![u-blox logo]

TIM-4H
ANTARIS® 4 Programmable
GPS Module with SuperSense®

Data Sheet

PRELIMINARY

Abstract

Technical description of the high sensitivity ANTARIS 4 GPS Module with SuperSense Indoor GPS in the industry standard form factor for use with passive and active antennas.

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Data Sheet

Title	TIM-4H	
Subtitle	ANTARIS® 4 Programmable GPS Module with SuperSense®	
Doc Type	Data Sheet	PRELIMINARY
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Revision Index	Date	Name	Status / Comments
P1	22. Sept 2005	GzB	Preliminary release
P2	31. Sept 2005	GzB	Disclaimer, section 1.3 and 4.2 (clarified power consumption)
P3	21. Dec 2005	GzB	Modified: Sections 1.3, 2, 3.3 (RESET_N), 4.2 (Vant)
P4	03. Feb 2006	GzB	Modified Section 1.3 and Table 4 (4 Hz update rate), Section 1.7, 6.2
P5	11. May 2006	GzB	Modified: Section 1.3, Table 3, Table 4 (Acquisition) Table 8, Table 9

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Data Sheet Revisions	Identification of applicable hardware	Comments
P1 … P5	All data codes	

Semiconductor technology provided by ATMEL.

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Contents

1 Functional Description

1.1 Overview

The TIM-4H module combines high sensitivity with exceptionally low power consumption. The -158 dBm tracking sensitivity extends positioning coverage into places where GPS was not possible before, and enables solutions using smaller or covert antennas.

The successor to the TIM-LH module also shares the TIM-LH's 25.4 x 25.4 x 3 mm industry standard form factor initially created by u-blox. A 35% reduction in power consumption means extended battery time for portable, handheld devices. Finally, its small form factor and SMT pads are designed for fully automatic assembly processes with standard pick-and-place equipment and reflow soldering, enabling cost-efficient, high-volume production.

