

**Integration Guide:  
GSM0408IG001**

# **Enfora Enabler IIIG BGA Integration Guide**

Version: Draft

**Enfora, Inc.**  
[www.enfora.com](http://www.enfora.com)

<b>Document Title:</b>	Enfora Enabler IIIG BGA Modem Integration Guide
<b>Version:</b>	1.0x
<b>Date:</b>	3/3/08
<b>Status:</b>	Draft
<b>Document Control ID:</b>	GSM0408IG001

## General

All efforts have been made to ensure the accuracy of material provided in this document at the time of release. However, the items described in this document are subject to continuous development and improvement. All specifications are subject to change without notice and do not represent a commitment on the part of Enfora, Inc. Enfora, Inc. will not be responsible for any loss or damages incurred related to the use of information contained in this document.

This product is not intended for use in life support appliances, devices or systems where a malfunction of the product can reasonably be expected to result in personal injury. Enfora, Inc. customers using, integrating, and/or selling this product for use in such applications do so at their own risk and agree to fully indemnify Enfora, Inc. for any damages resulting from illegal use or resale.

## Copyright

Complying with all applicable copyright laws is the responsibility of the user. Without limiting the rights under copyright, no part of this document may be reproduced, stored in or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording or otherwise), or for any purpose, without the express written permission of Enfora, Inc.

Enfora may have patents, patent applications, trademarks, copyrights or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from Enfora, the furnishing of this document does not give you any license to these patents, trademarks, copyrights or other intellectual property.

©2002, 2003, 2004, 2005, 2006, 2007, 2008 Enfora, Inc. All rights reserved.

Enabler and Spider are either registered trademarks or trademarks of Enfora, Inc. in the United States.

## Table of Contents

<b>1.</b>	<b>SAFETY PRECAUTIONS</b> .....	<b>1</b>
1.1.	IMPORTANT SAFETY INFORMATION .....	1
<b>2.</b>	<b>REGULATORY COMPLIANCE FCC</b> .....	<b>1</b>
2.1.	INTEGRATION CONSIDERATIONS AND INSTALLATION REQUIREMENTS .....	1
2.2.	DISCLAIMER.....	3
<b>3.</b>	<b>MANUAL OVERVIEW</b> .....	<b>4</b>
3.1.	REVISION HISTORY .....	4
3.2.	REFERENCE DOCUMENTS.....	5
3.2.1.	<i>Enfora Enabler IIIG BGA Product Documentation</i> .....	5
3.2.2.	<i>GSM Device Specifications</i> .....	6
3.2.3.	<i>US Government</i> .....	6
3.2.3.1.	Federal Communications Commission (FCC) .....	6
3.2.3.2.	FCC Office of Engineering and Technology (OET) .....	6
3.2.4.	<i>Industry Canada</i> .....	6
3.2.5.	<i>Environmental Regulations</i> .....	6
3.2.6.	<i>Mechanical Specifications</i> .....	7
3.2.7.	<i>RF and EMI Specifications</i> .....	7
3.2.8.	<i>Joint Industry Standards</i> .....	7
<b>4.</b>	<b>INTRODUCTION</b> .....	<b>8</b>
4.1.	PRODUCT OVERVIEW .....	8
4.2.	KEY FEATURES OF THE ENABLER IIIG BGA MODULE .....	8
4.3.	PROVIDING MULTI-BAND OPERATION .....	10
4.4.	WIRELESS DATA APPLICATION POSSIBILITIES .....	10
4.5.	SUMMARY OF FEATURES FOR THE ENABLER IIIG BGA MODULE .....	11
4.6.	LAYOUT GUIDELINES FOR THE ENABLER IIIG BGA .....	13
4.6.1.	<i>Placement</i> .....	13
4.6.2.	<i>Ground Plane</i> .....	14
4.6.3.	<i>Thermal Relief</i> .....	15
4.6.4.	<i>Antenna and RF Signal Trace</i> .....	15
4.6.5.	<i>Vbat Input</i> .....	16
4.6.6.	<i>I/O Routing and Fanout</i> .....	16
4.6.7.	<i>Audio Reference Design</i> .....	18
4.6.7.1.	Audio Schematic .....	18
4.6.7.2.	Audio Layout .....	19
4.7.	BGA HANDLING AND SOLDERING GUIDELINES.....	20
<b>5.</b>	<b>TECHNICAL SPECIFICATIONS</b> .....	<b>21</b>
5.1.	ENABLER IIIG BGA MODULE BLOCK DIAGRAM.....	21
5.2.	DETAILED PRODUCT SPECIFICATIONS .....	22
5.3.	OPERATING POWER .....	23
5.3.1.	<i>Typical Input Current</i> .....	23
5.3.2.	<i>GSM Transmit Power</i> .....	23
5.3.3.	<i>GSM Receiver Sensitivity</i> .....	24
5.4.	PHYSICAL INTERFACES.....	24
5.4.1.	<i>Module</i> .....	24
5.4.2.	<i>Host PCB Footprint</i> .....	24
5.5.	ELECTRICAL CONNECTIONS.....	25
5.5.1.	<i>BGA Map</i> .....	30
5.6.	CIRCUIT PROTECTION .....	31
5.7.	PAD SIGNAL DESCRIPTIONS AND FUNCTIONS .....	32

5.7.1.	Module Power (Pads C1, C2, D1, D2, E1, E2)	32
5.7.2.	Antenna (Pad A1)	33
5.7.3.	Reset Signal (Pad F6, also known as ON_OFF)	33
5.7.4.	Power Control (Pad K9) (PWR_CTL)	34
5.7.5.	Level Translation Reference Power (Pad G5)	37
5.7.6.	USB (Pads J2, J3, K1, K2)	37
5.7.7.	General Purpose Input/Output Interface	37
5.7.8.	RTC Sleep	39
5.7.9.	Serial Interface	40
5.7.10.	MCSI – Multi-Channel Serial Interface (Pads D13, D14, E13, E14)	41
5.7.11.	VBACKUP Input (Pad G6)	42
5.7.12.	32 kHz output (Pad A11)	43
5.7.13.	Analog-To-Digital Input (Pad K3)	43
5.7.14.	Handset Microphone Input (Pads K4, L4)	43
5.7.15.	Handset Microphone Bias Output (Pad J4)	44
5.7.16.	Handset Speaker Output (Pads M4, M5)	44
5.7.17.	Headset Microphone Input (Pad M2)	45
5.7.18.	Headset Microphone Bias Output (Pad J5)	45
5.7.19.	Headset Speaker Output Left & Right (Pads M3, L3)	46
5.7.20.	Headset Output Common Mode (Pad M6)	46
5.7.21.	Headset Detect (Pad H4)	47
5.7.22.	Remote Subscriber Identity Module (SIM) (Pads A7, A9, B7, B8, H5)	47
5.7.22.1.	Remote SIM Component Information	49
<b>6.</b>	<b>GSM/GPRS MODES OF OPERATION</b>	<b>50</b>
6.1.	ENABLING THE TRANSMISSION MODES FOR THE GSM/GPRS SERVICES	50
6.2.	VOICE COMMUNICATION	50
6.3.	CIRCUIT-SWITCHED DATA	50
6.4.	SMS: SHORT MESSAGE SERVICES	51
<b>7.</b>	<b>SIM OPERATION</b>	<b>52</b>
7.1.	PROVISIONING THE SIM	52
7.2.	GSM SERVICES SUPPORTED BY THE ENABLER IIIG BGA MODULE	52
7.3.	GPRS SERVICES SUPPORTED BY THE ENABLER IIIG BGA MODULE	52
7.4.	SELECTING THE GSM MODES OF OPERATION	52
<b>8.</b>	<b>SOFTWARE INTERFACE</b>	<b>54</b>
8.1.	SOFTWARE INTERFACE	54
8.2.	ENFORA AT COMMAND SET	55
8.3.	ENFORA PACKET APPLICATION PROGRAMMING INTERFACE	55
8.3.1.	API Architecture	55
8.4.	SETUP AND INITIALIZATION	55
8.4.1.	General Setup	55
8.4.2.	HyperTerminal Configuration for the Enabler IIIG BGA module	55
8.4.3.	Initialization (AT Command Interface)	56
8.4.4.	Initial Response to the AT Command	57
8.4.5.	Sending an Initialization String to the Enabler IIIG BGA Module	57
8.4.6.	Setting Up the Communication Mode for the Enabler IIIG BGA Module	58
8.4.7.	Querying the Status of the Enabler IIIG BGA Module	58
8.4.8.	Setting Module Reporting Parameters for GSM and GPRS	58
8.5.	GSM/SMS EXAMPLES	58
8.5.1.	Initialize the Enabler IIIG BGA Module to Send and Receive SMS Text Messages	58
8.5.2.	Managing SMS Messages	58
8.5.3.	Data Call Configuration	58
8.5.4.	Voice Call Configuration	58

8.6.	GPRS PACKET EXAMPLES.....	58
8.6.1.	GPRS ATTACH and ACTIVATE.....	58
8.6.2.	Windows PPP Setup.....	59
<b>9.</b>	<b>INTEGRATION AND TESTING.....</b>	<b>60</b>
9.1.	INTEGRATING THE ENFORA ENABLER IIIG BGA MODULE.....	60
<b>10.</b>	<b>APPENDIX A - LIMITED WARRANTY.....</b>	<b>62</b>
10.1.	SCOPE.....	62
10.2.	HARDWARE.....	62
10.3.	SOFTWARE.....	62
10.4.	OTHER CONSIDERATIONS.....	63
<b>11.</b>	<b>APPENDIX B - REGULATIONS AND COMPLIANCE.....</b>	<b>64</b>
11.1.	GCF/PTCRB APPROVAL (FORMERLY FTA).....	64
11.2.	ELECTROMAGNETIC COMPATIBILITY (EMC) AND SAFETY REQUIREMENTS.....	64
11.3.	EMC/SAFETY REQUIREMENTS FOR THE USA.....	64
11.4.	HUMAN EXPOSURE COMPLIANCE STATEMENT.....	65
11.5.	COMPLIANCE WITH FCC REGULATIONS.....	65
11.6.	UNINTENTIONAL RADIATORS, PART 15.....	65
11.7.	INTENTIONAL RADIATORS, PART 22 & 24.....	66
11.8.	INSTRUCTIONS TO THE ORIGINAL EQUIPMENT MANUFACTURER (OEM).....	66
11.8.1.	<i>OEM Responsibilities for All Products Containing the Enabler IIIG BGA module.....</i>	<i>67</i>
11.8.2.	<i>Specific OEM Responsibilities for Portable Products and Applications.....</i>	<i>69</i>
11.8.3.	<i>Specific OEM Responsibilities for Mobile Products and Applications.....</i>	<i>69</i>
11.8.4.	<i>Specific OEM Responsibilities for Fixed Products and Applications.....</i>	<i>69</i>
11.9.	EMC/SAFETY REQUIREMENTS FOR THE COUNTRIES OF THE EUROPEAN UNION (EU).....	70
11.10.	EMC/SAFETY REQUIREMENTS FOR OTHER COUNTRIES.....	70
<b>12.</b>	<b>APPENDIX C - GLOSSARY AND ACRONYMS.....</b>	<b>71</b>
<b>13.</b>	<b>APPENDIX D – TABLES AND FIGURES.....</b>	<b>73</b>
<b>14.</b>	<b>APPENDIX E - CONTACTING ENFORA.....</b>	<b>74</b>

DRAFT

# 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 IIIG BGA product to open flames.
- Ensure that liquids do not spill onto the device.
- Do not attempt to disassemble the product: Doing so will void the warranty. This product does not contain consumer-serviceable components.

# 2. Regulatory Compliance FCC

## 2.1. Integration Considerations and Installation Requirements

The Enabler IIIG BGA 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 or PocketPC®, monitor and control unit, etc. that must be considered to ensure continued compliance with FCC compliance requirements.

- Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

In order to use the Enabler IIIG BGA modem without additional FCC certification approvals, the installation must meet the following conditions:

- Maximum RF output power and antenna gain to meet Maximum Permissible Exposure Requirements: GSM850 mode: Power at antenna port is +33 dBm, the maximum gain is 1.4 dBi. GSM1900 mode: Power at antenna port is 30 dBm, the maximum gain is 7.0 dBi.
- If used in a "portable" application such as a handheld or body worn device with the antenna less than 20 cm (7.9 in.) from the human body when the device is operating, then the integrator is responsible for passing additional "as installed" testing and the device will require its own FCC ID:
  - i. SAR (Specific Absorption Rate) testing, with results submitted to the FCC for approval prior to selling the integrated unit. If unable to meet SAR requirements, then the host unit must be restricted to "mobile" use (see below).
  - ii. Unintentional emissions, FCC Part 15; results do not have to be submitted to the FCC unless requested, although the test provides substantiation for required labeling (see below).
  - iii. ERP and EIRP measurements for FCC Parts 22 and 24, alternatively a full retest on FCC Parts 22 and 24 can be performed

- If used in a "mobile" application where the antenna is normally separated at least 20 cm (7.9 in) from the human body during device operation, then an appropriate warning label must be placed on the host unit adjacent to the antenna. The label should contain a statement such as the following:

**WARNING**  
**RF exposure. Keep at least 20 cm**  
**(7.9 in) separation distance from**  
**the antenna and the human body.**

- Host unit user manuals and other documentation must also include appropriate caution and warning statements and information.
- If the FCCID for the modem 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 enclosed modem. For example, the label should contain wording such as:

Contains GSM/GPRS modem transmitter module  
FCC ID: MIVGSM0408  
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.

**OR**

Contains FCC ID: MIVGSM0408  
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.

- Any antenna used with the modem must be approved by the FCC or as a Class II Permissive Change (including MPEL or SAR data as applicable). The "professional installation" provision of FCC Part 15.203 does not apply.

- The transmitter and antenna must not be co-located or operating in conjunction with any other antenna or transmitter. Violation of this would allow a user to plug another transmitter in to the product and potentially create an RF exposure condition.

**WARNING**  
**The transmitter and antenna must not be collocated or operating in conjunction with any other antenna or transmitter. Failure to observe this warning could produce an RF exposure condition.**

## 2.2. 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.

Enfora strongly recommends that all installations, hookups, transmissions, etc., be performed by persons who are experienced in the fields of radio frequency technologies. Enfora acknowledges that the installation, setup and transmission guidelines contained within this publication are guidelines, and that each installation may have variables outside of the guidelines contained herein. Said variables must be taken into consideration when installing or using the product, and Enfora shall not be responsible for installations or transmissions that fall outside of the parameters set forth in this publication.

Enfora shall not be liable for consequential or incidental damages, injury to any person or property, anticipated or lost profits, loss of time, or other losses incurred by Customer or any third party in connection with the installation of the Products or Customer's failure to comply with the information and instructions contained herein.



**The Enabler IIIG BGA 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.**



## 3. Manual Overview

This document describes the available hardware interface of the Enabler IIIG BGA modem (herein also noted as “modem” or “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.

### 3.1. Revision History

Date	Rev	Description
03/10/08	.01	Initial Release Draft

## 3.2. Reference Documents

### 3.2.1. Enfora Enabler IIIG BGA Product Documentation

#### Manuals

- GSM0308AT001 - Enfora GSM/GPRS OEM Module AT Command Set Reference
- GSM0308UG001 - Enfora GSM-GPRS Family API Reference

DRAFT

DRAFT

### 3.2.2. 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>

### 3.2.3. US Government

#### 3.2.3.1. 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

#### 3.2.3.2. 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"

### 3.2.4. Industry Canada

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

### 3.2.5. Environmental Regulations

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

### **3.2.6. 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

### **3.2.7. RF and EMI Specifications**

- ETSI Standards
- EN 61000-4-6
- EN 61000-4-3
- 3GPP TS 51.010-1, Section 12.2
- EN 55022 Class B

### **3.2.8. Joint Industry Standards**

- IPC/JEDEC J-STD-020C

## 4. Introduction

### 4.1. Product Overview

The Enfora Enabler IIIG BGA modem is a compact, wireless Ball Grid Array surface mount OEM module that utilizes the Global System for Mobile Communications (GSM) and GPRS (General Packet Radio Services) international communications standards to provide two-way wireless capabilities via GSM services. The module is a fully Type-approved GSM/GPRS device, enabling application-specific, two-way communication and control.

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

### 4.2. Key Features of the Enabler IIIG BGA Module

The following table summarizes the main features of the module.

