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Enfora Enabler III LPP

Integration Guide

LPP0208IG001

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GENERAL

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1 Safety Precautions

1.1 IMPORTANT SAFETY INFORMATION

The following information applies to the devices described in this manual. Always observe all standard and accepted safety precautions and guidelines when handling any electrical device.

- Save this manual: it contains important safety information and operating instructions.
- Do not expose the Enfora Enabler III LPP product to open flames.
- Ensure that liquids do not spill onto the devices.
- Do not attempt to disassemble the product: Doing so will void the warranty. With the exception of the Subscriber Identification Module (SIM), this product does not contain consumer-serviceable components.

1.2 DISCLAIMER

The information and instructions contained within this publication comply with all FCC, GCF, PTCRB, R&TTE, IMEI and other applicable codes that are in effect at the time of publication. Enfora disclaims all responsibility for any act or omissions, or for breach of law, code or regulation, including local or state codes, performed by a third party.

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Warning: The Enabler III LPP platform is designed with features to support a robust connection. There are instances where the module performance is beyond the control of the intended design. Integrated designs that require 24 by 7 operation must implement power control via an external circuit or by implementing power management as specified within this design guide.

2 Manual Overview

This document describes the available hardware interface of the Enabler III LPP module. The purpose of this document is to define the electrical, mechanical and software interfaces while providing detailed technical information in order to streamline the process of hardware and system integration.

2.1 REFERENCES

2.1.1 ENFORA ENABLER III LPP PRODUCT DOCUMENTATION MANUALS

- LPP0208AT001 - Enfora Enabler III LPP AT Command Set Reference
- GSM0308UG001 - Enfora GSM-GPRS Family API Reference
- LPP0208PR001 – Enfora Enabler III LPP Programming Reference
- LPP0208SD001 – Enfora Enabler III LPP SDK Reference

2.1.2 GSM DEVICE SPECIFICATIONS

- 3GPP TS 51010-1 (850, 900,1800,1900 MHz devices)

To view the latest release, go to:

http://www.3gpp.org/ftp/Specs/html-info/51010-1.htm

2.1.3 FEDERAL COMMUNICATIONS COMMISSION (FCC)

Internet: http://www.fcc.gov/

- FCC Rules, Part 24

  - 47 CFR Subpart E--Broadband PCS
  - 47 CFR § 24.52, sections 1.1307(b), 2.1091, and 2.1093

- FCC Rules, Part 22 for GSM 850
- FCC Rules, Part 15
- FCC Rules, Part 2

  - Subpart J--Equipment Authorization Procedures
  - Section 2.925

2.1.4 FCC OFFICE OF ENGINEERING AND TECHNOLOGY (OET)

Internet: http://www.fcc.gov.oet/

- Bulletin Number 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
- Supplement C "Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Exposure to Radio Frequency Emissions"

2.1.5 INDUSTRY CANADA

- RSS-132
- RSS-133
- ICES-003

2.1.6 ENVIRONMENTAL REGULATIONS

- National Environmental Policy Act (NEPA) of 1969 (Part 1, Subpart 1)
- RoHS Compiant

2.1.7 MECHANICAL SPECIFICATIONS

- ASTM D999
- ASTM D775
- IEC 68-2-27
- Bellcore Gr-63-CORE
- ETS 300 019-1-1 Class 1.2
- ETS 300 019-1-2 Class 2.1
- ETS 300 019-1-3 Class 3.1

2.1.8 RF AND EMI SPECIFICATIONS

- ETSI Standards
- EN 61000-4-6
- EN 61000-4-3
- 3GPP TS 51.010-1, Section 12.2

3 Introduction

3.1 PRODUCT OVERVIEW

The Enfora Enabler III LPP module is a compact, wireless OEM module that utilizes the Global System for Mobile Communications (GSM) and General Packet Radio Services (GPRS) international communications standard to provide two-way wireless capabilities via GSM services. This GSM/GPRS module is combined with a Global Positioning System (GPS) chipset to provide physical location, an MSP430 processor to ensure very low power standby configurations, and vibration sensor to detect movement of the module. The Enfora Enabler III LPP module is a fully Type-approved GSM/GPRS device, enabling application-specific, two-way communication and control.

The small size of the Enfora Enabler III LPP module allows it to be integrated easily into the application and packaging.

3.2 KEY FEATURES OF THE ENABLER III LPP MODULE

The following table summarizes the main features of the Enfora Enabler III LPP Radio Module.

Interface	Data input/output interface	52 position 1.27mm pitch
	Primary serial port	2.2 V logic levels, '2-wire' UART implementation.
	Secondary serial Port	Single TX from GPS, NMEA data only. (2.2 V logic levels)
	USB port	USB Debug and Configuration
	Audio	Analog audio
	Command protocol	Enfora Packet API, GSM AT command set, Enfora MCP
	Subscriber Identification Module (SIM)	USIM port with SIM detect.
	Battery Charger	Lithium Ion battery charger, temperature and battery ID analog inputs
Power	Electrical power	3.3 to 4.5 Vdc (vbat)
	Peak currents and average power dissipation	Refer to the Operating Power table in the Technical Specifications for peak currents and average power dissipation for various modes of operation.
Radio Features	Frequency bands	EGSM 900, GSM1800, GSM 850 and GSM 1900 capability.
	GSM/GPRS features supported.	Provides for all GSM/GPRS authentication, encryption, and frequency hopping algorithms. GPRS Coding Schemes CS1-CS4 supported. Multi-Slot Class 10 (4RX/2TX, Max 5 Slots).

Regulatory	Agency approvals	GCF Type Approval PTCRB Type Approval FCC Certification RTTE CE (European Community Certification) IC (Industry Canada) Approval
GSM/GPRS Functionality	Mobile-originated and mobile-terminated SMS messages: up to 140 bytes or up to 160 GSM 7-bit ASCII characters. Reception of Cell Broadcast Message SMS Receipt acknowledgement Voice (EFR, FR, HR, AMR) Supports Unstructured Supplementary Service Data (USSD) Multi-Slot Class 10 Supported (4Rx/2TX), (5 Slot Max) PBCCH/PCCCH Supported	
Audio Input	Handset Microphone biasing, internal Handset microphone input (MICIN, MICIP pins)	
Audio Outputs	Handset earphone outputs (EARP, EARN pins)	
SIM	1.8/3 V Mini-Subscriber Identity Module (SIM) compatible	
Software	Free RTOS included	

Table 1 - Enabler III LPP Key Features

3.3 PROVIDING MULTI-BAND OPERATION

The Enfora Enabler III LPP module provides 4 frequency bands for compatibility with worldwide frequency standards. 850/1900 frequency bands are primarily used in North and South America, while 900/1800 bands are used throughout the world. The Enabler III LPP offers all four bands for use worldwide.

3.4 SUMMARY OF ENABLER III LPP MODULE FEATURES

The following summarizes the main features of the Enfora Enabler III LPP Module.

Mechanical:	
Dimensions	38.5 mm x 33.6 mm x 4.19 mm
Weight	8.6g
Packet Data Transfer:	
Protocol	GPRS Release 97
Coding Schemes	CS1-CS4
Multi-Slot Capability (Demonstrated @MS10)	MS10 (4RX/2TX) (Max 5 Slots)
Packet Channel Support	PBCCH/PCCCH
Short Message Services:	
GSM SMS	MO, MT, CB, Text and PDU Modes
GPRS SMS	MO, MT, CB, Text and PDU Modes
Voice Capability:	
Speech Codec	EFR, FR, HR, AMR
GSM/GPRS Radio Performance Multi-Band:	
LPP0208 Radio Frequencies	850/900/1800/1900 MHz
Sensitivity	< -106 dBm (Typical GPRS CS1)
850 & 900 MHz Transmit Power	Class 4 (2 W)
1800 & 1900 MHz Transmit Power	Class 1 (1 W)
System Requirements:	
Host Interface	Serial Interface. 2.2 V logic levels.
DC Voltage	3.3 to 4.5 Vdc
Application Interface:	
Host Protocol	MCP Protocol, AT Commands, OTA Enfora Packet API and USB
Internal Protocols	UDP stack and TCP/IP stack
Physical Interface	2 serial (2.2 V logic levels, primary - Default rate 115,200 baud; secondary - rate 19,200 baud), 1 USB
Audio Interface	Handset microphone input (MICIN, MICIP pins), Handset earphone outputs (EARP, EARN pins)
SIM Interface:	
Remote SIM	1.8/3-Volt SIM Capability
Environmental:	
Compliant Operating Temperature	-20 °C to 60 °C (Fully GSM Spec Compliant)
Operating Temperature	-30 °C to 70 °C (Not fully GSM Spec Compliant)
Storage Temperature	-40 °C to 85 °C
Humidity	5 to 95% non-condensing
EMC:	
Emissions	FCC Parts 15,22 & 24, Class B 3GPP TS 51010-1, Section 12.2 EN 55022 Class B

Operating Power (TYPICAL):

Function Block	State	Average Current	Units
MSP	Idle, Serial Port Connected	1.9	mA
	Idle, Serial Port Connected, Accelerometer ON with movement	2.02	mA
	Shutdown	< 6	uA
GPS	Acquiring	54	mA
	Tracking	47	mA
GSM only	Registered, sleep=0	57	mA
	GPRS 850	275	mA
GSM + GPS	GPRS 850, GPS Acquisition	328	mA
	GPRS 850, GPS Tracking	320	mA

Table 2: Typical Operating Power

GSM transmit Power:

1800/1900 MHz	GSM Power Class 1
	(30 dBm ± 2 dB @ antenna connection)
850/900 MHz	GSM Power Class 4
	(33 dBm ± 2 dB @ antenna connection)

GSM/GPRS Receiver Sensitivity (Typical):

1800/1900 MHz	<-106 dBm, GPRS Coding Scheme 1 (CS1)
850/900 MHz	<-106 dBm, GPRS Coding Scheme 1 (CS1)

3.5 GENERAL DESIGN GUIDELINES FOR UTILIZING ENFORA GSM MODULES

The following guidelines are provided in an effort to allow Enabler III LPP module users to successfully implement their PCB layout to obtain the best performance. This includes the lowest possible EMI emissions, maximum thermal conduction, mechanical integrity, and voice quality. The Enabler III LPP module is a very compact, high performance design, yet it is easy to interface into the final product. In order to realize its full potential, designers should pay close attention to ground structures, the routing of RF and Digital traces, and the size of the power supply lines.

