



NVIDIA Jetson Xavier NX and Jetson Nano Interface Comparison and Migration

Application Note

Document History

DA-09761-001_v1.1

Version	Date	Description of Change
0.5	December 12, 2019	Preliminary Information
1.0	April 20, 2020	<ul style="list-style-type: none">• Update Figure 1 and Figure 2• Updated Table 1• Added note regarding images for Figure 3 and Figure 4• Updated Table 3 to reflect change of lanes used for PCIe in latest Jetson Xavier NX module design• Updated “PCI Express” section• Updated “Camera” section
1.1	September 8, 2020	Corrected pin numbers for PCIe1 pins on Jetson NX in Figure 5

Table of Contents

- Introduction 1
- Jetson Xavier NX vs. Jetson Nano 2
- Module Interface Comparisons 4
- Function and Interface Difference Details 6
 - Mechanical Differences.....6
 - USB 3.x and PCI Express Mapping.....7
 - PCI Express.....8
 - Display9
 - DSI.....9
 - eDP, DP, and HDMI.....10
 - CAN10
 - Camera10
 - Debug11

List of Figures

Figure 1.	Jetson Nano Block Diagram	2
Figure 2.	Jetson Xavier NX Block Diagram.....	3
Figure 3.	Jetson Nano vs. Jetson Xavier NX Module Top.....	6
Figure 4.	Jetson Nano vs. Jetson Xavier NX Module Bottom.....	7
Figure 5.	Jetson Xavier NX and Jetson Nano PCIe Block Diagram.....	9
Figure 6.	Jetson Nano DSI Block Diagram.....	9
Figure 7.	Jetson Xavier NX CAN Block Diagram.....	10
Figure 8.	Jetson Xavier NX and Jetson Nano CSI Block Diagrams.....	11

List of Tables

Table 1.	Jetson Xavier and Jetson Nano Feature Comparison	4
Table 2.	Mechanical Differences	6
Table 3.	Jetson Xavier NX USB 3.1 and PCIe Lane Mapping Configurations.....	7
Table 4.	Jetson Nano USB 3.0 and PCIe Lane Mapping Configurations.....	8
Table 5.	eDP, DP, and HDMI Display Support.....	10

Introduction

This application note compares the features and interfaces supported on the NVIDIA® Jetson Xavier™ NX and Jetson Nano™ modules. This application note also describes the migration path for designers familiar with Jetson Nano to design a carrier board for Jetson Xavier NX that will support the features available on Jetson Xavier NX.

Jetson Xavier NX vs. Jetson Nano

The Jetson Xavier NX and Jetson Nano modules are pin compatible with a few exceptions. This application note describes the differences to allow users familiar with Jetson Nano to design a similar carrier board for Jetson Xavier NX.

The following figures show the Jetson Xavier NX and Jetson Nano block diagrams. The interfaces or blocks that are supported only by one of the modules are highlighted in **red**. The interface types that are supported on both modules but where the number of lanes/instances, voltage level, or access is different are highlighted in **magenta**.

