NVIDIA DRIVE AGX SYSTEM

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Product Brief

DOCUMENT CHANGE HISTORY

PB-09159-001_v08

Version	Date	Authors	Description of Change
01	August 31, 2018	JH, VS	Initial release
02	September 24, 2018	JH, VS	Updated nomenclature from DDP to AGX Developer System
03	October 12, 2018	JH, VS	• Updated Table 1-2 • Added references to the NVIDIA DRIVE AGX Developer System Mechanical Installation Guide in Sections 2.2 and 2.3
04	February 1, 2019	JH, VS	• Updated nomenclature from NVIDIA DRIVE AGX Developer System to NVIDIA DRIVE AGX System • Updated description of the modules in section 1.1 • Updated Table 1-1 to include relevant terms only • Updated Security Key Storage specification in Table 1-2 • Updated M.2 code row in Table 1-2 to provide more details
05	May 10, 2019	JH, VS	• Minor updates in block diagram (Figure 1-1) • Minor updates to Table 1-2 on the system RAM, M.2, Camera, Ethernet, note number 2 and added note number 6 • Added Appendix A for Dual Ethernet Dongle
06	November 15, 2019	JH, VS	• Updated Figure 1-1: NVIDIA DRIVE AGX System High Level Block Diagram; added COM EX PCIe connection information • Updated Table 1-2: Product Features per Configuration; reduced the number GPIO due to the GPIO5/GPIO6 removal • Updated note for Table A-5; replaced "KL30_VBAT voltage" with "input voltage"
07	March 13, 2020	JH, VS	• Added Appendix B for Dual 10GB Ethernet Dongle
08	August 10, 2020	JH, VS	• Updated Section: 2.1 and Table 2-1 to highlight that 24V battery is not supported. • Added notes to Table A-4 and Table B-2 to refer to Table 2-1 when installing the developer system in a vehicle. • Updated Appendix B text before Figure B-5 to emphasize that the 10GB Ethernet Dongle has no down-train support.

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Chapter 1. INTRODUCTION

1.1 OVERVIEW

The NVIDIA DRIVE AGX™ Developer Kit is an open AI car computing platform that enables automakers, tier 1 automotive suppliers, and other developers to accelerate production of automated and autonomous vehicles.

The kit includes the following main items:

- NVIDIA DRIVE AGX™ System (hereinafter referred as "**developer system**"), which is designed with two NVIDIA® Xavier™ SoC processors on the mainboard. This document provides details of the hardware features and specification of the developer system based on the NVIDIA® Xavier™ architecture.
- NVIDIA Dual Ethernet Dongle for converting the automotive T1 Ethernet to standard RJ45. The detailed information of this dongle can be found in Appendix A.
- Other accessories.

The following modules are installed, or can be installed onto the developer system:

- A preinstalled Camera Interface Module via a 400-pin CIM connector
- Two optional NVIDIA® GPU accelerator modules for additional computing power over NVIDIA® NVLink® high-speed interconnect technology via SXM2 form factor connector
- A reserved 699-pin CVM connector for NVIDIA SoC module
- A reserved 440-pin COM Express Type 7 connector for COM (Computer-On-Module) Express module

Other than the GPU accelerator modules, all other modules listed above are installed on the bottom side of the developer system mainboard.

Table 1-1. Terms and Definitions

Term	Definition
A^2B	Automotive Audio Bus
CAN	Controller Area Network
CIM	Camera Interface Module
CVM	NVIDIA SoC Module
DAP	Digital Audio Port
dGPU	Discrete Graphics Processing Unit
eMMC	Embedded MMC (embedded storage solution with MMC interface, and flash memory and controller)
FlexRay	An automotive network communications protocol developed by the FlexRay Consortium
GB	Giga Bytes
GMSL2	Gigabit Multimedia Serial Link v2.0
GPIO	General Purpose Input/output
GPU	Graphics Processor Unit
HDMI	High-Definition Multimedia Interface
HSD	High Speed Data
JTAG	Joint Test Action Group
KL30_VBAT	Battery positive voltage which is always present (KL30)
LPDDR4x	Low Power DDR4
M.2	A specification for internally mounted computer expansion cards and associated connectors, formerly known as the Next Generation Form Factor (NGFF)
MCU	Micro Controller Unit
NVLink	NVIDIA proprietary high-speed system interconnect technology
NVMe	Non-volatile Memory Express
PCIe	Peripheral Component Interconnect (PCI) Express
QSPI	Quad Serial Peripheral Interface
SoC	System on a Chip
SPI	Serial Peripheral Interface
SXM2	An NVIDIA dGPU form factor
UART	Universal Asynchronous Receiver/Transmitter
UFS	Universal Flash Storage
USB	Universal Serial Bus

1.2 NVIDIA DRIVE AGX SYSTEM HARDWARE BLOCK DIAGRAM

Figure 1-1 shows the major components and detailed interface connection of Xavier devices and CVM for the developer system.

