

Multiwavelength Gain Module - Mid-stage Access EDFA

Bookham Technology's MultiWavelength Gain Modules are supplied with the EDFA optical, optoelectronic and electronic functions built in, requiring only a +5 V power supply for operation. They allow sophisticated optical amplifier card level solutions to be implemented very easily.

The MultiWavelength Gain Module optical amplifiers have been specially designed for use in wide bandwidth WDM optical transmission systems. The series, consisting of a number of standard configurations, has been designed to allow rapid customization to meet the widely varying requirements of customer specific system design. Each module contains two amplifier stages providing Mid Stage Access (MSA). This allows insertion of network components such as add-drop multiplexers, dispersion compensators while maintaining optimum optical performance.

Through selection of certain component values within the gain block, the designs can be rapidly customized to meet specific amplifier requirements for output power and gain. All of the amplifiers have an integrated optical output monitor port on both stages.

Features

- High reliability
- Semi-custom design flexibility
- Flat optical amplification between 1530 - 1563 nm
- Fast gain and transient control modes
- Pre and booster amplifier in a single package
- Internal Variable Optical Attenuator for constant Mid-Stage Loss
- Single +5 V supply operation
- Low power consumption
- Low noise figure
- Optical output monitor from both stages

Applications

- In-line WDM Amplifier Pair with Mid-Stage Access (MSA)
- Raman Follower



Functional Description

Gain and Transient Control

Each amplifier contains two amplifier stages configured to operate as a pair with mid stage access. The onboard digital signal processors continually monitor input and output powers within each stage and drive the pump lasers under extremely fast firmware control to provide constant output power or constant gain with fast transient suppression.

These features permit wavelengths to be rapidly added or dropped from the amplifier whilst controlling the impact on the remaining channels.

Optical

The amplifiers have been optimized for full-band gain-bandwidth WDM operation by careful selection of both passive and active components. All amplifiers are pumped with high reliability 980 nm and 1480 nm pumps and are all provided with optical monitor outputs to allow customer spectral analysis or monitoring of the amplified signal.

Overall midstage loss is kept constant with the inclusion of a Variable Optical Attenuator located at the output of the Pre-amplifier stage, following the optical output monitor tap.

Each attenuator default setting is optimized during amplifier test to achieve optimum gain flatness at the specified gain.

Optical amplifier variants optimized for use with high operating input power levels, compatible with a separate Raman pump unit, are available.

Electrical

Electrical connection is through a male 50 way connector for mating with a female connector, type Samtec SSW-125-01-G-D.

Package

Optical connections are made through single mode fibre pigtailed with SC/PC connectors as standard.

Generic Data

This data sheet indicates generic operating parameters which can be achieved by the series of amplifiers. Bookham Technology's flexible approach to design allows customer specific operating conditions to be catered for within this range. All parameters specified in the product tables apply over temperature, wavelength and life unless otherwise stated.

Required Parameters

Optical Parameters	Min	Max	Unit
Generic			
Optimized operating wavelength range (variable over)	1530	1563	nm
Case temperature		0	65°C

Standard Configurations

MGMFM-2BRC28 -	Line Amplifier
MGMFM-2BEC28 -	Booster Amplifier
MGMFM-2BNC28 -	Line Amplifier
MGMFM-2BDC28 -	Raman Follower

