

APPLICATION NOTE

Champion ONE DACs and AOCs

Champion ONE provides a broad range of direct attach copper cables (DACs) and active optical cables (AOCs). This application note illustrates some of the available options and further explores use cases in the data center, wiring closet, and network engineering lab.

Portfolio Overview

	Speed ¹	Form Factor	Cable Type	Cable Length (Meter) ²
DACs	10G	SFP+ to SFP+	Passive Twinax Copper	0.5m to 10m
	25G	SFP28 to SFP28	Passive Twinax Copper	0.5m to 5m
	40G	QSFP+ to QSFP+	Passive Twinax Copper	0.5m to 7m
	40G Breakout	QSFP+ to 4x SFP+	Passive Twinax Copper	0.5m to 5m
	50G	QSFP56 to QSFP56	Passive Twinax Copper	1m to 6m
	100G	QSFP28 to QSFP28	Passive Twinax Copper	0.5m to 5m
	100G Breakout	QSFP28 to 4x SFP28	Passive Twinax Copper	0.5m to 5m
	400G	QSFP-DD to QSFP-DD	Passive Twinax Copper	0.5m to 2.5m
AOCs	10G	SFP+ to SFP+	Multimode Fiber	Up to 100m
	25G	SFP28 to SFP28	Multimode Fiber	Up to 100m
	40G	QSFP+ to QSFP+	Multimode Fiber	Up to 100m
	40G Breakout	QSFP+ to 4x SFP+	Multimode Fiber	Up to 100m
	50G	QSFP56 to QSFP56	Multimode Fiber	Up to 100m
	100G	QSFP28 to QSFP28	Multimode Fiber	Up to 100m
	100G Breakout	QSFP28 to 4x SFP28	Multimode Fiber	Up to 100m
	400G ³	QSFP-DD to QSFP-DD	Multimode Fiber	Up to 100m

1. Product type and configuration subject to change. Please consult your sales representative for product updates.
 2. AOCs are available in lengths up to 100m, but deploying cables longer than 30m is not recommended.
 3. To be released soon – roadmapped for 2021.



Champion ONE's DACs and AOCs are available in three product lines based on compatibility:

Product Line	Use Case
Passport™ DACs and AOCs	Interconnect open systems. Passport DACs and AOCs are programmed for multi-source agreement (MSA) compliance on both ends. They are designed to interconnect with open systems that do not require specific coding for system identification and compatibility.
Sureport™ DACs and AOCs	Interconnect specific OEM equipment. Sureport DACs and AOCs are designed to interconnect original equipment manufacturer (OEM) equipment that requires specific coding for system identification and compatibility.
Multi-Vendor DACs and AOCs	Interconnect equipment from 2 different OEMs. Multi-vendor DACs and AOCs have one end coded for one OEM vendor and the other end for a different vendor. The purpose-built multi-vendor DAC and AOC cables are compatible with more than two dozen OEMs including all major brands.

The following table compares Champion ONE DACs and AOCs with the traditional approach of optics plus fiber cabling:

	DAC	AOC	Optics with Fiber Cabling
Application	Interconnect within racks	Interconnect across racks	Interconnect across rack rows, server rooms, or sites
Relative Cost	\$	\$\$	\$\$\$
Deployment Complexity	Easiest. Pre-terminated cable requires no cleaning or field testing.	Easy. Pre-terminated cable requires no cleaning or field testing.	More complex. Requires professional installation, cleaning, and field testing.
Power Consumption	Lowest	Lower	Standard
Cable Management	Moving, adding, or changing requires touching the equipment network interface	Moving, adding, or changing requires touching the equipment network interface	Easy to move, add, or change at the patch panel
Cable Bundle Size	Largest	Medium	Smallest

Key Benefits

- **Guaranteed Compatibility.** Our DACs and AOCs are programmed by experts and 100% in-system tested at our robust California lab, which features virtually all major OEM switches and server cards.
- **Customized Solutions.** Our DACs and AOCs are fully customizable to fit your specific needs, including multi-vendor programming, lengths, cable colors, and labeling.
- **Availability and Fast Shipping.** We provide quick-turn solutions for small purchase needs and/or evaluations and the ability to ship large quantity orders in under 3 weeks on select form factors.
- **100% TAA Compliant.** Our DACs and AOCs are coded, tested, labeled, and packaged in California.
- **Single Source.** No matter what network environment and equipment you have, everything comes from one source.

