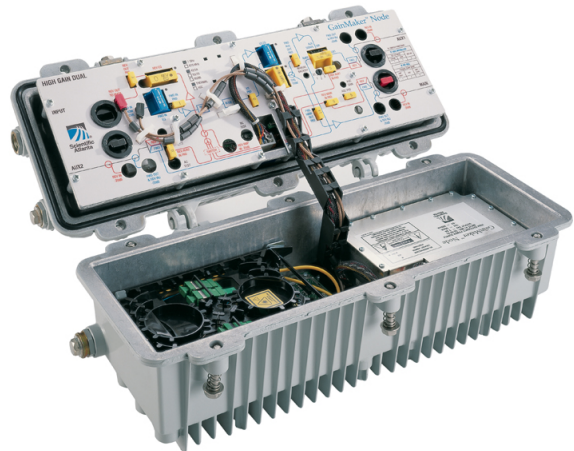


Optoelectronics

## GainMaker<sup>®</sup> Optoelectronic Node 1 GHz with 55/70 MHz Split

### Description

The GainMaker<sup>®</sup> 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<sup>®</sup> Optical components. Available with two or three high level RF output ports, 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 the full complement of functions required by advanced networks.



The GainMaker Node accommodates a second forward receiver with an RF switch to accommodate forward path optical redundancy. Reverse traffic can be combined and routed to FP, DFB, or CWDM reverse transmitters. The High Gain Dual launch amplifier module provides two high-level outputs (with the ability to split one internally to feed a third port). Additionally, the GainMaker Node is available with an optional custom status monitoring transponder for use with Scientific-Atlanta's ROSA / TNCS status monitoring and control element manager. On-board temperature, automatic gain control (AGC) levels, RF switch position, power supply condition, as well as other features/parameters can be monitored through this transponder.

Installation of the GainMaker Node is quick and easy. The GainMaker Node can be ordered as a complete node or as an upgrade kit for existing GainMaker System amplifiers. 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.

