GPS Receiver GNS501 Datasheet V01

confidential information ***preliminary*** *specification*

1 INTRODUCTION

The GNS 501 is an small outlined module for navigation, package tracking and any other applications where simple, reliable positioning data is a necessity. Since the patch antenna is already on board, there' s no costly implementation work needed. Connecting the power supply and a serial data connection is all that has to be done to put GNS501 to service.

Features

- Improved acquisition performance
- Improved tracking&navigation performance and minimized error in multi-path environments
- Standard NMEA 0183 output
- Pulse Per Second (PPS) output pin
- GPS fix indication output pin
- Push to Fix pin (PTF) for power management
- Automatic Power Management (APM) feature
- Compact design 18x17x7.8 mm
- Single 1.8 VDC supply
- UART interface
- Fast time to market
- RoHS compliant

Applications

- Navigation
  - In-vehicle Navigation equipment
  - Dynamic Navigation
  - Portable ("nomadic") devices
  - Netbooks, tablet PCs and mobile phones
  - Low volume applications with short time to market requirement
- Timing
  - Precision timing via GPS
- Location based applications
  - GPS Logger
  - GPS Tracker
  - Security devices
  - Camera equipment

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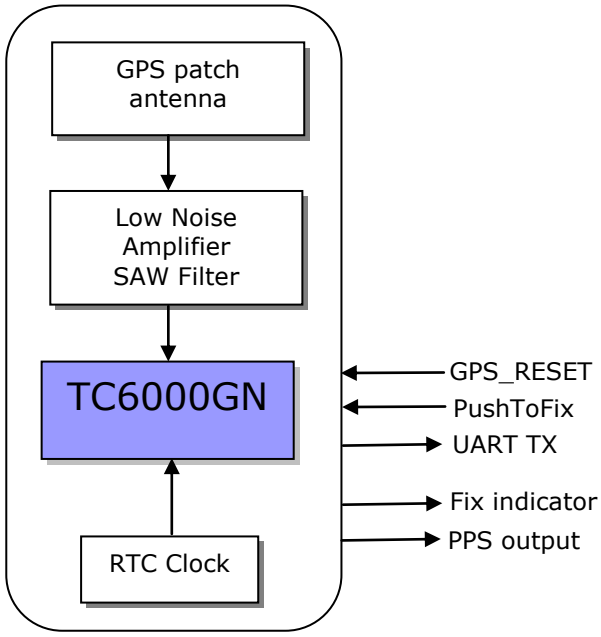
3 DETAILED FEATURES

3.1 GPS Features

- Significantly improved TTFF at low signal power levels provides the consumer with a compelling GPS experience
- Improved acquisition performance to process position fixes in deep indoor conditions
- Reduced power consumption through improvements to RF architecture, software techniques, receiver core, and RF noise figure partitioning
- Improved tracking performance and minimized error in multi-path environments through increased IF bandwidth and higher sampling rates in tracking channels
- Standard NMEA output
- 1PPS output
- GPS Fix indication output pin
- APM, Automatic Power Management reduces tracking power down to 54mW average.

4 BLOCK DIAGRAM



5 I/O REQUIREMENTS

5.1 I/O levels

GNS501 I/O sections work at 1.8V nominal. Absolute Maximum Ratings should not be exceeded
Should the GNS501 be interfaced to a host with I/O at higher levels, level shifters should be used.

6 GPS characteristics

Parameter	Min	Typ	Max	Unit	Note
general					
Frequency		1575.42		MHz	GPS L1 C/A code
Output data frequency	1/60	1	1	1/sec	Configurable
Navigation&tracking sensitivity		-161	-162	dBm	At LNA input, Note1
Acquisition sensitivity		-145	-146	dBm	autonomous , at LNA input, Note 1
TTFF hotstart			1	sec	All SVs@-130dBm, Note 1
TTFF hotstart			10	sec	All SVs @-155dBm, Note 1
TTFF autonomous cold start		34		sec	All SVs @-130dBm, Note 1
TTFF autonomous cold start		45		sec	All SVs @-142dBm, Note 1
Number of channels tracking		16			
Number of acquisition channels		40			
Power consumption					
GPS ACTIVE (acquisition)		72	83.6	mA	NMEA frequency = 1/sec
GPS ACTIVE (tracking)		50	58.8	mA	NMEA frequency = 1/sec
GPS ACTIVE (tracking)	25			mA	NMEA frequency=1/sec, -130dBm, APM feature active, Note 1
GPS shutdown		181		µA	GPS_RESET → GND
GPS deep sleep (RTC running)		81		µA	PTF → GND

