

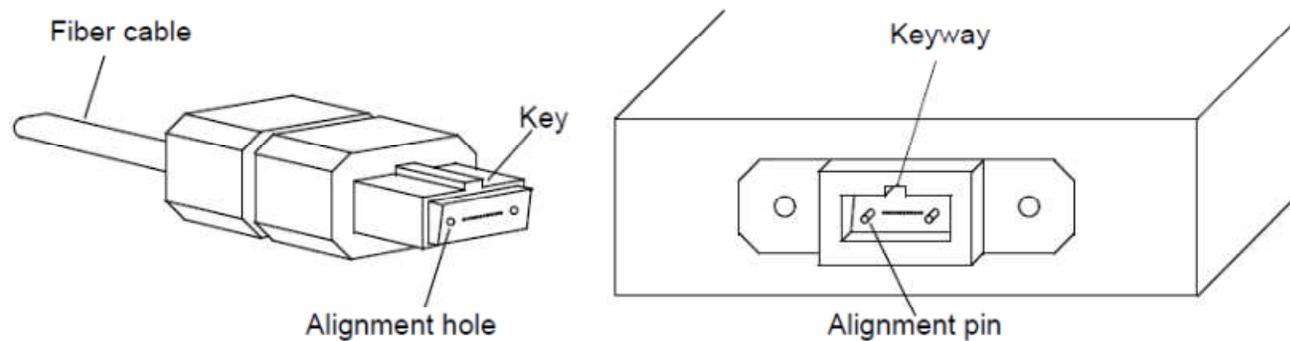
# Optical Connection Specs for PSM4

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# Purpose and Approach

- To define cable plant connection return loss and MDI connector physical and performance characteristics
  - for single-fiber-row MPO with angled (APC) interface
  - operating in environmental category appropriate for data centers
  - at performance level consistent with prior loss budget proposed in kolesar\_02\_0313
- Reference IEC specifications
  - IEC 61754-7 series for MPO physical characteristics
  - IEC 61753 series for performance characteristics

# The PSM4 MDI



- Examining above diagram we see
  - Similarity to MDI of clause 86 used for 40GBASE-SR4
    - Single row of twelve fibers
  - Left side resembles MPO plug on cable
    - Alignment holes: unpinned “female” plug
    - Down-angled ferrule end-face
      - Long side of ferrule on same side as key
  - Right side resembles MPO device receptacle
    - Alignment pins: pinned “male” interface
    - Up-angled ferrule end-face
      - Short side of ferrule on same side as the keyway that faces user

# Relevant IEC Standards for Reference

- Physical characteristics
  - IEC 61754-7-1 ed.1 ...*MPO connector family – one fibre row*
    - Defines plugs, adapters and device receptacles; of relevance are:
      - Interface 7-1-1: MPO female plug connector, down-angled interface for 2 to 12 fibres
      - Interface 7-1-9: MPO active device receptacle, angled interface
    - Entering FDIS ballot stage, so will be published within needed time frame
- Performance
  - IEC 61753-1 ed.1 ...*General and guidance for performance standards*
    - Defines tests and severities that form performance categories
      - Examples: vibration, change of temperature, flexing, cable retention, durability
    - Relates performance categories to operating service environments
      - Examples: Cat. C = controlled, Cat. U = uncontrolled, Cat. E = Extreme
    - Defines performance grades for single-mode connections
      - Insertion loss Grades A, B, C, D      – Return loss Grades 1, 2, 3, 4
  - IEC 61753-021-x series for single-mode connectors
    - Where x indicates environmental performance category:
      - Examples: 2 = Category C, 3 = Category U

# IEC Performance Category / Service Environment for connectors and passive components

Performance category	Description	Operating service environment
C	Controlled environment	Operating temperature: – 10 °C to +60 °C Relative humidity: 5 % to 93 % Typically within an office, equipment room, telecommunication centre or building. Not subjected to condensed water.

Note: all other performance categories are for more severe service environments

# IEC SM Connection Performance Grades

Attenuation grade	Attenuation in random mate
A	Not yet defined
B	$\leq 0.12$ dB mean $\leq 0.25$ dB max for > 97% of samples
C	$\leq 0.25$ dB mean $\leq 0.50$ dB max for > 97% of samples
D	$\leq 0.50$ dB mean $\leq 1.0$ dB max for > 97% of samples

 Appropriate for “un-tuned” LC  
 Appropriate for MPO

Return loss grade	Return loss in random mate
1	$\geq 60$ dB mated, $\geq 55$ dB unmated
2	$\geq 45$ dB
3	$\geq 35$ dB
4	$\geq 26$ dB

