XILINX®

Alveo U280 Data Center Accelerator Card Data Sheet

Summary

The Xilinx® Alveo™ U280 Data Center accelerator card is a full height, dual slot, ¾ length (passive cooling) or full length (active cooling) form factor. It supports PCI Express® Gen3 x16 or Gen4 x8, is equipped with 8 GB of high-bandwidth memory (HBM2), two 16 GB DDR4 RDIMMs operating at 2400 MT/s, and two QSFP28 Ethernet ports capable of 100 Gb/s each. The Alveo U280 card is designed to accelerate memory-bound, compute-intensive applications including database analytics and machine learning inference.

Alveo Product Details

Table 1: **Alveo U280 Accelerator Card Product Details**

Specification [1]	Active Cooling Version	Passive Cooling Version
Product SKU	A-U280-A32G-DEV-G [3]	A-U280-P32G-PQ-G [3]
Total electrical card load [2]	215W	215W
Thermal cooling solution	Active	Passive
Weight	1187g	1130g
Form factor	Full height, full length, dual width.	Full height, ¾ length, dual width.
Network interface	2x QSFP28	
PCIe Interface[4, 5]	Gen3 x16, Gen4 x8, CCIX	
HBM2 total capacity	8 GB	
HBM2 total bandwidth	460 GB/s	
Look-up tables (LUTs)	1,304K	
Registers	2,607K	
DSP slices	9,024	
Block RAMs	2,016	
UltraRAMs	960	
DDR total capacity	32 GB	
DDR maximum data rate	2400 MT/s	

Table 1: **Alveo U280 Accelerator Card Product Details** *(cont'd)*

Specification [1]	Active Cooling Version	Passive Cooling Version
DDR total bandwidth	38 GB/s	

Notes:

1. The specifications in this data sheet apply to production U280 cards. Any differences in U280 ES1 card specifications and capabilities are documented in the U280 ES1 Known Issues Xilinx Answer Record 71975.

2. The 215W PCIe CEM card can take 65W from the standard connector 12V supply and an additional 150W from the AUX connector 12V supply. The 3.3V supply from the standard connector is not used on this card. The CEM card requires that a 150W PCIe AUX power cable be connected to the card.

3. Passive and active cooling cards are qualified for deployment. The active DEV part number includes a USB cable for development purposes. For volume ordering options on active cards without USB cable included, contact your local Xilinx sales representative.

4. 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.

5. 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 U280 accelerator card.

Figure 1: **U280 Block Diagram**
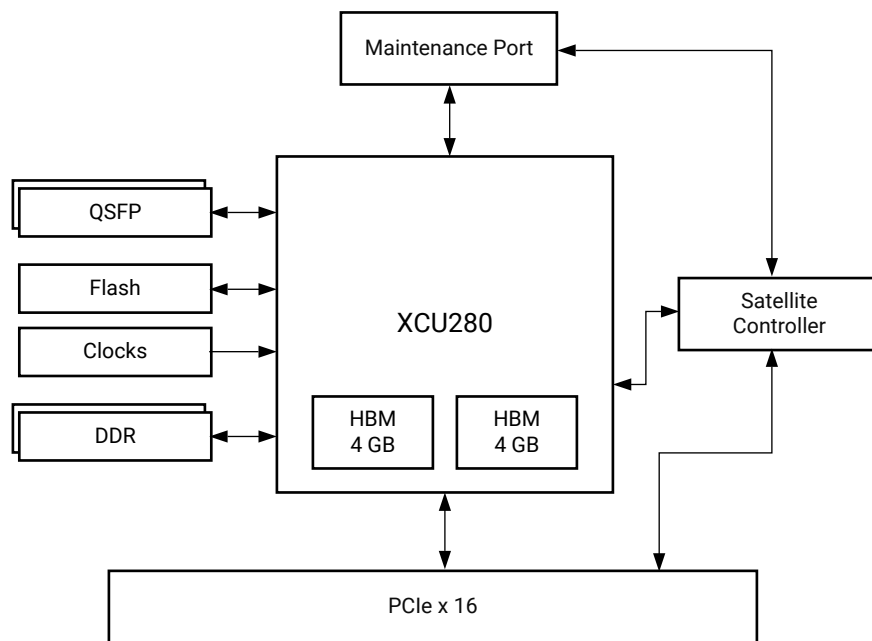
Card Specifications

Dimensions

The card is compliant with the PCIe CEM rev.3.0 Specification as a dual-slot, standard height card. The card with the passive cooling enclosure is three-quarter length, and the card with the active cooling enclosure is full length.

