Datasheet & Technical Description

Orcam GPS25 - GPS receiver module without integrated LNA

Orcam GPS26 - GPS receiver module with integrated LNA

Data Sheet

Version 1.0
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Orcam Systems AB
Linbanegatan 10, P.O. Box 833, SE-745 26 Enköping, Sweden.
Phone: +46 – 171 447 420, email: orcam-gps@orcam.eu
www.orcam.eu

Orcam Systems AB
Linbanegatan 10, P.O. Box 833, SE-745 26 Enköping, Sweden.
Phone: +46 – 171 447 420, email: orcam-gps@orcam.eu
www.orcam.eu

1. Introduction

1.1. Overview

The Orcam GPS25 & GPS26 GPS-receivers are based on the SiRF GSC2x chip and designed to fit the needs of today's GPS-market. The GPS25 is designed for use with an active GPS antenna, while the GPS26 features an on-board LNA, supporting designs using passive or active GPS antennas.

The compact size (25,4*22,86*3mm), on-board power regulation and FLASH-memory used to store software, provide the user the flexibility to adopt the receiver to fit most applications.

The receiver has no RF-connector, which makes it a true SMD-module that can be soldered with standard pick-and-place equipment.

The receiver supports WAAS (*1), EGNOS (*1) and DGPS (*2) functionality as a standard and is compatible with SiRFXtrac, and prepared for SiRFDRive and SiRFLoc software.

1.2 Main features

- SiRF GSC2x chipset
- Low power consumption
- 12 channel GPS-receiver
- On board LNA (GPS26) supports designs using passive antenna
- Standard WAAS, EGNOS and D-GPS support
- Integrated ARM7TDMI CPU available for embedded customer defined applications
- 4Mbit FLASH memory as standard
- 1Mbit SRAM on chip
- Two TTL level serial ports
- NMEA or SiRF binary protocol (user changeable by software command)
- Accurate 1PPS Signal
- GPS25X and GPS26X uses SiRFXtrac High Sensitivity Software
- Supports SiRFDRive (Dead Reckoning software) and SiRFLoc (A-GPS)

(*1) WAAS (Wide Area Augmentation System (USA)) and EGNOS (European Geostationary Navigation Overlay System) are Differential GPS, Satellite-Based Augmentation Systems designed to fulfil the needs of Civil Aviation Navigation. WAAS and EGNOS improve the accuracy of the GPS-receiver.

(*2) DGPS, Differential GPS is a technique to improve GPS accuracy that uses pseudorange errors recorded at known locations to improve the accuracy of other GPS receivers in the same geographical area.

The Orcam GPS25 and GPS26 supports DGPS protocol RTCM SC-104

2. Technical Specifications

2.1. Electrical specification

2.1.1. General

Frequency	L1, 1575,42 MHZ
C/A code	1.023 MHz chip rate
Channels	12

2.1.2. Accuracy (Open sky)

Position	~5 meters, 95% of the time <2m, DGPS on

2.1.3. Datum

Default	WGS-84

2.1.4. Acquisition Rate (Open sky, receiver stationary)

Cold Start	45 s (typical)
Warm Start	38 s (typical)
Snap Start (Push to Fix)	2-8 s (typical)
Reacquisition	0,1 s (typical)

2.1.5. Dynamic conditions

Altitude	18 000 meters (60 000 feet) max.
Velocity	545 meters/second (1000 knots) max.
Acceleration	Tracking up to 4g

2.1.6. Power

Main power input	3,0 - 5,5VDC
Supply current	GPS25S: 25 mA typ (continuous mode) GPS25X: 30 mA typ (continuous mode) GPS26S: 35 mA typ (continuous mode) GPS26X: 40 mA typ (continuous mode)
Antenna	Active or passive antenna support (3V). External power can be feed into to the module to support any active antenna voltage (pin 19, max 25V)

2.1.7. Serial Port A

Electrical interface	3V CMOS/TTL level serial ports
Default protocol message	NMEA-0183 or SiRF binary
Default NMEA messages	GGA, GSA, RMC, ZDA (1 s), GSV (5 s)

2.1.8. Serial Port B

Electrical interface	3V CMOS/TTL level serial ports
Default protocol Message	DGPS RTCM SC-104

2.1.9. Time Pulse – 1PPS

Level	CMOS
Time reference	At the pulse positive edge
Measurements	Aligned to GPS second, ±1 microsecond

NOTE! Not supported in GPS25X and GPS26X (SiRFXtrac versions**)**

2.2. Environmental Specifications

Operating temperature	-40…+85 ºC
Storage temperature	-55…+100 ºC

2.3. GPS25S and GPS26S Power modes (Standard software)

2.3.1. Full Power (default power mode)

The receiver is working at full power. It makes 10 measurements per second and reports one fix per second based on those measurements.

