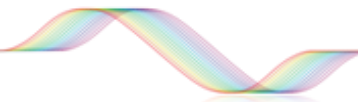




Transceivery versus kabeláž v datacentrech

Ing. Jaromír Šíma



Transceivery do 10 / 16/ 32 Gbit/s



1 GE

**GBIC transceiver
(Giga-bit Interface Converter)
SC duplex**

100 Mbit/s

1 Gbit/s

2,5/4/8/16/32 Gbit/s

10 Gbit/s (SFP+)



**SFP+ transceiver
(Small Formfactor Pluggable)
LC duplex**



**XFP transceiver
LC duplex**

10 Gbit/s



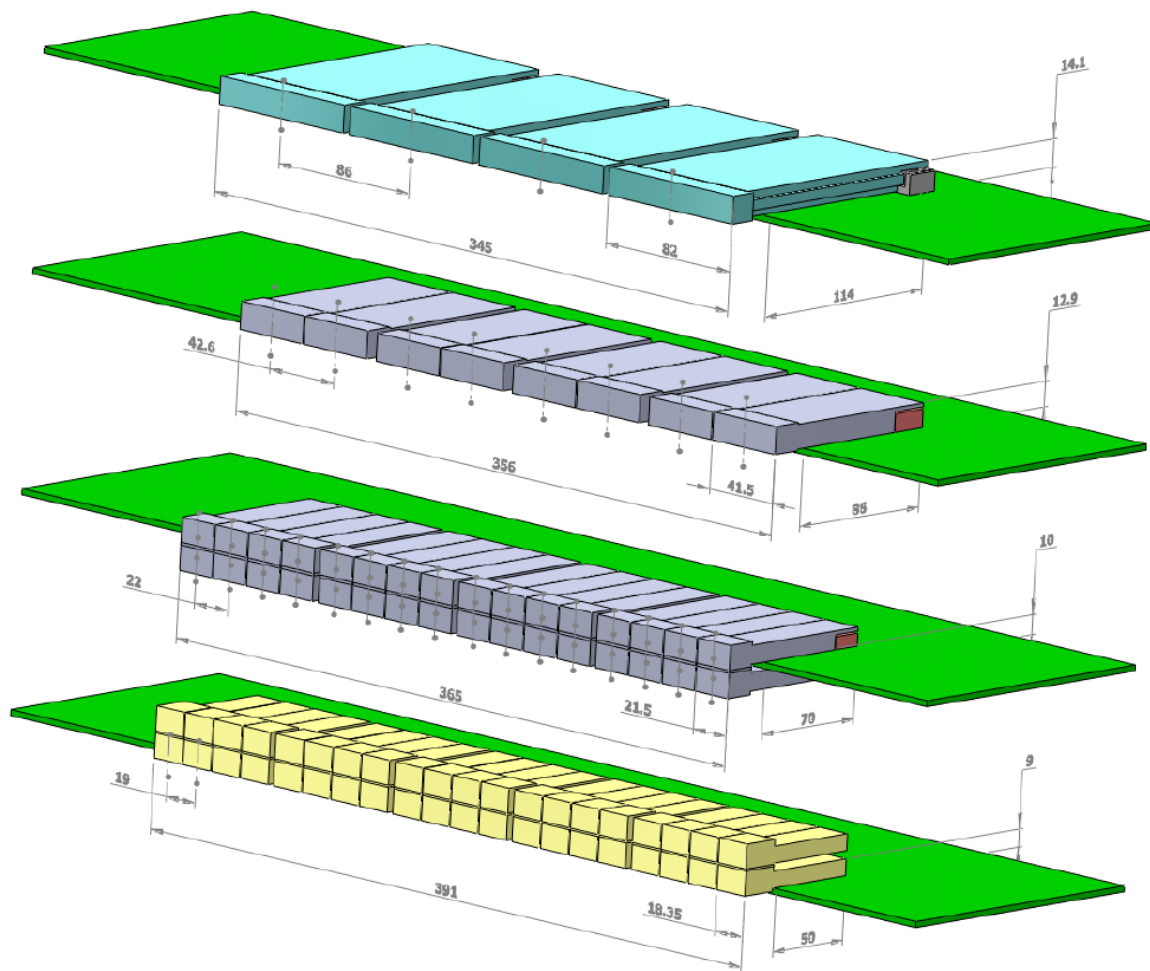
X2

XPAK



XENPAK transceiver