**Table 1 - Enabler IIIG BGA Key Features**

<b>Interface</b>	Data, RF input/output interface	167 pad soldered BGA
	Primary serial port	V.24 protocol, 1.8V levels, full 9-pin, UART implementation
	USB port	USB – Debug only (Enfora Use only)
	GPIO	Up to 20 GPIO Some GPIO pins have dual-purpose functionality.
	Audio	Digital audio via MCS1 port
	Voice	Supports four vocoder modes: full-rate (FR), enhanced full-rate (EFR), half-rate (HR), and adaptive multi-rate (AMR)
	Command protocol	Enfora Packet API, GSM AT command set
	Voltage backup	Voltage backup pad available to maintain RTC, battery capable
	Reference clock	32kHz output reference clock
	ADC	1 ADC port
	Remote Subscriber Identity Module (SIM)	1.8/3 V compatible with SIM detect
<b>Power</b>	Electrical power	3.3 to 4.5 Vdc (VBAT)
	Peak currents and average power consumption	Refer to the Operating Power table in the Technical Specifications for peak currents and average power consumption for various modes of operation.
<b>Radio Features</b>	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).
<b>Regulatory</b>	Agency approvals	<ul style="list-style-type: none"> <li>• GCF Type Approval</li> <li>• PTCRB Type Approval</li> <li>• FCC Certification</li> <li>• RTTE</li> <li>• CE (European Community Certification)</li> <li>• IC (Industry Canada) Approval</li> </ul>

<b>GSM/GPRS Functionality</b>	<ul style="list-style-type: none"> <li>• Mobile-originated and mobile-terminated SMS messages: up to 140 bytes or up to 160 GSM 7-bit ASCII characters.</li> <li>• Reception of Cell Broadcast Message</li> <li>• SMS Receipt acknowledgement</li> <li>• Circuit Switched Data (Transparent &amp; Non-transparent up to 9.6 Kbps)</li> <li>• Voice (EFR, FR, HR)</li> <li>• Supports Unstructured Supplementary Service Data (USSD)</li> <li>• Multi-Slot Class 10 Supported (4Rx/2TX), (5 Slot Max)</li> <li>• PBCCH/PCCCH Supported</li> </ul>
<b>Audio Features</b>	<ul style="list-style-type: none"> <li>• Handset Microphone biasing</li> <li>• Headset Microphone biasing</li> <li>• Headset Plug/Unplug detection</li> <li>• Headset Hook detection (call answer/end button on equipped Headset microphone device)</li> <li>• High output dynamic differential Earphone mode, using Headset outputs</li> <li>• Pop Noise attenuation circuitry implemented for all single-ended output stages</li> <li>• Handset microphone input (MICIN, MICIP pads)</li> <li>• Headset microphone input (HSMIC pad)</li> </ul>
<b>Outputs</b>	<ul style="list-style-type: none"> <li>• Handset earphone outputs (EARP, EARN pads)</li> <li>• Headset 32 <math>\Omega</math> stereo outputs (HSOL, HSOR pads)</li> </ul>

DRAFT

#### 4.3. Providing Multi-Band Operation

The Enfora Enabler IIIG BGA 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 through out the world.

#### 4.4. Wireless Data Application Possibilities

A variety of applications can use the module for transmitting/receiving data/voice, such as:

- Automated Meter Reading
- Point of Sale Applications
- E-mail and Internet access
- Automated Vehicle Location (AVL)
- Machine to Machine communication (M2M)
- Telematics
- Telemetry
- Wireless Security
- Smart Phones
- Telemedicine

#### 4.5. Summary of Features for the Enabler IIIG BGA Module

The following summarizes the main features of the module.

##### **Mechanical**

Dimensions..... 28.0 mm x 24.0 mm x 2.50 mm

Weight ..... 3.6g

##### **Packet Data Transfer:**

Protocol..... GPRS Release 97 and 99

Coding Schemes ..... CS1-CS4

Multi-Slot Capability: (Demonstrated @MS10)..... MS10 (4RX/2TX) (Max 5 Slots)

Packet Channel Support..... PBCCH/PCCCH

##### **Circuit Switched Data Transfer:**

V110 ..... 300 bps/1200 bps/2400 bps/4800 bps/9600 bps/14,400 bps

Non-Transparent ..... 300 bps/1200 bps/2400 bps/4800 bps/9600 bps/14,400 bps

##### **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:**

GSM0408 Radio Frequencies..... 850 MHz, 900 MHz, 1800 MHz, and 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

DC Voltage ..... 3.3 to 4.5 Vdc



**Application Interface:**

Host Protocol..... Enfora Packet API and AT Commands  
Internal Protocols ..... UDP stack, TCP/IP stack, PPP, PAD, and CMUX  
Physical Interface..... 1 serial (primary/Default, rate auto baud), 1 USB (debug)  
MCSI (PCM Audio only)  
Audio Interface..... Handset microphone input (MICIN, MICIP pads); Headset  
microphone input (HSMIC pad); Handset earphone outputs  
(EARP, EARN pads); Headset 32 Ω stereo outputs (HSOL,  
HSOR pads).

**SIM Interface:**

Remote SIM ..... 1.8/3-Volt SIM Compatible

**Environmental:**

Compliant Operating Temp. .... -20 °C to 60 °C (Fully GSM Spec Compliant)  
Operating Temperature..... -30 °C to 70 °C  
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):**

**GSM Operation**

GSM 850/900 (1 RX/1 TX, full power) ..... 250 mA average, 1.6 A peak  
GSM 1800 (1 RX/1 TX, full power) ..... 215 mA average, 1.3 A peak  
GSM 1900 (1 RX/1 TX, full power) ..... 204 mA average, 1.2 A peak  
Idle..... <2.5 mA Average in DFX 5  
Shutdown ..... ≈ 55 uA

**GPRS Operation Power**

EGSM 850/900 (4 RX/1 TX, full power) ..... 272 mA average, 1.6 A peak  
EGSM 850/900 (2 RX/2 TX, full power) ..... 420 mA average, 1.6 A peak  
GSM 1800 (4 RX/1 TX, full power) ..... 242 mA average, A peak  
GSM 1800 (2 RX/2 TX, full power) ..... 354 mA average, A peak  
GSM 1900 (4 RX/1 TX, full power) ..... 235 mA average, A peak  
GSM 1900 (2 RX/2 TX, full power) ..... 340 mA average, A peak  
Idle..... <2.5 mA average in DFX 5  
Shutdown ..... ≈ 55 uA

#### GSM Transmit Power

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

### 4.6. Layout Guidelines for the Enabler IIIG BGA

The following guidelines are provided in an effort to allow Enabler IIIG BGA 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 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.



**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.**

#### 4.6.1. Placement

When integrating the Enabler IIIG BGA into a host design, it is critical for the design engineer and system architect to take steps early on in the design to minimize the potential noise and interference issues associated with proximity of RF sources, clock sources and receivers. Carefully determining the optimum placement for the module will ensure the best performance for GSM communication. All potential sources of noise and interference should be taken into consideration before determining where each module and circuit should be physically placed in the design. A system frequency plan is recommended in order to avoid system clock frequencies with harmonics at 13MHz, 26MHz, or the GSM 850/900/1800/1900 operational bands.

Please refer to Figure 1. The module should be rotated and placed such that the RF antenna trace is as short as possible. Refer to section 4.6.4 for more detail on RF routing.

Bulk bypass capacitance should be placed adjacent to the power input pads as shown, and power traces should be 0.1" (2.54mm) wide as a minimum, or wider if routing is longer than 5" (127mm). Refer to section 4.6.5 for detailed discussion of power input.

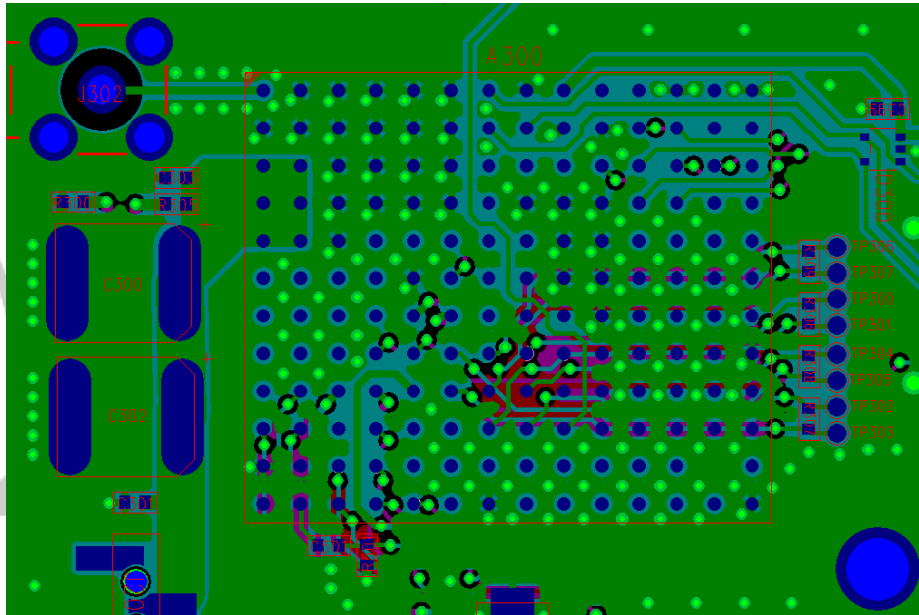


Figure 1 – Example of placement and ground plane for the module host board

#### 4.6.2. Ground Plane

To ensure the lowest possible EMI emissions and maximum thermal conductivity, it is imperative that all ground balls on the Enabler IIIG BGA module be soldered to a continuous ground plane. This ground plane should cover a minimum of the RF/power quadrant of the module, as shown in the upper left area of Figure 1, and should be interconnected to ground flooding on other layers so that there are no ground loops between module pads. Ground vias should be provided under or adjacent to each ground pad to create a low impedance ground. It is recommended to minimize the number of top-layer I/O traces under the module to allow for as much ground plane as possible. An example of a good ground structure and pad layout is shown in Figure 1, and solid grounding through via interconnect in Figure 2.

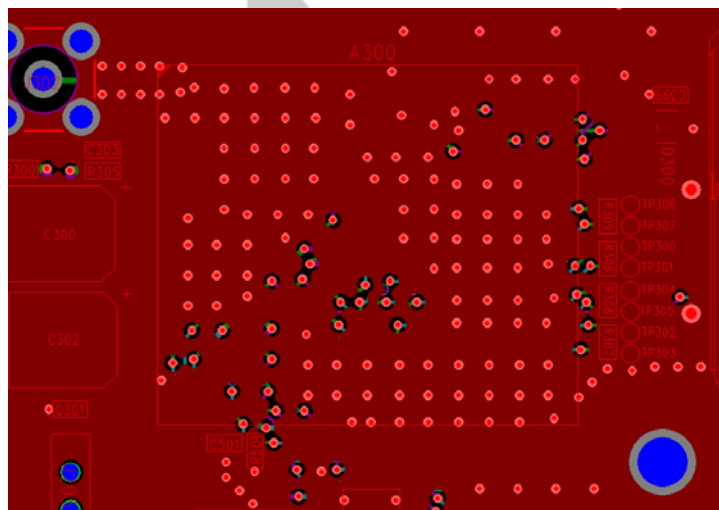


Figure 2 – Example of solid flooding on layer 4 with via interconnect

### 4.6.3. Thermal Relief

Because the ground plane acts as a large heat sink, it can affect the solder adhesion of the module. 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. Insufficient grounding caused by narrow elongated thermals will result in poor thermal transfer, constricted ground current return, and inadequate RF grounding. Poor RF grounding may be manifested by excessive radiated or conducted harmonics. Figure 3 shows an example of host board grounding in the RF/power area of the module. Recommended design parameters are 10 mils (.254 mm) copper flood clearance and 15 mils (.381 mm) thermal spoke width. A grounding via should be located either directly adjacent to the pad if using thru-hole vias or can optionally be located in the pad for blind via design. For blind via technology with via-in-pad, the vias must be filled and plated over to remove the dimple. See [section ???](#) for process specifications with regard to module attachment to the host.

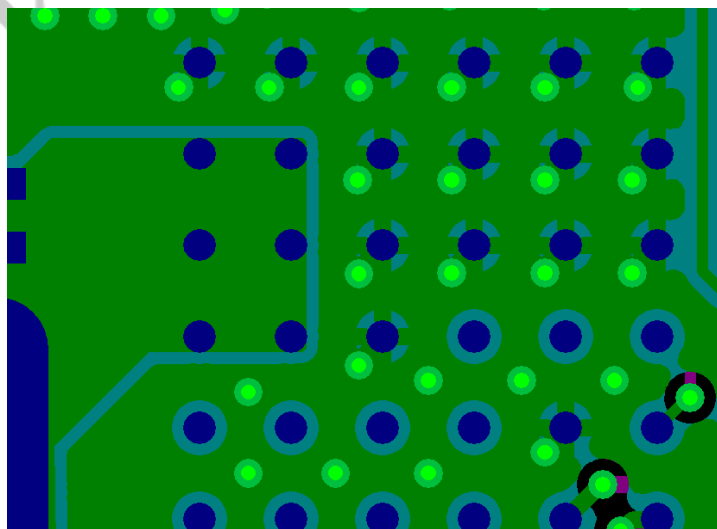


Figure 3 – Example of thermal relief and Vbat feed

### 4.6.4. Antenna and RF Signal Trace

The PCB trace that feeds the RF output port must be designed for a 50 ohm characteristic impedance. It should be 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 trace and launch pad. Special care should be taken when the RF trace changes layers between the module and the antenna port or connector, as such transitions can introduce an additional mismatch and degrade system sensitivity. If possible, keep I/O and power traces away from the RF port. This includes traces running parallel or orthogonal to it. The designer must pay close attention to the 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.

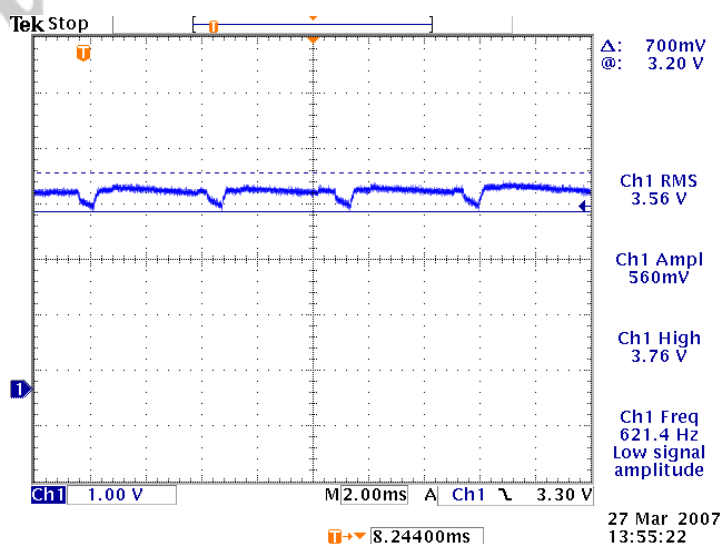
For minimum RF emissions due to the fundamental frequency of operation, the Enabler module works best with an antenna load that has a VSWR of 1.5:1 or better. The antenna should not have gain at the harmonic frequencies; otherwise, the conducted harmonics could be amplified to a point where the product 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.

#### 4.6.5. 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.

When routing connections to the Enabler Vbat pads, it would seem reasonable to use traces of the same width as the pads. However, such traces will not have sufficient copper. The use of narrow traces to connect the Vbat pads 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.



**Figure 4 - Example of Vbat Voltage Droop**

If Vbat drops too low, the Enabler module will reset. To minimize the trace loss, it is recommended to use a larger trace that spans several pads as shown in Figure 3. The layout should provide sufficient trace width over the entire route from the module to the source of the Vbat voltage. Any transitions between layers for this trace should utilize multiple vias.

Since even the best layout will have some impedance from the source to the Enabler module, sufficient bulk decoupling capacitance is required at the Vbat input to the module. It is suggested to use at least two 1000 uF low ESR tantalum capacitors located adjacent to the module Vbat pads. Any thermal relief used on these capacitors should comply with the information given above in order to provide the lowest impedance possible. The design should include multiple vias to the internal ground plane, placed close to the capacitors, as grounding of these capacitors is critical.

#### 4.6.6. I/O Routing and Fanout

The Enabler IIIG BGA interface is grouped by functions, as shown in the BGA map of section 5.5.1. Each functional group should be fanned out and routed as a group from the module. It is preferred to route as much of the I/O nets as possible on internal layers in order to maintain continuous grounding. Pad spacing on the module allows for flexibility in placing vias adjacent to the pads. Figure 5 and Figure 6 are both examples of functional grouping and fanout. Note that

I/O is routed down/away from the power/RF area of the module in order to minimize interference. Recommended audio I/O design is detailed in section 4.6.7 below.

