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TACTICAL FIBER OPTIC MODEMS

EuroCom D/1 and ITU Standards



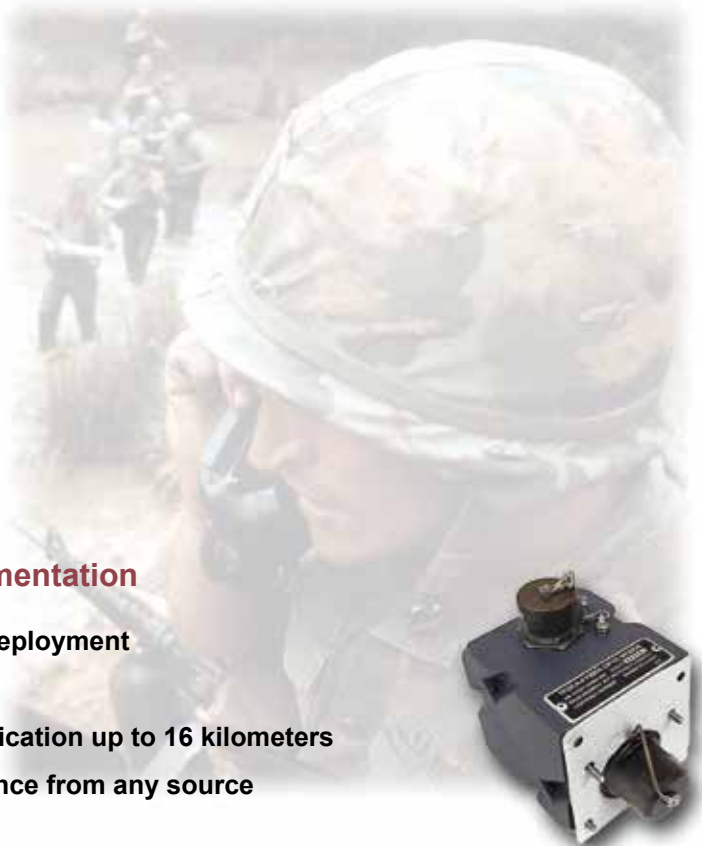
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PROTOKRAFT

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Overview

The family of Fiber Optic Modems (FOM) provide electrical to optical conversion of electronic communication and data signals for transmission using tactical fiber optic cable assemblies. The FOMs simultaneously receive incoming optical signals and converts them back to the original electronic signal allowing for full duplex transmission.

Together with tactical fiber optic cables, the FOMs provide a rugged, secure and easily deployable optical link. The FOM is available in both single channel and multi-channel configurations and can be mounted on the signal entry panel (SEP) of tactical shelters in 19 inch racks or placed on the ground (multi-channel versions only).

