

SyncServer S600/S650 Options, Upgrades, and Antenna Accessories

Maximize Performance and Flexibility



Options and Upgrades

- Security Protocol license
- GLONASS/BeiDou/SBAS license
- PTP grandmaster license
- Rubidium atomic oscillator upgrade
- OCXO oscillator upgrade
- Dual power supplies
- Timing I/O module (1 or 2)
- FlexPort™ technology for Timing I/O modules
- Antenna accessories
- Synchronization software

Microsemi makes it easy to configure the SyncServer S600/S650 to meet specific application needs and requirements with a variety of hardware and software options. Whether the application requires specific NTP stratum behaviors, precise time protocol PTP accuracy, sustained signal quality controllable with oscillator upgrades, more flexibility in signal

outputs, or just redundancy features like multiple constellation GNSS support, Microsemi has excellent solutions for all use cases. If the user is not sure how to achieve what they want in terms of configuring choices, they can contact Microsemi's timing experts for advice and guidance for customized solutions that meet their needs.

Security Protocol License with Security-Hardened NTP Reflector™/Firewall

Some applications require security enhancements above and beyond what might otherwise be acceptable. For this reason, the SyncServer S600/S650 can be seriously hardened from both the NTP operational perspective and the authentication perspective.

Operational Hardening

The security protocol license includes the security-hardened NTP Reflector with hardware firewall functionality. The GbE line speed NTP Reflector with 100% hardware based NTP packet processing can handle in excess of 360,000 NTP requests per second (mode three NTP client packets only). This same hardware also acts as a CPU protecting firewall by bandwidth limiting all non-NTP traffic. In addition to the Reflector are denial-of-service (DoS) functions monitoring the packet flow. Abnormally high NTP or non-NTP traffic initiates an SNMP trap. In a DoS attack the S600/S650 remains impervious to the level of network traffic that could be delivered as all packets are processed in hardware at line speed, though legitimate NTP client requests for time may be blocked elsewhere in the network due to the increased DoS flow. [See 1]

Authentication Hardening

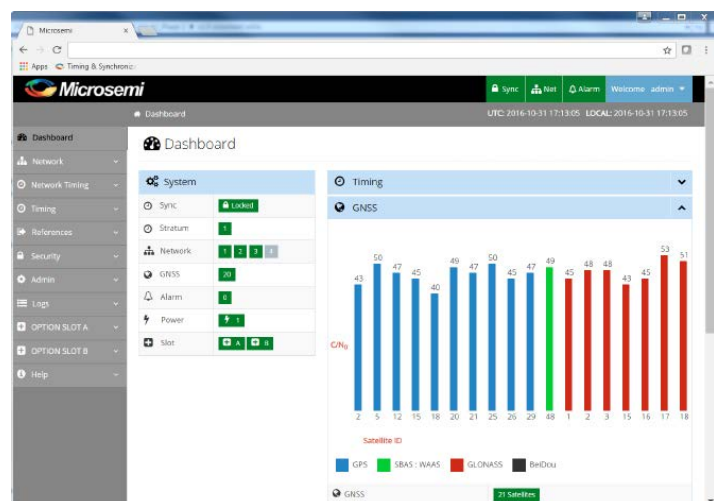
Authentication—whether client, server or user access—is the next level in security hardening. The NTP Autokey functionality is a step up from MD5 when it is required to have the next level of NTP client-to-server authentication. For user authentication/permission to access the web interface, TACACS+, RADIUS, LDAP, and CA-signed X.509 certificates are also included in the security protocol license.

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Multi-GNSS Constellation License

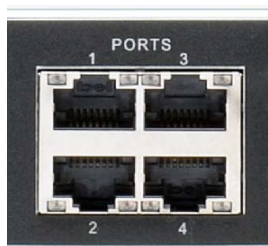
Timing integrity, continuity, and reliability can be improved with the multi-GNSS constellation license that adds support for GLONASS, BeiDou, and SBAS constellations in addition to the standard GPS constellation. With more satellites in view, timing performance can be improved in challenging environments such as urban canyons.



Track GPS/SBAS, GLONASS and/or BeiDou Satellite Constellations for improved integrity and satellite visibility in urban canyons.

