LOCOSYS

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# LS2003C Hardware Design Guide

**Version 1.0**

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# 1 General Rules for Design-in

In order to obtain good GPS performances, there are some rules which require attentions for using LS2003C GPS smart antenna module.

# 2 Circuit Design

## 2.1 Power supply VCC

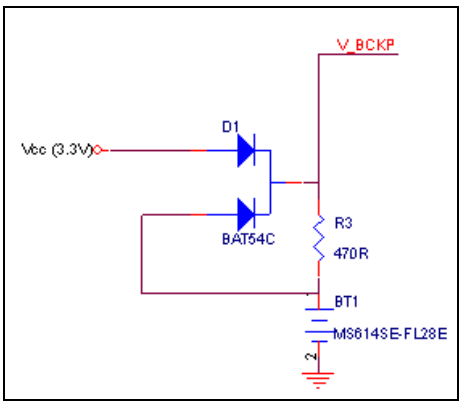
It is necessary to provide a clean and stable power supply for our GPS smart antenna module in order to obtain good performances. Unstable power source may have a significant negative impact on the GPS performance. To achieve this, the Vcc ripple must be controlled under 50mVpp. In addition, there are also some suggestions for main power circuit design:

(1). Add a ferrite bead, power choke or low pass filter for power noise reduction
(2). linear regulator is better than switch DC/DC power supplier in ripple
(3). Use enough decoupling capacitors beside VCC for stable voltage.

## 2.2 V_BCKP backup battery

Backup power is used for keeping RTC running and navigation data after the main power was turn off. For a short term VCC off, with backup power, the GPS module can have a faster TTFF, Time to First Fix, or hot start when next power on.

It is recommended to connect the module V_BCKP to a sustained power source (ex: Li-Ion rechargeable coin battery, super cap) for backup power. See figure for reference.




Using Coin Battery for GPS smart antenna module

Note: 1. The V_BCKP pin must be supplied power to make the module function-able.

2. The sequence of V_BCKP and VCC power supply must comply with the following conditions:

- V_BCKP priority than VCC power is supplied.
- V_BCKP and VCC's power is supplied at the same time.

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### 2.3 UART (RX/TX) –Serial Interface

(1). UART is the default interface (TTL level) that has the baud rate ranging from 4800 bps to 115200bps.

(2). Placing damping resistor on the RX and TX of the GPS module could limit the interference from host MCU or high speed digital logics. Fine tuning the damping resistor is required to suppress interference efficient. The damping resistor would be a chock coil as well.

(3). Please leave RX open if it is not used as there is an internal pull-up to VCC.

(4). Please don't connect diode(s) to RX/TX as it will decrease signal driving capability which might adversely affect RX/TX signal level (ex. no data output).

(5). If RS232 logic-level is needed for any particular application, and then the level shifter is necessary.

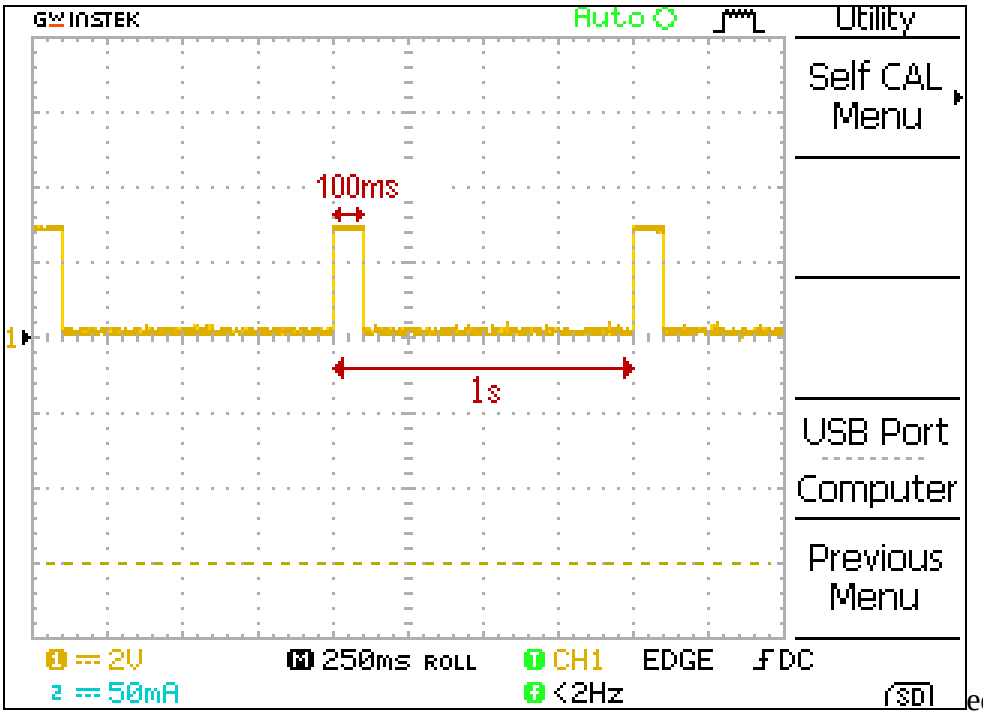
(6). If USB logic-level is needed for any particular application and then the USB bridge is necessary.