DACs and AOCs in the Data Center

Figure 1 below illustrates a typical spine-leaf fabric architecture, which has been widely adopted by the modern data center to support cloud applications. This architecture controls the day 1 build costs, while also allowing very fast scalability to meet today's ever-expanding data needs.

Access Layer

As illustrated in Figure 1, the server access switches are often located at the top of rack (ToR). Champion ONE DACs are ideal for connecting ToR access switches to rack-mounted servers. Whether you have a 10G connected server in an enterprise data center, a 25G server in a hyperscale/cloud provider data center, or a 40/100G server for high-performance computing applications, DAC and/or breakout cabling can provide the most robust, cost-effective connectivity to these servers at any required data rate.

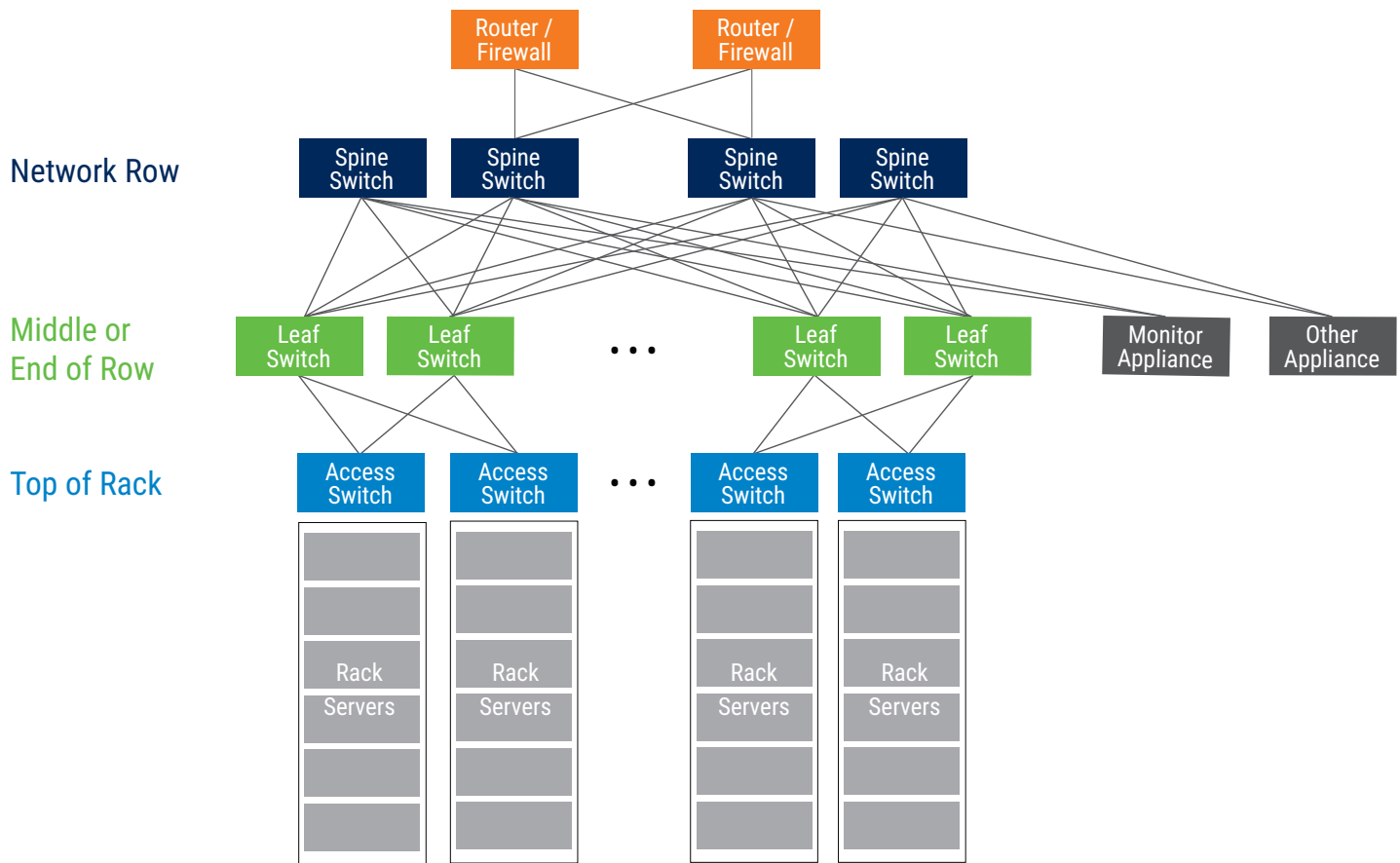


Figure 1. A typical spine-leaf architecture.

In high-density deployments at the server access layer, Champion ONE breakout DACs are ideal for connecting a ToR switch to servers. For example, using a 40G QSFP+ to 4x 10G SFP+ breakout DAC to connect a 40G port of the ToR switch to four 10G servers lowers the cost and complexity of these connections. Similarly, using a 100G QSFP28 to 4x 25G SFP28 breakout DAC to connect a 100G port to four 25G servers will do the same for 100G to 25G connections.

AOC breakouts can be used in the same high-density deployment for longer spans, e.g., between Middle-of-Row to the Network Row, or any other connection longer than 7m.

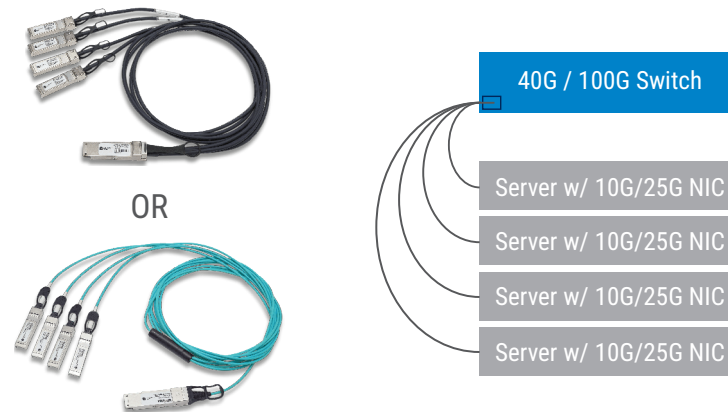


