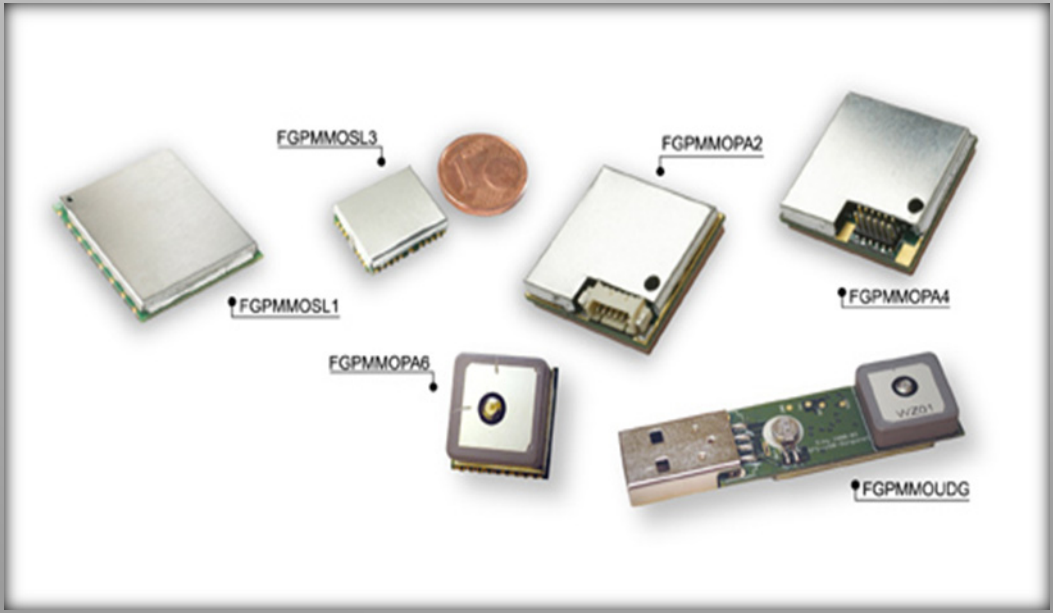
GlobalTop Technology Inc.

GPS Module Application Notes

Revision: A02



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Revision History

History		
Date	**Rev.**	**Description**
20090506	A00	First Release
20090717	A01	Add FGPMMOPA6B (Fully pin compatible with FGPMMOPA6)
20090813	A02	Add VBAKUP and Layout guideline description Change some description about content . Add Appendix page

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Contents

Preface

Please read carefully before you start:

- Global Positioning System (GPS) is the property of American Ministry of National Defense, and they held full responsibilities in regard to the preciseness and the maintenance of the entire system. Any changes they have made may have significant impacts on the capabilities and preciseness of GPS.

- If you use GPS receiver inside buildings, tunnels, or besides any huge objects, the GPS signals might be cut-off or disturbed. Please do not assume the receiver has malfunctioned.

- This application note provides the necessary guideline to successfully design a system using GPS modules. For detailed module specification, please refer to the corresponding datasheet of GPS module.

- GPS Module is an electrostatic sensitive device, please don't touch GPS module directly, please follow ESD safety rule when handling.

- For the first time, it is strongly recommended to bring the device, using GPS module, outdoor with under open sky for at least 10 to 15 minutes to ensure 3D position fix and almanac update.

Technical Support

If you have any technical problems or cannot find the required information in our documents, please feel free to contact us for technical support. Below is a list of information which you can provide that will be very useful to us in determining source of the problem and the necessary solution:

1. Your company name and website
2. Description about application and system
3. GPS module type
4. GPS firmware version
5. Description of the question or problems encountered, together with pictures or videos files
   - Test setup
   - The problem or issue shown in pictures

Technical contact information: support@gtop-tech.com

1. Descriptions

GlobalTop has a variety of GPS modules designed for many different applications. The modules are classified into two families: FGPMMOSLx and FGPMMOPAx series (x denotes the model number). The major difference between these two families is the inclusion of smart patch antenna. PAx comes with the ceramic antenna, while SLx does not. These GPS modules provide a complete GPS solution that excels in position, speed, and accuracy performances as well as high in sensitivity and tracking capabilities in urban environment. The GPS module are powered by MediaTek Inc. GPS chipset, the world's leading digital media solution provider and largest fab-less IC Company in Taiwan. GlobalTop's GPS solutions are suitable for assortment of devices, even small-form-factor ones.

2. General Rule for Design-in

In order to obtain good GPS performances, there are some rules which require attentions for using GPS module:

2.1 Circuit Design

■ Power supply Vcc

It is necessary to provide a clean and stable power supply for our GPS module in order to obtain good performances (Ex: TTFF). **Unstable power source will have a significant negative impact on the GPS performance**. **To achieve this, the Vcc ripple must be controlled under 50mV$_{pp}$.** In addition, there are also some important suggestions for main power circuit design:

- Add ferrite bead, power choke or low pass filter for power noise reduction
- Use linear regulator for voltage regulation
- Use enough decoupling capacitors for stable voltage due to current variation.

■ VBACKUP(BACKUP_PWR) backup battery

The backup power is necessary for all modules to work normally.

Backup power is used for keeping RTC running and navigation data after the main power was turn off. For most cases with backup power, the GPS module can have a shorter TTFF, Time to First Fix, or hot start.

It is recommended to connect the module via VBACKUP to a sustained power source (ex: Li-Ion rechargeable coin battery) for backup power. There are several ways to maintain the backup power, such as Li battery, super capacitor or just wired to VCC. See figure 1, 2 and 3 for reference. About super capacitor design, please refer to appendix.