MGMFM-2BRC28 - Line Amplifier

Parameter	Min	Typ	Max	Unit	Notes
Operating wavelength	1530.0		1561.5	nm	Calibrated to λ of 1540 nm
Optical input power		-5.0	-2.0	dBm	
Optical output power	21.0			dBm	-2 dBm input power
Gain		26.0		dB	@ 40°C Pre input to Boost output
Noise Figure		5.5	6.3	dB	-5 dBm input power, 1 dB VOA loss, 10 dB interstage loss
Backward ASE			-30	dBm	At typical input power
Total remnant pump at pre-amp IP			-25	dBm	At -5 dBm input power, 26 dB gain
Total remnant pump at pre-amp OP			-25	dBm	At -5 dBm input power, 26 dB gain
Total remnant pump at booster IP			-25	dBm	At -5 dBm input power, 26 dB gain
Total remnant pump at booster OP			-11.0	dBm	At -5 dBm input power, 26 dB gain
Optimum gain flatness			1.5	dB	@ 40°C, 21 dBm OP, optimized with 0 to 2 dB VOA loss
PDG			0.4	dB	At -5 dBm input power, 26 dB gain
PMD		0.5	1.4	ps	
Optical power monitors	1.0	2.5	5	%	
Optical input return loss			40	dB	Amplifier off
Optical output return loss			40	dB	Amplifier off
Mid stage power at pre output		14.0		dBm	-5 dBm input power, 1 dB VOA loss
Interstage stage loss			10	dB	
VOA margin	0.0	1.0	2.0	dB	i.e. ± 1 dB to achieve OFG

MGMFM-2BEC28 - Booster Amplifier

Parameter	Min	Typ	Max	Unit	Notes
Operating wavelength	1530.0		1561.5	nm	Calibrated to λ of 1540 nm
Optical input power		7.0	8.0	dBm	
Optical output power	20.5			dBm	7 dBm input power
Gain		13.5		dB	@ 40°C Pre input to Boost output
Noise figure		9.0	9.6	dB	7.0 dBm input power, 0.5 dB VOA loss, 7 dB interstage loss
Backward ASE			-30	dBm	At typical input power
Total remnant pump at pre-amp IP			-25	dBm	At 7 dBm input power, 13.5 dB gain
Total remnant pump at pre-amp OP			-25	dBm	At 7 dBm input power, 13.5 dB gain
Total remnant pump at booster IP			-25	dBm	At 7 dBm input power, 13.5 dB gain
Total remnant pump at booster OP			-5.0	dBm	At 7 dBm input power, 13.5 dB gain
Optimum gain flatness			1.5	dB	@ 40°C, 20.5 dBm OP, optimized with 0 to 1 dB VOA loss

MGMFM-2BEC28 - Booster Amplifier continued

Parameter	Min	Typ	Max	Unit	Notes
PDG			0.4	dB	At 7 dBm input power, 13.5 dB gain
PMD		0.4	1.4	ps	
Optical power monitors	1.0	2.5	5.0	%	
Optical input return loss			40	dB	Amplifier off
Optical output return loss			40	dB	Amplifier off
Mid stage power at pre output		16.0		dBm	7 dBm input power, 0.5 dB VOA loss
Interstage stage loss			7.0	dB	
VOA margin	0.0	0.5	1.0	dB	i.e. ± 0.5 dB to achieve OFG

MGMFM-2BNC28 - Line Amplifier

Parameter	Min	Typ	Max	Unit	Notes
Operating wavelength	1530.0		1561.5	nm	Calibrated to λ of 1540 nm
Optical input power		0.0	4	dBm	
Optical output power	21.0			dBm	0.0 dBm input power
Gain		21.0		dB	@ 40°C Pre input to Boost output
Noise figure		6.5	7.3	dB	0.0 dBm input power, 0.5 dB VOA loss, 9 dB interstage loss
Backward ASE			-30	dBm	At typical input power
Total remnant pump at pre-amp IP			-25	dBm	At 0.0 dBm input power, 21 dB gain
Total remnant pump at pre-amp OP			-25	dBm	At 0.0 dBm input power, 21 dB gain
Total remnant pump at booster IP			-25	dBm	At 0.0 dBm input power, 21 dB gain
Total remnant pump at booster OP			-6.0	dBm	At 0.0dBm input power, 21 dB gain
Optimum gain flatness			1.5	dB	@ 40°C, 21 dBm OP, optimized with 0 to 1 dB VOA loss
PDG			0.4	dB	At 0.0 dBm input power, 21 dB gain
PMD		0.4	1.4	ps	
Optical power monitors	1.0	2.5	5.0	%	
Optical input return loss			40	dB	Amplifier off
Optical output return loss			40	dB	Amplifier off
Mid-stage power at pre output		16.0		dBm	0.0 dBm input power, 0.5 dB VOA loss
Interstage loss			9.0	dB	
VOA margin	0.0	0.5	1.0	dB	i.e. ± 0.5 dB to achieve OFG

MGMFM-2BDC28 - Raman Follower

The Raman Follower has been designed to operate with a separate Raman Pump Unit for Ultra Long Haul applications. The specification detailed below is typical for the Raman gain spectrum as shown in the example below. Other Raman input spectra can be considered when designing matching amplifiers.

