

Product Bulletin

APETM Microwave Analog Intensity Modulators 1320 nm and 1550 nm

The low loss, high stability and flat response of JDS Uniphase microwave modulators make them the preferred device for this demanding market. JDS Uniphase analog intensity modulators cover frequencies from DC to 18 GHz. Single and dual output devices are available at 1300 nm or 1550 nm. These modulators are used in microwave fiberoptic transmitters and electromagnetic field sensors in terrestrial and airborne applications. The operating points are set for linear operation, so bias control may not be required for applications covering suboctave bandwidths. In addition, because APE optical waveguides provide over 50 dB of polarization extinction, no polarizing components are required in the system. The modulators are supplied with polarizationmaintaining fiber at the optical input port to simplify alignment of the laser output with the modulator waveguides.

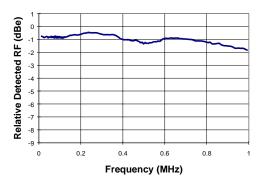
Key Features

- 1,3 &12 GHz bandwidths
- Efficient power transfer
- Low fiber-to-fiber insertion loss
- Single-polarization operation
- Superior bias stability
- Separate DC bias electrode
- 50-Ohm input impedance

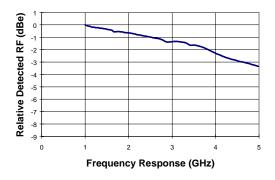
Applications

- Microwave frequency signal distribution
- Antenna remoting

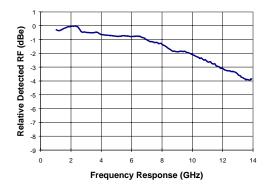
APE™Microwave Analog Intensity Modulators | 2



