Cisco CPAK 100GBASE Modules

Contents

Fiber line cards provide industry-leading port density while consuming up to 70 percent less power than competing models.

Product overview

Cisco CPAK® 100GBASE fiber modules for Cisco® switches and routers offer a selection of high-density 100-Gbps connectivity solutions. The modules are especially well suited for connections in enterprise and service provider data centers and in service provider edge networks.

The line cards use the Cisco CPAK form factor. They are 20 percent smaller and consume 40 percent less power than C Form-Factor Pluggable 2 (CFP2) modules; they use 70 percent less power than the CFP interface. Cisco CPAK modules give you up to 20 percent greater port density and front-panel bandwidth than competing products.

Choose the model that matches the distance you need to cover, the type of fiber cabling you are using, and the Cisco networking product you are using. Cisco CPAK 100GBASE modules work in the following Cisco networking equipment: ASR 1000 Series Router; ASR 9000 Series Router; CRS-X Carrier Routing System; NCS 2000, 4000, and 6000 Series Routers; the Nexus 7000 and 7700 Series Switches, and the Cisco ONS Transport Platform.

Features and benefits

Cisco CPAK modules combine high density and bandwidth with low power consumption and many are interoperable with any IEEE-compliant 100GBASE-LR4 or 100GBASE-SR10 for investment protection and product choice. Some models use Cisco Complementary Metal-Oxide Semiconductor (CMOS) photonic technology to provide industry-leading optical integration, performance, power savings, and scalability.

The key features of Cisco CPAK 100GBASE modules are listed in Table 1.

Table 1. Cisco CPAK 100GBASE module features and benefits

Requirement	Cisco CPAK Module Supporting Feature
Accommodate ever-growing bandwidth requirements	Up to 10 100-Gigabit Ethernet connections deliver as much as 1 Tbps of front-panel bandwidth
Control costs	Form factor consumes 40% less power than CFP2 and 70% less power than CFP form factors
Real estate conservation	Minimal footprint allows 20% greater port density and bandwidth than competing products
High availability for business continuity	Hot-swappable input/output device plugs into a Cisco CPAK-module-based switch, router, or optical platform port
Accommodate a variety of distance and fiber type requirements	Flexible interface choices
Investment protection, affordable migration to higher bandwidth	• Support for a “pay-as-you-grow” model • Can plug any Cisco 100-Gbps, 40-Gbps, and 10-Gbps line cards into Cisco CPAK modules (supports the Cisco AnyPort solution)
Manage performance	Digital Optical Monitoring (DOM) support

Requirement	Cisco CPAK Module Supporting Feature		
Proper functioning and high performance with all Cisco platforms	Cisco quality Identification (ID) feature enables a Cisco platform to identify whether the module is certified and tested by Cisco		
Standards compliance for equipment flexibility and choice	Interoperability with any IEEE-compliant: 100GBASE-SR4, 100GBASE-LR4, 100GBASE-SR10, 40GBASE-SR4, 10GBASE-SR, 10GBASE-LR		
Protocol support	**Product ID**	**Supported Mode(s)**	**Supported Protocol(s)**
	CPAK-100G-LR4	1x100G	IEEE 802.3ba
			ITU OTU4
	CPAK-100GE-LR4	1x100G	IEEE 802.3ba
	CPAK-100G-ER4L	1x100G	IEEE 802.3ba
			ITU OTU4
	CPAK-100G-ER4F	1x100G	IEEE 802.3ba
	CPAK-100G-CWDM4	1x100G	100G CWDM4 MSA
	CPAK-100G-PSM4	1x100G	100G PSM4 MSA
	CPAK-100G-SR4	1x100G	IEEE 802.3bm
	CPAK-100G-FR	1x100G	100G Lambda MSA
	CPAK-10x10G-LR	10x10G	IEEE 802.3ae
			FC
			ITU OTU2
			ITU OTU1e
			ITU OTU2e
	CPAK-10x10G-ERL	10x10G	IEEE 802.3ae
			FC
			ITU OTU2
			ITU OTU1e
			ITU OTU2e