Osazení – hustota portů 100G



4x CFP

24W/16W

400 Gb/s per blade

8-10x CFP2

8W

800 Gb/s - 1 Tb/s per blade

16/32x CFP4

4.5W

1.6 – 3.2 Tb/s per blade

20/40*x QSFP

3.5W

2-4 Tb/s per blade

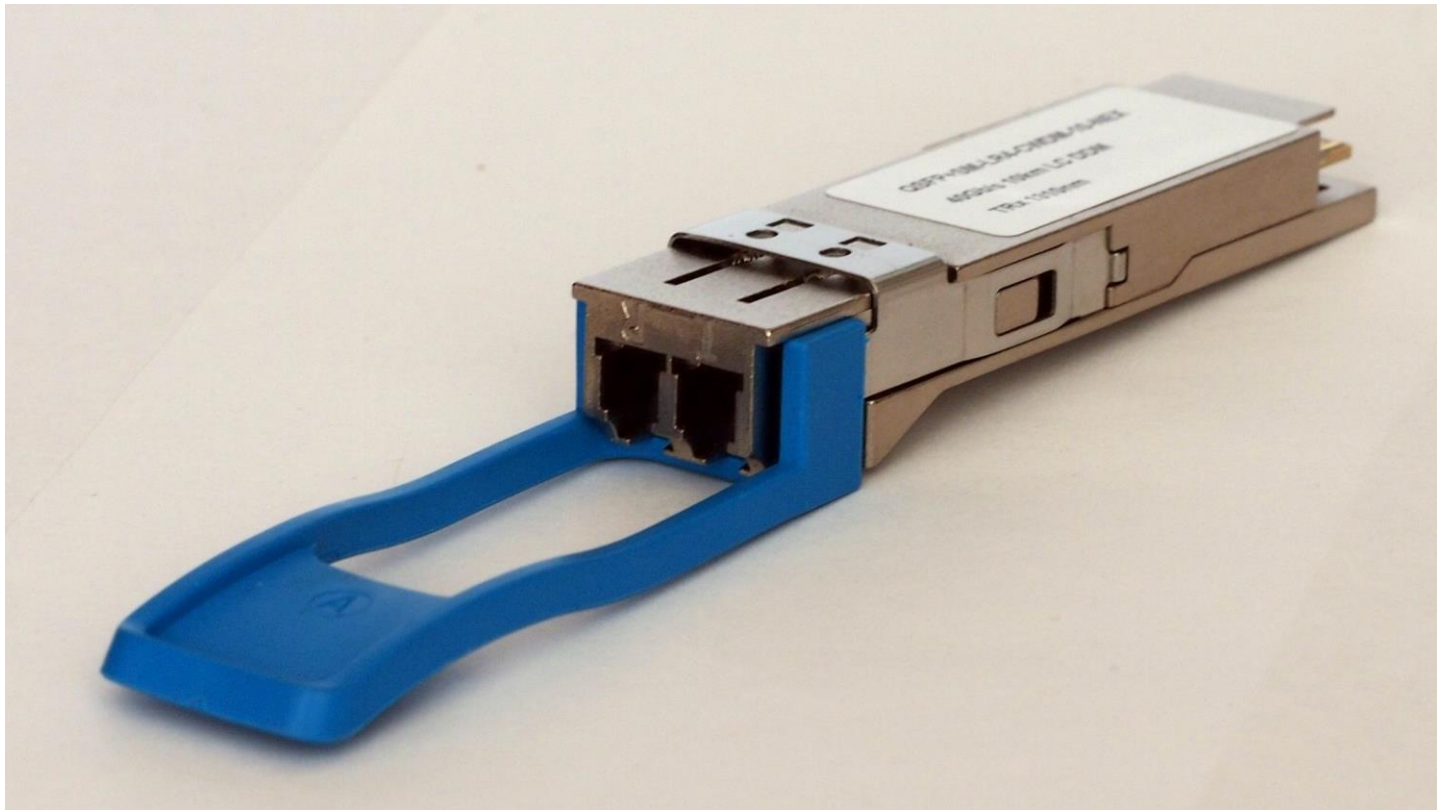
*if can cool stacked

Transceivery pro 100/200/400G

I/O	10x10	10x10 4x25	4x25	16x25	8x50	4x100
CFP MSA	CFP	CFP2	CFP4	CDP	CDP2 (= CFP2)	CDP4 (= CFP4)
Other MSA	CXP			CDFP		
SFF			QSFP28			QSFP56
Cisco		CPAK				