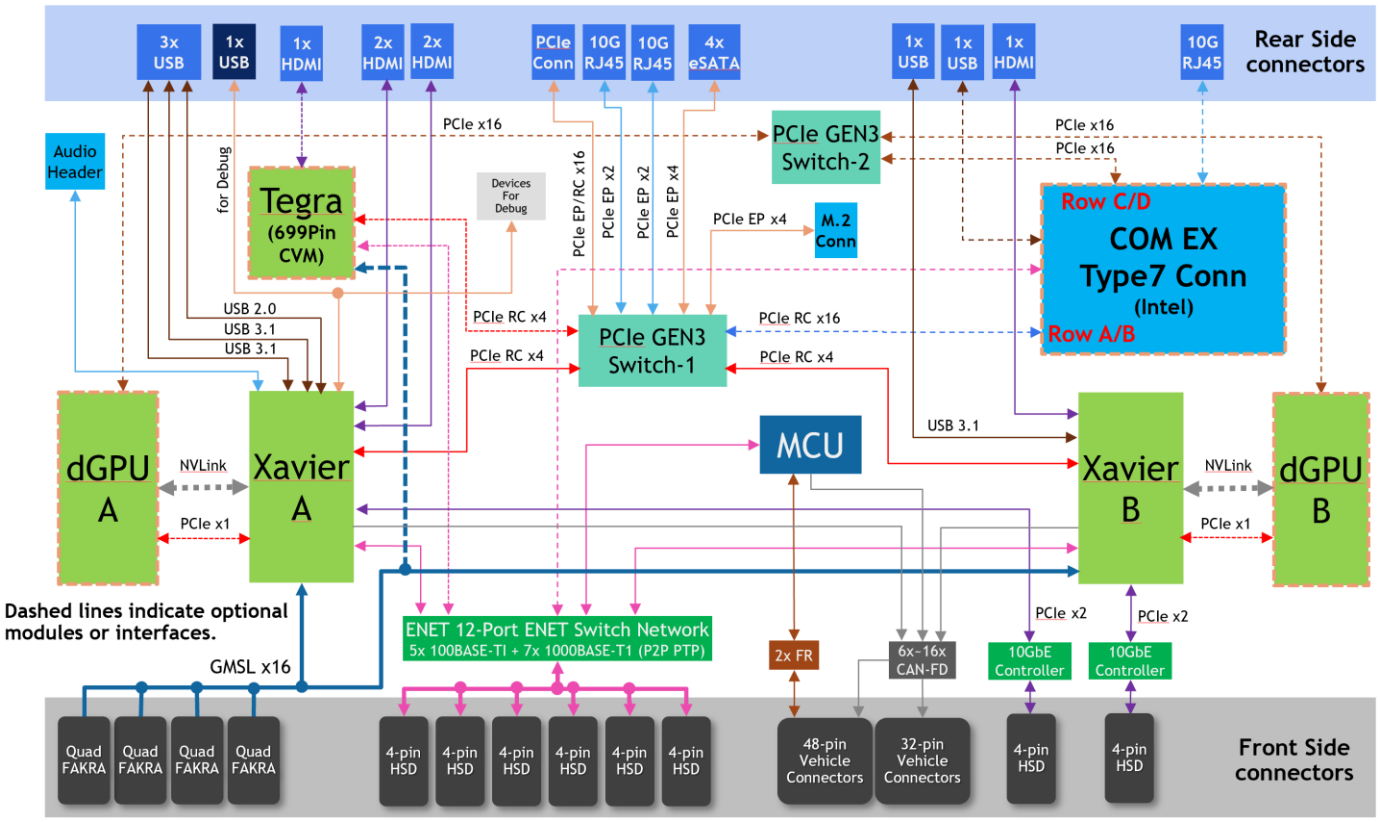

Figure 1-1. NVIDIA DRIVE AGX System High Level Block Diagram

1.3 NVIDIA DRIVE AGX SYSTEM PRODUCT FEATURE SET

The developer system core platform can be configured to different hardware configurations such as NVIDIA DRIVE™ AGX Pegasus II System, NVIDIA DRIVE™ AGX Xavier System and AI Car Computer that allow firmware and software to run on a specific developer system (see Figure 1-2). Table 1-2 lists the product features for each configuration.