> Warning: These design tips are strictly guidelines and are not meant to be a complete list of items that guarantee actual performance. Each application is different and may require variation from these guidelines; however, care should be given to utilize these sound engineering principles whenever possible.

3.5.1 ADVANCED TIPS FOR AN RF FRIENDLY LAYOUT

3.5.1.1 GROUND PLANE

To ensure the lowest possible EMI emissions and maximum thermal conductivity, it is recommended that all metal tabs on the GSM module shield must be soldered down onto a continuous ground plane that runs under the entire module. Ample ground vias should be provided to create a low impedance ground. It is recommended to minimize the number of I/O and power traces under the GSM module to allow for as much ground plane as possible. An example of a good ground structure and pad layout is shown below in Figure 1 - Example of good ground plane for GSM modules.
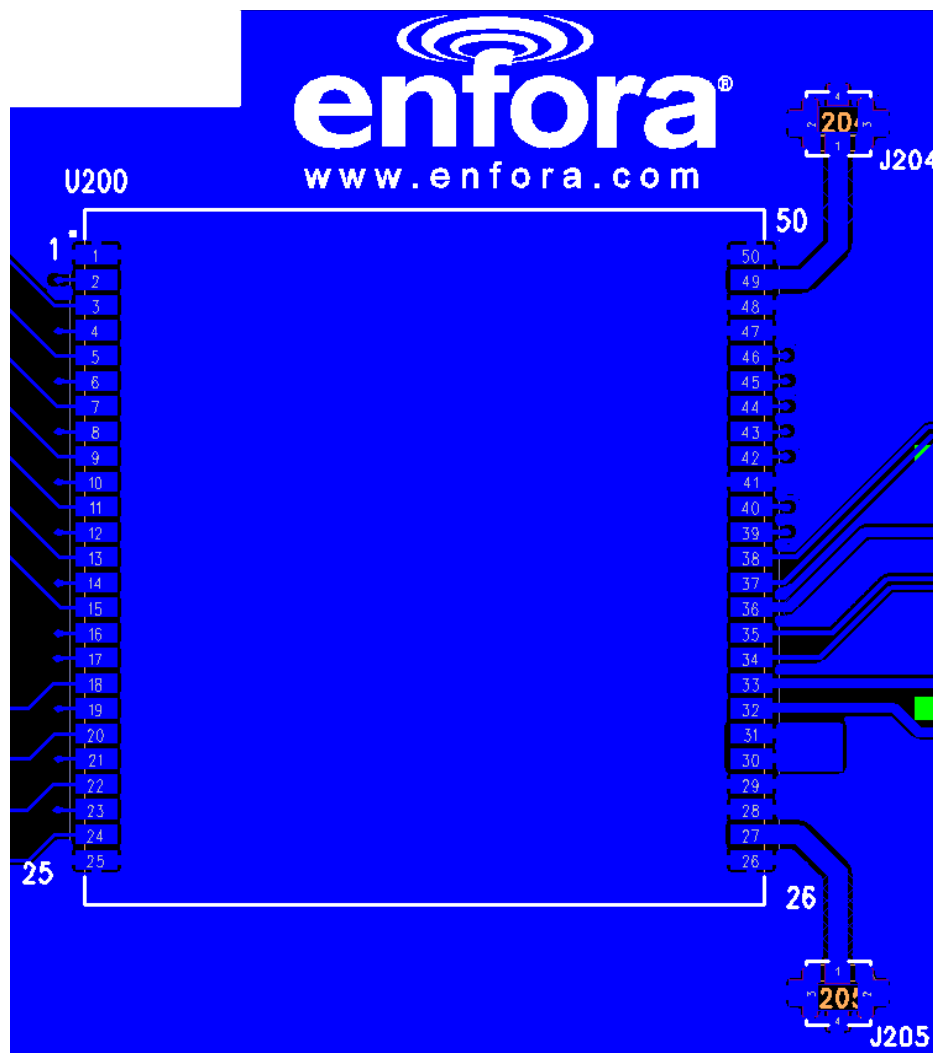
Figure 1 - Example of good ground plane for GSM modules

3.5.1.2 THERMAL RELIEF

Because the ground plane acts as a large heat sink, it can affect the solderability of components. A common method to reduce this effect is to use thermal relief around the pad in question. However, great care must be taken when using thermal relief for high current or high frequency applications

For example, a large thermal relief like the one shown in Figure 2 can serve the purpose for general applications such as low current, low speed data lines, DC connections and audio frequency applications. However, such thermal relief structures should be avoided for applications where high current and/or high frequency is involved, such as those using the Enabler Module. Depending on the frequency of operation, the long narrow thermal relief traces between the pad and the ground plane act like an RF choke. These RF chokes become higher impedance at harmonics of the fundamental frequency making it problematic for high frequency suppression. This can make it difficult to pass type approval testing.
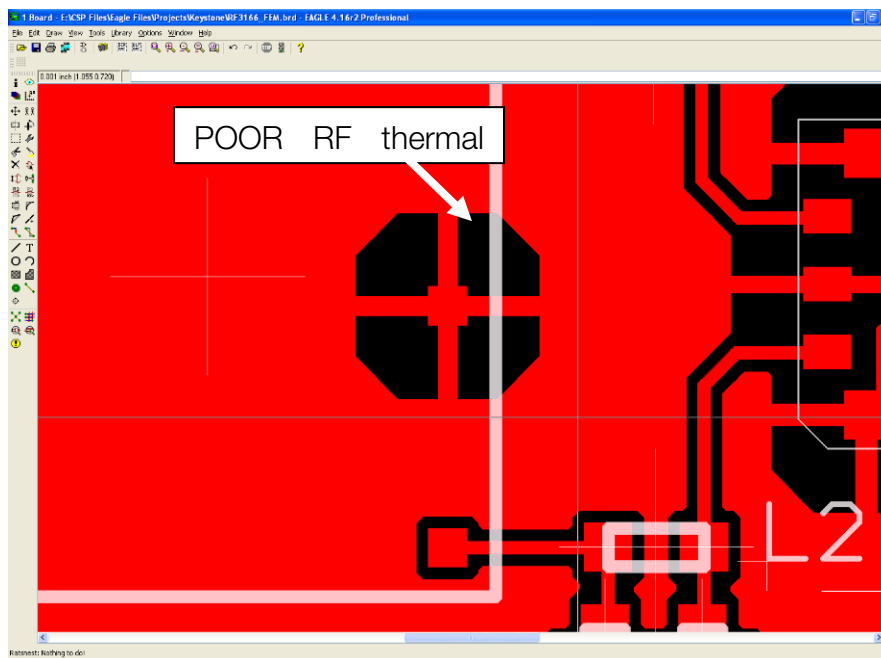
Figure 2 - Example of a POOR RF Thermal Relief

If thermal relief is necessary, it is recommended that you use short, fat traces similar to those shown in Figure 3. This will still provide a solderable connection, while providing a better RF connection. Making them shorter also allows for a more continuous ground plane due to less copper being removed from the area. It is also recommended to have ground vias around all thermal relief of critical ground pins.
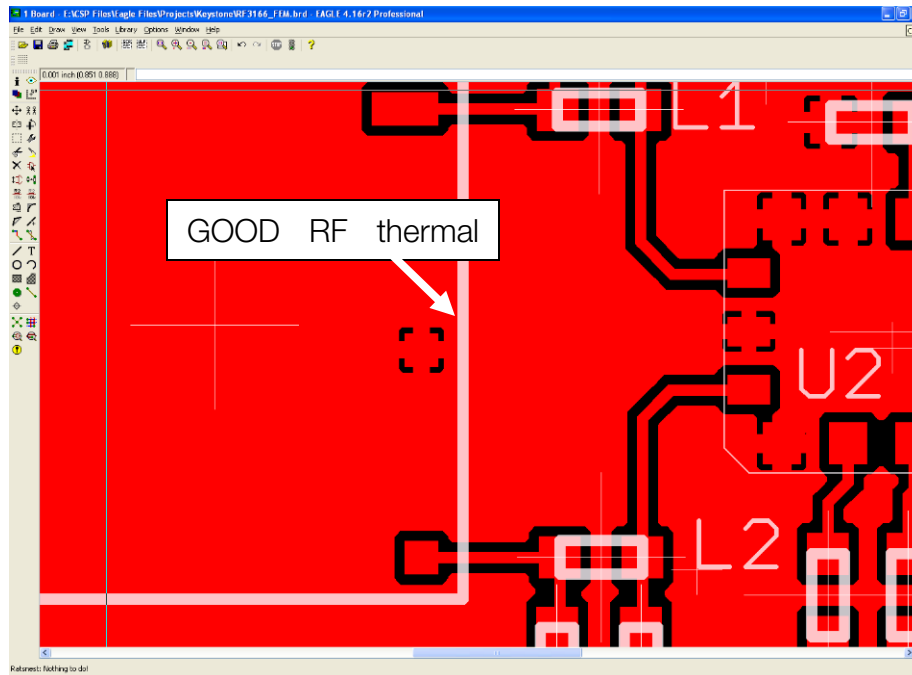
Figure 3 - Example of a GOOD RF Thermal Relief

3.5.1.3 ANTENNA AND RF SIGNAL TRACE

The PCB trace that feeds the RF output port must be designed for a 50 ohm characteristic impedance, coplanar, or routed into internal layers to keep the top layer continuous around and underneath the Enabler module. Ample ground vias should be provided around the RF contacts, the RF trace and launch pad. If possible, keep I/O and power traces away from the RF port. This includes traces running parallel or orthogonal to it. Thermal relief should not be used on the antenna output port ground pads. The designer must pay close attention to the size of the pad and thickness of the dielectric beneath the signal pad and trace. Most PCB manufacturers can adjust the trace width to maintain 50 ohms impedance if the traces are identified and instructions are included on the FAB drawing. This service is typically provided at no or minimal additional cost.

