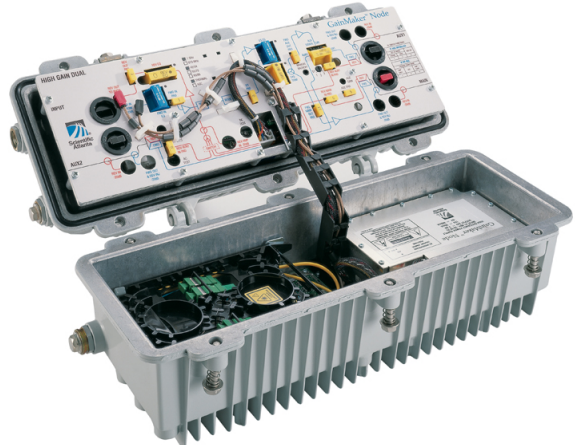


Optoelectronics

GainMaker® Optoelectronic Node 1 GHz with 40/52 MHz Split and RF Redundancy

Description

The GainMaker® Node is designed to serve as the cornerstone of today's emerging **fiber deeper** network architectures. The GainMaker Node combines the superior proven technologies of both the GainMaker RF Amplifier and Prisma® Optical components. Available with three high level RF output ports and RF redundancy, it is the ideal platform for delivering video (digital and analog) as well as high-speed data services over advanced hybrid fiber/coax (HFC) networks. With its modular design of fiber receiver, reverse fiber transmitter and RF amplifier electronics, the GainMaker Node station can provide an extensive complement of functions required by advanced networks. Reverse traffic can be combined and routed to FP, DFB, or CWDM reverse transmitters.



This version of the GainMaker Node is designed with RF redundancy to accommodate forward path and return path redundancy via coax to protect against fiber cuts in the network. This feature is ideal for networks with fiber limitations that still want the protection of redundancy.

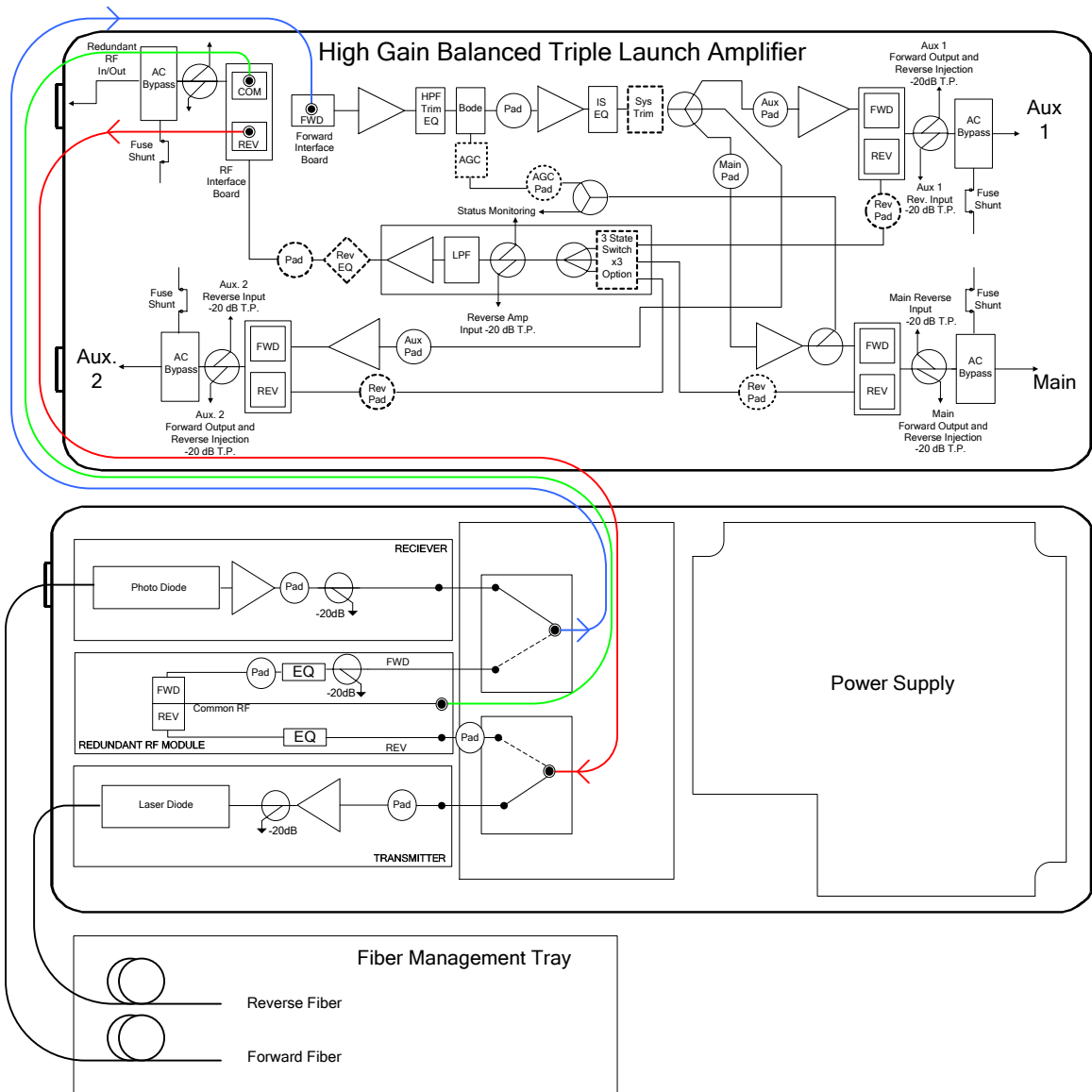
Installation of the GainMaker Node is quick and easy. The fiber receiver is delivered with preconnectorized fiber terminations. The optional preconnectorized cable stub is the ideal method for connecting the GainMaker Node to the fiber network (see cable stubs data sheet). External termination connectors are also available for central strength member and LXE style fiber optic cables. The GainMaker Node includes a 4-fiber handling tray for these cables.

