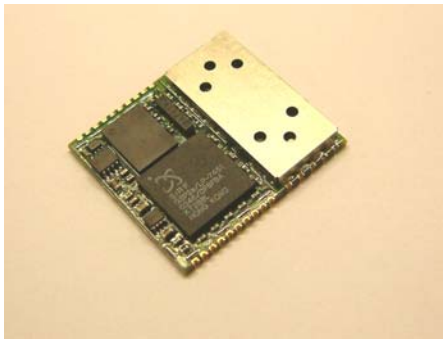
Orcam21

GPS receiver module with integrated LNA



Data Sheet

Version 1.2
January 2005

Preliminary

1. Introduction

1.1. Overview

The Orcam21 GPS-receiver is designed to fit the needs of today's GPS-market. The compact size (25,4*22,86*3mm) and its flexibility to suit various applications makes it a one of a kind in the market. 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 is based on the SiRFStarII/LP chipset.

The receiver supports WAAS, EGNOS and DGPS functionality as a standard and will be compatible with SiRF's software versions SiRFXtrac, SiRFDRive and SiRFLoc.

It is fair to say that the Orcam21 is a GPS-module that fits all GPS needs.

1.2 Main features

- Built in SiRFStarII/LP chipset
- Low power consumption
- 12 channel GPS-receiver
- 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
- Supports both NMEA and SiRF binary protocol
- Supports accurate 1PPS Signal
- Supports SiRF's High Sensitivity Software called SiRFXtrac (requires a TCXO which replaces the standard Crystal)
- Supports SiRFDRive (Dead Reckoning software) and SiRFLoc (A-GPS)

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	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	3,15 - 5,5VDC
Supply current	70mA (peak power)
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

Electrical interface	Two TTL level serial ports
Protocol message	NMEA-0183 and SiRF binary
DGPS protocol	RTCM SC-104

2.1.8. Time Pulse – 1PPS

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

NOTE! Not supported in SiRFXtrac versions

2.2. Environmental Specifications

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

2.3. Power modes (Standard software)

2.3.1. Full Power

The receiver is working at full power. In this mode it draws about 68mA (70mA peak). It makes 10 measurements per second and giving out one fix per second based on those measurements.

2.3.2. Trickle Power

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:

2.3.2.1.Tracking State

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

2.3.2.2.CPU State

In this state, the RF front end has been turned off, which removes the clock to the baseband. Without a clock, the RF front end is effectively powered down (although the RTC keeps running). The CPU processes the GPS data, until a position fix is determined and the result has been transmitted over the serial port.

2.3.2.3.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.

2.3.3. Adaptive Trickle Power

Adaptive Trickle Power is an intelligent power saving mode that automatically switches between Trickle Power and Full Power: In foliage environments the receiver will run on Full Power mode and in open environments it will run on Trickle Power. By using Adaptive Trickle Power the power consumption can be reduced by half for no noticeable loss of accuracy.

2.3.4. 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.

2.3.4.1.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.

2.3.4.2. Trickle State

In this state only the RTC is running. The receiver draws less than 300µA 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, a reset signal is generated by the CPU supervisor. 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. Power modes (SiRFXTrac)

SiRFXTrac version 2.0 supports a form of software power management called Advanced Power Management (APM). To support APM within SiRFXTrac version 2, a new version of SiRFdemo has been made available - SiRFdemo version 3.61

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.

