Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!


## Contact us

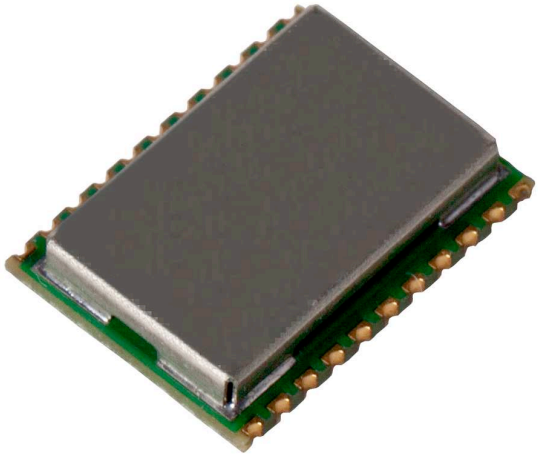
Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

# GPS/GLONASS Receiver A5100-A

**A Description of Maestro's**
**GPS/GLONASS Receiver Module A5100-A**

## User's Manual

**Version 1.0**



## Revision History

| Rev. | Date | Description |
|---|---|---|
| 0.1 | 10-29-13 | First draft. |
| 0.2 | 02-10-14 | Updates according to DV samples. |
| 1.0 | 03-03-14 | Updates Current data and add some picture |
| | mm-dd-yy | |

| | Name | Date | Signature |
|---|---|---|---|
| Written by | Happy wen | 03-03-14 | H W |
| Checked by | Sam Law, Matthieu | 03-03-14 | S L,M |
| Approval by | Frank Tang, Calvin Yau | 03-03-14 | F T,C Y |

## Disclaimer

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF MAESTRO WIRELESS SOLUTIONS LIMITED. IT MAY NOT BE COPIED OR TRANSMITTED BY ANY MEANS, PASSED TO OTHERS, OR STORED IN ANY RETRIEVAL SYSTEM OR MEDIA, WITHOUT PRIOR CONSENT OF MAESTRO OR ITS AUTHORIZED AGENTS.

THE INFORMATION IN THIS DOCUMENT IS, TO THE BEST OF OUR KNOWLEDGE, ENTIRELY CORRECT. HOWEVER, MAESTRO CAN NEITHER ACCEPT LIABILITY FOR ANY INACCURACIES, OR THE CONSEQUENCES THEREOF, NOR FOR ANY LIABILITY ARISING FROM THE USE OR APPLICATION OF ANY CIRCUIT, PRODUCT, OR EXAMPLE SHOWN IN THE DOCUMENT.

THE PRODUCT (HARD- AND SOFTWARE) DESCRIBED IN THIS DOCUMENTATION IS NOT AUTHORIZED FOR USE IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF MAESTRO.

THIS DOCUMENT MAY PROVIDE LINKS TO OTHER WORLD WIDE WEB SITES OR RESOURCES. BECAUSE MAESTRO HAS NO CONTROL OVER SUCH SITES AND RESOURCES, MAESTRO SHALL NOT BE RESPONSIBLE FOR THE AVAILABILITY OF SUCH EXTERNAL SITES OR RESOURCES, AND DOES NOT ENDORSE AND IS NOT RESPONSIBLE OR LIABLE FOR ANY CONTENT, ADVERTISING, PRODUCTS, OR OTHER MATERIALS ON OR AVAILABLE FROM SUCH SITES OR RESOURCES. MAESTRO SHALL NOT BE RESPONSIBLE OR LIABLE, DIRECTLY OR INDIRECTLY, FOR ANY DAMAGE OR LOSS CAUSED OR ALLEGED TO BE CAUSED BY OR IN CONNECTION WITH USE OF OR RELIANCE ON ANY SUCH CONTENT, GOODS OR SERVICES AVAILABLE ON OR THROUGH ANY SUCH SITE OR RESOURCE.

MAESTRO RESERVES THE RIGHT TO CHANGE, MODIFY, OR IMPROVE THIS DOCUMENT OR THE PRODUCT DESCRIBED HEREIN, AS SEEN FIT BY MAESTRO WITHOUT FURTHER NOTICE.

# Table of Contents

# 1 Introduction

A5100-A is a compact high sensitivity concurrent GNSS module that integrates CSR's latest SiRFstarV technology into a single and easy to integrate SMT device. By supporting simultaneous GLONASS, GPS, QZSS and SBAS measurements with the industry's best sensitivity engine, the highest accuracy, ground tracks and fastest time-to-first-fix (TTFF) are ensured even under tough operating conditions. The jammers removal algorithm not only facilitates integration in today's ever more complex communication devices, but guarantees performance even in hostile situations. SiRFaware's advanced low power management modes, high level of integration and multiple communication ports in a small form-factor makes the A5100-A suitable for a broad spectrum of GPS applications where performance, cost and time to market are prime considerations.

A5100-A is a drop-in replacement solution for all A2200-A customers. It is housed in a 15.0 x 10.2 x 2.5 mm 22 pins SMD package with castellated edge that includes the SiRFStarV (CSRG05e) chipset, referred to later as SS5e, built-in SPI Flash, all RF matching elements, antenna DC control, RF SAW filtering, various thermal and peripheral components and the TCXO crystal reference. A very easy implementation (power, serial, ON_OFF, and antenna) allows receiving position, velocity and time information.

A5100-A is designed for 3.3V power supply.

## 1.1 Feature Overview

The A5100-A is based on the well-established A2200-A outline and offering new outstanding features, especially GLONASS reception.