Power consumption in Full Power is from 25 – 40 mA depending on version (see 2.1.6. above).

2.3.2. Low Power modes

There are two modes of low-power operation, TricklePower and Push-to-Fix. In the TricklePower mode the power to the cycled periodically and a position is sent at customer specified intervals.

In Push-To-Fix mode the receiver is generally off, but turns on at regular intervals to collect ephemeris and maintain real-time clock so that, upon user request, a position fix can be obtained quickly after power-up.

2.3.3. TricklePower

In this mode the receiver is working in three different states. It is cycling the power between the CPU and the RF front end. The states are:

- **Tracking State (Measurement)**

  In this state, the receiver is running on full power and tracking satellites.

- **CPU State (Navigation computation)**

  In this state, the RF front end LNA and the GSC2x DSP clock are turned off but the RTC is kept running. The CPU processes the GPS data, until a position fix is determined and the result has been transmitted over the serial port.

- **Trickle State**

  In this state, the CPU is in standby mode and the RF front end is turned off. Only the RTC is on. After a pre-defined time, the CPU wakes up and the receiver goes into tracking state.

2.3.4. Adaptive Trickle Power

Adaptive Trickle Power is an intelligent power saving mode that automatically switches between TricklePower mode and Full Power mode. In difficult navigation environments the receiver will switch to Full Power mode until normal navigation conditions (4 or more satellite signals with C/No of 36 dB or higher) has been restored, then it will return to TricklePower mode.

By using Adaptive Trickle Power the power consumption can be reduced by half for no noticeable loss of accuracy.

2.3.5. Push-to-Fix

The purpose of this mode is to support applications where a position fix is only needed upon request. The receiver is left in Trickle state until commanded to generate a fix. In a background operation, the receiver will go to the power-on state automatically and regularly to refresh the satellite ephemeris information.

Push to fix mode (cont.)

- **Power-on State**
  In this state, the receiver calculates the position once, collects the ephemeris if necessary and re-calibrates the RTC before going back to Trickle State.
- **Trickle State**
  In this state only the RTC is running. The receiver draws less than 900µA including the standby current of the CPU.
  There are three events that will turn the CPU to normal operation:
  1. Power-on: If the main power is switched off and then on again, the CPU supervisor generates a reset signal. Afterwards the CPU will turn to normal operation, get a fix and return to Trickle State. This takes about 2-6 seconds.
  2. Ephemeris Download: Every 30 minutes the CPU goes into normal operation, calculates a fix, updates the ephemeris data, calibrates the RTC and then go back to Trickle State.
  3. Push to Fix: To wake up the CPU, toggle RSET low (Pin 22). The CPU is restarted and a fix in calculated. Before going back to the Trickle State, if needed the CPU will update the ephemeris data and calibrate the RTC.

2.4. GPS25X & GPS26X Power modes (SiRFXTrac enhanced sensitivity s/w)

In addition to Adaptive TricklePower mode (ATP) and Push-To-Fix mode, described in 2.3.4. and 2.3.5. above, GPS25X and GPS26X with SiRFXTrac version 2.1 supports a form of software power management called Advanced Power Management (APM). The APM provides the user full control over a number of parameters determining the operation of the receiver and the resulting power consumption. The user-defined parameters for the APM are usually transmitter from an external monitoring system (host computer) but can also be downloaded as default values into FLASH.

Available signal strength will affect the behavior of APM as APM will keep the receiver operating in full power until a position fix is possible before shutting down to conserve power. The lower the signals available, the longer the receiver must remain on to obtain a position fix.

