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## tML® - tde Modular Link

tML ${ }^{\circledR}$ is a patented, modular cabling system consisting of the three key components module, trunk cable and rack mount enclosure. The system components are 100 percent manufactured, pre-assembled and tested in Germany. They enable plug-and-play installation on site - especially in data centres, but also in industrial environments - within the shortest possible time. Heart of the system are the rear MPO/MTP® ${ }^{\circledR}$ and Telco connectors, which can be used to connect at least six or twelve ports at a time. Depending on the module configuration, transfer rates of up to 200G are currently possible with SR4. The fibre optic and TP modules can be used together in a module carrier with a very high port density. The tde offers its $\mathrm{tML}{ }^{\circledR}$ cabling system as a proven $\mathrm{tML}{ }^{\oplus}$ standard system and in the highly innovative variants $\mathrm{tML}^{\circledR}$ Xtended, tML® 24 System and now tML® 32 System for extreme scalability and very easy migration to higher transmission rates such as 40G, 100G, 200G and 400G.

The tML® Breakout Module MPO/MTP®is intended for the installation in the tML® Rack Mount Enclosure 1U (for $8 \times$ Modules).

## $i$

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tML® - FO Breakout Module MPO/MTP® with Pins/4x LC APC Duplex 9/125 $\mu$ OS2, LR4

## Technical Data

The end faces of the connectors are optimized by means of Lasercleaving and machine polish. The MPO/MTP®plug has a defined fiber height of $1-3.5 \mu$. The max. adjacent fiber height difference is $0.2 \mu \mathrm{~m}$ and for all fibers $0.3 \mu \mathrm{~m}$. All system components (modules, trunk cables and patch cords) are co-ordinated for the reaching of the performance particularly. The module is marked with sequential serial number and article number. The modules are ROHS compliant.

| Entry | $1 \times$ MPO/MTP®Male Adapter (green) front $^{\text {Exit }}$ |
| :--- | :--- |
| Tests | $4 \times$ LC APC Duplex Adapter (green) front |
|  | Interferometer, Insertion Loss, Return Loss and Visual Final Inspection; all measured values are <br> electronically archived |
|  | QS-Managementsystem ISO 9001, ISO 14001 and TL 9000 |


| Box | Galvanized steel sheet |
| :--- | :--- |
| Front Panel | Stainless steel |
| Dimensions | $110 \times 108 \times 20 \mathrm{~mm}$ |

## FO Adapters

| Type | LC Duplex |
| :--- | :--- |
| Application | Singlemode OS2 APC |
| Design | One-Piece without flange |
| Connector style | SC Simplex |
| Color | Green |
| Material | Plastic |
| Sleeve | Zirkonia Staight Split |
| Shutter | -- |
| Manufacturer | tde |

## FO Connectors

| Connector Type | LC APC Unibody Simplex |
| :--- | :--- |
| Housing | Plastic, Green |
| Ferrule | Zirconia Straight Split, Spring-loaded Axially |
| Ferrule Hole | $\leq 0.6 \mu$ |
| Ferrule Concentricity | 500 |
| Mating Cycles | $-40^{\circ} \mathrm{C}$ up to $+75^{\circ} \mathrm{C}$ |
| Operating Temperature | 100 N |
| Strain Relief to | tde |
| Manufacturer |  |

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Optical performance

| Fiber | Type | Wavelength | Insertion loss typ. | Insertion loss max. | Return loss min. |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $9 / 125 \mu$ | LC APC | $1310 / 1550 \mathrm{~nm}$ | $\leq 0.10 \mathrm{~dB}$ | 0.18 dB | 75 dB |

## FO Adapters

| Type | MPO/MTP® |
| :--- | :--- |
| Application | Singlemode OS2 APC |
| Design | without Flange |
| Connector style | SC Simplex |
| Key Orientation | Type A, Key up/down |
| Color | Green |
| Material | Plastic |
| Sleeve | -- |
| Shutter | -- |
| Standards | IEC 61754-7 |
|  | TIA 604-5 |
| Manufacturer | US Conec |

## FO Connectors

The end faces of the connectors are optimized by means of Lasercleaving and machine polish. The MPO/MTP® plug has a defined fiber height of $1-3.5 \mu$. The max. adjacent fiber height difference is $0.2 \mu \mathrm{~m}$ and for all fibers $0.3 \mu \mathrm{~m}$.