- Fast, responsive location experience
  - High-sensitive navigation engine with tracking down to -165dBm
  - 52 track verification channels
  - SBAS (WAAS, EGNOS, MSAS, GAGAN)
  - Concurrent tracking of multiple constellations of the GPS and GLONASS systems
- Breakthrough micro power technology
  - Requires only 60 – 600µA to maintain hot start capability
- Internal Power-On-Reset (POR) reset chipset to prevent memory corruption if main power removal abruptly
- Active CW interference rejection
- SiRFInstantFix™ extended ephemeris aiding – CGEE and SGEE

## 1.2 Characteristics Overview

The module's most important characteristics are:

- A5100-A
  - Operable at 3.3V / 28mA (typ.) @ 1 fix per second
  - V_BAK at 3.0V / 60uA (typ.)
  - UART interface at 3.3V CMOS level
  - SPI Slave support at 3.3V CMOS level
  - $I^2C$ Multi-master operation at 3.3V CMOS level
- Internal 4 Mb SPI Flash
- Direct passive antenna support
- Switched antenna voltage for active antenna support
- Small form factor of 10.2 mm x 15.0 mm (0.40" x 0.59"), 1mm longer than A2200-A but they are drop-in replaceable
- Supported temperature range: -40°C to +85°C
- Single-sided SMT component, for reflow soldering
- Tape & reel packaging

The A5100-A receiver modules is available as off-the-shelf components, 100% tested and shipped in standard tape-and-reel package.

## 1.3 RoHS and Lead-Free Information

Maestro's products marked with the lead-free symbol either on the module or the packaging comply with the "Directive 2002/95/EC of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment" (RoHS).



All Maestro GPS/GLONASS receiver modules, smart GPS or GPS&GLONASS antenna modules and telematics units are RoHS compliant.

## 1.4 Label

The A5100-A labels hold the following information:


Figure 1: A5100-A label

The label is placed on the shield of the module. The data matrix code holds the product type, part number, patch release, hardware release, factory code, year & week of assembly and a 6-digit serial number.

| Representing | Factory code | Product Number | Part Number | Patch Release | Hardware Release | Assembly Year/Week | Serial Number |
|---|---|---|---|---|---|---|---|
| Number of digits (27) | XX | XXXXXX | XXXXX | XX | XX | XXXX | XXXXXX |
| | 2 | 6 | 5 | 2 | 2 | 4 | 6 |
| Example | TF | A5100A | 30B01 | 01 | 01 | 1332 | 000005 |
| Meaning | TF | Given | Given | Given | Given | Year=13 Week=32 | Increment from 000001 up to 999999 |

Example of MID#: TFA5100A30B0101011332000005

**NOTE**: Hardware revision (rr) of the series product starts with 01. A hardware revision above 50 shows the module was produced before the product was fully qualified (Engineering Samples).

## 1.5 Characteristics

The modules are characterized by the following parameters.

### 1.5.1 GPS & GLONASS Characteristics

| | | |
|---|---|---|
| Channels | 52, parallel tracking | |
| Correlators | ~ 400,000 | |
| Frequency | GPS | L1 (= 1,575 MHz) |
| | GLONASS | FDM L1 (=1,602 MHz) |
| Tracking Sensitivity (1) | GPS & GLONASS | -165 dBm |
| Horizontal Position Accuracy | Stand alone | < 2.5 m CEP (SA off) |
| Time To First Fix – TTFF (theoretical minimum values; values in real world may differ) | Obscuration recovery (2) | 0.1 s |
| | Hot start (3) | < 1 s |
| | Warm (4) | < 30 s |
| | Cold (5) | < 35 s |

Table 1: A5100-A GPS&GLONASS characteristics

(1) Typical with good antenna – see also paragraph “3.2 Antennas”
(2) The calibrated clock of the receiver has not stopped, thus it knows precise time (to the µs level).
(3) The receiver has estimates of time/date/position and valid almanac and ephemeris data.
(4) The receiver has estimates of time/date/position and recent almanac.
(5) The receiver has no estimate of time/date/position, and no recent almanac.

Note: Performance (sensitivity and TTFF) might slightly decrease below -30°C.

### 1.5.2 Mechanical Characteristics

| | | |
|---|---|---|
| A5100-A Mechanical dimensions | Length<br>Width<br>Height | 10.2±0.20 mm, 0.4±0.008”<br>15±0.20 mm, 0.59±0.008”<br>2.5 mm, 0.1” (Max) |
| A5100-A Weight | | 0.6 g, 0.022 oz |

Table 2: A5100-A dimensions and weight

## 1.6 Handling Precautions

The GPS/GLONASS receiver module A5100-A is sensitive to electrostatic discharge (ESD). Please handle with appropriate care.

# 2 Ordering Information

## 2.1 GPS/GLONASS Receiver A5100-A

The order number is built as follows:

- **A5100-Axxxxxxx**

A5100-A is the model name. The “xxxxxxx” refers to the current chipset and patch (if appropriate) versions on the module. The latest version will be provided if no version number is specified.

## 2.2 Packing of the A5100-A

The A5100-A GPS/GLONASS module comes in a tape and reel package suitable for pick and place machines.