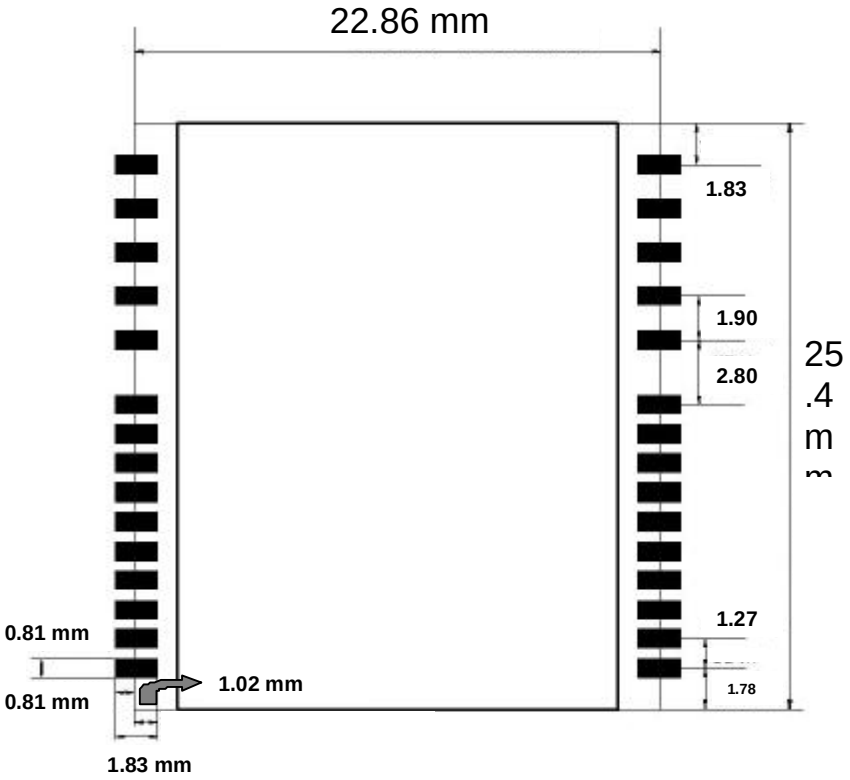
If power consumption (or duty cycle) is priority, the receiver will monitor the on-time and then set subsequent off-times to maintain the designated duty cycle. In changing signal environments, variable time between fixes can be expected.

If time between fixes is of priority, the receiver will maintain the expected time between fixes without maintaining duty cycle. In low signal environments, this may result in the receiver staying in full power to maintain time between fixes.

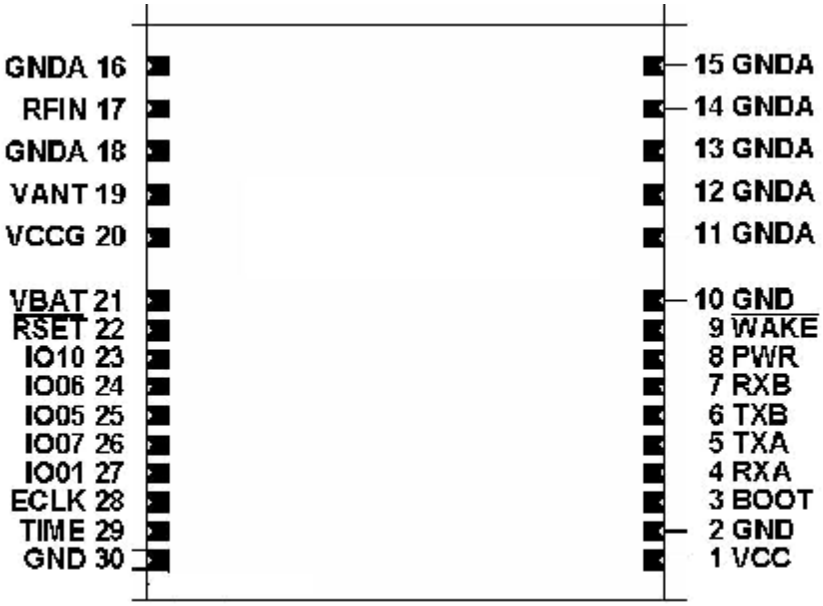
All Power modes are selected by software commands sent to the receiver using SiRF Binary protocol. For a stand-alone operation these software commands needs to be included in the software stored in FLASH.
For more information and a full description of the different power modes please see the following SiRF application notes: APM Modes, Xtrac Reference Manual, GSW2x Software SDK Reference Manual, SiRF Binary Protocol Reference Manual

