

# HARSH ENVIRONMENT

HIGH PERFORMANCE FIBER-OPTIC INTERCONNECT SOLUTIONS





## DIAMOND COMPANY PORTRAIT

DIAMOND is a leading global supplier of high-precision fiber-optic solutions and has been successfully supplying a wide range of markets for over 30 years now. Diamond is also recognised as a dynamic and innovative company that knows how to manufacture reliable and customised components and devices in order to satisfy the ever-increasing demands of clients. In addition to the company headquarters, which was founded in Switzerland in 1958, Diamond can count on a global distribution network with 4 subsidiaries and over 20 representatives.

## HARSH ENVIRONMENTS

The worldwide market for harsh-environment fiber optics is experiencing steady growth due to the rapid advances made in fiber-optic technology, as well as the increasing demand for fiber-optic components for challenging applications. As a result, DIAMOND has responded by developing a wide range of strong, reliable, and customisable indoor/outdoor field optical connectors with superior optical performances for both standard and special products that integrate technologies for High Power and Polarization Maintaining PM Solutions. These products must be able to withstand adverse temperatures and weather conditions, shocks, vibrations, tensile stress, external pressure, corrosive surroundings, etc., which are much harsher than the environmental conditions typically endured by standard commercial connectors and cable assemblies. Typical applications are: energy plants, coal mines, offshore oil platforms, cement factories, refineries etc., as well as field-deployable communications, mobile diagnostic units, avionics and space travel, security systems, machine controls, industrial machine networks.

## OUR STRENGTHS AT A GLANCE



# VERSATILE AND MODULAR FIBRE OPTIC SOLUTIONS



HE-2000™



MIL-38999 DM



MIL-83526 DM



X-BEAM



Mini-AVIM



AVIM

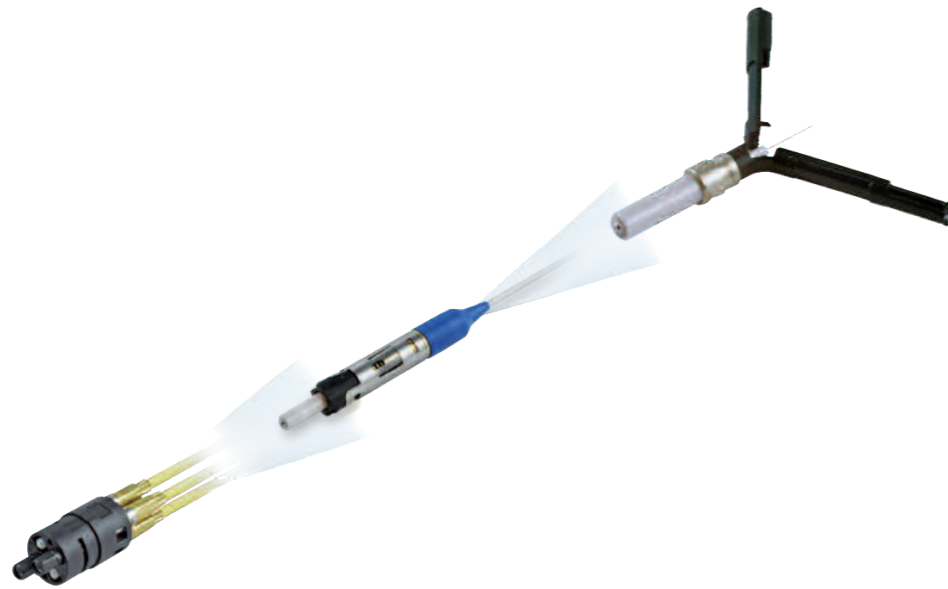


## NEW DIAMOND MULTIPURPOSE (DM) INSERT BASED ON CROCODILE ALBERINO

Diamond has developed the new factory-terminated and measured fiber-optic Crocodile **Alberino HE** (Harsh Environment) to allow customers to assemble precision-engineered **termini** ensuring low data loss and reliable, repeatable performances over long distances in many applications.

This assembly can be performed with the Zeus D50 HE fusion splicer from Diamond.

In addition to the optical termini, Diamond also developed the electrical termini with the same dimensions, and both parts form the base of the new Diamond Multi-purpose (DM) insert that is the core of our **HE-2000™**, **MIL-38999 DM** and **MIL-83526 DM** connectors.