All SyncServer S600 series are equipped with a GNSS receiver capable of simultaneously tracking more than one GNSS constellation. The primary constellations include GPS, GLONASS, and Beidou. In addition, the regional GPS Satellite Based Augmentation Satellites (WAAS, EGNOS, and MSAS) are also used. Users select one or two of the primary constellations to track. If GPS is one of the selected constellations then the SBAS satellites are automatically included in the tracking.

Note: The SyncServer S600 series uses a different antenna and splitter for GPS/SBAS/GLONASS compared to GPS/SBAS/GLONASS/BeiDou. See the antenna section of this datasheet for more details.



SyncServer S600 Series LAN Ports have hardware timestamping capability built-in ready to support PTP operations.

IEEE-1588 PTP Output License

Applications demanding very precise time accuracy can benefit from the IEEE-1588 precise time protocol (PTP). The IEEE-1588 PTP output license enables PTP grandmaster operations leveraging the built-in hardware timestamping in the S600 series models.

Currently the Enterprise Profile is supported on one user selectable LAN port. The Enterprise Profile in a grandmaster is an official recognition of the default multicast profile and the use of unicast delay_request messages (often referred to as hybrid mode). Operational modes include default profile multicast Sync messages with servicing of multicast delay_requests and hybrid operations with multicast Sync messages and unicast delay_request/delay_response and unicast delay_response messages. Multicast slave servicing capacity ranges from 360,000 slaves at 1 delay_request/second rate down to 2,800 slaves at 128 delay_request/second rate.

To maintain the security-hardened attributes of the S600 series that leverages hardware based firewall rules, users select what timing service to provide on a port-port basis. [See 1]

Compliance

- IEEE1588 2008 version 2
- Grandmaster
- Enterprise profile (default profile with Hybrid support, multicast or unicast delay request/response support)
- IPv4/IPv6
- One-step or two-step clock operation

PTP Performance

- PTP message capacity: 360,000 messages per second
- Timestamp accuracy
 - Sync packets: 30 ns relative to timebase in SyncServer with 1 GbE links
 - Delay_requests packets: 30 ns relative to timebase in SyncServer with 1 GbE links
- Timestamp resolution: 1 ns

Configurable PTP Parameters

- Transport protocol: UDP over IPv4/IPv6
- Delay mechanism: End-to-End (E2E)
- Sync and delay intervals: 128 packets/sec to 1 packet/128 seconds
- Packet TTL: 1 to 255
- Priority 1 and 2: 0 to 255
- Domain number : 0 to 127
- Mean announce message transmit interval: 1 second per Enterprise Profile specification
- Announce receipt timeout: 3
- Diffserv code point 0 to 63

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Rubidium Atomic Oscillator



Rubidium atomic clock oscillator upgrade improves not only the stability and ongoing accuracy of the SyncServer, but also its holdover accuracy, saving valuable time for the user. The standard SyncServer is equipped with a crystal oscillator that keeps the clock accurate to specifications while tracking GNSS. However, if the GNSS signal is lost, thereby placing the unit in holdover, the standard oscillator soon drifts away from perfect. Upgrading the oscillator significantly improves the clock accuracy during holdover.

Rubidium holdover accuracy is <math><1 \mu\text{s}</math> for the first 24 hours and <math><3 \mu\text{s}</math> after the first three days. The advantage of the rubidium oscillator is that if the GNSS signal is lost, the SyncServer continues to serve accurate time and maintain a high level of clock stability. This allows support personnel plenty of time to correct the GNSS signal problem with little degradation or disruption in time synchronization accuracy.

Oven Controlled Crystal Oscillator (OCXO)

Similar in application as the rubidium oscillator upgrade, the oven controlled crystal oscillator (OCXO) upgrade improves the holdover accuracy beyond the standard oscillator though not nearly as much as the rubidium oscillator. OCXO holdover accuracy is 25 μs for the first day. Depending on the level and duration of accuracy needed, the OCXO is a compromise between the standard oscillator and the rubidium oscillator.