3. Mechanical specifications and recommended pad layout

3.1. Recommended pad layout



3.2. **Pad assignments** (Pin out)



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4. Signal interface description

Pin out

Pin	Name	I/O	Description	Remarks
1	VCC	I	Supply voltage 3,0 - 5,5V	
2	GND	I	Digital Ground	
3	BOOT	I	Boot mode	Leave open if not used (normal operation) Module boots in debug mode if high during reset
4	RxA	I	Serial port A	Pull up if not used
5	TxA	O	Serial port A	Leave open if not used
6	TxB	O	Serial port B	Leave open if not used
7	RxB	I	Serial port B	Pull up if not used
8	PWR	I	GPS Power on	0 = GPS Power Off, 1 = GPS Power On
9	WAKE	O	Wakeup alarm*	Leave open if not used
10	GND	I	Digital Ground	
11	GNDA	I	Analog Ground	
12	GNDA	I	Analog Ground	
13	GNDA	I	Analog Ground	
14	GNDA	I	Analog Ground	
15	GNDA	I	Analog Ground	
16	GNDA	I	Analog Ground	
17	RFIN	I	GPS Signal input	50 Ohms @ 1575MHz, apply no DC through this pin
18	GNDA	I	Analog Ground	
19	VANT	I	Antenna Bias voltage	Leave unconnected if not used
20	VCCG	O	Output Voltage RF section	May be connected to VANT
21	VBAT	I	Backup voltage supply (2,5-5,5V)	Not to exceed VCC – 0,3 V. Connect to GND if not used
22	RSET	I	Reset (Active Low)	Leave open if not used
23	IO10	I	External interrupt	
24	IO6	I/O	General purpose I/O*	Synchronous serial interface, SPI Out
25	IO5	I/O	General purpose I/O*	Synchronous serial interface, SPI In
26	IO7	I/O	General purpose I/O*	Synchronous serial interface, SPI Clock
27	IO1	I	General purpose I/O*	
28	ECLK	I	External Clock source for GPS	
29	TIME	O	One pulse per second	Leave open if not used
30	GND	I	Digital Ground	

*Contact your local distributor for more information about this function

* Needed to run SiRFDRive

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4.1. Boot (Pin 3)

When powering up the Orcam GPS26 with a reset signal, the boot signal forces the module into a Flash-programming mode.

4.2. Serial interface (Pin 4-7)

The Orcam GPS26 has two serial ports. The serial interface signals (Port A: Pin 4&5; Port B: Pin 6&7) operate on 3,0V CMOS and 3,0V TTL compatible levels.

4.3. PWR (Pin 8)

The Orcam GPS26 can be switched on and off with an external signal. When PWR is pulled low, everything but the battery backup is switched off. The current consumption is 20µA in off-mode. Connect to VCC (Pin 1) if not used. Vlow should be between 0 - 0,6V. Vhigh is active between 1,5 - 5,5V. **Note that PWR should never exceed VCC more than 0,3V.**

4.4. RFIN (Pin 17)

The Orcam GPS26 has no RF-connector, the RF-input signal can be routed directly to pin 17. The track has to be a 50 Ω microstrip.

4.5. VANT (Pin19)

External power can be feed into the Orcam GPS26 to support any antenna voltage. **Note that input voltage shall never exceed 25V.**

4.6. VCCG (Pin20)

Connect VCCG and VANT to feed internal 3V into the active antenna on RFIN. Leave open if external power is feed into VANT. When using any power saving modes, the power to the antenna will be switched off whenever the RF front end is switched off.

4.7. VBAT (Pin 21)

Battery backup. Any voltage between 2,5 – 5,5V can be used, but shall not exceed VCC – 0,3V. As long as VBAT < VCC – 0,3V, there is no current drawn. In battery back-up mode, the current consumption of the battery backup is 20µA.