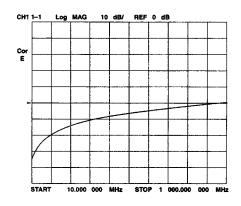
Frequency Response S21, 860 MHz



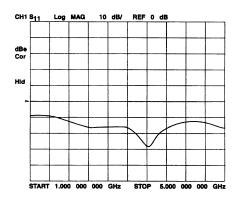
Frequency Response S21, 3 GHz



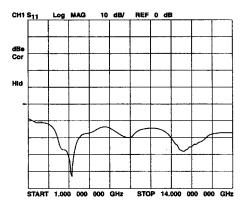
Frequency Response S21, 12 GHz



Electrical Return Loss S11, 860 MHz



Electrical Return Loss S11, 3 GHz



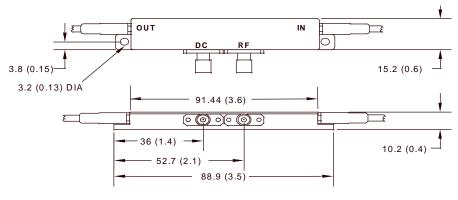
Electrical Return Loss S11, 12 GHz

Microwave Performance Specifications

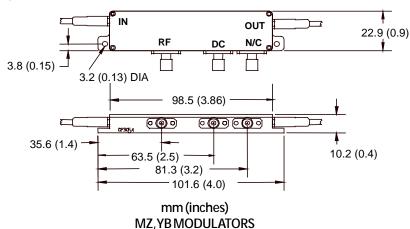
Crystal orientation x-cut, y-propagating										
Electrical connectors (package) SMA connectors										
Fibers PM input: Fujikura SM 13-P-7/125-UV/UV-400 SM output: Corning SMF 28 1550 nm device PM input: Fujikura SM 15-P-8/125-UV/UV-400 SM output: Corning SMF 28 Absolute Input optical power 200 mW maximum Operating temperature 0°C minimum, 70°C maximum Storage temperature -40°C minimum, 85°C maximum Model Description FY-150-009 MZ 130-030 MZ/YB-130-120 Operating Wavelength, MZ, min (nm) - 1300 1300 Operating Wavelength, MZ, max (nm) - 1340 1340 Operating Wavelength, YBBM, min (nm) ⁵ 1545 - 1315 Operating Wavelength, YBBM, max (nm) ⁵ 1555 - 1325 Insertion loss, maximum (dB) ⁶ 4.0 4.0 4.0 On/off extinction ratio, minimum (dB) 20 20 20 Optical return loss, minimum (dB) 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ±10 ±10 ±10 Electrical¹ RF port Bandwidth, typical (GHz) <t< td=""><td></td><td></td></t<>										
1320 nm device										
SM output: Corning SMF 28 PM input: Fujikura SM 15-P-8/125-UV/UV-400 SM output: Corning SMF 28 PM input: Fujikura SM 15-P-8/125-UV/UV-400 SM output: Corning SMF 28 SM output: Corning SM										
PM input: Fujikura SM 15-P-8/125-UV/UV-400 SM output: Corning SMF 28 SM output: Corning SMF 28 SM output: Optical power SMF 28 SM output: Optical power SMF 28 SM output: Optical power Storage temperature O°C minimum, 70°C maximum Storage temperature -40°C minimum, 85°C maximum SMZ/YB-130-120 Optical¹ Operating Wavelength, MZ, min (nm) - 1300 1300 Operating Wavelength, MZ, max (nm) - 1340 1340 Operating Wavelength, YBBM, min (nm)s 1545 - 1315 Operating Wavelength, YBBM, max (nm)s 1555 - 1325 Insertion loss, maximum (dB)s 4.0 4.0 4.0 On/off extinction ratio, minimum (dB) 20 20 20 Optical return loss, minimum (dB) 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ±10 ±10 ±10 Electrical¹ Electrical¹ RF port Small point, minimum (V) 7.3 3.0 7.8 Pπ at 1 GHz, typical (dBm) N/A 16.5 26 Pπ at 100 MHz, typical (dBm) 21 N/A										
SM output: Corning SMF 28 Absolute Input optical power 200 mW maximum Operating temperature 0°C minimum, 70°C maximum Storage temperature -40°C minimum, 85°C maximum Model Description FY-150-009 MZ 130-030 MZ/YB-130-120 Optical¹ Operating Wavelength, MZ, min (nm) - 1300 1300 Operating Wavelength, YBBM, min (nm) - 1340 1340 Operating Wavelength, YBBM, max (nm) - 1340 1340 Operating Wavelength, YBBM, max (nm) - 1340 1345 Operating Wavelength, YBBM, max (nm) 1555 - 1325 Insertion loss, maximum (dB) ⁶ 4.0 4.0 4.0 4.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2										
Input optical power 200 mW maximum										
Input optical power 200 mW maximum Operating temperature O°C minimum, 70°C maximum Storage temperature -40°C minimum, 85°C maximum		SM output: Corning SMF 28								
Operating temperature 0°C minimum, 70°C maximum Storage temperature -40°C minimum, 85°C maximum Model Description FY-150-009 MZ 130-030 MZ/YB-130-120 Optical¹ Operating Wavelength, MZ, min (nm) - 1300 1300 Operating Wavelength, MZ, max (nm) - 1340 1340 Operating Wavelength, YBBM, min (nm)⁵ 1545 - 1315 Operating Wavelength, YBBM, max (nm)⁵ 1555 - 1325 Insertion loss, maximum (dB)° 4.0 4.0 4.0 On/off extinction ratio, minimum (dB) 20 20 20 Optical return loss, minimum (dB) 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ±10 ±10 ±10 Electrical¹ Electrical¹ RF port Bandwidth, typical (GHz) 0.86⁴ 3³ 12³ Vπ at DC, maximum (V) 7.3 3.0 7.8 Pπ at 1 GHz, typical (dBm) N/A N/A N/A										
Storage temperature -40°C minimum, 85°C maximum -40°C minimum, 1300 MZ 130-030 -40°C minimum, 85°C maximum -40°C minimum, 85°C maximum, -40°C maximum, -40°C minimum, -										
Model Description FY-150-009 MZ 130-030 MZ/YB-130-120 Optical¹ Operating Wavelength, MZ, min (nm) - 1300 1300 Operating Wavelength, MZ, max (nm) - 1340 1340 Operating Wavelength, YBBM, min (nm)⁵ 1545 - 1315 Operating Wavelength, YBBM, max (nm)⁵ 1555 - 1325 Insertion loss, maximum (dB)⁶ 4.0 4.0 4.0 On/off extinction ratio, minimum (dB) 20 20 20 Optical return loss, minimum (dB) 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ±10 ±10 ±10 Electrical¹ RF port Bandwidth, typical (GHz) 0.86⁴ 3³ 12³ $V\pi$ at DC, maximum (V) 7.3 3.0 7.8 $P\pi$ at 1 GHz, typical (dBm) N/A 16.5 26 $P\pi$ at 100 MHz, typical (dBm) 21 N/A N/A		0°C minimum, 70°C maximum								