 Appropriate for APC  
 Aligned with present IEEE 802.3 specs

# Referencing IEC Standards (1 of 2)

- IEC explicitly details a few grade combinations (called performance levels) in the 61753-021-x series
  - Performance Levels B/1, B/2, C/1, C/2, C/3
- Defined grade combinations form 12 performance levels
  - IEEE 802.3 expects or specifies the equivalent of C/4 or D/4
  - D/1 is appropriate for SM APC MPO
- General & Guidance document defines everything needed to insert any grade combination into the connector specification established for the chosen environmental category
  - Category C (controlled environment) is appropriate for data centers
- Complete reference includes performance level
  - Example: IEC 61753-021-2 for performance level D/1

Single-mode  
Connectors

Category C  
Environment

Insertion Loss  
Grade

Return Loss  
Grade

# Referencing IEC Standards (2 of 2)

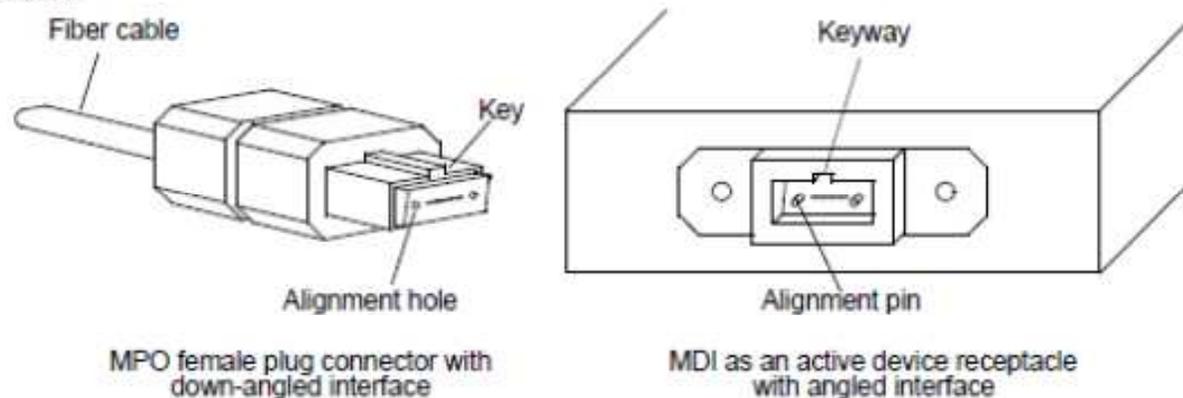
- IEC 61754-7-1 defines a dozen different MPO interfaces
  - Plugs, adapters, backplane & board housings, device receptacles
- Complete reference includes interface
  - Examples:
    - IEC 61754-7-1 interface 7-1-1: MPO female plug connector, down-angled interface for 2 to 12 fibers
    - IEC 61754-7-1 interface 7-1-9: MPO active device receptacle, angled interface

# Putting It All Together (1 of 2)

- Proposed content for Clause 96, underlined texts contain references

## 96.11.3.2 Medium Dependent Interface (MDI) requirements

The MDI shall meet the dimensional specifications of IEC 61754-7-1 interface 7-1-9: MPO device receptacle, angled interface. The plug terminating the optical fiber cabling shall meet the dimensional specifications of IEC 61754-7-1 interface 7-1-1: MPO female plug connector, down-angled interface for 2 to 12 fibres. The MDI shall optically mate with the plug on the optical fiber cabling. Figure 96-7 shows an MPO female plug connector with down-angled interface, and an MDI as an active device receptacle with angled interface.



**Figure 96-7—MPO female plug with down-angled interface and MDI active device receptacle with angled interface**

The MDI shall meet the interface performance specifications of IEC 61753-021-2 for performance level D/1.

NOTE—Transmitter compliance testing is performed at TP2 as defined in 96.5.1, not at the MDI.

# Putting It All Together (2 of 2)

- Proposed content for Clause 96

## **96.11.2.2 Maximum discrete reflectance**

The maximum discrete reflectance shall be less than  $-55$  dB .

# Summary and Closing Perspectives

- IEC specifications can be used to specify performance and physical characteristics of connections
  - No need for 802.3 to reinvent these specifications
- Specifying APC end-faces for single-mode MPO has several benefits
  - Matches the default SM MPO/MTP end-face commonly deployed in pre-terminated structured cabling environments
  - 55 dB return loss performance greatly mitigates (virtually eliminates) reflection-related impairments
  - Opens the door to a greater variety of transmission technologies
    - Example: Enables advanced encoding technologies like PAM
    - We will likely require combinations of technologies to enable practical solutions at rates higher than 100G

# Q & A