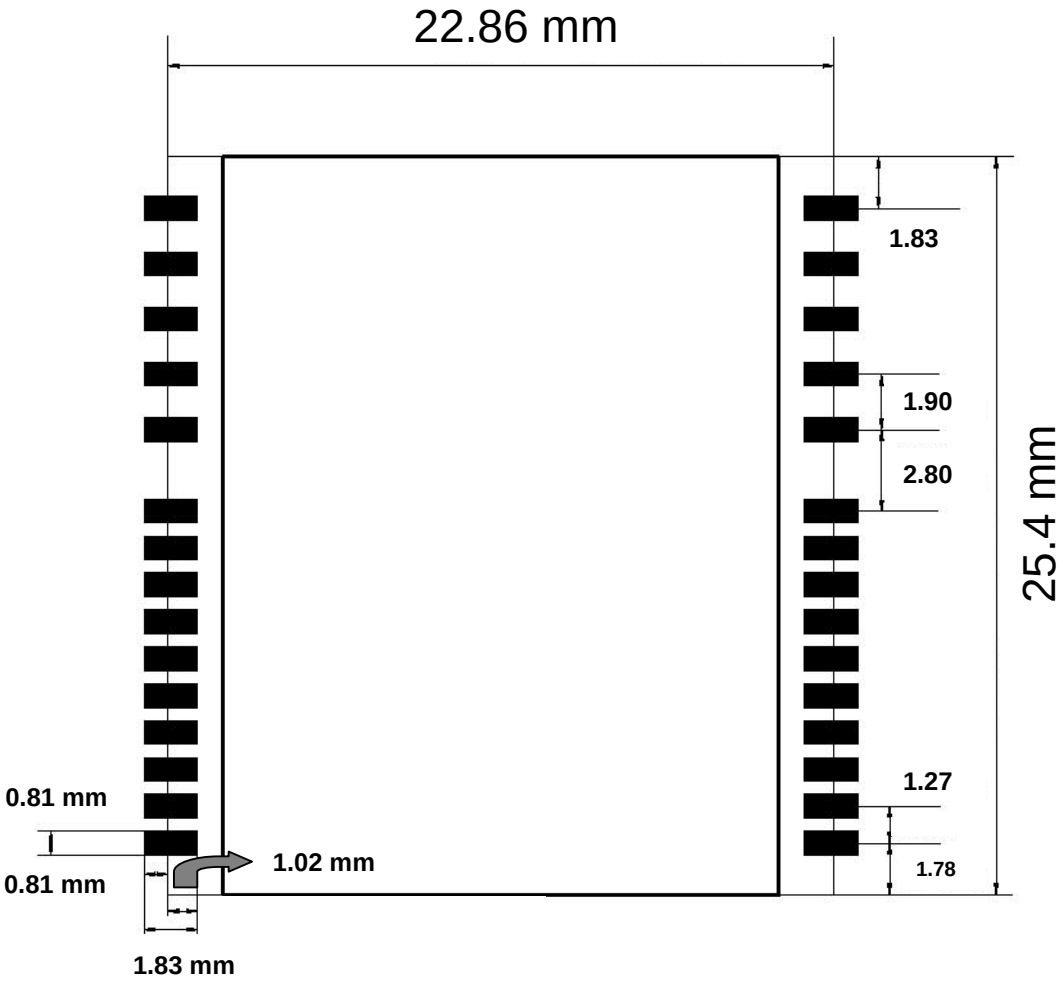
If power consumption (or duty cycle) is priority, the receiver will monitor the on-time and then set subsequent off-times to maintain the designated duty cycle. In changing signal environments, variable time between fixes can be expected.

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.