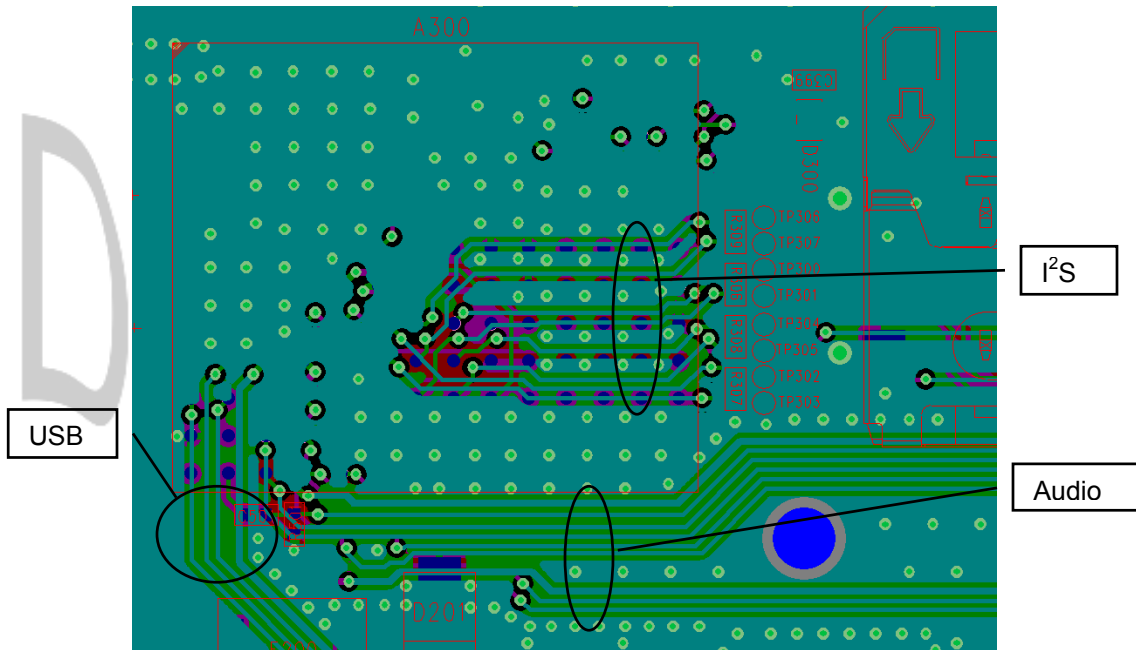


Figure 5 – Example of layer 2 routing fanout

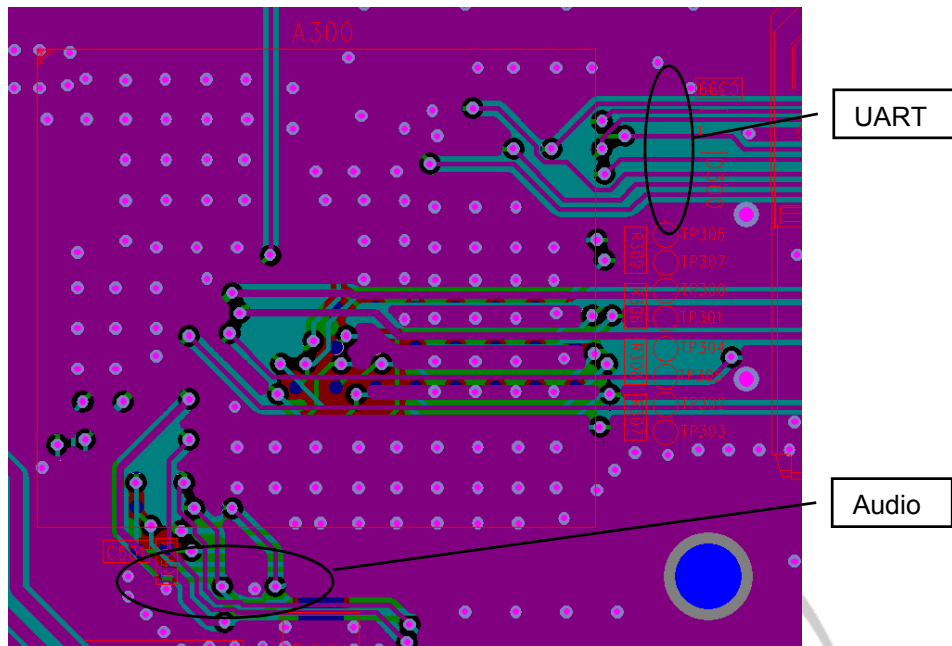


Figure 6 – Example of layer 3 UART and audio fanout

### 4.6.7. 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.

#### 4.6.7.1. Audio Schematic

Figure 8 and Figure 8 show examples for both handset and headset audio connections. The 47pF capacitors should be placed as close as possible to the interface connector in order to filter the 217Hz noise inherent in GSM mobile devices. All capacitors are low ESR ceramic; small values are NP0, while larger values are X7R or X5R. Resistors are all 5% thick film chip. The connector part numbers shown in the last line of each callout are available from CUI Inc.

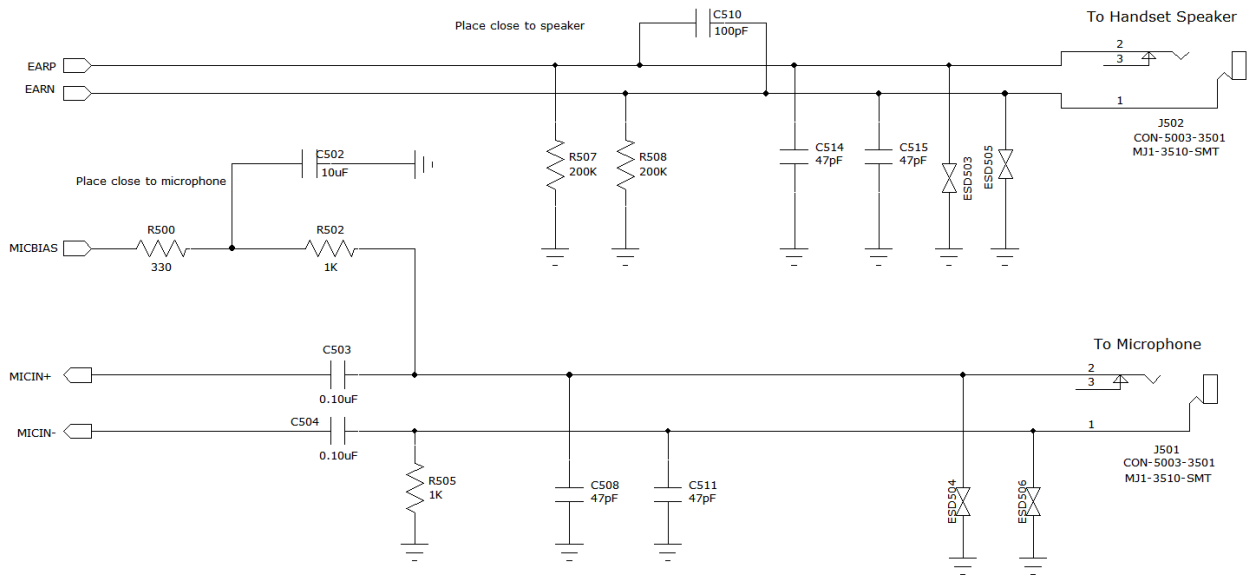
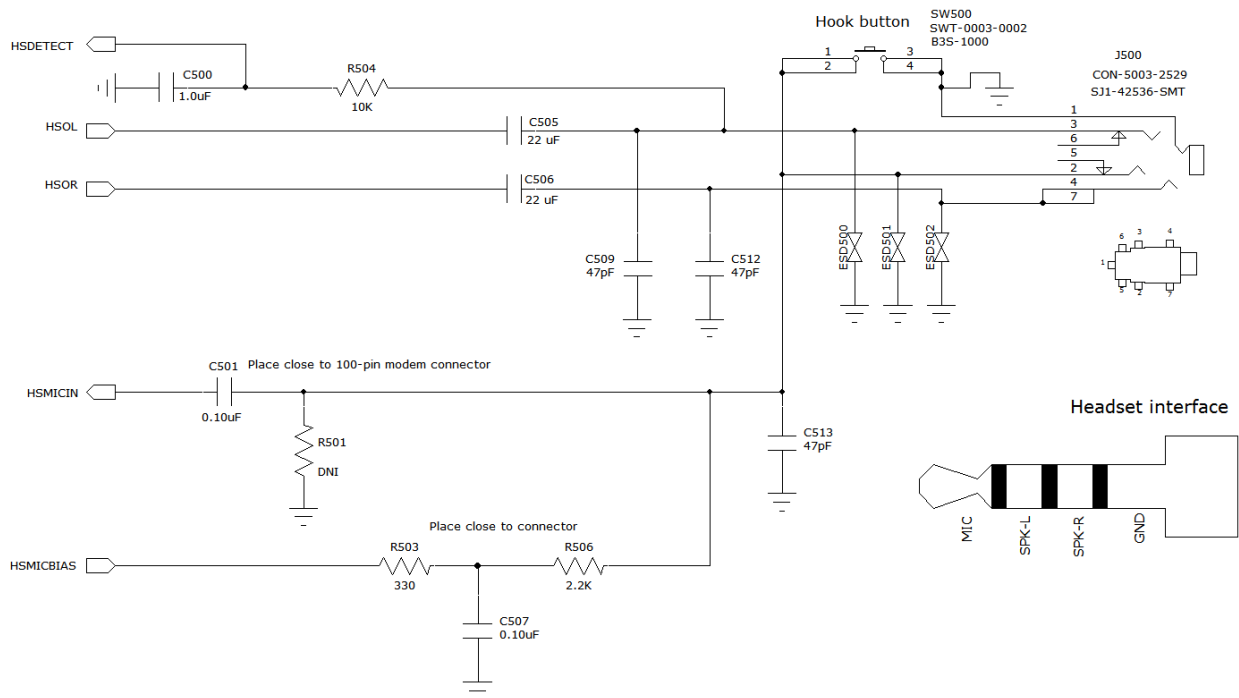


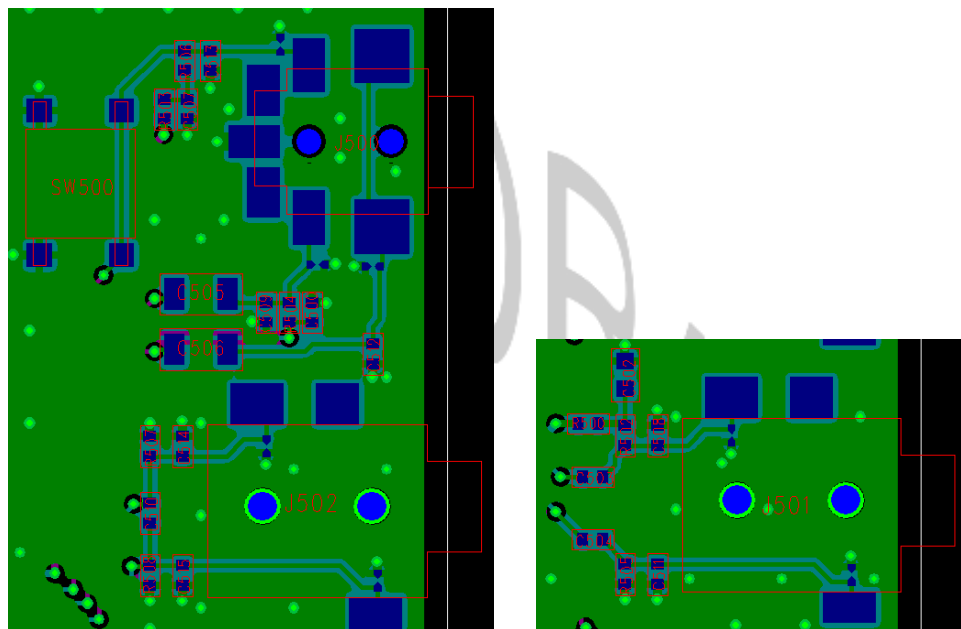
Figure 7– Handset Audio Reference Schematic



**Figure 8 – Headset Audio Reference Schematic**

**4.6.7.2. Audio Layout**

Layout plots for the audio interface section of the SDK are shown below in Figure 9. Audio lines should be routed from the module on internal layers in groups with differential pairs routed together. Care should be taken to isolate the audio signals from Vbat, higher speed digital I/O, and RF. An audio routing example is shown in Figure 5.



**Figure 9 – Audio interface layout examples**



#### 4.7. BGA 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 IIIG BGA module. Care should be taken to minimize module moisture exposure before reflow. The module is classified as a Type 3 MSL (moisture sensitivity level).

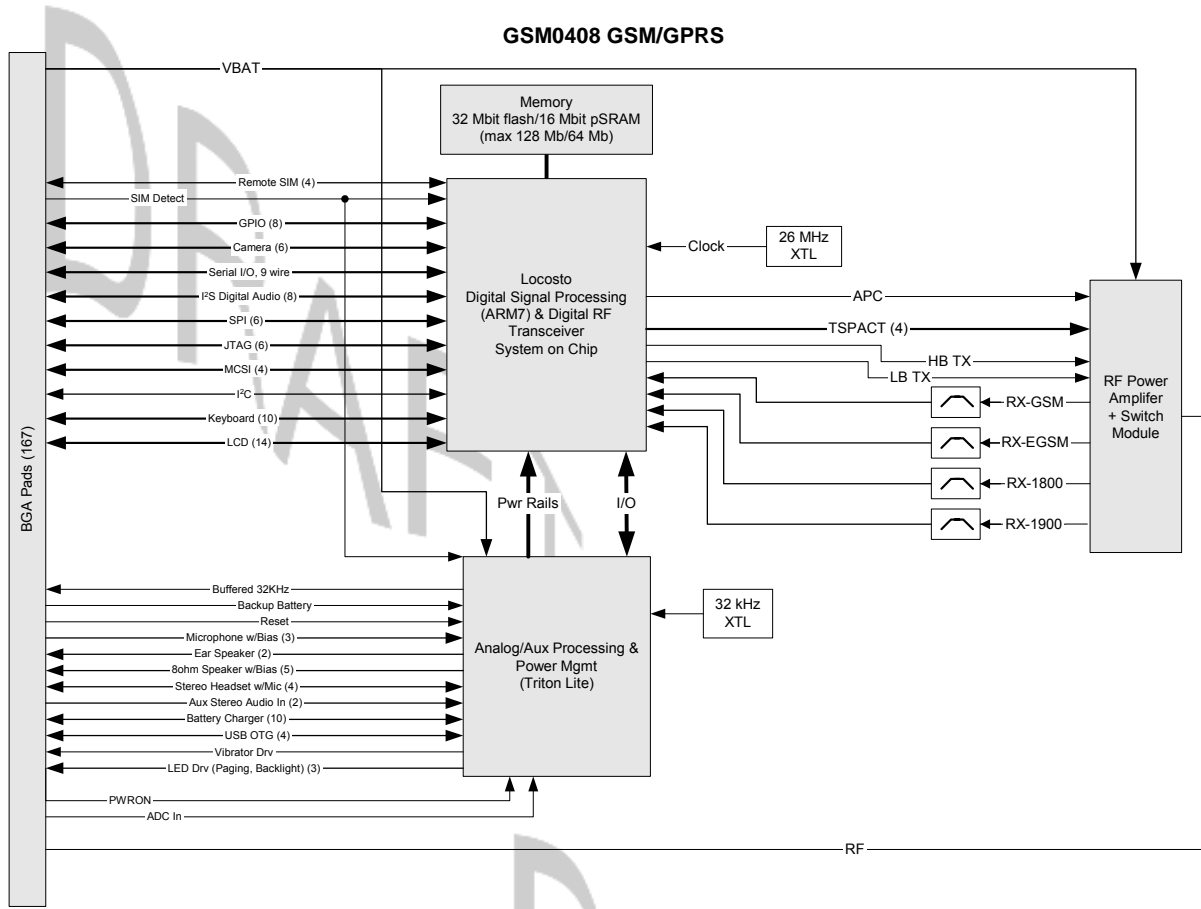
Additional information forthcoming

DRAFT

DRAFT

## 5. Technical Specifications

### 5.1. Enabler IIIG BGA Module Block Diagram



2/22/08

Figure 10 - Enabler IIIG BGA Module Block Diagram

## 5.2. Detailed Product Specifications

<b>Physical Dimensions and Weight</b>	
Size (L x W x H)	28.0 mm x 24.0 mm x 2.50 mm
Weight	Without SIM Connector – < 3.6 grams With SIM Connector (no SIM inserted) – < 4.2 grams

<b>Climatic: Operational</b>	
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)

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

<b>Mechanical: Operational</b>	
Operational vibration, sinusoidal	3.0 mm disp, 2 to 9 Hz; 1 m/s <sup>2</sup> , 9 to 350 Hz
Operational vibration, random	0.1 m <sup>2</sup> /s <sup>3</sup> , 2 to 200 Hz

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

<b>Mechanical: Proposed Standards</b>	
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

<b>Electromagnetic Emissions</b>	
Radiated spurious	FCC Part 22 & 24 / Part 15 Class \ B3GPP TS 51.010-1 Section 12.2 EN 55022 Class B

### 5.3. Operating Power

The module requires an input voltage of 3.3 Vdc to 4.5 Vdc.

#### 5.3.1. Typical Input Current

Test Conditions: Typical Results @ 3.8 V, 20 deg C, with 2000  $\mu$ F at connector input on V<sub>BAT</sub> and RF terminated into a 50  $\Omega$  resistive load.