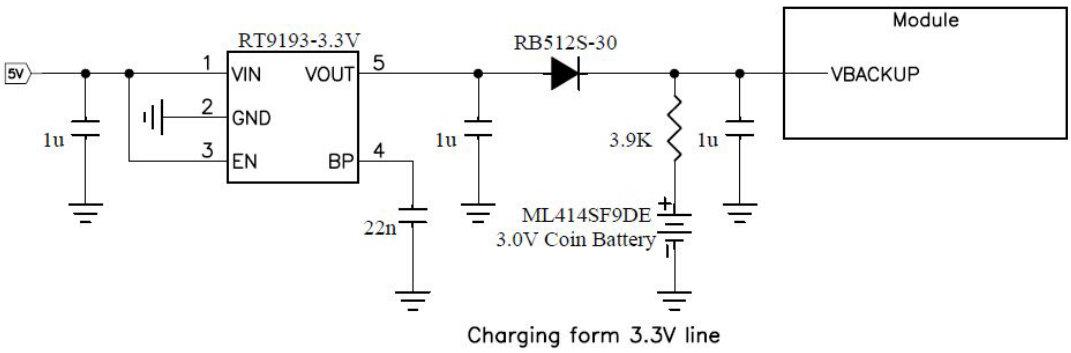


Figure 1, Backup power using regulator for GPS module

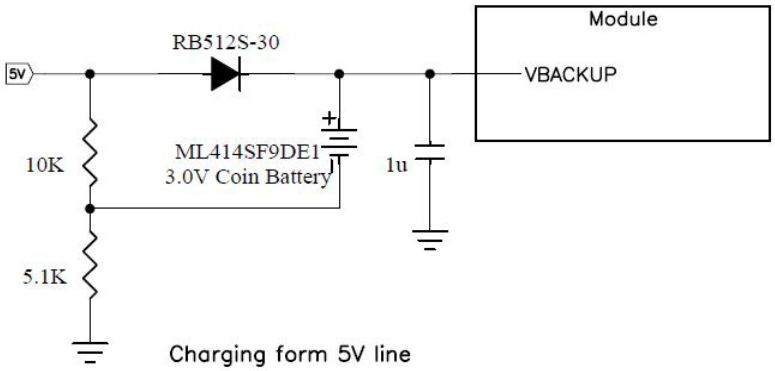


Figure F2, Backup power using voltage divider for GPS module

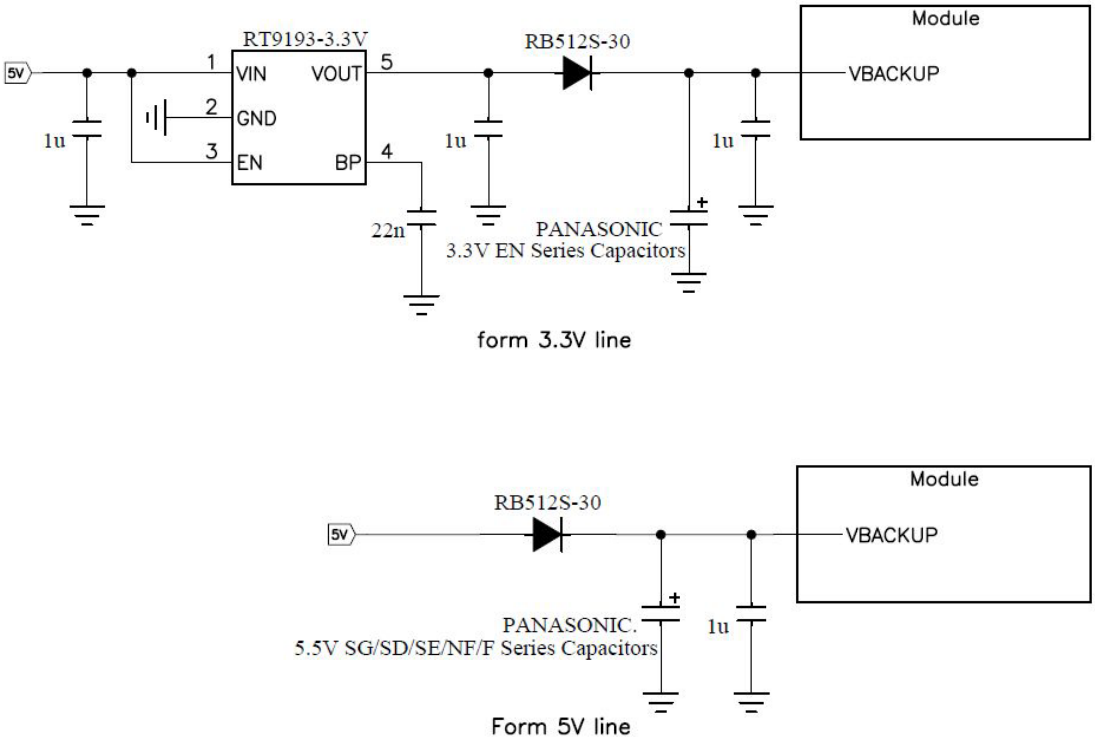


Figure F3, Backup power using regulator with super capacitor

- **UART 0 (RX/TX) –Serial Interface**

UART is the default interface, and it supports transfer baud rate ranging from 4800 bps to 115200 bps. The logic is TTL level. If the RS232 logic-level is needed for application, then the use of level shifters is necessary. Please leave RX open if it is not used, there is an internal pull-up to VCC. Please don't use an external pull-up for unexpected current draw.

- **GND-Ground**

Make sure all GND pins of module are linked to a good ground connection.

- **Antenna Design ,ANTENNA_IN**

GPS antenna is a receiving device to acquire week GPS signal from sky. Popular solution would be ceramic patch antenna due to its small form factor with low cost. There are two types of antennas, passive and active. Passive antenna is with solely antenna itself. Active antenna is with LNA to have high gain with the cost of current supply.

Antenna can be chosen according to radiation efficiency, radiation pattern, gain, bandwidth, form factor and cost. Make sure the ground plane is sufficient for the antenna to operate with acceptable performance. And place the matching circuit between antenna and GPS module to compensate the frequency shift due to PCB layout.

To optimize the reception performance under an unfavorable operation environment with noisy sources, please consider the use of an additional SAW filter as a possible solution

- The total noise figure, NF, must be under 1.5dB.
- Make sure the antenna is not placed closely to the noisy portion of the whole circuit design.

For the noise rejection of out-of-band, make sure the antenna do NOT have oscillation frequency except the L1 band, 1575.42MHz. For Example:

- ✓ 1575.42MHz - main frequency source form not GPS source
- ✓ 525.14MHz - frequency source (525.14 x 3 = 1575.42MHz)
- ✓ 315.084MHz - frequency (315.084 x5=1575.42 MHz)
- ✓ 4.092MHzMHz - GPS intermediate frequency

2.2 Layout Guideline

Please follow the layout criteria to design a system using GPS module.