Requirement	Cisco CPAK Module Supporting Feature		
	CPAK-100G-SR10	1x100G	IEEE 802.3ba
			ITU OTU4
		2x40G	IEEE 802.3ba
			ITU OTU3
		10x10G	IEEE 802.3ae
			FC
			ITU OTU2
			ITU OTU1e
			ITU OTU2e

Cisco CPAK 100GBASE-LR4 Module

The primary application of the Cisco CPAK-100G-LR4 and CPAK-100GE-LR4 modules is to support 100Gbps optical links over standard Single-Mode Fiber (SMF, G.652) terminated with SC connectors (Figure 1) or LC connectors (Figure 2). The LC-SC adapter on CPAK-100G-LR4 is removable if LC connectors are desired rather than the standard SC connectors.

The LR4 module is IEEE 802.3ba-compliant and supports link lengths of up to 10 km over standard SMF, G.652. It delivers an aggregate data signal of 100 Gbps, carried over four LAN Wavelength-Division Multiplexing (WDM) wavelengths operating at a nominal 25 Gbps per lane. Optical multiplexing and demultiplexing of the four wavelengths are managed within the module.

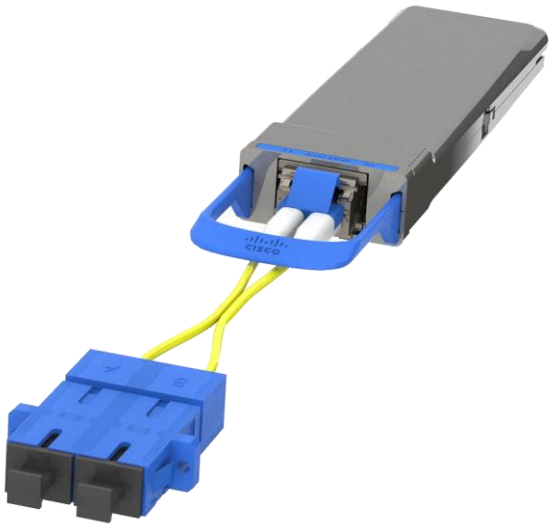

Figure 1.
Cisco CPAK-100G-LR4 Module with LC-SC Adapter

Figure 2.
Cisco CPAK-100GE-LR4 Module with LC Connectors

Cisco CPAK 100GBASE-ER4 Lite Module

The primary application of the Cisco CPAK-100G-ER4L and CPAK-100G-ER4F modules is to support 100-Gbps optical links over long distances of standard single-mode fiber (SMF, G.652) terminated with SC connectors (Figure 3) or LC connectors (Figure 4).

These ER4 Lite modules are compatible with the 100GBASE-ER4 standard and deliver an aggregate data signal of 100 Gbps, carried over four LAN Wavelength-Division Multiplexing (WDM) wavelengths operating at a nominal 25 Gbps per lane. CPAK-100G-ER4L (no available FEC) supports link lengths up to about 25 km and CPAK-100G-ER4F supports link lengths up to about 30km with FEC disabled and 40km with FEC enabled over standard SMF, G.652. Optical multiplexing and demultiplexing of the four wavelengths are managed within the module.

Figure 3.
Cisco CPAK-100G-ER4L Module with SC connectors

Figure 4.
Cisco CPAK-100G-ER4F Module with LC connectors

Cisco CPAK 10x10GBASE-LR Module

The Cisco CPAK-10X10G-LR module is used in 10 x 10Gb mode along with ribbon-to-duplex SMF breakout cables for connectivity to ten 10GBASE-LR optical interfaces. It supports link lengths up to 10km over standard SMF, G.652. The module delivers 100-Gbps links over 24-fiber ribbon cables terminated with MPO/MTP connectors.