Features

- Forward and reverse RF redundancy
- Fiber management tray provides fiber and connector storage for up to 4 connector pairs
- Local test points and LED indicators on optical receivers and transmitters to simplify installation and maintenance
- The GainMaker node uses pug-in accessories common to all GainMaker products
- Reverse input pad and RF test point for each reverse input port on GainMaker launch amplifier allow optimum reverse path design and alignment
- Chromate plated housing to withstand harsh operating environments

Block Diagrams

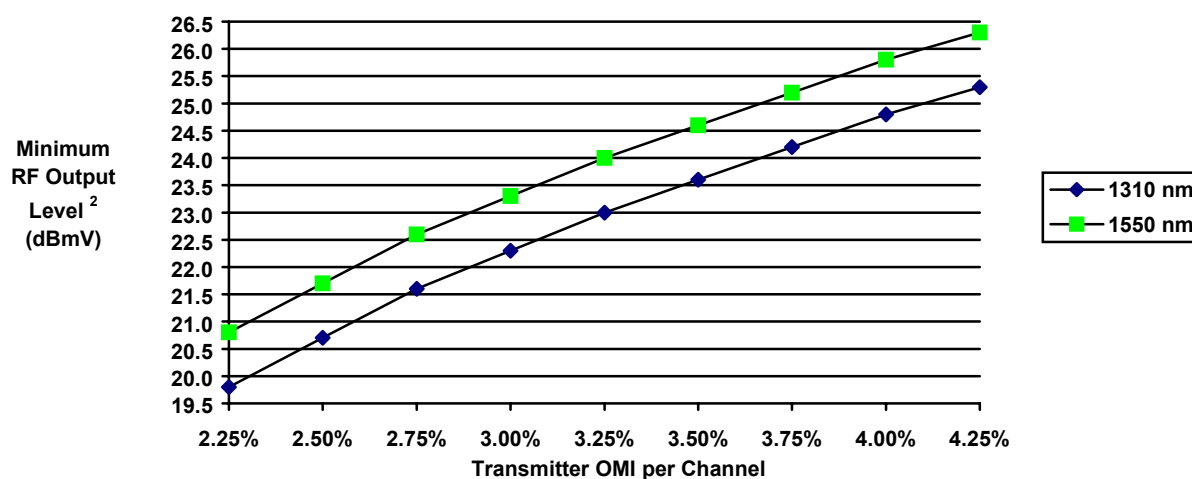
High Gain Balanced Triple (HGBT) with RF Redundancy