Table 2: **Card Dimensions**

Parameter	Dimension
Height	4.375 inch (111.15 mm)
Active cooling enclosure installed	
Assembly length	11.69 inch (297 mm)
Assembly width	1.54 inch (39.04 mm)
Passive cooling enclosure installed	
Assembly length	9.53 inch (242 mm)
Assembly thickness	1.54 inch (39.04 mm)

PCIe Connector/Data Rates

The Alveo U280 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:

1. For a list of limitations when operating at the Gen4 rate, see *UltraScale+ Devices Integrated Block for PCI Express LogiCORE IP Product Guide* (PG213).

DDR4 Specifications

Two 288-pin DDR4 DIMM sockets are populated with single rank DIMMs capable of operating at data rates up to 2400 MegaTransfers per second (MT/s).

Table 4: **DDR4 Interfaces**

Alveo Card	Parameter	Description
A-U280-A32G-DEV-G A-U280-P32G-PQ-G	Manufacturer	Micron
	Part Number	MTA18ASF2G72PZ-2G3B1
	Description	16 GB 288-pin DDR4 RDIMM
		Configuration: 2 Gb x 72
		Single rank
		Supports ECC error detection and correction
		Supports 2400 MT/s

For more details about the Micron DDR4 DIMM, see the Micron MTA18ASF2G72PZ-2G3B1IG data sheet at www.micron.com.

Network Interfaces

The Alveo U280 accelerator cards host two 100G interfaces, each comprised of a 4-lane QSFP28 connector. The QSFP case temperature must be less than 85°C for class 3 optical modules (< 2.5W), and less than 70°C for class 4 optical modules (< 3.5W). The user needs to provide sufficient airflow and ambient temperature to ensure the optical module remains within the manufacturer's specification. For available platforms, see *Alveo Data Center Accelerator Card Platforms User Guide* (UG1120). Each connector is housed within a single QSFP cage assembly located at the I/O bracket.

USB Maintenance Port

The Alveo U280 accelerator cards include a micro-USB maintenance port located at the back of the card.

Qualified Servers

A list of servers on which Alveo cards are fully qualified can be found here: https://www.xilinx.com/products/boards-and-kits/alveo/qualified-servers.html.

Operating System Compatibility

For the most up-to-date operating system support, refer to the *Vitis Unified Software Platform Documentation: Application Acceleration Development* (UG1393).

FPGA Resource Information

The Xilinx Alveo U280 accelerator card is a custom-built UltraScale+ FPGA that runs optimally (and exclusively) on the Alveo architecture. The Alveo U280 card features the XCU280 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 XCU280 comprises three SLRs with the bottom SLR (SLR0) integrating an HBM controller to interface with the adjacent 8 GB HBM2 memory. The bottom SLR also connects to 16 lanes of PCI Express® that can operate up to 16 GT/s (Gen4). SLR0 and SLR1 both connect to a DDR4 16 GB, 2400 MT/s, 64-bit with error correcting code (ECC) DIMM for a total of 32 GB of DDR4. SLR2 connects two QSFP28 connectors with associated clocks generated on the U280 board. The following figure shows the three SLR regions along with the connections for PCIe, DDR4, and QSFP28. The HBM is co-located on the XCU280 device and connects directly to SLR0.

Figure 2: **Floorplan of the XCU280 Device**
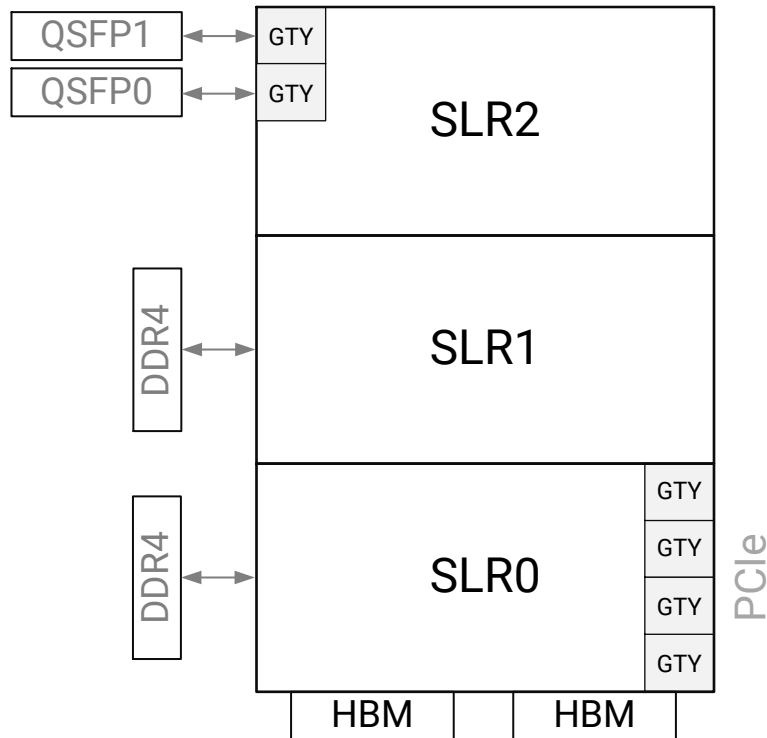
X23461-103119