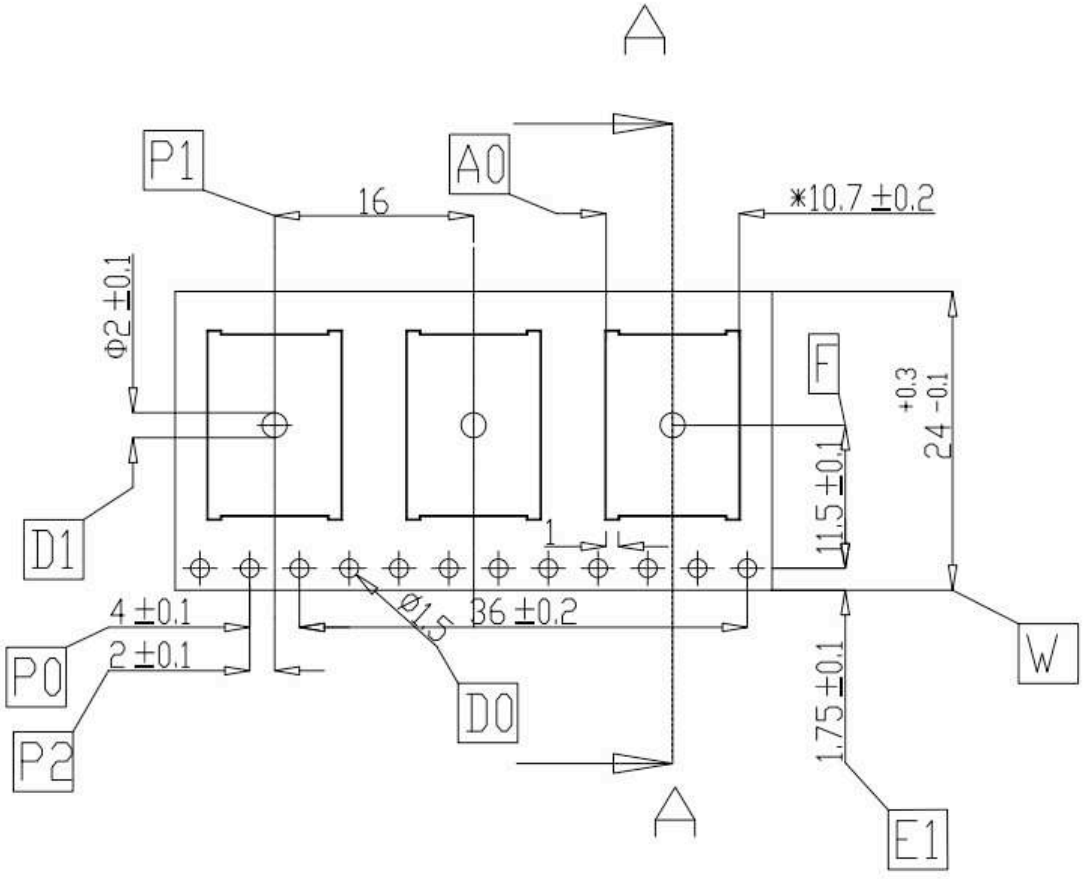



Figure 2: A5100-A tape specifications (1)

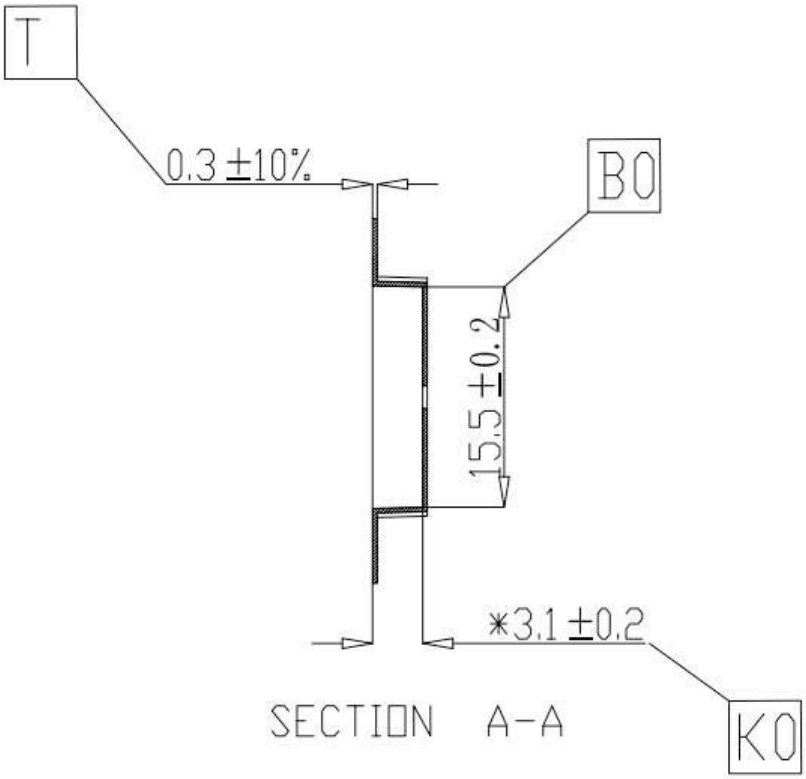



Figure 3: A5100-A tape specifications (2)

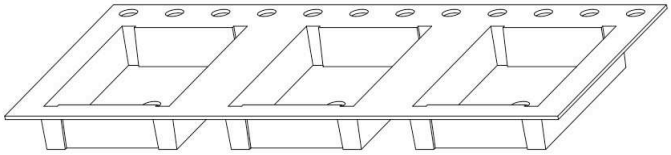


Figure 4: A5100-A tape specifications (3)

One complete reel holds 1300 PCS A5100-A modules.
There are 1 kinds of packaging for shipment:

- One box holds 1 reel
- Reel diameter: 33 cm
- Inner box dimensions: 36(W) x 36(L) x 4.5 (H) cm
- Box dimensions: 38.8 (W) x 38.8 (L) x 5.7 (H) cm
- Gross weight: 2.58 Kg
- Net weight: 0.78 Kg

## 2.3 Additional Equipment

| | |
|---|---|
| EVA5100-A | Evaluation Kit (including one module A5100-A) |

Table 3: Additional equipment

A detailed description of the EVA5100-A Evaluation Kit can be found in the appropriate manual. The evaluation boards are always shipped with latest ROM version and patch loaded.

The EVA5100-A includes the following components:

- Evaluation Board (labeled EVA5100-A) with one additional A5100-A GPS/GLONASS receiver
- Active GPS/GLONASS antenna
- USB cable to connect to your PC
- CD with complete documentation and SiRFLive 2.04P1 software

# 3 Quick Start

In order to allow an easy and quick start with the A5100-A module, this chapter provides a short overview on the important steps to be taken to receive NMEA messages with position information on a serial port (UART).