Figure 1. Jetson Nano Block Diagram

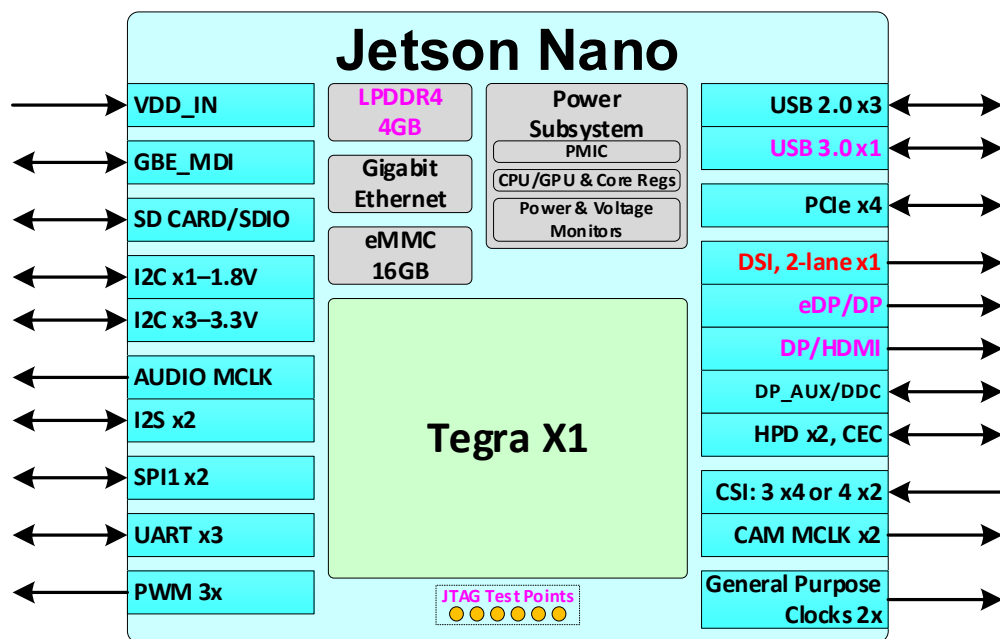
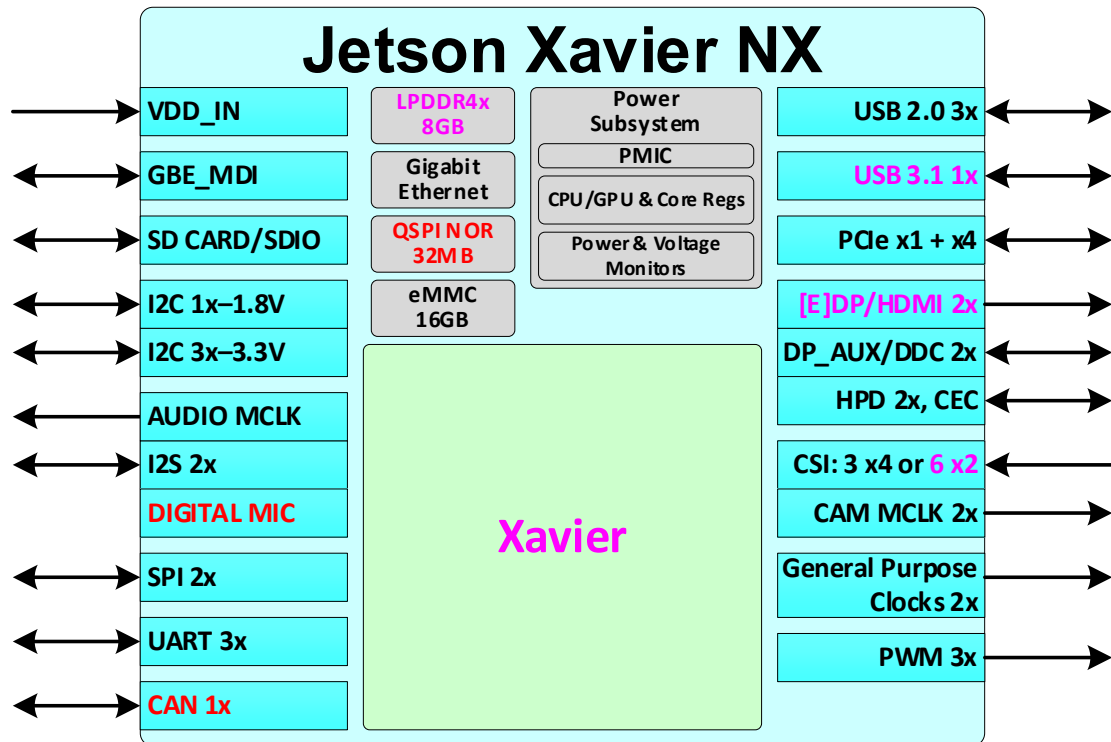


Figure 2. Jetson Xavier NX Block Diagram



Module Interface Comparisons

Table 1 lists the key system specifications, devices and interfaces that are supported on either the Jetson Xavier NX or the Jetson Nano module.