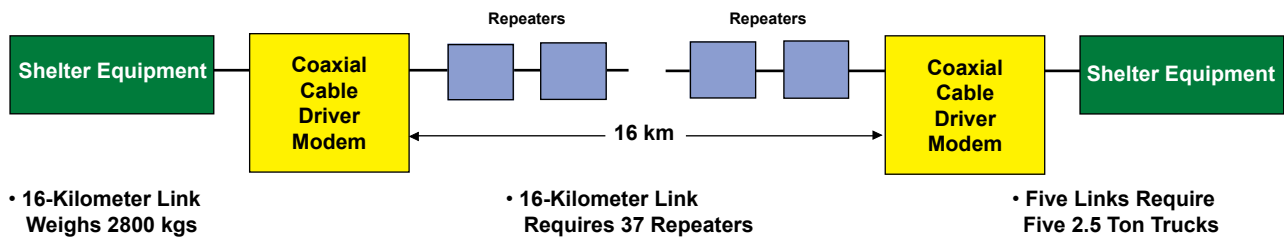


Benefits of Optical Fiber over Coaxial Implementation

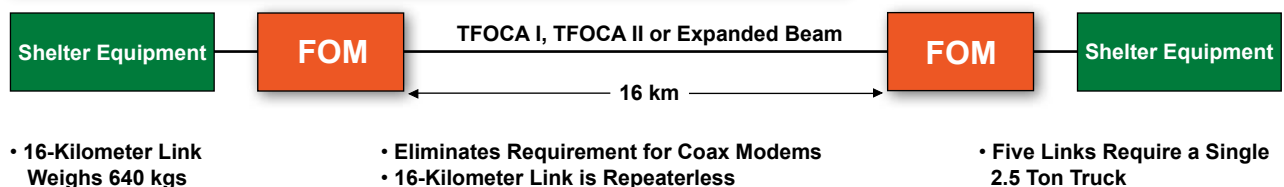
- Lighter weight and smaller size for much quicker deployment
- Higher bandwidth for increased throughput
- Lower loss for long distance repeaterless communication up to 16 kilometers
- Better quality - safe from electromagnetic interference from any source
- More secure - no electromagnetic signature
- Less expensive

All of the above enhance defense mobility and rapid deployment capabilities.

Coax Implementation (OLD WAY)



Optical Fiber Implementation (NEW WAY)



Single channel FOMs

The single channel FOM is currently available in four standards based communications interfaces: Standard EuroCom D/1 Interface B, E3, E1 and IP (Internet Protocol). These modems transmit up to 16 km without a repeater using multimode fiber and use less than 4 watts of power. The single channel FOMs are designed to mount on the Signal Entry Panel (SEP) of the tactical communication shelters or they can be installed in a rack mount panel. FOMs are available with various tactical fiber optic connectors, including TFOCA, *TFOCA-II™ and Expanded Beam.



General - Singlemode Fiber

- Up to 60 km repeaterless communication
- Wavelength 1550 nm ± 25 C°
- Designed for tactical environment
- <15 watts maximum power consumption
- Typical optical output power:
 - Minimum (at +60° C) = 3dBm
 - Maximum (at -35° C) = 3dBm
- Received optical power:
 - Minimum = -50 dBm
 - Maximum = -10 dBm

Physical Characteristics:

- Weight (kgs): 1.0
- Dimensions (cm): 10.16 x 10.16 x 9.53

Description	EuroFOM E1/1	EuroFOM-B/1	EuroFOM-E3/1	IP/1 10/100
Part Number	109700-201	109200	109000-101-201	110100-201
Power Requirement	28 VDC	28 VDC	-48 VDC or 5 VDC	28 VDC or 5 VDC
Electrical Signal	ITU G.703	EuroCom D/1, Interface B	ITU G.703	IEEE 802.3-2000
Optical Signal	JTC2A 9109C	JTC2A 9109C	JTC2A 9109C	JTC2A 9109C
Electrical Interface	75 Ohm BNC	MS3126E14-19P	75 Ohm BNC	CAT 5 / RJ45
Standard Accessories	Power Cable, Mounting Diagrams	Wiring and Mounting Diagrams	Power Cable, Mounting Diagrams	EMI Gasket
Alarms	Summary (LOS, BER, RAI)	Summary (LOS and Transmit Fault)	Summary (LOS, BPV, EXZ)	Optical and Electrical Signal Speeds
Environmental Specifications	Designed to Meet	Designed to Meet	Designed to Meet	Designed to Meet
Fiber	Multimode	Multimode	Single & Multimode	Multimode

Applications

- Interconnect tactical communication assemblages, including:

Radio Terminals **Tactical Multiplexers**
Radio Repeaters **Satellite Support Radios**
Tactical Switches **TACC Shelters**
Circuit Switches

- Tactical communication systems
- Down the hill links
- Intra-node cabling
- Dispersed command post
- Disaster relief



Single channel 10/100 Mbps FOM

The FOM-IP/1 integrates the MD1272/G and IP/1 10/100 Mbps fiber optic modems that provide a ruggedized optical link between mobile shelter equipment and remote sites for tactical communications. This unit provides electrical to optical conversion of IP (Internet Protocol) data and electro-optical conversion for full duplex transmission of digital communications signals between tactical shelters using multimode tactical fiber optic cable assemblies and is designed for use in harsh environments.