For minimum RF emissions due to the fundamental frequency of operation, the Enabler module works best with an antenna load that has a VSWR of 1.5:1 or better. The antenna should not have gain at the harmonic frequencies, otherwise, the conducted harmonics could get amplified to a point where the product no longer passes type approval. However, for applications where antenna quality is less than ideal, it is recommended to have a low pass filter (Pi structure with N=3) in the RF path to the antenna. This is a secondary plan should there be a need to lower harmonic levels at frequencies above the PCS band. The pad structure may also be used to match the antenna load impedance, if required. If it is not needed, a capacitor of low reactance may be used to bridge the Pi structure.

The RF cable going between the Enable module and the antenna is very lossy, therefore, the length of this cable should be kept as short as possible.

3.5.1.4 VBAT INPUT

The Enabler Vbat input can have a relative high current draw that can fluctuate rapidly, especially when transmitting at max power and burst mode. The Vbat interface must be designed to provide the required instantaneous voltage and current with minimal voltage droop. This includes both sufficient bulk decoupling capacitance as well as adequate layout provisions.

Similar to the discussion on thermal relief, the use of narrow traces to connect the Vbat pins to the source voltage can act like a high impedance and cause a significant voltage droop when higher currents are required as shown in Figure 4. If the Vbat drops too low, the Enabler modules will reset. To minimize the trace loss, it is suggested to use a larger trace that spans several pins. The layout should provide sufficient trace width over the entire trace from the Enabler module all the way to the source of the Vbat voltage. Any transitions between layers for this trace should utilize multiple vias.
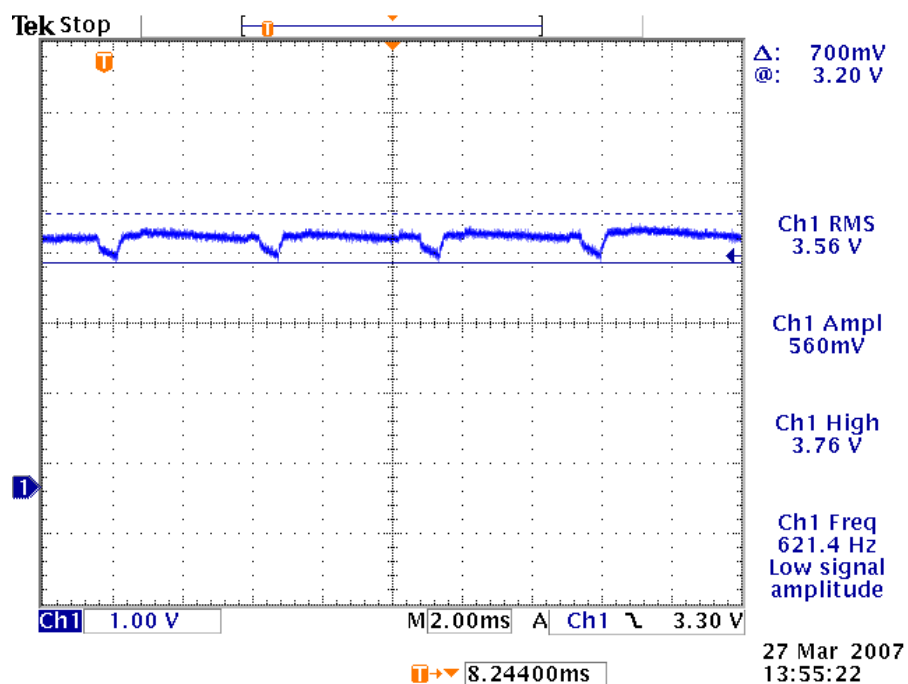
Figure 4 - Example of Vbat Voltage Droop

Two 470 uF, low ESR, tantalum capacitors are included in the design to provide decoupling of Vbat input voltage. Bulk decoupling capacitance is not required at the Vbat input external to the Enabler module.

3.5.2 AUDIO REFERENCE DESIGN

The audio quality is very dependent on the circuit design and layout. As an aid to obtaining good audio quality, a reference design has been included below. It has been proven to provide good performance on the SDK module.

3.5.2.1 AUDIO SCHEMATICS
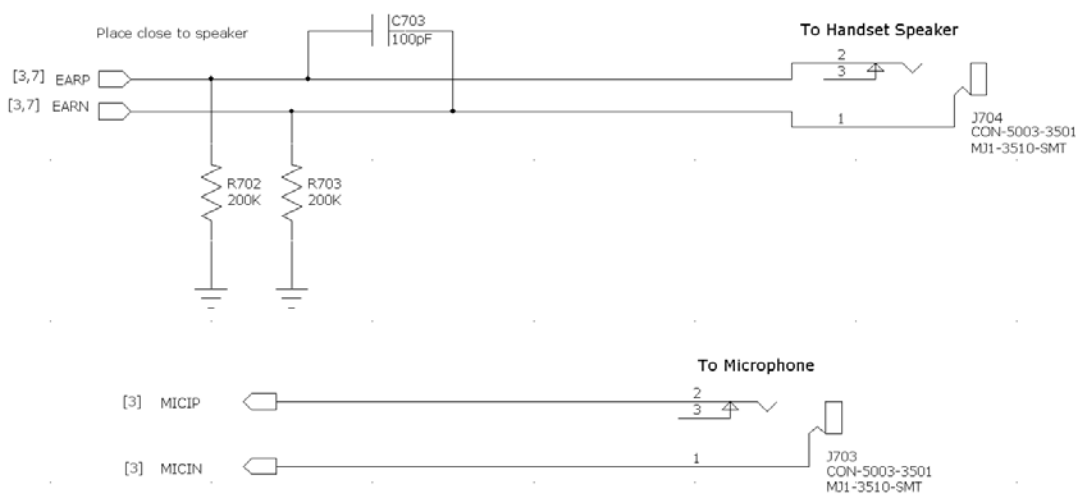
Figure 5 - Audio Reference Design Schematic

3.5.2.2 AUDIO LAYOUT

Layout plots for the audio section of the SDK are available upon request.

3.6 HANDLING AND SOLDERING GUIDELINES

The guidelines presented in IPC/JEDEC J-STD-020C for handling, preparation, and reflow of lead-free devices should be applied to the Enabler III LPP module. Care should be taken to minimize module moisture exposure before reflow. The module is classified as a Type 3 MSL (moisture sensitivity level).

4 Technical Specifications

4.1 ENABLER III LPP MODULE BLOCK DIAGRAM
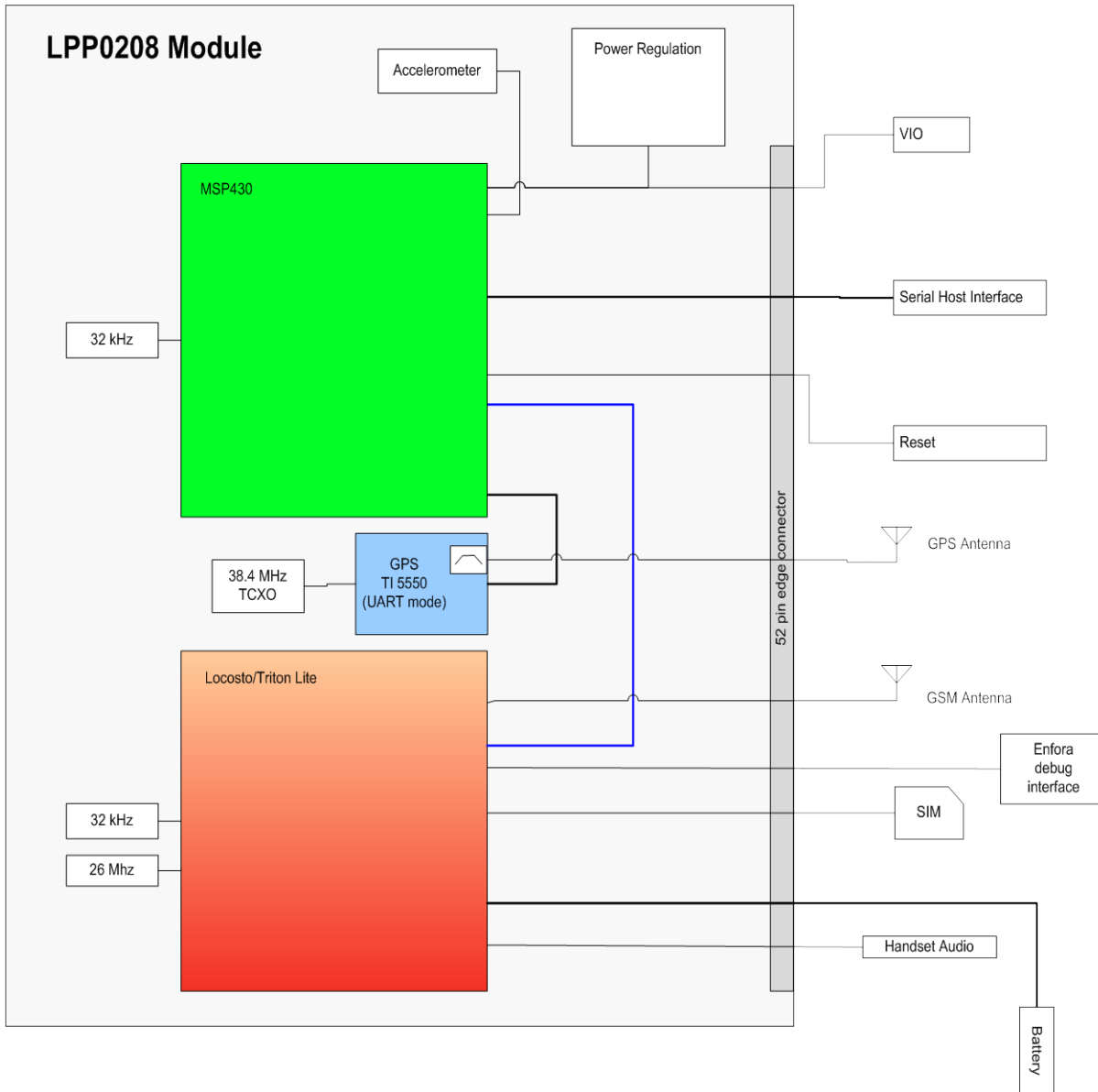
Figure 6 - Enabler III LPP Module Block Diagram