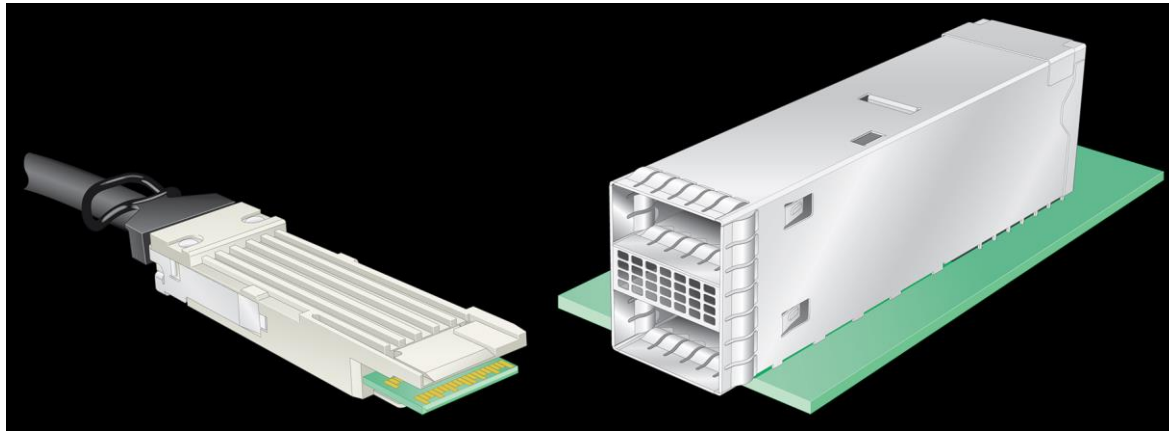
QSFP28 transceiver

- Verze 100Gbit
- Multimode nebo Singlemode



QSFP-DD MSA 200G, 400G

- **QSFP-DD Multi Source Agreement (MSA) Group**
 - <http://www.qsfp-dd.com/>
- **QSFP28 pro 40 a 100 Gigabit Ethernet**
- **QSFP-DD pro 200 a 400 Gigabit Ethernet**
 - 8 linek 25 Gbps pomocí NRZ modulace
 - 8 linek 50 Gbps pomocí PAM4 modulace



IEEE 802.3 40G a 100G

- **40GBASE-SR4** **100/150 m** **OM3/OM4**
- **40GBASE-FR** **2 km** **OS1/OS2**
- **40GBASE-LR4** **10 km** **OS1/OS2**
- **40GBASE-ER4** **30 (40) km** **OS1/OS2**

- **100GBASE-SR10** **100/150 m** **OM3/OM4**
- **100GBASE-SR4** **70/100 m** **OM3/OM4**
- **100GBASE-SWDM4** **100 m** **OM5, mimo standard IEEE**
- **100GBASE-LR4** **10 km** **OS1/OS2**
- **100GBASE-ER4** **30 (40) km** **OS1/OS2**
- **100GBASE-PSM4** **500 m** **SM, mimo standard IEEE**
- **100GBASE-CWDM4** **2 km** **SM, mimo standard IEEE**

Další vývoj Ethernetu

- IEEE P802.3bq 25G/40GBASE-T ukončen 30. 6. 2016
- IEEE P802.3by 25 Gb/s Ethernet ukončen 30. 6. 2016
- IEEE P802.3ca 25 Gb/s, 50 Gb/s, and 100 Gb/s Ethernet Passive Optical Networks Task Force.
- IEEE P802.3cc 25 Gb/s Ethernet over Single-Mode Fiber Task Force.
- IEEE P802.3cd 50 Gb/s, 100 Gb/s, and 200 Gb/s Ethernet Task Force.
- **400 Gbit/s Ethernet**
 - IEEE P802.3bs 200/400 Gb/s Ethernet Task Force
 - <http://www.ieee802.org/3/bs/>
 - Očekávaný standard v roce 2016/2017
 - Verze 8x50G, 4x100G, 2x200G, ...
 - Další typy transceiverů – CFP8, CFP16, CDP, CDP2, CDP4, CDFP, QSFP56
- **1 Terabit/s Ethernet**
 - 20x50G, 10 x 100G, ... ??
- **1,6 Terabit/s Ethernet**
 - 16x 100G, 8x200G, 4x400G, ... ??

40GBASE-SR4 a 100GBASE-SR10

Table 86–9—40GBASE–SR4 or 100GBASE–SR10 illustrative link power budgets

Parameter	OM3	OM4	Unit
Effective modal bandwidth at 850 nm ^a	2000	4700	MHz•km
Power budget (for maximum TDP)	8.3		dB
Operating distance	0.5 to 100	0.5 to 150	m
Channel insertion loss ^b	1.9	1.5	dB
Allocation for penalties (for maximum TDP) ^c	6.4	6.5	dB
Unallocated margin	0	0.3 ^d	dB
Additional insertion loss allowed	0		dB

^a Per IEC 60793-2-10.

^b The channel insertion loss is calculated using the maximum distances specified in Table 86–2 and cabled optical fiber attenuation of 3.5 dB/km at 850 nm plus an allocation for connection and splice loss given in 86.10.2.2.1.

^c Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

^d This unallocated margin is not available for use.

Zdroj:



100GBASE-SR4

- 4 vlákna v každém směru
- 25,78125 GBd

Table 95–8—100GBASE-SR4 illustrative link power budget

Parameter	OM3	OM4	Unit
Effective modal bandwidth at 850 nm ^a	2000	4700	MHz.km
Power budget (for max TDEC)	8.2		dB
Operating distance	0.5 to 70	0.5 to 100	m
Channel insertion loss ^b	1.8	1.9	dB
Allocation for penalties ^c (for max TDEC)	6.3		dB
Additional insertion loss allowed	0.1	0	dB

^aPer IEC 60793-2-10.

