

## Cisco GainMaker High Output High Gain Balanced Triple 1 GHz System Amplifier 5-85/102-1002 MHz

Consumer bandwidth demand continues to grow at a rapid rate every year. As a result, cable operators with DOCSIS<sup>®</sup>-based equipment have begun introducing fiber deeper and deeper into the network. They want to reduce service group sizes and ultimately double, triple, or quadruple bandwidth speeds. The Cisco<sup>®</sup> GainMaker<sup>®</sup> GaAs High Gain Balanced Triple (HGBT) System Amplifier is ideal for deep fiber applications. With higher output levels, up to 56 dBmV, and significantly improved linearity and performance, this amplifier meets longer reach needs. The GaAs also continues Cisco's legacy of simple, reliable and fast installation and setup. What's more, the Cisco GaAs HGBT System Amplifier scales to meet the needs of the HFC network architecture (one product for all amplifier applications).

The amplifier provides three high-level forward RF outputs - main and auxiliary. All Cisco GainMaker products share common plug-in accessories and perform to 1 GHz in the forward path. The system amplifiers in this portfolio provide multiple forward RF output ports while the line extenders provide a single forward RF output port.

Cisco GainMaker 1 GHz system amplifier modules have increased gain to allow drop in for 750-MHz spacing and are mechanically compatible with previous Cisco GainMaker System Amplifier II, II+, and III housing bases, often allowing upgrade to higher bandwidth with no respacing or resplicing. The DC power supply is modular and located in an updated housing lid for easy access. All Cisco GainMaker 1 GHz system amplifier modules are factory configured with reverse amplifier, diplex filters, thermal compensation circuit, forward interstage pads, and equalizer to promote optimal performance. Optional single-pilot automatic gain control (AGC) configurations are also available.

