

Author: Sierra Wireless		Date: February 24, 2010											
APN Content Level		BASIC	✓	INTERMEDIATE		ADVANCED		Confidentiality	Public	✓	Private		
Software Compatibility*	FW:	6.6x R6.5 R7.x	Software Suite:	SDK v4.22 v1.X v2.X	Plug-Ins:	TCP/IP	✓	Security	N/A	Compiler Used:	ADS GCC	Reference Hardware	No
						Internet	✓	LUA	N/A			Reference Software	Yes
						C-GPS	✓					RTE :	N/A
* refer to software compatibility matrix section for more detail													
Hardware Compatibility	AirPrime Q Series :	Q2686	✓	Q2687	✓	Q26Extreme		Q26Elite					
	AirPrime WMP Series :	WMP50	✓	WMP100	✓	WMP120	✓	WMP150	✓				
	AirPrime WS Series :	WISMO218		WISMO228									
	AirPrime AR Series	AR3550		AR5550		AR8550							
	AirLink FXT Series :	Fastrack Xtend GPRS		Fastrack Xtend EDGE		Fastrack Xtend HSPA		Fastrack Xtend CDMA					
	Legacy products (GSM):	Q24Classic		Q24Plus		Q24Extended		Q24Auto					
		Fastrack Supreme		Q64	✓	Q52 Omni							
Legacy products (CDMA):	Q2438F		Q2438R										

## 1 Version

Application Notes may be updated over their lifetime. To ensure you design with the correct version, please check the application notes page in [www.sierrawireless.com](http://www.sierrawireless.com) for latest versions.

## 2 Introduction

This Application Note (APN) is provided to Sierra Wireless distributors and clients to aid more rapid development of embedded applications using the Sierra Wireless portfolio of cellular solutions. To request a new application note, contact your regional Sierra Wireless Product Marketing Manager.

## 3 Application Note Description

The acronym C-GPS stands for Companion GPS. Sierra Wireless offers the C-GPS Plug-In to its customers to ease the integration process of the GPS functionalities with its GSM/GPRS Intelligent Embedded Modules by offering a ready-made library within the software environment. This library drives a Companion GPS chipset. In this release, the GPS solution is the Opus III from eRide, Inc.

In order to facilitate evaluation, testing and development, Sierra Wireless makes available three development kits which include a C-GPS Daughter board. One is based on the Opus III chipset from eRide Inc, the second is based on the Nanoride module from eRide Inc including an Opus III chipset, and the third is based on the ATS3625 automotive grade module from AT&S including an Opus III chipset. These development kits can be ordered from Sierra Wireless and Sierra Wireless distributors. The C-GPS chipset receives the GPS data, performs the preliminary processing on the data and forwards the data to the AirPrime embedded module. The application executed on the AirPrime module receives this data and performs processing based on the received data. The application needs not take care for low level interfacing with the GPS chipset as Sierra Wireless provides C-GPS library which performs the task of managing the lower level details.

The C-GPS chipset uses one of the available UART to send/receive data from the AirPrime module. Hence, to be able to receive the C-GPS data from the C-GPS chipset, FCM flow should be subscribed by the application. For Sierra Wireless Software Suite 2.21 and later, our samples are designed for Open UART not for FCM. As one of the UART is internally used by the GPS chipset, it is not possible to use this UART for any external application (like Terminal Emulator, TMT or Hyperterminal). However, the UART which is not used by GPS chipset can be used to interface with an external application. This UART can be used to send/receive AT commands/responses and also send the NMEA sentences.

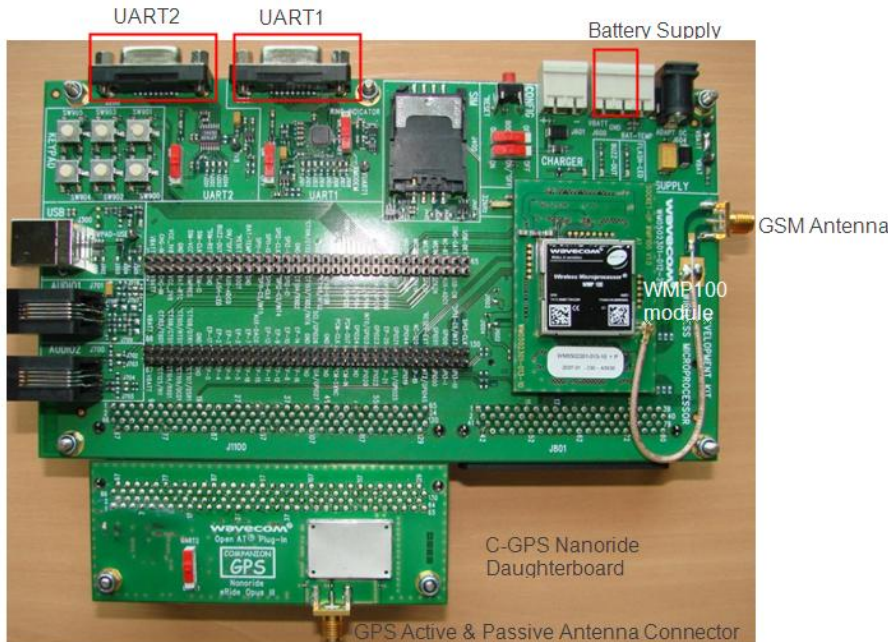
Sierra Wireless provides sample applications which can be used to provide guidelines to create customized application based on the requirements.

## 4 Hardware Configuration

### 4.1 Nanoride Development Kit

More details on the working of Daughter board are available in the C-GPS Nanoride Development kit User Guide (document [1]).

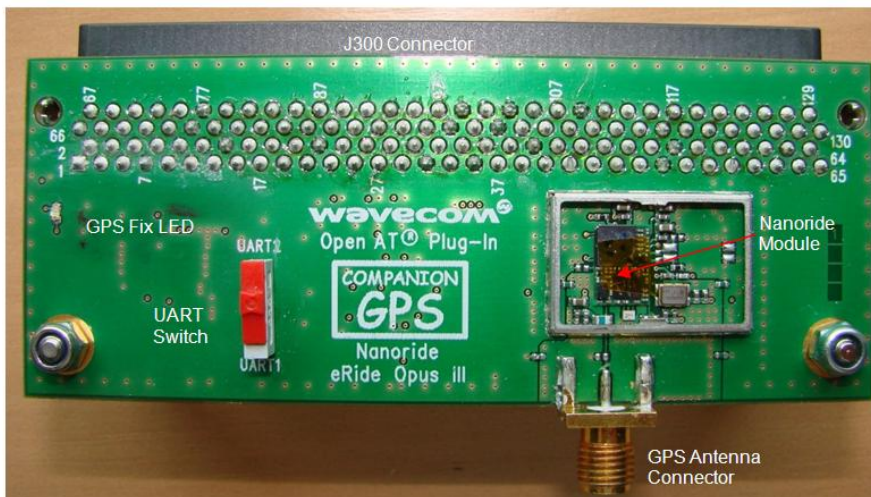
The C-GPS Nanoride Daughter board is connected to the module development kit board by its J300 connector, shown in the picture below:



The C-GPS Daughter board gets access to all the pins that are provided on the J300 connector. Using these pins, the C-GPS Daughter board is able to send/receive data to/from the AirPrime module and hence able to interact with it.

#### 4.2 Nanoride Daughter Board

The C-GPS Daughter board has the following layout:



The Daughter Board has the following main components:

1. **GPS Antenna Connector:** This connector is used to connect an external GPS antenna to the C-GPS chipset. Please note that the connection can be done using an active or passive antenna (an active antenna is provided with the C-GPS Nanoride Development Kit).
2. **UART1/UART2 configuration switch:** This switch is used to select the UART used by the C-GPS Daughter board to communicate with the module. If the switch is set to UART1, then the Rx and Tx pins of UART1 are used by C-GPS Daughter board to send/receive the GPS data. Hence, this UART cannot be used by the external application (like TE/Hyperterminal). The UART2 in this case, becomes the debug UART and can be used to send/receive AT commands, and receive Debug trace/NMEA messages. This UART can be used with Hyperterminal/TE. The reverse is true if the switch is set to UART2.
3. **GPS Fix LED:** A LED has been provided on the C-GPS Daughter board. This LED indicates whether GPS fix has been achieved or not. The behavior of this LED is as follows.

- If GPS fix has not been achieved, the LED glows steadily.
- As and when GPS fix is achieved, the LED starts blinking. The LED blink frequency is same as the one with which the NMEA frames are sent to the external application.
- If GPS fix is lost, then again, the LED stops blinking and glows steadily.

*Note:* The GPS FIX LED is internally connected to GPIO20 of the module.

#### 4.2.1 Configuration of Daughter Board

The C-GPS Daughter board is connected via its J300 connector to the AirPrime module. The UART switch must be positioned according to the UART selected for the communication between the C-GPS daughter board & the module Mother board (see section “UART1/UART2 configuration switch” in [Nanoride Daughter Board](#) for more information). The C-GPS Daughter board has the following serial communication parameters:

- **Baud Rate:** 57600 bps
- **Character Framing:** 8 Data bits, 1 stop bit and Odd Parity.
- **Flow control:** No flow control

These parameters need to be set by the application which is interacting with the C-GPS Daughter board.