■ Clearance

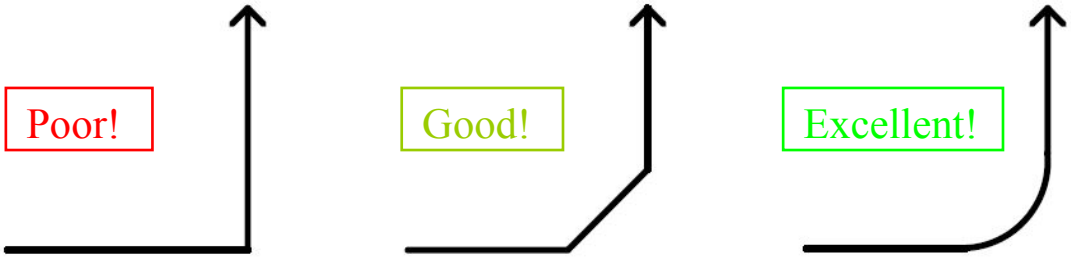
It is better to place GPS module higher than other circuitry for better reception.
There is only patch antenna on top layer, but other components place on bottom layer

■ Placement

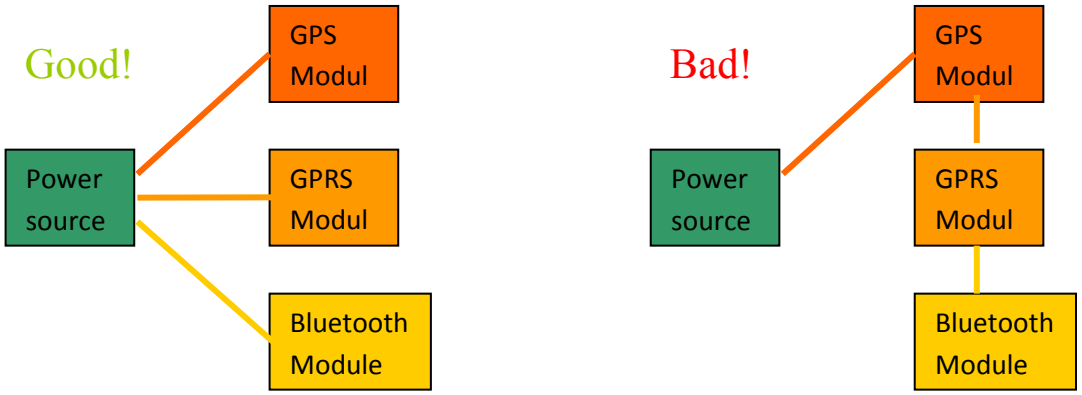
Place the decoupling capacitors close to GPS module
Place the damping resistors close to GPS module
Do not place GPS module close to high-speed digital processing circuitry
Do not place GPS module close to high-current switching power circuitry
Do not place GPS module close to clock sources circuitry
Do not place patch antenna close to the tall metal object.

■ Trace

Do not trace under the GPS module
The USB differential signals should be trace close for minimum loop radiation
RF traces have to execute the 50 ohm impedance control for good sensitivity
Any right angle turn in trace routing should be accomplished with two 135 degree turn or an arc turn



It is better to have independent trace of power source for any device

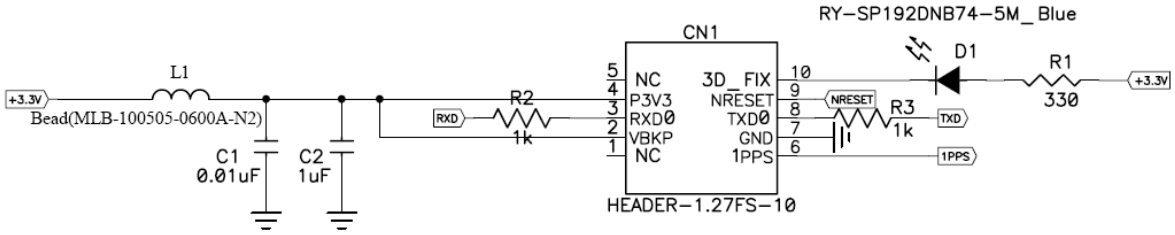


■ Ground Segmentation

It is better to have a complete ground plane under the layer of GPS module

3. Reference Design and Notice

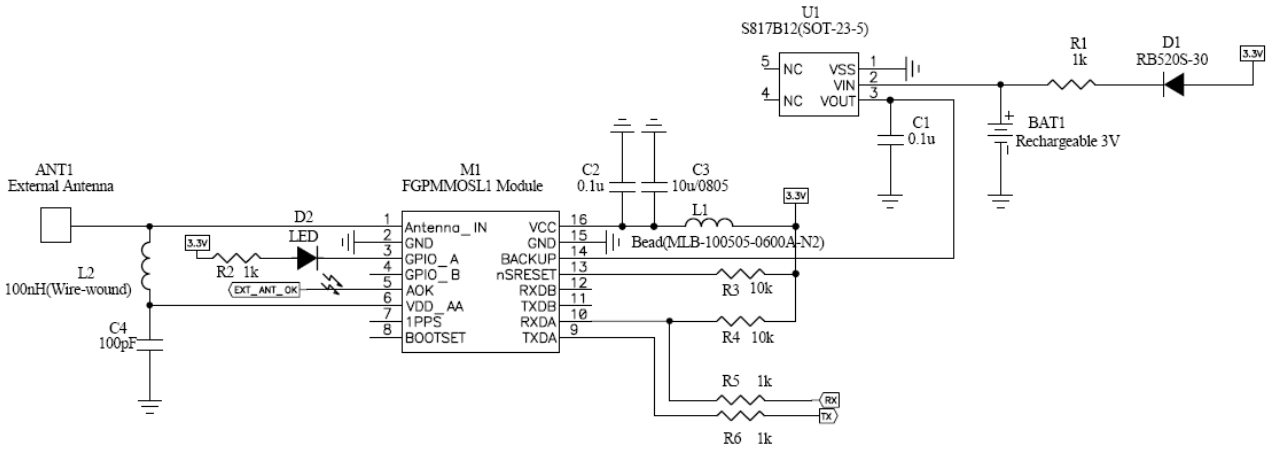
3.1 FGPMMOMI1 and FGPMMOMI3



Notice about design:

Please note the Vcc and VBAK power source design, it is recommended there are some capacitors and ferrite chip beads.