Figure 2. Breakout DACs or AOCs can connect a single switch port to four server ports.

Fabric

The leaf switch is often deployed in middle-of-row (MoR) or end-of-row (EoR) positions. The reach between the ToR switch and MoR/EoR switch typically exceeds 7m, but is often shorter than 30m. Champion ONE's AOCs are ideal to interconnect the ToR switch with the MoR/EoR switch at these distances. Although AOCs are available up to 100m long, the best practice is to deploy AOCs 30m or shorter, because of the challenge of pulling AOCs with bulk ends.

The fabric from the spine to leaf typically requires high-performance, high-bandwidth connectivity. In this use case, Champion ONE's 100G and 400G AOCs are ideal for building spine-leaf fabric connectivity.

Core routers, security appliances, monitor appliances, and similar devices are typically connected to either the spine or leaf switch, depending on the design. In this case as well, Champion ONE's AOCs or DACs are the ideal connectivity solution to interconnect these devices to the spine or leaf switch, depending on placement and reach.

Multi-Vendor Environment

The data center network is typically a multi-vendor environment. For example, a data center may include core routers made by Cisco or Juniper, spine switches by Arista, leaf or ToR switches by Juniper, servers with Intel/Broadcom/Mellanox network interface cards (NICs) installed, a firewall by Palo Alto, and monitor appliances by Gigamon or Netscout. The challenge arises when equipment from different OEMs must be connected, but at least one of the OEMs requires specific coding to ensure proper system identification.

