

# GPS GSM/GPRS EVALUATION BOARD

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## Introduction:

Introducing a simple integration GPS and GSM/GPRS evaluation board using MAX-xx (GPS) and SARA G3 (GSM/GPRS) wireless modules from U-blox.

The SARA-G3 series of u-blox GSM/GPRS modules features extremely low power consumption and a miniature LGA form factor. SARA-G350 is a full feature quad-band GSM/GPRS module with a comprehensive feature set including an extensive set of internet protocols (TCP, UDP, HTTP and FTP).

GPS receivers provide high performance and a high level of integration capability in a tiny package. The MAX-xx is optimized for cost sensitive applications .

## Image Description

Image with its labeled description is given below. Fig a shows the front view and Fig. b shows the back and side view.

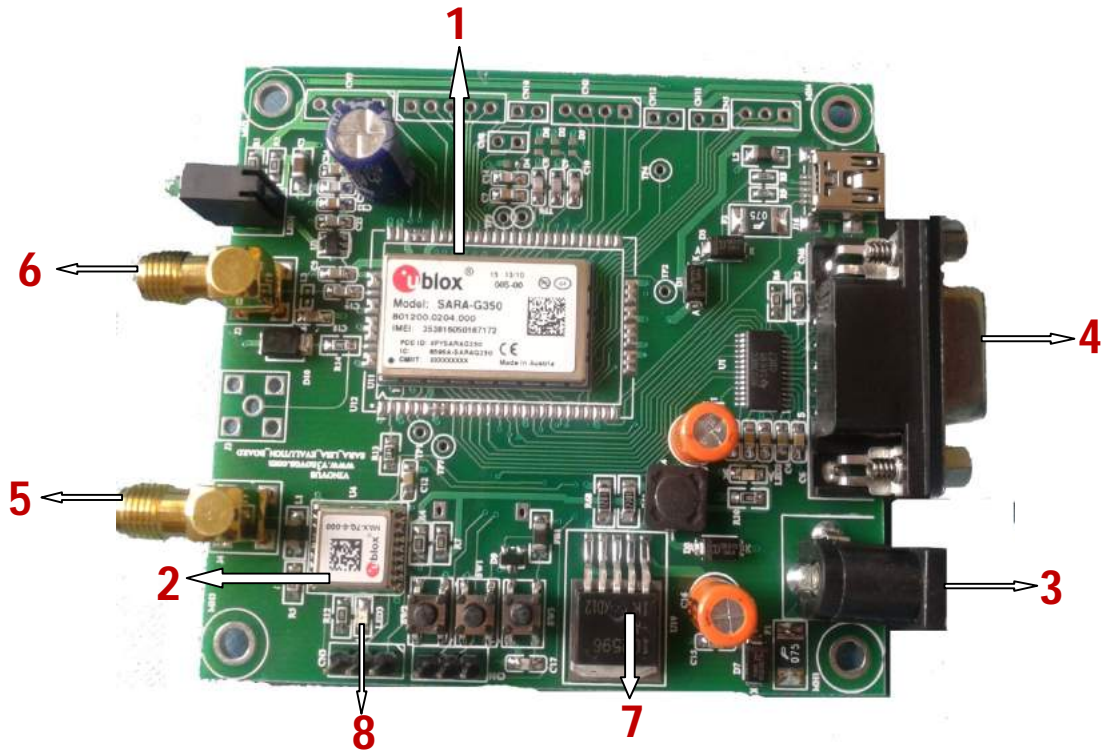


Fig. a

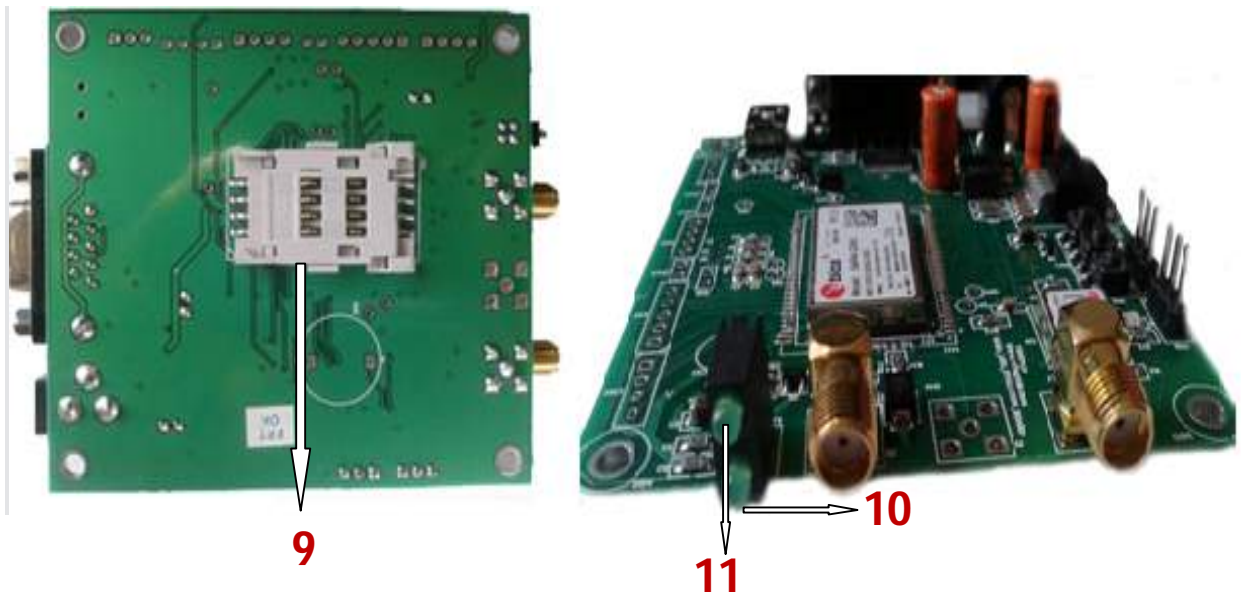


Fig. b

Figure a shows top view of GPS GSM/GPRS Evaluation board the description for the labels given below

## 1. SARA G530 Module:

SARA-G3 series modules are versatile 2.5G GSM/GPRS wireless modules in a miniature LGA (Land Grid Array) form factor. Featuring low power consumption, the SARA-G3 series combines baseband, RF transceiver, power management unit, and power amplifier in a single, easy-to-integrate solution.