4.2 DETAILED PRODUCT SPECIFICATIONS

Physical Dimensions and Weight	
Size (L x W x H)	38.5 mm x 33.6 mm x 4.19 mm
Weight	< 8.6 grams

Climatic: Operational	
GSM Compliant temperature Operating temperature	-20°C to +60°C -30°C to +70°C
Relative humidity	5 - 95%
Air pressure (altitude)	70 kPa to 106 kPa (-400 m to 3000 m)

Climatic: Storage and Transportation	
Duration	24 months
Ambient temperature	-40°C to +85°C
Relative humidity	5% to 95%, non condensing (at ̃4C)
Thermal shock	-50°C to +23°C, +70°C to +23°C; < 5 min
Altitude	-400 m to 15,000 m

Mechanical: Operational	
Operational vibration, sinusoidal	3.0 mm disp, 2 to 9 Hz; 1 m/s2 , 9 to 350 Hz
Operational vibration, random	0.1 m2 /s3 , 2 to 200 Hz

Mechanical: Storage and Transportation	
Transportation vibration, packaged	ASTM D999
Drop, packaged	ASTM D775 method A, 10 drops
Shock, un-packaged	150 m/s2 , 11 ms, half-sine per IEC 68-2-27
Drop, un-packaged	4-inch drop per Bellcore GR-63-CORE

Mechanical: Proposed Standards	
Transportation	ETSI Standard ETS 300 019-1-2 Class 2.3 Transportation
Operational	ETSI Standard ETS 300 019-1-3 Class 3.1 Operational
Storage	ETSI Standard ETS 300 019-1-1 Class 1.2 Storage

Electromagnetic Emissions	
Radiated spurious	FCC Part 22 & 24 / Part 15 Class \ B 3GPP TS 51.010-1 Section 12.2 EN 55022 Class B

4.3 OPERATING POWER

The Enfora Enabler III LPP module requires an input voltage of 3.3 Vdc to 4.5 Vdc.

4.3.1 TYPICAL INPUT CURRENT

Test Conditions:

- Typical Results @ 3.8V, 20 deg C, terminated into a 50Ω load.

GSM Operation		Input Current			
Band	Mode	Low	Nom/Avg	High/Peak	Units
1900	1 RX/1 TX, Full Power		TBD		mA
1800			TBD		mA
900			TBD		mA
850			TBD		mA
ALL	Idle		TBD		

GPRS Operation		Input Current			
Band	Mode	Low	Nom/Avg	High/Peak	Units
1900	4 RX/1TX, Full Power		TBD		mA
	2 RX/2TX, Full Power		TBD		mA
	1 RX/1TX, Full Power		TBD		mA
1800	4 RX/1TX, Full Power		TBD		mA
	2 RX/2TX, Full Power		TBD		mA
	1 RX/1TX, Full Power		TBD		mA
900	4 RX/1TX, Full Power		TBD		mA
	2 RX/2TX, Full Power		TBD		mA
	1 RX/1TX, Full Power		TBD		mA
850	4 RX/1TX, Full Power		TBD		mA
	2 RX/2TX, Full Power		TBD		mA
	1 RX/1TX, Full Power		TBD		mA
ALL	Idle		TBD		mA

4.3.2 GSM TRANSMIT POWER

Enfora Enabler III LPP Module	Power Class	Transmit Power
1900 MHz 1800 MHz	GSM Power Class 1	1-W conducted power maximum (30 dBm +/- 2 dB), measured at the antenna port
850 MHz 900 MHz	GSM Power Class 4	2-W conducted power maximum (33 dBm +/- 2 dB), measured at the antenna port

4.3.3 GSM RECEIVER SENSITIVITY

Enfora Enabler III LPP Module	Sensitivity	Mode
1900 MHz 1800 MHz	-106 dBm (typical)	GPRS Coding Scheme 1 (CS1)
900 MHz 850 MHz	-106 dBm (typical)	GPRS Coding Scheme 1 (CS1)

5 Physical Interfaces

5.1 MODULE MOUNTING TO HOST BOARD (REFERENCE)

TBD

5.2 I/O PIN ASSIGNMENTS

The following table shows the pin assignments for the input/output connector.

Pin #	I/O	Enabler LPP G	Description/Comments (Default Function / Secondary Function
1	R	GND	System Ground
2	I	BATT_TEMP	Battery Temperature Input
3	I	BATT_ID	Battery Identification Input
4	I	POWER ON/OFF	Power ON/OFF control Input
5	O	STATUS	Power ON/OFF status Output
6		Reserved	
7		Reserved	
8		Reserved	
9		Reserved	
10	I	GPI1	General Purpose INPUT 1
11	I	GPI2	General Purpose INPUT 2
12	O	GPO1	General Purpose OUTPUT 1
13	O	GPO2	General Purpose OUTPUT 2
14		Reserved	
15		Reserved	
16		Reserved	
17	O	MSP_UART_TX	UART Serial Data Output From Module
18	I	MSP_UART_RX	UART Serial Data Input To Module
19	O	GPS_TX	UART Serial Data Output (NMEA data only)
20		Reserved	
21		Reserved	
22		Reserved	
23		Reserved	
24	I	MSP_RESET	Reset Input
25	R	GND	System Ground
26	R	GND	System Ground
27	O	GSM_RF_ANT	GSM RF Antenna
28	R	GND	System Ground
29	R	GND	System Ground
30	P	VBAT_GSM	Power for GSM radio
31	P	VBAT	Power for non-GSM systems
32	PWR	VIN	Battery Charger input power supply

Pin #	I/O	Enabler LPP G	Description/Comments (Default Function / Secondary Function
33	O	VIO	2.2 / 3.3 VDC Output
34	I/O	USB_D-	USB Data Bus (negative Terminal)
35	I/O	USB_D+	USB Data Bus (Positive Terminal)
36	I	USB_VBUS	USB Power Supply Line
37	I	MIC+	Microphone amplifier positive input
38	I	MIC-	Microphone amplifier negative input
39	O	EAR+	Speaker positive output
40	O	EAR-	Speaker negative output
41	R	GND	System Ground
42	O	SIM_RESET	SIM Card Reset
43	I/O	SIM_CLK	SIM Card Reference Clock
44	I/O	SIM_IO	SIM Card I/O Data
45	PWR	SIM_VDD	SIM Output Voltage 1.8 V / 2.85 V
46	I	SIM_DETECT	SIM Card Detect
47	R	GND	System Ground
48	R	GND	System Ground
49	O	GPS_RF_ANT	GPS RF Antenna
50	R	GND	System Ground
51		RESERVED	
52		RESERVED	

Table 3 - Enabler III LPP Pin Assignments

I = Input into Module   P = Power Input to Module   I/O = Input/Output to/from Module
O = Output from Module   R = Power Return from Module   PWR = Other Power

5.3 CIRCUIT PROTECTION

Other than very low level ESD protection within the module's integrated circuits, the module does not have any protection against ESD events or other excursions that exceed the specified operating parameters.

Generally, ESD protection (typically TVS/Transorb devices) should be added to all signals that leave the host board. This includes V_{BAT}/V_{CC}.

Series resistors (typically 47Ω) can also be added in series with data lines to limit the peak current during a voltage excursion.

Warning: Do not add series resistance to the SIM electrical.

Minimum ESD Protection Levels		ESD/Input Voltage	
Pin #'s	ESD Test Method	High/Peak	Units
Pins 4-16, 17, 18, 19, 34, 35	Human Body Model EIA/JEDEC22-A114-A	500	V
	Charge Device Model EIA/JEDEC22-C101-A	200	V
Pins (all VBUS/PWR), 37, 38, 42, 43, 44, 46	Human Body Model EIA/JEDEC22-A114-A	2000	V
	Charge Device Model EIA/JEDEC22-C101-A	500	V
RF Antenna	IEC 61000-4-2	8000	V

Table 4: ESD Protection Levels

Warning: It is the Integrator's responsibility to protect the Enabler III LPP module from electrical disturbances and excursions, which exceed the specified operating parameters.

