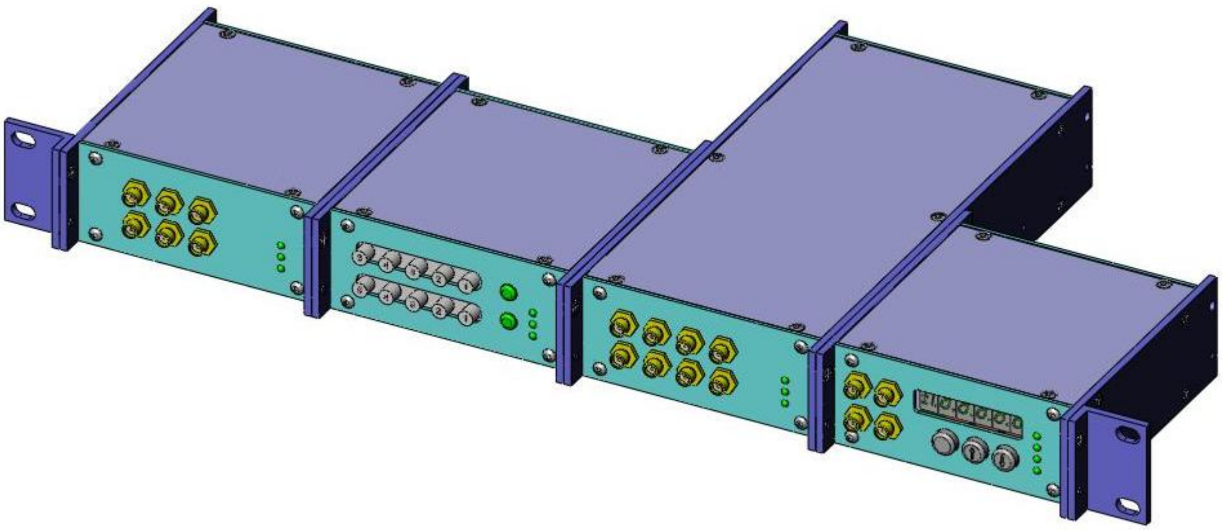
Third Millennium Engineering

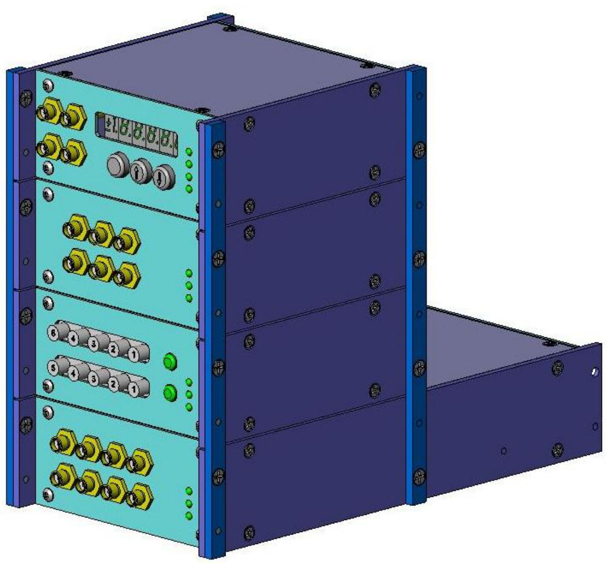
www.tmeplano.com

ModBlocks Catalog

Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories for the Lab, Prototyping, Test Systems, and Facility Installations



Example 1U ¼-rack 4 ModBlock set for 19” rack-mount, front view



Example 1U ¼-rack stacked 4 ModBlock set, front and rear views

New! PDV receivers (pages 49-68) and PDV transceivers (pages 91-96)

Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

Note1: This document is in Adobe pdf file format and contains hyperlinks for click convenience. Hyperlinks are provided for the Table of Contents, web addresses, any blue text, and any referenced figures or page numbers. The mouse cursor should change to a pointing finger when a hyperlink exists. *Right click "Next" or "Previous" arrows in Adobe Reader for more arrow options.*

Note 2: Readers are encouraged to suggest other ModBlocks they would like to see made available. Send an email to ModBlocks@tmeplano.com.

Note 3: See the Abbreviations in the reference section on page 188 as needed.

Table of Contents (hyperlinked)

The ModBlock System

Overview

"ModBlocks" is the name for a TME standard product line consisting of a modular system of fiber optic, microwave, high-speed logic, and utility functional blocks (module or ModBlock) and accessories. The product line is designed for bench-top use in R&D laboratories, implementing manual and automatic test equipment and test systems, prototyping new products, and for installations in facilities and vehicles. A special class of coherent receiver and transceiver ModBlocks is offered for the Photonic Doppler Velocimeter (PDV) "shock physics" community.

ModBlocks are based upon tried-and-proven, high-complexity, multi-functional, fiber optic, microwave, and high-speed logic equipment custom made by TME over the last decade. See full custom catalog at www.tmeplano.com for details. ModBlocks are low cost standard products because engineering and tooling costs have been spread over the product line due to design commonalities. Readers are encouraged to suggest other ModBlocks they would like to see made available by sending an email to ModBlocks@tmeplano.com. TME historically produces full custom products, so you can buy exactly the PDV system you need. Send an email to ModBlocks@tmeplano.com for initial inquiries and receive a free quote.

Most ModBlocks implement one active or passive optical or electrical signal processing function, while some ModBlocks combine two or more single functions into one unit. Each ModBlock is mechanically and electrically designed for stand-alone use or in combination with one or more ModBlocks of the same or different kind. ModBlocks are ¼, ½, or full 19" rack width and ½, 1, 2, or 3 U's high (1U = 1.75") and between 4.7" and 12.7" deep in 2" steps. ModBlocks can be firmly fastened together horizontally and/or vertically in any combination or size to form a variety of possible desktop or rack-mount configurations.

All active ModBlocks are powered by 12 volts DC (9-15V) via a pair of daisy-chained rear panel 2-pin connectors. DC power entering one ModBlock can be connected to another ModBlock in "daisy-chain" fashion. DC power is sourced by either by a commercial AC-to-12VDC power supply (desktop or wall-mount style) or a TME power supply ModBlock. More details on cables, power supplies, and arrangements are given in the ModBlock Accessories section starting on page 177

All active ModBlocks contain an embedded controller which manages front panel manual controls and displays, remote control and display, and internal functional circuitry. Remote operation is implemented via a standard 10Base-T Ethernet LAN port on the rear panel. Standard Cat5 cables, switches, and routers are used as needed with multiple ModBlocks for computer control. One Ethernet link is required per ModBlock under (optional) remote control. Front panel bi-color LED indicators are provided to monitor output voltage tolerance of all internal power supplies, LAN connectivity, and ModBlock control mode. All ModBlocks can be used manually without using remote communication.

Depending on the function, ModBlock prices range from ~$1K to ~$47K (typically $5K-15K). Some ModBlocks are stocked and many have a 2-4 week delivery time. Otherwise, delivery time is the longest lead-time major component “pacing item” in price lists) plus 1 week, typically 6 weeks. Unless otherwise specified, all ModBlocks are warranted for one year. Warranty excludes excessive electrical or optical input power as applicable, electrostatic discharge (ESD) damage, optical connector damage (dirt, wrong connector type), and general abuse. See warranty details in the “Standard Warranty” section on page 196.

Other ModBlocks will be added over time and upon user request. Send email requests to ModBlocks@tmeplano.com. The development priority of “Coming soon!” ModBlocks can be influenced by sending an email request to ModBlocks@tmeplano.com to make it sooner!

Fiber Optic ModBlocks

Fiber optic ModBlocks are available for single mode and multimode wavelengths in the 850 nm (SFP), 1310 nm, and 1550 nm bands. Digital data rates for 2.5 and 10 Gb/s regions and analog bandwidths up to 10 GHz class are provided. Passive fiber optic ModBlocks includes splitters, couplers, WDMs, circulators, isolators, and filters. Active fiber optic ModBlocks include:

- Amplifiers (EDFA, SOA)
- Switches (SPDT, transfer, SP4T, SP8T)
- Lasers (fixed WDM, CWDM and DWDM, tunable C or L band DWDM)
- Modulators (LN, EA, NRZ, RZ)
- Transmitters (analog, digital)
- Receivers (analog, PDV analog, limiting, digital)
- Transceivers (SFP, analog, digital, PDV)
- Phase Shifters and Attenuators (analog, digital control)
- Filters (tunable, C or L band, DWDM)
- Photonic Doppler Velocimeter (PDV) lasers and receivers
- Miscellaneous (Super-Luminescent LED)

Microwave ModBlocks

Microwave ModBlocks are available with 50 impedances from DC to 26.5 GHz (75 ohms on request). Passive microwave ModBlocks include splitters, couplers, circulators, and fixed filters. Active microwave ModBlocks include:

- Amplifiers (linear, limiting, modulator driver)
- Switches (SPDT, transfer, 2P3T, SP4T, SP6T)
- Phase Shifters and Attenuators (analog, digital control)
- Oscillators (fixed, VCO, sine, square)
- Miscellaneous (doublers, mixers, power detectors, phase-frequency comparators, counters)

High-Speed Logic ModBlocks

High-speed logic ModBlocks are available for speeds up to 13 GHz (25 GHz on request). Clock-Data Recovery (CDR) ModBlocks are available in three data rate ranges from 10 Mb/s to 13 Gb/s. All inputs and outputs are differential (can be used single-ended) and AC-coupled (0.1 uF or ~35KHz, DC coupling on special request). Active high-speed logic ModBlocks include:

- Gates (AND/NAND/OR/NOR, XOR/XNOR)
- Fan-outs (1 to 2, 1 to 4)
- Selectors (2 to 1, 4 to 1)
- Pre-scalars (div2, div4, div8, div1-2-4-8)
- Flip-Flops (D, T)
- Time Delays (0-120 ps)
- Encoders (differential a.k.a. DPSK, NRZ-to-RZ)
- Encoders with Clock Time Delay (differential a.k.a. DPSK, NRZ-to-RZ)
- Phase Locked Loops a.k.a. Clock-Data Recovery (9-13 Gb/s, 2.5-10 Gb/s, 10M-2.7Gb/s)

Utility ModBlocks

Utility ModBlocks are available for programmable DC power, digital I/O, and analog I/O. Active utility ModBlocks include:

- Programmable Power Supplies (1W to 20W, low to high voltage or current)
- Digital I/O (3.3V, 5V, buffered)
- Analog Output (DAC)
- Analog Input (ADC)

ModBlock Accessories

ModBlock accessories are available for 12VDC power supplies, cable assemblies, adapters, SFP modules, hardware, tools, supplies, and software. ModBlocks accessories include:

- Cable Assemblies (2-pin DC power, fiber optic, coax, LAN, AC power, utility)
- Adapters (2-pin DC power, fiber optic, coax, LAN, AC power, utility)
- AC-to-12VDC Power Supplies (24W to 120W, desktop, wall-mount)
- Networking (switch, router)

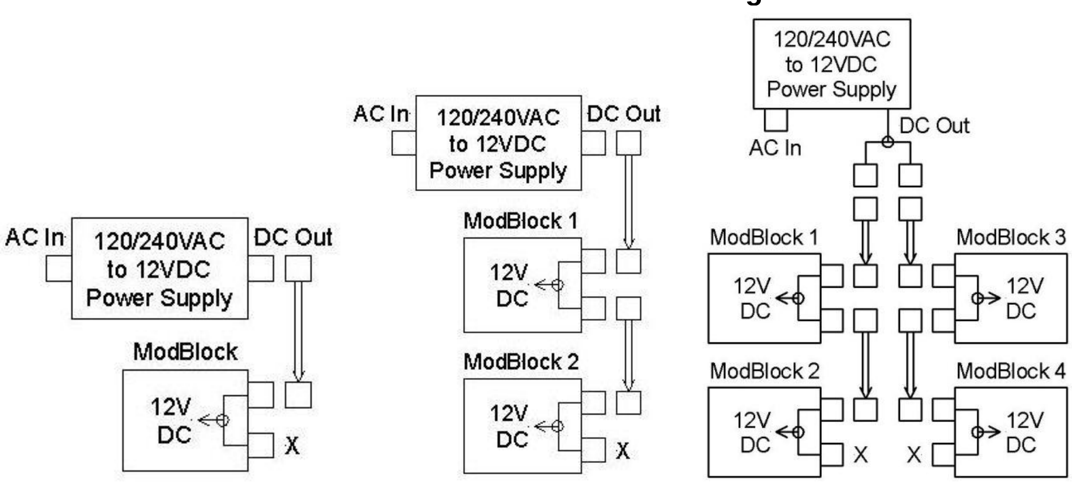
- SFP Modules
- 12VDC Current Sensor
- Hardware (horizontal fastener kits, vertical fastener kits, rack-mount kits)
- Tools and Supplies (fiber optic, microwave)
- Software (GUI)

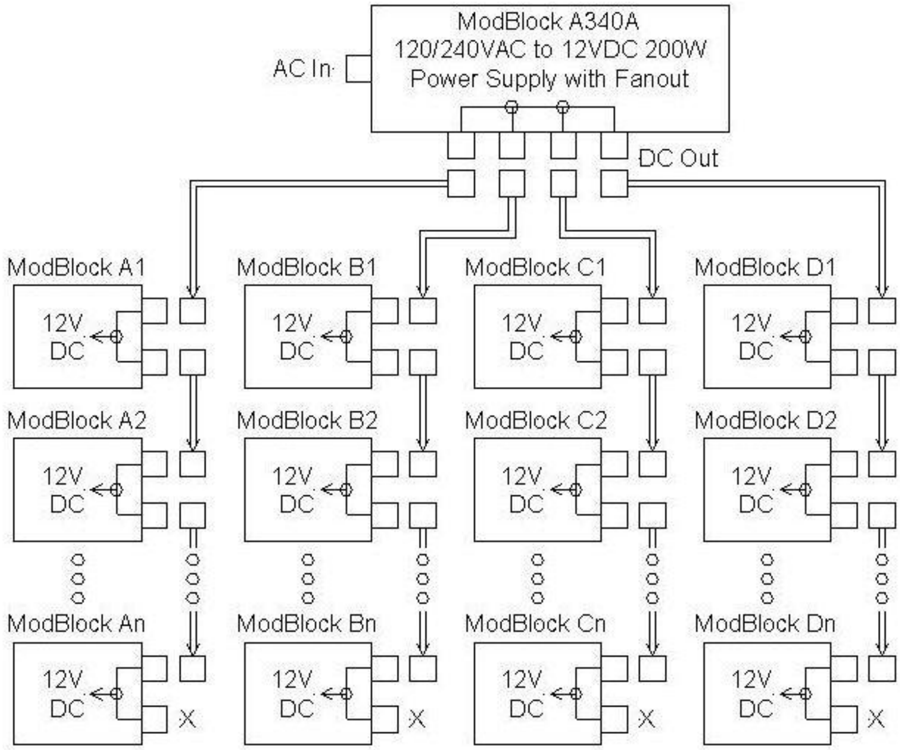
DC Power Port

All active ModBlocks are powered by 12 volts DC (9-15V) via a pair of rear panel 2-pin connectors. Either 2-pin connector can be used as the 12 VDC power input to a ModBlock. The other 2-pin connector can be used to connect 12 VDC power to another ModBlock in "daisy-chain" fashion using an A100 daisy-chain power jumper cable.

The main limitations to daisy-chain length are the 5 amp rating of the 2-pin connectors and the available 12 VDC power supply current needed to power a particular string of ModBlocks. If more total current is needed, then a larger 12 VDC power supply can be used. Alternatively, one or more additional 12 VDC power supplies can be added to the system to power separate daisy-chains. In this latter case, it is very important to keep each power supply and their daisy-chains electrically separate from other power supplies and their daisy-chains. In large ModBlock systems, the recommended powering method is to use a single large power supply with a DC power fan-out (such as A340A) and limit the daisy-chains to 5 amps each. A 12VDC current sensor (10 milliohm resistor and connectors) is provided as a ModBlock accessory.

Various ModBlock Power Arrangements





LAN Port

All active ModBlocks have an Ethernet 10Base-T LAN connector (RJ45-8) on the rear panel. The LAN connector provides a TCP/IP communication link to an external computer, switch, or router for optional remote control and monitoring of ModBlock functions.

Basic LED Indicators

All active ModBlocks have at least three basic front panel bi-color LED indicators. The LEDs are used to monitor the output voltage tolerance of all internal power supplies, LAN connectivity, and ModBlock control mode.

The power monitor LED (labeled "Power") indicates the combined status of all internal power supply output voltages. A green LED color indicates all internal power supplies are within ±10% of their nominal output voltage. A blinking yellow LED color indicates one or more internal power supplies are above or below 10% of its nominal output voltage. No LED color (i.e., off) indicates the 12 VDC inlet supply is off (i.e., less than ~3 volts), which also means that all other internal power supply output voltages are off. Note that a ±3V tolerance is used for the 12 VDC power input instead of ±10%.

The LAN connectivity LED (labeled “Link/Act”) indicates the status of the TCP/IP link to an external computer, switch, or router. A green LED color indicates a link has been made and a blinking yellow color indicates communication activity is occurring. No LED color (i.e., off) indicates there is no remote connection or the connection is not valid.

The control mode LED (labeled “Rem/LLO”) indicates the ModBlock control mode. A green LED color indicates the ModBlock is in remote control mode, but manual control will still operate the ModBlock and over-ride remote control. A yellow LED color indicates the ModBlock is in remote control mode and all manual controls will not operate (i.e., “local lock-out” or LLO). No LED color (i.e., off) indicates the ModBlock is in manual control mode only (i.e., remote control not operative).

Part Numbering

ModBlock part numbers begin with a letter followed by three digits and a letter, according to the following table:

Part Number Prefix	ModBlock Type
A*	Accessories
F*	Fiber Optic
L*	Logic
M*	Microwave
U*	Utility

Packaging

All ModBlock enclosures are designed for indoors desktop use and/or 19” rack-mount use via detachable rack-mount ears. All enclosures are made from aluminum with screw-on covers for a sealed and thermally conductive design. Enclosure surfaces are black anodized (anti-static) with white graphics.

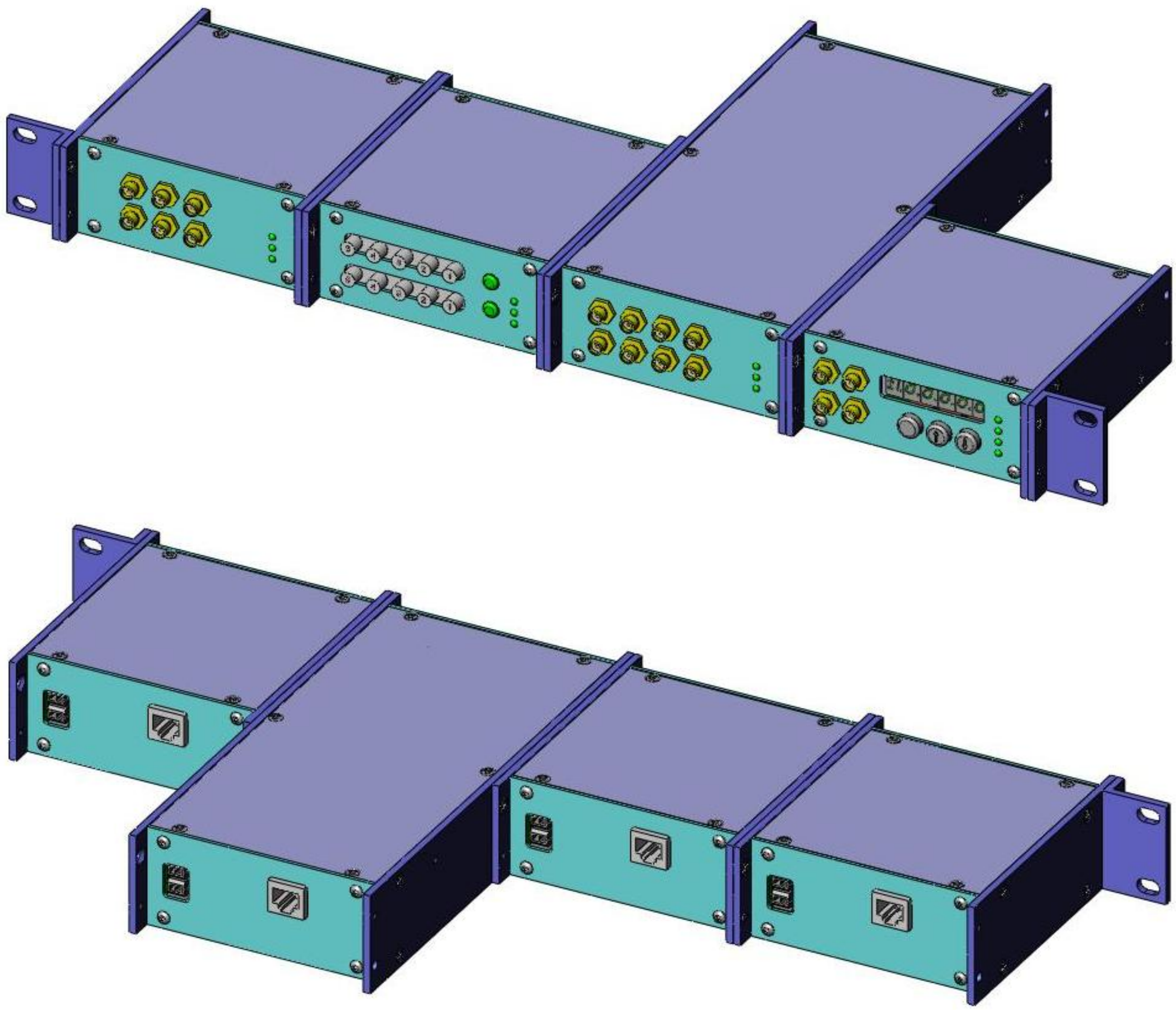
Depending upon the ModBlock function, enclosures are either ¼ or ½ width in rack-mount terms (4.18” or 8.37” respectively) and are either ½U, 1U, or 2U high in rack-mount terms (0.875”, 1.75”, or 3.5” respectively). Enclosure depths range from 4.7” to 10.7” in 2” steps.

ModBlocks of any size can be securely fastened together using ¼” #6-32 flat head screws in both vertical and horizontal directions to form a variety of desktop and rack-mount configurations. ¼ or ½ width ModBlocks can be horizontally fastened to become full rack width (or wider). ¼, ½, or full width ModBlocks can be vertically fastened into desktop or rack-mount stacks of various heights. ½ U high ModBlocks use left and right plates to adapt them to 1U or more.

Other finishes and colors are available on request. Examples are laser engraved graphics (white) on black anodized aluminum, natural aluminum (silver) with black (or other color) silk-screened graphics, or painted aluminum with black or color graphics. Customer logos or special graphics can also be applied.

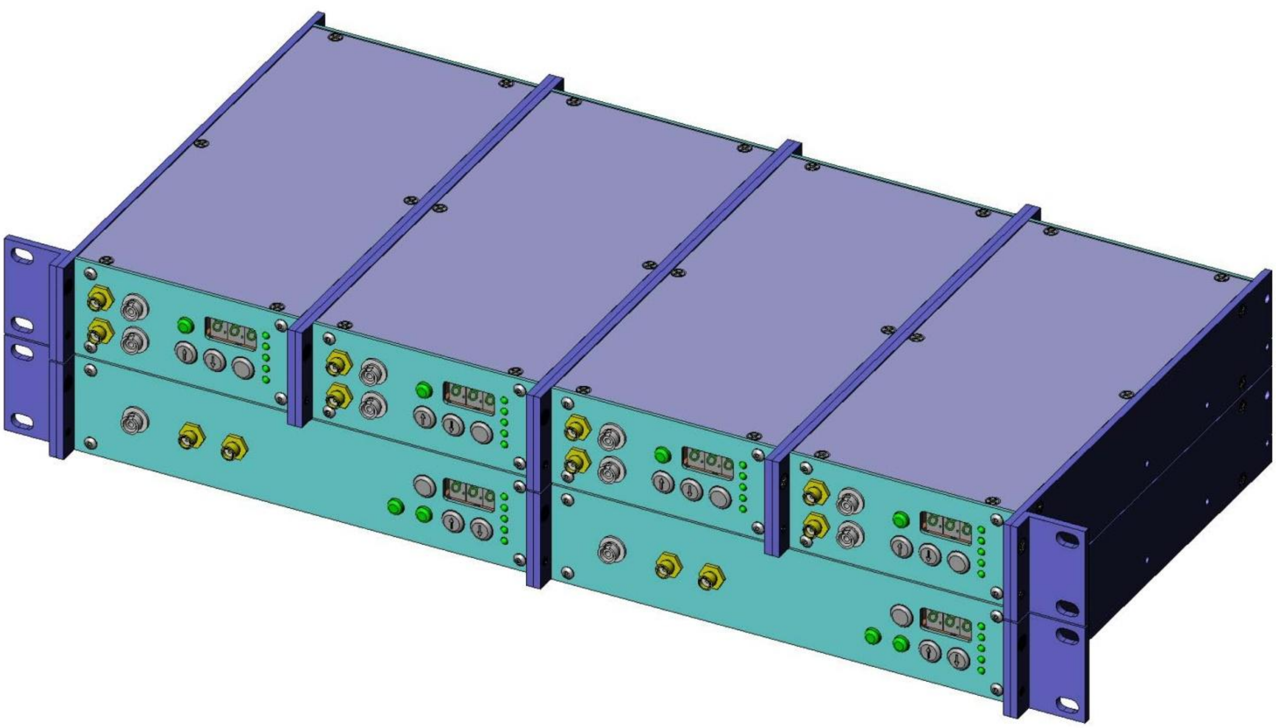
Multiple ModBlock Mounting Arrangements

A wide variety of arrangements are possible for fastening multiple ModBlocks together. Detachable 1U, 2U, 3U, and 4U rack-mount ear kits (A421A through A424A, page 184) are provided for horizontal mounting into a 19" rack. 2U, 3U, and 4U vertical fastener kits (A412A through A414A, page 183) are provided for vertical desktop stacking.

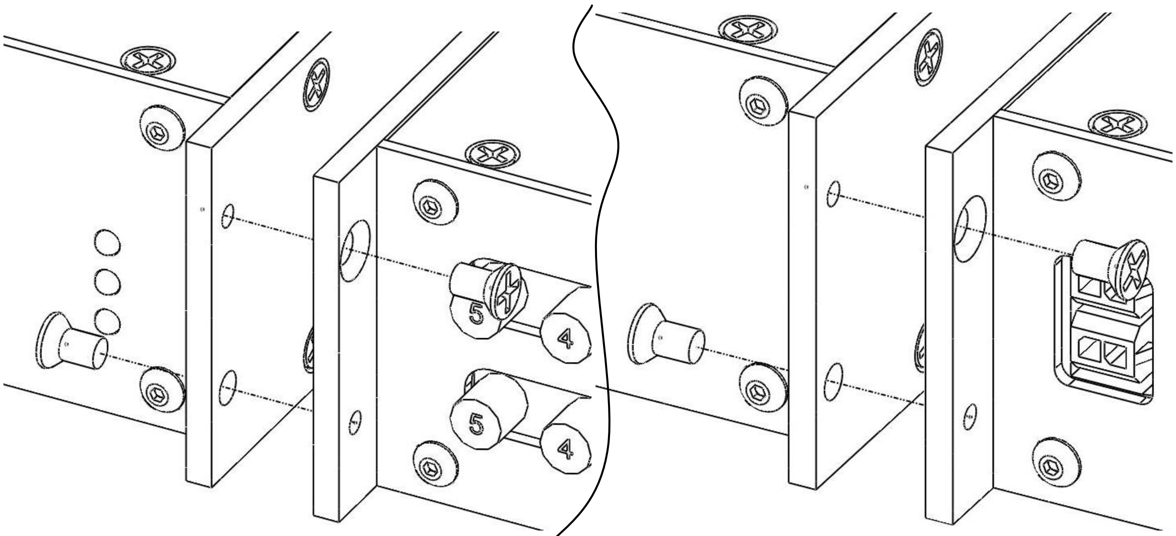


Example 1U ¼-rack 4 ModBlock set for 19" rack-mount, front and rear views

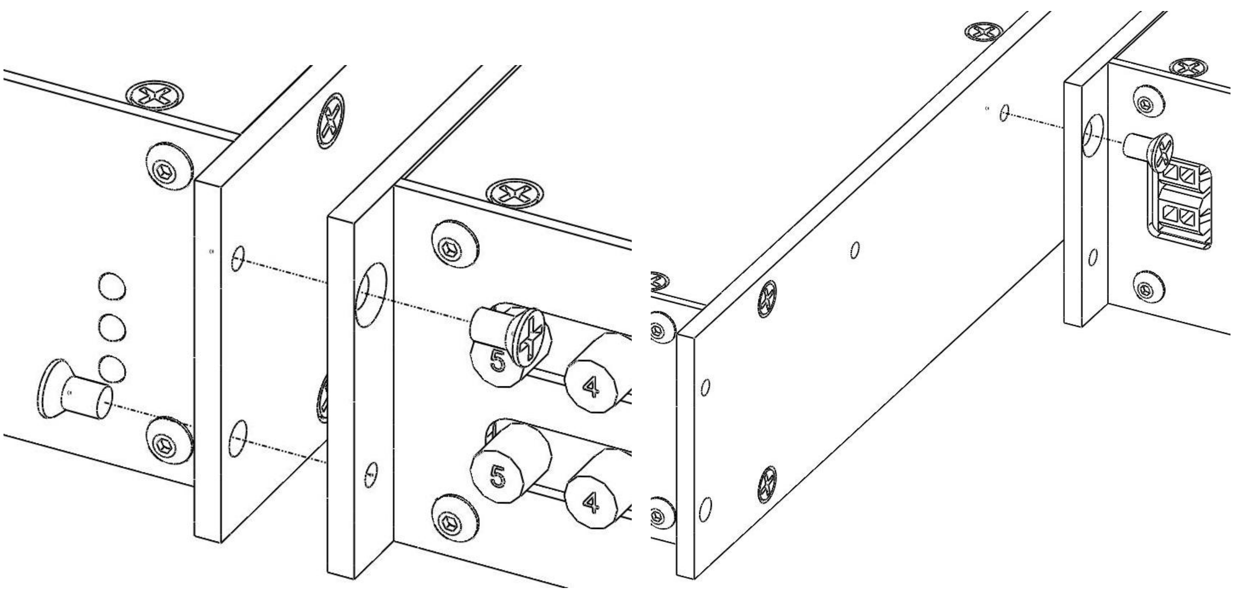
Example 1U ¼-rack stacked 4 ModBlock set, front and rear views



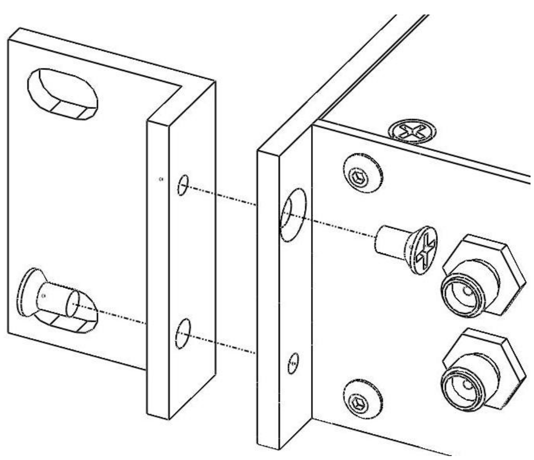
Example 1U dual PDV transceiver set and 1U quad PDV receiver set, for 19” rack-mount



Example ModBlock-to-ModBlock fastening for equal lengths, front and optional rear views



Example ModBlock-to-ModBlock fastening for unequal lengths, front and optional rear views



Example rack-mount ear fastening

Common ModBlock Specifications

Unless otherwise specified, the following specifications apply to all ModBlock models.

Common ModBlock Specifications

Parameter	Description
Chassis	• Anodized aluminum enclosure materials, ESD compliant antistatic surfaces • Black aluminum color with white graphics on front and rear panels
Environment	• For indoor use in office, lab, factory, or vehicle environments. Not for outdoor use. • Operating temperature range: 5°C to 45°C minimum • Storage temperature range: -20°C to +70°C minimum • Relative humidity range: 10% to 90% minimum, non-condensing, minimum • Shock and vibration range: 2G's minimum
Cooling	Conduction and convection (no fans)
Connectors	• Front panel: all optical and microwave I/O connectors • Rear panel: DC power inlet and RJ45-8 LAN Port (active ModBlocks only)
Power (active ModBlocks)	• Power port via two rear panel 2-pin "Utility" connectors, daisy-chained • 12 volts DC ±3 volts DC (9 to 15 VDC) • Front panel bi-color "Power" status LED, monitors all internal supplies • No power switch (unplug rear panel Utility connector if needed)
Computer Control (active ModBlocks)	• 10 Base-T LAN port, internal controller with non-volatile memory, C-program • Manages all manual controls and displays for local operation • Provides remote computer operation of all manual control and display functions • Front panel bi-color "Link/Act" status LED, monitors LAN link and activity • Front panel bi-color "Rem/LLO" status LED, monitors remote and local lockout status
Safety Ratings	Not required for passive ModBlocks or 12 VDC powered ModBlocks. AC to DC power supply ModBlocks not safety agency or FCC approved. For industrial use only by customer and their sub-contractors. Customer assumes liability for use. However, safety agency approved components (UL, CSA, VDE, etc.) and safe engineering practices used for grounding, fusing, labeling, flammability, insulation, wiring, etc., particularly for any primary AC power circuitry. Six-sided aluminum enclosure, and good engineering practices used for conductive and radiative EMI/RFI performance.
Documentation	Simple operating manual includes operating instructions, detailed descriptions, block diagrams, performance specifications, pictorial views, and software command set. Requires user to have basic knowledge of high-speed fiber optics, electronics, and related test equipment (brief explanations without lengthy tutorials).
Shipping	Can be shipped via commercial carriers with normal cushioned packing methods. Cover all microwave and optical ports with anti-static connector caps and then enclose unit in an anti-static bag or container prior to packing for shipment. ModBlocks contain no hazardous materials, liquids, etc.

Fiber Optic ModBlocks

A variety of Fiber Optic ModBlocks are offered using a variety of active and passive single mode and multi-mode devices. Such devices include lasers, receivers, modulators, transceivers, analog and digital transmitters and receivers, switches, amplifiers, phase shifters, attenuators, filters, passive devices, and other items. Chassis rear views are shown in the "Common Packaging Data" section on page 186. Price and delivery are shown in the "Domestic USA Pricing" section starting on page 199.

WARNING: Proper fiber optic connector cleaning practices **must** be used with all fiber optic ModBlocks to avoid connector damage from invisible "dirt" (connector damage is not warranted). See the Cleaning Supplies section on page 185 of the "ModBlock Accessories" section for recommended fiber optic cleaning supplies (swabs and "wipe box").

Common Specifications

Unless otherwise specified, the following key specifications apply to all Fiber Optic ModBlock models.

Key Specifications

Parameter	Value	Units	Qualifier
Channels	1	-	-
Connectors, high-speed electrical	SMA female	-	-
Impedance, high-speed electrical	50	ohms	nominal
I/O Coupling, high-speed electrical	AC, 0.1 uF	-	high performance capacitor
Low Frequency Cutoff, high-speed electrical	35	KHz	-3 dB point, typical
Connectors, fiber optic	FC/UPC Metal ferrule	-	-
Connectors, fiber optic	FC/APC ceramic ferrule	-	PDV receivers F170-F178 PDV transceivers F235-F238

Models with high-speed electrical differential inputs and/or outputs can be used single-ended or differentially. When used single-ended, unused inputs or outputs should be terminated with a 50-ohm load (see Signal Adapters starting on page 180). All high-speed electrical inputs and outputs are AC-coupled with a high performance 0.1 uF capacitor (~35 KHz low frequency cutoff), which can be ordered DC-coupled if required.

CW Lasers

Solid-state continuous wave (CW) laser ModBlocks are provided for the 1550 nm band with output power up to 10 mW (+10 dBm). All models have single mode polarization maintaining (PM) fiber outputs. Various fixed wavelength and tunable wavelength DWDM ModBlocks are provided for the C and L bands. The fixed wavelength models shown are selected from the large number of possible laser component types produced. Users are encouraged to inquire about and request models not shown by sending an email to ModBlocks@tmeplano.com.

Single mode laser ModBlocks can be used for the coherent laser source in many Photonic Doppler Velocimeter (PDV) applications not requiring watt-level power. Models are provided with output power up to 15 mW and typical coherence lengths up to ~40 meters. On request, other laser types can be used (~500 meters @ 6 mW, ~4000 meters @ 20 mW, ~200 meters @ 50 mW, etc.). These lasers can be used with the several PDV receiver ModBlocks offered (F170-F173) to implement a complete PDV front end system, along with the appropriate fiber optic probe and real-time oscilloscope.

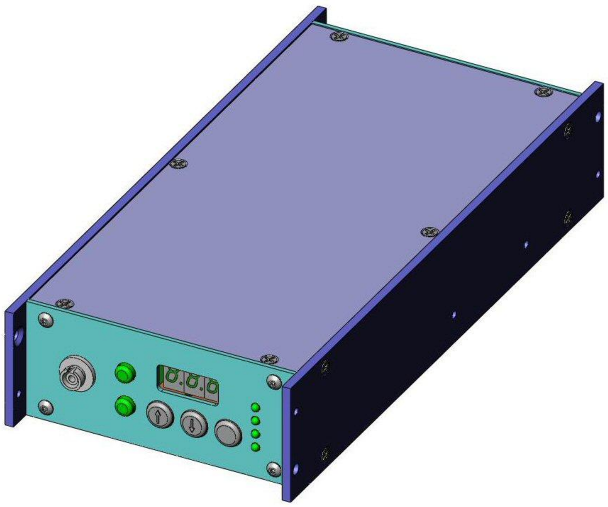
F100A-*, CW Laser, Fixed Wavelength, DWDM, SBS, Single-mode PM

DWDM fixed wavelength CW laser ModBlocks are provided for the 1550 nm region in the C and L bands. Laser wavelengths range from 1528.77 nm to 1564.68 nm on 100 GHz (0.8 nm) channel spacing (43 wavelengths). These lasers are DFB types, optically isolated, thermally stabilized, and have polarization maintaining single-mode fiber outputs (slow axis aligned to connector key). Laser wavelengths can be (thermally) adjusted ±100 GHz minimum, allowing wavelengths to be finely tuned or tuned to adjacent 50 GHz channels. Output power is fixed and a laser enable switch is provided. SBS suppression is provided (can be used for a “channel ID”), which is required for long haul spans with optical amplifiers. SBS amplitude and frequency (channel ID) are adjustable and an enable switch is provided. An internal user-replaceable “crash” cable is provided (laser output) for repair convenience in case of optical connector damage. These models are normally used as the optical source for a lithium niobate modulator to form a digital transmitter.

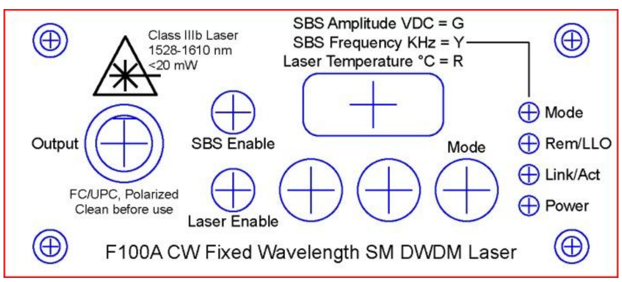
Front panel pushbuttons and a numeric readout provide manual control of the laser temperature (for fine tuning of the wavelength), SBS amplitude, and SBS frequency (which can also be operated remotely). The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Red indicates Laser Temperature control mode, yellow indicates SBS Frequency control mode, green indicates SBS

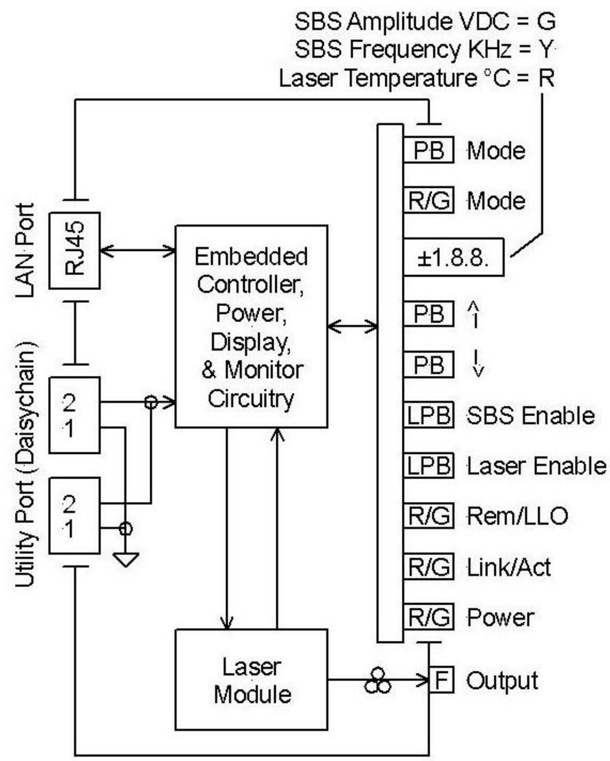
Amplitude control mode, and dark indicates off mode. Pushbuttons with up and down arrows allow parameter adjustment for the mode indicated by the bi-color LED.

F100A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





C-band 100 GHz DWDM laser wavelength choices (see following note)

Part Number	Wavelength (nm)	Part Number	Wavelength (nm)	Part Number	Wavelength (nm)
F100A-C61	1528.77	F100A-C45	1541.35	F100A-C29	1554.13
F100A-C60	1529.55	F100A-C44	1542.14	**F100A-C28**	**1554.94**
F100A-C59	1530.33	F100A-C43	1542.94	F100A-C27	1555.75
F100A-C58	1531.12	F100A-C42	1543.73	F100A-C26	1556.55
F100A-C57	1531.90	F100A-C41	1544.53	F100A-C25	1557.36
F100A-C56	1532.68	F100A-C40	1545.32	F100A-C24	1558.17
F100A-C55	1533.47	F100A-C39	1546.12	F100A-C23	1558.98
F100A-C54	1534.25	F100A-C38	1546.92	F100A-C22	1559.79
F100A-C53	1535.04	F100A-C37	1547.72	F100A-C21	1560.61
F100A-C52	1535.82	F100A-C36	1548.51	F100A-C20	1561.42
F100A-C51	1536.61	F100A-C35	1549.32	F100A-C19	1562.23
F100A-C50	1537.40	**F100A-C34**	**1550.12**	F100A-C18	1563.05
F100A-C49	1538.19	F100A-C33	1550.92	F100A-C17	1563.86
F100A-C48	1538.98	F100A-C32	1551.72	F100A-C16	1564.68
F100A-C47	1539.77	F100A-C31	1552.52		
F100A-C46	1540.56	F100A-C30	1553.33		

Note: There are many possible DWDM wavelengths, so only selected popular C-band 100 GHz channels are shown (bold ones preferred). However, any DWDM wavelength can be supplied on special order. See the "ITU Fiber Optic Frequencies, Wavelengths, and Channels for C and L bands" section on page 189 of the "Reference Data" section for the proper channel number to use to complete the part number "dash ending" as above. For example, the part number for a 50 GHz channel in the L-band at 1609.62 nm (channel Q62) is F101A-Q62.

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F100A-*	-	* = wavelength code
Fiber Type	Single mode Polarization maintaining	-	Slow axis aligned to connector key
Laser Type	DFB, InGaAsP	-	-
Power Output	10 and off	mW	fixed, typical
Spectral Width @ -3 dB point	2 5	MHz	typical maximum
Coherence Length	100 40	meters	typical minimum
Side Mode Suppression Ratio	40	dB	minimum
Wavelength tuning range (thermal)	±100	GHz	minimum
Wavelength Drift vs. Temperature	0.2 0.5	pm/°C	typical maximum
Relative Intensity Noise	-140	dB/Hz	maximum
Optical Isolation	30	dB	minimum
SBS Frequency Range	20 to 65	KHz	typical
SBS Frequency Step Size	500	Hz	typical
SBS Amplitude Range	0 to 5 and off	VDC	typical
SBS Amplitude Step Size	10	mV DC	typical
Dimensions	1.72H x 4.19W x 8.70D	Inches	nominal

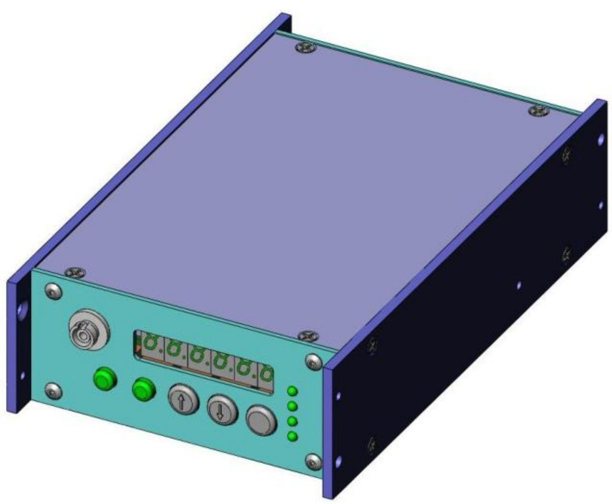
F110A, CW Laser, Tunable, C-Band 50 GHz DWDM, Single-mode PM

F111A, CW Laser, Tunable, L-Band 50 GHz DWDM, Single-mode PM

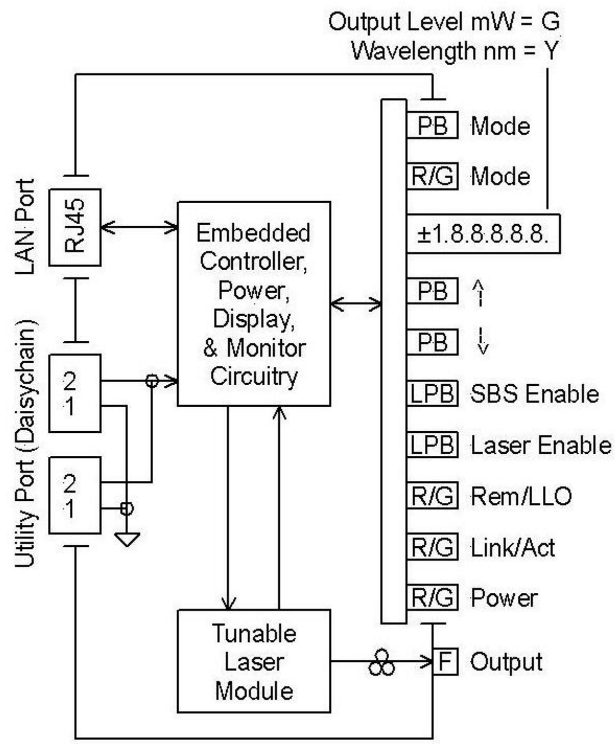
DWDM tunable wavelength CW laser ModBlocks are provided for the 1550 nm region in the C and L bands. Adjustable laser wavelengths range from 1528.77 nm to 1563.86 nm (F110A) and 1568.77 nm to 1607.47 nm (F110A) on 50 GHz (0.4 nm) channel spacing. These lasers are DSDBR types, optically isolated, thermally stabilized, and have polarization maintaining single-mode fiber outputs (slow axis aligned to connector key). The output power level is adjustable up to 10 mW and a laser enable switch is provided. SBS suppression is required for long haul fiber spans using optical amplifiers and is provided by using laser FM dithering and an SBS enable switch. An internal user-replaceable "crash" cable is provided (laser output) for repair convenience in case of optical connector damage. These models are normally used as the optical source for a lithium niobate modulator to form a digital transmitter.

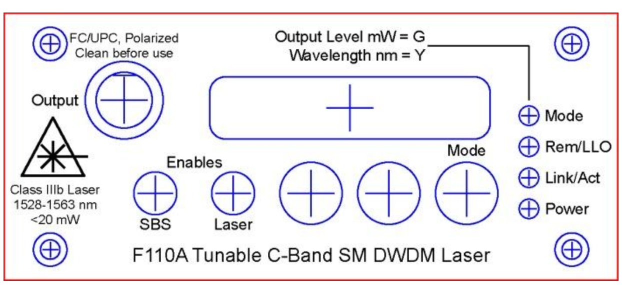
Front panel pushbuttons and a numeric readout provide manual control of the laser wavelength and power output level. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates Wavelength control mode, green indicates Output Level control mode, and dark indicates off mode. Pushbuttons with up and down arrows allow parameter adjustment for the mode indicated by the bi-color LED.

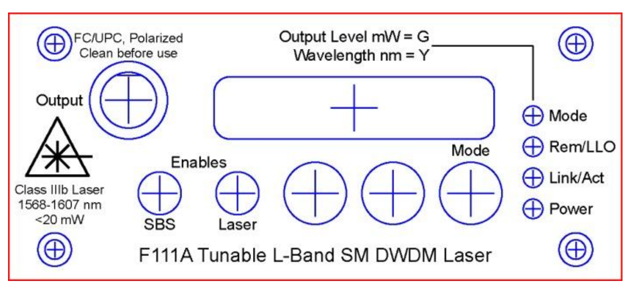
F110A and F111A front chassis view, graphics layouts, and simple block diagram



1U, quarter-rack, 6.7” deep







Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F110A F111A	-	C-Band L-Band
Fiber Type	Single mode Polarization maintaining	-	Slow axis aligned to connector key
Laser Type	DSDBR	-	-

Parameter	Value	Units	Qualifier
Power Output	1 to 10	mW	Adjustment range
Power Output, laser disabled	-30	dBm	maximum
Power Output Step Size	0.1	mW	typical
Tuning speed, adjacent channels	10	ms	maximum
Wavelength Range	1528.77 to 1563.86 1568.77 to 1607.47	nm	C-band, F110A L-band, F111A
Wavelength Accuracy	±2.5	GHz	maximum
Polarization Extinction Ratio	20	dB	minimum
Spectral Width @ -3 dB point SBS = off	1 5	MHz	typical maximum
Coherence Length SBS = off	200 40	meters	typical minimum
Spectral Width @ -3 dB point SBS = on	250 1000	MHz	minimum maximum
Coherence Length SBS = on	0.9 0.2	meters	typical minimum
Side Mode Suppression Ratio	40	dB	minimum
Optical SNR	50	dB	minimum
Optical Return Loss	40	dB	minimum
Back Reflection Tolerance	-8.2	dB	minimum
Relative Intensity Noise	-145	dB/Hz	maximum
SBS Dither Frequency, SBS = on	25	KHz	typical
SBS Modulation Depth, SBS = on	4	%	typical
Dimensions	1.72H x 4.19W x 6.70D	Inches	nominal

Modulators

Lithium niobate (LN) intensity modulators are currently offered, with and without modulator drivers. A LN intensity modulator is normally used with a fixed or tunable CW laser (such as the F100A, F110A, or E11A) to form an NRZ fiber optic transmitter. A modulator driver (such as the M211A, which is built in to the F121A) is required to attain the RF input drive level (~5-6 Vpp) needed to attain a good extinction ratio (ER>10). An RZ fiber optic transmitter can be implemented by connecting an L162A or L163A NRZ-to-RZ Encoder ModBlock before the modulator driver. An RZ fiber optic transmitter can also be implemented by cascading two intensity modulators (with modulator drivers). In this case, an NRZ signal drives one modulator driver and a sine wave drives the other modulator driver. Sine wave timing adjustment relative to the NRZ signal is required so that the sine wave is time-positioned in the middle of the NRZ bit period.

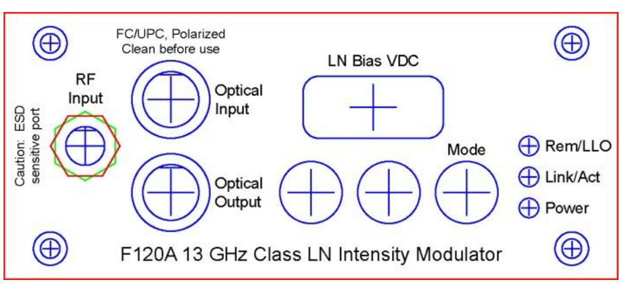
Lithium niobate phase modulators (normally used for optical chirping) and electro-absorptive (EA) intensity modulators will be offered in the near future. Send an email request to ModBlocks@tmeplano.com to make it sooner!

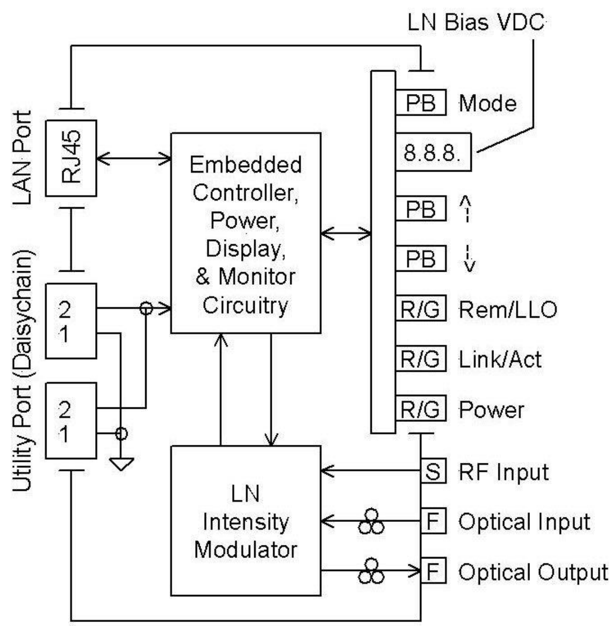
F120A, Lithium Niobate Intensity Modulator, 13 GHz Class

This Lithium Niobate (LN) modulator ModBlock contains a wide bandwidth fiber optic intensity modulator with DC-coupled RF input. Internal user-replaceable "crash" cables are provided (optical input and output) for repair convenience in case of optical connector damage. Front panel pushbuttons and a numeric readout provide manual control of the modulator DC bias voltage, which can also be operated remotely. The mode pushbutton turns the display on or off. Pushbuttons with up and down arrows allow adjustment of the bias voltage when the display is on. Inherent to LN, the optical output will be inverted from the RF input signal when a positive LN bias voltage (up to V-pi) is used and will be non-inverted with a negative LN bias voltage (up to V-pi).

F120A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 10.7" deep





Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F120A	-	-
Fiber Type, Input and Output	Single mode Polarized	-	Slow axis aligned to connector key
Modulator Type	Lithium Niobate, X-cut	-	-
Bandwidth, electrical to optical	12.5 20	GHz	minimum typical

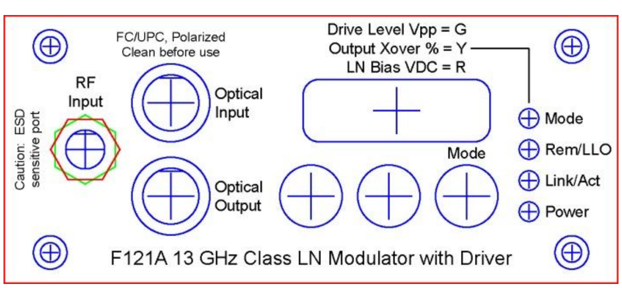
Parameter	Value	Units	Qualifier
Optical Bandwidth	1528-1610	nm	C + L bands
Optical Insertion Loss, V-pi = maximum transparency	4 3	dB	maximum typical
Extinction Ratio	30	dB	typical
RF V-pi @ 1 GHz	5	V	maximum
Bias V-pi	6	V	maximum
Optical Return Loss	40	dB	minimum
Alpha Chirp Factor	0	-	±0.1
RF Return Loss, 0.1-12 GHz	10	dB	minimum
Bias Voltage Adjustment Range	-10 to +10	VDC	typical
Bias Voltage Step Size	10	mV DC	typical
Dimensions	1.72H x 4.19W x 10.70D	Inches	nominal

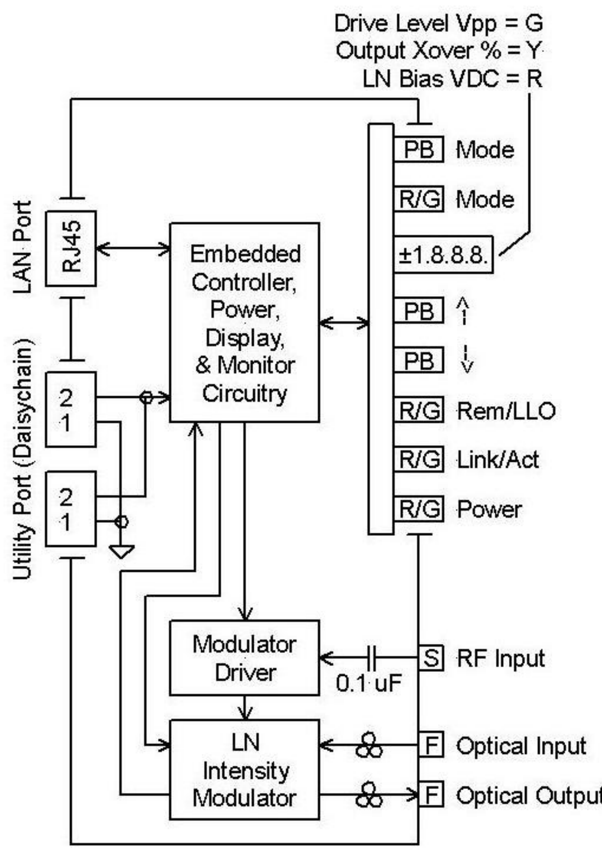
F121A, Lithium Niobate Intensity Modulator, with Modulator Driver, 13 GHz Class

This Lithium Niobate (LN) modulator ModBlock contains a wide bandwidth fiber optic intensity modulator along with a non-inverting modulator driver. The RF input is AC-coupled. Internal user-replaceable “crash” cables are provided (optical input and output) for repair convenience in case of optical connector damage.

F121A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 10.7” deep





Front panel pushbuttons and a numeric readout provide manual control of the modulator DC bias voltage, modulator RF voltage drive level, and optical output crossover point (which can also be operated remotely). The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Red indicates DC Bias control mode, yellow indicates Output Crossover control mode, green indicates Drive Level control mode, and dark indicates off mode. Pushbuttons with up and down arrows allow parameter adjustment for the mode indicated by the bi-color LED. Inherent to LN, the optical output will be inverted from the RF input signal when a positive LN bias voltage (up to V-pi) is used and will be non-inverted with a negative LN bias voltage (up to V-pi).

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F121A	-	-
Fiber Type, Input and Output	Single mode Polarized	-	Slow axis aligned to connector key
Modulator Type	Lithium Niobate, X-cut	-	-
Bandwidth, electrical to optical	12.5 20	GHz	minimum typical
Optical Bandwidth	1528-1610	nm	C + L bands
Optical Insertion Loss, V-pi = maximum transparency	4 3	dB	maximum typical
Optical Return Loss	40	dB	minimum
Alpha Chirp Factor	0	-	±0.1
Extinction Ratio, modulator only	30	dB	typical
Extinction Ratio, NRZ, after adjustment	10 15	dB	minimum typical
RF Input Voltage Range	250 1000	mVpp	Minimum Maximum
RF Input Voltage, absolute maximum	1.5	Vpp	Damage threshold
RF Input Return Loss	11	dB	Typical @ 12 GHz
Bias V-pi	6	V	maximum
Bias Voltage Adjustment Range	0 to ±10V	VDC	typical
Bias Voltage Step Size	10	mV DC	typical
Output Crossover Adjustment Range	35 to 70	%	Typical
Output Crossover Step Size	1	%	Typical
Additive Jitter	5	ps p-p	Typical @ 500 mVpp input
Additive Jitter	2	ps RMS	Maximum
Dimensions	1.72H x 4.19W x 10.70D	Inches	nominal

F122A, Lithium Niobate Phase Modulator, 13 GHz Class

F123A, Lithium Niobate Phase Modulator, with Modulator Driver, 13 GHz Class

F124A, Electro-Absorptive (EA) Modulator, 10 Gb/s Class

F124A, Electro-Absorptive (EA) Modulator, with Modulator Driver, 10 Gb/s Class

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Analog Transmitters

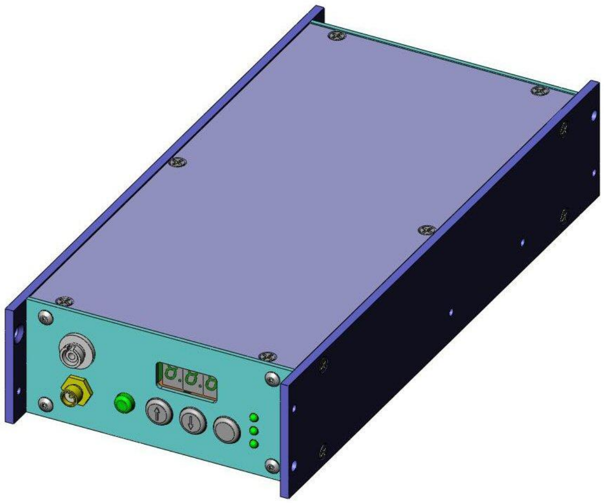
Fiber optic analog transmitter ModBlocks are provided for the 1310 nm and 1550 nm bands with output power up to 10 mW (+10 dBm). Models made with single mode (SM), 50 micron multimode (MM50), or 62.5 multimode (MM62.5 or MM62) fiber types are offered. Various fixed wavelength CWDM ModBlocks are offered for the 1310 and 1550 nm bands. Analog transmitter ModBlocks can be directly modulated (radio, analog, or digital) up to ~3 GHz or used CW. The models shown are selected from the large number of possible laser component types produced. Users are encouraged to inquire about models not shown by sending an email to ModBlocks@tmeplano.com.

Single mode analog transmitter ModBlocks used CW can be used for the coherent laser source in many Photonic Doppler Velocimeter (PDV) applications not requiring watt-level power. Models are provided with output power up to 2 mW and typical coherence lengths up to ~100 meters. On request, other laser types can be used (~500 meters @ 6 mW, ~4000 meters @ 20 mW, ~200 meters @ 63 mW, etc.). These lasers can be used with the several PDV receiver ModBlocks offered (F170-F173) to implement a complete PDV front end system, along with the appropriate fiber optic probe and real-time oscilloscope.

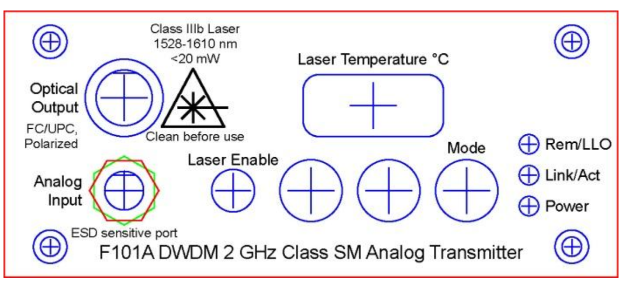
F101A-*, Analog Transmitter, DWDM, Single-mode, 2 GHz Class

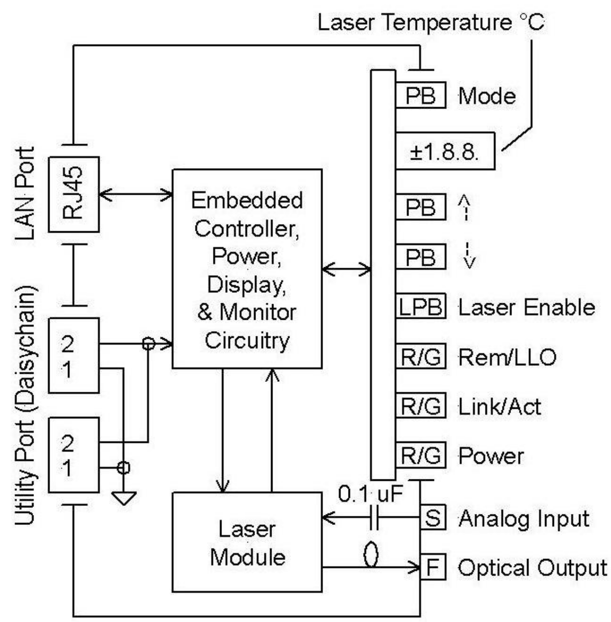
DWDM fixed wavelength analog transmitter ModBlocks are provided for the 1550 nm region in the C and L bands. Laser wavelengths range from 1528.77 nm to 1562.23 nm on 100 GHz (0.8 nm) channel spacing (43 wavelengths). These transmitters are directly modulated DFB types, highly linear, optically isolated, thermally stabilized, and supplied with non-polarized single-mode fiber outputs. Laser wavelength can be (thermally) adjusted ±100 GHz minimum, allowing wavelengths to be finely tuned or tuned to adjacent 50 GHz channels. Output power is fixed and a laser enable switch is provided. The analog modulation input is AC-coupled (0.1 uF, ~35 KHz), has ~2 GHz bandwidth, and can accept radio, analog, or digital signals. It can be used as a CW laser source by terminating the analog input. An internal user-replaceable “crash” cable is provided (optical output) for repair convenience in case of optical connector damage. These models are normally used with a 2.5 GHz class analog receiver (such as F166A-F168A) to form an inter-facility radio signal link or for CATV use.

F101A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





Front panel pushbuttons and a numeric readout provide manual control of the laser temperature (for fine tuning of the wavelength), which can also be operated remotely. The mode pushbutton turns the display on or off. Pushbuttons with up and down arrows allow adjustment of the laser temperature when the display is on.

DWDM Analog Laser Models

Part Number	Wavelength (nm)	Part Number	Wavelength (nm)	Part Number	Wavelength (nm)
F101A-C61	1528.77	F101A-C46	1540.56	F101A-C32	1551.72
F101A-C60	1529.55	F101A-C45	1541.35	F101A-C31	1552.52
F101A-C59	1530.33	F101A-C44	1542.14	F101A-C30	1553.33
F101A-C58	1531.12	F101A-C43	1542.94	F101A-C29	1554.13
F101A-C57	1531.90	F101A-C42	1543.73	**F101A-C28**	**1554.94**
F101A-C56	1532.68	F101A-C41	1544.53	F101A-C27	1555.75
F101A-C55	1533.47	F101A-C40	1545.32	F101A-C26	1556.55
F101A-C54	1534.25	F101A-C39	1546.12	F101A-C25	1557.36

Part Number	Wavelength (nm)
F101A-C53	1535.04
F101A-C52	1535.82
F101A-C51	1536.61
F101A-C50	1537.40
F101A-C49	1538.19
F101A-C48	1538.98
F101A-C47	1539.77

Part Number	Wavelength (nm)
F101A-C38	1546.92
F101A-C37	1547.72
F101A-C36	1548.51
F101A-C35	1549.32
F101A-C34	**1550.12**
F101A-C33	1550.92

Part Number	Wavelength (nm)
F101A-C24	1558.17
F101A-C23	1558.98
F101A-C22	1559.79
F101A-C21	1560.61
F101A-C20	1561.42
F101A-C19	1562.23

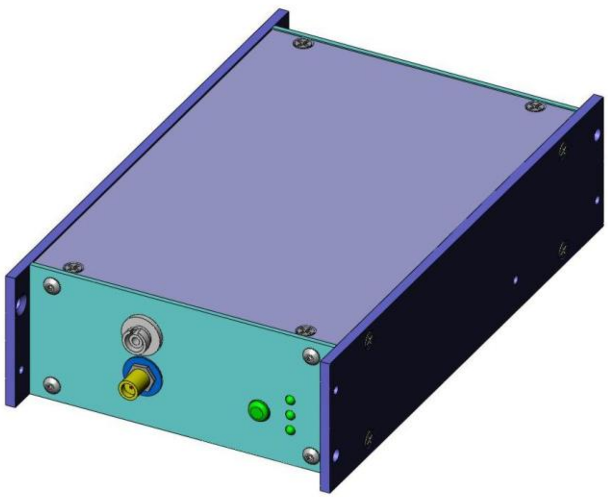
Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F101A-*	-	* = wavelength code
Fiber Type	Single mode	-	-
Laser Type	DFB	-	-
Power Output	10 and off	mW	fixed, typical
Side Mode Suppression Ratio	30	dB	minimum
Wavelength tuning range (thermal)	± 100	GHz	minimum
Relative Intensity Noise	-155	dB/Hz	maximum
Optical Isolation	30	dB	minimum
External Direct Modulation Input	Yes	-	-
Analog Bandwidth	35 KHz to 2 GHz	-	typical
Linear frequency range	5 to 1000	MHz	±0.5 dB maximum
IMD, second order	-50	dBc	maximum
IMD, third order	-60	dBc	maximum
Carrier to noise ratio	50	dB	minimum
Dynamic range	25	dB	minimum
External Input Sensitivity	20	mApp/Vpp	typical, laser modulation current
Laser Bias Current	120	mA	maximum
Laser Threshold Current	20	mA	maximum
Dimensions	1.72H x 4.19W x 8.70D	Inches	nominal

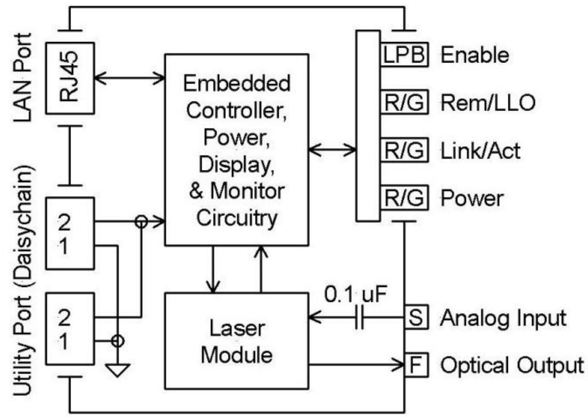
F102A-*, Analog Transmitter, CWDM, Single-mode, 2 GHz Class

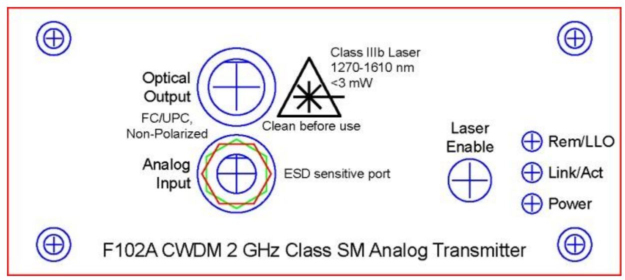
CWDM fixed wavelength analog laser ModBlocks are offered for the 1310 nm region and the 1550 nm region in the C and L bands. Wavelengths range from 1270 to 1610 nm in 10 nm steps. These lasers are directly modulated DFB types, highly linear, optically isolated, not thermally stabilized, and supplied with non-polarized single-mode fiber outputs. Output power is fixed and a laser enable switch is provided. The analog modulation input is AC-coupled (0.1 uF, ~35 KHz), has ~2 GHz bandwidth, and can accept radio, analog, or digital signals. It can be used as a CW laser source by terminating the analog input.

F102A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 6.7” deep





CWDM Laser Models

Part Number	Wavelength (nm)		Part Number	Wavelength (nm)		Part Number	Wavelength (nm)
F102A-127	1270		F102A-139	1390		F102A-151	1510
F102A-129	1290		F102A-141	1410		F102A-153	1530
F102A-131	1310		F102A-143	1430		F102A-155	1550
F102A-133	1330		F102A-145	1450		F102A-157	1570
F102A-135	1350		F102A-147	1470		F102A-159	1590
F102A-137	1370		F102A-149	1490		F102A-161	1610

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F102A-*	-	* = wavelength code
Fiber Type	Single mode	-	-
Laser Type	DFB	-	-
Power Output	2	mW	fixed, typical
Side Mode Suppression Ratio	30	dB	minimum
Wavelength temperature coefficient	0.1	nm/°C	typical
Relative Intensity Noise	-145	dB/Hz	typical
Optical Isolation	30	dB	minimum
External Direct Modulation Input	Yes	-	-
Analog Bandwidth	35 KHz to 2 GHz	-	typical
Linear frequency range	5 to 200	MHz	±1 dB maximum
IMD, second order	-40	dBc	maximum
IMD, third order	-50	dBc	maximum
Carrier to noise ratio	40	dB	minimum
External Input Sensitivity	20	mA/V	typical, laser modulation current
Laser Bias Current	50	mA	maximum

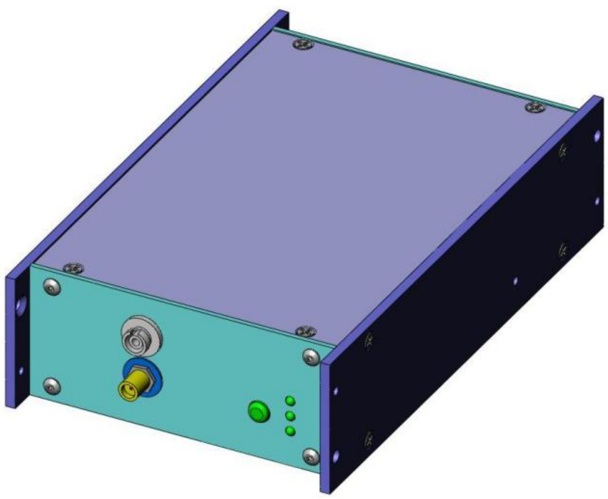
Parameter	Value	Units	Qualifier
Laser Threshold Current	20	mA	maximum
Dimensions	1.72H x 4.19W x 6.70D	Inches	nominal

F103A-*, Analog Transmitter, WDM, 50 micron Multimode, 2 GHz Class

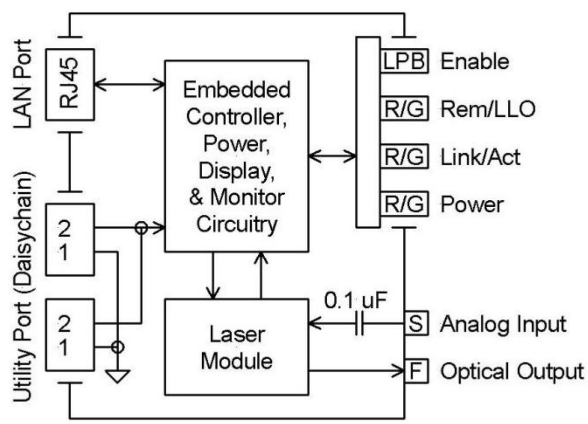
F104A-*, Analog Transmitter, WDM, 62.5 micron Multimode, 2 GHz Class

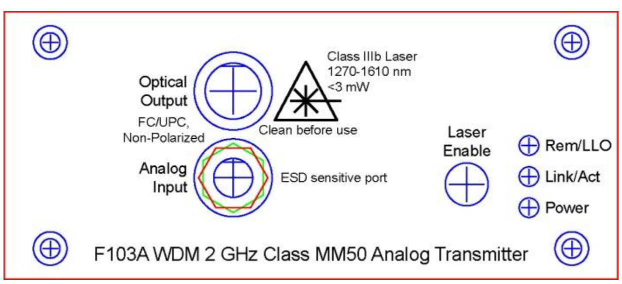
WDM fixed wavelength analog transmitter ModBlocks are provided for 1310 nm and 1550 nm (±10 nm). These transmitters are directly modulated DFB types, fairly linear, optically isolated, not thermally stabilized, and supplied with non-polarized single-mode fiber outputs. Output power is fixed and a laser enable switch is provided. The analog modulation input is AC-coupled (0.1 uF, ~35 KHz), has ~2 GHz bandwidth, and can accept analog or digital signals. It can be used as a CW laser source by terminating the analog input.