SARA-G modules are interchangeable, and have been designed with the diverse needs of M2M customers in mind. SARA-G350 is a full feature quad-band GSM/GPRS module with a comprehensive feature set including an extensive set of internet protocols (TCP, UDP, HTTP and FTP). SARA-G350 also provides fully integrated access to u-blox GPS/GNSS positioning chips and modules, along with embedded A-GPS (Assist Now Online and Assist Now Offline) functionality.

Any host processor connected to the wireless module through a single serial port can control both wireless module and the positioning chip module.

### Product Selector:

Module	Data Rate	Bands	Interfaces	Audio	Functions
	GPRS multi-slot class 10	GSM/GPRS quad-band GSM/GPRS dual-band (900/1800)	UART SPI USB DDC for u-blox GPS/GNSS receivers GPIO	Analog Audio Digital Audio	Network indication Antenna detection Jamming detection Embedded TCP/UDP FTP, HTTP, SMTP SSL GPS/GNSS via Modem AssistNow software FW update over AT (FOAT) FW update over the air (FOTA) In-band modem Celllocate™ Low power idle-mode ATEX certification
SARA-G300	•	•	2		• E
SARA-G310	•	•	2		• E
SARA-G350	•	•	2 • 4	• •	• • • A • • •
SARA-G350 ATEX	•	•	2 • 4	• •	• • • A • • • •

A = available upon request

E = 32 kHz signal at EXT32K input pin is required for low power idle-mode

## 2. Max-xx Module:

GPS receivers provide high performance and a high level of integration capability in a tiny package. This makes them perfectly suited for end products with strict size and cost requirements. These modules are featured with small low power resulting cost effective and best performance with simple integration.