**NOTE 1: The A5100-A needs an external pull-up resistor to be configured for UART operation. Please consider the pull-up resistor in your design or pull the GPIO up right after reset by other means.**

**NOTE 2: The ON_OFF input of the A5100-A needs to be connected to output of a microprocessor. For a wake-up, including the initial one after power on, a LOW-HIGH transmission is mandatory.**

## 3.1 Minimum Configuration

Figure 5 shows the minimum configuration for NMEA outputs and commands sent via an RS232 interface based on the GPS/GLONASS module A5100-A using a passive antenna. It's recommended to supply Vcc continuously for normal operation, the module can enter power saving and hibernation modes by toggling the ON_OFF pin or sending commands.

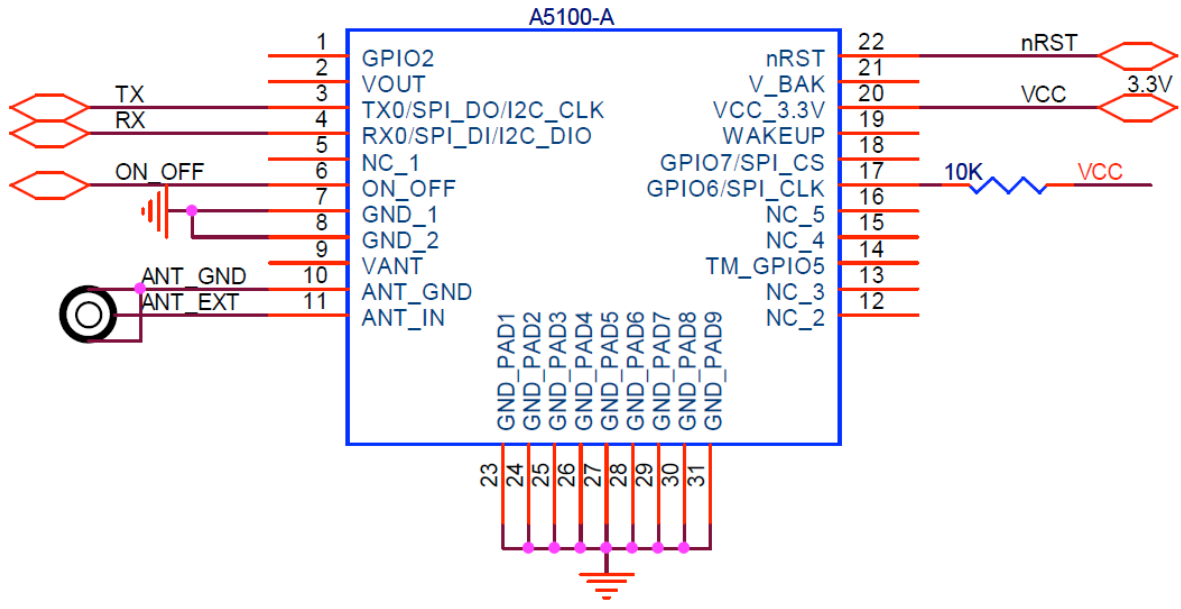



Figure 5: Minimum configuration A5100-A with continued Vcc supply

Remarks:

- External antenna input impedance is 50 Ω. Match as close as possible.
- Supply Vcc continuously, use toggling of ON_OFF to switch between normal operation and hibernate mode

Figure 6 shows the minimum configuration for NMEA outputs and commands sent via an RS232 interface based on the GPS/GLONASS module A5100-A using a passive antenna and with backup voltage on V_BAK. Before removing Vcc, it is highly recommended to put A5100-A into hibernation mode either by ON_OFF pin or software command
. Otherwise, high current drain will die out the backup battery in a short period of time.

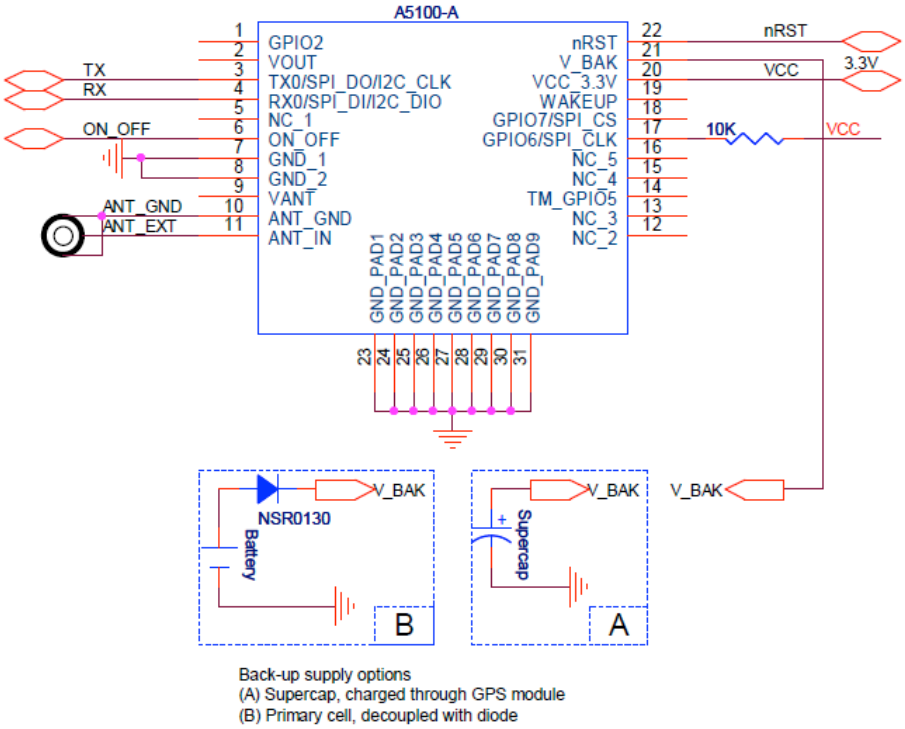



Figure 6: Minimum configuration A5100-A with Vbak

Remarks:

- External antenna input impedance is 50 Ω. Match as close as possible.
- A battery back-up circuit for the RTC (Real Time Clock) should be considered (see chapter: “10.6 Battery Back-up”)