Optical¹ Operating Wavelength, MZ, min (nm) - 1300 1300 Operating Wavelength, MZ, max (nm) - 1340 1340 Operating Wavelength, YBBM, min (nm)⁵ 1545 - 1315 Operating Wavelength, YBBM, max (nm)⁵ 1555 - 1325 Insertion loss, maximum (dB)⁶ 4.0 4.0 4.0 On/off extinction ratio, minimum (dB) 20 20 20 Optical return loss, minimum (dB) 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ± 10 ± 10 ± 10 Electrical¹ ± 10 ± 10 ± 10 ± 10 Electrical¹ ± 10 Figure 1 Figure 2 Figure 3 Figure 3 Figure 3 Figure 3 Figure 3 Figure 3 Figure 4 Figure 3 Figure 3 Figure 4 Figure 3 Figure 4 Figure 3 Figure 4 Figure 4 Figure 4 Figure 4 Figure 4 Figure 4 Figure 5 Figure 5 Figure 5 Figure 6 Figure	temperature -40°C minimum, 85°C maximum									
Operating Wavelength, MZ, min (nm) - 1300 1300 Operating Wavelength, MZ, max (nm) - 1340 1340 Operating Wavelength, YBBM, min (nm) ⁵ 1545 - 1315 Operating Wavelength, YBBM, max (nm) ⁵ 1555 - 1325 Insertion loss, maximum (dB) ⁶ 4.0 4.0 4.0 On/off extinction ratio, minimum (dB) 20 20 20 Optical return loss, minimum (dB) 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ±10 ±10 ±10 Electrical ¹ Electrical ¹ \times 10 ±10 ±10 ±10 RF port \times 20 \times 3 123 \times 20	MZ-150-030	MZ/YB-150-120								
Operating Wavelength, MZ, max (nm) - 1340 1340 Operating Wavelength, YBBM, min (nm) ⁵ 1545 - 1315 Operating Wavelength, YBBM, max (nm) ⁵ 1555 - 1325 Insertion loss, maximum (dB) ⁶ 4.0 4.0 4.0 On/off extinction ratio, minimum (dB) 20 20 20 Optical return loss, minimum (dB) 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ± 10 ± 10 ± 10 Electrical ¹ RF port Bandwidth, typical (GHz) 0.86 ⁴ 3 ³ 12 ³ V π at DC, maximum (V) 7.3 3.0 7.8 P π at 1 GHz, typical (dBm) N/A 16.5 26 P π at 100 MHz, typical (dBm) 21 N/A N/A										
Operating Wavelength, YBBM, min (nm) ⁵ 1545 - 1315 Operating Wavelength, YBBM, max (nm) ⁵ 1555 - 1325 Insertion loss, maximum (dB) ⁶ 4.0 4.0 4.0 On/off extinction ratio, minimum (dB) 20 20 20 Optical return loss, minimum (dB) 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ± 10 ± 10 ± 10 Electrical ¹ RF port Bandwidth, typical (GHz) 0.86 ⁴ 3 ³ 12 ³ $V\pi$ at DC, maximum (V) 7.3 3.0 7.8 $P\pi$ at 1 GHz, typical (dBm) N/A 16.5 26 $P\pi$ at 100 MHz, typical (dBm) 21 N/A N/A	1530	1530								
Operating Wavelength, YBBM, max (nm) ⁵ 1555 - 1325 Insertion loss, maximum (dB) ⁶ 4.0 4.0 4.0 0n/off extinction ratio, minimum (dB) 20 20 20 20 Optical return loss, minimum (dB) 50 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ± 10 ± 10 ± 10 ± 10 $Electrical$ ¹ RF port Bandwidth, typical (GHz) 0.86 ⁴ 3 ³ 12 ³ $V\pi$ at DC, maximum (V) 7.3 3.0 7.8 $P\pi$ at 1 GHz, typical (dBm) N/A 16.5 26 $P\pi$ at 100 MHz, typical (dBm) 21 N/A N/A	1570	1570								
Insertion loss, maximum (dB)6 4.0 4.0 4.0 On/off extinction ratio, minimum (dB) 20 20 20 Optical return loss, minimum (dB) 50 50 50 Passive bias point, relative to quadrature at center of wavelength band (Degrees) ± 10 ± 10 ± 10 Electrical1 Electrical2 ± 10 ± 10 ± 10 RF port Bandwidth, typical (GHz) 0.864 3^3 12^3 $Vπ$ at DC, maximum (V) 7.3 3.0 7.8 $Pπ$ at 1 GHz, typical (dBm) N/A 16.5 26 $Pπ$ at 100 MHz, typical (dBm) 21 N/A N/A	-	1545								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	-	1555								
Optical return loss, minimum (dB) 50 50 50 Fassive bias point, relative to quadrature at center of wavelength band (Degrees) ± 10 \pm	4.0	4.0								
Passive bias point, relative to quadrature at center of wavelength band (Degrees) ± 10 ± 10 ± 10 $Electrical^1$ RF port Bandwidth, typical (GHz) 0.86^4 3^3 12^3 $\sqrt{\pi}$ at DC, maximum (V) 7.3 3.0 7.8 $\sqrt{\pi}$ at 1 GHz, typical (dBm) $\sqrt{\pi}$ $$	20	20								
	50	50								
Electrical¹ RF port Bandwidth, typical (GHz) 0.86^4 3^3 12^3 $Vπ$ at DC, maximum (V) 7.3 3.0 7.8 $Pπ$ at 1 GHz, typical (dBm) N/A 16.5 26 $Pπ$ at 100 MHz, typical (dBm) 21 N/A N/A										
RF port Bandwidth, typical (GHz) 0.86^4 3^3 12^3 Vπ at DC, maximum (V) 7.3 3.0 7.8 Pπ at 1 GHz, typical (dBm) N/A 16.5 26 Pπ at 100 MHz, typical (dBm) 21 N/A N/A	<u>+</u> 10	<u>+</u> 10								
Bandwidth, typical (GHz) 0.86^4 3^3 12^3 Vπ at DC, maximum (V) 7.3 3.0 7.8 $Pπ$ at 1 GHz, typical (dBm) N/A 16.5 26 $Pπ$ at 100 MHz, typical (dBm) 21 N/A N/A										
Vπ at DC, maximum (V) 7.3 3.0 7.8 $Pπ$ at 1 GHz, typical (dBm) N/A 16.5 26 $Pπ$ at 100 MHz, typical (dBm) 21 N/A N/A										
Pπ at 1 GHz, typical (dBm)N/A16.526 $Pπ$ at 100 MHz, typical (dBm)21N/AN/A	33	12³								
$P\pi$ at 100 MHz, typical (dBm) 21 N/A N/A	3.5	9.8								
	18.5	28								
	N/A	N/A								
Impedance, typical $(\Omega)^3$ 50 50	50	50								
Max RF power (dBm) + 24 + 24 + 24	+ 24	+ 24								
S11, maximum (dB) -8 -8 -8	-8	-8								
DC port	-0									
$V\pi \text{ at DC, max (V)}$ 7.5 6.5	-0	7.5								
Impedance (k Ω)) > 10 > 10 > 10 Notes:	7.5	> 10								