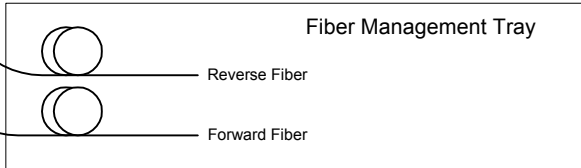
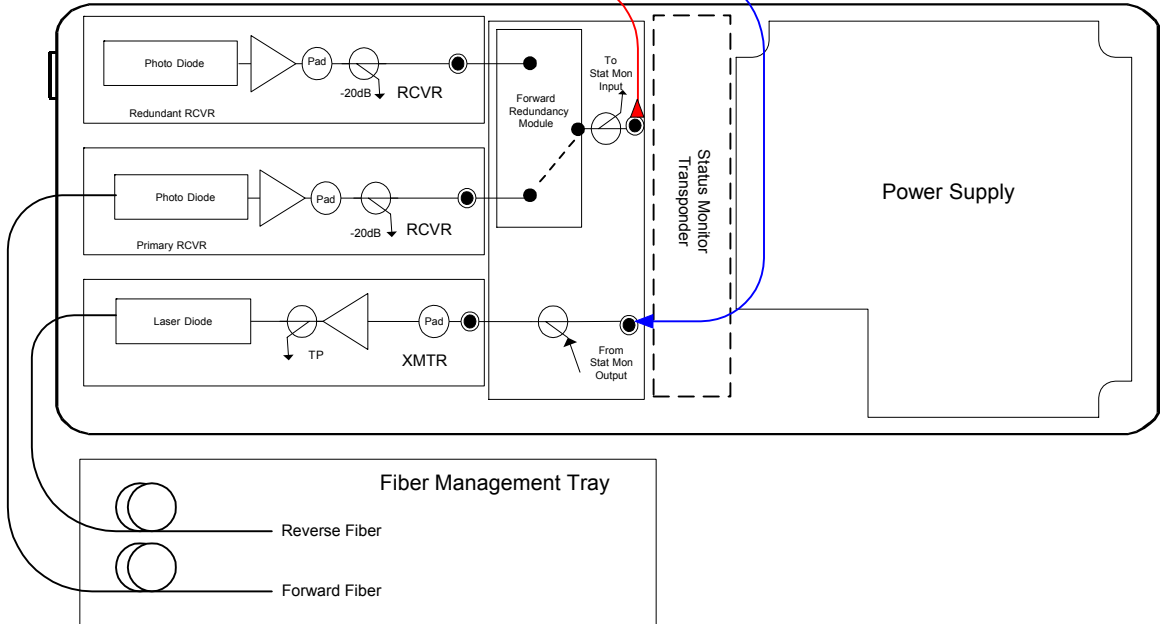
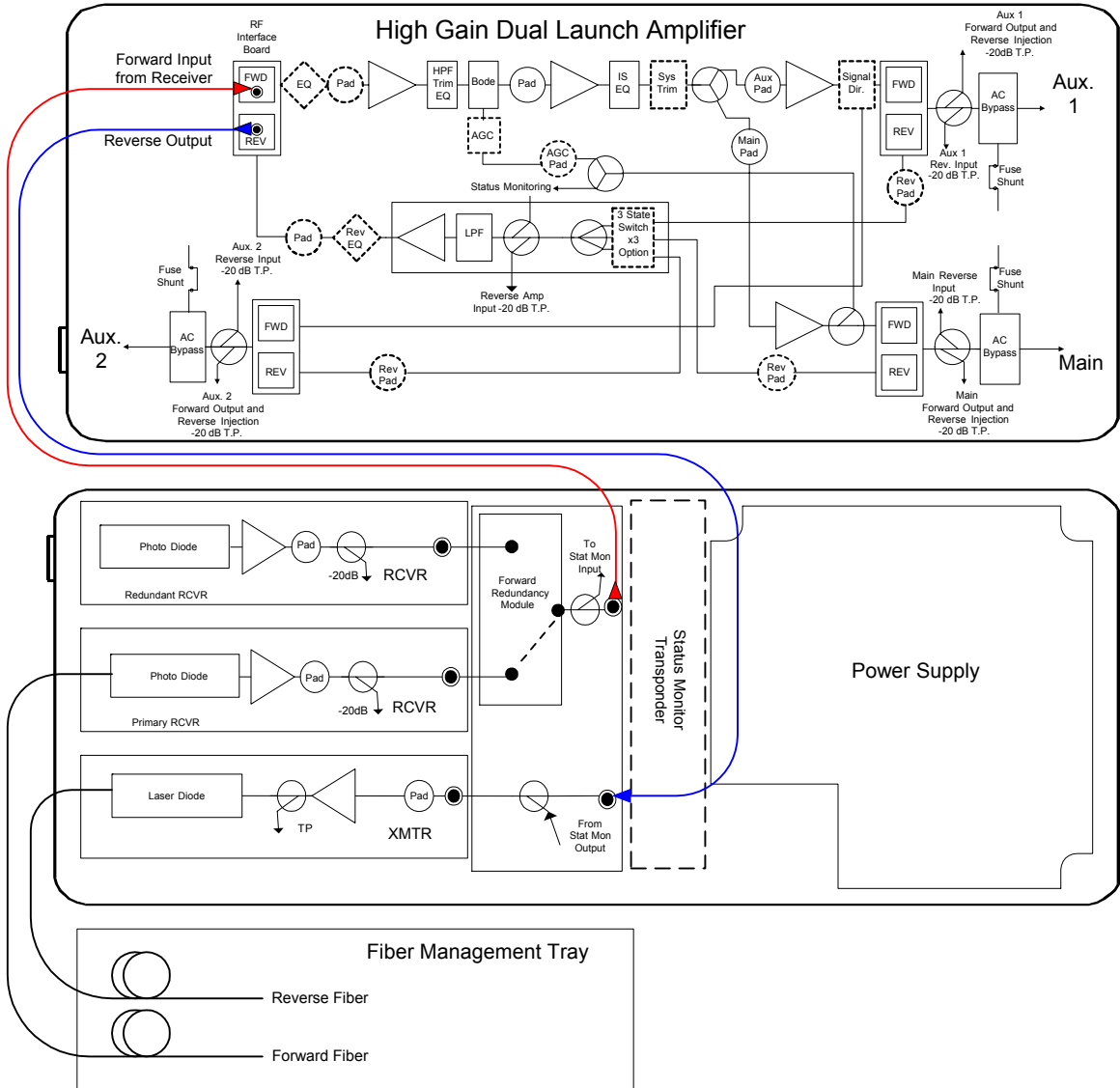
System reliability and upgrade flexibility are integral to the construction of the GainMaker Node. Key features include a chromate plated housing to withstand harsher operating environments, local status monitoring of each module, and a 1 GHz housing for future higher bandwidth applications.