Parameter	Min	Typ	Max	Unit	Notes
Operating wavelength	1530.0		1561.5	nm	Calibrated to λ of 1540 nm
Optical input power		3.5	6.5	dBm	
Optical output power	20.5			dBm	3.5 dBm input power
Gain		17.0		dB	@ 40°C Pre input to Boost output
Noise figure		9.0	10.0	dB	3.5 dBm input power, 0.5 dB VOA loss, 12 dB interstage loss
Backward ASE			-30	dBm	At typical input power
Total remnant pump at pre-amp IP			-25	dBm	At 3.5 dBm input power, 17 dB gain
Total remnant pump at pre-amp OP			-25	dBm	At 3.5 dBm input power, 17 dB gain
Total remnant pump at booster IP			-25	dBm	At 3.5 dBm input power, 17 dB gain
Total remnant pump at booster OP			-7.0	dBm	At 3.5 dBm input power, 17 dB gain
Optimum gain flatness			1.7	dB	@ 40°C, 20.5dBm OP, optimized with 0 to 1dB VOA loss
PDG			0.4	dB	At 3.5 dBm input power, 17 dB gain
PMD		0.5	1.4	ps	
Optical power monitors	1.0	2.5	5	%	
Optical input return loss			40	dB	Amplifier off
Optical output return loss			40	dB	Amplifier off
Mid stage power at pre output		16.0		dBm	3.5 dBm input power, 0.51 dB VOA loss
Interstage loss			12	dB	
VOA margin	0	0.5	1.0	dB	i.e. ± 0.5 dB to achieve OFG

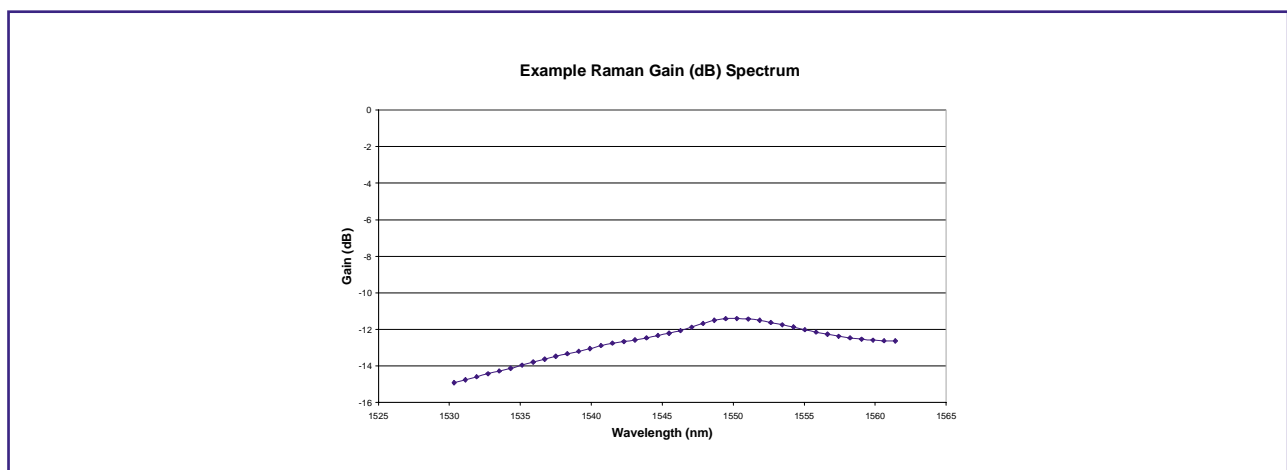


Figure 1: Raman Gain (dB) Spectrum

Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Storage temperature	T _{stg}	-25 to +75	°C
Operating temperature (1)	T _{op}	0 to 65	°C
Optical input power	P _{in}	+10	dBm
Fiber tensile strain (10 sec max)		10	N
Fiber bend radius (min)		30	mm
Fiber bend point distance from body		18	mm
Maximum power supply voltages		-0.3 to +5.5	V

notes:

(1) Temperature at the hottest point on the module enclosure.