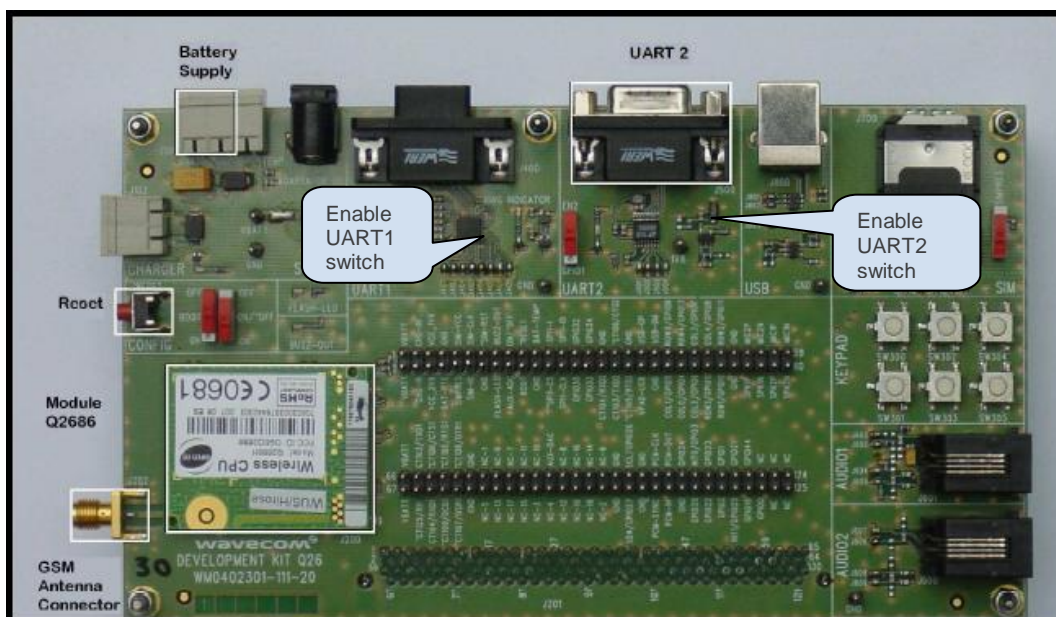
In addition to the above interface characteristics of the C-GPS board, the C-GPS chipset requires the following signals to be driven:

- **GPS\_NRST:** This input signal is used to reset the C-GPS Daughter board.
- **GPS\_EN\_3V\_RF:** This signal is used to enable the power supply of the GPS RF function.
- **GPS\_EN\_3V\_BB:** This signal is used to enable the power supply of the GPS Base Band function.

**Warning:** DC voltage (VBATT) is always present on the “RF” connector in order to power supply an antenna with LNA.

#### 4.2.2 Configuration of the module Motherboard

The motherboard of the AirPrime module which is connected to the C-GPS Daughter board should also be configured for proper working of the C-GPS Daughter board. The following image depicts the module motherboard which can be connected to the C-GPS Daughter board. Note that the mother board could be either a Q2686/87 development kit board (see the Q26 series development kit user guide [6] for more details) or a WMP100 development kit board (see the WMP100 development kit user guide [5] for more details).



C-GPS Daughter board requires the GPS\_NRST, GPS\_EN\_3V\_RF, and GPS\_EN\_3V\_BB to be driven by the application. These pins are connected with the following GPIOs on the Motherboard:

S.No.	Signal to be connected	GPIO providing the signal
1.	GPS_NRST	GPIO19
2.	GPS_EN_3V_RF	GPIO23
3.	GPS_EN_3V_BB	GPIO22
4.	GPS_STATUS_LED	GPIO20

#### 4.2.2.1 Configuration of Motherboard

The motherboard must be configured by providing the correct switch position for the UART1/UART2 configuration switch.

In case the user is planning to use UART1 for communication with the C-GPS function, it is recommended to disable UART1 on the mother board with the enable switch (see the development kit user guide [5] or [6]). UART2 must be enabled on the mother board if it is used for debug (see the development kit user guide [5] or [6]).

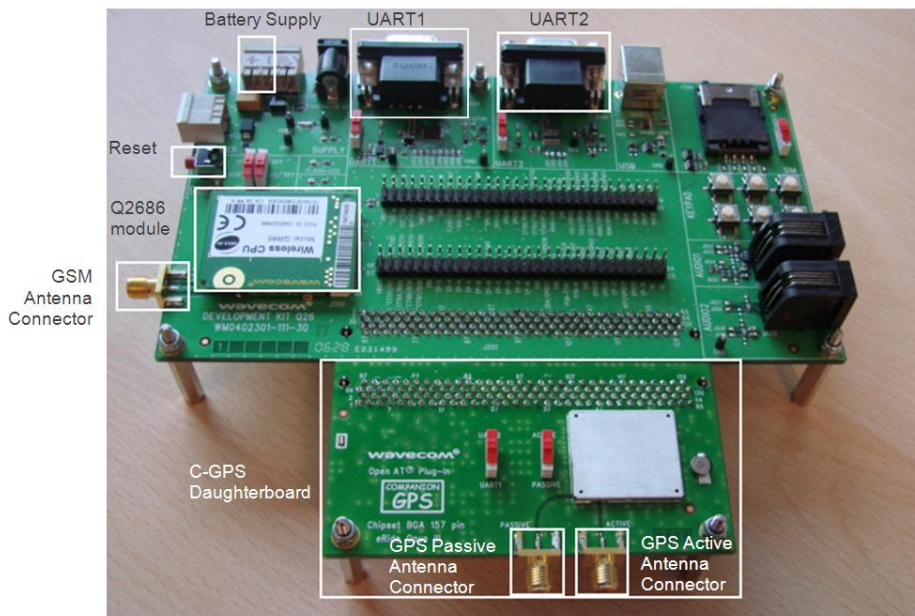
The reverse if UART2 is used for communication with the C-GPS function & UART1 for Debug.

In addition to these configurations, the ON/OFF switch must be set to ON and the Boot switch must be set to OFF.

### 4.3 Opus III Development Kit

More details on the working of Daughter board are available in the C-GPS Opus III Development kit User Guide (document [2]).

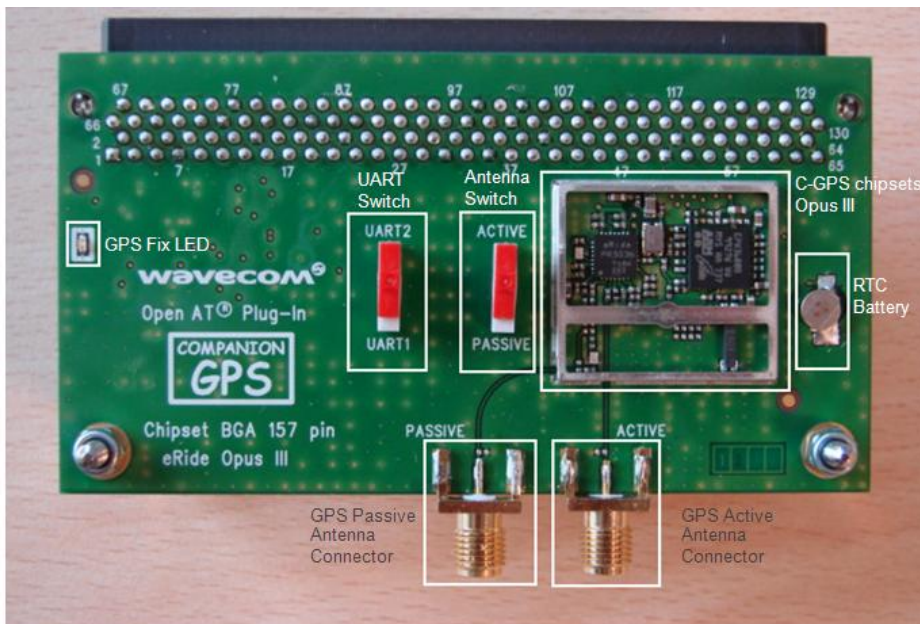
The C-GPS Opus III Daughter board is connected to the module development kit board by its J300 connector, as shown in the figure below:



The C-GPS Daughter board hence gets access to all the pins that are provided on the J300 connector. Using these pins, the C-GPS Daughter board is able to send/receive data to/from the AirPrime module and hence able to interact with it.