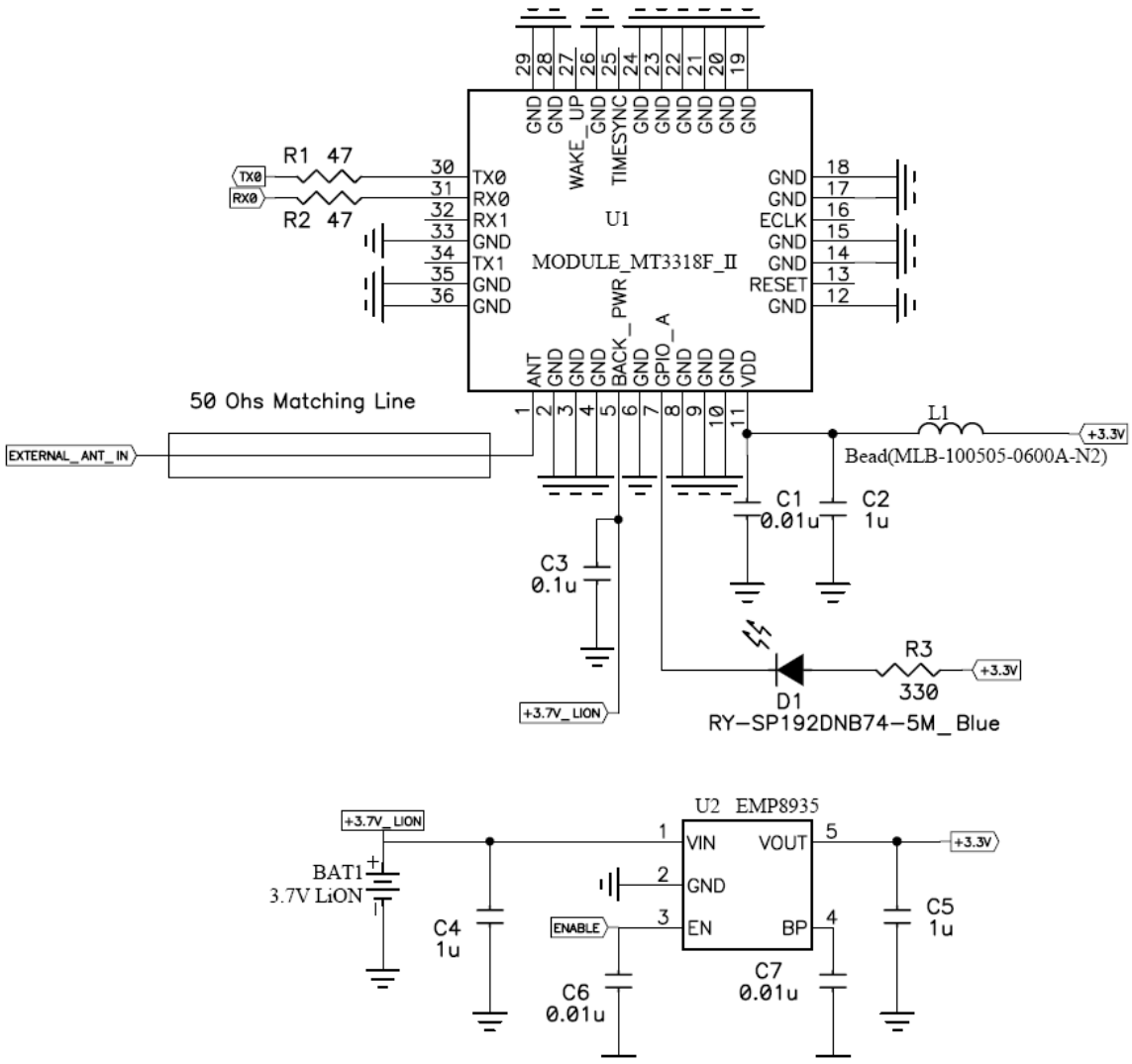
3.2 FGPMMOSL1



Notice about design:

Please note the Vcc and VBAK power source design, it is recommended there are some capacitors and ferrite chip beads.

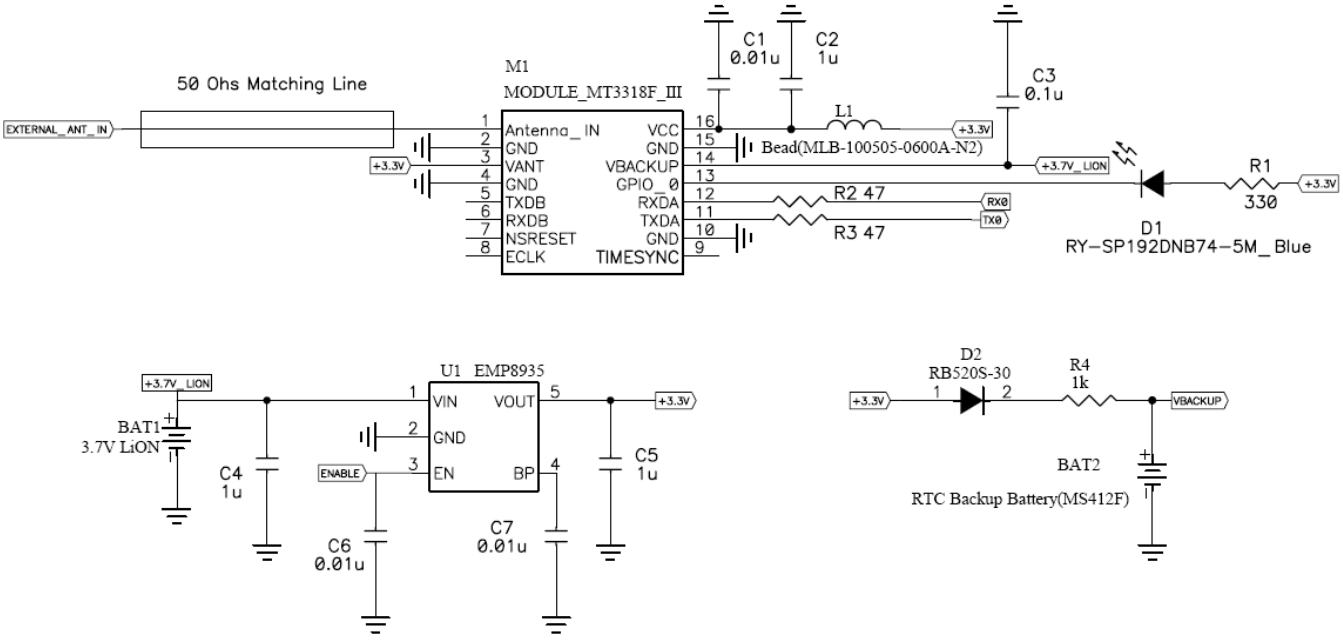
3.3 FGPMMOSL2



Notice about design:

Please note the Vcc and VBAK power source design, it is recommended there are some capacitors and ferrite chip beads.