The MAX-7 series provides maximum sensitivity while maintaining low system power. The MAX-7C is optimized for cost sensitive applications. The MAX-7Q provides best performance and lowest power, while the MAX-7W provides best performance and is optimized for active antennas. The industry proven MAX form factor allows easy migration from MAX-6 modules. Sophisticated RF-architecture and interference suppression ensure maximum performance even in GPS-hostile environments.

### Product Selector:

Model	Type	Supply	Interfaces	Features
	GPS QZSS GLONASS Timing Dead Reckoning Precise Point Positioning	2.7 V – 3.6 V 1.65 V – 3.6 V Lowest power (DC/DC)	UART USB SPI DDC (PC compliant)	Programmable (Flash) Data logger Extra front-end LNA Front-end SAW filter Oscillator RTC crystal Antenna supply Antenna short circuit detection / protection Antenna open circuit detection pin Timepulse External interrupt / Wakeup
MAX-7C	• • •	• •	• •	C ■ 0 0 0 • •
MAX-7Q	• • •	• •	• •	T • 0 0 0 • •
MAX-7W	• • •	• •	• •	T • • • 0 • •

○ = Optional, not activated per default or requires external components

C = Crystal / T = TCXO

■ = higher backup current

## 3. Power Connector:

The Power supply is available through a DC Jack. Input power of 12V.

#### **4. Serial Port:**

The RS-232 port is available through D - TYPE 9 pin female connector.

The main characteristics are:

Baud rate from 300 to 115,200 bits/s

Autobauding (300 to 38,400 bits/s)

Short circuit (to Ground) protection on all outputs.

Input voltage range: -12V to +12V

Pin out (refers to DTE side)

Pin 1 = DCD Output

Pin 2 = RX Output

Pin 3 = TX Input

Pin 4 = DTR Input

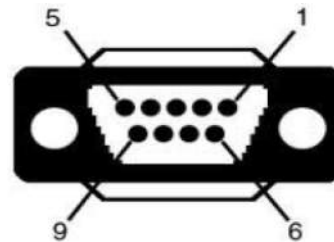
Pin 5 = Ground

Pin 6 = DSR Output

Pin 7 = RTS Input

Pin 8 = CTS Output

Pin 9 = RI Output



To connect to a PC / Laptop a pin to pin, 9 pin cable needed with D type connector (male).

#### **5. GPS Antenna Connector:**

The Antenna connector is available on the left side of the connector and is a female SMA Connector.

u-blox receivers are designed to receive and track the L1C/A signals provided at 1575.42 MHz by the Global Positioning System (GPS). Antenna used are good performance GPS/GLONASS active antenna with 50Ω impedance (u-blox 7 modules can be connected to passive or active antennas).

#### **6. GSM/GPRS Antenna Connector:**

The Antenna connector is available on the left side of the connector and is a female SMA Connector.



SARA-G3 module pin represents the RF input/output for transmission and reception of the GSM/GPRS RF signal with the following antenna requirement.

- Impedance – 50 $\Omega$  nominal characteristic impedance.
- Frequency range – SARA-G350, SARA-G310
  - 824..960 MHz (GSM 850, GSM 900)
  - 1710..1990 MHz (GSM 1800, GSM 1900)
- Input power – > 2W peak

## **7. Switching Voltage Regulator**

Regulator used is simple high efficiency step-down regulator capable of driving a 3A load with excellent line and load regulation. These are available in 3.3V, 5V, 12V adjustable output versions. Input range up to 40V.

## **8. GPS Indicator**

LED3 is an indicator for GPS in figure (shown by 8).

## **9. SIM Connector**

This Evaluation board features the SIM card holder on the back side of the board for inserting SIM card (Fig. b).

## **10. GSM/GPRS Indicator**

10 and 11 shown in Fig. b are power (10) and network indicators (11).

## **GSM/GPRS Evaluation:**

The Set up by connecting the evaluation board with Power Adapter and connecting the board through RS232 Serial Port to the Computer using a standard serial Cable or USB to serial Converter. Procedure to Evaluate GSM/GPRS evaluation board is as follows

- **Evaluation software setting:**

m-center is u-blox' powerful wireless module evaluation tool. M-center is PC-compatible, and provides an intuitive, easy to understand and use graphical interface. The application is provided free-of-charge.