**Figure 1.** The Cisco GainMaker HGBT System Amplifier

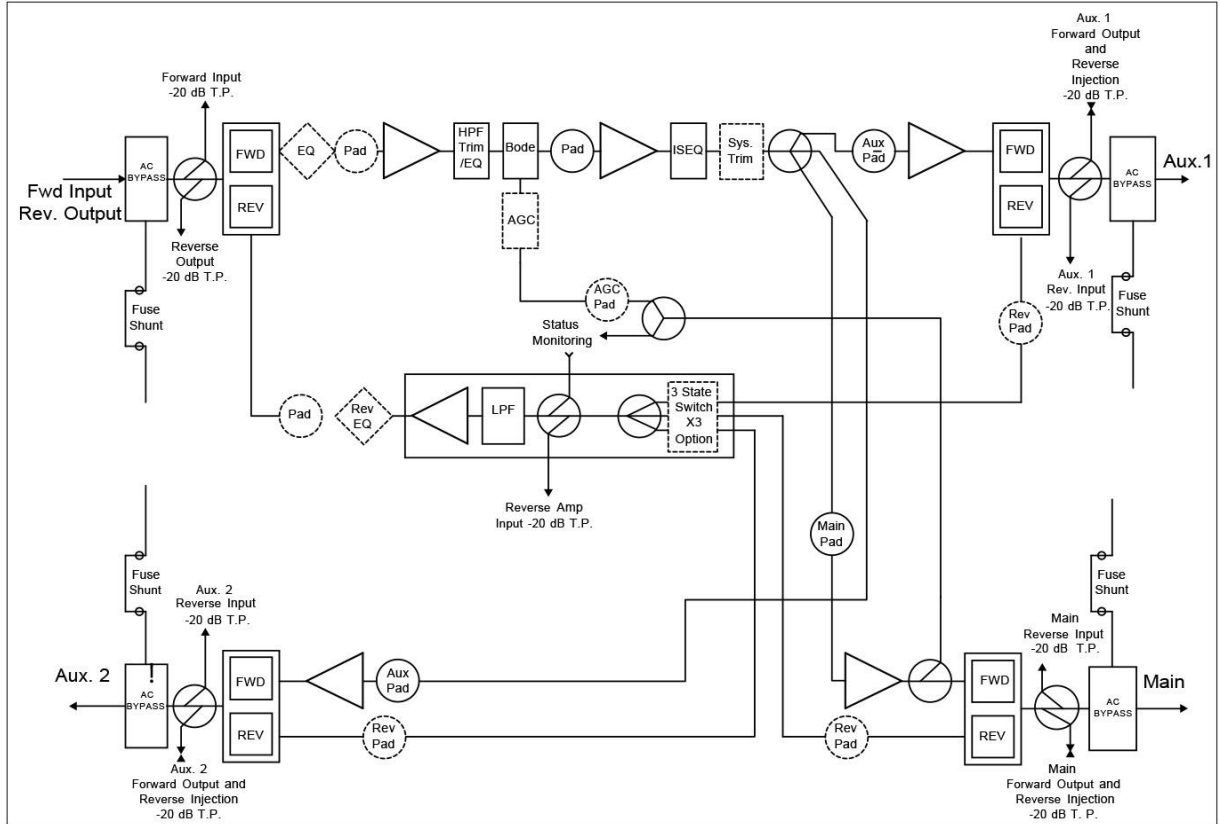


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## Features

- Capable of higher output levels than standard GainMaker amplifiers
- Common RF test points for forward output and reverse injection simplify reverse balancing
- Increased forward gain to facilitate drop-in bandwidth extensions without re-spacing
- High-performance GaAsFET gain stage technology
- Fixed-value, plug-in accessories are common to all GainMaker products
- 60 and 90 volt AC powering capability
- 15 ampere current capacity (steady state) and 25 ampere surge survivability
- Optional 3-state reverse switch (on/off/-6 dB) allows each reverse input to be isolated for noise and ingress troubleshooting (status monitoring required)
- AGC has Thermal backup, which eliminates disruptive RF output variation in the event of pilot loss
- QAM Pilot AGC now available in addition to existing analog carrier AGCs
- Improved hum modulation
- Plug-in, self-contained diplex filters
- Modular high-efficiency power supply allows simplified maintenance
- Reverse input pad and RF test point for each reverse input port allow optimum reverse path design and alignment
- Directional Coupler RF test points provide best accuracy
- Surge resistant circuitry ensures gain stage protection without fuses or other nuisance failure causing devices

Figure 2. Block Diagram



## Specifications

| General Station Performance                                       | Units | Forward                               | Reverse                         | Notes |
|---|-------|---------------------------------------|---------------------------------|-------|
| <b>Pass Band</b>  | MHz   | 105-1002                              | 5-85                            | 9     |
| <b>Amplifier Type</b>   | -     | GaAs FET                              | PP                              |       |
| <b>Frequency Response</b>   | dB    | ± 0.5                                 | ± 0.5                           |       |
| <b>Auto Slope and Gain Range</b>                                  | dB    | ± 5.5                                 | n/a                             |       |
| <b>Return Loss</b>  | dB    | 16                                    | 16                              | 7     |
| <b>Max AC Through Current (continuous)</b>                        | A     | 15                                    | -                               |       |
| <b>Max AC Through Current (surge)</b>                             | A     | 25                                    | -                               |       |
| <b>Hum Modulation @ 12 A<br/>(over specified frequency range)</b> | dB    | 70 (105-870 MHz)<br>60 (870-1002 MHz) | 60 (5-10 MHz)<br>70 (11-85 MHz) |       |
| <b>Hum Modulation @ 15 A<br/>(over specified frequency range)</b> | dB    | 65 (105-870 MHz)<br>60 (870-1002 MHz) | 60 (5-10 MHz)<br>65 (11-85 MHz) |       |
| <b>Test Points (± 0.5 dB)</b>                                     | dB    | -20                                   | -20                             |       |

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.

| General Station Performance          |          | Units | Forward | Reverse       | Notes |
|--------------------------------------|----------|-------|---------|---------------|-------|
| Reference Output Level @...          | 1002 MHz | dBmV  | 56.0    | 35 (@ 85 MHz) |       |
|                                      | 870 MHz  |       | 54.0    |               |       |
|                                      | 750 MHz  |       | 52.2    |               |       |
|                                      | 650 MHz  |       | 50.5    |               |       |
|                                      | 550 MHz  |       | 49.0    |               |       |
|                                      | 105 MHz  |       | 42.3    | 35 (@ 5 MHz)  |       |
| Reference Output Tilt (105-1002 MHz) |          | dB    | 13.7    | -             | 1     |

| Forward Station Performance           | Units | Auto/Thermal with 10.5 dB I/S EQ | Notes |
|---------------------------------------|-------|----------------------------------|-------|
| Operational Gain (minimum)            | dB    | 41                               | 2, 9  |
| Internal Tilt ( $\pm 0.5$ dB)         | dB    | 13.8                             | 3     |
| Noise Figure @ 54 MHz                 | dB    | 8.5                              | 2     |
| Noise Figure @ 1 GHz                  | dB    | 8.0                              | 2     |
| 73 NTSC channels (CW) with digital    |       |                                  | 4     |
| Composite Triple Beat                 | dB    | 65                               | 9     |
| Cross Modulation                      | dB    | 59                               | 5, 9  |
| Composite Second Order (high side)    | dB    | 64                               | 9     |
| Composite Intermodulation Noise (CIN) | dB    | 57                               | 8, 9  |