### Features

- Forward redundancy with two 1310/1550 nm optical receivers (optional)
- Fiber management tray provides fiber and connector storage for up to 4 connector pairs
- Local test points and LED indicators on optical receivers, transmitters, and optical interface board simplify installation and maintenance
- Optional 3-state reverse switch (on/off/-6 dB) allows each reverse input to be isolated for noise and ingress troubleshooting (status monitoring required)
- The GainMaker node uses plug-in accessories common to all GainMaker products
- AGC has thermal mode, eliminating disruptive RF output variation in the event of pilot loss
- Reverse input pad and RF test point for each reverse input port on GainMaker launch amplifier allow optimum reverse path design and alignment

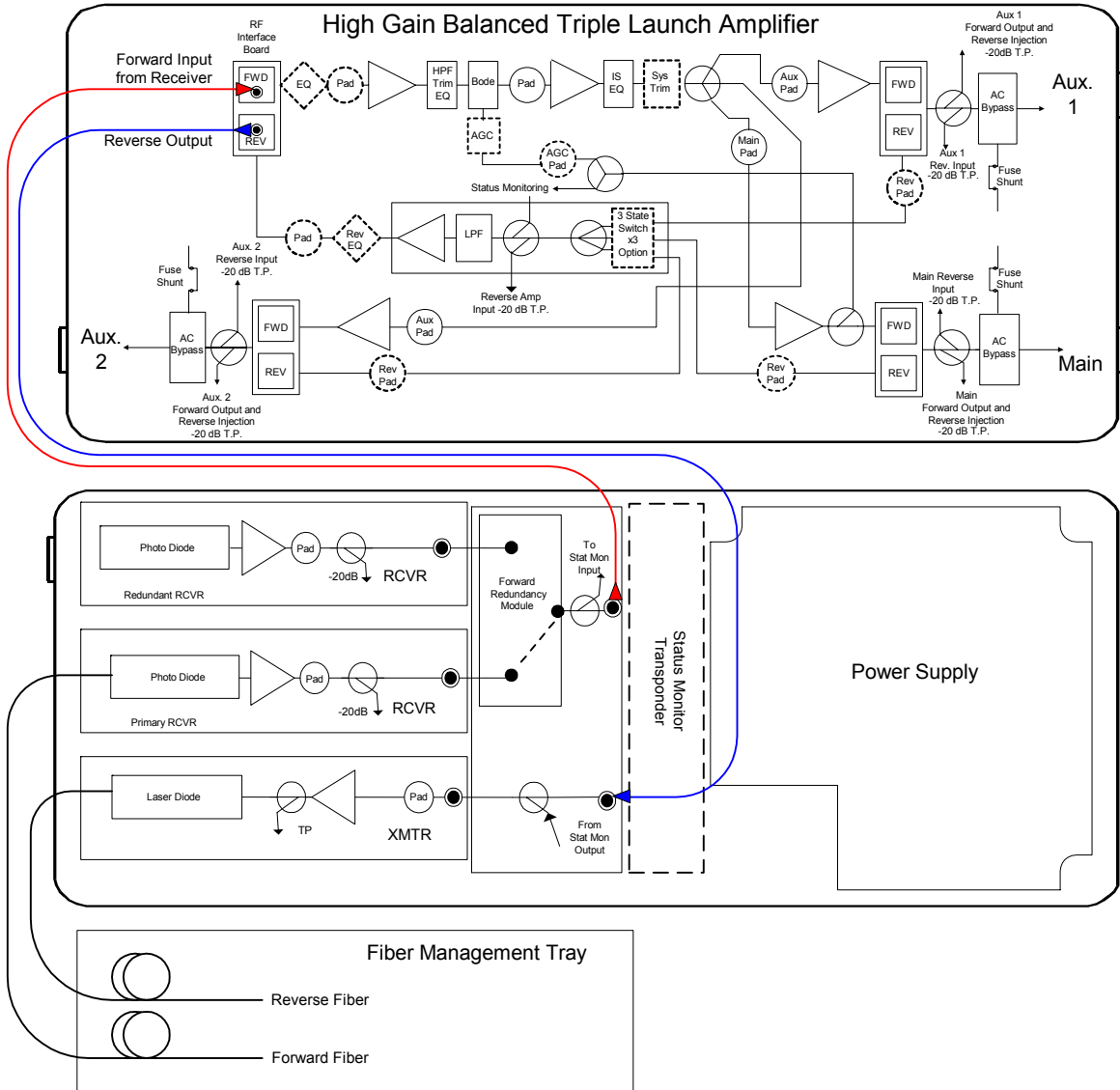
## Block Diagrams

### High Gain Dual (HGD)



## Block Diagrams

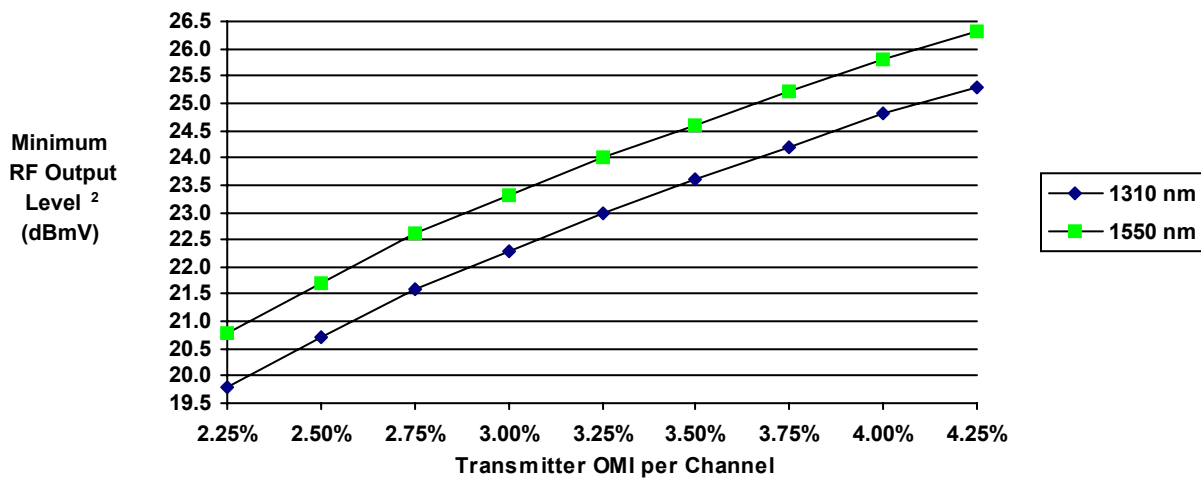
### High Gain Balanced Triple (HGBT)



## Optical Section Specifications

Optical Section - Forward Receiver Module	Units	GainMaker Standard RX	Notes
Wavelength	nm	1310 and 1550	
Optical Input Range	mW	0.5 to 1.6	
	dBm	-3 to +2	
Pass Band	MHz	52-1002	
Frequency Response	dB	± 0.75	1
Tilt (± 1.0 dB)	dB	0	
Optical Input Test Point (± 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	