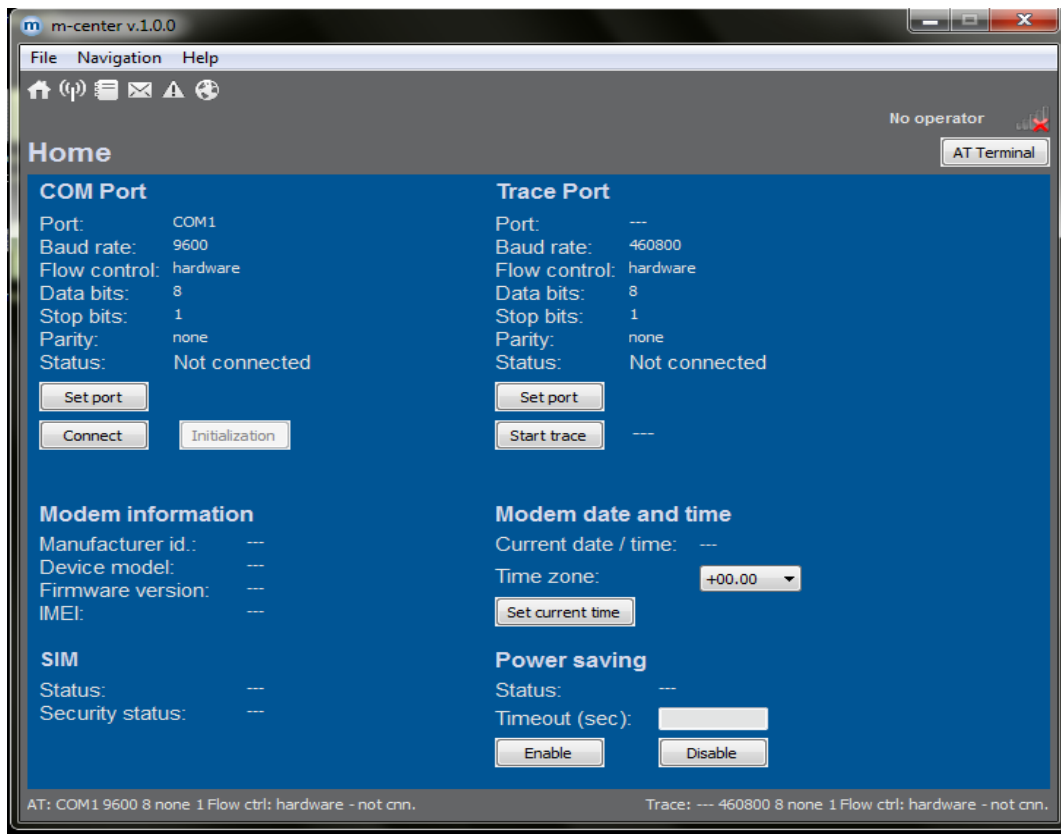


Fig. 5

[Note: you can find this evaluation tool from below link

<http://www.u-blox.com/en/evaluation-tools-a-software/u-center/m-center.html> ]

Open the application and select the com port to which the module is connected. Just click on set port and following settings has to be made.