For more information please see application note: APM Modes

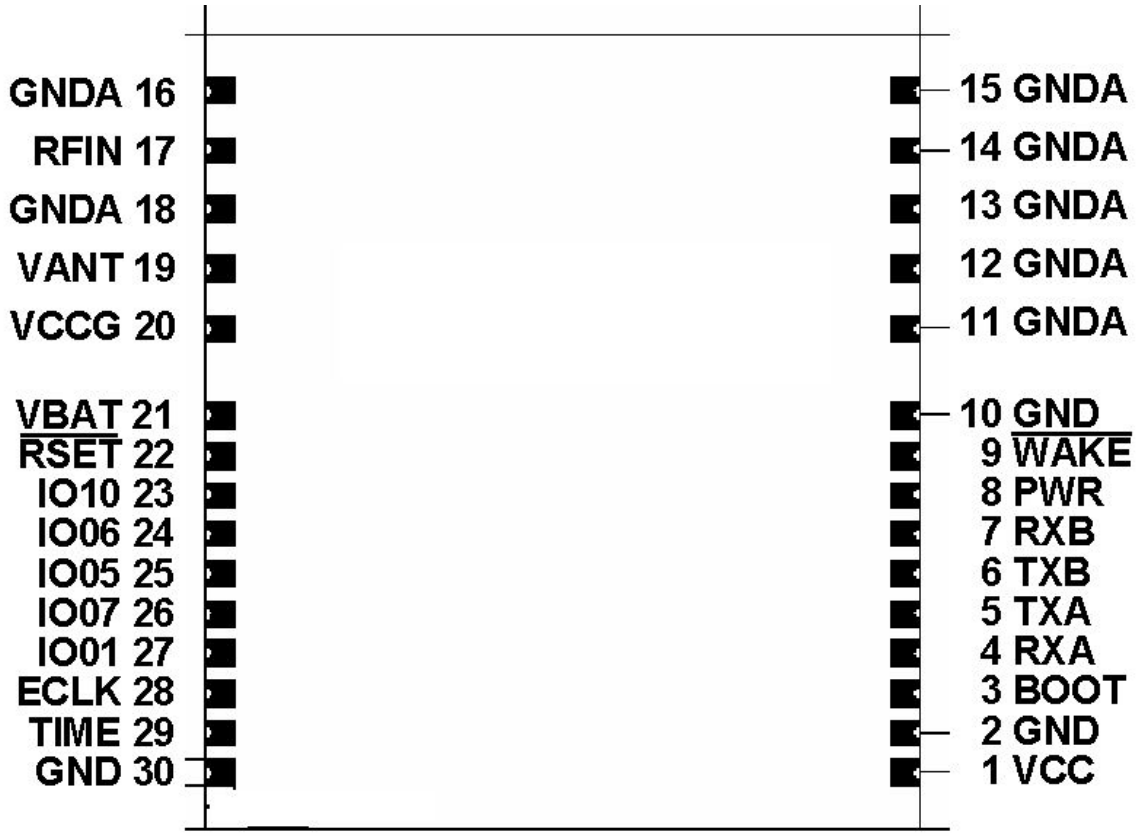
2.5. Mechanical specifications and recommended pad layout

The size of Orcam21: 25,4*22,86*3mm



3. Pin out

3.1. Pin layout



3.2. Description of pin outs:

Pin out

Pin	Name	I/O	Description	Remarks
1	VCC	I	Supply voltage 3,15 - 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)	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

3.3. Boot (Pin 3)

When powering up the Orcam21 with a reset signal, the boot signal forces the module into a Flash programming mode.

3.4. Serial interface (Pin 4-7)

The Orcam21 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.

3.5. PWR (Pin 8)

The Orcam21 can be switched on and off with an external signal. 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.**

3.6. RFIN (Pin 17)

The Orcam21 has no RF-connector, the RF-input signal can be routed directly to pin 17. The track has to be a 50 Ω microstrip.

3.7. VANT (Pin19)

External power can be feed into the Orcam21 to support any antenna voltage. **Note that input voltage shall never exceed 25V.**

3.8. 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.

3.9. VBAT (Pin 21)

Battery backup. Any voltage between 2,5 – 5,5V can be used. The current consumption of the battery backup is 20µA.

3.10. RSET (Pin 22)

By pulling down RSET for at least 1 µs, the Orcam21 can be reset externally. RSET is also needed in Push-to-Fix mode to wake up the module, when a position is needed.

3.11. TIME (Pin 29)

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

3.12. 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. Applications

The Orcam21 is high performance, easy to integrate, low power, low cost GPS-receiver. Its form factor makes it easy to implement into any application. Below are some samples of applications:

- Fleet Management
- Car Navigation
- Marine Navigation
- PDA's and Pocket PC's
- AVL and Location Based Services
- People/Animal Tracking

4.1.1. SiRFXtrac

SiRFXTrac is SiRF's high sensitivity GPS software solution. It dramatically extends the operating range in which GPS can be used. The SiRFXTrac high sensitivity software enables the Orcam21 to acquire, and continue tracking GPS signals at far lower signal levels than is currently possible with other autonomous GPS solutions. 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.