1.2 Block Diagram
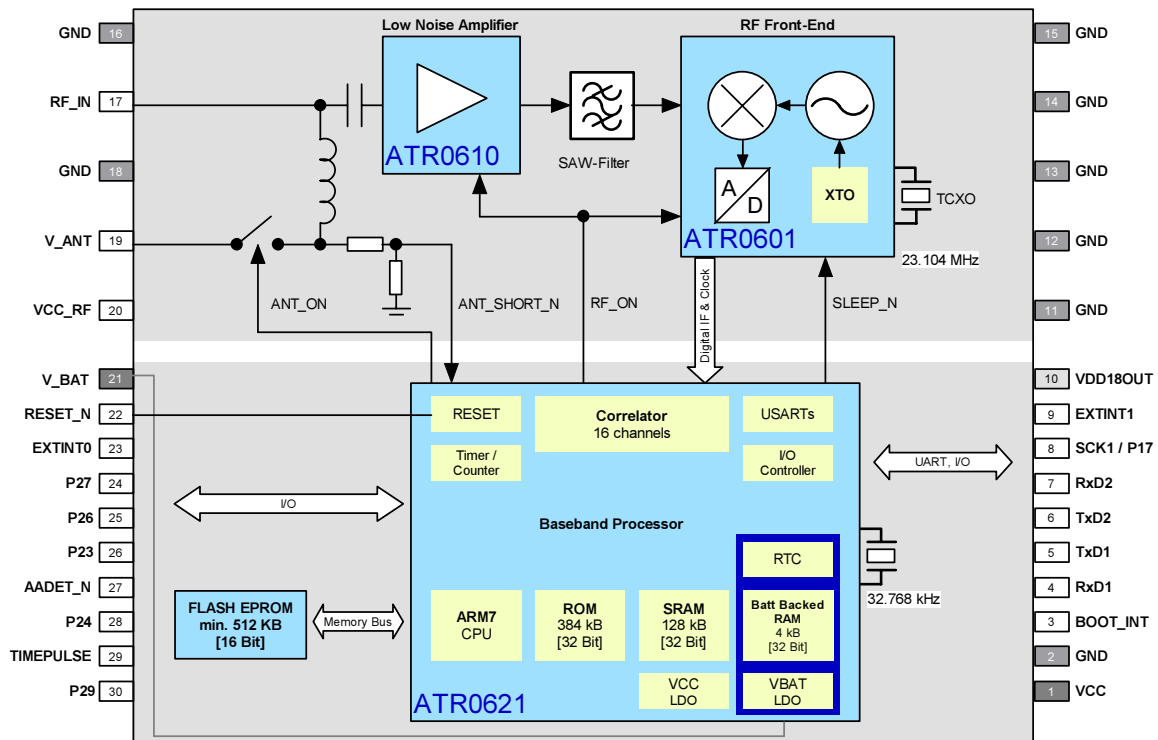
Figure 1: Block Diagram

1.3 Highlights

- **SuperSense® Indoor GPS**
- **Ultra low power consumption**
- **A-GPS and Autonomous GPS operation, AssistNow™ ready**
- **Flash EPROM: programmable and configurable**
- **4 Hz position update rate**
- **2 UART ports**

1.4 Features

- 16 channel ANTARIS 4 positioning engine
- Supports DGPS, WAAS, EGNOS and MSAS
- Power saving modes
- 5 µA backup current
- Supports passive and active antennas
- Antenna short and open circuit detection and protection
- Power brown-out protection: No external reset hardware needed
- Operating temperature range: –40 to 85°C
- RoHS compliant (lead-free)

1.8 Available Programming Resources (Preliminary Info)

Dedicated product variants of this GPS module are planned for use with customized software created with the ASK-4Q (ANTARIS 4 Software Customization Kit). Please contact u-blox for details.

Resources		Characteristics
Processor	ARM7TDMI running at 23 MHz	3.75 - 9 MIPS [1] @ 1 Hz navigation update rate
Memory	Flash EPROM	Min 512 K Bytes (physical memory size for all code)
	SRAM	8 K Bytes
Interfaces	USARTs, synchronous and asynchronous operation	2 interfaces, 3 V levels, 5V tolerant
Digital I/Os	7 GPIOs	3 V levels, 5V tolerant
	2 interrupt-capable GPIOs	3 V levels, 5V tolerant (EXTINT0, EXTINT1)

Table 3: Available Programming Resources

1.9 Antenna

This GPS receiver is designed for use with passive and active antennas. An antenna supervisor is provided. If activated, the GPS receiver is capable of detecting short circuits to the active antenna by checking the bias voltage level and can shut down the voltage bias immediately. A series resistor is needed in front of the **V_ANT** input. UBX and NMEA messages are provided to report the condition of the antenna supply. Open circuit detection can also be supported with an additional external circuit. For details, please refer to the *System Integration Manual for ANTARIS 4* [1].

Parameter	Specification	
Antenna Type		Passive and active antenna
Active Antenna Recommendations	Minimum gain	15 - 20 dB (to compensate signal loss in RF cable)
	Maximum noise figure	1.5 dB
	Maximum gain	50 dB
Antenna Supply		Using **VCC_RF** or external voltage source
Antenna Supervisor	Short circuit detection	Built-in
	Open circuit detection	Enabled with external circuit

Table 4: Antenna Specification

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[1] "VAX MIPS", calculated using Dhrystone, available for user code