GSM Operation		Input Current			
Band	Mode	Low	Nom/Avg	High/Peak	Units
1900	1 RX/1 TX, Full Power	21	204	1180	mA
1800		21	215	1280	mA
900		21	248	1600	mA
850		21	250	1600	mA
ALL	Idle	600uA	2.4mA	154mA	
N/A	Shutdown		53uA		

GPRS Operation		Input Current			
Band	Mode	Low	Nom/Avg	High/Peak	Units
1900	4 RX/1TX, Full Power	15	235	1180	mA
	2 RX/2TX, Full Power	15	340	1180	mA
	1 RX/1TX, Full Power	15	192	1180	mA
1800	4 RX/1TX, Full Power	15	242	1280	mA
	2 RX/2TX, Full Power	15	354	1280	mA
	1 RX/1TX, Full Power	15	201	1280	mA
900	4 RX/1TX, Full Power	15	272	1600	mA
	2 RX/2TX, Full Power	15	422	1600	mA
	1 RX/1TX, Full Power	15	232	1600	mA
850	4 RX/1TX, Full Power	15	268	1600	mA
	2 RX/2TX, Full Power	15	420	1600	mA
	1 RX/1TX, Full Power	15	231	1600	mA
ALL	Idle	600uA	2.4mA	140mA	
N/A	Shutdown		53uA		

#### 5.3.2. GSM Transmit Power

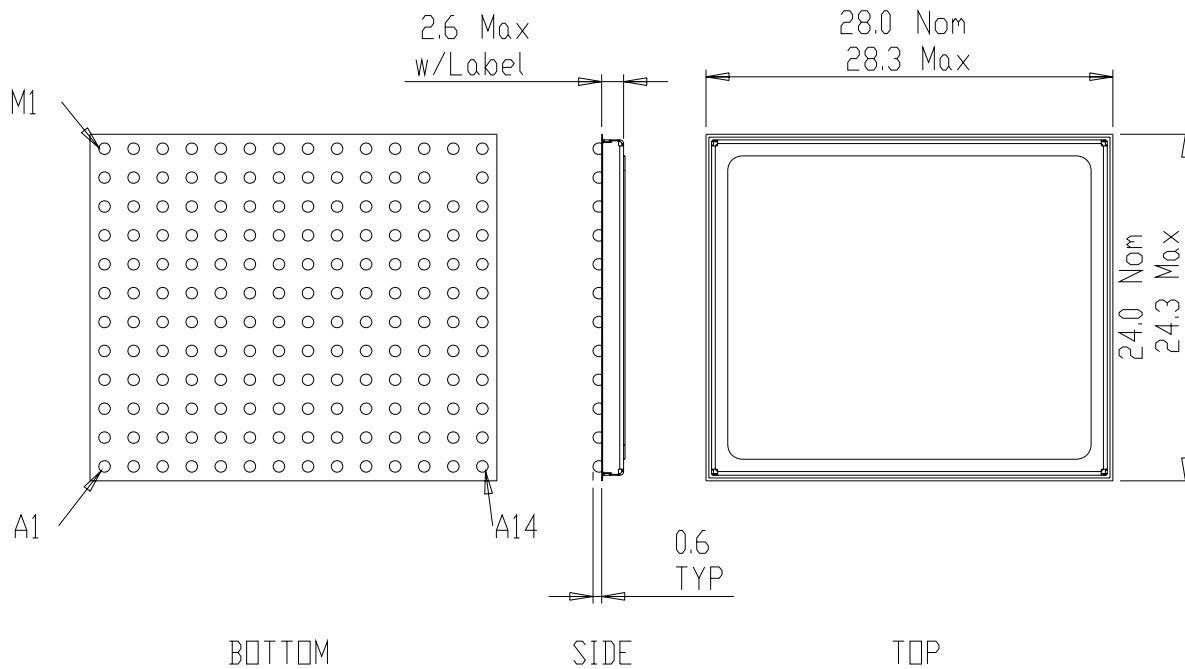
Enfora Enabler IIIG BGA module	Power Class	Transmit Power
1900 MHz 1800 MHz	GSM Power Class 1	1-W conducted power maximum (30 dBm +/- 2 dB), measured at the antenna port
850 MHz 900 MHz	GSM Power Class 4	2-W conducted power maximum (33 dBm +/- 2 dB), measured at the antenna port

### 5.3.3. GSM Receiver Sensitivity

Enfora Enabler IIIG BGA 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)

## 5.4. Physical Interfaces

### 5.4.1. Module

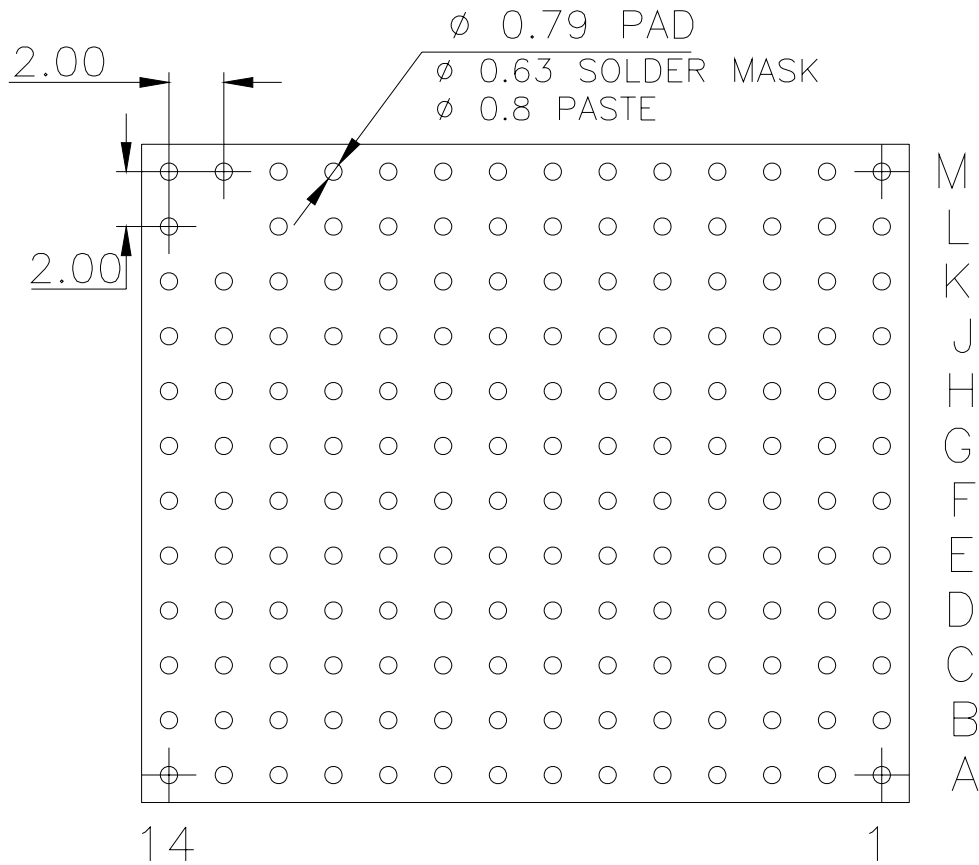


**Figure 11 - Module Dimensions**

All dimensions are in millimeters (mm).  
Shield cosmetics may change.

### 5.4.2. Host PCB Footprint

The recommend footprint for the host PCB is shown in Figure 12. Note that the pad dimensions given are for a solder mask defined pad, in order to avoid irregularities due to flooding, thermals, and routes.



**Figure 12 - Host PCB Footprint**  
(Dimensions are in millimeters.)

### 5.5. Electrical Connections

Pad	Signal Name	I/O	Description	Alternate Description/Function
A1	ANT	I/O	RF Port to Antenna	
A2	GND	I	GND	
A3	GND	I	GND	
A4	GND	I	GND	
A5	GND	I	GND	
A6	GND	I	GND	
A7	SIM_IO	I/O	SIM Data	
A8	GND	I	GND	
A9	VRSIM	O	SIM Power	
A10	GPIO-2	I/O	GPIO-2	*USB_BOOT: Input @ boot, I/O after boot. Must be Tri-State or Low at boot.
A11	CLK32K_BUF	O	Buffered 32 kHz clock	
A12	GND	I	GND	
A13	GPIO-5	I/O	GPIO-5	
A14	GND	I	GND	

Pad	Signal Name	I/O	Description	Alternate Description/Function
B1	GND	I	GND	
B2	GND	I	GND	
B3	GND	I	GND	
B4	GND	I	GND	
B5	GND	I	GND	
B6	GND	I	GND	
B7	SIM_CLK	O	SIM Clock	
B8	SIM_RST	O	SIM Reset	
B9	GND	I	GND	
B10	GND	I	GND	
B11	UART_RX	O	UART Serial Data Output	
B12	UART_DTR	I	UART Data Terminal Ready	
B13**	TRSTN	I	JTAG Test Reset Input	
B14*	I2C_2_SCL	I/O	I <sup>2</sup> C Serial Clock	
C1	VBAT	I	Main Power Input	
C2	VBAT	I	Main Power Input	
C3	GND	I	GND	
C4	GND	I	GND	
C5	GND	I	GND	
C6	GND	I	GND	
C7	TSPACT_12	O	Timed Gen Purpose Output	
C8*	KBR3	I	Keyboard Input	
C9	GPIO-1	I/O	GPIO-1	
C10	UART_RING	O	UART Ring Indicator	
C11	UART_DCD	O	UART DCD Output	
C12	UART_CTS	O	UART CTS Output	
C13	UART_RTS	I	UART RTS Input	
C14*	I2C_2_SDA	I/O	I <sup>2</sup> C Serial Data	
D1	VBAT	I	Main Power Input	
D2	VBAT	I	Main Power Input	
D3	GND	I	GND	
D4	GND	I	GND	
D5	GND	I	GND	
D6	GND	I	GND	
D7	KBC0	I	Keyboard Input	
D8	GND	I	GND	
D9	GND	I	GND	
D10	GND	I	GND	
D11	UART_TX	I	UART Serial Data Input	
D12	UART_DSR	O	UART Data Set Ready	
D13	GPIO-10	I/O	GPIO-10	*MCSI_FSYNC: Frame Synchronization I/O
D14	GPIO-12	I/O	GPIO-12	*MCSI_RX: Serial data input
E1	VBAT	I	Main power input	
E2	VBAT	I	Main power input	

Pad	Signal Name	I/O	Description	Alternate Description/Function
E3*	ADCIN3	I	ADCIN3	BATT_TEMP: Battery Temperature Input
E4*	LED_A	I	LED Current Sink	
E5*	LED_C	I	LED Current Sink	
E6*	KBC2	I	Keyboard Input	
E7*	KBR0	I	Keyboard Input	
E8	GPIO-19	I/O	GPIO-19	*KBR4: Keyboard Input
E9	GND	I	GND	
E10	GND	I	GND	
E11	GPIO-17	I/O	GPIO-17	*SPI_CS1: MSSPI Chip Select 1 Output
E12	GPIO-8	I/O	GPIO-8	
E13	GPIO-11	I/O	GPIO-11	*MCSI_TX: Serial Data Output
E14	GPIO-9	I/O	GPIO-9	*MCSI_CLK: Serial Clock I/O
F1*	ICTLUSB1	O	USB External Pass Transistor Control	
F2*	ICTLUSB2	O	USB External Pass Transistor Control	
F3*	BM_PRECH	I	Pre-Charge Boot Mode	
F4*	LED_B	I	LED Current Sink	
F5*	ADCIN2	I	ADCIN2	BATT_TYPE: Battery Type
F6	ON_OFF	I	Module Reset; <b>Must be driven by open collector/drain.</b>	
F7*	KBC1	I	Keyboard Input	
F8*	KBR1	I	Keyboard Input	
F9	GND	I	GND	
F10	GND	I	GND	
F11	GPIO-14	I/O	GPIO-14	*SPI_MISO: MSSPI Master-In Slave-Out
F12	GPIO-7	I/O	GPIO-7	
F13	No Connect		Do not connect. Leave open.	
F14	GPIO-3	I/O	GPIO-3	
G1*	PCHGAC	O	AC Pre-Charge Output Current	
G2*	ICTLAC1	O	AC External Pass-Transistor Control	
G3*	ICTLAC2	O	AC External Pass-Transistor Control	
G4*	VRWLED	O	PWM Drive for LED Control	
G5	VRIO	O	1.8 V Interface Voltage	
G6	VBACKUP	I	Battery Backup Input	
G7*	KBC3	I	Keyboard Input	
G8*	KBR2	I	Keyboard Input	
G9**	JEMU0	I/O	JTAG Test Emulation 0	
G10	GND	I	GND	
G11	GPIO-13	I/O	GPIO-13	*SPI_CLK: MSSPI Serial Clock
G12	GPIO-18	I/O	GPIO-18	*SPI_CS2: MSSPI Chip Select 2 Output
G13	GPIO-6	I/O	GPIO-6	
G14*	CAM_RST	I/O	Camera Reset	
H1*	PCHGUSB	O	Car-Kit Pre-Charge Output Current	
H2*	VAC	I	Battery Charger Input Power Supply	
H3*	VBATS	I	Charge Current Sense	
H4	HSDetect	I	Headset Detect	



Pad	Signal Name	I/O	Description	Alternate Description/Function
H5	SIMDTC	I	SIM Detect	
H6	CDO	O	I <sup>2</sup> S data out from Locosto (slave mode; mode only supported when used with onboard codec); <b>Must be connected to J6 (I2S_SDR) on Host PCB if external codec is not used.</b>	
H7	CSCLK	I	I <sup>2</sup> S clock into Locosto (slave mode; mode only supported when used with onboard codec); <b>Must be connected to J7 (I2S_SCK) on Host PCB if external codec is not used.</b>	
H8	CDI	I	I <sup>2</sup> S data into Locosto (slave mode; mode only supported when used with onboard codec); <b>Must be connected to K7 (I2S_SDY) on Host PCB if external codec is not used.</b>	
H9	GPIO-20	I/O	GPIO-20	*KBC4: Keyboard Input
H10*	LCD_RnW	I/O	6800 Mode: Read/write Control Pin. High = Read; Low = Write. 8086 Mode: Write Enable Clock. High = Read; Low = Write Send data to the LCD controller on the RnW falling edge. Can be used as GPIO (by default).	
H11	GPIO-16	I/O	GPIO-16	*SPI_LCS0: MSSPI Chip Select 0
H12	GPIO-15	I/O	GPIO-15	*SPI_MOSI: MSSPI Master-Out Slave-In
H13**	TDO	O	JTAG Test Data Out	
H14	GND	I	GND	
J1*	VCCS	I	Charge Current Sense	
J2*	USB_DP	I/O	USB Data I/O Positive	
J3*	VBUS	I	USB Bus Power; <b>Must be tied to ground if not used.</b>	
J4	MICBIAS	O	Microphone Bias Voltage	
J5	HSMICBIAS	O	Headset Microphone bias voltage	
J6	I2S_SDR	I	I <sup>2</sup> S Serial-Data into Analog Processor (master mode); <b>Must be connected to H6 (CDO) on Host PCB if external codec is not used.</b>	
J7	I2S_SCK	O	I <sup>2</sup> S Serial-Clock from Analog Processor (master mode); <b>Must be connected to H7 (CSCLK) on Host PCB if external codec is not used.</b>	
J8	CSYNC	I	I <sup>2</sup> S Sync Into Base-Band Processor (slave mode; mode only supported when used with onboard codec); <b>Must be connected to K8 (I2S_WS) on Host PCB if external codec is not used.</b>	
J9	GPIO-4	I/O	GPIO-4	
J10*	LCD_DATA3	I/O	LCD Interface I/O Data Bus	
J11*	CCP_CKN	I	Serial Camera Clock, Negative.	
J12*	CCP_DTP	I	Serial Camera Data, Positive.	
J13*	CAM PWR DN	I/O	Camera Power Down	
J14**	TDI	I	JTAG Test Data In	
K1*	ID_USB	I/O	USB Connector Identification	
K2*	USB_DM	I/O	USB Data I/O Negative	
K3	ADCIN	I	ADC Input	
K4	MICIN	I	Negative Microphone input	
K5*	SPKPA	O	8 $\Omega$ speaker amplifier positive output (A)	
K6*	SPKNA	O	8 $\Omega$ speaker amplifier negative output (A)	
K7	I2S_SDY	O	I <sup>2</sup> S serial data from Triton (master mode); <b>Must be connected to H8 (CDI) on Host PCB if external codec is not used.</b>	
K8	I2S_WS	O	I <sup>2</sup> S sync from Triton (master mode); <b>Must be connected to J8 (CSYNC) on Host PCB if external codec is not used.</b>	
K9	IPWON	I	Module Power Control	
K10*	LCD_DATA0	I/O	LCD interface I/O data bus	

Pad	Signal Name	I/O	Description	Alternate Description/Function
K11*	LCD_RS	I/O	LCD interface register selection (by default), used also as GPIO;	
K12*	CCP_DTN	I	Serial camera data negative	
K13*	CCP_CKP	I	Serial camera clock positive	
K14**	TCK	I	JTAG Test Clock	
L1	GND	I	GND	
L2*	FML	I	FM audio in - left	
L3	HSOR	O	Headset Output - Right	
L4	MICIP	I	Positive Microphone Input	
L5*	SPKPD	O	8 Ω speaker amplifier positive output (D)	
L6*	SPKND	O	8 Ω speaker amplifier negative output (D)	
L7*	SPKVDD	I	Speaker driver bias	
L8*	VIBDR	O	Vibrator driver	
L9*	LCD_CS0	O	LCD interface chip-select for chip 0. Data I/O are available when low. When high, data I/O are in a high impedance state. Bits shared with the GPIO module and used as GPIO by default. These bits are used as outputs for LCD interface.	
L10*	LCD_CS1	O	LCD interface chip-select for chip 1. Data I/O are available when low. When high, data I/O are in a high impedance state. Bits shared with the GPIO module and used as GPIO by default. These bits are used as outputs for LCD interface.	
L11*	LCD_DATA5	I/O	LCD Interface I/O Data Bus	
L12*	LCD_DATA2	I/O	LCD Interface I/O Data Bus	
L14**	TMS	I	JTAG Test Mode Select	
M1*	AUXI_FMR	I	Auxiliary audio/FM Input - Right	
M2	HSMIC	I	Headset microphone input	
M3	HSOL	O	Headset Output - Left	
M4	EARN	O	Handset Output - Negative	
M5	EARP	O	Handset Output - Positive	
M6	HSOVMID	O	Headset Amplifier Pseudo-Ground	
M7	GND	I	GND	
M8*	LCD_IRST	O	LCD Controller Reset	
M9*	LCD_STB	I/O	<b>6800 Mode:</b> Strobe enable (by default). Read data from the LCD controller on the strobe falling edge. Send data to the LCD controller on the strobe rising edge. <b>8086 Mode:</b> Read Enable (by default); Read data from the LCD controller on the strobe rising edge. Can be used as GPIO.	
M10*	LCD_DATA1	I/O	LCD Interface I/O Data Bus	
M11*	LCD_DATA6	I/O	LCD Interface I/O Data Bus	
M12*	LCD_DATA4	I/O	LCD Interface I/O Data Bus	
M13*	LCD_DATA7	I/O	LCD Interface I/O Data Bus	
M14	GND	I	GND	

Types → I = Input, O = Output, P = Power, G = Ground

\* Note 1: For hardware reference only. The current version of generic firmware does not support the use of this pad/function. Contact Enfora for further details.