Note 1: Measured by conductive measurement

Accuracy					
Static position error CEP68	-	2	-	m	**Normal open sky in Field** Horizontal position accuracy using open sky roof-top antenna
Static position error CEP95	-	3	-	m	**Normal open sky in Field** Horizontal position accuracy using open sky roof-top antenna
Static position error CEP68	-	-	2	m	**Simulator feed ,** IONO and TROPO errors oN at -130 dBm power level, Note 1
Static position error CEP95	-	-	3	m	**Simulator feed ,** IONO and TROPO errors oN at -130 dBm power level, Note 1
dynamic position error CEP68	-	-	3	m	**Simulator feed ,** IONO and TROPO errors oN at -130 dBm power level, Note 1
dynamic position error CEP95	-	-	4	m	**Simulator feed ,** IONO and TROPO errors oN at -130 dBm power level, Note 1
velocity error CEP68	-	-	0.1	m/s	**Simulator feed ,** IONO and TROPO errors oN at -130 dBm power level, Note 1
velocity error CEP95	-	-	0.7	m/s	**Simulator feed ,** IONO and TROPO errors oN at -130 dBm power level, Note 1
Accuracy for timepulse signal					
1PPS pulse duration	-	1	-	msec	
1PPS time jitter	-	15	100	nsec	Pulse rising edge deviation from expected pulse time, measured in a 300 seconds interval with full 3D fix @-130dBm, Note 1
1PPS rise and fall time			10	nsec	10%..90%
1PPS output impedance	-	10kΩ//20pF	-		
TCXO					
TCXO output frequency	-	26.000	-	MHz	±2.5 ppm
TCXO output impedance	-	1MΩ//5pF	-	-	

Note 1: Measured by conductive measurement

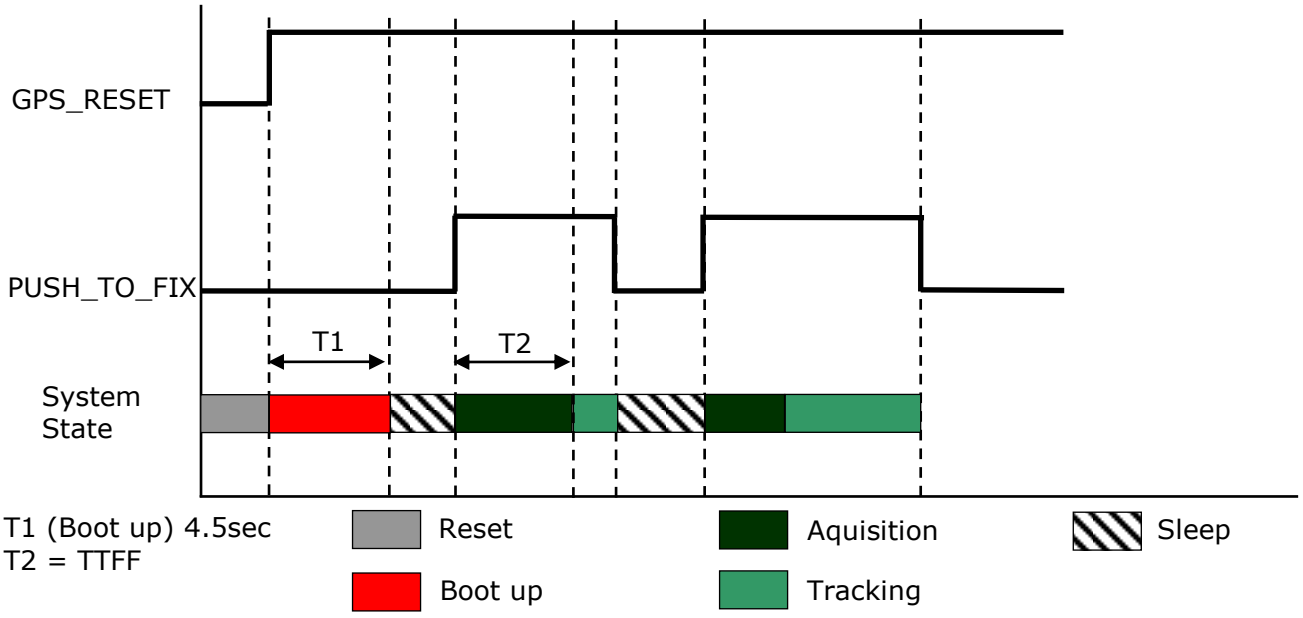
ITAR limits					
Operation altitude	-5,000	-	18,288	m	
Operation velocity	-	-	514	m/s	
Operation acceleration	-	-	-	m/s^2	No limit set

6.1 Automatic Power Management (APM) feature

GNS501 provides APM feature as as a user selectable option.
APM dynamically controls the GPS internal function blocks to achieve the lowest power consumption in a gives GPS signal condition. APM will work at full power (~115mW) during acquisition go down to 80mW in tracking mode and reduce the power further to just 54mW when satellite signal is unobstructed in an open sky scenario.
By default, APM is set to inactive. Please refer to Section 13 for more information.

