

# PolaRx5S

User Manual





User Manual Revision 2.7 Applicable to version 5.5.0 of the PolaRx5S Firmware

February 09, 2024

Thank you for choosing the PolaRx5S. This user manual provides detailed instructions on how to use PolaRx5S and we recommend that you read it carefully before you start using the device.

Please note that this manual provides descriptions of all functions of the PolaRx5 product family. However, the particular PolaRx5S you purchased may not support functions specific to certain variants.

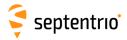
While we try to keep the manual as complete and up-to-date as possible, it may be that future features, functionality or other product specifications change without prior notice or obligation. The information contained in this manual is subject to change without notice. We recommend you to look for new or updated information in our Knowledge Base at https://customersupport.septentrio.com/s/topiccatalog



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Septentrio Greenhill Campus, Interleuvenlaan 15i B-3001 Leuven, Belgium

http://www.septentrio.com Phone: +32 16 300 800 Fax: +32 16 221 640 ✓ @Septentrio



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**1** Introduction

## **1.1 User Notices**

## 1.1.1 CE Notice

CE

PolaRx5S receivers carry the CE mark and are as such compliant with the 2004/108/EC - EMC Directive and amendments, 2006/95/EC - Low Voltage Directive, both amended by the CE-marking directive 93/68/EC.

With regards to EMC, these devices are declared as class B, suitable for residential or business environment.

## 1.1.2 ROHS/WEEE Notice



PolaRx5S receivers are compliant with the latest WEEE, RoHS and REACH directives. For more information see www.septentrio.com/en/environmental-compliance.





## 1.1.3 Safety information



Statement 1: The power supply provided by Septentrio (if any) should not be replaced by another. If you are using the receiver with your own power supply, it must have a double isolated construction and must match the specifications of the provided power supply.



Statement 2: Ultimate disposal of this product should be handled according to all national laws and regulations.



Statement 3: The equipment and all the accessories included with this product may only be used according to the specifications in the delivered release note, manual or other documents delivered with the receiver.



## 1.1.4 Support

For first-line support please contact your PolaRx5S dealer.

Additional documentation can be found in the following manuals:

- **The PolaRx5S Reference Guide** (contained inside the Firmware Package zip on our website) includes information on the receiver operation, the full list of receiver commands and a description of the format and contents of all SBF (Septentrio Binary Format) blocks.
- **The RxControl Manual** covers the RxTools software suite, including RxControl and RxLogger.

The Septentrio website has a dedicated Support section

(http://www.septentrio.com/support), where the User Manual, the Firmware Reference Guide and the latest officially supported Firmware version are readily available for download.

Further information can be found on our website or by contacting Septentrio's Technical Support department.

In case the PolaRx5S does not behave as expected and you need to contact Septentrio's Technical Support department, you should attach a short SBF log file containing the support blocks and a Diagnostic Report of the receiver (see Section 6.3).



http://www.septentrio.com

Headquarters

Septentrio NV Greenhill Campus Interleuvenlaan 15i, 3001 Leuven, **Belgium**  Phone: +32 16 300 800 Fax: +32 16 221 640 sales@septentrio.com



# 2 PolaRx5S overview

## 2.1 Hardware Specifications

## 2.1.1 Power Consumption

The power consumption of the PolaRx5S depends on its configuration. The following settings directly influence the amount of power consumed:

- The number of enabled GNSS frequency bands. For example, a receiver configured to track signals only in the L1 and L2 bands will consume less than a receiver configured to track in the L1, L2 and L5 bands. Use the **setSignalTracking** command to enable/disable signals. Note that a given frequency band is disabled only when all GNSS signals in that band are disabled.
- Activation of the Ethernet interface: in power-critical applications, it is recommended to not use Ethernet and to turn off the associated hardware. This can be done with the **setEthernetMode** command.
- Activation of the WiFi interface: use the **setWiFiMode** command or press the WiFi button to turn the WiFi module off or on.
- The REF OUT frequency reference output: in power-critical applications, REF OUT can be turned off with the **setREFOUTMode** command.

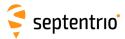
The following table shows the nominal power consumption measured when 12 VDC is supplied to the PWR connector:

Configuration	Power Consumption <sup>†</sup>
GPS + GLONASS L1, tracking and PVT	3.5W
GPS + GLONASS L1/L2, tracking and PVT	3.7W
GPS L1/L2/L5, GLO L1/L2, GAL E1/E5a, SBAS L1/L5, BDS B1/B2	3.8W
All constellations and all signals	4.6W
Enabling Ethernet ( <b>setEthernetMode</b> command)	+650mW
Enabling WiFi ( <b>setWiFiMode</b> command)	+450mW
Enabling REFOUT (setREFOUTMode command)	+30mW
Enabling wide-band interference mitigation (setWBIMitigation command)	+160mW
Enabling internal logging at 1 Hz/10 Hz	+50mW/+70mW
Stand-by mode <sup>†</sup>	1.6W

\* Note that initial power consumption can be 3W higher than the values listed due to warming up of the internal OCXO.

<sup>†</sup> Stand-by mode is described in Section 2.2.4





## 2.1.2 Physical and Environmental

Size: Weight:	284 x 140 x 37 mm (length includes connectors) 1.06 kg
Temperature Range:	-40 to +65 °C (operational) -40 to +85 °C (storage)
Certification:	IP65, RohS, CE FCC Class B Part 15

## 2.2 PolaRx5S design

## 2.2.1 Front panel

The front-panel layout of the PolaRx5S is shown in Figure 2-1. A description of the front-panel sockets as well as their PIN assignments can be found in Appendix A. The cables available for use with the PolaRx5S are listed in Appendix C and the LED behavior is described in Appendix D.

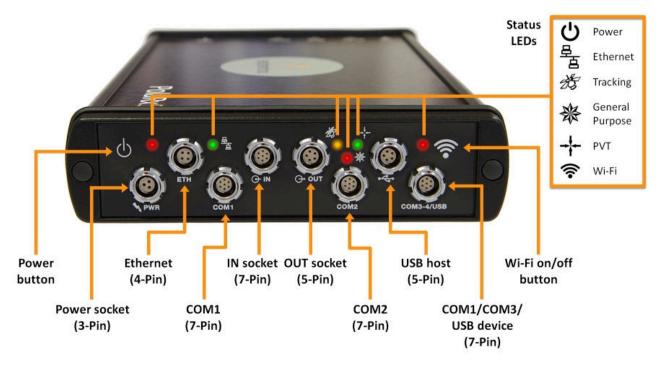


Figure 2-1: PolaRx5S front-panel layout



## 2.2.2 Rear panel

Figure 2-2 shows the layout of the rear-panel connectors on the PolaRx5S. More information on these connectors can be found in Appendix B.

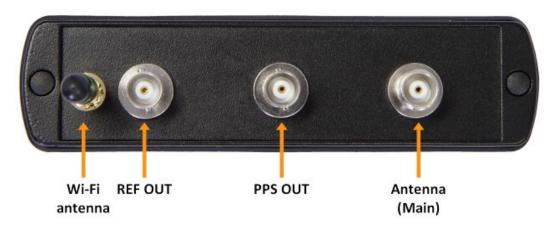


Figure 2-2: PolaRx5S rear-panel layout

## 2.2.3 Powering the Receiver

The receiver can be powered through either:

- The PWR connector (9-30 VDC)
- The Ethernet connector (Power over Ethernet PoE, 37-57 VDC). Please note that only mode A, as specified in the 802.3af standard, is supported.

If power is provided through both the Ethernet and the PWR connectors, Ethernet power takes precedence. This allows the connection of a back-up battery to the ODU PWR connector. The battery will only be used in case of an outage of the power over Ethernet.

The current power source (PWR or Ethernet connector), and the voltage at the PWR connector are reported in the <code>PowerStatus SBF bock</code>.

## 2.2.4 Power Button

When power is initially applied to the PWR or Ethernet connector, or after a power outage, the receiver always starts up without the need to press the power button.

Pressing the power button when the receiver is turned on will send the receiver into stand-by mode. Pressing the button again switches the receiver back on.

In all cases, the state of the power button is not retained across a power outage. If the receiver was in stand-by mode before the power outage, it will restart when power is restored.



## 2.2.5 WiFi Button

The WiFi button 🛜 toggles the WiFi modem on and off.

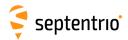
When the receiver starts up, WiFi is enabled or disabled according to the settings of the **setWiFiMode** command stored in the boot configuration file. When the receiver is operating, pressing the WiFi button turns WiFi on and off in turn. The red WiFi LED next to the WiFi button lights when WiFi is enabled.

## 2.2.6 Internal memory

The PolaRx5 has a 16 GB Memory for internal data logging. Data can be logged in SBF, RINEX, BINEX, NMEA or RTCM-MSM format and may be retrieved via the âĂŸLoggingâĂŹ menu of the web interface.

## 2.2.7 External memory

The PolaRx5S can log data to an external memory device.



# **3** Getting started with the PolaRx5S

This section details how to power-up, connect to and communicate with the PolaRx5S. The PolaRx5S has an on-board web interface which you can connect to in three ways: Ethernet, USB or WiFi. The PolaRx5S is fully configurable using the web interface. Please note that older versions of certain browsers may not properly display the web interface.

## 3.1 **Powering the PolaRx5S**

You can power the PolaRx5S by connecting the power adapter that is supplied as standard to the front-panel power socket as indicated in Figure 3-1. The receiver will start up automatically without pressing the power button.



Figure 3-1: Front-panel power socket

The PolaRx5S can also be powered over Ethernet (PoE) as described in Section 2.2.3 or by supplying 9 to 30 V via PIN 1 of the open-ended power cable (CBLe\_PWR\_OE) as detailed in Appendix A.8.

## 3.2 Connecting an antenna

The rear panel of the PolaRx5S has a TNC connector labeled **MAIN** to connect a GNSS antenna. Connect an antenna to the PolaRx5S using an antenna cable as shown in Figure 3-2. The connector can provide 5V DC and up to 200 mA to power an antenna (see Appendix B.1 for more information).



Figure 3-2: Rear-panel antenna connector

Before connecting an antenna, the orange front-panel tracking LED  $\frac{1}{25}$  will be blinking fast indicating that the receiver is searching for satellites. After connecting an antenna that has a clear view of the sky, the PolaRx5S will start to track satellites and the tracking LED will



start to blink more slowly. The number of blinks between pauses indicates the number of satellites being tracked as described in Appendix D.

# 3.3 Connecting to the PolaRx5S via the Web Interface

You can connect to the receiver on any device that supports a web browser using the receiver's on-board Web Interface. The connection can be made over USB, Ethernet or WiFi. The following sections describe each of the connection methods.

## 3.3.1 Using the USB cable

Connect the USB cable (CBLe\_USB) to the socket labeled **COM3-4/USB** on the front panel of the PolaRx5S as indicated in Figure 3-3.



Figure 3-3: Connecting to the front-panel USB socket

The first time that the USB cable is connected to your PC, you may be prompted to allow installation of drivers which can take several minutes. When the drivers have been installed, it is recommended to unplug then re-plug in the USB cable on your device to fully activate the drivers.

If the USB drivers do not install automatically, they can be installed manually by double clicking on the executable installer file found in the folder 'driver' as shown in Figure 3-4.



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	Pictures     Subversion     Videos	aller.exe	07/12/2015 19:54	Applicati
	Computer DSDisk (C:) CD Drive (E:) PolaRv5 ~ <			•

Figure 3-4: Manually installing the USB drivers

Again, when the drivers have been installed, it is recommended to unplug then re-plug in the USB cable on your device to fully activate the drivers.

The USB connection on the PolaRx5S functions as network adapter and the DHCP server running on the receiver will always assign the PolaRx5S the IP address 192.168.3.1.

To connect to the PolaRx5S, you can then simply open a web browser using the IP address **192.168.3.1** as shown in Figure 3-5.

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$\leftarrow$ $\rightarrow$ $\circlearrowright$ $\bigstar$ 19	92.168.3.1/			🛄 🕁 岸	≡ <i>l</i> ~	2 🖸	
	Receiver	Position	Status			<mark>&amp;</mark> I	.og in 🔷
4	PolaRx5-3012432 (SEPT)	Lat: N50°50'55.1095" 0.398m	Tracked Sats: 46	GRAS Status Overall Quality Int. Logging			
<b>T</b>	IP Address (Eth): 192.168.110.98	Lon: E4°43'55.6768" 0.354m	Time: 2019-06-18 12:08:40	Image: Overall Quality         Image: Overall Quality<			
septentrio	Uptime: 0d 00:15:15	Hgt: 129.351m 0.623m	Temp: 51.00 °C — V: 12.10 volts	🛠 Wifi 🔿 Internal X SECORX 🗰 Spectrum clea	an		

Figure 3-5: Connect to the Web Interface of the PolaRx5S over USB using the IP address 192.168.3.1 on any web browser



## 3.3.2 Over WiFi

The Web Interface can also be accessed over a WiFi connection. You can turn on the WiFi modem of the PolaRx5S by pressing firmly on the WiFi button as shown in Figure 3-6.



**Figure 3-6:** Press firmly on the front-panel WiFi button to turn on the WiFi modem. When active, the red WiFi led will be lit.

On your PC or tablet, search for visible WiFi signals: the PolaRx5S identifies itself as a wireless access point named 'PolaRx5S-*serial number*'. The serial number of the PolaRx5S can be found on an identification sticker on the receiver housing. Select and connect to the PolaRx5S as shown in Figure 3-7.

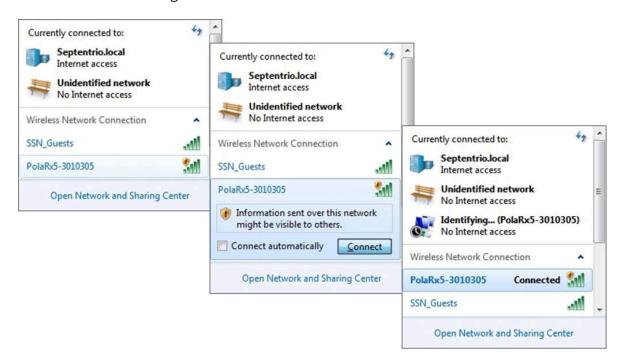


Figure 3-7: Select the PolaRx5S from the list of detected wireless signals and connect



When your PC has connected to the PolaRx5S WiFi signal, you can open a web browser using the IP address **192.168.20.1** as shown in Figure 3-8.

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$\leftarrow$ $\rightarrow$ $\heartsuit$ $\bigtriangleup$	192.168.20.1/				* *	⊨ <i>l</i> ~	Ŕ	۲	
	Receiver	Position	Status					Log	, in
-	PolaRx5-3012432 (SEPT)	Lat: N50°50'55.1098" 0.414m	Tracked Sats: 46	SBAS	🕙 Status				
2	IP Address (Eth): 192.168.110.98	Lon: E4°43'55.6770" 0.374m	Time: 2019-06-18 12:09:51	Overall Quality Corrections	<ul> <li>Int. Logging</li> <li>Ext. Logging</li> </ul>				
septentrio	Uptime: 0d 00:16:26	Hgt: 129.343m 0.642m	Temp: 51.00 °C — V: 12.10 volts	🛜 Wifi 🎉 SECORX	<ul> <li>Internal</li> <li>Spectrum cle</li> </ul>	an			

Figure 3-8: Connect to the Web Interface of the PolaRx5S over WiFi using the IP address 192.168.20.1 on any web browser



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## 3.3.3 Using the Ethernet cable

Connect the Ethernet cable (CBLe\_ETH\_MS) to the socket labeled **ETH** on the front panel of the PolaRx5S as shown in Figure 3-9.



Figure 3-9: Connecting to the front-panel Ethernet socket

For the most straightforward setup, the RJ45 socket of the Ethernet cable should be connected to a network running a DHCP server. The IP address assigned to the receiver will be associated with the hostname 'PolaRx5S-*xxxxxx*', where *xxxxxxx* are the 7 digits of the serial number of the GNSS Receiver Board (GRB) inside the PolaRx5S. This number can also be found on an identification sticker on the receiver housing. You can then make a connection to the receiver using the web address **http://PolaRx5S-xxxxxx**.

Figure 3-10 shows a screenshot of an Ethernet connection to a PolaRx5 receiver with serial number 3013369 using 'http://polarx5-3013369/'.

🖻 🖅 🕴 PolaRx5-3012432 (SEPT	(× + ×						-		×
$\leftarrow$ $\rightarrow$ $\circlearrowright$ $\textcircled{\begin{tabular}{ccc} \bigcirc \end{array}}$	http://PolaRx5-3012432/			0	<b>☆</b>	\$≡ <i>l</i> ~	Ŕ	۲	•••
	Receiver	Position	Status					Log	, in
4	PolaRx5-3012432 (SEPT)	Lat: N50°50'55.1079" 0.395m	Tracked Sats: 46	⊕ SBAS	Status				
<b>T</b>	IP Address (Eth): 192.168.110.98	Lon: E4°43'55.6759" 0.340m	Time: 2019-06-18 12:07:25	I Overall Quality	<ul> <li>Int. Logging</li> <li>Ext. Logging</li> </ul>	100			
septentrio	Uptime: 0d 00:14:00	Hgt: 129.377m 0.600m	Temp: 51.00 °C - V: 12.10 volts	🔀 Wifi 🎉 SECORX	<ul> <li>Internal</li> <li>Spectrum c</li> </ul>	lean			

Figure 3-10: Connecting to the Web Interface over Ethernet

# **4** Reference station operation

# 4.1 How to configure the PolaRx5S as an RTK base station

The PolaRx5S can be configured to work as a base station and provide differential correction data to one or more rover receivers. The steps below describe how to configure the position of the reference station and output differential corrections over an Ethernet connection. Connecting to the PolaRx5S over Ethernet is described in Section 3.3.3.

## Step 1: Configuring the PolaRx5S base station position

#### Set the position as static

To work as a base station, the position of the PolaRx5S should be set to static. If not, the PolaRx5S will still work as a base station however the position of the rover may show more variation. The 'Static' position mode can be selected in the 'Position' window of the 'Station' menu as shown in Figure 4-1.

ation > Position       Status     Settings       Position     Mode       Mode     Static       RTK     Image: Comparison of the set of the s	Logging Admin	Data Output	Corrections	Communication	Station	GNSS	Overview
Position Mode Mode  Static Rover RTK  StandAlone  SBAS							ation > Position
Position Mode Mode  Static Rover RTK  StandAlone  SBAS							
Mode     Static       RTK     Image: StandAlone       SBAS     Image: SBAS							
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55,5					1	StandAlone	
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					A	DGPS	
PPP 🖉					A.	PPP	
Reference position 💿 auto 🔍 Geodetic1 🔍 Cartesian1				letic1 Cartesian1	🔹 auto 🔍 Geod	Reference position	

Figure 4-1: Setting the PolaRx5S base station position to static

#### Set the correct position

An accurate position of the antenna that is connected to the PolaRx5S should also be set. The default setting of 'auto' can be used for demonstrations however, for most other purposes, a properly surveyed position is advisable. In the example shown in Figure 4-2, the position stored under 'Geodetic1' is used. The antenna position can be entered in either Geodetic or Cartesian coordinates.

#### Select the Datum of the antenna position

In the **Datum** field, you can select the datum to which the antenna coordinates refer. The selected value is stored in the Datum field of position-related SBF blocks (e.g. PVTCartesian) and also in any output differential corrections. Please note that the **Datum** setting does not apply any datum transformation to the antenna position coordinates.



Status Sett	tings
Position Mo	de
Mode	Static OROVER
<b>⊞</b> RTK	<ul> <li>Image: A start of the start of</li></ul>
StandAlone	2
SBAS	Image: A start of the start
DGPS	
PPP	
Static posit	ion 🔵 auto 💿 Geodetic1 💭 Cartesian1
Static Positi	ion Geodetic
	Geodetic
	Geodetic1
Latitude	Geodetic1 50.848639400deg

Figure 4-2: Setting the static position of the reference station antenna

Click on '**Ok**' to apply the new settings

i

## Step 2: Configure output of correction data over Ethernet

Output of differential corrections can be configured in the **Corrections Output** window as Figure 4-3 shows. Click on **New RTCM3 output** to start the sequence of configuration steps.

RTCMv3 is the most compact and robust differential correction format and it is recommended to use this format where possible.

Select the Ethernet port you wish to use avoiding the commands port (28784), the webserver port (80), the FTP port (21) as well as the default NTRIP port (2101) and the NTP port (123). The example shown in Figure 4-3 uses port 28785.

The messages necessary for RTK and DGNSS are selected by default. A summary of other RTK messages can be found in the 'PolaRx5S Reference Guide'.