2 Performance Specification

Parameter	Specification			
Receiver Type		L1 frequency, C/A Code,		
		16-Channels		
		8192 time / frequency search windows		
Max Navigation Update Rate		4 Hz		
Accuracy	Position	2.5 m CEP[3] 5.0 m SEP[4]		
	Position DGPS / SBAS[2]	2.0 m CEP 3.0 m SEP		
Acquisition[5, 6]	GPS Mode (UBX-CFG Msg):	Fast Acquisition Mode	Normal Mode	High Sensitivity Mode	Auto Mode
	Cold Start	34 s	36 s	41 s	34 s
	Warm Start	33 s			
	Hot Start	<3.5 s			
	Aided Start[7]	5 s			
	Reacquisition	<1 s			
Sensitivity[8]	Tracking	-158 dBm		
	Acquisition & Reacquisition	-148 dBm Includes aided starts (A-GPS)		
	Cold Starts	-142dBm		
Accuracy of Timepulse Signal	RMS	50 ns		
	99%	<100 ns		
	Granularity	43 ns		
Dynamics	Strong signals	≤ 4 g		
	Weak signals	typ. 1 g		
Operational Limits (COCOM)	Altitude	18,000 m		
	Velocity	515 m/s		
	One of the limits may be exceeded but not both.			

Table 5: Performance Specification

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[2] Depends on accuracy of correction data of DGPS or SBAS service

[3] CEP = Circular Error Probability: The radius of a horizontal circle, centered at the antenna's true position, containing 50% of the fixes.

[4] SEP = Spherical Error Probability. The radius of the sphere, centered at the true position, contains 50% of the fixes.

[5] The different start-up modes like cold, warm and hot start are described in the System Integration Manual [1]

[6] Measured with good visibility and -125 dBm signal strength

[7] Time synch. signal from aiding source must be supplied to **EXTINT0** or **EXTINT1** pin, having accuracy of better than 200 µs

[8] Demonstrated with a good active antenna

3 Mechanical Specification

3.1 Dimensions

25.4 ± 0.1 mm [1000 ± 4 mil]

25.4 ± 0.1 mm [1000 ± 4 mil]

16	GND	GND	15
17	RF_IN	GND	14
18	GND	GND	13
19	V_ANT	GND	12
20	VCC_RF	GND	11

TIM-4H Top View

1.9 ± 0.1 mm [75 ± 4 mil]

2.8 ± 0.1 mm [110 ± 4 mil]

21	V_BAT	VDD18OUT	10
22	RESET_N	EXTINT1	9
23	EXTINT0	SCK1 / P17	8
24	P27	RxD2	7
25	P26	TxD2	6
26	P23	TxD1	5
27	AADET_N	RxD1	4
28	P24	BOOT_INT	3
29	TIMEPULSE	GND	2
30	P29	VCC	1

1.277 ± 0.1 mm [50.27 ± 4 mil]

1.5 ± 0.1 mm [59 ± 4 mil]