### Characteristics of DM insert

- Based on standard 2.5-mm Alberinos with integrated springs to prevent termini separation
- Up to 4 channels
- Hybrid, FO - Electrical
- Genderless mating and self-aligning design
- Easy front-face ferrule access for cleaning & inspection
- Easy termini insertion and removal for field termination and repair

### Features of termini

- Compatible with several fiber types such as MM, SM, PM and small-core fibers
- Available in PC and APC versions
- Steady and repeatable low IL and high return loss (when APC is polished)
- High and steady ER when terminated with PM fibers
- Compatible with tight cable construction and semi-loose cable/fiber construction
- Field repair and termination available with the Diamond *Fusion Crocodile Alberino*
- Electrical pins 20 AWG
- Titanium ferrule front face



HE-2000™ connector



MIL-38999 DM connector

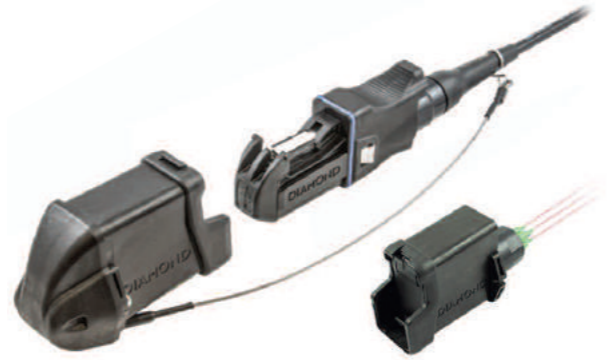


MIL-83526 DM connector

## OUTDOOR, INDUSTRIAL

### HE-2000™ Connector

- Automatic protection shutter on connector (manual on bulkhead)
- Push-pull mechanism for easy handling
- Harsh-environment plastic shell, made from nylon with 25% fiber-glass reinforcement
- IP class: IP67
- Easy front-face ferrule access for cleaning & inspection
- Mechanical and colour-coding upon request
- Electrical pins 20 AWG
- Available on cable reels up to 500 metres in length



### MIL-38999 DM Connector

- Size 13 shells (according to MIL std 38999 serie III)
- Low Insertion Loss and high reliability Typ. IL 0.2dB
- Easy field termination and repair
- Available on cable reel up to 500 meters length



### MIL-83526 DM Connector

- Rugged construction for highly reliable optical connections
- IP class: IP68 rated
- Easy ferrule front-face access for cleaning & inspection
- Keyed, self-aligning connector housing aides in "blind" mating" applications
- Electrical pin size 20 AWG
- Easy termini insertion and removal for field termination and repair



### DiaFlex (Fan-Out Connector)

- DIAMOND multi-fiber connector for 8, 12, 24 fibers
- Replaceable fiber whips
- Protective cap with feed-in eye
- IP class: IP68
- Cable retention 700 N
- Simple to use on site
- Robust metal fiber divider
- Can be used flexibly thanks to the small external diameter
- Client-specific connector types and cable lengths



### X-BEAM Connector

- Integrated expanded beam lens system to protect the fiber end-face
- Rugged construction for high reliability
- IP68 rated enclosure, IEC 60529 compliant
- Hermetic coupling (EN 1779 / DIN EN 13185)
- Low loss connection and high repeatability
- Genderless design to simplify mating
- Field repair and termination available
- Available on cable reel up to 500 meters length
- Loopback bulkheads available



### revos E-2000 Connector

- Rugged IP 65 rated metal enclosure (*Dust tight and spray proof*)
- Integrated caps and shutters  
*Laser eye safety*
- E-2000™ connector with Active Core Alignment  
*Exceptional optical performance*
- Easy lever locking
- Available on cable reel up to 500 meters length



### OPTELCON MEDIACONVERTER

- Variable mounting in cabinet walls as thick as 4 mm
- Compact, robust design
- M50 cutout sealed to IP65
- Robust revos E-2000 bulkhead with dust cap and IP65 protection
- Direct optical-electrical connection through the bulkhead
- Plug and play
- CE approved
- RoHS compliant



### OD3 Connector

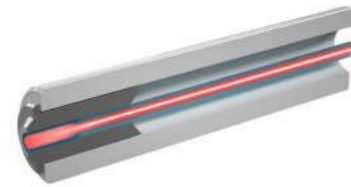
- Rugged IP 67 rated anodised metal enclosure  
*Dust-tight and waterproof*
- F-3000™ (LC compatible) SFF connector system  
*Exceptional optical performance in a high-density LC standard compliant connector. Integrated caps on the connectors and shutters in the couplers provide both laser eye safety and end face protection during mating/demating*
- Exceptional optical performance
- Available on cable reel up to 500 meters length