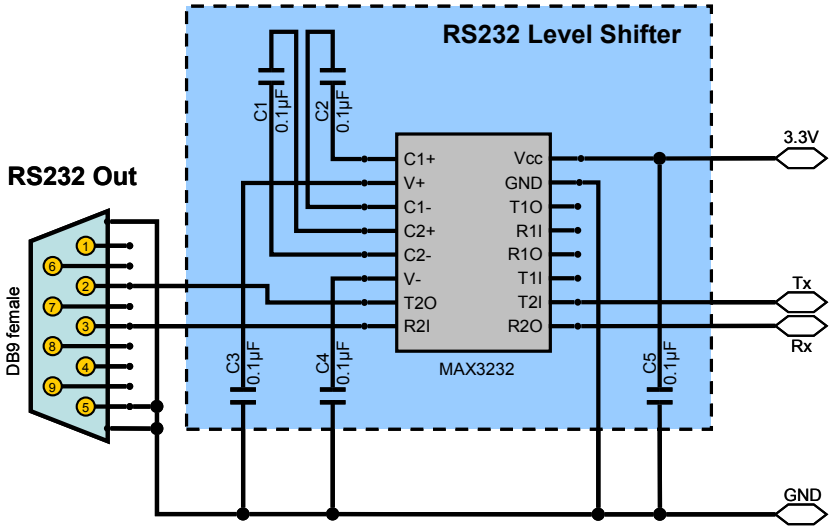



Figure 7: RS232 level shifter

Remarks:

- Place C1 to C5 (here: 0.1µF) close to MAX3232. For capacity values see datasheet of actual component used.
- Use 3.3V level shifter (MAX3232 or equivalent).
- External antenna input impedance is 50 Ω. Match as close as possible.

## 3.2 Antennas

Generally, the quality of the GPS&GLONASS antenna chosen (passive or active) is of paramount importance for the overall sensitivity of the GPS&GLONASS system. Losses through a bad antenna, long cables or tracks or a bad antenna position can't be compensated afterwards!

### 3.2.1 Passive Antennas

The A5100-A supports passive antennas via an integrated LNA directly.

### 3.2.2 Active Antennas

The A5100-A also supports active antennas directly, i.e. by offering an antenna voltage feed pin (VANT – pin 9). It is recommended to use an active antenna with a supply voltage of 3 to 5 VDC and a maximum current draw of 50 mA. The antenna should have a gain ≥ 15dB but the total gain (antenna gain minus cable loss at the antenna input of the module) should not exceed 30 dB. The noise figure should be ≤ 1.5dB.

## 3.3 Serial Port Settings

In UART operation (defined by the external pull-up resistor as outlined in Minimum Configuration) the default settings are:

- NMEA, 9600 baud, 8 data bits, no parity, 1 stop bit, no flow control

### 3.3.1 Change Serial Port setting

This command message is used to set the protocol (SiRF OSP or NMEA) and/or the communication parameters (Baud rate, data bits, stop bits, and parity). The command is used to switch the module back to SiRF OSP protocol mode where a more extensive command message set is available. When a valid message is received, the
parameters are stored in battery-backed SRAM and, after a reset, the receiver resumes using the saved parameters.

Table 4 contains the input values for the following example:

Switch to Serial Port Band rate at 4800

Example: $PSRF100,1,4800,8,1,0*0E <CR><LF>

| Name | Example | Description |
|---|---|---|
| MID | $PSRF100 | PSRF100 Protocol header |
| Protocol | 1 | 0 = SiRF OSP<br>1 = NMEA |
| Baud | 4800 | 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 |
| DataBits | 8 | 8 only |
| StopBits | 1 | 1 only |
| Parity | 0 | 0 = None only |
| Checksum | *0E | - |
| <CR><LF> | - | End of message termination |

Table 4: Set Serial Port Data Format

## 3.4 Improved TTFF

In order to improve the TTFF (Time To First Fix), it is recommended to keep Vcc supplied or backup battery at V_BAK at all times so that Navigation data and initial condition (timing and approximate location) are kept current. To reduce power consumption, customers can take advantage of the many sophisticated low power mode features available in the SiRFstarV chipset.

## 3.5 Self-start Configuration

In order to minimize the GPIO required for operating A5100-A, WAKEUP (pin 19) and ON_OFF (pin 6) can be tied together for entering the self-start mode such that no ON_OFF pulse requires. The following picture shows the recommended connection
for self-start configuration with UART host port enabled.