20



Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
orrections > Co	rrections Output			Corrections Input			
				Corrections Output			
CDa	ata Streams			SECORX			
				SECONT			
CD	ifferential Correct	ions Output		)			
Т	here is currently n	o corrections o	tput defined.				
			CM3 output 😳 New	CMDD			
	utput			I			
Ľ	acput	اے	New RTCMv3 Output				
		9	elect connection typ	e:			
			Serial port	1			
			USB port				
			NTRIP server				
			IP server				
						New	RTCMv3 Output-
			Back Next Fi	inish Cancel		Select	messages to out
				Mv3 Output			ISM1
							ISM1
			Select co	nnection/port:			ISM2
			New I	P server connection	on		ISM4
							15M4 1SM5
			Back	Next Finish	Cancel		ISM6
				New RTCM	2 Output		1SM7
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				Configure n	ew IP server con	action	M1002
				Port	28785		M1003
				Mode	TCP	the second se	M1004
					s 255.255.255.255		M1005
				o brindures			M1006
				Back	Next Finish		M1007
						RTC	M1008
						Bac	k Next Finis
						Pre	ss "OK" to apply t

Figure 4-3: Click New RTCM3 output to start the configuration steps to output differential corrections over Ethernet

## Step 3: Verifying the configuration

Having configured the settings and clicked 'Ok' to apply them, you can now connect to the configured Ethernet port of the PolaRx5S using a terminal emulator tool such as Data Link\*. The Ethernet IP address you need can be found in the information bar at the top of the web interface. In the example shown in Figure 4-4, the IP address is: 192.168.105.246.

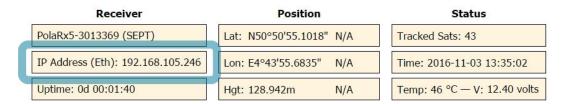


Figure 4-4: The IP address of the PolaRx5S can be found on the information bar

Data Link is part of Septentrio's RxTools suite of GUI Tools supplied with the PolaRx5S



This IP address and the port number 28785 can then be used to configure a Data Link connection as shown in Figure 4-5.

🧬 Data Link		
<u>F</u> ile <u>T</u> ools <u>H</u> elp		
Connection 1		
Connect	Serial COM15-115200-8-None-1-Off	
Show Data		
Link $\rightarrow \square 1$	Select the connection	
GGA → 1 Send every 10'th received Connect Script:	Connection Modes	TRIP
Send every 1.00 s.	TCPIP Client      TCPIP He	🔗 Data Link
Close Script:	Host Name or IP-Address	
🕅 Log File:	192.168.105.246	Connection 1
Press Connect	Port Number	Disconnect TCP/IP Client 192,168,105,246;28785
		Link $\rightarrow \Box 1$
		$GGA \rightarrow \square 1$
		Send every 10'th received GGA
		Connect Script:
		Send every 1.00 s.
		Close Script:
	ОК	Log File:
		Connected to 192. 168. 105. 246

**Figure 4-5:** Configure the Data Link terminal emulator tool to connect to the PolaRx5S Ethernet port over which differential corrections have been configured

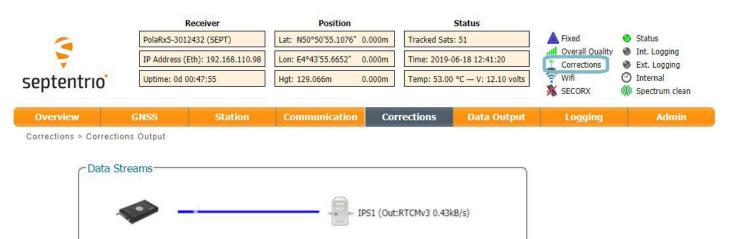
When connected to the output correction stream, click on the 'Show Data' button on Data Link and you should see output similar to that shown in Figure 4-6.

nata Link: Connection 1	
ÓÔ>À9ÑáBĐ4Qº┬≡ŪĐó&ÙÁÖÃý¢M-L/ÿļp;FpÍü ŗï¯ó!″ß œl6ê]l@3íkÁ-ÒFº¦¿újðơàuÌÿFXáëßÀY¥pf >Dض ‰¢°∽;¤µú	ß×\$%:FrDôm¦÷=Yÿh9ÿ‡c ▲ (└(
ç <sup>-</sup> ò`¶^İ <sub>1</sub>  Oèt6B¬GýÀèL±@çú+ <b>D</b> `Iÿ, ¿KÓÓB@•Unknov 1ÿ²E?Â, <sup>⊥</sup> 'òµH1èàríýV-ýß+8¿sÛ†ã@/ê¶Φ <u>*</u> çfý]@!? }r× ~=@\ysÉ-ÒoYOújādOwnÿFXáì®ÀY‰bf(ŋÈ	
7ÿx" <µ0-:ÿ¤µr <sup>⊥</sup> Ó▼ò`\$>r÷Oèt@6B″Óý Aè6ÒŒïú-∎I\ÿ, !u≢ÓB@•Unkno	wnSEPT POLARX575.0.0-tst
<u> </u>	
Show All data   Auto completion for None  Clear Freeze	Close

**Figure 4-6:** The RTCMv3 differential correction stream output from the IPS1 Ethernet connection of the PolaRx5S



When a connection to the configured Ethernet port has been established, in this example using Data Link, the 'Data Streams' field on the Corrections Output window should now show the active blue connection shown in Figure 4-7 and the corrections output icon in the information panel should appear active.



**Figure 4-7:** Web Interface showing differential corrections output over an Ethernet connection

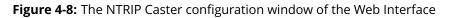


## 4.2 Configuring the PolaRx5S NTRIP Caster

The PolaRx5S includes a built-in NTRIP Caster that makes correction data from the PolaRx5S available to up to 10 NTRIP clients (or rovers) over the internet. The caster supports up to three mount points and can also broadcast correction data from a remote NTRIP server.

All settings relating to the PolaRx5S NTRIP Caster can be configured on the NTRIP Caster window of the Web Interface shown in Figure 4-8.

Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
Communication >	NTRIP Caster						
	Status Settings						
	-General Settings-						
	Enable NTRIP cast IP Port	er  off on 2101					
	Caster identifier	default					
	Custer Identifier	deradar					
	Mount Points		NTRIP Caster				
	There are currently	no mount points	Serial Port				
	New mount point	t	Point-to-Point Protocol				
	Client Users There are currently New user	no users defined.					



#### Step 1: Define a new mount point

In the NTRIP Caster window, click on 'Settings'.

In the General Settings field, enable the NTRIP Caster and select the IP port over which you wish to send correction data: the default port is 2101.

Click on ' New mount point' as indicated in Figure 4-9. Select 'Yes' to enable the mount point and give it a name. This is the name that will appear in the caster source table. Up to 3 mount points can be defined each with a different name. You can also select the type of **Client authentication** for the mount point: **none** - any client can connect without logging in or, **basic** - clients have to login with a username and password.

To select a correction stream from the NTRIP server of the PolaRx5S, select '**No**' in the 'Allow external server' field\*.

Click on the '**Local Server** ...' button to enable the local NTRIP server of the PolaRx5S and to select the individual messages you want to broadcast. By default, correction messages necessary for RTK are pre-selected. Click 'Ok' to apply the settings.

By setting 'Allow external server' to 'Yes' the mount point can receive a stream from a remote NTRIP server



	nt points defined.			Configure NTRIP Output Enable Local Server Enable Local Server on Output Type The internal caster mount point is configured to distribute RTCMv3 Currently, no RTCMv3 output is conf Messages to Output	igured.		
	Edit Mount Point Enabled	Yes	•	Which RTCMv3 messages do you wa output?	int to		
Client Users	Mount point name	Leuven		B MSM1			
There are currently no user	Allow external server		T	MSM2     ■			
C New user	Server user name			B MSM3			
	Server password		0	MSM4     MSM5			
Ok	Client authentication		•	MSM6	- Edit Mount Point		
	Data format	RTCMv3		MSM7     ■	Enabled	Yes	<u> </u>
	Manual format string			RTCM1001			
	Format details	rtcmv3		RTCM1002	Mount point name	Leuven	
	Torriac details	Itellivo		RTCM1003	Allow external server	No	•
	Ok Ca	ancel Local Se	erver	RTCM1005	Server user name		
l				RTCM1006 🖉 🗸	Server password	•	>
-				This selection will be applied for al	<b>Client</b> authentication	basic	T
				output.	Data format	RTCMv3	
					Manual format string		
				Ok Cancel	Format details	rtcmv3	
					Ca	ancel Local Serv	ver

Figure 4-9: The configuration sequence for defining a new mount point

#### Step 2: Define a new user

If you selected '**basic**' client authentication when configuring the mount point in the previous step, you will need to define at least one user. The user name and password are the credentials needed for the NTRIP client (rover) to access the correction stream.

In the 'Client Users' section, click on ' **New User**' as shown in Figure 4-10. Enter a User Name and Password for the user and select the mount points that they will have access to. Up to 10 NTRIP clients can log in as a particular user. Click 'Ok' to apply the settings.

Status       Settings         General Settings         Enable NTRIP caster       off         IP Port       2101         Caster identifier         Mount Points         Name       Format         Enabled       Authentication         •       Leuven         RTCMv3       Yes         •       New mount point         Client Users       Edit User         There are currently no users c       Edit User         •       New user	Leaven Richwa res Dasic
Allowed Mount Points Unu	User Name Allowed Max. Nr.
Max number of clients 10	
	Press "OK" to apply the changes.

Figure 4-10: Configuring the login credentials for a user



#### Step 3: Is the NTRIP Caster working?

In the '**Status**' tab of the NTRIP Caster window, you can see a summary of the NTRIP Caster to make sure that it has been properly configured. In the example shown in Figure 4-11, two rover clients are connected to the mount point named 'Leuven' as user 'Mildred'.

If the client rover receivers are configured to send a GGA message to the caster (as was the case in Figure 4-12), then their position will also be visible.

	Com	Co.	mach		
Mountpoint	Serve Connec		nnect ime	Rate	e Clients
Leuven	Yes	391	n31s	480 Bp	s 2
Connected Clie					
Connected Clie		Connect Time	Lati	tude	Longitude
		Connect Time 2m22s		<b>tude</b> '45.4"	Longitude 4°43'42.8"

Figure 4-11: Connecting as a client to the PolaRx5S NTRIP Caster

#### On the NTRIP Client side

Rover receivers can connect to the NTRIP Caster by entering its IP address and Port as shown in Figure 4-12. After clicking 'Ok', the mount point source table will be filled and a mount point can be selected. The user name and password can then be entered and within a few seconds, the rover receiver should report an RTK fixed position.

Ntrip-									
	N -			_1	h	RTCMv3			
							192.168.	.107.123: Le	uven
Edit NTF	RIP Connecti	on							
Mode		Client			¥				
Caster		192.168.107	.123						
Port		2101							
User na	me	Mildred							
Passwo	rd	••••		0					
Mount p	ooint	Leuven			Y				
	GA to caster	Details 1 sec			¥				
		Ok Canc	el						

Figure 4-12: Connecting as a client to the PolaRx5S NTRIP Caster

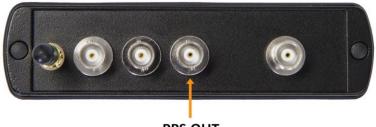


# 4.3 How to output a PPS (Pulse-per-Second) signal

The PolaRx5S can output a PPS (Pulse-per-Second) signal that can be used for example, to synchronize a secondary device to UTC time.

## Step 1: Connect a cable with a BNC connector

Connect a cable with a BNC connector to the rear-panel connector labeled 'PPS OUT' and indicated in Figure 4-13.



PPS OUT



#### **Step 2: Configure the PPS settings**

You can configure the PPS settings on the 'Timing' window of the 'GNSS' menu as shown in Figure 4-14.

Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
GNSS > PPS/Timi	Satellites and Signals						
	Tracking						
	Spectrum						
	Atmospheric Models	PPS OUT Para	motors				
	PPS/Timing	Interval	1 sec	]			
		Polarity	Low2High	High2Low			
		Delay	0.00	ns			
		Time scale	TimeSys	¥			
		Max sync age	60 s				
		CTiming System	n				
			ST 🖲 GPS 🔵 Beil	Dou			

Figure 4-14: PPS configuration field in the web interface

The **Interval** is the time interval between successive timing pulses and is selectable between 10 ms and 10 s. The default **Polarity** of the PPS signal is a low-to-high transition which can be alternatively configured as high-to-low.

The **Delay** argument can be used to compensate for signal delays in the system (including antenna, antenna cable and PPS cable). For example, if the antenna cable is replaced by a

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longer one, the overall signal delay would be increased by say, 20 ns. If the Delay value is left unchanged, the PPS pulse will arrive 20 ns too late. To re-synchronize the PPS pulse, the Delay should be increased by 20 ns. The delay can be configured with values between -1 ms and +1 ms.

By default, PPS pulses are aligned with the satellite time system (TimeSys) as shown in the **Time Scale** field. PPS signals can alternatively be aligned with UTC, local receiver time (RxClock) or GLONASS time.

When Time Scale is set to anything other than RxClock, the accuracy of the time of the PPS pulse depends on the age of the last PVT computation. During PVT outages, the PPS generation time, which is extrapolated from the last available PVT information, may start to drift. To avoid large biases, the receiver stops outputting the PPS pulse when the last available PVT is older than the specified **MaxSyncAge**. The MaxSyncAge is ignored when TimeScale is set to RxClock.

#### Step 3: Click on 'Ok' to apply settings

The new configuration can also be saved as the boot configuration by clicking 'Save' in the pop-up.

## 4.4 How to enable the NTP server

NTP (Network Time Protocol) is an Internet protocol for clock synchronization between computer systems over data networks. It is intended for synchronizing participating computers to within a few milliseconds of UTC. The NTP server functionality on the PolaRx5S can be configured as shown in Figure 4-15. When enabled, the NTP server accepts UDP time-stamp requests on port number 123.

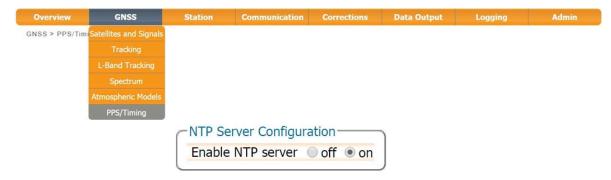


Figure 4-15: Enabling the NTP server



## 4.5 How to log data

The PolaRx5S has a 16 GB memory for internal data logging. Data can also be logged to an external USB memory disk.

## 4.5.1 Internal logging

#### Step 1: Defining the Disk Full action

When setting up a logging session for the first time, it is a good idea to define what you would like to happen when the internal memory is full. This can be configured on the 'Disk Full Management' page of the 'Logging' menu as shown in Figure 4-16. There are two options, either the receiver stops logging when the memory is full or it continues logging by making space for new files by deleting the oldest. The default setting is 'Delete oldest'.

Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
Logging > Global	Log Settings					Log Sessions	
	nternal Disk Ex	ternal Disk				Disk Contents	
	Disk Full Action-			]		Global Log Settings	
	When disk is full:						
	<ul> <li>Stop logging in</li> <li>Delete oldest fil</li> </ul>		ority				
	Session Priority— No log sessions de	fined for internal	disk.				
	obal File Naming C	and the second sec					
	dd .A suffix to curr refix all file names		O off ● on ID ● off ● on				
Def	fault Ok						

Figure 4-16: Selecting what you wish to happen when the internal 16 GB memory is full

## Step 2: Configuring a logging session

On the 'Log Sessions' window of the 'Logging' menu you can check which logging sessions have already been defined and define new ones. Up to 8 simultaneous logging sessions can be defined independently: logging Septentrio Binary Format (SBF), RINEX, BINEX, NMEA and RTCM (MSM).

To define a new logging session, click on a **Create** button as shown in Figure 4-17.



Overview		NSS	Station	Communication	Corrections	Data Output	Logging	Admin
ging > Log S	essions						Log Sessions	
							Disk Contents	
CL.	isk Usage	3				)		
		Inte	rnal Disk (15	5.1 GB)	External D	lisk	Global Log Settings	
	(	) 🗖 u	ised (0%, 88.0	) (KB)	Disk not	nresent		
		/ 🗆 f	ree (100%, 15	.1 GB)		r present		
	Unmount	Format						
						)		
CL	og Sessio	ns						
	ID	Name	Data	Auto-Delete Disk	FTP			
	LOG1	Unused Creat	e i					
	LOG2	Unused Creat	te					
	LOG3	Unused Creat	te					
	LOG3 LOG4	Unused Creat						
		Unused Creat	te					
	LOG4	Unused Creat Unused Creat	te )					
	LOG4 LOG5 LOG6	Unused Creat Unused Creat Unused Creat						
	LOG4 LOG5 LOG6 LOG7	Unused Creat Unused Creat Unused Creat	te le te					

Figure 4-17: Click on a 'Create' button to start defining a new logging session

You can then follow the sequence of steps shown in Figure 4-18 selecting the various configuration settings for the logging session. In this example, the default settings of 'Internal' Disk and 'Never' for Auto-Delete\* have been selected. In the 'Edit SBF Stream' window, the messages required for RINEX generation have been selected as well as those useful for the Support department for diagnosing problems. SBF messages can also be selected individually.

Edit Session LOG1           Session         SBF         NMEA         RINEX         RTCM-MSM           Session name	
Disk Internal 🔻	
Auto-delete Never 🔻	
Ok       Cancel         Session LOG1         Session SBF NMEA RINEX BINEX RTCM         Streams         There are currently no SBF streams defined.         New SBF stream         Ok         Cancel	Edit SBF Stream Interval 1 sc PostProcess Rinex (meas3) Support Measages Interval PostProcess+Rinex+Support 1 sc Measages RawNavBits GAL GAL GEO QZS MUTCat Ck Cancel
	Ok Cancel

Figure 4-18: Follow the sequence of windows to fully configure the logging session

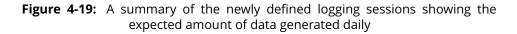
Please note that, this setting is overruled by the 'Disk Full Action' setting defined in the **Global Log Settings** window.



## Step 3: Verifying the configuration

When you have finished configuring the logging session, the 'Log Sessions' window will show a summary of the defined logging sessions as in Figure 4-19. An estimate of the daily size of data generated with the current logging configuration is also given.

	nmount		8.3 MB) , 15.1 GB) +SBF			rnal D		ent	
	ID	Name	Data	Auto-Delete	Disk	FTP			
0	LOG1		Data RINEX, SBF		Disk Internal		A Comments of the	×	ON
0	and the second second	my_logging_session	RINEX, SBF		and the second	۲	A Comments of the	××	
•	LOG1	my_logging_session	RINEX, SBF	Never	Internal	۲		××	ON ON
•	LOG1 LOG2	my_logging_session another_logging_session	RINEX, SBF	Never	Internal	۲		×	
•	LOG1 LOG2 LOG3	my_logging_session another_logging_session Unused <u>Create</u>	RINEX, SBF	Never	Internal	۲		××	
•	LOG1 LOG2 LOG3 LOG4	my_logging_session another_logging_session Unused Create Unused Create	RINEX, SBF	Never	Internal	۲		××	
•	LOG1 LOG2 LOG3 LOG4 LOG5	my_logging_session another_logging_session Unused Create Unused Create Unused Create	RINEX, SBF	Never	Internal	۲		×	





## 4.5.2 Logging to an external USB memory device

The PolaRx5S can also log data to an external memory device. To connect the device, you will need a USB Host cable\* (CBLe\_USB\_HOST) to connect to the front-panel socket indicated by the USB icon + as shown in Figure 4-20.

A hig session

A high-quality memory device is recommended for external logging as multiple logging sessions can result in a large throughput of data. The 4K random write speed should be greater than 0.1 MBps, and the 4K random read speed should be at least 2 MBps<sup>†</sup>.



Figure 4-20: Connecting an external USB memory device to the PolaRx5S

With an external memory device connected, the new device should be visible in the 'Log Sessions' window as shown in Figure 4-21. If the device is not formatted or the formatting is not compatible with the receiver file system, you will be prompted to format the device. This can be done by clicking on the 'Format' button.

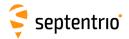
Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
Logging > Log Ses	Log Sessions						
C Disk L	Jsage					Disk Contents	
		ternal Disk (15.1 G used (26%, 4.0 GB) free (74%, 11.1 GB		used (19	i <b>sk (1.8 GB)</b> %, 26.1 MB) %, 1.8 GB)	Global Log Settings	
Unm	ount Format		Unmount	ormat			

Figure 4-21: With a 2 GB external USB memory device connected to the PolaRx5S

New logging sessions can then be defined in a similar way as in Section 4.5.1 making sure to select 'External' from the drop-down list in the 'Disk' field as shown in Figure 4-22.

The CBLe\_USB\_HOST is an optional item. It is not part of the standard PolaRx5S delivery

The 4K random read/write speed is a standard specification for memory devices. More information and a list of benchmarked devices can be found on: http://usb.userbenchmark.com



Session na	me			
Disk		Internal	T	
Auto-delete	е	Never	T	

Figure 4-22: Select 'External' from the drop-down list to log data to an external memory device

# 4.5.3 How to FTP push logged data to a remote location

SBF, RINEX and BINEX files can also be automatically sent to a remote FTP server (FTP push). A different FTP server can be configured for each logging session and, SBF and RINEX files logged in the same session can be sent to different servers.

The FTP server settings can be entered in the 'Edit Session' window, after configuring SBF or RINEX logging, as shown in Figure 4-23. FTP push will create the folder 'data' on the remote server if it does not yet exist. If file transfer fails, the receiver will retry after the 'Retry Interval' which has been selected as 15 minutes in this example.

-Stream- Type Signals		Interv	al Duration	
RINEX v2x GPS L1CA,L1P Glonass L1CA,I	L2CA,L3 6BC,E5a,E5b,E5 ,B3	1 sec	1 hour	₽ X
–■RINEX FTP Push Settir	igs			
Enable	on		۲	
Server	pc60devlin200	_		
Remote directory	data			
Login name	sarah			
Password			0	
Server FTP control port	21			
Retry interval	15 min		•	
Test				

Figure 4-23: Configure pushing of RINEX files to an external FTP server

You can check that the FTP server credentials are correct by clicking on the 'Test' button. This will push a small test file to the remote folder and then delete it. The receiver reports whether or not the file was successfully sent and deleted as shown in Figure 4-24. If the



server is configured such that files cannot be deleted then the receiver will also report this and the test file will remain in the remote folder.