## POWER SOLUTION

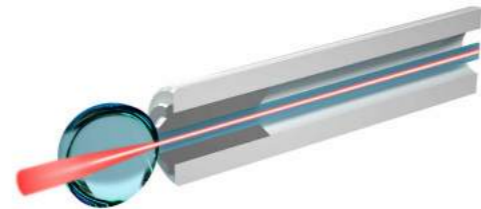
### PS collimated (contact)

Diamond's PS interfaces are contact solutions for SM fibers that allow supporting higher optical powers at the connectors' mating surface. Compared to standard SM fibers, the mode size is expanded 4-5 times and collimated by splicing an endcap consisting of a GRIN fiber section. This effectively reduces the power density at the connector's surface, which decreases the risk of catastrophic damages or, alternatively, improves the connector's resilience towards dust.



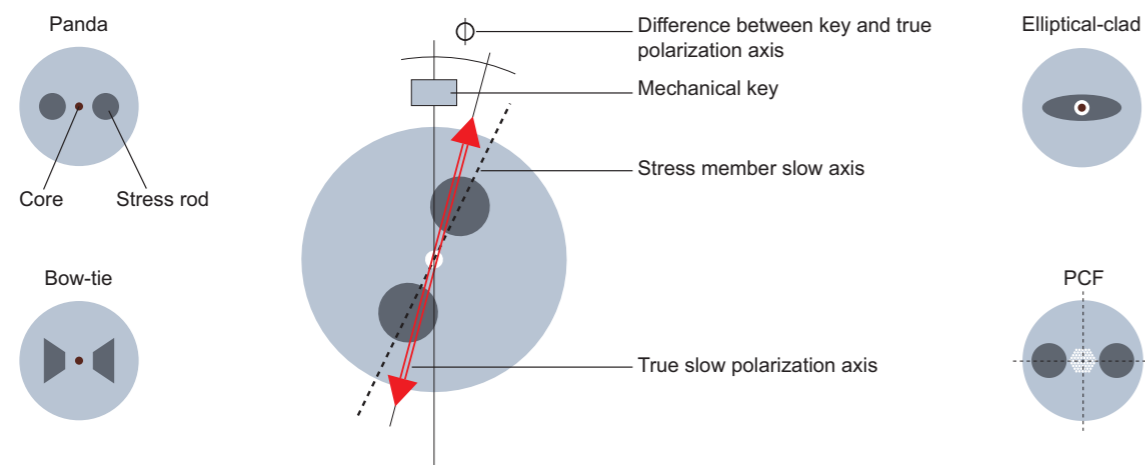
### PSb (Power Solution ball lens)

The PSb arrangement is a non-contact interface that allows for an expansion of the beam size of a MM fiber by means of an external spherical lens. The opto-mechanical alignment between fiber, ferrule and lens relies upon the active core alignment. The size of the collimated beam in free-space is sufficient to ensure a safe handling of medium to high optical power levels even in the presence of surface contaminants.



## POLARIZATION ORIENTATION (PO)

Polarization plays an important role in the industrial photonics market. Sensors and communication systems have been designed using Polarization Maintaining or Polarizing fibers. Only connectors with an orientation key are capable of properly terminating these fibers.



The connector key for a Polarization Maintaining connector can be aligned to the stress members (Passive Polarization Orientation, PPO) or to the true optical axis (Active Polarization Orientation, APO).

### ADVANTAGES

- Ultra low Insertion Loss
- High Extinction Ratio
- High Return Loss

## AVIONICS AND SPACE INTERCONNECTIONS

Diamond has been supplying the renowned AVIM connector for ruggedized applications for over 20 years. Upon completion of qualification under ECSS specifications for the European Space Agency, the AVIM and Mini-AVIM products will be the first fiber optic connectors qualified for space applications.

### AVIM Connector

AVIM are multipurpose, Commercial Off-The-Shelf fiber optic connectors offering high optical performance and capable in dynamic environments of mobile platforms, including avionics and especially space flight. These connectors are compatible with the widest range of optical fibers, including singlemode (SM), multimode (MM), polarization maintaining (PM) and other fibers of different core/cladding sizes.