Optical Section Specifications

Optical Section - Forward Receiver Module	Units	GainMaker Standard RX	Notes
Wavelength	nm	1310 and 1550	
Optical Input Range	mW dBm	0.5 to 1.6 -3 to + 2	
Pass Band	MHz	52-1002	
Frequency Response	dB	± 0.75	1
Tilt (± 1.0 dB)	dB	0	
Optical Input Test Point ($\pm 10\%$)	V DC	1V/mW	
Redundant Optical Rx switching threshold (± 1.0 dB)	dBm	-6	
RF Output Level @ 0 dBm Optical Input	dBmV	Refer to chart (below)	2
RF Output Test Point (± 1.0 dB)	dB	- 20	
Redundancy			
Optical Threshold:			
switch to redundant	dBm	-6.0 $\pm$ 0.4	
switch to primary	dBm	-4.0 $\pm$ 0.4	
Switch Time:			
switch to redundant (max)	ms	25	
switch to primary (min)	sec	10.0	

Receiver RF Output Level Vs Transmitter OMI



Notes for Optical Section Specifications:

- For forward receiver module only. Does not include frequency response contributions from forward optical transmitter.
- Minimum receiver RF output level for the stated transmitter percent OMI/ch. (Optical Modulation Index per channel), with receiver optical input power of 0 dBm. To determine RF output levels at other optical input power, add (or subtract) 2 dB in RF level for each 1 dB increase (or decrease) in receiver optical input power.

For reverse optical transmitter and link performance, see the "Analog Reverse Optical Transmitters for Model 6940/6944 and GainMaker Optoelectronic Stations" data sheet.

Unless otherwise noted, specifications reflect typical performance and are referenced to 68°F (20°C). Specifications are based upon measurements made in accordance with SCTE/ANSI standards (where applicable), using standard frequency assignments.

RF Section Specifications for Amplifier in Primary Mode

General Station Performance	Units	Forward	Reverse	Notes
Pass Band	MHz	52-1002	5-40	
Return Loss	dB	16	16	7
Hum Modulation @ 12 A	dB	70 (52-870 MHz) 60 (870-1002 MHz)	60 (5-10 MHz) 70 (11-40 MHz)	
Hum Modulation @ 15 A	dB	65 (52-870 MHz) 60 (870-1002 MHz)	60 (5-10 MHz) 65 (11-40 MHz)	
Test Points (± 0.5 dB)	dB	-20	-20	

Launch Amplifier Performance - Forward	Units	HGBT	Notes
Operational Gain (minimum)	dB	41	2
Frequency Response	dB	± 0.5	
Internal Tilt (± 1 dB)	dB	14.5	1,3
Noise Figure @... 54 MHz	dB	8.5	2
1002 MHz		8.0	
Reference Output Levels @... 1002 MHz	dBmV	49.5	
870 MHz		47.5	
750 MHz		45.7	
650 MHz		44.0	
550 MHz		42.5	
55 MHz		35.0	
Reference Output Tilt (55-1002 MHz)	dB	14.5	1,4
78 NTSC channels (CW) with digital			9
Composite Triple Beat	dB	78	5
Cross Modulation	dB	69	5
Composite Second Order (high side)	dB	70	5
94 NTSC channels (CW) with digital			10
Composite Triple Beat	dB	73	5
Cross Modulation	dB	65	5
Composite Second Order (high side)	dB	67	5

Forward Insertion Loss Optical Interface Board and Plug-Ins (Loss from specified optical receiver RF output to launch amplifier RF input)	Units	Specification	Notes
Receiver	dB	1.5	11

Unless otherwise noted, specifications reflect typical performance and are referenced to 68°F (20°C). Specifications are based upon measurements made in accordance with SCTE/ANSI standards (where applicable), using standard frequency assignments.