Figure 4-24: Testing the remote FTP server credential are correct

## 4.6 How to access logged data

## 4.6.1 Downloading data using the web interface

Data files logged by the PolaRx5S, both on its internal memory and to an external USB device, can be downloaded using the web interface on the 'Disk Contents' window of the 'Logging' menu. Each logging session is logged to a separate folder. Individual files can be downloaded by clicking on the green download arrow () next to the file name as shown in Figure 4-25.

If you need to download multiple files from the receiver, it may be more convenient to use the FTP server of the PolaRx5S as described in Section 4.6.2.

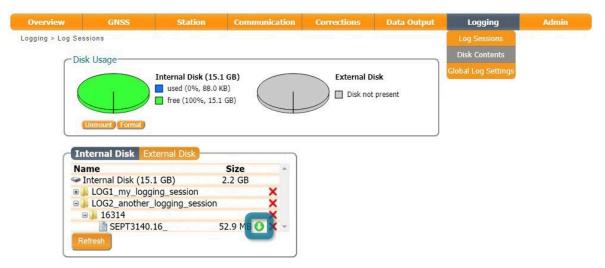


Figure 4-25: Downloading logged data files from the PolaRx5S



# 4.6.2 Downloading data using the on-board FTP server

FTP, SFTP or rsync can be used to download data files logged on the PolaRx5S. The example below details how the on-board FTP server can be used to download data files logged both internally or to an external device. Using an FTP client application such as FileZilla, multiple files can queued for download. The Host name is simply the address in the URL bar of the web interface. Figure 4-26 shows how to connect using FTP with FileZilla over both the USB connection (**192.168.3.1**) and over Ethernet (**PolaRx5S-3010305**\*).

The **DSK1** folder contains data files logged on the internal memory while **DSK2** contains files logged to an external device.

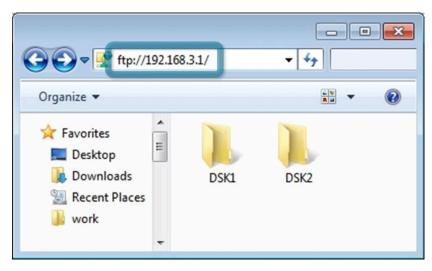
192.168.3.1	- FileZilla										
File Edit V	iew Transfer Server	Bookmarks Help									
	eq 11 😫 😫 🖷 🖽	🛯 💺 🛷 🔳 📰 🔗 🤹 🕯									
Host: 192.168	3.3.1 Username:	anonymous Pass	word:	Port:	Quic	kconnect					
Status:						r					
Status: Status:	🔁 polarx5-3010305 - FileZilla 📃 📼 📼										
Status:	File Edit View Transfer Server Bookmarks Help										
Status:											
Status:	Host: polarx5-3010305	Username: anonymou	us Passwo	ord:	Port:	(	Juickconnect	I,			
Local site: \											
Filename	Status: Resolving address of polarx5-3010305 Status: Connecting to 192.168.105.246:21										
	Status: Connecting to 192.108.103.240:21 Status: Connection established, waiting for welcome message										
C:	Status: Insecure server, it does not support FTP over TLS.										
E: (SSN_IN	Status: Connected										
	Status: Retrieving directory listing Status: Directory listing of "/" successful										
<											
8 directories	Local site: \		•	Remote site:	/	_		•			
1	Filename	Filesize Filetype	Last moc 📤	Filename	Filesize	Filetype	Last modified	d			
	ê C:	Local Disk	E	- DD							
	4 D:	CD Drive		DSK1		File folder	17/11/2015 14	4:			
	E: (SSN_INSTALL)	CD Drive	-	DSK2		File folder	17/11/2015 14	4:			
	1	III		4	111						
	8 directories										
					/ EEE Qu	eue: empty					

**Figure 4-26:** Downloading logged data files using the PolaRx5S FTP server with a FileZilla client (**DSK1**: files logged on the internal memory, **DSK2**: files logged on an external USB device)

You can also connect over FTP using a file manager such as Windows File Explorer. When connected to the PolaRx5S over USB for example, just enter **ftp://192.168.3.1** in the address bar as shown in Figure 4-27.

The 7-digit number is the serial number of the receiver.





**Figure 4-27:** Downloading logged data files using the FTP server with Windows File Explorer. (**DSK1**: files logged on the internal memory, **DSK2**: files logged on an external USB device)

# 4.7 **Preserve On Event Logging (POEL)**

## 4.7.1 Introduction

In some cases, especially when a lot of data is being logged on the receiver, it may be interesting to preserve certain valuable files which are linked to a specific event (e.g. the occurrence of an earthquake). Preserve On Event Logging (POEL) allows such Event-based marking of files in order to prevent them from being deleted.

To configure POEL, create a new log session as described in Section 4.5 and select Type: 'Preserve on Event'. Currently, 'Events' refers to hardware events: a voltage transition registered by either the Event A or the Event B pins. Data can be preserved from x minutes before until y minutes after event as shown in Figure 4-28. The maximum amount of time data can be preserved before the event is 24 hours.

Edit Session LOG	1			
Session SBF	NMEA	RINEX	BINEX	RTCM-MSM
Session name	Event_dat	а		
Туре	Preserve	DnEvent	•	
Disk	Internal		•	
Auto-delete	Never		•	
Preserve On Event	Event EventA EventB			
Time Before	15	min		
Time After	15	min		
	Ok	Cance		

**Figure 4-28:** Configuring a new Preserve On Event log session. In this example, data is preserved from 15 minutes before until 15 minutes after the event.



# 4.7.2 Using Preserve on Event Logging in combination with AutoDelete and Delete Oldest

Both enabling the AutoDelete feature and setting the DiskFullAction to 'Delete Oldest' will result in logged files being deleted from the receiver's internal disk over time. This may lead to complex scenarios in case Preserve On Event Logging is enabled as well.

#### **POEL and AutoDelete**

AutoDelete makes sure that files are deleted after a user-defined number of days. When a log file is flagged to be preserved using POEL, the AutoDelete functionality does not delete this file. Thus, as more events occur, the disk will continue to fill with preserved files until the disk is full and the Disk Full Action is activated.

#### **POEL and Delete Oldest**

When the Disk Full Action is set to 'Delete Oldest' as described in Section 4.5.1, the receiver deletes old files from the disk when it becomes full. The files in unused or disabled log sessions are first to be deleted. The receiver then scans the enabled low-priority sessions. The oldest file in these sessions is identified and deleted. If no file could be deleted, the receiver scans the medium-priority sessions, and finally it will scan the high-priority sessions.

Preserved files are the last to be deleted but, in case the disk fills with preserved files, these files will also be subject to the Disk Full Action settings. From oldest to newest, the preserved files from the low priority sessions are deleted. After that the preserved files from the medium priority session will be deleted, until the disk is full of High priority, preserved files. Once this is the case, the oldest preserved high priority files will be deleted (per day) to free up space for all other log sessions.

- Files of the active day and the day before the active day are not deleted. This is done to make sure that the user can preserve a sufficient amount of data before an event.
- When multiple events occur within one minute, these are all considered to be the same event by the POEL feature.



# 4.8 **Point-to-Point Protocol (P2PP)**

The PolaRx5S features a Point-to-Point Protocol (P2PP\*) server, which emulates an IP link over a serial port.

# 4.8.1 How to configure P2P Protocol

To start configuring the Point-to-Point Protocol, go to the Point-to-Point window as shown in Figure 4-29

Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
Communicatio	n > Point-to-Point Pro	tocol	Ethernet				
0	Point-to-Point Prot	ocol Settings	WiFi	:-to-Point Protoc	ol Status		
	Mode	Off	Dynamic DNS	N/A			
	Port	COM1	IP Ports	is N/A			
	Client IP	192.168.50.2	Firewall	N/A			
	Server IP	192.168.50.1	Web Server				
	Authentication	None	NTRIP				
	Password	0					
	Connect Timeout	60 s	NTRIP Caster				
	Activity Timeout	600 s	Serial Port				
C			Point-to-Point Protoco	1			
	Default Ok						

Figure 4-29: The Point-to-Point window

In the current version, the receiver implements a single P2PP server, and the first argument (ServerID) can only take the value P2PP1 .

To enable the P2PP server, change the Mode setting to 'Server'. Note that it is disabled by default. Once the server is enabled, all the other P2PP settings can be configured as shown in Figure 4-30. The Port option allows to select the COM port to be used for the point-to-point communication. Next the client and server IP's will need to be set. The ClientIP sets the IP address that will be given to the client (remote from the receiver's perspective) when a connection is established while the ServerIP refers to the IP address that will be given to the server (local from the receiver's perspective) when a connection is established.

Though sometimes abbreviated as PPP, this feature is referred to as P2PP in Septentrio receivers as to avoid confusion with Precise Point Positioning.



Mode	Server
Port	Off
Client IP	Server
Server IP	192.168.50.1
Authentication	None
Password	0
Connect Timeout	60 s
Activity Timeout	600 s

Press "OK" to apply the changes.

It is possible to require authentication when establishing the connection. To enable authentication, you will need to choose either the PAP or the CHAP protocol as shown in Figure 4-31. PAP will use Password Authentication Protocol and CHAP will use Challenge Handshake Authentication Protocol. When authentication is enabled, a password needs to be set in order to successfully configure this feature.

Mode	Server •
Port	COM1 •
Client IP	192.168.50.2
Server IP	192.168.50.1
Authentication	PAP 🔻
Password	•••••• (0)
Connect Timeout	60 s
Activity Timeout	600 s

Press "OK" to apply the changes.

Figure 4-31: Enabling P2PP authentication

Finally, Connect Timeout determines the maximum amount of time, in seconds, that a connection attempt may consume before being refused. Meanwhile, Activity Timeout sets the maximum time, in seconds, that a connection may be idle (no data transfer) before it is disconnected. When a timeout occurs, the receiver will shut down the P2PP server and restart it. When a server is enabled, and the configuration is correct, the receiver will start the P2PP server within a maximum of 30 seconds.

Figure 4-30: Configuring P2PP



# 4.9 CloudIt

CloudIt offers an alternative to FTP for RINEX or SBF file submission from the PolaRx5S receivers and supports OpenAM for authentication. To learn more about the CloudIt feature and learn how to set it up, please check the knowledge base on the Septentrio website.



#### Scintillation Monitoring with the 5 PolaRx5S

This chapter covers the configuration of the PolaRx5S receiver and the RxLogger GUI tool for ionospheric scintillation and TEC monitoring.

#### **High-level operation overview** 5.1

In a typical setup, the PolaRx5S generates and outputs 50 Hz phase and amplitude samples for all visible satellites and frequency bands. These samples are logged on a host PC in hourly files using the provided RxLogger graphical interface tool. At the end of every hour, TEC and scintillation indices are computed for all visible satellites and logged as comma-delimited ASCII records.

The receiver can also output S4 and  $\sigma_{\phi}$  indices in real time for all tracked satellites.

Appendices E, F and G provide further information on operating the receiver at 100 Hz, real-time S4 and  $\sigma_{\phi}$  output and also on the TEC calibration tool built into **sbf2ismr**.

#### **Configuring RxLogger** 5.2

Septentrio provides the RxTools suite of GUI tools among which is RxLogger. The RxLogger tool provides an easy and convenient way to log and monitor ISMR data from the PolaRx5S. A short description of the various RxTools and how to install them can be found in Appendix H. This section details how to use RxLogger for ISMR file generation.

#### **Connecting to the receiver** 5.2.1

The first time you run RxLogger, you will need to create a new connection. Future connections will reuse the last connection by default. Please refer to the RxControl Manual for a complete description of the connection options

For ISMR data logging, it is recommended to use either:

- one of the two Virtual USB COM port connections or
- an Ethernet connection (TCP/IP) to connect RxLogger to the receiver.

The example given in Figure 5-1 shows a connection via the USB COM Port1 of the receiver which maps onto the COM11 port of the PC.



The standard serial ports should **not** be used because their bandwidth is too low to support the high data throughput required for ionospheric scintillation monitoring.



Specit	fy the serial setting	s 🕯
Serial Port: Advance	Septentrio Virtual USB COM Port 1 Septentrio Virtual USB COM Port 2 Septentrio Virtual USB COM Port 1	(COM10)
Connection	Name: polarx5s	

Figure 5-1: Connecting to the PolaRx5S over USB using RxLogger

## 5.2.2 Selecting file names and directories

You need to specify where to store the raw data from the receiver. Raw data (high-rate phase and amplitude and low-rate support data) are stored in SBF (Septentrio Binary Format). Raw data files will be referred to as *SBF files* in the remainder of this chapter.

In the main window of RxLogger, on the **Global** tab select the directory where data files will be logged. In the example shown in Figure 5-2, data will be stored in the folder C:\Users\dean\DATA\.



🦆 polarx5s.serial - RxLogger - S/N 3009173
<u>File I</u> ools <u>H</u> elp
Status Global File Naming SBF NIMEA Post Processing
Log Directory
C:\Users\dean\DATA\
Message Types To Log  SBF Messages  MMEA Messages
Log Schedule (GNSS time)           □ Start at:         09/02/2016 ▼           15:55:00 ♀         □ Stop at:         09/02/2016 ▼           From manual start until manual stop
Startup Script
Send Script At Startup:
Always resend the script if the connection is lost
Start Logging Stop Logging
Tue 9-Feb-2016 18:01:47 (GNSS) SSRC7 - PolaRx5S

Figure 5-2: Select the location on your PC where data files will be logged

In the **File Naming** tab, you can set the file naming convention to one of the IGS options. Selecting 'IGS 1 hour' for example, will cause RxLogger to create hourly SBF files.

Every day, a new directory will be created under the directory specified in the 'Global' tab, with the name being formed from a concatenation of the two-digit year number and the 3-digit day-of-year. Within each of the daily directories, the hourly SBF files follow the IGS file naming convention:

```
ssssdddf.yy_
   +--- yy: two-digit year
f: file sequence character within day
A: 1st hour 00h-01h; B: 2nd hour 01h-02h; ...
X: 24th hour 23h-24h
----- ddd: day of the year of first record in file
      ----- ssss: 4-character station name designator
```



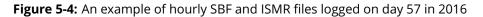
The 'ssss' field (the station name designator) can be freely chosen by selecting 'Force the MarkerName to:'. In the example shown in Figure 5-3, the 'ssss' field has been set to 'SEPT'.

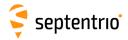
bolan:5s.serial - RxLog	gger - S/N 3009173
Status Global F	ile Naming SBF NMEA Post Processing
File Naming Convention	IGS 1 hour
☑ Limit the MarkerNa	n a "do not use" time stamp to "00000\ <markername>0000.00" ame to 4 characters erName from the receiver Name to: SEPT</markername>
-Manual File Name Opt	ons
File Name:	log
SBF File Extension:	sbf
NMEA File Extension:	nmea
☑ Split Files After:	Image: Size Limited:         100,000 MB ★           Time Limited:         0 00:10:00 ★
Station Settings	
Set Station Settings.	
SBF NMEA	Stop Logging
	Tue 9-Feb-2016 18:05:13 (GNSS) SSRC7 - PolaRx55

Figure 5-3: Specifying the station name designator as 'SEPT'

Figure 5-4 shows an example of data files logged on February 26, 2016. The files with the '.16\_' extension are SBF files containing the raw data from the receiver. The files with the '.16\_.ismr' extension are the post-processed files containing the scintillation indices. Section 5.2.4 describes how to configure post-processing actions.

Organize 🔻 🛛 I	nclude in library	▼ Share with ▼	Burn New folder	)III 🔹 🚺	0
Name		Date modified	Туре	Size	
SEPT057A.16_		26/02/2016 1:59 AM	Septentrio Binary Format	118,041 KB	
SEPT057A.16	ismr	26/02/2016 1:59 AM	ISMR File	802 KB	
SEPT057B.16_		26/02/2016 2:59 AM	Septentrio Binary Format	120,883 KB	
SEPT057B.16	smr	26/02/2016 2:59 AM	ISMR File	814 KB	
SEPT057C.16_		26/02/2016 3:59 AM	Septentrio Binary Format	122,760 KB	
SEPT057C.16	ismr	26/02/2016 3:59 AM	ISMR File	805 KB	





# 5.2.3 Selecting the set of raw data to log

Raw data in SBF format are arranged in so-called SBF blocks. You need to tell RxLogger which blocks to log and at what interval which is done in the **SBF** tab of the main window of RxLogger. For ionospheric scintillation and TEC monitoring, the following SBF blocks should be logged:

- At an interval of 20ms (50Hz):
  - IQCorr
- At an interval of 1s (1Hz)\* :
  - MeasEpoch
  - MeasExtra
- At an interval of 10s:
  - ReceiverStatus
  - ChannelStatus
  - ReceiverSetup
- At an interval of OnChange:
  - GPSNav
  - GLONav
  - GALNav
  - BDSNav
  - QZSNav

Click the 'Add Stream' button to add a new column in the window.

Message Interval 20 m Off 20 m Rinex 20 Support 20 RawData 20 PostProcess 20		emove Rem	nove Rer	nove nge 🔻				
Off Energy Control Con				nge 🔻				
Rinex  Support RawData PostProcess								
Support  RawData PostProcess								
RawData		(m)	Line I					
PostProcess			((***)					
	1000							
GUI 🔳				MeasEpoch	<u> </u>	V		<b></b>
				MeasExtra		<b>V</b>		
🗄 Measurements 🔲				EndOfMeas				
🗄 RawNavBits 📃				- IQCorr			<b>1</b>	
🗉 GPS 📃				- ISMR				
GLO								
🗄 GAL 📃								
⊕ GEO			(E)					
E CMP								
⊕ QZS 📃								
⊕ PVTCart 📃								
PVTGeod								
PVTExtra	(III)	(m)						
🗉 Attitude 🔲				OutputLink		1		
🗄 Time 🔲				- InputLink				
🗉 Event 🔲				SatVisibility				
DiffCorr				- ChannelStatus			<ul> <li>Image: A start of the start of</li></ul>	
🗄 Status 📃			E	ReceiverStatus			<ul> <li>Image: Construction of the second seco</li></ul>	
	1993	in the second se		necercistatas	-		62.0	
			Define SBF Gr	Add Stream	]			

Figure 5-5: Select the SBF blocks and logging rates needed for ISMR file generation

The MeasEpoch and MeasExtra SBF blocks can be logged at 1 Hz to reduce the CPU load and keep file sizes to a minimum



# 5.2.4 Configuring the post-processing options

The SBF files themselves do not contain the scintillation indices however, they can be computed using the **sbf2ismr** conversion program. RxLogger can be configured to automatically execute **sbf2ismr** on SBF files. You can do this by defining a post-processing action on the 'Post Processing' tab of the main window of RxLogger. When logging hourly files, as in this example, **sbf2ismr** will be executed every hour.

Refer to Section 5.3 for a detailed description of the **sbf2ismr** conversion program.

Click the **Add** button to start defining a new post processing action. From there you can select **ISMR Conversion** from the drop-down list as shown in Figure 5-6. Then click on 'Next'.

😍 polanx5s.serial - RxLogger - S/N 3009173 Eile Iools <u>H</u> elp	
Status Global File Naming SBF NMEA Post Proc	essing
Enable Input Post Process Action Name	
Add	🖓 💌
SBF NMEA Tue 9-Feb-2016 17:	Post Process Action Input and Type Select the input and which action that must be applied: SBF NG Conversion NMEA Natanaka Conversion Custom Conversion SBF Analyzer ISMR Conversion Next Cancel

Figure 5-6: Selecting automatic generation of ISMR files from SBF data files

On the 'ISMR Parameters' page shown in Figure 5-7, you can select the desired phase detrending cut-off frequency - the default is 0.10 Hz).

You may want to reduce the number of columns in the ISMR file if for example, you are only interested in single-frequency indices. Section 5.3.1 gives more details on how this can be done.

You can also exclude one or more constellations from the ISMR file, even if the data from satellites from these constellations are contained in the SBF file.

Optionally, you can also provide a TEC calibration file in order to correct for TEC biases. Section 5.3.1 provides more details on TEC calibration.

# 🗧 septentrio

? 🔀
🕒 😝 Create a new Post Process Action
ISMR Parameters
Phase detrending cut-off frequency: 0.10Hz
Limit number of columns to: Default
Exclude GPS satellites
Exclude GLONASS satellites
Exclude Galileo satellites
Exclude BeiDou satellites
Exclude SBAS satellites
Exclude QZSS satellites
Exclude Q255 satellites
Ignore broadcast group delay corrections
Show the status screen in the Logger Info window
TEC calibration file
Note: The ISMR conversion needs the following SBF blocks to be logged:
<ul> <li>MeasEpoch at a 1Hz rate (1s)</li> <li>MeasExtra at a 1Hz rate (1s)</li> </ul>
• IQCorr at a 50Hz rate (20ms)
ReceiverStatus at a 0.1Hz rate (10s)
<ul> <li>ChannelStatus at a 0.1Hz rate (10s)</li> <li>ReceiverSetup at a 0.1Hz rate (10s)</li> </ul>
GPSNav at a "onchange" rate
<ul> <li>GALNav at a "onchange" rate</li> </ul>
CMPNav at a "onchange" rate
QZSNav at a "onchange" rate
If a higher Az/El resolution is wanted please also log the SatVisibility SBF block at the same rate as the ChannelStatus SBF block.
Next Cancel

Figure 5-7: The default parameters for conversion of SBF to ISMR format

After clicking 'Next', you can select then select which compression to apply to the ISMR file. As these files are typically small (<200kbytes), file compression is not normally required.