4.8. RSET (Pin 22)

By pulling down RSET for at least 1 µs, the Orcam GPS26 can be reset externally. RSET is also needed in Push-to-Fix mode to wake up the module, when a position is needed.

4.9. TIME (Pin 29) – GPS25S and GPS26S only

The 1 PPS signal is 3,0V CMOS output.

4.10. GND & GNDA

GND and GNDA are separate ground planes and must be connected together in one point near pins 11-16 (GNDA) and 2 (GND).

Pins 10 and 30 can be left unconnected or connected to GND plane.

4.11. GPIO Pins (Pin 24 – 27)

Orcam GPS25 & 26 provides 4 General Purpose I/O connections. The functions of these GPIO pins are configured by software and can be tailored by the customer for the specific application. As default the pins are configured as follows:

Pin 24: Synchronous Serial interface, SPI Out
Pin 25: Synchronous Serial interface, SPI In
Pin 26: Synchronous Serial interface, SPI Clock
Pin 27: General Purpose I/O

5. Antenna Considerations

The Orcam GPS25 is designed to be used together with an active antenna, providing 16 - 27 dB of gain, while the GPS26 has an on-board LNA and can accept both passive and active antennas.

Selecting an antenna is a trade off between performance, space available and cost and depends on the actual application.

Care should be taken to ensure that the antenna selected provides enough gain to allow the GPS receiver to operate with C/N_0 values of ~ 47 dB-Hz under good conditions (open sky).

If the C/N_0 value exceeds 50 dB-Hz, the risk for cross correlation increases which may cause increasing TTFF.

If the gain is too low, the receiver's performance in weak signal conditions deteriorates.

It is recommended that SiRF Demo be used to verify the C/N_0 values seen under different conditions.

6. Enabling Differential GPS (DGPS) and SBAS (WAAS/EGNOS) Corrections

The Orcam GPS25 and GPS26 supports Differential GPS operation, either in the form of DGPS corrections in RTCM SC-104 format on Serial Port B or by using SBAS correction messages transmitted by WAAS/EGNOS Satellites.

DGPS systems are designed to improve the accuracy of the GPS-receiver by reducing the positional error arising from changing atmospheric conditions, by constantly measuring the position error in a number own known location and transmitting correction data. DGPS systems can be either ground- or Satellite-based.

There are currently two SBAS (Satellite Based Augmentation System) systems available:

WAAS (Wide Area Augmentation System), and

EGNOS (European Geostationary Navigation Overlay System).

When SBAS Corrections are enabled in the GPS25 and GPS26, one channel (Ch 12) in the receiver is reserved for monitoring and receiving the correction signals transmitted by the SBAS satellites.

To enable DGPS mode three SiRF Binary Control Messages are used.

MID_DGPSSourceControl - selects the source for differential correction, SBAS or RTCM
MIDDGPSSetSbasParam – sets the SBAS parameters to be used for corrections
MID_DGPSStatus – is a status message reporting if the DGPS settings in the receiver are changed

For a full description of these commands, please see the SiRF Binary Protocol Reference Manual.

7. Software

7.1. SiRF GSW2x

GSW2x is the Standard Sensitivity Software supplied with GPS25Sxx and GPS26Sxx.

7.2. SiRFXtrac

SiRFXTrac is SiRF's high sensitivity GPS software solution supplied with GPS25Xxx and GPS26Xxx that dramatically extends the operating range in which GPS can be used. The SiRFXTrac high sensitivity software enables the Orcam GPS25X & GPS26X to acquire, and continue tracking GPS signals at far lower signal levels than is currently possible with other autonomous GPS solutions. SiRFXTrac will do a cold start at C/N_0 = 32dB-Hz, warm start at C/N_0 = 28dB-Hz, hot start at C/N_0 = 23dB-Hz, and continue tracking down to C/N_0 = 16dB-Hz. This means that GPS can now be used in environments previously deemed inaccessible - environments such as severe urban canyons, parking garages, dense foliage, multi-level freeways, under bridges and overpasses, and, in many cases, indoors.
By expanding the number of areas in which GPS can get a position fix, SiRFXTrac will improve existing location-based applications and enable new ones that have been impractical until now.