\*\*Note 2: For Enfora Use ONLY



## 5.6. 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/Transzorb devices) should be added to all signals that leave the host board. This includes  $V_{BAT}/V_{CC}$ .

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

**NOTE:** DO NOT ADD SERIES RESISTANCE TO THE SIM ELECTRICAL LINES.

Minimum ESD Protection Levels		ESD/Input Voltage			
Pad #'s	ESD Test Method	Min	Nom/ Avg	High/ Peak	Units
All I/O, other than VBUS/PWR	Human Body Model EIA/JEDEC22-A114-A	500			V
	Charge Device Model EIA/JEDEC22-C101-A	200			V
All VBUS/PWR)	Human Body Model EIA/JEDEC22- A114-A	2000			V
	Charge Device Model EIA/JEDEC22- C101-A	500			V
RF Antenna, A1	IEC 61000-4-2			8000	V



**Caution – It is the Integrator's responsibility to protect the Enabler IIIG BGA module from electrical disturbances and excursions that exceed the specified operating parameters.**

DRAFT

## 5.7. Pad Signal Descriptions and Functions



Please note that 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.

### 5.7.1. Module Power (Pads C1, C2, D1, D2, E1, E2)

The module uses a single voltage source of  $V_{CC}=+3.3V$  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
Peak Current	1000 $\mu F$ on Host at module interface		TBD		mA



The uplink burst will cause strong ripple on the voltage lines and should be effectively filtered. It is recommended that 1000 to 2000  $\mu F$  of capacitance be placed as close to the modem power input pads as possible.

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.

### 5.7.2. Antenna (Pad A1)

The module has one RF antenna pad on the module. The connection is for the GSM section of the module.

### 5.7.3. Reset Signal (Pad F6, also known as ON\_OFF)

The Reset signal is used to force the modem to start at a known state. When the Reset is pulled low the modem 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 modem 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 detach the connection from the GSM network, which is not considered ideal. Typically during a normal shutdown, the modem will issue a detach request to the network to indicate that it is being removed. Reset should be used during network operations only when there is no response from the module.

Controlling the Reset signal must only be preformed by an open collector/open drain device. Driving the Reset signal high will interfere with the normal operation of the modem power on/off sequences. Power sequencing cannot be guaranteed if Reset is being driven high by an external device. If driving from an external microprocessor, the reset can be controlled by driving the control pin low as an output, then change the pin control to be an input. This will satisfy the high impedance requirement.

Parameter	Parameter/Conditions	MIN	TYP	MAX	UNIT
V <sub>IL</sub>	Input Voltage – Low or float			0.58	Vdc
V <sub>IH</sub>	Input Voltage – High	1.36		1.95	Vdc
I <sub>PU</sub>	Internal Pull-Up Resistor	-40	-31	-15	μA
I <sub>IL</sub>	Current sink			-2.0	mA
Reset Pulse Duration		10			mS

DRAFT

#### 5.7.4. Power Control (Pad K9) (PWR\_CTL)

The input is equivalent to a “phone ON-button”. A falling-edge on this Active-Low input will switch-ON the module or switch-OFF the module after a delay<sup>\*</sup>. This input has a “weak pull-up” resistor internal to the module. This input can be left grounded if the “RTC Sleep Function” is not required. If RTC Sleep is required, then the PWR\_CTL line must be floated to allow the internal resistor to pull the line high. See section 6.6.9 for more info on the RTC.

Controlling the Power Control signal must only be performed by an open collector/open drain device. Driving the Power Control signal high may interfere with the normal operation of the modem. If driving from an external microprocessor, the Power Control can be controlled by driving the control pin low as an output, then change the microprocessor’s pin control to be an input (this will satisfy the high impedance requirement).

**\*The OFF Delay is controlled by the AT\$OFFDLY command. A value of 0 disables the PWR\_CTL line from turning the module off. 0 is the default value.**



**To enable the module to switch-OFF via PWR\_CTL you must set AT\$OFFDLY to a value other than 0. The valid range is 100 to 1000 milliseconds.**

#### Turning ON the Enabler IIIG BGA

Pulling the PWR\_CTL line on the module LOW for at least 50mS (after Vbat is applied and stabilized) is required to turn it ON. Section 0 describes various ways to provide the signal.

Do not use a pull-up resistor on the PWR\_CTL line since the line is pulled up internal to the modem.

#### Turning OFF the Enabler IIIG BGA

The module can be turned off by either a low pulse on the PWR\_CTL line, or by a software command (AT\$OFF, see AT guide for further details). Section 0 describes various ways to provide the signal.

### Using the Power Control Signal

Typical use powering module on/off with a switch:

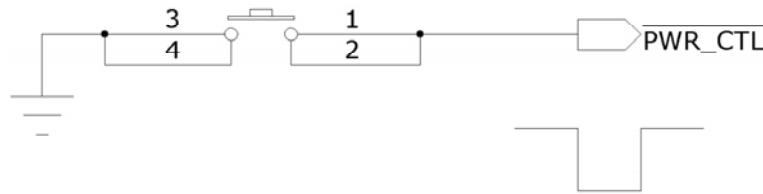


Figure 13 – Power Control Switch

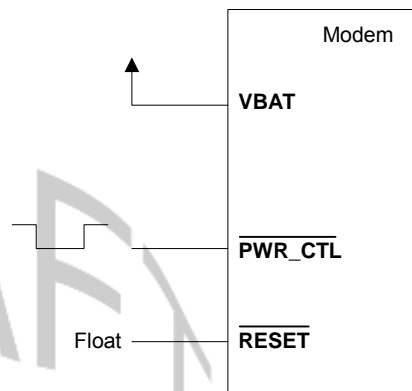


Figure 14 – Typical connection of PWR\_CTL to modem:

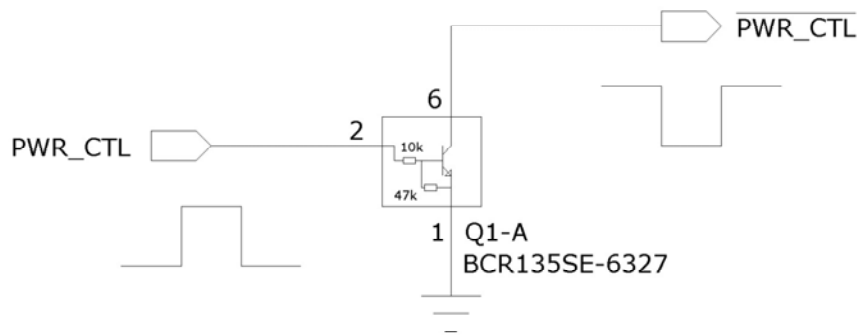
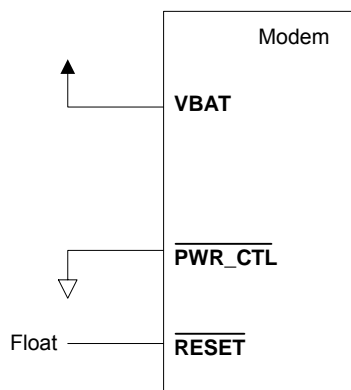


Figure 15 – Typical use controlling PWR\_CTL from microcontroller:

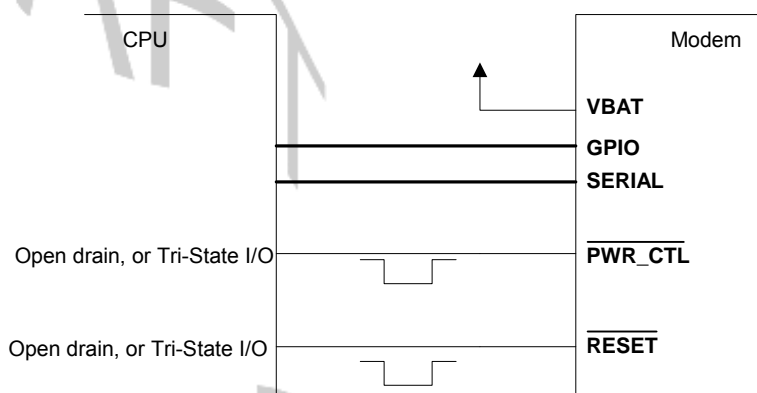
Figure 16 shows a typical connection to the module in a machine-to-machine application using the external **PWR\_CTL** signal, when there is not an external processor controlling the power on/off states. The RTC deep sleep functions will **NOT** function since the **PWR\_CTL** pad is tied low, the processor will never stay in a “RTC Sleep” mode. Either the **RESET** pad must be toggled (as described in section 5.7.3), or power (**VBAT**) must be cycled to reset the module.





**Figure 16 - External Power Control Signal (no external processor)**

Figure 17 shows a typical connection from an external processor to the module, using the external PWR\_CTL signal. The module can be powered on by using the PWR\_CTL signal, and reset with the RESET signal. When using PWR\_CTL, the I/O or serial lines can be at any voltage state desired. It is recommended that the I/O and serial lines be tri-stated or set low when the module is shutdown for an extended period of time to prevent any leakage current from the processor to the modem.



**Figure 17 - Power Control Signal (using external processor)**

Parameter	Parameter/Conditions	MIN	TYP	MAX	UNIT
V <sub>IL</sub>	Input Voltage – Low or float			0.3 x V <sub>BAT</sub>	Vdc
V <sub>IH</sub>	Input Voltage – High	0.7 x V <sub>BAT</sub>		1.95	Vdc
I <sub>PU</sub>	Internal Pull-Up Resistor	-40	-31	-15	μA
I <sub>IL</sub>	Current sink			-2.0	mA
ON Pulse Duration		10	50		mS
OFF Pulse Duration	Minimum is programmable (AT\$OFFDLY)	10	100	5000	mS
Boot time	Time to boot from power on to command prompt		1.1		Sec

### 5.7.5. Level Translation Reference Power (Pad G5)

To be used as a voltage reference source ONLY. Do not connect current loads to this pad. This pad must be decoupled to ground with at least a 0.1  $\mu$ F capacitor at the output. Noise induced on this pad will affect the performance of the baseband.

Low Power Mode is entered when RTCWAKE is used to power down the modem with just the RTC running.

V <sub>R</sub> I/O	Parameter/Conditions	Min	Typ	Max	Units
Output voltage V <sub>OUT</sub>	ON mode	1.65	1.8	1.95	Vdc
	LOW POWER mode	1.65	1.8	1.95	
Rated output current I <sub>OUT</sub>	ON mode			20	mA
	LOW POWER mode			0.5	

### 5.7.6. USB (Pads J2, J3, K1, K2)

Pad Name	Pad Number	Signal Direction	Description
USB_VBUS	J3	In	5 V tolerant power Supply VBUS line; Used only as a USB sense, not for powering the module. (optional connection)
USB_DP	J2	I/O	5 V tolerant USB differential positive data pin
USB_DM	K2	I/O	5 V tolerant USB differential negative data pin
ID_USB	K1	I/O	5 V tolerant ID line, it defines the type of device connected to the phone's USB port; And also the default state (host / device) at the cable connection; The transceiver senses the voltage of this pin to determine if the pin is either floating (typical), grounded or resistively connected to ground (102 k $\Omega$ , 200 k $\Omega$ , 440 k $\Omega$ );

This is for Enfora Debug only

### 5V Tolerant Transceiver

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	$\mu$ A

### 5.7.7. General Purpose Input/Output Interface

Each general-purpose signal may be selected as inputs or outputs. The GPIOs can be used independently as a user-specified function, or may be used to provide modem control and status signals. Several examples of modem control signals are: power shutdown command,

register/deregister on network command, and transmitter disable. Several examples of modem status signals are: registration status and ready-for-power-down status to be used with power shutdown command signal.

GPIO number	Pad number	Secondary Fuction
GPIO 1	C9	
GPIO 2	A10	
GPIO 3	F14	
GPIO 4	J9	
GPIO 5	A13	
GPIO 6	G13	
GPIO 7	F12	
GPIO 8	E12	
GPIO 9	E14	MCSI_CLK
GPIO 10	D13	MCSI_FSYNC
GPIO 11	E13	MCSI_TX
GPIO 12	D14	MCSI_RX
GPIO 13	G11	
GPIO 14	F11	
GPIO 15	H12	
GPIO 16	H11	
GPIO 17	E11	
GPIO 18	G12	
GPIO 19	E8	
GPIO 20	H9	

I/O Lines	Parameter/Conditions	Min	Typ	Max	Units
VIL	Input Voltage – Low	0		0.60	Vdc
VIH	Input Voltage – High	1.11		1.8	Vdc
VOL	Output Voltage – Low			0.45	Vdc
VOH	Output Voltage – High	1.26			Vdc
I <sub>OL</sub> / I <sub>OH</sub>	Rated Output Current			4	mA

The below table shows the factory default modem GPIO configuration:

I/O No	PU/PD Enabled	PU/DN	I/O setting	PU/PD capability	PU Value KOhm	PD Value KOhm	Iout	Notes
1	1	PU	IN	PU/PD	18	90	4	
2	X	X	IN		-	-	8	10k Pulldown on Modem
3	1	PD	IN	PD	-	18	8	
4	1	PU	IN	PU/PD	-	90	4	
5	1	PU	IN	PU/PD	-	90	8	
6	1	PU	IN	PU/PD	-	90	4	
7	1	PU	IN	PU/PD	-	90	4	
8	1	PU	IN	PU/PD	-	90	8	
9	1	PU	IN	PU	18	-	8	
10	1	PU	IN	PU	18	-	8	
11	1	PU	IN	PU	18	-	8	
12	1	PU	IN	PU	18	-	8	
13	1	PD	IN	PD	-	18	8	
14	1	PD	IN	PD	-	18	8	
15	1	PD	IN	PD	-	18	8	
16	1	PU	IN	PU/PD	90	90	8	
17	1	PU	IN	PU/PD	90	90	8	
18	1	PU	IN	PU	18	-	8	
19	1	PU	IN	PU/PD	18	90	8	
20	1	PU	IN	PU/PD	90	90	8	

**Factory Default Settings for I/O Pads, PU/PD Capability and Value of PU/PD Resistors.**

**5.7.8. RTC Sleep**

In this mode, the modem is off except for its Real-Time-Clock. When put into this mode, the modem can wake itself up at a designated time/interval. See Section 4.10 of the Enabler III AT command manual for details

DRAFT

### 5.7.9. Serial Interface

The pad naming for TX/RX/RTS/CTS/DTR/DSR is referenced as a DCE. The DTE device should match their input pads to the Enfora outputs and visa-versa. Additionally, there are AT commands that may need to be executed in order to ensure proper operation. See the chart below.

**NOTE:** The UART interface on the Enabler IIIG BGA, as well as other I/O, is 1.8V logic. It should not be directly connected to a higher voltage interface. The table below is a reference of D connector pin numbers only.

9 way D Connector Pin Number	Signal	Signal Direction	Enfora Pad Number	Enfora AT Command
1	Carrier Detect (CD)	from DCE	C11	AT&C
2	Receive Data (RD)	from DCE	B11	
3	Transmit Data (TD)	from DTE	D11	
4	Data Terminal Ready (DTR)	from DTE	B12	AT&D
5	Signal Ground	both		
6	Data Set Ready (DSR)	from DCE	D12	
7	Request To Send (RTS)	from DTE	C13	AT+IFC
8	Clear To Send (CTS)	from DCE	C12	AT+IFC
9	Ring Indicator (RI)	from DCE	C10	

The key features of the UART in the modem mode are as follows:

- 16C750 compatibility
- Baud rate from 300 bits/s up to 921600 Kbits/s, autobaud
- Configurable data format:
  - Data bit: 5, 6, 7, or 8 bits
  - Parity bit: even, odd, none
  - Stop bit: 1, 1.5, 2 bit(s)
- Hardware flow control RTS/CTS
- Software flow control using XON/XOFF characters

Default settings are 8 data, 1 stop, no parity, and autobaud. DTR may be used to force the modem into AT command mode from online data mode (See AT Command Document, command AT&D). RTS and CTS may be used for hardware handshaking. DSR is always active (asserted low) while the modem is on. RING may be used to alert the host to a variety of incoming calls.

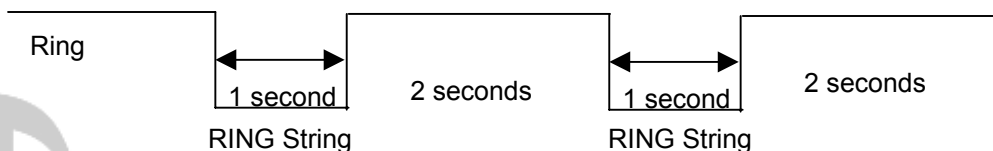
For a minimal implementation, connect RxData and TxData to the COM port serial data lines (through level translation if the interface is not 1.8V). Connect DTR and RTS on the host side of the interface to GND, while leaving the corresponding lines on the module floating.