Table 1. Jetson Xavier and Jetson Nano Feature Comparison

Feature	Jetson Xavier NX	Jetson Nano
System Specifications and Device on the Module		
GPU	NVIDIA Volta™ architecture with 384 NVIDIA® CUDA® cores and 48 Tensor cores	NVIDIA Maxwell™ architecture with 128 CUDA cores
CPU	6-core NVIDIA Carmel Armv8.2 64-bit CPU	Quad-core ARM Cortex-A57 MPCore processor
DL Accelerator	2x NVDLA Engines	Not supported
Vision Accelerator	7-Way VLIW Vision Processor	Not supported
Memory	8 GB 128-bit LPDDR4x	4 GB 64-bit LPDDR4
Storage	16 GB eMMC	
Networking	10/100/1000 Mbit	
Video Encode	2x 464 MP/sec 2x 4K @ 30 (HEVC) 6x 1080p @ 60 (HEVC) 14x 1080p @ 30 (HEVC)	250MP/sec 1x 4K @ 30 (HEVC) 2x 1080p @ 60 (HEVC) 4x 1080p @ 30 (HEVC) 4x 720p @ 60 (HEVC) 9x 720p @ 30 (HEVC)
Video Decode	2x 690MP/sec 2x 4K @ 60 (HEVC) 4x 4K @ 30 (HEVC) 12x 1080p @ 60 (HEVC) 32x 1080p @ 30 (HEVC) 16x 1080p @ 30 (H.264)	500MP/sec 1x 4K @ 60 (HEVC) 2x 4K @ 30 (HEVC) 4x 1080p @ 60 (HEVC) 8x 1080p @ 30 (HEVC) 9x 720p @ 60 (HEVC)
Camera	14 lanes (3x4 or 6x2) MIPI CSI-2 D-PHY 1.2 (2.5 Gb/s per pair)	12 lanes (3x4 or 4x2) MIPI CSI-2 D-PHY 1.1 (1.5 Gb/s per pair)

Feature	Jetson Xavier NX		Jetson Nano
System Specifications and Device on the Module			
Mechanical	69.6 mm x 45 mm 260-pin edge connector		
Input Voltage	5V (nominal)		
Interfaces			
USB 2.0	3x		
USB 3.x	1x (3.1 GEN2)	1x (3.0 GEN1)	
PCIe	1 x1 (Gen3) + 1 x4 (Gen4). x1 is Root Port only. x4 has both Root Port and Endpoint support	1 x4 (Gen2), Root Port only.	
Display	Two multi-mode (e)DP 1.4/HDMI™ 2.0a	HDMI 2.0 or DP1.2, eDP 1.4 DSI (1 x2)	
Audio (I2S)	2x		
SDIO/SD Card	1x SD Card/SDIO		
I2C	4x		
CAN	1x	Not supported	
UART	3x		
SPI	2x		
JTAG	Not supported	Brought to on-module test points only	
Fan	PWM and Tach Input		

Function and Interface Difference Details

Mechanical Differences

Table 2 lists the mechanical differences.

Table 2. Mechanical Differences

Feature	Jetson Xavier NX	Jetson Nano
Size	69.5 mm x 45 mm	
Built-in thermal solution	None	
Thermal solution mounting	4 holes in PCB for mounting thermal solution to Jetson Xavier NX.	Same approach as Jetson Xavier NX except that the thermal solution mounting hole locations are different.

Figure 3. Jetson Nano vs. Jetson Xavier NX Module Top

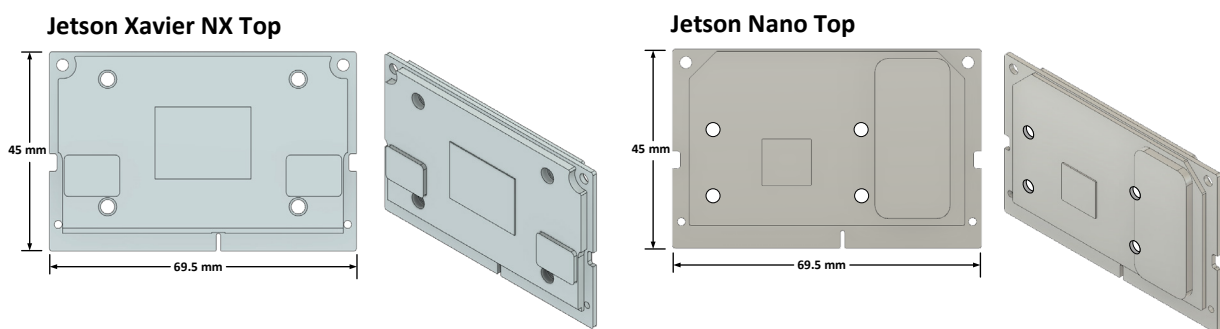
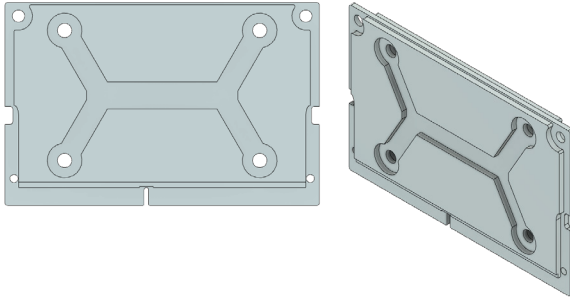
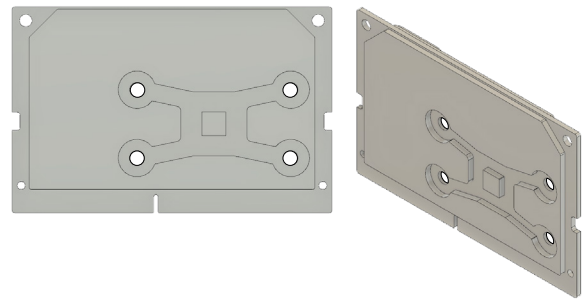