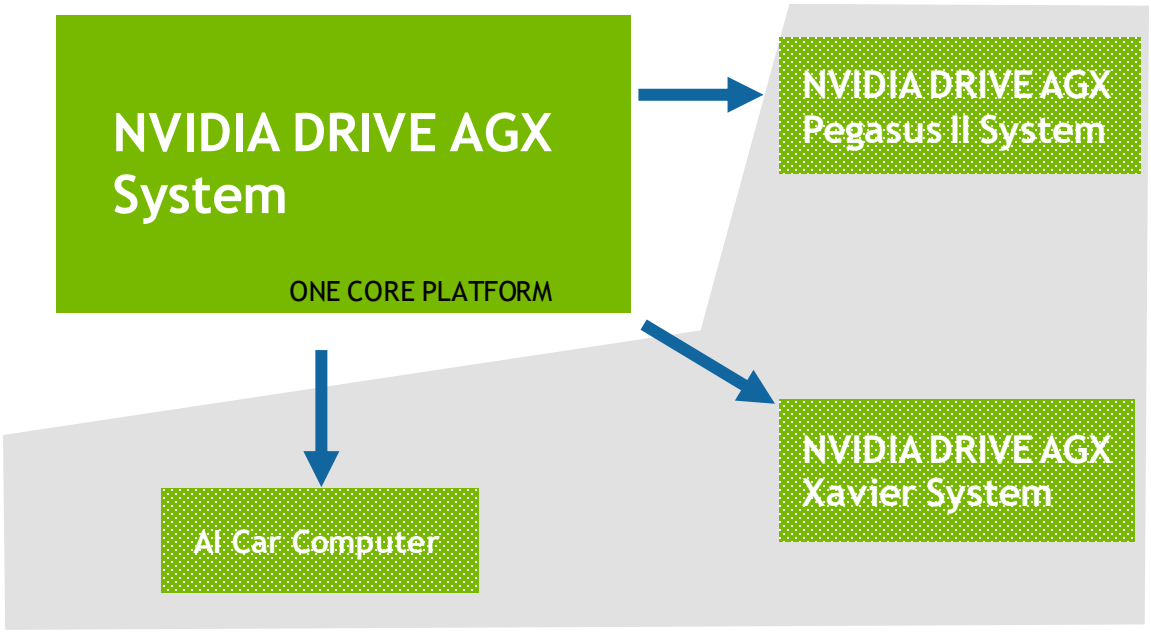

Figure 1-2. NVIDIA DRIVE™ AGX System Hardware Configurations

Table 1-2. Product Features per Configuration

Feature		NVIDIA DRIVE™ AGX System (E3550)	NVIDIA DRIVE™ AGX Pegasus II System (P3570) (Note 4)	NVIDIA DRIVE™ AGX Xavier System (P3479) (Note 4)
NVIDIA Xavier SoC		2	2	1
NVIDIA dGPU SXM2		2 (optional)	2	
System RAM		32GB LPDDR4x per Xavier	Up to 32GB LPDDR4x per Xavier	Up to 32GB LPDDR4x
QSPI NOR Flash		128MB per Xavier	128MB per Xavier	128MB
eMMC		128GB per Xavier	Up to 128GB per Xavier	Up to 128GB
Security Key Storage		8GB eMMC per Xavier	32MB total with 4MB secure region (Note 5)	32MB total with 4MB secure region (Note 5)
UFS		256GB per Xavier	Up to 256GB per Xavier	Up to 256GB
Camera		Up to 16 cameras: GMSL2 (Aggregators on CIM)	Up to 16 cameras: GMSL2 (On-board aggregators)	Up to 12 cameras: GMSL2 (On-board aggregators)
MCU		Infineon Aurix TC397	Infineon Aurix TC397	Infineon Aurix TC397
Ethernet (Note 1)	10 GbE	2x HSD (1 per Xavier), 2x RJ45	2x HSD (1 per Xavier)	1x HSD
	1 GbE	7 (3½ HSD) (Notes 2, 3)	8 (Notes 5, 6)	8 (Notes 3, 5)
	100 MbE	5 (2½ HSD) (Notes 2, 3)	4 (Notes 5, 6)	
CAN		Up to 6	Up to 12 (Note 5)	Up to 6
FlexRay to MCU		2	2	2
USB2 / USB3.1		Xavier: 4 (XA:3; XB:1) Others: 2 (Debug:1, Com Ex:1)	Up to 2 (1 per Xavier)	1
HDMI™		6 (XA:4, XB:1, CVM:1)	Up to 2 (1 per Xavier)	1
GPIO		4	Up to 6	4
PCIe		1 x16 (Mini-SAS connectors)	1 x8 (H-MTD connectors)	
eSATA		4		
M.2 code 2280 M-keyed		1 PCIe x4	512MB NVMe supported on board	
Automotive Audio Bus (A^2B)		No A^2B, but XA DAP ports are connected to headers	1 (XA only)	1
Debug and Development		JTAG, USB3.1, USB2, HDMI, UART	JTAG, USB3.1, USB2, HDMI, UART	JTAG, USB3.1, USB2, HDMI, UART

Notes:

1. Ethernet standards:
   - 10 GbE: 10GBASE-T (HSD: Single-Ended; RJ45: Differential Pair)
   - 1 GbE: 1000BASE-T1 (Each port occupies ½ HSD or ¼ quad housing H-MTD)
   - 100 MbE: 100BASE-T1 (Each port occupies ½ HSD or ¼ quad housing H-MTD)
2. The "½ HSD" in the "3½ HSD" and "2½ HSD" shown above is due to one of the HSD connectors is used for sharing one 1 GbE and one 100 MbE Ethernet ports.
3. A single HSD connector is used to provide two Ethernet ports.
4. The NVIDIA DRIVE™ AGX System can be configured to mimic NVIDIA DRIVE™ AGX Pegasus II System or NVIDIA DRIVE™ AGX Xavier System. Please contact NVIDIA for more information.
5. Due to minor differences in NVIDIA DRIVE™ AGX System, the feature might not be fully mimicked.
6. One quad housing H-MTD connector is used for four 1 GbE or four 100 MbE Ethernet ports.

Chapter 2. OPERATING CONDITION

2.1 OPERATING VOLTAGE

The NVIDIA document, *NVIDIA DRIVE™ AGX System Mechanical Installation Guide* contains information on how the power for the developer system is supplied via a power input connector on a cable harness. The VBAT terminal on the power input connector is connected to several VBATx wires for powering the whole developer system via the KL30_VBAT rail on the mainboard.