^bThe channel insertion loss is calculated using the maximum distance specified in Table 95–5 and cabled optical fiber attenuation of 3.5 dB/km at 850 nm plus an allocation for connection and splice loss given in 95.11.2.1.

^cLink penalties are used for link budget calculations. They are not requirements and are not meant to be tested.



Zdroj:

Standardy vláken pro LAN

Fiber Type	Industry Standards			
	ISO/IEC 11801 ANSI/TIA-568-C.3 (cable)	IEC 60793-2-10 (fiber)	TIA/EIA (fiber)	ITU-T (fiber)
62.5/125	OM1 ⁽¹⁾	A1b	492AAAA	---
50/125	OM2 ⁽²⁾	A1a.1	492AAAB	G.651.1
50/125	OM3	A1a.2	492AAAC	---
50/125	OM4	A1a.3	492AAAD	---
Std SM	OS1	B1.1	492CAAA	G.652.A or B
Low Water Peak SM	OS2 ⁽⁵⁾	B1.3	492CAAB	G.652.C or D

⁽¹⁾ OM1 is typically 62.5 μ m, but can also be 50 μ m

⁽²⁾ OM2 is typically 50 μ m, but can also be 62.5 μ m

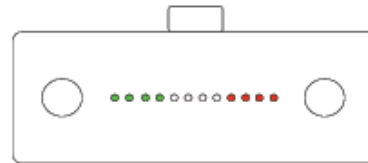
⁽⁵⁾ OS2 is referenced in the standard **ISO/IEC 24702** "Generic Cabling for Industrial Premises"

Nový standard MM vlákna – OM5

- **WBMMF (WideBand MultiMode Fiber) – vlákno pro WDM**
- **Dne 5. října 2016 bylo rozhodnuto komisí ISO/IEC tento typ vlákna označovat jako OM5.**
 - “The standard specifies 50/125-micron laser-optimized fiber that is optimized for enhanced performance for single-wavelength or multi-wavelength transmission systems with wavelengths in the vicinity of 850nm to 950nm. The actual operating band is from 850 to 953nm. The effective modal bandwidth for this new fiber is specified at the lower and upper wavelengths: 4700 MHz.km at 850nm and 2470 MHz.km at 953nm.”
 - OM5 fiber specifications are already published by the Telecommunications Industry Association as [TIA-492AAAE](#), and are in late-stage ballot within the IEC to be published as IEC 60793-2-10 edition 6.
- **Pro podporu 400GBASE-SR16 na 100m = 16x25 Gbit/s**

MPO/MTP konektory pro 40/100GE

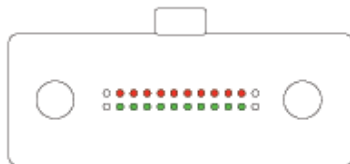
40GBASE-SR4
100GBASE-SR4



Left 4 pins are Tx
Right 4 pins are Rx
(inner 4 pins unused)

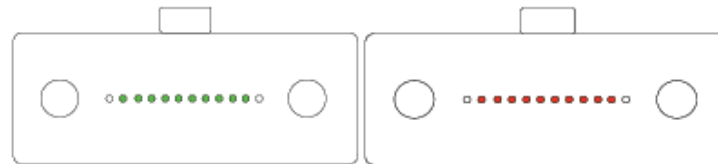


100GBASE-SR10



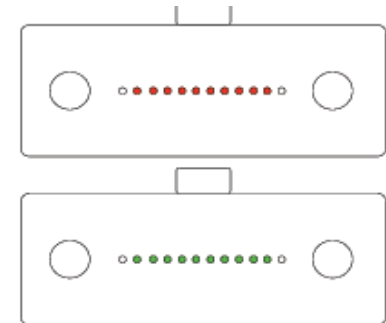
Inner 10 pins, Top Row are Rx
Inner 10 pins, Bot Row are Tx
(outermost pins both rows unused)

Option A
(recommended)



Inner 10 pins, Left Side are Tx
Inner 10 pins, Right Side are Rx
(outermost pins each side unused)