Figure 4. Jetson Nano vs. Jetson Xavier NX Module Bottom

Jetson Xavier NX Bottom



Jetson Nano Bottom



Note: Images in Figure 3 and Figure 4 are taken from the 3D CAD STEP models which show only the “envelop” view which provides the maximum component heights by region instead of the individual components. See the thermal design guides for more detailed images of the module.

USB 3.x and PCI Express Mapping

The following tables show the different options for mapping USB 3.x and PCIe to the common set of interface pins.

Table 3. Jetson Xavier NX USB 3.1 and PCIe Lane Mapping Configurations

Jetson Xavier NX Pin Names		PCIE0_RX3 PCIE0_TX3	PCIE0_RX2 PCIE0_TX2	PCIE0_RX1 PCIE0_TX1	PCIE0_RX0 PCIE0_TX0	PCIE1_RX0 PCIE1_TX0	USBSS_RX USBSS_TX
Xavier Lanes		NVHS Lane 3	NVHS Lane 2	NVHS Lane 1	NVHS Lane 0	PCIe Lane 11	Lane 1
USB 3.1	PCIe						
1	1x4 + 1x1	PCIe 0 lane 3 [Ctrl #5]	PCIe 0 lane 2 [Ctrl #5]	PCIe 0 lane 1 [Ctrl #5]	PCIe 0 lane 0 [Ctrl #5]	PCIe 1 lane 0 [Ctrl #4]	USB_SS Port #2
Recommended Usage		PCIe x4 connector or device (i.e. M.2 Key M)				PCIe x 1 conn. or device (i.e. M.2 Key E)	USB 3.1 connector, device or hub

