LinkX User Guide for 400G and 200G using 50G-PAM4 and 100G using 25G-NRZ Modulation Cables and Transceivers
# Table of Contents

NVIDIA LinkX QSFP-based Cables and Transceiver Portfolio ................................................................. 3  
  LinkX 400GbE Cables and Transceivers Portfolio .................................................................................. 3  
  LinkX 200GbE and InfiniBand HDR Cables and Transceiver Portfolio ................................................ 5  
  NVIDIA Spectrum 400G, 200G, 100GbE Ethernet Switch Portfolio ..................................................... 7  
  NVIDIA Quantum HDR 200G InfiniBand Switch Portfolio .................................................................. 8  
  NVIDIA ConnectX Network Adapter Portfolio ....................................................................................... 8  
  NVIDIA BlueField-3 DPU Portfolio ...................................................................................................... 10  
Where to Find More LinkX Documentation ........................................................................................... 11  
Document Revision History ..................................................................................................................... 12
LinkX 400GbE Cables and Transceivers Portfolio

This document profiles 400Gb/s QSFP-DD-based cables and transceivers for Ethernet only from 0.5-meters to 10km.

The LinkX® 400GbE QSFP-DD portfolio consists of straight and splitter DACs, an AOC cable and five transceivers with reaches from 1-to 10k-meters. QSFP-DD cables and transceivers support only Ethernet.

NVIDIA 400GbE QSFP-DD product line:

- DAC cables have 1:2 and 1:4 split configuration with maximum reach of 2.5-meters.
- AOC have only QSFP-DD-to-QSFP-DD AOC and no splitters.
- 400GbE SR8 multimode transceiver can be split to 2x 200G QSFP56 and to 2x 100G
  - Use 3rd party MPO-16/APC-to-2x MPO-12/UPC fiber cables - not offered by NVIDIA.
  - Note, the 400GbE SR8 uses a 16-fiber MPO-16/APC optical connector.
- 400GbE DR4 can be split to 4x 100G DR1 using 3rd party supplied splitter fiber cables.
  - MPO-12/APC-to-4x LC Duplex
  - DR1 is 1x100G-PAM4 optical to 4x25G-NRZ
- 400G FR4 and LR4 are optically multiplexed and cannot be split and used for long, leaf-spin and spine-super spine links.
400GBE ETHERNET QSFP-DD (50G-PAM4)

**Direct Attach Copper (DAC)**
- 400Gbe
  - MCP1960-W0xxExx
- 400Gbe-to-2x100Gbe
  - MCP7H60-W0xxRxx
- 400Gbe-to-4x100Gbe
  - MCP7F50-W0xxRxx

**Active Optical Cables (AOCs)**
- 400Gbe
  - C-DQ8FNM0xx-H0-M

**400Gbe SR8 QSFP-DD**
- 100m
  - T-DQ8FNS-N00-M

**400Gbe DR4 QSFP-DD**
- 500m
  - MMS1V00-WM

**400Gbe FR4 QSFP-DD**
- 2km
  - MMS1V50-WM

**400Gbe LR4 QSFP-DD**
- 10km
  - MMS1V90-WR

**Switch to Switch or ConnectX-6 and/or BlueField-2 DPU**

**SN5400**
- 400Gbe Spine/Super Spine Ethernet Switch
  - 64 400Gbe QSFP-DD cages
  - Spectrum-4

**SN4700**
- 400Gbe Spine/TOR Ethernet Switch
  - 32 QSFP-DD cages
  - Spectrum-3
LinkX 200GbE and InfiniBand HDR Cables and Transceiver Portfolio

The LinkX 200GbE and InfiniBand HDR QSFP56 portfolio consists of straight and 1:2 splitter DACs and AOC cables, two transceivers with reaches from 1-to 2k-meters. Some of the parts are either InfiniBand or Ethernet specific with different part numbers, or sometimes a single part number supports both InfiniBand and Ethernet.