The KL30_VBAT must be connected to the vehicle main battery as the specification listed in Table 2-1.

Table 2-1. Operating Voltage

Power Input	Minimum	Nominal	Maximum
KL30_VBAT	7V	12V	28V

Notes:

1. The developer system is designed to be powered by a 12V vehicle battery. The 28V specification is meant for momentary voltage spike like load dump. It **DOES NOT** support a 24V battery.
2. Includes DC level and any noise or other transients; ensure the input rail remains within the specified range.
3. If the developer system to be installed in vehicle comes with GV100 dGPU or COM Express modules, we recommend the following for the cold crank case:
   - Use an inverter and the power supply included in the NVIDIA DRIVE™ AGX Developer Kit
   - Use a second battery to maintain (12V-5%) or higher voltage.
   - Contact vehicle electronic companies such as CALEX for a solution.

2.2 OPERATING CURRENT

Please refer to the NVIDIA document, *NVIDIA DRIVE™ AGX System Mechanical Installation Guide (DI-08957-001).*

2.3 OPERATING AND STORAGE TEMPERATURE

Please refer to the NVIDIA document, *NVIDIA DRIVE™ AGX System Mechanical Installation Guide (DI-08957-001).*

Chapter 3. MECHANICAL SPECIFICATION

Figure 3-1 shows a pre-assembled developer system with baseplate on its bottom.

Figure 3-1. Pre-assembled NVIDIA DRIVE™ AGX System

The dimensions and the weight of the developer system are shown in Table 3-1. The weight is dependent on the SKU number because the developer system may ship with or without the two SXM2 form factor dGPU modules.

For more detailed dimensions, please refer to the NVIDIA document, *NVIDIA DRIVE™ AGX System Mechanical Installation Guide (DI-08957-001)*, which contains the 3D CAD model of the developer system (.stp, STEP format) as an attachment.

Table 3-1. Dimensions and Weight

Dimensions (mm)	
Length	307.00
Width	416.50
Height	122.70
Weight (Kg)	
With dGPU modules	7.98 ± 3%
Without dGPU modules	5.99 ± 3%

APPENDIX A. DUAL GIGABIT ETHERNET DONGLE

The NVIDIA® Dual Gigabit Ethernet dongle is designed to convert the automotive 1000BASE-T1 Ethernet to standard RJ45 1000BASE-T Ethernet. The dongle also supports automotive 100BASE-T1 along with the BroadR-Reach standard.

Table A-1. Supported Ethernet Standards

Automotive Ethernet Standard	Converted to
1000BASE-T1	1000BASE-T (RJ45)
100BASE-T1	100BASE-T (RJ45)

Notes:

1. Rate conversion between 1000Mb/s and 100Mb/s is not supported.
2. The dongle will advertise 1000BASE-T if the T1 link is 1000Mb/s. However, if the RJ45 link partner is 100BASE-T, which supports only 100Mb/s, the RJ45 link will drop data. When this is happening, it will be indicated through the LED as described in Table A-2.
3. Half duplex is not supported.

E3579 ETHERNET DONGLE

The E3579 Dual Gigabit Ethernet dongle, as shown in Figure A-1, is one of the accessories shipped with the NVIDIA DRIVE AGX™ Developer Kit.

Figure A-1. E3579 Dual Ethernet Dongle with HSD Connector

The dongle is designed to allow the automotive 1000BASE-T1 port on the HSD connectors of the NVIDIA DRIVE AGX™ System to communicate with other systems through the standard RJ45 Ethernet connectors and Ethernet cables.

Figure A-2 shows the high-level block diagram of the dongle.

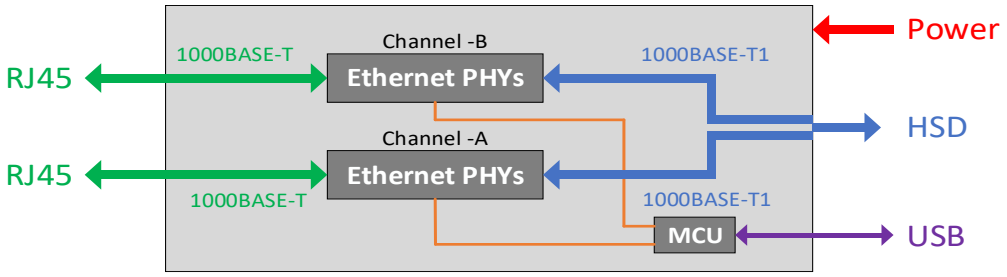

Figure A-2. E3579 Dual Ethernet Dongle High Level Block Diagram

As illustrated in Figure A-3, the dongle I/O ports on both the front and the rear panels are:

- **Power jack**: 4.75V to 28V DC power (Mating plug: 5.5x2.5mm)
- **Mini USB connector**: connecting to the USB port of a PC
- **LED indicators**: Blue for data transmitted, Yellow for data received, Red for power
- **HSD connector**: for connecting to the DRIVE AGX System HSD connectors
- **RJ45 connectors**: two connectors with LEDs for connecting to the other systems