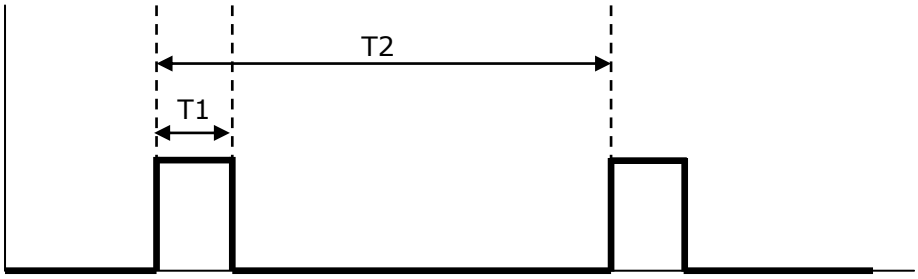
6.2 Push to fix (PTF)

The *PTF* signal pin is used to control the power state of the receiver. If PTF is high, the receiver is under full operation.
When PTF is going to low level, a *deep sleep* state is entered, only the memory and the real time clock will be powered to preserve almanach, ephemeris and real time.
Reactivating the receiver by setting PTF to high within a short period of time (up to 2 hours) will allow the receiver to re-fix within a few seconds or less.



6.3 Pulse Per Second (PPS)

TC6000GN provide a so called Pulse Per Second (PPS) for timing purposes. After calculation of a 3D postion fix, the PPS signal is accurately aligned to the GPS seconds boundaries. The pulse generated is approximately 1 millisecond in duration and the repetition rate is 1 second.



T1 = 1ms T2 = 1sec

More information about the accuracy of the time pluse, please refer to http://processors.wiki.ti.com/index.php/CC4000_GPS_for_MCU "**GPS PPS Timing Application Note**".

6.4 Fix Available

The *FIX AVAILABLE* signal is used to indicate the availability of GPS postion information. This is typically used to drive an LED buffer so that the state of the device can be easily indicated. The table below lists the various states.

State	Indication
Initial boot up	low
PTF low	low
PTF on and aquisition	Toggling (900ms low and 100ms high)
PTF on and loss of fix	Toggling (900ms low and 100ms high)
PTF on and postion fix	continuously high

6.5 GPS Antenna

GNS501 contains all input circuitry including a high performance 13x13x4mm patch antenna. This antenna is finely tuned and provides the best performance at small outline.
When mounting the module, any metal , metalized or (ESD-) coated materials should be avoided !
A plastic (ABS,PC or similar) cover of up to 2mm should be ok in any case.
Please keep an air gap of 2..3mm between antenna surface and cover whenever possible.

7 ELECTRICAL SPECIFICATION

7.1 Absolute Maximum Ratings

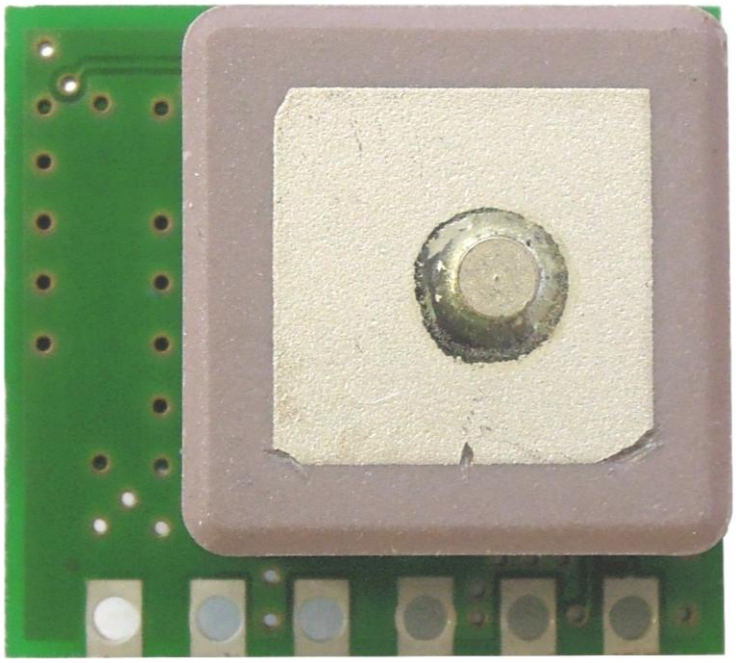
Parameter	Value	Unit
Supply voltage range: VDD	–0.5 to 2.1	V
Input voltage to all other pins	–0.5 to (VDD + 0.5)	V
Operating ambient temperature range	–40 to +85	°C
Storage temperature range	–40 to +85	°C