- 200GbE and HDR portfolios are very similar, except the InfiniBand DACs are maximum reach of 2-meters.
- 200G straight DAC and 200G SR4 multimode transceivers are InfiniBand part number specific and require more stringent BER testing.
- InfiniBand cables and transceivers can be used in NVIDIA Spectrum™ Ethernet switches in NVIDIA end-to-end configurations. InfiniBand testing is more stringent than Ethernet. However, Ethernet cables and transceivers cannot be used in InfiniBand systems.
- 200GbE and HDR SR4 transceivers can be split into 2x 100G creating 2x50G-PAM4 QSFP56 100GbE or HDR100 ends.
  - Use 3rd party MPO-12/UPC-to-MPO-12/UPC fiber cables -- not offered by NVIDIA.
- 200G FR4 is optically multiplexed and cannot be split and used for long, leaf-spin and spine-super spine links.
- 200G FR4 can be used in ConnectX®-6 adapters under specific air flow conditions in servers; check the NVIDIA ConnectX-6 User Manual.
- 200GbE and HDR use 4x50G PAM4 = 200G.
- HDR100 and 100GbE based on 2x50G PAM4 is 100G and not compatible with 100GbE based on 4x25G-NRZ.
NVIDIA Spectrum 400G, 200G, 100GbE Ethernet Switch Portfolio

There are many different switch port configurations in the Spectrum Ethernet switch product line using various combination of QSFP-DD, QSFP56, QSFP28 and SFP28. The DACs, AOCs and multimode transceiver are generally used in switch-to-server links and multimode for longer links beyond 2.5-meter DAC maximum reach.

The NVIDIA Spectrum, Spectrum-2, Spectrum-3, and Spectrum-4 are successive switch IC generations dating back to 2015 with the Spectrum-4 being the latest offering. The Spectrum-4 is also offered as the SN5600 in twin-port QSFP 800G 64-port configuration based on 100G-PAM4 modulation. The Spectrum Ethernet switches are protocol specific and do not support InfiniBand.

**NVIDIA Spectrum Ethernet Switch Portfolio**

<table>
<thead>
<tr>
<th>SN2000 Series Spectrum</th>
<th>SN3000 Series Spectrum-2</th>
<th>SN4000 Series Spectrum-3</th>
<th>SN5000 Series Spectrum-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>QSFP28 &amp; SFP28</td>
<td>QSFP56, QSFP28 &amp; SFP28</td>
<td>QSFP-DD, QSFP56 &amp; SFP28</td>
<td>QSFP-DD, QSFP56</td>
</tr>
</tbody>
</table>

The 400GbE QSFP-DD cables and transceivers line is for the NVIDIA SN5400, SN4700, SN4410 Ethernet switches only and not used for InfiniBand. The QSFP-DD cages are backwards compatible and accept all QSFP-based cables and transceivers, both 50G-PAM4 and 25G-NRZ line rates and 25, 40, 100, 200, and 400G aggregate data rates. Similarly, the 200GbE QSFP56 cages are backwards compatible to QSFP28.

- 400GbE
- 200GbE
- 100GbE
- QSFP-DD
- QSFP56
- QSFP28
- 8x50G-PAM4
- 4x50G-PAM4
- 4x25G-NRZ
NVIDIA Quantum HDR 200G InfiniBand Switch Portfolio

The 200G HDR is offered in 32-ports of 200G HDR in QSFP56 cages.

- QSFP56 cages accept 100G EDR cables and transceivers
- HDR was the first InfiniBand products to offer 1:2 splitter DACs and AOCs

The HDR cables and transceivers product line overlaps the 200GbE Ethernet portfolio with a few InfiniBand-only exceptions for a DAC and SR4 transceiver. InfiniBand has a much lower bit error ratio (BER) requirement to minimize the use of forward error correction which induces significant latency.

NVIDIA Quantum HDR InfiniBand Switch Portfolio
- NVIDIA Quantum QM8700 Switch
  - 32 cages QSFP56 200Gb/s

NVIDIA ConnectX Network Adapter Portfolio

The ConnectX line converts PCIe bus signals to Ethernet or InfiniBand protocols. The ConnectX portfolio consists of three generation of adapter ICs.