## Connector

| Type | MPO/MTP ${ }^{\circledR}$ APC Male Push Pull Locking with Elite Pins (green) |
| :--- | :--- |
| Ferrule | 12 Fiber SM Elite ${ }^{\circledR}$ ferrule, PPS |
| Boot colour | Black |
| Temperature range | $-40^{\circ} \mathrm{C}$ bis $+75^{\circ} \mathrm{C}$ |
| Manufacturer | tde/US Conec |

Optical Performance

| Fiber | Type | Wavelength | Insertion loss typ. | Insertion loss max. | Return loss min. |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $9 / 125 \mu$ OS2 | $\mathrm{MPO} / \mathrm{MTP}^{\circledR} \mathrm{APC}$ | $1310 / 1550 \mathrm{~nm}$ | $\leq 0.10 \mathrm{~dB}$ | 0.20 dB | 75 dB |

## FO Fiber

| Type | Corning SMF-28e $+{ }^{\circledR} 09 / 125 \mu \mathrm{OS} 2 \mathrm{G} .652$. D singlemode fiber |
| :--- | :--- |
| Maximum Attenuation | At $1310 \mathrm{~nm} \operatorname{max.} 0.33-0.35 \mathrm{~dB} / \mathrm{km}$ |
|  | At $1383 \pm 3 \mathrm{~nm}$ max. $0.31-0.35 \mathrm{~dB} / \mathrm{km}$ |
|  | At $1490 \mathrm{~nm} \max .0 .21-0.24 \mathrm{~dB} / \mathrm{km}$ |
|  | At $1550 \mathrm{~nm} \max .0 .19-0.20 \mathrm{~dB} / \mathrm{km}$ |
|  | At $1625 \mathrm{~nm} \operatorname{max.} 0.20-0.23 \mathrm{~dB} / \mathrm{km}$ |

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| Attenuation vs. Wavelength | Range: 1285-1330 mm; Ref. $\lambda: 1310 \mathrm{~nm}$; Max. Difference: $0.03 \mathrm{~dB} / \mathrm{km}$ Range: 1525-1575 mm; Ref. $\lambda: 1550 \mathrm{~nm}$; Max. Difference: $0.02 \mathrm{~dB} / \mathrm{km}$ |
| :---: | :---: |
| Macrobend Loss | Mandrel Diameter:32mm; Number of Turns: 1; Wavelength: 1550 nm ; Induced Attenuation: $\leq 0.03 \mathrm{~dB}$ Mandrel Diameter:50mm; Number of Turns: 100; Wavelength: 1310 nm ; Induced Attenuation: $\leq 0.03 \mathrm{~dB}$ Mandrel Diameter:50mm; Number of Turns: 100; Wavelength: 1550nm; Induced Attenuation: $\leq 0.03 \mathrm{~dB}$ Mandrel Diameter:60mm; Number of Turns: 100; Wavelength: 1625 nm ; Induced Attenuation: $\leq 0.03 \mathrm{~dB}$ |
| Point Discontinuity | Wavelength: 1310 nm ; Point Discontinuity: $\leq 0.05 \mathrm{~dB}$ Wavelength: 1550 nm ; Point Discontinuity: $\leq 0.05 \mathrm{~dB}$ |
| Cable Cutoff Wavelength ( $\lambda \mathrm{ccf}$ ) | $\lambda \mathrm{ccf} \leq 1260 \mathrm{~nm}$ |
| Mode-Field Diameter | At $1310 \mathrm{~nm}=9.2 \pm 0.4 \mu \mathrm{~m}$ At $1550 \mathrm{~nm}=10.4 \pm 0.5 \mu \mathrm{~m}$ |
| Dispersion | At $1550 \mathrm{~nm}=\leq 18.0[\mathrm{ps} /(\mathrm{nm} * \mathrm{~km})$ ] <br> At $1625 \mathrm{~nm}=\leq 22.0[\mathrm{ps} /(\mathrm{nm} * \mathrm{~km})$ ] |
|  | Zero Dispersion Wavelength $\left(\lambda_{0}\right): 1310 \mathrm{~nm} \leq \lambda_{0} \leq 1324 \mathrm{~nm}$ Zero Dispersion Slope ( $\mathrm{S}_{0}$ ): $\leq 0.092 \mathrm{ps} /\left(\mathrm{nm}^{2}{ }^{*} \mathrm{~km}\right)$ |
| Polarization Mode Dispersion (PMD) | PMD Link Design Value $=\leq 0.06 \mathrm{ps} / \sqrt{ } \mathrm{km}$ Maximum Individual Fiber $=\leq 0.1 \mathrm{ps} / \sqrt{ } \mathrm{km}$ |
| Norm | ITU-T Recommendation G. 652 (Tables A, B, C, and D) IEC Specifications 60793-2-50 Type B1.3 <br> TIA/EIA 492-CAAB <br> Telcordia Generic Requirements GR-20-CORE ISO 11801 OS2 |