Option B

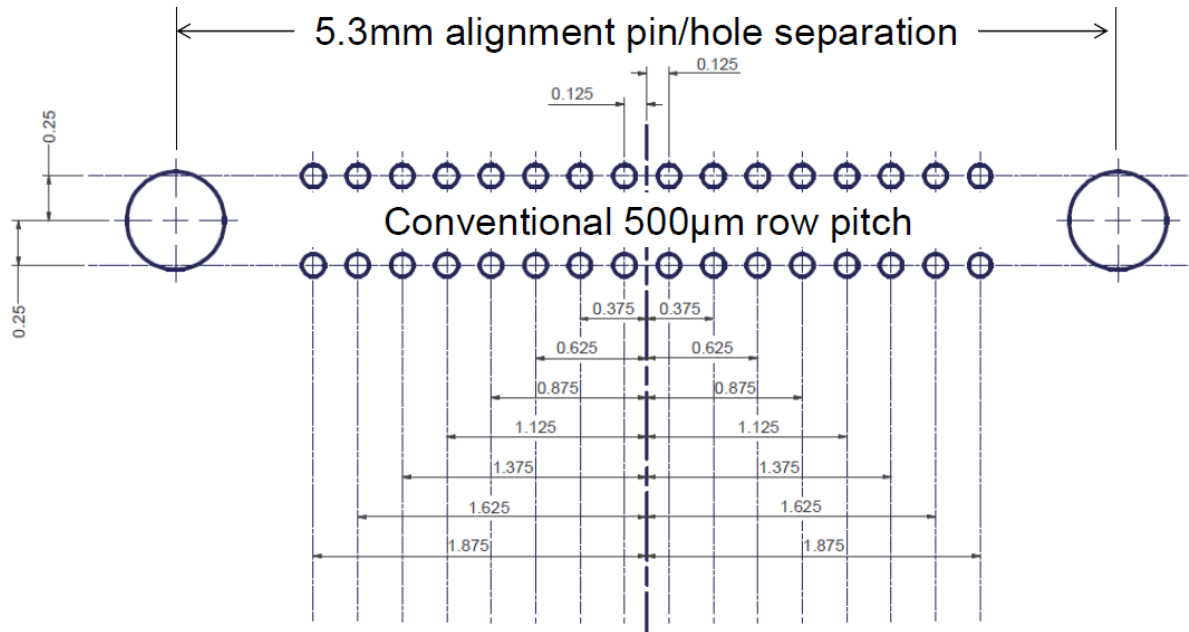
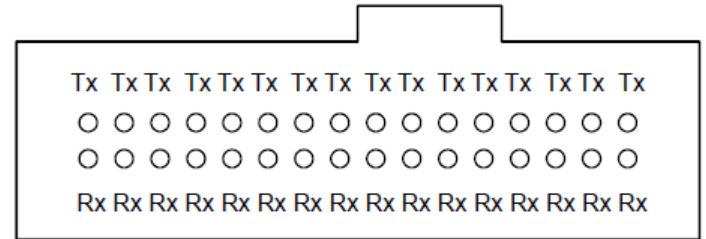


Inner 10 pins, Top are Rx
Inner 10 pins, Bot are Tx
(outermost pins Top & Bot unused)

Option C

Konektor pro 400GBASE-SR16

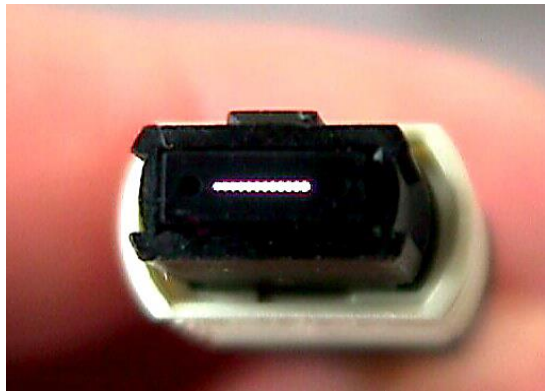
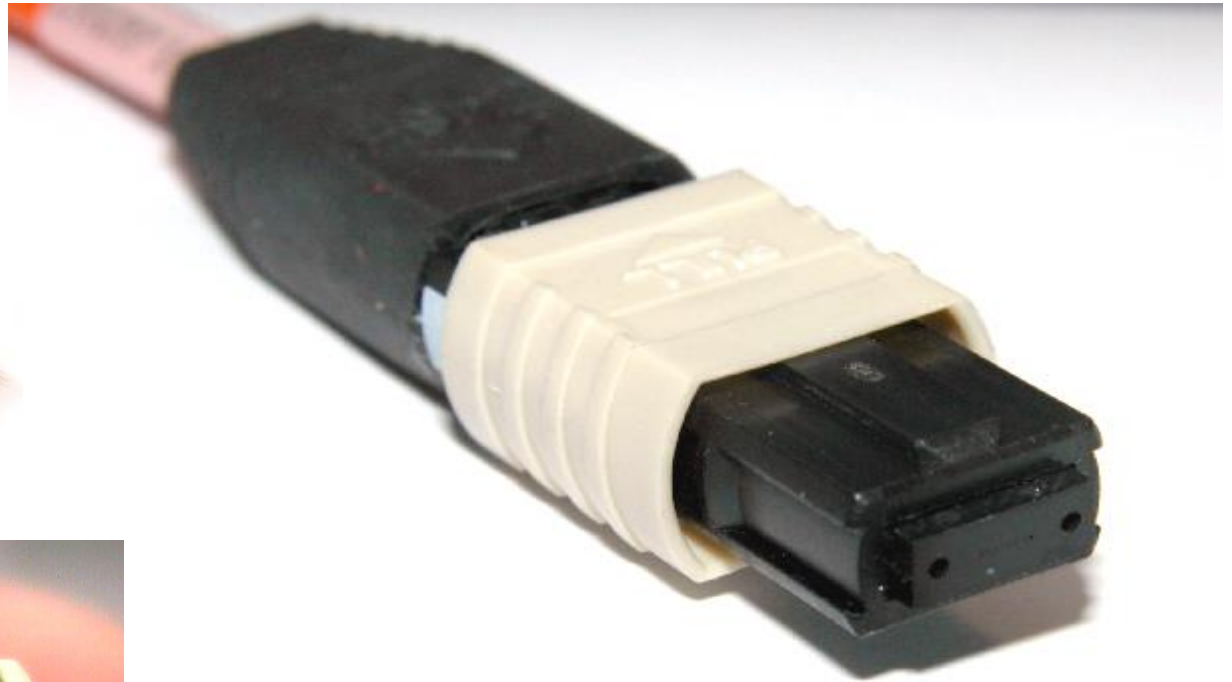
- MPO-16 konektor ANSI/TIA-604-18
- Konektor MPO/MTP 2x 16 vláken