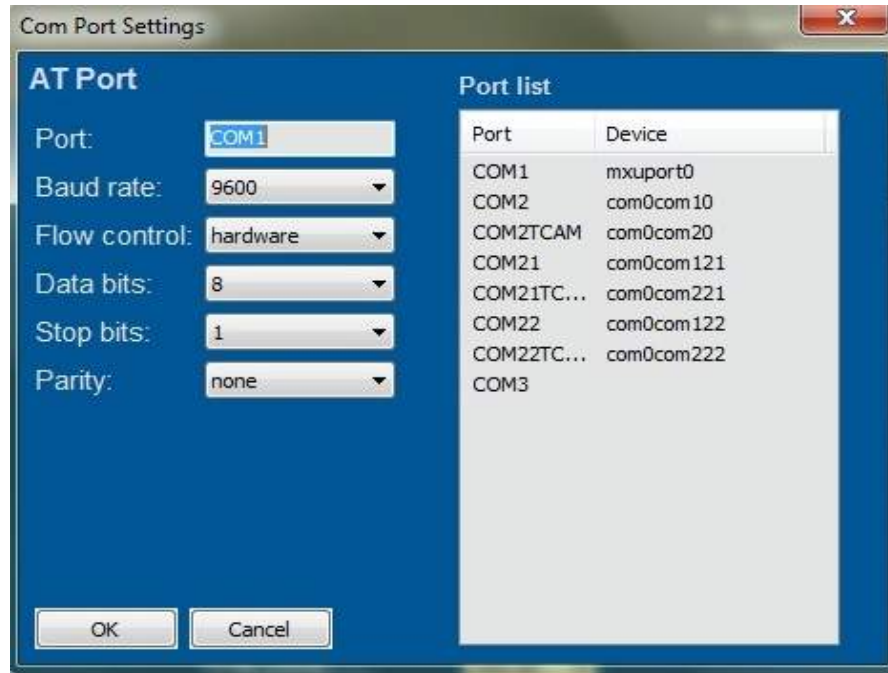


Fig. 6

To open the AT Terminal in a separate window, click the “AT Terminal” button in the upper right corner of Fig. 5.

• **Testing and Observation:**

In order to test for general AT commands on GSM/GPRS refer the “AT commands Examples for U-blox wireless modules” document available in link below.

<http://www.u-blox.com/en/download/resources-application-notes/wireless-application-notes.html>

**In the Module:**

- LED1 (number 10 in Fig. b) will glow constant when power on.
- LED1 number 11 in Fig. b serves as indicator during network connection.

**In Terminal Window:**

Check AT commands below once after connection.



## 1. SMS AT Commands

Command	Response	Description
AT	OK	Attention
AT+CMGF=1	OK	Set preferred message format to text mode
AT+CMGS="+919945374668"<CR> >This is a text Message <Ctrl-Z>	+CMGS: 6 OK	Send SMS from SIM card

## 2. GPRS Activation

Configuring a data connection for FTP, HTTP, SMTP and TCP/IP AT commands is performed as follows:

Command	Response	Description
AT+CGATT?	+CGATT: 1 OK	Check GPRS Attach Status  [NOTE: 1 – GPRS Attached 0 – GPRS not attached]
AT+UPSND=0,8	+UPSND: 0,8,0 OK	Check the status of the GPRS connection profile associated to GPRS connection profile identifier "0". The GPRS profile status is provided by the third parameter (in this case 0 – not active)
AT+UPSD=0,1,"airtelgprs.com"	OK	Setup APN for GPRS connection profile "0". APN depends on APN operator (SIM card used) EX: Airtel – airtelgprs.com Vodafone – www etc
AT+UPSDA=0,1	OK	Save GPRS profile in the NVM.
AT+UPSDA=0,3	OK	Activate the GPRS connection
AT+UPSND=0,8	+UPSND: 0,8,1 OK	Check the status of the GPRS connection profile associated to GPRS connection profile identifier "0". The GPRS profile status is provided by the third parameter (in this case 1 -active).
AT+UPSND=0,0	+UPSND: 0,0,"93.68.225.175" OK	Check the assigned IP address

### 3. Direct Link Mode/ Data mode:

When a modem is in data mode, any characters sent to the modem are intended to be transmitted to the remote party. The modem enters data mode immediately after it makes a connection.

The modem would report the word "CONNECT" and then switch to data mode. Any further characters received over the serial link are deemed to be from the remote party, and any characters sent are transmitted to the remote party.

To take the modem to direct link mode and exit, Please follow below commands. Verify that the module is registered with the network and a GPRS connection is activated. If not follow the steps in "GPRS Activation" (previous step 2).

Command	Response	Description
AT+USOCR=6	+USOCR: 0 OK	TCP socket creation. In this example socket #0 is created. The command response provides the new socket identifier (in this example #0). If a new socket is created, a new socket identifier will be returned.
AT+USOCO=0,"151.9.34.66",444	OK	Connect socket #0 to port 444 of a remote host with IP address 151.9.34.66. The connection is now uniquely associated to the socket. Socket is now ready for read/writes operations.
AT+USODL=0	CONNECT	Activate direct link mode for socket #0. CONNECT response means a transparent End – to – end communication has been established with the previous connected TCP socket via the serial interface. Now data received on socket #0 will be redirected to the serial port and data written on serial port will sent to socket #0.