## Dimensional Specifications

| Fiber Curl | $\geq 4.0 \mathrm{~m}$ radius of curvature |
| :--- | :--- |
| Cladding Diameter | $125.0 \pm 0.7 \mu \mathrm{~m}$ |
| Core-Clad Concentricity | $\leq 0.5 \mu \mathrm{~m}$ |
| Cladding Non-Circularity | $\leq 0.7 \%$ |
| Coating Diameter | $242 \pm 5 \mu \mathrm{~m}$ |
| Coating-Cladding Concentricity | $<12 \mu \mathrm{~m}$ |

## Environmental Specifications

| Environmental Test | Test Condition | Induced Attenuation $1310 \mathrm{~nm}, 1550 \mathrm{~nm} \&$ <br> 1625 nm |
| :--- | :--- | :--- |
| Temperature Dependence | $-60^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | $\leq 0.05$ |
| Temperature Humidity Cycling | $-10^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ up to $98 \% \mathrm{RH}$ | $\leq 0.05$ |
| Water Immersion | $23^{\circ} \mathrm{C} \pm 2^{\circ} \mathrm{C}$ | $\leq 0.05$ |
| Heat Aging | $85^{\circ} \mathrm{C} \pm 2^{\circ} \mathrm{C}$ | $\leq 0.05$ |
| Operating Temperature Range | $-60^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ |  |

## Mechanical Specifications

| Proof Test | The entire fiber length is subjected to a tensile stress $\geq 100 \mathrm{kpsi}(0.7 \mathrm{GPa})$. |
| :--- | :--- |
| Length | Fiber lengths available up to $63.0 \mathrm{~km} /$ spool. |

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## Performance Characterizations

| Core Diameter | $8.2 \mu \mathrm{~m}$ |
| :--- | :--- |
| Numerical Aperture | 0.14 |
| Zero Dispersion Wavelength $\left(\lambda_{0}\right)$ | 1317 nm |
| Zero Dispersion Slope $\left(\mathrm{S}_{0}\right)$ | $0.088 \mathrm{ps} /\left(\mathrm{nm}^{2 *} \mathrm{~km}\right)$ |
| Effective Group Index of Refraction | $1310 \mathrm{~nm}: 1.4676$ |
|  | $1550 \mathrm{~nm}: 1.4682$ |
| Fatigue Resistance Parameter (nd) | 20 |
| Coating Strip Force | Dry: $0.6 \mathrm{lbs}(3 \mathrm{~N})$ |
|  | Wet: 14 days room temperature: $0.6 \mathrm{lbs}(3 \mathrm{~N})$ |
| Rayleigh Backscatter Coefficient | $1310 \mathrm{~nm}:-77 \mathrm{~dB}$ |
| (for 1 ns Pulse Width) | $1550 \mathrm{~nm}:-82 \mathrm{~dB}$ |

## Product variants \& accessories

| Art.-No. | Description |
| :--- | :--- |
| TML-M04LCAD/MPP09E | tML® - FO Breakout Module MPO/MTP® with Pins/4x LC APC Duplex $9 / 125 \mu$ OS2, LR4 |
| TML-M04LCD/MPP50G3 | tML® - FO Breakout Module MPO/MTP® with Pins/4x LC Duplex 50/125 $\mu$ OM3, SR4 |
| TML-M04LCD/MPP50G4 | tML® - FO Breakout Module MPO/MTP® with Pins/4x LC Duplex 50/125 $\mu$ OM4, SR4 |
| TML-M04LCDS/MPP50G5 | tML® - FO Breakout Module MPO/MTP® with Pins/4x LC Duplex 50/125 $\mu$ OM5, SR4 |