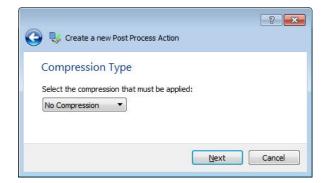


Figure 5-8: Selecting not to compress the generated ISMR data files



Clicking 'Next' in Figure 5-8 will now bring you to the 'Output File Settings' window where you can select a destination for the newly created ISMR files. A remote FTP server location can be selected or, clicking on 'Next' will select the default settings, as shown in Figure 5-9. This will store the ISMR files in the same directory as the raw SBF files.

Output File Destination	Local Folder 🔘 Local and FTP Folder
FTP Settings	
FTP Server:	
FTP Port:	21 (*)
Remote Path (*):	1
Login:	
Password:	
Error handling:	Retry every 10 minutes
FTP Timeout:	20 sec 🜲
FTP Transfer Mode	e: ) Passive 🔵 Active
Local Folder Setting	gs
Specify the destina	ation path or "." to use the path of the source SBF file
Output File Options	eady exists: 💿 Overwrite 🔘 Add index

**Figure 5-9:** Storing the generated ISMR files in the default location - alongside the logged raw SBF files

On the final configuration window shown in Figure 5-10, you are prompted to enter a name for the post-processing action and a description. The name used is for information only and has no bearing on the post processing.



Name and Description	
Name and Description	
Enter a name for the created act	ion:
ISMR conversion	
Enter a description for the create	ed action:
sbf2ismr conversion	

Figure 5-10: Enter a name and description for the newly configured SBF to ISMR data conversion

Click **Finish** to finalize the configuration and you will see the 'ISMR conversion' action appearing in the list of post processing actions. You can now click **Start Logging** to start data logging\*.

# 5.2.5 Monitoring logging and ISMR status

In the **Logger Info** window of the **Status** tab of the main window of RxLogger, as shown in Figure 5-11, you can follow the progress of the logging and post-processing and get a snapshot of the ISMR indices.

	PC Date	PC Time	GNSS Date	GNSS Time	C:\Users\	dean\ar	nData\	Local	Temp\11	548\0\	SEPTO	56P 16	is co	nverte	ed to T	SMR			Desc	riptio	n			
					RxType:   Time (0		:10:00		Feb 2016		:4002	00 WN:1	885)					198 sb1						
					PRN EL	TEC	Sig	LT	C/N0 (dBHz)	CCD			Sig	LT	C/NO	CCD	TotS4	Phi60	Sig	LT	C/NO (dBHz)	CCD	TotS4	
					[deg]		LICA		41.3	[m]	0.08	[rad]	L2C		(dBHz) 39.8	(m) 0.18	0.11	[rad]	LS	1965	44.3	(m) 0.02	0.06	[rad]
					IG11		LICA	520	32.6	0.05	0.22			1330	33.0	0.10	0.11		LS	1300	44.3	0.02	0.00	
					1612		IL1CA			0.04				1956	36.4	0.02	0.14		LS		_			
					IG13		IL1CA	1976		0.03	0.03					0.02								
					IG15		IL1CA	1976		0.02	0.02		1 L2C	1970	48.8	0.00	0.03	1	LS					
					IG17		IL1CA	1975	44.5	0.03	0.05		I L2C	1970	42.8	0.01	0.07		LS				1000	
					IG18		ILICA	1975	44.9	0.02	0.04		I L2C					1	L5					
					IG19		IL1CA	1971	41.9	0.05	0.06		I L2C					1	LS					
					IG20		IL1CA	1975	40.0	0.07	0.12		L2C	1000					LS		0.000			
					1G24		L1CA	1975	49.8	0.02	0.03		1 L2C	1970	48.8	0.01	0.04	1	LS	1974	\$4.0	0.01	0.02	
					IG28		L1CA	1975	47.1	0.00	0.03							1	L5					
					IG30		IL1CA	1964		0.15			I L2C	1957	33.0	0.01	0.22		LS	1964	38.9	0.01	0.11	
	2016-02-25	16:09:44	2016-02-25	15:10:01	IR01		IL1CA			0.01			L2CA		44.5	0.03	0.06							
100					IR02		IL1CA	1972	49.0	0.03	0.03		112CA	1971		0.02	0.05	1						
					1208		ILICA	1972					IL2CA		42.4	0.03	0.08							
					IR10		IL1CA	1972	51.6	0.01	0.03		IL2CA	1971		0.07	0.08							
					IR11		L1CA	1972 1972			0.02		1L2CA	1971	44.8	0.00	0.06							
					1820		ILICA	1971	40.4	0.20	0.09		1LZCA	1971		0.01	0.08	_						
					1821		IL1CA	208	39.3	0.08	0.11		IL2CA	204		0.03	0.16					_		
					1E09		LIBC	1191		0.01	0.06		I E5a	1191		0.01	0.05		ESD	1191	47.0	0.02	0.04	
					IE24		L1BC	1973		0.00	0.03		ESa		52.8	0.00	0.02			1973	54.0	0.00	0.02	
					1226		L1BC	1973			0.09				38.5		0.11	1		1972	40.8	0.01	0.09	
					1820		L1CA	1973	40.0	0.38	0.11		I LS					1						
					1523		L1CA	1973	44.0	0.17	0.06		L5	1972	44.B	0.01	0.06		i					
					1525		IL1CA	1937	39.8	4.96	0.09		I LS					1						
					1536		L1CA	1973	44.5	0.06	0.06		L5	1972	45.B	0.02	0.04	1						
					IC05					0.07			1	1971		0.04	0.08	1		1971	38.3	0.05	0.11	
					1008			1966		0.07	0.09		I B2	1966		0.03	0.07	1		1966	40.8	0.01	0.10	
					(C11			1966		0.07				1966		0.02	0.04		83	1966		0.01	0.05	
					(C12		B1	1971			0.09		1 B2	1970	45.3	0.03	0.06		B3	1970	43.0	0.02	0.06	
					1102		1 LS	1971	39.5	0.01	0.11							1						

Figure 5-11: The Logger Info field gives summary information on the ISMR indices as well as logging and post processing

Data logging can be stopped at any time by clicking the **Stop Logging** button



### 5.2.6 Compressing the raw SBF files

The hourly SBF files can be very large so it may be a good idea to compress these files. This can be done by defining a second post-processing action on the 'Post Processing' tab of the main window of RxLogger.

In the same way as before, click **Add** to configure a new post-processing action as shown in Figure 5-12. This time, in the 'Post Process Action Input and Type' window, just click 'Next' as there is no conversion to apply. You can now select the compression program you wish to use.

😍 polan5s.serial - RxLogger - S/N 3009173 <u>F</u> ile <u>I</u> ools <u>H</u> elp		
Status Global File Naming SBF NMEA Post Pro	cessing	
Enable     Input     Post Process Action Name       1     Image: SBF     ISMR conversion		
SBF NMEA Thu 18-Feb-2010	Create a new Post Process Action  Post Process Action Input and Type Select the input and which action that must be appled      SBF No Conversion      NMEA No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No Conversion      NMEA      No      NMEA      NMEA      No      NMEA      N      NMEA      No      NMEA      N      NMEA      No      NMEA      N	Create a new Post Process Action Compression Type Select the compression that must be applied: No Compression Comp

Figure 5-12: Add a second post processing action

As before, enter a name and description of this new post-processing action and click 'Finish'.

Make sure to check the **Remove Source Files** box in the *Post Processing* tab as shown in Figure 5-13 in order to delete the original (non-compressed) SBF files.



Juan	us Glo	bal	File Naming SBF NMEA	Post Processing	]
Γ	Enable	Input	Post Process Action Name		
1	V	SBF	ISMR conversion		
2		SBF	zip		
				Add	Remove Source Files     Edit     Delete

Figure 5-13: Select Remove Source Files to delete the non-compressed raw SBF files after generating the compressed files

# 5.2.7 Exiting and restarting RxLogger

When exiting and restarting RxLogger, all the user settings from the previous session of RxLogger are preserved: they are stored in the file .septentrio\rxlogger.conf in the user's home directory. Thus, the configuration steps described above need only be carried out once.

# 5.2.8 Starting RxLogger from the command line



RxLogger can be launched from the command line, as shown in Figure 5-14.

Figure 5-14: Launching RxLogger from the command line

Rxlogger starts in the configuration as stored in the rxlogger.conf file. The -A command line option causes RxLogger to immediately start logging without any user interaction. The command 'rxlogger -A' can be included in a boot script on the host PC to automatically start RxLogger at each boot.



# 5.3 sbf2ismr program

The **sfb2ismr** program converts a binary SBF file containing 50 or 100 Hz raw correlation and phase data into an ASCII ISMR file containing ionospheric scintillation and TEC indices. In addition, **sfb2ismr** can also produce an ASCII file containing the unprocessed 50 or 100 Hz raw correlations and phase data. **sfb2ismr** can also be used for TEC calibrations.

sfb2ismr is a command line tool: both Windows and Linux versions are provided. Typically,
sfb2ismr is automatically started from RxLogger at the end of each hourly file, but it can
also be manually called at any time to get an instant overview of the scintillation indices, or
to reprocess the raw high-rate data.

The output ISMR file contains comma-delimited ASCII records for all satellites in view for every minute. An example of the contents of an ISMR file is given below:

1462,540300,	11,00000074, 27,15,48.2,	0.029,	0.000,	0.017,	0.023,	0.028,	0.028,	0.028,	
1462,540300,	10,00000074,232,29,48.2,	0.049,	0.030,	0.026,	0.032,	0.036,	0.036,	0.036,	
1462,540300,	23,00000074,232,68,48.2,	0.039,	0.007,	0.023,	0.029,	0.033,	0.033,	0.034,	
1462,540300,	17,00000074,152,15,48.2,	0.039,	0.006,	0.020,	0.026,	0.030,	0.030,	0.031,	
1462,540300,	1,00000074,344,23,48.2,	0.030,	0.000,	0.018,	0.024,	0.029,	0.029,	0.029,	
1462,540300,	2,00000074, 17,45,48.2,	0.041,	0.012,	0.019,	0.025,	0.030,	0.030,	0.030,	
1462,540300,	15,00000074, 85,37,48.2,	0.029,	0.000,	0.017,	0.023,	0.028,	0.029,	0.029,	
1462,540300,	24,00000074,170,47,48.2,	0.029,	0.000,	0.016,	0.022,	0.028,	0.028,	0.028,	
1462,540300,	8,00000074,308,16,48.2,	0.031,	0.000,	0.017,	0.023,	0.029,	0.029,	0.029,	
1462,540360,	11,00000074, 27,15,48.0,	0.028,	0.000,	0.016,	0.022,	0.028,	0.029,	0.030,	
1462,540360,	10,00000074,232,30,48.0,	0.045,	0.022,	0.019,	0.024,	0.030,	0.031,	0.031,	
1462,540360,	23,00000074,231,68,48.0,	0.039,	0.000,	0.018,	0.023,	0.029,	0.031,	0.031,	
1462,540360,	17,00000074,152,15,48.0,	0.037,	0.000,	0.017,	0.022,	0.028,	0.030,	0.030,	
1462,540360,	1,00000074,344,23,48.0,	0.030,	0.000,	0.017,	0.022,	0.029,	0.030,	0.030,	
1462,540360,	2,00000074, 17,45,48.0,	0.042,	0.014,	0.019,	0.024,	0.030,	0.032,	0.032,	
1462,540360,	15,00000074, 85,37,48.0,	0.029,	0.000,	0.016,	0.022,	0.028,	0.029,	0.030,	
1462,540360,	24,00000074,170,46,48.0,	0.030,	0.000,	0.017,	0.022,	0.028,	0.029,	0.030,	
1462,540360,	8,00000074,309,16,48.0,	0.032,	0.000,	0.018,	0.022,	0.028,	0.030,	0.030,	

# The command **sfb2ismr** with the -h option prints the help screen, including a definition of all the fields (or columns) in a record:

C:\Program Files (x86)\Septentrio\RxTools\bin>sbf2ismr.exe -h sbf2ismr is a utility to convert the data in a SBF file into ASCII ionospheric scintillation monitoring records. The SBF file needs to contain the following SBF blocks at at least the specified interval: IQCorr, 20ms MeasEpoch, 1s MeasExtra, 1s ReceiverStatus, 10s ChannelStatus, 10s ReceiverSetup, 10s SatVisibility, 10s (optional, allows increased resolution of azimuth/elevation) GPSNav, OnChange OnChange GALNav, BDSNav, OnChange OZSNav, OnChange Command line options: sbf2ismr -f InputFile [-o ISMRFile][-p PreviousFile][-x Systems][-c DetFreq] [-n NoCols][-S][-r RawFile][-g][-b StartEpoch] [-e EndEpoch][-V][-h] -f InputFile (mandatory) Name of the input SBF file. -o ISMRFile Name of the output file containing the ISMR records (see format below). This argument is optional. If not provided, the output file name is the same as the input file name, with the extension .ismr being added. See below the format of the ISMR file.



-p PrevFile	Name of the previous input file, i.e. name of the SBF file logged just before input_file. The last epochs of the previous file are used to initialize the detrending filters. If there is no previous file, skip this option or use NA as PrevFile.
-C TECCalFile -x Systems	Name of the TEC calibration input file (see format below). Exclude one or more satellite systems from the observation file. Systems may be G (GPS), R (Glonass), E (Galileo), S (SBAS), C (BeiDou), J (QZSS), I (NavIC/IRNSS) or any combination thereof.
-c DetFreq	For instance -xERSCJI produces a GPS-only observation file. Cutoff frequency of the carrier phase detrending filter (6th order high pass butterworth). Units of Hz. Valid values range from 0.01 to 1.0 Hz, default 0.1Hz.
-n NoCols	Output the first NoCols in the ISMR file and discard the others (see column format below). By default, -n62 is assumed.
-S	Do not generate the ISMR file, but still print the status screen.
-d	When computing TEC, do not correct for satellite inter-frequency biases, i.e. ignore the group delay corrections transmitted by the satellites in their navigation message.
-r RawFile	Name of the "raw file" containing the raw data (carrier phase and correlations) in ASCII format. This argument is optional. If not provided, the raw file is not created. See below the format of the raw file.
-b StartEpoch	Time of first epoch to parse from the SBF file (in GPS time scale). Format: yyyy-mm-dd_hh:mm:ss.
-e EndEpoch	Time of last epoch to parse from the SBF file (in GPS time scale). Format: yyyy-mm-dd_hh:mm:ss.
-as	Do not generate ISMR data, but print TEC calibration values using the SBAS ionospheric corrections as reference.
-ak	Do not generate ISMR data, but print TEC calibration values using the Klobuchar ionospheric model as reference.
-s Signal	Select a different signal than the default "sig2" and "sig3" mentioned below. Supported options for the Signal argument are: G1L1C : Use L1C as first GPS signal type (default is L1C/A). J1L1C : Use L1C as first QZSS signal type (default is L1C/A). C1B1C : Use B1C as first BeiDou signal type (default is B1I). C2B2a : Use B2a as second BeiDou signal type (default is B2I). E3E6 : Use E6 as third Galileo signal type (default is E5b). E3E5 : Use E5AltBOC as third Galileo signal type (default is E5b). Note that multiple -s options can be provided, e.gsC2B2a -sE3E6.
-s Signal -T TECBands	<pre>mentioned below. Supported options for the Signal argument are: GlL1C : Use L1C as first GPS signal type (default is L1C/A). J1L1C : Use L1C as first QZSS signal type (default is L1C/A). ClB1C : Use B1C as first BeiDou signal type (default is B1I). C2B2a : Use B2a as second BeiDou signal type (default is B2I). E3E6 : Use E6 as third Galileo signal type (default is E5b). E3E5 : Use E5AltBOC as third Galileo signal type (default is E5b). Note that multiple -s options can be provided, e.gsC2B2a -sE3E6. Frequency bands to use for the computation of the TEC values for the GPS, Galileo, BeiDou and QZSS satellites. TECBands has the following format: [Ggg][Eee][Jjj][Ccc] with: G12: TEC from L1P and L2P for GPS satellites; G15: TEC from L1P and L5 for GPS satellites; J12: TEC from L1P and L5 for QZSS satellites; J12: TEC from L1CA and L2C for QZSS satellites; J25: TEC from L1CA and L5 for QZSS satellites; L15: TEC from E1BC and E5a for Galileo satellites; E17: TEC from E1BC and E5a for Galileo satellites; E17: TEC from E1BC and E5b for Galileo satellites; C27: TEC from B1I and B2I for BeiDou satellites. C26: TEC from B1I and B3I for BeiDou satellites.</pre>
-	<pre>mentioned below. Supported options for the Signal argument are: GlL1C : Use L1C as first GPS signal type (default is L1C/A). J1L1C : Use L1C as first QZSS signal type (default is L1C/A). ClB1C : Use B1C as first BeiDou signal type (default is B1I). C2B2a : Use B2a as second BeiDou signal type (default is B2I). E3E6 : Use E6 as third Galileo signal type (default is E5b). E3E5 : Use E5AltBOC as third Galileo signal type (default is E5b). Note that multiple -s options can be provided, e.gsC2B2a -sE3E6. Frequency bands to use for the computation of the TEC values for the GPS, Galileo, BeiDou and QZSS satellites. TECBands has the following format: [Ggg][Eee][Jjj][Ccc] with: G12: TEC from L1P and L2P for GPS satellites; G15: TEC from L1P and L5 for GPS satellites; J12: TEC from L1CA and L2C for QZSS satellites; J15: TEC from L1CA and L5 for QZSS satellites; L15: TEC from L1CA and L5 for QZSS satellites; E15: TEC from E1BC and E5a for Galileo satellites; E17: TEC from E1BC and E5a for Galileo satellites; E17: TEC from E1BC and E5b for Galileo satellites; E17: TEC from E1BC and E5b for Galileo satellites; E17: TEC from E1BC and E5b for Galileo satellites. C27: TEC from B1I and B2I for BeiDou satellites.</pre>

Format of the ISMR output file

Note: The default signals available in the ISMR file are as follows. Other signals can be selected with the -s option.

"Sig1": L1CA for GPS/GLONASS/SBAS/QZSS, E1 for GALILEO, B1I for BeiDou and L5 for NavIC(IRNSS). "Sig2": L2C for GPS/GLONASS/QZSS, E5a for GALILEO, L5 for SBAS, B2I for BeiDou and L1 for NavIC(IRNSS).

"Sig3": L5 for GPS/QZSS, E5b for GALILEO, B3 for BeiDou.