Oscillator Holdover Drift (1st 24 hours)

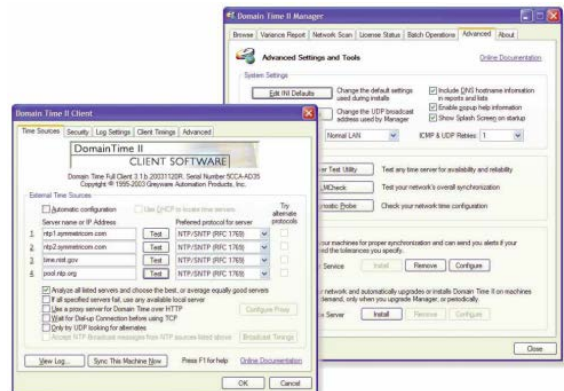
- Standard 400 microseconds
- OCXO 25 microseconds
- Rubidium <math><1</math> microsecond

Dual AC Power Supplies



The dual-corded, dual power supply option provides several levels of time service protection. The power supplies load share equally and there is an active power management system constantly monitoring the operation. If the power to one cord/circuit is lost or if one power supply fails, the entire load is instantly picked up by the remaining energized power supply with no interruption in time services to the network. Connecting both power supplies to the same circuit provides protection against a single power supply failure. In the event of a power supply failure, notification is instantly provided to the network operator via SNMP trap, or email. For extra level of assurance, the power cord(s) supplied with the SyncServers have locking rear IEC 60320 connectors to avoid accidental decoupling.

Windows Time Synchronization Software

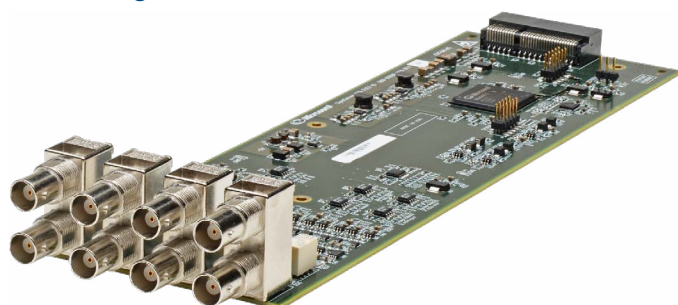


Network time synchronization software is an essential part of distributing time to network clients. Domain Time II software for Windows is a comprehensive NTP/PTP software solution that simplifies network time synchronization. Versatile time clients and software servers keep the network hierarchy synchronized to the SyncServer. Easy-to-use management tools simplify and automate many tasks related to keeping the clients up-to-date. Monitoring functions track synchronization across the network to notify the administrator of any problems. The result is a reliable time synchronization system that requires little management overhead, and provides tremendous value to the integrity of network operations and applications.

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S650 Timing I/O Module



The Timing I/O module is an exceedingly versatile time and frequency input and output option. In the standard configuration, it supports the most popular input and output time codes, sine waves, and rates. In the figure below, the user can see the standard configuration, and the configuration with the FlexPort option.

The standard configuration offers a broad yet fixed selection of signal I/O. J1 is dedicated to time code and rate inputs, J2 to sine wave inputs, and J3-J8 to mixed signal outputs. The standard Timing I/O module configuration is 1PPS or IRIG B AM-In, 10 MHz-In, IRIG AM and IRIG DCLS-Out, 1PPS-Out, and 10 MHz-Out. (See the following page for Timing I/O Module specifications.)

FlexPort™ License for Timing I/O Modules

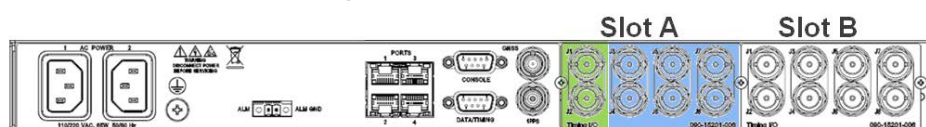
Microsemi's unique FlexPort technology efficiently and cost-effectively adds innovative "any signal, any connector" technology, eliminating the wasted space inherent with legacy style fixed signal modules/BNCs.

The FlexPort technology option enables the six output BNCs (J3-J8) to output any supported signal (time codes, sine waves, programmable rates, and so on) all configurable in real time via the secure web interface. Similarly, the two input BNCs (J1-J2) can support a wide variety of input signal types. This uniquely flexible BNC by BNC configuration makes efficient and cost effective use of the 1U space available.