### 2.4 GND-Ground

Make sure all GND pins of smart antenna module are connected to a good ground plane. Please refer to "3.3 Ground Segmentation".

### 2.5 1PPS

1PPS signal is an output pulse signal used for timing application, its electronic characteristic are list below:

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1PPS signal and its pulse width with 100ms duration

Low Voltage level: 0~0.4V

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High Voltage level: 2.8~3.1V
Duration: 100ms (Firmware customization for duration is available)
Period: 1s

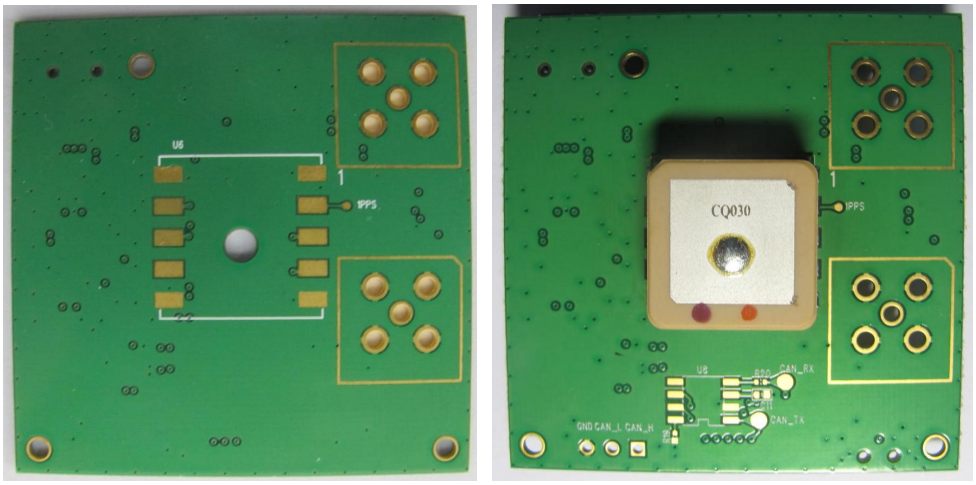
LOCOSYS provides following 1pps signal output mode for customer selections

- Standard GPS module will output the 1pps after the module is 3D_FIX.
- Free run 1PPS output after 3D_FIX
- GPS module will output the 1pps after the module is 2D_FIX.
- A customize firmware also could set the 1PPS plus out as soon as power-on disregard to 3D_Fix or not.

# 3 Layout Guideline

## 3.1 Layout underneath the GPS smart antenna module

GPS signal is very weak signal level around -160dBm~130dBm. Any noise or harmonic will decrease the quality of GPS. In modern GPS product, it almost includes LCD, MCU, High Speed digital and RF system (BT, Wi-Fi, DVB-T…). In order to minimize the influence of mentioned noise to GPS smart antenna module, please customer don't place any trace underneath the smart antenna module. In other word, give GPS smart antenna module a clean GND plane is very important.




