

# S14WI Splitter for Wireless Infrastructure

## Product User Manual

### Features

- Active or Passive Options Available
- Optional Antenna Current Monitor and Alarm
- Optional Antenna DC Bias Select
- Pole-mount Environmental Housing Available (IEC 529 level IP55)
- Surge Protection Available (Tested to EN61000-4-5)



### Description

Designed to eliminate the cost of multiple antennas and long cable runs in wireless base stations applications, the S14WI can satisfy the demanding, high reliability requirements of the wireless infrastructure market. The GPS Source S14WI is a high performance GPS signal splitter that can be configured to monitor the GPS antenna current and provide an alarm indication if the antenna is not operating according to spec. The S14WI also features an optional antenna DC bias “Pick-&-Choose” circuit which allows for the active antenna DC input to be applied to any or all of the RF outputs. With this option, one DC voltage will be chosen to power the antenna while the other inputs will be switched to DC loads. If the selected DC bias input should fail, the DC bias will be automatically switched to another DC input so as to ensure an uninterrupted supply to the active antenna. The S14WI may be configured as a passive or an active device, giving the network engineer the flexibility to specify the device gain and port-to-port isolation. The S14WI may also be ordered with surge protection on all five ports and in a sealed housing sufficient for many years of operation in external environments.

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## Functional Block Diagram

Figure 1 below illustrates the functionality of the GPS Source S14WI GPS Splitter. The S14WI consists of an RF Signal Processing System (illustrated in Blue), a DC Bias Select System (illustrated in Red), an Active GPS Antenna Monitoring System (illustrated in Green), and a Surge Arrestor System.

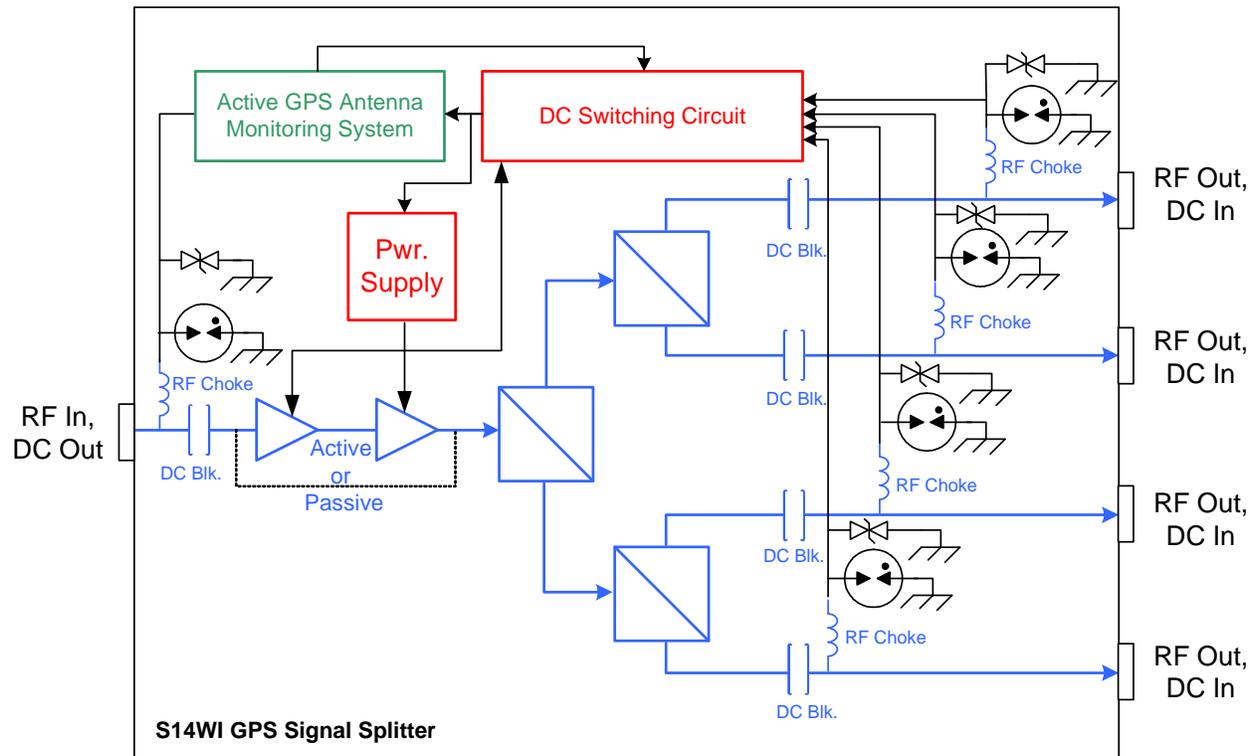


Figure 1 S14WI Functional Block Diagram

## Operational Description

### RF Signal Processing System

The RF signal processing system consists fundamentally of three classical Wilkinson Splitter elements that divide the RF signal from the antenna input evenly between four RF output ports.