#### Ring Indicate (Pad C10)

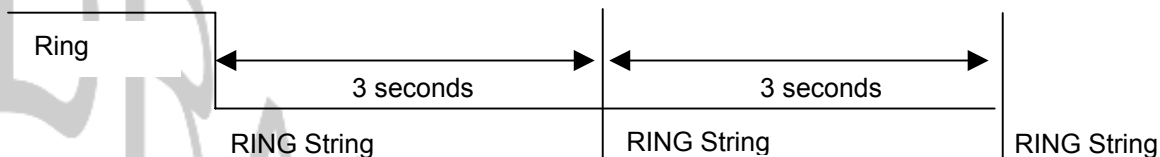
The module is capable of using the Ring line to discern the type of incoming call. The function of the Ring line depends on the type of the call received.

When the module is receiving a *voice call*, the Ring line goes low for 1 second and high for another 2 seconds. Every 3 seconds the ring string is generated and sent over the Receive (Data Out) (Rx) line. If there is a call in progress and call waiting is activated for a connected handset

or hands free device, Ring switches to ground in order to generate acoustic signals that indicate the waiting call.



When a *Fax* or *data call* is received, Ring goes low and will remain low. Every 3 seconds a ring string is generated and sent over the Receive (Data Out) (Rx) line.



When an incoming SMS is received, Ring indicate goes low for 1 second, then returns to a high state. See below logic diagram.

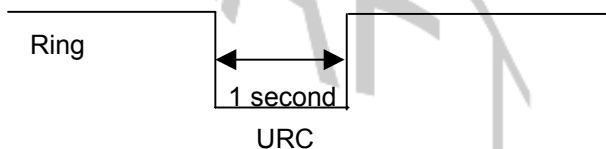


Figure 18 - Ring Indicate Timing

Serial I/O & Control	Parameter/Conditions	Min	Typ	Max	Units
V <sub>IL</sub>	Input Voltage – Low			0.54	Vdc
V <sub>IH</sub>	Input Voltage – High	1.26		1.95	Vdc
V <sub>OL</sub>	Output Voltage – Low			0.54	Vdc
V <sub>OH</sub>	Output Voltage – High	1.26		1.95	Vdc
I <sub>OL</sub> / I <sub>OH</sub>	Rated Output Current			2.0	mA

#### 5.7.10. MCSI – Multi-Channel Serial Interface (Pads D13, D14, E13, E14)

This port is only available in Master mode and to be used for PCM digital audio. Below are the settings for configuring it operation and the interface specification:

##### Digital Audio Configuration

The default settings for the digital audio are:

- Mode = Master
- MCSI\_CLK = 520KHz
- Word Size = 16 Bits
- Sync Pulse = 8KHz
- Frame mode = burst
- Clock edge Sync = rising edge

### Configuring the MCSI for Digital Audio

The following two commands are required to set the unit up in digital audio mode:

**AT\$voicepth=2** This configures the EIII module to use digital audio instead of analog audio.  
**at\$ioblks=0,1** This configures the I/O pads of the module to be used as the secondary function which is the MCSI port. It automatically configures the direction of the pads.

Do not alter the settings for these 4 pads manually (direction, pull up or alternate configuration) as this will stop the MCSI port working for digital audio.

### Data Format

The 16-bit word is sent MSB first. Data received is also MSB first. No other data manipulation is done within the module.

Pad Name	Pad Number	Signal Direction	Description
MCSI_RX	D14	I	Serial Data Input
MCSI_TX	E13	O	Serial Data Output
MCSI_CLK	E14	IO	Serial Clock I/O
MCSI_FSYNC	D13	IO	Frame Synchronization I/O

### 5.7.11. VBACKUP Input (Pad G6)

The backup battery can be recharged from the main battery. A programmable voltage regulator powered by the main battery allows recharging the backup battery. The backup battery charge starts when the following conditions are met:

Backup battery charge is enabled by a control bit:

- Main Battery voltage > Backup Battery voltage
- Main battery > 2.8 Vdc

**Note:** If the backup battery is not present, the backup battery pad is connected to main battery pad.  $V_{BACKUP}$  is a power input for the Real-Time-Clock when using RTC-Sleep Function (Section 5.7.8)

$V_{BACKUP}$	Parameter/Conditions	Min	Typ	Max	Units
Input Voltage Range	ON mode	2.5	$V_{CC1}$	5.5	Vdc
	BACKUP mode, VBAT=0v	1.9	$V_{BACKUP}$	5.5	
	BACKUP mode, VBACKUP=0v	1.9	$V_{CC2}$	3.0	
Input Current				10	$\mu A$

$V_{BACKUP}$  is a backup voltage that can maintain the RTC clock and alarm functions. If  $V_{BACKUP}$  is not present in the system (intentionally or not) the RTC clock may still be powered if leakage voltage exists on VCC. Otherwise, the RTC clock will lose power and be reset when VCC is restored.

PARAMETER	Parameter/Conditions	Min	Typ	Max	Units
<b>Backup Voltage (Real-Time-Clock)</b>					
$V_{\text{BACKUP}}$	Backup Voltage for Real-Time-Clock	2.7	3.0	4.5	Vdc
$I_{\text{BACKUP}}$	Input Current ( $V_{\text{BACKUP}} = 3.2 \text{ V}$ , $V_{\text{BAT}} = 0 \text{ V}$ , No Load on GPIO or Serial Port)		3.0	6.0	$\mu\text{A}$

$V_{\text{BACKUP}}$  has been tested in the above scenarios and does not contribute to leakage. It will properly provide backup power to the RTC clock.

#### 5.7.12. 32 kHz output (Pad A11)

A 32.768 kHz signal is available as an output from the module. This signal should only be used as an input to a high impedance device. Additional loads or capacitance on the line may cause performance issues with the module. If the line is not used, leave floating.

32kHz Clock-Out	Parameter/Conditions	Min	Typ	Max	Units
$V_{\text{IH}}$					Vdc
$V_{\text{IL}}$					Vdc
Maximum capacitor load				tbd	pF
Maximum resistive load					$\Omega$
Frequency	$\pm 30 \text{ ppm}$		32.768		kHz

#### 5.7.13. Analog-To-Digital Input (Pad K3)

The monitoring ADC (MADC) consists of a successive approximation 10-bit analog-to-digital converter (ADC).

Analog-To-Digital Input	Parameter/Conditions	Min	Typ	Max	Units
$\text{ADC}_{\text{BRES}}$	ADC Binary Resolution			10	Bits
$\text{ADC}_{\text{REF}}$	ADC Reference Voltage		1.75		Vdc
$V_{\text{ADC}}$	ADC Range	0		1.75	Vdc
Integral/Differential Non-Linearity		-2		2	LSB
Input Leakage			tbd		$\mu\text{A}$
Retuning Frequency			1		MHz

#### 5.7.14. Handset Microphone Input (Pads K4, L4)

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 and a bias generator MICBIAS provides an external voltage of 2 V or 2.5 V to bias the microphone.

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	$\text{mV}_{\text{RMS}}$
Nominal Ref. Level – Mic(+) to Mic(-)	Differential MIC		-10		dBm0



Differential Input Resistance – Mic(+) to Mic(-)	Differential MIC, <i>MICAMP</i> gain = 25.6 dB (INMODE = 0001)		36		kΩ
Microphone Pre-Amplifier Gain	Differential MIC		25.6		dB

### 5.7.15. Handset Microphone Bias Output (Pad J4)

Mic Bias Output	Parameter/Conditions	Min	Typ	Max	Units
Bias Voltage on Mic(+)	Set to 2.0 V	1.9		2.1	Vdc
	Set to 2.5 V	2.4		2.6	Vdc
Mic Bias Current Capability				2.0	mA

### 5.7.16. Handset Speaker Output (Pads M4, M5)

Pad Name	Pad Number	Signal Direction	Description
EARP	71	O	Earphone positive output
EARN	73	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 V <sub>PP</sub>		120		Ω
	Output Swing 1.5 V <sub>PP</sub>		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 dBm <sub>0</sub> , amp gain = -11 dB		0.98		V <sub>P-P</sub>
	Distortion ≤ 2% and 33 Ω, VSP input level = -5.34 dBm <sub>0</sub> , amp gain = -11 dB		0.38		
	Distortion ≤ 2% and 120 Ω, I2S input level = +3 dBm <sub>0</sub> , amp gain = -11 dB		0.93		
	Distortion ≤ 2% and 120 Ω, VSP input level = +3 dBm <sub>0</sub> , amp gain = 1 dB	3.1	3.92		
	Distortion ≤ 2% and 33 Ω, VSP input level = -5.34 dBm <sub>0</sub> , amp gain = 1 dB	1.2	1.5		
	Distortion ≤ 2% and 120 Ω, I2S input level = +3 dBm <sub>0</sub> , amp gain = 1 dB	2.96	3.7		
Earphone amplifier gain	EARG = 1		1		dB
	EARG = 0		-11		dB

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  $\Omega$  or if volume is inadequate.

### 5.7.17. Headset Microphone Input (Pad M2)

Mic Input	Parameter/Conditions	Min	Typ	Max	Units
The headset differential inputs HSMIC and AUXI can be amplified by the differential handset microphone amplifier. This amplifier has two different gains 4.9 dB or 25.6 dB and a bias generator HSMICBIAS provides an external voltage of 2 V or 2.5 V to bias the microphone. <b>Headset Mic Input</b>					
Maximum Input Range	Inputs 3 dBm0 (Maximum digital sample amplitude with PGA gain set to 0 dB), <i>AUXAMP</i> gain = 18 dB, Single HSMIC			78	mV <sub>RMS</sub>
Nominal Ref. Level			-10		dBm0
Microphone Pre-Amplifier Gain				18	dB
Input resistance at HSMIC	HSMIC single input, <i>AUXAMP</i> gain = 18 dB		40.5		k $\Omega$

### 5.7.18. Headset Microphone Bias Output (Pad J5)

Mic Bias Output	Parameter/Conditions	Min	Typ	Max	Units
Bias Voltage on Mic(+)	Set to 2.0 V	1.9		2.1	Vdc
	Set to 2.5 V	2.4		2.6	Vdc
Mic Bias Current Capability				2.0	mA

### 5.7.19. Headset Speaker Output Left & Right (Pads M3, L3)

Pad Name	Pad Number	Signal Direction	Description
HSOL	57	O	Headset Out 32Ω Speaker Left
HSOR	59	O	Headset Out 32Ω Speaker Right
HSOVMID	61	I	Headset Out pseudo ground return

The left and right headset amplifiers provide the stereo signal on terminals HSOL and HSOR. A pseudo ground is provided on terminal HSOVMID to eliminate external capacitors. The mono audio signal can be provided on the Right or the Right and Left headset outputs. HSOVMID is available to allow integrators to supply a bias or DC offset to increase the dynamic range of the Headset.

Headset Spkr Output	Parameter/Conditions	Min	Typ	Max	Units
Maximum Swing	Distortion $\leq$ 2% and 32 $\Omega$ , VSP input level = +3 dBm0	1.6	1.96		$V_{P-P}$
	Distortion $\leq$ 2% and 32 $\Omega$ , I <sup>2</sup> S input level = +3 dBm0	1.48	1.85		
Maximum Capacitive Load				100	pF
Minimum resistive load at HSOL and HSOR: Zload			32		$\Omega$
Amplifier Gain			-5		dB
HSOL/R amplifier Power supply rejection	1 kHz, 100 mVpp		50		dB
Amplifier State in Power Down			High Z		

The left and right channels of the headset speaker output are a single ended output. An external audio amplifier should be used for loads of less than 32  $\Omega$  or if volume is inadequate.

### 5.7.20. Headset Output Common Mode (Pad M6)

The left and right headset amplifiers provide the stereo signal on terminals HSOL and HSOR. A pseudo ground is provided on terminal HSOVMID to eliminate external capacitors.

**NOTE:** In the audio reference design outlined above, this pin is left unconnected. It is recommended that a series zero ohm resistor be used if unsure of the levels required by the application.

HSOVMID	Parameter/Conditions	Min	Typ	Max	Units
Maximum Capacitor Load				200	pF
DC Level		1.2	1.35	1.5	V

### 5.7.21. Headset Detect (Pad H4)

Headset Plug/Unplug detection. This pad is used to automatically switch to the headset audio path when enabled with AT\$VSELECT=3. The device will default to handset when no Headset is detected.

- 2 modes:
  - Module already ON (Battery connected, VRIO ON) and plug event;
  - Module OFF and plug event: the plug detection will be effective once VRIO is set ON
- Plug and unplug detections are digitally debounced (debouncing time = 8 ms).
- The jack plug detection feature is addressed through the HSDDET pad. The integrated pull up, connected to the pad, forces a high level (VBAT) when the headset load is not connected. At jack insertion headset load connection (32 Ω) imposes a low level on that node (Headset left channel): as an example HSDDET = 1 mV after jack plug for VBAT = 4 V.
- Input comparator threshold voltages are defined as  $V_{T_{low}} = VBAT/2 - 100 \text{ mV}$  and  $V_{T_{high}} = VBAT/2 + 100 \text{ mV}$ ,  $VBAT_{min} = 3.2 \text{ V}$ . The plug and unplug detection remains functional if there is no signal from HSOL amplifier output (stereo path is OFF) or if there is a signal from HSOL (stereo path is ON): maximum level on HSOL when the stereo path is ON is 1 Vp-p which stays far enough from the comparator threshold levels  $VBAT_{min}/2 - 100 \text{ mV}$  and  $VBAT_{min}/2 + 100 \text{ mV}$ .
- Jack plug detection is functional if a plug event occurs before the power up of the module or if the plug event occurs after the power up of the module: analog detection part is always active if the battery is connected. Detection interrupts will be generated once the VRIO regulator is power up during the module power up sequence.
- A level change on HSDDET pad is sensed by a Schmitt trigger to provide a jack detection signal to the audio digital control. The audio digital control receives the detection signal and proceeds to a digital debouncing (time: 8 ms = 256 \* 32 kHz clock periods) before sensing that a plug event happened on the jack connector.

Headset Detect	Parameter/Conditions	MIN	TYP	MAX	UNIT
Low level input voltage VIL related to VBAT				0.3 * VBAT	V
High level input voltage VIH related to VBAT		0.7 * VBAT			V
Current with pull-up		-40	-31	-15	μA

### 5.7.22. Remote Subscriber Identity Module (SIM) (Pads A7, A9, B7, B8, H5)

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 microprocessor and memory installed on a plastic card.

**Note:** The Enabler IIIG BGA module does not include an on-board SIM carrier, nor is a SIM provided with the 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 module will not operate properly without an attached SIM.

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.

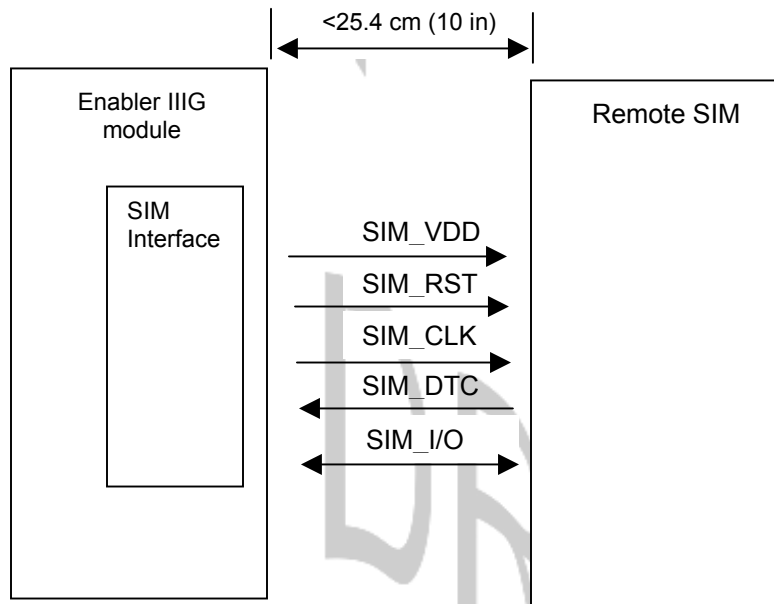
The module supports the use of 1.8 V and 3 V SIM cards. All baud-rates defined in ISO 7816-3 standard are supported for high-speed transmission.

As noted above, the Enabler IIIG BGA requires a remote SIM carrier/connector. When using a remote SIM, the following guidelines are provided:

- To utilize a remote SIM, 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;
  - 8 kV Contact Discharge;

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

Enfora PN: TRS-0000-5009



Manufacturer: On Semi  
Manufacturer PN: NSQA6V8AW5T2G

**Figure 19 - Remote SIM Interface**

Pad Name	Pad Number	Signal Direction	Description
SIM_VDD	A8	O	SIM VDD
SIM_CLK	B7	O	Card Reference Clock
SIM_RST	B8	O	Card Reset
SIM_I/O	A7	I/O	Card I/O Data
SIMDTC	H5	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 EIII AT Command Manual for settings). When enabled, the SIMDTC pad 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 be 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 even when the system is in idle mode.

USIM	Parameter/Conditions	Min	Typ	Max	Units
VDD	SIM VDD voltage	1.65	1.8	1.95	V
		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

### 5.7.22.1. Remote SIM Component Information

Any compatible SIM carrier can be used in conjunction with the Enabler IIIG BGA module. For example:

Lumberg P/N 8840\_A\_21.

or Suyin P/N: 254016MA006G103ZL

## 6. GSM/GPRS Modes of Operation

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

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

### 6.1. 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.

### 6.2. Voice Communication

The Enfora Enabler IIIG BGA module has full voice capabilities, provided the necessary connections have been made for the speaker and microphone pads. The Enfora **Enabler-IIIG AT Command Set Reference - GSM0308AT001** has the entire list of commands that can be used to control the voice functionality. The quick start guide in this manual provides a basic command set that can be used to initialize and test the voice functionality.