4.1.2. SiRFDRive

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. This feature is supported by Orcam21 via its standard pin-out and with the addition of an ADC, and a signal conditioning circuit on the wheel pulse input.

4.1.3. SiRFLoc

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.

4.1.4. WAAS/EGNOS

WAAS (Wide Area Augmentation System (USA)) and EGNOS (European Geostationary Navigation Overlay System) is a Differential GPS, Ground-Based Augmentation System designed to fulfill the needs of Civil Aviation Navigation. WAAS and EGNOS improves the accuracy of the GPS-receiver.

4.1.5. DGPS

The Orcam21 GPS-module supports DGPS protocol RTCM SC-104

5. Operation and test

The Orcam21 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 Orcam21. For more information see: *Evaluation Kit Manual*

5.1. SiRFdemo

See application note: Sirfdemo Software

6. Ordering information

The different versions of Orcam21 GPS-module are described below

6.1. Standard SW – Orcam21S

The standard version is based on SiRF's latest SW.

6.2. Enhanced Sensitivity – Orcam21E

The Enhance Sensitivity Increases low signal level reception at the cost of TTFF and strong signal reception. E version is based on SiRF's latest SW, ES_LOW.

6.3. SiRFXtrac – Orcam21X

This High Sensitivity version requires a Temperature Controlled Crystal Oscillator (TCXO). SiRFXTrac will do a cold start at 32dB-Hz, warm start at 28dB-Hz, hot start at 23dB-Hz, and continue tracking down to 16dB-Hz. This version is based on SiRF's latest revison of SiRFXtrac.

6.4. SiRFDRive – Orcam21D

This version requires SW development and should always be treated on a case-by-case basis. The standard module can be used running specialized SiRFDRive software from SiRF. Only and external ADC needs to be added.

6.5. SiRFLoc – Orcam21L

This version requires SW and system development and should always be treated on a case-by-case basis. This version requires a TCXO and will run the specialized SiRFLoc Lite software from SiRF. SiRF's server software can also be made available.

Part number description of Orcam2x

GPS	2	x	S	A	x	-	TR100
	Generation	Model	Model version	Interface	Revision		Package
		0 = No LNA	S = Standard	A = NMEA 4800bps			SMPL5
		1 = LNA	E = Enhanced Sensitivity	B = NMEA 9600bps			TR100
			X = Xtrac	J = SiRF Binary 38400bps			TR500
			D = SiRFDrive				
	Available versions:		L = SiRFLoc				

Crystal

GPS2xSAx	GPS2xEAx	GPS2xDAx
GPS2xSBx	GPS2xEBx	GPS2xDBx
GPS2xSJx	GPS2xEJx	GPS2xDJx

TCXO

GPS2xXAx	GPS2xLAx
GPS2xXBx	GPS2xLBx
GPS2xXJx	GPS2xLJx

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 desciption of the Evaluation Kit for Orcam2x

GPS	2	x	S	EVAL
	Generation	Model	Model version	Interface
		0 = No LNA	X = Xtrac	Default NMEA 9600bps
		1 = LNA		
	Available versions:			

Crystal

GPS2xSEVAL

TCXO

GPS2xXEVAL

7. 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 Orcam21. This feature is not available in SiRFXtrac.
Handling and Soldering	This application note describes recommendations for the processing and handling of the Orcam21 GPS receiver modules.
Low Power Modes	Describes the different Low Power Modes of the Orcam21. This feature is not available in SiRFXtrac.
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 use the Orcam21 Evaluation Kit

8. Components used on board the Orcam21

www.actcrystals.com

www.analogictech.com

www.sirf.com

www.taitien.com

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