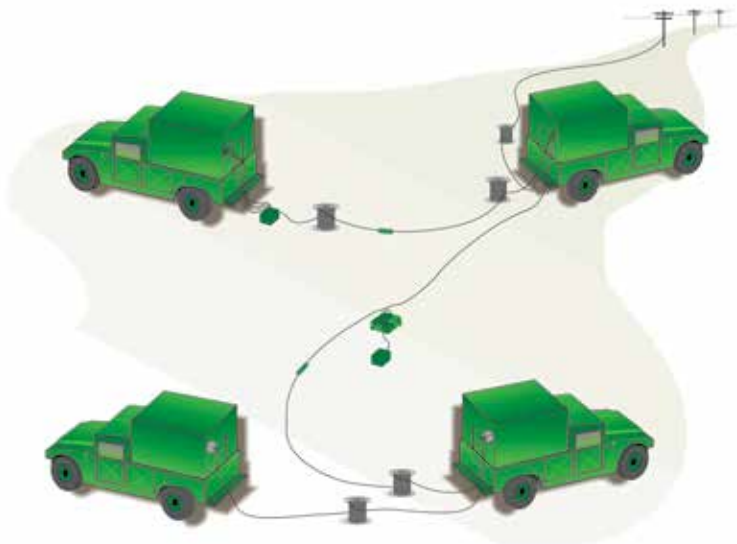
The interface at each end of the multimode optical cable, converts between electronic and optical transmission modes for repeaterless communication at distances of up to 2 kilometers. The FOM IP/1 automatically configures itself for 10 or 100 Mbps operation and is available with various tactical fiber optic connectors, including *TFOCA-II™ and Expanded Beam.

- Power Requirement: ————— 5 VDC or 28 VDC
Electrical Signal: ————— IEEE802.3-2000
Optical Signal: ————— JTC2A 9109C
Electrical Interface: ————— Shielded RJ45
Standard Accessories: ————— Wiring and Mounting Diagrams
Alarms: —————

Discrete Status outputs provided:

- Optical signal speed (10/100)
- Electrical signal speed (10/100)
- Optical signal (packets) received
- Electrical signal speed (packets) received

- Environmental Specs: ————— Designed to Meet
Fiber ————— Multimode



Physical Characteristics:

- Weight (kgs): 1.8
- Dimensions (cm): 10.16 x 10.16 x 9.53

General Specifications

- Up to 2 kilometer communication
- Light Emitting Diode (LED) light source
- TFOCA-II™, or Expanded Beam tactical fiber connectors
- 3.75 Watts maximum power consumption
- Typical Optical Output Power:
 - Minimum = - 19 dBm
 - Maximum = - 14 dBm
- Received Optical Power:
 - Minimum = - 31 dBm
 - Maximum = - 14 dBm
- Discrete Status outputs provided:
 - Optical signal speed (10/100)
 - Electrical signal speed (10/100)
 - Optical signal (packets) received
 - Electrical signal speed (packets) received



*TFOCA-II is a registered trademark of Amphenol Fiber Systems International

Multi-channel FOMs

The multi-channel FOM is available in E1 (ITU 9.703) and EuroCom D/1 Interface B. They accept multiple electrical inputs which are multiplexed and converted to a single optical signal for full duplex transmission over the fiber optic cable. The multi-channel FOMs are available with either singlemode (E1 only) or multimode transmitters. Multimode FOMs transmit up to 32 km with a repeater. Singlemode FOMs transmit up to 60 km using 2 km cable assemblies. The multichannel FOMs are packaged in a rugged transit case that can either be placed on the ground or rack mounted with available adapter plates. The all-weather design allows for exposure to harsh environments without affecting performance or reliability.