7.2 Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit	Note
VDD	1.7		1.95	V	Power-supply voltage
High level output voltage V_{OH}	0.8 * V_{DD}		V_{DD}	V	IOUT = 4 mA
Low level output voltage V_{OL}	0		0.2*V_{DD}	V	IOUT = 4 mA
High-level input voltage V_{IH}	0.65x VDD		VDD	V	
Low-level input voltage V_{IL}	0		0.35x VDD	V	
Operating temperature	-40		85	°C	Full specified performance

8 DEVICE PINOUT DIAGRAM

TOP VIEW



1 2 3 4 5 6

NO	NAME	TYPE[1]	DESCRIPTION
Power-Management Signals			
1	FIX AVAILABLE	O	Signal to indicate GPS fix status. Leave open if not used
2	UART TX	O	UART Tx line. Output of NMEA message data
3	GND	P	Connect to GND
4	VDD	P	Power supply 1.8V DC
5	PTF	I	Push To Fix, switches between active and idle, receiver active when high
6	PPS	O	1 pulse per second precision GPS second output

(1) I = INPUT; O = OUTPUT; I/O = BIDIRECTIONAL; P = POWER PIN; ANA = ANALOG PIN.

9 POWER MANAGEMENT

For quick re-acquisition after power-on, the GNS501 should stay tied to Vdd during off-times to keep it's RTC clock running. The receiver is put in sleep mode by holding the *PTF* pin low. The pin may be controlled by the host controller or by another power management circuitry, which might be also a simple electromechanical switch.
A static low level on *PTF* will keep the GNS501 in a deep sleep with power consumption at 81µA.

10 HARDWARE HOST INTERFACE

GNS501 is connected to host system by a UART Interface.
Since GNS501 is used only to deliver NMEA to the host only a single data line from the receiver to the host is necessary. The interface requires 1.8V I/O. The idle state of the lines is positive voltage. To interface a standard RS232 UART (e.g. a PC serial interface), please add an inverting level shifter. To interface processors that have a different interfacing voltage level, level shifters are required.

10.1 GPS UART Interface details

- The UART interface is used to send NMEA messages and control data.
- The default baud rate is 9600, other baud rates can be selected by ordering option.
- The maximum baud rate deviation supported is ±2%.

GPS UART Default Settings	
Parameter	**Value**
Baud rate	9600
Data length	8 bits
Stop bit	1
Parity	None