MPO/MTP[®] konektor

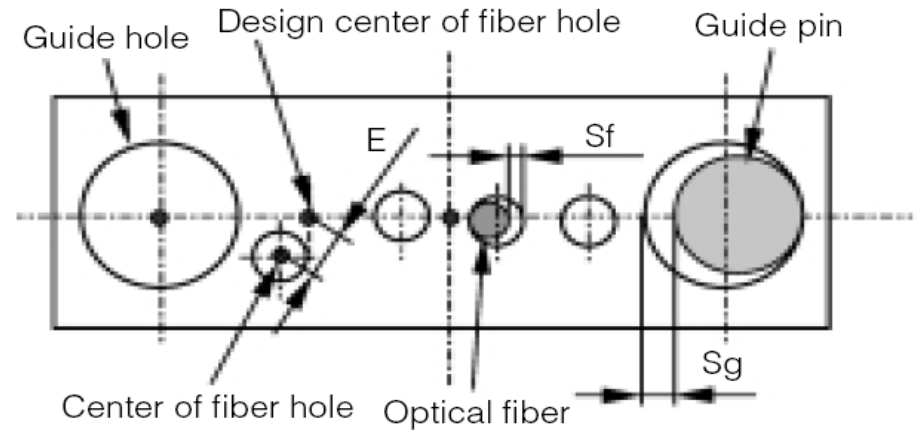
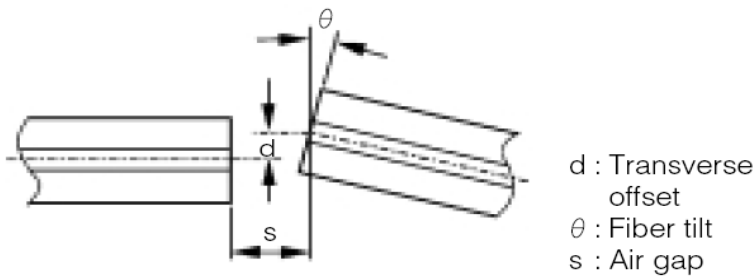
- **MPO konektor je „ Multi-fiber Push On connector“**
- **IEC-61754-7**
 - **Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 7: Type MPO connector family**
- **TIA-604-5-D (FOCIS 5)**
 - **Fiber Optic Connector Intermateability Standard , Type MPO.**
- **Obdélníková ferule – plast, vystředění pomocí trnů (Samec/Samice)**
- **MTP[®] je registrovaná značka firmy US Conec**
- **MTP[®] konektor je kompatibilní s konektorem MPO**
 - **Vylepšené vedení MT ferule, Oválná pružina, Vyměnitelný klíč**
 - **Možnost změny Samec-Samice, Přesnější navedení středících trnů, eliptický tvar špičky**

MPO / MTP optický konektor

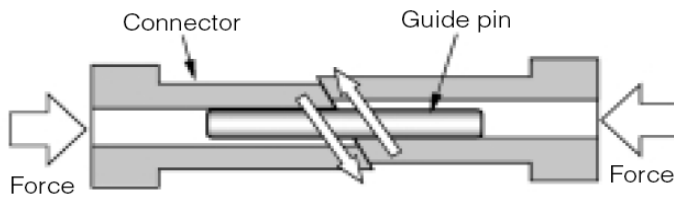


Transceiver vždy zásuvka = samec s trny !!