For customers using the Vitis™ application acceleration development flow, a platform is created that manages the PCIe interface, data transfers, and card status information. It also remotely loads kernels and performs several functions that greatly simplify developing an application. This platform is part of the static region (an area of the FPGA that is not reconfigurable). This platform consumes resources from the available resources listed in Table 1. The specific amount of resources depends on which platform, and even which version of a platform is used. This information is available in *Alveo Data Center Accelerator Card Platforms User Guide* (UG1120).

For developing applications, refer to the *Vitis Unified Software Platform Documentation: Application Acceleration Development* (UG1393).

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 45°C
Storage temperature	−40°C to 75°C

Table 5: **Operating and Storage Temperatures and Humidity Conditions** *(cont'd)*

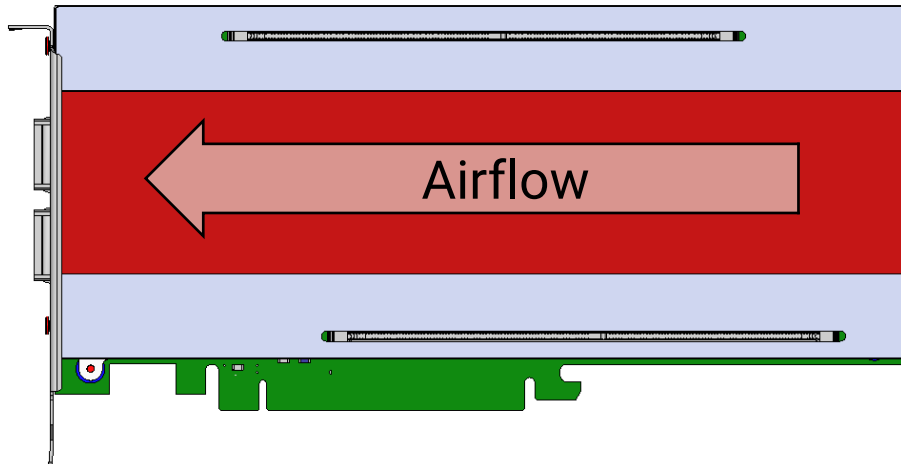| Specification	Condition
Operating humidity, non-condensing	8% to 90%
Storage humidity, non-condensing	5% to 95%

Related Information

Operating Conditions

Airflow Direction Support

Passive cards do not include a built-in fan and therefore require an external mechanism to ensure proper airflow for cooling. Passive cards should not be powered without a forced airflow mechanism in place. The passively cooled Alveo U280 cards support airflow as illustrated below.

Figure 3: **Airflow Direction for Passively Cooled Cards**

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Note: Other environmental conditions are possible, including bidirectional flow. However, this is specific to server configurations, and testing is performed by individual OEMs. Contact your server provider for more information and options.

Operating Conditions

Inlet Temperature versus Airflow Requirement in Server

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

Note: In the following tables, the term *load* refers to the total thermal power dissipation of the card.

Table 6: **Inlet Temperature versus Airflow Requirement for the U280 Card at Sea Level with ~190W Load for 70°C Rated QSFP**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (39.62 mm x 97.54 mm) at Sea Level for 70°C Rated QSFP			
Inlet Temperature to the Card (°C)	Linear Feet per Minute (LFM)	Cubic Feet per Minute (CFM)	Pressure (inwg)
5	300	12.5	0.37
10	320	13.3	0.42
15	350	14.6	0.50
20	390	16.2	0.62
25	440	18.3	0.79
30	500	20.8	1.02
35	570	23.7	1.32
40	660	27.5	1.77
45	750	31.2	2.28
50 (not supported)	870	36.2	3.06

Table 7: **Inlet Temperature versus Airflow Requirement for the U280 Card at Sea Level with ~190W Load for 85°C Rated QSFP**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (39.62 mm x 97.54 mm) at Sea Level for 85°C Rated QSFP			
Inlet Temperature to the Card (°C)	Linear Feet per Minute (LFM)	Cubic Feet per Minute (CFM)	Pressure (inwg)
5	220	9.2	0.20
10	230	9.6	0.22
15	250	10.4	0.26
20	280	11.6	0.32
25	310	12.9	0.40
30	350	14.6	0.50
35	390	16.2	0.62
40	450	18.7	0.83
45	520	21.6	1.10
50 (not supported)	600	25.0	1.46