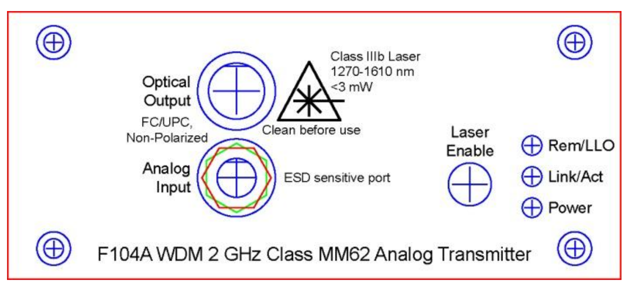
F103A and F104A front chassis view, graphics layouts, and simple block diagram



1U, quarter-rack, 6.7” deep







WDM Laser Models

Part Number	Wavelength (nm)	Part Number	Wavelength (nm)
F103A-131	1310	F104A-131	1310
F103A-155	1550	F104A-155	1550

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier

Parameter	Value	Units	Qualifier
Model Number	F103A-*, F104A-*	-	* = wavelength code
Fiber Type	50 micron multimode 62.5 micron multimode	-	F103A-* F104A-*
Laser Type	DFB	-	-
Power Output	1	mW	fixed, typical
Side Mode Suppression Ratio	30	dB	minimum
Optical Isolation	30	dB	minimum
External Direct Modulation Input	Yes	-	-
External Input Bandwidth	35 KHz to 2 GHz	-	typical
Output Transition Time	200	ps	typical
External Input Sensitivity	20	mA/V	typical, laser modulation current
Laser Bias Current	50	mA	maximum
Laser Threshold Current	20	mA	maximum
Dimensions	1.72H x 4.19W x 6.70D	Inches	nominal

Digital Transmitters

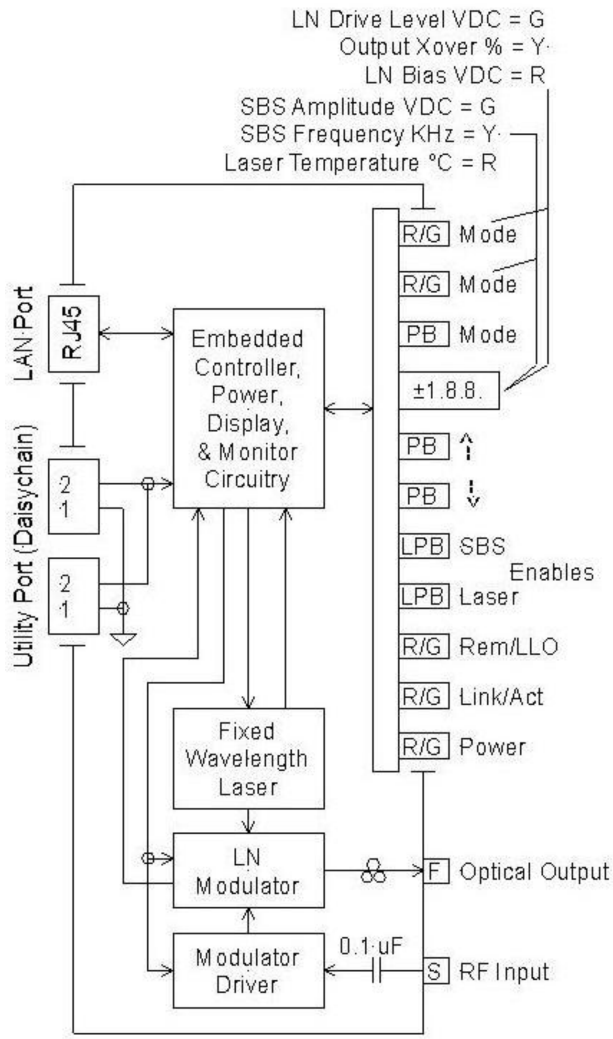
These ModBlocks convert an electrical digital input signal into a fiber optic digital output signal. Fixed and tunable wavelength DWDM transmitters using LN modulators are offered for 13 Gb/s class NRZ operation. Fixed wavelength CWDM (SM) and WDM (MM50 and MM62) transmitters using direct modulation are offered for 2.7 Gb/s class NRZ operation. Fixed and tunable wavelength DWDM RZ and DPSK digital transmitters using LN modulators will be offered in the near future. Send an email request to ModBlocks@tmeplano.com to make it sooner!

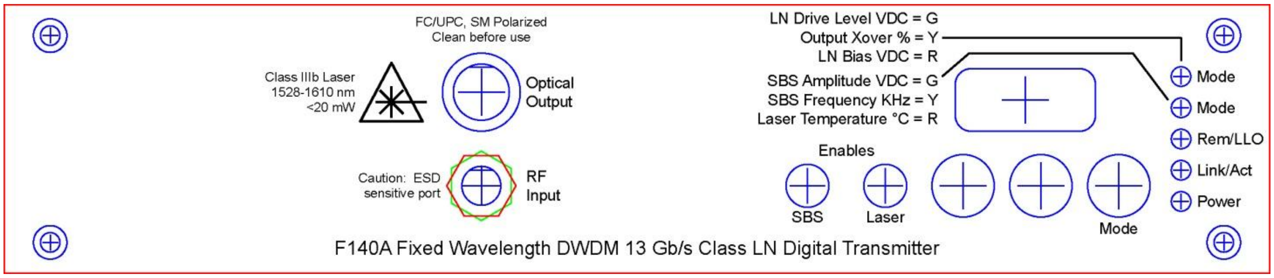
F140A-*, Digital Transmitter, Fixed Wavelength DWDM, Lithium Niobate, 13 Gb/s Class

DWDM fixed wavelength digital transmitter ModBlocks are provided for the 1550 nm region in the C and L bands. Laser wavelengths range from 1528.77 nm to 1564.68 nm on 100 GHz (0.8 nm) channel spacing (43 wavelengths). These transmitters contain fixed wavelength DFB type lasers and adjustable LN modulators with non-inverting modulator drivers. They are optically isolated, thermally stabilized, and have polarization maintaining single-mode fiber outputs (slow axis aligned to connector key). Laser wavelength can be (thermally) adjusted ±100 GHz minimum, allowing wavelengths to be finely tuned or tuned to adjacent 50 GHz channels. Output power is fixed and a laser enable switch is provided. SBS suppression is provided (can be used for a “channel ID”), which is required for long haul spans with optical amplifiers. SBS amplitude and frequency (channel ID) are adjustable and an enable switch is provided. The digital modulation input is AC-coupled (0.1 uF, ~35 KHz) and normally accepts an NRZ digital signal, but can accept analog or other digital signals within its bandwidth. These transmitters can be used as a variable power CW laser source by terminating the digital input and adjusting the LN bias voltage. An internal user-replaceable “crash” cable is provided (optical output) for repair convenience in case of optical connector damage. These models are normally used with a 13 Gb/s class analog receiver (such as F160A or F161A), limiting receiver (such as F180A or F181A), or digital receiver (such as F200A or F201A) to form an inter-facility fiber optic data link up to ~100KM, fiber optic digital test systems, or general lab and development use. These models are also available with full front panel connector access to the internal laser, modulator, and modulator driver on special order if required.

F140A front chassis view, graphics layout, and simple block diagram

1U, half-rack, 8.7” deep





Front panel pushbuttons and a numeric readout provide manual control of the laser temperature (for fine tuning of the wavelength), SBS amplitude, SBS frequency, LN bias voltage, output crossover point, and LN drive level (which can also be operated remotely). The mode pushbutton changes the display and two bi-color mode LEDs (along with front panel graphics) indicate the parameter being displayed. For the lower LED, red indicates Laser Temperature control mode, yellow indicates SBS Frequency control mode, green indicates SBS Amplitude control mode, and dark indicates off mode. For the upper LED, red indicates LN Bias control mode, yellow indicates Output Crossover control mode, green indicates LN Drive Level control mode, and dark indicates off mode. Pushbuttons with up and down arrows allow parameter adjustment for the mode indicated by the bi-color LEDs. Inherent to LN, the optical output will be inverted from the RF input signal when a positive LN bias voltage (up to V-pi) is used and will be non-inverted with a negative LN bias voltage (up to V-pi).

C-band 100 GHz DWDM laser wavelength choices (see following note)

Part Number	Wavelength (nm)	Part Number	Wavelength (nm)	Part Number	Wavelength (nm)
F140A-C61	1528.77	F140A-C45	1541.35	F140A-C29	1554.13
F140A-C60	1529.55	F140A-C44	1542.14	**F140A-C28**	**1554.94**
F140A-C59	1530.33	F140A-C43	1542.94	F140A-C27	1555.75
F140A-C58	1531.12	F140A-C42	1543.73	F140A-C26	1556.55
F140A-C57	1531.90	F140A-C41	1544.53	F140A-C25	1557.36
F140A-C56	1532.68	F140A-C40	1545.32	F140A-C24	1558.17
F140A-C55	1533.47	F140A-C39	1546.12	F140A-C23	1558.98
F140A-C54	1534.25	F140A-C38	1546.92	F140A-C22	1559.79
F140A-C53	1535.04	F140A-C37	1547.72	F140A-C21	1560.61
F140A-C52	1535.82	F140A-C36	1548.51	F140A-C20	1561.42
F140A-C51	1536.61	F140A-C35	1549.32	F140A-C19	1562.23
F140A-C50	1537.40	**F140A-C34**	**1550.12**	F140A-C18	1563.05
F140A-C49	1538.19	F140A-C33	1550.92	F140A-C17	1563.86
F140A-C48	1538.98	F140A-C32	1551.72	F140A-C16	1564.68
F140A-C47	1539.77	F140A-C31	1552.52		
F140A-C46	1540.56	F140A-C30	1553.33		

Note: There are many possible DWDM wavelengths, so only selected popular C-band 100 GHz channels are shown (bold ones preferred). However, any DWDM wavelength can be supplied on special order. See the "ITU Fiber Optic Frequencies, Wavelengths, and Channels for C and L bands" section on page 189 of the "Reference Data" section for the proper channel number to use to complete the part number "dash ending" as above. For example, the part number for a 50 GHz channel in the L-band at 1609.62 nm (channel Q62) is F101A-Q62.

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F140A-*	-	* = wavelength code
Fiber Type	Single mode Polarization maintaining	-	Slow axis aligned to connector key
Laser Type	DFB, InGaAsP	-	-
Power Output, CW Power Output, LN at quadrature	4 and off 2 and off	mW	typical
Spectral Width @ -3 dB point, Un-modulated, SBS = off	2 5	MHz	typical maximum
Coherence Length, Un-modulated, SBS = off	100 40	meters	typical minimum
Side Mode Suppression Ratio	40	dB	minimum
Wavelength tuning range (thermal)	±100	GHz	minimum
Wavelength Drift vs. Temperature	0.2 0.5	pm/°C	typical maximum
Relative Intensity Noise	-140	dB/Hz	maximum
Optical Isolation (laser)	30	dB	minimum
Bandwidth, electrical to optical	12.5	Gb/s	minimum
Extinction Ratio, NRZ, after adjustment	10 15	dB	minimum typical
RF Input Voltage Range	250 1000	mVpp	Minimum Maximum
RF Input Voltage, absolute maximum	1.5	Vpp	Damage threshold
Modulator Type	Lithium Niobate, X-cut	-	0 ± 0.1 chirp
Bias V-pi	6	V	maximum
Bias Voltage Adjustment Range	0 to ±10V	VDC	typical
Bias Voltage Step Size	10	mV DC	typical
Output Crossover Adjustment Range	35 to 70	%	typical
Output Crossover Step Size	1	%	typical
Additive Jitter	5	ps p-p	typical @ 500 mVpp input
Additive Jitter	2	ps RMS	typical
SBS Frequency Range	20 to 65	KHz	typical
SBS Frequency Step Size	500	Hz	typical
SBS Amplitude Range	0 to 5 and off	VDC	typical
SBS Amplitude Step Size	10	mV DC	typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

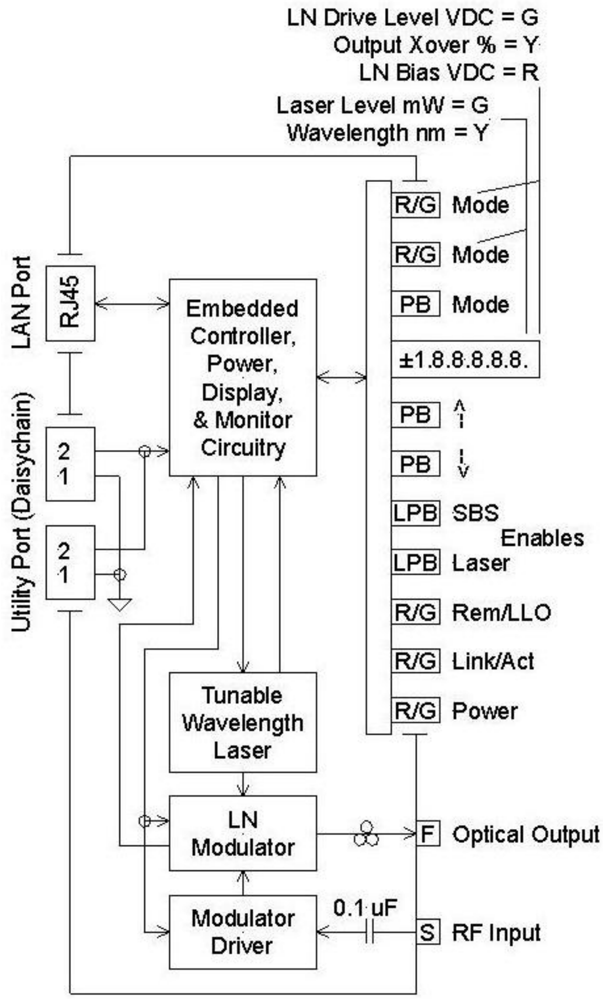
F141A, Digital Transmitter, Tunable, C-band 50 GHz DWDM, Lithium Niobate, 13 Gb/s Class
F142A, Digital Transmitter, Tunable, L-band 50 GHz DWDM, Lithium Niobate, 13 Gb/s Class

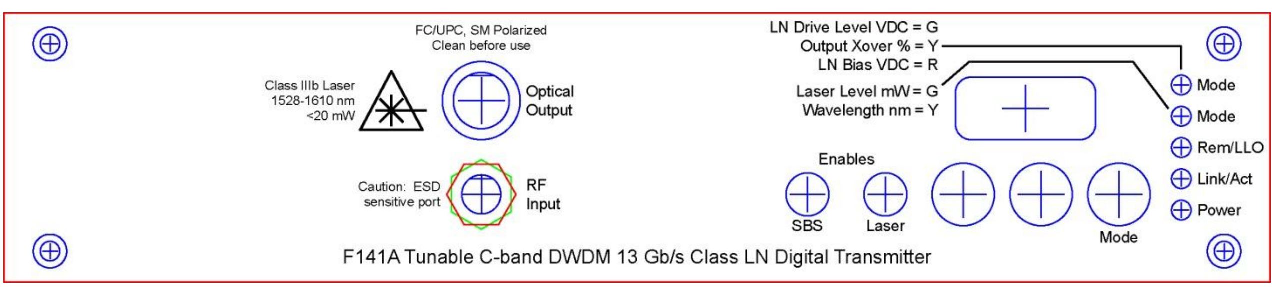
DWDM tunable wavelength digital transmitter ModBlocks are provided for the 1550 nm region in the C and L bands. Adjustable laser wavelengths range from 1528.77 nm to 1563.86 nm (F141A) and 1568.77 nm to 1607.47 nm (F142A) on 50 GHz (0.4 nm) channel spacing. These transmitters contain tunable DSDBR type lasers and adjustable LN modulators with non-inverting modulator drivers. They are optically isolated, thermally stabilized, and have polarization maintaining single-mode fiber outputs (slow axis aligned to connector key). The output power level is adjustable up to 10 mW and a laser enable switch is provided. SBS suppression is required for long haul fiber spans using optical amplifiers and is provided by using laser FM dithering and an SBS enable switch. The digital modulation input is AC-coupled (0.1 uF, ~35 KHz) and normally accepts an NRZ digital signal, but can accept analog or other digital signals within its bandwidth. These transmitters can be used as a variable power CW laser source by terminating the digital input and adjusting the LN bias voltage. An internal user-replaceable “crash” cable is provided (optical output) for repair convenience in case of optical connector damage. These models are normally used with a 13 Gb/s class analog receiver (such as F160A or F161A), limiting receiver (such as F180A or F181A), or digital receiver (such as F200A or F201A) to form an inter-facility fiber optic data link up to ~100KM, fiber optic digital test systems, or general lab and development use. These models are also available with full front panel connector access to the internal laser, modulator, and modulator driver on special order if required.

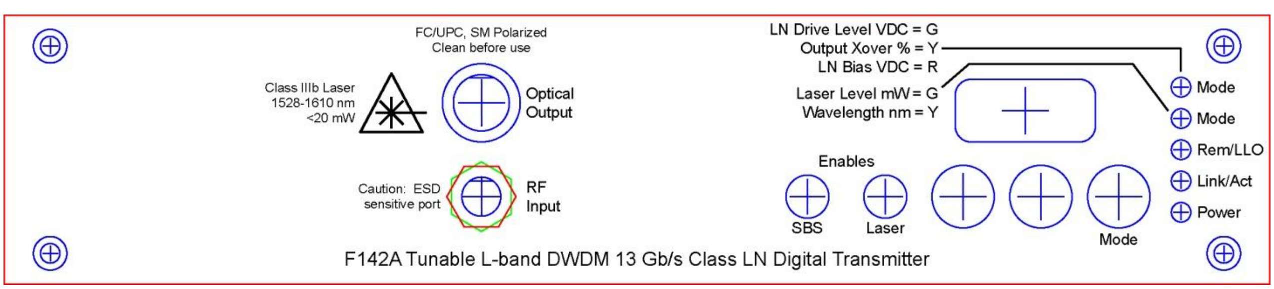
Front panel pushbuttons and a numeric readout provide manual control of laser wavelength, output power level, LN bias voltage, output crossover point, and LN drive level (which can also be operated remotely). The mode pushbutton changes the display and two bi-color mode LEDs (along with front panel graphics) indicate the parameter being displayed. For the lower LED, red indicates Wavelength control mode, yellow indicates Output Level control mode, and dark indicates off mode. For the upper LED, red indicates LN Bias control mode, yellow indicates Output Crossover control mode, green indicates LN Drive Level control mode, and dark indicates off mode. Pushbuttons with up and down arrows allow parameter adjustment for the mode indicated by the bi-color LEDs. Inherent to LN, the optical output will be inverted from the RF input signal when a positive LN bias voltage (up to V-pi) is used and will be non-inverted with a negative LN bias voltage (up to V-pi).

F141A and F142A front chassis view, graphics layouts, and simple block diagram

1U, half-rack, 8.7” deep







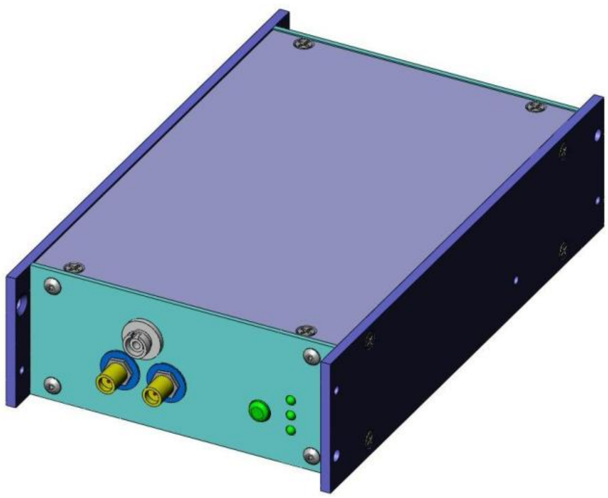
Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F141A F142A	-	C-Band L-Band
Fiber Type	Single mode Polarization maintaining	-	Slow axis aligned to connector key
Laser Type	DSDBR	-	-
Wavelength Range	1528.77 to 1563.86 1568.77 to 1607.47	nm	C-band, F110A L-band, F111A
Wavelength Accuracy	±2.5	GHz	maximum
Tuning speed, adjacent channels	10	ms	maximum
Power Output, CW Power Output, LN at quadrature	0.4 to 4 and off 0.2 to 2 and off	mW	typical
Power Output Step Size	0.1	mW	typical
Power Output, laser disabled	-35	dBm	maximum
Spectral Width @ -3 dB point, Un-modulated, SBS = off	1 5	MHz	typical maximum
Coherence Length, Un-modulated, SBS = off	200 40	meters	typical minimum
Spectral Width @ -3 dB point Un-modulated, SBS = on	250 1000	MHz	minimum maximum
Coherence Length Un-modulated, SBS = on	0.9 0.2	meters	typical minimum
Side Mode Suppression Ratio	40	dB	minimum
Relative Intensity Noise	-145	dB/Hz	maximum
Optical Isolation (laser)	30	dB	minimum
Bandwidth, electrical to optical	12.5	Gb/s	minimum
Extinction Ratio, NRZ, after adjustment	10 15	dB	minimum typical
RF Input Voltage Range	250 1000	mVpp	Minimum Maximum
RF Input Voltage, absolute maximum	1.5	Vpp	Damage threshold
Modulator Type	Lithium Niobate, X-cut	-	0 ± 0.1 chirp
Bias V-pi	6	V	maximum
Bias Voltage Adjustment Range	0 to ±10V	VDC	typical
Bias Voltage Step Size	10	mV DC	typical
Output Crossover Adjustment Range	35 to 70	%	typical
Output Crossover Step Size	1	%	typical
Additive Jitter	5	ps p-p	typical @ 500 mVpp input
Additive Jitter	2	ps RMS	typical
SBS Dither Frequency, SBS = on	25	KHz	typical
SBS Modulation Depth, SBS = on	4	%	typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

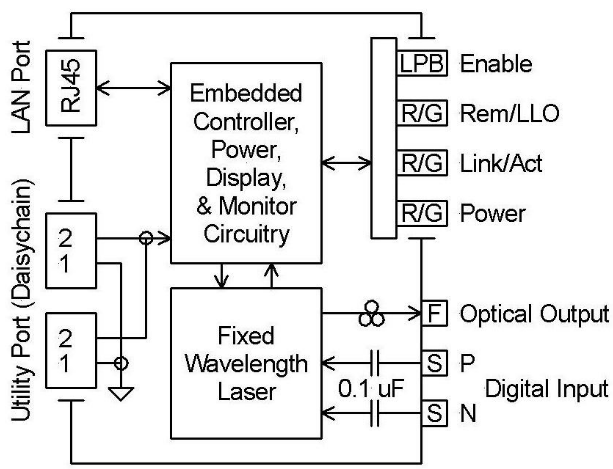
F145A-*, Digital Transmitter, Fixed Wavelength CWDM, 2.7 Gb/s Class, Single-mode

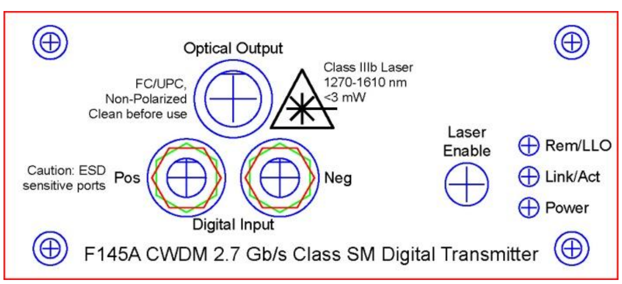
CWDM fixed wavelength digital laser ModBlocks are offered for the 1310 nm region and the 1550 nm region in the C and L bands. Wavelengths range from 1270 to 1610 nm in 10 nm steps. These transmitters contain fixed wavelength DFB type lasers and direct modulation laser drivers with temperature compensated automatic power control. They are optically isolated, not thermally stabilized, and supplied with non-polarized single-mode fiber outputs. Output power is fixed and a laser enable switch is provided. The digital modulation inputs are AC-coupled (0.1 uF, ~35 KHz) and normally accept an NRZ digital signal (differential or single-ended), but can accept analog or other digital signals within its bandwidth. It can be used as a CW laser source by terminating the digital inputs. These models are normally used with a 2.7 Gb/s class analog receiver (such as F166A), limiting receiver (such as F186A), or digital receiver (such as F206A or F207A) to form an inter-facility fiber optic data link up to ~100KM, fiber optic digital test systems, or general lab and development use.

F145A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 6.7” deep





CWDM Transmitter Models

Part Number	Wavelength (nm)		Part Number	Wavelength (nm)		Part Number	Wavelength (nm)
F145A-127	1270		F145A-139	1390		F145A-151	1510
F145A-129	1290		F145A-141	1410		F145A-153	1530
F145A-131	1310		F145A-143	1430		F145A-155	1550
F145A-133	1330		F145A-145	1450		F145A-157	1570
F145A-135	1350		F145A-147	1470		F145A-159	1590
F145A-137	1370		F145A-149	1490		F145A-161	1610

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F145A-*	-	* = wavelength code
Fiber Type	Single mode	-	-
Laser Type	DFB	-	-
Power Output	2 and off	mW	typical
Side Mode Suppression Ratio	30	dB	minimum
Wavelength temperature coefficient	0.1	nm/°C	typical
Relative Intensity Noise	-145	dB/Hz	typical
Optical Isolation	30	dB	minimum
Data Rate Range	0.1 to 2.7	Gb/s	typical
RF Input Coupling	AC, 0.1 uF	-	~35 KHz roll-off
Modulation Type	direct	-	-
Extinction Ratio, NRZ	8 10	dB	minimum typical
RF Input Voltage Range, single-ended	100 1200	mVpp	Minimum Maximum
RF Input Voltage Range, differential	200 2400	mVpp	Minimum Maximum
RF Input Voltage, absolute maximum	3	Vpp	Damage threshold
Jitter, deterministic	50	ps-pp	typical
Jitter, random	2	ps RMS	typical
Dimensions	1.72H x 4.19W x 6.70D	Inches	nominal

F146A-*, Digital Transmitter, Fixed Wavelength WDM, 2.7 Gb/s Class, 50 micron Multimode

F147A-*, Digital Transmitter, Fixed Wavelength WDM, 2.7 Gb/s Class, 62.5 micron Multimode

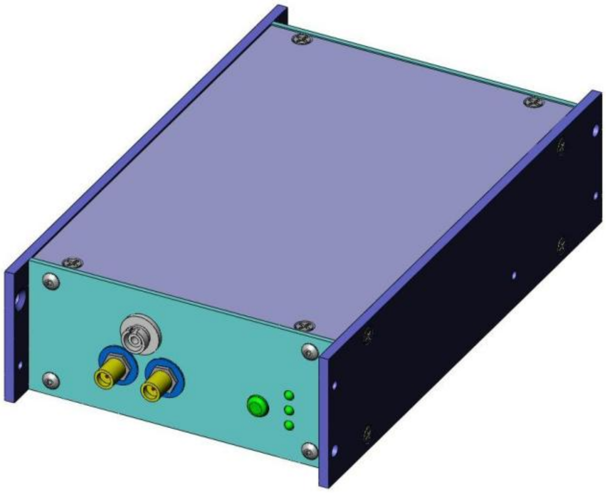
WDM fixed wavelength digital transmitter ModBlocks are offered for 1310 nm and 1550 nm (±10 nm) wavelengths in two sizes of multimode fiber. These transmitters contain fixed wavelength DFB type lasers and direct modulation laser drivers with temperature compensated automatic power control. They are optically isolated, not thermally stabilized, and supplied with non-polarized single-mode fiber outputs. Output power is fixed and a laser enable switch is provided. The digital modulation inputs are AC-coupled (0.1 uF, ~35 KHz) and normally accept an NRZ digital signal (differential or single-ended), but can accept analog or other digital signals within its bandwidth. It can be used as a CW laser source by terminating the digital inputs. These models are normally used with a 2.7 Gb/s class analog receiver (such as F166A), limiting receiver (such as F186A), or digital receiver (such as F206A or F207A) to form an inter-facility fiber optic data link up to ~100KM, fiber optic digital test systems, or general lab and development use.

WDM Transmitter Models

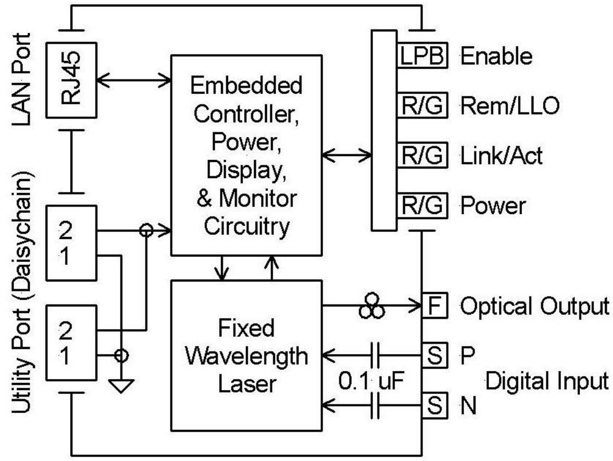
Part Number	Wavelength (nm)		Part Number	Wavelength (nm)
F146A-131	1310		F147A-131	1310
F146A-155	1550		F147A-155	1550

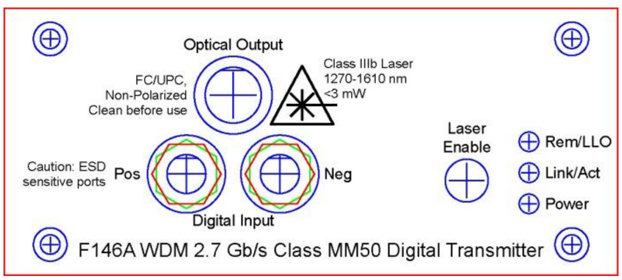
Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

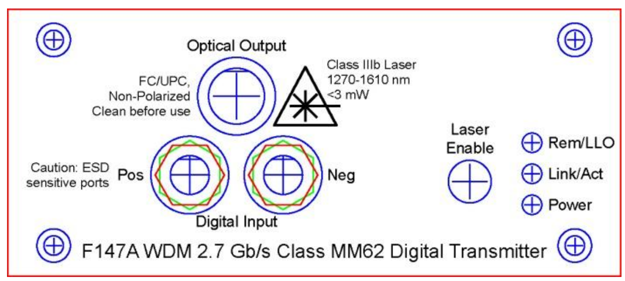
F146A and F147A front chassis view, graphics layouts, and simple block diagram



1U, quarter-rack, 6.7” deep







Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F146A-*, F147A-*	-	* = wavelength code
Fiber Type	50 micron multimode 62.5 micron multimode	-	F103A-* F104A-*
Laser Type	DFB	-	-
Power Output	1 and off	mW	fixed, typical
Side Mode Suppression Ratio	30	dB	minimum
Optical Isolation	30	dB	minimum
Data Rate Range	0.1 to 2.7	Gb/s	typical
RF Input Coupling	AC, 0.1 uF	-	~35 KHz roll-off
Modulation Type	direct	-	-
Extinction Ratio, NRZ	8 10	dB	minimum typical
RF Input Voltage Range, single-ended	100 1200	mVpp	Minimum Maximum
RF Input Voltage Range, differential	200 2400	mVpp	Minimum Maximum
RF Input Voltage, absolute maximum	3	Vpp	Damage threshold
Jitter, deterministic	50	ps-pp	typical
Jitter, random	2	ps RMS	typical
Dimensions	1.72H x 4.19W x 6.70D	Inches	nominal

F150A-*, Digital Transmitter, RZ, Fixed Wavelength DWDM, Lithium Niobate, 13 Gb/s Class

F151A-*, Digital Transmitter, RZ, Tunable DWDM, Lithium Niobate, 13 Gb/s Class

F152A-*, Digital Transmitter, DPSK, Fixed Wavelength DWDM, Lithium Niobate, 13 Gb/s Class

F153A-*, Digital Transmitter, DPSK, Tunable DWDM, Lithium Niobate, 13 Gb/s Class

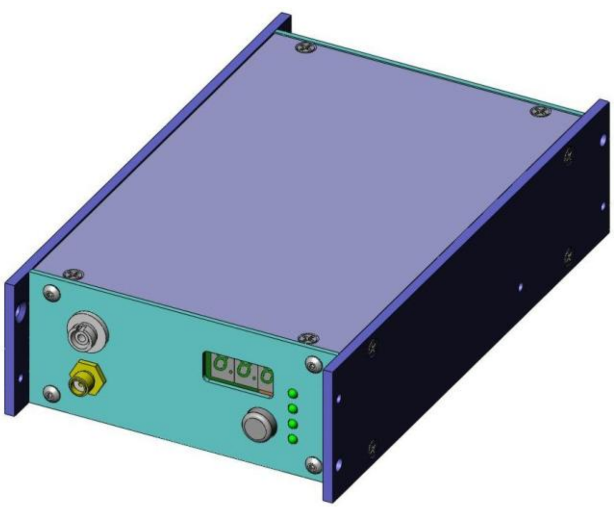
Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Analog Receivers

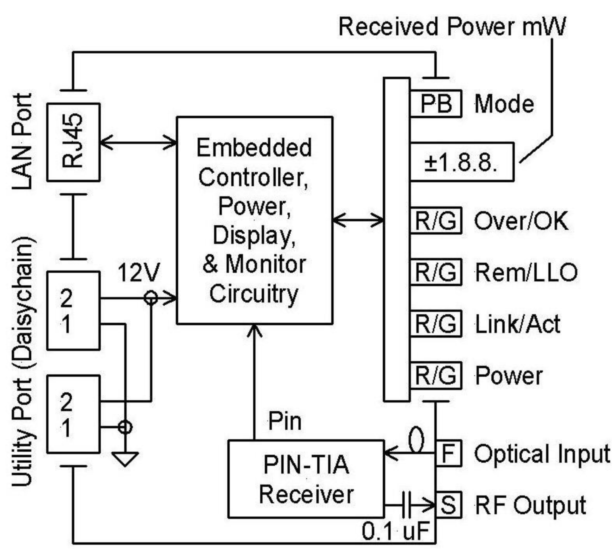
Analog fiber optic receiver ModBlocks are offered for use in the 1310 nm and 1550 nm bands. PIN or APD photodiodes are used for models with 10 GHz class operation, which have single-ended AC-coupled RF outputs. PIN photodiodes with AGC are used for models with 2 GHz class operation, which have differential AC-coupled RF outputs. Models are offered with single mode (SM), 50 micron multimode (MM50), or 62.5 multimode (MM62.5 or MM62) fiber types.

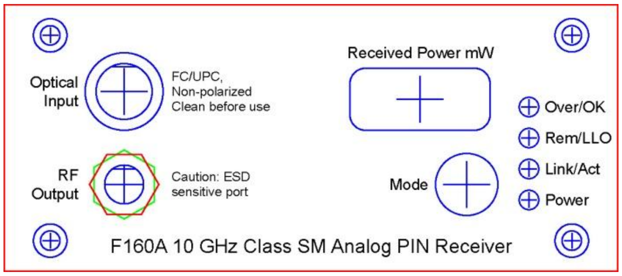
F160A, Analog Receiver, PIN-TIA, 10 GHz Class, Single-mode
F162A, Analog Receiver, PIN-TIA, 10 GHz Class, 50 micron Multimode
F164A, Analog Receiver, PIN-TIA, 10 GHz Class, 62.5 micron Multimode

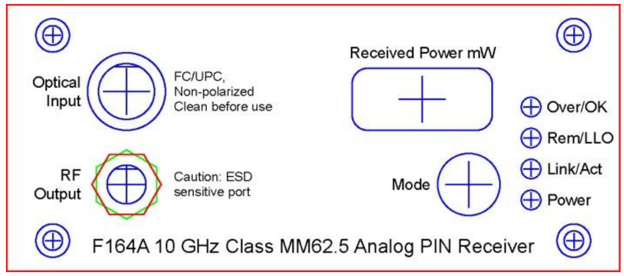
F160A, F162A, and F164A front chassis view, graphics layouts, and simple block diagram

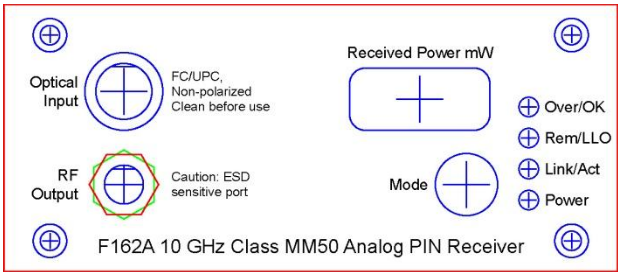


1U, quarter-rack, 6.7” deep









Analog receivers are offered with 10 GHz class PIN photodiodes and transimpedance amplifiers for use in the 1310 nm and 1550 nm bands. RF outputs are single-ended and AC coupled (0.1 uF, ~35 KHz). Models are offered with single mode (SM), 50 micron multimode (MM50), or 62.5 multimode (MM62.5 or MM62) fiber types. An internal user-replaceable “crash” cable is provided (optical input) on all models for repair convenience in case of optical connector damage.

A front panel bi-color “Over/OK” LED monitors the optical input power level. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power. The optical input power level can be monitored using the front panel “Mode” pushbutton and numeric readout, which can also be monitored remotely. The mode pushbutton turns the display on or off.

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F160A F162A F164A	-	Single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	Single-mode 50 micron multimode 62.5 micron multimode	-	F160A F162A F164A
Receiver Type	PIN-TIA	-	-
Wavelength Range	800 to 1650	nm	-
Receiver Sensitivity, 10^{-10} BER, PRBS 2^{23}-1, NRZ, 1550 nm	-18 -19	dBm	minimum typical
Receiver Overload, 10^{-9} BER	3	dBm	typical

Parameter	Value	Units	Qualifier
Receiver Damage Threshold	4	dBm	typical
Polarity, optical to electrical conversion	Non-inverting	-	-
Responsivity, 1310 to 1550 nm	0.7 0.8	mA/mW	minimum typical
Responsivity, 850 nm	0.2 0.25	mA/mW	minimum typical
Transimpedance	400 500 650	ohms	minimum typical maximum
Gain Flatness	±0.75	dB	typical
Bandwidth, 1550 nm	9.5 10	GHz	minimum typical
Low Frequency Cutoff	35	KHz	typical
Linearity, -15 to 0 dBm	<1	%	typical
Group Delay, NRZ, 1550 nm, <7 GHz	±10	ps	typical
Noise Figure	3	dB	typical
Optical Return Loss, 1550 nm	30	dB	typical
RF Output Voltage, typical	900 28 13	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

F161A, Analog Receiver, APD, 10 GHz Class, Single-mode

F163A, Analog Receiver, APD, 10 GHz Class, 50 micron Multimode

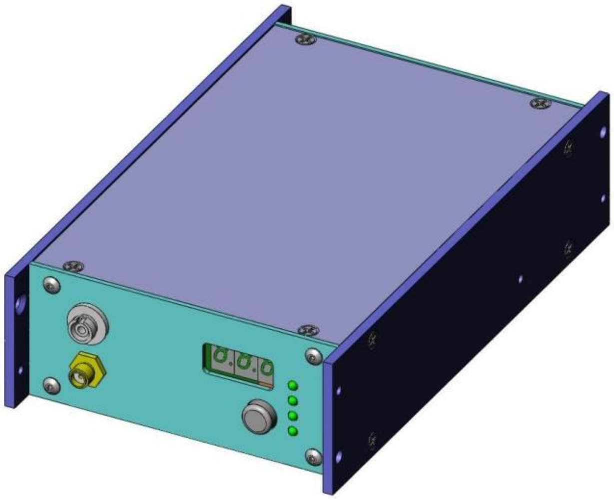
F165A, Analog Receiver, APD, 10 GHz Class, 62.5 micron Multimode

Analog receivers are offered with 10 GHz class APD photodiodes and transimpedance amplifiers for use in the 1310 nm and 1550 nm bands. RF outputs are single-ended and AC coupled (0.1 uF, ~35 KHz). Models are offered with single mode (SM), 50 micron multimode (MM50), or 62.5 multimode (MM62.5 or MM62) fiber types. An internal user-replaceable “crash” cable is provided (optical input) on all models for repair convenience in case of optical connector damage.

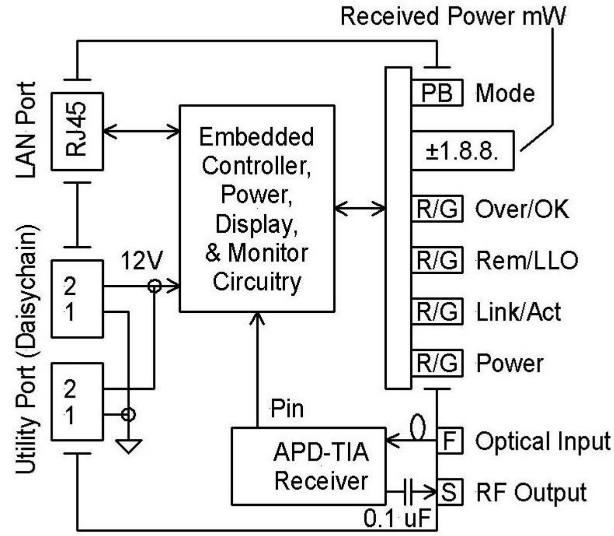
A front panel bi-color “Over/OK” LED monitors the optical input power level. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power. The optical input power level can be monitored using the front panel “Mode” pushbutton and numeric readout, which can also be monitored remotely. The mode pushbutton turns the display on or off.

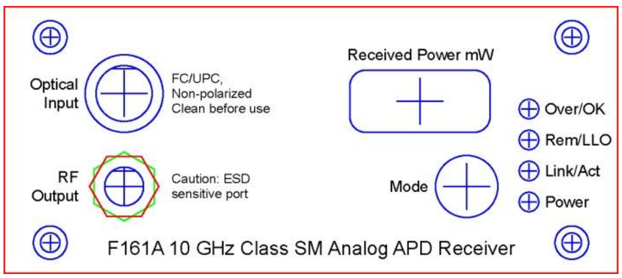
Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

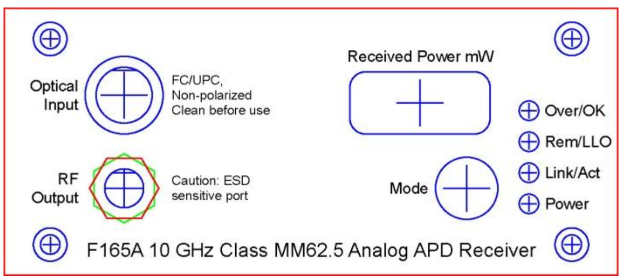
F161A, F163A, and F165A front chassis view, graphics layouts, and simple block diagram

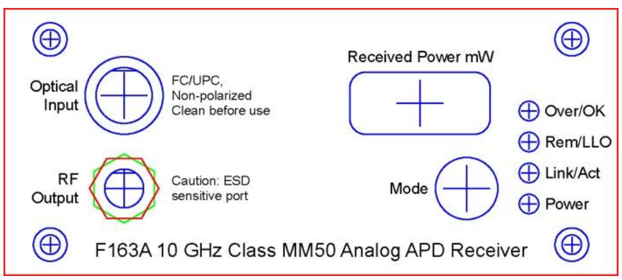


1U, quarter-rack, 6.7" deep









Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F161A F163A F165A	-	Single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	Single-mode 50 micron multimode 62.5 micron multimode	-	F161A F163A F165A
Receiver Type	APD-TIA	-	-
Wavelength Range	950 to 1650	nm	-
Receiver Sensitivity, 10^{-12} BER, PRBS 2^{31}-1, NRZ, 1550 nm	-25	dBm	typical
Receiver Overload, 10^{-12} BER	0	dBm	typical
Receiver Damage Threshold	3	dBm	typical
Polarity, optical to electrical conversion	Non-inverting	-	-

Parameter	Value	Units	Qualifier
Responsivity, 1310 to 1550 nm	0.7	mA/mW	typical
Transimpedance	500	ohms	typical
Gain Flatness	±1	dB	typical
Bandwidth, 1550 nm	10	Gb/s	typical
Low Frequency Cutoff	35	KHz	typical
Group Delay, NRZ, 1550 nm, <7 GHz	±15	ps	typical
Optical Return Loss, 1550 nm	27	dB	minimum
RF Output Voltage, typical	350	mVpp	0 dBm input
RF Output Return Loss	10	dB	minimum
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

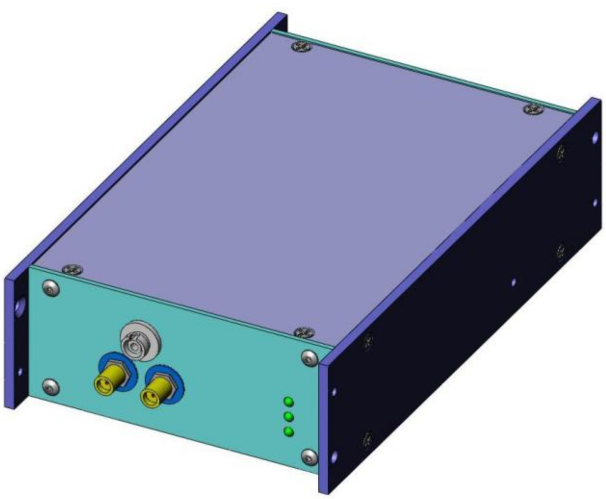
F166A, Analog Receiver, AGC-PIN, 2 GHz Class, Single-mode

F167A, Analog Receiver, AGC-PIN, 2 GHz Class, 50 micron Multimode

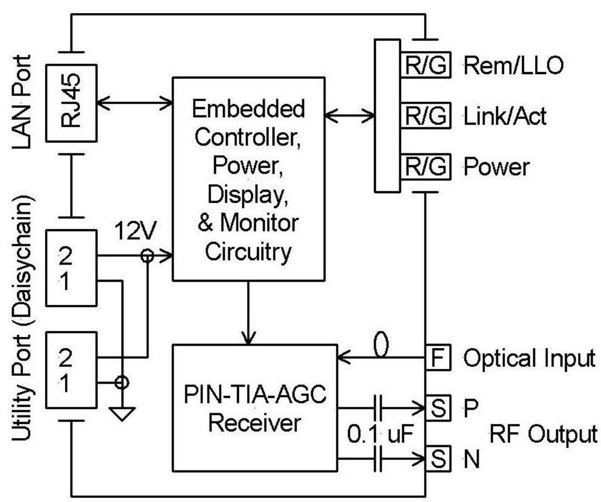
F168A, Analog Receiver, AGC-PIN, 2 GHz Class, 62.5 micron Multimode

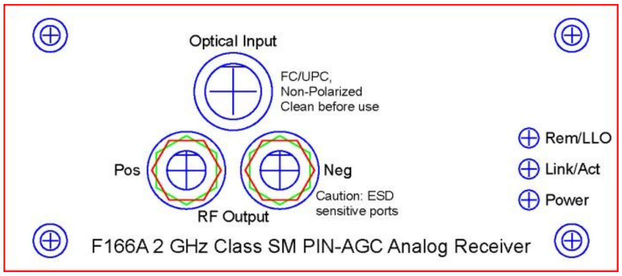
Analog receivers are offered with 2 GHz class PIN photodiodes, transimpedance amplifiers, and automatic gain control (AGC) for use in the 1310 nm and 1550 nm bands. RF outputs are differential (can be used single-ended) and AC coupled. Models are offered with single mode (SM), 50 micron multimode (MM50), or 62.5 multimode (MM62.5 or MM62) fiber types.

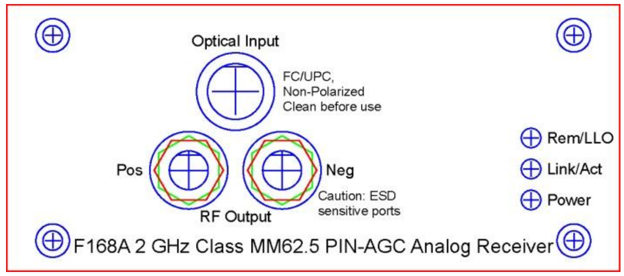
F166A, F167A, and F168A front chassis view, graphics layouts, and simple block diagram

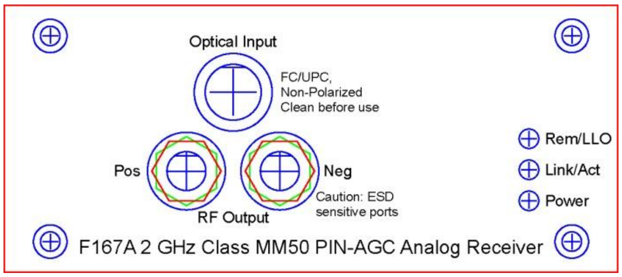


1U, quarter-rack, 6.7” deep









Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F166A F167A F168A	-	Single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	Single-mode 50 micron multimode 62.5 micron multimode	-	F166A F167A F168A
Receiver Type	PIN-TIA-AGC	-	-
Wavelength Range	1100 to 1600	nm	-
Receiver Sensitivity	-18 -21	dBm	minimum typical
Receiver Overload	-3	dBm	typical
Receiver Damage Threshold	0	dBm	typical
Bandwidth	1.6 2.0	GHz	minimum typical
Low Frequency Cutoff	35	KHz	typical
RF Output Coupling	AC, 0.1 uF	-	-
RF Output Voltage, differential	600	mVpp	typical
RF Output Transition Time	150	ps	maximum
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

PDV Receivers

Fiber optic receiver ModBlocks are offered for Photonic Doppler Velocimeter (PDV) applications in the 1550 nm C-band. Models are available with choices of 10 GHz class analog PIN or APD receivers, AC or DC coupled RF outputs, for use with back-reflecting or non-back-reflecting probes, and with or without a red “spotting” laser. TME recommends AC coupled PIN receivers for most applications.

Summary of PDV Receiver ModBlock Types

Model Number	Receiver Type	RF Output Coupling	Probe Type	Spotting Laser?
F170A-AC	PIN-TIA	AC	Back-Reflecting	No
F170A-DC	PIN-TIA	DC	Back-Reflecting	No
F171A-AC	APD-TIA	AC	Back-Reflecting	No
F171A-DC	APD-TIA	DC	Back-Reflecting	No
F172A-AC	PIN-TIA	AC	Non-Back-Reflecting	No
F172A-DC	PIN-TIA	DC	Non-Back-Reflecting	No
F173A-AC	APD-TIA	AC	Non-Back-Reflecting	No
F173A-DC	APD-TIA	DC	Non-Back-Reflecting	No
F175A-AC	PIN-TIA	AC	Back-Reflecting	Yes
F175A-DC	PIN-TIA	DC	Back-Reflecting	Yes
F176A-AC	APD-TIA	AC	Back-Reflecting	Yes
F176A-DC	APD-TIA	DC	Back-Reflecting	Yes
F177A-AC	PIN-TIA	AC	Non-Back-Reflecting	Yes
F177A-DC	PIN-TIA	DC	Non-Back-Reflecting	Yes
F178A-AC	APD-TIA	AC	Non-Back-Reflecting	Yes
F178A-DC	APD-TIA	DC	Non-Back-Reflecting	Yes

These receivers can be used with the several PDV laser ModBlocks offered (F100A-* or F110A) or other long-coherence laser to implement a complete PDV front end system, along with the appropriate fiber optic probe and real-time oscilloscope. High power optical splitters are also available (such as F310A or F311A) to operate multiple receivers from one high power laser. In addition, PDV transceiver ModBlocks (F235A on page 91 and F236A on page 96) are offered with both an internal 20 mW coherent laser, a PDV receiver, and a red “spotting” laser.

Brief Specifications for PDV Receivers

All PDV receivers contain an analog 10 GHz bandwidth PIN-TIA or APD-TIA fiber optic receiver for C-band (1528 to 1563 nm) operation with AC or DC coupled RF output. Model architectures are provided (30 dB VOAs, couplers, circulators) for use with back-reflecting or non-back-reflecting probes and with or without a “spotting” laser (red laser, switch). Target velocity range is 0 to 7500 m/s (DC coupled) or 0.05 to 7500 m/s (AC coupled, ~35 KHz cutoff). Maximum laser input power is 500 mW or +27 dBm (circulator and/or coupler limited) with 1 to 2 dB loss to probe port for all models.

For back-reflecting (BR) probe model types, the probe port reflected input power ranges from 5 to 35 dBm maximum to -18 dBm minimum for PIN models and 2 to 32 dBm maximum to -25 dBm minimum for APD, depending on VOA setting. RF output voltage is ~715 mVpp @ 0 dBm input for PIN models and ~350 mVpp for APD models. For non-back-reflecting (NBR) probe model types, the probe port reflected input power range is 7 dBm maximum to -15 dBm minimum for PIN models and 4 dBm maximum to -22 dBm minimum for APD. RF output voltage is ~536 mVpp @ 0 dBm input for PIN models and ~210 mVpp for APD models. See PDV receiver section of full ModBlock catalog for block diagrams and complete specifications for each model.

All models use single-mode fiber with FC/APC connectors. Internal user-replaceable “crash” cables are provided (laser input and probe port) on all models for repair convenience in case of optical connector damage. A front panel auxiliary DC output (SMA connector) is provided for optical input power level monitoring by external hardware. All models are packaged in a black 1.72”H x 4.19”W x 8.70”D modular chassis allowing simple horizontal or vertical ModBlock stacking, are daisy-chain powered by 12 volts DC ±3 volts DC (9 to 15 VDC), and are computer controllable via Ethernet.

A front panel bi-color “Over/OK” LED monitors the optical input power level to the receiver. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power.

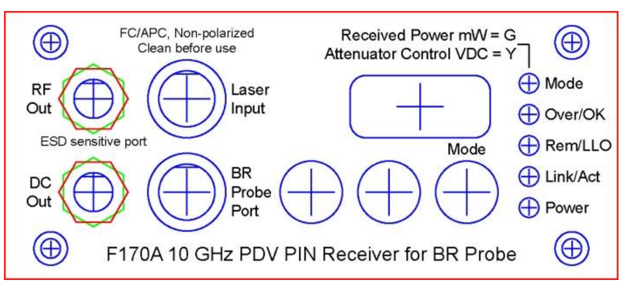
Front panel pushbuttons and a numeric readout provide manual attenuator (VOA) control and received optical power monitoring, which can also be used remotely. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates Attenuator Control mode, green indicates Received Power monitor mode, and dark indicates off mode. Pushbuttons with up and down arrows allow attenuation adjustment for either mode indicated by the bi-color LED. The mode pushbutton is also used to turns the display off. Models with a “spotting” laser contain a 1 mW red laser, optical switch, and “Spot Enable” lighted pushbutton switch for use in visual alignment of probe to target prior to PDV use (which can also be remotely operated).

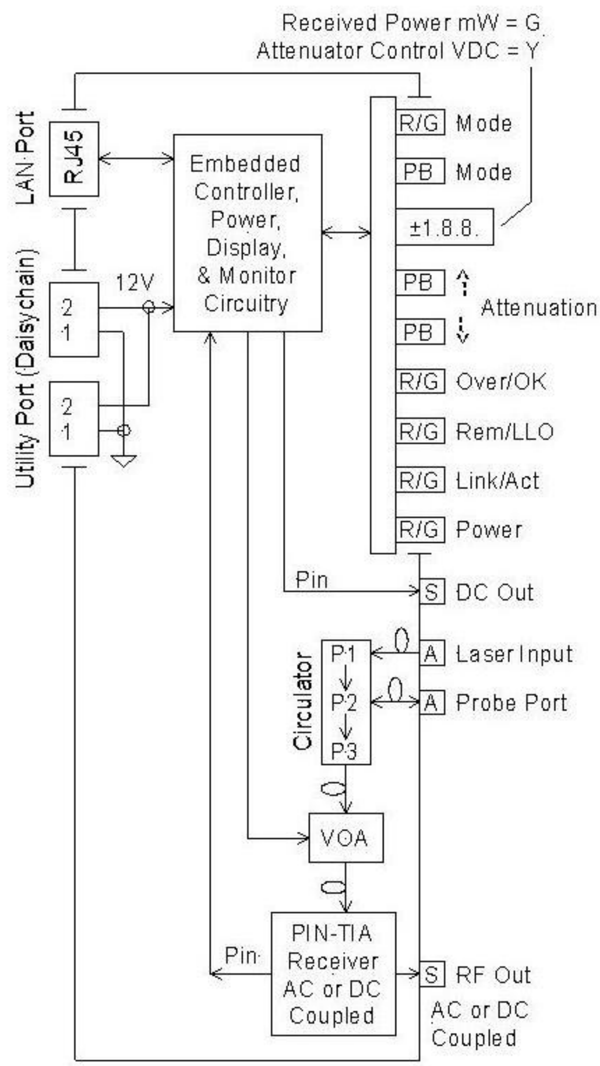
F170A-AC, Analog Receiver, PIN, 10 GHz Class, AC-coupled, for PDV Back-Reflecting Probe
F170A-DC, Analog Receiver, PIN, 10 GHz Class, DC-coupled, for PDV Back-Reflecting Probe

This analog receiver is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a back-reflecting (BR) probe. A coherent interferometer condition occurs at the BR probe tip due to Fresnel loss and reflected target light. The receiver contains a linear 10 GHz class PIN photodiode with transimpedance amplifier, preceded by a variable optical attenuator (VOA) and a 3-port circulator. The VOA is used to insure the receiver optical input power is within its operating range and especially to avoid receiver damage from excessive optical input power. All optical connections are FC/APC (angled tip) using single-mode fiber. Internal user-replaceable “crash” cables are provided (laser input and probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware. See the **Brief Specifications for PDV Receivers** section starting on page 50 for front panel LED, switch, and numeric readout operation.

F170A-* front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 8.7” deep





Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F170A-AC, F170A-DC	-	-
Probe Type	Back-reflecting	-	-
Fiber Type	Single-mode	-	-
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range	1528 to 1563	nm	minimum
Polarity, O-to-E conversion	Non-inverting	-	-
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-

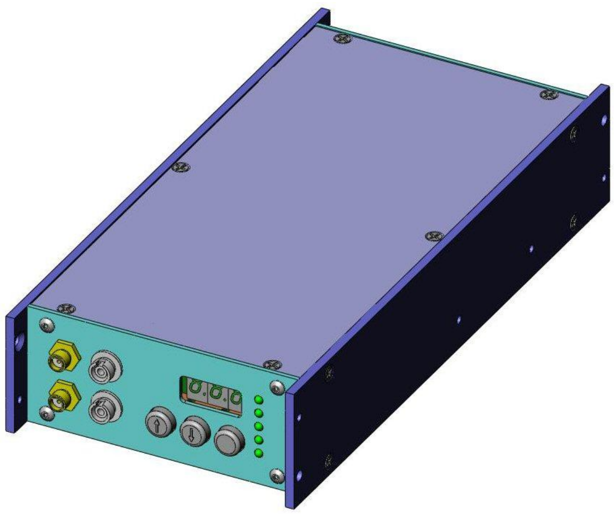
Parameter	Value	Units	Qualifier
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical
Receiver Type	PIN-TIA	-	-
Laser Input Power, maximum	500 27	mW dBm	-
Optical Insertion Loss, Laser Input to Probe Port	1	dB	typical
Probe Port Input Power, damage threshold (normally by probe back-reflection)	6 36	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, maximum (normally by probe back-reflection)	5 35	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, minimum, VOA = 0 (normally by probe back-reflection)	-18 16	dBm uW	typical, -20 dBm at receiver input
Optical Insertion Loss, Probe Port to Receiver	2	dB	typical, VOA = 0
Optical Return Loss, Laser Input or Probe Port	50	dB	minimum
Sensitivity, 10^{-10} BER	-16 -17	dBm	minimum typical
Receiver Sensitivity, 10^{-10} BER (receiver only)	-18 -19	dBm	minimum typical
Receiver Responsivity	0.7 0.8	mA/mW	minimum typical
Receiver Transimpedance	400 500 650	ohms	minimum typical maximum
Receiver Gain Flatness	±0.75	dB	typical
Receiver Bandwidth	9.5 10	GHz	minimum typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F170-AC F170-DC
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F170-AC F170-DC
Receiver Linearity, -15 to 0 dBm	<1	%	typical
Receiver Group Delay, <7 GHz	±10	ps	typical
Receiver Noise Figure	3	dB	typical
RF Output Coupling	AC, 0.1 uF DC	-	F170-AC F170-DC
RF Output Voltage, typical (receiver input to RF output)	900 28 13	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Voltage, typical (probe port input to RF output, VOA = 0)	715 22 10	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

F171A-AC, Analog Receiver, APD, 10 GHz Class, AC-coupled, for PDV Back-Reflecting Probe

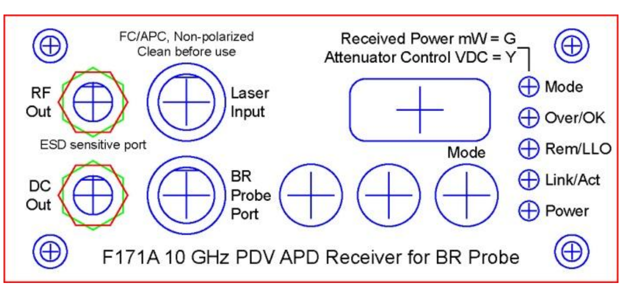
F171A-DC, Analog Receiver, APD, 10 GHz Class, DC-coupled, for PDV Back-Reflecting Probe

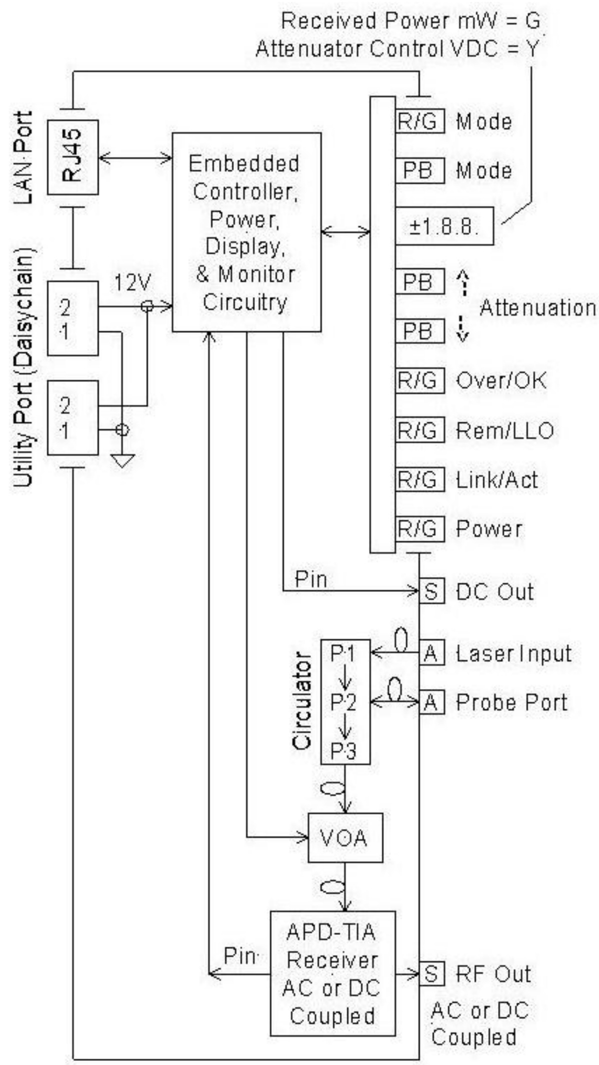
This analog receiver is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a back-reflecting (BR) probe. A coherent interferometer condition occurs at the BR probe tip due to Fresnel loss and reflected target light. The receiver contains a linear 10 GHz class APD photodiode with transimpedance amplifier, preceded by a variable optical attenuator (VOA) and a 3-port circulator. The VOA is used to insure the receiver optical input power is within its operating range and especially to avoid receiver damage from excessive optical input power. All optical connections are FC/APC (angled tip) using single-mode fiber. Internal user-replaceable “crash” cables are provided (laser input and probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware. See the **Brief Specifications for PDV Receivers** section starting on page 50 for front panel LED, switch, and numeric readout operation.

F171A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

Key specifications (also see Common Specifications on page 20)

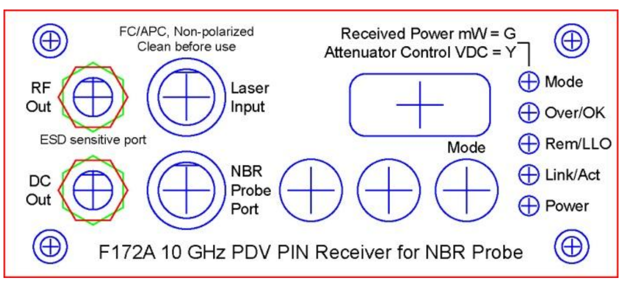
Parameter	Value	Units	Qualifier
Model Number	F171A-AC, F171A-DC	-	-
Probe Type	Back-reflecting	-	-
Fiber Type	Single-mode	-	-
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range	1528 to 1563	nm	minimum
Polarity, O-to-E conversion	Non-inverting	-	-
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical
Receiver Type	APD-TIA	-	-
Laser Input Power, maximum	500 27	mW dBm	-
Optical Insertion Loss, Laser Input to Probe Port	1	dB	typical
Probe Port Input Power, damage threshold (normally by probe back-reflection)	5 35	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, maximum (normally by probe back-reflection)	2 32	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, minimum, VOA = 0 (normally by probe back-reflection)	-25 3	dBm uW	typical, -27 dBm at receiver input
Optical Insertion Loss, Probe Port to Receiver	2	dB	typical, VOA = 0
Optical Return Loss, Laser Input or Probe Port	50	dB	minimum
Sensitivity, 10^{-10} BER	-23	dBm	typical
Receiver Sensitivity, 10^{-12} BER (receiver only)	-25	dBm	typical
Receiver Responsivity	0.7	mA/mW	typical
Receiver Transimpedance	500	ohms	typical
Receiver Gain Flatness	±1	dB	typical
Receiver Bandwidth	10	Gb/s	typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F171-AC F171-DC
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F171-AC F171-DC
Receiver Group Delay, <7 GHz	±15	ps	typical
RF Output Coupling	AC, 0.1 uF DC	-	F171-AC F171-DC
RF Output Voltage, minimum (receiver input to RF output)	350	mVpp	0 dBm input
RF Output Voltage, minimum (probe port input to RF output, VOA = 0)	278	mVpp	0 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

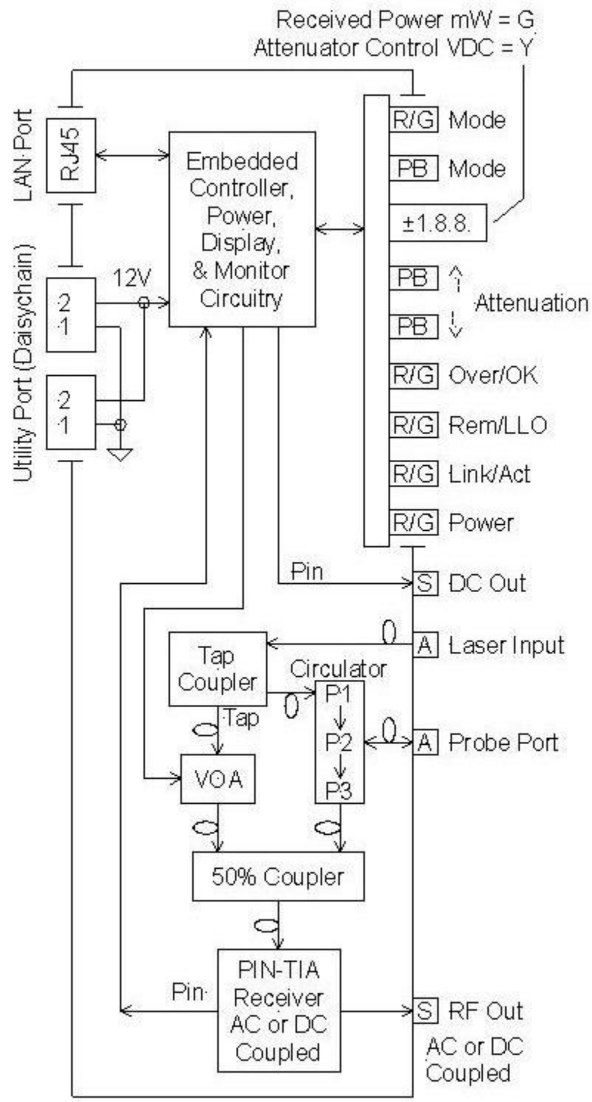
F172A-AC, Analog Receiver, PIN, 10 GHz Class, AC-coupled, for PDV Non-Back-Reflecting Probe

F172A-DC, Analog Receiver, PIN, 10 GHz Class, DC-coupled, for PDV Non-Back-Reflecting Probe

F172A-* front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 8.7" deep





This analog receiver is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a non-back-reflecting (NBR) probe. The receiver contains a linear 10 GHz class PIN photodiode with transimpedance amplifier, preceded by a 50% coupler, variable optical attenuator (VOA), 3-port circulator, and a tap coupler. A coherent interferometer condition occurs in the 50% coupler by combining the tapped laser input light and reflected target light from the NBR probe. The VOA is used to roughly match their amplitudes, insure the receiver optical input power is within its operating range, and especially to avoid receiver damage from excessive optical input power. All optical connections are FC/APC (angled tip) using single-mode fiber. Internal user-replaceable “crash” cables are provided (laser input and probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware. See the **Brief Specifications for PDV Receivers** section starting on page 50 for front panel LED, switch, and numeric readout operation.