LS2003C GPS smart antenna module on a 45 x 45 mm clean GND plane

## 3.2 Module Placement

Place the decoupling capacitors close to GPS module
Place the damping resistors close to GPS module
Keep far away from high profile or metal canned components
Do not place:

- GPS module close to high-speed digital processing circuitry

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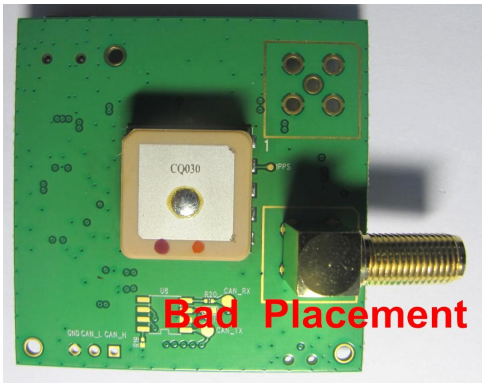
- GPS module close to high-current switching power circuitry
- GPS module close to clock sources circuitry





### 3.3 Ground Segmentation

The separation of ground between GPS module and the rest of the system is recommended to avoid system interference. If this is not possible, it is best to follow these typical rules: segmentation of ground between digital and analogue system, high current and low current system, and different radiation systems in general (such as GPS and GPRS).

One way to segment the ground is to place digital and noise component at one corner of the board, while placing analog and quiet components at the opposite corner of the board. Make sure there is no crossing of microstrip or current between the two component sets and grounds of each sets are contacted in one point only.

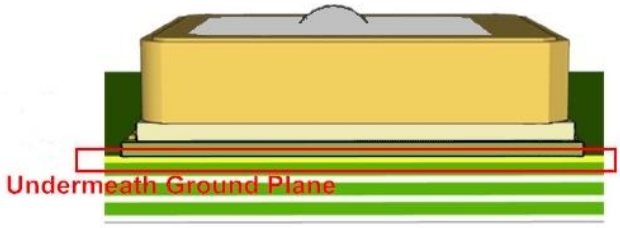
Another way to do this is the place the two different sets at different layers of the board, while the ground of each layer is contacted in one point only (preferable at border of the board).

### 3.4 Ground Plane

A large GND plane direct underneath the module could enhance the magnetic-field line of the antenna for better GPS signal reception. Typical it will improve ~2dB as maximum. It is strongly recommended to have a 45 x 45 mm ground plane designed underneath the LS2003C GPS smart antenna module.

The recommended thickness for the ground layer is 0.5 to 1 ounce (0.0175 to 0.035 mm).

It is best to place the ground plane on the top layer of the PCB, directly underneath the GPS smart antenna module as the figure below shows:



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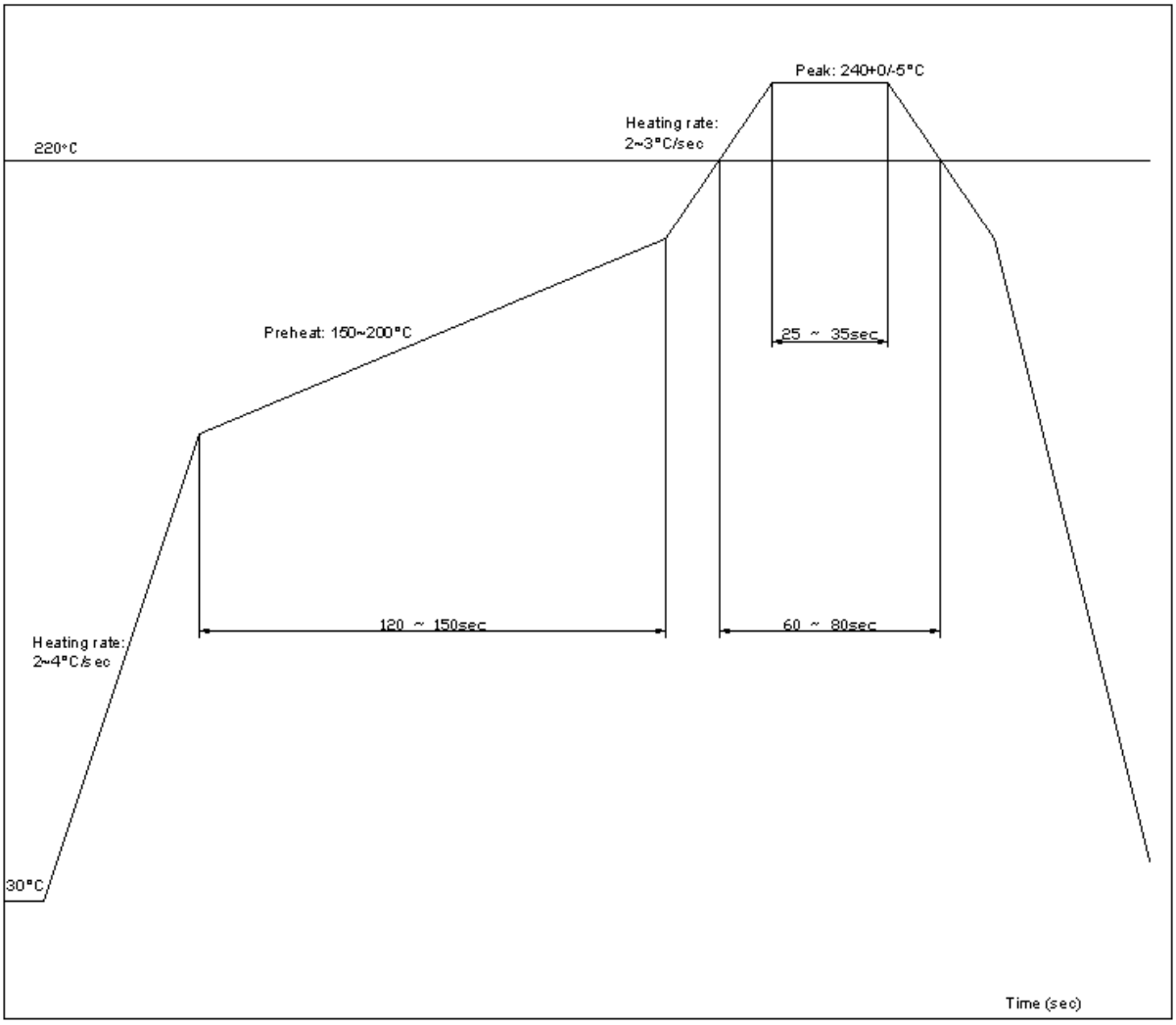
### 3.5 Housing (Case) consideration

The housing (case) of the device should not include any conductive material for the basic antenna reception. The air gap between housing and ceramic patch antenna should maintain 1.5mm in order to maintain antenna frequency.


## 4 Thermal Profile for LS2003C GPS smart antenna module

All the information in this sheet should be used only for Pb-free certification.




Lead –Free Solder Paste (Sn 96.5-Ag 3.0-Cu 0.5) Cycle Interval: 300sec

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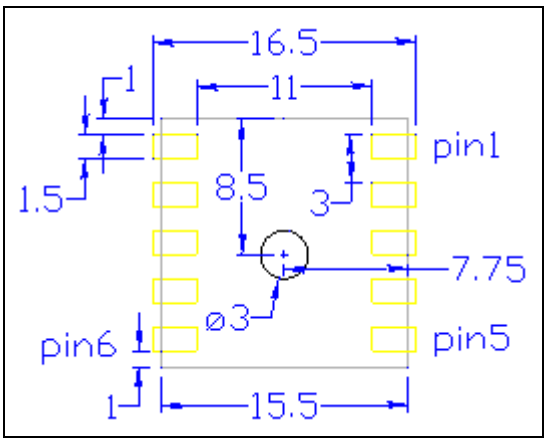
### 4.1 SMT Solder Mask:

Please use the dimension of PCB pad as reference and shrink the size by 0.1 to 0.2 mm and use that as layout for paste mask.




LS2003C Recommended land pattern dimensions

If double-sided SMT soldering is adopted and LS2003C is flipped over to pass through the reflow oven, heat curable SMD adhesives are strongly suggested between LS2003C and the PCB board to avoid LS2003C from falling off.

### 4.2 Manual Soldering:

Soldering iron: Bit Temperature: Under 380°C Time: Under 3 second.