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

### 6.3. Circuit-Switched Data

In this mode, the module supports both of the connection modes of transmission that are provided by GSM:

- 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 Public Switched Telephone Network (PSTN) line.

**Note:** All GSM service providers may not support transparent mode. In those cases, the module can be configured to switch automatically to Non-Transparent mode. This capability depends on the settings in the AT+CBST command.

#### 6.4. SMS: Short Message Services

Short Message Services (SMS) is a feature-rich GSM service. The Enabler IIIG BGA 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. SIM Operation

### 7.1. 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)

It is imperative for the Enabler IIIG BGA module that the SIM be configured for the optional services that are required for the application.

### 7.2. GSM Services Supported by the Enabler IIIG BGA Module

The module supports four GSM services (modes of operation) that must be enabled by the operator:

- Voice calls (MO and MT): requires a telephone number
- SMS (MO and MT): uses the telephone number for Voice
- Circuit-switched data calls (MO and MT): requires a telephone number
- The GSM SIM can have multiple telephone numbers.

### 7.3. GPRS Services Supported by the Enabler IIIG BGA Module

The 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
- Multi-slot 10 Class of Service

### 7.4. Selecting the GSM Modes of Operation

When provisioning the SIM for the 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)
- Circuit Switched Data: configure the SIM either for MO alone (to send) or for both MO and MT (to send and receive)

Voice	SMS	CS Data	GPRS	Function
MO/MT	MT	MO		Voice calls, receive SMS, make data calls
MO/MT	MO/MT	MO		Voice calls, receive / send SMS, make data calls
MO/MT	MO/MT	MO/MT		Voice calls, receive / send SMS, make / receive data calls (requires an additional data telephone number)

DRAFT

DRAFT

## 8. Software Interface

### 8.1. Software Interface

The application sends commands to the module via the UART interface pads. These commands use the Enfora AT Command Set and/or Enfora's Packet API.

The Enabler IIIG BGA module operates in one of the following modes:

- **Command mode:** Used for configuring the module, for interrogating the GSM network, and for placing and receiving calls. It uses the AT command set via the serial port for communication.
- **On-line mode:** Used after a circuit-switched data call has been established. Data is passed between the Enabler IIIG BGA module and the controlling application without command interpretation. The only AT command that is interpreted in On-line mode is the +++ command. (This command places the module in Command mode but does not terminate the circuit-switched data call.)
- **IP Packet /API Mode:** Used to read/write modem parameters, interrogate network information, and place and receive calls in real-time, multi-tasking mode. The Packet API mode is facilitated over a PPP connection and the packets can be constructed according to the information provided in the *Enfora GSM-GPRS Family API Reference GSM0308UG001*.

The AT command driver of the module never exits the Command state, that is, it never enters the On-line mode. Although the host interface may not be able to access the AT command interpreter, it is always running and is available via the API Mode over a PPP connection and/or via the RF interface.

- In the Command state, characters that are received from the Customer Premise Equipment (CPE) are treated as AT commands by the module.
- In response to the commands received from the CPE, the module sends characters (AT commands) to the CPE.
- Various events can also trigger the module to send characters (AT commands) to the CPE.

#### Format for the AT Commands

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

<b>&lt;prefix&gt;</b>	AT
<b>&lt;command&gt;</b>	See AT Command Manual
<b>&lt;CR&gt;</b>	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-IIIG AT Command Set Reference – GSM0308AT001*.

## 8.2. Enfora AT Command Set

For a full description of the AT commands, refer to the Enfora **GSM0308AT001 - Enabler-III AT Command Set**.

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

## 8.3. Enfora Packet Application Programming Interface

### 8.3.1. API Architecture

For description and overview of the Enfora UDP and TCP-based API architecture please refer to the **GSM0308UG001 - Enfora GSM-GPRS Family -API Reference**.

## 8.4. Setup and Initialization

### 8.4.1. General Setup

The GPRS modem is controlled through the Modem RS232 port on the development board. Connect a 9-pin straight through serial cable from the Modem RS232 connector to the serial port on the controlling computer.

Hook up power supply, connect antenna, and install SIM into modem.

### 8.4.2. HyperTerminal Configuration for the Enabler IIIG BGA module

The following provides an example for setting up a Windows HyperTerminal session that can be used to experiment with various configurations on the module for controlling computer:

1. Select the connection interface, Direct to Com 1 (or whatever port is the serial port).



Figure 20 – Hyper Terminal Definition

2. Configure the COM port as displayed below.

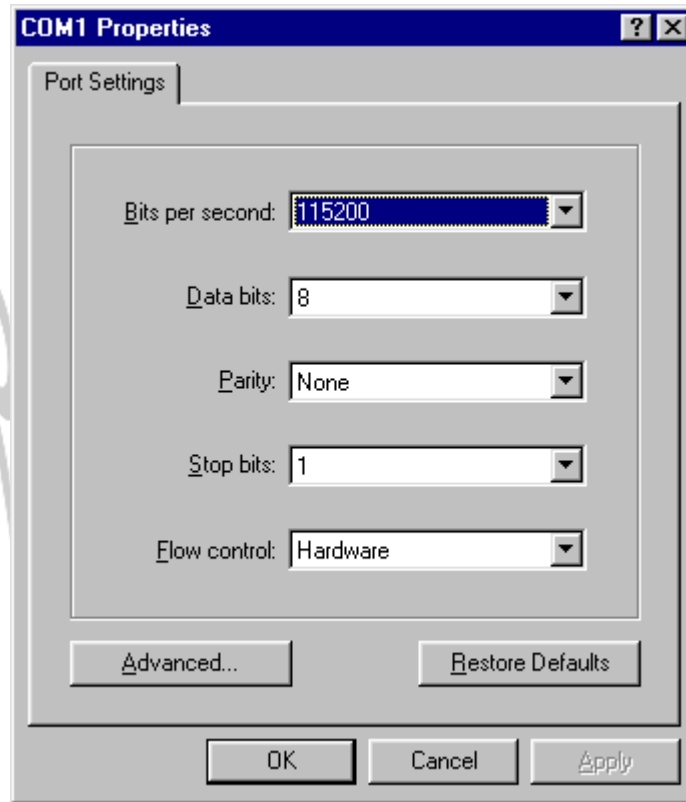


Figure 21 - COM Port Settings

#### 8.4.3. Initialization (AT Command Interface)

In the GSM vocabulary, a call from GSM mobile to the PSTN is called a "mobile-originated call" or "outgoing call". A call from the fixed network to a GSM mobile is called a "mobile-terminated call" or "incoming call."

In the following examples, "Entry" refers to the application. The following convention describes the direction of the data exchange:

- The data exchange from the customer application to the module is designated as:

Entry

The data exchange from the module to the customer application is designated as:

Response

**Note:** With the exception of the +++ command (Online Escape Sequence), all commands must be preceded by the AT attention code (or command prefix) and terminated by pressing the <CR> character.

In the following examples, the <CR> and <CR><LF> are intentionally omitted for clarity and space.

#### 8.4.4. Initial Response to the AT Command

After power is applied to the module, the module performs a power-up self-test. The self-test completes within one (1) second. When queried with the AT command, the module responds with one of the following result codes:

- OK signifies that the module is ready, that it correctly interprets the AT command, and that it has executed the command.
- ERROR signifies that the module does not understand the command or that the command is invalid.

<b>Entry</b>	AT	
<b>Response</b>	OK	Command valid: module is ready

The module must be in AT Command mode (please refer to section 8.6 GPRS Packet Examples for packet mode initialization and setup) when any command is entered (with the exception of the online escape sequence). Commands entered when the module is in On-line mode are treated as data, and are transmitted as such to the receiving module. i.e. If the module is in PPP or SLIP mode, AT commands cannot be entered.

#### 8.4.5. Sending an Initialization String to the Enabler IIIG BGA Module

The following example provides the sample AT commands and responses for the following initialization tasks:

- Reset the module to the factory defaults
- Disable character echo
- Transmit Result Codes
- Set the module to Verbose mode (to display result codes as words)
- Set the DCD to match the state of remote modem
- Ignore the DTR

<b>Entry</b>	AT&FE0Q0V1&C1&d0	Initialization string
<b>Response</b>	OK	Command is valid
<b>Entry</b>	ATSO=1	Auto answer on 1st ring
<b>Response</b>	OK	Command is valid

#### 8.4.6. Setting Up the Communication Mode for the Enabler IIIG BGA Module

The following example sequence provides the AT command and response for setting the Enabler IIIG BGA module for full phone functionality, automated operator selection, 9600 baud, non-transparent mode.

<b>Entry</b>	AT+CFUN=1	FULL phone functionality
<b>Response</b>	OK	Command is valid
<b>Entry</b>	AT+COPS=0	Automatic operator selection
<b>Response</b>	OK	Command is valid
<b>Entry</b>	AT+CBST=7,0,1	9600 baud, non-transparent mode
<b>Response</b>	OK	Command is valid

#### 8.4.7. Querying the Status of the Enabler IIIG BGA Module

This topic is addressed in the Enfora Application Note **GSM0000AN006 – Enabler-G Module Status Query**.

#### 8.4.8. Setting Module Reporting Parameters for GSM and GPRS

This topic is addressed in the Enfora Application Note **GSM0000AN007 - Enabler-G Status Reporting**.

### 8.5. GSM/SMS Examples

#### 8.5.1. Initialize the Enabler IIIG BGA Module to Send and Receive SMS Text Messages

This topic is addressed in the Enfora Application Note **GSM0000AN004 - Enabler-G SMS Configuration and Use**.

#### 8.5.2. Managing SMS Messages

This topic is addressed in the Enfora Application Note **GSM0000AN004 - Enabler-G SMS Configuration and Use**.

#### 8.5.3. Data Call Configuration

This topic is addressed in the Enfora Application Note **GSM0000AN003 - Enabler-G Data Circuit Switched Call Configuration and Use**.

#### 8.5.4. Voice Call Configuration

This topic is addressed in the Enfora Application Note **GSM0000AN003 - Enabler-G Data Circuit Switched Call Configuration and Use**.

### 8.6. GPRS Packet Examples

#### 8.6.1. GPRS ATTACH and ACTIVATE

This topic is addressed in the Enfora Application Note **GSM0000AN005 - Enabler-G Automated Network Connection Configuration and Use**.

### 8.6.2. Windows PPP Setup

The Enabler IIIG BGA module can be used in a Windows operating system environment as a standard serial modem device. The required setup and configuration process is contained in Enfora Application Notes **GSM0000AN001 - Enabler-G PPP Configuration for Windows 98** and **GSM0000AN002 - Enabler-G PPP Configuration for Windows 2000**.

DRAFT

DRAFT



## 9. Integration and Testing

The Enabler IIIG BGA module has been designed to minimize the amount of time required for integration and testing the application. By being fully certified by the appropriate bodies, the module provides seamless integration into the GSM network.

The integration issues for the application can be narrowed to the utilization of the AT commands and the use of the GSM functionality. Coverage and signal quality may be evaluated by using the RSSI commands. Additional network information can be determined by using AT commands.

Integration of the GPRS Packet capabilities is more complicated than using AT command sequences to initiate the connection and begin transferring data. The following Application Notes should be used to integrate the GPRS packet capabilities:

***GSM0000AN001 - Enabler-G PPP Configuration for Windows 98***

***GSM0000AN002 - Enabler-G PPP Configuration for Windows 2000***

***GSM0000AN008 - Enabler-G PPP Configuration for Windows XP***

***GSM0000AN010 - Enabler-G PPP Configuration for PocketPC 2002***

***GSM0000AN005 - Enabler-G Automated Network Connection Configuration and Use***

### 9.1. Integrating the Enfora Enabler IIIG BGA Module

**Note:** Generally, all interfaces that are externally available to the end user need to be ESD-conditioned and terminated in some way. Many of these interfaces should not be connected with power applied.

At the highest level, this is done using some type of GSM test equipment (such as, Racal 6103E), a computer, and a serial interface tester. The GSM test equipment must be able to simulate a GSM call and measure the key parameters related to the module.

Additionally, the serial interfaces and some minimal SIM functionality can be verified by sending AT commands to the module.

All of these conditions need to be verified at ambient as well as extreme conditions.

As part of integration, each of the following interfaces must be verified:

Information	Recommendations
<b>SIM</b>	The maximum line length of the SIM interface is 25.4 cm (10 inches). The module takes care of the signal conditioning As a minimum, an external application with a remote SIM will require a standard SIM carrier. Filter the SIM VCC signal with a 10 uf / 10 V capacitor to help with the line length.
<b>Primary and secondary serial Interfaces</b>	The Enfora Enabler IIIG BGA module uses a 1.8V digital interface. The RS-232 signals must be level-shifted to get standard levels. These signals must be ESD-protected.
<b>Reset Interface</b>	Resets the module when tied low. The signal must be driven from an open collector/drain source.
<b>Audio/Microphone Interface</b>	Preliminary balancing on the module. Maximum length TBD

Testing the following parameters verifies the RF parameters that may be affected by such things as RF path loss, power supply noise, and external interference.

Functionality	Parameters to be Tested
<b>Transmitter</b>	Frequency Error Phase Error PA Ramp Modulation Spectrum RF Power Steps Timing Advance
<b>Receiver</b>	BER Based RX Tests (RXQUAL RXLEV) BER Based Sensitivity

Testing the following GSM functionality verifies proper network communication.

Functionality	Parameters to be Tested
<b>Transmitter</b>	Frequency Error Phase Error PA Ramp Modulation Spectrum RF Power Steps Timing Advance
<b>Receiver</b>	BER Based RX Tests (RXQUAL RXLEV) BER Based Sensitivity

Testing the following GSM functionality verifies proper network communication.

Functionality	Parameters to be Tested
<b>Network Function</b>	Synchronization and registration Call set-up and call termination (both MT and MO calls) SMS and/or data calls

## 10. APPENDIX A - LIMITED WARRANTY

### 10.1. Scope

Enfora warrants to the original purchaser of the product that, for a period of one (1) year from the date of product purchase, the product hardware, when used in conjunction with any associated software (including any firmware and applications) supplied by Enfora, will be free from defects in material or workmanship under normal operation. Enfora further warrants to such original purchaser that, for a period of ninety (90) days from the date of product purchase, any software associated with the product will perform substantially in accordance with the user documentation provided by Enfora, and any software media provided with the product will be free from defects in material or workmanship under normal operation. Enfora does not warrant that (a) the product hardware or any associated software will meet the purchaser's requirements, (b) that the operation of the product hardware or software 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 user documentation. This limited warranty is only for the benefit of the original purchaser and is not transferable. No other party may act on behalf of such purchaser for the purpose of claiming or exercising any rights or benefits under or in connection with this limited warranty except as may be provided in a written agreement between Enfora and such other party.

### 10.2. Hardware

During the warranty period applicable to the product hardware, Enfora, at its expense and in its sole discretion, will repair or replace the product if it is determined to have a covered hardware defect, provided that the purchaser first notifies Enfora of any such defect, furnishes Enfora with a proof of purchase, requests and obtains a return merchandise authorization (RMA) number from Enfora, and returns the product, shipping charges prepaid, to Enfora under that RMA. 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, in which case purchaser shall be responsible for paying Enfora's usual charges for unpacking, testing, and repacking the product for reshipment to purchaser. 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. In the event Enfora repairs or replaces a defective product, the repaired or replacement product will be covered under this limited warranty for the remainder of the original warranty period on the defective product. If Enfora is unable to repair or replace a defective product, the purchaser's exclusive remedy shall be a refund of the original purchase price. Any returned and replaced product, or any product for which Enfora has refunded the original purchase price, becomes the property of Enfora.

### 10.3. Software

During the warranty period applicable to the software or its media, Enfora, at its expense, will replace any defective software or media if purchaser gives written notification of the defect to the technical support department at Enfora during the applicable warranty period. Enfora will ship or otherwise transmit the replacement software or media to purchaser, and purchaser shall be responsible for incorporating any replacement software in the product. Enfora shall not have any obligation to provide any software 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 applicable warranty period. Enfora, from time to time and in its sole discretion, may make available for download on its website ([www.enfora.com](http://www.enfora.com)) certain software bug fixes, upgrades or new releases for the product. The purchaser should periodically visit such website to determine whether any such bug fixes, upgrades or new releases have become available. 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 purchaser does not notify or 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 software other than any software 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. Unless otherwise provided in a written agreement between the purchaser and Enfora, the purchaser shall be solely responsible for the proper configuration, testing and verification of the product prior to deployment in the field.

ENFORA'S SOLE RESPONSIBILITY AND PURCHASER'S SOLE REMEDY UNDER THIS LIMITED WARRANTY SHALL BE TO REPAIR OR REPLACE THE PRODUCT HARDWARE, SOFTWARE OR SOFTWARE MEDIA (OR IF REPAIR OR REPLACEMENT IS NOT POSSIBLE, OBTAIN A 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.

#### **10.4. 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.

In some instances, certain aspects of the product warranty may also be covered in a separate written agreement between Enfora and the distributor or reseller, if any, from whom purchaser purchased the product. That agreement may provide, for example, a different product return procedure that may also be available to purchaser (e.g., the product may be returned to Enfora through that distributor or reseller).