Drop/Add Repeaters**

The EuroFOM-B/RPT Drop/Add Repeater allows the user to separate or "Drop" one of the original signals from the optical link at any point in the link. The dropped signal is converted back to the original electronic format for transmission to user equipment. The user can replace or "Add" a new electronic signal providing the data rate does not exceed that of the dropped signal or the maximum data rate of the link. As the name implies, the unit also performs a repeater function, extending the link up to an additional 16 km.

** Applicable for the multimode EuroFOM-B/4 Model FOMs only

Characteristic	Singlemode	Multimode
Transmit / Receive Distance (with repeater)	N/A	Up to 32 km
Power Consumption	<15 Watts	<15 Watts
Typical Optical Output Power	0.0 dbm	-16 dbm
Received Optical Power	-48.0 dbm	-44.5 dbm



Physical Characteristics:

- Weight (kgs): Less than 10.0
- Dimensions (cm): 25.4 x 30.0 x 36.0

Environmental Specification (all models)

- Temperature
 - Operating: -35 °C to +52 °C
 - Storage: -57 °C to +71 °C
- Humidity: Up to 95% ± 5% at +28 °C (including condensation)
- Vibration: MIL-STD-810D, Method 514.3
- Shock: MIL-STD-810D (prepare for transit) Method 516.3
- Salt/Fog: MIL-STD-810D, Method 509.2
- Fungus: MIL-STD-810D, Method 508.3
- EMI: MIL-STD-461A

Description	EuroFOM-B/4	EuroFOM-E1/4	EuroFOM-E1/16	EuroFOM-Drop/Add
Part Number	107700	108100	108100-103	107701
Power Requirement	28 VDC 120 VAC 220 VAC	24-48 VDC 120 VAC 220 VAC	24-48 VDC	28 VDC 120 VAC 220 VAC
Electrical Signal	EuroCom D/1, Interface B	ITU G.703	ITU G.703	EuroCom D/1, Interface B
Optical Signal	EuroCom D/1 Interface Co	JTC3A 9109C	JTC3A 9109C	EuroCom D/1 Interface Co
Electrical Interface	MS3126E14-19P	MS3126E14-19P	MS3126E14-19P	MS3126E14-19P
Standard Accessories	Power and Data Cables, 19" Rack Mount Kit	Power and Data Cables, 19" Rack Mount Kit	Power and Data Cables, 19" Rack Mount Kit	Power and Data Cables, 19" Rack Mount Kit
Alarms	Summary (LOS and Transmit Fault)	Summary (LOS and Transmit Fault)	Summary (LOS, OOF, RAI, BER Transmit Fault)	Summary (LOS and Transmit Fault)
Environmental Specifications	Designed to meet	Designed to meet	Designed to meet	Designed to Meet
Electric Channels	Up to 4	Up to 4	Up to 16	Up to 2
Fiber	Multimode up to 16 km	Singlemode up to 60 km	Singlemode	Multimode up to 16 km

EuroFOM E1/16 (SM)

The EuroFOM E1/16 (SM) Fiber Optic Modem is a rugged, field exposed or rack mountable unit that provides an interface between sixteen asynchronous full-duplex E1 signals and singlemode fiber optic cable for full-duplex, long distance and repeaterless communication. The EuroFOM E1/16 (SM) provides the signal interfaces, modem functions, electro-optic conversion and a power supply, all within a portable unit. The EuroFOM E1/16 (SM) may be powered from 24 VDC or -48 VDC. Mating cables shall be supplied for the power interfaces.