**Receiver RF Output Level Vs Transmitter OMI**



**Notes for Optical Section Specifications:**

1. For forward receiver module only. Does not include frequency response contributions from forward optical transmitter.
2. 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

General Station Performance	Units	Forward	Reverse	Notes
Pass Band	MHz	70-1002	5-55	
Return Loss	dB	16	16	7
Hum Modulation @ 12 A	dB	70 (70-870 MHz) 60 (870-1002 MHz)	60 (5-10 MHz) 70 (11-55 MHz)	
Hum Modulation @ 15 A	dB	65 (70-870 MHz) 60 (870-1002 MHz)	60 (5-10 MHz) 65 (11-55 MHz)	
Test Points (±0.5 dB)	dB	-20	-20	

Launch Amplifier Performance - Forward	Units	HGD	HGBT	Notes
Operational Gain (minimum)	dB	43	41	2
Frequency Response	dB	±0.5	±0.5	
Internal Tilt (±1 dB)	dB	14.3	14.3	1,3
Noise Figure @...	dB			2
	70 MHz	8.5	8.5	
	1002 MHz	8.0	8.0	
Reference Output Levels @...	dBmV			
	1002 MHz	49.5	49.5	
	870 MHz	47.5	47.5	
	750 MHz	45.7	45.7	
	650 MHz	44.0	44.0	
	550 MHz	42.5	42.5	
	70 MHz	35.3	35.3	
Reference Output Tilt (70-1002 MHz)	dB	14.2	14.2	1,4
<b>64 PAL B/G channels (CW) with digital</b>				<b>10</b>
Composite Triple Beat	dB	81	79	5
Cross Modulation	dB	73	70	5,15
Composite Second Order (high side)	dB	70	70	5
<b>64 PAL I channels (CW) with digital</b>				<b>11</b>
Composite Beat	dB	74	72	5
Cross Modulation	dB	72	69	5,15
<b>42 CENELEC channels (CW)</b>				<b>14</b>
Composite Triple Beat	dBuV	113.5	112.5	
Cross Modulation	dBuV	112.5	111.5	
Composite Second Order (high side)	dBuV	115.0	115.0	
<b>78 NTSC channels (CW) with digital</b>				<b>9</b>
Composite Triple Beat	dB	80	78	5
Cross Modulation	dB	72	69	5,15
Composite Second Order (high side)	dB	70	70	5

Forward Insertion Loss Optical Interface Board and Plug-Ins (Loss from specified optical receiver RF output to launch amplifier RF input)	Units	with Redundancy Module installed	Notes
Receiver position 1	dB	1.5	12
Receiver position 2	dB	1.5	12

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, continued

Launch Amplifier Performance - Reverse	Units	Reverse	Notes
Amplifier Type	-	Push-Pull	
Operational Gain (minimum)	dBmV	19.5	7,13
Frequency Response	dB	±0.5	
Internal Tilt (+/- 1 dB)	dB	-0.5	
Noise Figure	dB	14.5	7,13
Reference Output Levels @ 5 and 42 MHz	dBmV	35	6
<b>6 NTSC Channels (CW)</b>			
Composite Triple Beat	dB	92	
Cross Modulation	dB	80	13
Composite Second Order	dB	82	
<b>Station Performance – Reverse</b>			
(Station port input to optical transmitter input)	<b>Units</b>		
Operational Gain (minimum)	dB	17.5	7,8

Station Delay Characteristics			
Forward (Chrominance to Luminance Delay)		Reverse (Group Delay in 1.5 MHz bandwidth)	
Frequency (MHz)	Delay (ns)	Frequency (MHz)	Delay (ns)
71.25 - 75.68	15	5.0 - 6.5	29
76.25 - 80.68	8	6.5 - 8.0	13
83.25 - 87.68	3	8.0 - 9.5	8
112.25 - 116.68	2	50.5 - 52.0	9
		52.0 - 53.5	15
		53.5 - 55.0	27