Two Timing I/O modules doubles the number of supported input and output signals. Unlike legacy modules with fixed count BNCs outputting fixed signal types per module, with FlexPort technology the user can have up to 12 BNCs (two Timing I/O modules) outputting any combination of supported signal types. Fine tuning of rate and time code signal outputs is possible as each output BNC can be individually phase adjusted to the nanosecond level to accommodate different output cable lengths.

This level of timing signal flexibility is unprecedented, and can even eliminate the need for additional signal distribution chassis as there is no degradation in the precise quality of the coherent output signals.

FlexPort vs Standard Configuration



→ BNC Connectors		Input		Output					
↓ Signals		J1	J2	J3	J4	J5	J6	J7	J8
Standard	1PPS	●					●	off	off
	IRIG B AM	●		●				off	off
	IRIG B DCLS					●		off	off
	10 MHz		●		●			off	off
FlexPort	IRIG A/B/C37/E/G NASA/2137/XR3 AM/DCLS	■		■	■	■	■	■	■
	Selectable/Programmable Rates	■		■	■	■	■	■	■
	1/5/10 MHz Sine Waves		■	■	■	■	■	■	■

- = Fixed specific signal type
- = User configurable Time Codes, Selectable/Programmable Rates or Sine Waves

A single FlexPort license enables configuration flexibility on all installed Timing I/O modules.

Note: All Timing I/O modules are factory installed and must be ordered at the time of initial purchase. The FlexPort license can be added at any time.

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Timing I/O Module Signal Characteristics

Configuration	Input BNCs		Output BNCs					
	J1	J2	J3	J4	J5	J6	J7	J8
Standard	IRIG B AM 124 or 1PPS	10 MHz	IRIG B AM 124	10 MHz	IRIG B B004 DCLS	1PPS	off	off
FlexPort Option	IRIG: A000/A004/A130/A134 B000/B004/B120/B124 E115/E125 C37.118.1a-2014 IEEE-1344 Rates: 1PPS 10MPPS	1 MHz 5 MHz 10 MHz	FlexPort J3-J8 software selectable outputs per BNC (Configured via the web interface): <ul style="list-style-type: none"> • Pulse: <ul style="list-style-type: none"> • Fixed Rate: 10/5/1MPPS, 100/10/1kPPS, 100/10/1/0.5PPS, 1PPM • Programmable period: 100 ns to 2 sec, step size of 10 ns • Timecode: <ul style="list-style-type: none"> • IRIG A 004/134 • IRIG B 000/001/002/003/004/005/006/007/C37.118.1a-2014/1344 DCLS • IRIG B 120/122/123/124/125/126/127/1344 AM • IRIG E 115/125 • IRIG G 005/145 • NASA 36 AM/DCLS, 2137 AM/DCLS, XR3 • Sine: 1/5/10 MHz • BNC-by-BNC output phase adjustment for timecodes and pulses 					

Signal Levels

Output Signal	Specification
IRIG-In	AM: Ratio 2:1 to 3.5:1 Amp: 1 V to 8 V p-p, into 50 Ω DCLS: <0.8 V for logic 0, >2 V for logic 1
IRIG-Out	AM: Ratio 10:3, Amp: 3.5 ± 0.5 Vpp, Zout 50 Ω DCLS: <0.8 V for logic 0, >2.4 V for logic 1, Zout 50 Ω
1PPS-In	Rising edge active, TTL into 50 Ω
Rate/Pulse Out	Rising edge on-time, TTL into 50 Ω
1,5,10 MHz-In	Sine wave, 1 Vpp to 8 Vpp, into 50 Ω
1/5/10 MHz-Out	Sine wave 2 Vpp-3 Vpp into 50 Ω
10 MPPS In	<0.8 V for logic 0, >2 V for logic 1, into 50 Ω

Output Stability (10 MHz)

Oscillator	1 S	10 S	100 S	1 kS	10 kS
Standard	<1×10 ⁻⁹	<2×10 ⁻¹⁰	<1×10 ⁻¹⁰	<1×10 ⁻¹¹	<1×10 ⁻¹²
OCXO	<1×10 ⁻⁹	<5×10 ⁻¹¹	<5×10 ⁻¹¹	<7×10 ⁻¹²	<7×10 ⁻¹³
Rubidium	<2×10 ⁻¹⁰	<3×10 ⁻¹¹	<3×10 ⁻¹¹	<5×10 ⁻¹²	<5×10 ⁻¹³