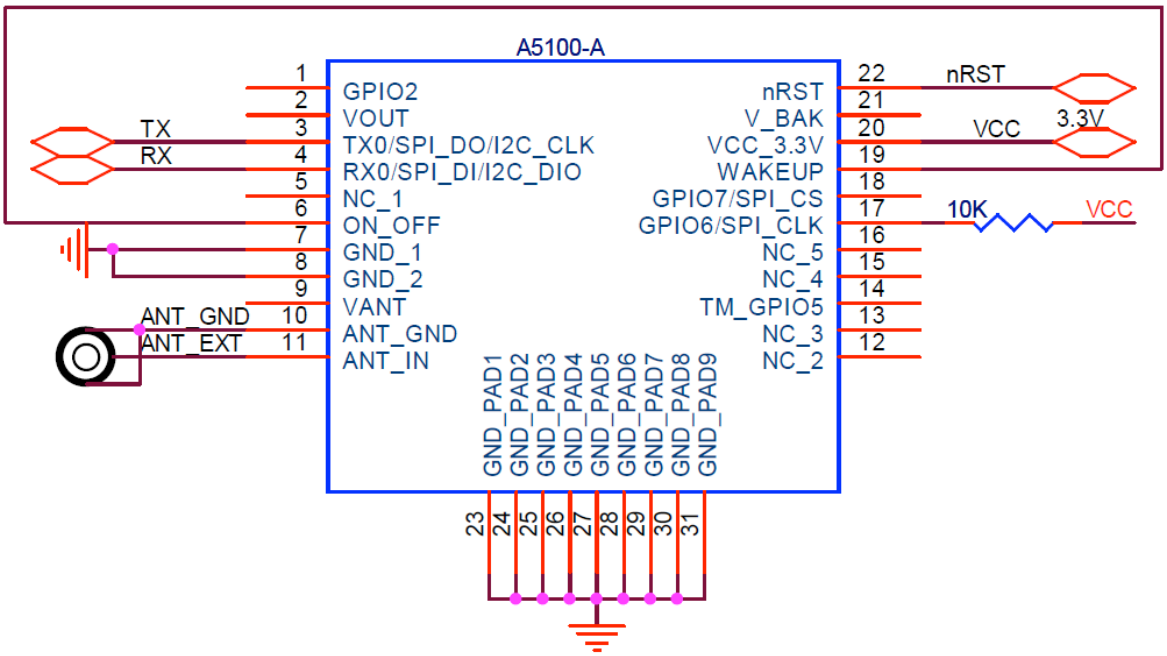



Figure 8: Self-start configuration A5100-A

Remarks:

- For self-start mode, full power operation will be activated once Vcc applied. No power save mode (PTF / MPM / TP) will be supported. If customer accidentally configuring A5100-A into hibernation mode, Vcc has to be disconnected and re-plugged so as to operate the module in full power mode.

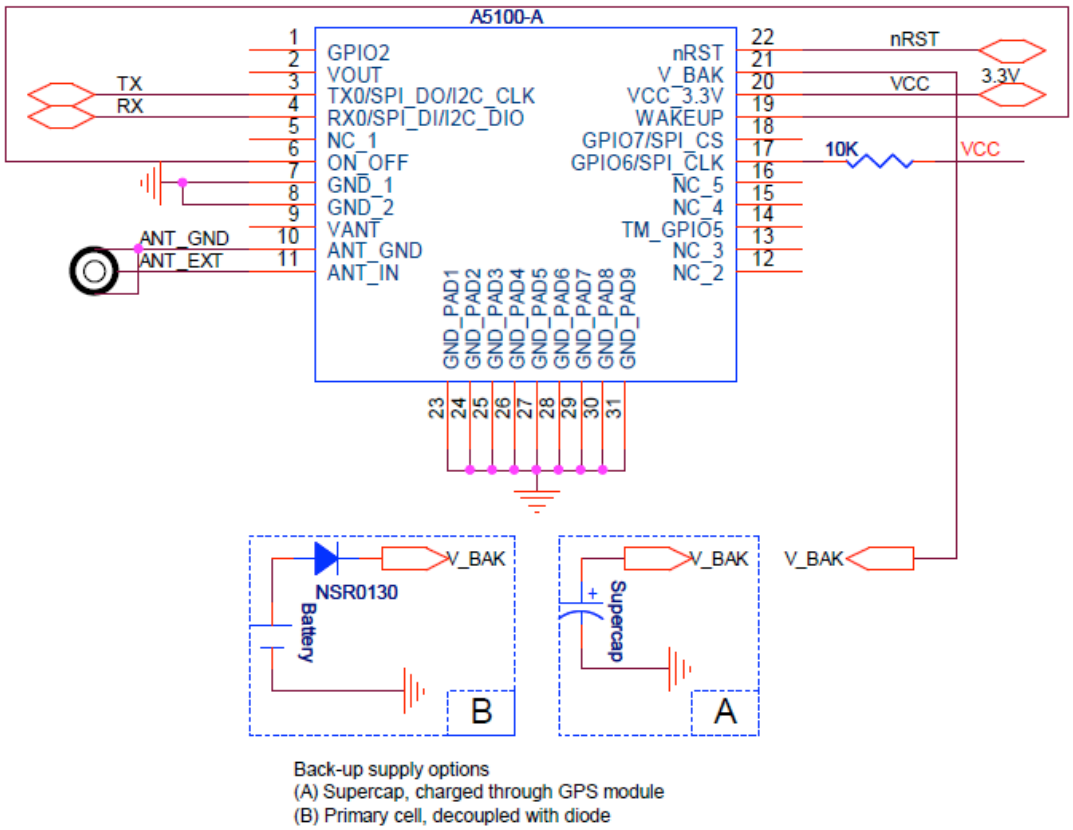


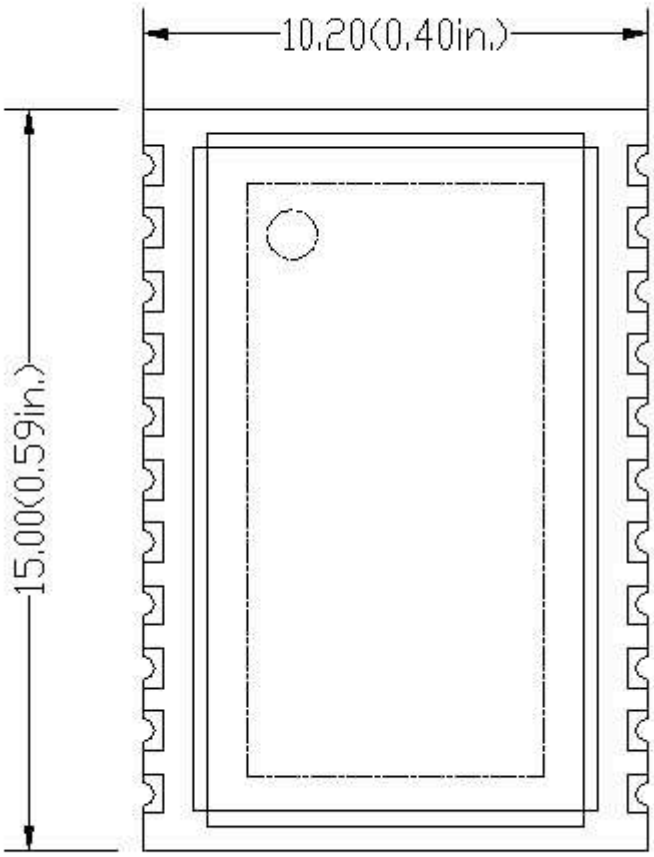

Figure 9: Self-start configuration A5100-A with Vbak

Remarks:

- External antenna input impedance is 50 Ω. Match as close as possible.
- A battery back-up circuit for the RTC (Real Time Clock) should be considered (see chapter: “10.6 Battery Back-up”)
- For self-start mode, full power operation will be activated once Vcc applied. No power save mode (PTF / MPM / TP) will be supported. Customer can toggle the ON_OFF pin so as to put the module into hibernation and then remove the Vcc. A5100-A will be self-started again in full power mode when Vcc applied.

