

# GPS Receiver Design Document

GPS Receiver (Rojone A-G305NOT23200C (Rojone Lot 1505 0001))

Continuous: 185mA; Trickle: 225mA initial, 180mA continuous, 20mA sleep; Memory Backup: ~20µA (CR-2025 150mAh = 7000hrs = 290days = 9.5 months)

## Power Supply

MAX757 based DC-DC step-up converter (Farnell 459-549 \$12.33)

Input: 1.9-3.1VDC, Output: 5VDC regulated, 200mA peak output

Low Battery: On: 1.875VDC Off: 1.904VDC

Input Filter Capacitor (C1): 220µF 10V (Farnell 661-030 \$7.86), Output Filter Capacitor (C2): 100µF 10V (Farnell 661-028 \$5.64), Inductor: 22µH (RS ???-??? \$?.??)

Output Voltage Resistors (R1 & R2): 30kΩ & 10kΩ (5VDC)

Low Battery Voltage Resistors (R3 & R4): 33kΩ & 68kΩ (1.8V)

NOTE: Extra 1MΩ resistor between MAX757 pins 1 and 6, diode used is a 1N5819.

Batteries (2×AA): ~280mA @ 3.06V (855mW), ~450mA @ 1.965V (885mW), 7hr lifetime

## Components Used

Plastic Case – Dick Smith (DSE) H-2949 (\$7.70)

DIP Switch – DSE P-7851 (\$2.00)

Power Switch – DSE P-7610 (\$0.95)

Case: 133mmL×68mmW×24mmD, add 4mmW for switch, 3mmL for DB25 connector

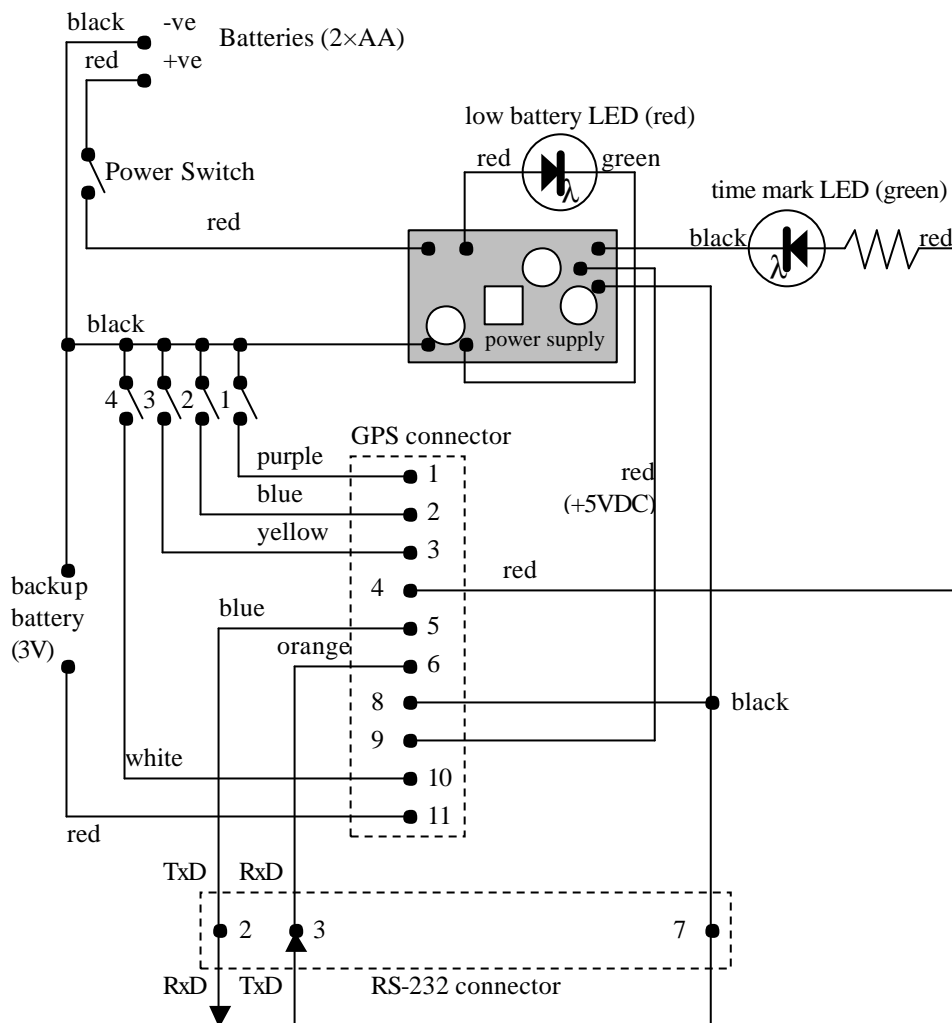
Total Weight: 140g without batteries, 2×AA batteries add 50g.