5.4 CONTROL CONNECTOR SIGNAL DESCRIPTIONS AND FUNCTIONS

Note: The following descriptions are intended to provide hardware-level definitions. In some cases, specific lines will have no firmware functionality implemented. Information for each hardware-specific feature will be noted in the appropriate section.

5.4.1 MODULE POWER (PINS 30, 31)

The Enfora Enabler III LPP module uses a single voltage source of VCC=+3.3V to 4.5V. (The exact values of the uplink currents are shown in the tables in section 5.3.1.)

V_{BAT}	Parameter/Conditions	Min	Typ	Max	Units
Main Battery Supply	Voltage In Regulation	3.3		4.5	Vdc

Warning: The uplink burst will cause strong ripple on the voltage lines and should be effectively filtered.

External capacitance is not typically required by low current or extended life applications. However, if capacitance is added, then current leakage of the capacitor needs to be taken into consideration for these types of applications.

It should be noted that the input voltage level should not drop below the minimum voltage rating under any circumstances, especially during the uplink burst period.

5.4.2 ON/OFF SIGNAL (PIN 4)

The module may be set into a low power 'off' mode by pulling the pin low for a minimum of 3 seconds. This will shut down any active functions including GPS and GSM, and stop the MSP430 processor. This is the lowest power mode of the module, it can be ideally used when storing or shipping units and the controller is not to be enabled.

Once the module is in the 'off' state, it can be turned 'on' by holding the pin low for a minimum of 3 seconds. This will start the MSP430 processor, once booted the controller will be enabled and run as per the saved settings.

The module will normally start in the 'on' state and enable the controller logic when power is applied.

5.4.3 ON/OFF STATUS (PIN 5)

When the On/Off pin is used to put the module into an 'off' state or to turn it 'on', the status pin will indicate when it has successfully entered either state.

When turning off the unit, the status signal is set high after the On/Off signal is sufficiently held low (3 seconds). The status signal is held high for 3 seconds but can stay enabled if the system is waiting for the modem to shut down.

When turning on the unit, the on/off status signal will blink 12 times within a 3 second period if the battery voltage is in its highest range. If the battery is within its normal voltage range, the on/off status signal will blink on for one second, off for one second, then on for one second. The on/off status signal will then go off. When the signal is off, the unit is activated.

5.4.4 GENERAL PURPOSE INPUT SIGNALS (PINS 10, 11)

Two signals are available for input signals which can be controlled via user configuration of the modem software. The voltage level of the signal must be in reference to the selected VIO voltage (Pin 33).

5.4.5 GENERAL PURPOSE OUTPUT SIGNALS (PINS 12, 13)

Two signals are available for output signals which can be controlled via user configuration of the modem software. Commands are provided to change the state of the output signals. The voltage level of the signal must be in reference to the selected VIO voltage (Pin 33).

5.4.6 RESET SIGNAL (PIN 24)

The Reset signal is used to force the micro-controller to start at a known state. When the Reset is pulled low the micro-controller will immediately suspend any function and will not exit the reset state until the reset signal is released to be pulled

high. Once the transition from low to high is complete, the micro-controller will boot. The Reset signal is falling edge triggered, so the reset function is set immediately when the signal is pulled low.

When using Reset, it will immediately lose the connection to the GSM network, this is not considered ideal. Typically during a normal shutdown, the module will issue a detach request to the network to indicate that it is being removed.

Parameter	Parameter/Conditions	Vcc	MIN	TYP	MAX	UNIT
V_{IL}	Input Voltage – Low or float	2.2V	Vss		Vss+0.6	Vdc
V_{IH}	Input Voltage – High	2.2V	0.8*Vcc		Vcc	Vdc
Reset Pulse Duration			2			µS

5.4.7 USB (PINS 34, 35, 36)

Note: USB is used for software upgrades, modem configuration, and Enfora debug. Use this interface for local connection upgrades. Alternatively, FOTA can be used to upgrade the module software..

Pin Name	Pin Number	Signal Direction	Description
USB_VBUS 5 V T o i	36	In	5 V tolerant power Supply VBUS line; Used only as a USB sense, not for powering the module. (optional connection)
USB_DP	35	Analog I/O	5 V tolerant data plus pin in USB
USB_DM	34	Analog I/O	5 V tolerant data minus pin in USB

USB	Parameter/Conditions	Min	Typ	Max	Units
Input Voltage		4.4	4.65	5.25	V
Output voltage	High (Driven)	2.8	3.3	3.6	Vdc
	Low	0.0	0.1	0.3	Vdc
Transceiver D+/- Leakage Current		-2		2	µA

5.4.8 SERIAL INTERFACES

5.4.8.1 MAIN SERIAL INTERFACE (PINS 17, 18)

The pin naming for TX/RX is referenced as a DTE. The DTE device should match their input pins to the Enfora outputs and vice-versa. Module is on 2.2 V logic levels, so appropriate level translation needs to be accounted for.

9 way D Connector Pin Number	Signal	Signal Direction	Enfora Pin Number	Enfora Module Signal Direction
1	N/A			
2	Receive Data (RD)	from DCE	17	Output
3	Transmit Data (TD)	from DTE	18	Input
4	N/A			
5	Signal Ground	both		
6	N/A			
7	N/A			
8	N/A			
9	N/A			

The key features of the UART in the Enabler III LPP module mode are as follows:

- 16C550 compatibility
- Baud rate 115200 Kbits/s
- Data format:
- Data bit: 8 bits
- Parity bit: none
- Stop bit: 1bit
- Flow Control: None

5.4.8.2 GPS SERIAL INTERFACE (PIN 19)

It is optional as to whether something should be connected to the RS232 GPS DEBUG OUT. If streaming NMEA messages are needed for external processing, above and beyond the NMEA sent to the server, then a serial cable can be connected between this serial connector and a PC. The baud rate is fixed at 57600.

9 way D Connector Pin Number	Signal	Enfora Pin Number	Enfora Module Signal Direction
1	N/A		
2	Receive Data (RD)	19	Output
3	N/A		
4	N/A		
5	Signal Ground		
6	N/A		
7	N/A		
8	N/A		
9	N/A		

The key features of the UART in the Enabler III LPP module mode are as follows:

- Baud rate 57600 Kbits/s
- Data format:
    - Data bit: 8 bits
    - Parity bit: none
    - Stop bit: 1bit

5.4.9 HANDSET MICROPHONE INPUT (PINS 37, 38)

The handset differential inputs MICIP and MICIN can be amplified by the differential handset microphone amplifier. This amplifier has a gain of 25.6 dB.

Handset Mic Input	Parameter/Conditions	Min	Typ	Max	Units
Maximum Input Range – Mic(+) to Mic(-)	Inputs 3 dBm0 (Max. digital sample amplitude when PGA gain set to 0 dB)			32.5	mV_{RMS}
Nominal Ref. Level – Mic(+) to Mic(-)	Differential MIC		-10		dBm0
Differential Input Resistance – Mic(+) to Mic(-)	Differential MIC, MICAMP gain = 25.6 dB (INMODE = 0001)		36		$k\Omega$
Microphone Pre-Amplifier Gain	Differential MIC		25.6		dB

5.4.10 HANDSET SPEAKER OUTPUT (PINS 39, 40)

Pin Name	Pin Number	Signal Direction	Description
EARP	39	O	Earphone positive output
EARN	40	O	Earphone negative output

The earphone amplifier provides a full differential signal on the terminals EARP and EARN (Earphone).

Handset Spkr Output	Parameter/Conditions	Min	Typ	Max	Units
Maximum Differential Resistive Load	Output Swing 3.9 VPP		120		Ω
	Output Swing 1.5 VPP		33		Ω
Maximum Differential Capacitive Load				100	pF

Common Mode Minimum Resistive Load	At Internal Speaker (+) or (-)		200		kΩ
Common Mode Maximum Capacitive Load	At Internal Speaker (+) or (-)			50	pF
Amplifier Gain	EARG = 1		1		DB
	EARG = 0		-11		dB

Parameter	Test Conditions	Min	Typ	Max	Units
Earphone output swing at EARP-EARN	Distortion ≤ 2% and 120 Ω, VSP input level = +3 dBm0, amp gain = -11 dB		0.98		V_{P-P}
	Distortion ≤ 2% and 33 Ω, VSP input level = -5.34 dBm0, amp gain = -11 dB		0.38		
	Distortion ≤ 2% and 120 Ω, I2S input level = +3 dBm0, amp gain = -11 dB		0.93		
	Distortion ≤ 2% and 120 Ω, VSP input level = +3 dBm0, amp gain = 1 dB	3.1	3.92		
	Distortion ≤ 2% and 33 Ω, VSP input level = -5.34 dBm0, amp gain = 1 dB	1.2	1.5		
	Distortion ≤ 2% and 120 Ω, I2S input level = +3 dBm0, amp gain = 1 dB	2.96	3.7		
Earphone amplifier state in power down			High Z		
Earphone amplifier power supply rejection	1 kHz, 100 mVp-p		50		dB

An external audio amplifier should be used for loads of less than 16 Ω or if volume is inadequate.