7.3. *SiRFDRive* (available as customer specific software development)

SiRFDRive is a closely coupled Dead Reckoning option. This option allows the navigation system to accept inputs from low cost heading rate sensors and vehicle speed wheel ticks in order to compute dead-reckoning positions when GPS signals are blocked or degraded. Unlike most dead reckoning systems that function independently from the GPS, the SiRF DR scheme incorporates dead-reckoning information into the main navigation filter in a patented closely coupled manner to take advantage of all available measurements at all time. It will therefore maximize accuracy in all cases. Orcam GPS26 supports this feature via its standard pin-out and with the addition of an ADC, and a signal conditioning circuit on the wheel pulse input.

7.4. *SiRFLoc* (available as customer specific software development)

SiRFLoc is a wireless standard based, Aided-GPS (A-GPS) Location Service solution. SiRFLoc architecture is optimized for wireless environments to enable enhanced sensitivity and fast TTFF in wireless handsets.

7.5. SiRF Demo

The Orcam GPS25 & GPS26 GPS-module can be tested using SiRFdemo software. With this SW all parameters can be either real-time monitored or downloaded into a

log file on a computer and analysed later. There is also available an Evaluation Kit for the Orcam GPS25 & GPS26.

For more information see: *Evaluation Kit Manual and Sirfdemo Software*

8. Ordering information

The different versions of Orcam GPS25 and GPS26 GPS-module are described below

Part number description of Orcam2x

GPS	**2**	**x**	**S**	**A**	**x**	**-**	**TR100**
	Generation	**Model**	**Model version**	**Interface**	**Revision**		**Package**
		5 = No LNA	**S = Standard**	**A = NMEA 4800bps**			**SMPL5**
		6 = LNA	**X = Xtrac**	**B = NMEA 9600bps**			**TR100**
			By special agreement	**J = SiRF Binary 38400bps**			**TR500**
			D = SiRFDrive				
	Available versions:		*L = SiRFLoc*				

Crystal

GPS2xSAx	*GPS2xDAx*	*Special order only*
GPS2xSBx	*GPS2xDBx*	*Special order only*
GPS2xSJx	*GPS2xDJx*	*Special order only*

TCXO

GPS2xXAx	*GPS2xLAx*	*Special order only*
GPS2xXBx	*GPS2xLBx*	*Special order only*
GPS2xXJx	*GPS2xLJx*	*Special order only*

SMPL5= Package of 5 modules
TR100= Tape and reel 100pcs per reel, 13" reel, 44mm tape
TR500= Tape and reel 500pcs per reel, 13" reel, 44mm tape

Part number description of the Evaluation Kit for Orcam2x

GPS	**2**	**x**	**x**	**EVAL**
	Generation	**Model**	**Software version**	**Interface**
		5 = No LNA	**S = Standard**	**Default NMEA 9600bps**
		6 = LNA	**X = Xtrac**	

Available versions:

Crystal

GPS2xSEVAL

TCXO

GPS2xXEVAL

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9. Related documents

Application Notes	Description
Antenna Open & Short Detector	This application note will discuss a monitoring circuit that detects an open or a short circuit at the antenna of the GPS receiver.
APM Modes	Describes how to set Advanced Power Management. APM is only supported in SiRFXtrac-versions.
DGPS	Describers the DGPS functionalities of the Orcam GPS2x. This feature is not available in SiRFXtrac.
Handling and Soldering	This application note describes recommendations for the processing and handling of the Orcam GPS receiver modules.
Low Power Modes	Describes the different Low Power Modes of the Orcam GPS modules.
NMEA Reference Manual	The NMEA Reference Manual provides details of NMEA messages developed and defined by SiRF. It does not provide information about the complete NMEA-0183 interface standard.
SiRF Binary Reference Manual	Describes detailed information about the SiRF Binary protocol - the standard protocol used by all SiRF architectures.
SiRFdemo Map	Describes the Map functionality of SiRFdemo Software
User's Manuals	**Description**
SiRFdemo Software Manual	Describes how to use SiRFdemo software. The SiRFdemo software is provided to simplify real-time monitoring of the Evaluation Receiver, configuration of the Evaluation Receiver, and efficient logging of data in the field for further analysis.
Evaluation Kit Manual	Describes how to use the Orcam GPS26 Evaluation Kit

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