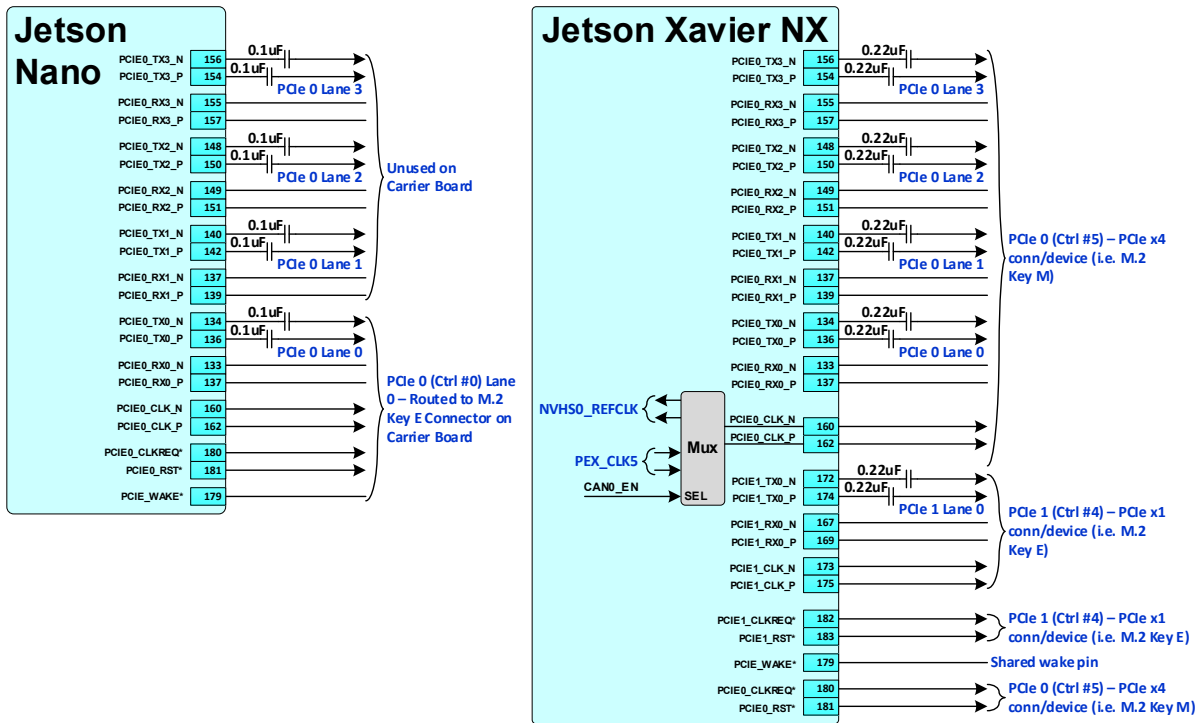
Table 4. Jetson Nano USB 3.0 and PCIe Lane Mapping Configurations

Jetson Nano Pin Names		na	PCIE0_RX3 PCIE0_TX3	PCIE0_RX2 PCIE0_TX2	PCIE0_RX1 PCIE0_TX1	PCIE1_RX0 PCIE1_TX0	USBSS_RX USBSS_TX
NVIDIA Tegra X1 Lanes		Lane 0	Lane 1	Lane 2	Lane 3	Lane 4	Lane 6
USB 3.0	PCIe						
1	1 x4	PCIe 1 lane 0 – Used on- module for Ethernet	PCIe 0 lane 3 (Ctrl #0)	PCIe 0 lane 2 (Ctrl #0)	PCIe 0 lane 1 (Ctrl #0)	PCIe 0 lane 0 (Ctrl #0)	USB_SS Port #0
Usage on NVIDIA DevKit Carrier Board		Ethernet	Unused			M.2 Key E	USB 3.0 Type A

PCI Express

Jetson Xavier NX supports two PCIe interfaces: A x1 lane interface and a x4 lane interface (can be x2 or x1 instead) at the module pins. Jetson Nano supports only the x4 lane interface (can be x2 or x1 instead).at the module pins. Jetson Xavier NX supports both Root Port and Endpoint operation on the x4 interface up to Gen4. The x1 interface supports only Root Port and only up to Gen3. Jetson Nano only supports Root Port operation up to Gen2.

Figure 5. Jetson Xavier NX and Jetson Nano PCIe Block Diagram



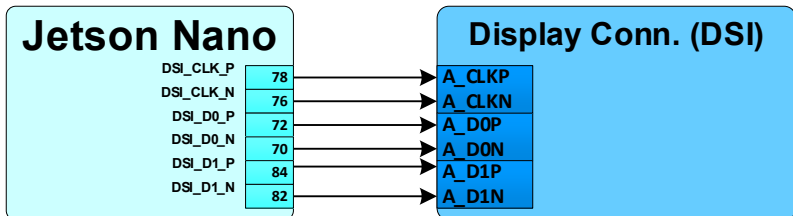
Display

Jetson Nano supports DSI, Vesa® DisplayPort™ (DP), embedded DisplayPort (eDP), and HDMI as described in this section. Jetson Xavier NX does not support DSI but does support DisplayPort (DP), embedded DisplayPort (eDP), and HDMI with some differences.

DSI

Jetson Xavier NX does not support DSI. Jetson Nano supports a single 2-lane DSI interface.

Figure 6. Jetson Nano DSI Block Diagram



eDP, DP, and HDMI

Both Jetson Xavier NX and Jetson Nano can support eDP, DP, and HDMI displays. Jetson Xavier NX can support any of these displays on either of the two interfaces. Jetson Nano has one interface that supports only eDP (or DP - display only) while the other supports HDMI, eDP, or DP.