# 4 Mechanical Outline

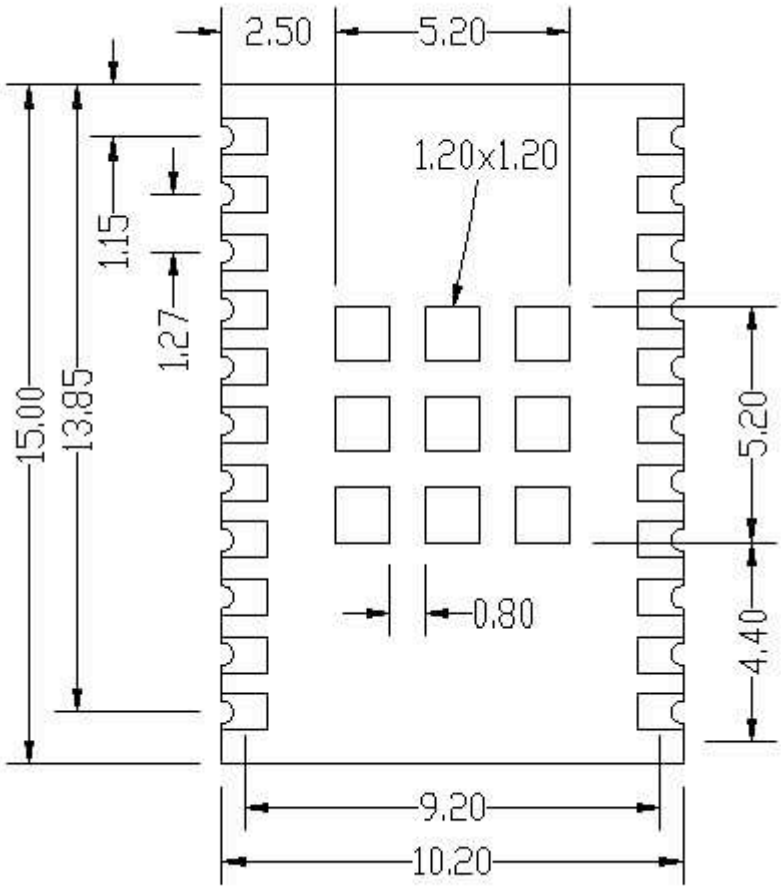
## 4.1 Details Component Side A5100-A




All dimensions in [mm, (inch)]

Figure 10: Mechanical outline component side A5100-A

## 4.2 Details Solder Side A5100-A




Solder pad size (outer pads): 1.0 x 0.8
Solder pad size (inner pads): 1.2 x 1.2
All dimensions in [mm]