- Low IL thanks to Active Core Alignment (A.C.A.)
- High return loss thanks to Diamond polishing technique
- High performing polarization extinction ratio (PER), when terminated with PM fibers
- Miniaturized MIL-style ratchet system with high vibration/shock resistance
- Unique AVIM 2-piece cleanable adapter for easy cleaning and maintenance access
- Right angle boot available for facilitating unique installation and routing requirements



Longest heritage of space optical connector (1995)

### Mini-AVIM Connector

The Mini-AVIM connector has been developed upon market request for a smaller and lighter version of our acclaimed AVIM connector, especially for space applications.

The Mini-AVIM combines two leading edge technologies: the AVIM MIL-style ratchet system and the base construction of the Diamond Micro Interface (DMI) connector. Applications will range from Space to underwater, applying to mobile, avionics, shipboard, oil downhole, etc.



- Compact, small and lightweight
- Low loss thanks to Diamond Active Core Alignment (A.C.A.)
- High return loss thanks to Diamond polishing technique
- High performing polarization extinction ratio (PER), when terminated with PM fibers
- Miniaturized MIL-style ratchet system with high vibration/shock resistance
- All Titanium – ZrO2 material for ultra low CTE mismatch

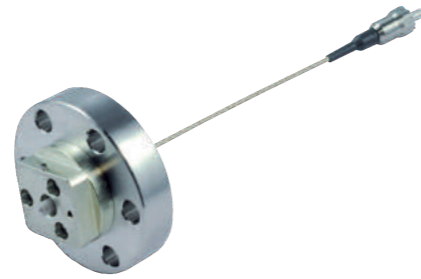


Developed for ExoMars rover

**Vacuum feedthrough**

Diamond proposes vacuum feedthrough **V-FT** solutions for a large range of optical fiber and adapters, using an epoxy sealing technology. **V-FT** integrates a standard 2.5mm ferrule permanently sealed in a standard CF flange with a variety of adapters. The obtained feedthrough benefits from a very low leak rate. It can be ordered for many type of fibers, including SM, MM, PM, PS, large core MM and others.

Multi-channel systems are also available using standard CF building block elements.



- Compact, robust, stable
- Low loss due to Diamond Active Core Alignment
- High return loss due to Diamond polishing technique
- Low leakage due to Diamond sealing technology

**High Temperature Connectors**

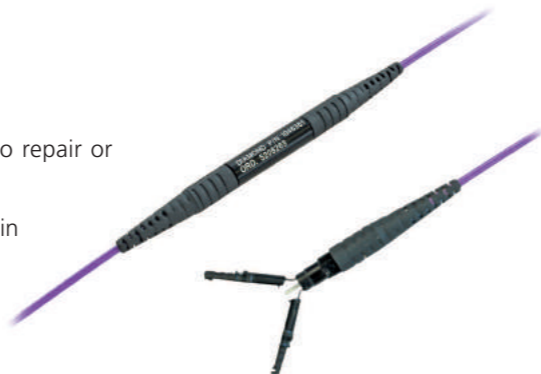
Diamond HT assemblies rely upon a combination of specialized assembly techniques and materials, together with special fibers with appropriate coatings suitable for deployment in harsh environments. Further to the traditional advantages, these assemblies offer immunity to electromagnetic interference, better environmental stability and enhanced remote sensing compared to traditional electronic sensors. Assemblies are available in PC and AP version with MM or SM fibers.



- Reliable operation up to 150°C (302° F)
- Low Insertion loss thanks to ACA
- Ultra high polish for High return loss

**Crocodile Repair Set**

Diamond's Crocodile repair set provides a simple way to repair or add cable extensions to existing cable installations. Its light weight and robust construction permits to use it in harsh environments and under high mechanical stress. It is available for SM and MM service, for secondary coated fiber and fiber cables (1.6mm – 3.1 mm). The Crocodile repair set is to be field terminated via a low loss fusion splice based on DIAMOND's ZEUS Fusion Field Termination Kit.



- Simple, fast and reliable field repair, even in severe conditions
- Integrated, small and robust splice protection and cable boots
- Compact, light weight
- Resistant to high cable tensions

**FIELD INSTALLATION AND SERVICES**

**Zeus D50 HE Fusion splicers**

Complete set of all tools required for the full termination process starting from cable preparation to connector assembly (including cleaver and automatic stripper with heated jaws for tough secondary coating 900 µm)

- Based on Diamond's Crocodile Alberino Fusion
- Suitable for use with 3-8mm military and outdoor cables
- Special cable clamps on bearing slides for secure and easy cable handling
- Removable work plate – compatible with stand



**Launch fibers**

Diamond offers two types of launch fiber boxes for outdoor connectors: one for the revos E-2000 and the other for the HE-2000™.