Table 8: **Inlet Temperature versus Airflow Requirement for the U280 Card above Sea Level with ~190W Load for 70°C Rated QSFP**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (39.62 mm x 97.54 mm) at 1200m above Sea Level for 70°C Rated QSFP			
Inlet Temperature to the Card (°C)	Linear Feet per Minute (LFM)	Cubic Feet per Minute (CFM)	Pressure (inwg)
5	300	12.5	0.37
10	320	13.3	0.42
15	350	14.6	0.50
20	390	16.2	0.62

Table 8: **Inlet Temperature versus Airflow Requirement for the U280 Card above Sea Level with ~190W Load for 70°C Rated QSFP** *(cont'd)*

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (39.62 mm x 97.54 mm) at 1200m above Sea Level for 70°C Rated QSFP			
Inlet Temperature to the Card (°C)	**Linear Feet per Minute (LFM)**	**Cubic Feet per Minute (CFM)**	**Pressure (inwg)**
25	440	18.3	0.79
30	500	20.8	1.02
35	570	23.7	1.32
40	660	27.5	1.77
45	750	31.2	2.28
50 (not supported)	870	36.2	3.06

Table 9: **Inlet Temperature versus Airflow Requirement for the U280 Card above Sea Level with ~190W Load for 85°C Rated QSFP**

Inlet Temperature versus Airflow Requirement of PCIe Card Slot (39.62 mm x 97.54 mm) at 1200m above Sea Level for 85°C Rated QSFP			
Inlet Temperature to the Card (°C)	**Linear Feet per Minute (LFM)**	**Cubic Feet per Minute (CFM)**	**Pressure (inwg)**
5	240	10.0	0.24
10	250	10.4	0.26
15	270	11.2	0.30
20	300	12.5	0.37
25	330	13.7	0.45
30	370	15.4	0.56
35	420	17.5	0.72
40	480	20.0	0.94
45	560	23.3	1.28
50 (not supported)	650	27.0	1.72

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 90% 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 95% 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

Regulatory Compliance Statements are valid for the production version of Alveo™ cards; not for ES cards.

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/EU

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)
- 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
- 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.*

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⚠️ **ATTENTION!** *Si l'appareil est modifié sans l'autorisation de Xilinx, l'utilisateur peut annuler son abilité 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)

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EU WEEE Logo

Manufacturer Declaration European Community

CE

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

- China RoHS Declaration: Standards SJ/T 11363-2006, 11364-2006, and GB/T 26572-2011

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

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

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

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

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

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

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Responsible Party

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References

The following documents provide additional information.

- *Getting Started with Alveo Data Center Accelerator Cards* (UG1301)

- *Alveo Data Center Accelerator Card Platforms User Guide* (UG1120)

Revision History

The following table shows the revision history for this document.

Section	Revision Summary
09/24/2021 Version 1.4	
Table 1	Updated total electrical card load from 225W to 215W.
Manufacturer Declaration European Community	Removed GS compliance mark.
05/11/2020 Version 1.3	
Summary	Updated description of DDR4 RDIMMs.
Table 1	Updated number of LUTs and added block RAMs.
Network Interfaces	Updated wattage description.
FPGA Resource Information	Updated paragraph after Figure 2.
Table 2	Updated assembly length for active cooling enclosure installed.
Table 5	Updated operating temperature.
Standard Compliance Details	Removed section.

Section	Revision Summary
Airflow Direction Support	Added note after figure.
Operating Conditions	Updated tables.
Humidity	Updated upper end of relative humidity range from 85% to 90%.
Storage and Non-Operating Conditions	Updated upper end of relative humidity range from 90% to 95%.
11/20/2019 Version 1.2	
General updates	Updated to the Vitis unified software platform throughout.
General updates	Updated to the Vitis unified software platform throughout.
Alveo Product Details	Updated table and figure.
Qualified Servers	Replaced table with link to Alveo Qualified Servers Catalog.
Network Interfaces	Removed sentence about QSFP connectors not being supported in target platform.
Operating System Compatibility	Updated section.
FPGA Resource Information	Updated section, including figure.
06/28/2019 Version 1.1	
Alveo Product Details	Updated the block diagram.
Qualified Servers	Added servers.
Operating System Compatibility	Updated operating systems.
Standard Compliance Details	Added a note about altitude.
02/15/2019 Version 1.0	
Initial release	N/A

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