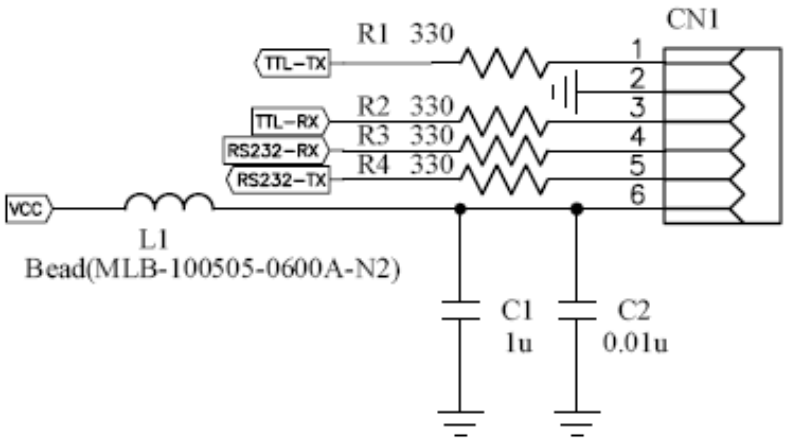
3.4 FGPMMOSL3



Notice about design:

Please note the Vcc and VBAK power source design, it is recommended there are some capacitors and ferrite chip beads.

3.5 FGPMMOPA1



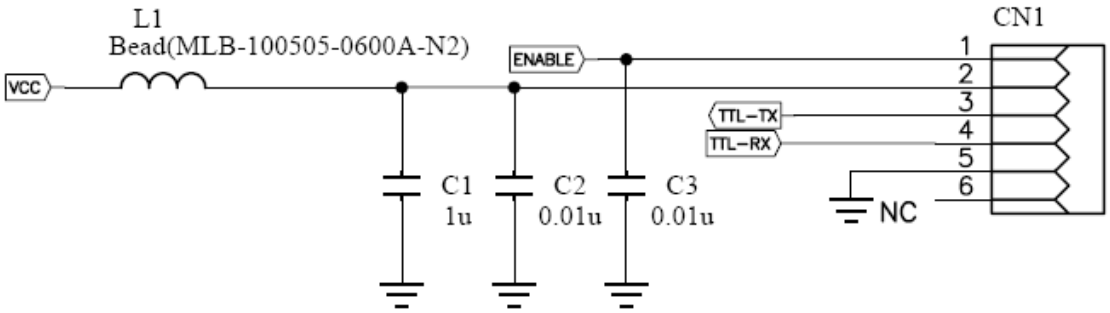
Note: For better filtering L1/C1/C2/R1/R2/R3/R4 components need to be placed Closely CN1

Notice about design:

Please note the Vcc and VBAK power source design, it is recommended there are some capacitors and ferrite chip beads.

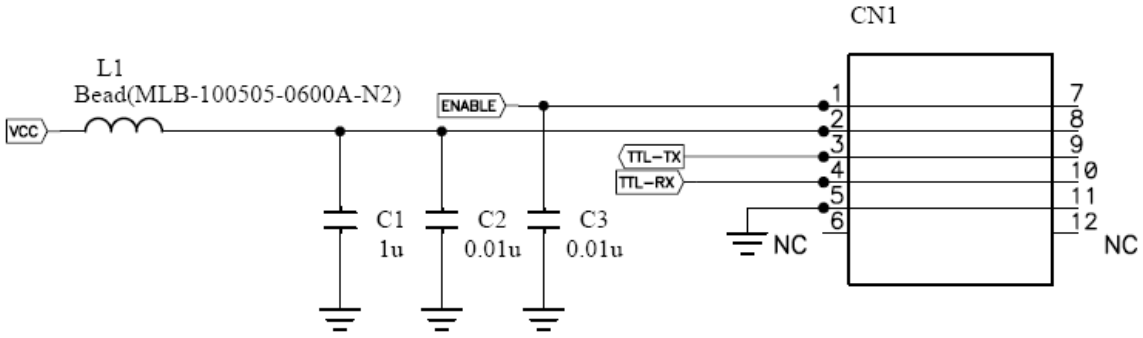
3.6 FGPMMOPA2

FGPMMOPA2-C reference design



Note: For better filtering L1/C1/C2/C3 components need to be placed Closely CN1

FGPMMOPA2-P reference design

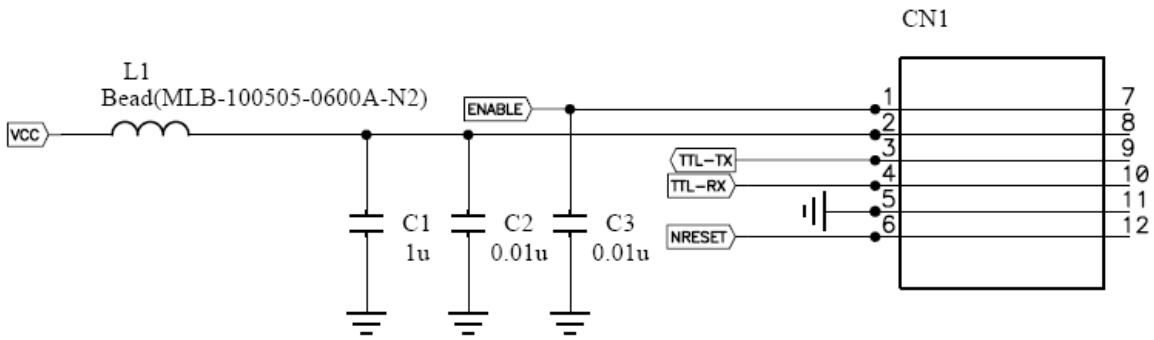


Note: For better filtering L1/C1/C2/C3 components need to be placed Closely CN1

Notice about design:

Please note the Vcc and VBAK power source design, it is recommended there are some capacitors and ferrite chip beads.