| Reverse Station Performance        | Units |      | Notes |
|------------------------------------|-------|------|-------|
| Operational Gain (minimum)         | dB    | 19.5 | 6, 7  |
| Internal Tilt ( $\pm 0.5$ dB)      | dB    | -0.5 | 3     |
| Noise Figure                       | dB    | 12   | 6, 7  |
| 6 NTSC Channels (CW)               |       |      |       |
| Composite Triple Beat              | dB    | 92   | 9     |
| Cross Modulation                   | dB    | 80   | 5, 9  |
| Composite Second Order (high side) | dB    | 82   | 9     |

| Station Delay Characteristics            |            |  |            |
|--|------------|--|------------|
| Forward (Chrominance to Luminance Delay) |            | Reverse (Group Delay in 1.5 MHz Bandwidth) |            |
| Frequency (MHz)                          | Delay (nS) | Frequency (MHz)                            | Delay (nS) |
| 109.25-112.83                            | 13         | 5.0-6.5                                    | 60         |
| 115.25-118.83                            | 7          | 6.5-8.0                                    | 22         |
| 121.25-124.83                            | 5          | 8.0-9.5                                    | 12         |
|  |            | 80.5-82.0                                  | 10         |
|  |            | 82.0-83.5                                  | 13         |
|  |            | 83.5-85.0                                  | 18         |

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.

| Station Powering Data                 |             |                |            |      |      |      |      |      |      |      |      |      |      |      |
|---------------------------------------|-------------|----------------|------------|------|------|------|------|------|------|------|------|------|------|------|
| GainMaker High Output HGBT            | I DC (Amps) |                | AC Voltage |      |      |      |      |      |      |      |      |      |      |      |
|                                       |             |                | 90         | 85   | 80   | 75   | 70   | 65   | 60   | 55   | 50   | 45   | 40   | 35   |
| Thermal                               | 2.21        | AC Current (A) | 0.86       | 0.88 | 0.88 | 0.89 | 0.93 | 0.98 | 1.21 | 1.25 | 1.37 | 1.52 | 1.72 | 2.01 |
|                                       |             | Power (W)      | 59.6       | 59.6 | 59.8 | 59.1 | 59.2 | 59.3 | 59.0 | 59.1 | 59.1 | 59.5 | 59.6 | 60.2 |
| AGC                                   | 2.27        | AC Current (A) | 0.87       | 0.90 | 0.90 | 0.92 | 0.95 | 1.01 | 1.24 | 1.26 | 1.39 | 1.54 | 1.75 | 2.05 |
|                                       |             | Power (W)      | 60.7       | 61.2 | 61.2 | 60.6 | 60.4 | 61.2 | 60.6 | 60.6 | 60.7 | 60.9 | 61.5 | 62.0 |
| AGC with Status Mon. & Reverse Switch | 2.41        | AC Current (A) | 0.91       | 0.94 | 0.94 | 0.97 | 1.01 | 1.08 | 1.34 | 1.38 | 1.50 | 1.64 | 1.90 | 2.25 |
|                                       |             | Power (W)      | 64.7       | 65.2 | 64.9 | 65.0 | 64.6 | 64.2 | 64.7 | 65.1 | 65.0 | 65.2 | 65.0 | 65.9 |

Data is based on stations configured for 2-way operation. AC currents specified are based on measurements made with typical CATV type ferroresonant AC power supply (quasi-square wave), and Cisco GainMaker HGBT System Amplifier power supply (2.5 A, 24 VDC, pn 4026517).

DC supply has a user configurable 30 V, 40 V, or 50 VAC under voltage lockout circuit. Default setting is 30 V. 40 V or 50 VAC under voltage lockout may be selected by changing the position of the lockout jumper.

**Notes:**

1. Reference output tilt is specified as "LINEAR" tilt (as opposed to "cable" tilt).
2. Forward Gain and Noise Figure measured with 0 dB input EQ and 1 dB input pad.
3. Down tilt, the effect of cable, is represented by a (-). Up tilt, the effect of equalization, is represented by a (+).
4. 73 CW NTSC channels loaded from 115 to 550 MHz. Digital refers to 550-1002 MHz loading with QAM carriers at -6 dB levels relative to analog video carrier levels.
5. X-mod (@ 15.75 kHz) specified using 100% synchronous modulation and frequency selective measurement device.
6. Reverse Gain and Noise Figure for station with 0 dB reverse input pad, 0 dB reverse output EQ, and 1 dB output pad.
7. 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.
8. Composite Intermodulation Noise is a broadband noise-like distortion product associated with QAM loading. Distortion performance at reference output levels and tilt. Consult Cisco Systems Engineering for CIN calculation.
9. The gain at 102 MHz is < 1.5 dB below the gain at 105 MHz. 102 to 105 MHz is recommended for out of band communication only. No video carriers should be used between 102 and 105 MHz.