Útlum MPO konektoru



Sg : Clearance between guide pin and guide hole
 Sf : Clearance between optical fiber and fiber hole
 E : Fiber hole eccentricity



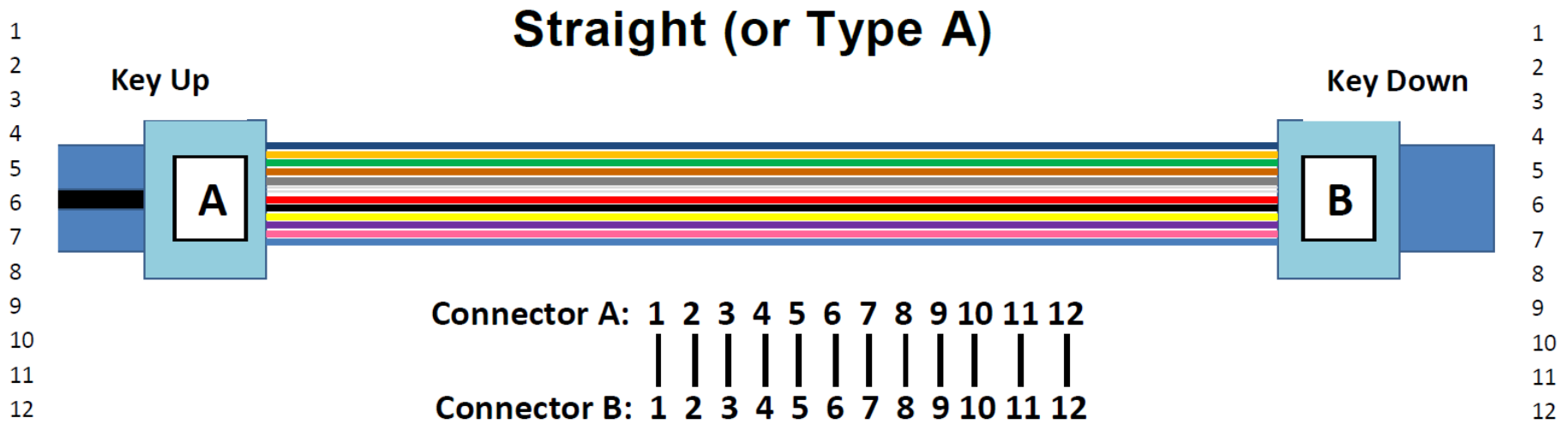
Vložný útlum MPO konektoru

Connector Grade	IL With PC*	IL Without PC*	RL with PC*	Fiber Counts
MM	0.6 dB	1 dB	25dB	12-72F PC ≤24F
MM MT Elite®	0.35 dB	0.75 dB	25dB	PC 12-24F
SM APC	0.75 dB	1.15 dB	60dB	PC 12-24F
SM MT Elite® APC	0.35dB	0.75dB	60dB	PC 12-24F
SM MT SuperElite™ APC	0.20dB	0.75dB	60dB	PC 12F

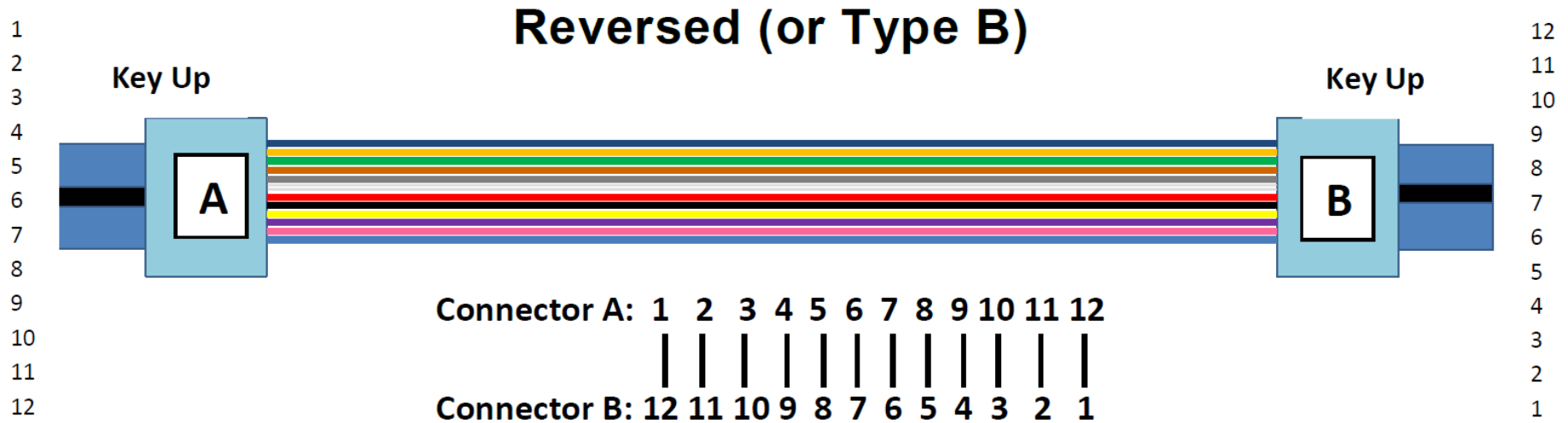
Polarita zapojení MPO konektorů

- **Definováno TIA-568-C**
- **Metoda A**
 - Pátevní kabel zapojen A-A Key Up – Key Down (pin 1 = pin 1)
 - Spojka typ A (Key Up – Key Down)
 - Patchkordy na koncích linky – jeden A-A, druhý A-B
- **Metoda B**
 - Pátevní kabel křížený = zapojen A-B Key Up – Key Up (pin 1 = pin 12)
 - Spojka typ B (Key Up – Key Up)
 - Patchkordy na koncích linky – oba A-B
 - Není možné použít SM APC konektory
- **Metoda C**
 - Pátevní kabel křížené páry = zapojen A-A Key Up – Key Down (pin 1 = pin 2)
 - Spojka typ A (Key Up – Key Down)
 - Patchkordy na koncích linky – oba A-B