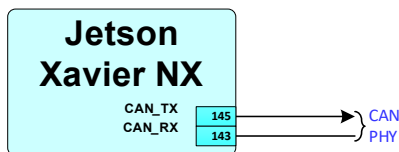
Table 5. eDP, DP, and HDMI Display Support

Feature	Jetson Xavier NX	Jetson Nano
eDP/DP	DP[1:0]_TXD[3:0]_P/N, DP[1:0]_AUX_P/N, DP[1:0]_HPD	DP0_TXD[3:0]_P/N, DP0_AUX_P/N, DP0_HPD
HDMI/DP		DP1_TXD[3:0]_P/N, DP1_AUX_P/N, DP1_HPD, HDMI_CEC

CAN

Jetson Xavier NX supports a single CAN interface. Jetson Nano does not support CAN.

Figure 7. Jetson Xavier NX CAN Block Diagram

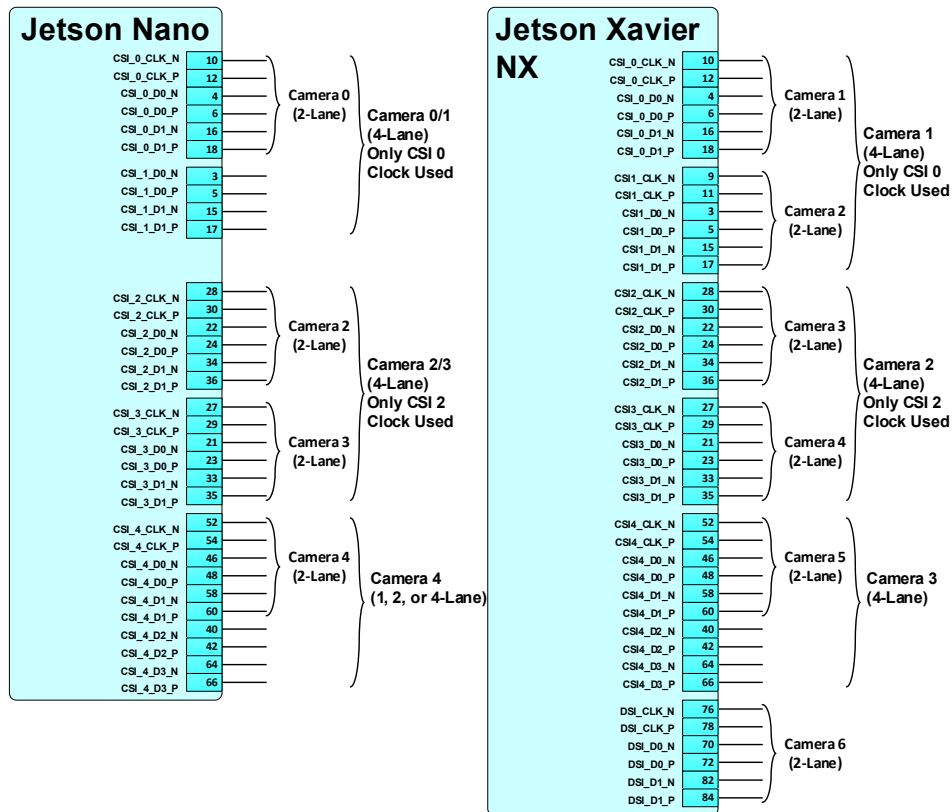


Camera

Jetson Nano has 12 CSI data lanes. Jetson Xavier NX has 14 total data lanes although only 12 can be used in a design. Jetson Xavier NX and Jetson Nano support the following configurations to cameras or serializers:

- Jetson Xavier NX
 - 3 x4, 2 x4 + 2 x2, 1 x4 + 4 x2, or 6 x2
- Jetson Nano
 - 3 x4, 2 x4 + 2 x2, 1 x4 + 3 x2, or 4 x2

Figure 8. Jetson Xavier NX and Jetson Nano CSI Block Diagrams



Debug

Jetson Nano brings the JTAG interface to test points on the module only. Jetson Xavier NX does not support JTAG. Both Jetson Nano and Jetson Xavier NX provide UART2 for debug purposes.