(Measured on any 10 MHz output)

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Outdoor Antenna Basics

Antenna cables and accessories enable versatile solutions that are easy to achieve. Inline GNSS amplifiers installed at the antenna are an easy way to extend cable runs from 225 feet to up to 900 feet, depending on cable type. Lightning arrestors provide valuable electrical shock protection to the SyncServer. Antenna cable splitters leverage a single antenna and cable for up to four GNSS receivers.

Ordering antenna components is a simple task. The most important thing the user needs to have is a rough idea of the total cable length needed between the SyncServer and the mounting location of the antenna. Any extra cable can be coiled to the side.

Pre-configured kits that include cable, antenna, and related mounting accessories are available. These kits vary by total cable length, and based on whether a lightning arrestor is required or not. For long cable runs (>225 ft.), the components are assembled individually.

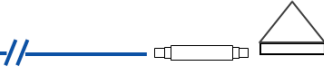
To assist and simplify configuration, Microsemi has included an excel-based antenna configurator on the website. The configurator helps the user determine the exact part numbers they need for the desired cable length and accessories.

Important: The antenna kit (part number 093-15202-001) includes a short SyncServer adapter cable with BNC(m)-N(f) connectors. All primary antenna cables use N(m) connectors on either end. A single cable must be used between the adapter cable and the next accessory (lightning arrestor, inline amplifier, or antenna). Lightning arrestors include a 25 ft. cable to connect to the next accessory (inline amplifier or antenna).


50-225 ft.
Standard cable



225-450 ft.
Standard cable +
Inline Amplifier



450-900 ft.
Low loss cable +
Inline Amplifier



Antenna Kits and Components

Description	Part Number
Kit: Total length: 50 ft, cable: 50 ft; GPS/GLONASS antenna kit	990-15202-050
Kit: Total length: 75 ft, cable: 50 ft; lightning arrestor; cable: 25 ft; GPS/GLONASS antenna kit	990-15202-075
Kit: Total length: 100 ft, cable: 100 ft; GPS/GLONASS antenna kit	990-15202-100
Kit: Total length: 125 ft, cable: 100 ft; lightning arrestor; cable: 25 ft; GPS/GLONASS antenna kit	990-15202-125
Kit: Total length: 150 ft, cable: 150 ft; GPS/GLONASS antenna kit	990-15202-150
Kit: Total length: 175 ft, cable: 150 ft; lightning arrestor; cable: 25 ft; GPS/GLONASS antenna kit	990-15202-175
Kit: Total length: 200 ft, cable: 200 ft; GPS/GLONASS antenna kit	990-15202-200
Kit: Total length: 225 ft, cable: 200 ft; lightning arrestor; cable: 25 ft; GPS/GLONASS antenna kit	990-15202-225
250 ft. antenna cable	060-15202-250
350 ft. antenna cable	060-15202-350
450 ft. antenna cable	060-15202-450
500 ft. low loss antenna cable	060-15202-500
750 ft. low loss antenna cable	060-15202-750
900 ft. low loss antenna cable	060-15202-900
Kit: GPS/GLONASS antenna; mounting bracket; adapter cable for chassis	093-15202-001
Kit: GPS/GLONASS/BeiDou antenna; mounting bracket; adapter cable for chassis	093-15202-006
Inline amplifier with adapter	093-15202-005
Kit: Lightning arrestor with 25 ft. cable	093-15202-002
Kit: Lightning arrestor with 25 ft. low loss cable	093-15202-003
Kit: 1:4 GPS splitter with two 3 ft. cables	093-15202-004
Kit: GPS/GLONASS/BeiDou 1:4 splitter with two 3 ft. cables	093-15202-007

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GPS/GLONASS Antenna

The standard antenna used with the SyncServer S600/S650 is a high-gain (40dB) GNSS antenna covering the GPS L1, GLONASS L1, and SBAS (WAAS, EGNOS, and MSAS) frequency band (1575 MHz to 1606 MHz). The antenna has a three stage low-noise amplifier, with a mid-section SAW with a tight pre-filter to protect against saturation by high-level sub-harmonics and L-Band signals making it excellent for timing applications. An L-bracket for pole mounting and 3-foot BNC(m) to N(f) cable is also included.