Col 1: WN, GPS Week Number



Col 2: TOW, GPS Time of Week (seconds) 3: SVID (see numbering convention in the 'SBF Outline' section of the Reference Guide) Col Col 4: Value of the RxState field of the ReceiverStatus SBF block Col 5: Azimuth (degrees) Col 6: Elevation (degrees) Col  $\ 7:$  Average Sig1 C/NO over the last minute (dB-Hz) Col 8: Total S4 on Sig1 (dimensionless) 9: Correction to total S4 on Sig1 (thermal noise component only) (dimensionless) Col Col 10: Phi01 on Sig1, 1-second phase sigma (radians) Col 11: Phi03 on Sig1, 3-second phase sigma (radians) Col 12: Phil0 on Sig1, 10-second phase sigma (radians) Col 13: Phi30 on Sig1, 30-second phase sigma (radians) Col 14: Phi60 on Sig1, 60-second phase sigma (radians) Col 15: AvgCCD on Sig1, average of code/carrier divergence (meters) Col 16: SigmaCCD on Sigl, standard deviation of code/carrier divergence (meters) Col 17: TEC at TOW-45s (TECU), taking calibration into account (see -C option) Col 18: dTEC from TOW-60s to TOW-45s (TECU) Col 19: TEC at TOW-30s (TECU), taking calibration into account (see -C option) Col 20: dTEC from TOW-45s to TOW-30s (TECU) Col 21: TEC at TOW-15s (TECU), taking calibration into account (see -C option) Col 22: dTEC from TOW-30s to TOW-15s (TECU) Col 23: TEC at TOW (TECU), taking calibration into account (see -C option) Col 24: dTEC from TOW-15s to TOW (TECU) Col 25: Sig1 lock time (seconds) Col 26: sbf2ismr version number Col 27: Lock time on the second frequency used for the TEC computation (seconds) Col 28: Averaged C/N0 of second frequency used for the TEC computation (dB-Hz)  $% \left( dB-Hz\right) =0$ Col 29: SI Index on Sig1: (10\*log10(Pmax)-10\*log10(Pmin))/(10\*log10(Pmax)+10\*log10(Pmin)) (dimensionless) Col 30: SI Index on Sig1, numerator only: 10\*log10(Pmax)-10\*log10(Pmin) (dB) Col 31: p on Sig1, spectral slope of detrended phase in the 0.1 to 25Hz range (dimensionless) Col 32: Average Sig2 C/NO over the last minute (dB-Hz) Col 33: Total S4 on Sig2 (dimensionless) Col 34: Correction to total S4 on Sig2 (thermal noise component only) (dimensionless) Col 35: Phi01 on Sig2, 1-second phase sigma (radians) Col 36: Phi03 on Sig2, 3-second phase sigma (radians) Col 37: Phil0 on Sig2, 10-second phase sigma (radians) Col 38: Phi30 on Sig2, 30-second phase sigma (radians) Col 39: Phi60 on Sig2, 60-second phase sigma (radians) Col 40: AvgCCD on Sig2, average of code/carrier divergence (meters) Col 41: SigmaCCD on Sig2, standard deviation of code/carrier divergence (meters) Col 42: Sig2 lock time (seconds) Col 43: SI Index on Sig2 (dimensionless) Col 44: SI Index on Sig2, numerator only (dB) Col 45: p on Sig2, phase spectral slope in the 0.1 to 25Hz range (dimensionless) Col 46: Average Sig3 C/NO over the last minute (dB-Hz) Col 47: Total S4 on Sig3 (dimensionless) Col 48: Correction to total S4 on Sig3 (thermal noise component only) (dimensionless) Col 49: PhiO1 on Sig3, 1-second phase sigma (radians) Col 50: Phi03 on Sig3, 3-second phase sigma (radians) Col 51: Phil0 on Sig3, 10-second phase sigma (radians) Col 52: Phi30 on Sig3, 30-second phase sigma (radians) Col 53: Phi60 on Sig3, 60-second phase sigma (radians) Col 54: AvgCCD on Sig3, average of code/carrier divergence (meters) Col 55: SigmaCCD on Sig3, standard deviation of code/carrier divergence (meters) Col 56: Sig3 lock time (seconds) Col 57: SI Index on Sig3 (dimensionless) Col 58: SI Index on Sig3, numerator only (dB) Col 59: p on Sig3, phase spectral slope in the 0.1 to 25Hz range (dimensionless) Col 60: T on Sig1, phase power spectral density at 1 Hz (rad^2/Hz) Col 61: T on Sig2, phase power spectral density at 1 Hz (rad^2/Hz) Col 62: T on Sig3, phase power spectral density at 1 Hz (rad^2/Hz)

Format of the raw ASCII output file (option -r)

Col 1: TOW, GPS Time of Week (seconds)
Col 2: SVID (see numbering convention in the 'SBF Outline' section of the Reference Guide)
Col 3: Signal type (see numbering convention in the 'SBF Outline' section of the Reference Guide)
Col 4: Carrier phase (cycles)
Col 5: I correlation (dimensionless)
Col 6: Q correlation (dimensionless)



Format of the TEC calibration input file (option -C) The TEC calibration file is a text file that can be provided as input to sbf2ismr to correct for TEC biases. Each line of the file must contain a satellite identifier (RINEX convention) followed by the TEC calibration value in TECU for that particular satellite. It is possible to apply the same calibration value to all satellites of a constellation by replacing the satellite number by wildcards. If the calibration value is set to 'NA', no TEC is computed for the specified satellite. If the same satellite is addressed multiple times in the file, only the last entry is taken into account. Comments can be added by preceding them with a  $^{\prime}\,\#^{\prime}$  character. Example of a valid calibration file: #This is a comment E12 9.45 R03 -0.3 G\*\* 2.4 G21 2.8 S\*\* NA With this file, the TEC calibration value is 9.45TECU for Galileo E12, -0.3TECU for GLONASS R03, 2.4 for all GPS satellites except G21 where it is 2.8TECU. TEC

should not be computed for SBAS satellites (calibration value set to 'NA'). For all satellites not addressed in the calibration file, the TEC calibration value is assumed to be zero. Corrected TEC values are obtained by subtracting the TEC calibration value

#### from the raw TEC. The ISMR file contains corrected values.

#### 5.3.1 ISMR record details

#### Time tag

The first two columns contain the week number and time-of-week. The time scale is GPS time, even for non-GPS satellite records.

#### **Supported satellites**

ISMR records are generated every minute for all satellites tracked by the receiver.

The SVID column identifies the satellite and the different constellations are assigned their own range of values. For example, SVID values in the range 1-37 refer to GPS satellites. You can find the full list of satellite constellation SVID ranges in the 'SBF Outline' section of the 'PolaRx5S Reference Guide'.

#### **Supported signals**

For each satellite, the ISMR file contains iono indices (S4, Phixx, ...) for up to three signals, as listed in the table below. The signals in italic can be selected with the -s option of **sfb2ismr**.



Satellite system	Signal 1	Signal 2	Signal 3
GPS	L1CA	L2C	L5
GLO	L1CA	L2CA	
GAL	E1	E5a	E5b <i>(E6, E5)</i>
BDS	B1I	B2I <i>(B2a)</i>	B3I
QZSS	L1CA	L2C	L5
SBAS	L1CA	L5	
NavIC(IRNSS)	L5	L1	

#### Number of columns

By default, the ISMR file contains 62 columns, i.e. 62 values for each satellite every minute.

It is possible to specify the number of columns to be included in the ISMR file by using the -n option of **sfb2ismr**. For example, a user only interested in the satellite azimuth and elevation (columns 5 and 6) could use the option -n6 to skip all columns after the 6th one.

#### **Not-Applicable values**

Not-applicable columns or fields for which the value is unknown contain the 'nan' (not-a-number) string.

#### S4 index

The total S4 (columns 8, 33 and 47) is the standard deviation of the 50 Hz raw signal power normalized to the average signal power over the last minute.

The S4 correction (columns 9, 34 and 48) accounts for the thermal noise contribution in the total S4.

The corrected S4 (i.e. without the thermal noise contribution) can be computed as follows:

$$\begin{split} X &= S4_{total}^2 - S4_{correction}^2 \\ S4_{corrected} &= \begin{cases} \sqrt{X} & \text{if } X > 0 \\ 0 & \text{if } X \leq 0 \end{cases} \end{split}$$

#### Phixx indices

The Phixx indices (columns 10 to 14, 35 to 39 and 49 to 53) contain the standard deviation, in radians, of the 50 Hz detrended carrier phase averaged over intervals of 1, 3, 10, 30 and 60 seconds. More specifically:



- Phi01 is the average of the 60 standard deviations computed over 1-s intervals during the last minute.
- Phi03 is the average of the 20 standard deviations computed over 3-s intervals during the last minute.
- Phi10 is the average of the 6 standard deviations computed over 10-s intervals during the last minute.
- Phi30 is the average of the 2 standard deviations computed over 30-s intervals during the last minute.
- Phi60 is the standard deviation computed over the whole last minute.

The phase detrending is done by filtering the raw 50 Hz carrier phase measurements by a 6th order Butterworth high-pass filter. The cutoff frequency of that filter is user selectable with the -c option of **sfb2ismr**.

#### **Code-phase divergence**

Columns 15-16, 40-41 and 54-55 report the average value and the standard deviation of the difference between the pseudorange and the carrier phase measurements over the last minute.

#### TEC

TEC and dTEC values (both in TECU unit) are provided in columns 17-24.

Absolute TEC values are reported every 15 seconds (there are 4 TEC columns per ISMR record) which are based on dual-frequency pseudorange measurements only. dTEC values report the change of TEC over the four 15-second intervals of the previous minute. dTEC is computed from the carrier phase measurements only. It is much more accurate than TEC but only gives information on the TEC variation over time.

Note that absolute TEC values can be biased by satellite and station inter-frequency biases. Sources of station biases include the antenna, the antenna cable, splitters, amplifiers, and the receiver.

The table below lists the default signals used for each constellation in the determination of TEC values as well as how the satellite biases are handled for that constellation.



Satellite system	TEC signal combination	Default handling of satellite-induced biases
GPS*	L1P-L2P	The correction ( $T_{GD}$ ) transmitted by GPS satellites is applied.
GLO	L1CA-L2CA	Uncorrected
GAL	E1-E5a	The correction (BGD(E1,E5a)) transmitted by Galileo satellites is applied.
BDS	B1I-B2I	The correction ( $T_{GD1}$ , $T_{GD2}$ ) transmitted by BeiDou satellites is applied.
QZSS	L1CA-L2C	The correction ( $T_{GD}$ ) transmitted by QZSS satellites is applied.
SBAS	L1CA-L5	Uncorrected
NavlC	L1-L5	Uncorrected

\* For GPS, the TEC is based on the P-code measurements (as opposed to the C/A-code) on L1 and L2. There is therefore no need for correction of the L1P-L1CA satellite biases.

For some constellations, other signal combinations can be selected with the -T option of **sfb2ismr**.

It is possible to disable the correction of the satellite inter-frequency biases, i.e. to ignore the corrections transmitted by the satellites. This is done using the option '-g' with **sfb2ismr** 

Station biases (and residual satellites biases) can be provided in a TEC calibration file using the '--C' option with **sfb2ismr**. See the help text in Section 5.3 for the TEC calibration file format. **sfb2ismr** can be used to generate the calibration file. See Appendix G for details.

Note that, by default, the receiver does not apply any code smoothing which results in noise of a few TECUs on the TEC values. To reduce the noise at the expense of filtering short-term TEC variations, code smoothing can be enabled using the '**setSmoothingInterval**' command on the receiver. This remark does not apply to dTEC, which is computed on the basis of carrier phase measurements.

#### Scintillation index

The SI index (columns 29, 43 and 57) is computed as follows:

$$SI = \frac{10log(Pmax) - 10log(Pmin)}{10log(Pmax) + 10log(Pmin)}$$

Where Pmax is conventionally defined as the power amplitude of the third peak down from the maximum excursion over the 3000 samples in the last minute, and Pmin is the power amplitude of the third level up from the minimum excursion.

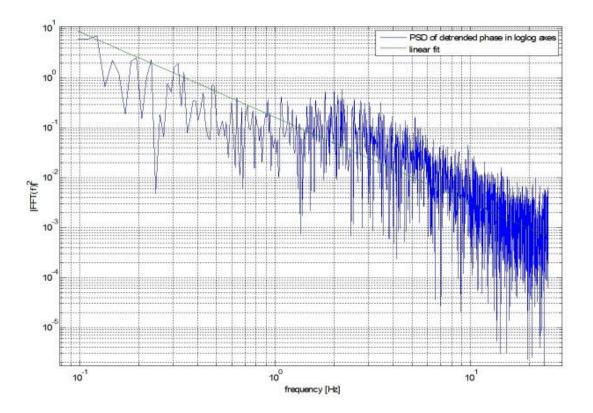
Columns 30, 44 and 58 provide a modified scintillation index where only the numerator is computed (it is expressed in dB).

#### Spectral slope and strength



Columns 31, 45 and 59 provide the opposite of the slope (often denoted 'p') of the phase PSD in log-log axes, where the PSD is obtained by computing the FFT of the 3000 detrended phase samples in the last minute. The slope is computed by fitting a linear polynomial to the PSD over the 0.1 to 25 Hz frequency range.

The figure below illustrates the way the slope is computed. In the example depicted, p is about 1.7.



Next to the spectral slope, the spectral strength (often noted 'T') is provided in columns 60 to 62. The spectral strength is the detrended phase power spectral density at 1.0 Hz, i.e. the intercept of the linear polynomial described above.

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# 5.3.2 Monitoring the current scintillation status with sbf2ismr

Invoking **sfb2ismr** with the -s option produces a 'status screen' output, which is handy for checking the current status of the receiver and the level of the major scintillation indices. When using the -s option, no ISMR file is created, a status screen only is produced.

C:\sbf2isr																			
RxType: Time (GI	PolaRx	5S_PRO	C	SN	:20038	386		F				L1205r	33427	sbf2i	.smr-4.	6.0x			
 PRN El			 LT	C /NO		Tot 9/	 Phi60			C/N0		Tot 9/	 Phi60			 C/N0		Tot 9/	 Phi60
[dea]	[TECU]			[dBHz]	[m]	10134	[rad]			dBHz 1	[m]	10134	[rad]	. ,		dBHz1	[m]	10134	[rad]
S24 7			11320	36.3	2.67	0.19	1.34												
G20 61			13829	49.8	0.08	0.06		L2C						,   L5					
G23 50	25.2	L1CA	11793	50.8	0.06	0.05	0.02	L2C						L5					
G31 16	32.8	L1CA	18480	42.1	0.34	0.26	0.05	L2C	18910	39.5	0.25	0.13	0.04	L5					
G13 35	28.9	L1CA	6297	48.4	0.15	0.10	0.03	L2C						L5					
G16 20	39.5	L1CA	4075	42.3	0.28	0.16	0.03	L2C						L5					
G32 53	19.6	L1CA	17439	50.7	0.09	0.08	0.03	L2C						L5					
R11 72		L1CA	7058	49.1	0.13	0.06		L2CA	6966	42.2	0.21	0.09	0.04						
G07 18			2426	42.8	0.16	0.13		L2C	2415	36.8	0.38	0.20	0.06						
G11 38		•	17724	48.3	0.07	0.10		L2C						L5					
G30 22		L1CA		44.3	0.13	0.07		L2C						L5					
S20 42			65534	43.0	0.58	0.07													
R01 28			5624	45.0	0.22	0.22		L2CA		35.8	0.47	0.23	0.09						
R08 42			16188	49.1	0.17	0.07		L2CA		46.8	0.17	0.07	0.08						
S38 23			65534	44.5	0.80	0.06													
R23 13			13454	44.2	0.27	0.15		L2CA		40.3 42.7	0.31	0.23	0.08						
R12 22 R07 13			2787 25367	47.7 42.7	0.23	0.08		L2CA  L2CA		42.7	0.21	0.08	0.09						
S33 32			20553	42.7	0.43	0.17	0.10		20339	42.4	0.27	0.10	0.08						
R10 38			12821	42.3	0.83	0.08		L2CA		41.5	0.31	0.10							
G01 59			12021	40.9 50.5	0.19	0.07		L2CA		41.5	0.31	0.10	0.04	I T.5	14593	53.5	0.15	0.05	0.02
R24 16		•	7164	44.1	0.09			L2CA		42.4	0.15	0.00	0.02	1			J.±J		0.02
E31:					0.10				12346	46.8	0.08	0.05	0.16	I E5b					

# 5.3.3 Parsing the raw data

Using the -r option, in addition to the ISMR file, **sfb2ismr** produces an ASCII comma-delimited file containing the raw phase and correlation values. The format of this file is described in the help screen of **sfb2ismr** (see the screen dump in Section 5.3).

For example, to extract raw data from the SBF file test1.sbf, use the following command:

#### C: \sbf2ismr -f test1.sbf -r out\_ascii.txt

The output file (out\_ascii.txt in the example above) contains records such as those given below:

```
183601.00,101,20,98042793.214,119,11

183601.00,13,0,120929967.314,-305,-2

183601.00,2,0,120488916.249,258,-5

183601.00,8,0,108470409.601,-890,0

183601.00,10,0,107547455.595,806,0

183601.00,4,0,133013504.780,-165,7

183601.00,7,0,108677898.257,-836,-13

183601.00,7,3,84684077.234,266,5

183601.00,26,0,118815821.740,-323,-2

183601.00,5,0,110675377.978,727,-27

...
```



# 6 Receiver monitoring

# 6.1 Basic operational monitoring

The 'Overview' page of the web interface in Figure 6-1 shows at a glance a summary of the PolaRx5S's operational status.

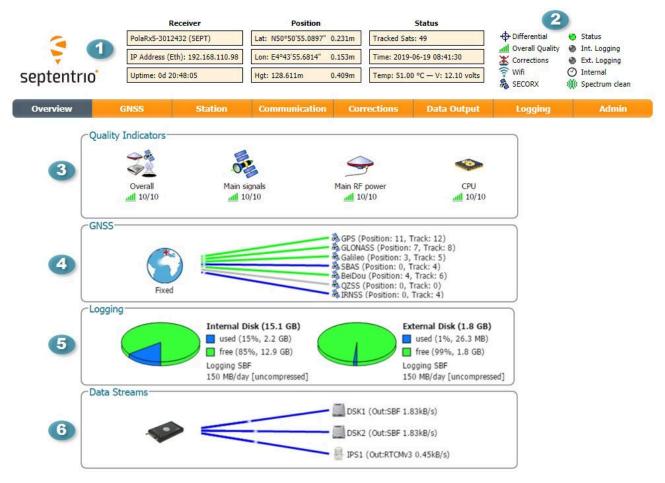


Figure 6-1: Overview page of the web interface

1 The main information bar at the top of the window gives some basic receiver information: receiver type, serial number and position. The length of time since the last power cycle (Uptime) and the total number of satellites in tracking is also given. The temperature of the receiver board and the voltage supplied is also shown.

2 The icons to the right of the information bar show that, in this example, the position of the receiver is fixed, the overall signal quality is Excellent (5 out of 5 bars) and the receiver is logging both internally (Int. Logging) and to an external USB memory device (Ext. Logging). The Corrections icon indicates that differential corrections are being sent out to a rover receiver. The active WiFi icon shows that the on-board WiFi modem is turned on and the clock icon shows that in this case, the receiver is using its own internal clock<sup>†</sup>.

In the case of the PolaRxS receiver, this icon will indicate that an External clock is being used



# 🗧 septentrio



The Quality indicators gives a simple overview of signal quality, RF antenna power and CPU load of the receiver.

The GNSS field details how many satellites for each constellation are being tracked and used in the position solution (PVT). A green line indicates that at least one satellite in the constellation is being used in the PVT, a blue line indicates that satellites are being tracked but not used and a grey line that there are no satellites from that particular constellation in tracking. More information can be found in the Satellites and Signals page on the 'GNSS' menu.



The Logging field summarizes the current logging sessions and disk capacities. The complete logging information and configuration windows can be found via the **Logging** menu.

6 The **Data Streams** field gives and overview of the data streams into (green lines) and out from (blue lines) the receiver. In this example, the receiver is logging SBF data to the internal memory (DSK1) and an external device (DSK2). The receiver is also sending out RTCMv3 differential correction data over the IPS1 port.



# 6.2 AIM+: Detecting and mitigating interference

The PolaRx5S is equipped with a sophisticated RF interference monitoring and mitigation system (AIM+). To mitigate the effects of narrow-band interference, three notch filters can be configured in either auto or manual mode. These notch filters effectively remove a narrow part of the RF spectrum around the interfering signal. The L2 band being open for use by radio amateurs is particularly vulnerable to this type of interference. The effects of wideband interference both intentional and unintentional can be mitigated by turning on the WBI mitigation system. The WBI system also reduces, more effectively than traditionally used pulse-blanking methods, the effects of pulsed interference.

#### The spectrum view plot

In the Spectrum window of the GNSS menu, you can monitor the RF spectrum and configure three separate notch filters to cancel out narrowband interference. Figure 6-2 shows the L2 frequency band with the GPS L2P signal at 1227.60 MHz indicated. Different bands can be viewed by clicking on the 'Show table' button as shown. The spectrum is computed from baseband samples taken at the output of the receiver's analog to digital converters.

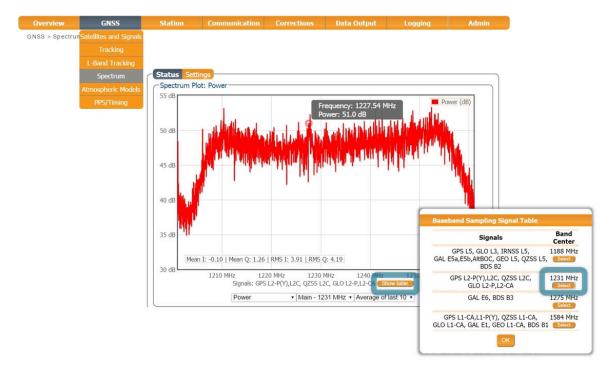


Figure 6-2: The RF spectrum of the L2 Band



# 6.2.1 Narrowband interference mitigation

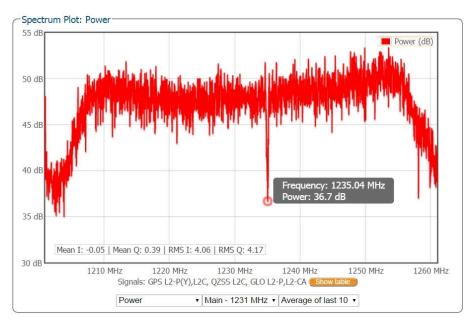
#### Configuring the notch filters

In the default auto mode of the notch filters, the receiver performs automatic interference mitigation of the region of the spectrum affected by interference. In manual mode as shown configured for Notch1 in Figure 6-3, the region of the affected spectrum is specified by a centre frequency and a bandwidth which is effectively blanked by the notch filter.

Mode			L2L5 auto	▼ au	ito 🗖				
Gain	35	dB	35	dB 3	35 dB	_			
Baseba	and Sa	mplin	g Conf	iguration			)		
Baseb	and sa	mplin	g mod	e 🔍 Befo	oreIM 🖲	AfterIM			
N	0						)		
Notch	Filters		-						
	Filters		-	Notch1		Notch2		Notch3	
Mode		ency		manual	▼ 000 MHz	auto	•	auto	
Mode Center	Filters- r freque		dwidth	manual 1235	.000 MHz	auto	▼ 000MHz	auto	• 000 MHz kHz
Mode Center	r frequ		dwidth	manual 1235	.000 MHz	auto 1100.	▼ 000 MHz	auto 1100.	000 MHz
Mode Center Double	r freque e-sided	l band		manual 1235	.000 MHz kHz	auto 1100.	▼ 000 MHz	auto 1100.	000 MHz

Figure 6-3: Configuring the first notch filter Notch1 at 1235 MHz

With the **Notch1** settings as shown in Figure 6-3, the L2-band after the notch filter (After IM) is shown in Figure 6-4 with the blanked section clearly visible.