- Notes for RF Section Specifications:**
- Reference output tilt and internal tilt are both “Linear” tilt.
  - Forward Gain and Noise Figure measured with 0 dB input EQ and 1 dB input pad.
  - 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.
  - Loaded with 78 NTSC CW carriers from 77-550 MHz. “Digital” refers to 550 - 1002 MHz loading with QAM carriers at -6 dB relative to analog video carrier levels.
  - Loaded with 64 PAL B/G CW carriers from 112-600 MHz. “Digital” refers to 600 - 1002 MHz loading with QAM carriers at -6 dB relative to analog video carrier levels.
  - Loaded with 64 PAL I CW carriers from 88-600 MHz. “Digital” refers to 600 - 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.
  - Tested per CENELEC Standard EN50083-3. RF output level is at 870 MHz (forward).
  - X-mod (@ 15.75 kHz) specified using 100% synchronous modulation and frequency selective measurement device.

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			
<b>Component DC Power Consumption (typical)</b>		<b>@ +24 VDC</b>	<b>@ +15 VDC</b>	<b>@ -6 VDC</b>	<b>1</b>
Launch Amplifier High Gain Dual (thermal)	Amps	1.51	-	-	
Status Monitoring Transponder	Amps	0.15	-	-	
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 HGD Node	I <sub>DC</sub> (Amps at 24 V DC)		AC Voltage										
			90	85	80	75	70	65	60	55	50	45	40
1 or 2 RX, 1 TX, & Stat Mon	2.1	AC Current (A)	0.89	0.91	0.90	0.91	0.93	0.98	1.12	1.19	1.30	1.43	1.62
		Power (W)	60.1	60.0	59.8	59.7	59.6	59.5	59.6	59.6	59.6	59.7	59.8
GainMaker HGBT Node	I <sub>DC</sub> (Amps at 24 V DC)		AC Voltage										
			90	85	80	75	70	65	60	55	50	45	40
1 or 2 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 20.5 dB <ul style="list-style-type: none"> <li>• 1 required for forward input</li> <li>• 1 required for AGC, if applicable*</li> <li>• 4 required for reverse (3 input, 1 output)</li> </ul> *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 <ul style="list-style-type: none"> <li>• 1 required for forward input</li> </ul>	4007228 (0 dB) sequentially thru 4007248 (30 dB)
Plug-in Reverse Equalizer – Available in 1 dB steps from 0 to 12 dB at 55 MHz <ul style="list-style-type: none"> <li>• 1 required for reverse output - unless design value is 0 dB (0 dB EQ is provided)</li> </ul>	712719 (0 dB) and 712679 (1 dB) sequentially thru 712690 (12 dB)
Plug-In Signal Director for Auxiliary output – 1 required (HGD only), choose from below: <ul style="list-style-type: none"> <li>• Jumper</li> <li>• 2-way Splitter</li> <li>• DC-8 Directional Coupler</li> <li>• DC-12 Directional Coupler</li> </ul>	4008208 4008364 4008365 4008366

Required Accessories for Optical Components	Part Number
Plug-in Pads (attenuators) - Available in 0.5 dB steps from 0 to 20.5 dB <ul style="list-style-type: none"> <li>• 1 ea required for Transmitter and Receiver(s).</li> </ul>	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

<b>Optical Receivers</b> (available as part of configuration or separately)	<b>Part Number on Module</b>	<b>Part Number for Ordering</b>
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
<b>Optical Transmitters</b> (available as part of configuration or separately)	<b>Part Number on Module*</b>	<b>Part Number for Ordering*</b>
<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

<b>Related Equipment</b> (available as part of configuration or separately)	<b>Part Number on Module</b>	<b>Part Number for Ordering</b>
GainMaker Node - Standard DC Power Supply 40 - 90 V AC	744160	4018686
GainMaker - Crowbar Surge Protector	715973	4007682
GainMaker Reverse RF Switch	-	589347
GainMaker Node Status Monitoring Transponder (See Transponder Data Sheet)	744234	4018687



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