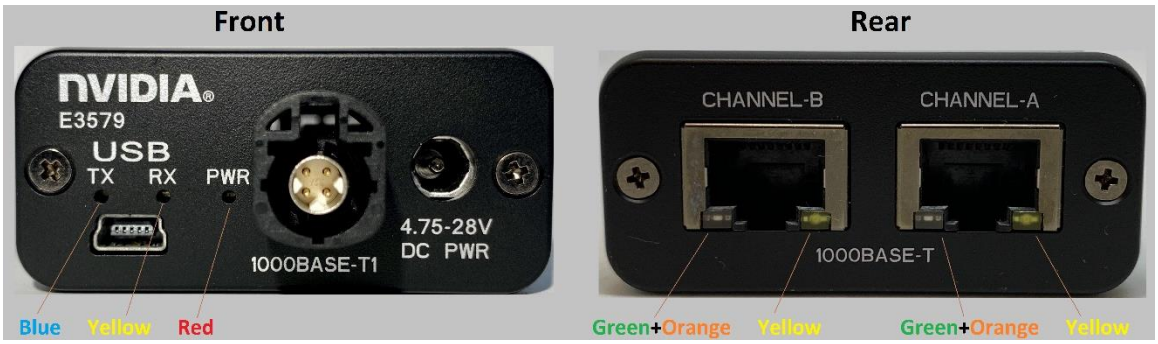

Figure A-3. Front and Rear Panels of the E3579 Ethernet Dongle

E3579 LED INDICATORS

There are three LEDs on the front panel. Each of the two RJ45 connectors on the rear panel also has two LEDs. These LEDs are used for indicating the dongle status. See Table A-2 for the details.

Table A-2. LED Locations and Status Descriptions

Panel	LED Location	LED Color	LED Activity	Status Description
Front	TX (Left)	Blue	Lit / Blink	Serial data bits transferring
	RX (Middle)	Yellow	Lit / Blink	Serial data bits receiving
	PWR (Right)	Red	Lit	External power is okay
			Blink	External power is missing
Rear	RJ45 x2 (Lower Left)	Green	Lit / Blink	Ethernet link running at 1GbE
		Orange	Lit / Blink	Ethernet link running at 100MbE
	RJ45 x2 (Lower Right)	Yellow	Lit	HSD/1000BASE-T1 linked up
			Blink	T1 link is faster than RJ45 link

CONNECTING E3579 TO DRIVE AGX SYSTEM

As shown in Figure A-4, the dongle must be powered externally with the DC power adapter. The HSD connector of the dongle is connected to the HSD connector of the DRIVE AGX System through the HSD cable provided with the kit. The USB connection to the PC is optional and is not required for dongle operation.

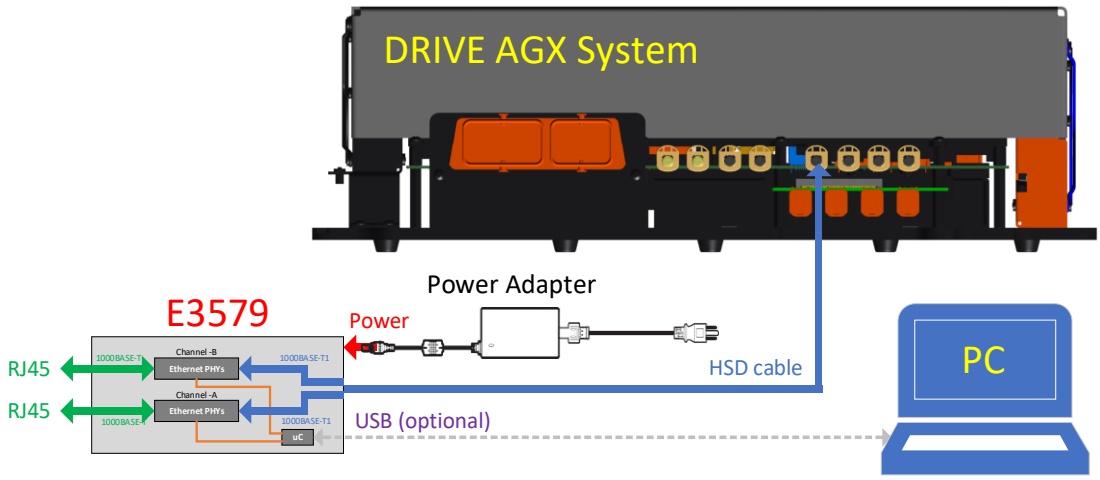

Figure A-4. E3579 System Connections

Each of the HSD connectors on the DRIVE AGX System carries two Ethernet channels. The HSD connector on the dongle is the same as the HSD connectors on the DRIVE AGX System. The HSD connector pinout is shown in Table A-3.

The HSD connectors on the DRIVE AGX System support both 1000BASE-T1 and 100BASE-T1. Depending on which HSD connector the dongle is connected, the RJ45 channel may be 1Gbit Ethernet or 100Mbit Ethernet. Please refer to the NVIDIA document, *NVIDIA DRIVE AGX System Mechanical Installation Guide (DI-08957-001)*, in which all the possible connections are listed in a table.