#### 4.3.1 Opus III Daughter Board

The C-GPS Daughter board has the following layout:



The Daughter Board has the following main components:

1. **GPS Antenna Connectors:** These two connectors are used to connect an external GPS antenna with the C-GPS chipset. Please note that the connection must be made using an active (active antenna connector) or passive (passive antenna connector) antenna. A switch is provided on the board for antenna selection. An active antenna is provided with the Opus III (chipset) C-GPS Development Kit.
2. **UART1/UART2 configuration switch:** This switch is used to select the UART used by the C-GPS Daughter board to communicate with the module. If the switch is set to UART1, then the Rx and Tx pins of UART1 are used by C-GPS Daughter board to send/receive the GPS data. Hence, this UART cannot be used by the external application (like TE/Hyperterminal). The UART2 in this case, becomes the debug UART and can be used to send/receive AT commands, receive Debug traces, NMEA messages. This UART can be used with Hyperterminal/TE. The reverse is true if the switch is set to UART2.
3. **GPS Fix LED:** A LED has been provided on the C-GPS Daughter board. This LED indicates whether GPS fix has been achieved or not. The behavior of this LED is as follows.
  - If GPS fix has not been achieved, the LED glows steadily.
  - As and when GPS fix is achieved, the LED starts blinking. The LED blink frequency is same as the one with which the NMEA frames are sent to the external application.
  - If GPS fix is lost, then again, the LED stops blinking and glows steadily

*Note: The GPS FIX LED is internally connected to GPIO20 of the module.*

#### 4.3.1.1 Configuration of Daughter Board

The C-GPS Opus III Daughter board is connected via its J300 connector to the AirPrime module. The UART switch must be positioned according to the UART selected for the communication between the C-GPS daughter board & the module Mother board (see section "UART1/UART2 configuration switch" in [Opus III Daughter Board](#) for more information). An incorrect switch position might lead to the C-GPS Daughter board not working properly. The C-GPS Daughter board has the following serial communication parameters:

- **Baud Rate:** 57600 bps
- **Character Framing:** 8 Data bits, 1 stop bit and Odd Parity.
- **Flow control:** No flow control

These parameters need to be set by the application interacting with the C-GPS Daughter board.

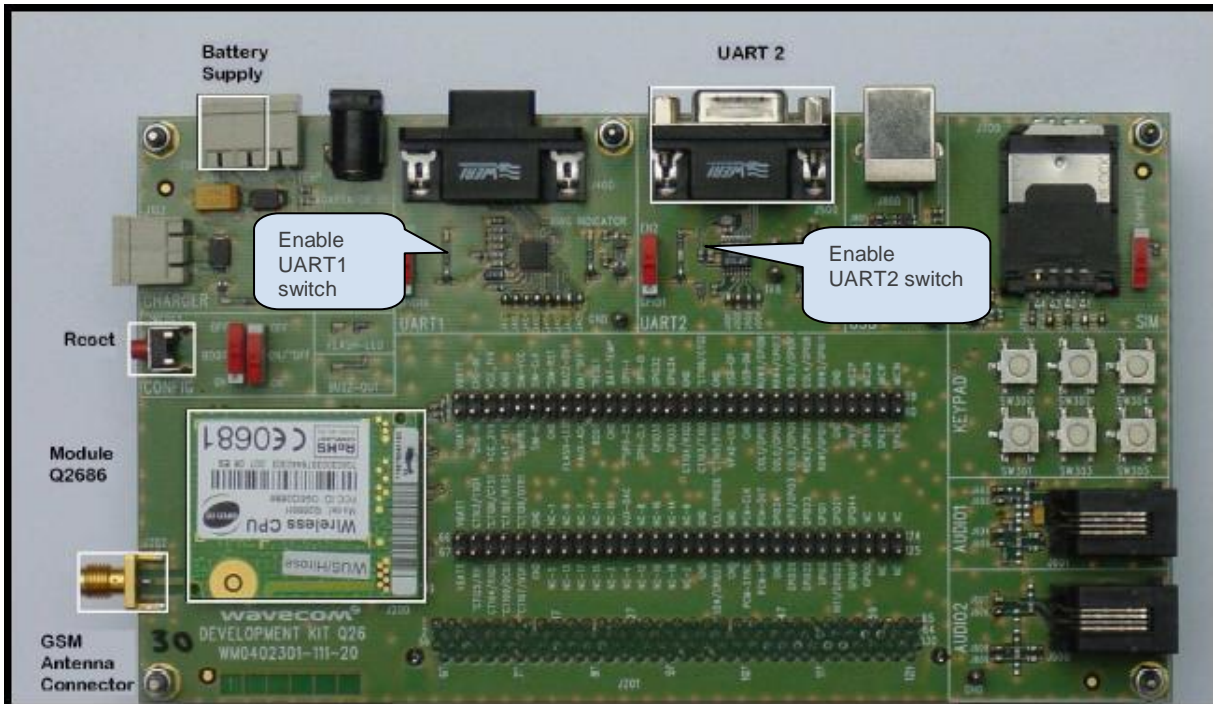
In addition to the above interface characteristics of the C-GPS board, the C-GPS chipset requires the following signals to be driven:

- **GPS\_NRST:** This input signal is used to reset the C-GPS Daughter board.
- **GPS\_EN\_3V\_BB:** This signal is used to enable the power supply of the GPS function.

**Warning:** DC voltage (VBATT) is always present on the “RF” connector in order to power supply an antenna with LNA.

### 4.3.2 Configuration of AirPrime Motherboard

The motherboard of the AirPrime module which is connected to the C-GPS Daughter board should also be configured for proper working of the C-GPS Daughter board. The following image depicts the module motherboard which can be connected to the C-GPS Daughter board. Note that the mother board could be either a Q2686/87 development kit board (see the Q26 series development kit user guide [6] for more details) or a WMP100 development kit board (see the WMP100 development kit user guide [5] for more details).



C-GPS Daughter board requires the GPS\_NRST and GPS\_EN\_3V\_BB to be driven by the application. These pins are connected with the following GPIOs on the Motherboard:

S.No.	Signal to be connected	GPIO providing the signal
1.	GPS_NRST	GPIO19
2.	GPS_EN_3V_BB	GPIO22
3.	GPS_STATUS_LED	GPIO20

#### 4.3.2.1 Configuration of Motherboard

The motherboard must be configured by providing the correct switch position for the UART1/UART2 configuration switch.

If the user is planning to use UART1 for communication with the C-GPS function, it is recommended to disable UART1 on the mother board with the enable switch (see the development kit user guide [5] or [6]). UART2 must be enabled on the mother board if it is used for debug (see the development kit user guide [5] or [6]).

The reverse if UART2 is used for communication with the C-GPS function & UART1 for Debug.

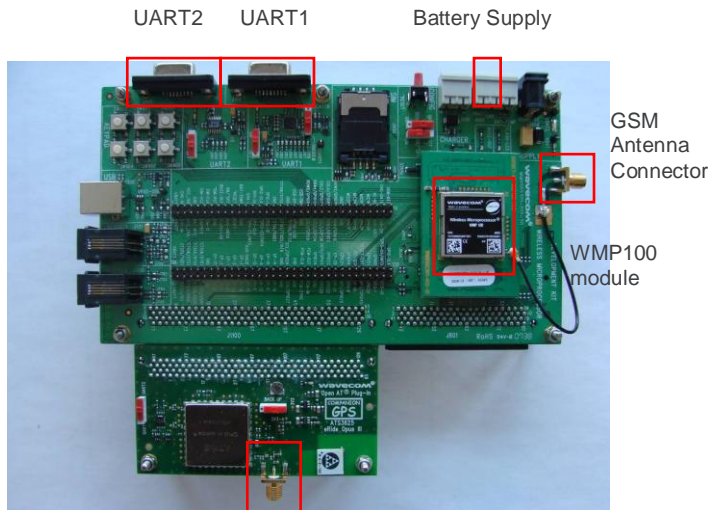
In addition to these configurations, the ON/OFF switch must be set to ON and the Boot switch must be set to OFF.

### 4.4 Opus III ATS3625 Development Kit

*Note:* The C-GPS Opus III ATS3625 is only available with the C-GPS Plug-In 3.08.

More details on the working of Daughter board are available in the C-GPS Opus III ATS3625 Development kit User Guide (document [7]).

The C-GPS Opus III ATS3625 Daughter board is connected to the module development kit board by its J300 connector, as shown in the figure below:

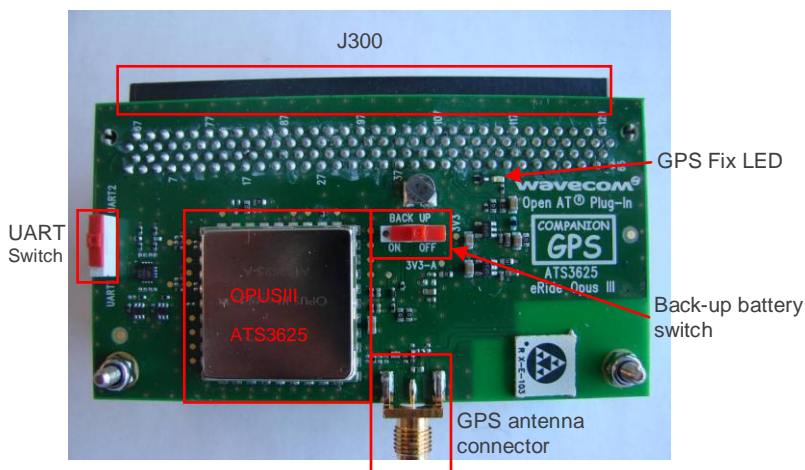


GPS Active & Passive Antenna Connector

The C-GPS Opus III ATS3625 Daughter board hence gets access to all the pins that are provided on the J300 connector. Using these pins, the C-GPS Daughter board is able to send/receive data to/from the AirPrime module and hence able to interact with it.