Technical

Specification	Value
1 dB bandwidth	31 MHz
Antenna gain	4.5 dBic
Axial ratio	<4 dB at 1590 MHz, 8 dB typical at band-edges
Filtered LNA frequency bandwidth	1575 MHz to 1606 MHz
Gain	40 dB minimum flatness ± 2 dB, 1575 MHz to 1606 MHz

Out-of-Band Rejection

Specification	Value
<1550 MHz	>50 dB
>1640 MHz	>70 dB
VSWR (at LNA output)	<1.5:1
Noise figure	2.5 dB typical
Supply voltage range	2.5 VDC to 16 VDC nominal (12 VDC recommended maximum)
Supply current	20 mA maximum at 85 °C
Mechanical size	66.5 mm diameter x 21 mm height
Operating temp.	-40 °C to 85 °C
Weight	150 g
Environmental	IP67, CE, REACH, and RoHS-compliant
Salt Fog/Spray	MIL-STD-810F Section 509.4

GPS/GLONASS/BeiDou Antenna

This wide-band antenna is a precision high gain GNSS antenna covering the BeiDou B1, Galileo E1, GPS L1, GLONASS L1, and SBAS (WAAS, EGNOS, QZSS, and MSAS) frequency band (1557 MHz to 1606 MHz). It provides very circular polarized signal reception through the entire bandwidth of the antenna, thereby providing superior multipath signal rejection. The antenna has a three stage low noise amplifier, comprised of one input LNA per feed, a mid section SAW to filter the combined output, and a final output gain stage. An additional pre-filter provides extra strong protection from near frequency and strong harmonic signals. An L-bracket for pole mounting and 3-foot BNC(m) to N(f) cable is also included.



Technical

Specification	Value
2 dB bandwidth	47 MHz
Antenna gain (with 100 mm ground plane)	4.25 dBic
Axial ratio	<2 dB typical, 3 dB max
Filtered LNA frequency bandwidth	1559 MHz to 1606 MHz
Gain	40 dB minimum

Out-of-Band Rejection

Specification	Value
<1500 MHz	>50 dB
>1640 MHz	>70 dB
VSWR (at LNA output)	<1.5:1
Noise figure	3 dB typical
Supply voltage range	2.5 VDC to 16 VDC nominal (12 VDC recommended maximum)
Supply current	19 mA maximum at 85 °C
Mechanical size	66.5 mm diameter x 21 mm height
Operating temp.	-40 °C to 85 °C
Weight	150 g
Environmental	IP67, CE, REACH, and RoHS-compliant
Salt Fog/Spray	MIL-STD-810F Section 509.4

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GNSS Inline Amplifier

Cable length is a common cause for signal loss between the GNSS antenna and the GNSS receiver. As with any electromagnetic radio wave, GNSS signals become attenuated as they pass through an electrical cable. The amount of signal loss depends on the length and type of cable used. The inline amplifier attaches the antenna and the antenna cable. It uses the same power as the antenna and does not require extra wiring.

Features

- Extended cable length up to 900 ft depending on the cable type
- Fits inline with antenna cable
- No external power source needed
- Simple installation



Electrical

Specification	Value
Nominal gain	25 dB 4/0 dB typical
Pass band ripple	±2 dB
Impedance	50 Ω
Noise figure	2 dB typical.
Bandwidth	1.2 GHz to 1.8 GHz
Input VSWR	1.5 typical/2 maximum
Output VSWR	1.5 typical/2 maximum
Reverse isolation	>35 dB
Output 1 dB	-10 dB
Output IP3	5 dBm

Mechanical and Environmental

Specification	Value
Mechanical size	2.32" length x 0.787" diameter
Connector	N-Type
Operating temp.	Range -40 °C to 85 °C
Environmental	RoHS, REACH, and IP67

GNSS Lightning Arrestor

Lightning does not have to strike the antenna to significantly damage the antenna or the GNSS receiver. Damage is often due to the effects of a lightning strike on a nearby structure, not a direct strike on the antenna itself. Since lightning strikes may induce damaging voltages in the antenna system when striking nearby objects, attempt to locate the antenna away from lightning rods, towers, and other structures that attract lightning. Also, locate the GNSS antenna lower than any nearby structures that are likely to attract a strike.