Figure 5.
Cisco CPAK-10X10G-LR Module

Cisco CPAK 100GBASE-SR10 Module

The Cisco CPAK-100G-SR10 module delivers 100-Gbps links over 24-fiber ribbon cables terminated with MPO/MTP connectors. It can also be used in 10 x 10Gb mode along with ribbon-to-duplex-fiber breakout cables for connectivity to ten 10GBASE-SR optical interfaces. It supports link lengths of 100m and 150m on laser-optimized OM3 and OM4 multifiber cables, respectively.

Figure 6.
Cisco CPAK-100G-SR10 Module

Cisco CPAK 10x10GBASE-ERL Module

The Cisco CPAK-10X10G-ERL module is used in 10 x 10Gb mode along with ribbon-to-duplex SMF breakout cables for connectivity to ten 10GBASE-ER optical interfaces. It supports link lengths up to 25km over standard SMF, G.652. The module delivers 100Gbps links over 24-fiber ribbon cables terminated with MPO/MTP connectors.

Figure 7.
Cisco CPAK-10X10G-ERL Module

Cisco CPAK 100GBASE-SR4 Module

The Cisco CPAK-100G-SR4 Module supports link lengths of up to 70m (100m) over OM3 (OM4) Multimode Fiber with MPO connectors. It primarily enables high-bandwidth 100G optical links over 12-fiber parallel fiber terminated with MPO multifiber connectors. CPAK-100GE-SR4 supports 100GBase Ethernet rate.

Figure 8.
Cisco CPAK-100G-SR4 Module

Cisco CPAK 100GBASE CWDM4 Module

The Cisco CPAK-100G-CWDM4 Module supports link lengths of up to 2 km over a standard pair of G.652 Single-Mode Fiber (SMF) with duplex LC connectors. The 100 Gigabit Ethernet signal is carried over four wavelengths. Multiplexing and demultiplexing of the four wavelengths are managed within the device.

Figure 9.
Cisco CPAK-100G-CWDM4 Module

Cisco CPAK 100GBASE PSM4 Module

The Cisco CPAK-100G-PSM4 Module supports link lengths of up to 500 meters over Single-Mode Fiber (SMF) with MPO connectors. The 100 Gigabit Ethernet signal is carried over 12-fiber parallel fiber terminated with MPO multifiber connectors.

Figure 10.
Cisco CPAK-100G-PSM4 Module

Cisco CPAK 100GBASE FR Module

The Cisco CPAK-100G-FR Module supports link lengths of up to 2 km over a standard pair of G.652 Single-Mode Fiber (SMF) with duplex LC connectors. The 100 Gigabit Ethernet optical signal is carried over a single wavelength using a PAM4 (Pulse-Amplitude Modulation 4-Level) modulation scheme.

Figure 11.
Cisco CPAK-100G-FR Module

Technical specifications

Platform support

Cisco CPAK modules are supported on Cisco high-end switches, routers, and transport equipment:

- ASR 1000 Series Router
- ASR 9000 Series Router
- CRS-X Carrier Routing System
- NCS 2000, 4000, and 6000 Series Routers
- Nexus 7000 and 7700 Series Switches
- Cisco ONS Transport Platform

Connectors and cabling

- Dual SC/PC connector (Cisco CPAK-100G-LR4 and Cisco CPAK-100G-ER4L module)

  For duplex SMF modules, only connections with patch cords terminated with PC or UPC connectors are supported.

- Dual LC connector (Cisco CPAK-100GE-LR4, Cisco CPAK-100G-ER4F, Cisco CPAK-100G-CWDM4, and CPAK-100G-FR module)

  Cisco CPAK-100G-LR4 can also accommodate Dual LC connector if LC-SC adapter is removed.

  For duplex SMF modules, only connections with patch cords terminated with PC or UPC connectors are supported.