3.0 ± 0.3 mm [118 ± 12 mil]
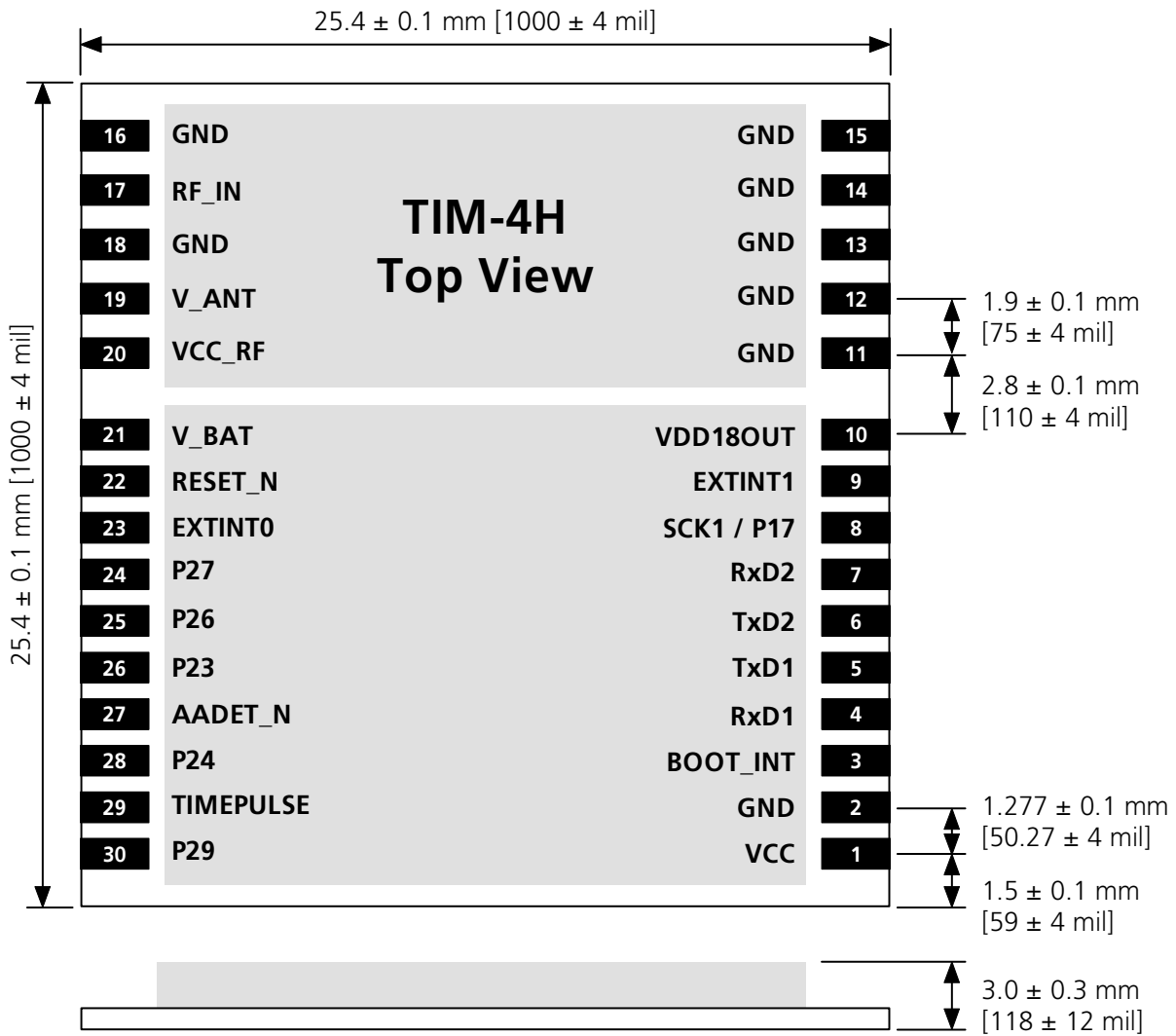
Figure 2: TIM-4H Dimensions

3.2 Specification

Parameter	Specification	Tolerance	Unit
Length	25.4	±0.1	mm
Width	25.4	±0.1	mm
Thickness	3.0	±0.3	mm
Pitch RF pins	1.9	±0.1	mm
Pitch Digital pins	1.277	±0.1	mm
Weight	3		g

Table 6: Mechanical Specification

3.3 Pin Assignment

Standard Function				Alternative Functions[9]			Remarks
No	Name	I/O	Description	Name	I/O	Description	
1	VCC	I	Supply voltage				
2	GND	I	Ground				
3	BOOT_INT	I	Boot mode				Internal pull-down
4	RxD1	I	Serial Port 1				Internal pull-up
5	TxD1	O	Serial Port 1				
6	TxD2	O	Serial Port 2				
7	RxD2	I	Serial Port 2				Internal pull-up
8	-	I	(Not assigned)	SCK1 P17	I/O I/O	Serial Clock 1 GPIO	Internal pull-down
9	EXTINT1	I	External Interrupt Pin	P13	I/O	GPIO	Internal pull-up
10	VDD18OUT	O	1.8V output				
11 – 16	GND	I	Ground				
17	RF_IN	I	GPS signal input				Apply no DC through this pin
18	GND	I	Ground				
19	V_ANT	I	Antenna Bias voltage				
20	VCC_RF	O	Output Voltage RF section				
21	V_BAT	I	Backup voltage supply				
22	RESET_N	I/O	Reset				Open drain, do not drive high
23	EXTINT0	I	External Interrupt Pin	P9	I/O	GPIO	Internal pull-up
24	-	I	(Not assigned)	P27	I/O	GPIO	Default configuration: Input, internal pull-up
25	-	I	(Not assigned)	P26	I/O	GPIO	Default configuration: Input, internal pull-up
26	-	I	(Not assigned)	P23	I/O	GPIO	Default configuration: Input, internal pull-up
27	AADET_N	I	Active Antenna Detect	P14	I/O	GPIO	Default configuration: Input, internal pull-down
28	-	I	(Not assigned)	P24	I/O	GPIO	Default configuration: Input, internal pull-up
29	TIMEPULSE	O	Time pulse (1PPS)	SCK2	I/O	Serial Clock 2	
30	-	I	(Not assigned)	P29	I/O	GPIO	Default configuration: Input, internal pull-up