For these environments, Champion ONE provides multi-vendor DACs and AOCs with one end coded for one vendor and the other end for a different vendor. These purpose-built multi-vendor DACs and AOCs can be compatible with over two dozen OEMs, and are available in a broad range of lengths, speeds, and form factors. All multi-vendor DACs and AOCs are 100% tested in-system at Champion ONE's engineering lab to ensure compatibility and quality. Prior to shipping, the multi-vendor DACs and AOCs are labeled at each end for the intended OEM brands to reduce in-field operational confusion.

Champion ONE DACs and AOCs can also be used for connections of applicable lengths in other data center network architectures (e.g., the traditional multi-tier architecture).

DACs and AOCs in the Wiring Closet

The wiring closet facilitates network access for desktop computers, laptops, and mobile devices in commercial buildings. Often, the wiring closet hosts servers for local access, but can also host routers such as a campus core router or a customer premise equipment (CPE) router for wide area network (WAN) access. In this environment, DACs and AOCs can be used to interconnect routers to switches, switches to switches, or switches to local servers wherever the cable length is applicable.

In this environment, it is commonly necessary to interconnect equipment made by different OEM vendors. For example, in order to deploy voice over IP phones in a commercial building, the networking design might require connections between an Adtran switch and an Aruba switch. As in our data center example, network engineers can choose a multi-vendor Champion ONE DAC or AOC coded for Adtran at one end and Aruba at the other end.

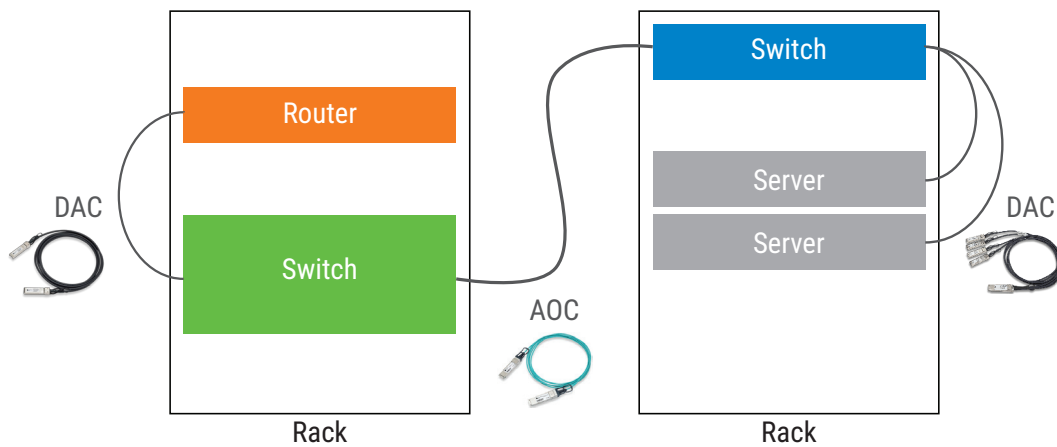


Figure 3. DACs and AOCs in a two-rack environment.

Note: the best practice is to avoid pulling AOCs across rooms or floors. The bulk ends of AOCs will not fit through conduits or similarly small spaces. For those applications, standard fiber riser cabling should be used.

DACs and AOCs in the Network Engineering Lab

Another ideal –yet often overlooked– place to benefit from DACs and AOCs is the network engineering lab. Figure 4 is a high-level illustration of the network engineering lab environment.

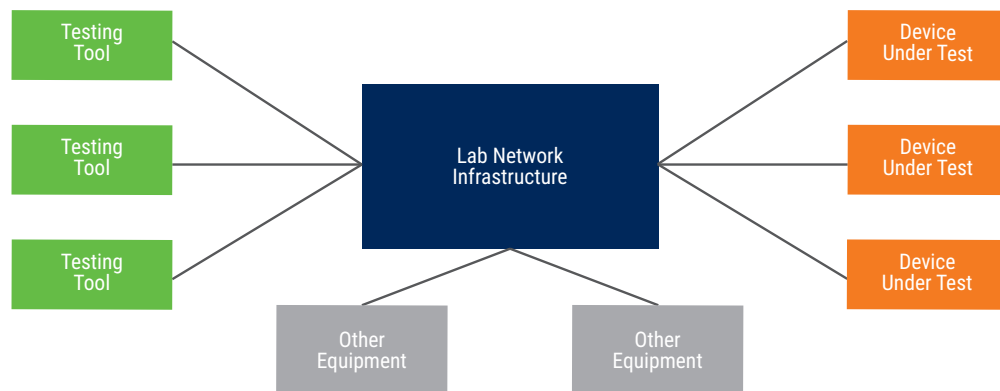


Figure 4. A typical network engineering lab environment.