#### 4.4.1 Opus III ATS3625 Daughter Board

The C-GPS Opus III ATS3625 Daughter board has the following layout:



The Daughter Board has the following main components:

1. **GPS Antenna Connector:** This connector is used to connect an external GPS antenna to the C-GPS chipset. Please note that the connection can be done using an active or passive antenna (an active antenna is provided with the C-GPS Opus III ATS3625 Development Kit).
2. **UART1/UART2 configuration switch:** This switch is used to select the UART used by the C-GPS Daughter board to communicate with the module. If the switch is set to UART1, then the Rx and Tx pins of UART1 are used by C-GPS Daughter board to send/receive the GPS data. Hence, this UART cannot be used by the external application (like TE/Hyperterminal). The UART2 in this case, becomes the debug UART and can be used to send/receive AT commands, and receive Debug trace/NMEA messages. This UART can be used with Hyperterminal/TE. The reverse is true if the switch is set to UART2.

3. **GPS Fix LED:** A LED has been provided on the C-GPS Daughter board. This LED indicates whether GPS fix has been achieved or not. The behavior of this LED is as follows.
  - If GPS fix has not been achieved, the LED glows steadily.
  - As and when GPS fix is achieved, the LED starts blinking. The LED blink frequency is same as the one with which the NMEA frames are sent to the external application.
  - If GPS fix is lost, then again, the LED stops blinking and glows steadily.

*Note: The GPS FIX LED is internally connected to GPIO20 of the module.*

#### 4.4.1.1 Configuration of Daughter Board

The C-GPS Opus III ATS3625 Daughter board is connected via its J300 connector to the AirPrime module. The UART switch must be positioned according to the UART selected for the communication between the C-GPS daughter board & the module Mother board (see section “UART1/UART2 configuration switch” in [CGPS Opus III ATS3625 Daughter Board](#) for more information). The C-GPS Opus III ATS3625 Daughter board has the following serial communication parameters:

- **Baud Rate:** 57600 bps
- **Character Framing:** 8 Data bits, 1 stop bit and Odd Parity.
- **Flow control:** No flow control

These parameters need to be set by the application which is interacting with the C-GPS Daughter board.

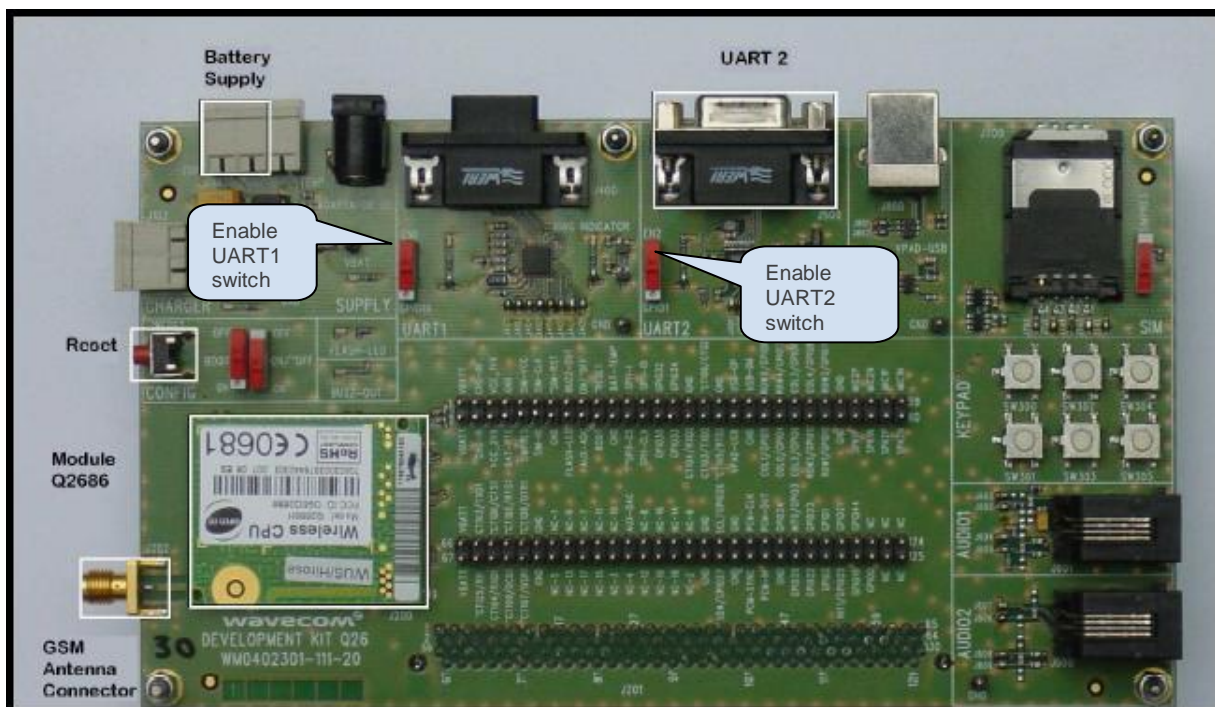
In addition to the above interface characteristics of the C-GPS board, the C-GPS chipset requires the following signals to be driven:

- **GPS\_NRST:** This input signal is used to reset the C-GPS Daughter board.
- **GPS\_EN\_3V3:** This signal is used to enable the power supply of the GPS Base Band function.

**Warning:** DC voltage (VBATT) is always present on the “RF” connector in order to power supply an antenna with LNA.

#### 4.4.2 Configuration of the module Motherboard

The motherboard of the AirPrime module which is connected to C-GPS Opus III ATS3625 Daughter board should also be configured for proper working of the C-GPS Opus III ATS3625 Daughter board. The following image depicts the module motherboard which can be connected to the C-GPS Opus III ATS3625 Daughter board. Note that the mother board could be either a Q2686/87 development kit board (see the Q26 series development kit user guide [6] for more details) or a WMP100 development kit board (see the WMP100 development kit user guide [5] for more details).



C-GPS Opus III ATS3625 Daughter board requires the GPS\_NRST and GPS\_EN\_3V\_BB to be driven by the application. These pins are connected with the following GPIO's on the Motherboard:

S.No.	Signal to be connected	GPIO providing the signal
1.	GPS_NRST	GPIO19
2.	GPS_EN_3V3	GPIO22
3.	GPS_STATUS_LED	GPIO20

#### 4.4.2.1 Motherboard Configuration

The motherboard must be configured by providing the correct switch position for the UART1/UART2 configuration switch.

If the user is planning to use UART1 for communication with the C-GPS Opus III ATS3625 function, it is recommended to disable UART1 on the mother board with the enable switch (see the development kit user guide [5] or [6]). UART2 must be enabled on the mother board if it is used for debug (see the development kit user guide [5] or [6]).

The reverse if UART2 is used for communication with the C-GPS Opus III ATS3625 function & UART1 for Debug.

In addition to these configurations, the ON/OFF switch must be set to ON and the Boot switch must be set to OFF.

#### 4.5 Customer application

While designing an application using an AirPrime module (Q2686, Q2687, WMP100, WMP120, and WMP150) and a C-GPS function, the connection between the module & GPS Function is done via a serial port interface.

For this it is recommended to use the UART2 module serial port as UART1 is dedicated to download.

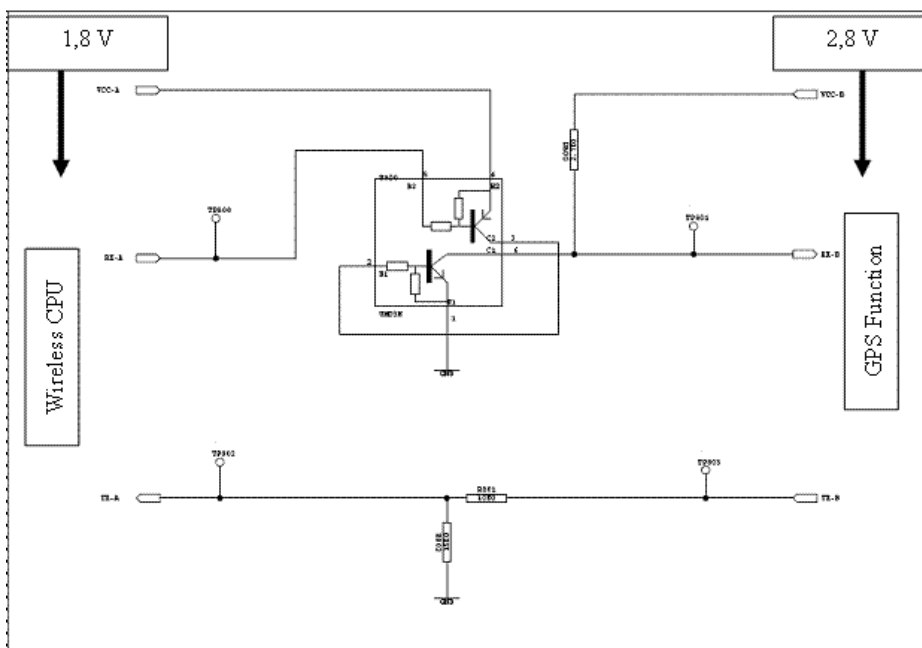
The problem of this connection is that the level of UART2 and the UART of the GPS function don't match:

- Unlike UART1 (V-Hi is 2.8V) , the UART2 pins of the module use voltages of 1.8V, which are not directly compatible with C-GPS Opus III serial communication pins (RX and TX), requiring 2.8V.