3.7 FGPMMOPA3

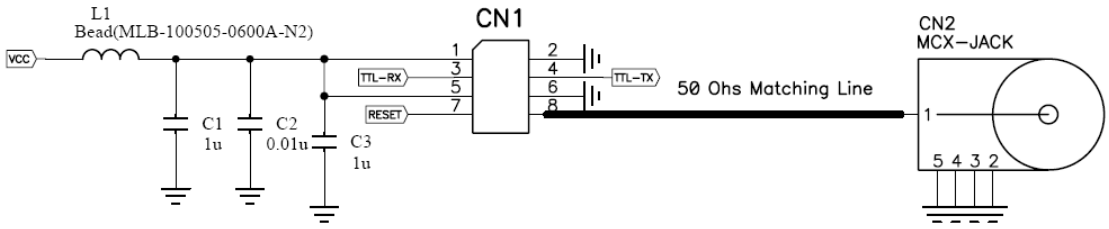


Note: For better filtering L1/C1/C2/C3 components need to be placed Closely CN1

Notice about design:

Please note the Vcc and VBAK power source design, it is recommended there are some capacitors and ferrite chip beads.

3.8 FGPMMOPA4

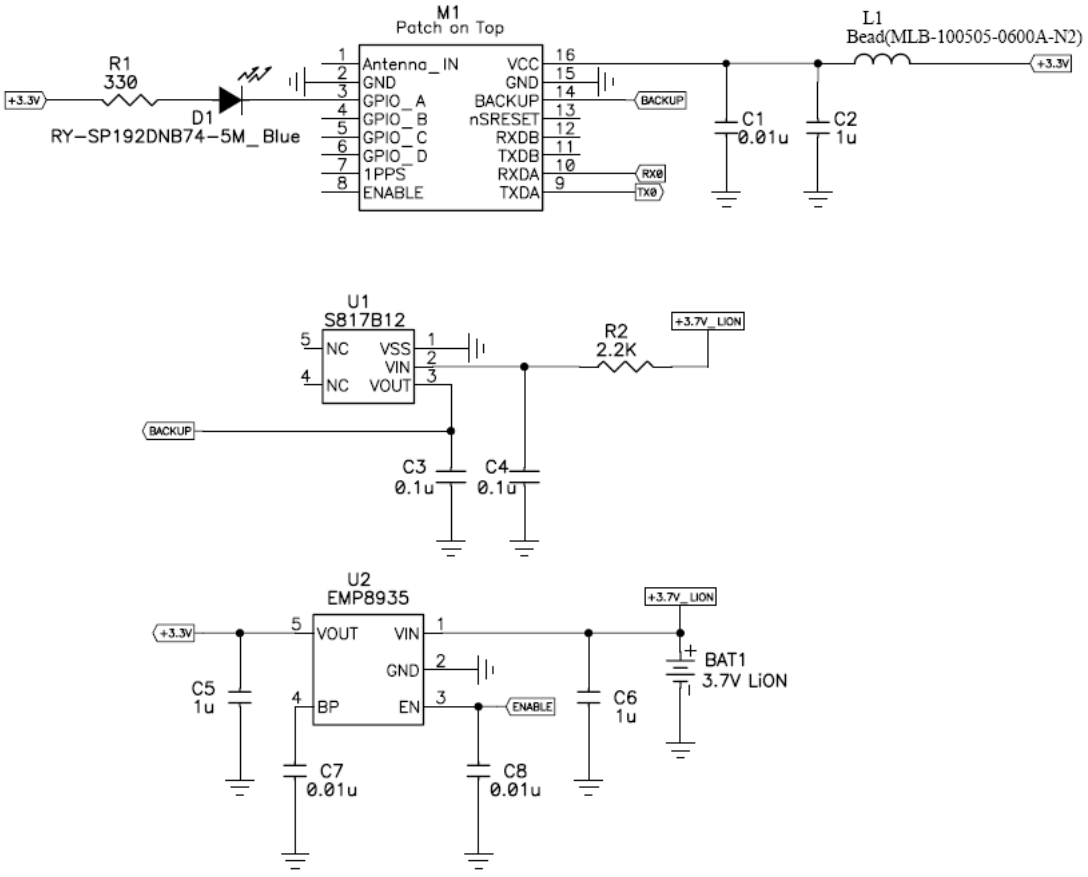


Note: For better filtering L1/C1/C2/C3 components need to be placed Closely CN1

Notice about design:

Please note the Vcc and VBAK power source design, it is recommended there are some capacitors and ferrite chip beads.

3.9 FGPMMOPA5

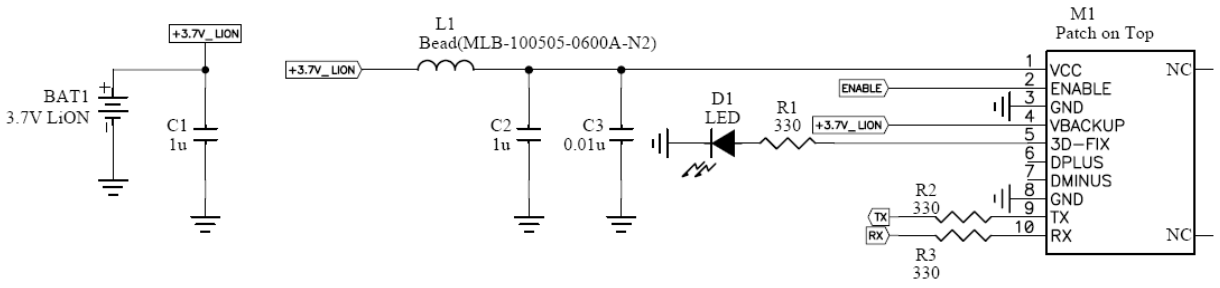


Notice about design:

Please note the Vcc and VBAK power source design, it is recommended there are some capacitors and ferrite chip beads.