RF Section Specifications for Amplifier in Primary Mode, continued

Launch Amplifier Performance - Reverse	Units	Reverse	Notes
Amplifier Type	-	Push-Pull	
Operational Gain (minimum)	dBmV	19.5	7,12
Frequency Response	dB	±0.5	
Internal Tilt (+/- 1 dB)	dB	-0.5	
Noise Figure	dB	14.5	7,12
Reference Output Levels @ 5 and 42 MHz	dBmV	35	6
6 NTSC Channels (CW)			
Composite Triple Beat	dB	92	
Cross Modulation	dB	80	
Composite Second Order	dB	82	
Station Performance – Reverse			
(Station port input to optical transmitter input)	Units		
Operational Gain (minimum)	dB	17.5	7,8

Station Delay Characteristics 40 / 52 Split			
Forward (Chrominance to Luminance Delay)		Reverse (Group Delay in 1.5 MHz BW)	
Frequency (MHz)	Delay (nS)	Frequency (MHz)	Delay (nS)
55.25 - 58.83	17	5.0 - 6.5	29
61.25 - 64.83	8	6.5 - 8.0	13
67.25 - 70.83	5	8.0 - 9.5	8
		35.5 - 37.0	16
		37.0 - 38.5	17
		38.5 - 40.0	29

Notes for Primary Mode RF Section Specifications:

- Reference output tilt and internal tilt are both "Linear" tilt.
- Forward Gain and Noise Figure measured with Forward Interface Board installed.
- Forward internal tilt specified is primarily due to an on-board equalizer and a factory configured 7.5 dB linear interstage equalizer (ISEQ).
- The forward reference output tilt specified is achieved via field installation of appropriate input EQ, in conjunction with the internal tilt of the launch amplifier and the tilt associated with the optical link (transmitter/receiver combination).
- Station performance can be determined by combining optic performance and launch amplifier performance. Stated distortion performance is for launch amplifier section operated at reference output levels and tilt.
- Reverse output reference level at the RF output of the launch amplifier.
- Reverse Operational Gain, Noise Figure, and Return Loss are specified without reverse switch option. If switch is installed, reduce Gain by 0.5 dB, increase Noise Figure by 0.5 dB, and decrease Return Loss by 1 dB.
- Station reverse gain from station input(s) to reverse transmitter input. With 0 dB reverse input pad, 1 dB reverse output pad, and 0 dB reverse EQ in launch amplifier. Includes optical interface board losses.
- "Digital" refers to 550 - 1002 MHz loading with QAM carriers at -6 dB relative to analog video carrier levels.
- "Digital" refers to 650 - 1002 MHz loading with QAM carriers at -6 dB relative to analog video carrier levels.
- Insertion loss from optical receiver RF output to launch amplifier RF input, with specified forward plug-in module installed in the optical interface board. Subtract this loss from the launch amplifier operational gain to determine forward station gain from optical receiver output to station output.
- Reverse Gain and Noise Figure for launch amp with 0 dB reverse input pad, 0 dB reverse output EQ, and 1 dB output pad.

Unless otherwise noted, specifications reflect typical performance and are referenced to 68°F (20°C). Specifications are based upon measurements made in accordance with SCTE/ANSI standards (where applicable), using standard frequency assignments.

RF Section Specifications for Amplifier in Redundant Mode

General Station Performance	Units	Forward	Reverse	Notes
Pass Band	MHz	52-1002	5-40	
Return Loss	dB	15	15	19
Hum Modulation @ 12 A	dB	70 (52-870 MHz) 60 (870-1002 MHz)	60 (5-10 MHz) 70 (11-40 MHz)	
Hum Modulation @ 15 A	dB	65 (52-870 MHz) 60 (870-1002 MHz)	60 (5-10 MHz) 65 (11-40 MHz)	
Test Points (± 1.0 dB)	dB	-20	-20	