| Environmental                      | Value  |
|------------------------------------|--|
| <b>Operating Temperature Range</b> | -40 -140°F (-40 -60°C)   |
| <b>Mechanical</b>                  |  |
| <b>Housing Dimensions</b>          | 17.3 in. L x 7.2 in. H x 7.8 in. D<br>439.4 mm L x 182.9 mm H x 198.1 mm D |
| <b>Weight</b>                      |  |
| • Housing with power supply        | 12 lbs, 5 oz. (5.6 kg)   |
| • Module                           | 5 lbs, 5 oz. (2.4 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 Cisco GainMaker High Output High Gain Balanced Triple Amplifier is available in a wide variety of configurations. The desired configuration is “built” by accessing the Cisco Commerce Workspace tool at <https://cisco-apps.cisco.com/cisco/psn/commerce>. The user specifies the new Assemble To Order (ATO) Product ID for the Cisco GainMaker System Amplifier High Gain Balanced Triple “GMSA-HGBT” and the tool steps through the available options. Services may also be selected during this process. Once all the desired options are selected, the configuration and price are displayed. When the “Done” radio button is clicked, the configuration can be exported and saved for future use or immediate ordering.

This page contains ordering information for required and optional accessories. Please consult with your Account Representative, Customer Service Representative, or System Engineer to determine the best configuration for your particular application.

The following **Required Accessories** must be ordered separately:

| Required Accessories  | Part Number  |
|---|--|
| <b>Plug-in Pads (attenuators) - Available in 0.5 dB steps from 0 to 20.5 dB</b> <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> <small>* To determine AGC pad value, subtract 34 dB from the design value main port RF output level at the AGC pilot frequency</small> | 589693 (0 dB) sequentially thru 589734 (20.5 dB)                   |
| <b>Plug-in Forward Cable Equalizer - Available in 1.5 dB steps from 0 to 30 dB at 1002 MHz</b> <ul style="list-style-type: none"> <li>• 1 required for forward input</li> </ul>   | 4007228 (0 dB) sequentially thru 4007248 (30 dB)                   |
| <b>Plug-in Reverse Cable Equalizer - Available in 1 dB steps from 0 to 12 dB at 85 MHz</b> <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 4036769 (1 dB) sequentially thru 4036780 (12 dB) |

The following **Optional Accessories** may be ordered separately:

| Optional Accessories  | Part Number   |
|---|---|
| <b>24V Power Supply for GainMaker High Output HGBT</b>  | 4026157   |
| <b>230 V AC Crowbar Surge Protector (plug-in, one per station)</b>  | 4007682   |
| <b>Plug-in Inverse Equalizer. Simulates cable equivalent tilts (creates tilt opposite that of equalizers). Use in place of forward input EQ as needed to maintain proper output tilt in short spaced locations. Available in approx. 1.6 dB “cable equivalent” steps from 1.6 to 16.2 dB.</b> | 4007486 (1.6 dB) sequentially thru 4007495 (16.2 dB)  |
| <b>Long Reach Test Point Adapter</b>  | 562580  |
| <b>Status Monitoring Transponder - see GainMaker Status Monitoring Transponder Data Sheet</b>   | Refer to the Cisco GainMaker Status Monitoring Transponder Data Sheet.<br><a href="http://www.cisco.com/c/en/us/products/video/transponders/index.html">http://www.cisco.com/c/en/us/products/video/transponders/index.html</a> |

The following **Housing Options** may be included with the product if ordered using the GainMaker Ordering Matrix. They may also be ordered separately.

| GainMaker System Amplifier Housing - 1 required Housing includes housing base, lid, wiring harness, and 24 V power supply # 4026157. All Housings have 15 amp capacity.  | Part Number   |
|--|---------------|
| • Uncoated 4 port housing <b>without</b> external test point access  | 4026387       |
| • Chromate Plated 4 port housing <b>without</b> external test point access   | 4026388       |
| • Uncoated 4 port housing <b>with</b> external test point access   | 4026385       |
| • Chromate Plated 4 port housing <b>with</b> external test point access  | 4026386       |
| <b>GainMaker System Amplifier Housing Upgrade Kit - 1</b> required if upgrading an existing SA II, II+, or III housing to allow use of GainMaker System Amplifier modules. Includes a GainMaker System Amplifier housing lid, wiring harness, and 24 V power supply # 4022846. |               |
| • Uncoated 4 port housing lid <b>without</b> external test point access  | 4026389       |
| • Painted 4 port housing lid <b>without</b> external test point access   | 4026390       |
| • Uncoated 4 port housing lid <b>with</b> external test point access   | 4026391       |
| • Painted 4 port housing lid <b>with</b> external test point access  | 4026392       |
| <b>Seizure Upgrade Kit - 1</b> required if upgrading an existing SAll or SAll+ housing base to allow use of GainMaker System Amplifier Modules. Includes high current (15 amp) rated seizure screws and anvils.  | <b>548775</b> |

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