+++	DISCONNECT  OK	Exit from direct link mode; this will not close the TCP connection. Now you are in command mode. Data can be read or written on socket #0 using usual TCP commands (+USOWR, +USORD). DISCONNECT message is provided on LEON-G100-04S / LEON-G200-04S and subsequent versions and LISA-U1 series
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#### 4. Sending an email / SMTP:

To send an email using SARA-G Modules, follow SMTP AT commands given below.

Sets up the necessary parameters for SMTP service, or resets parameters to a factory-programmed value. To change the settings the Set command needs to be executed for each single <param\_tag>. Read command returns the current setting of all the SMTP parameters, one per line (i.e. the SMTP profile).

The SMTP parameter values specified with this command are all volatile (not stored in non-volatile memory).

Make sure the module is registered with the network and a GPRS connection is activated. Follow the steps in "GPRS Activation"

Type	Syntax	Response	Example
Read	AT+USMTP?	+USMTP: 0,<param_val1_0> ... +USMTP: 6,<param_val1_6>,<param_val2_6> OK	+USMTP:0,"69.147.102.58" +USMTP: 1,"" +USMTP: 2,"username" +USMTP: 4,1 +USMTP: 5,0 +USMTP: 6,0,0 OK
Test	AT+USMTP=?	+USMTP: (list of supported <param_tag> s)  OK	+USMTP: (0-6) OK

[Note: **param\_val1** Type and content depend on <param\_tag> (details below). If <param\_val1> is not specified, the value for the corresponding <param\_tag> is reset

**Param\_val2** Type and content depend on related <param\_tag> (see details Below)

**Param\_tag** type – Number, Description is given below

- **0: SMTP server IP address;**  
<param\_val1> is text string of SMTP server IP address in dotted decimal notation form  
<param\_val2> parameter is not allowed
- **1: SMTP server name**  
<param\_val1> is text string of SMTP server name (e.g. "smtp.server.com")  
Maximum length is 128 characters  
<param\_val2> is not allowed
- **2: Username**  
<param\_val1> is user name text string (maximum 30 characters) for the SMTP login procedure, if authentication is used  
<param\_val2> is not allowed.
- **3: Password**  
<param\_val1> is password text string (maximum 30 characters) for the SMTP login procedure, if authentication is used  
<param\_val2> is not allowed
- **4: Authentication type**  
<param\_val1> is the SMTP authentication method (if any):  
0 (default value): No authentication  
1: Plain authentication  
2: Login authentication  
<param\_val2> is not allowed
- **5: Inactivity timeout**  
<param\_val1> is the inactivity timeout period in seconds, from 0 to 86400 s. 0 means no timeout (the SMTP session will not be terminated in the absence of incoming traffic); the default value is 30 s  
<param\_val2> is not allowed.
- **6: Time zone, used for the date header field of mails**  
<param\_val1> Number type value with hour differential, in range [-12; 12] (default is 0).  
<param\_val2> Number type value of minute differential, in range [0; 59] (default is 0). This is a mandatory parameter if <param\_tag>=6 and <param\_val1> is specified.

Configuration for SMTP (+USMTP):

Command	Response	Description
AT+USMTP=1,"mail.v3novus.com"	OK	SMTP server hostname
AT+USMTP=2,"user name"	OK	Login ID
AT+USMTP=3,"password"	OK	Login Password
AT+USMTP=4,0	OK	Authentication type (no authentication)
AT+USMTP=5,3600	OK	Inactivity timeout
AT+UDNSRN=0,"mail.v3novus.com"	+UDNSRN:"69.167.151.16" OK	Hostname resolution

Prepare mail envelope and body (+USMTPM):

Command	Response	Description
AT+USMTPM	OK	Reset all the parameters
AT+USMTPM=0,"USER1@v3novus.com"	OK	Set up mail sender address
AT+USMTPM=1,"USER1@v3novus.com"	OK	Set up the reply-to mail address
AT+USMTPM=2,"USER2@v3novus.com"	OK	Set up the mail receiver address
AT+USMTPM=3,"This is the subject of mail"	OK	Set up the mail subject
AT+USMTPM=4,"this is the body text of mail"	OK	Set up the mail text