### **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.

## 11. APPENDIX B - Regulations and Compliance

This section summarizes the responsibilities and actions required of manufacturers and integrators who incorporate OEM versions of the Enfora Enabler IIIG BGA 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.

### 11.1. GCF/PTCRB Approval (Formerly FTA)

The Enfora Enabler IIIG BGA 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.

### 11.2. Electromagnetic Compatibility (EMC) and Safety Requirements

The Enfora Enabler IIIG BGA module has been tested and approved for application in the United States of America (US) and the European Union (EU). The compliance details for each of these markets follow. For other markets, additional or alternative regulatory approvals may be required. Always ensure that all rules and regulations are complied with in every country that the OEM application is to be operated. Regardless of the country or market, the OEM must comply with all applicable regulatory requirements.

### 11.3. EMC/Safety Requirements for the USA

Compliance to the US rules and regulations falls under two categories:

- Radio approvals: Federal Communications Commission (FCC)
- Transmitter: FCC Rules, Part 22 & 24
- Unintentional emission: FCC Rules, Part 15

Although the Enfora Enabler IIIG BGA module has been authorized by the FCC and listed as a component by an NRTL, products and applications that incorporate the module will require final verification of EM emission and product safety approval.

**Note:** Particular attention should be made to the following statements regarding RF Exposure:

#### 11.4. Human Exposure Compliance Statement

##### GSM0408 GSM/GPRS Module

Enfora certifies that the Enabler IIIG BGA 850/900/1800/1900 MHz GSM Radio Module (FCC ID: MIVGSM0408) complies with the RF hazard 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 BGA 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 IIIG BGA 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.

**Note:** Installation and operation of this equipment must comply with all applicable FCC Rules and Regulations, including those that implement the National Environmental Policy Act of 1969 (Part 1, Subpart I), with specific regard to antenna siting and human exposure to radio frequency radiation. For further guidance, consult the FCC Rules, a certified FCC test house, or Enfora.

#### 11.5. Compliance with FCC Regulations

The Federal Communications Commission (FCC) is the agency of the Federal Government that oversees all non-governmental radio frequency transmitters that operate within the United States. Unintentional emissions from digital devices are regulated by Part 15 of the FCC Rules and Regulations, which distinguishes between the environments in which these devices may operate. Intentional radiators operating as a GSM-1900 radio transmitter are regulated under Part 22 & 24, Subpart E—Broadband PCS of the FCC Rules and Regulations.

#### 11.6. Unintentional Radiators, Part 15

Equipment designated as Class A is intended for use in a commercial, industrial or business environment. The Enfora Enabler IIIG BGA module has been tested and found to comply with the limits for a Class A digital device and can be integrated into equipment or applications intended for use in commercial, industrial or business environments.

The following statement must be included in the user manual for such products:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Equipment intended for use in a residential environment (notwithstanding use in commercial, industrial or business environments) is designated as Class B. The Enfora Enabler IIIG BGA module has been tested and found to comply with the limits for a Class B digital device and can be integrated into equipment or applications intended for use in residential environments.

The following statement must be included in the user manual for such products:

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.

#### 11.7. Intentional Radiators, Part 22 & 24

Products incorporating the Enfora Enabler IIIG BGA module operate as Personal Communications Services (PCS) devices under the authority of Part 22 & Part 24, Subpart E—Broadband PCS, of the FCC Rules and Regulations. All such transmitters must be authorized by the FCC through its Certification process, as detailed in Part 2, Subpart J - Equipment Authorization Procedures. Through the Certification process, the FCC verifies that the product complies with all applicable regulatory and technical requirements, including those that address human exposure to radio frequency radiation. In general, radio frequency transmitters cannot be sold or operated in the US prior to FCC approval.

#### 11.8. Instructions to the Original Equipment Manufacturer (OEM)

To comply with the requirements of the National Environmental Policy Act (NEPA) of 1969, operation of an FCC-regulated transmitter may not result in human exposure to radio frequency radiation in excess of the applicable health and safety guidelines established by the FCC. Further information on RF exposure issues may be found in the FCC's Office of Engineering and Technology (OET) Bulletin Number 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields" and Supplement C, "Additional Information for Evaluating Compliance of Mobile and Portable devices with FCC Limits for Human Exposure to Radio Frequency Emissions." Both of these documents are available via the Internet at the OET web site: <http://www.fcc.gov/oet>

The Enfora Enabler IIIG BGA modules are GSM radio transceivers, which operate under the authority of 47 CFR Part 24, Subpart E and Part 22 of the FCC Rules and Regulations. When installed and operated in accordance with the instructions provided in this manual, these devices comply with current FCC regulations regarding human exposure to radio frequency radiation.

The following installation and operation restrictions apply to all Enfora Enabler IIIG BGA devices:

- This device may only be used in fixed and mobile applications.
- Portable applications, as defined by the FCC, are prohibited.
- The use of this device for desktop and other applications where the antenna can easily be relocated are considered by the FCC to be mobile applications.
- A separation distance of at least 20 cm (7.87 inches) between the antenna and the body of the user and other persons must be maintained at all times
- In FIXED applications, *antenna gain* is limited to a maximum of 7 dBi, with a corresponding Equivalent Isotropic Radiated Power (EIRP) of 37 dBm / 5 W.
- In MOBILE applications, *antenna gain* is limited to a maximum of 2 dBi, with a corresponding EIRP of 33 dBm / 2 W.

- End products must provide instructions to ensure compliance with radio frequency radiation exposure requirements.
- A warning label visible to all persons exposed to the antenna and identical to that described in this manual must be displayed on or next to the antenna.
- Separate FCC approval for RF exposure compliance is required for end products that do not meet these conditions.

Antenna gain is defined as gain in dBi (dB referenced to an isotropic radiator) minus cabling loss.

**Note:** Additional care must be taken by the installer and/or user of the Enfora Enabler IIIG BGA module to ensure proper antenna selection and installation. Adherence to the above conditions is necessary to comply with FCC requirements for safe operation regarding exposure to RF radiation.

Depending upon the application and type of product into which the Enfora Enabler IIIG BGA module has been incorporated, specific OEM actions and responsibilities required to meet these conditions vary. However, in all cases the primary concern is to ensure compliance with current FCC guidelines and regulations that limit human exposure to radio frequency radiation.

### **Definitions**

For the purpose of determining compliance with current FCC rules addressing human exposure to radio frequency radiation, the FCC has established the following three categories of transmitting devices:

- Portable Devices – devices where the antenna is located within 20 cm (7.87 inches) of any person, including the user, if applicable. Portable devices operating under the authority of Part 22 or 24 (broadband PCS) are limited to a maximum of 2 W EIRP.
- Mobile Devices – devices designed to be used in other than fixed locations and generally such that the antenna is located at a minimum of 20 cm (7.87 inches) from any person, including the user, if applicable. Mobile devices operating under the authority of Part 22 or 24 (broadband PCS) are limited to a maximum of 2 W EIRP.
- Fixed devices – devices in which the antenna, either integral to the product or remotely located, is physically secured at one location and is not able to be easily moved to another location. The antenna for a fixed device is mounted on an outdoor permanent structure with a minimum separation distance of 2 meters (79 inches)

#### **11.8.1. OEM Responsibilities for All Products Containing the Enabler IIIG BGA module**

In addition to any other regulatory requirements, OEMs and integrators must include or provide the following information, instructions, warnings and labels with any device or product into which the Enfora Enabler IIIG BGA GSM1900 GSM transceiver has been incorporated:



Information	Description	
<p><b>Detailed Operating Instructions</b> for ensuring compliance with current FCC guidelines which limit human exposure to radio frequency radiation</p>	<p>The OEM must provide an operating/installation manual with the final product which clearly indicates that these operating conditions and restrictions must be observed at all times to ensure compliance with current FCC guidelines which limit human exposure to radio frequency radiation.</p> <p>20 cm (7.87 inch) separation distance between the antenna and all persons must be maintained at all times for all fixed and mobile products and applications</p> <p>Portable devices and applications are prohibited unless such devices and products are specifically authorized by the FCC</p> <p>Maximum antenna gain is limited to 2 dBi* in mobile products and applications</p> <p>For fixed applications (2 meter separation) the antenna gain can be as much as 26 dBi.</p> <p>Modifications and/or additions to the Enfora Enabler IIIG BGA GSM transceiver, including use of antennas with higher gain than those authorized by the FCC, are prohibited</p> <p>*dBi = antenna gain in dB relative to an isotropic radiator</p>	
<p><b>Antenna Avoidance Label</b></p>	<p>Attach the following warning label directly to or displayed next to the antenna. Furthermore, this label must be visible to and easily readable by all persons in the immediate vicinity of the antenna</p>	<p style="text-align: center;"><b>WARNING</b></p> <p style="text-align: center;"><b>To comply with FCC RF exposure requirements, a separation distance of 20 cm (7.87”) or more must be maintained between this antenna and all persons</b></p>
<p><b>Human Exposure Compliance Statement</b></p>	<p>Include the following statement in the instruction / operation manual.</p>	<p>Enfora certifies that the Enfora Enabler IIIG BGA™ GSM Radio Module (FCC ID: MIVGSM0408) complies with the RF hazard requirements applicable to broadband PCS equipment operating under the authority of 47 CFR Part 22 or Part 24, Subpart E of the FCC Rules and Regulations.</p> <p>This certification is contingent upon installation, operation and use of the Enfora Enabler IIIG BGA 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 IIIG BGA 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.</p>

### **11.8.2. Specific OEM Responsibilities for Portable Products and Applications**

Each device or product into which the Enfora Enabler IIIG BGA PCS-1900 GSM transceiver has been incorporated, and which is intended to be used in an application that meets the definition of "portable", MUST be separately authorized by the FCC for the purposes of determining compliance with current FCC guidelines limiting human exposure to radio frequency radiation.

Portable devices must be evaluated for RF exposure based on Specific Absorption Rate (SAR) limits; further information on such evaluations are available from the FCC via the Internet.

### **11.8.3. Specific OEM Responsibilities for Mobile Products and Applications**

Separate or additional FCC approvals are NOT required for devices or products, into which the Enfora Enabler IIIG BGA PCS-1900 GSM transceiver has been incorporated, that are used in applications that meet the definition of "mobile."

For all end products, the OEM or integrator must provide instructions, warnings and labels to ensure that the product complies with current FCC guidelines limiting human exposure to radio frequency radiation.

Current FCC regulations limit the EIRP of mobile devices to 2 W. Because the nominal RF output power of the Enfora Enabler IIIG BGA GSM1900 GSM transceiver is 1.0 W (31 dBm), antenna gain for mobile products and applications cannot exceed 2 dBi.

### **11.8.4. Specific OEM Responsibilities for Fixed Products and Applications**

Separate or additional FCC approvals are not required for devices or products, into which the Enfora Enabler IIIG BGA GSM transceiver has been incorporated, that are used in applications that meet the definition of "fixed."

For all end products, the OEM or integrator must provide the instructions, warnings and labels to ensure that the product complies with current FCC guidelines limiting human exposure to radio frequency radiation.

Separate or additional FCC approvals are required for devices or end products used in fixed applications where antenna gain in excess of 7dBi is desired.

### 11.9. EMC/Safety Requirements for the Countries of the European Union (EU)

The European Union (EU) is comprised of fifteen countries that follow a harmonized set of standards, utilizing the CE mark as a uniform mark of acceptance. The member countries are:

- Austria
- Belgium
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- The Netherlands
- Poland
- Portugal
- Slovakia
- Slovenia
- Spain
- Sweden
- United Kingdom

### 11.10. EMC/Safety Requirements for Other Countries

In most other countries that have not been listed above there are similar rules and regulations that must be met for importing the Enfora Enabler IIIG BGA module. Each may require a different mark of approval (for example, the CB Scheme) as an acceptance requirement. For each of these cases the country should be identified, and the appropriate steps should be taken to meet the requirements set forth in the intended market.

## 12. APPENDIX C - Glossary and Acronyms

<b>AMR</b>	Adaptive Multi-Rate
<b>API</b>	Application Programming Interface.
<b>App Application</b>	Refers to the Application which sends or receives commands/responses from the Enfora Enabler IIIG BGA Module
<b>AT Command Set</b>	Commands issued by intelligent device to a modem to perform functions, such as to initiate call, to answer call, or to transmit data.
<b>BER Bit Error Rate</b>	Bit Error Rate
<b>CMUX</b>	Multiplexer protocol that operates between an MS and a TE and allows a number of simultaneous sessions over a normal serial asynchronous interface
<b>CPE Customer Premise Equipment</b>	A terminal in fixed location on the customer's premises.
<b>CSD Circuit Switched Data</b>	Data link from a terminal through the network allowing real-time, duplex connectivity at 9600 bytes/second.
<b>dBi</b>	Decibels referenced to an isotropic radiator
<b>DCE Data Communications Equipment</b>	Data Communications Equipment
<b>DCS Digital Cellular System</b>	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.
<b>DTE Data Terminal Equipment</b>	Data Terminal Equipment
<b>EFR Enhanced Full Rate</b>	Voice (vocoder) compression algorithms which offer the highest quality voice communication.
<b>EIR Equipment Identity Register</b>	A database used to store International Mobile Equipment Identity (IMEI) of a locally issued terminal.
<b>EIRP Equivalent Isotropic Radiated Power</b>	In a given direction, the gain of a transmitting antenna multiplied by the net power accepted by the antenna from the connected transmitter.
<b>EMC Electromagnetic Compatibility</b>	The ability of a device to function satisfactorily in its electromagnetic environment without inducing intolerable disturbance to that environment (or to other devices)
<b>ESD Electrostatic Discharge</b>	Static electricity that can damage electronic equipment.
<b>EU European Union</b>	An organization of 15 European states whose purpose is to organize relations between the Member States and between their peoples.
<b>FTA Full Type Approval</b>	GSM Full Type Approval
<b>GPRS General Packet Radio Service</b>	Standard for packet communications utilizing Global Standard for Mobility (GSM) infrastructure.
<b>GSM Global System for Mobile Communications</b>	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.

<b>HLR</b> <b>Home Location Register</b>	Stores the identity and user data for all subscribers belonging to the area of the related MSC.
<b>IMEI</b> <b>International Mobile Equipment Identity</b>	A unique number for each GSM Terminal tracked by the GSM operators in their Equipment Identity Register (EIR) database.
<b>IMSI</b> <b>International Mobile Subscriber Identification</b>	A unique number identifying the subscriber stored in the SIM card. Number is used in conjunction with the network for call routing.
<b>Ki</b>	A secret code used in authentication and encryption by the terminal.
<b>MO</b> <b>Mobile Originated</b>	Any GSM/GPRS service originated at the mobile terminal.
<b>MT</b> <b>Mobile Terminated</b>	Any GSM/GPRS service originated from or routed through the network and sent to the mobile terminal.
<b>MSC</b> <b>Mobile Switching Center</b>	The central switch of the GSM network. Performs call routing, collects call detail records for billing, and supervises system operations.
<b>Non-Transparent Mode</b>	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.
<b>NRTL</b> <b>Nationally Recognized Test Laboratory</b>	OSHA-approved Nationally Recognized Testing Laboratory
<b>OEM</b>	Original Equipment Manufacturer.
<b>PA</b>	Power Amplifier.
<b>Packet</b>	A collection of data transmitted over a digital network in a burst.
<b>PCS</b>	Personal Communication Services.
<b>PDA</b>	Personal Digital Assistant.
<b>PDU</b>	Packet Data Unit.
<b>PPP</b>	Point-To-Point Protocol.
<b>SIM</b>	Subscriber Identity Module.
<b>SMS</b>	Short Message Service.
<b>SMSC</b>	Short Message Service Center.
<b>SUPL</b>	Secure User Plane Location
<b>UDP</b>	User Datagram Protocol.

DRAFT

## 13. APPENDIX D – Tables and Figures

### TABLES

<b>Table 1 - Enabler IIIIG BGA Key Features</b> .....	8
-------------------------------------------------------	---

### FIGURES

Figure 1 – Example of placement and ground plane for the module host board.....	14
Figure 2 – Example of solid flooding on layer 4 with via interconnect.....	14
Figure 3 – Example of thermal relief and Vbat feed .....	15
Figure 4 - Example of Vbat Voltage Droop .....	16
Figure 5 – Example of layer 2 routing fanout.....	17
Figure 6 – Example of layer 3 UART and audio fanout .....	17
Figure 7– Handset Audio Reference Schematic.....	18
Figure 8 – Headset Audio Reference Schematic.....	19
Figure 9 – Audio interface layout examples.....	19
Figure 10 - Enabler IIIIG BGA Module Block Diagram .....	21
Figure 11 - Module Dimensions .....	24
Figure 12 - Host PCB Footprint.....	25
Figure 13 – Power Control Switch .....	35
Figure 14 – Typical connection of PWR_CTL to modem:.....	35
Figure 15 – Typical use controlling PWR_CTL from microcontroller:.....	35
Figure 16 - External Power Control Signal (no external processor) .....	36
Figure 17 - Power Control Signal (using external processor).....	36
Figure 18 - Ring Indicate Timing.....	41
Figure 19 - Remote SIM Interface.....	48
Figure 20 – Hyper Terminal Definition .....	55
Figure 21 - COM Port Settings.....	56

## 14. 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](http://www.enfora.com/support_newissue.asp)

DRAFT

DRAFT