5.5 SUBSCRIBER IDENTITY MODULE (SIM) (PINS 42, 43, 44, 45, 46)

The SIM, an integral part of any GSM terminal device, is a "smart card" that is programmed with subscriber information:

- The user information consists of an International Mobile Subscriber Identity (IMSI) number, which is registered with the GSM provider, and an encryption Ki (pronounced "key"). This information consists of a MSP430 processor and memory installed on a plastic card.

> Note: The SIM is not provided with the Enfora Enabler III LPP module. The SIM must be obtained from the GSM service provider and must be provisioned by the operator for data and/or voice. Always take care to protect the SIM: the GSM terminal will not operate without the SIM installed.

The SIM provides the IMSI for authentication. To gain access to the GSM network, the network must recognize the IMSI number, and the terminal must be able to properly decrypt the data sent by the network. The SIM also serves as a buffer for SMS messages, storing the message for transmission until a radio link is available and buffering received messages until retrieved.

5.5.1 USING A REMOTE SIM WITH THE ENFORA ENABLER III LPP MODULE (PINS 42, 43, 44, 45, 46)

The Enabler III LPP module does not include an on-board SIM carrier.

The module supports the use of 1.8 V and 3 V SIM cards. The module includes a hardware interface module dedicated to Universal Subscriber Identity Module (USIM). All baud-rates defined in ISO 7816-3 standard are supported for high-speed transmission.

- The integrator must provide a suitable SIM connector.
- The maximum distance from the module to the remote SIM connector must not exceed 25.4 cm (10 inches).
- It is recommended to have Zero resistance between the SIM connector and the module.
- External ESD Protection is Required

  - 15 kV Air Discharge
  - kV Contact Discharge

The transorb must have a low junction capacitance (typically < 10 pf) such as the following part:

Example:

Manufacturer: On Semi

Manufacturer PN: NSQA6V8AW5T2G
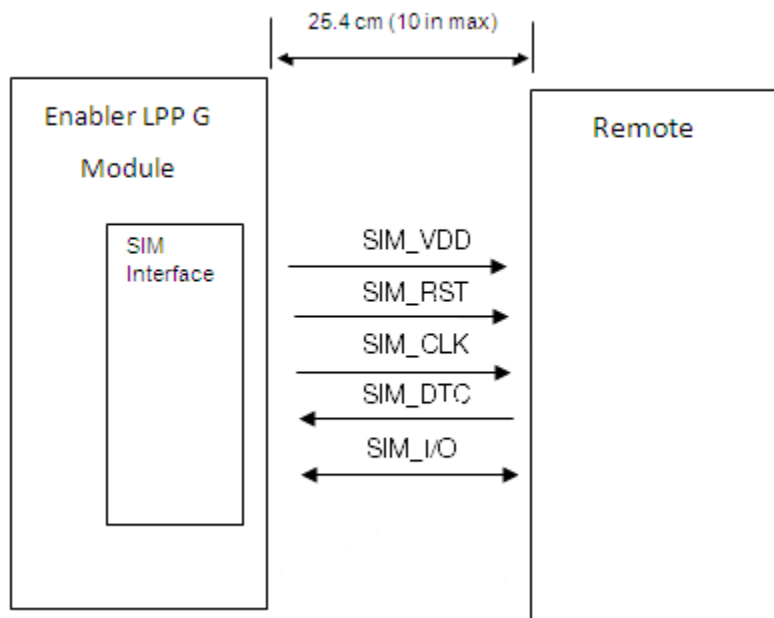
Figure 7 - Remote SIM Interface

Pin Name	Pin Number	Signal Direction	Description
SIM_VDD	45	O	SIM VDD
SIM_CLK	43	O	Card Reference Clock
SIM_RST	42	O	Card Reset
SIM_I/O	44	I/O	Card I/O Data
SIMDTC	46	I	Card Detect

The module provides the regulated supply voltage for the SIM-card and the circuitry to detect the insertion or extraction of the SIM-Card in or from the mobile.

The SIMDTC is disabled by default (see AT$SIMDTC in the AT Command Manual for settings). When enabled, the SIMDTC pin has an internal pull up to Vcc and can

be configured to detect a SIM insertion when the SIMDTC is either pulled to ground or left floating.

It can configured to detect either just a SIM removal or both removal and insertion.

When the module detects a SIM removal, it will de-register from the network. When the module is configured to and detects a SIM insertion, it will reset the module and re-register on the network.

The SIM-card presence detection logic is active when the GSM modem is on and is checked each time the GSM modem is powered up.

USIM	Parameter/Conditions	Min	Typ	Max	Units
VDD	SIM VDD voltage 1.8V	1.64	1.8	1.96	V
	3.3V	2.7	2.85	2.95	V
VIH	High level input voltage	1.15			V
VIL	Low level input voltage			0.61	V
VOH	High level output voltage, IO = 4 mA	Vdd-0.45			V
VOL	Low level output voltage, IO = 1 mA			0.4	V
II	Input leakage current			±1	µA
Iout	Output current		4		mA
PU	PU resistance		32		kΩ
PD	PD resistance		30		kΩ
Iz	Leakage current			± 30	µA
Card Detect	Debouncing time (SIM-card insertion)		0.5		mS
	Debouncing time (SIM-card extraction)		15		mS
	Pull-up resistor (resistor + resistive switch)		475		kΩ

5.5.1.1 REMOTE SIM COMPONENT INFORMATION

Any compatible SIM carrier can be used in conjunction with the Enabler III LPP module.

5.6 ANTENNA

The LPP0208 module has two RF antenna connections. One connection is for the GSM section of the module and the other for GPS. Please be sure to follow proper RF design practices when designing the antennas.

5.6.1 GSM

A GSM antenna should be designed from proper RF design practices.

5.6.2 GPS

The GPS_ANT is the RF connection from the GPS antenna; no external LNA is required. The LPP0208 can support both passive and active GPS antenna. However, external power supply and circuitry is required for an active GPS antenna. See Figure 12 - GPS Antenna Sample Schematic
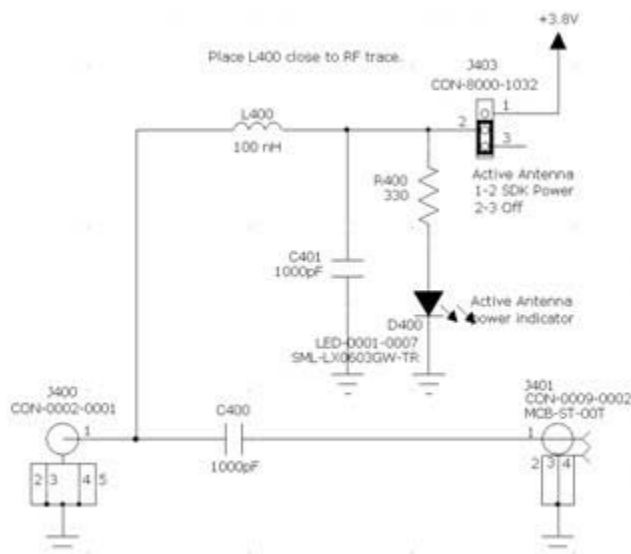
Figure 8 - GPS Antenna Sample Schematic

Active antenna is enabled by placing a jumper on J403 in the sample schematic between pins 1 and 2.

Passive antenna is enabled by placing a jumper on J403 in the sample schematic between pins 2 and 3.

6 GPS Performance

Specification	Parameter/Conditions	Typ	Units
Accuracy	-130 dBm, Autonomous CEP (50%)	<2	m
	-140 dBm, Autonomous CEP (50%)	<2	m
	-150 dBm, Autonomous CEP (50%)	<3	m
	-155 dBm, Autonomous CEP (50%)	<11	m
	-130 dBm, Autonomous CEP (95%)	<3	m
	-140 dBm, Autonomous CEP (95%)	<3	m
	-150 dBm, Autonomous CEP (95%)	<8	m
	-155 dBm, Autonomous CEP (95%)	<30	m
Acquisition Times -130 dBm, 25 °C	Cold Start TTFF	<40	Sec
Sensitivity	Tracking	- 160	dBm
	Reacquisition	-155	dBm
	Cold Start	-145	dBm

CEP (50%): The radius of a horizontal circle centered at the antenna's true position that contains 50% of the fixes.

CEP (95%): The radius of a horizontal circle centered at the antenna's true position that contains 95% of the fixes.

TTFF (Time To First Fix (seconds)): The number of seconds to provide a position fix (latitude & longitude).

Cold Start: The GPS receiver does not have valid almanac or time data.

Reacquisition: The GPS receiver has valid ephemeris, almanac and time data.

7 GSM/GPRS Modes of Operation

GSM/GPRS supports many optional services and modes. The Enfora Enabler III LPP module supports the following GSM/GPRS services:

- Short-Message Services (SMS)
- Class B GPRS Functionality
- Voice communication

7.1 ENABLING THE TRANSMISSION MODES FOR THE GSM/GPRS SERVICES

Each of the GSM/GPRS services has two modes that can be enabled separately:

- Mobile-originated (MO): allows the making of a service request (such as, making a telephone call or sending an SMS)
- Mobile-terminated (MT): allows receiving a service request (such as receiving a telephone call or an SMS)

Note: Contact your local GSM operator to ensure that the services and modes have been provisioned for the SIM.

7.2 VOICE COMMUNICATION

The Enfora Enabler III LPP module has voice capabilities, provided the necessary connections have been made for the speaker and microphone pins. The Enfora Enabler-LPP G AT Command Set Reference – LPP0208AT001 has the entire list of commands that can be used to control the voice functionality.

The Enfora Enabler III LPP module supports four vocoder compression algorithms for voice communication: Full-Rate (FR), Enhanced Full-Rate (EFR), Half-rate (HR) and Adaptive Multi-rate (AMR).