Send the email (+USMTPC)

Command	Response	Description
AT+USMTPC=1	OK +UUSMTPCR: 1,1	Connect to the SMTP server
AT+USMTPC=2	OK +UUSMTPCR: 2,1	Send the email
AT+USMTPC=0	OK +UUSMTPCR: 0,1	Disconnect from the SMTP server The notification of the operation is provided by the reception of the +UUSMTPCR URC (1 means success).

**5. TCP/IP AT Commands:**

Verify that the module is registered with the network and a GPRS connection is activated. Follow the steps in “GPRS Activation” to activate GPRS.



**a. Socket connect:**

Command	Response	Description
AT+USOCR=6	+USOCR: 0 OK	TCP socket creation. In this example Socket #0 is created. The command response returns the created socket identifier (in this case #0). If a new socket is created (without closing the already existent), a new socket identifier will be returned
AT+USOCR=6	+USOCR: 1 OK	Create another socket (in this case the socket identifier is 1).
AT+USOCO=0,"151.9.34.66",444	OK	Connect socket #0 to port 444 of a remote host with IP address 151.9.34.66. The connection is now uniquely associated to the socket. A socket is now ready for read or write operations.

**b. Socket write:**

Command	Response	Description
AT+USOWR=0,2	@	Request to write 2 data bytes into socket #0. Wait "@" symbol indicating the data prompt is now open (AT commands are not allowed in data prompt).
Hi	+USOWR : 0,2 OK	Write data bytes. It is not allowed to write fewer bytes than previously specified with AT+USOWR command. If more bytes are written respect to the threshold, the remaining bytes will be truncated. The interface is blocked until all bytes are written. If the command response is returned then the data is sent to lower level of protocol stack. This is not a notification of an acknowledgment received from the remote host data bytes have been sent to.
AT+USOWR=0,2,"12"	+USOWR: 0,2 OK	Write 2 data bytes data on socket #0. If the command response is returned then the data is sent to lower level of protocol stack. This is not a notification of an acknowledgment received from the remote host data bytes have been sent to.

### c. Socket Read:

Command	Response	Description
	+UUSORD: 0,2	Remote server sends 2 data bytes on socket #0. A URC is returned indicating the socket on which the data is received and the total amount of data received.
AT+USORD=0,2	+USORD: 0,2,"ar" OK	Read data. Data is returned between quotation marks.

### d. Socket Close:

#### *By remote server*

Command	Response	Description
	+UUSOCL: 1	The URC indicates the TCP connection associated to socket 1 is closed. Socket 1 is cleared. WARNING: After this indication has been received the socket buffer is cleared.

#### *By module*

Command	Response	Description
AT+USOCL=0	OK	Socket closed by the module (socket #0). WARNING: No +UUSOCL URC returned.

## GPS Evaluation

Procedure to evaluate Global Positioning system using u-blox MAX-7 series modules is as follows.

- **Evaluation software setting:**

Evaluation software can be used same as GSM/GPRS evaluator else it can be worked on other Data equipment terminal like hyper terminal.

### Output data format:

Output obtained should be in NMEA format (82 character format) as shown below.

**Syntax:**

**\$ Address field \*<cr><lf>**

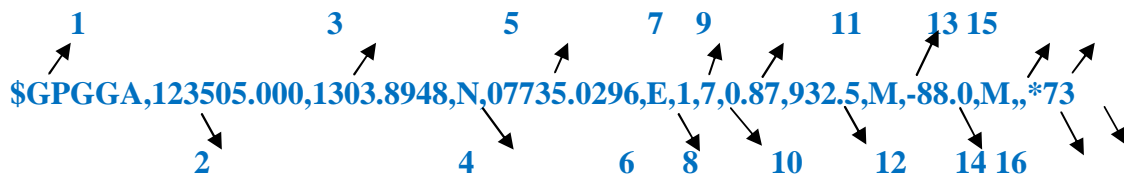
\$ - Start character.