Notice

The information provided in this specification is believed to be accurate and reliable as of the date provided. However, NVIDIA Corporation ("NVIDIA") does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information. NVIDIA shall have no liability for the consequences or use of such information or for any infringement of patents or other rights of third parties that may result from its use. This publication supersedes and replaces all other specifications for the product that may have been previously supplied.

NVIDIA reserves the right to make corrections, modifications, enhancements, improvements, and other changes to this specification, at any time and/or to discontinue any product or service without notice. Customer should obtain the latest relevant specification before placing orders and should verify that such information is current and complete.

NVIDIA products are sold subject to the NVIDIA standard terms and conditions of sale supplied at the time of order acknowledgement, unless otherwise agreed in an individual sales agreement signed by authorized representatives of NVIDIA and customer. NVIDIA hereby expressly objects to applying any customer general terms and conditions with regards to the purchase of the NVIDIA product referenced in this specification.

Unless specifically agreed to in writing by NVIDIA, NVIDIA products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of the NVIDIA product can reasonably be expected to result in personal injury, death or property or environmental damage. NVIDIA accepts no liability for inclusion and/or use of NVIDIA products in such equipment or applications and therefore such inclusion and/or use is at customer's own risk.

NVIDIA makes no representation or warranty that products based on these specifications will be suitable for any specified use without further testing or modification. Testing of all parameters of each product is not necessarily performed by NVIDIA. It is customer's sole responsibility to ensure the product is suitable and fit for the application planned by customer and to do the necessary testing for the application in order to avoid a default of the application or the product. Weaknesses in customer's product designs may affect the quality and reliability of the NVIDIA product and may result in additional or different conditions and/or requirements beyond those contained in this specification. NVIDIA does not accept any liability related to any default, damage, costs or problem which may be based on or attributable to: (i) the use of the NVIDIA product in any manner that is contrary to this specification, or (ii) customer product designs.

No license, either expressed or implied, is granted under any NVIDIA patent right, copyright, or other NVIDIA intellectual property right under this specification. Information published by NVIDIA regarding third-party products or services does not constitute a license from NVIDIA to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property rights of the third party, or a license from NVIDIA under the patents or other intellectual property rights of NVIDIA. Reproduction of information in this specification is permissible only if reproduction is approved by NVIDIA in writing, is reproduced without alteration, and is accompanied by all associated conditions, limitations, and notices.

ALL NVIDIA DESIGN SPECIFICATIONS, REFERENCE BOARDS, FILES, DRAWINGS, DIAGNOSTICS, LISTS, AND OTHER DOCUMENTS (TOGETHER AND SEPARATELY, "MATERIALS") ARE BEING PROVIDED "AS IS." NVIDIA MAKES NO WARRANTIES, EXPRESSED, IMPLIED, STATUTORY, OR OTHERWISE WITH RESPECT TO THE MATERIALS, AND EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. Notwithstanding any damages that customer might incur for any reason whatsoever, NVIDIA's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the NVIDIA terms and conditions of sale for the product.

VESA DisplayPort

DisplayPort and DisplayPort Compliance Logo, DisplayPort Compliance Logo for Dual-mode Sources, and DisplayPort Compliance Logo for Active Cables are trademarks owned by the Video Electronics Standards Association in the United States and other countries.

HDMI

HDMI, the HDMI logo, and High-Definition Multimedia Interface are trademarks or registered trademarks of HDMI Licensing LLC.

ARM

ARM, AMBA and ARM Powered are registered trademarks of ARM Limited. Cortex, MPCore and Mali are trademarks of ARM Limited. All other brands or product names are the property of their respective holders. "ARM" is used to represent ARM Holdings plc; its operating company ARM Limited; and the regional subsidiaries ARM Inc.; ARM KK; ARM Korea Limited.; ARM Taiwan Limited; ARM France SAS; ARM Consulting (Shanghai) Co. Ltd.; ARM Germany GmbH; ARM Embedded Technologies Pvt. Ltd.; ARM Norway, AS and ARM Sweden AB.

Trademarks

NVIDIA, the NVIDIA logo, CUDA, Jetson Nano, Jetson Xavier, NVIDIA Maxwell, NVIDIA Volta, Xavier, and Tegra are trademarks and/or registered trademarks of NVIDIA Corporation in the U.S. and other countries. Other company and product names may be trademarks of the respective companies with which they are associated.

Copyright

© 2019, 2020 NVIDIA Corporation. All rights reserved.