Analogue Outputs

Four analogue voltage output ports are provided for optical input and output power monitoring.

TTL Outputs

These TTL compatible alarm outputs are all active high logic. i.e. TTL LOW = normal operation, TTL HIGH = alarm. Hysteresis is included on all alarms to prevent alarms oscillating.

EDFA Temperature Alarm

This alarm is activated if the case temperature should exceed 60 °C.

Loss Of Output Power Alarm

If the output power degrades by more than 2 dB from its beginning of life value in constant output power modes, or if the gain cannot be maintained within 2 dB of its set point in constant gain modes then this alarm will be set.

Pump Bias Alarm

Set if any of the pumps are driven at greater than 95% of their end of life value.

Pumps Temperature alarm

Set if any of the pump submount temperatures are higher or lower than the set temperature by greater than 10 °C.

TTL Inputs

Output Power Mute

The Output Power Mute will clamp the output power to a nominal 5 mW. This may be used when servicing a 'live' system to improve eye safety. TTL LOW = normal operation, TTL HIGH = reduced output power.

Amplifier Disable Input

Amplifier Disable will turn the pump laser drivers off. The pump thermo electric coolers and other module electronics are unaffected by this input.

NOTE THAT UNDER HIGH INPUT POWER CONDITIONS, CONSIDERABLE OUTPUT POWER CAN STILL EXIST EVEN WHEN THE AMPLIFIER IS DISABLED. THIS INPUT MUST NOT BE REGARDED AS AN INTERLOCK AND THE AMPLIFIER MUST STILL BE CONSIDERED AS CLASS IIIb.

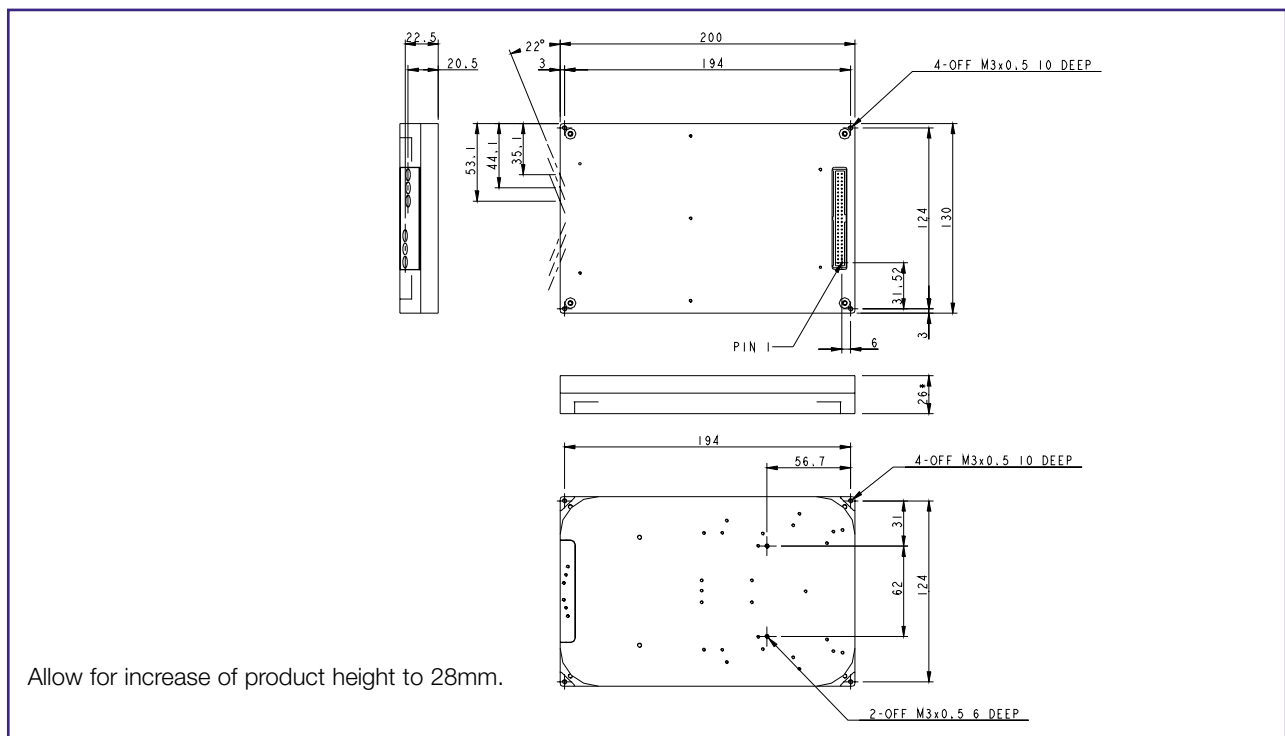
TTL LOW = normal operation, TTL HIGH = pump drive disabled