There are several options that are available concerning the RF Signal Processing System. These options are:

1. Passive
2. Amplified
3. Amplified - High Isolation

### **Passive Option:**

In the Passive Configuration, the RF input from the antenna bypasses the amplification stages and is passed directly to the input Wilkinson Splitter element. This splitter element divides the RF signal evenly, resulting in 3dB (ideally) reduction in signal level at the output of each splitter. The signal is then split again, resulting in four outputs, each output being 6dB (ideally) below the input signal. In reality, since the Wilkinson Splitter elements are realized with non-ideal components which have a finite Q, the signal reduction for each Wilkinson Splitter element is approximately 4dB, resulting in an overall signal reduction through the splitters of approximately 8dB. When other losses are accounted for, such as losses in the RF connectors and the “Bias-T’s”, the overall signal reduction through the passive configuration is approximately 9dB.

### **Amplified Option:**

In the Amplified Configuration, the RF signal from the input is applied to two RF gain stages prior to the Wilkinson Splitter elements. The first of these amplification stages provides approximately 17dB of gain at a very low noise figure. The second stage provides additional gain so as to ensure that the input port to any output port gain of the splitter is approximately 21dB.

### **Amplified – High Isolation Option:**

In the Amplified – High Isolation Configuration, resistive, 50 Ohm signal attenuators are added in the RF output paths to provide additional isolation between each RF port. This configuration may be chosen if it is possible for spurious emissions from one GPS receiver on one port of the splitter to cause interference with GPS receivers connected to other output ports. In the high isolation configuration the input port to any output port gain of the splitter is approximately 10dB.

### **Termination of Unused Ports:**

Note that in the Passive and Amplified (NON-High Isolation) configuration, all ports must be terminated in 50 Ohms in order to ensure proper operation of the Wilkinson Splitter elements. If all ports are not terminated properly, the S14WI input/output SWR and Gain/Loss may not meet specifications.

In the Amplified-High Isolation configuration, the 50 Ohm signal attenuators provide substantial isolation from open circuits on unterminated output ports. Consequently, RF outputs may be left unterminated without adversely affecting the operation of the S14WI.

### **Bias-T’s:**

GPS RF signal splitters are unique relative to other generic RF signal splitters in that they typically operate in conjunction with an active GPS antenna (that is a GPS antenna that includes an integrated Low Noise Amplifier). Consequently, a GPS RF signal splitter must have provisions for managing the DC voltages to the active GPS antenna. These DC voltages are typically applied to the center conductor of the RF coaxial cable which runs from the antenna

down to the application's receiver(s). As such, each input and output port of the S14WI includes a "Bias-T" functionality which allows for DC voltages to be applied on the center pins of the RF connectors. In this arrangement, DC voltages for powering the antenna may be applied to the center pin of the RF outputs. The DC voltage passes through the RF chokes to the DC Bias Select System and on to the RF input connector to power the antenna. This DC voltage is blocked from the RF section by DC blocking capacitors.

### **Antenna DC Bias Select System**

The S14WI splitter requires that a DC voltage be applied to one or more of the RF output ports by way of the RF connector center conductor. If DC voltages are applied to more than one of the RF output ports, the S14WI DC Bias Select System will choose one of these DC inputs to power the active circuitry of the S14WI and will also pass this DC voltage through the splitter to the center conductor of the RF input port. The DC voltage available on the RF input port can then be used to power the application's active antenna. The DC voltages applied to the RF outputs that are not chosen by the DC Bias Select circuitry will be automatically switched through an RF choke to 200Ohm DC loads. The DC voltages may be applied to any or all of the RF outputs; however, the DC Bias Select circuit will always select the DC voltage on the lowest numbered RF port that has a DC voltage applied to power the S14WI and the application's antenna. If the chosen DC input were to be removed or fail, the DC Bias Select circuit will automatically switch to the next higher numbered RF port to which a DC voltage is applied.

The S14WI requires that only one RF output port have an external DC voltage applied (i.e. the device will operate properly even if any one, two, or three ports do not have a DC voltage applied or if a DC voltage is removed from one of the ports). Ports that do not have an external DC voltage applied or from which an external DC voltage is removed are internally pulled down so as to ensure that false input voltage indications do not occur.