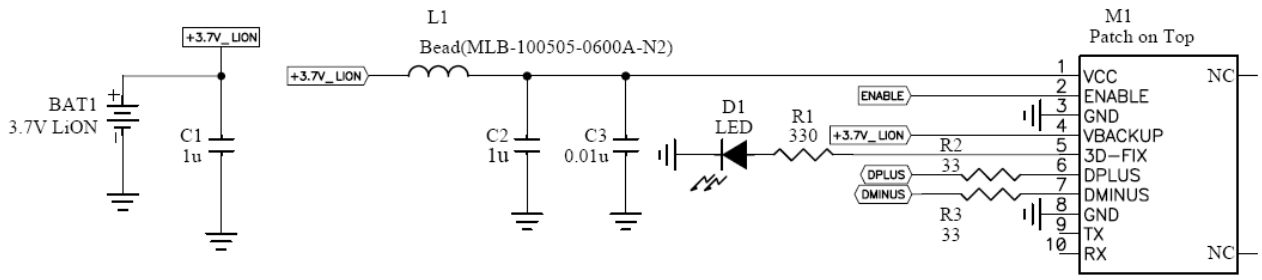
3.10 FGPMMOPA6/FGPMMOPA6B

FGPMMOPA6/PA6B UART reference design



Note: For better filtering L1/C2/C3 components need to be placed Closely Pin 1(VCC)

FGPMMOPA6/PA6B USB reference design



Notice about the design:

ENABLE (Pin2)

Keep open or pull high to Power ON. Pull low to shutdown the module.

Enable (High): 1.8V<= Venable<=VCC

Disable (Low): 0V<= Venable<=0.25V

The pin could be left open if system doesn't want to shut down the power.

VBACKUP (Pin4)

This is the power for GPS chipset to keep RTC running when main power is removed. The voltage should be kept between 2.0V and 4.3V. (Typical：3.0V)

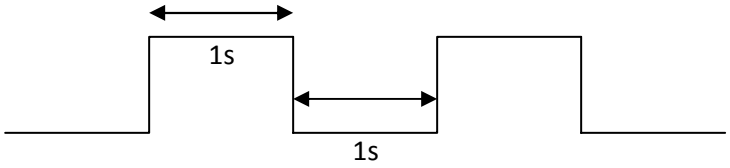
The pin must be connected for normal operation.

■ 3D-FIX (Pin5)

The 3D-FIX was assigned as fix flag output. If not used, keep floating.

■ Before 2D Fix

The pin should continuously output one-second high-level with one-second low-level signal.



■ After 2D or 3D Fix

The pin should continuously output low-level signal.

DPLUS (Pin6)

USB Port DPLUS Signal: if you use the USB interface for connection, please install MT3329 USB VCP driver before you use the module.

DMINUS (Pin7)

USB Port DMINUS Signal: if you use the USB interface for connection, please install MT3329 USB VCP driver before you use the module.

(Reference Only)

4. Thermal Profile for SMD Modules

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

SMT Reflow Soldering Temperature Profile:

Average ramp-up rate (25 ~ 150℃): 3℃/sec. max.

Average ramp-up rate (270℃ to peak): 3℃/sec. max.

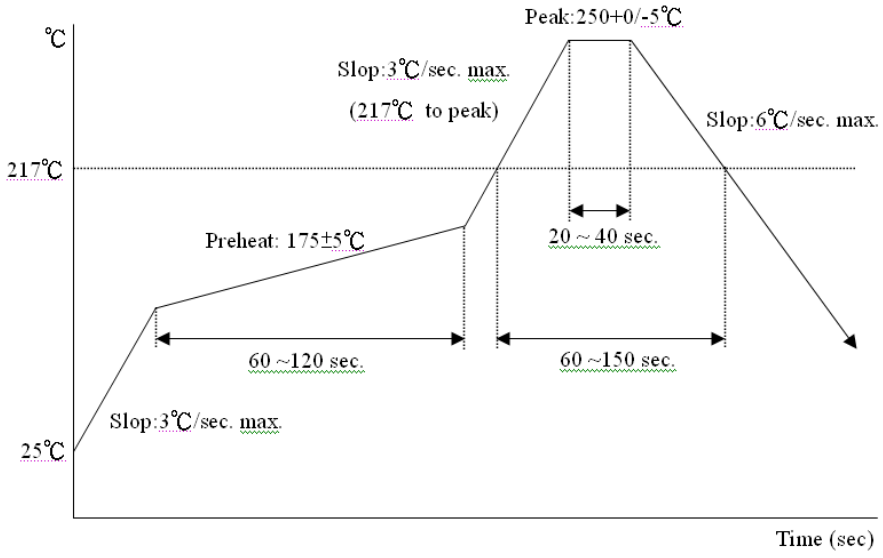
Preheat: 175 ± 25℃ 、60 ~ 120 seconds

Temperature maintained above 217℃: 60~150 seconds

Peak temperature: 250 +0/-5℃ 、20~40 seconds

Ramp-down rate: 6℃/sec. max.

Time 25℃ to peak temperature: 8 minutes max.



Manual Soldering:

Soldering iron: Bit Temperature: Under 380℃ Time: Under 3 second.

5. Troubleshooting

How to check for the working status of PA6/PA6B?

The first thing to check for is the NMEA sentence output through TX by using various application tools. For example: you can use windows default tool - WinXP Hyperterminal, or you can use other GPS application program to check for GPS status.