Lab managers and network engineers often need to use network testing tools and other equipment on devices under test (DUTs). The tests may include functionality, interoperability, performance, and stress tests. If the tests do not require certain Layer 1 connectivity and the cable length is applicable, Champion ONE DACs and AOCs can be utilized to build the connectivity for the test beds.

For example, a service provider's network engineering lab might need to test IP Multiprotocol Label Switching (IP/MPLS) functionalities over a 100 Gigabit Ethernet (100GE) link between a Cisco router and a Nokia router. This IP/MPLS interoperability test does not require specific Layer 1 connectivity products. As long as the Layer 2 link of 100GE is established, the tests can be performed. Network engineers can choose a Champion ONE 100G DAC or AOC with one end coded for Cisco and the other end for Nokia. This approach is much more cost-effective, and more reliable, than using optics plus fiber cabling.

Conclusion

Champion ONE provides a broad range of DACs and AOCs to support applications in the data center, wiring closet, network engineering lab, and more. Using Champion ONE DACs and AOCs means guaranteed compatibility, customized solutions, fast delivery, 100% TAA compliance, and cost-effectiveness.

For more information on ordering DACs and AOCs, please refer to the appendices on the following pages.



Appendix 1: DAC Ordering Information

Passport DACs

C1 Part Number	Description
CAB-SFP-10GB-DACP-xM-C1	10G SFP+ to SFP+ Passive Direct Attach Cable, 0.5 to 10m (x = 50C / 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10)
CAB-SFP-25G-DACP-xM-C1	25G SFP28 to SFP28 Passive Direct Attach Cable, 0.5 to 5m (x = 50C / 1 / 2 / 3 / 4 / 5)
CAB-QSFP-40G-DACP-xM-C1	40G QSFP+ to QSFP+ Passive Direct Attach Cable, 0.5 to 7m, i-temp (x = 50C / 1 / 2 / 3 / 4 / 5 / 6 / 7)
CAB-QSFP-100G-DACP-xM-C1	100G QSFP28 to QSFP28 Passive Direct Attach Cable, 0.5 to 5m (x = 50C / 1 / 2 / 3 / 4 / 5)
BREAKOUT DACS	
CAB-QSFP-4SFP10G-DACP-xM-C1	40G QSFP+ to 4x10G SFP+ Passive Breakout Direct Attach Cable, 0.5 to 5m (x = 50C / 1 / 2 / 3 / 4 / 5)
CAB-QSFP28-4SFP25G-CUXM-C1	100G QSFP28 to 4x25G SFP28 Passive Breakout Direct Attach Cable, 0.5 to 5m (x = 50C / 1 / 2 / 3 / 4 / 5)

Sureport DACs

To order a cable programmed for use in a specific system, simply add **"-C1"** to the end of your network OEM part number. For example, to order a 3m 100G DAC programmed for 100% Cisco compatibility, your C1 part number will be **QSFP-100G-CU3M-C1**.

Multi-Vendor DACs

For multi-vendor environments that require programming for one-to-one compatibility, please use the following schemes:

10G Ethernet to 10G Ethernet: **SFP10G-XX₁XX₂-CU-YM-C1**
 25G Ethernet to 25G Ethernet: **SFP25G-XX₁XX₂-CU-YM-C1**
 40G Ethernet to 40G Ethernet: **QSFP40G-XX₁XX₂-CU-YM-C1**
 100G Ethernet to 100G Ethernet: **QSFP100G-XX₁XX₂-CU-YM-C1**

40G Ethernet to 4x10G Ethernet: **Q40X10G-XX₁XX₂-CU-YM-C1**
 100G Ethernet to 4x25G Ethernet: **Q100X25G-XX₁XX₂-CU-YM-C1**