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F172A-AC, F172A-DC	-	-
Probe Type	Non-back-reflecting	-	-
Fiber Type	Single-mode	-	-
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range	1528 to 1563	nm	minimum
Polarity, O-to-E conversion	Non-inverting	-	-
Coupler Type, tap and 50% combiner	Fused Bi-conical Taper	-	-
Tap Coupler Ratio	1	%	typical
Combiner Coupler Ratio	50	%	typical
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical
Receiver Type	PIN-TIA	-	-
Laser Input Power, maximum	500 27	mW dBm	-
Optical Insertion Loss, Laser Input to Probe Port	1.2	dB	typical
Probe Port Input Power, damage threshold (normally by probe back-reflection)	8 6	dBm mW	typical
Probe Port Input Power, maximum (normally by probe back-reflection)	7 5	dBm mW	typical
Probe Port Input Power, minimum (normally by probe back-reflection)	-15 30	dBm uW	typical, -20 dBm at receiver input
Optical Insertion Loss, typical Laser Input to Receiver	23 53	dB	VOA = 0 VOA = max.
Optical Insertion Loss, Probe Port to Receiver	4.5	dB	typical
Optical Return Loss, Laser Input or Probe Port	50	dB	minimum
Sensitivity, 10^{-10} BER	-13 -14	dBm	minimum typical
Receiver Sensitivity, 10^{-10} BER (receiver only)	-18 -19	dBm	minimum typical
Receiver Responsivity	0.7 0.8	mA/mW	minimum typical
Receiver Transimpedance	400 500 650	ohms	minimum typical maximum
Receiver Gain Flatness	±0.75	dB	typical
Receiver Bandwidth	9.5 10	GHz	minimum typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F172-AC F172-DC

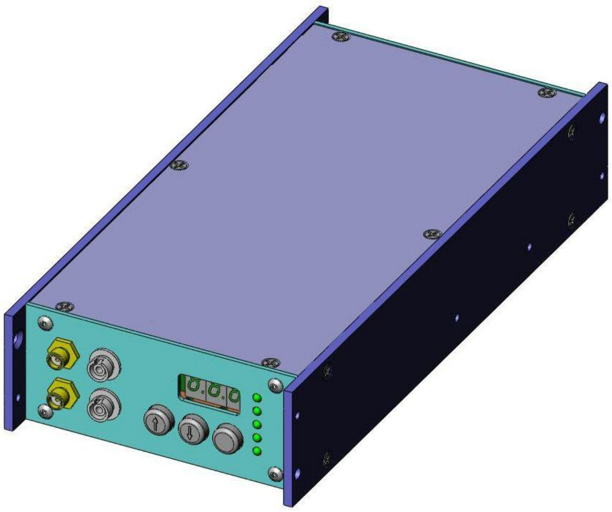
Parameter	Value	Units	Qualifier
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F172-AC F172-DC
Receiver Linearity, -15 to 0 dBm	<1	%	typical
Receiver Group Delay, <7 GHz	±10	ps	typical
Receiver Noise Figure	3	dB	typical
RF Output Coupling	AC, 0.1 uF DC	-	F172-AC F172-DC
RF Output Voltage, typical (receiver input to RF output)	900 28 13	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Voltage, typical (probe port input to RF output)	536 16 8	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

F173A-AC, Analog Receiver, APD, 10 GHz Class, AC-coupled, for PDV Non Back-Reflecting Probe

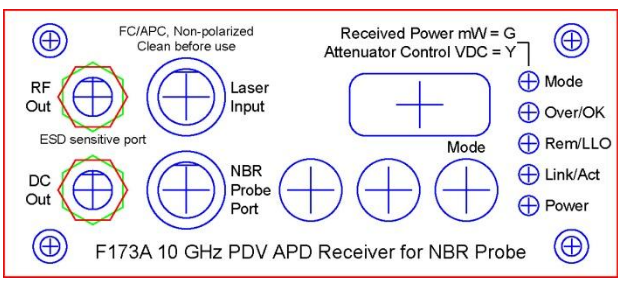
F173A-DC, Analog Receiver, APD, 10 GHz Class, DC-coupled, for PDV Non Back-Reflecting Probe

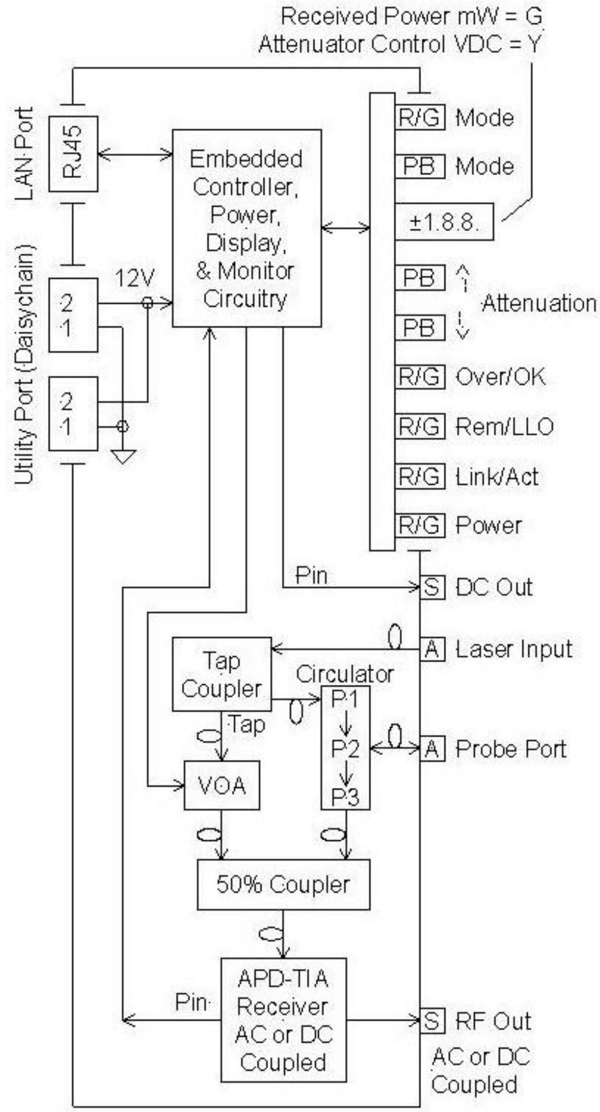
This analog receiver is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a non-back-reflecting (NBR) probe. The receiver contains a linear 10 GHz class APD photodiode with transimpedance amplifier, preceded by a 50% coupler, variable optical attenuator (VOA), 3-port circulator, and a tap coupler. A coherent interferometer condition occurs in the 50% coupler by combining the tapped laser input light and reflected target light from the NBR probe. The VOA is used to roughly match their amplitudes, insure the receiver optical input power is within its operating range, and especially to avoid receiver damage from excessive optical input power. All optical connections are FC/APC (angled tip) using single-mode fiber. Internal user-replaceable "crash" cables are provided (laser input and probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware. See the **Brief Specifications for PDV Receivers** section starting on page 50 for front panel LED, switch, and numeric readout operation.

F173A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7" deep





Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F173A-AC, F173A-DC	-	-
Probe Type	Non-back-reflecting	-	-
Fiber Type	Single-mode	-	-
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range	1528 to 1563	nm	minimum
Polarity, O-to-E conversion	Non-inverting	-	-
Coupler Type, tap and 50% combiner	Fused Bi-conical Taper	-	-
Tap Coupler Ratio	1	%	typical
Combiner Coupler Ratio	50	%	typical
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical

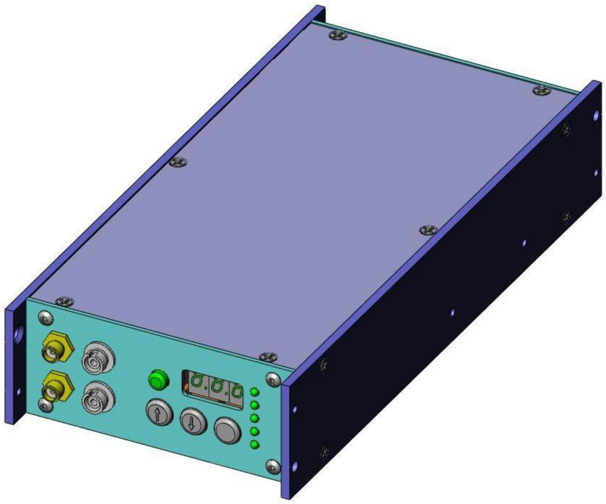
Parameter	Value	Units	Qualifier
Receiver Type	APD-TIA	-	-
Laser Input Power, maximum	500 27	mW dBm	-
Optical Insertion Loss, Laser Input to Probe Port	1.2	dB	typical
Probe Port Input Power, damage threshold (normally by probe back-reflection)	7 5	dBm mW	typical
Probe Port Input Power, maximum (normally by probe back-reflection)	4 2.5	dBm mW	typical
Probe Port Input Power, minimum (normally by probe back-reflection)	-22 6	dBm uW	typical, -27 dBm at receiver input
Optical Insertion Loss, typical Laser Input to Receiver	23 53	dB	VOA = 0 VOA = max.
Optical Insertion Loss, Probe Port to Receiver	4.5	dB	typical
Optical Return Loss, Laser Input or Probe Port	50	dB	minimum
Sensitivity, 10^{-10} BER	-20	dBm	typical
Receiver Sensitivity, 10^{-12} BER (receiver only)	-25	dBm	typical
Receiver Responsivity	0.7	mA/mW	typical
Receiver Transimpedance	500	ohms	typical
Receiver Gain Flatness	±1	dB	typical
Receiver Bandwidth	10	Gb/s	typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F173-AC F173-DC
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F173-AC F173-DC
Receiver Linearity, -15 to 0 dBm	<1	%	typical
Receiver Group Delay, <7 GHz	±15	ps	typical
RF Output Coupling	AC, 0.1 uF DC	-	F173-AC F173-DC
RF Output Voltage, minimum (receiver input to RF output)	350	mVpp	0 dBm input
RF Output Voltage, minimum (probe port input to RF output)	210	mVpp	0 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

F175A-AC, Analog Receiver, PIN, 10 GHz Class, AC-coupled, with Red Spotting Laser, for PDV Back-Reflecting Probe

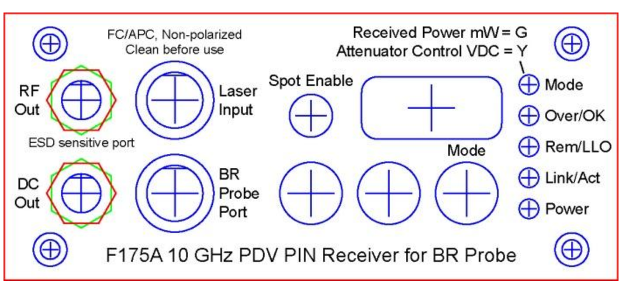
F175A-DC, Analog Receiver, PIN, 10 GHz Class, DC-coupled, with Red Spotting Laser, for PDV Back-Reflecting Probe

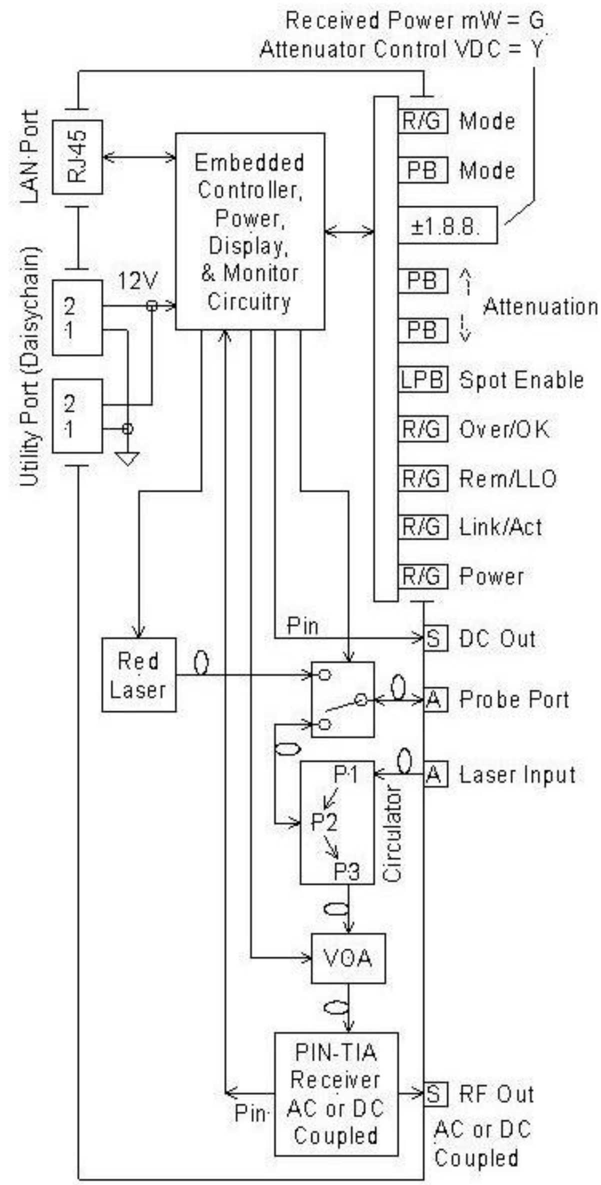
This analog receiver is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a back-reflecting (BR) probe. A coherent interferometer condition occurs at the BR probe tip due to Fresnel loss and reflected target light. The receiver contains a linear 10 GHz class PIN photodiode with transimpedance amplifier, preceded by a variable optical attenuator (VOA) and a 3-port circulator. The VOA is used to insure the receiver optical input power is within its operating range and especially to avoid receiver damage from excessive optical input power. All optical connections are FC/APC (angled tip) using single-mode fiber. Internal user-replaceable “crash” cables are provided (laser input and probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware. See the **Brief Specifications for PDV Receivers** section starting on page 50 for front panel LED, switch, and numeric readout operation.

F175A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F175A-AC, F175A-DC	-	-
Probe Type	Back-reflecting	-	-

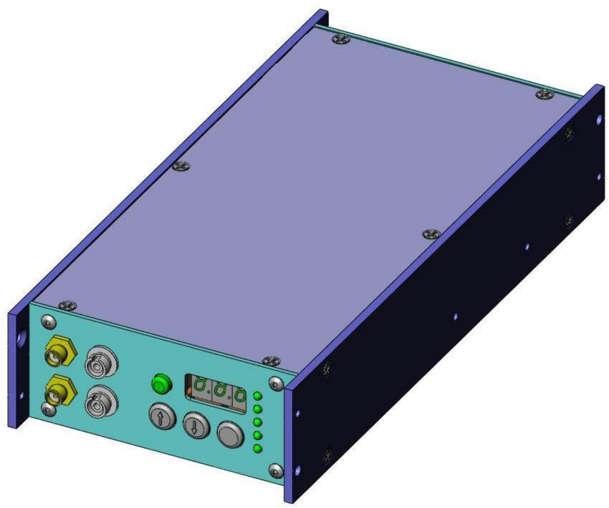
Parameter	Value	Units	Qualifier
Fiber Type	Single-mode	-	-
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range	1528 to 1563	nm	minimum
Polarity, O-to-E conversion	Non-inverting	-	-
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical
Receiver Type	PIN-TIA	-	-
Laser Input Power, maximum	500 27	mW dBm	-
Optical Insertion Loss, Laser Input to Probe Port	1	dB	typical
Probe Port Input Power, damage threshold (normally by probe back-reflection)	6 36	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, maximum (normally by probe back-reflection)	5 35	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, minimum, VOA = 0 (normally by probe back-reflection)	-18 16	dBm uW	typical, -20 dBm at receiver input
Optical Insertion Loss, Probe Port to Receiver	2	dB	typical, VOA = 0
Optical Return Loss, Laser Input or Probe Port	50	dB	minimum
Sensitivity, 10^{-10} BER	-16 -17	dBm	minimum typical
Receiver Sensitivity, 10^{-10} BER (receiver only)	-18 -19	dBm	minimum typical
Receiver Responsivity	0.7 0.8	mA/mW	minimum typical
Receiver Transimpedance	400 500 650	ohms	minimum typical maximum
Receiver Gain Flatness	±0.75	dB	typical
Receiver Bandwidth	9.5 10	GHz	minimum typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F175-AC F175-DC
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F175-AC F175-DC
Receiver Linearity, -15 to 0 dBm	<1	%	typical
Receiver Group Delay, <7 GHz	±10	ps	typical
Receiver Noise Figure	3	dB	typical
RF Output Coupling	AC, 0.1 uF DC	-	F175-AC F175-DC
RF Output Voltage, typical (receiver input to RF output)	900 28 13	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Voltage, typical (probe port input to RF output, VOA = 0)	715 22 10	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Spotting Laser Wavelength	635	nm	nominal
Spotting Laser Output Power	1 or off	mW	nominal

Parameter	Value	Units	Qualifier
Switching Time	10	ms	typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

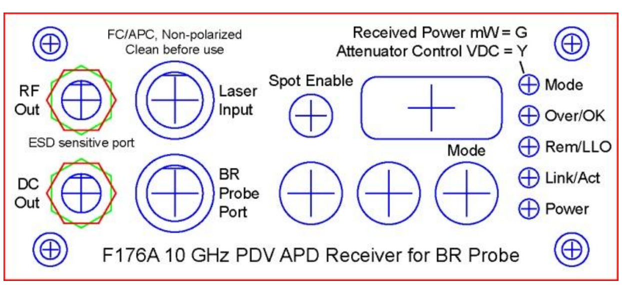
F176A-AC, Analog Receiver, APD, 10 GHz Class, AC-coupled, with Red Spotting Laser, for PDV Back-Reflecting Probe

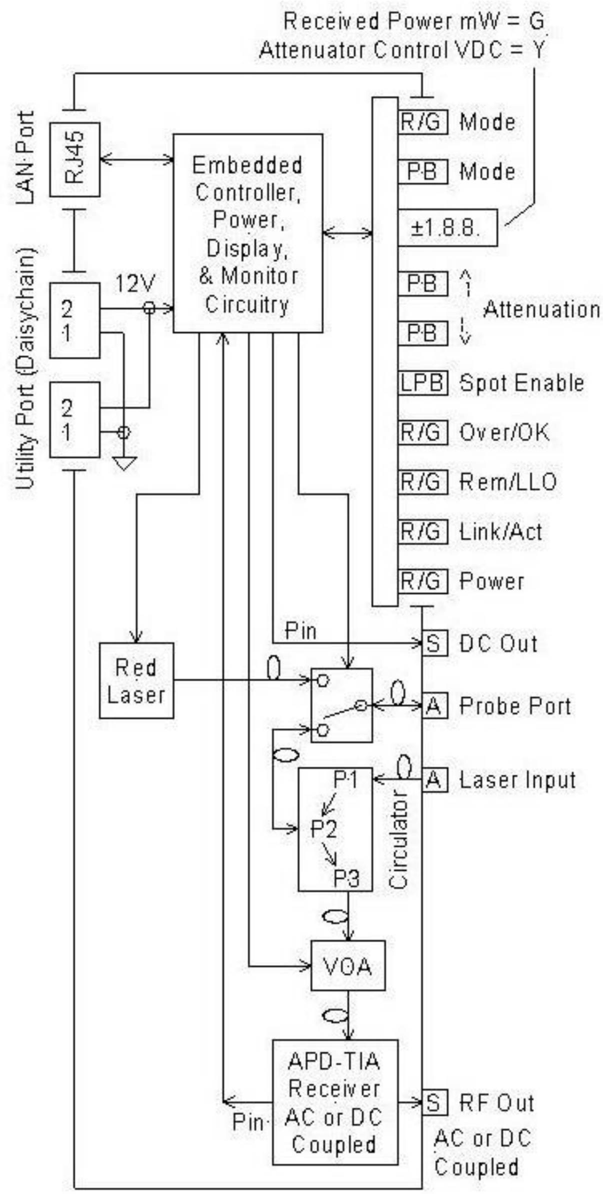
F176A-DC, Analog Receiver, APD, 10 GHz Class, DC-coupled, with Red Spotting Laser, for PDV Back-Reflecting Probe

F176A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7" deep





This analog receiver is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a back-reflecting (BR) probe. A coherent interferometer condition occurs at the BR probe tip due to Fresnel loss and reflected target light. The receiver contains a linear 10 GHz class APD photodiode with transimpedance amplifier, preceded by a variable optical attenuator (VOA) and a 3-port circulator. The VOA is used to insure the receiver optical input power is within its operating range and especially to avoid receiver damage from excessive optical input power. All optical connections are FC/APC (angled tip) using single-mode fiber. Internal user-replaceable "crash" cables are provided (laser input and probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware. See the **Brief Specifications for PDV Receivers** section starting on page 50 for front panel LED, switch, and numeric readout operation.

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F176A-AC, F176A-DC	-	-
Probe Type	Back-reflecting	-	-
Fiber Type	Single-mode	-	-
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range	1528 to 1563	nm	minimum
Polarity, O-to-E conversion	Non-inverting	-	-
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical
Receiver Type	APD-TIA	-	-
Laser Input Power, maximum	500 27	mW dBm	-
Optical Insertion Loss, Laser Input to Probe Port	1	dB	typical
Probe Port Input Power, damage threshold (normally by probe back-reflection)	5 35	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, maximum (normally by probe back-reflection)	2 32	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, minimum, VOA = 0 (normally by probe back-reflection)	-25 3	dBm uW	typical, -27 dBm at receiver input
Optical Insertion Loss, Probe Port to Receiver	2	dB	typical, VOA = 0
Optical Return Loss, Laser Input or Probe Port	50	dB	minimum
Sensitivity, 10^{-10} BER	-23	dBm	typical
Receiver Sensitivity, 10^{-12} BER (receiver only)	-25	dBm	typical
Receiver Responsivity	0.7	mA/mW	typical
Receiver Transimpedance	500	ohms	typical
Receiver Gain Flatness	±1	dB	typical
Receiver Bandwidth	10	Gb/s	typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F176-AC F176-DC
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F176-AC F176-DC
Receiver Group Delay, <7 GHz	±15	ps	typical

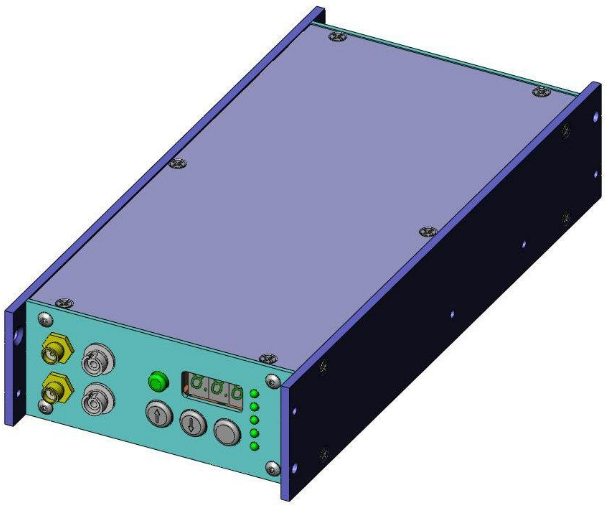
Parameter	Value	Units	Qualifier
RF Output Coupling	AC, 0.1 uF DC	-	F176-AC F176-DC
RF Output Voltage, minimum (receiver input to RF output)	350	mVpp	0 dBm input
RF Output Voltage, minimum (probe port input to RF output, VOA = 0)	278	mVpp	0 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Spotting Laser Wavelength	635	nm	nominal
Spotting Laser Output Power	1 or off	mW	nominal
Switching Time	10	ms	typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

F177A-AC, Analog Receiver, PIN, 10 GHz Class, AC-coupled, with Red Spotting Laser, for PDV Non-Back-Reflecting Probe

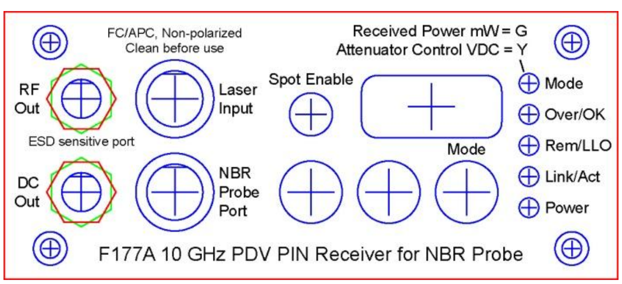
F177A-DC, Analog Receiver, PIN, 10 GHz Class, DC-coupled, with Red Spotting Laser, for PDV Non-Back-Reflecting Probe

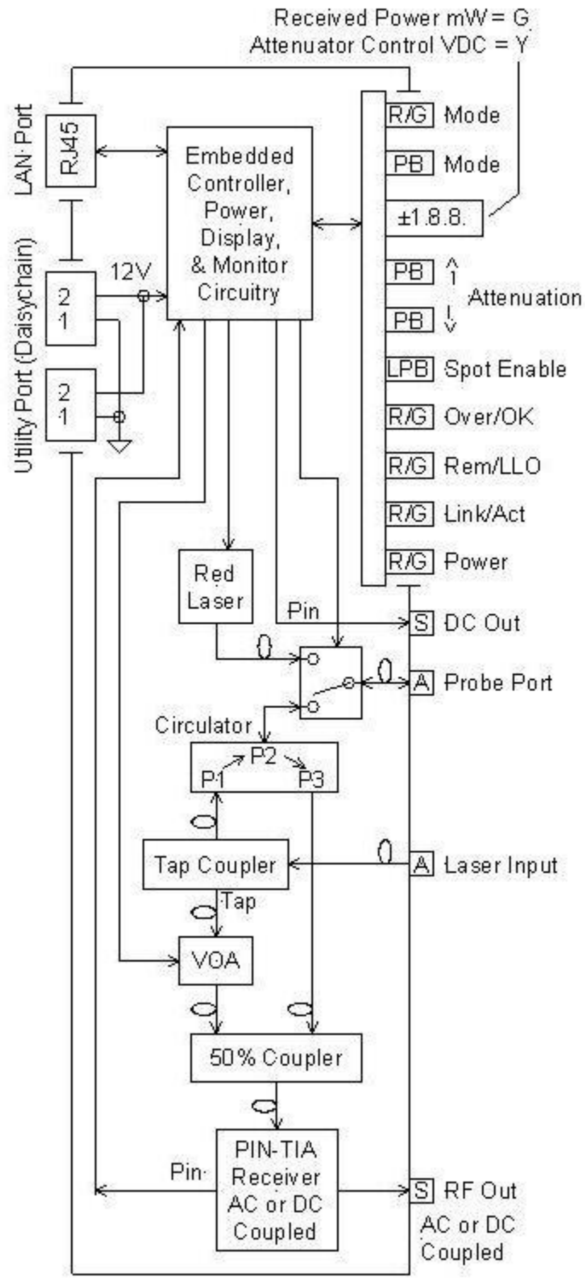
This analog receiver is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a non-back-reflecting (NBR) probe. The receiver contains a linear 10 GHz class PIN photodiode with transimpedance amplifier, preceded by a 50% coupler, variable optical attenuator (VOA), 3-port circulator, and a tap coupler. A coherent interferometer condition occurs in the 50% coupler by combining the tapped laser input light and reflected target light from the NBR probe. The VOA is used to roughly match their amplitudes, insure the receiver optical input power is within its operating range, and especially to avoid receiver damage from excessive optical input power. All optical connections are FC/APC (angled tip) using single-mode fiber. Internal user-replaceable “crash” cables are provided (laser input and probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware. See the **Brief Specifications for PDV Receivers** section starting on page 50 for front panel LED, switch, and numeric readout operation.

F177A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F177A-AC, F177A-DC	-	-
Probe Type	Non-back-reflecting	-	-
Fiber Type	Single-mode	-	-
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range	1528 to 1563	nm	minimum
Polarity, O-to-E conversion	Non-inverting	-	-
Coupler Type, tap and 50% combiner	Fused Bi-conical Taper	-	-

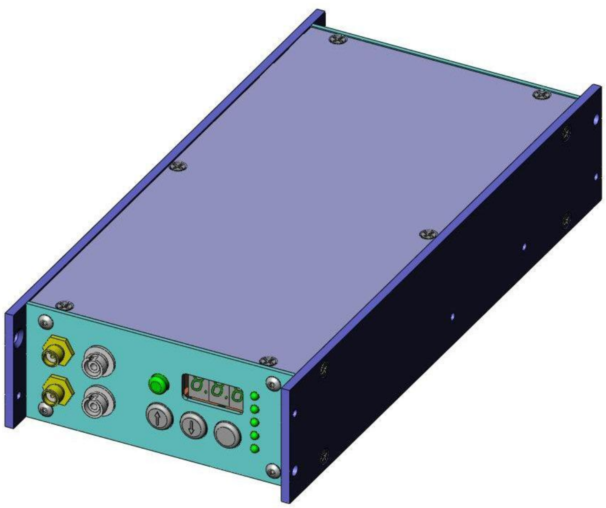
Parameter	Value	Units	Qualifier
Tap Coupler Ratio	1	%	typical
Combiner Coupler Ratio	50	%	typical
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical
Receiver Type	PIN-TIA	-	-
Laser Input Power, maximum	500 27	mW dBm	-
Optical Insertion Loss, Laser Input to Probe Port	1.2	dB	typical
Probe Port Input Power, damage threshold (normally by probe back-reflection)	8 6	dBm mW	typical
Probe Port Input Power, maximum (normally by probe back-reflection)	7 5	dBm mW	typical
Probe Port Input Power, minimum (normally by probe back-reflection)	-15 30	dBm uW	typical, -20 dBm at receiver input
Optical Insertion Loss, typical Laser Input to Receiver	23 53	dB	VOA = 0 VOA = max.
Optical Insertion Loss, Probe Port to Receiver	4.5	dB	typical
Optical Return Loss, Laser Input or Probe Port	50	dB	minimum
Sensitivity, 10^{-10} BER	-13 -14	dBm	minimum typical
Receiver Sensitivity, 10^{-10} BER (receiver only)	-18 -19	dBm	minimum typical
Receiver Responsivity	0.7 0.8	mA/mW	minimum typical
Receiver Transimpedance	400 500 650	ohms	minimum typical maximum
Receiver Gain Flatness	±0.75	dB	typical
Receiver Bandwidth	9.5 10	GHz	minimum typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F177-AC F177-DC
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F177-AC F177-DC
Receiver Linearity, -15 to 0 dBm	<1	%	typical
Receiver Group Delay, <7 GHz	±10	ps	typical
Receiver Noise Figure	3	dB	typical
RF Output Coupling	AC, 0.1 uF DC	-	F177-AC F177-DC
RF Output Voltage, typical (receiver input to RF output)	900 28 13	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Voltage, typical (probe port input to RF output)	536 16 8	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Spotting Laser Wavelength	635	nm	nominal
Spotting Laser Output Power	1 or off	mW	nominal

Parameter	Value	Units	Qualifier
Switching Time	10	ms	typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

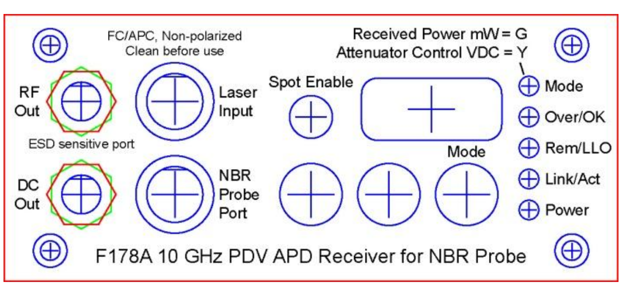
F178A-AC, Analog Receiver, APD, 10 GHz Class, AC-coupled, with Red Spotting Laser, for PDV Non Back-Reflecting Probe

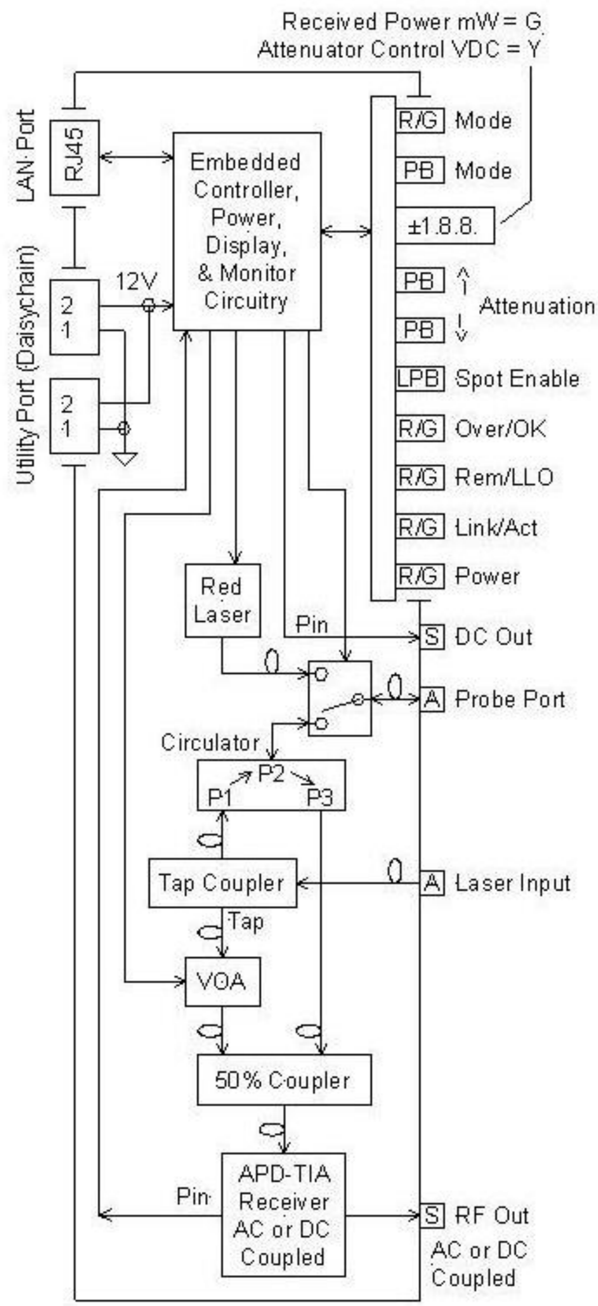
F178A-DC, Analog Receiver, APD, 10 GHz Class, DC-coupled, with Red Spotting Laser, for PDV Non Back-Reflecting Probe

F178A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





This analog receiver is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a non-back-reflecting (NBR) probe. The receiver contains a linear 10 GHz class APD photodiode with transimpedance amplifier, preceded by a 50% coupler, variable optical attenuator (VOA), 3-port circulator, and a tap coupler. A coherent interferometer condition occurs in the 50% coupler by combining the tapped laser input light and reflected target light from the NBR probe. The VOA is used to roughly match their amplitudes, insure the receiver optical input power is within its operating range, and especially to avoid receiver damage from excessive optical input power. All optical connections are FC/APC (angled tip) using single-mode fiber. Internal user-replaceable "crash" cables are provided (laser input and probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware. See the **Brief Specifications for PDV Receivers** section starting on page 50 for front panel LED, switch, and numeric readout operation.

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F178A-AC, F178A-DC	-	-
Probe Type	Non-back-reflecting	-	-
Fiber Type	Single-mode	-	-
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range	1528 to 1563	nm	minimum
Polarity, O-to-E conversion	Non-inverting	-	-
Coupler Type, tap and 50% combiner	Fused Bi-conical Taper	-	-
Tap Coupler Ratio	1	%	typical
Combiner Coupler Ratio	50	%	typical
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical
Receiver Type	APD-TIA	-	-
Laser Input Power, maximum	500 27	mW dBm	-
Optical Insertion Loss, Laser Input to Probe Port	1.2	dB	typical
Probe Port Input Power, damage threshold (normally by probe back-reflection)	7 5	dBm mW	typical
Probe Port Input Power, maximum (normally by probe back-reflection)	4 2.5	dBm mW	typical
Probe Port Input Power, minimum (normally by probe back-reflection)	-22 6	dBm uW	typical, -27 dBm at receiver input
Optical Insertion Loss, typical Laser Input to Receiver	23 53	dB	VOA = 0 VOA = max.
Optical Insertion Loss, Probe Port to Receiver	4.5	dB	typical
Optical Return Loss, Laser Input or Probe Port	50	dB	minimum
Sensitivity, 10^{-10} BER	-20	dBm	typical
Receiver Sensitivity, 10^{-12} BER (receiver only)	-25	dBm	typical

Parameter	Value	Units	Qualifier
Receiver Responsivity	0.7	mA/mW	typical
Receiver Transimpedance	500	ohms	typical
Receiver Gain Flatness	±1	dB	typical
Receiver Bandwidth	10	Gb/s	typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F178-AC F178-DC
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F178-AC F178-DC
Receiver Linearity, -15 to 0 dBm	<1	%	typical
Receiver Group Delay, <7 GHz	±15	ps	typical
RF Output Coupling	AC, 0.1 uF DC	-	F178-AC F178-DC
RF Output Voltage, minimum (receiver input to RF output)	350	mVpp	0 dBm input
RF Output Voltage, minimum (probe port input to RF output)	210	mVpp	0 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Spotting Laser Wavelength	635	nm	nominal
Spotting Laser Output Power	1 or off	mW	nominal
Switching Time	10	ms	typical
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

Custom PDV Receiver Equipment

TME can design, produce, and support any kind of custom PDV equipment required, including specialized research or developmental experimental equipment. An example 4-channel PDV receiver is shown below, which was built using customer specified fiber optic modules.

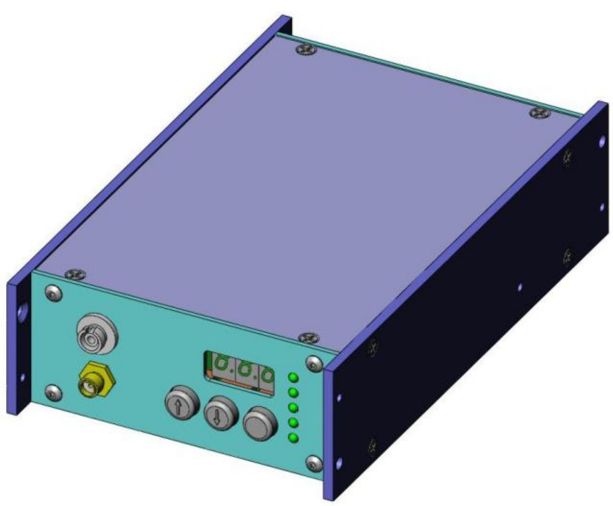
Limiting Receivers

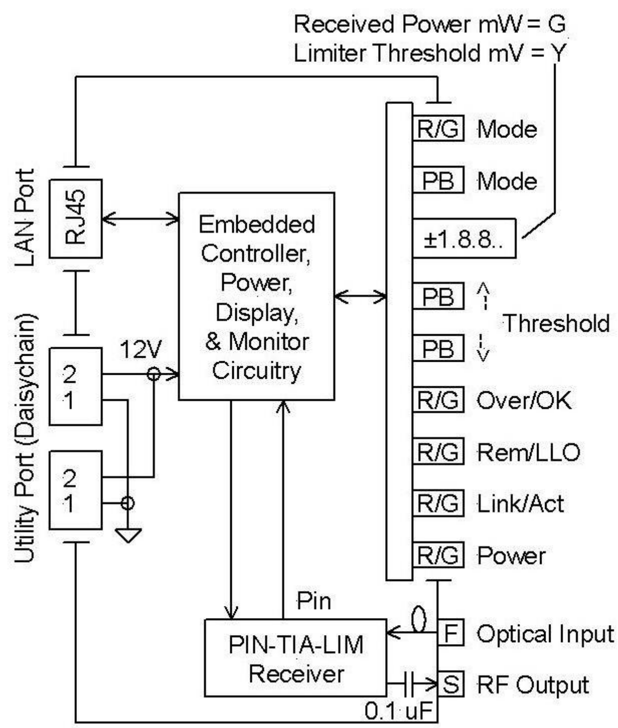
Analog fiber optic receiver ModBlocks with limiter amplifiers are offered for use in the 1310 nm and 1550 nm bands. PIN or APD photodiodes are used for models with 10 GHz class operation, which have single-ended AC-coupled RF outputs. PIN photodiodes are used for models with 2 GHz class operation, which have differential AC-coupled RF outputs. Models are offered with single mode (SM), 50 micron multimode (MM50), or 62.5 multimode (MM62.5 or MM62) fiber types.

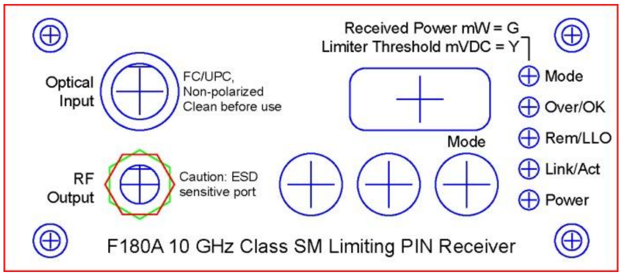
F180A, Limiting Receiver, PIN, 10 GHz Class, Single-mode
F182A, Limiting Receiver, PIN, 10 GHz Class, 50 micron Multimode
F184A, Limiting Receiver, PIN, 10 GHz Class, 62.5 micron Multimode

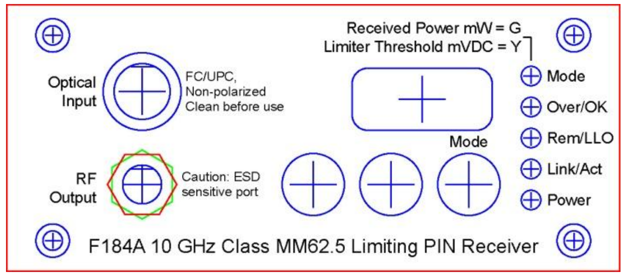
Analog receivers with limiter amplifiers are offered with 10 GHz class PIN photodiodes for use in the 1310 nm and 1550 nm bands. They provide a constant RF output level over a wide range of input optical power levels. The logic 1/0 decision point can be changed (usually done for small optical input signals) by adjusting the limiter threshold voltage. RF outputs are single-ended and AC coupled (0.1 uF, ~35 KHz). Models are offered with single mode (SM), 50 micron multimode (MM50), or 62.5 multimode (MM62.5 or MM62) fiber types. An internal user-replaceable “crash” cable is provided (optical input) on all models for repair convenience in case of optical connector damage.

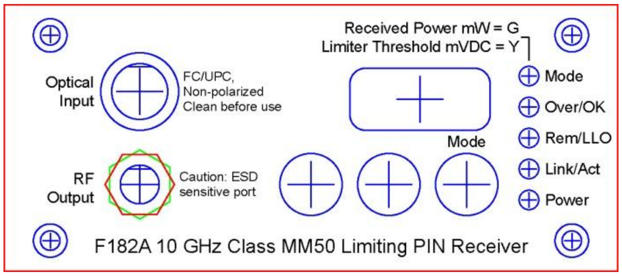
F180A, F182A, and F184A front chassis view, graphics layouts, and simple block diagram


1U, quarter-rack, 6.7” deep









A front panel bi-color “Over/OK” LED monitors the optical input power level. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power.

Front panel pushbuttons and a numeric readout provide limiter threshold voltage control and received optical power monitoring, which can also be used remotely. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates Limiter Threshold control mode, green indicates Received Power monitor mode, and dark indicates off mode. Pushbuttons with up and down arrows allow attenuation adjustment for the yellow mode indicated by the bi-color LED. The mode pushbutton is also used to turns the display off.

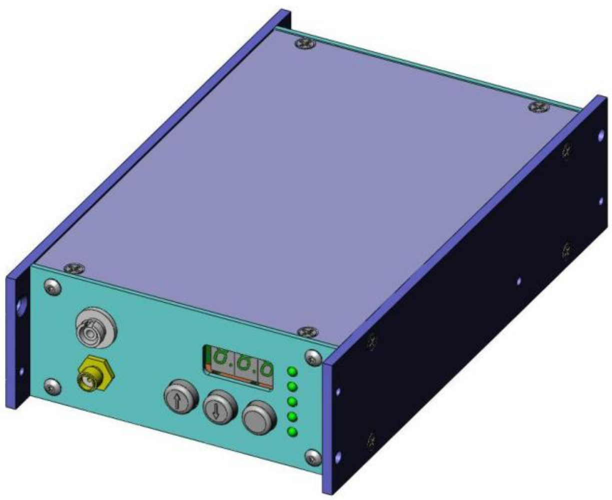
Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F180A F182A F184A	-	Single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	Single-mode 50 micron multimode 62.5 micron multimode	-	F180A F182A F184A
Receiver Type	PIN-TIA-Limiter	-	“2R” type
Wavelength Range	800 to 1650	nm	-
Receiver Sensitivity, 10^{-10} BER, PRBS 2^{23}-1, NRZ, 1550 nm	-18 -19	dBm	minimum typical
Receiver Overload	0	dBm	typical
Receiver Damage Threshold	1	dBm	typical

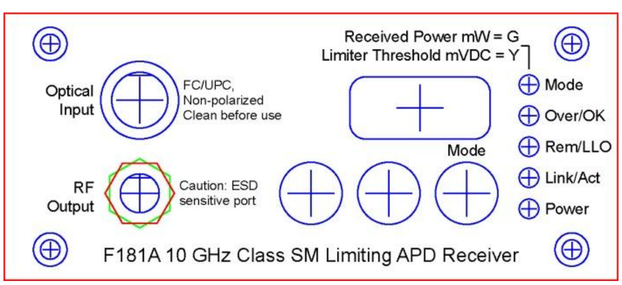
Parameter	Value	Units	Qualifier
Responsivity, 1310 to 1550 nm	0.7 0.8	mA/mW	minimum typical
Responsivity, 850 nm	0.2	mA/mW	typical
Bandwidth	10	Gb/s	typical
Low Frequency Cutoff	50	KHz	typical
Optical Return Loss, 1550 nm	30	dB	typical
Limiter Threshold Adjustment Range	0 to 1.8	VDC	typical
Limiter Threshold Adjustment Step Size	10	mV DC	typical
RF Output Voltage, typical	350	mVpp	0 to -20 dBm input
RF Output Return Loss (<8 GHz)	10	dB	minimum
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

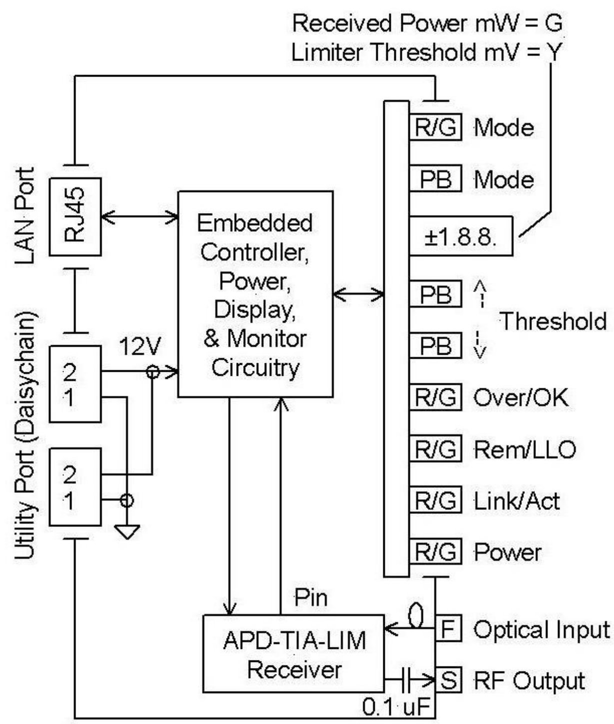
F181A, Limiting Receiver, APD, 10 GHz Class, Single-mode

F181A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 6.7” deep





This analog receiver has a 10 GHz class APD photodiode (with TIA) followed by a limiter amplifier for use in the 1310 nm and 1550 nm bands. It provides a constant RF output level over a wide range of input optical power levels. The logic 1/0 decision point can be changed (usually done for small optical input signals) by adjusting the limiter threshold voltage. The RF output is single-ended and AC coupled (0.1 uF, ~35 KHz). This model uses single mode (SM) fiber (multimode on request). An internal user-replaceable “crash” cable is provided (optical input) for repair convenience in case of optical connector damage.

A front panel bi-color “Over/OK” LED monitors the optical input power level. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power.

Front panel pushbuttons and a numeric readout provide limiter threshold voltage control and received optical power monitoring, which can also be used remotely. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates Limiter Threshold control mode, green indicates Received Power monitor mode, and dark indicates off mode. Pushbuttons with up and down arrows allow attenuation adjustment for the yellow mode indicated by the bi-color LED. The mode pushbutton is also used to turns the display off.

Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F181A	-	-
Fiber Type	Single-mode	-	-
Receiver Type	APD-TIA-Limiter	-	“2R” type
Wavelength Range	1100 to 1600	nm	-
Receiver Sensitivity, 10 Gb/s NRZ, 10^{-12} BER, PRBS 2^{31}-1, 1550 nm	-22	dBm	typical
Receiver Overload, <10^{-12} BER	-7	dBm	typical
Receiver Damage Threshold	-2	dBm	typical
Responsivity	0.7	mA/mW	typical
Bandwidth	10	Gb/s	typical
Low Frequency Cutoff	30	KHz	typical
Optical Return Loss, 1550 nm	27	dB	minimum
Limiter Threshold Adjustment Range	0 to 1.8	VDC	typical
Limiter Threshold Adjustment Step Size	10	mV DC	typical
RF Output Voltage, typical	300	mVpp	-6 to -22 dBm input
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

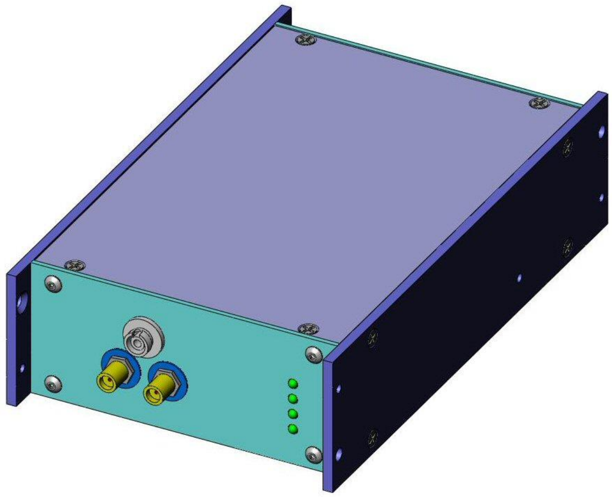
F186A, Limiting Receiver, PIN, 2 GHz Class, Single-mode

F187A, Limiting Receiver, PIN, 2 GHz Class, 50 micron Multimode

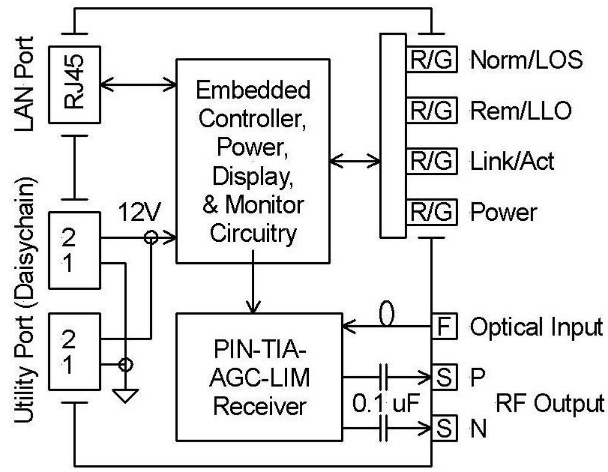
F188A, Limiting Receiver, PIN, 2 GHz Class, 62.5 micron Multimode

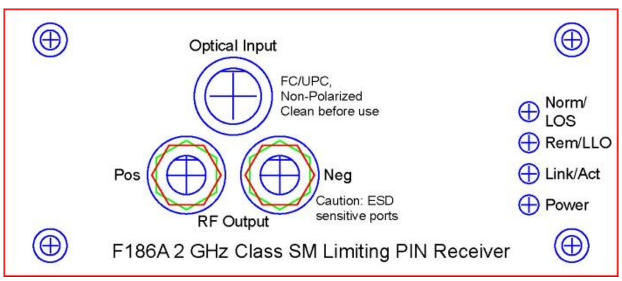
Analog receivers with limiter amplifiers are offered with 2 GHz class PIN photodiodes for use in the 1310 nm and 1550 nm bands. They provide a constant RF output level over a wide range of input optical power levels. RF outputs are complementary single-ended (can be used differentially) and AC coupled (0.1 uF, ~35 KHz). Models are offered with single mode (SM), 50 micron multimode (MM50), or 62.5 multimode (MM62.5 or MM62) fiber types. A front panel bi-color LED indicates the presence of an input signal (green=normal) or loss of signal (yellow=LOS).

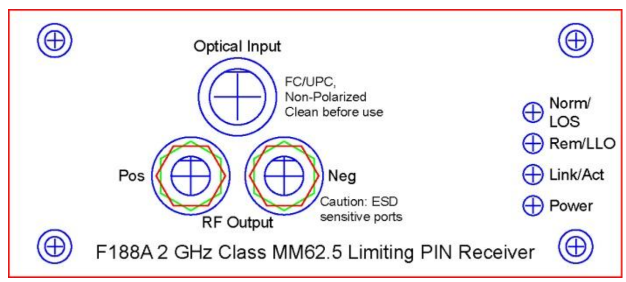
F186A, F187A, and F188A front chassis view, graphics layouts, and simple block diagram

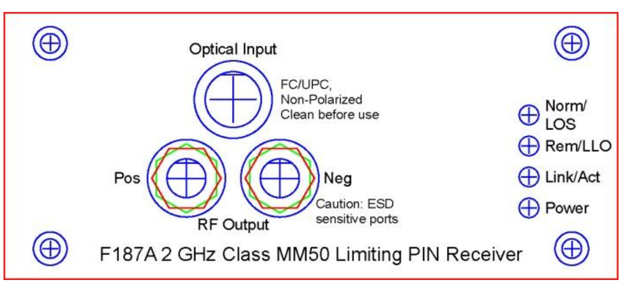


1U, quarter-rack, 6.7” deep









Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F186A F187A F188A	-	Single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	Single-mode 50 micron multimode 62.5 micron multimode	-	F186A F187A F188A
Receiver Type	PIN-TIA-Limiter	-	-
Wavelength Range	1100 to 1600	nm	-

Parameter	Value	Units	Qualifier
Receiver Sensitivity	-18 -21	dBm	minimum typical
Receiver Overload	-3	dBm	typical
Receiver Damage Threshold	0	dBm	typical
Bandwidth	2.5	Gb/s	typical
Low Frequency Cutoff	35	KHz	typical
RF Output Coupling	AC, 0.1 uF	-	-
RF Output Voltage, differential	1100 1500	mVpp	minimum typical
RF Output Voltage, single-ended	550 750	mVpp	minimum typical
RF Output Transition Time	90	ps	typical
RF Output Return Loss	10	dB	minimum
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

Digital Receivers

High-Speed Digital Logic ModBlock phase-locked loops (PLLs) are offered, including NRZ Clock-Data Recovery (CDR) PLLs in three data rate ranges from 10 Mb/s to 13 Gb/s. All inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3dB roll-off point). An internal user-replaceable "crash" cable is provided (optical input) on all models for repair convenience in case of optical connector damage. Other PLLs or DC-coupled PLLs can be provided on request (send an email request to ModBlocks@tmeplano.com).

F200A, Digital Receiver, NRZ, PIN, 9-13 Gb/s, Single-mode

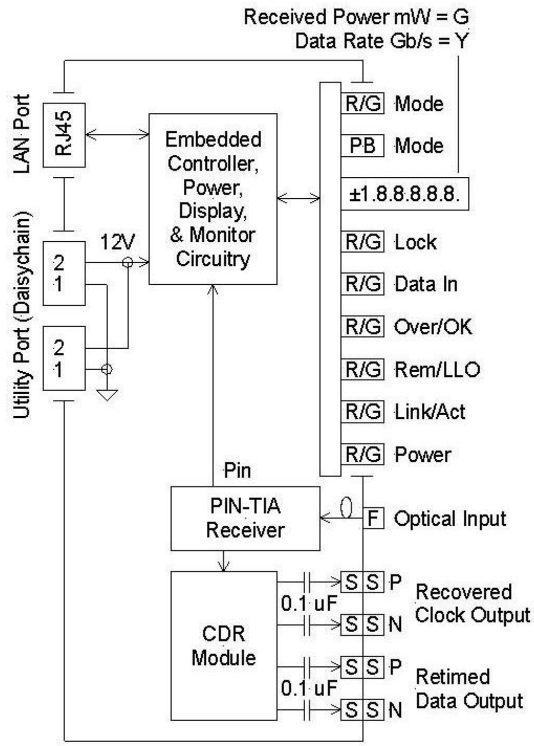
F202A, Digital Receiver, NRZ, PIN, 9-13 Gb/s, 50 micron Multimode

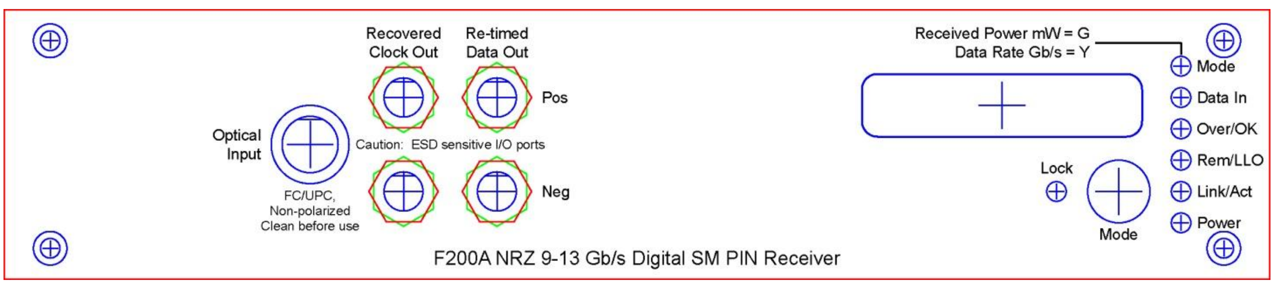
F204A, Digital Receiver, NRZ, PIN, 9-13 Gb/s, 62.5 micron Multimode

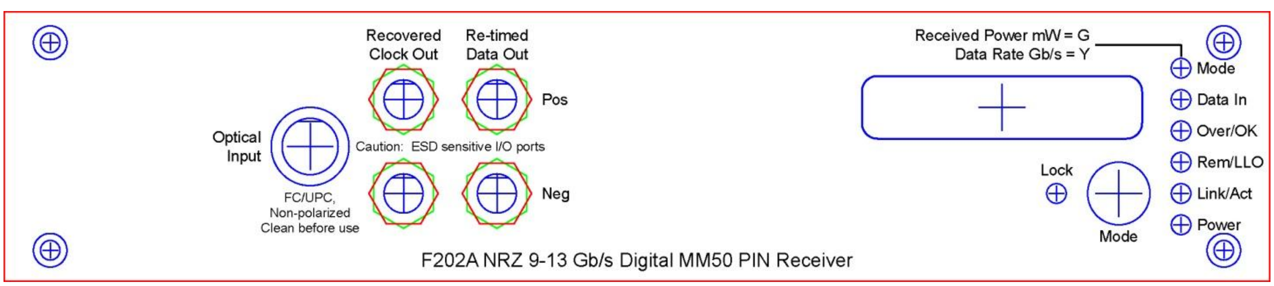
These digital receivers contain a 10 GHz class PIN type fiber optic receiver and an NRZ clock-data recovery (CDR) PLL. The receiver output drives the CDR, which is designed to accept an NRZ data stream between 9 and 13 Gb/s. The CDR will lock on to the data stream (if possible), output a clock signal recovered from the data stream, and output the original data stream retimed by the recovered clock. The receiver output signal passes through a limiting amplifier to CDR circuitry, providing a wide NRZ optical input power range. The PLL accepts input data streams over a continuous range and acquires lock automatically in less than 50 milliseconds.

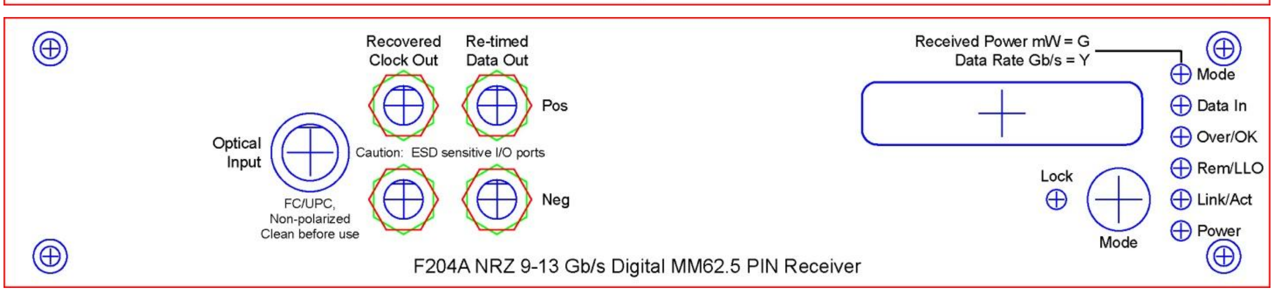
F200A, F202A, and F204A front chassis view, graphics layouts, and simple block diagram

1U, half-rack, 6.7” deep









An internal user-replaceable "crash" cable is provided (optical input) on all models for repair convenience in case of optical connector damage. Front panel pushbuttons and a numeric readout display the locked data rate to ~0.01% accuracy or the received optical input power level. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates the Data Rate monitoring mode, green indicates the Received Power monitoring mode, and dark indicates off mode. The mode pushbutton turns the display on or off.

A front panel bi-color "Over/OK" LED monitors the optical input power level. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power. A second front panel bi-color "Data In" LED monitors whether a data stream is present (green = present, yellow = absent).

Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F200A F202A F204A	-	single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	single-mode 50 micron multimode 62.5 micron multimode	-	F200A F202A F204A
Receiver Type	PIN-TIA	-	-
Wavelength Range	800 to 1650	nm	-
Receiver Sensitivity, 10^{-10} BER, PRBS 2^{23}-1, NRZ, 1550 nm	-18 -19	dBm	minimum typical
Receiver Overload, 10^{-9} BER	3	dBm	typical
Receiver Damage Threshold	4	dBm	typical
Data Rate Range	9 to 13	Gb/s	continuous range
CDR Lock Time	50	ms	maximum
RF Connectors	SMA female	-	-
RF Impedance	50	ohms	nominal
RF Output Coupling	AC, 0.1 uF	-	
RF Output Low Frequency Cutoff	35	KHz	-3 dB point, typical
RF Output Voltage, differential, Clock or Data	900 1100	mVpp	minimum typical
RF Output Voltage, single-ended, Clock or Data	450 550	mVpp	minimum typical
RF Output Return Loss, single-ended,	10	dB	minimum, @ 13 GHz
RF Output Transition Time	30	ps	typical
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

F201A, Digital Receiver, NRZ, APD, 9-13 Gb/s, Single-mode

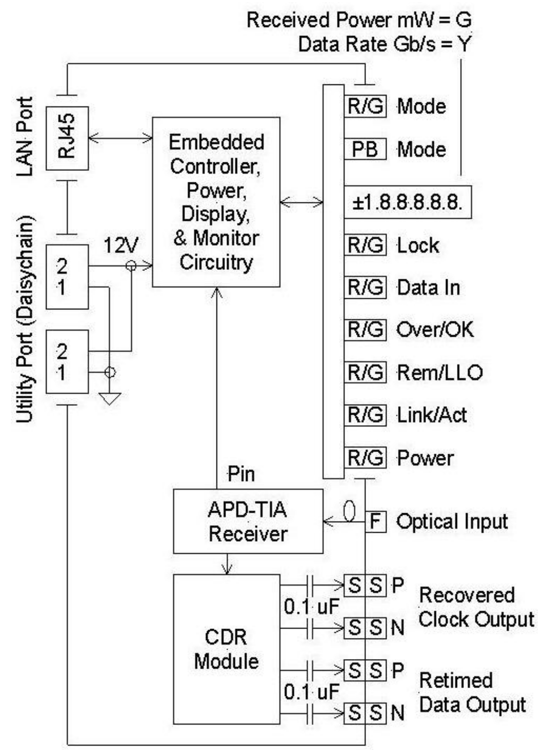
F203A, Digital Receiver, NRZ, APD, 9-13 Gb/s, 50 micron Multimode

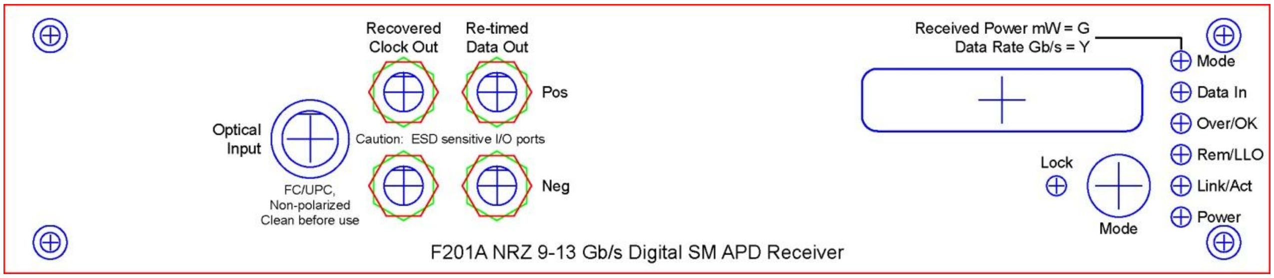
F205A, Digital Receiver, NRZ, APD, 9-13 Gb/s, 62.5 micron Multimode

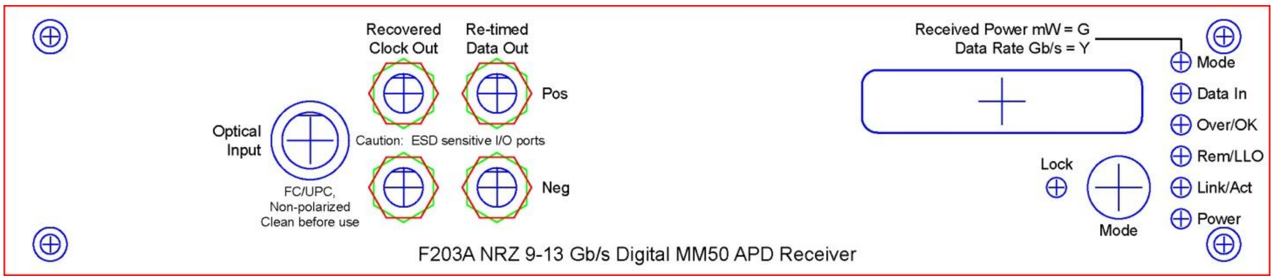
These digital receivers contain a 10 GHz class APD type fiber optic receiver and an NRZ clock-data recovery (CDR) PLL. The receiver output drives the CDR, which is designed to accept an NRZ data stream between 9 and 13 Gb/s. The CDR will lock on to the data stream (if possible), output a clock signal recovered from the data stream, and output the original data stream retimed by the recovered clock. The receiver output signal passes through a limiting amplifier to CDR circuitry, providing a wide NRZ optical input power range. The PLL accepts input data streams over a continuous range and acquires lock automatically in less than 50 milliseconds. An internal user-replaceable “crash” cable is provided (optical input) on all models for repair convenience in case of optical connector damage.

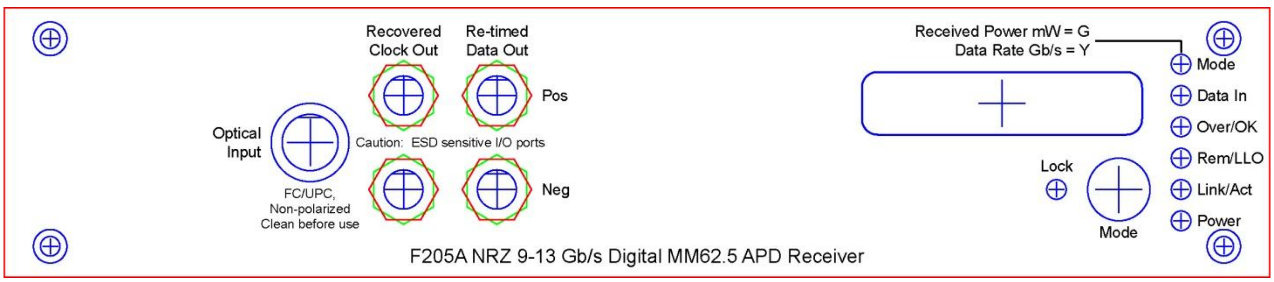
F201A, F203A, and F205A front chassis view, graphics layouts, and simple block diagram

1U, half-rack, 6.7” deep









Front panel pushbuttons and a numeric readout display the locked data rate to ~0.01% accuracy or the received optical input power level. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates the Data Rate monitoring mode, green indicates the Received Power monitoring mode, and dark indicates off mode. The mode pushbutton turns the display on or off.

A front panel bi-color “Over/OK” LED monitors the optical input power level. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power. A second front panel bi-color “Data In” LED monitors whether a data stream is present (green = present, yellow = absent).

Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F201A F203A F205A	-	single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	single-mode 50 micron multimode 62.5 micron multimode	-	F201A F203A F205A

Parameter	Value	Units	Qualifier
Receiver Type	APD-TIA	-	-
Wavelength Range	950 to 1650	nm	-
Receiver Sensitivity, 10^{-12} BER, PRBS 2^{23}-1, NRZ, 1550 nm	-25	dBm	typical
Receiver Overload, 10^{-12} BER	0	dBm	typical
Receiver Damage Threshold	3	dBm	typical
Data Rate Range	9 to 13	Gb/s	continuous range
CDR Lock Time	50	ms	maximum
RF Connectors	SMA female	-	-
RF Impedance	50	ohms	nominal
RF Output Coupling	AC, 0.1 uF	-	
RF Output Low Frequency Cutoff	35	KHz	-3 dB point, typical
RF Output Voltage, differential, Clock or Data	900 1100	mVpp	minimum typical
RF Output Voltage, single-ended, Clock or Data	450 550	mVpp	minimum typical
RF Output Return Loss, single-ended,	10	dB	minimum, @ 13 GHz
RF Output Transition Time	30	ps	typical
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

F206A, Digital Receiver, NRZ, PIN, 2.7-10.8 Gb/s, Single-mode

F208A, Digital Receiver, NRZ, PIN, 2.7-10.8 Gb/s, 50 micron Multimode

F210A, Digital Receiver, NRZ, PIN, 2.7-10.8 Gb/s, 62.5 micron Multimode

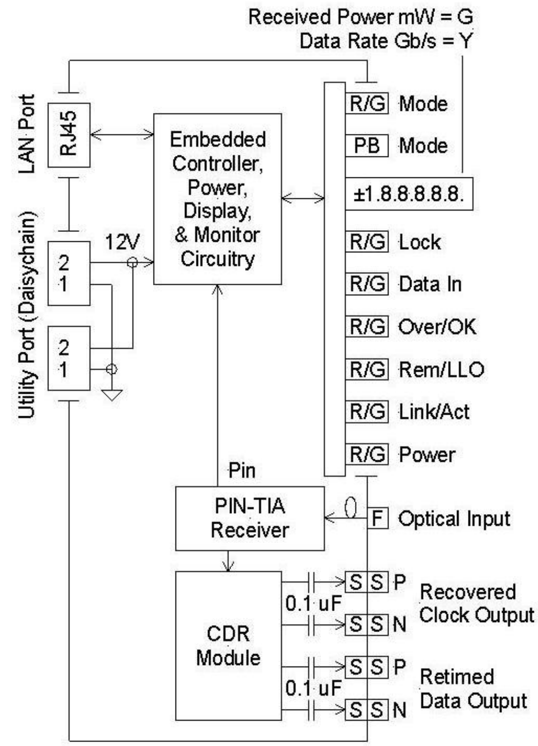
These digital receivers contain a 10 GHz class PIN type fiber optic receiver and an NRZ clock-data recovery (CDR) PLL. The receiver output drives the CDR, which is designed to accept an NRZ data stream between 2.7 and 10.8 Gb/s. The CDR will lock on to the data stream (if possible), output a clock signal recovered from the data stream, and output the original data stream retimed by the recovered clock. The receiver output signal passes through a limiting amplifier to CDR circuitry, providing a wide NRZ optical input power range. The PLL accepts input data streams over a continuous range and acquires lock automatically in less than 50 milliseconds. An internal user-replaceable “crash” cable is provided (optical input) on all models for repair convenience in case of optical connector damage.

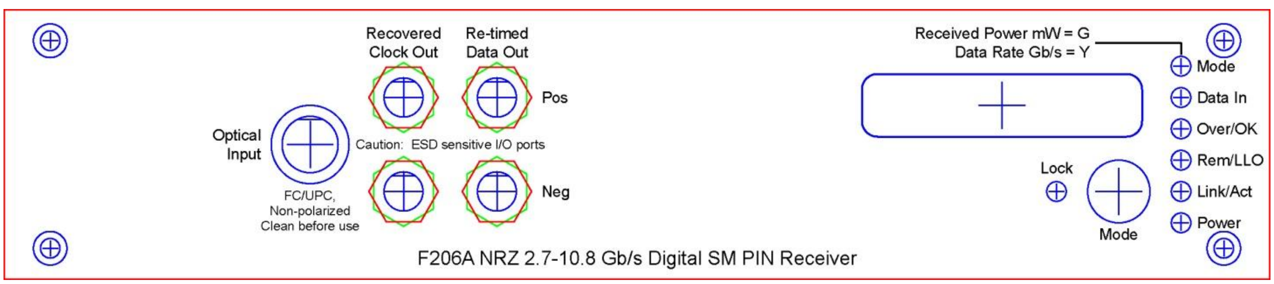
Front panel pushbuttons and a numeric readout display the locked data rate to ~0.01% accuracy or the received optical input power level. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates the Data Rate monitoring mode, green indicates the Received Power monitoring mode, and dark indicates off mode. The mode pushbutton turns the display on or off.

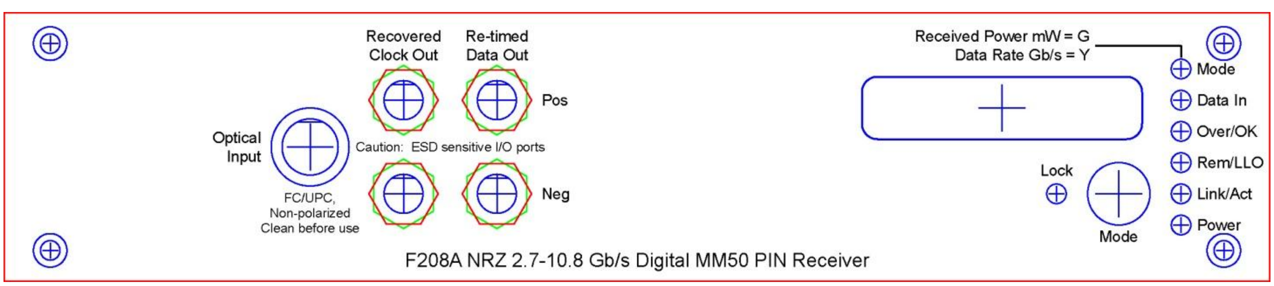
Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

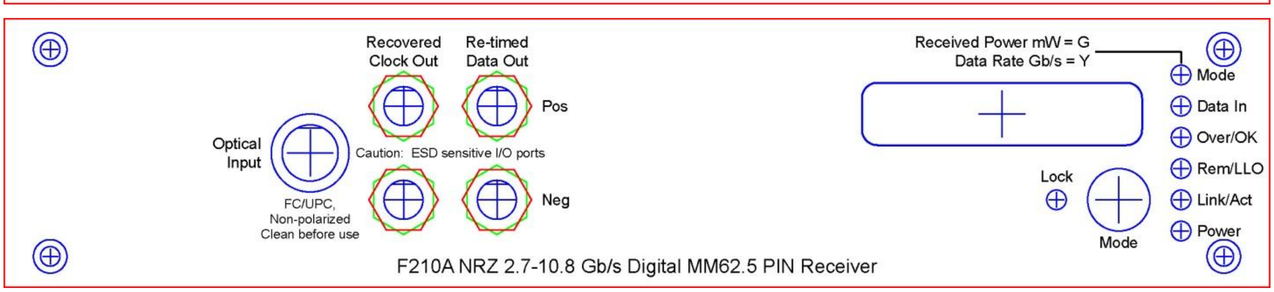
F206A, F208A, and F210A front chassis view, graphics layouts, and simple block diagram

1U, half-rack, 6.7” deep









A front panel bi-color “Over/OK” LED monitors the optical input power level. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power. A second front panel bi-color “Data In” LED monitors whether a data stream is present (green = present, yellow = absent).

Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F206A F208A F210A	-	single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	single-mode 50 micron multimode 62.5 micron multimode	-	F206A F208A F210A
Receiver Type	PIN-TIA	-	-
Wavelength Range	800 to 1650	nm	-
Receiver Sensitivity, 10^{-10} BER, PRBS 2^{23}-1, NRZ, 1550 nm	-18 -19	dBm	minimum typical
Receiver Overload, 10^{-9} BER	3	dBm	typical
Receiver Damage Threshold	4	dBm	typical
Data Rate Range	2.7 to 10.8	Gb/s	continuous range
CDR Lock Time	50	ms	maximum
RF Connectors	SMA female	-	-
RF Impedance	50	ohms	nominal
RF Output Coupling	AC, 0.1 uF	-	
RF Output Low Frequency Cutoff	35	KHz	-3 dB point, typical
RF Output Voltage, differential, Clock or Data	900 1100	mVpp	minimum typical
RF Output Voltage, single-ended, Clock or Data	450 550	mVpp	minimum typical
RF Output Return Loss, single-ended,	10	dB	minimum, @ 13 GHz
RF Output Transition Time	30	ps	typical
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

F207A, Digital Receiver, NRZ, APD, 2.7-10.8 Gb/s, Single-mode

F209A, Digital Receiver, NRZ, APD, 2.7-10.8 Gb/s, 50 micron Multimode

F211A, Digital Receiver, NRZ, APD, 2.7-10.8 Gb/s, 62.5 micron Multimode

These digital receivers contain a 10 GHz class APD type fiber optic receiver and an NRZ clock-data recovery (CDR) PLL. The receiver output drives the CDR, which is designed to accept an NRZ data stream between 2.7 and 10.8 Gb/s. The CDR will lock on to the data stream (if possible), output a clock signal recovered from the data stream, and output the original data stream retimed by the recovered clock. The receiver output signal passes through a limiting amplifier to CDR circuitry, providing a wide NRZ optical input power range. The PLL accepts input data streams over a continuous range and acquires lock automatically in less than 50 milliseconds.

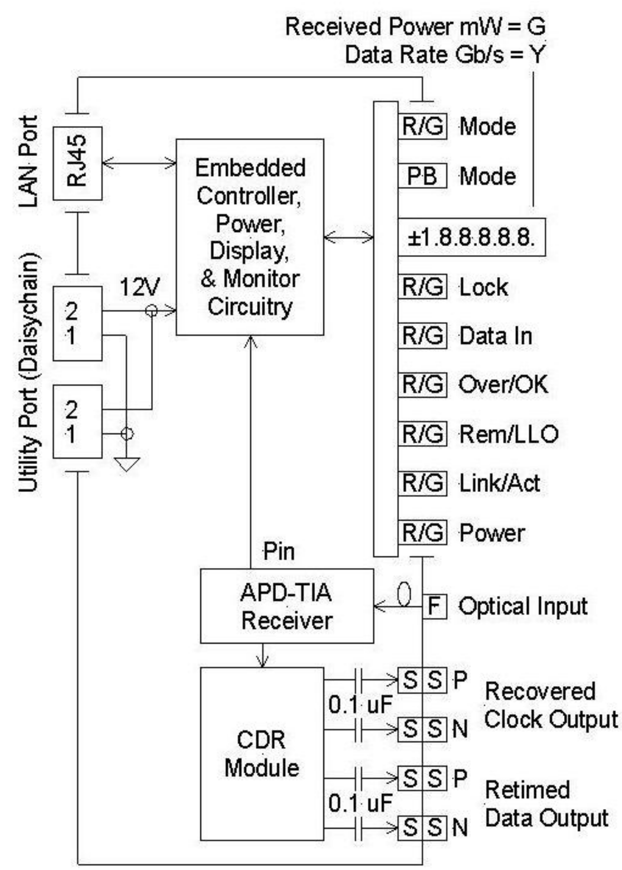
An internal user-replaceable “crash” cable is provided (optical input) on all models for repair convenience in case of optical connector damage.

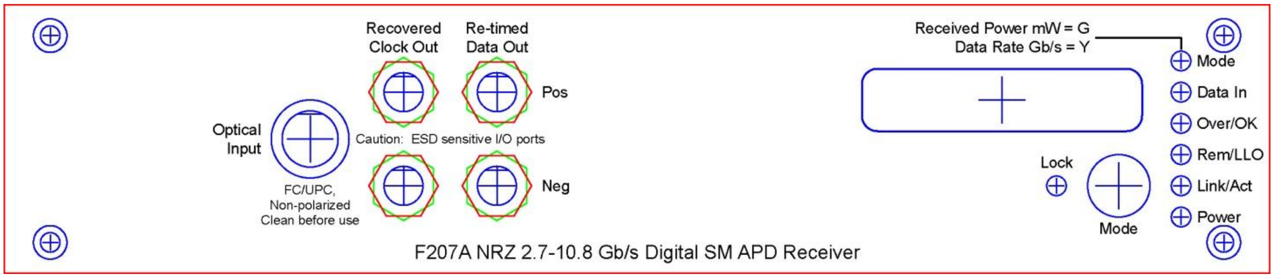
Front panel pushbuttons and a numeric readout display the locked data rate to ~0.01% accuracy or the received optical input power level. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates the Data Rate monitoring mode, green indicates the Received Power monitoring mode, and dark indicates off mode. The mode pushbutton turns the display on or off.

A front panel bi-color “Over/OK” LED monitors the optical input power level. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power. A second front panel bi-color “Data In” LED monitors whether a data stream is present (green = present, yellow = absent).

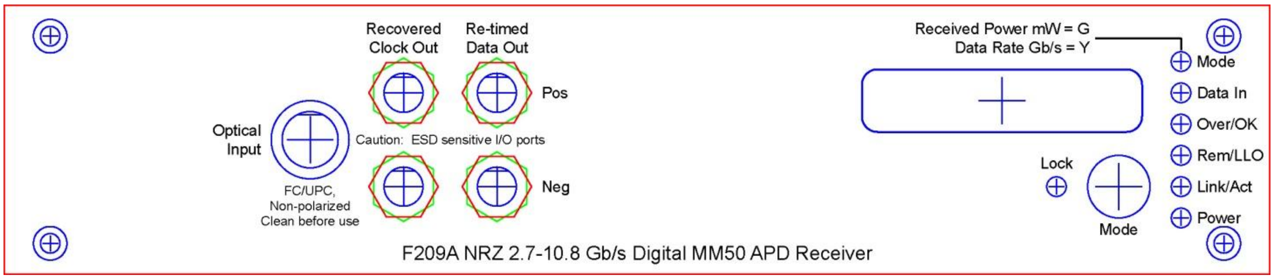
F207A, F209A, and F211A front chassis view, graphics layouts, and simple block diagram

1U, half-rack, 6.7” deep

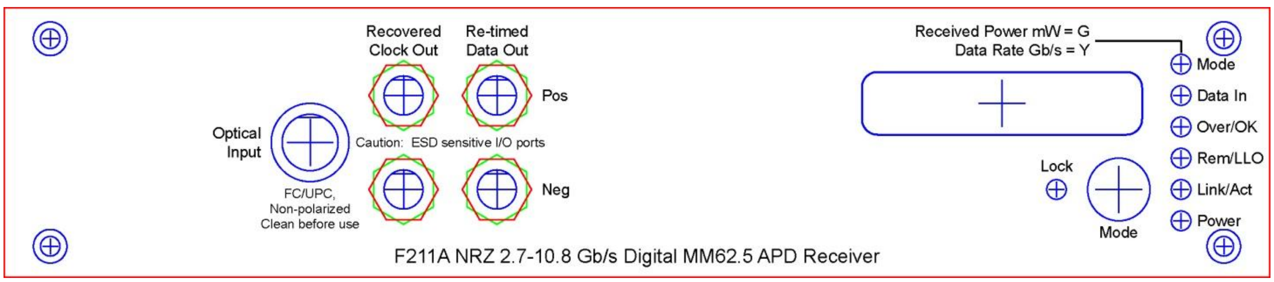




F207A NRZ 2.7-10.8 Gb/s Digital SM APD Receiver



F209A NRZ 2.7-10.8 Gb/s Digital MM50 APD Receiver



F211A NRZ 2.7-10.8 Gb/s Digital MM62.5 APD Receiver

Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F207A F209A F211A	-	single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	single-mode 50 micron multimode 62.5 micron multimode	-	F207A F209A F211A
Receiver Type	APD-TIA	-	-
Wavelength Range	950 to 1650	nm	-
Receiver Sensitivity, 10^{-12} BER, PRBS 2^{23}-1, NRZ, 1550 nm	-25	dBm	typical
Receiver Overload, 10^{-12} BER	0	dBm	typical
Receiver Damage Threshold	3	dBm	typical
Data Rate Range	2.7 to 10.8	Gb/s	continuous range
CDR Lock Time	50	ms	maximum
RF Connectors	SMA female	-	-
RF Impedance	50	ohms	nominal
RF Output Coupling	AC, 0.1 uF	-	
RF Output Low Frequency Cutoff	35	KHz	-3 dB point, typical
RF Output Voltage, differential, Clock or Data	900 1100	mVpp	minimum typical
RF Output Voltage, single-ended, Clock or Data	450 550	mVpp	minimum typical

Parameter	Value	Units	Qualifier
RF Output Return Loss, single-ended,	10	dB	minimum, @ 13 GHz
RF Output Transition Time	30	ps	typical
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

F212A, Digital Receiver, NRZ, PIN, 10 Mb/s to 2.7 Gb/s, Single-mode

F213A, Digital Receiver, NRZ, PIN, 10 Mb/s to 2.7 Gb/s, 50 micron Multimode

F214A, Digital Receiver, NRZ, PIN, 10 Mb/s to 2.7 Gb/s, 62.5 micron Multimode

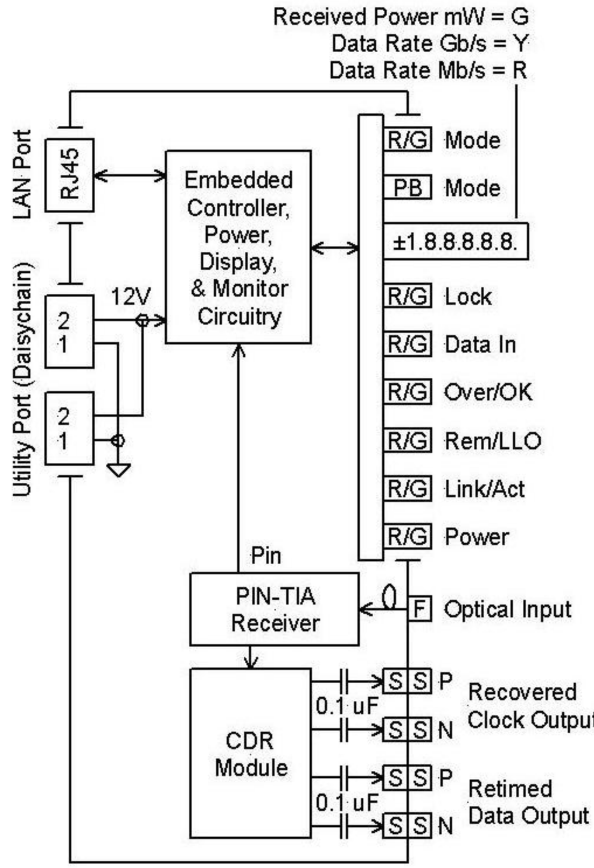
These digital receivers contain a 2 GHz class PIN type fiber optic receiver and an NRZ clock-data recovery (CDR) PLL. The receiver output drives the CDR, which is designed to accept an NRZ data stream between 10 Mb/s and 2.7 Gb/s. The CDR will lock on to the data stream (if possible), output a clock signal recovered from the data stream, and output the original data stream retimed by the recovered clock. The receiver output signal passes through a limiting amplifier to CDR circuitry, providing a wide NRZ optical input power range. The PLL accepts input data streams over a continuous range and acquires lock automatically in less than 50 milliseconds. An internal user-replaceable “crash” cable is provided (optical input) on all models for repair convenience in case of optical connector damage.

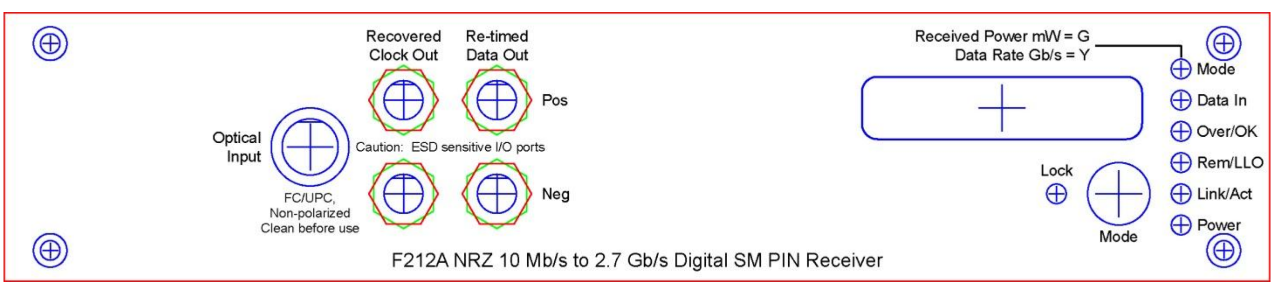
Front panel pushbuttons and a numeric readout display the locked data rate to ~0.01% accuracy or the received optical input power level. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Red indicates the Data Rate monitoring mode in Mb/s, yellow indicates the Data Rate monitoring mode in Gb/s, green indicates the Received Power monitoring mode, and dark indicates off mode. The mode pushbutton turns the display on or off.

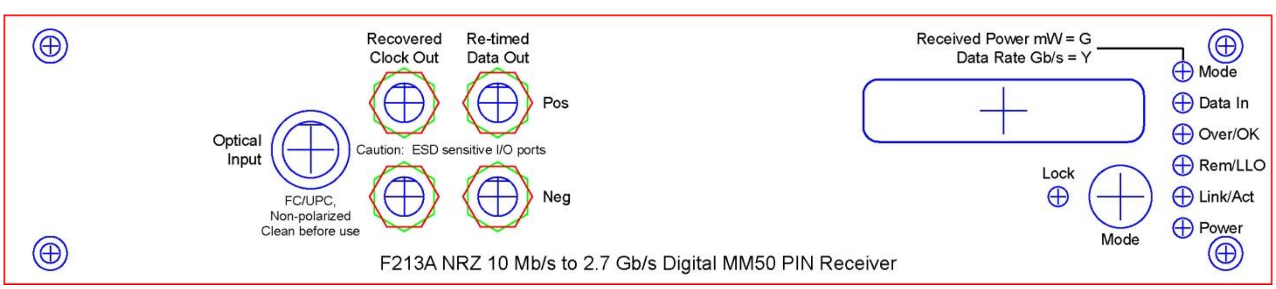
A front panel bi-color “Over/OK” LED monitors the optical input power level. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power. A second front panel bi-color “Data In” LED monitors whether a data stream is present (green = present, yellow = absent).

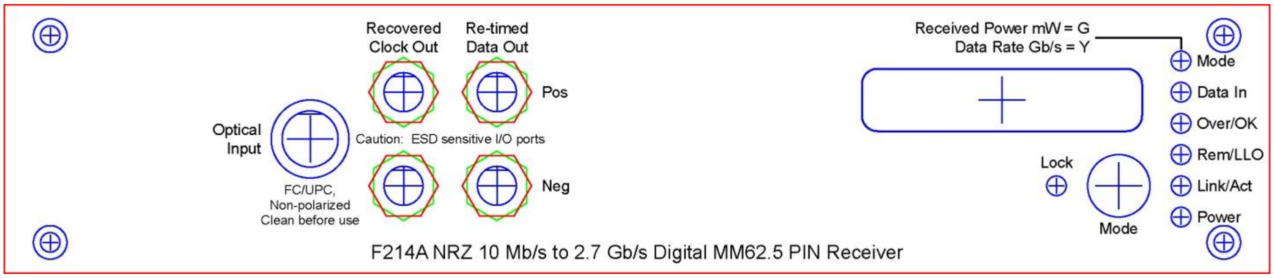
F212A, F213A, and F214A front chassis view, graphics layouts, and simple block diagram

1U, half-rack, 6.7” deep









Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F212A F213A F214A	-	single-mode 50 micron multimode 62.5 micron multimode
Fiber Type	single-mode 50 micron multimode 62.5 micron multimode	-	F212A F213A F214A
Receiver Type	PIN-TIA	-	-
Wavelength Range	1100 to 1650	nm	-
Receiver Sensitivity	-18 -21	dBm	minimum typical
Receiver Overload, 10^{-9} BER	-3	dBm	typical
Receiver Damage Threshold	0	dBm	typical
Data Rate Range	0.01 to 2.7	Gb/s	continuous range
CDR Lock Time	50	ms	maximum
RF Connectors	SMA female	-	-
RF Impedance	50	ohms	nominal
RF Output Coupling	AC, 0.1 uF	-	
RF Output Low Frequency Cutoff	35	KHz	-3 dB point, typical
RF Output Voltage, differential, Clock or Data	600 700	mVpp	minimum typical
RF Output Voltage, single-ended, Clock or Data	300 350	mVpp	minimum typical
RF Output Transition Time	120	ps	maximum
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

Transceivers

These ModBlocks contain both a fiber optic transmitter and a fiber optic receiver in one unit. Pluggable SFP transceivers are currently offered with O-E plus E-O functions and with O-O functions. NRZ and RZ transceivers for the 10 Gb/s class will be offered in the near future. Send an email request to ModBlocks@tmeplano.com to make it sooner!

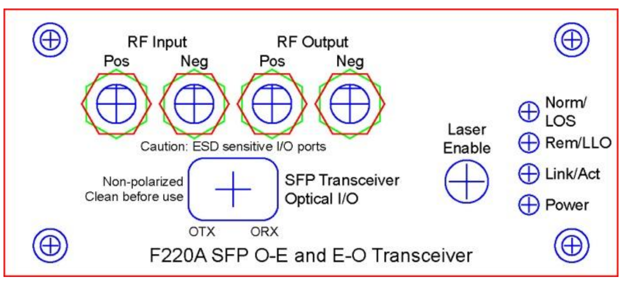
F220A, Transceiver, SFP, O-to-E and E-to-O

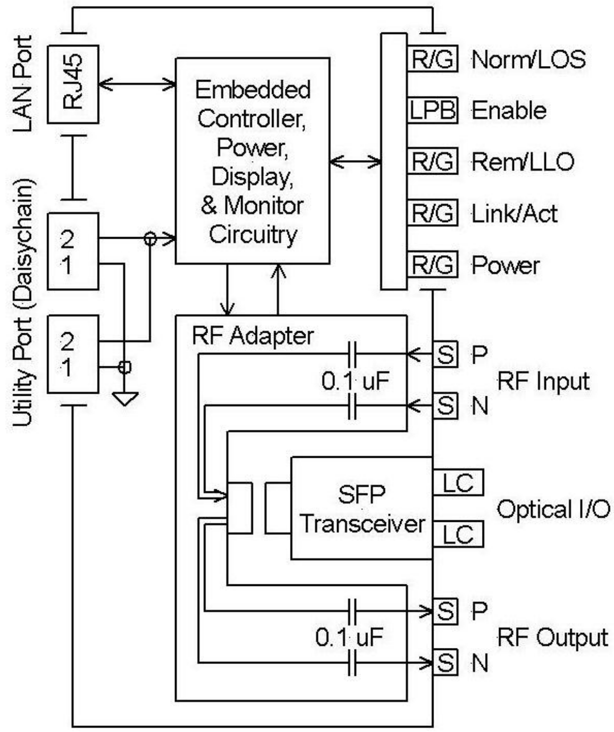
This transceiver accepts a pluggable SFP transceiver module and provides an AC-coupled (0.1 uF, ~35 KHz), differential (usable single-ended), RF electrical I/O interface to the SFP module.

A laser enable switch is provided. A bi-color LED provides received signal status, where green indicates normal received signal level (“Norm”) and yellow indicates loss of signal (“LOS”).

F220A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 6.7” deep





A wide variety of fiber optic and “copper” SFP modules are available from many suppliers, so these transceivers are offered without SFP modules installed. However, selected popular fiber optic (850 nm, 1310 nm, 1550) and “copper” SFP modules are offered for convenience as a ModBlock Accessory (see page 184).

Key Specifications

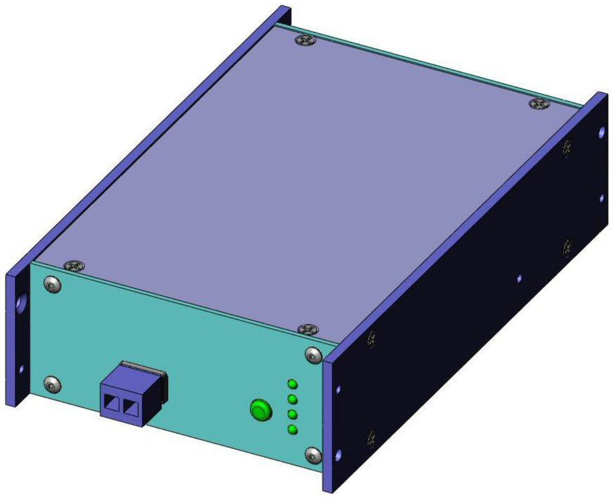
Parameter	Value	Units	Qualifier
Model Number	F220A	-	(less SFP module)
Module Type	SFP	-	-
Transmitter Type	SFP dependent	-	-
Receiver Type	SFP dependent	-	-
Data Rate Range	SFP dependent	-	-
RF Input Voltage	SFP dependent	-	-
RF Output Voltage	SFP dependent	-	-
RF Connectors	SMA female	-	-
RF Impedance	50	ohms	nominal
RF I/O Coupling	AC, 0.1 uF	-	
RF I/O Low Frequency Cutoff	35	KHz	-3 dB point, typical

Parameter	Value	Units	Qualifier
Dimensions	1.72H x 4.19W x 6.70D	inches	nominal

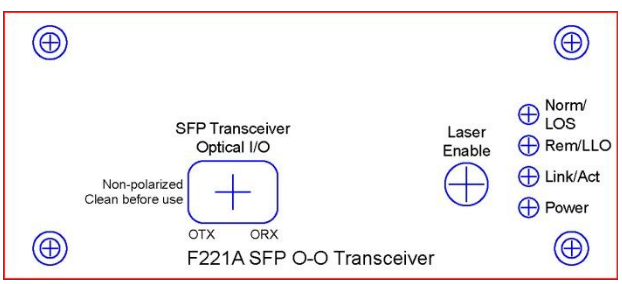
F221A, Transceiver, SFP, O-to-O

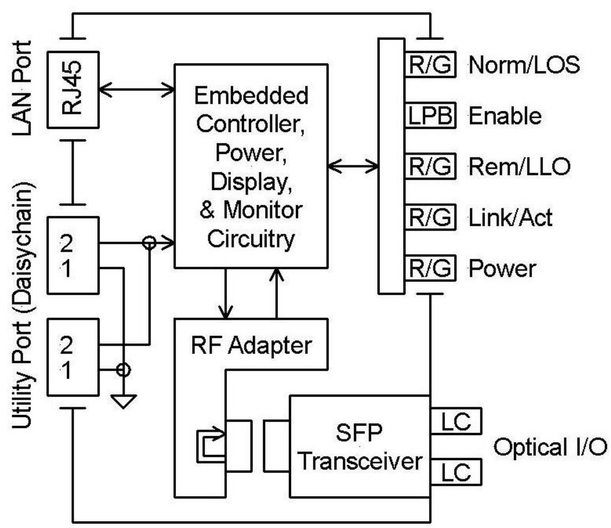
This transceiver accepts a pluggable SFP transceiver module and internally connects the SFP transmitter electrical port to the receiver electrical port. This arrangement is useful as a wavelength converter or as a regenerator. A laser enable switch is provided. A bi-color LED provides received signal status, where green indicates normal received signal level (“Norm”) and yellow indicates loss of signal (“LOS”).

F221A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 6.7” deep





A wide variety of fiber optic and “copper” SFP modules are available from many suppliers, so these transceivers are offered without SFP modules installed. However, selected popular fiber optic (850 nm, 1310 nm, 1550) and “copper” SFP modules are offered for convenience as a ModBlock Accessory (see page 184).

Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F221A	-	(less SFP module)
Module Type	SFP	-	-

Parameter	Value	Units	Qualifier
Transmitter Type	SFP dependent	-	-
Receiver Type	SFP dependent	-	-
Data Rate Range	SFP dependent	-	-
Dimensions	1.72H x 4.19W x 6.70D	inches	nominal

F225A-*, Transceiver, NRZ, 10 Gb/s Class

F230A-*, Transceiver, RZ, 10 Gb/s Class

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

PDV Transceivers

Fiber optic transceiver ModBlocks are offered for Photonic Doppler Velocimeter (PDV) applications in the 1550 nm C-band. A PDV transceiver ModBlock contains an internal 20 mW coherent laser, a 10 GHz class analog PDV receiver, and a red “spotting” laser. A complete PDV front end can be conveniently implemented by connecting a probe to a transceiver. Models are available with choices of AC or DC coupled RF outputs and for use with back-reflecting or non-back-reflecting probes. Models with APD-TIA receivers, 50 mW coherent lasers, or without the spotting laser can be provided on request.

Summary of PDV Transceiver ModBlock Types

Model Number	Receiver Type	RF Output Coupling	Probe Type	Spotting Laser?
F235A	PIN-TIA	AC	Back-Reflecting	Yes
F236A	PIN-TIA	DC	Back-Reflecting	Yes
F237A	PIN-TIA	AC	Non-Back-Reflecting	Yes
F238A	PIN-TIA	DC	Non-Back-Reflecting	Yes

Brief Specifications for PDV Transceivers

All PDV transceivers contain an analog 10 GHz bandwidth PIN-TIA fiber optic receiver for C-band (1528 to 1563 nm) operation with AC or DC coupled RF output, a 20 mW InGaAsP DFB laser with a 40 meter coherence length (5 MHz line width), and a 1 mW red “spotting” laser. Model architectures are provided (30 dB VOAs, couplers, circulators, red laser, switch) for use with back-reflecting or non-back-reflecting probes. Target velocity range is 0 to 7500 m/s (DC coupled) or 0.05 to 7500 m/s (AC coupled, ~35 KHz cutoff). Probe coherent laser output power is 15 mW or +12 dBm and red “spotting” laser output power is 1 mW or 0 dBm. Both laser power levels are fixed to these levels and can be turned off with front panel “enable” controls (or remotely).

For back-reflecting (BR) probe model types, the probe port reflected input power ranges from 5 to 35 dBm maximum to -18 dBm minimum, depending on VOA setting. RF output voltage is ~715 mVpp @ 0 dBm input. For non-back-reflecting (NBR) probe model types, the probe port reflected input power range is 7 dBm maximum to -15 dBm minimum. RF output voltage is ~536 mVpp @ 0 dBm input. See PDV transceiver section of full ModBlock catalog for block diagrams and complete specifications for each model.

All models use single-mode fiber with FC/APC connectors. An internal user-replaceable "crash" cable is provided (probe port) on all models for repair convenience in case of optical connector damage. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware. All models are packaged in a black 1.72"H x 8.38"W x 8.70"D modular chassis allowing simple horizontal or vertical ModBlock stacking, are daisy-chain powered by 12 volts DC ±3 volts DC (9 to 15 VDC), and are computer controllable via Ethernet.

A front panel bi-color "Over/OK" LED monitors the optical input power level to the receiver. Green indicates optical input power exists and is within the normal operating range for the receiver. Red indicates optical input power exists, but is too high, risking receiver damage. Yellow indicates no (or too low) optical input power.

Front panel pushbuttons and a numeric readout provide manual attenuator (VOA) control and received optical power monitoring, which can also be used remotely. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates Attenuator Control mode, green indicates Received Power monitor mode, and dark indicates off mode. Pushbuttons with up and down arrows allow attenuation adjustment for either mode indicated by the bi-color LED. The mode pushbutton is also used to turns the display off. An optical switch and "Spot Enable" lighted pushbutton switch controls the internal red "spotting" laser, which is used in visual alignment of probe to target prior to PDV use (which can also be remotely operated).

F235A, Transceiver, Laser-PIN, 10 GHz Class, AC-coupled, with Red Spotting Laser, for PDV Back-Reflecting Probe

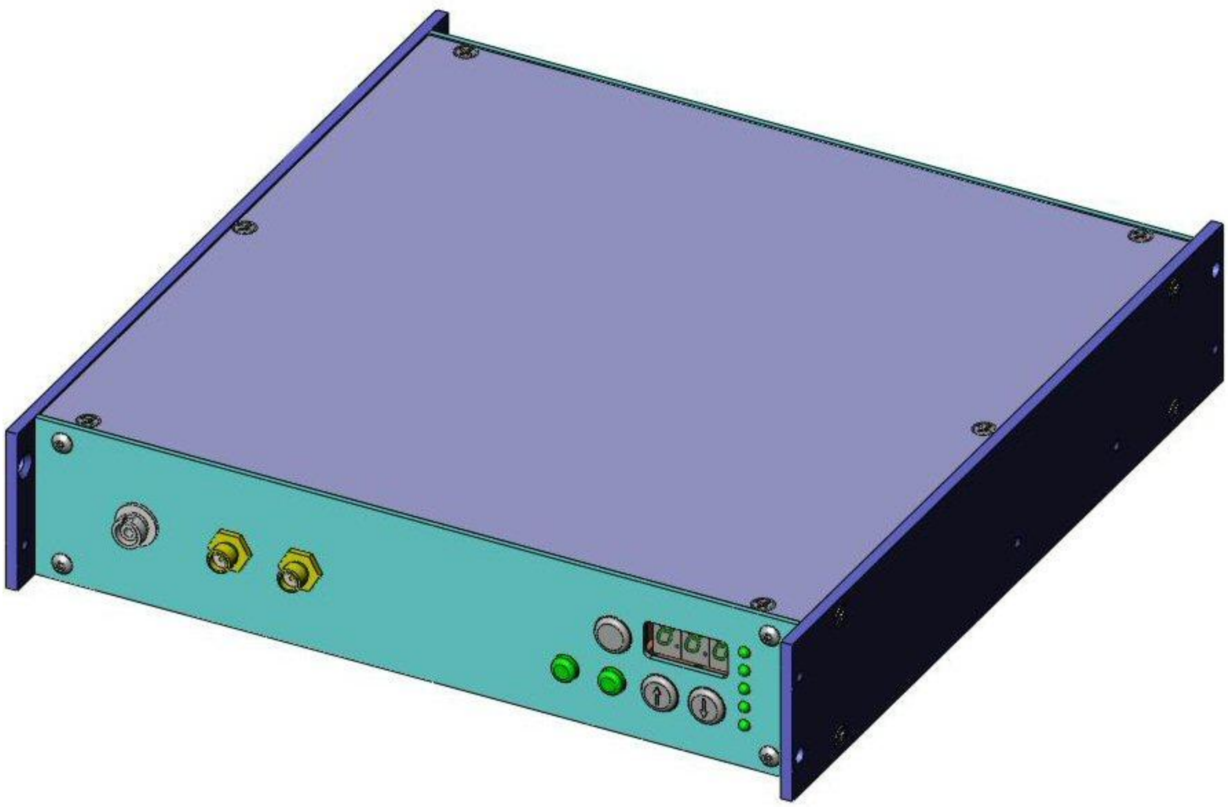
F236A, Transceiver, Laser-PIN, 10 GHz Class, DC-coupled, with Red Spotting Laser, for PDV Back-Reflecting Probe

This PDV transceiver ModBlock type is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a back-reflecting (BR) probe. It contains both an internal 20 mW (optional 50 mW) 1550 nm coherent laser (thermally stabilized) and an analog PDV PIN receiver (similar to F175A). A coherent interferometer condition occurs at the BR probe tip due to Fresnel loss and reflected target light. The receiver contains a linear 10 GHz class PIN photodiode with transimpedance amplifier, preceded by a variable optical attenuator (VOA) and a

3-port circulator. The VOA is used to insure the receiver optical input power is within its operating range and especially to avoid receiver damage from excessive optical input power. All optical connections are FC/APC (angled tip) using single-mode fiber. An internal user-replaceable “crash” cable is provided (probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware.

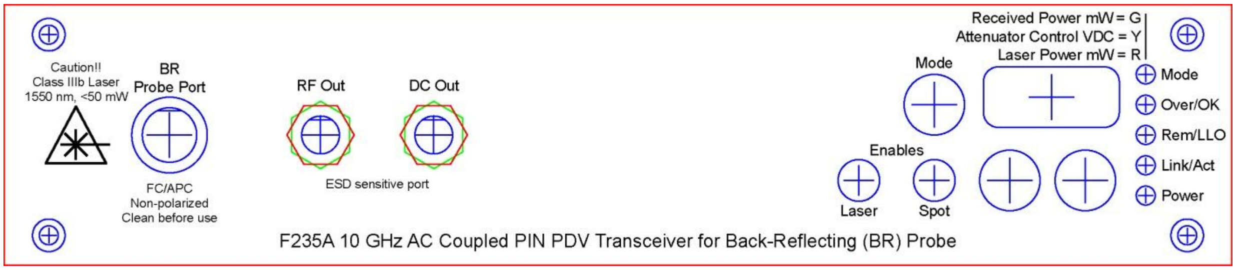
The laser is fixed at its maximum optical output power and a “Laser Enable” lighted pushbutton switch is provided (can also be remotely operated). A red “spotting” laser, optical switch, and “Spot Enable” lighted pushbutton switch are provided for use in visual alignment of probe to target prior to PDV use (which can also be remotely operated). See the **Brief Specifications for PDV Transceivers** section starting on page 91 for front panel LED, switch, and numeric readout operation.

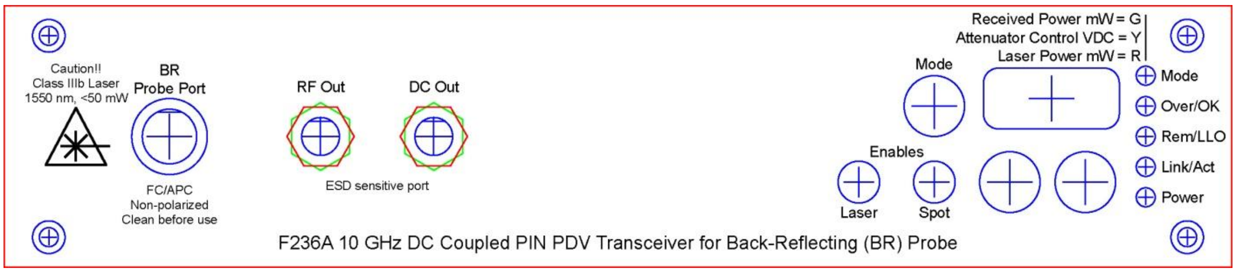
F235A and F236A front chassis view, graphic layouts, and simple block diagram

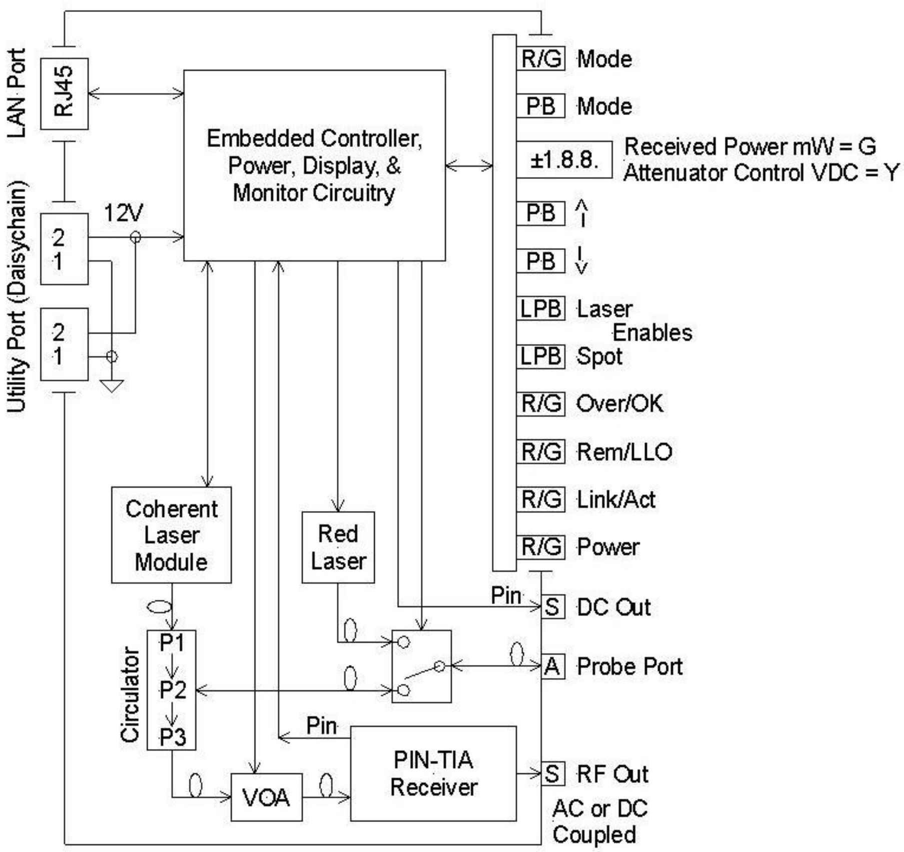


1U, half-rack, 8.7” deep

Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories







Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F235A F236A	-	AC coupled output DC coupled output
Probe Type	Back-reflecting	-	-
Fiber Type	Single-mode	-	-

Parameter	Value	Units	Qualifier
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range (receive path)	1528 to 1563	nm	minimum
Receiver Polarity, O-to-E conversion	Non-inverting	-	-
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical
Laser Type	DFB, InGaAsP	-	-
Probe Output Power Range, from internal 20 mW laser	15 and off 12 and off	mW dBm	nominal
Laser Spectral Width @ -3 dB point	5	MHz	maximum
Laser Coherence Length	40	meters	minimum
Laser Side Mode Suppression Ratio	40	dB	minimum
Relative Intensity Noise	-140	dB/Hz	maximum
Receiver Type	PIN-TIA	-	-
Probe Port Input Power, damage threshold (normally by probe back-reflection)	6 36	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, maximum (normally by probe back-reflection)	5 35	dBm	typical, VOA = 0 typical, VOA = max
Probe Port Input Power, minimum, VOA = 0 (normally by probe back-reflection)	-18 16	dBm uW	typical, -20 dBm at receiver input
Optical Insertion Loss, Probe Port to Receiver	2	dB	typical, VOA = 0
Optical Return Loss, Laser Input or Probe Port	50	dB	minimum
Sensitivity, 10^{-10} BER	-16 -17	dBm	minimum typical
Receiver Sensitivity, 10^{-10} BER (receiver only)	-18 -19	dBm	minimum typical
Receiver Responsivity	0.7 0.8	mA/mW	minimum typical
Receiver Transimpedance	400 500 650	ohms	minimum typical maximum
Receiver Gain Flatness	±0.75	dB	typical
Receiver Bandwidth	9.5 10	GHz	minimum typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F235A F236A
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F235A F236A
Receiver Linearity, -15 to 0 dBm	<1	%	typical
Receiver Group Delay, <7 GHz	±10	ps	typical
Receiver Noise Figure	3	dB	typical
RF Output Coupling	AC, 0.1 uF DC	-	F235A F236A
RF Output Voltage, typical (receiver input to RF output)	900 28 13	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Voltage, typical (probe port input to RF output, VOA = 0)	715 22 10	mVpp	0 dBm input -16 dBm input -20 dBm input

Parameter	Value	Units	Qualifier
RF Output Return Loss	10 15	dB	minimum typical
Spotting Laser Wavelength	635	nm	nominal
Spotting Laser Output Power	1 or off	mW	nominal
Switching Time	10	ms	typical
Dimensions	1.72H x 8.38W x 8.70D	inches	nominal

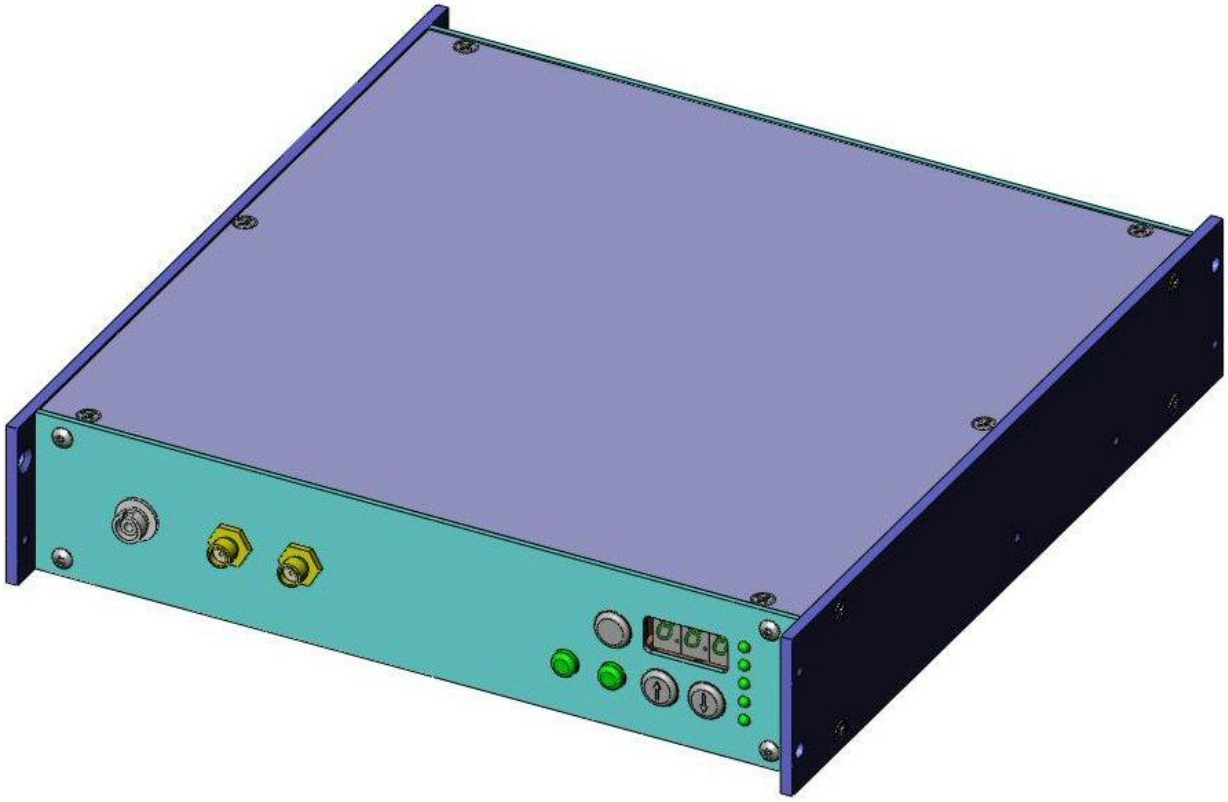
F237A, Transceiver, Laser-PIN, 10 GHz Class, AC-coupled, with Red Spotting Laser, for PDV Non-Back-Reflecting Probe

F238A, Transceiver, Laser-PIN, 10 GHz Class, DC-coupled, with Red Spotting Laser, for PDV Non-Back-Reflecting Probe

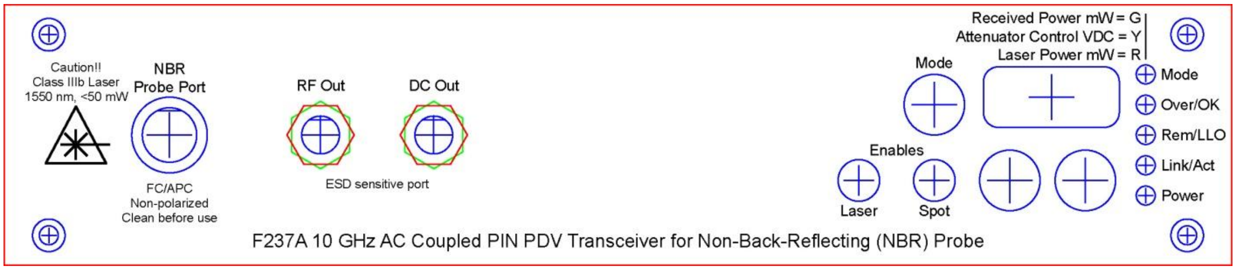
This PDV transceiver ModBlock type is designed for use in a 1550 nm Photonic Doppler Velocimeter coherent optical system that uses a non-back-reflecting (NBR) probe. It contains both an internal 20 mW (50 mW optional) 1550 nm coherent laser (thermally stabilized) and an analog PDV PIN receiver (similar to F175A). Coherent laser light emitted from the probe reflects back from the target where it is combined with a coupler tapped small portion of the original laser light, forming a coherent interferometer condition. The VOA is used to roughly balance the reflected target optical input power with the tapped original laser light. The receiver contains a linear 10 GHz class PIN photodiode with transimpedance amplifier, preceded by a variable optical attenuator (VOA) and a 3-port circulator. All optical connections are FC/APC (angled tip) using single-mode fiber. An internal user-replaceable "crash" cable is provided (probe port) for repair convenience in case of optical connector damage. The RF output is single-ended with choice of AC or DC coupled RF output. A front panel auxiliary DC output is provided for optical input power level monitoring by external hardware.

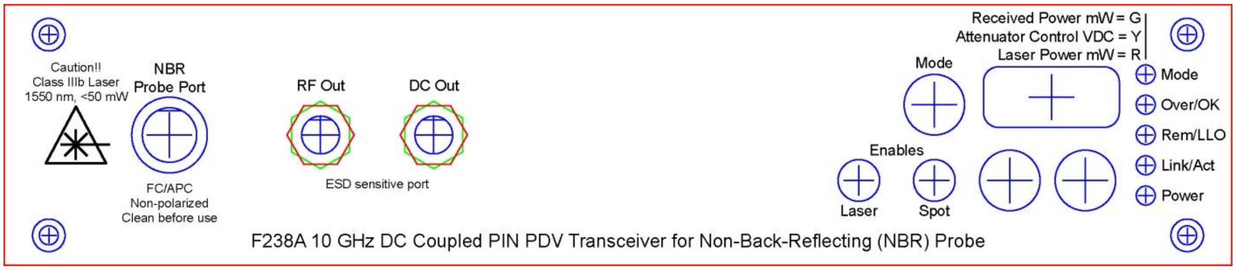
The laser is fixed at its maximum optical output power and a "Laser Enable" lighted pushbutton switch is provided (can also be remotely operated). A red "spotting" laser, optical switch, and "Spot Enable" lighted pushbutton switch are provided for use in visual alignment of probe to target prior to PDV use (which can also be remotely operated). See the **Brief Specifications for PDV Transceivers** section starting on page 91 for front panel LED, switch, and numeric readout operation.

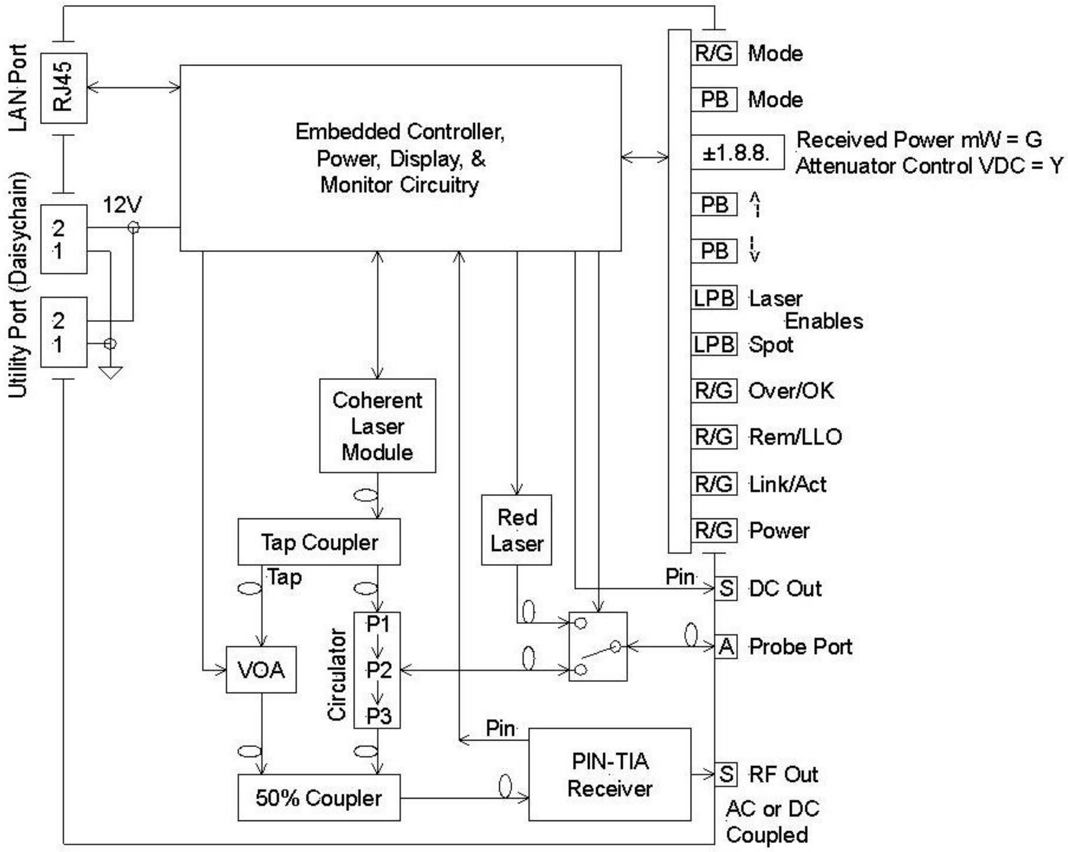
F237A and F238A front chassis view, graphic layouts, and simple block diagram



1U, half-rack, 8.7" deep







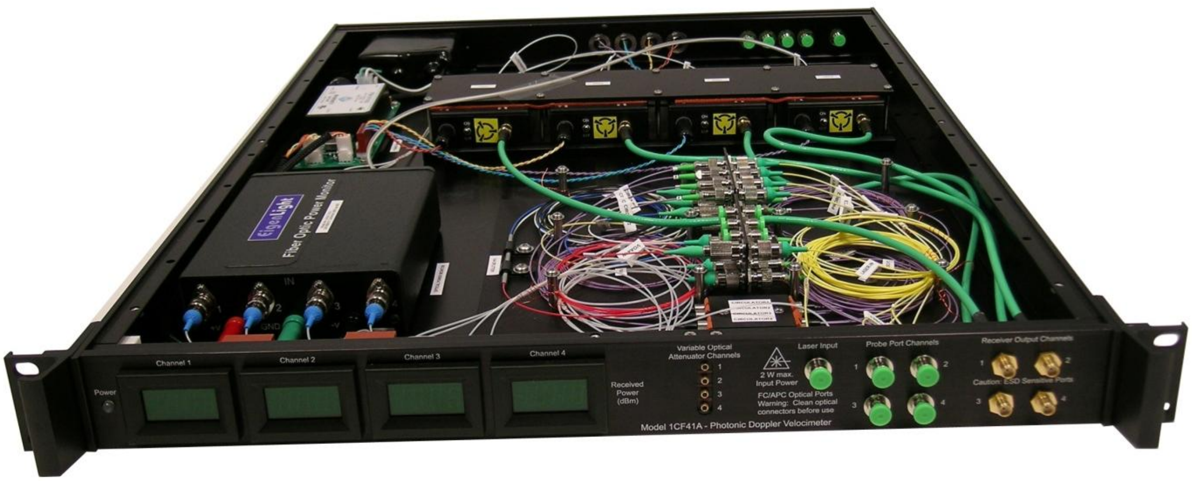
Key specifications (also see Common Specifications on page 20)

Parameter	Value	Units	Qualifier
Model Number	F237A F238A	-	AC coupled output DC coupled output
Probe Type	Non-back-reflecting	-	-
Fiber Type	Single-mode	-	-
Optical Connector Type	FC/APC	-	(angled tip)
Wavelength Range (receive path)	1528 to 1563	nm	minimum
Receiver Polarity, O-to-E conversion	Non-inverting	-	-
Coupler Type, tap and 50% combiner	Fused Bi-conical Taper	-	-
Tap Coupler Ratio	1	%	typical
Combiner Coupler Ratio	50	%	typical
Circulator Type	3-port	-	-
VOA Type	MEMS, analog control	-	-
VOA Attenuation Range	0 to 30	dB	0 to 5V control
VOA Control Step Size	10	mV	typical
Laser Type	DFB, InGaAsP	-	-
Probe Output Power Range, from internal 20 mW laser	15 and off 12 and off	mW dBm	nominal
Laser Spectral Width @ -3 dB point	5	MHz	maximum
Laser Coherence Length	40	meters	minimum
Laser Side Mode Suppression Ratio	40	dB	minimum
Relative Intensity Noise	-140	dB/Hz	maximum
Receiver Type	PIN-TIA	-	-

Parameter	Value	Units	Qualifier
Probe Port Input Power, damage threshold (normally by probe back-reflection)	8 6	dBm mW	typical
Probe Port Input Power, maximum (normally by probe back-reflection)	7 5	dBm mW	typical
Probe Port Input Power, minimum (normally by probe back-reflection)	-15 30	dBm uW	typical, -20 dBm at receiver input
Optical Insertion Loss, typical Internal Laser to Receiver	23 53	dB	VOA = 0 VOA = max.
Optical Insertion Loss, Probe Port to Receiver	4.5	dB	typical, VOA = 0
Optical Return Loss, Probe Port	50	dB	minimum
Probe Port Sensitivity, 10^{-10} BER	-13 -14	dBm	minimum typical
Receiver Sensitivity, 10^{-10} BER (receiver only)	-18 -19	dBm	minimum typical
Receiver Responsivity	0.7 0.8	mA/mW	minimum typical
Receiver Transimpedance	400 500 650	ohms	minimum typical maximum
Receiver Gain Flatness	±0.75	dB	typical
Receiver Bandwidth	9.5 10	GHz	minimum typical
Receiver Low Frequency Cutoff	~35 KHz DC	-	F237A F238A
Target Velocity Range, typical	0.05 to 7500 0 to 7500	meters/ second	F237A F238A
Receiver Linearity, -15 to 0 dBm	<1	%	typical
Receiver Group Delay, <7 GHz	±10	ps	typical
Receiver Noise Figure	3	dB	typical
RF Output Coupling	AC, 0.1 uF DC	-	F237A F238A
RF Output Voltage, typical (receiver input to RF output)	900 28 13	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Voltage, typical (probe port input to RF output, VOA = 0)	536 16 8	mVpp	0 dBm input -16 dBm input -20 dBm input
RF Output Return Loss	10 15	dB	minimum typical
Spotting Laser Wavelength	635	nm	nominal
Spotting Laser Output Power	1 or off	mW	nominal
Switching Time	10	ms	typical
Dimensions	1.72H x 8.38W x 8.70D	inches	nominal

Custom PDV Transceiver Equipment

TME can design, produce, and support any kind of custom PDV equipment required, including specialized research or developmental experimental equipment. An example 4-channel PDV receiver is shown below, which was built using customer specified fiber optic modules.



Switches

Fiber optic switch ModBlocks are offered using prism-collimator technology or other patented technologies for 850 nm, 1310 nm, and 1550 nm bands. SPDT and 2x2 (i.e., transfer) switches are offered in single or dual channel versions and with choice of single-mode (SM), single-mode polarized (PM), 50 micron multimode (MM50), or 62.5 micron multimode (MM62.5 or MM62) fiber. SP4T and SP8T switches are offered with one channel and single-mode fiber. All switches use front panel FC/UPC fiber optic connectors, unless otherwise specified. Internal “crash” cables are not provided but can be added upon request at extra cost. Many other switch types and technologies are available. Send an email request to ModBlocks@tmeplano.com if you don’t see the switch or performance you need.

F240A-*, Switch, Dual SPDT, Single-mode
F241A-*, Switch, Single SPDT, Single-mode
F250A-*, Switch, Dual SPDT, 50 micron Multimode
F251A-*, Switch, Single SPDT, 50 micron Multimode
F255A-*, Switch, Dual SPDT, 62.5 micron Multimode
F256A-*, Switch, Single SPDT, 62.5 micron Multimode

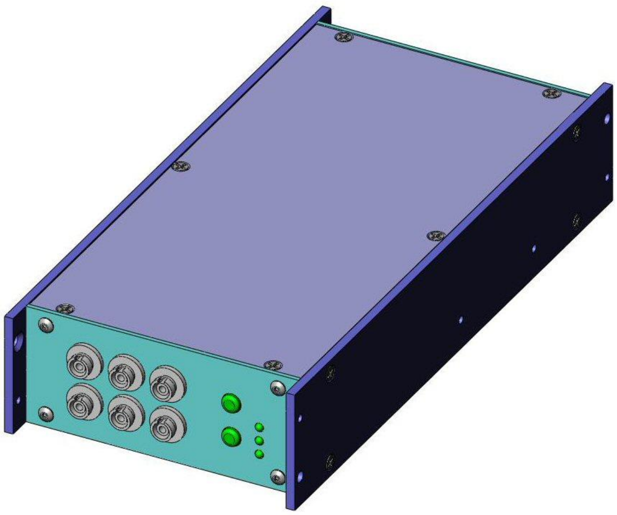
These ModBlock switches contain one or two SPDT fiber optic switches and related circuitry, with choice of single-mode (SM), 50 micron multimode (MM50), or 62.5 micron multimode (MM62.5 or MM62) fiber. The front panel lighted pushbutton provides toggle operation of the switch and also indicates the switch state. When the switch indicator is off, the fiber optic switch is in its normal state, as shown in the simple block diagram (COM→NC). When the switch indicator is on (green), the fiber optic switch is in its alternate state (COM→NO).

SPDT Switch Models

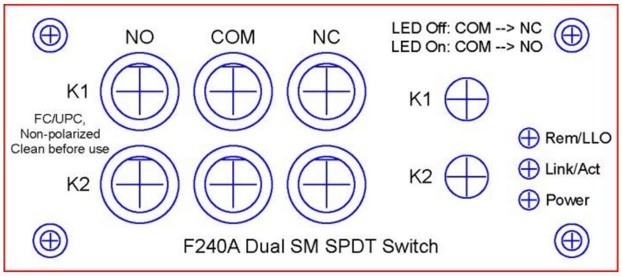
Part Number	Channel Count	Fiber Type	Wavelength (nm)
F240A-85	2	SM	850
F240A-131	2	SM	1260-1360
F240A-155	2	SM	1510-1610
F241A-85	1	SM	850
F241A-131	1	SM	1260-1360
F241A-155	1	SM	1510-1610
F250A-85	2	MM50	850
F250A-131	2	MM50	1310
F250A-155	2	MM50	1550

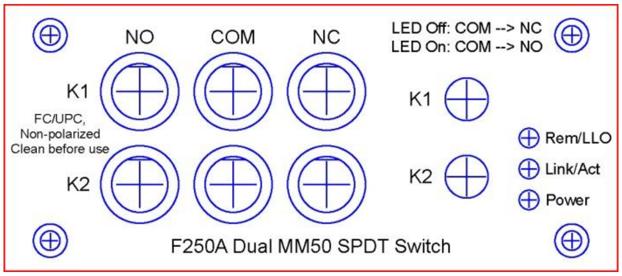
Part Number	Channel Count	Fiber Type	Wavelength (nm)
F251A-85	1	MM50	850
F251A-131	1	MM50	1310
F251A-155	1	MM50	1550
F255A-85	2	MM62	850
F255A-131	2	MM62	1310
F255A-155	2	MM62	1550
F256A-85	1	MM62	850
F256A-131	1	MM62	1310
F256A-155	1	MM62	1550

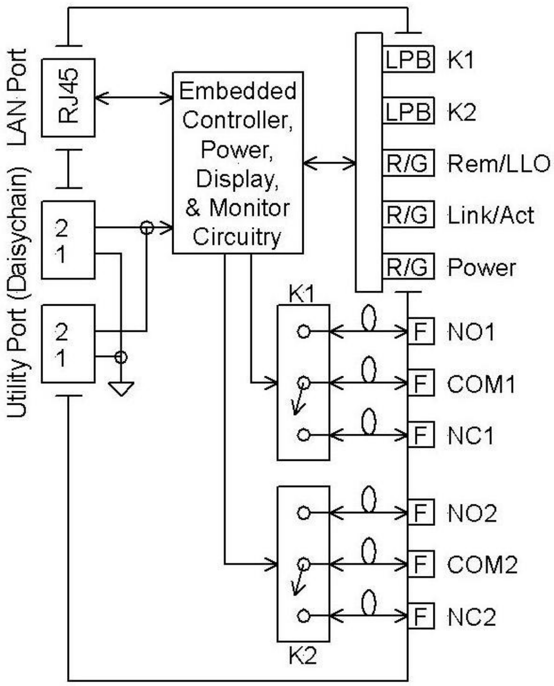
F240A, F250A, and F255A-* front chassis view, graphics layouts, and simple block diagram

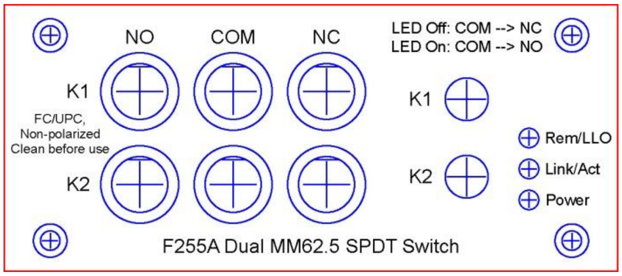


1U, quarter-rack, 8.7" deep



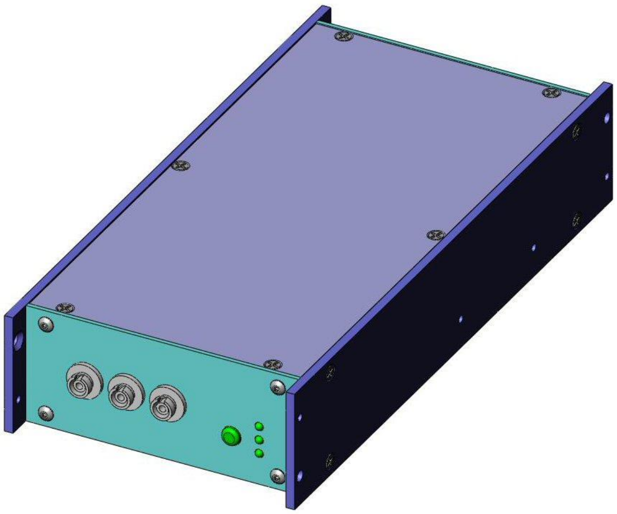




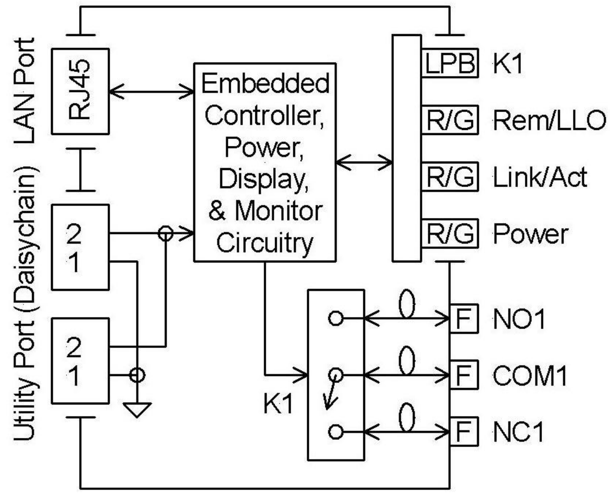


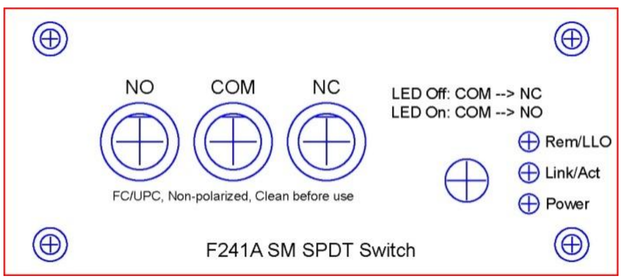
Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

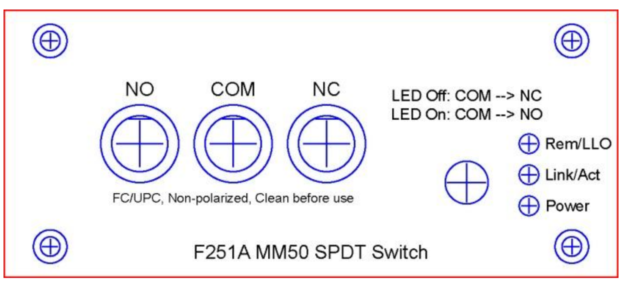
F241A, F251A, and F256A-* front chassis view, graphics layouts, and simple block diagram

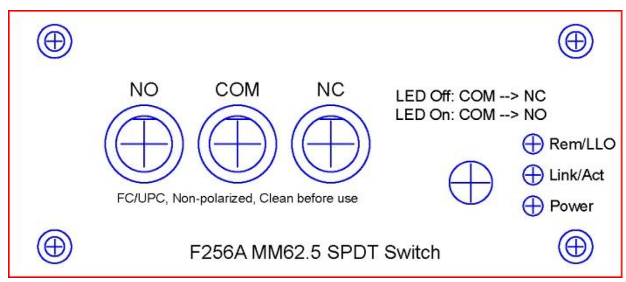


1U, quarter-rack, 8.7” deep









Key Specifications

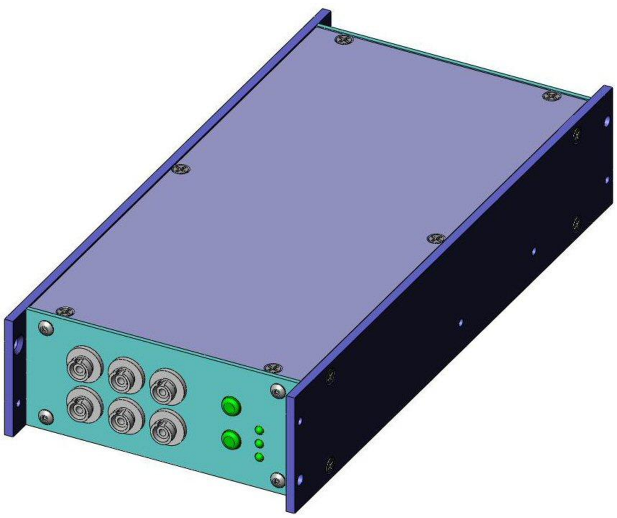
Parameter	Value	Units	Qualifier
Model Number	F240A-*, F241A-* F250A-*, F251A-* F255A-*, F256A-*	-	single-mode 50 micron multimode 62.5 micron multimode
Channels	1 or 2	-	See above model table
Switch Type	SPDT	-	-
Fiber Type	single-mode 50 micron multimode 62.5 micron multimode	-	F240A-*, F241A-* F250A-*, F251A-* F255A-*, F256A-*
Wavelength Range (per spec, usable beyond)	850 1260-1360 1510-1610	nm	See above model table
Optical Insertion Loss	1.0	dB	typical

Parameter	Value	Units	Qualifier
Optical Return Loss	55	dB	minimum
Optical Crosstalk Loss	55	dB	minimum
Wavelength Dependent Loss	0.15 0.25	dB	maximum, SM maximum, MM
Polarization Dependent Loss	0.1	dB	maximum, SM
Optical Input Power	500	mW	maximum
Repeatability	±0.02	dB	maximum
Switching Life	10 million	cycles	minimum
Switching Time	20	ms	typical
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	1.72H x 4.19W x 8.70D	Inches	nominal

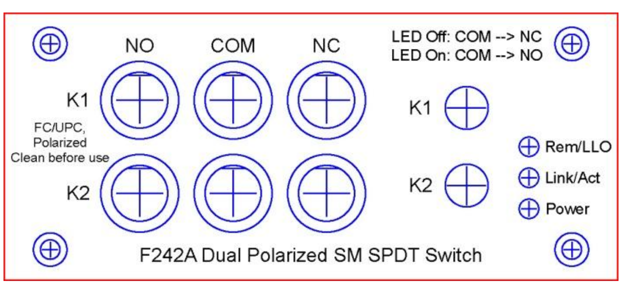
F242A-*, Switch, Dual SPDT, Single-mode, Polarized

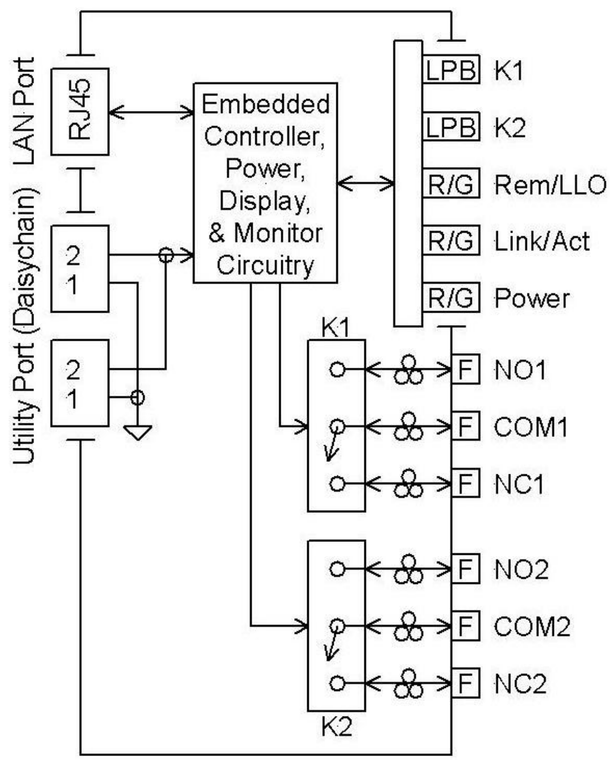
F243A-*, Switch, Single SPDT, Single-mode, Polarized

F242A-* front chassis view, graphics layout, and simple block diagram

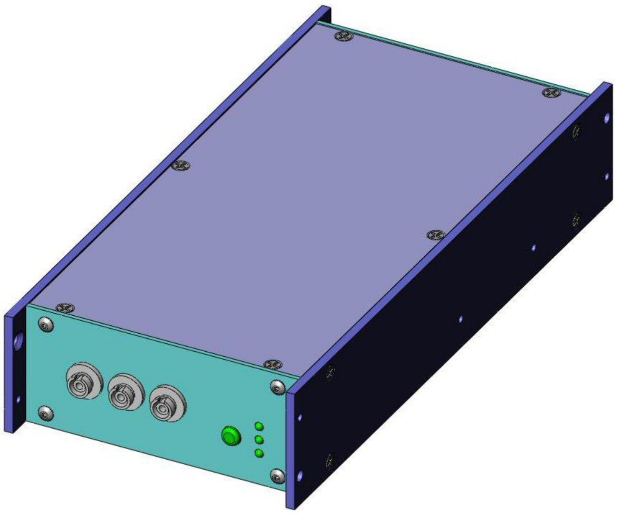


1U, quarter-rack, 8.7” deep

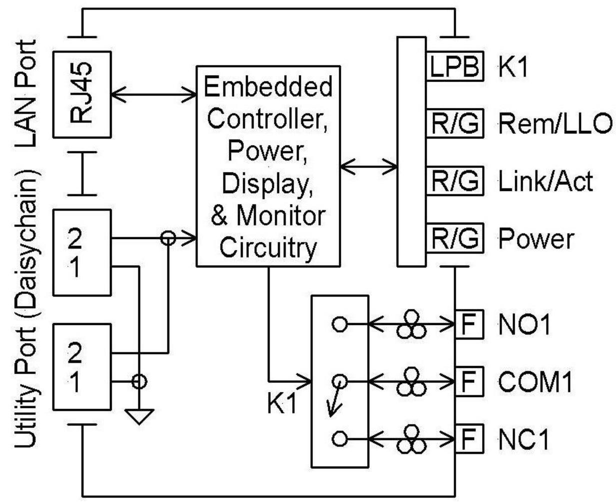


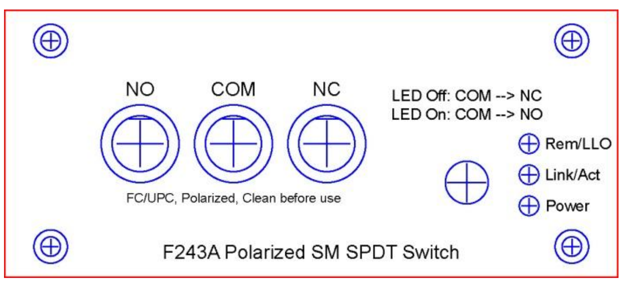


F243A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





These ModBlock switches contain one or two SPDT fiber optic switches and related circuitry, with single-mode polarization-maintaining (PM) fiber (slow axis aligned to connector key). The front panel lighted pushbutton provides toggle operation of the switch and also indicates the switch state. When the switch indicator is off, the fiber optic switch is in its normal state, as shown in the simple block diagram (COM→NC). When the switch indicator is on (green), the fiber optic switch is in its alternate state (COM→NO).