- 1. All measurements made at 23°C unless otherwise noted.
- $2.~V\pi$ is specified at the modulator. $P\pi$ is the power required to generate full extinction at the RF connector at a specific frequency.
- 3. Bandwidth measured relative to 1 GHz. Input impedance transformer is inactive below 1 GHz (impedance becomes 25 ohms).
- 4. Bandwidth measured relative to 40 MHz.
- 5. Output coupler restricts wavelength range. Operation outside wavelength window results in degraded on/off extinction ratio and insertion loss balance performance. Bandwidth and S11 performance is not affected.
- 6. Optical loss is measured at the maximum of the modulator transfer function and does not include the 3 dB loss incurred when operated at quadrature.

APETM Microwave Analog Intensity Modulators | 4



mm (inches) FY MODULATOR



Ordering information

Indicate your requirements by selecting one option from each configuration table. For more information on this or other products and their availability, please contact your local JDS Uniphase sales representative or JDS Uniphase directly at 860 769-3000, or by fax 860 769-3001, or via email at sales.ct@us.jdsunph.com, or visit our Web site at www.jdsunph.com.

Sample: FY-130-009-T-1-3-C2

AA-BBB-CCC-T-1-D-EE

AA	Product Line Product Line	BBB	Wavelength	CCC	Frequency	T	1	Inputfiber	D	Output Fiber	EE	Fiber Cabling
FY	Low frequency, dual output	130	1300 nm	009	086 GHz	Used in 3 GHz	1	Fujukura PM	1	Fujukura PM	C1	3 mm loose tube
MZ	Mach-Zehnder, single output	150	1550 nm	030	3 GHz	and 12 GHz			3	Corning SM	C2	900 micron loose tube
YB	High frequency, dual output			120	12 GHz	models only						



JDS Uniphase Corporation 1289 Blue Hills Avenue Bloomfield, Connecticut 06002 USA Tel 860 769-3000 Fax 860 769-3001 sales.ct@us.jdsunph.com www.jdsunph.com

European Sales GCA House/Building #16 Thorney Leys Business Park Witney, Oxon OX8 7GE United Kingdom

Tel +44 1993 601 601 Fax +44 1993 700 444

All information contained herein is believed to be accurate and is subject to change without notice. No responsibility is assumed for its use. JDS Uniphase Corporation, its subsidiaries and affiliates, or manufacturer, reserve the right to make changes, without notice, to product design, product components, and product manufacuring methods. Some specific combinations of options may not be available. Please contact JDS Uniphase for more information. ©JDS Uniphase Corporation. All rights reserved.