Launch Amplifier Performance - Forward	Units	HGBT	Notes
Operational Gain (minimum)	dB	35	14
Frequency Response:			
52 - 60 MHz	dB	± 1.25	
61 - 1002 MHz	dB	± 0.5	
Internal Tilt (± 2 dB)	dB	12.5	13,15
Noise Figure @...	dB	10	14
		12	
Reference Output Levels @...	dBmV	49.5	
1002 MHz		47.5	
870 MHz		45.7	
750 MHz		44.0	
650 MHz		42.5	
550 MHz		35.0	
55 MHz			
Reference Output Tilt (55-1002 MHz)	dB	14.5	13,16
78 NTSC channels (CW) with digital			21
Composite Triple Beat	dB	78	17
Cross Modulation	dB	69	17
Composite Second Order (high side)	dB	70	17
94 NTSC channels (CW) with digital			22
Composite Triple Beat	dB	73	17
Cross Modulation	dB	65	17
Composite Second Order (high side)	dB	67	17

Unless otherwise noted, specifications reflect typical performance and are referenced to 68°F (20°C). Specifications are based upon measurements made in accordance with SCTE/ANSI standards (where applicable), using standard frequency assignments.

RF Section Specifications for Amplifier in Redundant Mode, continued

Launch Amplifier Performance - Reverse	Units	Reverse	Notes
Amplifier Type	-	Push-Pull	
Operational Gain (minimum)	dBmV	19.5	19,23
Frequency Response	dB	±0.5	
Internal Tilt (+/- 1 dB)	dB	-0.5	
Noise Figure	dB	12	19,23
Reference Output Levels @ 5 and 42 MHz	dBmV	35	18
6 NTSC Channels (CW)			
Composite Triple Beat	dB	92	
Cross Modulation	dB	80	
Composite Second Order	dB	82	
Station Performance – Reverse			
(Station port input to optical transmitter input)	Units		
Operational Gain (minimum)	dB	17.5	19,20

Station Delay Characteristics 40 / 52 Split			
Forward (Chrominance to Luminance Delay)		Reverse (Group Delay in 1.5 MHz BW)	
Frequency (MHz)	Delay (nS)	Frequency (MHz)	Delay (nS)
55.25 - 58.83	26	5.0 - 6.5	60
61.25 - 64.83	12	6.5 - 8.0	21
67.25 - 70.83	8	8.0 - 9.5	12
77.25 - 80.23	4	35.5 - 37.0	17
		37.0 - 38.5	23
		38.5 - 40.0	42

Notes for Redundant Mode RF Section Specifications:

13. Reference output tilt and internal tilt are both "Linear" tilt.
14. Forward Gain and Noise Figure measured with a 0 dB EQ and 0 dB pad in the RF Redundancy module located in the housing lid.
15. Forward internal tilt specified is primarily due to an on-board equalizer and a factory configured 8.5 dB linear interstage equalizer (ISEQ).
16. The forward reference output tilt specified is achieved via field installation of appropriate input EQ, in conjunction with the internal tilt of the launch amplifier.
17. Stated distortion performance is for launch amplifier section operated at reference output levels and tilt.
18. Reverse output reference level at the RF output of the launch amplifier.
19. Reverse Operational Gain, Noise Figure, and Return Loss are specified without reverse switch option. Reverse Switch option will not work in this configuration.
20. Station reverse gain from station input(s) to redundant RF output. With 0 dB reverse input pad, 1 dB reverse output pad, and 0 dB reverse EQ in launch amplifier. Includes optical interface board and redundant module losses.
21. "Digital" refers to 550 - 1002 MHz loading with QAM carriers at -6 dB relative to analog video carrier levels.
22. "Digital" refers to 650 - 1002 MHz loading with QAM carriers at -6 dB relative to analog video carrier levels.
23. Reverse Gain and Noise Figure for launch amp with 0 dB reverse input pad, 0 dB reverse output EQ, and 1 dB output pad.

Unless otherwise noted, specifications reflect typical performance and are referenced to 68°F (20°C). Specifications are based upon measurements made in accordance with SCTE/ANSI standards (where applicable), using standard frequency assignments.