#### *Example:*

Assume DC voltages are applied to RF outputs 1, 3 and 4. In this scenario, the DC voltage on port 1 will be used to power the S14WI and the application antenna. Ports 3 & 4 will be switched to 200Ohm DC loads.

Now assume that the DC voltage on port 1 is removed. The S14WI will automatically terminate the input internally with a pull down resistor and switch operation of the splitter and antenna to the DC voltage applied to the next high numbered port with a DC voltage applied: port 3. Port 4 will remain switched to a 200 Ohm load.

### **Active GPS Antenna Monitoring System**

The S14WI includes an option to monitor the status of the application's active antenna and to provide an alarm indication if the antenna's current is not within a specified range. The default current window for the S14WI is 15mA to 150mA (e.g. antenna current below 15mA indicates an open circuit, above 150mA indicates a short circuit); however, for large volume orders, the antenna current window may be specified to meet the customer's specific requirements.

The S14WI samples the antenna current 16 times per second. So long as the average of four samples are within the specified antenna current window, the S14WI will continue to operate normally, passing the DC voltage applied to lowest number RF output on to the RF input. In this mode, DC voltages applied to the remaining RF outputs are switched to 200Ohm DC loads. If the average of four antenna current samples falls outside of the specified antenna monitor current window, the DC voltage to the antenna is removed (open circuit) and all DC inputs are switch to Pass DC. Since the DC path to the antenna has been opened, the DC current on all four DC inputs will be at or near zero (less than 0.5mA for the passive configuration and less than 5mA each for the active). In this alarm condition, all GPS receivers connected to the RF outputs will also see very low antenna current draw, resulting in corresponding antenna alarm conditions within each receiver.

Once in the alarm condition, the S14WI will periodically (every 60 seconds) attempt to re-connect DC power to the antenna. If the antenna failure condition persists, the S14WI will re-enter the fault condition, repeating this cycle until the fault condition is removed.

### **Surge Arrestor System**

The S14WI includes standard Gas Discharge Tubes and Transient Voltage Suppressors on each RF input/output. Furthermore, provisions for high current grounding are included in the metal enclosure of the device. The Surge Arrestor System is intended to provide a limited capability to survive power line surges and voltage surges that may be induced by "near miss" lightning strikes. Protection is rated to 4KA, according the IEC-61000-4-5. In order to ensure proper protection of the device, the S14WI must be connected via a (8 AWG minimum) ground cable to a low impedance ground.

### **Connecting the S14WI**

When installing the S14WI, connect the coaxial cable feeding the active GPS antenna prior to connecting RF outputs. Once the antenna coaxial cable is attached, coaxial cables with or without DC voltages may be connected to the outputs. Note that at least one coaxial cable connected any output of the device must provide a DC voltage suitable for operating the active GPS antenna and the S14WI.

Note that in some instances, upon initial connection of the DC voltage, the S14WI may power up in the "Antenna Fault" mode which will prevent DC voltage from being applied to the active antenna. If this behavior is observed immediately after power up, wait for approximately one minute. Proper operation should be restored by this time. If after 1 minute proper operation is not observed, ensure that a "known-good" active GPS antenna that sinks a DC current within the specified range is connected to the IN port of the S14WI via a "known-good" RF coaxial cable.

## Performance Specifications

For additional detailed electrical performance specifications, see the S14WI Datasheet.

### Electrical Specifications, Operating Temperature -40 to 85 °C

Parameter	Conditions	Min	Typ	Max	Units
Freq. Range	Ant – Any Port, Unused Ports - 50 Ω <sup>(1)</sup>	1.2		1.7	GHz
Gain <sup>(2)</sup> -Amplified (Norm) -Amplified (Hi Iso.)	Ant – Any Port, Unused Ports - 50 Ω <sup>(1)</sup> (Gain may be specified by the customer)	20	21	24	dB
		9	10	11	
Loss-Passive	Ant – Any Port, Unused Ports - 50 Ω <sup>(1)</sup>	7	9.0	9.5	dB
Input/Output SWR	All Ports 50Ω <sup>(1)</sup>		1.3:1	2.0:1	-
DC IN	DC Input on any RF Output	4		12	VDC
Device Current	Current Consumption of Active device, excludes Ant. Cur.		18	20	mA
Ant/Thru Current <sup>(3)</sup>	Max source DC current through device			250	mA
Antenna Monitor <sup>(4)</sup>	I <sub>oc</sub>	Range for Open Circuit Threshold		75	mA
	I <sub>sc</sub>	Range for Short Circuit Threshold <sup>(5)</sup>		180	
Surge Protection	8/20us		5		KA

#### Notes:

- (1). Note that for proper RF performance, the S14WI must have all RF ports terminated into a 50Ohm coaxial cable system or a 50Ohm load.
- (2). Custom gain option available.
- (3). Maximum current available from the DC source through the S14WI when output of S14WI is short circuited.
- (4). Open circuit and Short Circuit Current (I<sub>oc</sub>, I<sub>sc</sub>) may be specified by the customer within the specified range.
- (5). In-rush current shall not exceed 3A or exceed I<sub>sc</sub> for greater than 1ms

GPS Source, Inc. reserves the right to change or modify product performance and specifications without prior notification.