- 24-fiber MPO/MTP connector (Cisco CPAK-100G-SR10 module receives a female MPO/MTP-24 connector) Spring force required is 20N.
- 24-fiber MPO/MTP connector (Cisco CPAK-10X10G-LR and CPAK-10X10G-ERL modules receive a female MPO/MTP-24 APC connector). The MPO-24 SMF APC connector used on the CPAK-10X10G-LR and CPAK-10X10G-ERL has been designed to be compliant to IEC 61754-7-1, dated 2008-03. The standard specifies a nominal spring force of 10N for the connector. Performance of these devices is specified with the use of connectors with a 10N spring force. Customers should be careful not to use 22N spring force connectors at this time. Performance of the modules is not guaranteed with the higher spring force.

Note: All cables and cable assemblies used must be compliant with the standards specified in the Regulatory and Standards Compliance section.

For more compatibility details, refer to Cisco 100 Gigabit Ethernet Transceiver Modules Compatibility Matrix.

Product specifications

Tables 2 and 3 provide specifications for Cisco CPAK port cabling and modules.

Table 2. Cisco CPAK port cabling specifications

Cisco CPAK Module	Wavelength (nm)	Cable Type	Core Size (Microns)	Modal Bandwidth (MHz*km)[a]	Cable Distance[b]
Cisco CPAK-100G-LR4 and Cisco CPAK-100GE-LR4	1310	SMF Duplex	9-micron core SMF per G.652	-	10 km
Cisco CPAK-100G-ER4L	1310	SMF Duplex	9-micron core SMF per G.652	-	25 km
Cisco CPAK-100G-ER4F	1310	SMF Duplex	9-micron core SMF per G.652	-	30 km (no FEC) 40 km (with FEC)
Cisco CPAK-10X10G-LR	1310	SMF (24 fibers)	9-micron core SMF per G.652	-	10 km
Cisco CPAK-10X10G-ERL	1550	SMF (24 fibers)	9-micron core SMF per G.652	-	25 km
Cisco CPAK-100G-SR10	850	MMF (24 fibers)	50.0 50.0	2000 (OM3) 4700 (OM4)	100m 150m[c]
Cisco CPAK-100G-SR4	850	MMF (12 fibers)	50.0 50.0	2000 (OM3) 4700 (OM4)	70m 100m[c]
Cisco CPAK-100G-CWDM4	1271, 1291, 1311, 1331	SMF Duplex	9-micron core SMF per G.652	-	2 km
Cisco CPAK-100G-PSM4	1295 to 1325	SMF (12 fibers)	9-micron core SMF per G.652	-	500m
Cisco CPAK-100G-FR	1310	SMF Duplex	9-micron core SMF per G.652	-	2 km

[a] Specified at transmission wavelength.

[b] Minimum cabling distance for -LR4 modules is 2 meters, according to the IEEE 802.3ba.

[c] Considered an engineered link with maximum 1dB allocated to connectors and splice loss.

Table 3 lists the primary optical characteristics and specifications for Cisco CPAK 100GBASE modules.

Table 3. Optical transmit and receive specifications

Module	Type	Transmit Power (dBm)[1]		Receive Power (dBm)[1]		Transmit and Receive Center Wavelength Range (nm)
		Maximum	Minimum	Maximum	Minimum	
Cisco CPAK-100G-LR4 and Cisco CPAK-100GE-LR4	100GBASE-LR4 1310 nm SMF	4.5 per lane	-4.3 per lane	4.5 per lane	-10.6 per lane	Four lanes: 1294.53 to 1296.59 1299.02 to 1301.09 1303.54 to 1305.63 1308.09 to 1310.19
Cisco CPAK-100G-ER4L	100GBASE-ER4 1310 nm SMF	2.9 per lane	-2.9 per lane	4.5 per lane	-14 per lane[2]	Four lanes: 1294.53 to 1296.59 1299.02 to 1301.09 1303.54 to 1305.63 1308.09 to 1310.19
Cisco CPAK-100G-ER4F	100GBASE-ER4 1310 nm SMF	6.5 per lane	-2.5 per lane	-3.5 per lane	-18.5 per lane	Four lanes: 1294.53 to 1296.59 1299.02 to 1301.09 1303.54 to 1305.63 1308.09 to 1310.19
Cisco CPAK-10X10G-LR[3,4]	1310 nm SMF	0.5 per lane	-8.2 per lane	0.5 per lane	-14.4 per lane	Ten lanes 1260 to 1355 nm
Cisco CPAK-10X10G-ERL[3,4]	1550 nm SMF	4.0 per lane	-7.7 per lane[5]	0.5 per lane	-14.4 per lane	Ten lanes 1530 to 1565 nm
Cisco CPAK-100G-SR10	100GBASE-SR10 850 nm MMF	-1.0 per lane	-7.6 per lane	2.4 per lane	-9.5 per lane	Ten lanes: 840 to 860 nm
Cisco CPAK-100G-SR4	100GBASE-SR4 850 nm MMF	+2.4, per lane	-8.4, per lane	+2.4, per lane	-5.2, per lane	Four lanes: 840 to 860 nm