<table>
<thead>
<tr>
<th>Speed</th>
<th>ConnectX-7</th>
<th>ConnectX-6</th>
<th>ConnectX-5</th>
<th>QSFP112</th>
<th>QSFP56</th>
<th>QSFP28</th>
<th>OSFP</th>
<th>SFP56</th>
<th>SFP28</th>
</tr>
</thead>
<tbody>
<tr>
<td>400GbE/NDR</td>
<td>ConnectX-7</td>
<td>ConnectX-6</td>
<td>ConnectX-5</td>
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<td>100GbE/EDR</td>
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<td>ConnectX-5</td>
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<td>QSFP56</td>
<td>QSFP28</td>
<td>OSFP</td>
<td>SFP56</td>
<td>SFP28</td>
</tr>
</tbody>
</table>

- ConnectX-7 is offered in 4x100G-PAM4 OSFP and QSFP112.
- ConnectX-7 and most ConnectX-6 products support both Ethernet and InfiniBand.
- SFP56 and OCP cards are Ethernet specific.
- As with the switch port cages, the ConnectX-7 QSFP112 is backwards compatible to the slower QSFP56, QSFP28, etc. Similarly, for the QSFP56 based ConnectX-6 and QSFP28.
- ConnectX line is not offered with QSFP-DD cages.

NVIDIA ConnectX-7 Network Adapter Portfolio
CONNECTX-7 PORTFOLIO

Comprehensive portfolio to support entry level & premium boards

- **4P X SFP56 - HHHL / FHHL**
  - 25G/50G - W/ & W/O SYNCE/GNSS

- **2P X QSFP112 - HHHL**
  - 200G - PAM4 56 & PAM4 112

- **2P X QSFP112 - OCP3.0**
  - 200G - PAM4 56 & PAM4 112

- **1P X QSFP - HHHL**
  - 400G - PAM4 112

- **1P X QSFP - OCP3.0**
  - 400G - PAM4 112
NVIDIA BlueField-3 DPU Portfolio

BlueField DPUs contain an ARM® CPU, memory, accelerators, PCIe switch and ConnectX-6 or ConnectX-7 adapters.

- BlueField-2 DPUs are offered in 200G QSFP56 for InfiniBand and Ethernet
- BlueField-3 DPUs are offered in 200G and 400G QSFP112 for InfiniBand and Ethernet
- Not offered with OSFP or QSFP-DDs
- QSFP112 cages accept 200G QSFP56 and 100G QSFP28

NVIDIA BlueField-3 DPU Portfolio 200G & 400G, InfiniBand and Ethernet QSFP112

<table>
<thead>
<tr>
<th>Single QSFP112</th>
<th>Dual QSFP112</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Single QSFP112" /></td>
<td><img src="image2.png" alt="Dual QSFP112" /></td>
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</tbody>
</table>
Where to Find More LinkX Documentation

This user guide is to be used in conjunction with other documents located in folders in docs.nvidia.com/networking/ > Interconnect. This site is where the following LinkX cables and transceivers documents are provided.

<table>
<thead>
<tr>
<th>LinkX Overview Documents:</th>
<th>Review of parts, important notes, and configuration details for linking to NVIDIA switches and adapters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• LinkX Cables and Transceivers Guide to Key Technologies</td>
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<tr>
<td></td>
<td>• LinkX User Guide for 400Gb/s 100G-PAM4 OSFP &amp; QSFP112-based Cables and Transceivers</td>
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<td></td>
<td>• LinkX User Guide for 400Gb/s and 200Gb/s using 50G-PAM4 and 100Gb/s using 25G-NRZ Modulation Cables and Transceivers (this document)</td>
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<table>
<thead>
<tr>
<th>Configuration Maps:</th>
<th>Picture and part number-based PowerPoint® slides for every configuration with NVIDIA switches, network adapters, and DGX GPU systems for 100G-PAM4, 50G-PAM4, 25G-NRZ cables and transceivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Configuration Maps</td>
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</tbody>
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<tr>
<th>Parts Lists:</th>
<th>Tables summarize by speed, form factor, connector, power, reach, etc. and hyperlinks to individual products specs</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• 400Gb/s (100G-PAM4) Transceivers and Fiber Parts List</td>
</tr>
<tr>
<td></td>
<td>• 400Gb/s and 200Gb/s (50G-PAM4) and 100Gb/s (25G-NRZ) Cables and Transceivers Parts List using QSFP-DD, QSFP56, QSFP28, SFP28</td>
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<thead>
<tr>
<th>Product Specifications:</th>
<th>10-to-16-page detailed hardware datasheets with physical, thermal, electrical, and optical specifications for each product</th>
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<tr>
<td></td>
<td>• docs.nvidia.com/networking/ &gt; Interconnect &gt; select speed and type</td>
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| Additional Docs: | • NVIDIA Cable Management Guidelines and FAQ |
## Document Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Changes</th>
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<tbody>
<tr>
<td>1.0</td>
<td>August 2023</td>
<td>Initial release</td>
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