XX _N	Vendor Brand		
AC	Accedian	F5	F5 Networks
AD	Adtran	FN	Fortinet
AL	Alcatel	HP	HP
AN	Arista	IB	IBM
AR	Aruba	IN	Intel
AV	Avaya	JN	Juniper
BC	Broadcom	LN	Lenovo
BR	Brocade	MK	Meraki
CX	Calix	MX	Mellanox
CS	Cisco	NP	NetApp
CD	Cohesity	NX	Nutanix
DF	Dell	PA	Palo Alto
EN	Enterasys	RB	Rubrik
EX	Extreme	XN	Xilinx

Y	Cable Length
50C	50cm
1	1m
2	2m
3	3m
4	4m
5	5m
6	6m
7	7m
8	8m
9	9m
10	10m



Appendix 2: AOC Ordering Information

Passport AOCs

C1 Part Number	Description
CAB-SFP+-SFP+-AOC-xM-C1	SFP+ to SFP+ Active Optical Cable, xx meters (x = 1 / 2 / 3 / 5 / 10 / 20 / 30 / 50 / 100)
CAB-SFP25-SFP25-AOC-xM-C1	SFP28 to SFP28 Active Optical Cable, xx meters (x = 1 / 2 / 3 / 5 / 10 / 20 / 30 / 50 / 100)
CAB-QSFP-QSFP-AOC-xM-C1	QSFP+ to QSFP+ Active Optical Cable, xx meters (x = 1 / 2 / 3 / 5 / 10 / 20 / 30 / 50 / 100)
CAB-QSFP28-QSFP28-AOC-xM-C1	QSFP28 to QSFP28 Active Optical Cable, xx meters (x = 1 / 2 / 3 / 5 / 10 / 20 / 30 / 50 / 100)
BREAKOUT AOCs	
CAB-QSFP-4XSFP-AOC-xM-C1	QSFP+ to 4xSFP+ Breakout Active Optical Cable, xx meters (x = 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 / 20 / 30)
CAB-QSFP28-4SFP25G-AOC-xM-C1	QSFP28 to 4xSFP28 Breakout Active Optical Cable, xx meters (x = 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 / 20 / 30)

Sureport AOCs

To order a cable programmed for use in a specific system, simply add “-C1” to the end of your network OEM part number. For example, to order a 3m 100G AOC programmed for 100% Cisco compatibility, your C1 part number will be **QSFP-100G-AOC3M-C1**.

Multi-Vendor AOCs

For multi-vendor environments that require programming for one-to-one compatibility, please use the following schemes:

10G Ethernet to 10G Ethernet: **SFP10G-XX₁XX₂-AOC-YM-C1**
 25G Ethernet to 25G Ethernet: **SFP25G-XX₁XX₂-AOC-YM-C1**
 40G Ethernet to 40G Ethernet: **QSFP40G-XX₁XX₂-AOC-YM-C1**
 100G Ethernet to 100G Ethernet: **QSFP100G-XX₁XX₂-AOC-YM-C1**

40G Ethernet to 4x10G Ethernet: **Q40X10G-XX₁XX₂-AOC-YM-C1**
 100G Ethernet to 4x25G Ethernet: **Q100X25G-XX₁XX₂-AOC-YM-C1**

XX _N	Vendor Brand		
AC	Accedian	F5	F5 Networks
AD	Adtran	FN	Fortinet
AL	Alcatel	HP	HP
AN	Arista	IB	IBM
AR	Aruba	IN	Intel
AV	Avaya	JN	Juniper
BC	Broadcom	LN	Lenovo
BR	Brocade	MK	Meraki
CX	Calix	MX	Mellanox
CS	Cisco	NP	NetApp
CD	Cohesity	NX	Nutanix
DF	Dell	PA	Palo Alto
EN	Enterasys	RB	Rubrik
EX	Extreme	XN	Xilinx

Y	Cable Length
50C	50 cm
1	1 m
2	2 m
3	3 m
4	4 m
5	5 m
6	6 m
7	7 m
8	8 m
9	9 m
10	10 m