Module	Type	Transmit Power (dBm)[1]		Receive Power (dBm)[1]		Transmit and Receive Center Wavelength Range (nm)
		Maximum	Minimum	Maximum	Minimum	
Cisco CPAK-100G-CWDM4	100GBASE CWDM4 SMF	+2.5, per lane	-6.5, per lane	+2.5, per lane	-10, per lane	Four lanes: 1271, 1291, 1311, 1331
Cisco CPAK-100G-PSM4	100GBASE PSM4 SMF	+2.0, per lane	-9.4, per lane	+2.0, per lane		Four lanes: 1295 to 1325
Cisco CPAK-100G-FR	100GBASE FR SMF	4.0, per lane	-2.4, per lane	4.5, per lane	-6.4, per lane	One lane: 1304.5 to 1317.5

[1] Transmitter and receiver power are in averages, unless specified.

[2] Receiver sensitivity does not fully meet IEEE 100GBASE-ER4 specifications. Application of this module is targeted for links less than 25km with links where Cisco CPAK modules are at both ends of the link.

[3] Tx Disabled power for an individual lane is <-10dBm. Tx Disabled power for an individual lane is <-30dBm when the subject lane and its partner lane are both Tx disabled. Subject/Partner lanes are: Lanes 0 and 1, lanes 2 and 3, lanes 4 and 5, lanes 6 and 7, or lanes 8 and 9. For example, if only lane 2 is Tx Disabled, Tx Power for lane 2 will be <-10dBm. If both lanes 2 and 3 are Tx Disabled, Tx Power for both lanes 2 and 3 will be <-30dBm.

[4] Host FEC is required when operating in OTN mode.

[5] Output power of this module is 3dB below the IEEE 100GBASE-ER specification. Application of this module is targeted for links less than 25km where Cisco CPAK modules are at both ends of the link.

Dimensions

Maximum outer dimensions for the Cisco CPAK modules (H x W x D): 11.6 x 34.8 x 101.2 mm (0.46 x 1.37 x 3.98 in).

The Cisco CPAK modules typically weigh approximately 127 grams (4.48 oz.).

Environmental conditions and power requirements

- Storage temperature range: -40 to 85° C (-40 to 185° F)
- Operating temperature range: 0 to 70° C (32 to 158° F)
- Cisco CPAK 100GBASE-LR4 power consumption at 70° C: <8.0W maximum
- Cisco CPAK 100GBASE-ER4L power consumption at 70° C: <8.5W maximum
- Cisco CPAK 100GBASE-ER4F power consumption at 70° C: <10.0W maximum
- Cisco CPAK 10x 10GBASE-LR power consumption at 70° C: <5.0W maximum
- Cisco CPAK 10x 10GBASE-ERL power consumption at 70° C: <5.0W maximum
- Cisco CPAK 100GBASE-SR10 power consumption at 70° C: <4.5W maximum
- Cisco CPAK 100GBASE-SR4 power consumption at 70° C: <9.0W maximum
- Cisco CPAK 100GBASE CWDM4 power consumption at 70° C: <9.0W maximum
- Cisco CPAK 100GBASE PSM4 power consumption at 70° C: <9.0W maximum
- Cisco CPAK 100GBASE FR power consumption at 70° C: <9.0W maximum

Warranty

- Standard warranty: 1 year
- Expedited replacement available via a Cisco SMARTnet® Service support contract

Ordering information

Table 4 provides ordering information for Cisco CPAK modules and related cables.