SPDT Switch Models

Part Number	Channel Count	Fiber Type	Wavelength (nm)	Part Number	Channel Count	Fiber Type	Wavelength (nm)
F242A-85	2	SM	850	F243A-85	1	SM	850
F242A-131	2	SM	1260-1360	F243A-131	1	SM	1260-1360
F242A-155	2	SM	1510-1610	F243A-155	1	SM	1510-1610

Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F242A-*, F243A-*	-	-
Channels	1 or 2	-	See above model table
Switch Type	SPDT	-	-
Fiber Type	Single mode Polarization maintaining	-	Slow axis aligned to connector key

Parameter	Value	Units	Qualifier
Wavelength Range (per spec, usable beyond)	850 1260-1360 1510-1610	nm	See above model table
Optical Insertion Loss	1.0	dB	typical
Optical Return Loss	55	dB	minimum
Optical Crosstalk Loss	55	dB	minimum
Wavelength Dependent Loss	0.15	dB	maximum
Extinction Dependent Loss	18	dB	minimum
Optical Input Power	500	mW	maximum
Repeatability	±0.02	dB	maximum
Switching Life	10 million	cycles	minimum
Switching Time	20	ms	typical
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	1.72H x 4.19W x 8.70D	Inches	nominal

F245A-*, Switch, Dual 2x2, Single-mode

F246A-*, Switch, Single 2x2, Single-mode

F252A-*, Switch, Dual 2x2, 50 micron Multimode

F253A-*, Switch, Single 2x2, 50 micron Multimode

F257A-*, Switch, Dual 2x2, 62.5 micron Multimode

F258A-*, Switch, Single 2x2, 62.5 micron Multimode

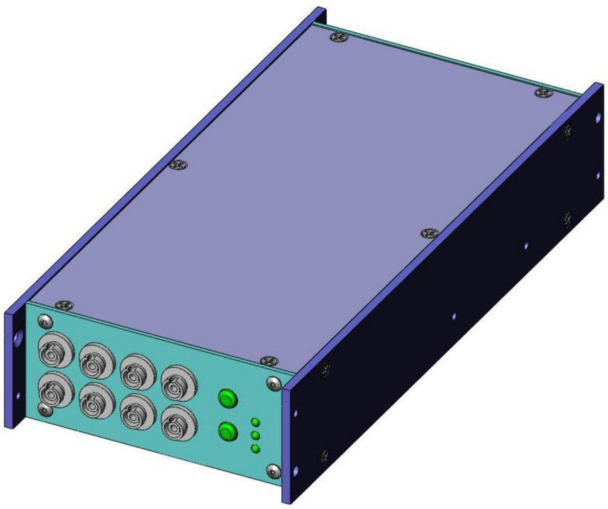
These ModBlock switches contain one or two 2x2 fiber optic switches (“transfer” or “bypass” switch) and related circuitry, with choice of single-mode (SM), 50 micron multimode (MM50), or 62.5 micron multimode (MM62.5 or MM62) fiber. The front panel lighted pushbutton provides toggle operation of the switch and also indicates the switch state. When the switch indicator is off, the fiber optic switch is in its normal state, as shown in the simple block diagram (COM→NC). When the switch indicator is on (green), the fiber optic switch is in its alternate state (COM→NO).

2x2 Switch Models

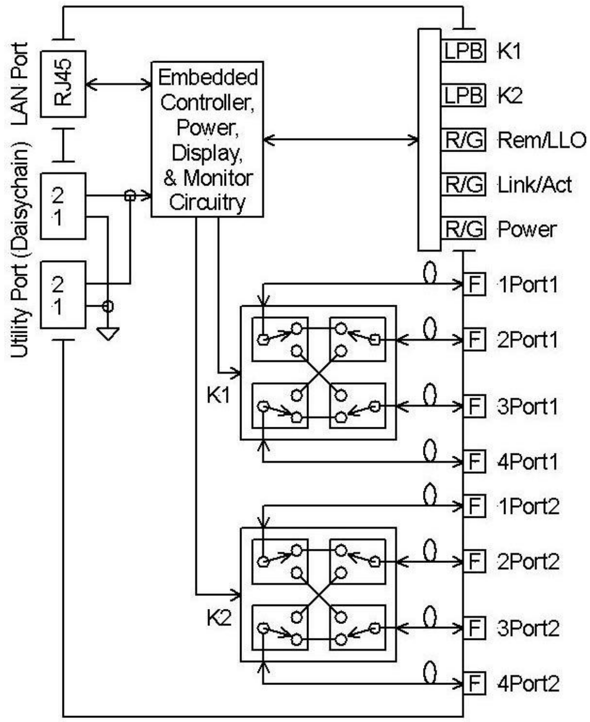
Part Number	Channel Count	Fiber Type	Wavelength (nm)
F245A-85	2	SM	850
F245A-131	2	SM	1260-1360
F245A-155	2	SM	1510-1610
F246A-85	1	SM	850
F246A-131	1	SM	1260-1360
F246A-155	1	SM	1510-1610
F252A-85	2	MM50	850
F252A-131	2	MM50	1310
F252A-155	2	MM50	1550

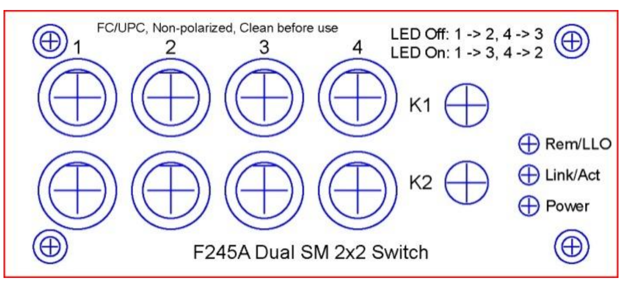
Part Number	Channel Count	Fiber Type	Wavelength (nm)
F253A-85	1	MM50	850
F253A-131	1	MM50	1310
F253A-155	1	MM50	1550
F257A-85	2	MM62	850
F257A-131	2	MM62	1310
F257A-155	2	MM62	1550
F258A-85	1	MM62	850
F258A-131	1	MM62	1310
F258A-155	1	MM62	1550

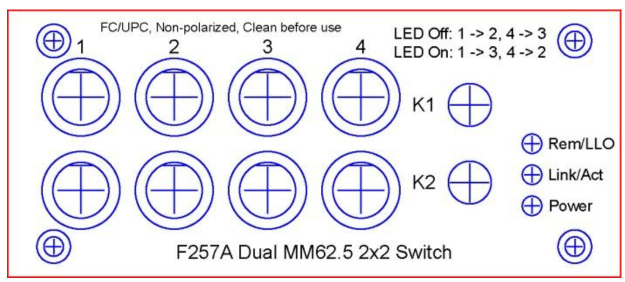
F245A, F252A, and F257A-* front chassis view, graphics layouts, and simple block diagram

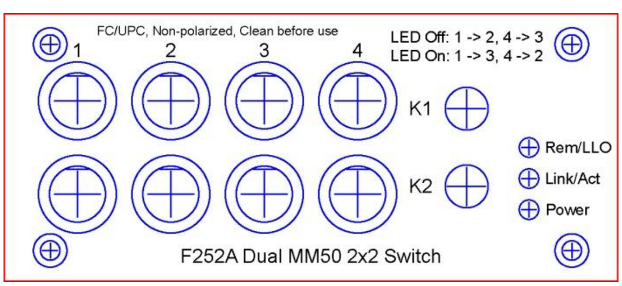


1U, quarter-rack, 8.7” deep



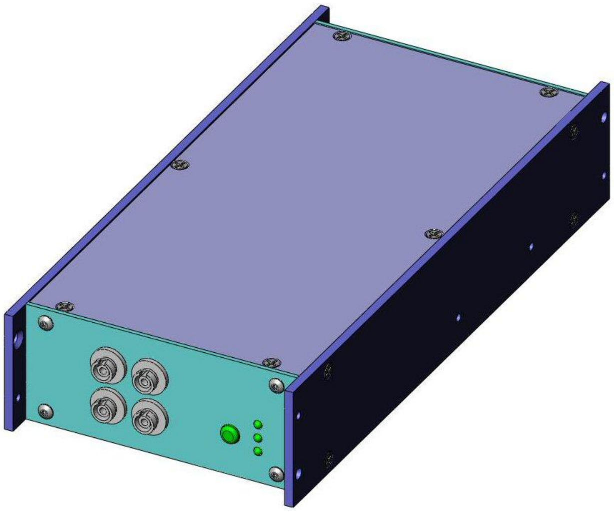




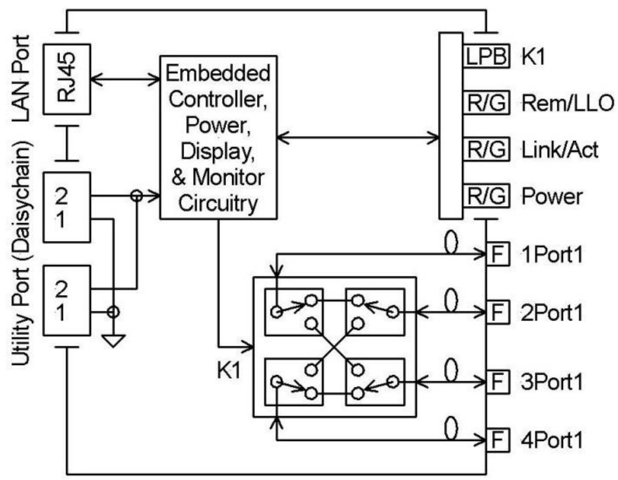


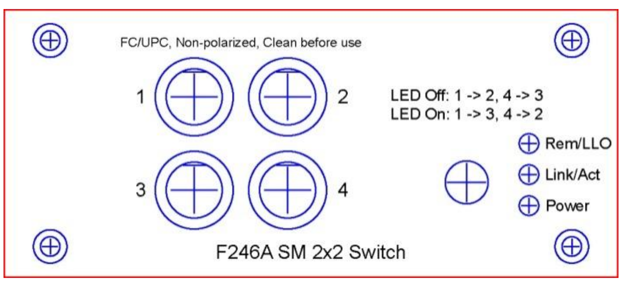
Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

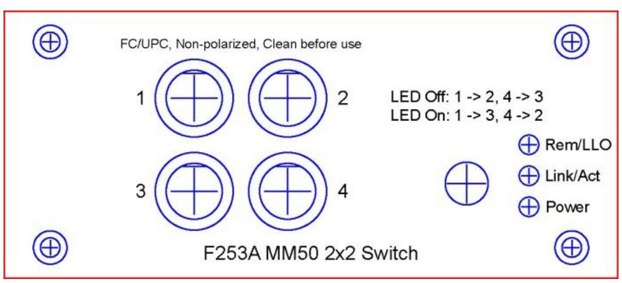
F246A, F253A, and F258A-* front chassis view, graphics layouts, and simple block diagram

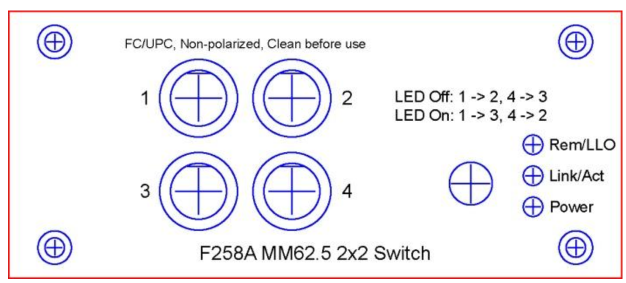


1U, quarter-rack, 8.7” deep









Key Specifications

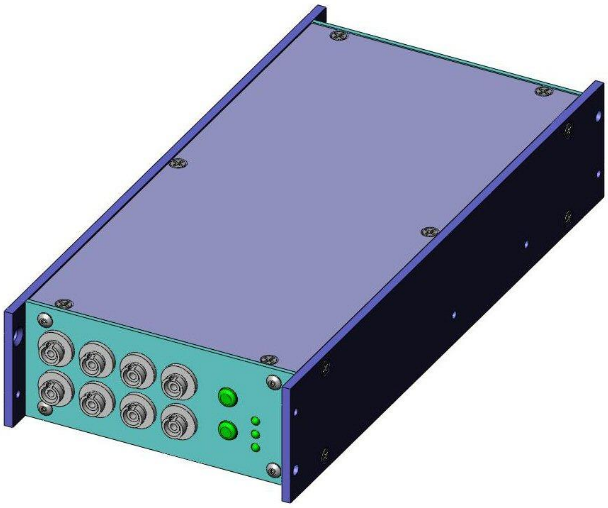
Parameter	Value	Units	Qualifier
Model Number	F245A-*, F246A-* F252A-*, F253A-* F257A-*, F258A-*	-	single-mode 50 micron multimode 62.5 micron multimode
Channels	1 or 2	-	See above model table
Switch Type	2x2	-	-
Fiber Type	single-mode 50 micron multimode 62.5 micron multimode	-	F245A-*, F246A-* F252A-*, F253A-* F257A-*, F258A-*
Wavelength Range (per spec, usable beyond)	850 1260-1360 1510-1610	nm	See above model table
Optical Insertion Loss	1.0	dB	typical

Parameter	Value	Units	Qualifier
Optical Return Loss	55	dB	minimum
Optical Crosstalk Loss	55	dB	minimum
Wavelength Dependent Loss	0.15 0.25	dB	maximum, SM maximum, MM
Polarization Dependent Loss	0.1	dB	maximum, SM
Optical Input Power	500	mW	maximum
Repeatability	±0.02	dB	maximum
Switching Life	10 million	cycles	minimum
Switching Time	20	ms	typical
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	1.72H x 4.19W x 8.70D	Inches	nominal

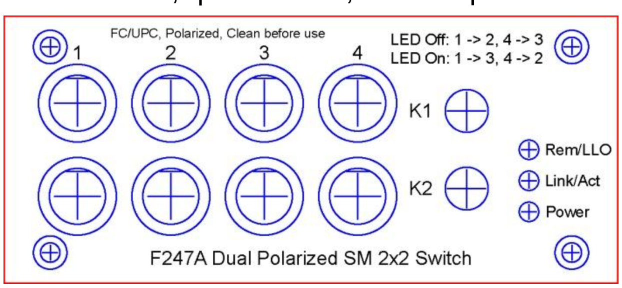
F247A-*, Switch, Dual 2x2, Single-mode, Polarized

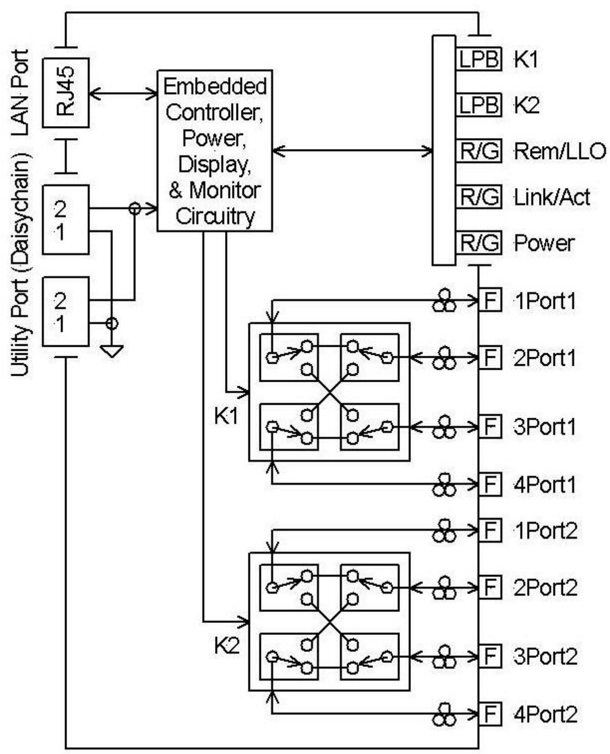
F248A-*, Switch, Single 2x2, Single-mode, Polarized

F247A-* front chassis view, graphics layout, and simple block diagram

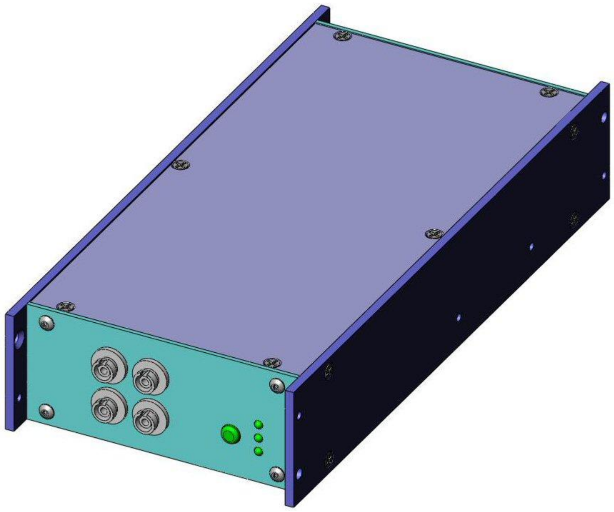


1U, quarter-rack, 8.7” deep

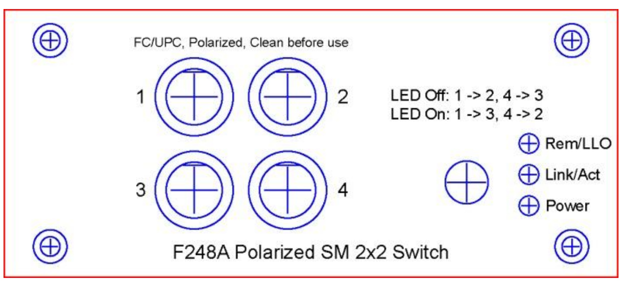


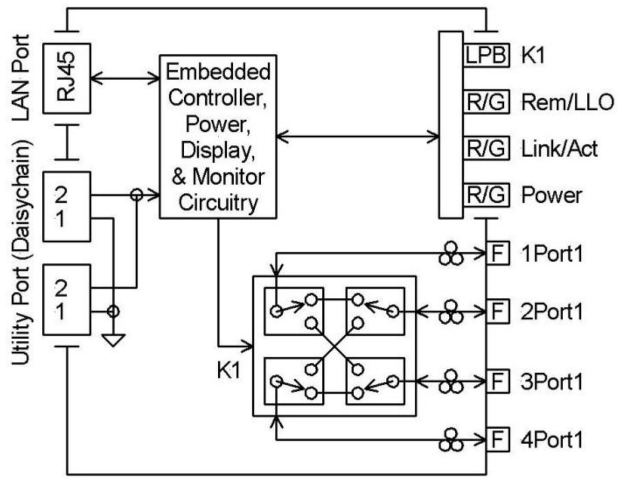


F248A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





These ModBlock switches contain one or two 2x2 fiber optic switches (“transfer” or “bypass” switch) and related circuitry, with single-mode polarization-maintaining (PM) fiber (slow axis aligned to connector key). The front panel lighted pushbutton provides toggle operation of the switch and also indicates the switch state. When the switch indicator is off, the fiber optic switch is in its normal state, as shown in the simple block diagram (COM→NC). When the switch indicator is on (green), the fiber optic switch is in its alternate state (COM→NO).

2x2 Switch Models

Part Number	Channel Count	Fiber Type	Wavelength (nm)
F247A-85	2	SM	850
F247A-131	2	SM	1260-1360
F247A-155	2	SM	1510-1610

Part Number	Channel Count	Fiber Type	Wavelength (nm)
F248A-85	1	SM	850
F248A-131	1	SM	1260-1360
F248A-155	1	SM	1510-1610

Key Specifications

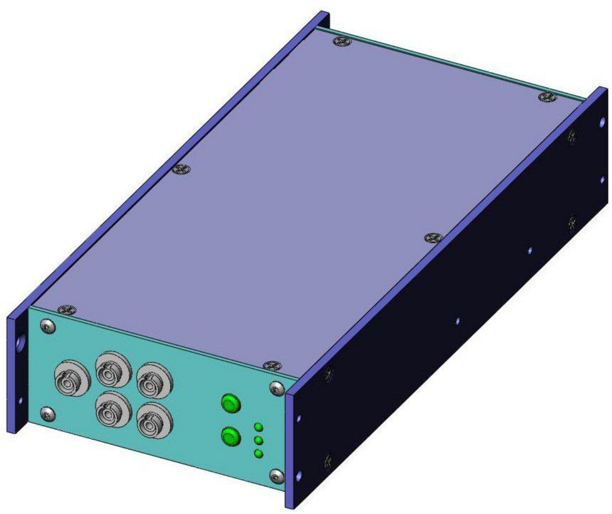
Parameter	Value	Units	Qualifier
Model Number	F247A-*, F248A-*	-	-
Channels	1 or 2	-	See above model table
Switch Type	2x2	-	-
Fiber Type	Single mode Polarization maintaining	-	Slow axis aligned to connector key

Parameter	Value	Units	Qualifier
Wavelength Range (per spec, usable beyond)	850 1260-1360 1510-1610	nm	See above model table
Optical Insertion Loss	1.0	dB	typical
Optical Return Loss	55	dB	minimum
Optical Crosstalk Loss	55	dB	minimum
Wavelength Dependent Loss	0.15	dB	maximum
Extinction Dependent Loss	18	dB	minimum
Optical Input Power	500	mW	maximum
Repeatability	±0.02	dB	maximum
Switching Life	10 million	cycles	minimum
Switching Time	20	ms	typical
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	1.72H x 4.19W x 8.70D	Inches	nominal

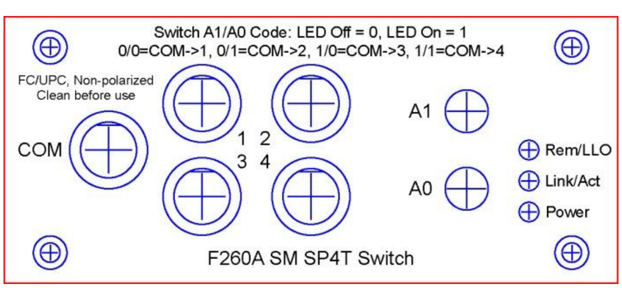
F260A-*, Switch, SP4T, Single-mode

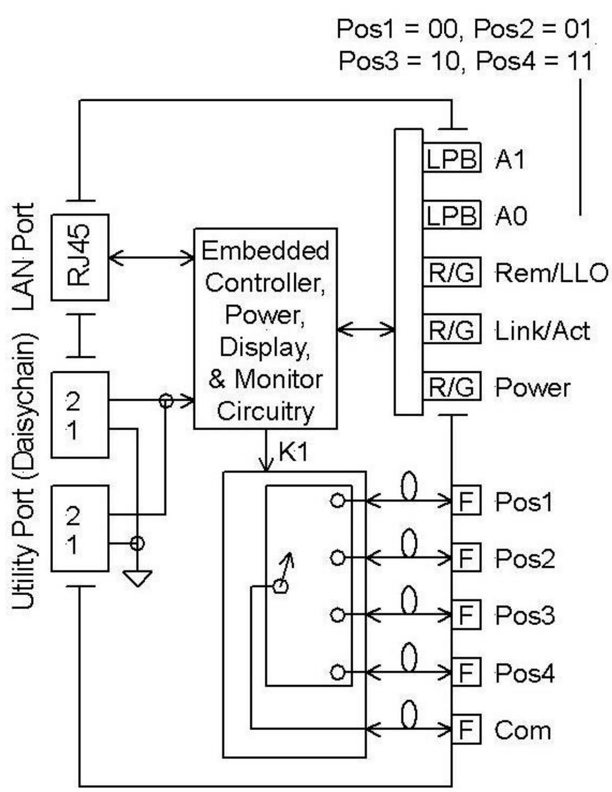
This ModBlock switch contains one SP4T fiber optic switch and related circuitry, using single-mode (SM) fiber. Two front panel lighted pushbutton switches are used for manual selection of the switch position using a classic 2-bit binary code, as shown in the block diagram. A SP4T switch with polarization-maintaining SM fiber is available on request.

F260A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7" deep





SP4T Switch Models

Part Number	Wavelength (nm)
F260A-85	820-880
F260A-131	1260-1360
F260A-155	1510-1610

Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F260A-*	-	-
Channels	1	-	-
Switch Type	SP4T	-	-
Fiber Type	single-mode	-	-
Wavelength Range (per spec, usable beyond)	820-880 1260-1360 1510-1610	nm	See above model table
Optical Insertion Loss	1.0	dB	typical
Optical Return Loss	50	dB	minimum
Optical Crosstalk Loss	50	dB	minimum
Wavelength Dependent Loss	0.3	dB	maximum
Polarization Dependent Loss	0.2	dB	maximum
Optical Input Power	500	mW	maximum
Repeatability	±0.05	dB	maximum
Switching Time	20	ms	typical
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	1.72H x 4.19W x 8.70D	Inches	nominal

F265A-*, Switch, SP8T, Single-mode

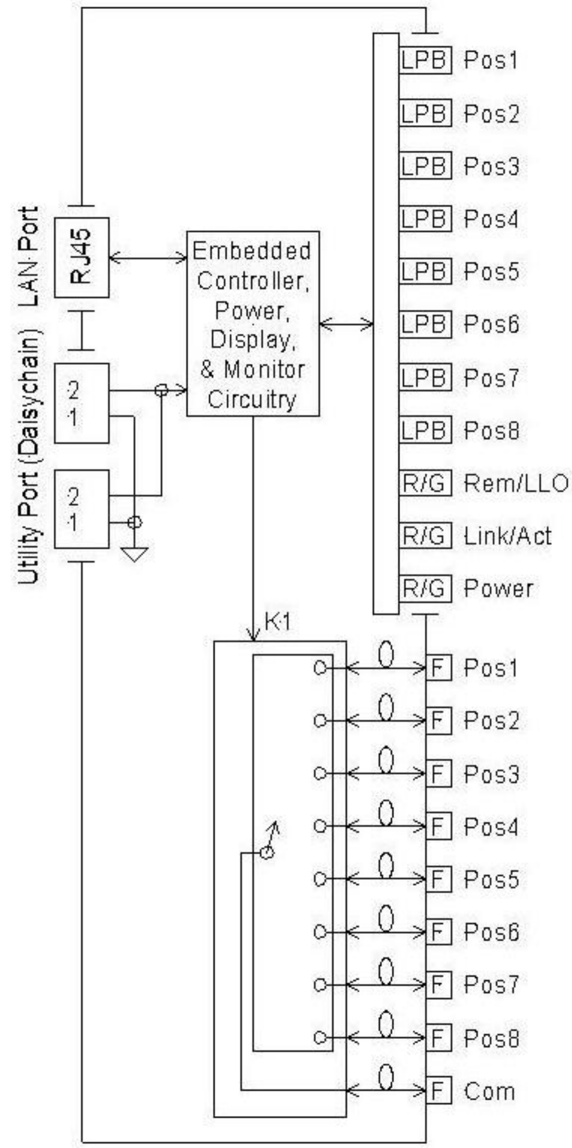
This ModBlock switches contains one SP8T fiber optic switch and related circuitry, using single-mode (SM) fiber. A SP8T switch with polarization-maintaining SM fiber is available on request. The 8 front panel lighted pushbutton switches provide “radio button” manual operation of the switch and also indicates the switch position (by either manual or remote operation). The switch is in position 1 by default. When a numbered switch is turned on by pressing the pushbutton or by remote control (indicator = green), COM is connected to the corresponding numbered port. When a numbered switch indicator is on and then a different numbered switch is turned on (by pressing a different pushbutton or by remote control), then COM is disconnected from the original port and re-connected to the new port (“radio button” operation) and the switch indicators change accordingly.

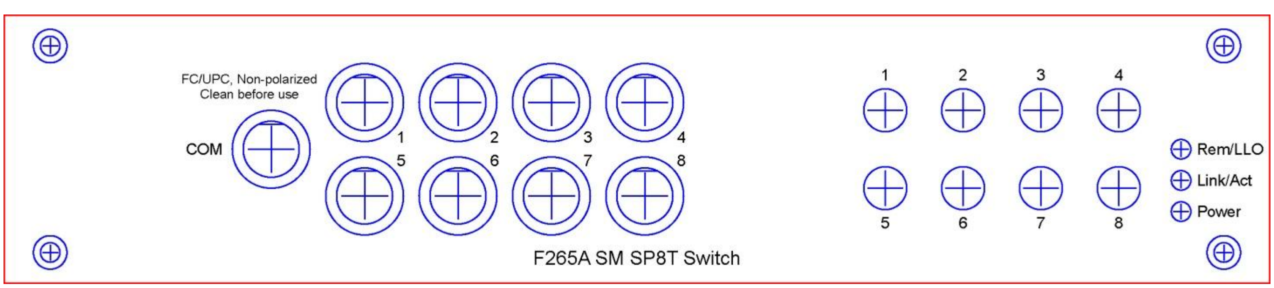
SP8T Switch Models

Part Number	Wavelength (nm)
F265A-85	820-880
F265A-131	1260-1360
F265A-155	1510-1610

F265A-* front chassis view, graphics layout, and simple block diagram

1U, half-rack, 6.7” deep





Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F265A-*	-	-
Channels	1	-	-

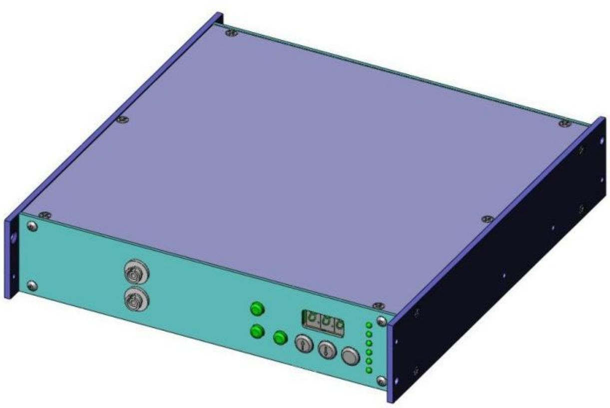
Parameter	Value	Units	Qualifier
Switch Type	SP8T	-	-
Fiber Type	single-mode	-	-
Wavelength Range (per spec, usable beyond)	820-880 1260-1360 1510-1610	nm	See above model table
Optical Insertion Loss	1.2	dB	typical
Optical Return Loss	50	dB	minimum
Optical Crosstalk Loss	50	dB	minimum
Wavelength Dependent Loss	0.3	dB	maximum
Polarization Dependent Loss	0.2	dB	maximum
Optical Input Power	500	mW	maximum
Repeatability	±0.05	dB	maximum
Switching Time	20	ms	typical
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

Amplifiers

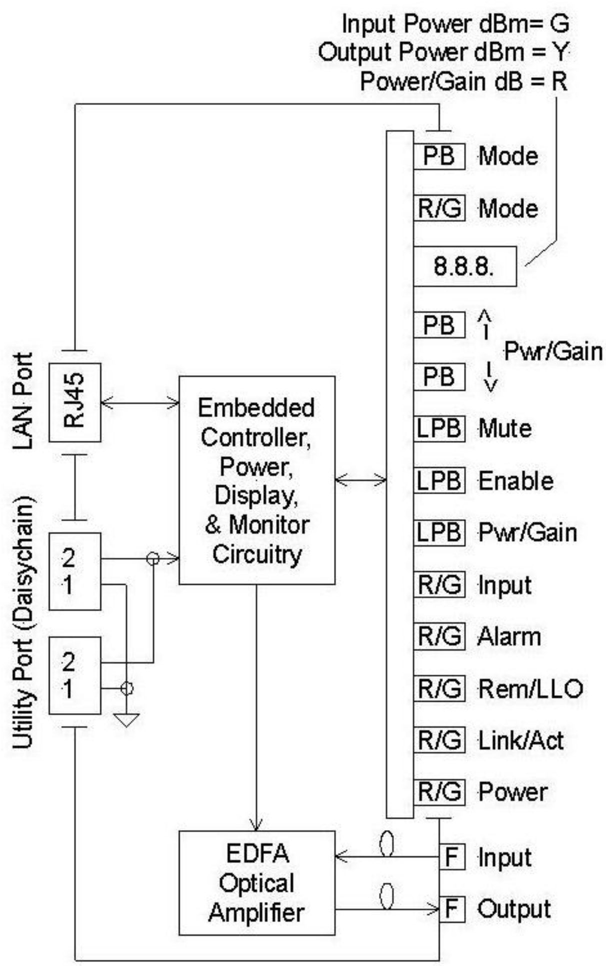
Optical amplifier ModBlocks are offered for the O, S, C, and L bands, including an erbium doped fiber amplifier (EDFA) and several semiconductor optical amplifiers (SOA). These amplifiers are bit-rate independent. Many different optical amplifiers are available in the market. Send an email request to ModBlocks@tmeplano.com if you don't see the amplifier or performance you need. Chassis rear views are shown in the "Common Packaging Data" section on page 186. Price and delivery are shown in the "Domestic USA Pricing" section starting on page 199.

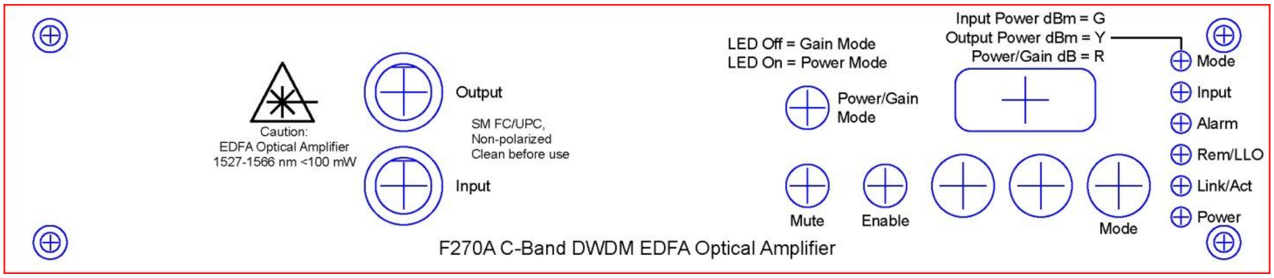
F270A, Optical Amplifier, EDFA, Variable Gain/Power, DWDM C-Band

F270A front chassis view, graphics layout, and simple block diagram



1U, half-rack, 8.7" deep





This EDFA optical amplifier ModBlock operates in the C-band for DWDM signals, using single-mode fiber. The amplifier can be operated in a constant output power (up to +15 dBm) or constant gain mode (up to 25 dB), where the power/gain is adjustable. Internal user-replaceable “crash” cables are provided (optical input and output) for repair convenience in case of optical connector damage.

Front panel pushbuttons and a numeric readout provide manual control of amplifier output power or gain and monitoring of input and output power levels (which can also be operated remotely). The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Red indicates Power/Gain control mode, yellow indicates Output Power monitoring mode, green indicates Input Power monitoring mode, and dark indicates off mode. Pushbuttons with up and down arrows allow power or gain adjustment when the bi-color LED is red. The mode pushbutton turns the display on or off.

Front panel switches select constant power or constant gain operating mode (green = power, dark = gain), output enable, and output mute (“eye-safe”, ~+10 dBm). A front panel bi-color LED monitors the input signal presence. Green indicates optical input power exists and is within the normal operating range for the amplifier. Yellow indicates loss of optical input power. A second front panel bi-color LED monitors EDFA alarms (green = OK, yellow = warning, red = alarm). Alarms include loss of signal, low output power, EDFA pump temperature, pump bias end of life, and excess output reflection.

Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F270A	-	-
Amplifier Type	EDFA	-	DWDM grade
Fiber Type	single-mode	-	-
Wavelength Range	1529-1563	nm	-
Channel Spacing	25, 50, 100	GHz	or single channel
Input Power Range, total	-29 to +7	dBm	-
Input Power Range, per channel	-32 to +2	dBm	-
Output Power Range	-4 to +17	dBm	power mode
Gain Range	10 to 25	dB	gain mode

Parameter	Value	Units	Qualifier
Gain Flatness	1.0	dB pp	maximum, over C-band
Gain Tilt, full C-band	0 to 2	dB	maximum
Noise Figure, maximum	5.5 6.5 10.0 15.5	dB	Pin = -8 dBm, Gain = 25 dB Pin = -3 dBm, Gain = 20 dB Pin = +2 dBm, Gain = 15 dB Pin = +7 dBm, Gain = 10 dB
Polarization Dependent Gain	0.5	dB	maximum
Optical Return Loss, input or output	40	dB	minimum
Pump Leakage	-30 -20	dBm	at input at output
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	1.72H x 8.38W x 8.70D	Inches	nominal

F275A-*, Optical Amplifier, SOA

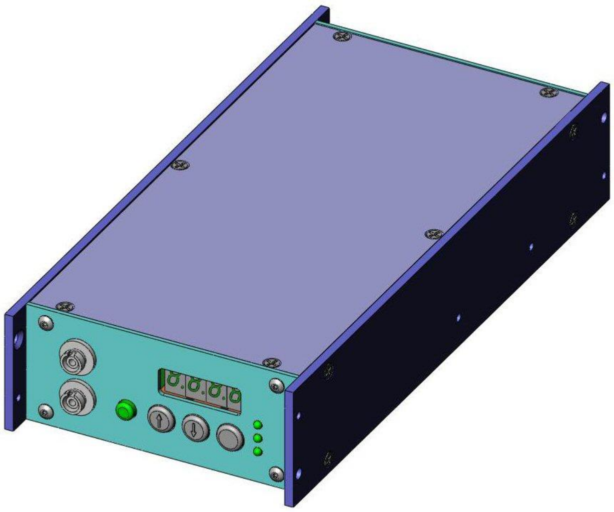
Semiconductor optical amplifier (SOA) ModBlocks are offered for the O-band and C-band, using single-mode fiber. Amplifier operating current can be adjustable to vary the gain. These SOAs are thermally stabilized and use single mode fiber (polarization-maintaining fiber types available upon request). The output power is adjustable and a SOA enable switch is provided. Internal user-replaceable “crash” cables are provided (optical input and output) for repair convenience in case of optical connector damage.

Front panel pushbuttons and a numeric readout provide manual control of the SOA current (for output power level control), which can also be operated remotely. The mode pushbutton turns the display on or off. Pushbuttons with up and down arrows allow adjustment of the SOA current when the display is on.

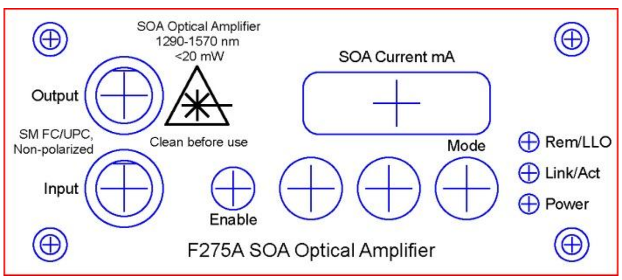
SOA optical amplifier choices

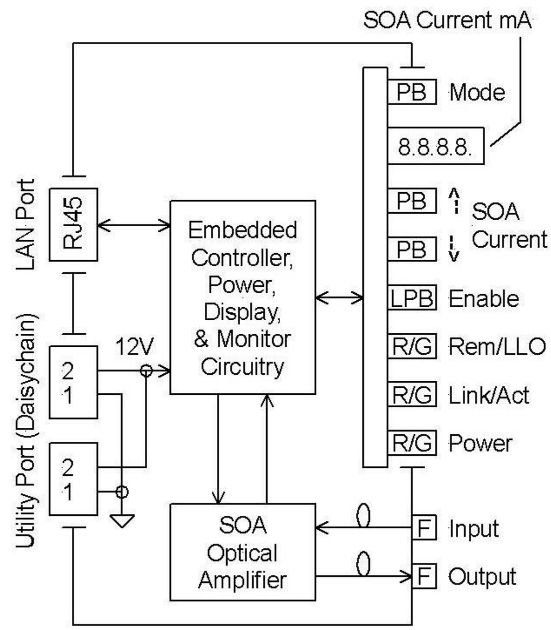
Part Number	Band	Wavelength Range (nm)	Gain (dB)	Noise Figure (dB)	Output Power (dBm)	Polarization Dependent Gain (dB)	Wavelength Gain Ripple (dB)
F275-1	O	1280-1340	10 min.	6 typ.	8 min.	0.5 typ.	0.5 typ.
F275-2	O	1280-1340	16 typ.	7 typ.	10 min.	0.5 typ.	0.5 typ.
F275-3	O	1280-1340	22 typ.	7 typ.	10 min.	0.5 typ.	0.5 typ.
F275-4	S	1470-1530	10 min.	7 typ.	12 typ.	1.5 typ.	0.3 typ.
F275-5	S	1470-1530	15 min.	7 typ.	12 typ.	1.5 typ.	0.3 typ.
F275-6	S	1470-1530	20 typ.	7 typ.	11 typ.	1.5 typ.	0.3 typ.
F275-7	C	1510-1590	15 typ.	9 max.	10 typ.	0.5 typ.	0.5 typ.
F275-8	C	1510-1590	20 typ.	9 max.	10 typ.	0.5 typ.	0.5 typ.
F275-9	C	1529-1563	10 min.	6 typ.	11 typ.	0.5 typ.	0.3 typ.
F275-10	C	1529-1563	15 min.	6 typ.	13 typ.	0.5 typ.	0.3 typ.
F275-11	C	1529-1563	20 min.	6 typ.	11 typ.	0.5 typ.	0.3 typ.
F275-12	L	1550-1610	15 typ.	7 typ.	12 typ.	1.5 typ.	0.3 typ.
F275-13	L	1550-1610	20 typ.	7 typ.	11 typ.	1.5 typ.	0.3 typ.

F275A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





Other Specifications

Parameter	Value	Units	Qualifier
Model Number	F275A-*	-	* = SOA type code
Amplifier Type	SOA	-	-
Fiber Type	single-mode	-	-
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	1.72H x 4.19W x 8.70D	Inches	nominal

Phase Shifters

Variable Attenuators

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Passive Devices

A variety of passive fiber optic ModBlocks are offered, including couplers, circulators, isolators, and wavelength splitters. 0.5U ModBlocks require a side panel kit (A430A on page 184) in order to fasten them to other ModBlocks. These ModBlocks use FC/UPC connectors by default, but can be built using FC/APC connectors upon request. Internal “crash” cables are not provided but can be added upon request at extra cost. Many different passive devices are available in the market. Send an email request to ModBlocks@tmeplano.com if you don't see the device or performance you need. Price and delivery are shown in the "Domestic USA Pricing" section starting on page 199.

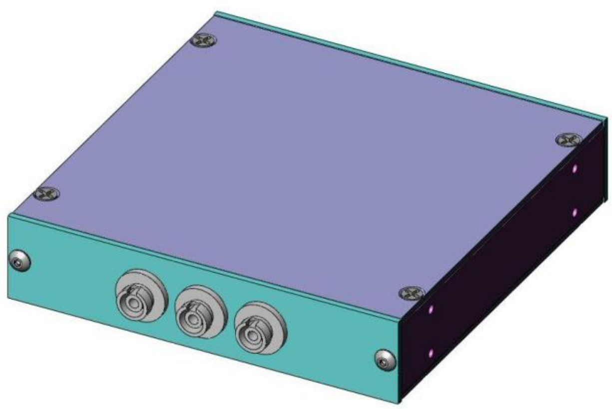
F310A-*, Coupler, 1x2, Single-mode

F320A-*, Coupler, 1x2, 50 micron Multimode

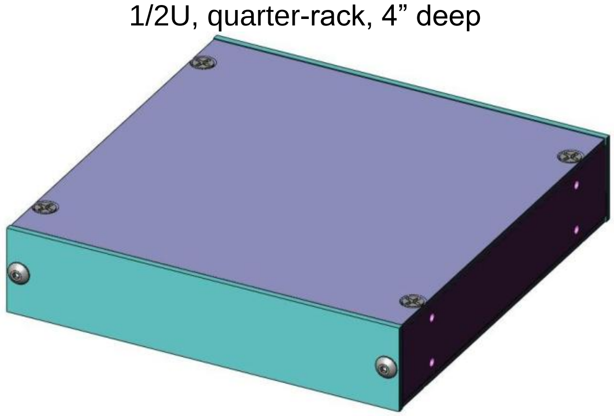
F322A-*, Coupler, 1x2, 62.5 micron Multimode

Passive fiber optic ModBlock 1x2 couplers are offered, with choice of single-mode (SM), 50 micron multimode (MM50), or 62.5 micron multimode (MM62.5 or MM62) fiber. Coupling ratios vary from 50%/50% (splitters) to 1%/99% (taps). Couplers can be used to split an incoming light source into two parts or to combine two light sources into a single part.

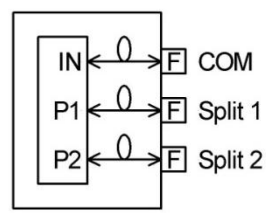
F310A, F320A, and F322A-* chassis views, graphics layouts, and simple block diagram

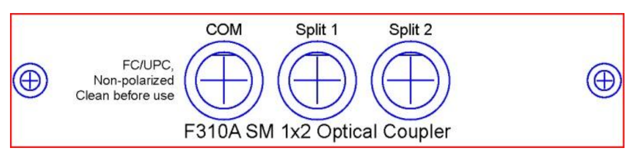


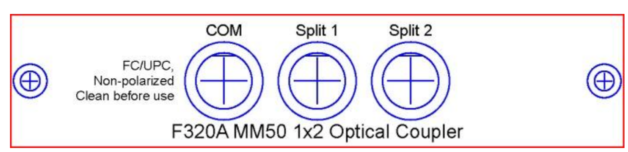
1/2U, quarter-rack, 4" deep

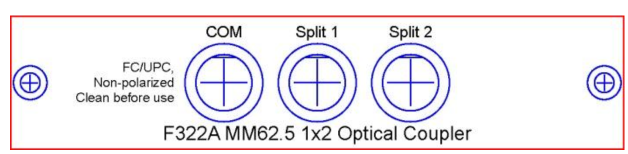


Rear View









Single-mode coupler choices

Part Number	Wavelength Range (nm)	Coupling Ratio (%) Split 1/2	Coupling Loss (dB)
F310-1	1270-1350	50/50	3.3/3.3 max.
F310-2		20/80	7.4/1.1 max.

Part Number	Wavelength Range (nm)	Coupling Ratio (%) Split 1/2	Coupling Loss (dB)
F310-3		10/90	11.0/0.60 max.
F310-4		5/95	13.8/0.45 max.
F310-5		1/99	21.0/0.2 max.
F310-11	1510-1590	50/50	3.3/3.3 max.
F310-12		20/80	7.4/1.1 max.
F310-13		10/90	11.0/0.60 max.
F310-14		5/95	13.8/0.45 max.
F310-15		1/99	21.0/0.2 max.

Multimode coupler choices

Part Number	Fiber Type	Wavelength Center (nm)	Coupling Ratio (%) Split 1/2	Coupling Loss (dB)
F320-1	50 micron	850	50/50	4.0/4.0 max.
F320-2			20/80	8.0/1.9 max.
F320-3			10/90	10.8/1.3 max.
F320-4			5/95	14.0/0.45 max.
F320-11		1310	50/50	4.0/4.0 max.
F320-12			20/80	8.0/1.9 max.
F320-13			10/90	10.8/1.3 max.
F320-14			5/95	14.0/0.45 max.
F320-21		1550	50/50	4.0/4.0 max.
F320-22			20/80	8.0/1.9 max.
F320-23			10/90	10.8/1.3 max.
F320-24			5/95	14.0/0.45 max.
F322-1	62.5 micron	850	50/50	4.0/4.0 max.
F322-2			20/80	8.0/1.9 max.
F322-3			10/90	10.8/1.3 max.
F322-4			5/95	14.0/0.45 max.
F322-11		1310	50/50	4.0/4.0 max.
F322-12			20/80	8.0/1.9 max.
F322-13			10/90	10.8/1.3 max.
F322-14			5/95	14.0/0.45 max.
F322-21		1550	50/50	4.0/4.0 max.
F322-22			20/80	8.0/1.9 max.
F322-23			10/90	10.8/1.3 max.
F322-24			5/95	14.0/0.45 max.

Other Specifications

Parameter	Value	Units	Qualifier
Model Number	F310A-* F320A-* F322A-*	-	single-mode 50 micron multimode 62.5 micron multimode
Channels	1	-	-
Coupler Type	Fused bi-conical taper	-	-
Fiber Type	single-mode 50 micron multimode 62.5 micron multimode	-	F310A-* F320A-* F322A-*
Wavelength Range (per spec, usable beyond)	See above model table	nm	-

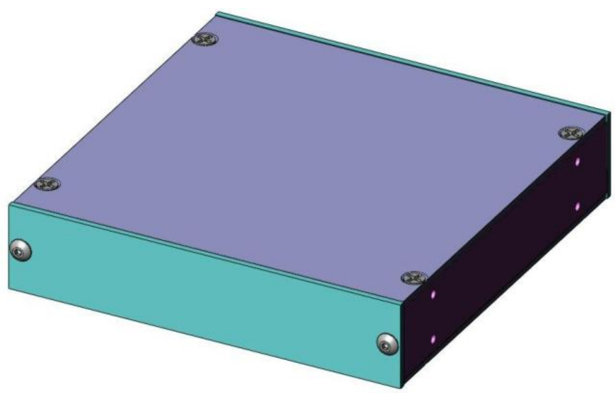
Parameter	Value	Units	Qualifier
Optical Power	4 2	watts	maximum, SM maximum, MM
Optical Return Loss	55 minimum 40 minimum	dB	single-mode multimode
Directivity	55 minimum 40 minimum	dB	single-mode multimode
Polarization Dependent Loss	0.1	dB	maximum, SM
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	0.85H x 4.19W x 4.00D	Inches	nominal

F311A-*, Coupler, 1x4, Single-mode

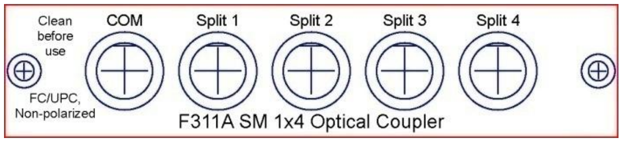
A passive fiber optic ModBlock 1x4 coupler is offered, using single-mode (SM) fiber. The coupling ratio is 25/25/25/25% (equal splits). A coupler can be used to split an incoming light source into four parts or to combine four light sources into a single part. Multimode fiber versions (50 and 62.5 micron) are also available upon request.

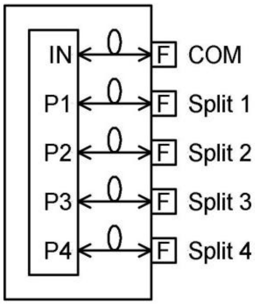
F311A-* chassis views, graphics layout, and simple block diagram

1/2U, quarter-rack, 4” deep



Rear View





Key Specifications

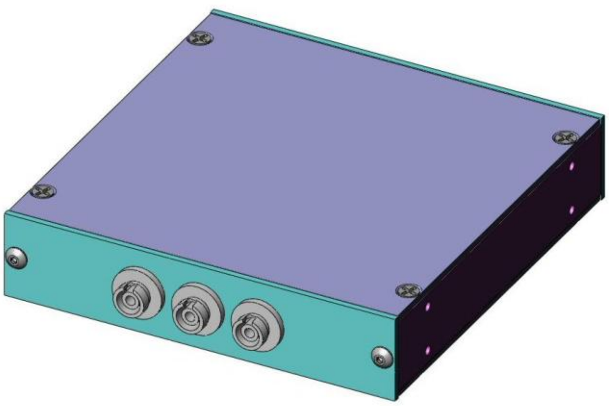
Parameter	Value	Units	Qualifier
Model Number	F311A-1 F311A-2	-	1310 nm 1550 nm
Channels	1	-	-
Coupler Type	1X4 fused bi-conical taper	-	-
Fiber Type	single-mode	-	-

Parameter	Value	Units	Qualifier
Wavelength Range (per spec, usable beyond)	1270-1350 1510-1590	nm	-
Coupling Ratio	25/25/25/25	%	
Optical Power	4	watts	maximum
Insertion Loss	7.8	dB	maximum
Optical Return Loss	55	dB	minimum
Directivity	55	dB	minimum
Polarization Dependent Loss	0.20	dB	maximum
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	0.85H x 4.19W x 4.00D	Inches	nominal

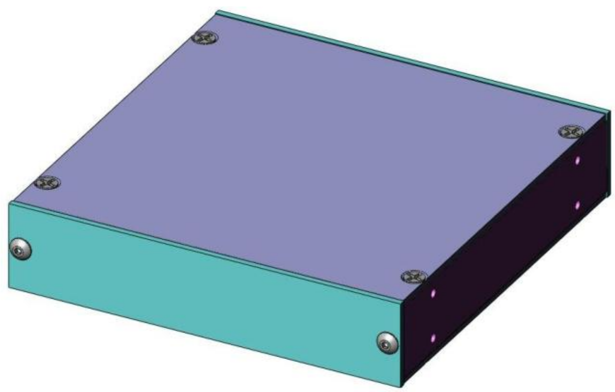
F315A-*, Coupler, 1x2, Single-mode, Polarized

Passive fiber optic ModBlock 1x2 couplers are offered, using single-mode (SM) fiber. Coupling ratios vary from 50%/50% (splitters) to 1%/99% (taps). Couplers can be used to split an incoming light source into two parts or to combine two light sources into a single part.

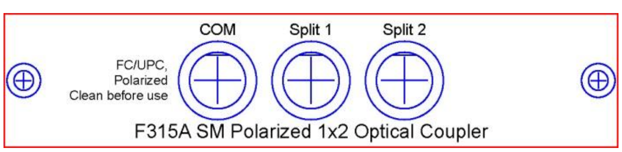
F315A chassis views, graphics layout, and simple block diagram

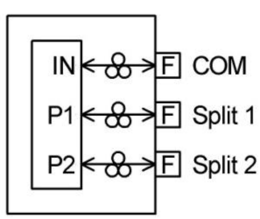


1/2U, quarter-rack, 4” deep



Rear View





PM coupler choices

Part Number	Coupling Ratio (%) Split 1/2	Coupling Loss (dB)
F315-1	50/50	4.0/4.0 typ.
F315-2	20/80	8.4/1.7 typ.
F315-3	10/90	11.8/1.1 typ.
F315-4	5/95	15.7/0.9 typ.
F315-5	1/99	24.0/0.8 typ.

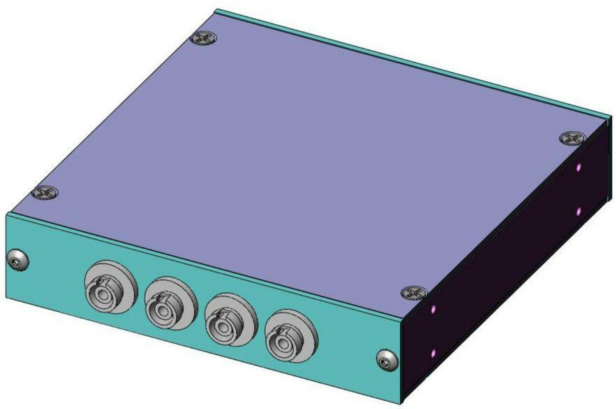
Other Specifications

Parameter	Value	Units	Qualifier
Model Number	F315A-*	-	* = coupler type code
Channels	1	-	-
Coupler Type	1x2	-	-
Fiber Type	Single mode Polarization maintaining	-	Slow axis aligned to connector key
Wavelength Range	1530-1570	nm	-
Optical Power	2	watts	maximum
Optical Return Loss	50	dB	minimum
Directivity	55	dB	minimum
Polarization Extinction Ratio	18	dB	minimum
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	0.85H x 4.19W x 4.00D	Inches	nominal

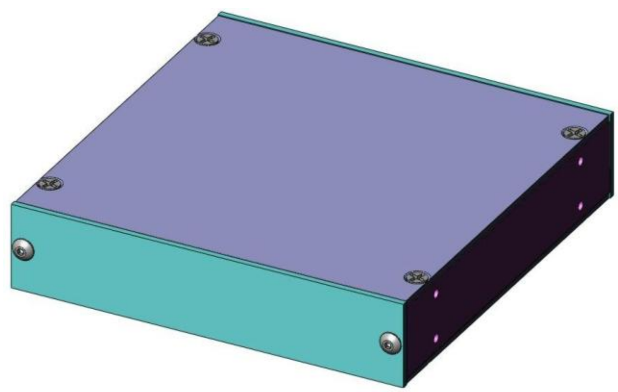
F325A-*, Circulator, 3-Port, Single-mode

Passive fiber optic ModBlock 3-port circulators are offered for 1310 nm and 1550 nm C and L bands, using single-mode (SM) fiber. Light entering port 1 passes to port 2 and light entering port 2 passes to port 3. These ModBlocks use FC/UPC connectors by default, but can be built using FC/APC connectors upon request. Polarization-maintaining versions are also available upon request.

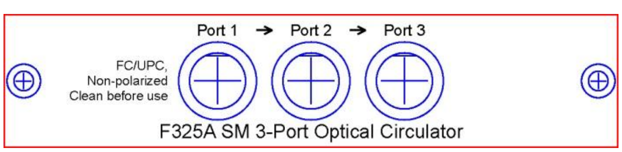
F325A-* chassis views, graphics layout, and simple block diagram

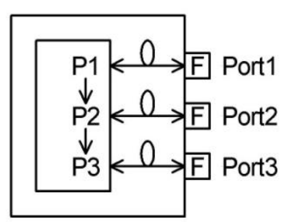


1/2U, quarter-rack, 4” deep



Rear View





3-port circulator choices

Part Number	Wavelength Range (nm)
F325-1	1295-1325

Part Number	Wavelength Range (nm)
F325-2	1530-1570
F325-3	1570-1610
F325-4	1525-1610

Other Specifications

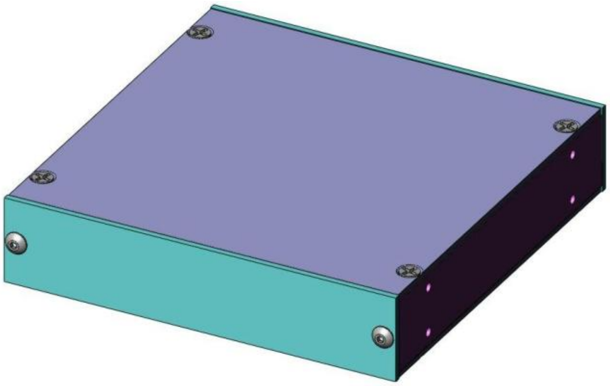
Parameter	Value	Units	Qualifier
Model Number	F325A-*	-	* = circulator type code
Channels	1	-	-
Fiber Type	single-mode	-	-
Optical Insertion Loss, Between adjacent ports	0.8 1.2	dB	typical maximum
Optical Isolation, 2→1 or 3→2	36	dB	typical
Directivity, 1→3	50	dB	minimum
Optical Power	500	mW	maximum
Optical Return Loss	50	dB	minimum
Polarization Dependent Loss	0.1	dB	maximum
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	0.85H x 4.19W x 4.00D	Inches	nominal

F326A-*, Circulator, 4-Port, Single-mode

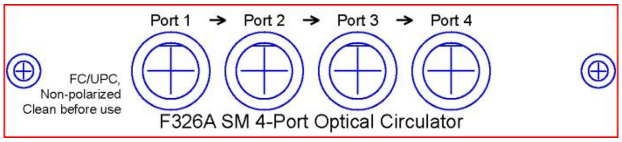
Passive fiber optic ModBlock 4-port circulators are offered for 1310 nm and 1550 nm C and L bands, using single-mode (SM) fiber. Light entering port 1 passes to port 2, light entering port 2 passes to port 3, and light entering port 3 passes to port 4. These ModBlocks use FC/UPC connectors by default, but can be built using FC/APC connectors upon request. Polarization-maintaining versions are also available upon request.

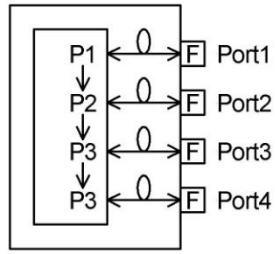
F326A-* chassis views, graphics layout, and simple block diagram

1/2U, quarter-rack, 4" deep



Rear View





4-port circulator choices

Part Number	Wavelength Range (nm)
F326-1	1295-1325
F326-2	1530-1570
F326-3	1570-1610
F326-4	1525-1610

Other Specifications

Parameter	Value	Units	Qualifier
Model Number	F326A-*	-	* = circulator type code
Channels	1	-	-
Fiber Type	single-mode	-	-
Optical Insertion Loss, Between adjacent ports	0.9 1.3	dB	typical maximum
Optical Isolation, 2→1, 3→2, or 4→3	36	dB	typical
Directivity, 1→3 or 2→4	50	dB	minimum
Optical Power	500	mW	maximum
Optical Return Loss	50	dB	minimum
Polarization Dependent Loss	0.15	dB	maximum
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	0.85H x 4.19W x 4.00D	Inches	nominal

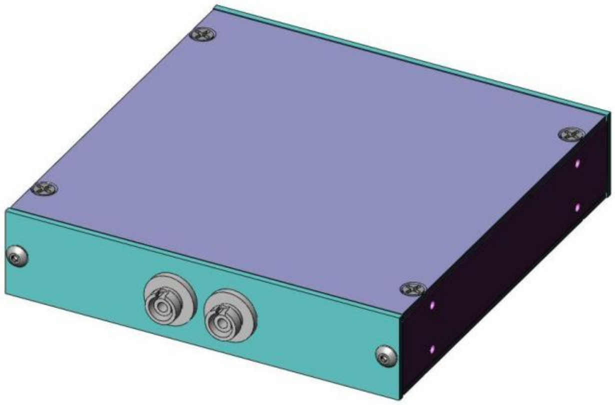
F327A-*, Isolator, Single-mode

Passive fiber optic ModBlock single-stage optical isolators are offered for 1310 nm and 1550 nm C and L bands, using single-mode (SM) fiber. Dual stage isolators are available on request. Light entering port 1 passes to port 2 and light entering port 2 is blocked from port 1, much like a diode. These ModBlocks use FC/UPC connectors by default, but can be built using FC/APC connectors upon request. Polarization-maintaining versions are also available upon request.

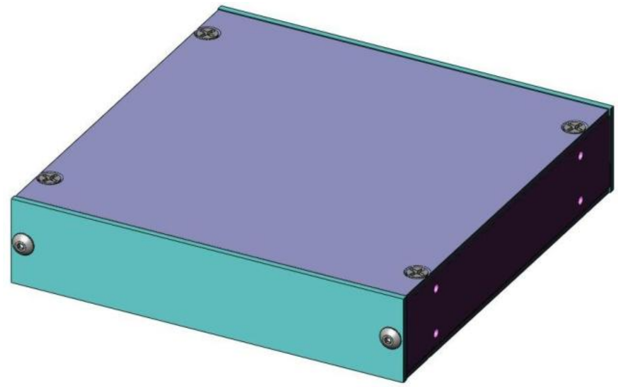
Isolator choices

Part Number	Wavelength Range (nm)
F327-1	1295-1325
F327-2	1535-1565
F327-3	1570-1590

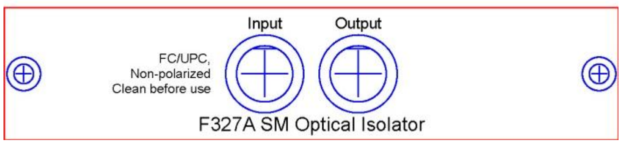
F327A-* chassis views, graphics layout, and simple block diagram

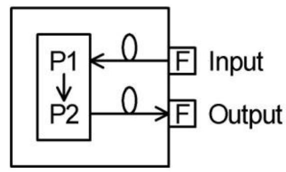


1/2U, quarter-rack, 4” deep



Rear View



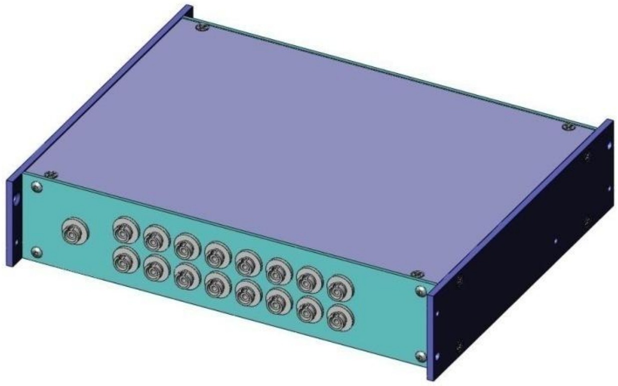


Other Specifications

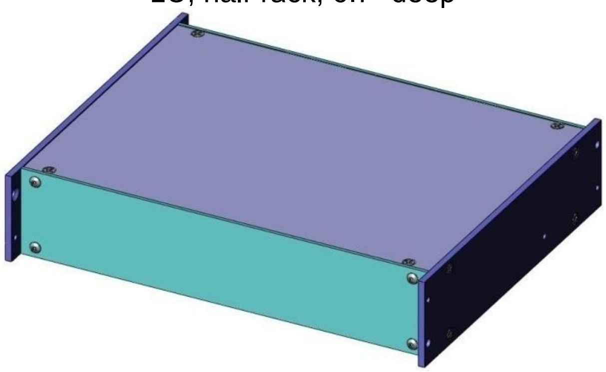
Parameter	Value	Units	Qualifier
Model Number	F327A-*	-	* = isolator type code
Channels	1	-	-
Fiber Type	single-mode	-	-
Optical Insertion Loss	0.5 0.7	dB	typical maximum
Optical Isolation	40 30	dB	typical minimum
Optical Power	400	mW	maximum
Optical Return Loss	60	dB	minimum
Polarization Dependent Loss	0.1	dB	maximum
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	0.85H x 4.19W x 4.00D	Inches	nominal

F340A-*, DWDM Splitter, 100 GHz, 16-Channel, Single-mode

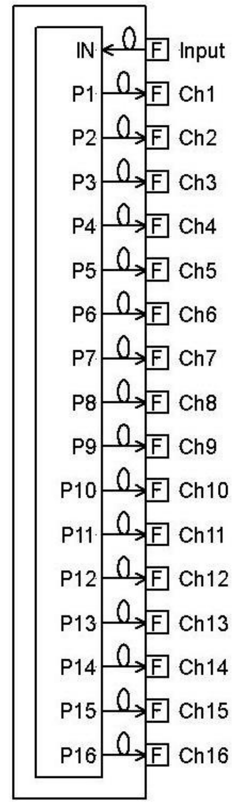
F340A-* chassis views, graphics layout, and simple block diagram

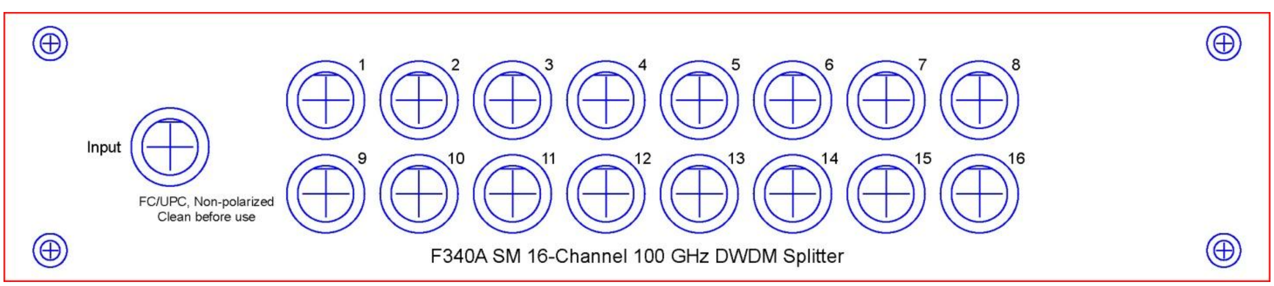


1U, half-rack, 6.7” deep



Rear View





A passive fiber optic ModBlock DWDM wavelength splitter is offered, using single-mode (SM) fiber. This model has 16-channels on 100 GHz spacing in the C-band, with user-specified starting channel (such as C59, C43, or C27, etc.). See the “ITU Fiber Optic Frequencies, Wavelengths, and Channels for C and L bands” section on page 189 of the “Reference Data” section for the proper channel number (C* codes only) to use when ordering. CWDM splitters (2, 4, 8, 16 channels) are also available upon request.

Key Specifications

Parameter	Value	Units	Qualifier
Model Number	F340A-*	-	* = starting channel code

Parameter	Value	Units	Qualifier
Channels	1	-	-
Fiber Type	single-mode	-	-
Technology	thin film filter		
Pass-band, 0.5 dB points	0.25	nm	minimum
Pass-band Flatness	0.5	dB	maximum
Optical Insertion Loss	3.8 4.5	dB	typical maximum
Channel Non-Uniformity	1	dB	maximum
Adjacent Channel Isolation	25	dB	minimum
Non-adjacent Channel Isolation	45	dB	minimum
Directivity	50	dB	minimum
Optical Power	100	mW	maximum
Optical Return Loss	45	dB	minimum
Polarization Dependent Loss	0.25	dB	maximum
Connectors, fiber optic	FC/UPC	-	Metal ferrule
Dimensions	1.72H x 8.38W x 6.70D	Inches	nominal

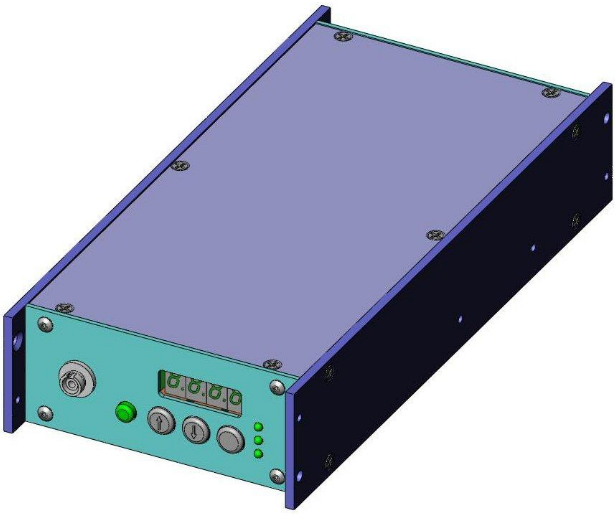
Miscellaneous

A variety of miscellaneous ModBlocks are offered, including Super-Luminescent LEDs, optical channel monitors, polarization controllers, polarization scramblers, differential group delay lines, and tunable filters.

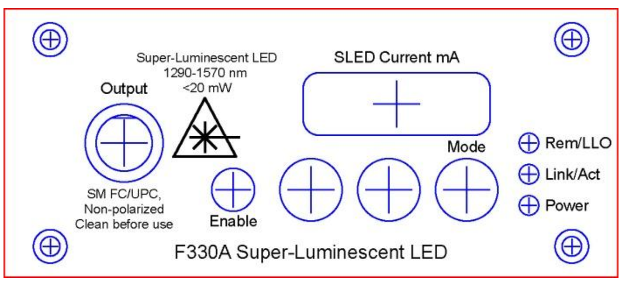
F330A-*, LED, Super-Luminescent,

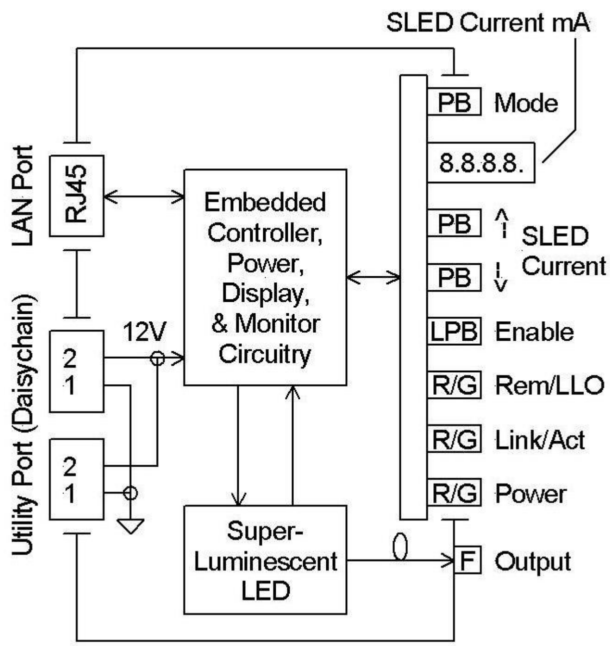
Super-Luminescent LED (SLED) ModBlocks are provided for the 1310 nm and 1550 nm region. These SLEDs are thermally stabilized and use single mode fiber (polarization-maintaining fiber types available upon request). The output power is adjustable and a SLED enable switch is provided. An internal user-replaceable “crash” cable is provided (optical output) for repair convenience in case of optical connector damage. SLEDs are a broadband light source and can be used for chromatic dispersion measurement, fiber optic sensors, and biomedical applications (OCT, imaging, healing, etc.).

F330A-* front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7" deep





Front panel pushbuttons and a numeric readout provide manual control of the SLED current (for output power level control), which can also be operated remotely. The mode pushbutton turns the display on or off. Pushbuttons with up and down arrows allow adjustment of the SLED current when the display is on.