Table A-3. HSD Connection Mapping

DRIVE AGX System HSD Pin #	Polarity	HSD Cable	E3579 HSD Pin #	Polarity	E3579 Channel #
2	P		3	P	Channel -A
4	N		1	N	
3	P		2	P	Channel -B
1	N		4	N	

E3579 OPERATING VOLTAGE

Table A-4. Operating Voltage

Power Input Type	Voltage Range
DC Power	4.75V to 28V*
Note: See Table 2-1 when installing the developer system in a vehicle.	

E3579 OPERATING CURRENT

The operating current is depending on factors such as the number of active channels and the Ethernet speed. Table A-5 shows the required current when the power input is at 12V.

Table A-5. Operating Current

Power Input Voltage	Current Range
12VDC (using the 12V power adapter)	0.15A to 0.25A
Note: The current numbers in this table are specified at the nominal input voltage of 12V. Please calculate the worst-case current based on the lowest possible input voltage, $Vmin\ (v)$, using the following equation: $$Current\ @\ Vmin = Current\ @\ 12V \times \frac{12V}{Vmin\ (v)}$$	

E3579 OPERATING AND STORAGE TEMPERATURE

The system should be operating and stored under the temperature specifications.

Table A-6. Operating and Storage Temperatures

Mode	Ambient Temperature Range
Operating	0ºC to 45ºC
Storage	-40ºC to 65ºC

E3579 MECHANICAL SPECIFICATION

Figure A-5 shows how the enclosure dimensions are labeled and Table A-7 lists out the typical dimensions and the typical weight of the dongle.

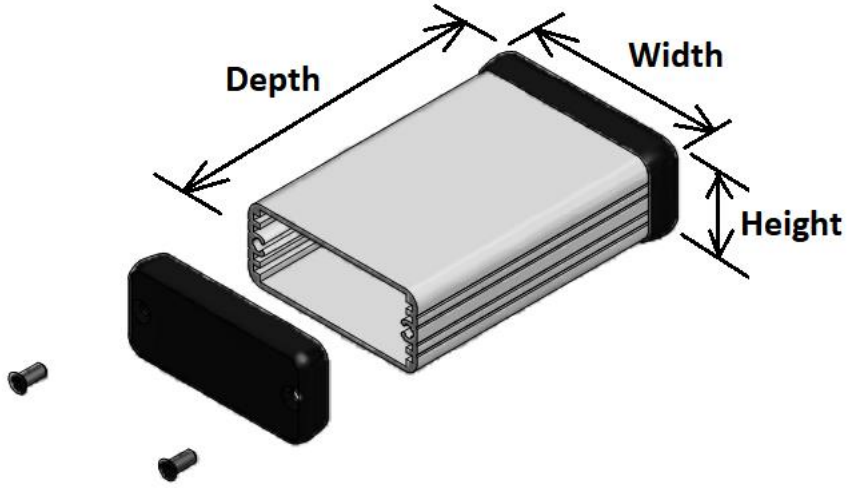

Figure A-5. Dual Ethernet Dongle Enclosure Dimensions

Table A-7. Dimensions and Weight

Dimensions (mm)	
Width	57.10
Height	26.00
Depth	85.50
Weight (g)	
With no cable connected	100 ± 3%

APPENDIX B. DUAL 10G ETHERNET DONGLE

The NVIDIA® E3585 Dual 10G Ethernet dongle is designed to convert the single-ended version of 10GBASE-T Ethernet from the High-Speed Data (HSD) connector to the standard RJ45 10GBASE-T Ethernet, which carries differential signals. This allows the 10G Ethernet of the NVIDIA DRIVE AGX™ System (E3550) and the NVIDIA DRIVE AGX Pegasus™ II System (P3570) to be connected to other systems by using industry standard CAT6 or CAT6A cables.

E3585 DUAL 10G ETHERNET DONGLE

The E3585 dongle, as shown in Figure B-1, is one of the optional accessories designed for the NVIDIA DRIVE AGX™ Developer Kit.

Figure B-1. E3585 Dual 10G Ethernet Dongle with HSD Connector

Figure B-2 shows the high-level block diagram of the dongle.

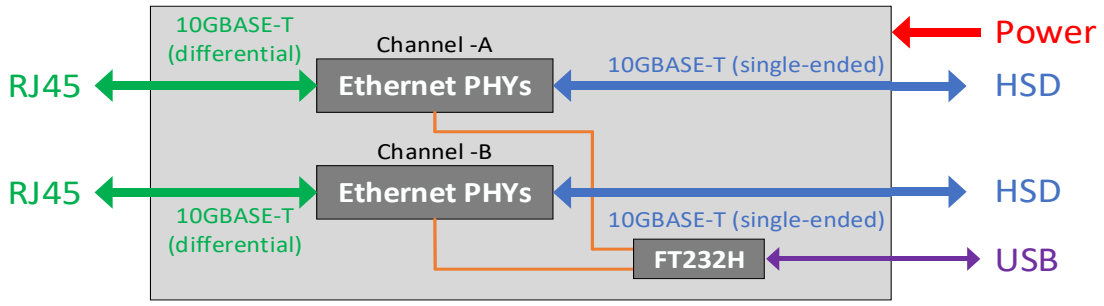

Figure B-2. E3585 Dual 10G Ethernet Dongle High Level Block Diagram

The dongle contains two instances of the circuit that converts 10G Ethernet from HSD form factor to RJ45. The NVIDIA DRIVE AGX System connects to the dongle using two HSD cables which are provided in the kit. The HSD cables have the same connectors at both ends and are mated to the HSD connectors on the NVIDIA DRIVE AGX System and the E3585 dongle respectively.