Electrical Power Supplies

Electrical power to the unit is supplied from a single power supply rail.

Parameter	Min	Typ	Max
Positive supply voltage	+4.75 V	+5.0 V	+5.25 V
Power dissipation (Start of Life)	-	20 W	-
Power dissipation (End of Life)	-	-	65 W
Ripple noise	-	-	2% PP
Transient pulse	+4.6 V for 75 ms.		+6.0 V for 75 ms
Radiated emissions	EN5022 class B		
Conducted emissions	EN5022 class B		
Radiation immunity	IEC801-3		
ESD	IEC801-2		

Module Outline Drawing (Dimensions in mm)



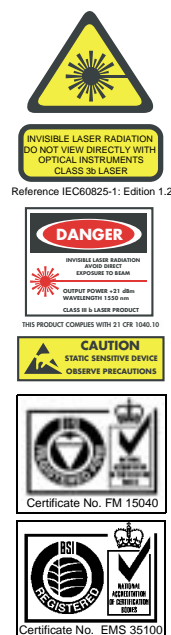
Connector Pin -Out

The pinout for the male connector.

PIN #	Function	PIN #	Function
1	+5.0 V	2	+5.0 V
3	+5.0 V	4	+5.0 V
5	+5.0V	6	+5.0 V
7	GND	8	GND
9	GND	10	GND
11	N/ C	12	N/ C
13	N/C	14	N/C
15	RS-232 IN (TTL Levels)	16	RS-232 OUT (TTL Levels)
17	Pump Bias Alarm	18	Loss of Signal Alarm
19	GND	20	GND
23	Power Monitor (Boost IP)	24	Power Monitor (Boost IP) GND ref
21	Power Monitor (Pre IP)	22	Power Monitor (Pre IP) GND ref
25	GND	26	GND
27	Power Monitor (Pre OP)	28	Power Monitor (Pre OP) GND ref
29	Power Monitor (Boost OP)	30	Power Monitor (Boost OP) GND ref
31	GND	32	GND
33	EDFA Temperature Alarm	34	Loss of Output Power Alarm
35	Pumps Temperature Alarm	36	N/C
37	Amplifier Disable Input	38	Output Power Mute Input
39	N/C	40	N/C
41	GND	42	GND
43	GND	44	GND
45	+5.0 V	46	+5.0 V
47	+5.0 V	48	+5.0 V
49	+5.0 V	50	+5.0 V

Ordering Information

The above specification is a guide to the operating parameters that can be achieved with the MultiWavelength Gain Module - Mid-stage Access EDFA series of amplifiers. Please contact your Bookham Technology representative to discuss any issues regarding customization of these units to meet specific system needs.



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