Key specifications

Parameter	Value	Units	Qualifier
Model Number	F330A-1 F330A-2	-	1310 nm 1550 nm
Fiber Type	single mode	-	-
LED Type	Super-Luminescent	-	-
Peak Wavelength	1280-1360 1520-1590	nm	F330A-1 F330A-2
Optical Bandwidth, 3 dB points, minimum	40 50	nm	F330A-1 F330A-2
Power Output, minimum	0 to 20 and off 0 to 4 and off	mW	F330A-1 F330A-2
Spectral Ripple, typical/maximum	0.2/0.5 0.2/0.3	dB	F330A-1 F330A-2
SLED Current, maximum, for full power output	450 300	mA	F330A-1 F330A-2

Parameter	Value	Units	Qualifier
Dimensions	1.72H x 4.19W x 8.70D	Inches	nominal

Optical Channel Monitor

Polarization Controller

Polarization Scrambler

Differential Group Delay Line

Tunable Filter, DWDM, 50 GHz

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Microwave ModBlocks

A variety of microwave ModBlocks are offered, including switches, amplifiers, phase shifters, attenuators, oscillators, mixers, and miscellaneous items. Chassis rear views are shown in the "Common Packaging Data" section on page 186. Price and delivery are shown in the "Domestic USA Pricing" section starting on page 199.

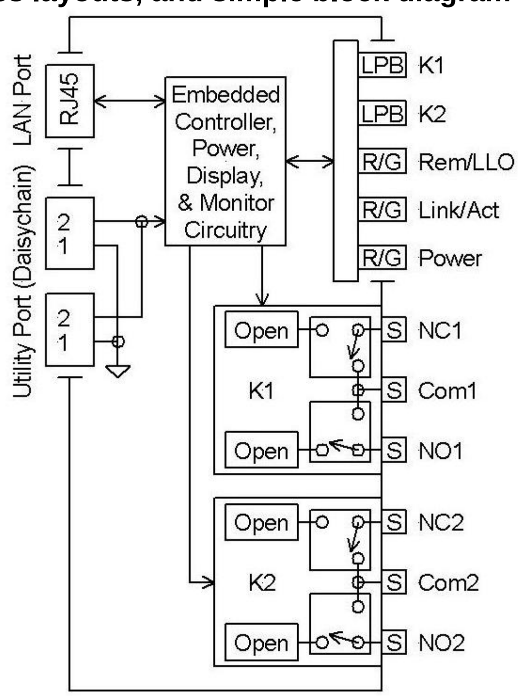
Switches

Microwave switch ModBlocks are provided using movable contact latching relays. The 50-ohm relays are rated for DC to 18 GHz or DC to 26.5 GHz operation and have SMA connectors. Single and dual channel ModBlocks are provided in 1U ¼ rack enclosures for SPDT (unterminated and terminated), transfer, and 2P3T switches. Single channel ModBlocks are provided in 2U ¼ rack enclosures for SP4T and SP6T switches in either terminated or unterminated types.

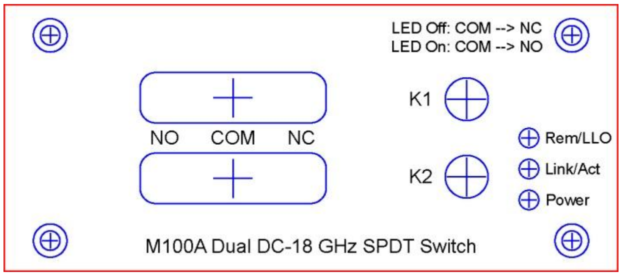
M100A, Switch, Dual SPDT 18 GHz
M101A, Switch, Single SPDT, 18 GHz
M104A, Switch, Dual SPDT, 26.5 GHz
M105A, Switch, Single SPDT, 26.5 GHz

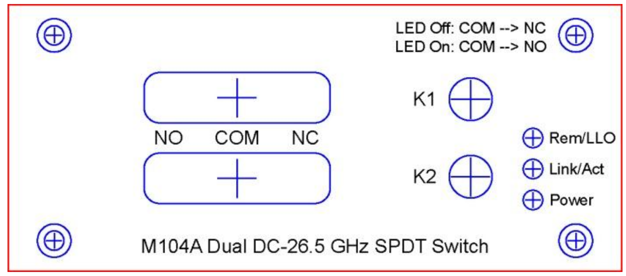
M100A and M104A front chassis view, graphics layouts, and simple block diagram

1U, quarter-rack, 4.7" deep



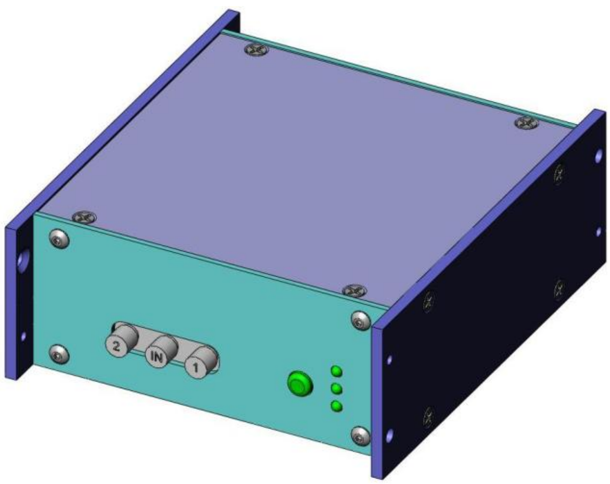
Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories



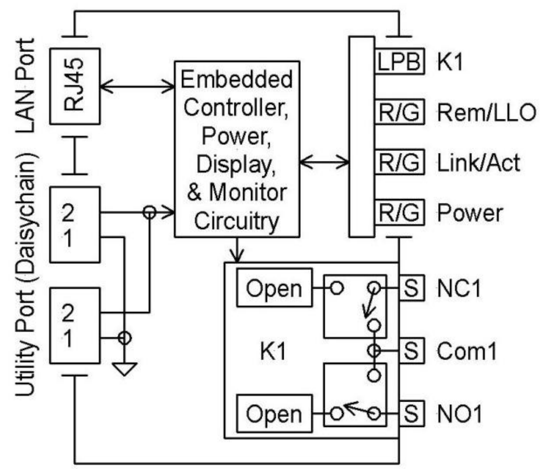


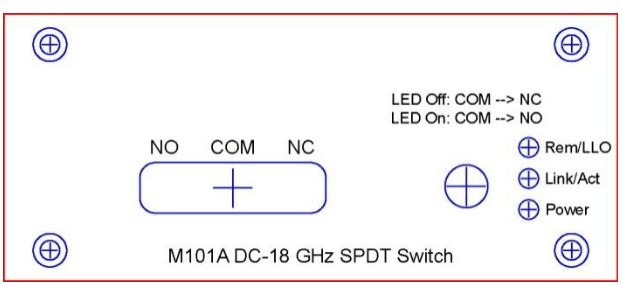
These ModBlock switches contain one or two microwave relays and related circuitry, with choice of DC to 18 GHz or DC to 26.5 GHz bandwidths. The front panel lighted pushbutton provides toggle operation of the relay and also indicates the relay state. When the switch indicator is off, the relay is in its normal state, as shown in the simple block diagram (COM→NC). When the switch indicator is on (green), the relay is in its alternate state (COM→NO). An unused switch port is internally open (not terminated).

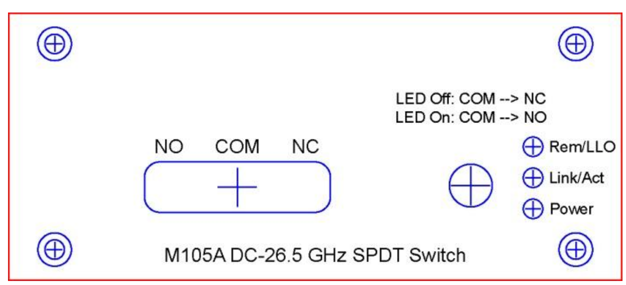
M101A and M105A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7” deep







Key Specifications

Parameter	M100A	M101A	M104A	M105A	Units	Qualifier
Channels	2	1	2	1	-	SPDT
Connectors	SMA female				-	-

Parameter	M100A	M101A	M104A	M105A	Units	Qualifier
Impedance	50				ohms	nominal
Frequency Range	DC to 18		DC to 26.5		GHz	typical
Internal Termination	None				-	-
Switching	Break before make, 10 ms max.				-	-
Insertion Loss, Typical	0.10 0.12 0.22 -		0.10 0.12 0.20 0.22		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
Return Loss, Typical	28 26 16 -		31 26 18 16		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
Isolation, Typical	91 85 78 -		91 86 82 62		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
RF CW Power, Maximum	350 100 40 25 -		350 100 40 25 15		watts	@ 100 MHz @ 1 GHz @ 12 GHz @ 18 GHz @ 26.5 GHz
Contact Life	5 million				Cycles	typical
Dimensions	1.72H x 4.19W x 4.70D				Inches	nominal

M102A, Switch, Dual SPDT, 18 GHz, Terminated

M103A, Switch, Single SPDT, 18 GHz, Terminated

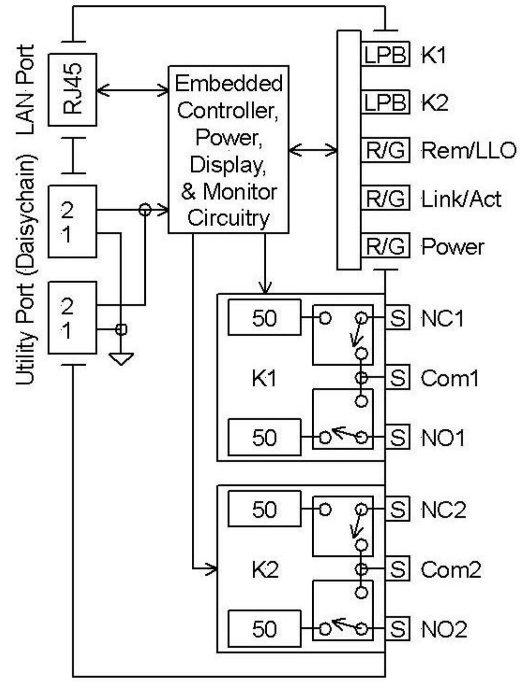
M106A, Switch, Dual SPDT, 26.5 GHz, Terminated

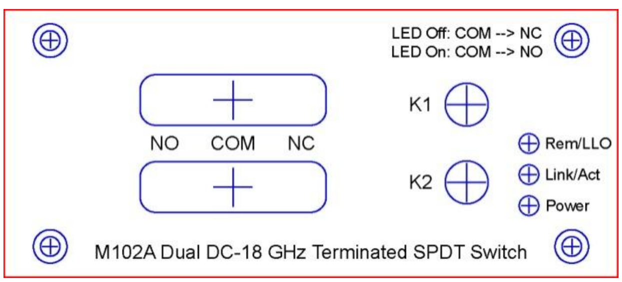
M107A, Switch, Single SPDT, 26.5 GHz, Terminated

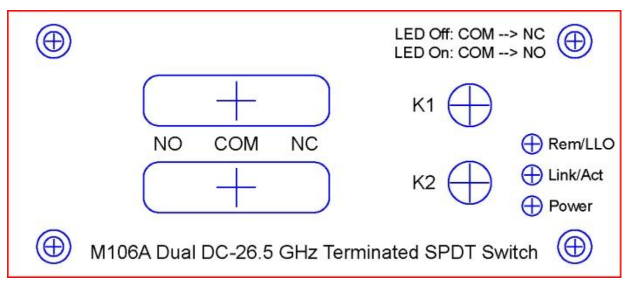
These ModBlock switches contain one or two microwave relays and related circuitry, with choice of DC to 18 GHz or DC to 26.5 GHz bandwidths. The front panel lighted pushbutton provides toggle operation of the relay and also indicates the relay state. When the switch indicator is off, the relay is in its normal state, as shown in the simple block diagram (COM→NC). When the switch indicator is on (green), the relay is in its alternate state (COM→NO). An unused switch port is internally terminated by a 50 ohm microwave resistor.

M102A and M106A front chassis view, graphics layouts, and simple block diagram

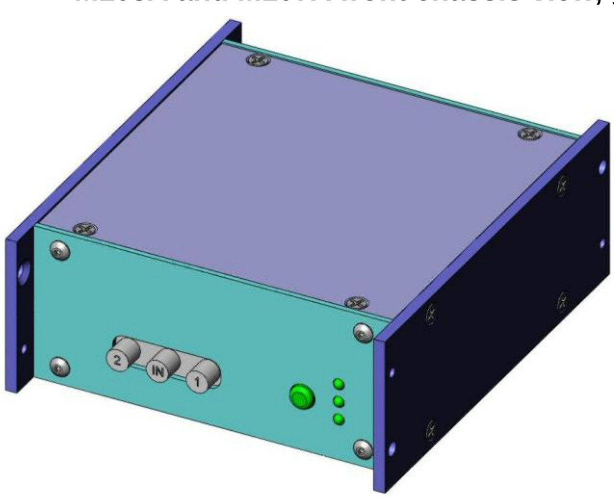
1U, quarter-rack, 4.7” deep



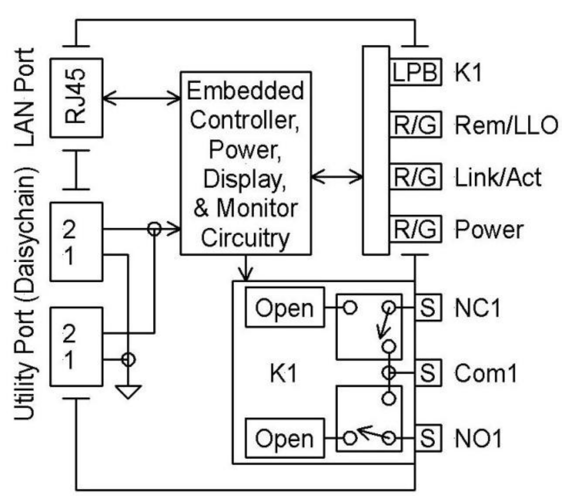


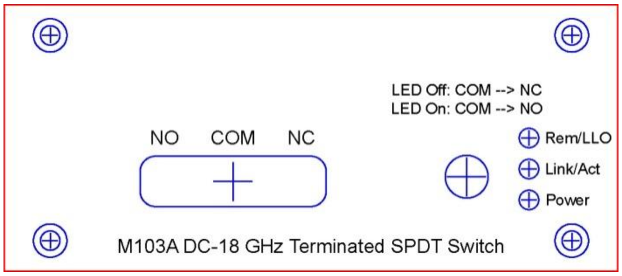


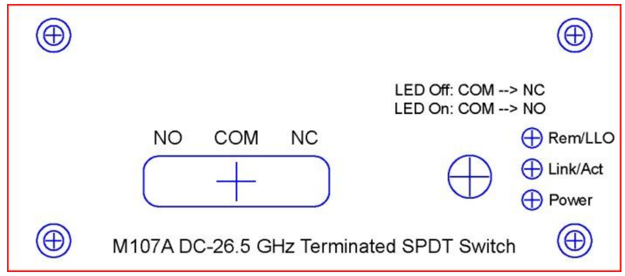
M103A and M107A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7” deep







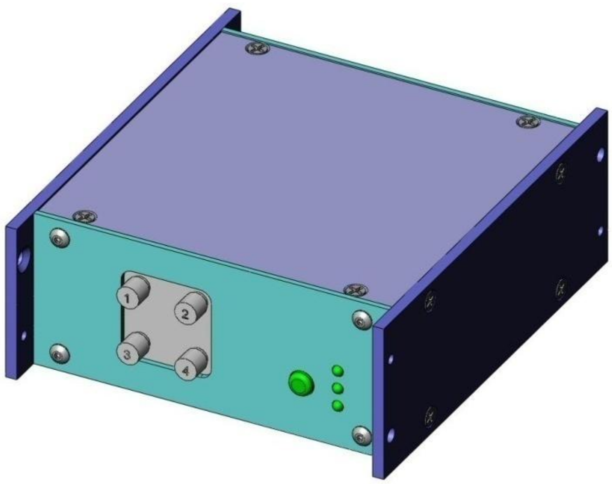
Key Specifications

Parameter	M102A	M103A	M106A	M107A	Units	Qualifier
Channels	2	1	2	1	-	SPDT
Connectors	SMA female				-	-
Impedance	50				ohms	nominal
Frequency Range	DC to 18		DC to 26.5		GHz	typical
Internal Termination	50 ohms				-	-
Switching	Break before make, 10 ms max.				-	-
Insertion Loss, Typical	0.10 0.12 0.22 -		0.10 0.12 0.20 0.22		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
Return Loss, Typical	28 26 16 -		31 26 18 16		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
Isolation, Typical	91 85 78 -		91 86 82 62		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
RF CW Power, Maximum	350 100 40 25 -		350 100 40 25 15		watts	@ 100 MHz @ 1 GHz @ 12 GHz @ 18 GHz @ 26.5 GHz
Contact Life	5 million				Cycles	typical
Dimensions	1.72H x 4.19W x 4.70D				Inches	nominal

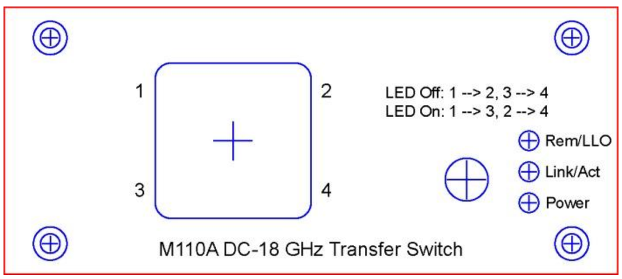
M110A, Switch, Transfer, 18 GHz

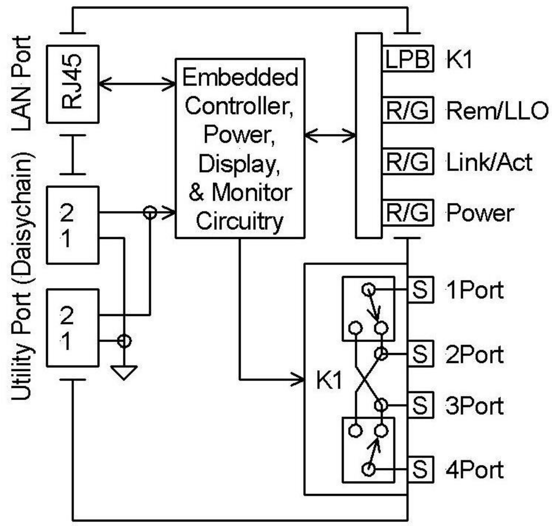
This ModBlock switch contains one microwave transfer relay and related circuitry. The front panel lighted pushbutton provides toggle operation of the relay and also indicates the relay state. When the switch indicator is off, the relay is in its normal state, as shown in the simple block diagram (1Port→2Port, 3Port→4Port). When the switch indicator is on (green), the relay is in its alternate state (1Port→3Port, 2Port→4Port).

M110A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7" deep





Key Specifications

Parameter	Value	Units	Qualifier
Model Number	M110A	-	-
Channels	1	-	Transfer
Connectors	SMA female	-	-
Impedance	50	ohms	nominal
Frequency Range	DC to 18	GHz	typical
Internal Termination	None	-	-
Switching	Break before make, 15 ms max.	-	-
Insertion Loss, Typical	0.10 0.15 0.22	dB	DC-6 GHz 6-12 GHz 12-18 GHz
Return Loss, Typical	28 22 19	dB	DC-6 GHz 6-12 GHz 12-18 GHz
Isolation, Typical	96 92 85	dB	DC-6 GHz 6-12 GHz 12-18 GHz
RF CW Power, Maximum	350 100 40 25	watts	@ 100 MHz @ 1 GHz @ 12 GHz @ 26.5 GHz
Contact Life	5 million	Cycles	typical
Dimensions	1.72H x 4.19W x 4.70D	Inches	nominal

M120A, Switch, Dual 2P3T, 18 GHz

M121A, Switch, Single 2P3T, 18 GHz

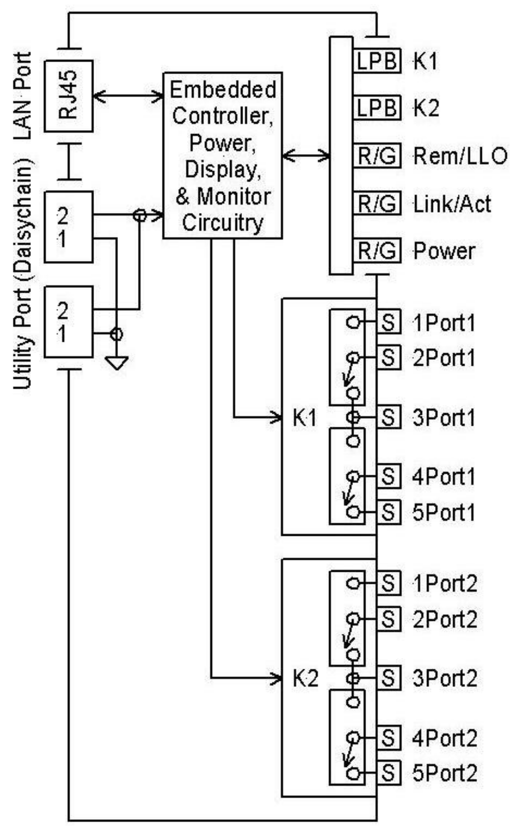
M122A, Switch, Dual 2P3T, 26.5 GHz

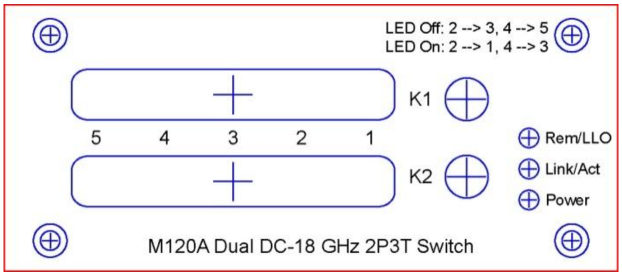
M123A, Switch, Single 2P3T, 26.5 GHz

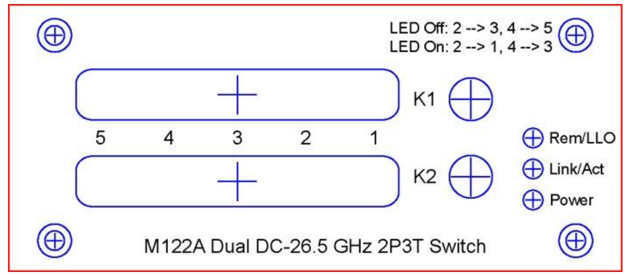
These ModBlock switches contain one or two microwave relays and related circuitry, with choice of DC to 18 GHz or DC to 26.5 GHz bandwidths. Each front panel lighted pushbutton provides toggle operation of its corresponding relay and also indicates the relay state. When the switch indicator is off, the relay is in its normal state, as shown in the simple block diagram (2Port→3Port, 4Port→5Port). When the switch indicator is on (green), the relay is in its alternate state (2Port→1Port, 4Port→3Port). This switch type is often used as a transfer switch by using 2Port and 3Port as the main path, 1Port and 5Port as the insertion path, and 4Port terminated.

M120A and M122A front chassis view, graphics layouts, and simple block diagram

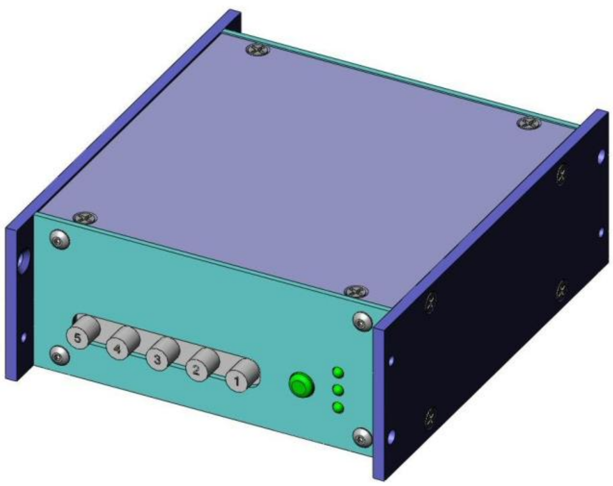
1U, quarter-rack, 4.7” deep



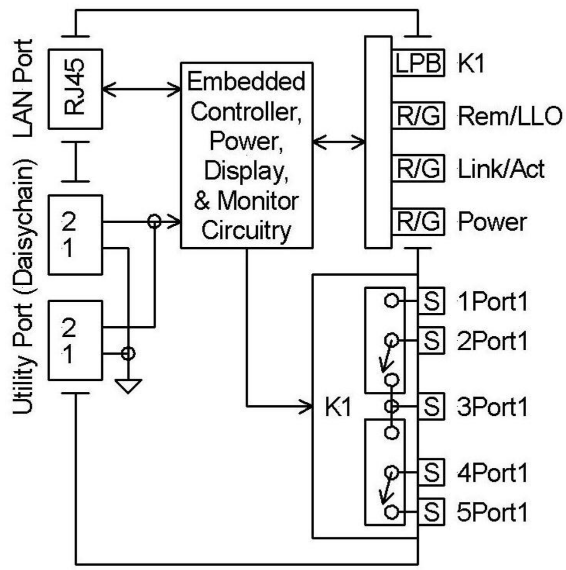


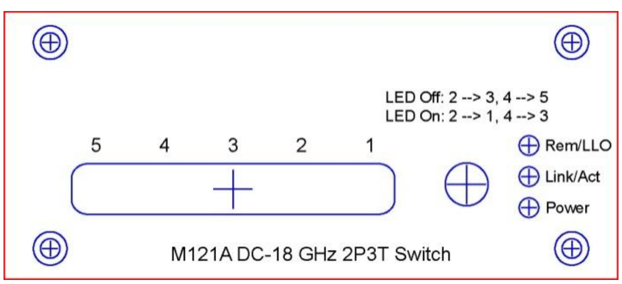


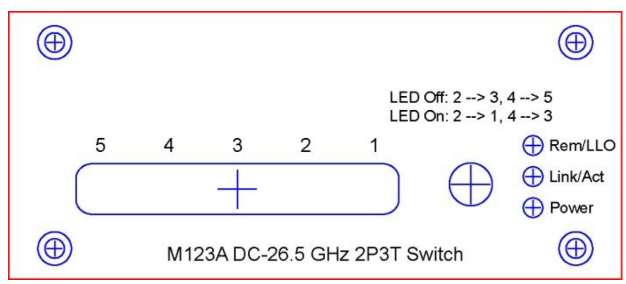
M121A and M123A front chassis view, graphics layouts, and simple block diagram



1U, quarter-rack, 4.7” deep







Key Specifications

Parameter	M120A	M121A	M122A	M123A	Units	Qualifier
Channels	2	1	2	1	-	2P3T
Connectors	SMA female				-	-
Impedance	50				ohms	nominal
Frequency Range	DC to 18		DC to 26.5		GHz	typical
Internal Termination	None				-	-
Switching	Break before make, 10 ms max.				-	-
Insertion Loss, Typical	0.10 0.12 0.22 -		0.10 0.12 0.20 0.22		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz

Parameter	M120A	M121A	M122A	M123A	Units	Qualifier
Return Loss, Typical	28 26 16 -		31 26 18 16		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
Isolation, Typical	91 85 78 -		91 86 82 62		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
RF CW Power, Maximum	350 100 40 25 -		350 100 40 25 15		watts	@ 100 MHz @ 1 GHz @ 12 GHz @ 18 GHz @ 26.5 GHz
Contact Life	5 million				Cycles	typical
Dimensions	1.72H x 4.19W x 4.70D				Inches	nominal

M130A, Switch, SP4T, 18 GHz

M131A, Switch, SP4T, 18 GHz, Terminated

M135A, Switch, SP4T, 26.5 GHz

M136A, Switch, SP4T, 26.5 GHz, Terminated

These ModBlock switches contain one SP4T microwave relay and related circuitry, with choice of DC to 18 GHz or DC to 26.5 GHz bandwidths. Each front panel lighted pushbutton provides both toggle and "radio button" manual operation of the relay and also indicates the relay switch position (by either manual or remote operation).

- When all switch indicators are off, the relay makes no connection from any port to COM (COM is open circuit). All 4 ports are either open circuit (M130A and M135A) or terminated by a 50-ohm microwave resistor (M131A and M136A), as shown in the simple block diagrams.
- When a numbered switch indicator is turned on (green) by pressing the pushbutton or by remote control, COM is connected to the corresponding numbered port. All other ports are either open circuit (M130A and M135A) or 50-ohm terminated (M131A and M136A). If the same numbered switch indicator is turned off again (by pressing the pushbutton again or by remote control), COM is disconnected from the corresponding numbered port (toggle operation) leaving all switch indicators off (see previous case).
- When a numbered switch indicator is on and then a different numbered switch indicator is turned on (by pressing a different pushbutton or by remote control), COM is disconnected from the original port and re-connected to the new port ("radio button" operation).

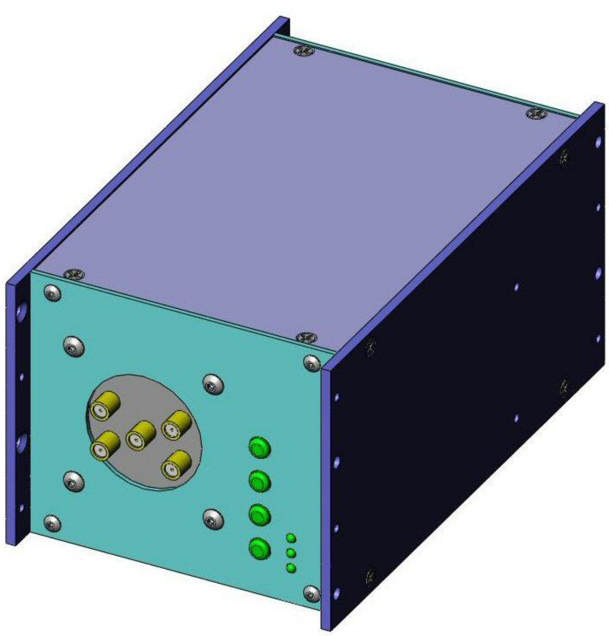
Key Specifications

Parameter	M130A	M131A	M135A	M136A	Units	Qualifier
Channels	1				-	SP4T

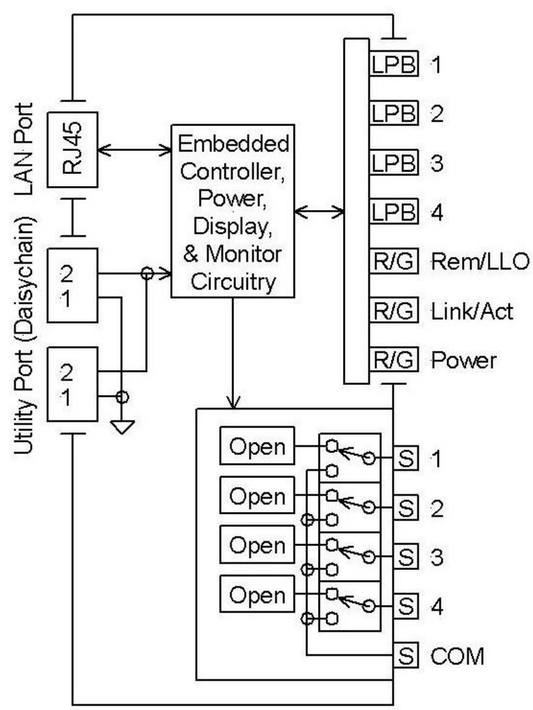
Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

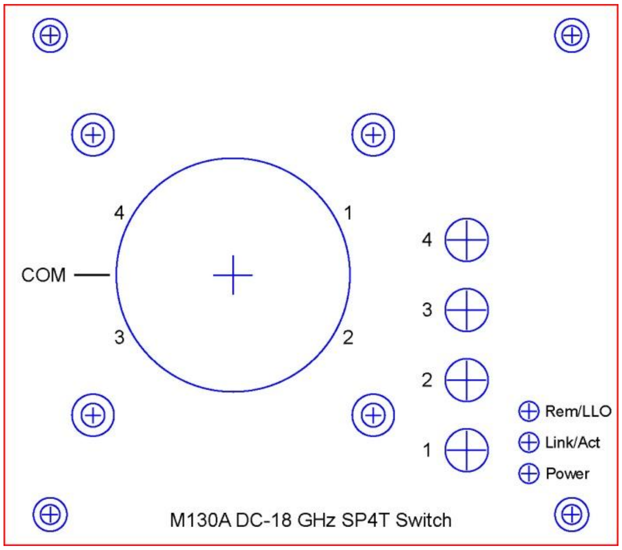
Parameter	M130A	M131A	M135A	M136A	Units	Qualifier
Connectors	SMA female				-	-
Impedance	50				ohms	nominal
Frequency Range	DC to 18		DC to 26.5		GHz	typical
Internal Termination	None	50 ohms	None	50 ohms	-	-
Switching	Break before make, 20 ms max.				-	-
Insertion Loss, Typical	0.10 0.16 0.20 -		0.09 0.15 0.19 0.40		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
Return Loss, Typical	23 19 17 -		23 19 17 13		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
Isolation, Typical	91 86 82 -		91 86 82 65		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
RF CW Power, Maximum	350 100 40 25 -		350 100 40 25 15		watts	@ 100 MHz @ 1 GHz @ 12 GHz @ 18 GHz @ 26.5 GHz
Contact Life	5 million				Cycles	typical
Dimensions	1.72H x 4.19W x 4.70D				Inches	nominal

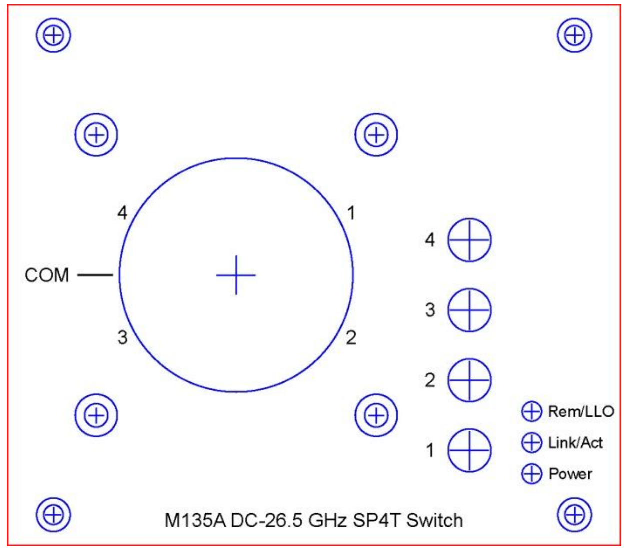
M130A and M135A front chassis view, graphics layouts, and simple block diagram



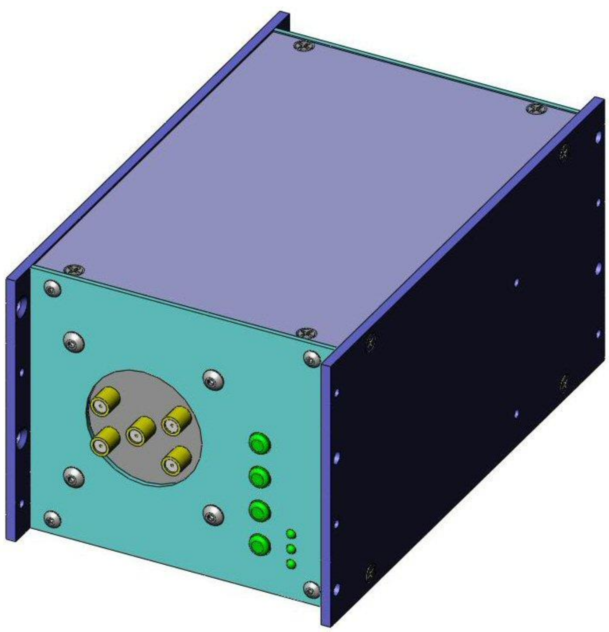
2U, quarter-rack, 6.7” deep



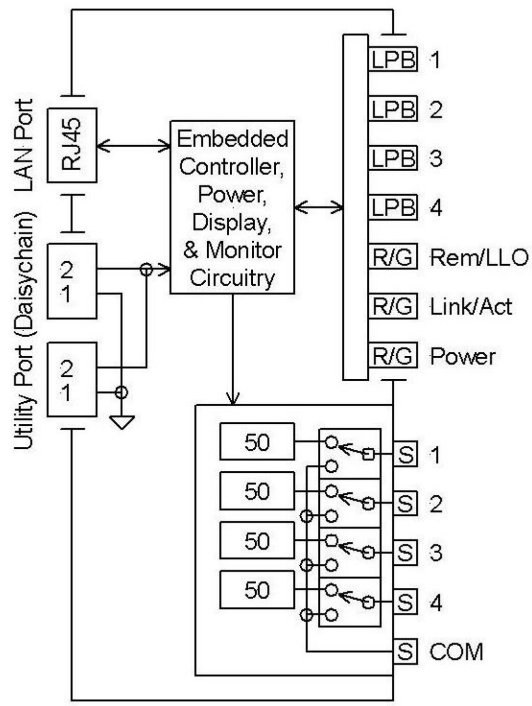


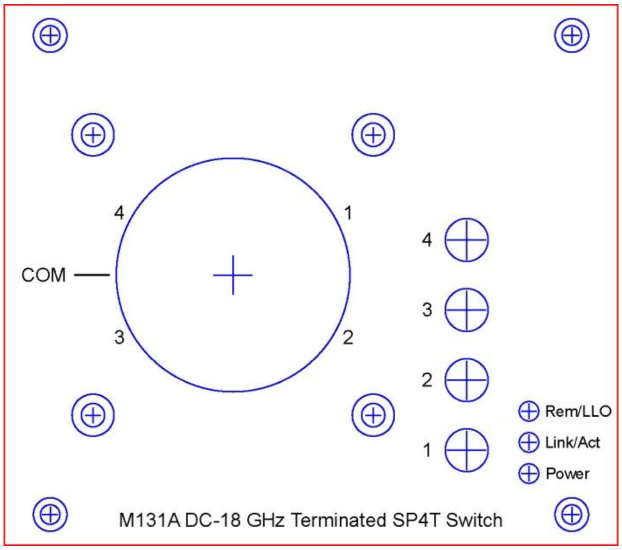


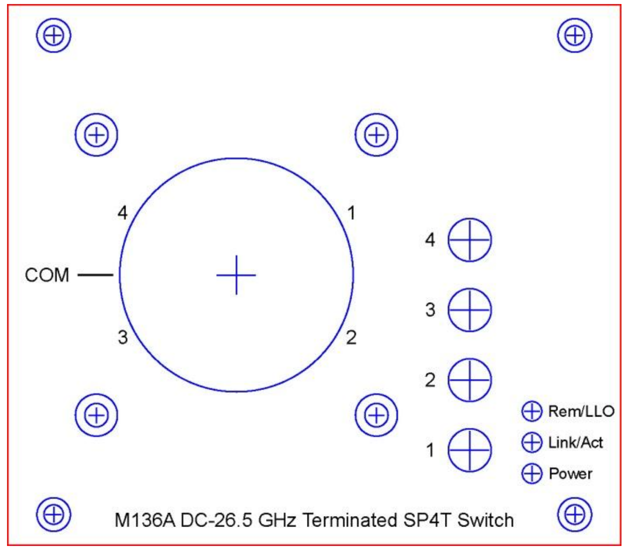
M131A and M136A front chassis view, graphics layouts, and simple block diagram



2U, quarter-rack, 6.7" deep







M132A, Switch, SP6T, 18 GHz

M133A, Switch, SP6T, 18 GHz, Terminated

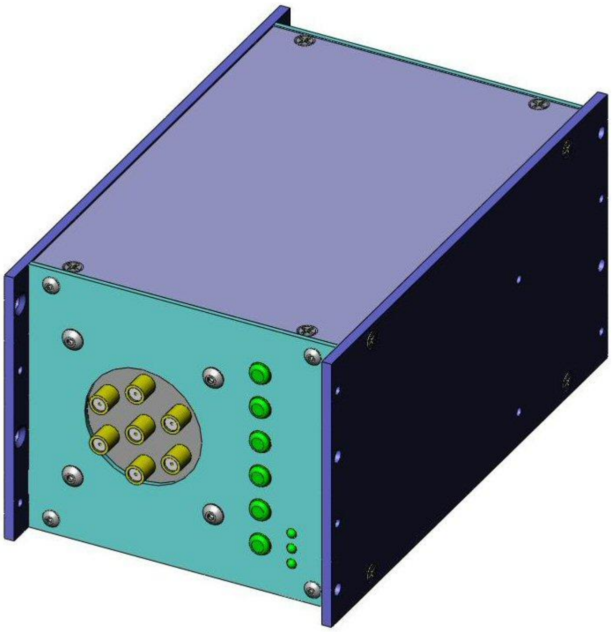
M137A, Switch, SP6T, 26.5 GHz

M138A, Switch, SP6T, 26.5 GHz, Terminated

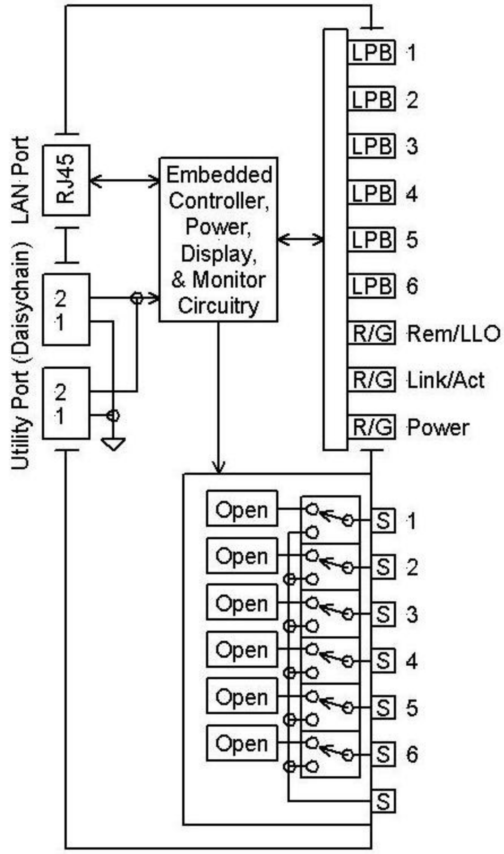
These ModBlock switches contain one SP6T microwave relay and related circuitry, with choice of DC to 18 GHz or DC to 26.5 GHz bandwidths. Each front panel lighted pushbutton provides both toggle and “radio button” manual operation of the relay and also indicates the relay switch position (by either manual or remote operation).

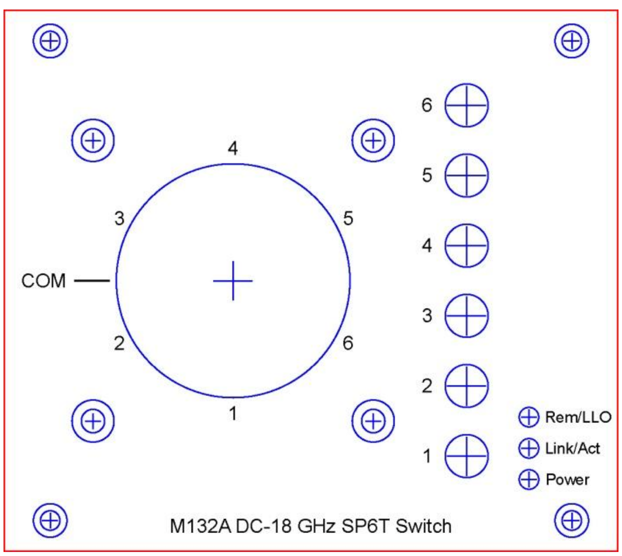
- When all switch indicators are off, the relay makes no connection from any port to COM (COM is open circuit). All 6 ports are either open circuit (M132A and M137A) or terminated by a 50-ohm microwave resistor (M133A and M138A), as shown in the simple block diagrams.
- When a numbered switch indicator is turned on (green) by pressing the pushbutton or by remote control, COM is connected to the corresponding numbered port. All other ports are either open circuit (M132A and M137A) or 50-ohm terminated (M133A and M138A). If the same numbered switch indicator is turned off again (by pressing the pushbutton again or by remote control), COM is disconnected from the corresponding numbered port (toggle operation) leaving all switch indicators off (see previous case).
- When a numbered switch indicator is on and then a different numbered switch indicator is turned on (by pressing a different pushbutton or by remote control), COM is disconnected from the original port and re-connected to the new port (“radio button” operation).

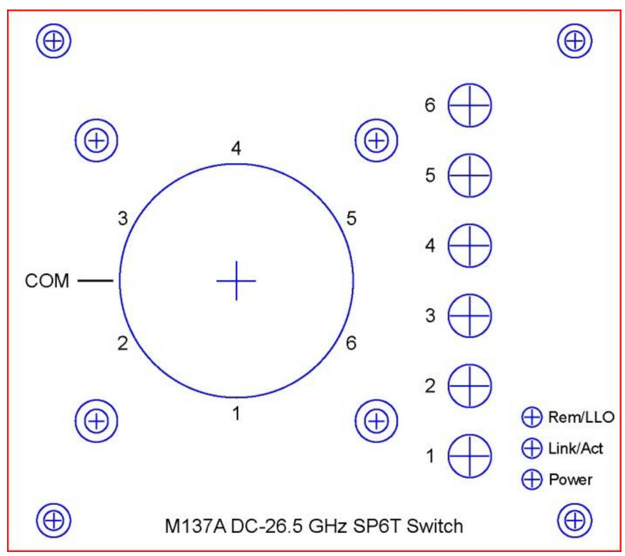
M132A and M137A front chassis view, graphics layouts, and simple block diagram



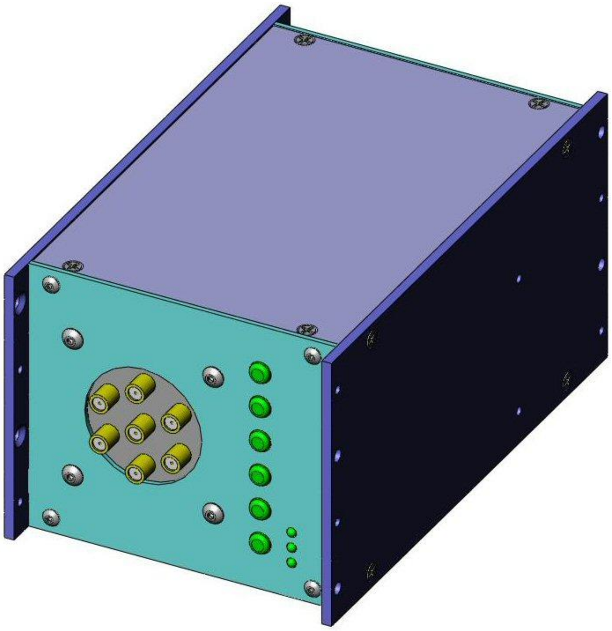
2U, quarter-rack, 6.7” deep



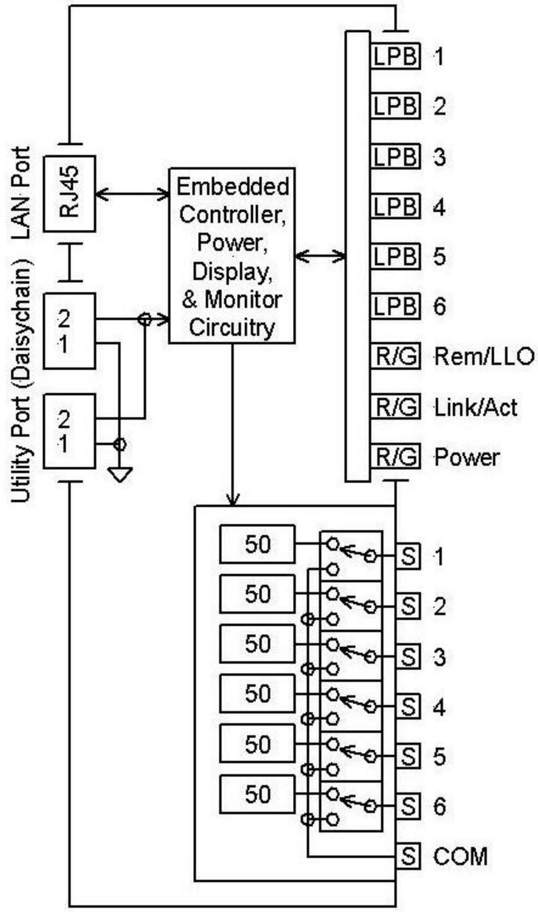


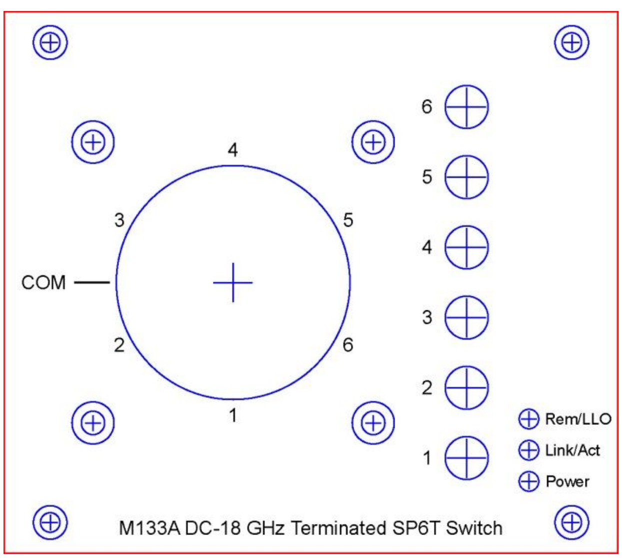


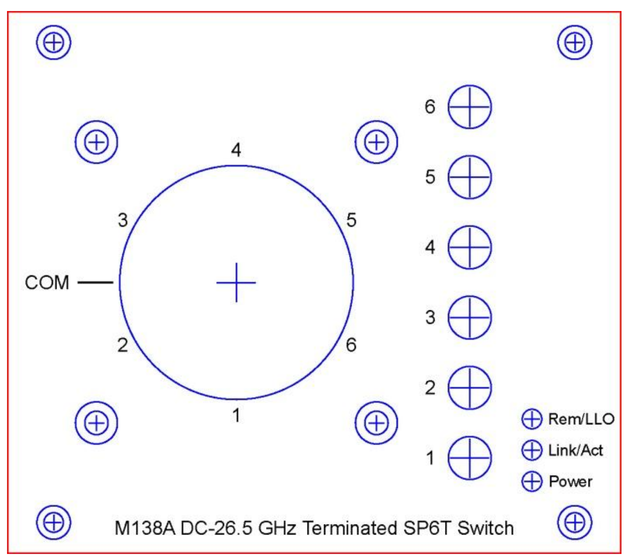
M133A and M138A front chassis view, graphics layouts, and simple block diagram



2U, quarter-rack, 6.7” deep







Key Specifications

Parameter	M132A	M133A	M137A	M138A	Units	Qualifier
Channels	1				-	SP6T

Parameter	M132A	M133A	M137A	M138A	Units	Qualifier
Connectors	SMA female				-	-
Impedance	50				ohms	nominal
Frequency Range	DC to 18		DC to 26.5		GHz	typical
Internal Termination	None	50 ohms	None	50 ohms	-	-
Switching	Break before make, 20 ms max.				-	-
Insertion Loss, Typical	0.10 0.16 0.20 -		0.09 0.15 0.19 0.40		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
Return Loss, Typical	23 19 17 -		23 19 17 13		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
Isolation, Typical	91 86 82 -		91 86 82 65		dB	DC-6 GHz 6-12 GHz 12-18 GHz 18-26.5 GHz
RF CW Power, Maximum	350 100 40 25 -		350 100 40 25 15		watts	@ 100 MHz @ 1 GHz @ 12 GHz @ 18 GHz @ 26.5 GHz
Contact Life	5 million				Cycles	typical
Dimensions	1.72H x 4.19W x 4.70D				Inches	nominal

Amplifiers

A variety of microwave amplifier ModBlocks are offered, including linear amplifiers, limiting amplifiers, and modulator drivers. Linear amplifiers are offered in 1, 2, or 4 channel models with bandwidths from 50 KHz to 18 GHz and single-ended AC-coupled inputs and outputs. Limiting amplifiers are offered for 2.5 Gb/s and 10 Gb/s class operation with differential inputs and outputs. Limiting amplifier ModBlocks can be used as single-ended to differential converters or differential to single-ended converters. All limiting amplifier ModBlocks inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3 dB roll-off point). A 10 Gb/s class modulator driver is offered with single-ended AC-coupled inputs and outputs. Chassis rear views are shown in the “Common Packaging Data” section on page 186. Price and delivery are shown in the “Domestic USA Pricing” section starting on page 199.

M201A-*, Linear Amplifier, Single Channel
M202A-*, Linear Amplifier, Dual Channel
M204A-*, Linear Amplifier, Quad Channel

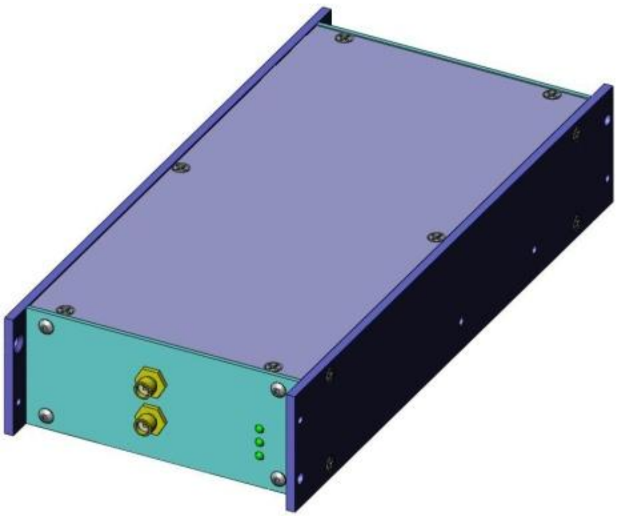
These ModBlocks contain one, two, or four linear microwave amplifiers and related circuitry. Amplifiers choices are listed in the table below and are the same type for dual and quad versions. Types can be mixed or other amplifiers choices can be used upon user request. Send requests by email to ModBlocks@tmeplano.com.

Linear amplifier choices

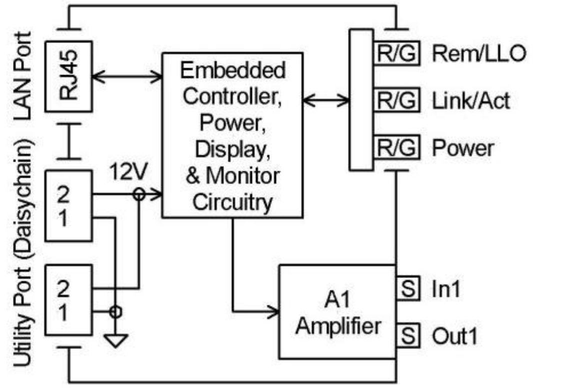
Part Number			Main Features	F-lo	F-hi	Gain (dB)	Pout (dBm)	NF (dB)
Single	Dual	Quad						
M201A-1	M202A-1	M204A-1	Wideband	300 KHz	14 GHz	12	11	5.5
M201A-2	M202A-2	M204A-2	Wideband	700 MHz	18 GHz	26	24	3.0
M201A-3	M202A-3	M204A-3	Wideband, inverting	50 KHz	14 GHz	10	12	6.0
M201A-4	M202A-4	M204A-4	Wideband, noninverting	80 KHz	13 GHz	21	12	5.8
M201A-5	M202A-5	M204A-5	Half-octave	8 GHz	12 GHz	22	10	2.5
M201A-6	M202A-6	M204A-6	Ultra-Broadband	2 GHz	18 GHz	32	20	2.8

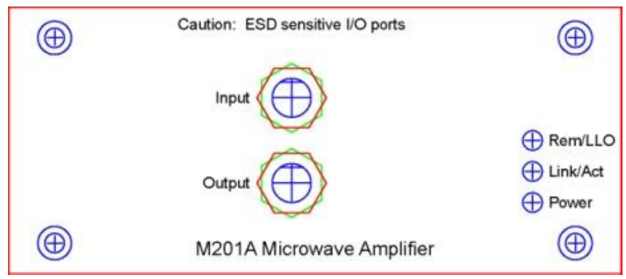
Notes: “Pout” is at the 1 dB gain compression point. “F-lo” is the -3 dB low frequency cutoff point. “F-hi” is the -3 dB high frequency cutoff point. “NF” means noise figure.

M201A front chassis view, graphics layout, and simple block diagram

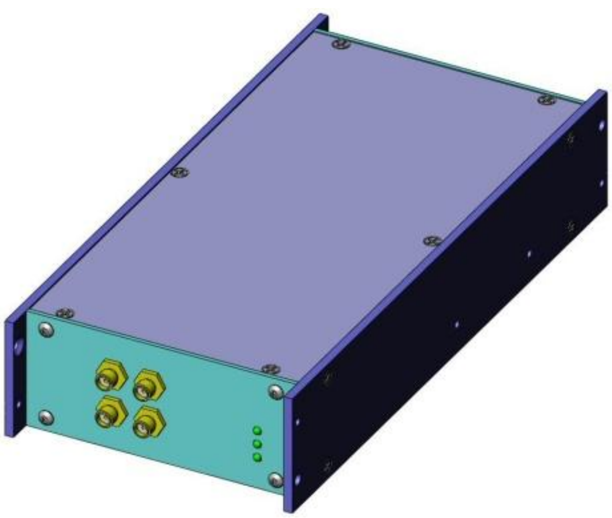


1U, quarter-rack, 8.7” deep

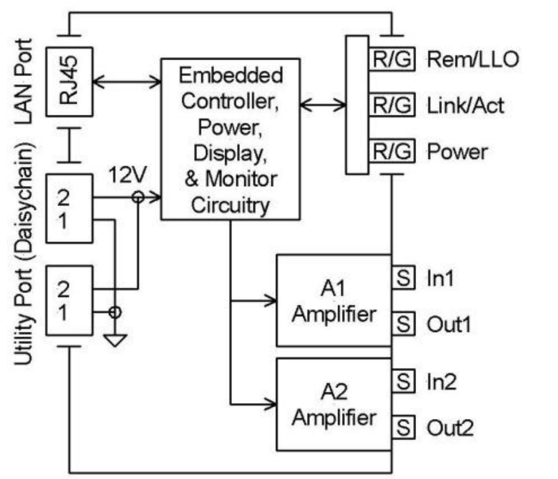


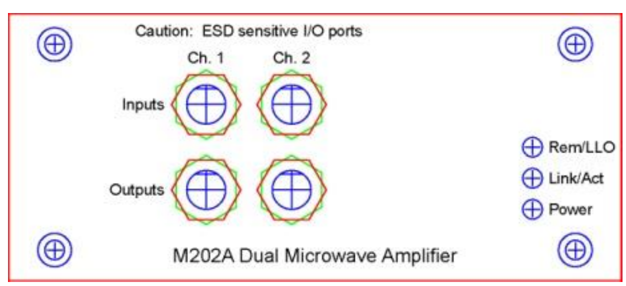


M202A front chassis view, graphics layout, and simple block diagram

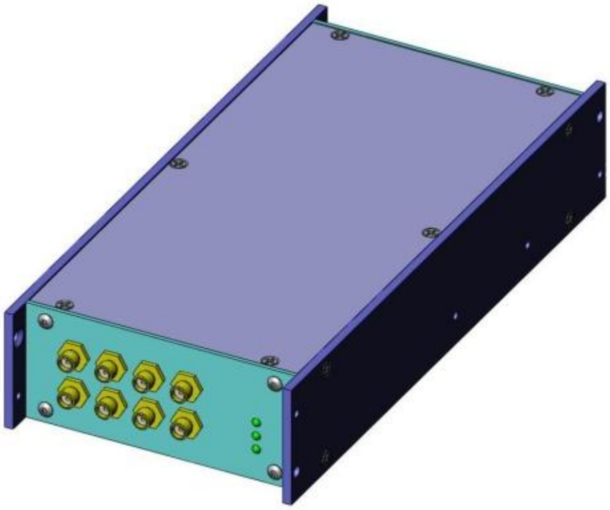


1U, quarter-rack, 8.7” deep

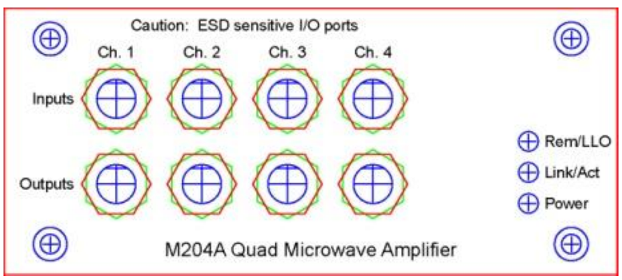


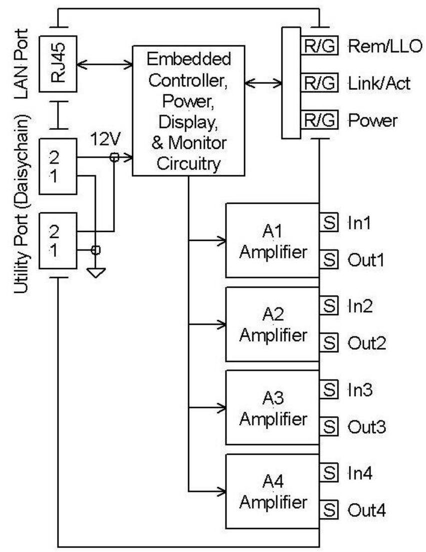


M204A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7" deep

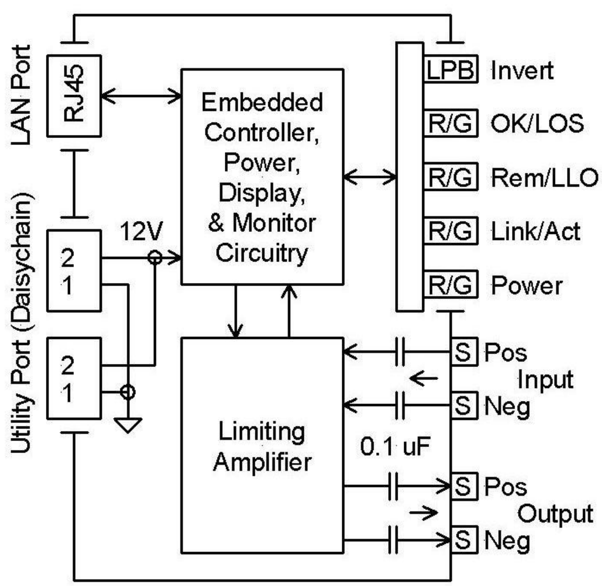


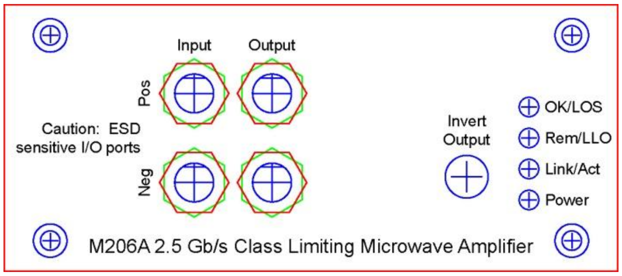


M206A, Limiting Amplifier, 2.5 Gb/s Class

M206A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7" deep





This limiting amplifier ModBlock accepts a wide range of analog, data, or clock input signal levels and produces a constant digital output signal level up to 2.5 Gb/s (typical). The amplifier has a 100 ohm differential input and 50 ohm complementary single ended outputs, both AC-coupled. When used single-ended, unused inputs or outputs should be terminated with a 50-ohm load (see Signal Adapters starting on page 180). The amplifier can be used as a single-ended to differential converter or differential to single-ended converter. A front panel bi-color LED indicates the presence of an input signal (green=OK) or loss of input signal (yellow=LOS) and a lighted pushbutton controls output polarity (norm=off, invert=on).

Key Specifications

Parameter	Value	Units	Qualifier
Model	M206A	-	-
Channels	1	-	-
I/O Connectors	SMA female	-	-
Input Impedance, differential	100	ohms	nominal
Output Impedance, single-ended	50	ohms	nominal
I/O Coupling	AC, 0.1 uF	-	-
Low Frequency Cutoff	35	KHz	-3 dB point, typical
Maximum Data Rate	2.5	Gb/s	typical
Input Voltage Range, Differential	15 1200	mVpp	minimum maximum
Input Voltage, absolute maximum, Differential	3	Vpp	damage threshold
Output voltage, Differential	1100 1500	mVpp	minimum typical
Input return loss, differential	10	dB	typical @ 4 GHz
Output return loss, single-ended	10	dB	typical @ 2.5 GHz
Output Transition Time	90	ps	typical
Output Return Loss	10	dB	minimum
Jitter, deterministic	5	ps-pp	typical
Jitter, random	3	ps RMS	typical
Dimensions	1.72H x 4.19W x 4.70D	Inches	nominal

M207A, Limiting Amplifier, 10 Gb/s Class

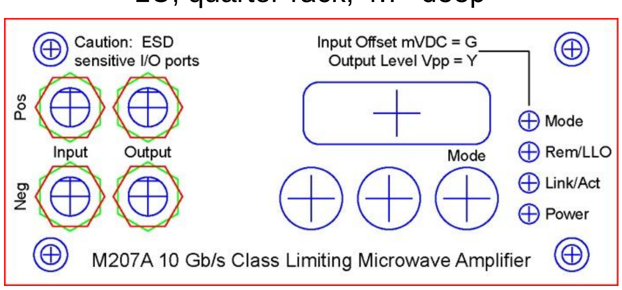
This limiting amplifier ModBlock accepts a wide range of analog, data, or clock input signal levels and produces a constant digital output signal level up to 10 Gb/s (typical). The amplifier has

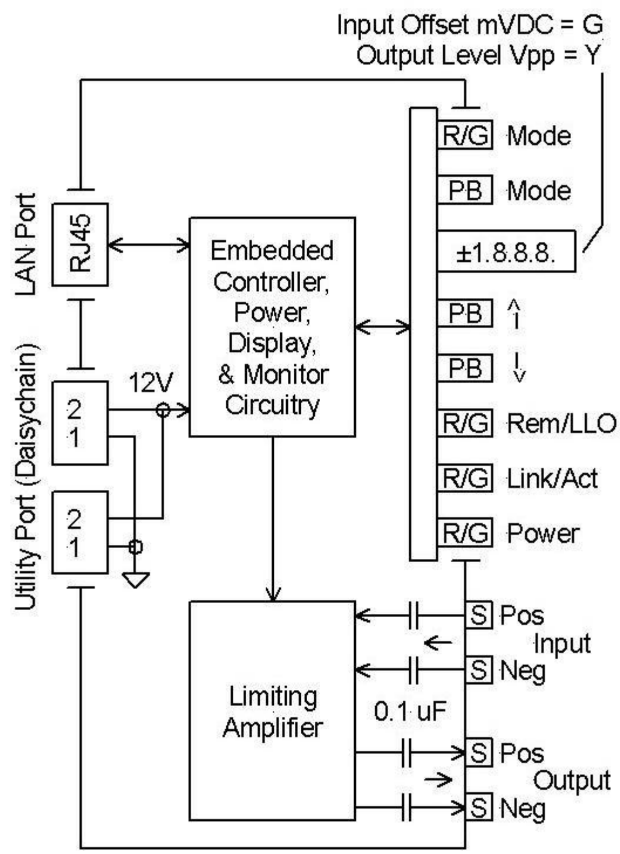
AC-coupled 50 ohm complementary single ended inputs and outputs. When used single-ended, unused inputs or outputs should be terminated with a 50-ohm load (see Signal Adapters starting on page 180). The amplifier can be used as a single-ended to differential converter or differential to single-ended converter.

Front panel pushbuttons and a numeric readout provide manual control of the output voltage level and the input offset level (logic decision threshold), which can also be operated remotely. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates Output Level control mode, green indicates Input Offset control mode, and dark indicates off mode. Pushbuttons with up and down arrows allow parameter adjustment for the mode indicated by the bi-color LED.

M207A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7” deep





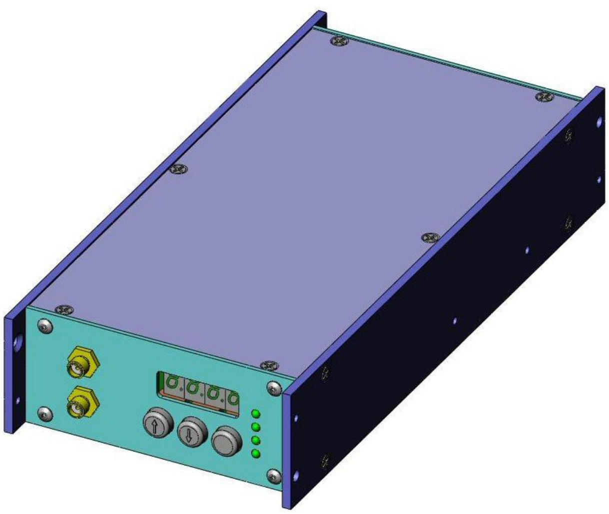
Key Specifications

Parameter	Value	Units	Qualifier
Model	M207A	-	-
Channels	1	-	-
I/O Connectors	SMA female	-	-
I/O Impedance, single-ended	50	ohms	Nominal

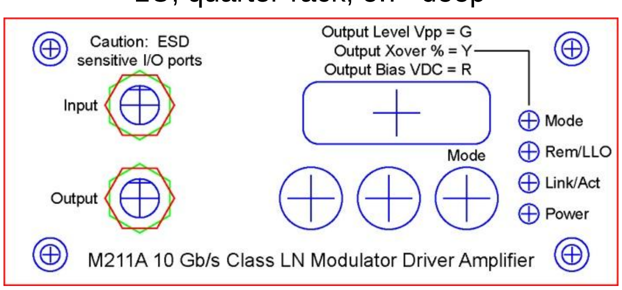
Parameter	Value	Units	Qualifier
I/O Coupling	AC, 0.1 uF	-	-
Low Frequency Cutoff	35	KHz	-3 dB point, typical
Maximum Data Rate	12.5	Gb/s	Typical
Input Voltage Range, Differential	7 1000	mVpp	Minimum Maximum
Input Voltage, absolute maximum, Differential	3	Vpp	Damage threshold
Maximum Output Voltage, Differential	1100 1300	mVpp	Minimum Typical
Input offset adjustment range	0 to ±150	mV DC	Minimum
Input offset adjustment resolution	1	mV DC	Typical
Output voltage adjustment range	0 to 1300	mVpp	Typical
Output voltage adjustment resolution	10	mVpp	Typical
Input return loss, single-ended	20	dB	Typical @ 10 GHz
Output return loss, single-ended	15	dB	Typical @ 10 GHz
Output Transition Time	30	ps	Typical @ 10 mVpp input
Additive Jitter	12	ps p-p	Typical @ 10 mVpp input
Additive Jitter	2	ps RMS	Maximum
Dimensions	1.72H x 4.19W x 4.70D	Inches	Nominal

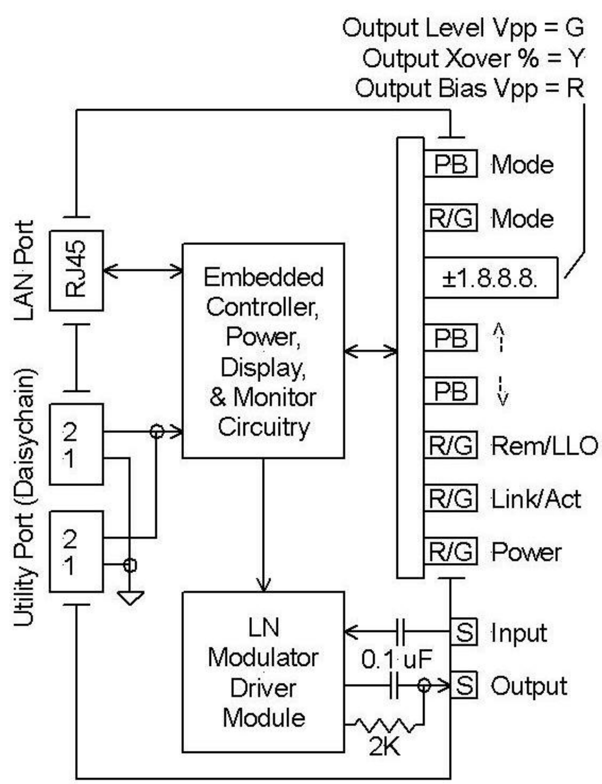
M211A, Limiting Amplifier, LN Modulator Driver, 10 Gb/s Class

M211A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 8.7” deep





This modulator driver ModBlock accepts a wide range of analog, data, or clock input signal levels and produces a constant digital output signal level (limiting amplifier function) up to 12.5 Gb/s (typical). The amplifier has an AC-coupled 50 ohm single ended input and output and is non-inverting. It is normally used to drive a lithium niobate modulator, such as the F120.

Front panel pushbuttons and a numeric readout provide manual control of the output voltage level, crossover point, and DC bias voltage, which can also be operated remotely. The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Red indicates Output Bias control mode, yellow indicates Output Crossover control mode, green indicates Output Level control mode, and dark indicates off mode. Pushbuttons with up and down arrows allow parameter adjustment for the mode indicated by the bi-color LED.