Table 4. Ordering information

Description	Product Number
100GBASE-LR4 Cisco CPAK Module for SMF (terminated with SC Connectors via LC-SC adapter), Dual rate (100G Ethernet and OTU4)	CPAK-100G-LR4
100GBASE-LR4 Cisco CPAK Module for SMF (terminated with LC Connectors), 100G Ethernet rate only	CPAK-100GE-LR4
100GBASE-ER4 Lite Cisco CPAK Module for SMF (terminated with SC Connectors), Dual rate (100G Ethernet and OTU4)	CPAK-100G-ER4L
100GBASE-ER4 Lite Cisco CPAK Module for SMF (FEC available, terminated with LC Connectors), 100G Ethernet rate only	CPAK-100G-ER4F
10x10G-LR Cisco CPAK Module for SMF	CPAK-10X10G-LR
100GBASE-SR10 Cisco CPAK Module for MMF	CPAK-100G-SR10
10x10G-ERL Cisco CPAK Module for SMF	CPAK-10X10G-ERL
100GBASE-SR4 Cisco CPAK Module for MMF	CPAK-100G-SR4
100GBASE-CWDM4 Cisco CPAK Module for SMF	CPAK-100G-CWDM4
100GBASE PSM4 Cisco CPAK Module for SMF	CPAK-100G-PSM4
100GBASE FR Cisco CPAK Module for SMF	CPAK-100G-FR

Product sustainability

Information about Cisco's environmental sustainability policies and initiatives for our products, solutions, operations, and extended operations or supply chain is provided in the "Environment Sustainability" section of Cisco's Corporate Social Responsibility (CSR) Report.

Reference links to information about key environmental sustainability topics (mentioned in the "Environment Sustainability" section of the CSR Report) are provided in the following table:

Sustainability topic	Reference
Information on product material content laws and regulations	Materials
Information on electronic waste laws and regulations, including products, batteries, and packaging	WEEE compliance

Cisco makes the packaging data available for informational purposes only. It may not reflect the most current legal developments, and Cisco does not represent, warrant, or guarantee that it is complete, accurate, or up to date. This information is subject to change without notice.

Regulatory and standards compliance

Standards

- GR-20-CORE: Generic Requirements for Optical Fiber and Optical Fiber Cable
- GR-326-CORE: Generic Requirements for Single-Mode Optical Connectors and Jumper Assemblies
- GR-1435-CORE: Generic Requirements for Multifiber Optical Connectors
- IEEE 802.3ba (LR4, ER4, 10GBASE-LR, SR10)
- Reduction of Hazardous Substances (RoHS) 6 compliant

Safety

Product	Laser Class
Cisco CPAK 100GBASE-LR4	1
Cisco CPAK 100GBASE-ER4Lite	1
Cisco CPAK 10x 10GBASE-LR	1
Cisco CPAK 100GBASE-SR10	1
Cisco CPAK 10x 10GBASE-ERLite	1
Cisco CPAK 100GBASE-SR4	1
Cisco CPAK 100GBASE-CWDM4	1
Cisco CPAK 100GBASE PSM4	1
Cisco CPAK 100GBASE FR	1

Next steps

Learn more about Cisco CPAK 100GBASE switch and router modules by contacting your sales representative or visiting https://www.cisco.com/go/dcnm.

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Document history

Table 5. Document history

New or Revised Topic	Described In	Date
Documented change for CPAK-100G-LR4 from native SC connector to version with native LC connector + LC-SC adapter. Added Note 3 in Table 3 for CPAK 10x10G optics.	Pages 3-6, Tables 2 and 4 Table 3	Aug 16, 2021

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