Specifications, continued

Electrical	Units				Notes
Max. AC Through Current (continuous)	Amps	15			
Max. AC Through Current (surge)	Amps	25			
Component DC Power Consumption (typical)		@ +24 VDC	@ +15 VDC	@ -6 VDC	1
Launch Amplifier HGBT (thermal)	Amps	1.51	-	-	
Standard Optical Receiver	Amps	0.25	0.01	0.035	
Reverse Transmitter – Standard FP	Amps	0.14	-	0.07	
Reverse Transmitter – Standard DFB	Amps	0.14	-	0.09	
Power Supply DC Current Rating	Amps	3.0	0.05	0.3	1

Station Powering Data													
GainMaker HGBT Node	I _{DC} (Amps at 24 V DC)		AC Voltage										
			90	85	80	75	70	65	60	55	50	45	40
1 RX, 1 TX, & Stat Mon	2.5	AC Current (A)	0.98	1.02	1.01	1.05	1.09	1.16	1.32	1.41	1.54	1.71	1.93
		Power (W)	70.8	70.7	70.5	70.4	70.2	70.2	70.4	70.4	70.4	70.6	70.8

Data is based on stations configured for 2-way operation with status monitoring transponder. AC currents specified are based on measurements made with typical CATV type ferro-resonant AC power supply (quasi-square wave), and standard version DC power supply.

DC supply has a user configurable 40 V or 50 V AC under-voltage lockout circuit.

Note:

- The total DC Power consumption of installed components should not exceed the power supply DC current rating.

Environmental	Units	
Operating Temperature Range	degrees	-40°F to 140°F (-40°C to 60°C)
Relative Humidity Range	percent	5% to 95%
Mechanical		
Housing Dimensions	Weight	
17.5 in. L x 7.3 in. H x 7.5 in. D (445 mm L x 185 mm H x 191 mm D)	Station with 1 RX, 1 TX, & power supply: 22 lbs (9.9 kg)	

Unless otherwise noted, specifications reflect typical performance and are referenced to 68°F (20°C). Specifications are based upon measurements made in accordance with SCTE/ANSI standards (where applicable), using standard frequency assignments.

Ordering Information

The GainMaker Node is available in a wide variety of configurations. The GainMaker Ordering Matrix provides ordering information for configured node stations, existing amp to node upgrade kits, and launch amplifiers. This page contains ordering information for required and optional accessories. Please consult with your Account Representative, Customer Service Representative, or Applications Engineer to determine the best configuration for your particular application.

Required Accessories for RF Module	Part Number
Plug-in Pads (attenuators) - Available in 0.5 dB steps from 0 to 20 dB 1 required for AGC, if applicable* 4 required for reverse (3 input, 1 output) *To determine AGC pad value, subtract 34dB from the design value main port RF output level at the AGC pilot frequency.	589693 (0 dB) sequentially thru 589734 (20.5dB)
Plug-in Forward Equalizer - Available in 1.5 dB steps from 0 to 30 dB at 1002 MHz 1 required for RF redundant module	4007228 (0 dB) sequentially thru 4007248 (30 dB)
Plug-in Reverse Equalizer – Available in 1 dB steps from 0 to 12 dB at 40 MHz 1 required for reverse output - unless design value is 0 dB (0 dB EQ is provided)	712719 (0 dB) and 589628 (1 dB) sequentially thru 589639 (12 dB)
Plug-in Forward Equalizer for RF redundant module - Available in 1 dB steps from 0 to 12 dB at 40 MHz 1 required for RF redundant module (unless design value is 0 dB which is provided)	4009826 (0 dB) and 545107 (1 dB) sequentially thru 545118 (12 dB)

Required Accessories for Optical Components	Part Number
Plug-in Pads (attenuators) - Available in 0.5 dB steps from 0 to 20.5 dB 1 ea required for Transmitter and Receiver(s). 1 ea required for RF Redundant Mode – redundant forward path 1 ea required for Optical Interface Board – redundant reverse path	279500 (0 dB) sequentially thru 279513 (13 dB) in 1 dB steps
	504151 (14 dB) sequentially thru 504157 (20 dB) in 1 dB steps
	565231 (0.5 dB) sequentially thru 565251 (20.5 dB) in 1 dB steps