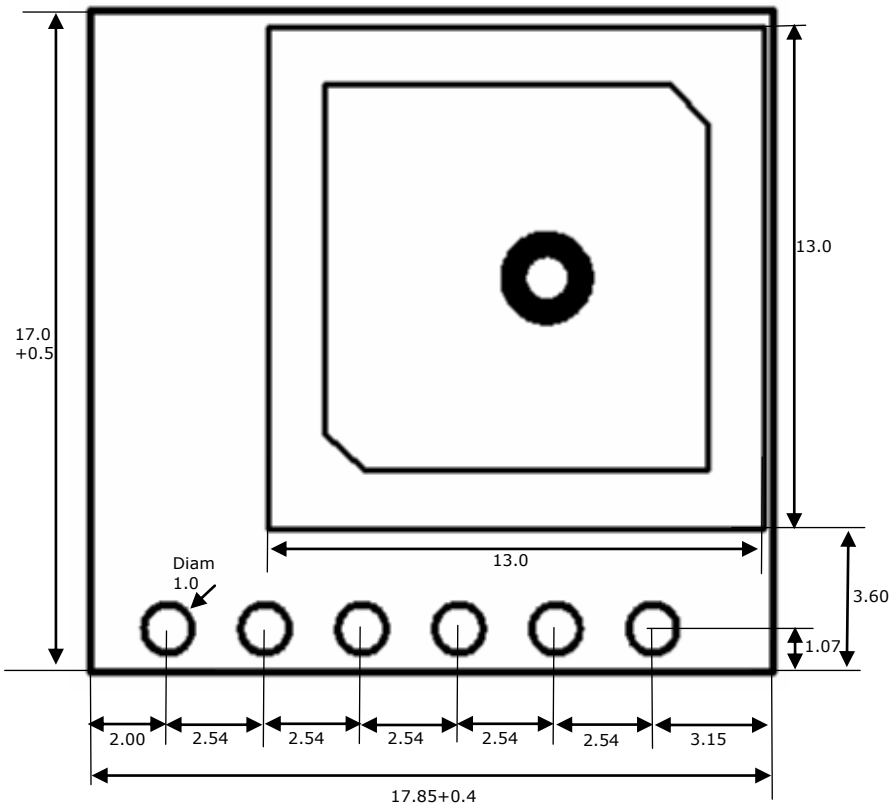
11 NMEA DATA

The GNS501 provides NMEA (National Marine Electronics Association) 0183 compatible data.
The following table shows the available NMEA sentences. All active NMEA sentences are sent at the selected baud rate.

NMEA available sentences	
Type	**content**
$GPRMC	Recommended Minimum Navigation Information
$GPGGA	Global Positioning System Fix Data, Time, Position and fix related data for a GPS receiver
$GPGSV	Satellites in view
$GPGLL	Geographic Position - Latitude/Longitude
$GPGSA	GPS DOP and active satellites
$GPVTG	Track made good and Ground speed

12 PHYSICAL DIMENSIONS

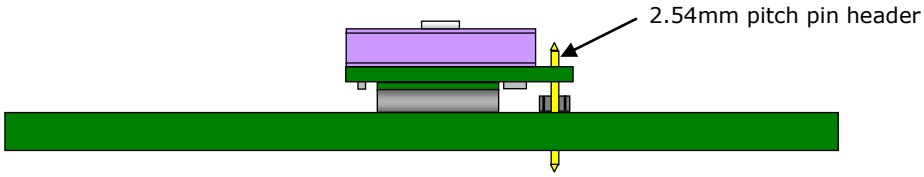
TOP VIEW



all units in mm
max. thickness is 8.5 mm

13 PCB MOUNTING

Using a standard 1x6pin 2.54mm pitch header, the GNS501 can be simply mouted on the application PCB. The picture below shows a side view how to assemble the GNS501 to an application board.



14 ORDERING INFORMATION

Ordering information			
Type	**Part#**	**marking**	**Description**
GNS501 _<options>	4037735104624	-	GPS receiver

0702

15 CUSTOMER SPECIFIC FACTORY OPTIONS

Some features of GNS501 are factory presets, that should be added to your order information. Just replace <options> by the **Short** options given in the table below.
Please use a comma "**-**" for separating the options.
You do not need to specify option values that are shown to be default.

Type	**Default value**	**Possible options**	**Short**	**note**
UART baudrate	9,600 baud	Baud=9600bps Baud=19200bps Baud=38400bps Baud=57600bps Baud=115200bps	9 19 38 57 115	The serial output baud rate.
APM feature	Not active	APM active APM not active	A	APM feature allows the GPS engine to save energy under good reception conditions. Please define A , if you wish to have APM activated.
GPS output rate	1 second (R1)	Rate is x seconds (x=1,2,3,4,5,10, 30,60)	R<x>	This option is useful to optimize transfer times by lowering the rate of NMEA messages. Has no influence on the GPS engine activity.
NMEA selection	All 6 types	All combinations possible	RMC GGA GSV GLL GSA VTG	saving unused NMEAs. Please specify all types that should be available
GSV output rate	1	GSV=1 GSV=5	G1 G5	GSV rate can be selected as a multiple of the GPS output rate. This option is used to reduce average data transfer. G5 with a rate of 1 will produce GSV output every 5 seconds
Pulse per second output	active (on)	PPS on PPS off	/P	Activates or deactivates the hardware precision pulse per second. Since active is default, please define /P (no PPS) if PPS should not be available.

For example, if you wish to have a baudrate of 115.2k, and only RMC (once per second) and GSV (every 5 seconds) as output data, please order as follows :

GNS501 115-RMC-GSV-G5

In another example, Baud Rate is 38400bps, all NMEA sentences except GSV and VTG should be sent at a rate of once per 5 seconds. PPS shall be off:

GNS501 38-RMC-GGA-GLL-GSA-R5-/P

16 ENVIRONMENTAL INFORMATION

This product is free of environmental hazardous substances and complies to 2002/95/EC. (RoHS directive).

17 DOCUMENT REVISION HISTORY

V0.01	Sep 25 2012	P.Skaliks	initial document