**Cleaning and Inspection**

**Cleaning Kit with hand microscope**

After repeated matings or when degraded performance is observed, it may become necessary to clean the individual ferrules and mating sleeve. DIAMOND's Cleaning Kit contains all necessary tools for proper cleaning and inspection procedures to help ensure optimal connector performance.

- Easy-to-use, lightweight, robust and field-proven



**Video Microscope Kit with cleaning tools**

Contains all necessary tools for proper inspection and cleaning of the connector's front-faces to help ensure optimal connector performance. The Microscope offers an high resolution display, integrated end-face illumination for inspection of 2.5 mm or 1.25 mm (PC and APC) ferrules, for both unmated and mated connectors with the inspection probe.

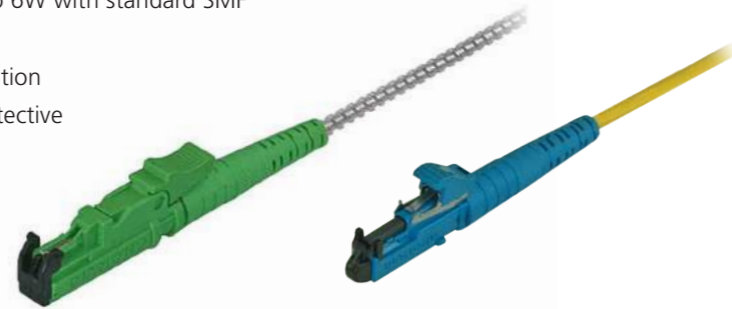
- Integrated optical power measurement for wavelengths from 780 to 1625 nm
- Generates certification reports
- Pass/fail acceptance criteria with dedicated profiles for each requirement
- Automatic fiber-image centering



## FIBER CONNECTORS FOR HARSH ENVIRONMENTS DERIVED FROM STANDARD TELECOM COMPONENTS

The continuous broadening of fiber optics in new application fields is driving the demand for conventional telecom products but with enhanced performances and robustness to be used in more hostile environments. Diamond offers now two of its most popular connectors, E-2000™ and F-3000™, that can provide the same high-quality optical performances even when subjected to more stringent and tougher operating conditions.

- Spring-loaded protective caps for increased safety protection
- E-2000™ with unparalleled 0.1 dB max. insertion loss (random mating tests)
- E-2000™ PS for applications up to 6W with standard SMF
- E-2000™ IP65-rated
- E-2000™ non-magnetic configuration
- Cable assemblies with various protective (metal or plastic) jacketing



### Environmental conditions

Measurement / Test	Parameters	Method
Change of temperature (Reliability)	-40°C / +85°C / 1 h dwell / 500 cycles	IEC 61300-2-22
Low temperature	-51°C / 96 h	MIL-STD-810F
Dry heat (Reliability)	+85°C / 2'000 h	IEC 61300-2-18
Thermal shock	-51°C / +71°C / 1 h dwell / 3 cycles	MIL-STD-810F
Low pressure, procedure II	4'572 m / 1 h	MIL-STD-810F
Low pressure, procedure III	2'438 m to 12'192 m / 60 s	MIL-STD-810F
Damp heat, cyclic (Reliability)	+25°C / +55°C / 95% r.h. / 100 cycles	IEC 61300-2-46
Composite* temperature-humidity cycling	-10°C / +25°C / +65°C / 93% r.h. / 15 cycles	IEC 61300-2-21
Extended humidity (Reliability)	+85°C / 85% rh / 2'000 h	Telcordia GR-326-CORE
Salt mist	+35°C / 50 g/l / 96 h	IEC 61300-2-26

\* E-2000™ only

### Mechanical conditions

Measurement / Test	Parameters	Method
Proof at 0°	4.5 Kg - 6.8 Kg / 5 s	Telcordia GR-326-CORE
Proof at 90°	2.3 Kg - 3.4 Kg / 5 s	Telcordia GR-326-CORE
Twist	1.35 Kg / ±1'800° / 10 cycles	Telcordia GR-326-CORE





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