Key Specifications

Parameter	Value	Units	Qualifier
Model	M211A	-	-
Channels	1	-	-
I/O Connectors	SMA female	-	-
I/O Impedance	50	ohms	Nominal
Polarity	Non-inverting	-	-
I/O Coupling	AC, 0.1 uF	-	-
Low Frequency Cutoff, small signal	30	KHz	-3 dB point, typical
High Frequency Cutoff, small signal	12	GHz	-3 dB point, typical
Gain, small signal	26 23	dB	Typical @ 2 GHz Typical @ 12 GHz
Noise Figure, small signal	5.8	dB	Typical @ 1 GHz
Output Power @ 1 dB compression point	23	dBm	Typical @ 2 GHz
Maximum Data Rate	12.5	Gb/s	Typical
Input Voltage Range	250 1000	mVpp	Minimum Maximum
Input Voltage, absolute maximum	1.5	Vpp	Damage threshold
Maximum Output Voltage	7.5 9.5	Vpp	Minimum Typical
Minimum Output Voltage	1.0 2.0	Vpp	Typical Maximum
Output DC Bias Impedance	2K	ohms	Typical
Output DC Bias Load Current	3	mA	Maximum
Output Voltage Adjustment Range	1.0 to 9.5	Vpp	Typical
Output Voltage Adjustment Resolution	100	mVpp	Typical
Output Crossover Adjustment Range	35 to 70	%	Typical
Output Crossover Step Size	1	%	Typical
Output DC Bias Voltage adjustment range	0 to ±10	VDC	Typical
Output DC Bias Voltage Step Size	10	mV DC	Typical
Input Return Loss	11	dB	Typical @ 12 GHz
Output Return Loss	11	dB	Typical @ 12 GHz
Output Transition Time @ 12.5 Gb/s	25	ps	Typical @ 500 mVpp input

Parameter	Value	Units	Qualifier
Additive Jitter	5	ps p-p	Typical @ 500 mVpp input
Additive Jitter	2	ps RMS	Maximum
Dimensions	1.72H x 4.19W x 8.70D	Inches	Nominal

Phase Shifters

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

M301A, Phase Shifter, Analog, 600° range, 6-15 GHz

M302A, Phase Shifter, 6-bit Digital, 360° range, 9-12.5 GHz

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Attenuators

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

M321A, Attenuator, Analog, 30 dB range, DC-18 GHz

M322A, Attenuator: 6-bit Digital, 31.5 dB range, DC-13 GHz

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Oscillators

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

M330A-*, Oscillator, Sine Wave, Fixed Frequency

M331A-*, Oscillator, Square Wave, Fixed Frequency

M332A-*, Oscillator, VCO, Sine Wave, Narrowband

M333A-*, Oscillator, VCO, Sine Wave, Wideband

M334A-*, Oscillator, VCO, Square Wave, Narrowband

M335A-*, Oscillator, VCO, Square Wave, Wideband

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Mixers

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

M340A, Mixer

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Miscellaneous

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

M360A, Frequency Doubler: 4.95-6.35 →9.9-12.7 GHz

M365A, Power Detector, Logarithmic, 70 dB range,1-8000 MHz

M370A, Phase-Frequency Comparator: 0.01-1300 MHz

M375A, Frequency Counter

M380A, Noise Source

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

High-Speed Logic

A variety of high-speed digital Logic ModBlocks are offered, including gates, fan-outs, selectors, pre-scalers, flip-flops, time delays, encoders, and phase-locked loops (PLLs). All models have differential inputs and outputs, which can be used single-ended or differentially. When used single-ended, unused inputs or outputs should be terminated with a 50-ohm load (see Signal Adapters starting on page 180). All Logic ModBlocks can be used as single-ended to differential converters or differential to single-ended converters. All Logic ModBlock inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency cutoff). All models can be ordered DC-coupled if required. Chassis rear views are shown in the "Common Packaging Data" section on page 186. Price and delivery are shown in the "Domestic USA Pricing" section starting on page 199.

Common Specifications

Unless otherwise specified, the following key specifications apply to all Logic ModBlock models.

Key Specifications

Parameter	Value	Units	Qualifier
Channels	1	-	-
Connectors	SMA female	-	-
Impedance	50	ohms	nominal
I/O Coupling	AC, 0.1 uF	-	
Low Frequency Cutoff	35	KHz	-3 dB point, typical
High Frequency Cutoff	13	GHz	-3 dB point, typical
Internal Termination	50 ohms	-	-
Input Voltage Range, Differential	300 1000	mVpp	Minimum Maximum
Input Voltage, absolute maximum, Differential	2.5	Vpp	Damage threshold
Output Voltage, Differential	900 1100	mVpp	Minimum Typical
Input Return Loss, single-ended	10	dB	Minimum, @ 13 GHz
Output Return Loss, single-ended	10	dB	Minimum, @ 13 GHz
Output Transition Time	30	ps	Typical
Jitter, deterministic	6	ps	Typical
Jitter, random	2	ps RMS	Typical
Dimensions	1.72H x 4.19W x 4.70D	Inches	nominal

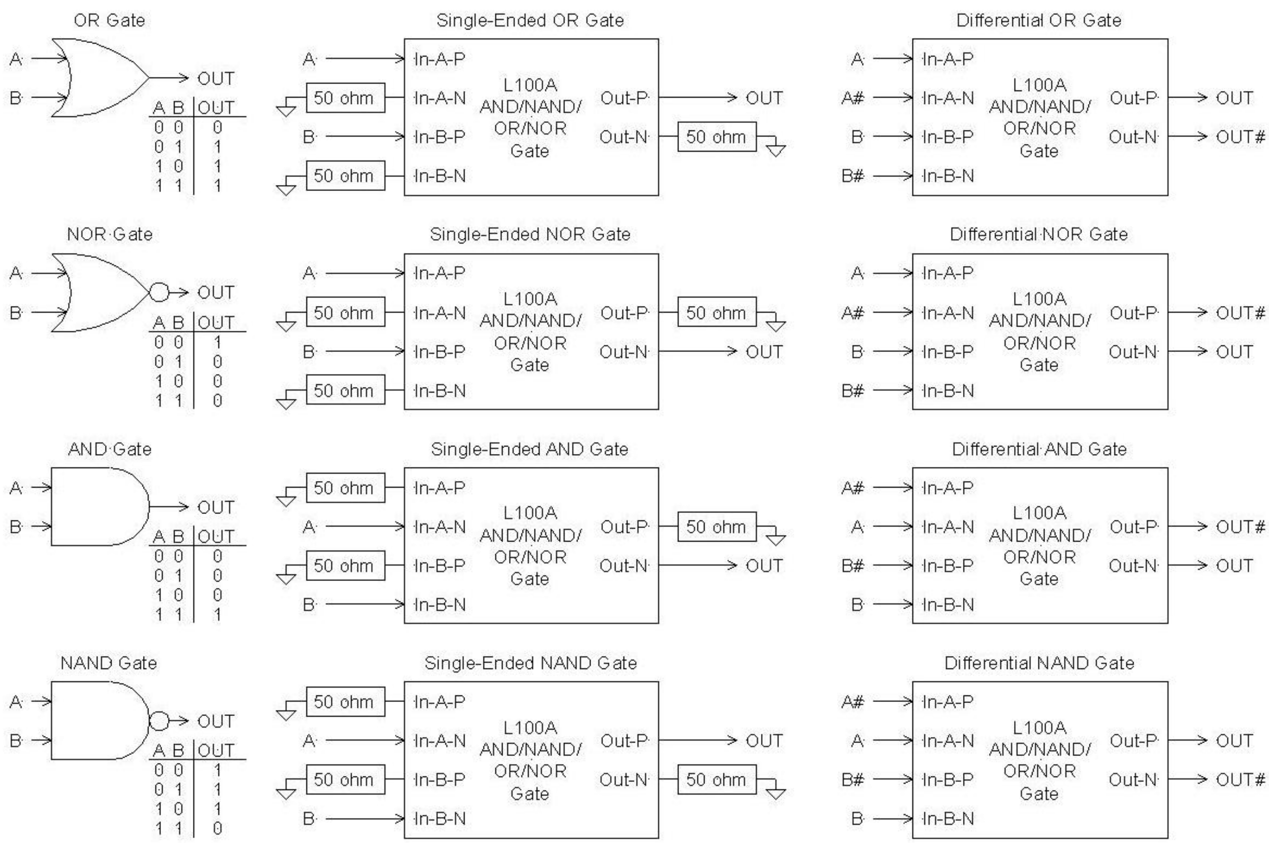
Gates

High-Speed Digital Logic ModBlock gates are offered, including 13 GHz class AND/NAND/OR/NOR and XOR/XNOR gates. These gates will operate with data or clock signals. All inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3 dB roll-off point). Other gates, 25 GHz class gates, or DC-coupled gates can be provided on request (send an email request to ModBlocks@tmeplano.com).

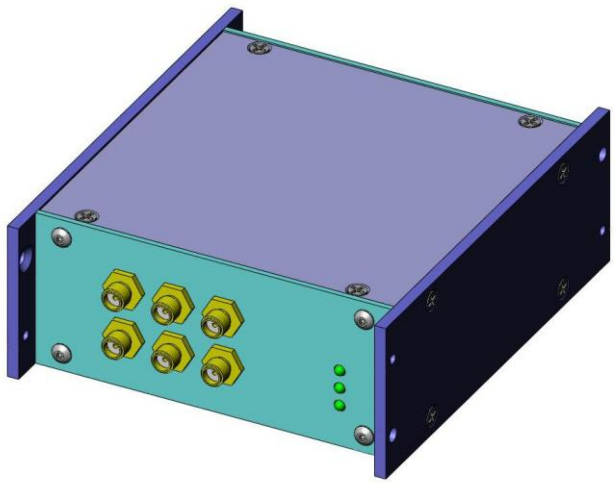
L100A, Gate, AND/NAND/OR/NOR, 13 GHz Class

This gate can perform single-ended or differential AND, NAND, OR, or NOR logic functions on data or clock signals, depending upon how the inputs and outputs are connected. Connections are shown in the figure below.

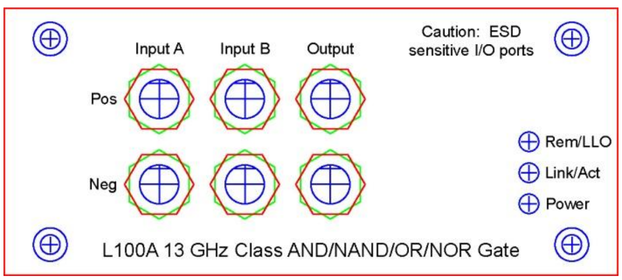
L100A connections for AND, NAND, OR, and NOR logic functions

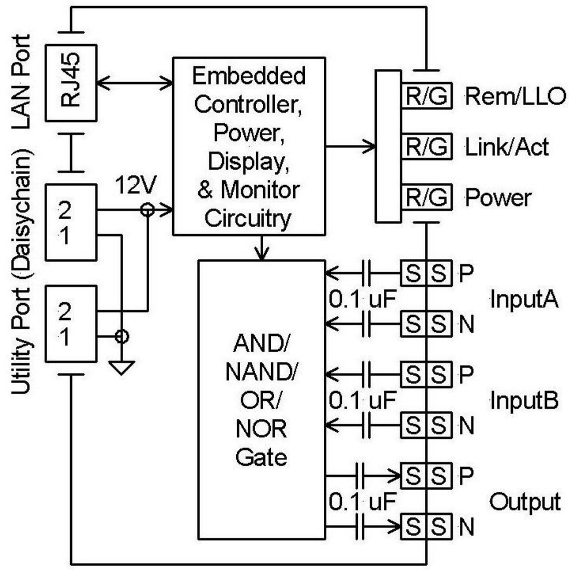


L100A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7” deep

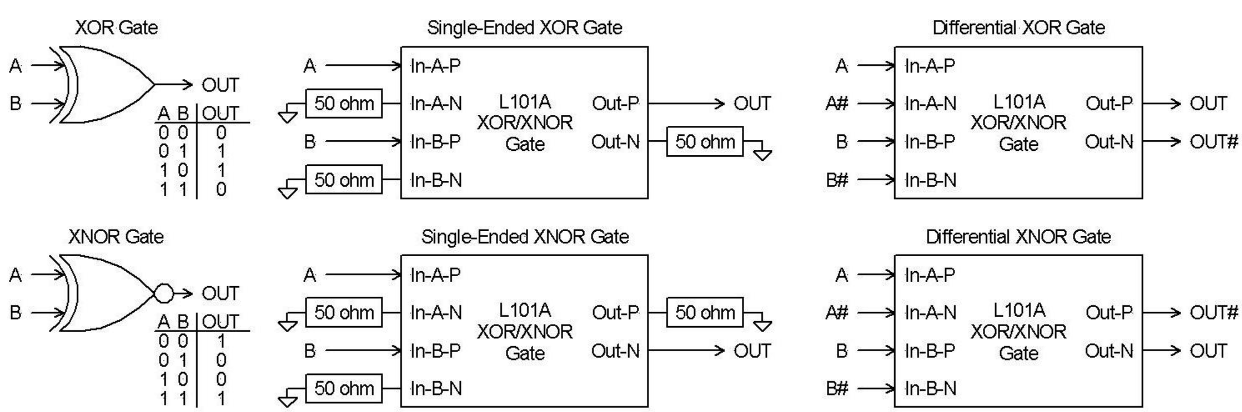




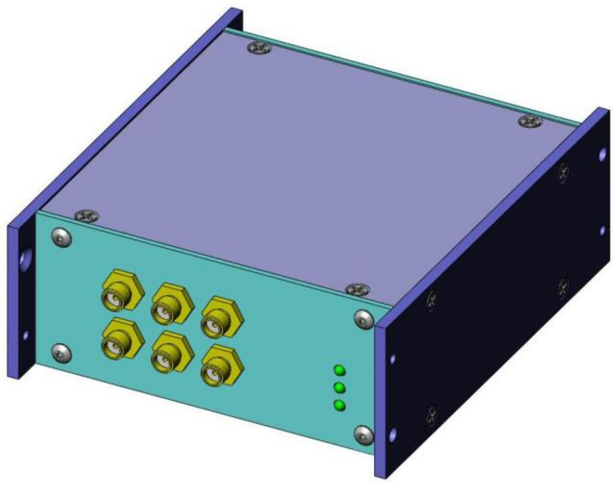
L101A, Gate, XOR/XNOR, 13 GHz Class

This gate can perform single-ended or differential XOR or XNOR logic functions on data or clock signals, depending upon how the outputs are connected. Connections are shown in the figure below.

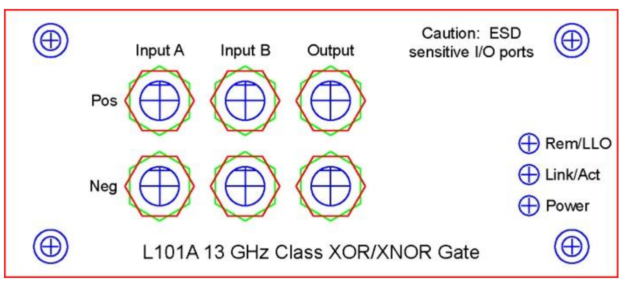
L101A connections for XOR and XNOR logic functions

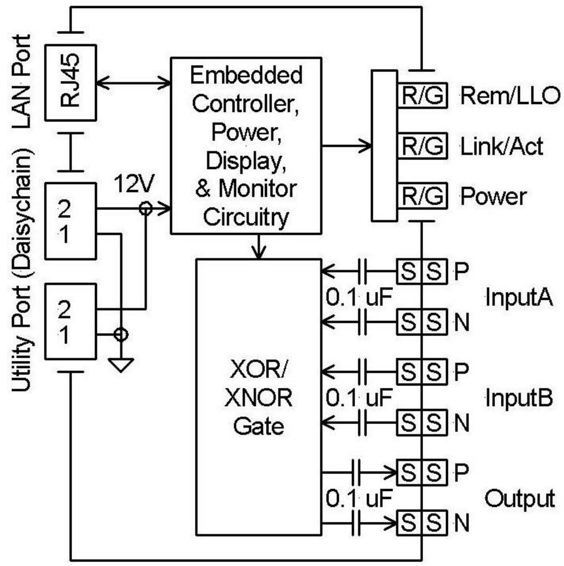


L101A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7” deep





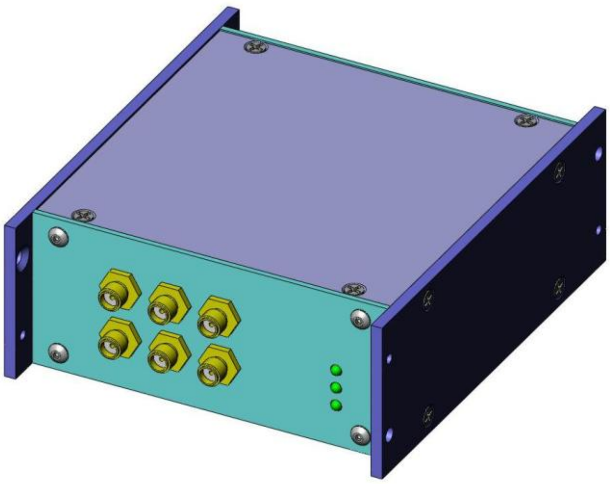
Fan-out Buffers

High-Speed Digital Logic ModBlock fan-out buffers are offered, including 13 GHz class 1-to-2 and 1-to-4 fan-outs. These buffers will operate with data or clock signals. All inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3 dB roll-off point). Other fan-outs, 25 GHz class fan-outs, or DC-coupled fan-outs can be provided on request (send an email request to ModBlocks@tmeplano.com).

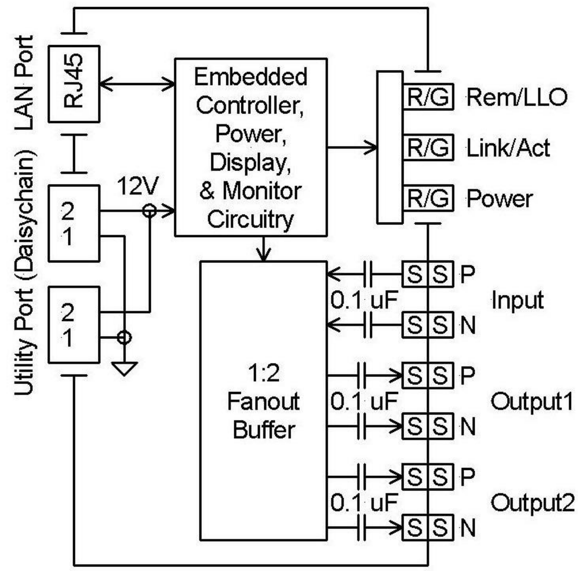
L110A, Fan-out Buffer, 1:2, 13 GHz Class

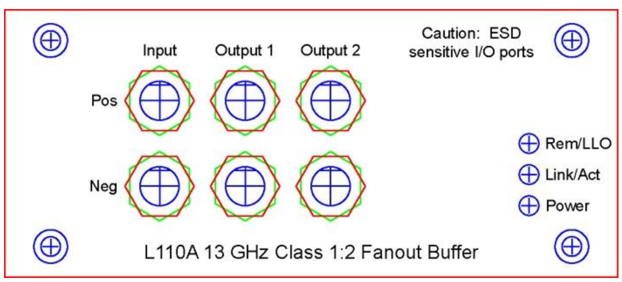
This fan-out buffer accepts a logic input from a data or clock signal and delivers two identical non-inverted logic outputs.

L110A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7” deep



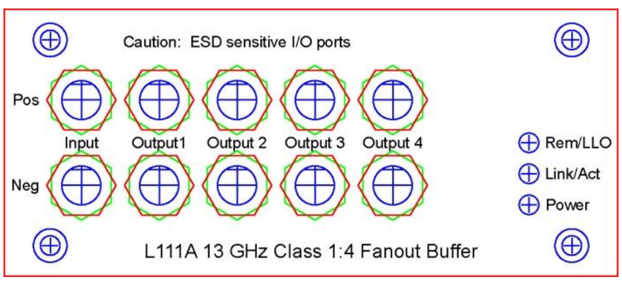


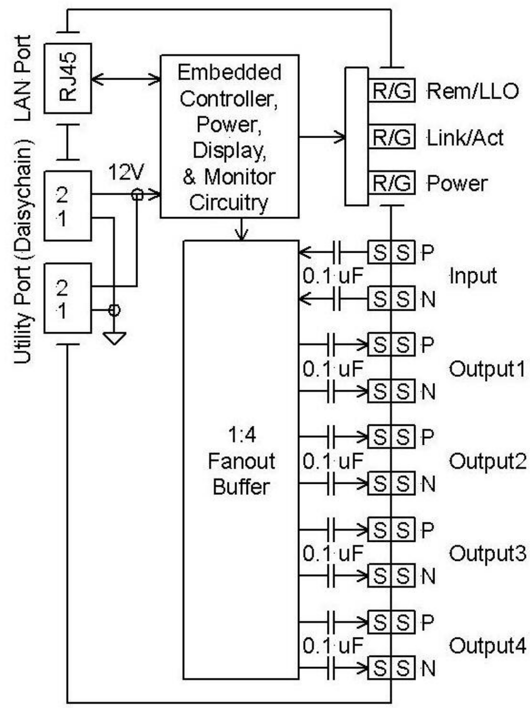
L111A, Fan-out Buffer, 1:4, 13 GHz Class

This fan-out buffer accepts a logic input from a data or clock signal and delivers four identical non-inverted logic outputs.

L111A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7” deep





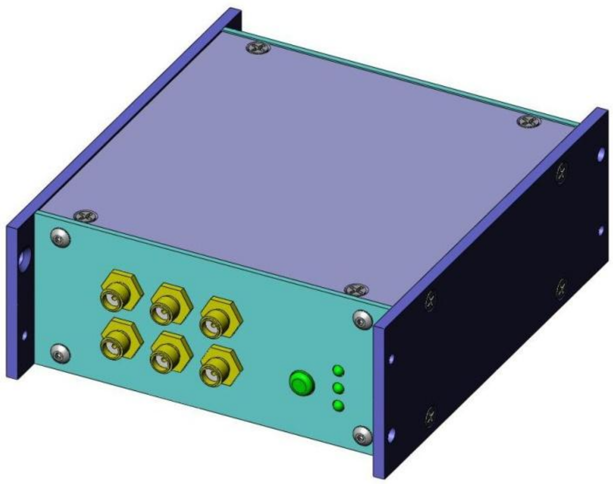
Data Selectors

High-Speed Digital Logic ModBlock data selectors are offered, including 13 GHz class 2-to-1 and 4-to-1 selectors. These selectors will operate with data or clock signals. All inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3 dB roll-off point). Other selectors, 25 GHz class selectors, or DC-coupled selectors can be provided on request (send an email request to ModBlocks@tmeplano.com).

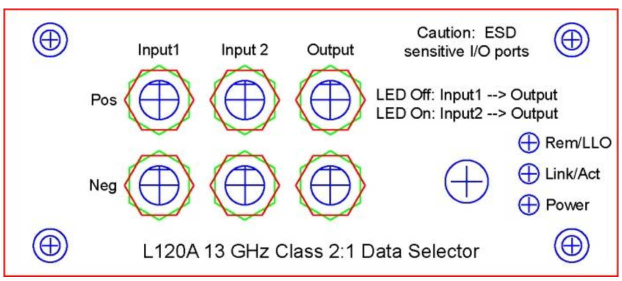
L120A, Data Selector, 2:1, 13 GHz Class

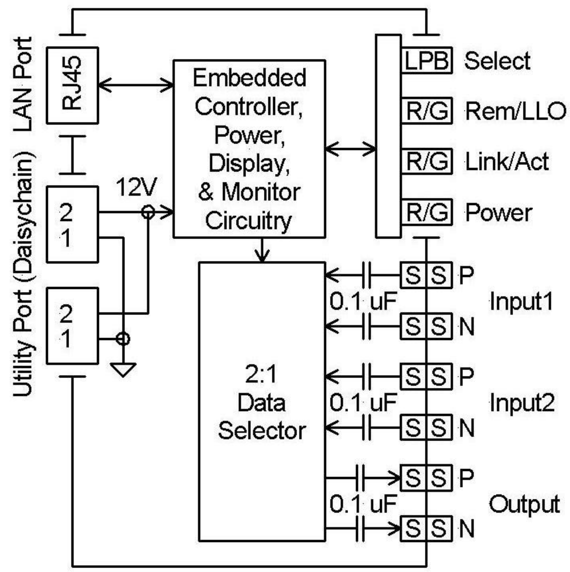
This data selector accepts two logic inputs from data or clock signals and selects one of them to deliver a non-inverted logic output.

L120A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7" deep



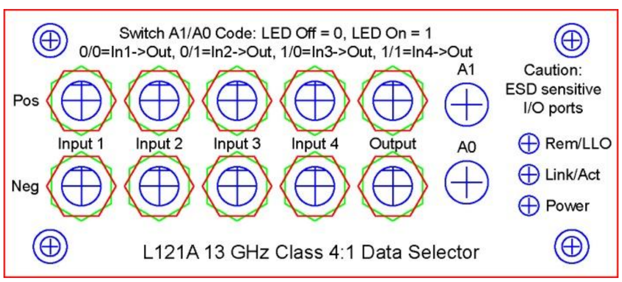


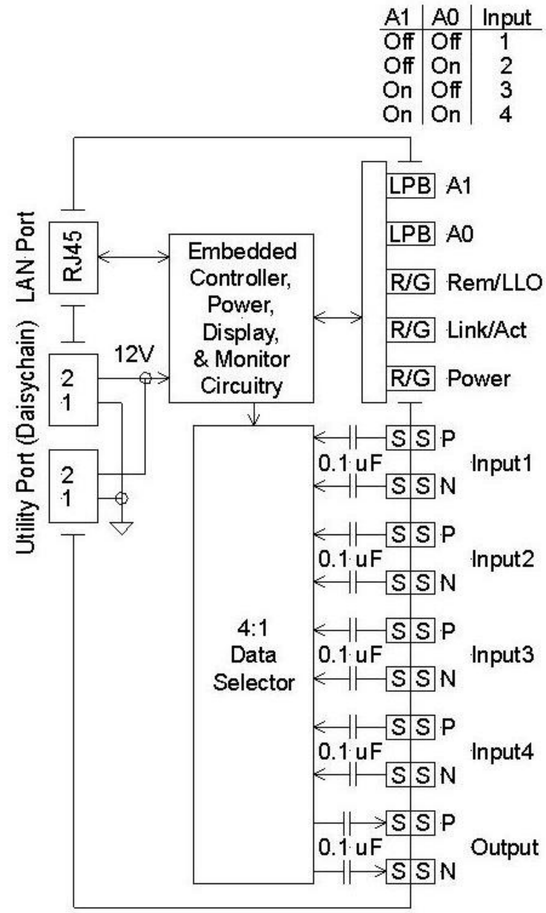
L121A, Data Selector, 4:1, 13 GHz Class

This data selector accepts four logic inputs from data or clock signals and selects one of them to deliver a non-inverted logic output. Two lighted pushbutton switches are used for manual input selection using a classic 2-bit binary code, as shown in the block diagram.

L121A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7" deep





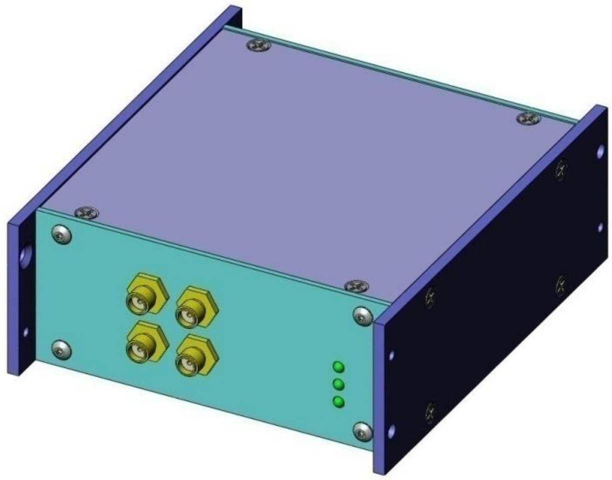
Pre-Scalers

High-Speed Digital Logic ModBlock pre-scalers (dividers) are offered, including 13 GHz class 2-to-1 and 4-to-1 selectors. These pre-scalers will operate with data or clock signals. All inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3 dB roll-off point). Other pre-scalers, 25 GHz class pre-scalers, or DC-coupled pre-scalers can be provided on request (send an email request to ModBlocks@tmeplano.com).

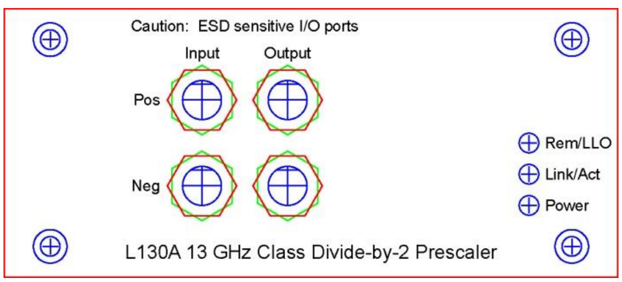
L130A, Pre-Scaler, Divide by 2, 13 GHz Class

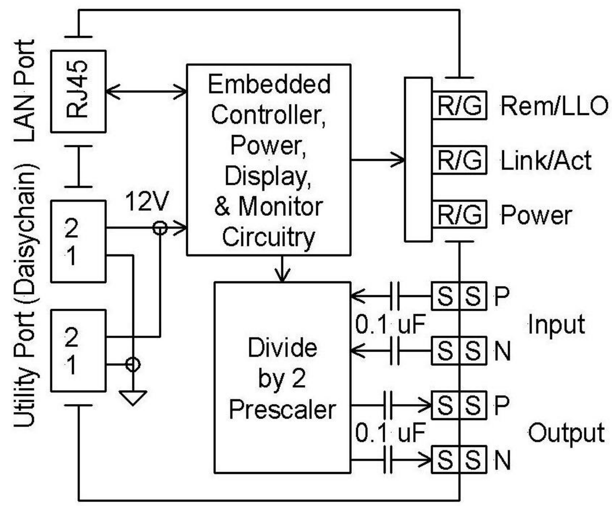
This pre-scaler accepts a logic input from a data or clock signal and divides it by two to deliver a non-inverted logic output.

L130A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7” deep



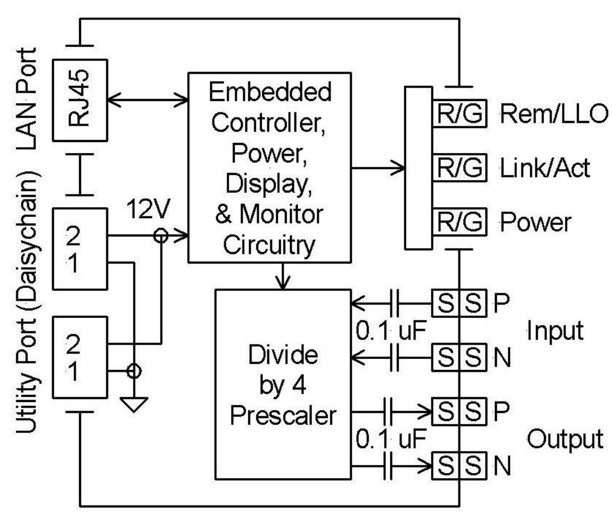


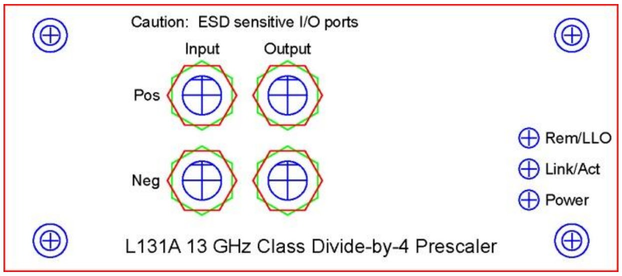
L131A, Pre-Scaler, Divide by 4, 13 GHz Class

This pre-scaler accepts a logic input from a data or clock signal and divides it by four to deliver a non-inverted logic output.

L131A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7” deep



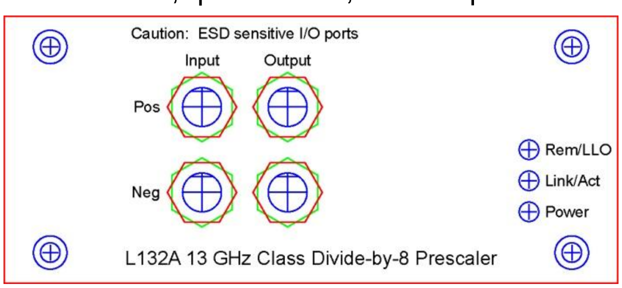


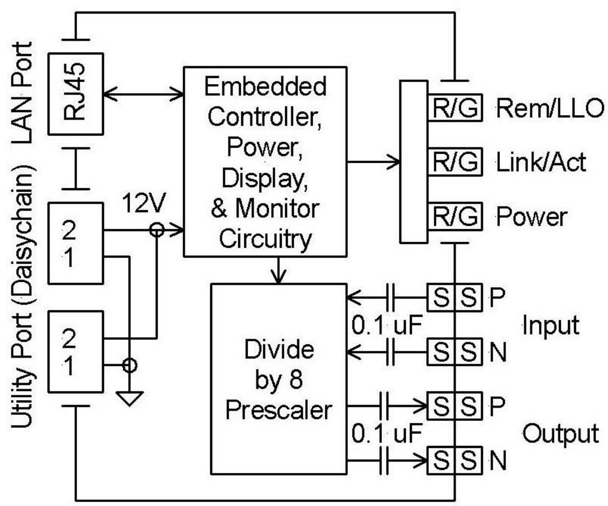
L132A, Pre-Scaler, Divide by 8, 13 GHz Class

This pre-scaler accepts a logic input from a data or clock signal and divides it by eight to deliver a non-inverted logic output.

L132A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7” deep



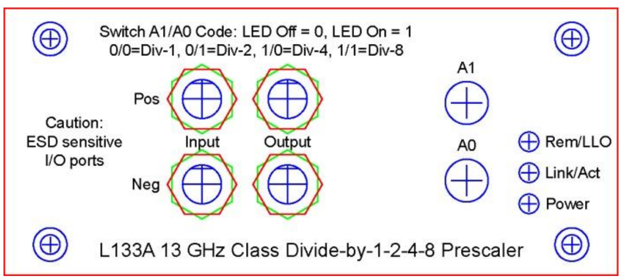


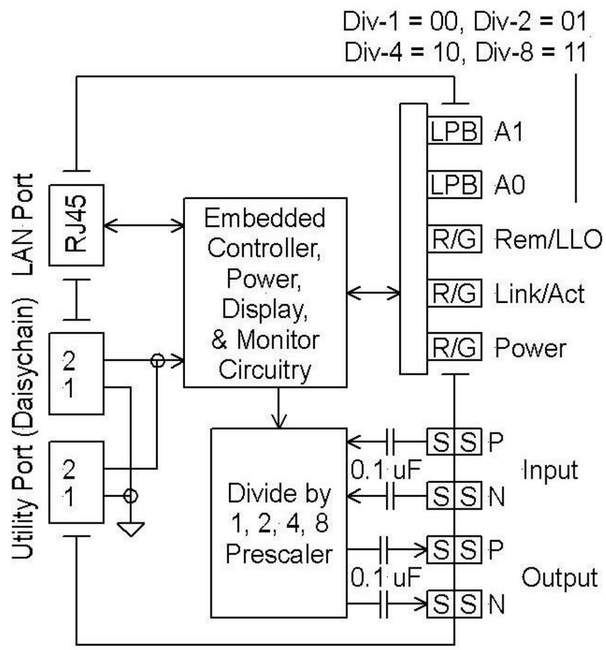
L133A, Pre-Scaler, Divide by 1-2-4-8, 13 GHz Class

This pre-scaler accepts a logic input from a data or clock signal and divides it by one, two, four, or eight to deliver a non-inverted logic output. Two lighted pushbutton switches are used for manual selection of the divisor value by using a classic 2-bit binary code.

L133A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7” deep





Flip-Flops

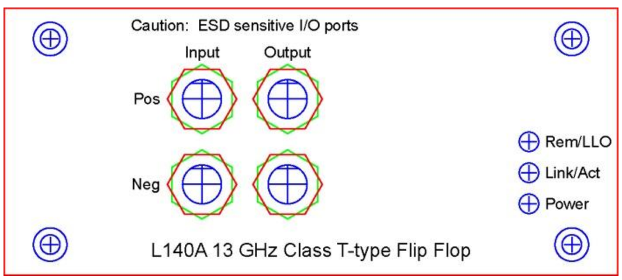
High-Speed Digital Logic ModBlock flip-flops are offered, including 13 GHz toggle and D-type flip-flops. These flip-flops will operate with data or clock signals. All inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3 dB roll-off point). Other flip-flops, 25 GHz class flip-flops, or DC-coupled flip-flops can be provided on request (send an email request to ModBlocks@tmeplano.com).

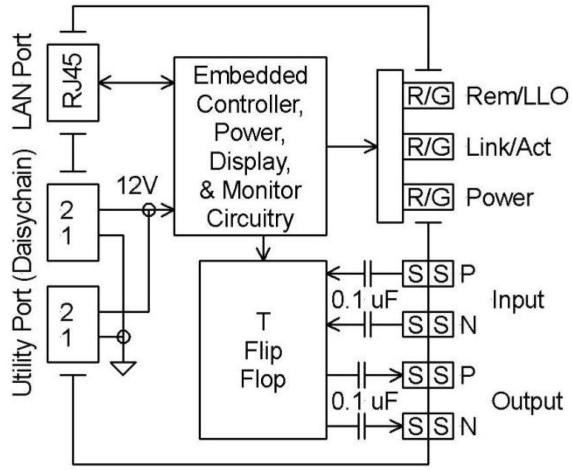
L140A, Flip-Flop, Toggle Type, 13 GHz Class

This flip-flop accepts a logic input from a data or clock signal and divides it by two (toggle function) to deliver a non-inverted logic output. A toggle occurs on the rising edge of the input signal. By reversing the input polarity, a toggle occurs on the falling edge of the clock.

L140A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7” deep

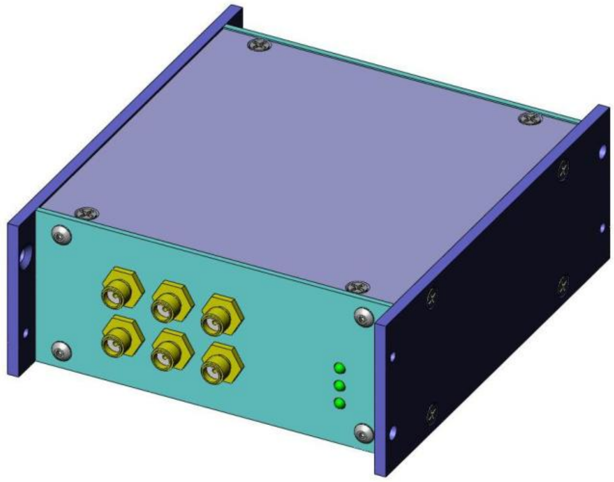




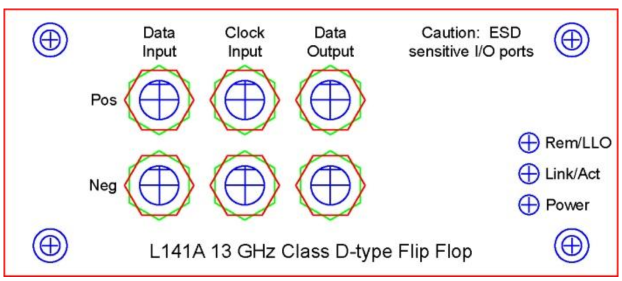
L141A, Flip-Flop, D-Type, 13 GHz Class

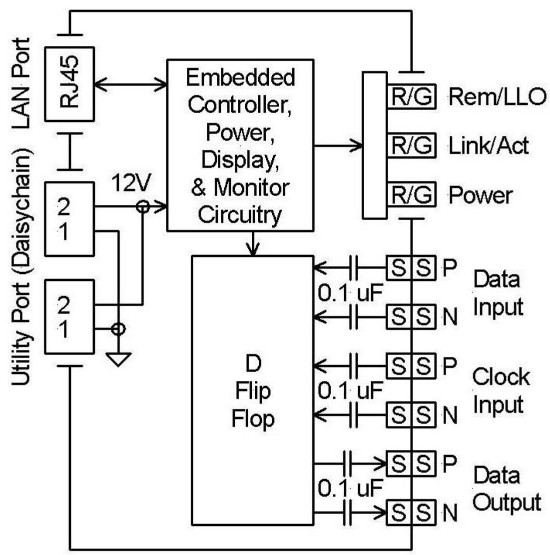
This flip-flop accepts logic inputs from a data signal and a clock signal and delivers a non-inverted logic output. Input data is transferred to the output on the rising edge of the clock. By reversing the clock input polarity, input data is transferred to the output on the falling edge of the clock.

L141A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7" deep





Time Delays

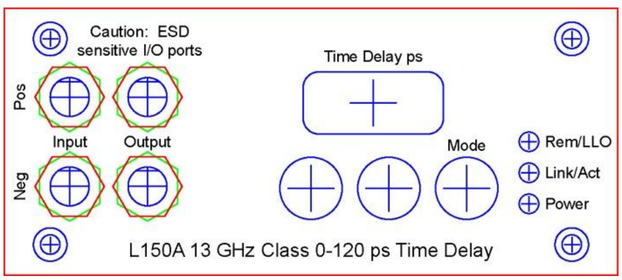
High-Speed Digital Logic ModBlock time delays are offered, currently including a 0 to 120 picosecond time delay. These time delays will operate with data or clock signals. All inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3 dB roll-off point). Other time delays or DC-coupled time delays can be provided on request (send an email request to ModBlocks@tmeplano.com).

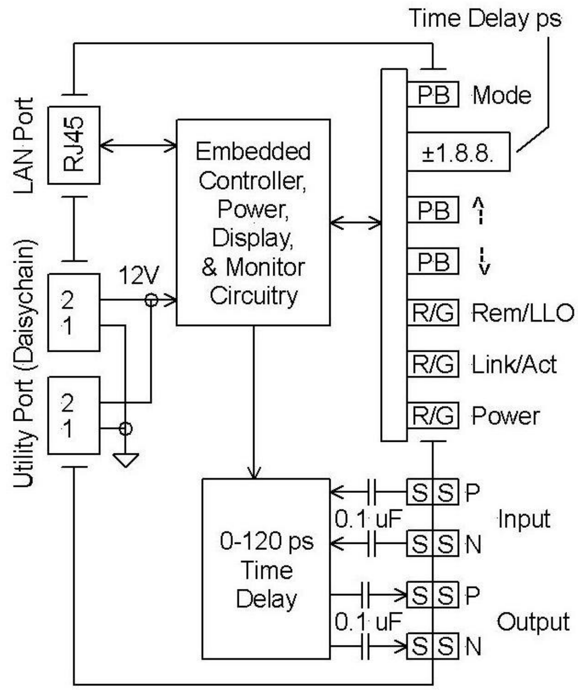
L150A, Time Delay, 0-120 ps, 13 GHz Class

This time delay accepts a logic input from a data or clock signal, adds 0 to 120 picoseconds of time delay to the signal, and delivers a non-inverted logic output. Front panel pushbuttons and a numeric readout provide manual control of the delay time in 1 picosecond increments (which can also be operated remotely). The mode pushbutton allows the display to be turned on or off. Pushbuttons with up and down arrows allow the user to adjust the time delay when the display is on.

L150A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7" deep





Encoders

High-Speed Digital Logic ModBlock encoders are offered, including a differential (DPSK) encoder and an NRZ to RZ encoder, with or without a built-in 0 to 120 picosecond clock time delay. All inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3 dB roll-off point). Other encoders or DC-coupled encoders can be provided on request (send an email request to ModBlocks@tmeplano.com).

L160A, Encoder, Differential (DPSK), 13 GHz Class

L161A, Encoder, Differential (DPSK), 13 GHz Class, with 0-120 ps Clock Delay

These encoders accept data and clock logic inputs, perform modulo-two addition of the current data input bit with the previous data output bit, and deliver a non-inverted logic output. Input data is retimed before encoding to provide a large phase margin (290° typical @ 12.5 Gb/s). These encoders operate on the rising edge of the clock (a.k.a. DSPK1). By reversing the clock input polarity, these encoders operate on the falling edge of the clock (a.k.a. DPSK0). These encoders are normally used for Differential Phase-Shift Keying (DPSK) and Duo-Binary (DB) applications.

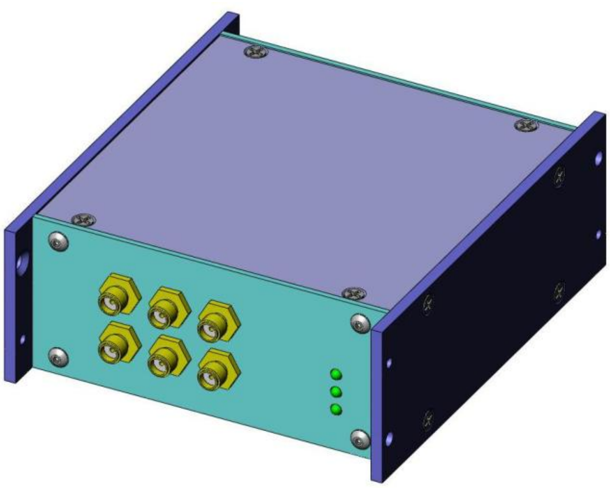
Encoder operation is based upon the well-known differential encoder equation $Dout_k = Dout_{k-1} \oplus Din_{k-1}$ (as modified by the input data re-timing), which is shown in the truth table below. The parameter “k” refers to the logic level during a bit period.

L160A and L161A differential encoder truth table

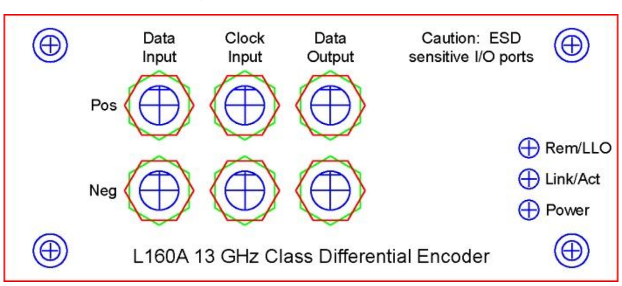
$Dtin_{k-1}$	$Dtout_{k-1}$	$Dtout_k$
0	0	0
0	1	1
1	0	1
1	1	0

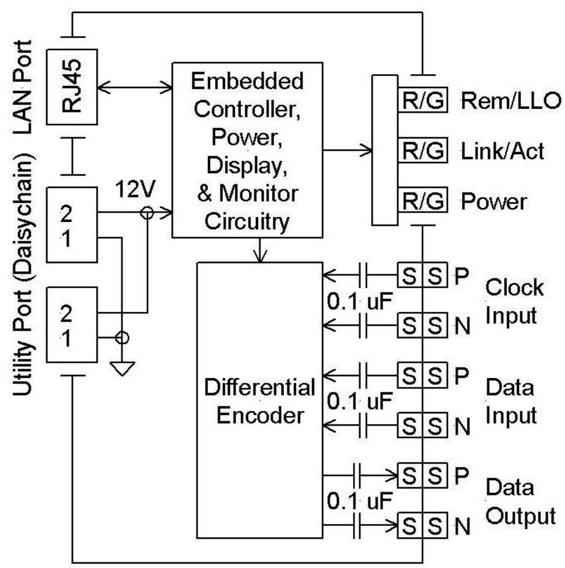
The L161A is the same as the L160A, excepting that a 0 to 120 picoseconds clock time delay has been added for phase margin control. Front panel pushbuttons and a numeric readout provide manual control of the delay time in 1 picosecond increments (which can also be operated remotely). The mode pushbutton allows the display to be turned on or off. Pushbuttons with up and down arrows allow the user to adjust the time delay when the display is on.

L160A front chassis view, graphics layout, and simple block diagram



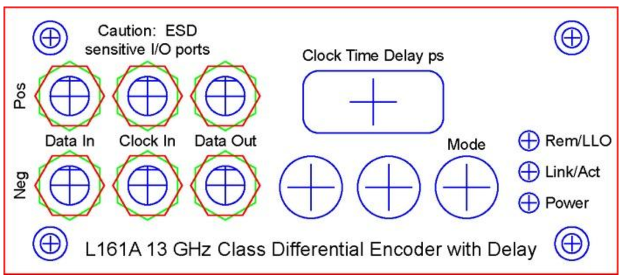
1U, quarter-rack, 4.7” deep

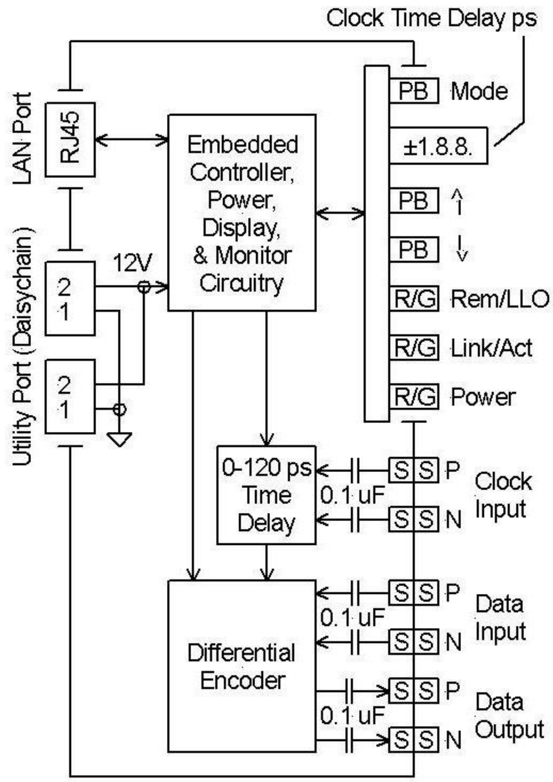




L161A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7” deep





L162A, Encoder, NRZ to RZ, 13 GHz Class
L163A, Encoder, NRZ to RZ, 13 GHz Class, with 0-120 ps Clock Delay

These encoders accept data and clock logic inputs, re-time the incoming data, generate an RZ pulse, and deliver the pulse as a non-inverted logic output. Input data is retimed before encoding to provide a large phase margin (270° typical @ 10 Gb/s). These encoders operate on the falling edge of the clock. By reversing the clock input polarity, these encoders operate on the rising edge of the clock. These encoders are normally used with a lithium niobate modulator to generate an optical RZ signal.

Encoder operation is shown in the truth table below. The parameter “k” refers to the logic level during a bit period. “RZ” means a return-to-zero pulse (0→1→0 within 1 clock period and “R1” means a return-to-one pulse (1→0→1 within 1 clock period).

L162A and L163A NRZ to RZ truth table

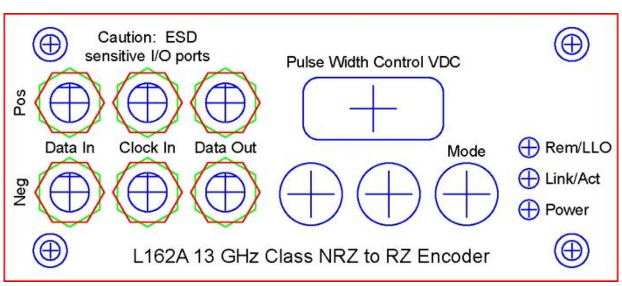
$Dtin_{k-1}$	CLKin	$Dtout\text{-}P_k$	$Dtout\text{-}N_k$
0	1→0	0	1
1	1→0	RZ	R1

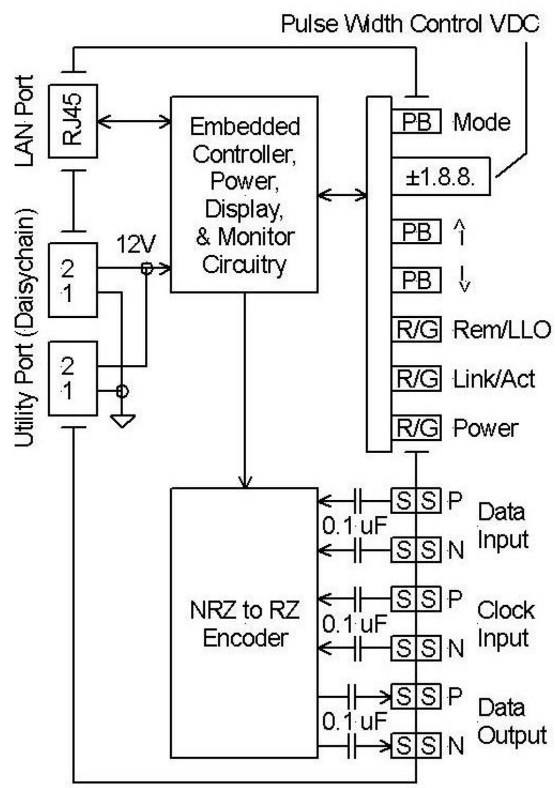
Front panel pushbuttons and a numeric readout provide manual control of the RZ pulse width. The RZ pulse width can be changed from 33% (~0.2 VDC) to 50% (~0.8 VDC) to 60% (~1.2 VDC) in 1% increments (which can also be operated remotely). The mode pushbutton allows the display to be turned on or off. Pushbuttons with up and down arrows allow the user to adjust the RZ pulse width when the display is on.

The L163A is the same as the L162A, excepting that a 0 to 120 picoseconds clock time delay has been added for phase margin control. Front panel pushbuttons and a numeric readout provide manual control of the delay time in 1 picosecond increments (which can also be operated remotely). The mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates RZ pulse width control mode, green indicates clock time delay mode, and dark indicates off mode. Pushbuttons with up and down arrows allow parameter adjustment for the mode indicated by the bi-color LED.

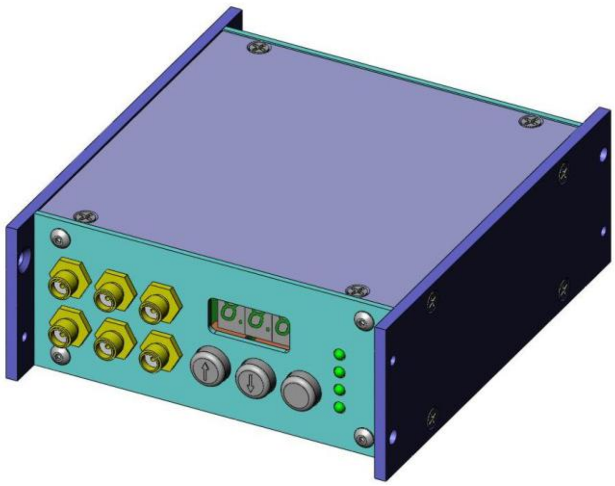
L162A front chassis view, graphics layout, and simple block diagram

1U, quarter-rack, 4.7” deep

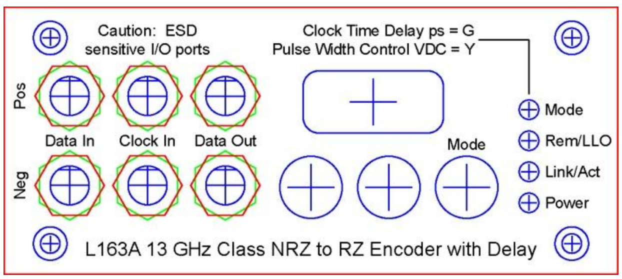


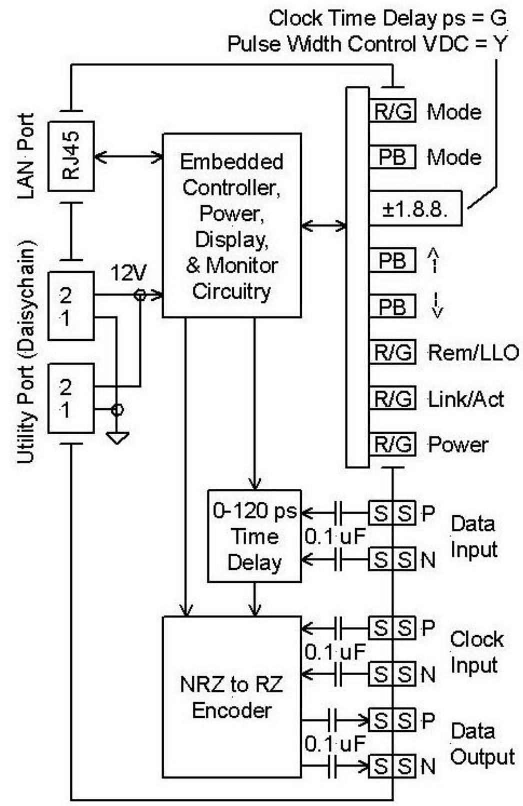


L163A front chassis view, graphics layout, and simple block diagram



1U, quarter-rack, 4.7” deep





Phase Locked Loops

High-Speed Digital Logic ModBlock phase-locked loops (PLLs) are offered, including NRZ Clock-Data Recovery (CDR) PLLs in three data rate ranges from 10 Mb/s to 13 Gb/s. All inputs and outputs are AC-coupled with a 0.1 uF capacitor (~35 KHz low frequency -3 dB roll-off point). Other PLLs or DC-coupled PLLs can be provided on request (send an email request to ModBlocks@tmeplano.com).

L200A, PLL, NRZ Clock-Data Recovery, 10Mb/s-2.7 Gb/s

L201A, PLL, NRZ Clock-Data Recovery, 2.5-10.8 Gb/s

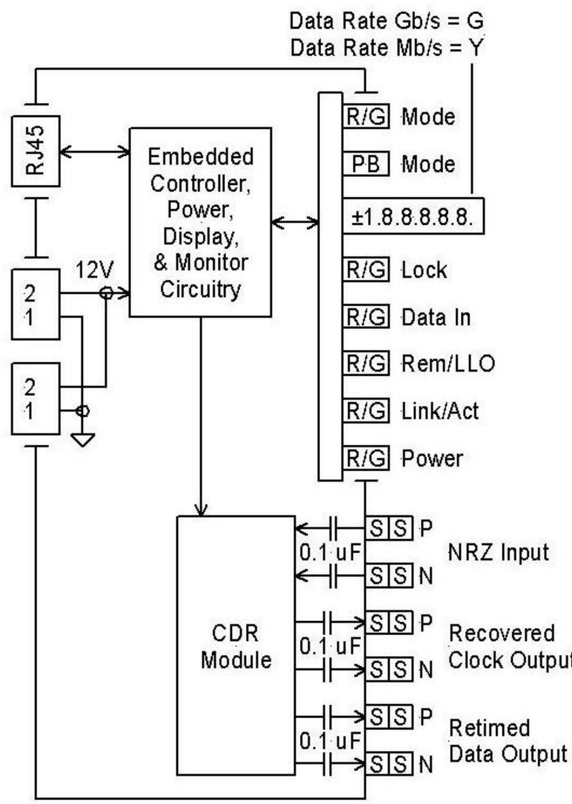
L202A, PLL, NRZ Clock-Data Recovery, 9-13 Gb/s

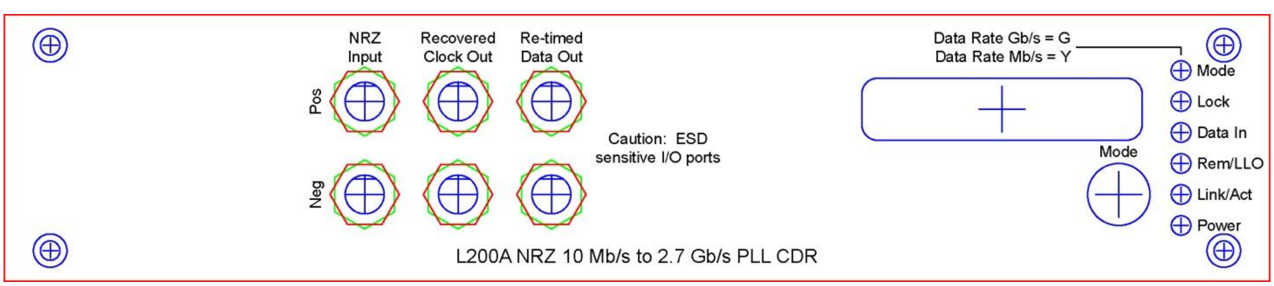
These clock-data recovery PLLs accept an NRZ data stream at their inputs, lock on to the data stream (if possible), and output a clock signal recovered from the data stream and the original data stream retimed by the recovered clock. Input data passes through a limiting amplifier to CDR circuitry, providing a wide NRZ input voltage range (10 to 1000 mVpp). The PLL accepts input data streams over a continuous range (according to the model) and acquires lock automatically in less than 50 milliseconds. Output rise and fall times are ~100 ps for the M200A. Otherwise, Common Specifications on page 155 apply, excepting for the chassis dimensions shown below.

Front panel bi-color LEDs indicate the input signal level (green = OK, yellow = loss of signal) and PLL lock status (green = locked, yellow = un-locked). Front panel pushbuttons and a numeric readout display the data rate to ~0.01% accuracy. For the L200, the mode pushbutton changes the display and a bi-color mode LED (along with front panel graphics) indicates the parameter being displayed. Yellow indicates the data rate in Mb/s, green indicates the data rate in Gb/s, and dark indicates off mode. For the L201A and L202A, the mode pushbutton turns the display on (data rate indicated in Gb/s) or off.

L200A front chassis view, graphics layout, and simple block diagram

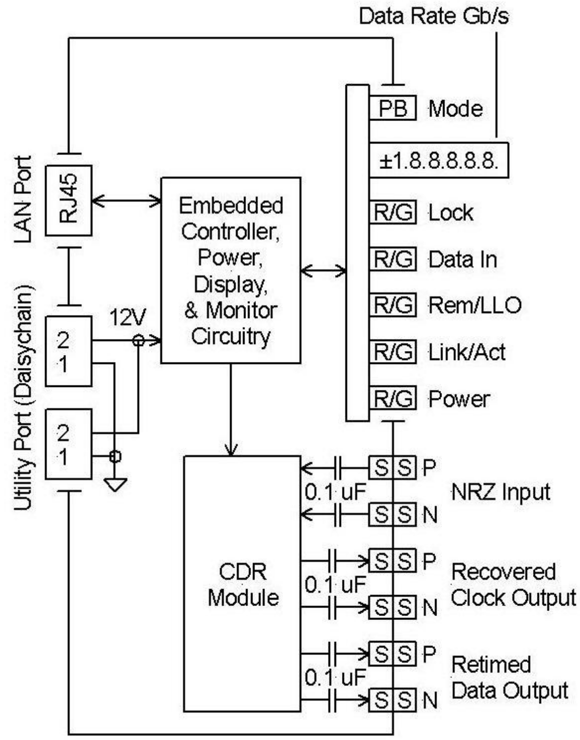
1U, half-rack, 6.7” deep

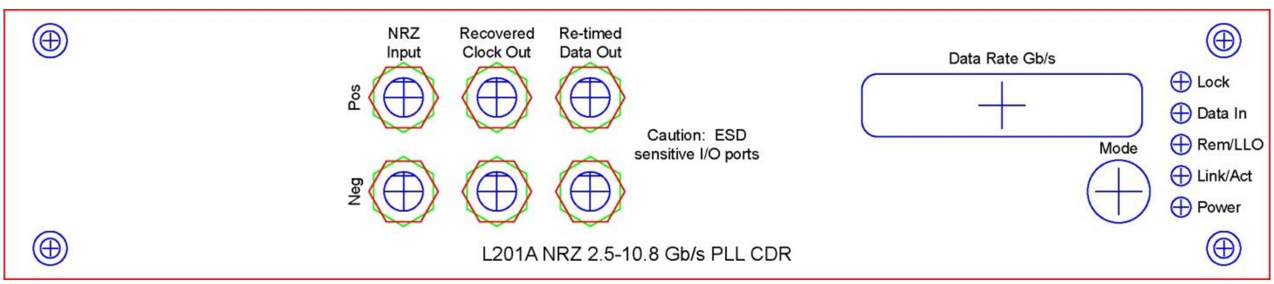




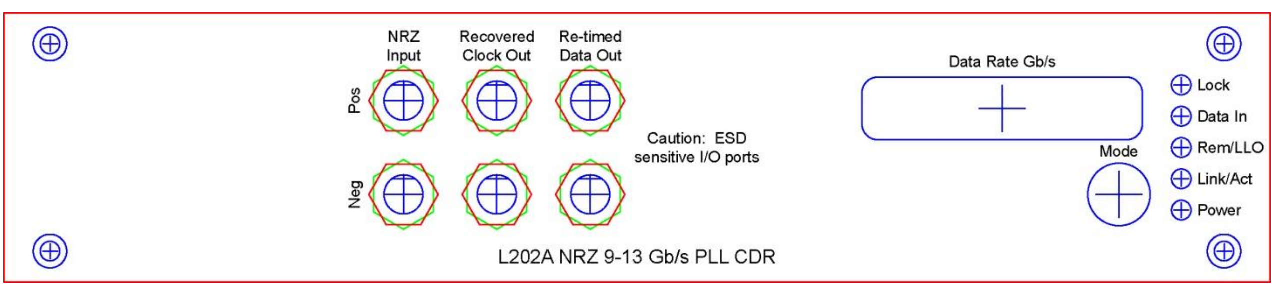
L201A front chassis view, graphics layout, and simple block diagram

1U, half-rack, 6.7” deep

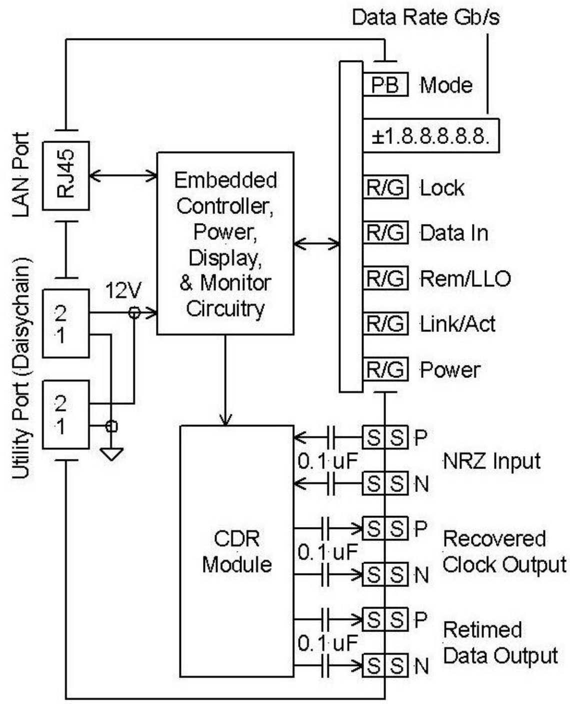




L202A front chassis view, graphics layout, and simple block diagram



1U, half-rack, 6.7” deep



Utility ModBlocks

Utility ModBlocks are currently available for various kinds of digital I/O, analog I/O, and programmable power supplies. Other ModBlocks will be added over time and upon user request. Chassis rear views are shown in the "Common Packaging Data" section on page 186. Price and delivery are shown in the "Domestic USA Pricing" section starting on page 199.

U100A-*, Digital I/O

U120A-*, Digital-to-Analog Converters

U140A-*, Analog-to-Digital Converters

U200A-*, Programmable Power Supplies

U250A-*, Programmable High Voltage Power Supplies

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

ModBlock Accessories

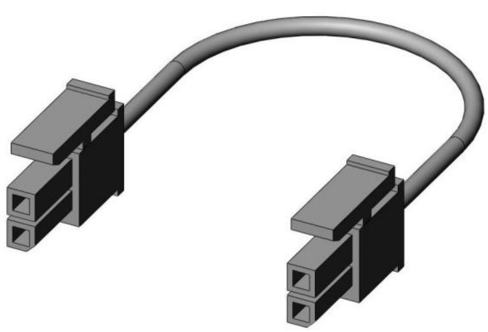
Accessories are available for various kinds of cable assemblies, adapters, commercial power supplies, fastening hardware, rack-mount kits, SFP modules, fiber optic cleaning supplies, tools, and graphical user interface (GUI) software. Other accessories will be added over time and upon user request.

Cable Assemblies

Cable assemblies are offered to make ModBlock power, LAN, coaxial, and fiber optic connections. AC power cords are not listed, as they are included with power supplies.

A100A-*, ModBlock Power Daisy-chain Jumpers

ModBlock 2-pin power cable assemblies are required to daisy-chain jumper 12 VDC power between active ModBlocks. These cable assemblies are made with twisted Teflon-coated #22 stranded wires (brown=negative, red=positive) and a 2-pin plug on each end (both with female contacts). They are rated up to 5 amps of current, which is a 50 mV drop per conductor per foot (i.e., low). The plugs are locking, keyed, and have gold-plated contacts for long-term reliability. A 6 inch cable is recommended for daisy-chain connecting quarter rack width ModBlocks horizontally. A 4 inch cable is recommended for daisy-chain connecting 1U ModBlocks vertically. Cable lengths are measured between connector mating faces. Any length can be provided upon request.



ModBlock Daisy-chain Jumper Cable Assembly Choices

Part Number	Cable Assy Length (in)
A100A-3	3
A100A-4	4
A100A-5	5
A100A-6	6
A100A-7	7
A100A-8	8

Part Number	Cable Assy Length (in)
A100A-9	9
A100A-10	10
A100A-12	12
A100A-15	15
A100A-18	18
A100A-21	21

Part Number	Cable Assy Length (in)
A100A-21	24
A100A-30	30
A100A-36	36
A100A-42	42
A100A-48	48

A101A-*, ModBlock Power Extension Cords

ModBlock 2-pin power cable assemblies extend the length of 12 VDC power cables assemblies for active ModBlocks. These cable assemblies are made with twisted Teflon-coated #22 stranded wires (brown=negative, red=positive) and a 2-pin plug on each end (one with female contacts, one with male contacts). They are rated up to 5 amps of current, which is a 50 mV drop per conductor per foot (i.e., low). The plugs are locking, keyed, and have gold-plated contacts for long-term reliability. Cable lengths are measured between connector mating faces. Any length can be provided upon request.

ModBlock Power Cable Assembly Choices

Part Number	Cable Assy Length (in)	Part Number	Cable Assy Length (in)	Part Number	Cable Assy Length (in)
A101A-3	3	A101A-9	9	A101A-21	24
A101A-4	4	A101A-10	10	A101A-30	30
A101A-5	5	A101A-12	12	A101A-36	36
A101A-6	6	A101A-15	15	A101A-42	42
A101A-7	7	A101A-18	18	A101A-48	48
A101A-8	8	A101A-21	21		

A105A, ModBlock Power Y-Cord

ModBlock 2-pin power "Y-cord" cable assemblies are useful to supply 12 VDC power to several active ModBlocks and avoid excessively long DC power cable daisy-chains. These Y-cords are made with twisted Teflon-coated #22 stranded wires (brown=negative, red=positive) and three 2-pin plugs (two with female contacts, one with male contacts). Y-cords are rated up to 5 amps of current and are 3 inches long. The plugs are locking, keyed, and have gold-plated contacts for long-term reliability.

A120A-*, Cat5E LAN Patch Cords

A121A-*, Cat5E LAN Crossover Patch Cords

All active ModBlocks have an embedded controller for optional remote ModBlock operation via 10Base-T Ethernet LAN. For remote operation, a LAN cable is required to directly connect to a computer (crossover cable type) or to a router (normal type). There is nothing special about the Cat5E LAN cables listed below, available from many commercial distributors. These listed LAN cables are provided for purchasing convenience. Normal cables are black (available up to 100 feet) and crossover cables are yellow. Other colors are available.

Normal LAN Cable Assembly Choices

Part Number	Cable Assy Length (ft)	Part Number	Cable Assy Length (ft)	Part Number	Cable Assy Length (ft)
A120A-1	1	A120A-5	5	A120A-14	14

Part Number	Cable Assy Length (ft)	Part Number	Cable Assy Length (ft)	Part Number	Cable Assy Length (ft)
A120A-2	2	A120A-7	7	A120A-20	20
A120A-3	3	A120A-10	10	A120A-25	25

Crossover LAN Cable Assembly Choices

Part Number	Cable Assy Length (ft)	Part Number	Cable Assy Length (ft)	Part Number	Cable Assy Length (ft)
A121A-1	1	A121A-5	5	A121A-15	15
A121A-2	2	A121A-7	7	A121A-25	25
A121A-3	3	A121A-10	10		

A130A-*, Coaxial Patch Cords, SMA-male to SMA-male

Most fiber optic and all microwave and high-speed logic ModBlocks require coaxial cable assemblies with SMA-male connectors (at least on one end) to deliver high-speed electrical signals. Many kinds of SMA coaxial cable assemblies with a variety of microwave performance specifications are available from many commercial distributors and could be used. The listed SMA coaxial cable assemblies are provided for purchasing convenience, but also represent a good price-performance-durability value from TME experience. These cables are 18 GHz grade, 0.141" diameter type with insulated jacket, have low-loss dielectrics (<0.5 dB @ 10 GHz), and male SMA connectors on both ends.