**Note:** To solve this issue the use of a level shifter 1.8V-2.8V is **mandatory**.

This is true whatever the Wireless CPU used (Q2686, Q2687, WMP100, WMP120 & WMP150) and the C-GPS technology used (Opus III chipset, Opus III ATS3625 module & Nanoride module)

The figure below gives a schematic of this level shifter:



Note that all Sierra Wireless C-GPS Development (Opus III chipset, Opus III ATS3625 & Nanoride) includes this level shifter. See the schematics of their Development Kit for more details.

## 5 C-GPS applications

Sierra Wireless provides sample applications which demonstrate how applications can be created which can be used to interface with the C-GPS Daughter board.

The following sample applications are provided by Sierra Wireless:

1. Simple Sample
2. Query Application
3. Query Application Aiding

For each of the above mentioned sample applications, there is a version for each C-GPS Daughter board, i.e. one version for Opus III chipset, one version for Opus III ATS3625 and one version for Nanoride. There is no need to adapt the gpioconfig.h anymore.

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*Note: RTE mode is available with restrictions; see the Sierra Wireless Software Suite Customer Release Note.*

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RTE mode may work with C-GPS if the baud rate is 460800 for the UART used with the PC.

### 5.1 Reduce power consumption on C-GPS chipset:

Customer should consider turning off the C-GPS chipset when C-GPS functionality is not required, and turn the chipset back on when C-GPS functionality is required, in order to reduce power consumption. The proper steps to power on/off C-GPS chipset are shown below. For details, please contact Sierra Wireless support.

To turn off:

1. Call API to shutdown C-GPS stack
2. Stop the function which processes the output from C-GPS chipset
3. Toggle the signals (**GPS\_EN\_3V\_RF, GPS\_EN\_3V\_BB** and **GPS\_NRST for Nanoride**, or **GPS\_EN\_3V\_BB** and **GPS\_NRST for Opus III** or **GPS\_EN\_3V3** and **GPS\_NRST for Opus III ATS3625**) used to control C-GPS chipset

To turn on:

1. Toggle the signals (**GPS\_EN\_3V\_RF, GPS\_EN\_3V\_BB** and **GPS\_NRST for Nanoride**, or **GPS\_EN\_3V\_BB** and **GPS\_NRST for Opus III** or **GPS\_EN\_3V3** and **GPS\_NRST for Opus III ATS3625**) used to control C-GPS chipset
2. Resume the function which processes the output from C-GPS chipset
3. Call API to start C-GPS stack

Power consumption can be further reduced, if slow idle mode (W32K) is also considered.

### 5.2 Simple Sample

This sample application uses the C-GPS Daughter board and receives the GPS data from it. The application sends the position information to the user in the form of AT responses. There is no custom AT command to be used with the application. The application takes the raw data received from the GPS chipset and calculates the position to be displayed. It does not create NMEA frames and just displays the position information in the form of longitude and latitude.

**References:** For more information, as to how the sample works, please refer to the Simple Sample Application Description HTML document. This document is present in the /Samples/SimpleSample directory in the installation). This document describes the functionality of the application, the points to note and how the position information will be displayed to the user.

### 5.3 Query Application

This sample application uses the C-GPS Daughter board and receives the GPS data from it. The application can also be configured to display the NMEA built from the GPS data (formatted NMEA format) or to display GPS core traces using a customer AT command (AT+NMEA). These frames can be received over the Debug UART. Hence, the user can use mapping software to get the GPS coordinates.

**References:** For more information, as to how the sample works, please refer to the Query Application sample description HTML document. (This document is present in the /Samples/QueryApp directory in the installation) This document describes the custom AT commands which can be used to configure various parameters for the sample application and the format in which the GPS information is sent.

## 5.4 Query Application Aiding

This sample application demonstrates the use of Assisted GPS (A-GPS). This sample is based on the Query Application only, with the difference being that, in case of reduced satellite visibility, the sample requests for the position information from the eRide A-GPS Server. The eRide A-GPS Server requires the cell information from the module using which it determines the estimate position of the module. It should be noted that the aiding server is hosted and maintained by eRide only. To use the application, the user has to get a group ID for the eRide A-GPS Server, which will be used to authenticate if the user has registered itself for the assisted GPS solution with the eRide A-GPS Server. Please contact Sierra Wireless or eRide in order to get this group ID. AT+ERAGPSID is used to enable the group ID.

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*Note: For more information about the eRide A-GPS Server, see the eRide A-GPS Server Access guide [8].*

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The C-GPS library has some new APIs which can be used to provide some specific callbacks that are called whenever the location information has to be provided to the server. It is worth noting that the Query Application Aiding sample also uses the WIP library to create a TCP socket, and the cell information of the module is sent to the eRide A-GPS Server using a TCP socket. To obtain aiding information for the position fix, the solution sends about 80 bytes of data to the server. This data consists of the LAC ID of the main cell and the neighboring cells along with other cell information. The eRide A-GPS Server responds with up to 3000 bytes of data, which can assist the module in getting the position fix.

The application monitors the state of the neighboring cells continuously, and in case, there is some change in the cells, the application can request for another fix if no GPS information is available from the satellites.

**References:** For more information as to how the sample works, please refer to the Query Application Aiding sample description HTML document. (This document is present in the /Samples/QueryAppAiding directory in the installation.) This document describes the custom AT commands which can be used to configure various parameters for the sample application and the format in which the GPS information is sent.

## 5.5 Steps to Download the Samples

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*Note: UART2 or USB cannot be used to download the application.*

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### 5.5.1 Downloading using XModem Protocol

The user can download the sample using the XModem protocol using Hyperterminal (or a similar serial port utility which provides XModem protocol to transfer information). Following steps should be taken to download the sample.

1. Connect UART1 with the PC which has the application binary. The connection parameters for Hyperterminal (or similar application should be):
  - a. Baud Rate: 115200 bauds/sec
  - b. Data bits: 8 data bits, no parity, 1 stop bit.
2. Set the BOOT switch on the AirPrime module Motherboard to OFF. The ON/OFF switch should be set to ON. Make sure that the CGPS Daughter board is not connected.
3. Execute the command AT+WDWL. The XModem NACK characters ('\$') would start to appear.
4. Transfer the sample binary application (compilerused\_workspacename\_H.wpb.dwl or compilerused\_workspacename\_H.dwl). NOTE: The literal compilerused can have the values "ads" or "gcc" depending on the compiler which is used to compile the application.
5. After the download is complete, execute AT+CFUN=1 command to reset the module.
6. Execute AT+WOPEN=1 command to start the sample application.

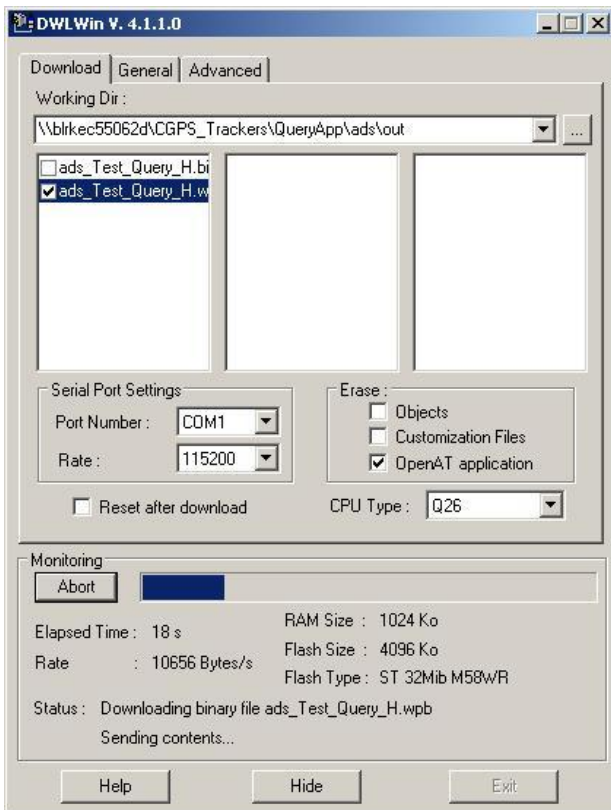
### 5.5.2 Downloading using DwlWin

Sierra Wireless provides a utility called DwlWin which can be used to download the sample applications.