Table 7: Signals and Module Interface

For more information see the *System Integration Manual for ANTARIS 4* [1].

[9] ANTARIS™ Software Customization Kit needed to explore alternate functions. The SPI (available on the TIM-LP, -LF and –LL) is not supported in the TIM-4P.

4 Electrical Specification

4.1 Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units
Power Supply				
Power supply voltage (VCC)	Vcc	-0.3	3.6	V
Backup battery voltage (V_BAT)	Vbat	-0.3	3.6	V
Input Pins				
Input pin voltage (all except RESET_N)	Vin	-0.3	5	V
Input pin voltage of RESET_N	Vin_reset	-0.3	1.95	V
Voltage Supply output for Active Antenna and RF Section				
VCC_RF output current	Iccrf		50	mA
RF Input				
Antenna bias voltage (applied via V_ANT)	Vant	0	6	V
Antenna bias current (applied via V_ANT)	Iant		100	mA
Input power at RF_IN (source impedance 50Ω, continuous wave)	Prfin		-5	dBm
Environment				
Storage temperature	Tstg	-40	125	°C

Table 8: Absolute Maximum Ratings

! **Warning**   Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection diodes.

4.2 Operating Conditions

Parameter[10]	Symbol	Condition	Min	Typ	Max	Units
Power Supply						
Power supply voltage	Vcc		2.7		3.3	V
Power supply voltage ripple	Vcc_PP				50	mV
Sustained supply current [11]	Icc	Vcc = 3.0 V		39		mA
Peak supply current [12]	Iccp	Vcc = 3.3 V			70	mA
Sleep mode current	Iccs	Vcc = 3.0 V		80		µA
Backup battery voltage	Vbat		1.5		3.6	V
Backup battery current	Ibat	Vbat = 3.3 V		5		µA
1.8V output voltage (VDD18OUT pin)	Vdd18out		1.65	1.8	1.95	V
1.8V output current (VDD18OUT pin)	Idd18out				30	mA
UART and all I/O Signals[13]						
Input pin voltage range	Vin		0		5	V
Input pin low voltage	Vin_low				0.41	V
Input pin high voltage	Vin_high		1.46			V
Output pin voltage range	Vout		0		VCC	V
Output pin low voltage	Vout_low	Iout = 0.3 mA			0.1	V
Output pin high voltage	Vout_high	Iout = 0.3 mA	VCC-0.1			V
RESET_N Input (Open-Drain I/O)						
Input and output pin voltage range	VinR		0		1.8	V
Input pin low voltage	Vin_lowR				0.46	V
Input pin high voltage	Vin_highR		1.3			V
Output pin low voltage	Vout_lowR	Iout = 0.3 mA			0.1	V
Output pin high voltage	Vout_highR	Iout = 0.1 mA	VDD18OUT -0.2			V
RF input						
Antenna gain	Gant				50	dB
V_ANT antenna bias voltage (must connect to ground if not used)	Vant		2		6	V
Antenna bias voltage drop	Vant_drop	Iant=10mA		20	50	mV
VCC_RF voltage	Vccrf			Vcc – 0.1		V
VCC_RF output current	Iccrf			20	50	mA
Environment						
Operating temperature	Topr		-40		85	°C

Table 9: Operating Conditions

Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.