General Specifications

- Up to 60 kilometer communication
- Laser Diode light source
- TFOCA I, *TFOCA-II™, or Expanded Beam tactical fiber connectors
- 3.75 Watts maximum power consumption
- Typical Optical Output Power:
 - 3dBm over a temperature range of -35°C to +60°C.
- Received Optical Power:
 - Minimum = - 45 dBm Maximum = - 10 dBm
- Discrete Status indicators:
 - Loss of signal (LOS)
 - Out of frame (OOF)
 - Bit error rate (BER)
 - Remote alarm indicator (RAI)
 - Summary alarm



Physical Characteristics:

- Weight (kgs): 11.5
(in transportation configuration)
- Dimensions (cm): 36.0 x 30.0 x 25.4
(excluding handle, latches, or other protrusions)

Power Requirement:	24 VDC or -48 VDC
Electrical Signal:	ITU G.703
Optical Signal:	ITU G.703 E3 data rate
Electrical Interface:	ITU G.703
Standard Accessories:	- Manual - Mounting hardware - 24 and 48 VDC power cables - Circuit breaker/on-off switch - Adapter cable assembly - Two 15 dB attenuators - One air bulb
Environmental Specs:	Designed to meet
Fiber:	Singlemode

Optical Distribution Frame ODF-1

The ODF-1 is a rugged, lightweight wall-mounted steel enclosure, providing a clean, controlled-access environment for splicing and patching of fiber optic trunk and distribution cables. Entry holes located at the bottom of the ODF-1 are fitted with dust proof grommets and locking metal door provide secure access for service and installation to the units interior. Four externally accessible TFOCA-II™ and twenty-four internally accessible FC connectors accommodate patching and distribution of fiber links. An aluminum splice tray shall be included with the ODF-1 to secure and protect up to 12 fusion or mechanical splices.

Standard Accessories:	- Manual (Tactical) - FC connectors - Spare key
Tactical Connectors:	- TFOCA, TFOCA-II™ and Expanded Beam
Fiber:	- Singlemode or Multimode



Physical Characteristics:

- Weight (kgs): 9.0
- Dimensions (cm): 30.5 x 30.5 x 15.25
(excluding handle, latches or other protrusions)
- Mounting protrusions from top and bottom are 7.62 centimeters
- Stainless steel

LTU (Line Terminating Unit)

LTU (Line Terminating Unit)

The **108600** is a rugged, lightweight transmission unit for EuroCom networks, that converts digital signals from EuroCom A/B to EuroCom C and visa versa. It is used when the distance between relevant equipment units is too long for EuroCom A/B transmissions, or when standard cable lengths are too short. It is also used when equipment units with different interface types are to be connected. The TDM bit-rate can be selected between 256, 512, 1024 or 2048 kilobits per second. When transmitting at the highest bit rate (2048 kilobits per second) and with the use of a dry field cable, the cable length can be up to 1000 meters. At lower bit rates, the cable length may be increased.

The **108700-01** is a rugged, lightweight transmission unit utilizing time division multiplexing to convert up to four duplex EuroCom D/1 "B" interfaces to a single switch-selectable choice of EuroCom D/1 interface C, or E1 per ITU G.703. It is rack mountable and suitable for either mobile or fixed installations. The LTU is also suited for applications where the distance between equipment units is too long for EuroCom D/1 interface B transmissions or when standard cable lengths are too short. Additionally it is used in applications where equipment units with different interface types are to be connected. The LTU is powered by 24 VDC and is supplied with a mating power cable. A 2-wire, 16 Kb/s engineered orderwire (EuroCom "F" EOW) capability is provided.

The **108700-02 LTU-V.35** is a rugged, lightweight transmission unit, that converts the clock, data, control and handshaking signals of a single ITU-T V.35 interface to EuroCom D/1 interface C. It is rack mountable and suitable for either mobile or fixed installations. The LTU-V.35 is suitable for applications where the distance between equipment units is too long for ITU-T V.35 transmissions or when standard cable lengths are too short. The LTU is powered by 24 VDC and supplied with mating power cable. A 2-wire, 16 Kb/s engineering orderwire (EuroCom "F" EOW) capability is also provided.



