICHTIG! *Dieses Gerät wurde getestet und entspricht den Grenzwerten für digitale Geräte der Klasse A gemäß Teil 15 der FCC-Bestimmungen. Diese Grenzwerte bieten einen angemessenen Schutz gegen schädliche Interferenzen, wenn das Gerät in einer gewerblichen Umgebung betrieben wird. Dieses Gerät erzeugt und verwendet Hochfrequenzenergie und kann diese abstrahlen. Wenn es nicht gemäß den Anweisungen installiert und verwendet wird, kann dies Funkstörungen verursachen. Der Betrieb dieses Geräts in einem Wohngebiet kann schädliche Interferenzen verursachen. In diesem Fall muss der Benutzer die Interferenz auf eigene Kosten beheben.*

CAUTION! *If the device is changed or modified without permission from Xilinx, the user may void his or her authority to operate the equipment.*

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

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

Canadian Compliance (Industry Canada)

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

China RoHS Compliance

SJ/T 11363-2006, 11364-2006, and GB/T 26572-2011

VCCI Class A Statement

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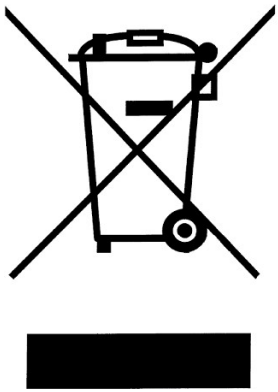
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BSMI Class A Notice (Taiwan)

<p>警告使用者:</p> <p>此為甲類資訊技術設備，於居住環境中使用時，可能會造成射頻擾動，在此種情況下，使用者會被要求採取某些適當的對策。</p>
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EU WEEE Logo



Manufacturer Declaration European Community



Manufacturer Declaration

Xilinx 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
- RoHS Directive 2011/65/EU, 2015/863

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

Dette produkt er i overensstemmelse med det europæiske direktiv 1999/5/EC.

Dit product is in navolging van de bepalingen van Europees Directief 1999/5/EC.

Tämä tuote noudattaa EU-direktiivin 1999/5/EC määräyksiä.

Ce produit est conforme aux exigences de la Directive Européenne 1999/5/EC.

Dieses Produkt entspricht den Bestimmungen der Europäischen Richtlinie 1999/5/EC.

Pessi vara stenst reglugerð Evrópska Efnahags Bandalagsins númer 1999/5/EC.

Questo prodotto è conforme alla Direttiva Europea 1999/5/EC.

Dette produktet er i henhold til bestemmelsene i det europeiske direktivet 1999/5/EC.

Este produto cumpre com as normas da Diretiva Europeia 1999/5/EC.

Este producto cumple con las normas del Directivo Europeo 1999/5/EC.

Denna produkt har tillverkats i enlighet med EG-direktiv 1999/5/EC.


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.

EN 60950-1:2006/A11:2009/A1:2010/A12:2011 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.

 **CAUTION!** *In a domestic environment, Class A products may cause radio interference, in which case the user may be required to take adequate measures.*

 **ATTENTION!** *Dans un environnement domestique, les produits de Classe A peuvent causer des interférences radio, auquel cas l'utilisateur peut être tenu de prendre des mesures adéquates.*

 **VORSICHT!** *In einer häuslichen Umgebung können Produkte der Klasse A Funkstörungen verursachen. In diesem Fall muss der Benutzer möglicherweise geeignete Maßnahmen ergreifen.*

Responsible Party

Xilinx, Inc.
2100 Logic Drive, San Jose, CA 95124
United States of America
Phone: (408) 559-7778

References

The following document provides additional information:

- *Getting Started with Alveo Data Center Accelerator Cards* (UG1301)
- *Alveo U50 Data Center Accelerator Card Installation Guide* (UG1370)
- *Alveo U50 Data Center Accelerator Card User Guide* (UG1371)
- *Card Management Solution Subsystem Product Guide* (PG348)
- *Alveo Debug and Maintenance Board User Guide* (UG1377)

Revision History

The following table shows the revision history for this document.

Section	Revision Summary
	08/02/2019 v1.0
Initial release.	N/A

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