## Certifications and Approvals

- o EMC/Emissions: FCC part 15B and R&TTE equivalent
- o Power Line Surge: IEC-61000-4-5
- o Safety/Low Voltage: EN60950-1
- o Environmental: IEC 60529, IP55

**Part Number****S14WI - A - PC - AM- SF**

Product: \_\_\_\_\_  
1x4 Splitter for Wireless  
(Std: Pass DC J1-Ant, J2,J3,J4 DC Blk.)

Gain Option: \_\_\_\_\_  
**A** – Amplified  
**Axx** – Custom Gain  
**Blank** – Passive  
**H** – Hi Isolation

Pick & Choose Option: \_\_\_\_\_  
**PC** – Add Pick & Choose  
**Blank** – Std. Config.

Antenna Monitor Option: \_\_\_\_\_  
**AM** – Add Ant. Monitor  
**Blank** – Std. Config.

Connector Options: \_\_\_\_\_  
**NM** – N, Male  
**NF** – N, Female  
**SM** – SMA, Male  
**SF** – SMA, Female  
**TM** – TNC, Male  
**TF** – TNC, Female  
**BM** – BNC, Male  
**BF** – BNC, Female  
**SB** – SMB Jack, Female  
**SC** – SMC Jack, Female  
**MX** – MCX Jack, Female

For help in creating the part number to meet your exact needs, contact us at [Sales@gpssource.com](mailto:Sales@gpssource.com) or visit our website at [www.gpssource.com](http://www.gpssource.com) .

**Mechanical**

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

NO PAINT (MASK) -- ALL 5 CONNECTORS SEE NOTE 3

GROUND LUG SHOWN FOR ILLUSTRATION NOT INCLUDED IN SHIPPED ASM

M5x1.0 SOCKET HEAD CAP SCREW (5mm HEX) USE FOR GROUND LUG ATTACHMENT

NO PAINT (MASK) SEE NOTE 3

RoHS

NOTES:

- ANY CHANGES IN DESIGN, COMPOSITION, OR PROCESSING FROM APPROVED PRODUCTION SAMPLE PARTS REQUIRE COMPANY ENGINEERING APPROVAL PRIOR TO CHANGE IMPLEMENTATION.
- PAINT SPECIFICATION: SHERWIN WILLIAMS POLANE T F63TXA1415 - 4386 WITH EXTERIOR CATALYST V66V26 61
- PAINT MASKING AREAS:  
NO PAINT ON CONNECTOR THREADED PORTIONS NOR ON CONNECTOR INSIDES.  
NO PAINT ON HOUSING FACE FOR GROUND LUG SURFACE.

ASM DESCRIPTION	ASM PART NUMBER	DIFFERENCE
FSA 814WI AMPLFD W/IRG SPPRSSN W/DC BIAS SEL W/ANTENNA MNTR	FSA-ABQ-AAS-AGZ	
FSA 814WI PASSIVE W/IRG SPPRSSN W/DC BIAS SEL W/ANTENNA MNTR	FSA-AAQ-AAS-AGZ	

ALL MATERIALS AND FINISHES SHALL COMPLY WITH EUROPEAN UNION RESTRICTION OF HAZARDOUS SUBSTANCES. (RoHS)

DRAWN JWK	DATE 27JUNE2005	THE INFORMATION CONTAINED IN THIS DESIGN SET IS THE SOLE PROPERTY OF GPS SOURCE. USE OF THIS DESIGN IS RESERVED EXCLUSIVELY FOR SAID COMPANY. REPRODUCTION OR DISTRIBUTION OF ANY PORTION OF DESIGN IS FORBIDDEN WITHOUT THE EXPRESS WRITTEN CONSENT OF GPS SOURCE.	
CHECKED PWC		SIZE A	DWG FILE NAME 031-FSA-AAQ-AAS-AGZ
APPROVED		SCALE 1/2	GPS SOURCE PART NUMBER SEE TABLE
		SHEET	1 OF 1