Figure B-3 shows the front and rear views of the E3585 Ethernet dongle. The HSD connectors (white color) on the DRIVE AGX System are the same as the connectors used on the E3585 Ethernet dongle.

The dongle I/O ports on both the front and the rear panels are as follows:

- **DC Power jack**: 7V to 28V, with 2.5mm diameter inner pin (Mating plug: 5.5x2.5mm)
- **Micro USB connector**: connecting to the USB port of a PC
- **LED indicators**: on both the front side and rear side for power and Ethernet status
- **HSD connectors**: two connectors for connecting to the DRIVE AGX System
- **RJ45 connectors**: two connectors with edge LEDs for connecting to the other systems

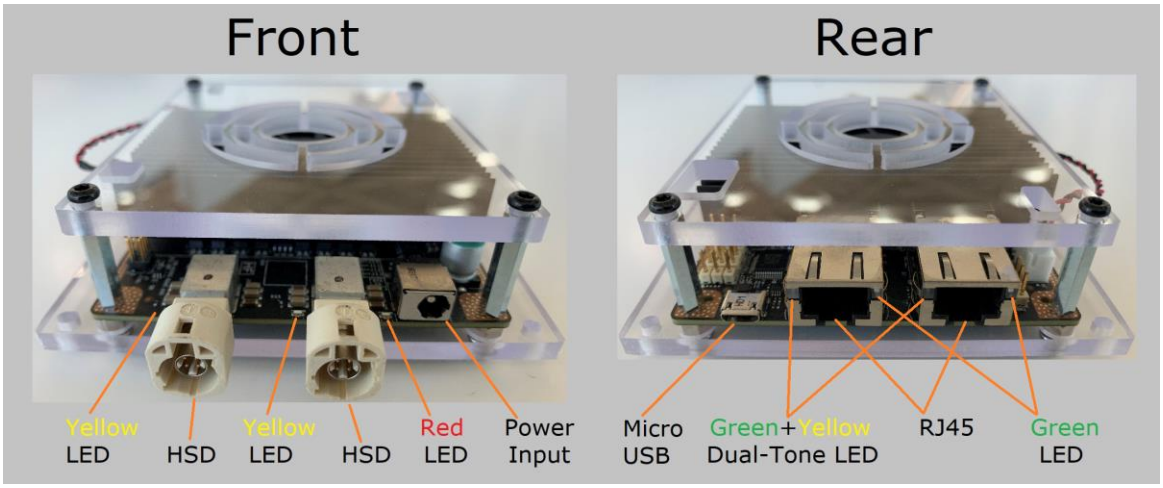

Figure B-3. Front and Rear Panels of the E3579 Ethernet Dongle

E3585 LED INDICATORS

Three LEDs on the front side of E3585 are:

- **Red** (x1): on the left side of the power jack
- **Yellow** (x2): on the left side of the HSD connector

Two LEDs on each of the two RJ45 connectors on the rear side of E3585 are:

- **Green**: on the right side of the RJ45 connector
- **Green**/**Yellow** (dual tone): on the left side of the RJ45 connector (only **Yellow** is used)

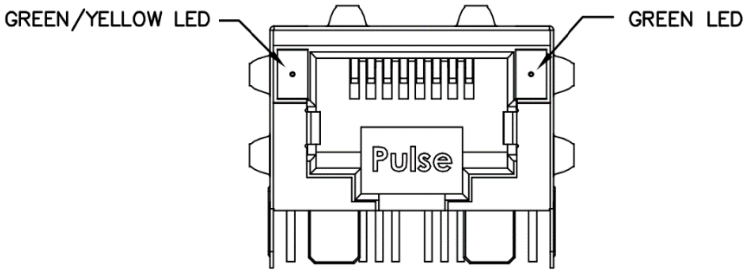

Figure B-4. LEDs on the RJ45 Ethernet

These LEDs are used for indicating the dongle status as listed in Table B-1.

Table B-1. LED Locations and Status Descriptions

Side	LED Location	LED Color	LED Status	Description
Front	Left side of power jack	Red	Lit	E3585 is powered
	Left side of HSD	Yellow	Lit	10GbE Link Status
Rear	Right edge of RJ45	Green	Lit	10GbE Link Status
	Left edge of RJ45	Green / Yellow	Blink on Yellow	10GbE Traffic

CONNECTING E3585 TO THE NVIDIA DRIVE AGX SYSTEM

As shown in Figure B-5, the dongle must be powered externally with a DC power adapter. The dongle can only link at 10GbE – there is no down-train support. Using the HSD cables provided with the dongle, connect the 10GBASE-T from the dongle's HSD connectors to the DRIVE AGX System front panel 10GbE HSD connectors labeled **XA** and **XB** on the silkscreen. The USB connection to the PC is optional and is not required for the dongle to operate.