7.3 SMS: SHORT MESSAGE SERVICES

Short Message Services (SMS) is a feature-rich GSM service. The Enfora Enabler III LPP module can perform the following tasks:

- Sending and receiving binary messages of up to 160 characters (7-bit characters)
- Sending and receiving text messages of up to 140 bytes (8-bit data)
- Submitting a SMS Protocol Data Unit (PDU) to a SMSC (Short Message Service Center) and storing a copy of the PDU until either a report arrives from the network or a timer expires
- Receiving a SMS PDU from a SMSC
- Returning a delivery report to the network for a previously received message
- Receiving a report from the network
- Notifying the network when the module has sufficient memory capacity available to receive one or more SMS messages (after the module had previously rejected a message because its memory capacity was exceeded)

7.4 SIM OPERATION

7.4.1 PROVISIONING THE SIM

The SIM can support optional features or services. Most operators typically configure the SIM to send/receive voice calls and to receive SMS; however, some may require an additional tariff to enable the SIM to send SMS. The transmission of circuit switched and GPRS data are also additional services that may be required to allow the service:

- Mobile-originated (MO): allows making a service request (such as, making a call or sending an SMS)
- Mobile-terminated (MT): allows receiving a service request (such as, receiving a phone call or an SMS)
- The GSM SIM can have multiple telephone numbers.

It is imperative for the Enfora Enabler III LPP module that the SIM be configured for the optional services that are required for the application.

7.5 GPRS SERVICES SUPPORTED BY THE ENFORA ENABLER III LPP MODULE

The Enfora Enabler III LPP module supports the following GPRS (modes of operation) that must be enabled by the operator:

- GPRS Packet Connectivity (MO and MT) with Both Dynamic and Static IP option
- GPRS SMS (MO and MT): uses the IP (Dynamic or Static) set by the operator
- Multiple APN Setting
- Quality of Service Options
- Up to Multi-slot 10 Class of Service

7.6 SELECTING THE GSM MODES OF OPERATION

When provisioning the SIM for the Enfora Enabler III LPP module, enable the following modes of operation:

- Voice calls: configure the SIM for both MO and MT service (to send and receive)
- SMS: configure the SIM either for MT alone (to receive) or for both MO and MT (to send and receive)

Voice	SMS	GPRS	Function
MO/MT	MT		Voice calls, receive SMS
MO/MT	MO/MT		Voice calls, receive / send SMS
MO/MT	MO/MT		Voice calls, receive / send SMS

7.7 POWER MANAGEMENT

TBD

8 Software Interface

The application sends commands to the Enfora Enabler III LPP module via the 52-pin I/O signal connector. These commands use the Enabler III LPP Menu System, Enfora AT Command Set and/or Enfora GSM-GPRS Family API.

The Enfora Enabler III LPP module operates in one of the following modes:

- Command Menu mode: Used for configuring the Enfora Enabler III LPP module. It uses menu based commands via the serial port for communication. See LPP0208PR001 - Enfora Enabler III LPP Programming Reference for more details on specific commands.
- Modem Pass-Thru mode: Used to communicate directly with the modem. It uses the AT command set via the serial port for communication. Entry to this mode is available via a menu mode command.
- AT Command via USB: The USB port may be used to send AT commands directly to the GSM modem. This method should be used for configuration purposes, not normal usage. The GSM modem remains powered on as long as the USB port is connected.

8.1 FORMAT FOR THE AT COMMANDS

The general format of the command line is: <prefix> <command> <CR>

<prefix>	AT
<command>	See AT Command Manual
<CR>	0X0D

The prefix AT obtains synchronization, identifies the character parameters, and indicates that a command may be in the following characters.

AT commands are not case sensitive; use either capital letters or lower-case letters for the AT command.

> Note: Some AT Command parameter values ARE case sensitive and are documented in the Enfora Enabler-LPP G AT Command Set Reference - LPP0208AT001.

8.2 ENFORA AT COMMAND SET

For a full description of the AT commands, refer to the Enfora Enabler-LPP G AT Command Set Reference – LPP0208AT001.

Note: A command description that includes an *asterisk denotes that the GSM service provider must enable supplementary services functionality before the command is available.

9 APPENDIX A - LIMITED WARRANTY

LIMITED WARRANTY

[Revised: 4/2/2010]

SCOPE

This warranty applies to (a) products sold directly by Enfora, unless a different warranty is specified in a written agreement between Enfora and the purchaser; and (b) products sold to end users through a distributor authorized by Enfora, but only where the authorized distributor does not provide a separate warranty on such products, and Enfora has agreed to provide this warranty to such end users. If you purchased the product from an authorized distributor, please check whether this warranty from Enfora, or a separate warranty from the distributor, applies to your purchase.

Enfora warrants to the original purchaser of the product from Enfora or its authorized distributor (as applicable) that, for a period of one (1) year from the date of shipment of the product from Enfora, the product hardware will be substantially free from defects in material or workmanship under normal operation, and the product firmware will perform substantially in accordance with the product documentation provided by Enfora. Enfora does not warrant that (a) the product hardware or firmware will meet the purchaser's requirements; (b) the operation of the product hardware or firmware will be uninterrupted or error-free; or (c) the product, when integrated in, or combined with, other products or software not supplied by Enfora, will continue to perform substantially in accordance with the product documentation. This limited warranty is for the benefit of the original purchaser, and is not transferable.

HARDWARE AND SOFTWARE

During the warranty period, Enfora, at its expense and in its sole discretion, will repair the product, or replace the product with a corresponding or equivalent product, if it is determined to have a covered defect, provided that the purchaser first notifies Enfora (directly or through its authorized distributor from which the product was purchased) of any such defect, furnishes Enfora with a proof of purchase (if required), requests and obtains a return merchandize authorization (RMA) number from Enfora, and returns the product under that RMA to Enfora (or, at Enfora's option, to its authorized distributor), with the shipping charges being prepaid by purchaser. If, upon reasonable examination of the returned product, Enfora does not substantiate the defect claimed by purchaser, or determines that the defect is not covered under this limited warranty, Enfora will not be required to repair or replace the product, but may instead reship the product to the purchaser (or, at Enfora's option, to its authorized distributor where the product can be made available to purchaser), in which case the purchaser shall be responsible for paying Enfora's cost for reshipping the product to purchaser (or to Enfora's authorized

distributor), and Enfora's usual charges for unpacking, testing, and repacking the product for reshipment to purchaser (or to Enfora's authorized distributor).Purchaser shall bear the risk of loss or damage in transit to any product returned by purchaser to Enfora, or any returned product not found to be defective or covered under this warranty, and reshipped by Enfora to purchaser (or to Enfora's authorized distributor). In the event Enfora repairs or replaces a defective product covered by this limited warranty, the repaired or replacement product will be covered under this limited warranty for the remainder of the original warranty period on the defective product, or a period of ninety (90) days, whichever is longer. If Enfora is unable to repair or replace a defective product covered by this limited warranty, Enfora will provide to purchaser a credit or a refund (at Enfora's option) of the original purchase price (excluding taxes and shipping charges). Any returned and replaced product, or any product for which Enfora has furnished a credit or a refund, becomes the property of Enfora.

Enfora shall not have any obligation to provide any firmware bug fixes, upgrades or new releases except as may be necessary to correct any covered defect of which purchaser notifies Enfora in writing during the warranty period. Enfora, from time to time and in its sole discretion, may make available for download on its website (www.enfora.com), or may provide via email, certain firmware bug fixes, upgrades or new releases for the product. Download and use of any such bug fixes, upgrades or new releases is subject to all of the applicable terms and conditions of Enfora's technical support policy as posted and updated on its website.

EXCEPTIONS AND DISCLAIMERS

Enfora shall have no obligation under this limited warranty for (a) normal wear and tear; (b) the cost of procurement of substitute products; or (c) any defect that is (i) discovered by purchaser during the warranty period but for which purchaser does not request an RMA number from Enfora, as required above, until after the end of the warranty period, (ii) caused by any accident, misuse, abuse, improper installation, handling or testing, or unauthorized repair or modification of the product, (iii) caused by use of any materials not supplied by Enfora, or by use of the product other than in accordance with its documentation, or (iv) the result of electrostatic discharge, electrical surge, fire, flood or similar causes.

The purchaser (or its customers, as applicable) shall be solely responsible for the proper configuration, testing and verification of the Enfora product prior to deployment in the field, and for ensuring that any end user product or system into which the Enfora product is integrated or incorporated operates as intended and meets the requirements of purchaser (or its customers). Enfora shall have no responsibility whatsoever for the integration, configuration, testing, verification, installation, upgrade, support or maintenance of any such end user product or system, or for any liabilities, damages, costs or expenses associated therewith.

ENFORA'S SOLE RESPONSIBILITY AND PURCHASER'S SOLE REMEDY UNDER THIS LIMITED WARRANTY SHALL BE FOR ENFORA TO REPAIR OR REPLACE THE PRODUCT (OR IF REPAIR OR REPLACEMENT IS NOT POSSIBLE, PROVIDE A CREDIT OR REFUND OF THE PURCHASE PRICE) AS PROVIDED ABOVE. ENFORA EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, SATISFACTORY PERFORMANCE AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL ENFORA BE LIABLE FOR ANY INDIRECT, SPECIAL, EXEMPLARY, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING WITHOUT LIMITATION LOSS OR INTERRUPTION OF USE, DATA, REVENUES OR PROFITS) RESULTING FROM A BREACH OF THIS WARRANTY OR BASED ON ANY OTHER LEGAL THEORY, EVEN IF ENFORA HAS BEEN ADVISED OF THE POSSIBILITY OR LIKELIHOOD OF SUCH DAMAGES.