**Figure 6-4:** The RF spectrum of the L2 Band after applying the notch filter at 1235 MHz



# 6.2.2 Wideband interference mitigation

Wideband interference of GNSS signals can be caused unintentionally by military and civilian ranging and communication devices. There are also intentional sources of interference from devices such as chirp jammers. The wideband interference mitigation system (WBI) of the PolaRx5S can reduce the effect of both types of interference on GNSS signals.

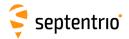
#### Configuring WBI mitigation

The Wideband Interference Mitigation system (WBI) can be enabled by selecting **on** as shown in Figure 6-5. Enabling WBI will increase the power consumed by the PolaRx5S by about 160 mW.

-Notch Filters			
	Notch1	Notch2	Notch3
Mode	manual 🔹	auto 🔹	auto •
Center frequency	1235.000 MHz	1100.000 MHz	1100.000 MHz
Double-sided bandwidth	80 kHz	30 kHz	30 kHz
Wideband Interference M Enable WBI mitigation			
Default Ok			

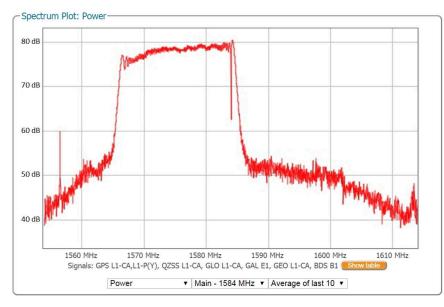
Press "OK" to apply the changes.

**Figure 6-5:** Select **on** to enable Wideband Interference Mitigation then 'OK' to apply the new setting



#### WBI mitigation in action

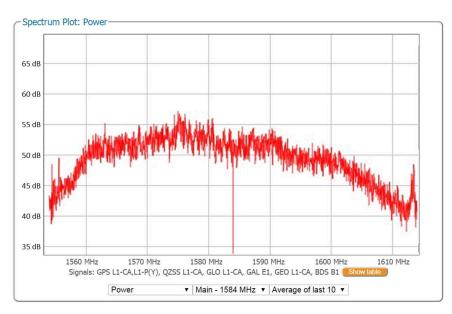
The GPS L1 band interference shown in Figure 6-6 is produced by combining the GNSS antenna signal with the output from an in-car GPS chirp jammer.



**Figure 6-6:** Simulated wideband interference in the GPS L1 band using an in-car chirp jammer

When WBI mitigation is enabled the effect of the interference is dramatically reduced to the extent that the small signal bump at the GPS L1 central frequency of 1575 MHz is clearly visible as Figure 6-7 shows.

In this particular test, the interference signal caused the receiver to fall back to the less precise DGNSS or standalone positioning modes. With WBI mitigation enabled however, the receiver was able to maintain an RTK fix position throughout.



**Figure 6-7:** Enabling WBI interference mitigation greatly reduces the effect of the interference caused by the chirp jammer



# 6.3 How to log data for problem diagnosis

If the PolaRx5S does not behave as expected and you need to contact Septentrio Support Department, it is often useful to send a short SBF data file that captures the anomalous behavior, as well as a Diagnostic Report from the receiver.

# 6.3.1 Support SBF file

#### Step 1: Configuring a new logging session

On the menu bar select 'Logging' then the 'Log Sessions' window where you can define a new logging session.

Overview	G	NSS	Station	Communication	Corrections	Data Output	Logging	Admin
Logging > Log Se	ssions						Log Sessions	
- Die	sk Usage						Disk Contents	
	Sit Usuge		Teternel Diele	(15.1.00)	- Cutural 0		Global Log Settings	
			Internal Disk		External D			
			free (100%,		Disk not	t present		
	Unmount	Format						
CLO	g Sessio	ns						
	ID	Name	Data	a Auto-Delete Disk	FTP			
	LOG1	Unused 📒	Create					
	LOG2	Unused 🧧	Create					
	LOG3	Unused 🧧	Create					
	LOG4	Unused 🤵	Create					
	LOG5	Unused	Create					
	LOG6	Unused	Create					
	LOG7	Unused	Create					
	LOG8	Unused 🧧	Create					

Figure 6-8: Click on the 'Create' button to start defining a new logging session

#### Step 2: Select to log the Support data blocks

In the 'Edit Session' window click on 'SBF Logging' and 'New SBF stream' as usual. In the final 'Edit SBF Stream' field, make sure to select the 'Support' option as shown in Figure 6-9. This option automatically selects all the SBF blocks that are useful for the Support Department to help diagnose receiver problems.



Session name support_file		
Disk Internal T		
Auto-delete Never •		
Ok Cancel Edit Session LC Session Streams	GI	
There are a	urrently no SBF streams defined.	
U New 3D	Interval 1 sec	
	Contraction of the second second	1
	Rinex	
	Dinau (mars2)	
	Hide detailed selection	
	Measurements	1
	🕀 Meas3	
	🗷 RawNavBits	/
	<b>⊮</b> GPS	
	B⊢ GLO	/
	GAL 6	1
	œ- GEO	1
		1
	BDS 6	20

Figure 6-9: Configure a logging session selecting 'Support' in the 'Edit SBF Stream' field

When logging has been correctly configured, the 'Log Sessions' window will show the newly defined session as active as indicated in Figure 6-10.

Logging > Log Sessions UISK USage UISK Usage UISK Usage UISK Usage Used (15%, 2.3 GB) Used (15%, 2.3 GB) Used (15%, 2.3 GB) Used (15%, 2.3 GB) Used (2%, 36.4 MB) There (98%, 1.8 GB) There (98%, 1.8 GB) There (98%, 1.8 GB) There (98%, 1.8 GB) UNIT Format USE Sessions USE Sessions	Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
Disk Obdge       Internal Disk (15.1 GB)       used (15%, 2.3 GB)       used (2%, 36.4 MB)         Image: Serie (85%, 12.9 GB)       image: Serie (85%, 1.8 GB)       image: Serie (98%, 1.8 GB)         Ummount       Format       Format       Format         Log Sessions       Immount       Format       Immount         Log1 support_file       SBF       Never       Internal       Immount         LOG2       Unused       Greate       Internal       Immount       Immount         LOG1       support_file       SBF       Never       Internal       Immount       Immount         LOG2       Unused       Greate       Immount       Immount       Immount       Immount         LOG2       Unused       Greate       Immount       Immount       Immount       Immount       Immount       Immount         LOG2       Unused       Greate       Immount	Logging > Log Ses	sions					Log Sessions	
Log Sessions Log Sessions Log Support_file SBF Never Internal  Log Unused Create Log Unused Create		Usage					Disk Contents	
Log Sessions Log Sessions Log Support_file SBF Never Internal  Log Cuused Create LOG3 Unused Create LOG5 Unused Create			nternal Disk (15.1	(B)	External Dis	(18GB)	Global Log Settings	
Log Sessions Log Sessions Log Support_file SBF Never Internal  Log Create LOG3 Unused Create LOG5 Unused Create LOG5 Unused Create LOG6 Unused Create LOG6 Unused Create LOG6 Unused Create						- 54 - 15 - L		
Unmount       Format         650 MB/day [uncompressed]       Unmount         Log Sessions         • LOG1 support_file       SBF         Never       Internal         LOG2       Unused         LOG3       Unused         Corcate       LOG4         LOG5       Unused         Corcate       LOG6         LOG6       Unused         Corcate       LOG7         LOG7       Unused								
LOG2 Unused Create LOG3 Unused Create LOG4 Unused Create LOG5 Unused Create LOG5 Unused Create LOG5 Unused Create LOG5 Unused Create LOG6 Unused Create								
ID       Name       Data       Auto-Delete       Disk       FTP         ◆       LOG1       support_file       SBF       Never       Internal       ●       ▷       X       ○         LOG2       Unused       Create         ○       ○       X       ○	Unn	nount Format 6	50 MB/day [uncomp	ressed] Unmount Form	nat			
ID       Name       Data       Auto-Delete       Disk       FTP         ◆       LOG1       support_file       SBF       Never       Internal       ●       ▷       X       ○         LOG2       Unused       Create         ○       ○       X       ○								
<ul> <li>▶ LOG1 support_file SBF Never Internal ●</li></ul>	-Log S	Sessions						
LOG2 Unused Oreats LOG3 Unused Create LOG4 Unused Create LOG5 Unused Create LOG6 Unused Create LOG7 Unused Create		ID Name	Data Au	to-Delete Disk I				
LOG3 Unused Create LOG4 Unused Create LOG5 Unused Create LOG6 Unused Create LOG7 Unused Create	🕘 L	.OG1 support_file	SBF	Never Internal	👻 🖹 🗙 💽			
LOG4 Unused Create LOG5 Unused Create LOG6 Unused Create LOG7 Unused Create		.OG2 Unused 💽	reate					
LOG5 Unused Create LOG6 Unused Create LOG7 Unused Create	L	.OG3 Unused 💽	reate					
LOG6 Unused Create LOG7 Unused Create	L	.0G4 Unused 💽	reate					
LOG7 Unused Create	L	.OG5 Unused 💽	reate					
	L	.OG6 Unused 💽	reate					
LOG8 Unused Create	L	.OG7 Unused 💽	reate					
	L	.OG8 Unused 💽	reate					

Figure 6-10: The 'Log Sessions' window showing an active logging session





#### Step 3: Downloading the logged SBF file

The logged SBF file can be downloaded on the 'Disk Contents' page as shown in Figure 6-11. Click on the download icon **()** next the SBF file you want to download.

Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
Logging > Log Ses	sions					Log Sessions	
Disk	Usage					Disk Contents	
		Internal Disk (7.5 G	6B)	Externa	al Disk	Global Log Settings	
		used (9%, 688.8		Disk	not present	-	
		free (91%, 6.9 GE		_			
Un	mount						
Int	ernal Disk Ext	ernal Disk					
Nar	ne	Size	-				
🥯 Ir	nternal Disk (7.5	GB) 688.8 MB					
8	LOG1_support_f	file	×				
۲	15343		×				
	log.sbf	452.6 MB 🕚	× -				
	fresh						
- No	i costi						

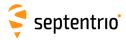
Figure 6-11: Click on the green download icon to next to the file you want to download

# 6.3.2 Diagnostic Report

A **Diagnostic Report** can be generated under the **Admin/About** tab on the Web interface as shown in Figure 6-12 and saved to your PC.



Figure 6-12: Generate a Diagnostic Report



1

# 6.4 Activity logging

The PolaRx5S reports various events in the 'Receiver Messages' window of the 'Admin' menu that can be used to check the receiver operations. The example in Figure 6-13 shows that four, 15 minute SBF files have been successfully FTP pushed to a remote location.

Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
Admin > Receiver	Messages						Configurations
							Reset
	ceiver Messages -	1.53.241 Last sh	itdown caused by comm	and			Upgrade
[1	:Tue 2019-06-18 1:	L:53:29] Mount :	Success on mounting No external disk ava	internal disk in	35		User Administration
[3	:Tue 2019-06-18 1:	L:53:31] CPU Over	load occurred at 91.	17%	250- 4022028 700->		Expert Control
[4	:Tue 2019-00-16 1.	1:55:57] Stored 1	nitial position (402	1427.084m,552692.	559m,4925028.700m)		Receiver Messages
							About
			Clear	Freeze			

Figure 6-13: Receiver events reported by the PolaRx5S in the Receiver Messages window

# 6.5 How to use the Monitoring feature to configure the receiver to power down on low voltage

The monitoring feature allows the receiver to turn itself off when the external voltage supply is below a certain threshold. Note that the monitoring feature only considers the external voltage supplied to the 3-pin PWR connector and will not consider the voltage when the receiver is powered using Power over Ethernet or through the internal battery (in case of the PolaRx5e). While in standby mode, the power consumption of the receiver is reduced to approximately 0.22W.

# 6.5.1 Configuring the monitoring feature

#### Step 1: Define a voltage threshold and standby time

On the menu bar, select 'Station' and then 'Power Mode'. Next, click on the 'Monitoring'-tab. Here you can configure the voltage threshold and define how long the receiver should remain in standby before attempting to wake up again as shown in Figure 6-14. If the voltage level is still below the threshold value when the receiver tries to wake up, it will remain in standby and will periodically (as defined by the standby duration) check the voltage level until the voltage is at a sufficiently high level for the receiver to wake up.

Scheduling Monitoring Standby Now
Monitoring Settings
Standby duration 20 minutes  Supply Voltage Threshold
External supply voltage threshold 10.5V
If the changes to the settings are saved:
The receiver will go in standby when the external (Vin) power supply voltage drops below 10.5 V.
The receiver will recheck after 20 min of standby.
Default Ok

Press "OK" to apply the changes.

**Figure 6-14:** Defining a voltage threshold and standby time. In this example, the receiver is configured to go into Standby mode when the voltage level drops below 10.5V and to check the voltage after 20 minutes.



#### Step 2: Save the configuration

Press "OK" to apply the changes. Since the receiver will load the boot configuration when waking up again after having gone into standby due to low voltage, make sure to save the configuration to boot as shown in Figure 6-15. Note that, if the current voltage is lower than the threshold value defined in step 1, the receiver will not go into standby immediately but will display a warning and wait for 30 seconds, allowing the user to save the configuration to boot or increase the threshold value.

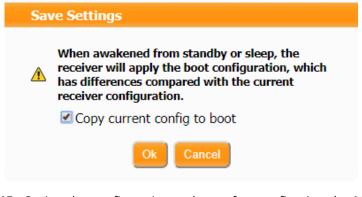


Figure 6-15: Saving the configuration to boot after configuring the Monitoring feature

Note that the receiver will not attempt to wake up to check the voltage levels during time periods for which scheduled sleep is enabled. For more information see Section 6.6.



## 6.6 Scheduled sleep

The Scheduled Sleep feature allows users to configure the receiver in such a way that it will sleep for a predefined amount of time and/or during a number of predefined intervals.

### 6.6.1 Configuring scheduled sleep

#### Step 1: Configure a new Wake-Up Schedule

On the menu bar select 'Station' and then 'Power Mode'. Next, click on the 'Scheduling'-tab. Here you can configure a full 'Wake-Up Schedule' as shown in Figure 6-16.

Scheduling Moni	itoring Standby Now
-Wake-Up Schedul	le
Awake duration	Stay awake 10 minutes ▼
Repetition period	No repetition     1 hours
Schedule start	
he receiver will not	t enter sleep automatically again.
efault Ok	

Figure 6-16: Overview of the Wake-Up Schedule

The Wake-Up schedule allows you to configure both the length of the period the receiver should be awake and whether or not this wake-up period should recur, and if so, how frequently (See Figure 6-17).



Scheduling Monitoring Standby No	w
Wake-Up Schedule	
Awake duration	nutes V
Repetition period ONO repetition	urs T
Schedule start O In 10	0:00:00 minutes ▼
If the changes to the schedule are	saved:
If put to sleep now, the receiver would	wake up at:
GNSS time: Wed 2020-01-0	01 00:00:00
Local time: Wed 2020-01-0	1 00:59:42 UTC+01:00
Time left: 8 days and 15	hours
The receiver will enter sleep at:	
GNSS time: Wed 2020-01-0	01 00:10:00
Local time: Wed 2020-01-0	1 01:09:42 UTC+01:00
Time left: 8 days and 15	hours
The receiver will stay awake for 10 min.	
The schedule repeats every 1 hour.	
During sleep, the receiver can be awake port.	ened by sending input to its <b>COM1</b>
Default Ok	

Press "OK" to apply the changes.

Figure 6-17: Example of a fully configured Wake-Up schedule.

#### Step 2: Determine the awake duration

To determine how long the receiver should stay awake, fill in the desired time span in the Awake duration field. In the example shown in Figure 6-17, this is set to 10 minutes.

#### Step 3: Define the repetition period

Next, determine how often the receiver needs to wake up for the previously configured period of time. If you wish for the receiver to wake up just once, leave the Repetition Period option at its default value of 'No RepetitionâĂŹ. The example shown in Figure 6-17 shows a receiver which is configured to wake up for 10 minutes every hour.

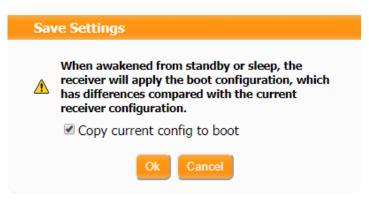


#### Step 4: Choose when the schedule should start

Finally, define a time in the Schedule Start field to choose when you want the Wake-Up Schedule to start taking effect. This effectively corresponds to the first time the receiver will attempt to wake up from standby mode for the period of time defined in the 'Awake DurationâĂŹ field.

#### Step 5: Save the configuration

After pressing 'Ok' to apply the changes, the receiver will suggest to copy the current configuration to boot. This is because when waking up from standby or sleep, the receiver will apply the boot configuration which at this point does not contain the recently configured changes (Figure 6-18).



**Figure 6-18:** Upon applying the changes, the receiver will show a warning suggesting to copy the current configuration to boot

Note that you can also configure the receiver to wake up at a certain point in the future and then just stay awake. To do this, simply leave both the Awake duration and Repetition Period options at their default setting and define when the receiver should wake up by choosing an appropriate Start Schedule time as shown in Figure 6-19.



Scheduling Monit	toring Standby Now
Wake-Up Schedule	3
Awake duration	Stay awake       10     minutes
Repetition period	No repetition     1 hours
Schedule start	At 2020-01-01 00:00:00     In 10 minutes ▼
If the changes to t	he schedule are saved:
If put to sleep now, t	the receiver would wake up at:
Local tim	ne: Wed 2020-01-01 00:00:00 ne: Wed 2020-01-01 00:59:42 UTC+01:00 :: 8 days and 14 hours
After waking up, the	receiver will not enter sleep automatically again.
During sleep, the rec port.	eiver can be awakened by sending input to its COM1

**Figure 6-19:** Example of how to configure the receiver to wake up at a certain point in the future and then just stay awake. In this example, the receiver is set to wake up at the first of January 2020

# 6.6.2 Combining the Monitoring and Scheduling features

It is possible to combine the monitoring feature with a Wake-Up Schedule. In this case, when the receiver is scheduled to be awake, but the voltage level is below the threshold value defined in the monitoring tab, the receiver will remain in standby but will periodically attempt to wake up in order to check the voltage level. Conversely, during time periods for which the receiver is scheduled to sleep, the receiver will not attempt to wake up to check the voltage levels. An example illustrating this behavior is shown below in Figure 6-20.



Planned Awake for Scheduled Sleep:

I		.1	I
Threshold(s) met:			
I	 _1		
Receiver Awake:			
			I

**Figure 6-20:** Combining the monitoring feature with a Wake-Up Schedule will lead the receiver to remain in standby but periodically check the voltage level when the receiver is scheduled to be awake, but the voltage level is below the threshold value. When the receiver is scheduled to sleep, the receiver will not attempt to wake up to check the voltage levels.



# 7 Security

## 7.1 How to manage access to the PolaRx5S

You can manage the access that users have to the PolaRx5S in the 'User Administration' window of the 'Admin' menu.

By default, the web interface, file transfer and communication ports are all assigned User-level access as shown in Figure 7-1. 'User' level allows full control of the receiver while 'Viewer' level only allows viewing the configuration. The File Transfer is by default at the âĂŹViewerâĂŹ level such that anonymous users can only read files.

Overview	GNSS		Station	(	Communication	Corrections	Data Outp	ut	Logging	Admin
Admin > User Adn	ninistration									Configurations
	ers									Reset
				]						Upgrade
	ere are curre New user	entry no	users denn	eu.						User Administratior
	new user									Expert Control
C De	efault Access	Level Pe	er Interface	<u>.                                    </u>						Receiver Messages
W	eb	none	Viewer	User						About
Fi	le Transfer	none	<ul> <li>Viewer</li> </ul>	OUser						
IP	ports	none	○ Viewer	<ul> <li>User</li> </ul>						
C	OM ports	none	Viewer	<ul> <li>User</li> </ul>						
			Viewer	A						

Figure 7-1: The default access levels of the PolaRx5S

In the example shown in Figure 7-2:

**Web Interface:** Anonymous users (without password) can connect to the receiver via the web interface as Viewers. They can browse the various windows but cannot change any of the settings.

**File Transfer:** For the File Transfer argument, Viewer means that the anonymous user is allowed to download log files from the receiver using FTP, SFTP or rsync, but not to delete them. User means that the anonymous user can both download and delete files, and none disables anonymous accesses.

**IP, COM and USB Ports:** Only users with User access to the IP, COM and USB ports so can change receiver settings over these connections. Users with Viewer access to the IP, COM and USB ports so can only send commands to show the configuration. Anonymous users can neither change or view the receiver configuration over these connections.



Default Acce	Onone						
		<b></b>					
		🔾 Viewer 💿 User					
File Transfe	rone	● Viewer ○ User					
IP ports	Onone	- Edit User					
COM ports	Onone	User name	George				
USB ports	Onone	Password		0			
		User access level		<u> </u>			
Default Ok		SSH Key					
	-						
		Ok	Cancel	Users			
				User Nan	e Access Level	SSH Key	
				George	Viewer	No	2

Figure 7-2: Defining user access levels

After defining the Users/Viewers and their access levels, they can login on the web interface by clicking on **Log in** on the upper-right corner as shown in Figure 7-3.