Kabel MPO typ A (A-A)

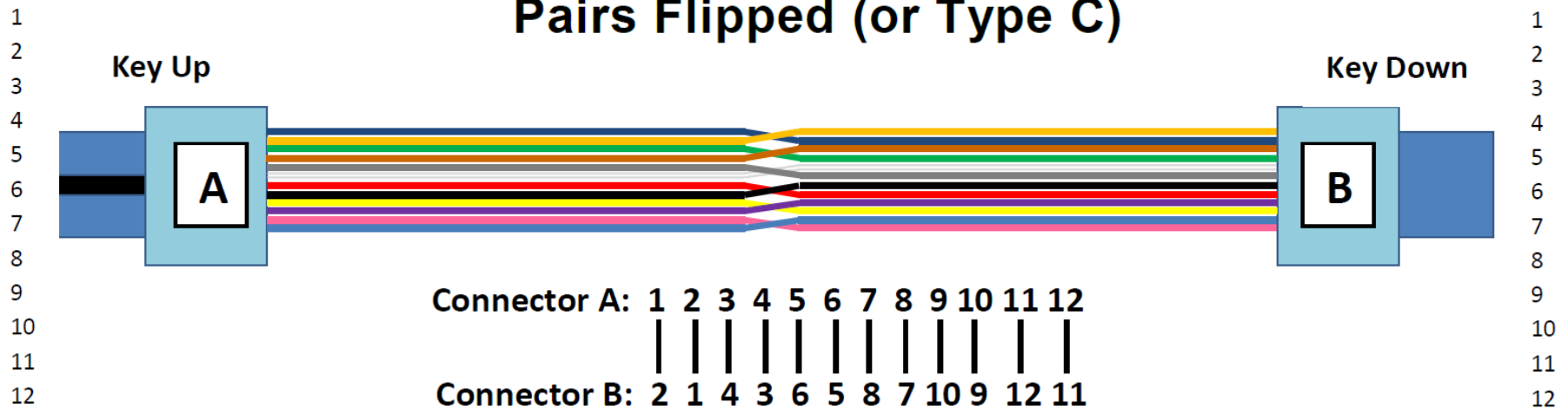


Kabel MPO typ B (A-B)



Kabel MPO typ C

Pairs Flipped (or Type C)

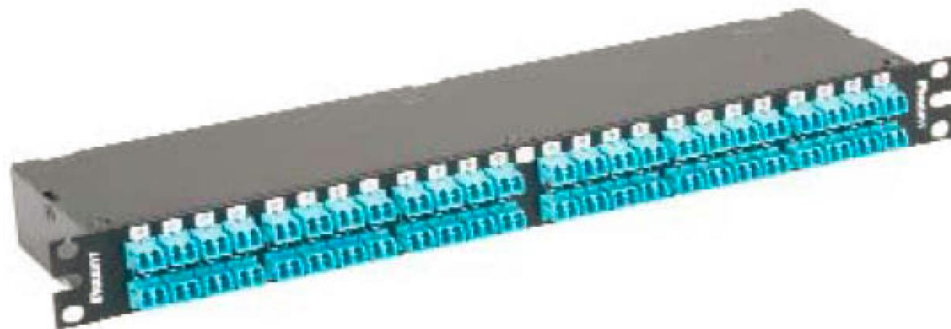


Jaký typ vlákna zvolit ?

Délka trasy	FastEthernet	1GEthernet	10GEthernet	40/100G
0 < 100 m	OM1	OM1	OM3	OM3/OM4
0 < 150 m	OM1	OM1	OM3	OM4
150 < 275 m	OM1	OM1	OM3	OS1/2
275 < 300 m	OM1	OM1/OM2	OM3	OS1/2
300 < 500 m	OM1	OM1/OM2	OS1/2	OS1/2
500 < 1500 m	OM1	OM3	OS1/2	OS1/2
1500 < 2000 m	OM1	OM3	OS1/2	OS1/2

- Vlákno 50/125
- Pro datacentra OM3/OM4/OM5 podle vzdálenosti a aplikace
- Rezerva v trase pro budoucí pokládku SM vlákna
- Pokládka kombinovaných kabelů MM + SM

MPO moduly nebo klasické LC ?



Pozvánka na školení

Optické sítě v DataCentrech 40/100/200 Gbit/s a jejich měření

4. 5. 2017

Email: sima@rlc.cz