Ordering Information, continued

Optical Receivers (available as part of configuration or separately)	Part Number on Module	Part Number for Ordering
GainMaker Node Optical Receiver with SC/APC Connector	4007501	4007671
GainMaker Node Optical Receiver with SC/UPC Connector	4007502	4007672
GainMaker Node Optical Receiver with FC/APC Connector	4007503	4007673
Optical Transmitters (available as part of configuration or separately)	Part Number on Module*	Part Number for Ordering*
<i>All listed below are Thermally Compensated Transmitters</i>		
GainMaker Node FP Optical Transmitter with SC/APC Connector	717904	590930
GainMaker Node FP Optical Transmitter with SC/UPC Connector	717905	590931
GainMaker Node FP Optical Transmitter with FC/APC Connector	717902	590928
1310 nm DFB Optical Transmitter – Standard Gain, with SC/APC connector	4013903.1310	590934
1310 nm DFB Optical Transmitter – Standard Gain, with SC/UPC connector	4013904.1310	590935
1310 nm DFB Optical Transmitter – Standard Gain, with FC/APC connector	4013905.1310	590932
1470 nm CWDM DFB Optical Transmitter – Standard Gain with SC/APC connector	4013903.1470	4006971
1490 nm CWDM DFB Optical Transmitter – Standard Gain with SC/APC connector	4013903.1490	4006972
1510 nm CWDM DFB Optical Transmitter – Standard Gain with SC/APC connector	4013903.1510	4006973
1530 nm CWDM DFB Optical Transmitter – Standard Gain with SC/APC connector	4013903.1530	4006974
1550 nm CWDM DFB Optical Transmitter – Standard Gain with SC/APC connector	4013903.1550	4006975
1570 nm CWDM DFB Optical Transmitter – Standard Gain with SC/APC connector	4013903.1570	4006976
1590 nm CWDM DFB Optical Transmitter – Standard Gain with SC/APC connector	4013903.1590	4006977
1610 nm CWDM DFB Optical Transmitter – Standard Gain with SC/APC connector	4013903.1610	4006978
1470 nm CWDM DFB Optical Transmitter – Standard Gain with SC/UPC connector	4013904.1470	4006979
1490 nm CWDM DFB Optical Transmitter – Standard Gain with SC/UPC connector	4013904.1490	4006980
1510 nm CWDM DFB Optical Transmitter – Standard Gain with SC/UPC connector	4013904.1510	4006981
1530 nm CWDM DFB Optical Transmitter – Standard Gain with SC/UPC connector	4013904.1530	4006982
1550 nm CWDM DFB Optical Transmitter – Standard Gain with SC/UPC connector	4013904.1550	4006983
1570 nm CWDM DFB Optical Transmitter – Standard Gain with SC/UPC connector	4013904.1570	4006984
1590 nm CWDM DFB Optical Transmitter – Standard Gain with SC/UPC connector	4013904.1590	4006985
1610 nm CWDM DFB Optical Transmitter – Standard Gain with SC/UPC connector	4013904.1610	4006986
1470 nm CWDM DFB Optical Transmitter – Standard Gain with FC/APC connector	4013905.1470	4006987
1490 nm CWDM DFB Optical Transmitter – Standard Gain with FC/APC connector	4013905.1490	4006988
1510 nm CWDM DFB Optical Transmitter – Standard Gain with FC/APC connector	4013905.1510	4006989
1530 nm CWDM DFB Optical Transmitter – Standard Gain with FC/APC connector	4013905.1530	4006990
1550 nm CWDM DFB Optical Transmitter – Standard Gain with FC/APC connector	4013905.1550	4006991
1570 nm CWDM DFB Optical Transmitter – Standard Gain with FC/APC connector	4013905.1570	4006992
1590 nm CWDM DFB Optical Transmitter – Standard Gain with FC/APC connector	4013905.1590	4006993
1610 nm CWDM DFB Optical Transmitter – Standard Gain with FC/APC connector	4013905.1610	4006994
Related Equipment (available as part of configuration or separately)	Part Number on Module	Part Number for Ordering
GainMaker Node - Standard DC Power Supply 40 - 90 V AC	744160	4018686
GainMaker - Crowbar Surge Protector	715973	4007682



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Scientific-Atlanta, Inc.
 1-800-722-2009 or 770-236-6900
www.scientificatlanta.com

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