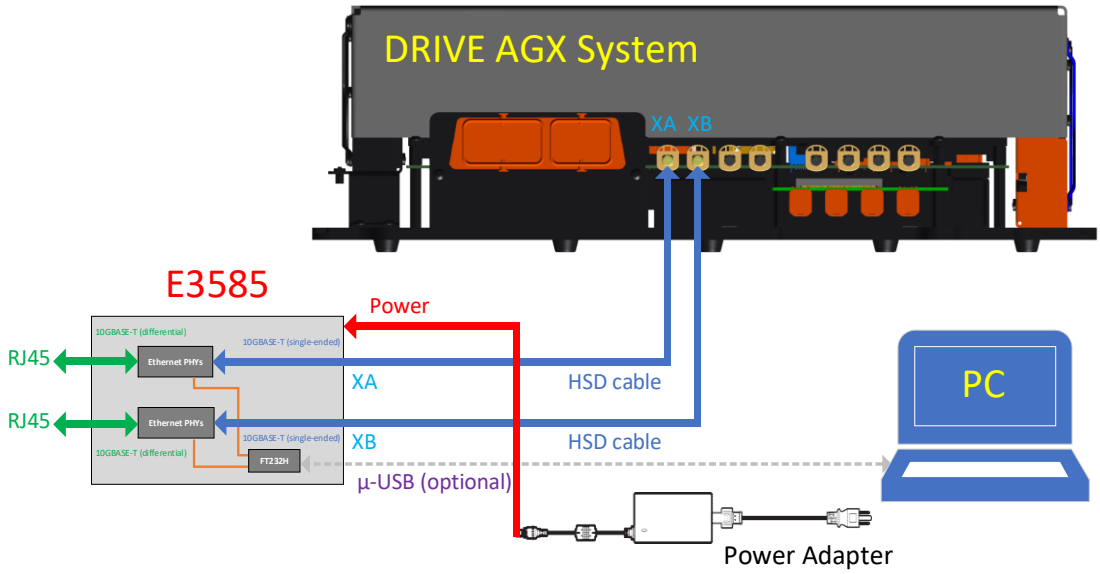

Figure B-5. E3585 System Connections

E3585 OPERATING VOLTAGE

Table B-2. Operating Voltage

Power Input Type	Voltage Range
DC Power	7V to 28V*
Note: See Table 2-1 when installing the developer system in a vehicle.	

E3585 OPERATING CURRENT

The operating current is dependent on factors such as the number of active channels and the Ethernet speed. Table B-3 contains the required current when the power input is at 12V.

Table B-3. Operating Current

Power Input Voltage	Current Range
12VDC (using the 12V power adapter)	1A to 3A
Note: The current numbers in this table are specified at the nominal input voltage of 12V. Please calculate the worst-case current based on the lowest possible input voltage, $Vmin\ (v)$, using the following equation: $$Current\ @\ Vmin = Current\ @\ 12V \times \frac{12V}{Vmin\ (v)}$$	

E3585 OPERATING AND STORAGE TEMPERATURE

The system should be operating and stored under the temperature specifications.

Table B-4. Operating and Storage Temperatures

Mode	Ambient Temperature Range
Operating	0°C to 45°C
Storage	-40°C to 65°C

E3585 MECHANICAL SPECIFICATION

Figure B-6 shows how the E3585 dimensions are labeled and Table B-5 lists out the typical dimensions and the typical weight of the dongle.

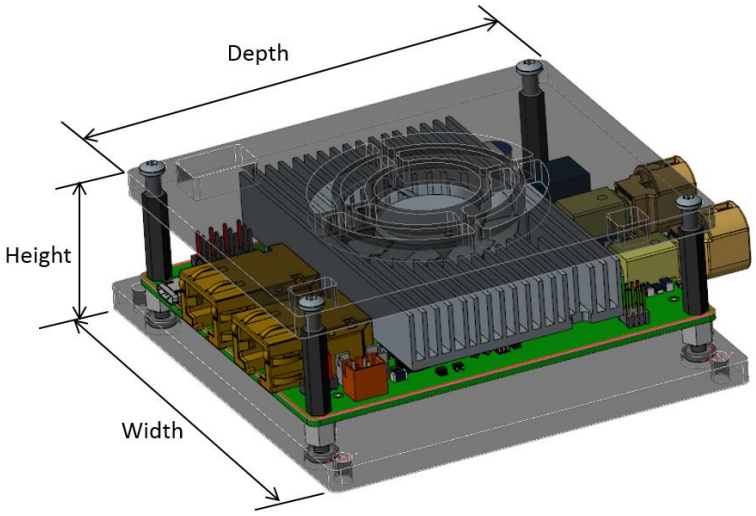

Figure B-6. E3585 Dimensions with Plexiglass Panels on Top and Bottom

Table B-5. Dimensions and Weight

Dimensions (mm)	
Width	105.00 ± 0.25
Height (excluding the height of the four screws on top, which adds an additional 2mm)	35.58 ± 0.25
Depth	96.00 ± 0.25
Weight (g)	
With no cable connected	255 ± 3%