The steps to download the sample are:

1. Connect to UART1 (115200 bauds, 8 data bits, no parity, 1 stop bit).
2. On the AirPrime module Development Board set the boot switch to ON.
3. Configure DWLWIN as shown below.
4. Make sure the C-GPS Daughter board is not connected.
5. Select the sample application having the extension .wpb at the end.
6. Start the download.
7. Once completed, switch the boot back to OFF.

8. Connect the C-GPS Daughter board.
9. Set UART1/UART2 switch on C-GPS Daughter board to UART2.
10. Push the hardware reset.
11. If needed start the application using AT+WOPEN=1.
12. Connect to the port UART2 (115200 bauds, 8 data bits, no parity, 1 stop bit).
13. NMEA should be received on the UART2.



## 5.6 Steps to Execute the Samples

To start the application, the command AT+WOPEN=1 needs to be given. The user must configure the switch positions on the Daughter board (to select the UART to be used for C-GPS) and the switch positions on the AirPrime module motherboard as described earlier in this document.

Using the above mentioned commands, the following steps should be used to execute the sample applications:

1. Execute AT+WOPEN=1 command.
2. Set the availability of NMEA frames over the Debug UART using AT+NMEA command.
3. Execute the AT+CGPS command to select the UART which must be used by the C-GPS Daughter board. The parameter given for the command must be coherent with the switch position provided on the C-GPS Daughter board. The C-GPS sample application will start at this point of time and will take roughly 15 seconds to receive the NMEA frames. If AT+NMEA command is configured to display the NMEA frames over the Debug UART, then the frames will be received over the UART after 15 seconds.
4. If the parameters set using AT+NMEA and AT+CGPS commands are to be saved, then the command AT+CONFIG=1 should be issued. In this case, after module reset, the application would automatically start using the saved parameters and there is no need for the user to execute AT+NMEA and AT+CGPS commands again. To prevent the module from using the same configuration again and again (after reset), the command AT+CONFIG=0 should be given and the module should be reset.

## 6 Annexes

This section provides vital statistical information regarding the performance, the GPS core traces flow information and NMEA Frame description.

## 6.1 Footprint

### C-GPS ARM lib footprint

	Library	QueryApp application
<b>ROM</b>	295 Kbytes	362 Kbytes
<b>RAM (Static)</b>	68 Kbytes	84 Kbytes

### C-GPS GCC lib footprint

	Library	QueryApp application
<b>ROM</b>	356 Kbytes	442 Kbytes
<b>RAM (Static)</b>	68 Kbytes	86.6 Kbytes

NB: For Memory footprint: The ADL library RAM and ROM sizes should be added to the GPS Plug In sizes to estimate the global RAM and ROM footprint.

## 6.2 CPU Requirements

The processing power requirements are measured as follows:

- using C-GPS QueryApp sample application of the C-GPS package
- no NMEA output on debug UART (i.e. AT+NMEA=0 configuration is used)
- W-CPU running at 26MHz (i.e. its default mode)
- processing power includes all processing linked to GPS feature, in particular the C-GPS library, the QueryApp sample and the serial interface with GPS companion hardware. It excludes other processing such as the GSM/GPRS stack processing.
- reported processing power is the averaged over 2 seconds' periods

Under these conditions, the C-GPS processing power requirement does not exceed 13% of the total W-CPU processing power. The maximum is achieved in tracking mode (once first fix has been achieved); during GPS acquisition phase, the processing power requirements are lower than 13%

## 6.3 GPS Performances

### 6.3.1 Nanoride

	Conditions	Notes	Value	
<b>Position Accuracy</b>	Outdoor (open sky)	50% percentile	1.3 m CEP	
	Indoor	95% percentile	12.5 m CEP	

	Conditions	Notes	Value	
<b>Acquisition Sensitivity</b>	Warm start	Passive antenna <sup>1</sup>	-144dBm	Min.
		Active antenna	TBD <sup>4</sup>	
	Hot start	Passive antenna	-159dBm	Min.
		Active antenna	TBD <sup>4</sup>	
	Cold Start	Passive antenna	-144dBm	Min.
		Active antenna	TBD <sup>4</sup>	
<b>TTFF<sup>3</sup></b>	Hot Start <sup>2</sup>	-130dBm	0,7s	Typ
		-140dBm	2,4s	
	Warm Start <sup>2</sup>	-130dBm -140dBm	34s 39s	Typ
	Cold Start <sup>2</sup>	-130dBm -140dBm	34s 73s	Typ
<b>Desensitization due to GSM Tx bursts<sup>5</sup></b>	1 GSM burst over 8 slots	Continuous fixes	1,1 dB	Typ

<sup>1</sup>: Passive antenna or LNA active antenna with no more than 10dB gain.

<sup>2</sup>: Simulator with all signals at -130dBm & -140dBm

<sup>3</sup>: Using 0.5ppm TCXO and the optional TCO circuit

<sup>4</sup>: To be defined, Active value is close to the passive value but a confirmation is required.

<sup>5</sup>: Desensitization is a phenomenon due to the use of an antenna bimode GSM/GPS.

### 6.3.2 OPUS III chipsets

	Conditions	Notes	Value	
<b>Position Accuracy</b>	Outdoor (Open Sky)	50% percentile	2,5 m CEP	
		Indoor	10 m CEP	
<b>Acquisition Sensitivity</b>	Warm start	Passive antenna	-142 dBm	Min.
		Active antenna	-144.5 dBm	Min.
	Hot start	Passive antenna	-158dBm	Min.
		Active antenna	-161dBm	Min.
<b>TTFF</b>	Hot Start	-130dBm	0,8s	Typ
		-140dBm	2,3s	
	Warm Start	-130dBm -140dBm	35s 46s	Typ
	Cold Start	-130dBm -140dBm	37,4s 73,3s	Typ

	Conditions	Notes	Value	
<b>Desensitization due to GSM Tx bursts<sup>1</sup></b>	1 GSM burst over 8 slots	Continuous fixes	1,1 dB	Typ

<sup>1</sup>: Desensitization is a phenomenon due to the use of an antenna bimode GSM/GPS.

### 6.3.3 OPUS III ATS3625

	Conditions	Notes	Value	
<b>Position Accuracy</b>	Outdoor (Open Sky)	50% percentile	2,5 m CEP	
	Indoor	50% percentile	10 m CEP	
<b>Acquisition Sensitivity</b>	Warm start	Active antenna	-145 dBm	Min.
	Hot start	Active antenna	-159dBm	Min.
	Cold Start	Active antenna	-142 dBm	Min
<b>TTFF</b>	Hot Start	TBD	TBD	Typ
	Warm Start	TBD	TBD	Typ
	Cold Start	TBD	TBD	Typ
<b>Desensitization due to GSM Tx bursts<sup>1</sup></b>	1 GSM burst over 8 slots	Continuous fixes	1,1 dB	Typ

<sup>1</sup>: Desensitization is a phenomenon due to the use of an antenna bimode GSM/GPS.

## 6.4 GPS Core Traces

It is recommended to have the ability to retrieve GPS core traces.

The function “cbPutDebug” has to be activated by the application. (Please refer to the “Query application” sample for the use of “AT+NMEA” command to display GPS core traces).

The GPS core traces are displayed on the debug UART in Data mode.

## 6.5 Description of NMEA Frames

NMEA 0183 standard defines the NMEA sentences and for each of these sentences the first word, called a data type defines how the rest of the sentence is interpreted. Each data has its own unique interpretation, as defined by the NMEA standard.

Sentences vary in the information they contain. Some sentences will repeat some of the information already provided, while others provide new data.

Types of NMEA tags included in the C-GPS sample application are:

- \$GPGLL Geographic Position, Latitude/Longitude
- \$GPGSV GPS Satellites in View Data
- \$GPZDA UTC Date & Time
- \$GPGGA Global Positioning System Fix Data
- \$GPVTG Course over ground and ground speed
- \$GPGSA GPS DoP (Dilution of Precision) and Active Satellites
- \$GPRMC Recommended Minimum Specific GNSS GPS/TRANSIT Data

This section describes what information is included in which NMEA sentence and how to interpret various fields in the NMEA sentence:

#### 6.5.1 GLL (Geographic Position Latitude Longitude)

\$GPGLL, llll.ll, E, yyyyy.yy, F, hhmss.ss, A\*hh

- llll.ll Destination waypoint latitude
- E N or S (for latitude)
- yyyyy.yy Destination waypoint longitude
- F E or W (for longitude)
- hhmss.ss UTC of position fix (time)
- A Data Status (A = OK, V = Void)
- \*hh Checksum

#### 6.5.2 GSV (Satellites in View Data)

\$GPGSV, A, B, C, D1, E1, Az1, SNR1, D2, E2, Az2, SNR2, D3, E3, Az3, SNR3, D4, E4, Az4, SNR4\*hh

- A Number of messages required to hold data on all SVs in view
- B Message number
- C Total number of satellites in view
- D1-D4 Satellite PRN number
- E1-E4 Elevation in degrees (90 maximum)
- Az1-Az4 Azimuth (measured in degrees from True north, 000 to 359)
- SNR1-SNR4 Signal-to-noise ratio (the higher the number the better the signal)
- \*hh Checksum