<ul> <li>♀ PolaRx5-3013369 (SEPT)</li> <li>← ⇒ C △ ③ 192.</li> </ul>	168.105.246				☆ : Not logged in	
Ç septentrio	Authentication Requining Authentication Requining Authentication Requining Authentication Requining Authentication Reprint Authentication Reprint Authentication Reprint Authentication Reprint Reprin	quires a username and passv te is not private. Je	in the second se	Fixed Status Overall Quality Int. Loggin Corrections Ext. Loggin Wifi O Internal	Log in	
		Log In Can ×	cel			(A) ( 00 - 33 ♥ ☆) :
		Receiver	Position	Status		Logged in as George Log out
	<b>Ş</b>	PolaRx5-3013369 (SEPT) IP Address (Eth): 192.168.105.246	Lat: N50°50'55.1018" N/A	Tracked Sats: 43 Time: 2016-11-10 13:33:23	Fixed all Overall Quality Corrections	<ul> <li>Status</li> <li>Int. Logging</li> <li>Ext. Logging</li> </ul>
	septentrio	Uptime: 1d 03:55:27	Hgt: 128.942m N/A	Temp: 45 °C — V: 12.40 volts	Wifi	Internal

Figure 7-3: Logging in to the PolaRx5S web interface



Users/Viewers can logout by clicking on **Log out** on the upper-right corner and leaving the 'User Name' and 'Password' fields of the pop-up empty as shown Figure 7-4.

http://192.168.105.246 r	equires a username a	nd password
Your connection to this	site is not private.	
User Name:		
Password:		
	Log In	Cancel

Figure 7-4: Adding an SSH key

### 7.1.1 SSH key authentication

By default, anonymous users have full access over FTP, SFTP and rsync to the files logged on the PolaRx5S. FTP, SFTP and rsync access can be limited by configuring user access, as described in Section 7.1. For added security, user authentication for SFTP and rsync access can be configured using an SSH public key. When an SSH key is defined, the configured user can download files using SFTP or rsync without entering a password provided of course, that the matching private key is known by the key agent running on the same PC.

You can generate public and private keys using for example, **PuTTY Key Generator** as shown in Figure 7-5.

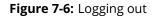
PuTTY Key Generato	r		2			
ile Key Conversions	Help					
Key						
Public key for pasting i	nto OpenSSH authorized_	keys file:				
ecdsa-sha2-nistp521						
		omlzdHA1MjEAAACFBAF 5euag6T9igHX4sGhfk/nSl				
	/VRmDzA9WyAqUjgqO0		-HG980ewG8YGN			
+Z1IUxR7VXb8AgffH//	AwyDemiKuhTC77kgadW	A== ecdsa-key-20161027	Ψ.			
Key fingerprint	ecdsa-sha2-nistp5215	21 2f:49:b5:96:b2:8e:8c:be:	53:61:ec:0e:64:ad:2b:12			
Key comment	nent ecdsa-key-20161027					
Key passphrase:						
Key p <u>a</u> sspillase.						
Confirm passphrase:	•••••					
Actions						
Generate a public/priv	ate key pair	1	<u>G</u> enerate			
Load an existing privat	e key file		Load			
Save the generated keep	ey.	Save p <u>u</u> blic key	Save private key			
Parameters						
Type of key to general		~	~			
© <u>R</u> SA ©	DSA O ECDS	SA © ED <u>2</u> 5519	SSH-1 (RSA)			
Curve to use for generation	ating this key:		nistp521 💌			

Figure 7-5: Generating SSH keys using the PuTTY Key Generator. The public key is highlighted.



The generated public key is the highlighted text that can be pasted directly into the **SSH Key** field of the PolaRx5S Web Interface as shown in Figure 7-6.

Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
Admin > User	r Administration						Configurations
,	-Edit User						Reset
		George					Upgrade
		•••••••••••••••••••••••••••••••••••••••					User Administration
	User access level	User	~				Expert Control
	SSH Key	AAAAE2VjZHNhLXNo	YTItb				Receiver Messages
	Ok	Cancel					About
l							



521-bit ECSDA keys offer the best security however, ECSDA 256 and 384-bit keys can also be used. Alternatively, RSA 512 and 1024 key encryption is also supported.



H

## 7.2 How to control access using the PolaRx5S Firewall

You can control access to the PolaRx5S using the receiver's firewall in the **Firewall** window. By default, all Ethernet and WiFi ports are open (i.e. those defined on the **IP Ports** menu).

In the example shown in Figure 7-7, Ethernet ports 2101, 2102 and 2103 are accessible but only from devices with the IP address 84.199.9.148. Similarly, all WiFi ports are open but only those from IP 84.199.9.148.

Please note that the firewall settings do not apply when connecting to the web interface using USB. In the case of WiFi, firewall settings only apply when the receiver is in WiFi client mode.

	G	NSS		Station	Communication	Corrections	Data Output	Logging
					Ethernet			
Firow		ottinge-						
1 II CW	Firewall Settings Open ports IP port list			IP port list	Dynamic DNS			
Ether	net	PortList	٠	2101 2102 2103	IP Ports			
WiFi	WiFi all 🔻			Firewall				
	(separated by space				Web Server			
Defau	t: al	l ports op	pen		NTRIP			
-IP Ad	dres	s Filtering	9—		NTRIP Caster			
Mode				● off ● on	Serial Port			
Allow	ed I	P address	ses	84.199.9.148	Point-to-Point Protocol			
				(separated by space	es)			

Press "OK" to apply the changes.

Figure 7-7: Configuring the Firewall of the PolaRx5S

# 8 **Receiver administration operations**

### 8.1 How to change IP settings of the PolaRx5S

The IP settings of the PolaRx5S can be configured in the Ethernet window of the Communication menu. By default, the PolaRx5S is configured to use DHCP to obtain an IP address. You can specify a 'Static' address in the TCP/IP Settings field as shown in Figure 8-1.

In Static mode, the receiver will not attempt to request an address via DHCP but will use the specified IP address, netmask, gateway, domain name and DNS. DNS1 is the primary DNS and DNS2 is the backup DNS. In DHCP mode, the arguments IP, Netmask, Gateway, Domain, DNS1, and DNS2 are ignored.

Having entered the settings, click on 'Ok' then 'Apply And Reboot' in the pop-up dialog as shown, as the receiver needs to be reset for the new settings to become active.

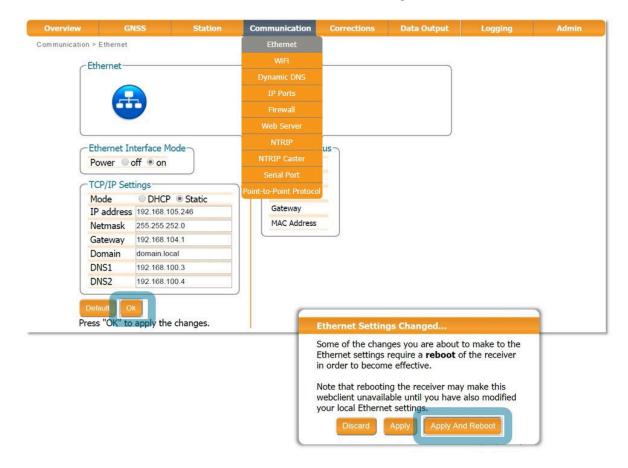


Figure 8-1: Changing the TCP/IP settings of the PolaRx5S



After reboot, the Ethernet Status field should now show the correct IP settings as shown in Figure 8-2.

_	Ethernet Sta	tus
	IP Address	192.168.105.246
	Hostname	
	Netmask	255.255.252.0
	Gateway	192.168.104.1
	MAC Address	00:50:C2:36:3B:EF
2		

Figure 8-2: TCP/IP settings

Note that the IP settings will keep their value after a power cycle and even after a reset to factory default in order to avoid accidentally losing an Ethernet connection to the receiver.

## 8.2 How to configure Dynamic DNS

Dynamic DNS allows remote contact with the PolaRx5S using a hostname.

When devices are connected to the internet, they are assigned an IP address by an internet service provider (ISP). If the IP address is *dynamic* then it may change over time resulting in a loss of connection. Dynamic DNS (DynDNS or DDNS) is a service that addresses this problem by linking a user-defined hostname for the device to whichever IP address is currently assigned to it.

To make use of this feature on the PolaRx5S, you should first create an account with a Dynamic DNS provider (**dyndns.org** or **no-ip.org**) to register a hostname for your receiver. In the example shown in Figure 8-3, the hostname *polarx5.mine.nu* has been registered with dyndns.org. The *Bind* option, selected in this case, tells the Dynamic DNS provider only to update IP addresses assigned over an Ethernet LAN connection.

Overview	GN	ISS Stati	on	Communication	Corrections	Data	a Output	Logging	Admin
Communication >	⊳ Dynamic [	ONS		Ethernet					
CD	ynamic Di	NS			namic DNS St	atus —			
P	Provider	○ off ● dyndns.or	g 🔍 no	Dynamic DNS	tus	Off			
U	Jsername	ssncom			or	No error			
P	assword	•••••• 0			und IP address	N/A			
		polarx5.mine.nu			-		)		
В	Bind	e auto	t 🔍 WiF						
		he <u>Firewall Settings</u>		NTRIP Caster					
acce	ess is enab	led to the required	ports.	Serial Port					
De	efault O	k		Point-to-Point Protoco					
Pres	ss "OK" t	o apply the chang	jes.						

Figure 8-3: Configuring Dynamic DNS



# 8.3 How to upgrade the firmware or upload a new permission file

The PolaRx5S firmware and permission files both have the extension .suf (Septentrio Upgrade File) and can be uploaded to the PolaRx5S as shown in the steps below. Firmware upgrades can be downloaded from the Septentrio website and are free for the lifetime of the receiver. Permission files enable additional features on the PolaRx5S and can be purchased from our sales department.

#### Step 1: Select the .suf file and start the upgrade

The upgrade procedure is started by clicking on the 'Choose file' button in the 'Upgrade' window of the 'Admin' menu and which is highlighted in Figure 8-4.

Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
Admin > Upgrade							Configurations
							Reset
ſ	lpgrade Receiver F	irmware					Upgrade
S	elect upgrade (*.s	uf) file:					User Administration
	Choose file No file ch	nosen					Expert Control
	Skall upgrade						Receiver Messages
c	Current firmware	version: 4.9.0					About
			ng its WiFi network, again after the upgr		: once		

Figure 8-4: Selecting the .suf file to upload to the receiver

Having already saved the .suf file to your PC, you can then select this file and click on the 'Start upgrade' button. The pop-up window shown in Figure 8-5 will show the progress of the upgrade.



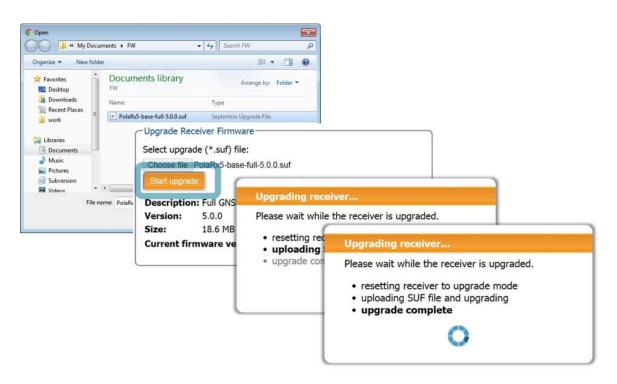


Figure 8-5: The upgrade procedure

#### Step 2: Verifying the upgrade

If there were no problems with the upgrade, the message 'Upgrade successful' will appear. You can then check on the Admin/About window, as shown in Figure 8-6, that the new firmware version or permission file has been updated.

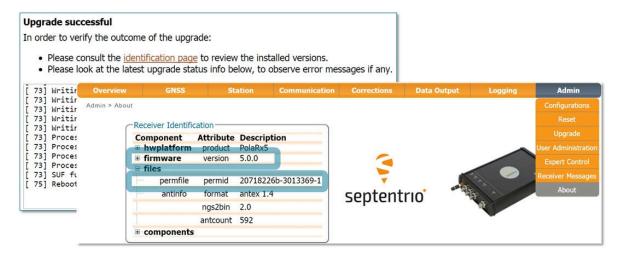
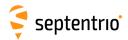


Figure 8-6: Checking the firmware and permission file versions



# 8.4 How to set the PolaRx5S to its default configuration

You can set the PolaRx5S configuration to its default settings on the Configurations window of the Admin menu as shown in Figure 8-7. Select 'RxDefault' from the 'Source' drop-down list and either 'Current' or 'Boot' in the 'Target' menu. You will then be prompted to Save the new current configuration as the boot configuration so the receiver will boot up with saved configuration after a power cycle.

Overview	GNSS	Station	Communic	ation	Corrections	Data Output	Logging	Admin
Admin > Configura	tions							Configurations
-Cor	y Configuration Fi		-Receiver Con	figuration	c		_	Reset
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Jrce RxDefault •				1004	ry default 🚺 🚺		Upgrade
(and and	get Current •		Boot		t from facto	and the second se		User Administration
			User1	Equ	al to factory d	lefault 🚺		Expert Control
Defa	ult Ok		User2	Equ	al to factory d	lefault 🛛 🚺 🚺		Receiver Messages
Press	"OK" to apply the	changes.					_	About
					ofiguration uration. Ignore			

Figure 8-7: Setting the PolaRx5S to its default configuration

### 8.5 How to reset the PolaRx5S

If the PolaRx5S is not operating as expected, a simple reset may resolve matters. The PolaRx5S can be fully power-cycled by disconnecting then reconnecting the power supply. However, on the Admin/Reset window as shown in Figure 8-8 different functions can be reset individually. A 'Soft' level reset will cause the PolaRx5S to boot up with its current configuration while a 'Hard' reset will use the configuration stored in the boot file.

Overview	GNSS	Station	Communication	Corrections	Data Output	Logging	Admin
dmin > Reset							Configurations
-1	Reset Receiver—						Reset
	Level	Soft Hard					Upgrade
	Config						User Administratio
	PVTData						Expert Control
	SatData						Receiver Message
	BaseStations						
	WiFiAccessPoints						About
Contraction of the second	efault Ok	the changes	Reset C	onfirmation			
Pre	ss "OK" to apply	the changes.		will result in the receiver.	reset the receiver? loss of the connectio	'n	

**Figure 8-8:** Resetting the PolaRx5S configuration to its boot configuration using a Hard reset



# 8.6 How to copy the configuration from one receiver to another

In the Admin/Configurations window, the configuration of a PolaRx5S can be easily saved to a PC as a text file. A saved configuration can then be uploaded to any other PolaRx5S.

#### Step 1: Downloading the configuration from a PolaRx5S

Click the green download arrow 🕓 next the configuration you wish to download as shown in Figure 8-9. The configuration will be saved as a .txt file.

Overview	GNSS	Station	Communica	tion	Corrections	Data Output	Logging	Admin
Admin > Configu	rations							Configurations
								Reset
ſ	-Copy Configuration		eceiver Configu					Upgrade
	ALC: NO DECIDENT	▼ (#			t from factory of the from factory of the factory o			User Administratio
l	Target Boot		Jser1		al to factory defa			Expert Control
	Default Ok	U	Jser2		al to factory defa			Receiver Message
						)		About
		C	Save As					
		G	🖉 🗸 🕨 🕹 Lit	oraries 🕨	Documents + confi	gs 👻 🗲	earch configs	Q
			Organize 🔻 Ne	w folder			833	• 0
			ጵ Favorites 📃 Desktop	Î	Documents lil	brary	Arrange by: Fol	lder 🕶
			Downloads Recent Places work	E	Name	Type No items match your	search.	
			🔚 Libraries					
			Documents					
			Music E Pictures	+ 4		.III		•
			File name:	PolaRx5	_3010305_Boot_2015-1	2-10-122625.txt		
			Save as type:	Text Doo	cument			-
			Hide Folders				Save	ancel

Figure 8-9: Saving a configuration from a PolaRx5S as a text file

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#### Step 2: Uploading the configuration to another PolaRx5S

Again on the Admin/Configurations window, click on the blue upload arrow (), as indicated in Figure 8-10, to upload a configuration file stored on you PC. In this example, the saved file will be uploaded as the Boot configuration.

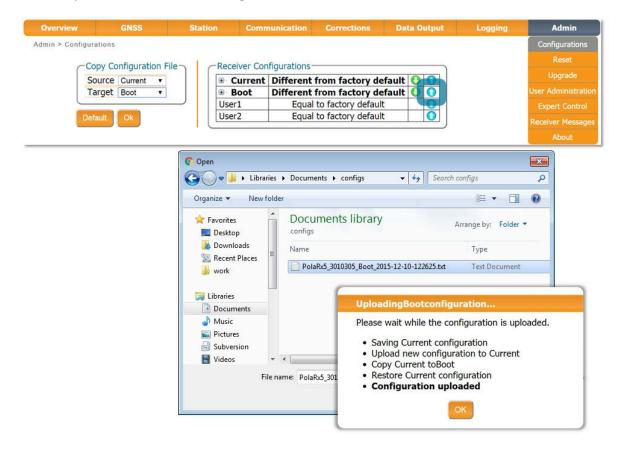


Figure 8-10: Uploading a configuration to a PolaRx5S





# A Front-panel port descriptions

The PolaRx5S front panel features 8 ODU connectors which are described in the following sections. These connectors are all of type ODU MINI SNAP Series F. The pinout of the female connectors and the ODU part number of the corresponding male connectors are shown in Figure A-1.

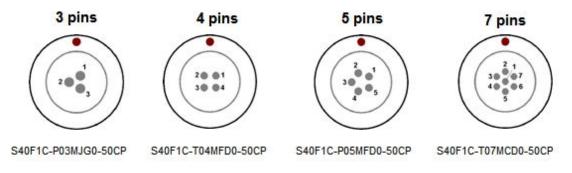


Figure A-1: Pinout of the front-panel female connectors and the ODU part numbers of the corresponding male connectors

## A.1 COM1

This 7-pin connector provides access to the first serial port (COM1). The receiver behaves as Data Terminal Equipment (DTE).

PIN #	Description
1	Not connected
2	Signal ground (GND)
3	Not connected
4	Not connected
5	Receive Data (RXD - input to the receiver)
6	Transmit Data (TXD - output from the receiver)
7	Not connected

# A.2 COM2

This 7-pin connector provides access to the second serial port (COM2). The receiver behaves as Data Terminal Equipment (DTE).

PIN #	Description
1	+5V DC output
2	Signal ground (GND)
3	Clear To Send (CTS - input)
4	Request To Send (RTS - output)
5	Receive Data (RXD - input to the receiver)
6	Transmit Data (TXD - output from the receiver)
7	Not connected





### A.3 COM3-4/USB

This 7-pin connector can be configured in two modes:

- COM3 and COM4
- USB device

The electrical level at pin#7 defines the operating mode.

#### **COM3-4 device**

This mode is selected by leaving pin#7 unconnected.

PIN #	Description
1	Not connected
2	GND
3	COM4 RX
4	COM4 TX
5	COM3 RX
6	COM3 TX
7	Leave unconnected

#### **USB** device

This mode is selected by applying 5V DC to pin#7.

PIN #	Description
1	Not connected
2	GND
3	USB D-
4	Reserved
5	USB D+
6	Reserved
7	USB Vbus

## A.4 Ethernet

The receiver can be powered through the Ethernet port (Power-Over-Ethernet). Please note that only mode A, as specified in the 802.3af standard, is supported on the PolaRx5S.

PIN #	Description
1	TxD+
2	TxD-
3	RxD+
4	RxD-



# A.5 OUT

PIN #	Description
1	Reserved
2	GND
3	GP1 output, 3.3V. Use the command <b>setGPIOFunctionality</b> to set the level of this pin.
4	GP2 output, 3.3V. Use the command <b>setGPIOFunctionality</b> to set the level of this pin.
5	nRST_OUT. Open-collector output, driven low when the receiver is resetting.

# A.6 IN

PIN #	Description
1	Reserved, leave unconnected.
2	Ground
3	Reserved, leave unconnected.
4	nRST_IN. Driving this pin low resets the receiver. Internally pulled-up. Debouncing and deglitching is foreseen.
5	EVENTA input, 0-30V, pulled down. Input voltage should be at least 3V to be detected as high. First input for external event timing. Event polarity is controlled by the <b>setEventParameters</b> command.
6	EVENTB input, 0-30V, pulled down. Input voltage should be at least 3V to be detected as high. Second input for external event timing. Event polarity is controlled by the <b>setEventParameters</b> command.
7	ANT_EXT, external antenna power. Can be used to apply an external supply voltage to the antenna. The voltage applied to ANT_EXT(V <sub>ANT</sub> ) determines the voltage source on the MAIN connector, as follows: • if $V_{ANT} < 2.0V$ or ANT_EXT left open, the antenna is powered by the internal 5V supply; • if $3.0V < V_{ANT} < 4.0V$ , there is no power provided to the MAIN connector; • if $5.0V < V_{ANT} < 12.0V$ , the antenna power supply is taken from ANT_EXT. <b>Warning:</b> Exceeding 12.0V for V <sub>ANT</sub> , or drawing more than 200mA from the antenna connector can permanently damage the receiver.