If there is no NMEA output, this indicates the PA6/PA6B module is currently not working. Please double check your schematic design. Down below we listed some of the possible items to check for your reference:

Item 1: VCC (Pin1)

The voltage should be kept between 3.2V to 5.0V. **(Typical：3.3V)**, **Please double-check.**

Item 2: ENABLE (Pin2)

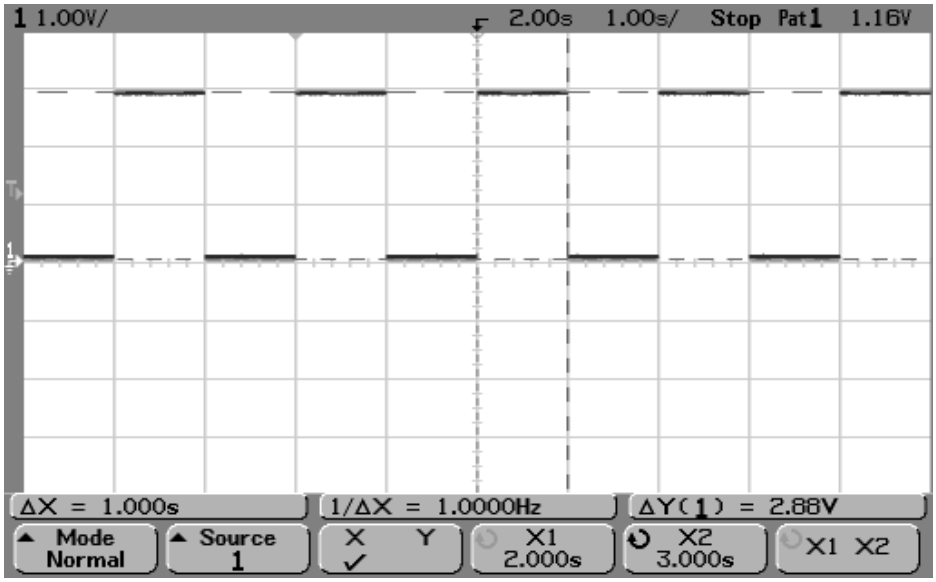
PA6/PA6B module have Internal resistor to pull high (to Vcc), the level is Vcc level, please check the enable pin should be kept between 3.2V to 5.0V . (Typical：3.3V), **Please double-check.**

Item 3: VBACKUP (Pin4)

The voltage should be kept between 2.0V~4.3V. **(Typical：3.0V)**. If the module has no power for the VBACKUP, the GPS module will not work. It is recommended that a sustain power for VBACUP is supplied to keep RTC time and navigation data, **Please double-check**

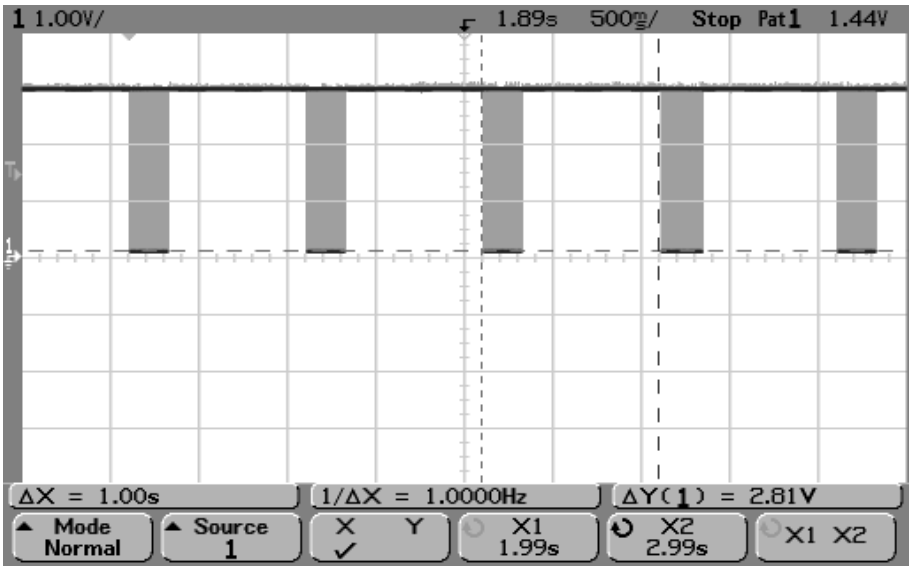
Item 4: 3D-FIX (Pin5)

If all the measurements are within the specifications, please also measure 3D-FIX (Pin5) signal. Before 2D Fix, **the pin should output one-second high-level signal follow with one-second low-level signal.**



TXD (Pin9)

The UART transmitter of the module, it outputs the GPS NMEA information for application.



6. Contact

For help or further information, please contact us via the following methods:

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Appendix. Supper Capacitor Design

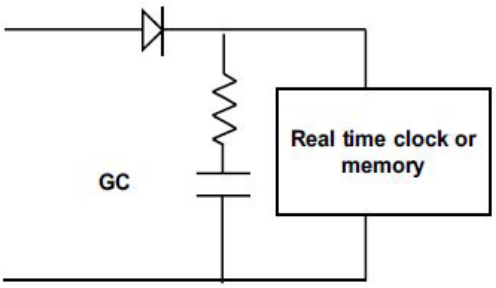
About Supper capacitors

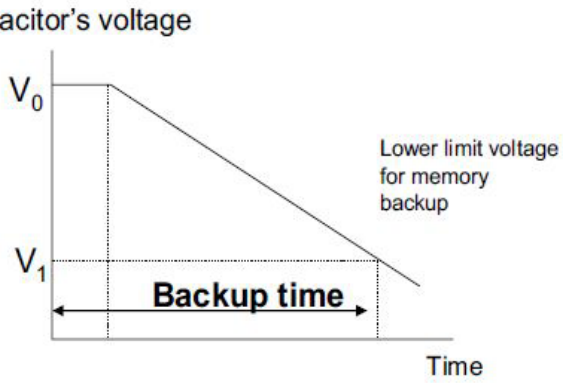
Supper capacitors have a useful life-time similar to aluminum electrolytic capacitors. The life of a supper capacitors capacitor is largely dependent on the operating temperature, humidity, applied voltage, current and backup time requirements. Therefore, the life of a supper capacitor is determined based on the backup time set by the customer.

How to calculate the backup time

The example teach how to calculate the backup time.

$$T=C\ (V_0 - V_1) / (I + I_L)$$





Example:

$V_0 = 2.5V$, $V_1 = 1.8V$, $I = 10uA$, $C = 0.2F$

$T = 0.2\ (\ 2.5 - 1.8\ ) / (10\ e\text{-}6 + 0.2x10^{-6})$
$= 0.14/10.2x10^{-6}$
$= 13,725$ seconds
$= 3.8$hours

T: Backup time (second)
C: Capacitance of Gold Capacitor (F)
V_0: Applied voltage(V)
V_1: Lower limit voltage for memory backup(V)
I: Current during backup(A)
I_L: Leakage current(A) about 0.2uA