#### 6.5.3 ZDA (Date and Time)

\$GPZDA, hhmss.ss, dd, mm, yyyy, xx, yy, \*hh

- hhmss.ss UTC of position fix (time)
- dd Day
- mm Month
- yyyy Year
- xx Local zone hours (-13 to 13)
- yy Local zone minutes (00 to 59)
- \*hh Checksum

#### 6.5.4 GGA (Global Positioning System Fix Data)

\$GPGGA, hhmss.ss, llll.ll, E, yyyyy.yy, F, A, bb, x.x, y.y, M, z.z, M, s.s, #####, \*hh

- hhmss.ss UTC of position fix (time)
- llll.ll Destination waypoint latitude
- E N or S (for latitude)
- yyyyy.yy Destination waypoint longitude
- F E or W (for longitude)
- A Fix quality:
  - 0 = Invalid
  - 1 = GPS fix (SPS)
  - 2 = DGPS fix
  - 3 = PPS fix
  - 4 = Real Time Kinematic
  - 5 = Float RTK
  - 6 = Estimated (dead reckoning)

- 7 = Manual input mode
- 8 = Simulation mode
- bb Number of satellites in use
- x.x Horizontal error (precision)
- y.y,M Antenna height in meters
- z.z,M Height of geoid (mean sea level) in meters
- s.s Time in seconds since last update
- ##### DGPS station ID
- \*hh Checksum

#### 6.5.5 VTG (Course over Ground and Ground Speed)

\$GPVTG, COG, T, COG, M, SOG, N, SOG, K, A\*hh

- COG,T Course over Ground (T = true)
- COG,M Course over Ground (M = magnetic)
- SOG,N Speed over Ground (N= knots)
- SOG,K Speed over Ground (K = km/h)
- M Mode indicator
  - A= Autonomous
  - D= Differential
  - E= Estimated (Dead Reckoning)
  - N= None
- \*hh Checksum

#### 6.5.6 GSA (GNSS DOP – Dilution of Precision and active satellites)

\$GPGSA, OM, NM, D1-D12, PDOP, HDOP, VDOP\*hh

- OM Operation Mode
- M : Manual forced to operate in 2D or 3D
- A : Automatic 2D/3D
- NM Navigation Mode
  - 1 : Fix not available
  - 2 : 2D
  - 3 : 3D
- D1-D12 Satellite Vehicles Used in Position Fix
- PDOP Position Dilution of Precision (PDOP)
- HDOP Horizontal Dilution of Precision (HDOP)
- VDOP Vertical Dilution of Precision (VDOP)
- \*hh Checksum

#### 6.5.7 RMC (Recommended Minimum Specific Data)

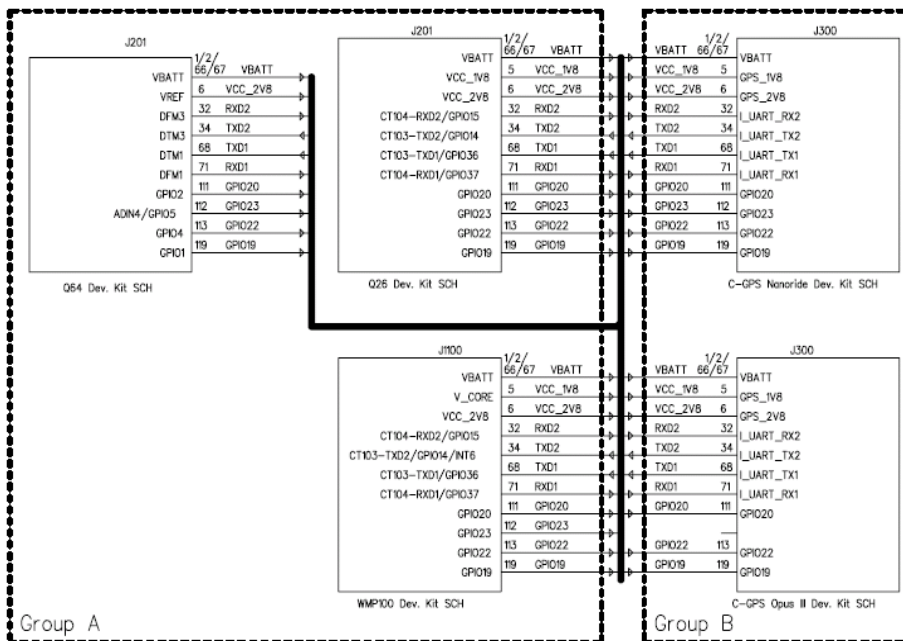
\$GPRMC, hhmss.ss, A, llll.ll, E, yyyyy.yy, F, SOG, COG, ddmmyy, MV, F, M\*hh

- hhmss.ss UTC of position fix (time)
- A Data Status (A = OK, V = Void)
- llll.ll Destination waypoint latitude
- E N or S (for latitude)
- yyyyy.yy Destination waypoint longitude
- F E or W (for longitude)
- SOG Speed Over Ground (knots)
- COG Course Over Ground (°)

- Ddmmy Date Stamp coordinated
- MV Magnetic Variation (°)
- F East or West Magnetic Variation Direction
- M Mode indicator
  - A= Autonomous
  - D= Differential
  - E= Dead Reckoning,
  - N= None
- \*hh Checksum

## 7 Schematic Combination

The simplified schematic shown below indicates the inter-connection of the module and C-GPS.



*Note: The C-GPS Opus III ATS3625 inter-connection is similar to the C-GPS Opus III inter-connection.*

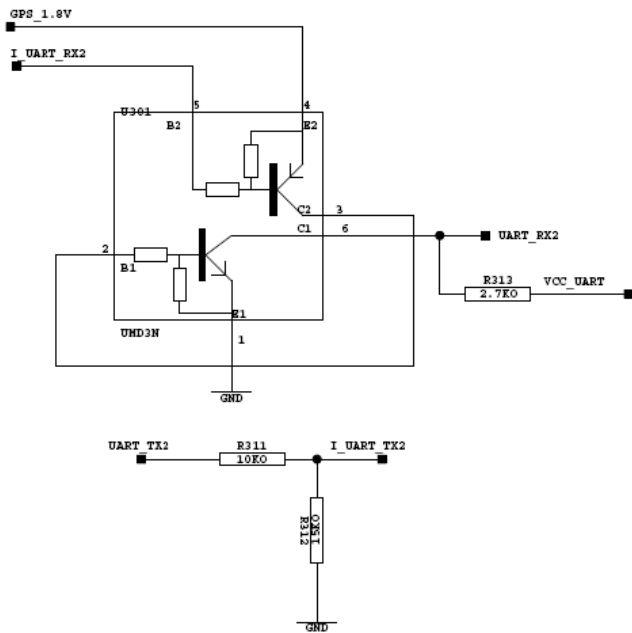
The table below is the reworked list for the particular schematic combination.

Group A	Group B	Rework list
Q26 Dev. Kit SCH	C-GPS Nanoride FSD SCH (Chipset)	No
WMP100 Dev. Kit SCH		No
Q64 Dev. Kit SCH		C-GPS Nanoride FSD SCH - Remove U301 and R313, and short U301 pin5 to U301 pin6. - Replace R311 from 10kΩ to 0Ω.  [level shifter included in Q64]

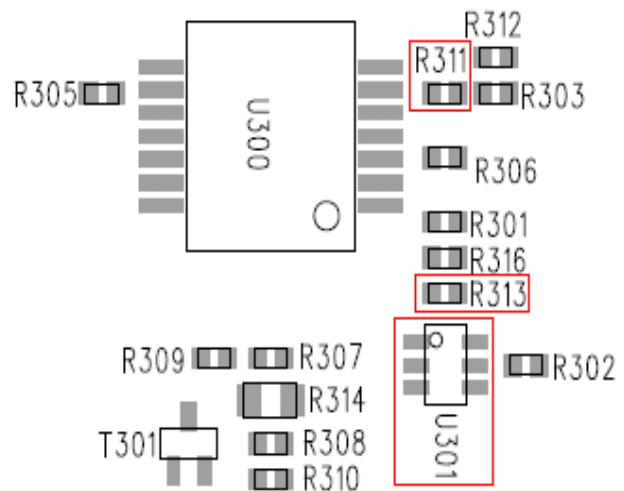
Group A	Group B	Rework list
Q26 Dev. Kit SCH	C-GPS Opus III Dev. Kit SCH (Module)	No
WMP100 Dev. Kit SCH		No
Q64 Dev. Kit SCH		C-GPS Opus III Dev. Kit SCH - Remove U301 and R316, and short U301 pin5 to U301 pin6. - Replace R313 from 10kΩ to 0Ω.  [level shifter included in Q64]
Q26 Dev. Kit SCH	C-GPS ATS3625 Dev. Kit SCH (Module)	No
WMP100 Dev. Kit SCH		No
Q64 Dev. Kit SCH		C-GPS ATS3625 Dev. Kit SCH - Remove U302 and R316, and short U302 pin5 to U301 pin6. - Replace R314 from 10kΩ to 0Ω.  [level shifter included in Q64]

Due to the Q64 embedded level shifter, below is the rework example for C-GPS Dev. Kit.