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[10] All specification are at an ambient temperature of 25°C.
[11] Average current drawn during Continuous Tracking Mode with 1 Hz update rate, using 9 channels for tracking and navigation and 3 channels for searching satellites (= acquisition). Use this figure to determine required battery capacity.
[12] Peak current drawn during initial acquisition phase. Use this figure to dimension maximum current capability of power supply.
[13] RxD1, RxD2, EXTINT0 and EXTINT1 provide internal pull-up to V_BAT18 (Battery supply regulated to 1.8V) and not VCC.

5 Environmental Specification

Detailed description of the test series:

Test		Standard
Visual inspection		IPC-A-610 "Acceptability of electronic assemblies" I.T.R.I. Publication No. 700 IPC-SM-840B Class 2.
Thermal shock	-40°C...+125°C, 100 cycles	IEC 68-2-14
Function at various temperatures	-40°C/2 hours; RT/2 hours; +85°C/2 hours; function tests at stable temperature	IEC 68-2-1 and IEC 68-2-2
Lifespan test	+85°C/1000 hours, in function	IEC 68-2-2
Damp heat, cyclic	+25°C...+55°C; >90% rH	IEC 68-2-30
Vibration	10-500 Hz; 2 hours/axis; 5g	IEC 68-2-6
Shock	30g/11ms (halfsine); 3 Shock/axis; no function	IEC 68-2-27
Metallographic investigations		IPC-QE-650

Note: This specification is preliminary and yet subject to confirmation.

Table 10: Environmental Specification

6 Product Lineup

6.1 Default Settings

Please refer to the *System Integration Manual for ANTARIS 4* [1] for information about further settings.

Interface	Settings
Serial Port 1 Output	9600 Baud, 8 bits, no parity bit, 1 stop bit Configured to transmit both NMEA and UBX protocols, but only following NMEA and no UBX messages have been activated at start-up: **GGA, GLL, GSA, GSV, RMC, VTG, ZDA, TXT** Additional messages can be activated with appropriate input messages.
Serial Port 1 Input	9600 Baud, 8 bits, no parity bit, 1 stop bit, Autobauding disabled Automatically accepts following protocols without need of explicit configuration: **UBX, NMEA, RTCM** The GPS receiver supports interleaved UBX and NMEA messages.
Serial Port 2 Output	57600 Baud, 8 bits, no parity bit, 1 stop bit Configured to transmit both NMEA and UBX protocols, but only following UBX and no NMEA messages have been activated at start-up: **NAV-POSLLH, NAV-SOL, NAV-SVINFO, NAV-STATUS** MON-IO, MON-SCHD, MON-TXBUF, INF-Warning, INF-Error, INF-Notice Additional messages can be activated with appropriate input messages.
Serial Port 2 Input	57600 Baud, 8 bits, no parity bit, 1 stop bit, Autobauding disabled Automatically accepts following protocols without need of explicit configuration: **UBX, NMEA, RTCM** The GPS receiver supports interleaved UBX and NMEA messages.
TIMEPULSE	1 pulse per second, synchronized at rising edge, pulse length 100ms

Table 11: Available Protocols

6.2 Ordering Information

Ordering No.	Product
TIM-4H-0-000-0	TIM-4H Programmable GPS Module with SuperSense Delivery Packing **0** = Single samples **1** = Tape on reel (100 pieces)

Table 12: Ordering Information

Parts of this product are patent protected.

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Related Documents

[1]   System Integration Manual for ANTARIS 4, Docu. No GPS.G4-MS4-05007

[2]   ANTARIS 4 Protocol Specification, Docu. No GPS.G3-X-03002

All these documents are available on our homepage (http://www.u-blox.com).

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