Male SMA to SMA Coaxial Cable Assembly Choices

Part Number	Cable Assy Length (in)	Part Number	Cable Assy Length (in)	Part Number	Cable Assy Length (in)
A130A-3	3	A130A-9	9	A130A-30	30
A130A-4	4	A130A-12	12	A130A-36	36
A130A-6	6	A130A-18	18	A130A-42	42
A130A-8	8	A130A-24	24	A130A-48	48

A140A-*, Fiber Optic Patch Cords, Single-mode, FC/UPC to FC/UPC
A141A-*, Fiber Optic Patch Cords, Single-mode, FC/UPC to FC/APC
A142A-*, Fiber Optic Patch Cords, Single-mode, FC/APC to FC/APC
A143A-*, Fiber Optic Patch Cords, Polarized Single-mode, FC UPC to FC/UPC
A144A-*, Fiber Optic Patch Cords, 50 micron Multimode, FC UPC to FC/UPC
A145A-*, Fiber Optic Patch Cords, 62.5 micron Multimode, FC UPC to FC/UPC

Fiber optic ModBlocks require different kinds of fiber optic cable assemblies to deliver optical signals. Many kinds of fiber optic cable assemblies with a variety of performance specifications are available from many commercial distributors and could be used. The listed fiber optic cable assemblies are provided for purchasing convenience, but also represent a good price-performance-durability value from TME experience. All cables have a 3mm OD protective jacket and lengths are in meters. Any length can be provided upon request. Polarized cable assemblies are made with narrow type connectors and with the slow axis aligned to the connector key.

Single-mode FC/UPC to FC/UPC Fiber Optic Cable Assembly Choices

Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)
A140A-1	1	A140A-3	3	A140A-5	5
A140A-2	2	A140A-4	4	A140A-10	10

Single-mode FC/UPC to FC/APC Fiber Optic Cable Assembly Choices

Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)
A141A-1	1	A141A-3	3	A141A-5	5
A141A-2	2	A141A-4	4	A141A-10	10

Single-mode FC/APC to FC/APC Fiber Optic Cable Assembly Choices

Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)
A142A-1	1	A142A-3	3	A142A-5	5
A142A-2	2	A142A-4	4	A142A-10	10

Polarized Single-mode FC/UPC to FC/UPC Fiber Optic Cable Assembly Choices

Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)
A143A-1	1	A143A-3	3	A143A-5	5
A143A-2	2	A143A-4	4	A143A-10	10

50 Micron Multimode FC/UPC to FC/UPC Fiber Optic Cable Assembly Choices

Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)
A144A-1	1	A144A-3	3	A144A-5	5
A144A-2	2	A144A-4	4	A144A-10	10

62.5 Micron Multimode FC/UPC to FC/UPC Fiber Optic Cable Assembly Choices

Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)	Part Number	Cable Assy Length (m)
A145A-1	1	A145A-3	3	A145A-5	5
A145A-2	2	A145A-4	4	A145A-10	10

A160-*, Utility Patch Cords

These cable assemblies are used with Utility ModBlocks and will be coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Signal Adapters

Signal adapters are often needed to convert cable assembly or ModBlock I/O connectors from one type or gender to another. Such adapters are available from several commercial distributors and could be used. The listed adapters are provided for purchasing convenience, but also represent a good price-performance-durability value from TME experience. Listed utility adapters are not commercially distributed.

A600A-*, Fiber Optic

A620A-*, Coaxial

A640A-*, LAN

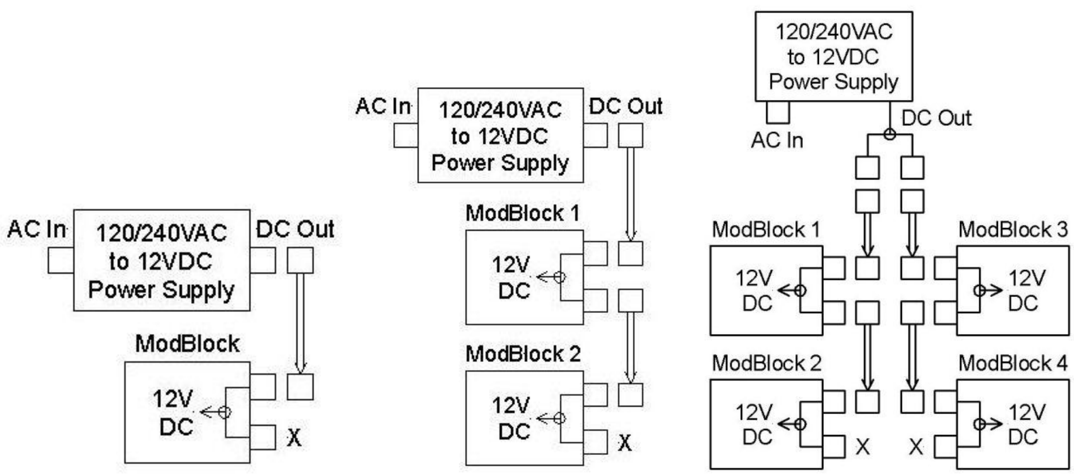
A660A-*, Utility

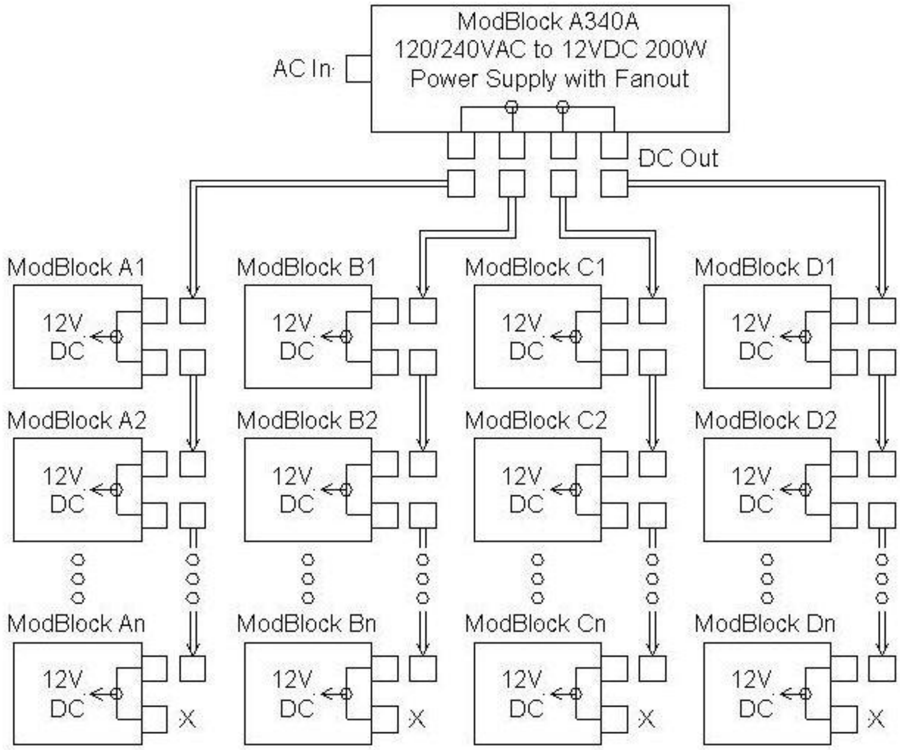
Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

ModBlock 12VDC Power Supplies

Active ModBlocks require 12 VDC power to operate, which can be accomplished many ways (see figures below for examples). 12 VDC power can be supplied from a commercial wall-mount or desktop AC to 12 VDC power supply, provided the DC output has the proper 2-pin plug with correct wiring polarity. When only one or a few ModBlocks are in use, a wall mount supply may be adequate. When more than a few ModBlocks are in use, a desktop supply may be adequate. When many ModBlocks are in use, a ModBlock power supply with multiple 5 amp rated fan-outs (such as A340A) may be required. A Y-cord (A105A) or ModBlock power fan-out may be needed to avoid excessively long DC power cable daisy-chains.

Various ModBlock Power Arrangements





A300A, Power Supply, Wall-mount Style, 24 Watt

This desktop power supply is a commercial grade switching power supply. It measures 2.2”Wx3.4”Lx1.3”H and has an integral 2-prong AC plug (male) to directly plug into an AC wall outlet. It accepts worldwide AC power (120/240 VAC, 47-63 Hz) and outputs 12 VDC at up to 2 amps. It is over-current and short circuit protected and has ±2% maximum line regulation, ±5% load regulation, 1% maximum ripple and noise, and Energy Star Compliant Level 4 efficiency. It has a 6 foot long DC power cord with a 2-pin plug (female contacts), which can be plugged directly into a ModBlock.

A320A, Power Supply, Desktop Style, 120 Watt

This desktop power supply is a medical grade switching power supply. It measures 2.9”Wx9.0”Lx2.0”H and has an IEC320 type AC power inlet for use with a separable 3-prong AC power cord. It accepts worldwide AC power (120/240 VAC, 47-63 Hz) and outputs 12 VDC at up to 10 amps via a 5 foot long DC power cord. It is over-current and short circuit protected and has ±1% combined line and load regulation, 1% maximum ripple and noise, 86% typical efficiency, and weighs 1.5 pounds. A Y-cord adapter (6 inches long, brown=negative, red=positive) is provided with two 2-pin plugs (female contacts), each rated for a 5 amp load. Each of the two adapter plugs can be plugged directly into a ModBlock. A 6 foot 120VAC power cord is included.

A340A-*, ModBlock Power Supply, 200 Watt

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

ModBlock 12VDC Current Monitor

ModBlock Ethernet Switch

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

ModBlock Fastening Hardware

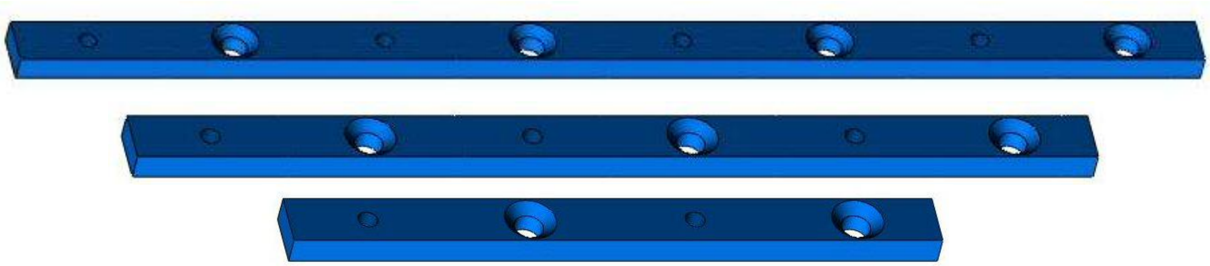
Hardware is offered for fastening multiple ModBlocks horizontally or vertically or for rack-mounting.

A400A, ModBlock Horizontal Fastener Screws

ModBlocks are fastened horizontally using #6-32 by ¼" long, black-oxide finished, stainless steel, Phillips flat head screws. These screws are widely available and a set of 5 screws is normally shipped with each ModBlock. A box of 100 screws is offered for purchasing convenience if additional screws are needed.

A412A, ModBlock Vertical Fastener Kit, 2U
A413A, ModBlock Vertical Fastener Kit, 3U
A414A, ModBlock Vertical Fastener Kit, 4U

ModBlocks are fastened vertically into desktop stacks by using a vertical fastener kit. Kits are offered for 2U, 3U, and 4U high stacks (kits for higher stacks available upon request). Each kit includes two black aluminum machined bars and a set of A400A screws. At least one kit is required for fastening the front panel ends vertically. A second kit can be added near the rear panels for added mechanical strength or better overall alignment as needed.

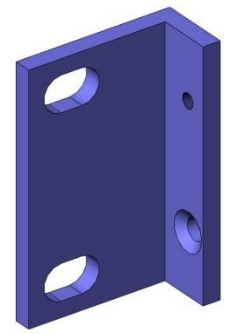


A421A, ModBlock Rack-mount Kit, 1U

A422A, ModBlock Rack-mount Kit, 2U

A423A, ModBlock Rack-mount Kit, 3U

A424A, ModBlock Rack-mount Kit, 4U



ModBlocks can be adapted for 19 inch rack-mount use by installing a rack-mount kit (1U size shown). Kits are offered for 1U, 2U, 3U, and 4U high stacks (kits for higher stacks available upon request). Each kit includes two black aluminum machined rack-mount ears and a set of A400A screws.

A430A, ModBlock Side Panel Kit, 1U-4.7", for 0.5U ModBlocks

0.5U ModBlocks require a side panel kit in order to fasten them to other ModBlocks. Each kit includes two black 1U x 4.7" long aluminum machined side panels and a set of #4-40 PFH mounting screws. The kit will accommodate two 0.5U ModBlocks.

A600 Series, SFP Modules

Various pluggable SFP transceiver modules are offered for use in F220A (page 88) and F221A (page 90) transceiver fiber optic ModBlocks. If required, SFP module performance specification details listed as "SFP dependent" for the F200A and F221A can be provided upon request. Fiber optic SFP modules have LC duplex optical connections and "copper" SFP modules have RJ-45 LAN connectors.

Selected Fiber Optic SFP Modules

Model	Wavelength (nm)	Data Rate (max.)	Fiber Type	Reach (meters)
A600	850	2.125 Gb/s	MM	500 (MM50) 300 (MM62)
A601	850	4.25 Gb/s	MM	500 (MM50) 300 (MM62)
A605	1310	200 Mb/s	MM	2,000
A610	1310	155 Mb/s	SM	15,000
A611	1310	155 Mb/s	SM	40,000
A615	1310	622 Mb/s	SM	15,000
A616	1310	622 Mb/s	SM	40,000
A620	1310	1.25 Gb/s	SM	10,000
A625	1310	2.125 Gb/s	SM	10,000
A626	1310	2.125 Gb/s	SM	55,000
A630	1310	2.67 Gb/s	SM	2,000
A631	1310	2.67 Gb/s	SM	15,000
A632	1310	2.67 Gb/s	SM	40,000
A635	1310	4.25 Gb/s	SM	4,000
A636	1310	4.25 Gb/s	SM	10,000
A637	1310	4.25 Gb/s	SM	30,000

Model	Wavelength (nm)	Data Rate (max.)	Fiber Type	Reach (meters)
A640	1550	155 Mb/s	SM	80,000
A645	1550	622 Mb/s	SM	80,000
A650	1550	2.125 Gb/s	SM	90,000
A651	1550	2.125 Gb/s	SM	115,000
A655	1550	2.67 Gb/s	SM	80,000

Selected "Copper" SFP Module

Model	Data Rate (max.)	Connector	Protocols
A670	1.25 Gb/s	RJ45	10/100/1000 BaseT

Cleaning Supplies

Proper fiber optic connector cleaning practices **must** be used with all fiber optic ModBlocks to avoid connector damage from invisible "dirt" (connector damage is not warranted). The proper cleaning supplies are to use both a "wipe" box and swabs, as described below. Both are available from a few distributors, but are listed here for purchasing convenience.

A700A, Fiber Optic "Wipe" Box

A701A, Fiber Optic "Wipe" Box Refill Cartridge

This fiber optic "wipe" box is used to clean the tips of fiber optic cable assemblies, prior to mating to a fiber optic panel connector or fiber optic adapter.

A702A, Fiber Optic Swabs

These fiber optic swabs are used to clean the tips of fiber optic cable assemblies that are within the hole in a fiber optic panel connector or fiber optic adapter. They are packaged 5 swabs per plastic bag and 200 swabs per box (40 bags).

Tools

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

A720A, Torque Wrench, 5/16" Jaw, 8 in-oz

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

Graphical User Interface (GUI) Software

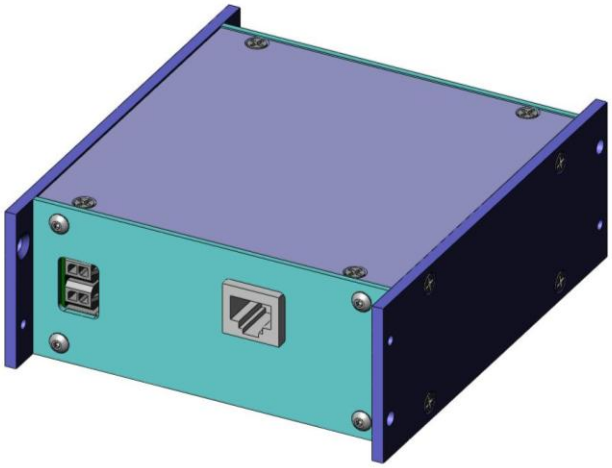
Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

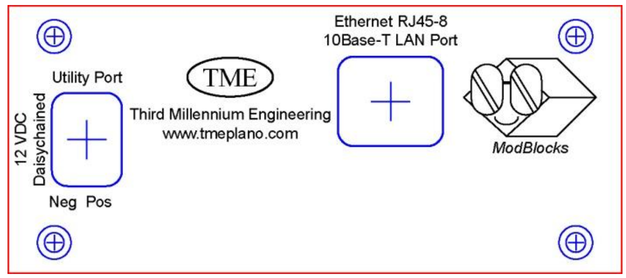
A800A-*, LAN to ModBlock GUI

Coming soon! Send an email request to ModBlocks@tmeplano.com to make it sooner!

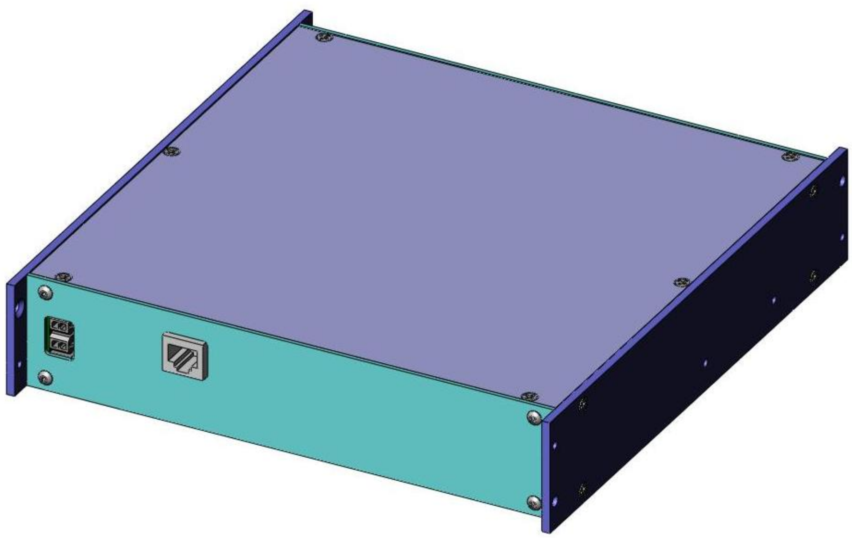
Common Packaging Data

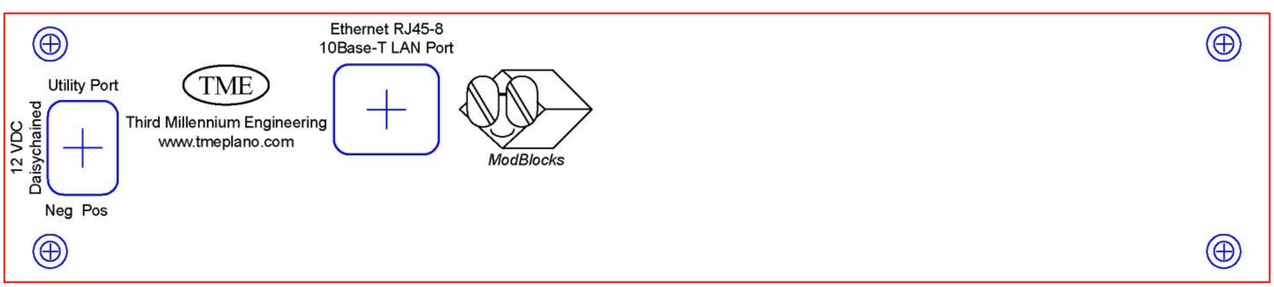
Many of the ModBlocks have identical rear panels and graphics. To reduce redundancy in the catalog information, repeated rear panels and graphics are shown in this section.



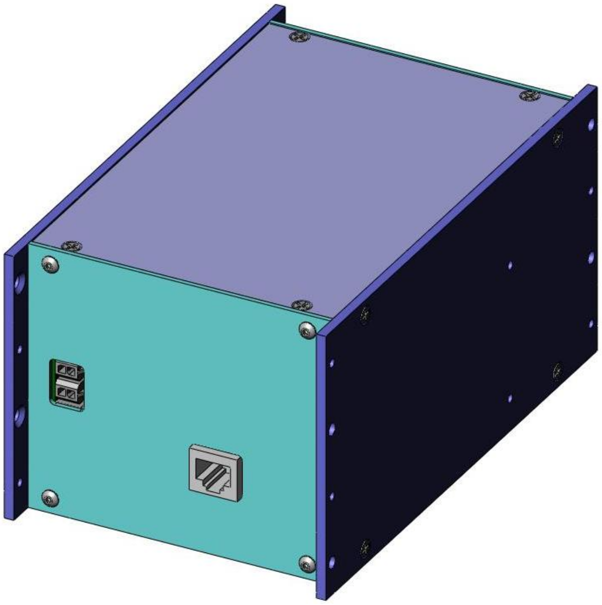


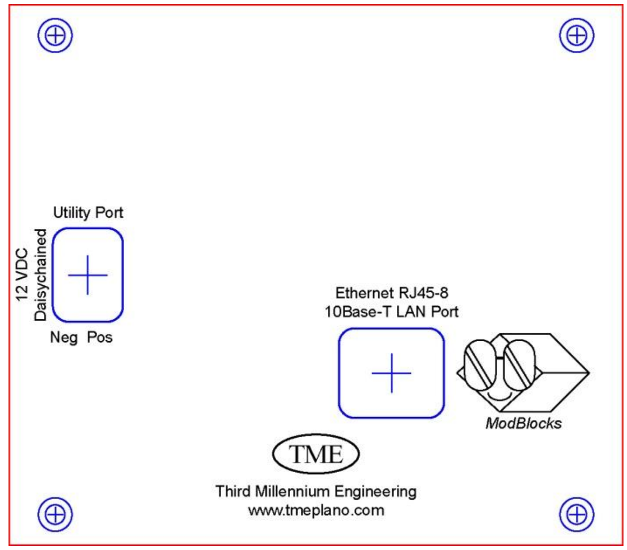
Rear chassis layout and graphics for ModBlocks (1U 1/4 rack 4" size shown)



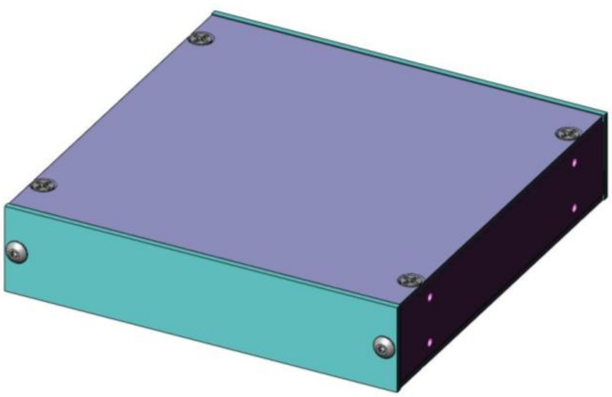


Rear chassis layout and graphics for ModBlocks (1U 1/2 rack 8" size shown)





Rear chassis layout and graphics for ModBlocks (2U 1/4 rack 6" size shown)



Rear chassis layout and graphics for ModBlocks (1/2U 1/4 rack 4" size shown)

Reference Data

Readers are encouraged to notify TME of any errors in the reference data shown in this section or make suggestions of reference data to add. Send an email to ModBlocks@tmeplano.com.

Abbreviations

Term	Meaning	Term	Meaning
AGC	automatic gain control	nm	nanometer
APD	avalanche photodiode	NRZ	digital non-return to zero
BER	bit error rate or bit error ratio	O-E	optical to electrical
BERT	bit error rate tester	O-E-O	optical to electrical to optical
CAD	computer aided design	OMA	optical modulation amplitude
CDR	clock-data recovery	OPM	optical power monitor
CR	clock recovery	ORX	optical receiver
CRZ	chirped return to zero	OTX	optical transmitter
CW	continuous wave	OTR	optical transceiver
CWDM	coarse WDM	PDV	photonic Doppler velocimeter
dB	decibel of power ratio	PIN	PIN photodiode
dBm	decibel of power relative to 1 milliwatt	PLL	phase-locked loop
Diff.	differential electrical signal	RF	radio frequency
DPSK	differential phase shift keying	RMS	root mean square
DWDM	dense WDM	RX	receiver
E-O	electrical to optical	RZ	digital return to zero
EA	electro-absorptive (external modulator)	SBS	stimulated Brillouin scattering
EDFA	erbium doped fiber amplifier	SDH	synchronous digital hierarchy
ESD	electro-static discharge	SE	single ended electrical signal
FEC	forward error correction	SFP	small form pluggable
Gb/s	giga (billion) bits per second	SM	single mode fiber (~7-9 micron core)
GHz	gigahertz (billion cycles per second)	SOA	semiconductor optical amplifier
IL	insertion loss	SONET	synchronous optical network
ITU	International Telecommunication Union	TIA	transimpedance amplifier
KHz	kilohertz (thousand cycles per second)	TME	Third Millennium Engineering
$LiNbO_3$	lithium niobate (external modulator)	TR	transceiver
LN	lithium niobate (external modulator)	TX	transmitter
max.	maximum	typ.	typical
Mb/s	mega (million) bits per second	UI	unit interval (one bit period)
MHz	megahertz (million cycles per second)	USD	United States dollars

Term	Meaning	Term	Meaning
min.	minimum	VOA	variable optical attenuator
MM50	multi-mode 50 micron core fiber	WDM	wavelength division multiplexing
MM62	multi-mode 62.5 micron core fiber	WWDM	wide WDM
mod.	Modulation	~	approximately

ITU Fiber Optic Frequencies, Wavelengths, and Channels for C and L bands

Notes:

Channels with a "C" or "L" prefix are on an ITU 100 GHz grid
Channels with an "H" or "Q" prefix are on an ITU 50 GHz grid
Channels with a "C" or "H" prefix are in the ITU "C-band"
Channels with an "L" or "Q" prefix are in the ITU "L-band"
Lambda means wavelength

Frequency (THz)	Lambda in nm	Channel	Frequency (THz)	Lambda in nm	Channel	Frequency (THz)	Lambda (nm)	Channel
196.15	1528.38	H61	192.35	1558.58	H23	188.55	1589.99	Q85
196.10	1528.77	C61	192.30	1558.98	C23	188.50	1590.41	L85
196.05	1529.16	H60	192.25	1559.39	H22	188.45	1590.83	Q84
196.00	1529.55	C60	192.20	1559.79	C22	188.40	1591.26	L84
195.95	1529.94	H59	192.15	1560.20	H21	188.35	1591.68	Q83
195.90	1530.33	C59	192.10	1560.61	C21	188.30	1592.10	L83
195.85	1530.72	H58	192.05	1561.01	H20	188.25	1592.52	Q82
195.80	1531.12	C58	192.00	1561.42	C20	188.20	1592.95	L82
195.75	1531.51	H57	191.95	1561.83	H19	188.15	1593.37	Q81
195.70	1531.90	C57	191.90	1562.23	C19	188.10	1593.79	L81
195.65	1532.29	H56	191.85	1562.64	H18	188.05	1594.22	Q80
195.60	1532.68	C56	191.80	1563.05	C18	188.00	1594.64	L80
195.55	1533.07	H55	191.75	1563.45	H17	187.95	1595.06	Q79
195.50	1533.47	C55	191.70	1563.86	C17	187.90	1595.49	L79
195.45	1533.86	H54	191.65	1564.27	H16	187.85	1595.91	Q78
195.40	1534.25	C54	191.60	1564.68	C16	187.80	1596.34	L78
195.35	1534.64	H53	191.55	1565.09	H15	187.75	1596.76	Q77
195.30	1535.04	C53	191.50	1565.50	C15	187.70	1597.19	L77
195.25	1535.43	H52	191.45	1565.90	H14	187.65	1597.62	Q76
195.20	1535.82	C52	191.40	1566.31	C14	187.60	1598.04	L76
195.15	1536.22	H51	191.35	1566.72	H13	187.55	1598.47	Q75
195.10	1536.61	C51	191.30	1567.13	C13	187.50	1598.89	L75
195.05	1537.00	H50	191.25	1567.54	H12	187.45	1599.32	Q74
195.00	1537.40	C50	191.20	1567.95	C12	187.40	1599.75	L74
194.95	1537.79	H49	191.15	1568.36	H11	187.35	1600.17	Q73
194.90	1538.19	C49	191.10	1568.77	C11	187.30	1600.60	L73
194.85	1538.58	H48	191.05	1569.18	H10	187.25	1601.03	Q72
194.80	1538.98	C48	191.00	1569.59	C10	187.20	1601.46	L72
194.75	1539.37	H47	190.95	1570.01	H09	187.15	1601.88	Q71
194.70	1539.77	C47	190.90	1570.42	C09	187.10	1602.31	L71

Frequency (THz)	Lambda in nm	Channel
194.65	1540.16	H46
194.60	1540.56	C46
194.55	1540.95	H45
194.50	1541.35	C45
194.45	1541.75	H44
194.40	1542.14	C44
194.35	1542.54	H43
194.30	1542.94	C43
194.25	1543.33	H42
194.20	1543.73	C42
194.15	1544.13	H41
194.10	1544.53	C41
194.05	1544.92	H40
194.00	1545.32	C40
193.95	1545.72	H39
193.90	1546.12	C39
193.85	1546.52	H38
193.80	1546.92	C38
193.75	1547.32	H37
193.70	1547.72	C37
193.65	1548.11	H36
193.60	1548.51	C36
193.55	1548.91	H35
193.50	1549.32	C35
193.45	1549.72	H34
193.40	1550.12	C34
193.35	1550.52	H33
193.30	1550.92	C33
193.25	1551.32	H32
193.20	1551.72	C32
193.15	1552.12	H31
193.10	1552.52	C31
193.05	1552.93	H30
193.00	1553.33	C30
192.95	1553.73	H29
192.90	1554.13	C29
192.85	1554.54	H28
192.80	1554.94	C28
192.75	1555.34	H27
192.70	1555.75	C27
192.65	1556.15	H26
192.60	1556.55	C26
192.55	1556.96	H25
192.50	1557.36	C25
192.45	1557.77	H24

Frequency (THz)	Lambda in nm	Channel
190.85	1570.83	H08
190.80	1571.24	C08
190.75	1571.65	H07
190.70	1572.06	C07
190.65	1572.48	H06
190.60	1572.89	C06
190.55	1573.30	H05
190.50	1573.71	C05
190.45	1574.13	H04
190.40	1574.54	C04
190.35	1574.95	H03
190.30	1575.37	C03
190.25	1575.78	H02
190.20	1576.20	C02
190.15	1576.61	H01
190.10	1577.03	C01
190.05	1577.44	Q00
190.00	1577.86	L00
189.95	1578.27	Q99
189.90	1578.69	L99
189.85	1579.10	Q98
189.80	1579.52	L98
189.75	1579.93	Q97
189.70	1580.35	L97
189.65	1580.77	Q96
189.60	1581.18	L96
189.55	1581.60	Q95
189.50	1582.02	L95
189.45	1582.44	Q94
189.40	1582.85	L94
189.35	1583.27	Q93
189.30	1583.69	L93
189.25	1584.11	Q92
189.20	1584.53	L92
189.15	1584.95	Q91
189.10	1585.36	L91
189.05	1585.78	Q90
189.00	1586.20	L90
188.95	1586.62	Q89
188.90	1587.04	L89
188.85	1587.46	Q88
188.80	1587.88	L88
188.75	1588.30	Q87
188.70	1588.73	L87
188.65	1589.15	Q86

Frequency (THz)	Lambda (nm)	Channel
187.05	1602.74	Q70
187.00	1603.17	L70
186.95	1603.60	Q69
186.90	1604.03	L69
186.85	1604.46	Q68
186.80	1604.88	L68
186.75	1605.31	Q67
186.70	1605.74	L67
186.65	1606.17	Q66
186.60	1606.60	L66
186.55	1607.04	Q65
186.50	1607.47	L65
186.45	1607.90	Q64
186.40	1608.33	L64
186.35	1608.76	Q63
186.30	1609.19	L63
186.25	1609.62	Q62
186.20	1610.06	L62
186.15	1610.49	Q61
186.10	1610.92	L61
186.05	1611.35	Q60
186.00	1611.79	L60
185.95	1612.22	Q59
185.90	1612.65	L59
185.85	1613.09	Q58
185.80	1613.52	L58
185.75	1613.98	Q57
185.70	1614.39	L57
185.65	1614.83	Q56
185.60	1615.26	L56
185.55	1615.70	Q55
185.50	1616.13	L55
185.45	1616.57	Q54
185.40	1617.00	L54
185.35	1617.44	Q53
185.30	1617.88	L53
185.25	1618.31	Q52
185.20	1618.75	L52
185.15	1619.19	Q51
185.10	1619.62	L51
185.05	1620.06	Q50
185.00	1620.50	L50
184.95	1620.94	Q49
184.90	1621.38	L49
184.85	1621.81	Q48

Frequency (THz)	Lambda in nm	Channel
192.40	1558.17	C24

Frequency (THz)	Lambda in nm	Channel
188.60	1589.57	L86

Frequency (THz)	Lambda (nm)	Channel
184.80	1622.25	L48

Various Communication Data Rates and Protocols

Data Rate in Mb/s	Data Format
1.544	DS1, T1, J1
2.048	E1
3.152	DS1C, T1C, J1C
6.312	DS2, T2, J2
8.448	E2
10	10BaseT Ethernet
32.064	J3
34.368	E3
44.736	DS3, T3
51.840	OC1, STS1
89.472	DS3C, T3C
97.728	J4
100	100BaseT Ethernet (Fast Ethernet, FE)
100	FDDI
100	P1394 (FireWire)
124.416	DVD
125	FDDI
132.8	Fibre Channel
134.208	DS3X, T3X
139.264	E4
140	DS4C
143	DTV
143.18	SMPTE 259M Level “A” (NTSC)
150	DS4C
155.52	OC3, STS3
155.52	SDH1, STM1
166.63	OC3FEC-G.975
177	SMPTE 259M Level “B” (PAL, 4 fsc)
200	ESCON
200	P1394 (FireWire)
265.6	Fibre Channel
270	DTV, HDTV
270	SMPTE 259M Level “C”, 4:2:2
270	CCIR656
270	ITU-R601
274.176	DS4, T4
278.528	CMI (Coded Mark Inversion of E4)
311.04	CMI (Coded Mark Inversion of OC-3)
360	SMPTE 259M Level “D”, 4:2:2 (HDTV)
400	P1394 (FireWire)
400.352	J5
411.264	DS4E, T4E
450	DTV
466.56	OC9, STS9
466.56	SDH3, STM3

Data Rate in Gb/s	Data Format
560.160	DS4C, T4C
565.148	E5
622.080	OC12, STS12
622.08	SDH4, STM4
644.5	10GE / 16
666.51	OC192FEC-G.975 / 16
669.31	OC192FEC-G.709 / 16
765.56	OC192FEC-Enhanced / 16
781.25	OC192SuperFEC / 16
800	Fibre Channel
822.528	DS4X, T4X
933.12	OC18, STS18
933.12	SDH6, STM6
1000	1000BaseT Ethernet
1.062	FC, Fibre Channel (100 Mb/s)
1.120	DS5, T5
1.130	DSC4
1.244	OC24, STS24
1.244	SDH8, STM8
1.250	1GE, Gigabit Ethernet (1000 Mb/s)
1.339	GbE + FEC
1.400	DS5X, T5X
1.440	EU95 (HDTV)
1.485	SMPTE 292M (HDTV)
1.680	DS5E, T5E
1.866	OC36, STS36
1.866	SDH12, STM12
2.125	2FC, 2xFibre Channel (200 Mb/s)
2.488	OC48, STS48
2.488	SDH16, STM16
2.500	2GbE
2.667	OC48FEC-G.709
3.125	XAUI-PMD (for 10GE)
4.250	4FC, 4xFibre Channel (400 Mb/s)
9.953	OC192
10.3125	10GE
10.625	10GFC, Fibre Channel FC-10
10.664	OC192FEC-G.975
10.709	OC192FEC-G.709
12.249	OC192FEC-Enhanced
12.276	?
12.400	?
12.500	OC192SuperFEC
12.750	10GFC, Fibre Channel FC-12
39.813	OC768, STM256, OTN OTU-3

Data Rate in Mb/s	Data Format
531.3	Fibre Channel
540	Fibre Channel

Data Rate in Gb/s	Data Format
42.836	OC768FEC-G.709

Various Communication Data Rates and Jitter Bandwidths

Standard Data Rates	Technology	Standard Jitter Bandwidth	Max. Jitter Generation	Other Jitter Bandwidths
44.736 Mb/s	PLL	45 KHz typ.	13 mUI RMS	
51.840 Mb/s	PLL	52 KHz typ.	13 mUI RMS	
139.264 Mb/s	PLL	E4 standard	E4 standard	
155.52 Mb/s	PLL	130 KHz max.	10 mUI RMS	60 KHz max. 10 KHz max.
166.63 Mb/s	PLL	250 KHz max.	10 mUI RMS	
622.08 Mb/s	PLL	500 KHz max.	10 mUI RMS	350 KHz to 3.5 MHz
666.51 Mb/s	PLL	1 MHz max.	10 mUI RMS	
1.0625 Gb/s	PLL	FC standard	FC standard	
1.244 Gb/s	PLL	SONET standard	SONET standard	
1.250 Gb/s	PLL	1 MHz max.	10 mUI RMS	
1.339 Gb/s	PLL	GbE+FEC std.	10 mUI RMS	
2.488 Gb/s	PLL	2 MHz max.	10 mUI RMS	
2.500 Gb/s	PLL	2FC standard	2FC standard	
2.666 Gb/s	PLL	2 MHz max.	10 mUI RMS	
9.953 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
9.953 Gb/s	Resonator	3 MHz	13 mUI RMS	20 or 80 MHz
10.312 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
10.312 Gb/s	Resonator	3 MHz	13 mUI RMS	20 or 80 MHz
10.512 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
10.512 Gb/s	Resonator	3 MHz	13 mUI RMS	20 or 80 MHz
10.664 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
10.664 Gb/s	Resonator	3 MHz	13 mUI RMS	20 or 80 MHz
10.709 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
10.709 Gb/s	Resonator	3 MHz	13 mUI RMS	20 or 80 MHz
11.095 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
11.095 Gb/s	Resonator	3 MHz	13 mUI RMS	20 or 80 MHz
12.249 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
12.249 Gb/s	Resonator	3 MHz	13 mUI RMS	20 or 80 MHz
12.4 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
12.4 Gb/s	Resonator	3 MHz	13 mUI RMS	20 or 80 MHz
12.5 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
12.5 Gb/s	Resonator	3 MHz	13 mUI RMS	20 or 80 MHz
9.95 to 10.75 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
9.95 to 11.1 Gb/s	PLL	Selectable	10 mUI RMS	-
12 to 12.6 Gb/s	PLL	5 MHz	7 mUI RMS	20 or 80 MHz
1.0 to 1.5 Gb/s	PLL	Selectable	10 mUI RMS	-
1.5 to 2.5 Gb/s	PLL	Selectable	10 mUI RMS	-
2.5 to 4.0 Gb/s	PLL	Selectable	10 mUI RMS	-
3.0 to 5.0 Gb/s	PLL	Selectable	10 mUI RMS	-
4.0 to 6.0 Gb/s	PLL	Selectable	10 mUI RMS	-
5.0 to 8.0 Gb/s	PLL	Selectable	10 mUI RMS	-

Standard Data Rates	Technology	Standard Jitter Bandwidth	Max. Jitter Generation	Other Jitter Bandwidths
8.0 to 12.0 Gb/s	PLL	Selectable	10 mUI RMS	-
9.0 to 14.0 Gb/s	PLL	Selectable	10 mUI RMS	-
8.0 to 16.0 Gb/s	PLL	Selectable	10 mUI RMS	-

Units Conversions

dBm to Power and Voltage Conversion (50 ohm system)

dBm	Power in milliwatts	Volts pk-pk	Volts peak	Volts RMS
+30	1000	19.997	9.998	7.071
+27	501.2	14.157	7.078	5.006
+25	316.2	11.245	5.623	3.976
+23	199.5	8.932	4.466	3.159
+20	100.0	6.324	3.162	2.236
+17	50.12	4.477	2.238	1.583
+15	31.62	3.556	1.778	1.257
+13	19.95	2.825	1.412	0.999
+10	10.00	2.000	1.000	0.707
+9	7.943	1.783	0.891	0.630
+8	6.310	1.589	0.794	0.562
+7	5.012	1.416	0.708	0.501
+6	3.981	1.262	0.631	0.446
+5	3.162	1.125	0.562	0.398
+4	2.512	1.002	0.501	0.354
+3	1.995	0.893	0.447	0.316
+2	1.585	0.796	0.398	0.282
+1	1.259	0.710	0.355	0.251
0	1.000	0.632	0.316	0.224

dBm	Power in microwatts	Millivolts pk-pk	Millivolts peak	Millivolts RMS
0	1000	632	316	224
-1	794.3	564	282	199
-2	631.0	502	251	178
-3	501.2	448	224	158
-4	398.1	399	200	141
-5	316.2	356	178	126
-6	251.2	317	159	112
-7	199.5	283	141	99.9
-8	158.5	252	126	89.0
-9	125.9	224	112	79.3
-10	100.0	200	100	70.7
-13	50.12	142	70.8	50.1
-15	31.62	113	56.2	39.8
-17	19.95	89.3	44.7	31.6
-20	10.00	63.3	31.6	22.4
-23	5.012	44.8	22.4	15.8
-25	3.162	35.6	17.8	12.6
-27	1.995	28.3	14.1	9.99
-30	1.000	20.0	10.0	7.07

dBm to Power and Voltage Conversion (75 ohm system)

dBm	Power in milliwatts	Volts pk-pk	Volts peak	Volts RMS
+30	1000	24.495	12.247	8.660
+27	501.2	17.341	8.671	6.131
+25	316.2	13.774	6.887	4.870
+23	199.5	10.941	5.471	3.868
+20	100.0	7.746	3.873	2.739
+17	50.12	5.484	2.742	1.939
+15	31.62	4.356	2.178	1.540
+13	19.95	3.460	1.730	1.223
+10	10.00	2.449	1.225	0.866
+9	7.943	2.183	1.092	0.772
+8	6.310	1.946	0.973	0.688
+7	5.012	1.734	0.867	0.613

dBm	Power in microwatts	Millivolts pk-pk	Millivolts peak	Millivolts RMS
0	1000	775	387	274
-1	794.3	690	345	244
-2	631.0	615	308	218
-3	501.2	548	274	194
-4	398.1	489	244	173
-5	316.2	436	218	154
-6	251.2	388	194	137
-7	199.5	346	173	122
-8	158.5	308	154	109
-9	125.9	275	137	97.2
-10	100.0	245	122	86.6
-13	50.12	173	86.7	61.3

dBm	Power in milliwatts	Volts pk-pk	Volts peak	Volts RMS
+6	3.981	1.546	0.773	0.546
+5	3.162	1.377	0.689	0.487
+4	2.512	1.228	0.614	0.434
+3	1.995	1.094	0.547	0.387
+2	1.585	0.975	0.488	0.348
+1	1.259	0.869	0.435	0.307
0	1.000	0.775	0.387	0.274

dBm	Power in microwatts	Millivolts pk-pk	Millivolts peak	Millivolts RMS
-15	31.62	138	68.9	48.7
-17	19.95	109	54.7	38.7
-20	10.00	77.5	38.7	27.4
-23	5.012	54.8	27.4	19.4
-25	3.162	43.6	21.8	15.4
-27	1.995	34.6	17.3	12.2
-30	1.000	24.5	12.2	8.66

VSWR to Return Loss and Reflected Power Conversion (50 ohm system)

VSWR	Return Loss (dB)	Reflected Power (%)
1.00	Infinity	0.000
1.01	46.06	0.005
1.02	40.09	0.010
1.03	36.61	0.022
1.04	34.15	0.040
1.05	32.26	0.060
1.06	30.71	0.082
1.07	29.42	0.116
1.08	28.30	0.144
1.09	27.32	0.184
1.10	26.44	0.228
1.11	25.66	0.276
1.12	24.94	0.324
1.13	24.29	0.375
1.14	23.69	0.426
1.15	23.13	0.488
1.16	22.61	0.550
1.17	22.12	0.615
1.18	21.66	0.682
1.19	21.23	0.750
1.20	20.83	0.816
1.21	20.44	0.90
1.22	20.08	0.98
1.23	19.73	1.08
1.24	19.40	1.15
1.25	19.08	1.23

VSWR	Return Loss (dB)	Reflected Power (%)
1.26	18.78	1.34
1.27	18.49	1.43
1.28	18.22	1.52
1.29	17.95	1.62
1.30	17.69	1.71
1.31	17.45	1.81
1.32	17.21	1.91
1.33	16.98	2.02
1.34	16.75	2.13
1.35	16.54	2.23
1.36	16.33	2.33
1.37	16.13	2.44
1.38	15.94	2.55
1.39	15.75	2.67
1.40	15.56	2.78
1.41	15.38	2.90
1.42	15.21	3.03
1.43	15.04	3.14
1.44	14.88	3.28
1.45	14.72	3.38
1.46	14.56	3.50
1.47	14.41	3.62
1.48	14.26	3.74
1.49	14.12	3.87
1.50	13.98	4.0

VSWR	Return Loss (dB)	Reflected Power (%)
1.55	13.32	4.8
1.60	12.74	5.5
1.65	12.21	6.2
1.70	11.73	6.8
1.75	11.29	7.4
1.80	10.88	8.2
1.85	10.51	8.9
1.90	10.16	9.6
1.95	9.84	10.2
2.0	9.54	11.0
2.1	9.00	12.4
2.2	8.52	13.8
2.3	8.09	15.3
2.4	7.71	16.6
2.5	7.36	18.0
2.6	7.04	19.5
2.7	6.76	20.8
2.8	6.49	22.3
2.9	6.25	23.7
3.0	6.02	24.9
3.5	5.11	31.0
4.0	4.44	36.0
4.5	3.93	40.6
5	3.52	44.4
6	2.92	50.8

English to Metric Dimension Conversion

1 inch = 2.54 cm = 25.4 mm. 1 inch = 1000 mils.

English (in)	Metric (mm)
10	254.0

English (in)	Metric (mm)
1.0	25.40

English (in)	Metric (mm)
0.1	2.540

English (in)	Metric (mm)
9	228.6
8	203.2
7	177.8
6	152.4
5	127.0
4	101.6
3	76.2
2	50.8
1	25.4

English (in)	Metric (mm)
0.9	22.86
0.8	20.32
0.7	17.78
0.6	15.24
0.5	12.70
0.4	10.16
0.3	7.62
0.2	5.08
0.1	2.54

English (in)	Metric (mm)
0.09	2.286
0.08	2.032
0.07	1.778
0.06	1.524
0.05	1.270
0.04	1.016
0.03	0.762
0.02	0.508
0.01	0.254

Metric to English Dimension Conversion

1 mm = 0.03937 inches = 39.4 mils. 1 cm = 0.3937 inches = 393.7 mils. 1 inch = 1000 mils.

Metric (mm)	English (in)
100	3.937
90	3.543
80	3.150
70	2.756
60	2.362
50	1.969
40	1.575
30	1.181
20	0.787
10	0.394

Metric (mm)	English (in)
10	0.394
9	0.354
8	0.315
7	0.276
6	0.236
5	0.197
4	0.158
3	0.118
2	0.079
1	0.039

Metric (mm)	English (mils)
1.0	39.4
0.9	35.4
0.8	31.5
0.7	27.6
0.6	23.6
0.5	19.7
0.4	15.8
0.3	11.8
0.2	7.9
0.1	3.9

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Third Millennium Engineering (TME) warrants that the Products it manufactures are free from defective material and workmanship for a period of one (1) year.

TME will remedy any such warranted defect subject to the following terms and conditions:

1. An RMA number must be obtained from TME before returning a Product to TME
2. Returned Products to be delivered for TME examination:
    a. With the RMA number on paperwork
    b. With transportation charges to TME paid by sender
    c. Within one (1) year from the date of sale to the original customer
    d. With the product returned intact
3. TME will determine in its sole discretion
    a. Whether an alleged defect actually exists
    b. Whether to repair or replace a defective Product
4. TME will return the Product to sender
    a. With transportation charges to sender paid by TME for the domestic USA
    b. Using 3-5 day “ground” common carrier services
    c. At sender’s cost if faster shipment or international shipment required

This warranty does not extend to any TME Product which has been:

1. Subjected to misuse, neglect, accident, improper installation, static discharge, fiber optic connector damage, excessive optical or electrical input power levels, or used in violation of operating instructions or operating environment
2. Repaired, calibrated, or altered in any way by a facility that is not approved, in writing, by TME to perform such work
3. Subjected to removal, defacing, or changing Product seals or serial numbers
4. Manufactured by another company and resold intact by TME

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Third Millennium Engineering

Third Millennium Engineering (TME) is a multi-disciplinary Texas-based professional engineering company with one location in Plano, Texas USA. It is classified as a small business and sole proprietorship, owned and operated by Dr. Steve Morra since 1996. Dr. Morra is a Doctor of Engineering (multi-disciplinary), Professional Engineer (Texas), and highly experienced in many technical fields. TME's mission is "to help customers create and manufacture advanced technology products for our future". TME is registered with the Federal Central Contractor (CCR), Dunn & Bradstreet, and SBA Pro-NET programs. TME is a "Star Supplier" for Lockheed-Martin, being rated in the top 100 of ~2500 suppliers. See www.tmeplano.com for more details or contact Dr. Morra by email at steve@tmeplano.com or by telephone at 972-491-1132.

TME has historically designed and manufactured various custom engineered, complex, multi-functional, high-speed fiber optic test equipment and products for the commercial-industrial and defense industries. TME still provides custom equipment, low volume high technology product manufacturing, and engineering and consulting services involving fiber optic, microwave, electronic, packaging, and many other technologies. You can buy exactly what you need with as little as verbal specifications from an email or phone call.

Recently TME has ventured into designing and producing its first standard product line of Modular Fiber Optic, Microwave, and Utility Functional Blocks, as shown in this catalog. These modular blocks are a spinoff of the technologies successfully used in past custom designs. TME encourages prospective and current customers to request adding new standard products to this line.

Why risk making it or doing without it, when you can buy exactly what you need?

Domestic USA Pricing and Delivery

Prices and deliveries shown below are expected to remain constant through 2009. However, TME reserves the right to change price and/or delivery without notice, primarily due to changes in supplier prices and market conditions. All prices are in United States dollars.

Depending on the function, ModBlock prices range from ~$1.5K to ~$60K (typically $8K-15K) each. Some ModBlocks are stocked or have a 2-4 week delivery time. Otherwise, delivery time is the longest lead-time major component ("pacing item" in price lists) plus 1 week, typically 6 weeks. Quantity discounts are listed for each price list in this section.

Unless otherwise specified, all ModBlocks are warranted for one year. Warranty excludes excessive electrical or optical input power as applicable, electrostatic discharge (ESD) damage, optical connector damage (dirt, wrong connector type), and general abuse. See warranty details in the "Standard Warranty" section on page 196.

Placing an Order

Prices and delivery times listed in this section are firm and valid. A formal request for quote (RFQ) will be sent if required before purchase. Place purchase orders directly with Third Millennium Engineering. To place an order, send an email purchase order to sales@tmeplano.com or mail purchase order to Third Millennium Engineering, 3308 Omar Lane, Plano Texas, 75023-3949. Order acceptance may be contingent upon satisfactory credit review or approval of credit terms by TME. TME identifiers are EIN = 72-1535334, D&B = 11-568-9809, and TME Cage Code = 3CPK6. See the following sections for details on taxes, shipping, insurance, returns, cancellations, and payment.

Taxes

Prices do not include any applicable taxes, such as state and local taxes. Any required taxes will be added to the total order. Sales tax is applicable to sales made to locations in Texas.

Sales tax will not be added to an order if TME receives a valid and signed sales tax exemption form prior to shipment.

Shipping and Insurance

Prices do not include shipping or shipment insurance. Shipping and insurance will be added to the total order unless other arrangements have been made. Shipping will be by FedEx 3 day delivery in the domestic USA, unless otherwise specified by the customer. Insurance for "FOB Destination" is typically about 0.5% of the shipment's declared value up to a $50,000 limit per carton. The declared value will be the total price of the items shipped within each carton.

Alternatively, the customer may elect to provide TME with a common carrier shipping account number and shipping charges will not be added to the order. Alternatively, the customer may elect that shipment be made "FOB Origin" for insurance purposes. "FOB Origin" means the customer is insuring the shipment and neither TME nor the carrier is liable for loss or damage during shipment.

Returns and Cancellations

All sales are final and are "Non-Returnable" and "Non-Cancelable" (NRNC), except as provided by the Warranty.

Payment

An invoice will be sent out when an order is shipped. Payment is due "net 30 days". Make payment by electronic funds transfer (preferred), by company check, or credit card check. Credit cards are not accepted for payment at this time.

Fiber Optic ModBlock Price and Delivery

Domestic USA Pricing and Delivery for Fiber Optic ModBlocks (last update on June 14, 2009)

Quantity Discount: 1-4 = 0%, 5-9 = 5%, 10+ = 10%

Part Number	Brief Description	Price Each	Delivery (weeks)	Pacing Item
F100A-*	CW Laser, fixed DWDM, SM	$9,800	6	Laser
F101A-*	Analog Transmitter, DWDM, SM	$10,000	6	Laser
F102A-*	Analog Transmitter, CWDM, SM	$5,250	6	Laser
F103A-*	Analog Transmitter, WDM, MM50	$4,525	6	Laser
F104A-*	Analog Transmitter, WDM, MM62	$4,525	6	Laser
F110A	CW Laser, tunable, C-band 50 GHz DWDM	$9,750	6	Laser
F111A	CW Laser, tunable, L-band 50 GHz DWDM	$9,750	6	Laser
F120A	LN Modulator, 13G	$13,700	8	Modulator
F121A	LN Modulator, with driver, 13G	$20,200	8	Modulator
F140A-*	Digital Transmitter, fixed DWDM, 13G	$26,225	8	Laser, modulator
F141A	Digital Transmitter, tunable, C-band DWDM, 13G	$26,250	8	Laser, modulator
F142A	Digital Transmitter, tunable, L-band DWDM, 13G	$26,250	8	Laser, modulator
F145A-*	Digital Transmitter, CWDM, 2.7G, SM	$5,550	6	Laser
F146A-*	Digital Transmitter, WDM, 2.7G, MM50	$4,825	6	Laser
F147A-*	Digital Transmitter, WDM, 2.7G, MM62	$4,825	6	Laser
F160A	Analog Receiver, PIN, 10G, SM	$9,875	6	Receiver
F161A	Analog Receiver, APD, 10G, SM	$11,325	6	Receiver
F162A	Analog Receiver, PIN, 10G, MM50	$16,175	6	Receiver
F163A	Analog Receiver, APD, 10G, MM50	$18,300	6	Receiver
F164A	Analog Receiver, PIN, 10G, MM62	$16,175	6	Receiver

Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

Part Number	Brief Description	Price Each	Delivery (weeks)	Pacing Item
F165A	Analog Receiver, APD, 10G, MM62	$18,300	6	Receiver
F166A	Analog Receiver, AGC-PIN, 2.5G, SM	$4,700	5	Receiver
F167A	Analog Receiver, AGC-PIN, 2.5G, MM50	$4,700	5	Receiver
F168A	Analog Receiver, AGC-PIN, 2.5G, MM62	$4,700	5	Receiver
F170A-AC	Analog Receiver, PDV-PIN, 10G, BR probe	$12,225	6	Receiver
F170A-DC	Analog Receiver, PDV-PIN, 10G, BR probe	$13,100	6	Receiver
F171A-AC	Analog Receiver, PDV-APD, 10G, BR probe	$13,675	6	Receiver
F171A-DC	Analog Receiver, PDV-APD, 10G, BR probe	$21,950	6	Receiver
F172A-AC	Analog Receiver, PDV-PIN, 10G, NBR probe	$12,675	6	Receiver
F172A-DC	Analog Receiver, PDV-PIN, 10G, NBR probe	$13,550	6	Receiver
F173A-AC	Analog Receiver, PDV-APD, 10G, NBR probe	$14,100	6	Receiver
F173A-DC	Analog Receiver, PDV-APD, 10G, NBR probe	$22,400	6	Receiver
F175A-AC	Analog Receiver, PDV-PIN, 10G, BR, red-spot	$13,875	6	Receiver
F175A-DC	Analog Receiver, PDV-PIN, 10G, BR, red-spot	$14,750	6	Receiver
F176A-AC	Analog Receiver, PDV-APD, 10G, BR, red-spot	$15,325	6	Receiver
F176A-DC	Analog Receiver, PDV-APD, 10G, BR, red-spot	$23,625	6	Receiver
F177A-AC	Analog Receiver, PDV-PIN, 10G, NBR, red-spot	$14,325	6	Receiver
F177A-DC	Analog Receiver, PDV-PIN, 10G, NBR, red-spot	$15,200	6	Receiver
F178A-AC	Analog Receiver, PDV-APD, 10G, NBR, red-spot	$15,750	6	Receiver
F178A-DC	Analog Receiver, PDV-APD, 10G, NBR, red-spot	$24,050	6	Receiver
F180A	Limiting Receiver, PIN, 10G, SM	$11,500	6	Receiver
F181A	Limiting Receiver, APD, 10G, SM	$15,025	6	Receiver
F182A	Limiting Receiver, PIN, 10G, MM50	$18,450	6	Receiver
F183A	Limiting Receiver, APD, 10G, MM50	$20,600	6	Receiver
F184A	Limiting Receiver, PIN, 10G, MM62	$18,450	6	Receiver
F185A	Limiting Receiver, APD, 10G, MM62	$20,600	6	Receiver
F186A	Limiting Receiver, PIN, 2.5G, SM	$4,750	5	Receiver
F187A	Limiting Receiver, PIN, 2.5G, MM50	$4,750	5	Receiver
F188A	Limiting Receiver, PIN, 2.5G, MM62	$4,750	5	Receiver
F200A	NRZ Receiver, PIN, 9-13G, SM	$52,550	6	Receiver, ICs
F201A	NRZ Receiver, APD, 9-13G, SM	$54,000	6	Receiver, ICs
F202A	NRZ Receiver, PIN, 9-13G, MM50	$58,825	6	Receiver, ICs
F203A	NRZ Receiver, APD, 9-13G, MM50	$60,975	6	Receiver, ICs
F204A	NRZ Receiver, PIN, 9-13G, MM62	$58,825	6	Receiver, ICs
F205A	NRZ Receiver, APD, 9-13G, MM62	$60,975	6	Receiver, ICs
F206A	NRZ Receiver, PIN, 2.7-10.8G, SM	$52,550	6	Receiver, ICs
F207A	NRZ Receiver, APD, 2.7-10.8G, SM	$54,000	6	Receiver, ICs
F208A	NRZ Receiver, PIN, 2.7-10.8G, MM50	$58,825	6	Receiver, ICs
F209A	NRZ Receiver, APD, 2.7-10.8G, MM50	$60,975	6	Receiver, ICs
F210A	NRZ Receiver, PIN, 2.7-10.8G, MM62	$58,825	6	Receiver, ICs
F211A	NRZ Receiver, APD, 2.7-10.8G, MM62	$60,975	6	Receiver, ICs
F212A	NRZ Receiver, PIN, 10M-2.7G, SM	$24,725	6	ICs
F213A	NRZ Receiver, PIN, 10M-2.7G, MM50	$24,725	6	ICs
F214A	NRZ Receiver, PIN, 10M-2.7G, MM62	$24,725	6	ICs
F220A	SFP Transceiver, O-E and E-O	$4,575	3	
F221A	SFP Transceiver, O-O	$3,650	3	
F235A	Transceiver, PDV-PIN, 10G, AC, BR, red-spot	$19,475	6	Laser, Receiver
F236A	Transceiver, PDV-PIN, 10G, DC, BR, red-spot	$20,350	6	Laser, Receiver
F237A	Transceiver, PDV-PIN, 10G, AC, NBR, red-spot	$19,900	6	Laser, Receiver

Part Number	Brief Description	Price Each	Delivery (weeks)	Pacing Item
F238A	Transceiver, PDV-PIN, 10G, DC, NBR, red-spot	$20,775	6	Laser, Receiver
F240A-*	Switch, dual SPDT, SM	$5,075	5	Switch
F241A-*	Switch, single SPDT, SM	$4,250	5	Switch
F242A-*	Switch, dual SPDT, SM, polarized	$10,350	5	Switch
F243A-*	Switch, single SPDT, SM, polarized	$6,875	5	Switch
F245A-*	Switch, dual 2x2, SM	$5,725	5	Switch
F246A-*	Switch, single 2x2, SM	$4,575	5	Switch
F247A-*	Switch, dual 2x2, SM, polarized	$12,475	5	Switch
F248A-*	Switch, single 2x2, SM, polarized	$7,950	5	Switch
F250A-*	Switch, dual SPDT, MM50	$5,200	5	Switch
F251A-*	Switch, single SPDT, MM50	$4,325	5	Switch
F252A-*	Switch, dual 2x2, MM50	$5,300	5	Switch
F253A-*	Switch, single 2x2, MM50	$4,375	5	Switch
F255A-*	Switch, dual SPDT, MM62	$5,200	5	Switch
F256A-*	Switch, single SPDT, MM62	$4,325	5	Switch
F257A-*	Switch, dual 2x2, MM62	$5,300	5	Switch
F258A-*	Switch, single 2x2, MM62	$4,375	5	Switch
F260A-*	Switch, SP4T, SM	$5,525	5	Switch
F265A-*	Switch, SP8T, SM	$7,875	5	Switch
F270A	Optical Amplifier, EDFA, C-band, DWDM	$23,625	6	Amplifier
F275A-*	Optical Amplifier, SOA	$9,800	6	Amplifier
F310A-*	Coupler, 1x2, SM	$1,425	5	Coupler
F311A-*	Coupler, 1x4, SM	$1,700	5	Coupler
F315A-*	Coupler, 1x2, SM, polarized	$3,050	5	Coupler
F320A-*	Coupler, 1x2, MM50	$1,475	5	Coupler
F321A-*	Coupler, 1x4, MM50	$1,725	5	Coupler
F322A-*	Coupler, 1x2, MM62	$1,425	5	Coupler
F323A-*	Coupler, 1x4, MM62	$1,700	5	Coupler
F325A-*	Circulator, 3-port, SM	$2,350	5	Circulator
F326A-*	Circulator, 4-port, SM	$3,400	5	Circulator
F327A-*	Isolator, SM	$1,725	5	Isolator
F330A	LED, Super-Luminescent	$9,700	6	SLED
F340A-*	DWDM Splitter, 100G, 16 Ch, SM	$6,025	6	DWDM splitter

Microwave ModBlock Price and Delivery

Domestic USA Pricing and Delivery for Microwave ModBlocks
(last update on June 14, 2009)

Quantity Discount: 1-4 = 0%, 5-9 = 5%, 10+ = 10%

Part Number	Brief Description	Price Each	Delivery (weeks)	Pacing Item
M100A	Switch, dual SPDT, 18G	$4,200	2	-
M101A	Switch, single SPDT, 18G	$3,750	2	-
M102A	Switch, dual SPDT, 18G, terminated	$7,275	2	-
M103A	Switch, single SPDT, 18G, terminated	$5,275	2	-
M104A	Switch, dual SPDT, 26G	$5,075	10	Switch
M105A	Switch, single SPDT, 26G	$4,175	10	Switch
M106A	Switch, dual SPDT, 26G, terminated	$9,550	10	Switch

M107A	Switch, single SPDT, 26G, terminated	$6,425	10	Switch
M110A	Switch, transfer, 18G	$4,175	2	-
M120A	Switch, dual 2P3T, 18G	$9,075	10	Switch
M121A	Switch, single 2P3T, 18G	$6,200	10	Switch
M122A	Switch, dual 2P3T, 26G	$9,725	10	Switch
M123A	Switch, single 2P3T, 26G	$6,500	10	Switch
M130A	Switch, SP4T, 18G	$7,000	10	Switch
M131A	Switch, SP4T, 18G, terminated	$10,500	10	Switch
M132A	Switch, SP6T, 18G	$7,850	10	Switch
M133A	Switch, SP6T, 18G, terminated	$11,550	10	Switch
M135A	Switch, SP4T, 26G	$5,975	10	Switch
M136A	Switch, SP4T, 26G, terminated	$10,850	10	Switch
M137A	Switch, SP6T, 26G	$6,450	10	Switch
M138A	Switch, SP6T, 26G, terminated	$11,975	10	Switch
M201A-1	Linear Amplifier, 1x, 300K-14G, 12 dB, 11 dBm	$4,600	3	Amplifier
M201A-2	Linear Amplifier, 1x, 700M-18G, 26 dB, 24 dBm	$7,150	2	-
M201A-3	Linear Amplifier, 1x, 50K-14G, 10 dB, 12 dBm	$5,525	2	-
M201A-4	Linear Amplifier, 1x, 80K-13G, 21 dB, 12 dBm	$6,600	2	-
M201A-5	Linear Amplifier, 1x, 2G-18G, 16 dB, 17 dBm	$5,375	4	Amplifier
M201A-6	Linear Amplifier, 1x, 2G-18G, 32 dB, 20 dBm	$7,775	7	Amplifier
M202A-1	Linear Amplifier, 2x, 300K-14G, 12 dB, 11 dBm	$5,800	3	Amplifier
M202A-2	Linear Amplifier, 2x, 700M-18G, 26 dB, 24 dBm	$10,925	2	-
M202A-3	Linear Amplifier, 2x, 50K-14G, 10 dB, 12 dBm	$7,625	2	-
M202A-4	Linear Amplifier, 2x, 80K-13G, 21 dB, 12 dBm	$9,800	2	-
M202A-5	Linear Amplifier, 2x, 2G-18G, 16 dB, 17 dBm	$7,350	4	Amplifier
M202A-6	Linear Amplifier, 2x, 2G-18G, 32 dB, 20 dBm	$12,150	7	Amplifier
M204A-1	Linear Amplifier, 4x, 300K-14G, 12 dB, 11 dBm	$8,300	3	Amplifier
M204A-2	Linear Amplifier, 4x, 700M-18G, 26 dB, 24 dBm	$18,525	2	-
M204A-3	Linear Amplifier, 4x, 50K-14G, 10 dB, 12 dBm	$11,950	2	-
M204A-4	Linear Amplifier, 4x, 80K-13G, 21 dB, 12 dBm	$16,300	2	-
M204A-5	Linear Amplifier, 4x, 2G-18G, 16 dB, 17 dBm	$11,400	4	Amplifier
M204A-6	Linear Amplifier, 4x, 2G-18G, 32 dB, 20 dBm	$21,050	7	Amplifier
M206	Limiting Amp, 2.5 Gb/s	$4,925	2	-
M207	Limiting Amp, 10 Gb/s	$5,525	3	Amplifier
M211	Mod Amp	$10,700	2	-

High-Speed Logic ModBlock Price and Delivery

Domestic USA Pricing and Delivery for High-Speed Logic ModBlocks (last update on June 14, 2009)

Quantity Discount: 1-4 = 0%, 5-9 = 5%, 10+ = 10%

Part Number	Brief Description	Price Each	Delivery (weeks)	Pacing Item
L100A	Gate, AND/NAND/OR/NOR, 13G	$6,225	2	-
L101A	Gate, XOR/XNOR, 13G	$6,225	2	-
L110A	Fan-out Buffer, 1:2, 13G	$6,225	2	-
L111A	Fan-out Buffer, 1:4, 13G	$9,225	2	-
L120A	Data Selector, 2:1, 13G	$6,225	2	-
L121A	Data Selector, 4:1, 13G	$9,300	2	-
L130A	Pre-Scalar, Div2, 13G	$5,450	2	-

L131A	Pre-Scalar, Div4, 13G	$5,450	2	-
L132A	Pre-Scalar, Div8, 13G	$5,450	2	-
L133A	Pre-Scalar, Div1-2-4-8, 13G	$5,125	2	-
L140A	Flip-Flop, toggle, 13G	$5,575	2	-
L141A	Flip-Flop, D-type, 13G	$6,050	2	-
L150A	Time Delay, 0-120ps, 13G	$5,950	2	-
L160A	Encoder, differential, 13G	$6,275	2	-
L161A	Encoder, differential, 13G, 0-120ps delay	$7,550	2	-
L162A	Encoder, NRZ to RZ, 13G	$6,525	2	-
L163A	Encoder, NRZ to RZ, 13G, 0-120ps delay	$7,550	2	-
L200A	PLL, NRZ CDR, 10M-2.7G	$24,725	6	ICs
L201A	PLL, NRZ CDR, 2.7-10.8G	$47,300	6	ICs
L202A	PLL, NRZ CDR, 9-13G	$47,300	6	ICs

Utility ModBlock Price and Delivery

Domestic USA Pricing and Delivery for Utility ModBlocks (last update on June 14, 2009)

Part Number	Brief Description	Price Each	Delivery (weeks)
	Coming soon		

ModBlock Accessories Price and Delivery

Domestic USA Pricing and Delivery for Fiber Optic ModBlocks (last update on June 14, 2009)

Quantity Discount: 1-4 = 0%, 5-9 = 10%, 10+ = 15%

Part Number	Brief Description	Price Each	Delivery (weeks)
A100A-*	Cable Assy, ModBlock power jumpers	$85	1
A101A	Cable Assy, ModBlock extension cords	$85	1
A105A	Cable Assy, ModBlock Y-cord	$85	1
A120A-*	Cable Assy, Cat5E patch cord, 1-7 feet	$59	1
A120A-*	Cable Assy, Cat5E patch cord, 10-25 feet	$78	1
A121A-*	Cable Assy, Cat5E Xover patch cord, 1-7 feet	$59	1
A121A-*	Cable Assy, Cat5E Xover patch cord, 10-25 feet	$85	1
A130A-*	Cable Assy, coax, SMA-SMA male	$189	1
A140A-*	Cable Assy, fiber optic, SM, FC/UPC-FC/UPC	$85	1
A141A-*	Cable Assy, fiber optic, SM, FC/UPC-FC/APC	$98	2
A142A-*	Cable Assy, fiber optic, SM, FC/APC-FC/APC	$117	2
A143A-*	Cable Assy, fiber optic, PM, FC/UPC-FC/UPC	$364	2
A144A-*	Cable Assy, fiber optic, MM50, FC/UPC-FC/UPC	$85	1
A145A-*	Cable Assy, fiber optic, MM62, FC/UPC-FC/UPC	$85	1
A300A	Power Supply, wall mount,24 watt	$195	1
A320A	Power Supply, desktop,120 watt	$579	1
A400A	Hardware, fastener screws, box of 100	$59	1
A412A	Hardware, vertical fastener kit, 2U	$189	2
A413A	Hardware, vertical fastener kit, 3U	$215	2
A414A	Hardware, vertical fastener kit, 4U	$247	2

Modular Fiber Optic, Microwave, High-Speed Logic, and Utility Functional Blocks and Accessories

Part Number	Brief Description	Price Each	Delivery (weeks)
A421A	Hardware, rack-mount kit, 1U	$189	2
A422A	Hardware, rack-mount kit, 2U	$215	2
A423A	Hardware, rack-mount kit, 3U	$247	2
A424A	Hardware, rack-mount kit, 4U	$273	2
A430A	Hardware, side panel kit, 1U, for 0.5U ModBlocks	$215	2
A600	SFP Transceiver, 850nm, 2.125Gb/s	$202	2
A601	SFP Transceiver, 850nm, 4.25Gb/s	$202	2
A605	SFP Transceiver, 1310nm, 200Mb/s, 2km	$208	2
A610	SFP Transceiver, 1310nm, 155Mb/s, 15km	$312	2
A611	SFP Transceiver, 1310nm, 155Mb/s, 40km	$345	2
A615	SFP Transceiver, 1310nm, 622Mb/s, 15km	$293	2
A616	SFP Transceiver, 1310nm, 622Mb/s, 40km	$579	2
A620	SFP Transceiver, 1310nm, 1.25Gb/s, 10km	$306	2
A625	SFP Transceiver, 1310nm, 2.125Gb/s, 10km	$325	2
A626	SFP Transceiver, 1310nm, 2.125Gb/s, 55km	$910	2
A630	SFP Transceiver, 1310nm, 2.67Gb/s, 2km	$501	2
A631	SFP Transceiver, 1310nm, 2.67Gb/s, 15km	$657	2
A632	SFP Transceiver, 1310nm, 2.67Gb/s, 40km	$1,463	2
A635	SFP Transceiver, 1310nm, 4.25Gb/s, 4km	$468	2
A636	SFP Transceiver, 1310nm, 4.25Gb/s, 10km	$930	2
A637	SFP Transceiver, 1310nm, 4.25Gb/s, 30km	$1,242	2
A640	SFP Transceiver, 1550nm, 155Mb/s, 80km	$754	2
A645	SFP Transceiver, 1550nm, 622Mb/s, 80km	$806	2
A650	SFP Transceiver, 1550nm, 2.125Gb/s, 90km	$1,138	2
A651	SFP Transceiver, 1550nm, 2.125Gb/s, 115km	$1,638	2
A655	SFP Transceiver, 1550nm, 2.67Gb/s, 80km	$1,937	2
A670	SFP Transceiver, copper, 10/100/1000BaseT	$202	2
A700A	Supply, fiber optic, “wipe” box	$319	1
A701A	Supply, fiber optic, “wipe” box refill cartridge	$130	1
A702A	Supply, fiber optic, swabs, box of 200	$507	1