Address field - contains talker id (that identifies a GPS receiver) and message identifier (contains various data field separated by ',' character).

\* - indicates start of checksum.

<cr> - carriage return.

<lf> - line feed sequence (end character).

**Example:**

\$GPGGA,123505.000,1303.8948,N,07735.0296,E,1,7,0.87,932.5,M,-88.0,M,,\*73

The diagram shows the following field mappings:

- 1: Global Positioning System Fix Data
- 2: Universal Time Coordinated (UTC)
- 3: Latitude
- 4: N-north S-south
- 5: Longitude
- 6: E-east W-west
- 7: Status (0-invalid, 1-2D/3D, 2-DGPS, 6-Dead reckoning)
- 8: Number of SVs used for Navigation
- 9: Horizontal dilution of precision
- 10: Altitude (m above mean sea level)
- 11: Unit in meters
- 13: Meters
- 14: Meters
- 15: Meters
- 16: Meters

1 – Global Positioning System Fix Data.

2 – Universal Time Coordinated (UTC).

3 – Latitude

4 – N-north S-south

5 – Longitude

6 – E-east W-west

7 – Status (0-invalid, 1-2D/3D, 2-DGPS, 6-Dead reckoning)

8 – Number of SVs used for Navigation

9 – Horizontal dilution of precision

10 – Altitude (m above mean sea level)

11 – Unit in meters

12 – Geoids Separation = alt (HAE) - alt (MSL)

13 – Unit in meters

14 – Age of differential corrections

15 – Start of checksum

16 – End character

• **Testing and Observation:**

Power up the module with 12V supply (3-power connector in image) and following observation has to be done.

**In the Module:**

- LED2 and LED3 will glow constant when power on.
- As soon as GPS fixed LED3 starts blinking once for every 1sec interval and LED2 will remain same.

**In Terminal Window:**

Follow the AT commands below in order to get NMEA messages for position date time speed etc. It is possible to read the current data only if it is enabled.

Command	Response	Description
AT+UGPS=1,0	OK	To switch on GPS here parameter 1 indicates switching in/off. [0 – switch off 1– switch on ] Second parameter indicates aiding mode 0 (default value which means no aiding).
AT+UGGSV=1	OK	Get number of GNSS satellites in view To enable/disable NMEA \$GSV messages (1-enable 0-disable )
AT+UGGSV?	+UGGSV:<state><\$gsv msg>	Read NMEA \$GSV messages

AT+UGTMR?	+UGTMR: <time zone> OK	Indicates the time zone value set by user. (-96 , 96 : defined range).
AT+UGTMR= -1	OK	It is also possible to set date and time format within the specified range (-96, 96). [here it is -1 as an example]
AT+UGZDA?	+UGZDA:<state>,<\$ZDA msg> OK	Gives the state (1/0) and specifies the current GPS date and time.
AT+UGGGA=1	OK	Enable GPS fix data.
AT+UGGGA?	+UGGGA:<state>,<\$GGA msg> OK	Read current GPS fix data.
AT+UGGLL=1	OK	Enables/disables storing of the last value of NMEA \$GLL messages, and gets the current messaging state. (1 – Enable 0 – Disable).
AT+UGGLL?	+UGGLL: <state>,<\$GLL msg> OK	Read current geographic position.
AT+UGRMC?	+UGRMC:<state>,<\$RMC msg> OK	Read the current minimum GNSS data (RMC data)
AT+UGVTG=1	OK	Enables/disables storing of the last value of course over ground and ground speed messages and gets know the current messaging state.
AT+UGVTG?	+UGVTG: <state>,<\$VTG msg> OK	Get current value of course over ground and ground speed messages



## **Conclusion:**

The device serves its best in providing GSM/GPRS along with GPS using MAX-xx and SARA-G series modules. Thus Max series GPS receivers are known for its excellent navigation performance even in the most challenging environments and a high level of integration capability in a tiny package which makes them perfectly suited for mass-market end products with strict size and cost requirements. SARA-G350 allows customers to develop M2M devices with minimal software development on the host processor and also different functionalities and feature sets to meet different customer and application requirements.