## A.7 USB Host

PIN #	Description
1	USB-H VBus (max current: 500mA)
2	Ground
3	USB-H D-
4	USB-H D+
5	Reserved



# A.8 PWR

PIN #	Description
1	Power: 9 to 30V DC
2	Always ON. When this pin is tied to pin#1 the receiver is always on regardless of the state of the power button. Connect to Ground to enable the power button.
3	Ground



## **B** Rear-panel connectors

The following sections describe the connectors on the rear-panel of the PolaRx5S.

## **B.1 MAIN (TNC)**

Connect an active GNSS antenna to this connector. The resultant gain at the connector (antenna gain minus cable losses) must be in the range 15 to 50dB.

By default, the receiver provides a 5V DC supply on the MAIN connector to feed the antenna. Other voltages can be supplied through pin ANT\_EXT of the IN connector on the front panel (see Appendix A.6). The maximum supported current is 200mA.



Never inject a DC voltage into the MAIN connector as it may damage the receiver. When using a splitter to distribute the antenna signal to several receivers, make sure that no more than one output of the splitter passes DC. Use DC-blocks otherwise.

## **B.2 PPS OUT (BNC)**

xPPS output (5V, output impedance 50- $\Omega$ ). The rate and polarity of the xPPS output signal can be specified by the **setPPSParameters** command or on the Web Interface The pulse duration is 5ms.

# **B.3 REF OUT (BNC)**

The REF OUT connector provides a 10 MHz output signal synchronized with the frequency of the internal receiver clock. It is a sinusoidal signal with unloaded peak-to-peak amplitude of 1.1V and output impedance of 50  $\Omega$ .

Note that the REF OUT signal can be turned off with the **setREFOUTMode** command. See also Section 2.1.1

## B.4 WiFi (SMA)

Connector for the WiFi antenna.



# C Cables

Cable Name (Part #)	Details				
<b>CBLe_COM_1.8_rev.1</b> (216374, replaces 200416)	either the C	OM1 or	COM2 connec	e). To be connec tor. Note that R ected to COM2.	
<b>CBLe_COM_DUO_7_rev.1</b> (216373, replaces 201204)	connected t	to the C	•	connector. Not	To b e tha
	Open-ended pinout in Ap			the OUT connecte	or (se
		Pin #	Function	Wire Colour	]
CBLe_GPO_OE_5_rev.1		1	Reserved	Blue	1
(216367, replaces 201203)		2	Ground	Blue/Black	
		3	GP1 output	Orange	
		4	GP2 output	Green	
		5	nRST_OUT	Brown	
	Open-ended pinout in Ap			n the IN connecto	or (se
		Pin #	Function	Wire Colour	
		1	PPS_IN	Blue	
		2	Ground	Blue/White	
		3	IO1	Orange	
CBLe_GPI_OE (200419)		4	RESET	Green	
		5	EVENTA	Brown	
		6	EVENTB	Green/White	
		7	ANT_EXT	Orange/White	
	them to grou	7 the Brow und if no	ANT_EXT wn and Green t used. This wi		effect
	them to grou that could le EvB inputs.	7 e the Brow und if no ad to spu	ANT_EXT wn and Green, t used. This wi urious level tra	Orange/White /White wires float ll avoid crosstalk	effect vA an
<b>CBLe_USB_rev.1</b> (216377, replaces 201202) <b>CBLe_USB_HOST_rev.1</b> (216371, replaces 214935)	them to grou that could le EvB inputs. USB device connector.	7 e the Brov und if no ad to spu cable to	ANT_EXT wn and Green t used. This wi urious level tra b be connecte	Orange/White /White wires float Il avoid crosstalk ansitions on the Ev	effect vA an -4/US



Cable Name (Part #)	Details		
	Open-end	ed cable	e for the PWR
	connector	(see pir	nout in Appendix A.8).
	Pin #	Function	Wire Colour
<b>CBLe_PWR_OE_rev.1</b> (216376, replaces 200422)	1	Power	Blue and blue/white with re sleeve (these two wires are bot connected to Pin#1)
(210370, replaces 200422)	2	ON/OFF	Orange
	3	Ground	Green and green/white with blac sleeve (these two wires are bot connected to Pin#3)
<b>PWRe_ADAPTER</b> (200431)	A power a	dapter to be co	nnected to PWR connector.



## **D** LED behavior

LED name	colour	lcon	Behavior	
POWERLED	red	Ċ	<b>Off</b> : Receiver is powered of <b>On</b> : Receiver is powered or	
LANLINKLED	green	<del>垦</del>	<b>Off</b> : No Ethernet connecti <b>Blinking</b> : Sending or receiv	
			Behavior	Number of satellites in tracking
			Blinks fast (10 per second)	0
TRACKLED	orange	range	Blinks once, then pauses	1, 2
INACILLD	orange		Blinks twice, then pauses	3, 4
		•	Blinks 3 times, then pauses	5, 6
			Blinks 4 times, then pauses	7, 8
			Blinks 5 times, then pauses	9 or more

By default, GPLED functions as DIFFCORLED but, it can also be configured as LOGLED using the **setLEDMode** command. In rover PVT mode, when acting as DIFFCORLED, this LED reports the number of satellites for which differential corrections have been provided in the last received differential correction message (RTCM or CMR).

GPLED

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red

Behavior	Number of satellites
(configured as DIFFCORLED)	with corrections
Off	No diff corr received
On	The LED is solid 'ON' when the receiver outputs differential corrections as a static base station.
Blinks fast (10 per second)	0
Blinks once, then pauses	1, 2
Blinks twice, then pauses	3, 4
Blinks 3 times, then pauses	5, 6
Blinks 4 times, then pauses	7, 8
Blinks 5 times, then pauses	9 or more

Behavior (configured as LOGLED)	Logging status
Off	Not logging
On	Logging active



LED name	colour	lcon	Behavior
PVTLED	green		<b>Off</b> : No PVT available <b>On</b> : PVT available
WIFILED	red	((:-	Off: WiFi disabled On: Access-point mode or client mode Blinking slowly: Establishing a connection in client mode Blinking quickly: Error, not connected



# E 100 Hz Output Rate

As described in the previous chapters, ionospheric monitoring typically involves sampling I&Q correlation and carrier phase data at a 50 Hz rate. However, the PolaRx5S also supports 100 Hz rate for advanced research.

To prevent overloading the receiver's CPU when operating at 100 Hz output rate, the only SBF block that should be output at 100 Hz is the IQCorr block. That block contains the I&Q correlation values and the carrier phase modulo 65.536 cycles. To be able to reconstruct the full carrier phase at 100 Hz (i.e. to fix the 65.536-cycle ambiguity), it is sufficient to log the MeasEpoch SBF block at a lower rate, e.g. 1 Hz.

The **sfb2ismr** program, with the -r option, can be used to recover full carrier phase and correlation values from a SBF file containing 100 Hz IQCorr blocks and 1 Hz MeasEpoch blocks. See Section 5.3.3 for details.



To avoid data gaps, it is recommended to use either the receiver's USB or Ethernet connection when operating at 100 Hz. The standard serial ports should **not** be used because their bandwidth is too low to support such a high data throughput.

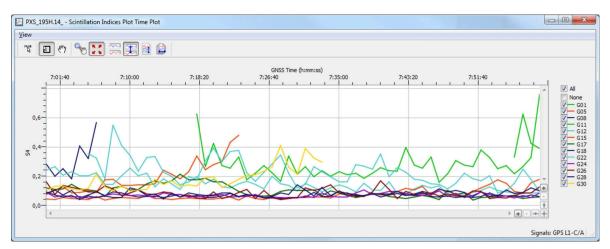


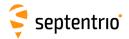


# F Real-Time ISMR data

The PolaRx5S contains a built-in real-time S4 and  $\sigma_{\phi}$  monitor. S4 and  $\sigma_{\phi}$  are computed every minute for all tracked satellites and signals (except GPS (L1P and L2P) and GLONASS (L2P)), and are made available in the ISMR SBF block.

Using the RxControl graphical interface, it is possible to view the S4 and  $\sigma_{\phi}$  indices in real-time. This is enabled in the *View* > *Time Plots* > *Scintillation Indices Plot* menu. An example of real-time S4 view is shown below.





# **G TEC** Calibration

Absolute TEC values can be biased by satellite and station inter-frequency biases. Sources of station biases include the antenna, the antenna cable, splitters, amplifiers, and the receiver. Satellite biases are compensated for when available (see Section 5.3.1), but station biases need to be calibrated. This Appendix details a procedure to calibrate the station biases.

**sbf2ismr** includes a tool for TEC calibration. Calibration values can be computed for the TEC computed from GPS, Galileo, Compass/BeiDou, GLONASS and QZSS satellites.

Calibration is done by comparing the measured TEC values (after correction of the satellite biases as documented in Section 5.3.1) with reference TEC values. The TEC reference can either be the SBAS ionospheric corrections or the Klobuchar ionospheric model. The bias between the measured and the reference TEC values is averaged over several passes for each satellite individually or, for a whole constellation in case satellite biases are corrected. A fixed elevation mask of 15 degrees is applied.

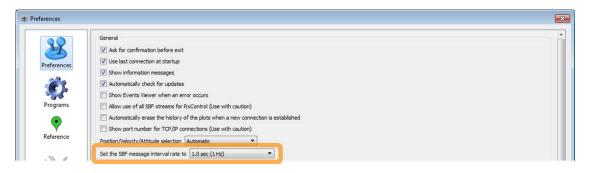
To perform a TEC calibration with respect to SBAS, **sbf2ismr** must be invoked with the '-as' option. To use the Klobuchar model as a reference, the '-ak' option must be used. When using Klobuchar as a reference, only the satellites tracked between 00:00 and 06:00 local time are considered, to avoid times of increased ionospheric activity. The Klobuchar parameters are decoded from the GPS navigation messages.

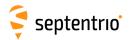
In regions covered by an SBAS system, it is recommended to calibrate against SBAS for better accuracy.

The recommended procedure for generating a TEC calibration file is outlined below. TEC calibration is most accurate in times of quiet ionospheric conditions. If strong ionospheric activity is foreseen, it is preferable to delay the calibration procedure until a time of lower activity.

The calibration accuracy using the procedure below mainly depends on the accuracy of the reference TEC values and on the accuracy of the satellite bias values transmitted by the satellites. When using the SBAS ionospheric corrections as TEC reference, the overall calibration accuracy is expected to be on the order of 3TECU.

- 1. Connect to the receiver using the RxControl graphical interface.
- 2. In the *File > Preferences* menu, make sure that the SBF message interval is set to 1.0s (this is the default).





3. Make sure that the receiver is in its default configuration. This can be done by checking the 'Config' option in the *File* > *Reset Receiver* menu:

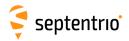
🖶 Reset Rece	eiver 🗾
Reset Recei	ver
Level	🔘 Soft 💿 Hard 🔘 Upgrade
Erase Memo	ory Off All Config PVTData SatData BaseStations <u>ResetReceiver</u>
	Default Apply OK Cancel

4. Navigate to the *Navigation* > *Positioning Mode* > *SBAS Corrections* menu and make sure the receiver is configured in MixedSystems navigation mode:

PVT Mode	SBAS Corrections	PPP and Differential Corrections	GNSS Attitude	
SBAS Corre	ections Usage			
Satellite	auto 💌			
Satellite SIS Mode	auto ▼	Operational		
SIS Mode	⊙ Test ()			
SIS Mode	⊙ Test ()			
SIS Mode	○ Test ● 0 Mode ○ EnRoute	Operational		

5. Under the Logging > RxControl Logging > SBF menu, enable the following SBF blocks for logging: MeasEpoch, PVTGeodetic, GEOCorrections, GPSNav, GPSIon, GLONav, GALNav, GEONav, QZSNav, BDSNav, ChannelStatus and ReceiverSetup.





	٩,	polarx5s_tec.serial -	RxControl Logger - 1	S/N 3009173	
	Į.	Status Global	File Naming SBF	NMEA Post Processi	ng
			Stream A		*
		Off			
		Rinex			
		Support			
		RawData		-	
		PostProcess		MeasEpoch	
		GUI		MeasExtra	
		Measurements		- EndOfMeas	
				IQCorr	
				I ISMR	
			<b>V</b>		
		. GAL	<b>V</b>		E
				BaseVectorGeod	
DOP	N			PVTGeodetic	
PVTSatCartesian		PVTCart		PosCovGeodetic	
PVTResiduals		PVTGeod		VelCovGeodetic	
RAIMStatistics		PVTGeod     PVTGeod     PVTExtra		PosLocal	
GEOCorrections		Attitude			
BaseLine				OutputLink	
EndOfPVT		⊞-Time		- InputLink	
PVTSupport	N	Event		- SatVisibility	
		DiffCorr		- ChannelStatus	
		Status		- ReceiverStatus	
				IPStatus	
		UserGroups		- QualityInd	
		PosCart		- NTRIPClientStatus	
		ReceiverSetup		- DiskStatus	
		Commands			Define SBF Groups
				Start Logging S	top Logging Close

6. In the *File Naming* tab, select manual file naming, and provide a file name:



Status Global	File Naming SBF NMEA Post Processing
File Naming Conventio	on: Manual
IGS Options	
Log messages v	with a "do not use" time stamp to "00000\ <markername>0000.00"</markername>
	rName to 4 characters
	arkerName from the receiver
Force the Market	
	ervane to: SEPT
Manual File Name O	options
File Name:	TECCalibration.log
SBF File Extension:	sbf
NMEA File Extension	n: nmea
	:      Size Limited: 100.000 MB <
Split Files After:	
Split Files After:	Time Limited: 0 00:10:00 +
Split Files After:	⑦ Time Limited: 0 00:10:00 ♀
Station Settings	

Note: the logging directory can be specified under the Global tab.

- 7. Start logging by clicking the 'Start Logging' button
- 8. Collect data for at least 24 hours. The longer the log file, the more accurate the TEC calibration. Stop logging by clicking the 'Stop Logging' button.
- 9. Open a command window and run sbf2ismr in TEC calibration mode. On Windows, sbf2ismr.exe can usually be found under C:\Program Files (x86)\Septentrio\RxTools\bin.

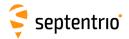
In regions covered by an SBAS system, use the option '-as' to generate TEC calibration values using SBAS ionospheric corrections as reference. Otherwise use the option '-ak'.

For example, assuming that the path to the log file collected in step 7 is Q:\TECCalibrationLog.sbf, the **sbf2ismr** command and its output is shown below:



#Approx Lat:50.84864deg Lon:4.73213deg	
HSBAS ionospheric corrections used as reference, 15-degree elevation mask HBroadcast group delay corrections applied for GPS, Galileo, QZSS and BeiDou J** -4.07 # mean of 7516 raw samples (stddev of raw samples: 3.19 TEC J** 7.16 # mean of 6135 raw samples (stddev of raw samples: 1.56 TEC J** -4.07 # mean of 7516 raw samples (stddev of raw samples: 1.91 TEC J** -4.07 # mean of 7516 raw samples (stddev of raw samples: 3.19 TEC J** -4.07 # mean of 1227 raw samples (stddev of raw samples: 3.80 TEC J** -2.80 # mean of 1227 raw samples (stddev of raw samples: 3.57 TEC J*4 -7.71 # mean of 1227 raw samples (stddev of raw samples: 3.57 TEC	U> U> U>
115       11.44       # mean of       1227 raw samples (studiev of raw samples: 3.23 lEG)         115       31.44       # mean of       1227 raw samples (studiev of raw samples: 3.21 lEG)         116       9.85       # mean of       1227 raw samples (studiev of raw samples: 4.61 TEC)         121       18.60       # mean of       1227 raw samples (studiev of raw samples: 4.61 TEC)         122       17.81       # mean of       1227 raw samples (studiev of raw samples: 4.66 TEC)	U> U> U>

The output of **sbf2ismr** can be copied into a TEC calibration file without modification, and this file can be provided as TEC calibration input with the '-C' option of **sbf2ismr** (see Section 5.3.1).



# H RxTools

The RxTools is a suite of Graphical User Interface tools for advanced monitoring and configuration of the receiver. They can be used to log SBF (Binary Format) data files (including raw measurements) as well as analyze the logged SBF data files and convert them to various other formats. The RxTools manual contains detailed instructions on how to use the tools.



RxControl is a graphical user interface which allows configuration and monitoring of the receiver in real time. It offers numerous views for monitoring data and a simple logger for recording data files. RxControl can also be used to upgrade receiver firmware.



SBF Converter is a GUI for converting SBF data files to various other formats including ASCII, RINEX and KML.



SBF Analyzer allows users to generate time plots from SBF files for detailed analysis. It can also create standard reports for reporting purposes.



RxLogger allows flexible logging of SBF and NMEA data. Users can select multiple streams each with a different update rate.



RxPlanner is a Satellite Mission Planning software. It shows the satellite visibility and DOP at the user defined location over a selectable time period.

## H.1 Installing RxTools

You can install the full suite of RxTools by running the RxTools Installer. The Installer file can be found on the memory stick provided with the receiver. The latest version of the Installer is also available for download from the Support section of the Septentrio website: http://www.septentrio.com/support

To run the Installer, double click on the executable file.

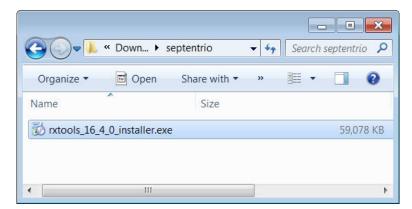


Figure H-1: Install the suite of RxTools by running the Installer file



# I Connecting to the PolaRx5S using RxControl

You can connect to RxControl over a serial, USB or internet connection. If you don't have the RxControl icon on your desktop, type 'RxControl' in the Start menu of your PC to locate the tool as shown in Figure I-1.

rograms (1)		
RxControl		
	 Shut down	

Figure I-1: Type RxControl in the Start menu of your PC

In the 'File' menu, select 'Change Connection...'. In the example shown in Figure I-2, a USB cable was used. The USB connection of the PolaRx5S maps onto two virtual serial connections which are identified as 'USB COM Port 1' and 'USB COM Port 2'. Select one of these connections and give it a name. When connected to a receiver, the various information fields in RxControl will be filled as shown.

TRXControl		0		×		
Eile View Tools Logging Help		-				
			<u></u>			
Manage Connections C	trl+M					
	trl+P					
	trl+C					
	trl+S trl+U					
-	0110					
Show Receiver Configurations Upgrade Receiver using Current Connection						
Exit C	trl+W	RNSS L	L-Band			🔹 usb_polarx5tr.serial - RxControl - S/N 3013369
			1			<u>File View Communication Navigation L-Band Tools Logging Help</u>
G01 G02 G03 G04 G05 G06 G07 G08 G0	9 610 6	G11 G12				📶 🖽 🖬 🕢 🕌 🤾 🝩 🦼 🕶 🔛 🖉 🖾
G13 G14 G15 G16 G17 G18 G19 G20 G2	G22 0	G23 G24				▼ Position Information
G25 G26 G27 G28 G29 G30 G31 G32						Position Velocity
						Geodetic φ: N 50.848639552° σ <sub>N</sub> : +0.362m
						WGS84/ITRS $\lambda$ : E 004.732133625° $\sigma_{E}$ : +0.312m
<ul> <li>Receiver Status</li> </ul>						h: +129.090m σ <sub>υ</sub> : +0.630m
Time RxClock DOP PL RAIM	🕀 Char	nge Conn	ection			▼ Satellite Status
GNSS time frame PDOP: N/A						GPS GLONASS Galileo BeiDou SBAS QZSS IRNSS L-Band
N/A TDOP: N/A	Se	lect C	Conr	necti	<b>4</b>	
N/A HDOP: N/A	0 5	erial Conn	oction:	Crea		G01         G02         G03         G04         G05         G06         G07         G08         G09         G10         G11         G12
offset to UTC N/A VDOP: N/A		CP/IP Con	W/M			G13 G14 G15 G16 G17 G18 G19 G20 G21 G22 G23 G24
SBF      Status      DiffCorr      ExEvent      ExEvent      ExSer		BF File Cor		<u> </u>	thange Connection	G25 G26 G27 G28 G29 G30 G31 G32
Change the connection to the receiver	<u> </u>	BF File Col	nnecuo	I: Selec		
change the connection to the receiver		Vork Offline	e	< Back	Next > Specify the serial settin	Search: 6 0G, 1R, 1E, 0C, 4S, 0J, 0L, 0L Track: 35 12G, 8R, 5E, 6C, 4S, 0J, 0I, 0L
				2	Serial Port: Septentrio Virtual USB COM Port	Sync: 0 0G, 0B, 0E, 0C, 0S, 01, 0L, 0L, PVT: 25 10G, 8B, 3E, 4C, 0S, 01, 0L, 0L
					Advanced Settings	✓ Receiver Status
					A distance Settings	Time RxClock DOP PL RAIM PVT Status
					Connection Name: usb_polarx5tr	GNSS time frame PDOP: 0.87 Mode: EGNOS (S136)
						Wed 16-Nov-2016         TDOP:         0.41         System:         GPS+GLONASS+Galileo+BeiDou
						15:13:32.000 HDOP: 0.50 Info: LC+FC+I
					Work Offline < <u>B</u> ack Next >	+17s offset to UTC VDOP: 0.71 Corr Age: 1.60s
						🖷 🕏 SBF 🐵 Status 👁 DiffCorr 🐵 ExEvent 👁 ExSensor 🛛 🔛 🍰 🕀 😩
						SSRC7 - PolaRx5TR - SEP

Figure I-2: Connecting to the PolaRx5S over a USB connection using RxControl