## Car Adaptor

Cigarette Lighter Plug – DSE P-1675 (\$1.40)

7805 5V 1A Regulator – DSE Z-6545 (\$1.25)

Filter Capacitors (2) 0.1µF – DSE R-4700 (\$0.70)



## NMEA Protocol Analysis

Max Bytes per Message	70	49	63	67×3	70	36
UTC Year					RMC	
UTC Month					RMC	
UTC Day					RMC	
UTC Hour	GGA	GLL			RMC	
UTC Minute	GGA	GLL			RMC	
UTC Second	GGA	GLL			RMC	
Latitude	GGA	GLL			RMC	
Longitude	GGA	GLL			RMC	
Altitude	GGA					
Speed					RMC	VTC
Course					RMC	VTC
Magnetic Variation					RMC	
PDOP			GSA			
HDOP	GGA		GSA			
VDOP			GSA			
Data Valid		GLL			RMC	
Service Mode (includes Data Valid)	GGA					
Fix Type			GSA			
Fix Mode			GSA			
SVs Used	GGA		GSA			
SVs In View				GSV		
SV# (12)			GSA	GSV		
Elevation (12)				GSV		
Azimuth (12)				GSV		
S/N (12)				GSV		
Geoid Sep.	GGA					
Age of Diff Corr.	GGA					
Diff Ref Station	GGA					

It can be seen that the GLL and VTC data are subsets of the RMC data.

If uninteresting data is excluded (magnetic variation, geoid separation and age of diff corr, diff ref station (both DGPS data)), then the RMC, GSA and GSV messages contain all other information, except for Altitude and Service Mode which can only be obtained via the GGA message. Of the four possible Service Modes, two will be unavailable (DGPS/SPS and PPS modes), the remaining two (unavailable and GPS/SPS-valid mode) can be obtained via the Data Valid information in the RMC message. This leaves altitude as the sole missing data point.

The tests below assume the units uses 180mA while receiving data for 100ms, 100mA for 100ms processing, and 100mA (for xms) to transmit the data, plus 20mA sleeping current.

NOTE: The SiRF protocol appears to send 349 bytes of data every second at 19200 baud. It does not appear to be possible to alter the once per second rate.

### Test #1 (4 March 2000)

Sending the GGA, GSA, GSV, and RMC messages every two seconds, the batteries lasted for 7 hours. The maximum data could have been 404 bytes. At 4800 baud, that would have taken 842ms to transmit. However, rather than the maximum of 3 GSV messages, mostly only one GSV message was sent. This changes the totals to 270 bytes and 563ms.

The average current should be  $(180 \times 0.2 + 100 \times 0.3 + 100 \times 0.563 + 20 \times 0.937) / 2000 = 70\text{mA}$

### Test #2 (5-6 March 2000)

GSA and GSV data is not likely to change rapidly, therefore if the RMC data is sent every two seconds (for a good update rate), and the GSA/GSV data every minute, this results in a maximum of 2364 bytes per minute. At 19200 baud, this can be sent in ~1230ms. Averaged over the minute gives 41ms every 2 seconds.

The average current should be  $(180 \times 0.2 + 100 \times 0.3 + 100 \times 0.041 + 20 \times 1.459) / 2000 = 50\text{mA}$

Selecting 38400 baud (the maximum): 2364 bytes in 616ms, 21ms every 2 seconds.

The average current should be  $(180 \times 0.2 + 100 \times 0.3 + 100 \times 0.021 + 20 \times 1.479) / 2000 = 49\text{mA}$

Selecting 4800 baud: 2364 bytes in 4925ms, 164ms every 2 seconds.

The average current should be  $(180 \times 0.2 + 100 \times 0.3 + 100 \times 0.164 + 20 \times 1.336) / 2000 = 55\text{mA}$

Result: 9h40m at 4800 baud.

### Test #3 (? ??? ????)

RMC data sent every five seconds, GSA/GSV every minute. Total 1104 bytes per minute.

Selecting 4800 baud: 1104 bytes in 2300ms, 192ms every 5 seconds.

The average current should be  $(180 \times 0.2 + 100 \times 0.3 + 100 \times 0.192 + 20 \times 4.308) / 5000 = 34\text{mA}$

Selecting 19200 baud: 1104 bytes in 575ms, 48ms every 5 seconds.

The average current should be  $(180 \times 0.2 + 100 \times 0.3 + 100 \times 0.048 + 20 \times 4.452) / 5000 = 32\text{mA}$