For C-GPS Nanoridge Developer Kit:

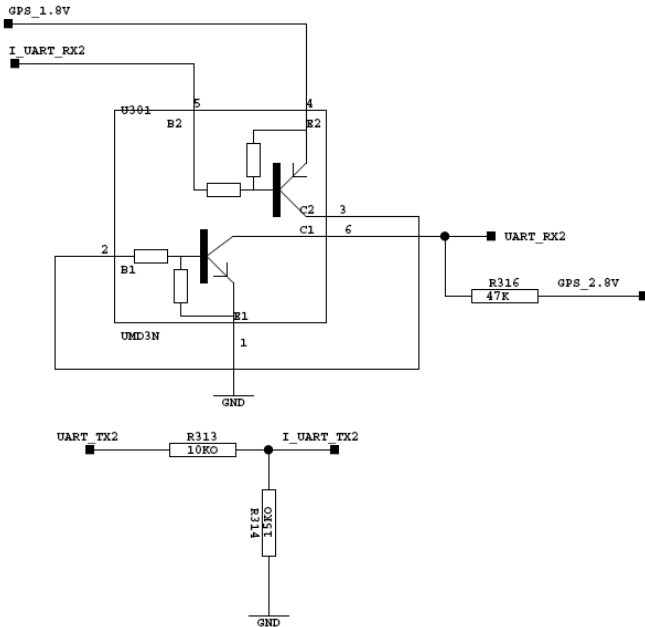


Circuitry

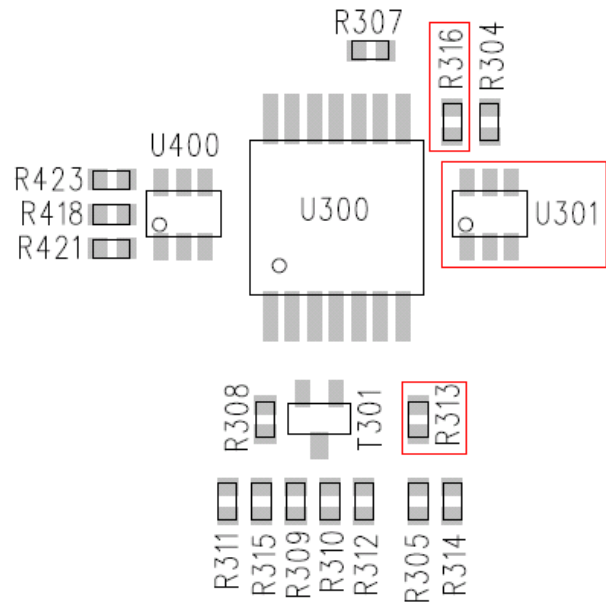


PCB

For C-GPS Opus III Developer Kit:

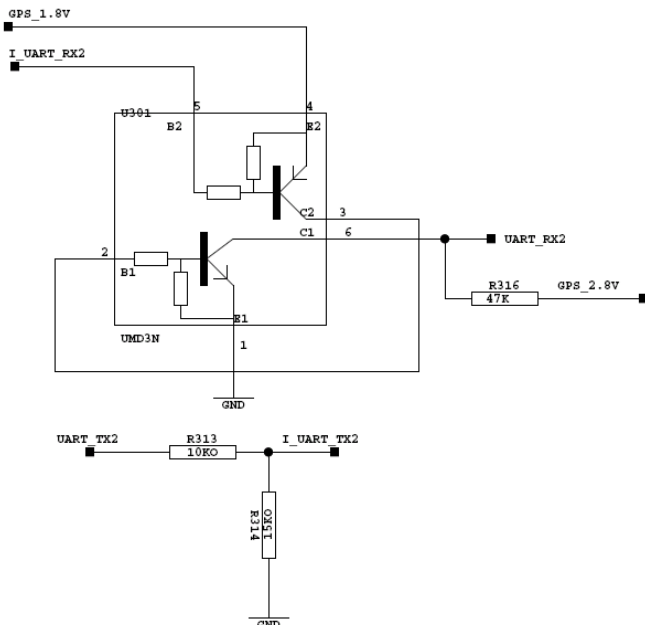


Circuitry

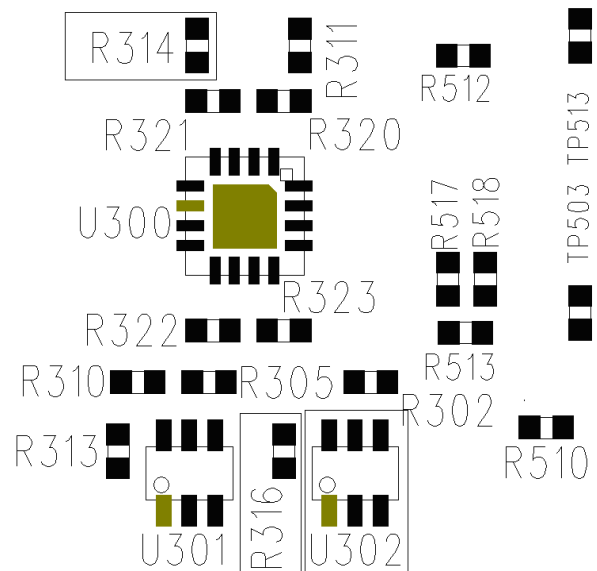


PCB

For C-GPS Opus III ATS3625 Developer Kit:



Circuitry



PCB

## 8 Package Deliverables

This application note is delivered as a single compressed zip archive as follows:

Filename	Description
OpusIII_C-GPS_Application_Note_Rev003.zip	Application Note

## 9 Related Documents

	Filename	Comment
[1]	WM_DEV_CGPS3_UGD_002	C-GPS Nanoride Development kit User Guide
[2]	WM_DEV_CGPS3_UGD_001	C-GPS Opus III Development kit User Guide
[3]	eRide Opus III GPS Library APIs Developer's Guide	Provided on each version of Plug-In software
[4]	eRide Opus III GPS Aiding APIs Developer's Guide	Provided on each version of Plug-In software
[5]	WM_DEV_WUP_UGD_001	WMP100 development kit user guide
[6]	WM_BBD_Q26_UGD_001	Q26 series development kit user guide
[7]	WM_DEV_CGPS3_UGD_004	C-GPS Opus III ATS3625 Development kit User Guide
[8]	eRide A-GPS Server Access	How to obtain and how to program GroupIDs

*Note: Data sheets and application notes related to Opus III chipset, Nanoride module and ATS3625 module are available from eRide distributor Hitachi High-Tech (see SUPPORT).*

## 10 Software Compatibility Matrix

Firmware	Sierra Wireless Software Suite	Plug-Ins
6.63	SDK v4.22	WIP v3.X C-GPS v3.04
6.5	Sierra Wireless Software Suite v1.X	WIP v2.02/v3.1X C-GPS v3.04
7.x	Sierra Wireless Software Suite v2.X	WIP v3.1X/v4.X C-GPS v3.04
7.3a and later	Sierra Wireless Software Suite v2.21 and later	WIP v5.X and upper C-GPS v3.08

**Caution:** *The C-GPS Opus III Daughter board doesn't work with Firmware 7.1 because of an anomaly (ANO47317) which is only present on this firmware.*

The C-GPS Nanoride Daughter board is not impacted by this anomaly.

## 11 Support

C-GPS Plug-In support (software, development kits, application design, etc.): Sierra Wireless

- For direct clients: contact your Sierra Wireless FAE
- For distributor clients: contact your distributor FAE
- For distributors: contact your Sierra Wireless FAE

GPS hardware support (GPS design review, etc.): eRide

- [www.eRide.com](http://www.eRide.com)
- [support@eRide.com](mailto:support@eRide.com)

Sales channel support (quotation, sourcing, datasheet): Hitachi High-Technology

- Hitachi High Technology local representative

- [www.hitachi-hitec.com/global](http://www.hitachi-hitec.com/global)
- [gps\\_contact@nst.hitachi-hitec.com](mailto:gps_contact@nst.hitachi-hitec.com)

## 12 Document History

Version	Date	History
001	June 18, 2008	Creation
002	April 29, 2009	ATS3625 updates
003	February 24, 2010	Update to Sierra Wireless format and general review

## 13 Legal Notice

### Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

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6,191,741	6,199,168	6,339,405	6,359,591	6,400,336	6,516,204	6,561,851	6,643,501
6,653,979	6,697,030	6,785,830	6,845,249	6,847,830	6,876,697	6,879,585	6,886,049
6,968,171	6,985,757	7,023,878	7,053,843	7,106,569	7,145,267	7,200,512	7,295,171
7,287,162	D442,170	D459,303	D599,256	D560,911			

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