OTHER CONSIDERATIONS

Some jurisdictions may require a longer warranty period than specified above and, accordingly, for products sold in those jurisdictions the applicable warranty period shall be extended as required under the laws of those jurisdictions. Furthermore, some jurisdictions may not allow the disclaimer of implied warranties or the exclusion or limitation of incidental or consequential damages, so the above disclaimer, limitation or exclusion may not apply to products sold in those jurisdictions. This limited warranty gives the purchaser specific legal rights and the purchaser may have other legal rights that vary from jurisdiction to jurisdiction.

GOVERNING LAW

This limited warranty shall be governed by the laws of the State of Texas, United States of America, without regard to conflict of laws principles. This limited warranty shall not be governed in any respect by the United Nations Convention on Contracts for the International Sale of Goods.

10 APPENDIX B - Regulatory Compliance

This section summarizes the responsibilities and actions required of manufacturers and integrators who incorporate OEM versions of the Enfora Enabler IIILPP module into their products. In certain situations and applications, these products will require additional FCC, CE, GCF, PTCRB or other regulatory approvals prior to sale or operation. Appropriate instructions, documentation and labels are required for all products. For more information concerning regulatory requirements, please contact Enfora.

10.1 GCF/PTCRB APPROVAL (FORMERLY FTA)

The Enfora Enabler IIILPP module is type approved in accordance with the requirements of and through the procedures set forth by the GSM industry association. The relevant conformance specification is 3GPP TS 51010-1. Any OEM changes in the SIM interface, antenna port, software or the physical makeup of the unit may require an incremental FTA to ensure continued compliance with the above-mentioned standard. For more information concerning type approval, please contact Enfora.

10.2 FCC CERTIFICATION

Enfora certifies that the Enfora Enabler IIILPP 850/900/1800/1900 MHz GSM Radio Module (FCC ID: MIVLPP0208) complies with the RF requirements applicable to broadband PCS equipment operating under the authority of 47 CFR Part 24, Subpart E and Part 22 of the FCC Rules and Regulations. This certification is contingent upon installation, operation and use of the Enfora Enabler IIIG module and its host product in accordance with all instructions provided to both the OEM and end user. When installed and operated in a manner consistent with the instructions provided, the Enfora Enabler IIILPP module meets the maximum permissible exposure (MPE) limits for general population / uncontrolled exposure at defined in Section 1.1310 of the FCC Rules and Regulations.

The Enabler IIILPP modem is designed for use in a variety of host units, "enabling" the host platform to perform wireless data communications. However, there are certain criteria relative to integrating the modem into a host platform such as a PC, laptop, handheld, monitor and control unit, etc. that must be considered to ensure continued compliance with FCC compliance requirements.

In order to use the Enabler IIILPP module without any additional FCC certification the installation must meet the following conditions:

- The system antenna(s) connected to the Enabler IIILPP module must be installed to provide at least 20cm separation from the human body during normal operation.
- The system antennas must not be co-located with any other transmitter or antenna.
- The system antenna(s) used with the Enabler IIILPP module must not exceed the following levels:

  - GSM850 mode: the maximum gain is 1.4 dBi.

  - GSM1900 mode: the maximum gain is 3 dBi.

If any of these conditions are not met then additional information should be sought from the FCC or an FCC qualified test laboratory.

The system user manuals and other documentation must also include appropriate caution and warning statements and information.

10.2.1 FCC NOTICE TO USERS

Enfora has not approved any changes or modifications to this device by the user. Any changes or modifications could void the users authority to operate the device. See 47 CFR Sec. 15.21. The device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. See 47 CFR Sec. 15.19.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

If the FCCID of the module is not visible when installed in the host platform, then a permanently attached or marked label must be displayed on the host unit referring to the module.

The label should contain wording such as:

> Contains FCC ID: MIVGSM0308
> This device complies with Part 15 of the FCC Rules.
> Operation is subject to the following two conditions:
> (1) This device may not cause harmful interference, and
> (2) This device must accept any interference received,
> including interference that may cause undesired operation.

10.3 CE MARKING - R&TTE DIRECTIVE

The Enabler IIILPP module have been tested and certified to comply with the requirements of the European Directive 1999/5/EC, the R&TTE Directive. The modules are certified directly against Article 3.2 of the directive for Radio transceiver aspect. The modules are not directly certified against Article 3.1a (Safety) and 3.1b (EMC), but are shown to be in compliance through testing on a typical integrated device utilizing the module. The module is marked with the CE marked and the notified body number of the reviewing organization as is shown below.

$$CE0889$$

It is the responsibility of the integrator to ensure that the device incorporating the Enabler IIILPP module is in compliance with the requirements of Article 3.1a (Safety) and 3.1b (EMC), as well as ensuring that the integrated device remains in compliance with the requirements of Article 3.2 of the directive.

10.4 REGULATORY REQUIREMENTS FOR OTHER COUNTRIES

In most other countries there are similar rules and regulations that may need to be met for importing the Enfora Enabler IIILPP module and for placing it on the market in the integrated device. Each country may require a different mark of approval as an acceptance requirement. For each of these cases the country should identified, and the appropriate steps should be taken to meet the requirements set forth in the intended market.

10.5 ROHS COMPLIANCE

As a part of Enfora's corporate policy of environmental protection, Enfora takes every step to ensure that the Enabler IIILPP modules are designed and manufactured to comply to the European Union Directive 2002/95/EC for the Restriction of Hazardous Substances (RoHS).

11 APPENDIX C - Glossary and Acronyms

API	Application Programming Interface.
App Application	Refers to the Application which sends or receives commands/responses from the Enfora Enabler III LPP Module
AT Command Set	Commands issued by intelligent device to a modem to perform functions, such as to initiate call, to answer call, or to transmit data.
BER Bit Error Rate	Bit Error Rate
CMUX	Multiplexer protocol that operates between an MS and a TE and allows a number of simultaneous sessions over a normal serial asynchronous interface
CPE Customer Premise Equipment	A terminal in fixed location on the customer's premises.
CSD Circuit Switched Data	Data link from a terminal through the network allowing real-time, duplex connectivity at 9600 bytes/second.
dBi	Decibels referenced to an isotropic radiator
DCE Data Communications Equipment	Data Communications Equipment
DCS Digital Cellular System	A collection of services and capabilities providing flexibility of access and mobility through a combination of wireless and wire-line networks, utilizing the 1800 MHz bandwidth.
DTE Data Terminal Equipment	Data Terminal Equipment
EFR Enhanced Full Rate	Voice (vocoder) compression algorithms which offer the highest quality voice communication.
EIR Equipment Identity Register	A database used to store International Mobile Equipment Identity (IMEI) of a locally issued terminal.
EIRP Equivalent Isotropic Radiated Power	In a given direction, the gain of a transmitting antenna multiplied by the net power accepted by the antenna from the connected transmitter.
EMC Electromagnetic Compatibility	The ability of a device to function satisfactorily in its electromagnetic environment without inducing intolerable disturbance to that environment (or to other devices)

API	Application Programming Interface.
ESD Electrostatic Discharge	Static electricity that can damage electronic equipment.
EU European Union	An organization of 15 European states whose purpose is to organize relations between the Member States and between their peoples.
FTA Full Type Approval	GSM Full Type Approval
GPRS General Packet Radio Service	Standard for packet communications utilizing Global Standard for Mobility (GSM) infrastructure.
GSM Global System for Mobile Communications	Standard for digital communications. Allows consistent communications in various parts of the world despite variations in RF spectrum allocations. Transferring the SIM (see below) permits users to roam by changing terminal equipment.
GPS	Global Positioning System
HLR Home Location Register	Stores the identity and user data for all subscribers belonging to the area of the related MSC.
IMEI International Mobile Equipment Identity	A unique number for each GSM Terminal tracked by the GSM operators in their Equipment Identity Register (EIR) database.
IMSI International Mobile Subscriber Identification	A unique number identifying the subscriber stored in the SIM card. Number is used in conjunction with the network for call routing.
Ki	A secret code used in authentication and encryption by the terminal.
MO Mobile Originated	Any GSM/GPRS service originated at the mobile terminal.
MT Mobile Terminated	Any GSM/GPRS service originated from or routed through the network and sent to the mobile terminal.
MSC Mobile Switching Center	The central switch of the GSM network. Performs call routing, collects call detail records for billing, and supervises system operations.
Non-Transparent Mode	Delivers a constantly low error rate but with a non-guaranteed throughput or delay. The Non-Transparent service provides a performance that is closest to using a modem over a fixed PSTN line.
NRTL Nationally Recognized Test	OSHA-approved Nationally Recognized Testing Laboratory

API	Application Programming Interface.
Laboratory	
OEM	Original Equipment Manufacturer.
PA	Power Amplifier.
Packet	A collection of data transmitted over a digital network in a burst.
PCS	Personal Communication Services.
PDA	Personal Digital Assistant.
PDU	Packet Data Unit.
PPP	Point-To-Point Protocol.
SIM	Subscriber Identity Module.
SMS	Short Message Service.
SMSC	Short Message Service Center.
SUPL	Secure User Plane Location
TCP	Transfer Control Protocol
UDP	User Datagram Protocol.

12 APPENDIX E - Contacting Enfora

For technical support and customer service dealing with the modem itself, contact the company where you purchased the product. If you purchased the product directly from Enfora, visit the SUPPORT page on the Enfora website: http://www.enfora.com/support_newissue.asp