Figure 11: Mechanical outline solder side A5100-A

# 5 Pin-out Information

## 5.1 Layout A5100-A

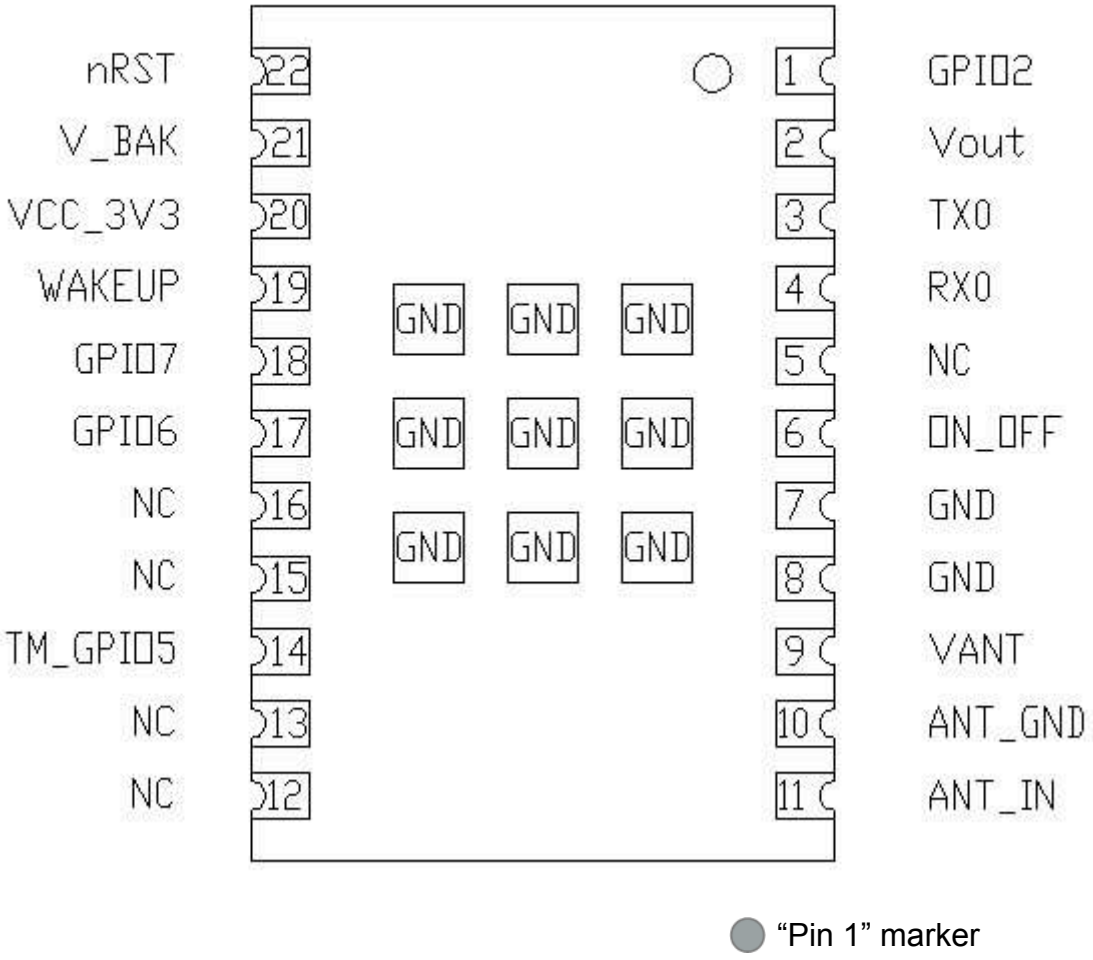



Figure 12: Pin-out information (bottom view) A5100-A

Center Ground pins are for shock / vibration resistance purpose.

## 5.2 Description A5100-A Signals

| Pin | Symbol | Function | Description |
|---|---|---|---|
| 1 | GPIO2 | Input/Output | Leave open |
| 2 | VOUT | Voltage output | Permanent VCC-0.1 V voltage output for up to 50mA current max |
| 3 | TX0/<br>SPI DO/<br>I2C CLK | Output | Serial output 0, NMEA out if configured for UART<br>SPI data out pin when module works in SPI mode<br>I2C clock pin when module works in host port I2C mode |
| 4 | RX0/<br>SPI DI/<br>I2C DIO | Input | Serial input 0, NMEA in if configured for UART<br>SPI data in pin when module works in SPI mode<br>I2C data I/O pin when module works in host port I2C mode. |
| 5 | N.C. | None | Leave open |
| 6 | ON_OFF | Input | Connect to push-pull output! This is mandatory!<br>- Set to LOW by default<br>- Toggle to HIGH and back to LOW<br>> for first start-up after power on<br>> to request a fix in SiRFaware™ or PTF mode<br>> to go into or wake up out of hibernate mode<br>- Connect it to WAKEUP pin for self-start mode |
| 7 | GND | Power Supply | Ground (power supply) |
| 8 | GND | Power Supply | Ground (power supply) |
| 9 | VANT | Antenna Supply Voltage Input | Power supply input for external active antenna – provide according voltage (up to 5.0 VDC) – switched internally |
| 10 | ANT_GND | RF GND | Antenna Ground |
| 11 | ANT_IN | Antenna Input | Antenna signal / Z=50 Ohm (antenna input) – must not exceed 30dB gain including cable loss |
| 12 | N.C. | None | Leave open |
| 13 | N.C. | None | Leave open |
| 14 | TM_GPIO5 | Output | Time Mark – 1PPS signal |
| 15 | N.C. | None | Leave open |
| 16 | N.C. | None | Leave open |
| 17 | GPIO6/<br>CTS/<br>SPI CLK | Input | Configuration pin to run in UART mode (10k pull-up to 3.3V, e.g. to pin 3),<br>Leave open for SPI & host port I2C modes.<br>SPI clock pin when module works in SPI mode |
| 18 | GPIO7/<br>RTS/<br>SPI CS | Input | Configuration pin for communication mode. 10K to GND for host port I2C mode; leave open for SPI & UART modes.<br>SPI chip select pin when module works in SPI mode |
| 19 | WAKEUP | Output | - Status of digital section, Push-Pull output<br>Low = OFF, KA (Keep Alive)-only, Hibernate, or Standby mode<br>High = ON, operational mode<br>- Connect it to ON_OFF pin for self-start mode |
| 20 | VCC | Power Supply | 3.0 – 3.6 VDC (power supply) |

| | | | |
|---|---|---|---|
| 21 | V_BAK | Power Supply | Back - up pin of module for “super cap” or battery |
| 22 | nRST | Input | Reset input, active low |

Table 5: Pin description A5100-A

# 6 Electrical Characteristics

## 6.1 Operating Conditions

| Pin | Description | Min | Typical | Max |
|---|---|---|---|---|
| 21 | Vbak | 1.8V | 3.0V | 3.6V |
| | Standby Current (4) | | 60uA | |
| 20 | $V_{cc}$ | 3.0V | 3.3V | 3.6V |
| | Full power Mode (Searching) Peak Current(1) | | 40mA | |
| | Full power mode (Searching) Average Current(2) | | 34mA | |
| | Full power mode (Tracking) Average Current(3) | | 28mA | |
| | TricklePower Mode | | 10mA | |
| | Push-to-Fix Mode | | 600uA | |
| | Micro Power Mode（SiRFaware ™） | | 300uA | |
| | Hibernate Status | | 60uA | |

Table 6: A5100-A electrical characteristics

(1) Peak searching current is characterized by millisecond bursts above average searching current
(2) Average searching current is typically only the first two seconds of TTFF
(3) Tracking current typically includes tracking and the post searching portion of TTFF
(4) During standby state: RTC block and core powered on and clock off.

## 6.2 Absolute Maximum Ratings

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| Vcc | A5100-A Power supply | -0.3 | +3.6 | V |
| Vin | Voltage to I/O pins | -0.3 | +3.6 | V |
| Iov | Input current on I/O pins | -10 | 10 | mA |
| Itdv | Absolute sum of all input currents during overload condition | | 200 | mA |
| Tst | Storage temperature | -40 | 85 | °C |
| Vant | Antenna supply voltage | 0 | 5.5 | V |
| Iant | Antenna supply current | 0 | 50 | mA |

Table 7: Absolute maximum ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.