Technical

Specification	Value
Type	DC pass
Mount type	Bulkhead mount
PIM rated	N
Standards	CE-compliant, RoHS-compliant
Connector	N
Surge side connector	Bi-directional N
Protected side connector	Bi-directional N
Frequency range	dc to 5 GHz
Turn on voltage	150 Vdc (spark over)
RF power	25 W
VSWR	≤1.2 dB to 1
Insertion loss	≤0.1 dB
Protocol/Application	Gas tube, DC pass RF coaxial protection for dc to 5 GHz

The lightning arrestor also ships with 25 ft of either standard or low loss cable.

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GPS L1 4:1 Active Splitter

The Microsemi Active Splitter allows multiple GPS receivers to share a single antenna. Designed for both manufacturing and position/timing redundancy applications, the GPS L1 Active Splitter provides dependable signals for four GPS receivers.

Features

- Four ports
- High isolation

Benefits

- Cascades conveniently without adding separate amplifiers and bias-tees between splitters
- Delivers precise GPS signals over a wide temperature range and in harsh environmental conditions
- Eliminates feedback and interaction between any GPS system connected to it.



Technical

Specification	Value
Number of output ports	Four
Input/output impedance	50 Ω
VSWR (typical)	Input and output 1.6 at L1
Bandwidth (-3 dB)	L1 (1575.42 MHz) ±20 MHz
Gain (antenna input to any output at L1)	0 dB ±3 dB
Noise figure	5 dB typical, at 25 °C
Port-to-port isolation L1 ±40 MHz	50 dB typical
DC power	4.5 V DC to 13 V DC
Damage threshold	18 V DC either polarity
Operating current	23 mA to 48 mA depending on voltage
Pass through current	450 mA
Group delay	40 ns typical
RF connectors	Female N-type
RoHS 6/6	Not compliant

Complete specifications for this Microsemi model 58536A GPS Splitter can be found on the Microsemi web site.

GPS/GLONASS/BeiDou Splitter

This L band frequency, RoHS compliant 4:1 active splitter makes it possible to use a single GPS referencing antenna and cable arrangement for multiple synchronization systems. The antenna DC bias select circuit allows for the active antenna DC input to be applied to any or all RF outputs. One DC voltage will be chosen to power the antenna while other inputs will be switched to DC loads. If the selected DC bias input should fail, the DC bias will automatically switch to another DC input to ensure an uninterrupted supply to the active antenna.

Features

- Four ports
- GPS/GLONASS/Beidou compatible

Benefits

- Amplified to offset splitter losses
- Standard antenna DC bias select
- Cascades conveniently without adding separate amplifiers and bias-tees between splitters



Technical

Specification	Value
Number of output ports	4
Input/output impedance	50 Ω
Frequency range	1 GHz to 2 GHz
Noise figure	2 dB max
Port-to-port isolation	30-40 dB
DC power	3.3 V DC to 12 V DC
Operating current	18 mA to 20 mA
Pass through current	250 mA
Group delay, L1	5 ns
RF connectors	Female N-type
RoHS 6/6	Compliant
Gain	0 dB ±2 dB

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Option Availability Matrix

Order Time	Option/Upgrade	S600	S650	S650i
Only at initial time of purchase	Rubidium upgrade	●	●	
	OCXO upgrade	●	●	
	Dual power supplies	●	●	
	Timing I/O module(s)		●	
Anytime	Security Protocol license [See 1]	●	●	●
	FlexPort license*		●	●
	GNSS license (add GLONASS/SBAS/BeiDou to the standard GPS)	●	●	
	PTP Output license (grandmaster operations) [See 1]	●	●	●
	Synchronization software	●	●	●

*Only applicable if one or two Timing I/O modules are previously installed in the SyncServer S650.

1 – The NTP Reflector and PTP Grandmaster cannot operate simultaneously.



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