Physical Characteristics:

- Weight (kgs): Less than 1.2
- Dimensions (cm): 11.0 x 23.5 x 8.9
- Designed to fit four across in a 19" rack

Description	LTU	LTU 4 Channel	LTU-V.35
Part Number	108600	108700-01	108700-02
Power	24 VDC nominal	24 VDC nominal	24 VDC nominal
Input Interface	EuroCom D/1 "A/B"	Up to 4 EuroCom D/1 "B" interfaces	ITU-T V.35
Output Interface	EuroCom D/1 "C"	Single EuroCom D/1 "C" interface or one ITU G.703 E1 interface	EuroCom D/1 "C"
Power Consumption	5 watts max	< 15 watts	< 15 watts
Operating Temperature	-40° C to +55° C	-40° C to +55° C	-40° C to +55° C
Storage Temperature	-55° C to +70° C	-55° C to +70° C	-55° C to +70° C
EOW	EuroCom "F"	EuroCom "F"	EuroCom "F"
Weight	< 2.0 Kg	< 2.0 Kg	< 2.0 Kg

Line Terminating Unit Specifications

B-interface:	Balance inputs, AMI-code 256, 512, 1024 or 2048 kilobits per second. Input line is 50 meters maximum.
C-interface:	Maximum cable length is 1000 meters with new, dry cable. Maximum bit error rate is 1×10^{-6} connection to socket on front panel or binding posts on the rear of the unit.
Power Supply:	24 VDC nominal, 12 to 36 VDC maximum
Power Consumption:	5 watts Maximum
Operation Temperature:	-40°C to +55°C
Storage Temperature:	-55°C to +70°C
EOW:	Connection for Field Telephone (LB)



Multimode and Singlemode Tactical Fiber Optic Cable Assembly (TFOCA)

Overview

The Tactical Fiber Optic Cable Assembly (TFOCA) provides the physical connection between Fiber Optic Modems (FOMs), repeaters or other equipment capable of electronic to optical conversion. The TFOCA is a ruggedized, lightweight and tactically superior fiber optic cable that replaces existing CX-11230 coaxial cable.

Description

The TFOCA was specifically designed for quick and easy deployment in rugged, harsh environments. It was engineered to satisfy the stringent environmental and mechanical requirements for United States military tactical operations.

The cables consist of radiation-hardened multimode or singlemode optical fibers enclosed in an outer jacket of flame retardant polyurethane. An inner strength laid of aramid yarn ensures superior tensile loading and crush resistant properties.

Fiber Cable Specifications

- Optical Fiber Bandwidth @ 1300nm: ≥ 500 Mhz-km multimode, singlemode N/A
- Attenuation: ≤ 2.75 dB nominal (1km length w/2 connectors)
- Operating Temperature Range: -55 °C to $+85$ °C
- Tensile Load: (Newtons)
 - Deployment: 1780
 - Long Term: 500
- Corner Bend: 500 Newtons
- Knot: 500 Newtons

Available Lengths

Multimode

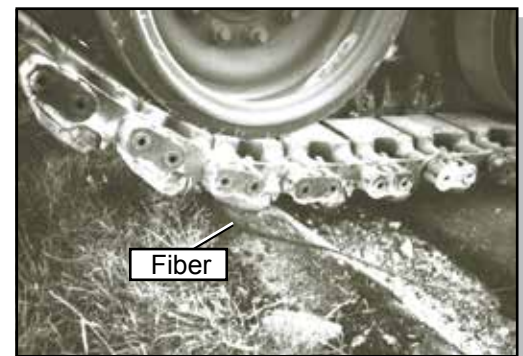
- 300 meters, 1 km, 2 km and custom lengths

Singlemode

- 2 km and custom lengths

Available Connectors

- TFOCA I and *TFOCA-II™
- Expanded Beam



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423-578-7200 • FAX 423-578-7201
email: salesmp@moog.com
www.moogprotokraft.com

4545 West Stone Drive, Bldg. 135
Kingsport, TN 37660-1048