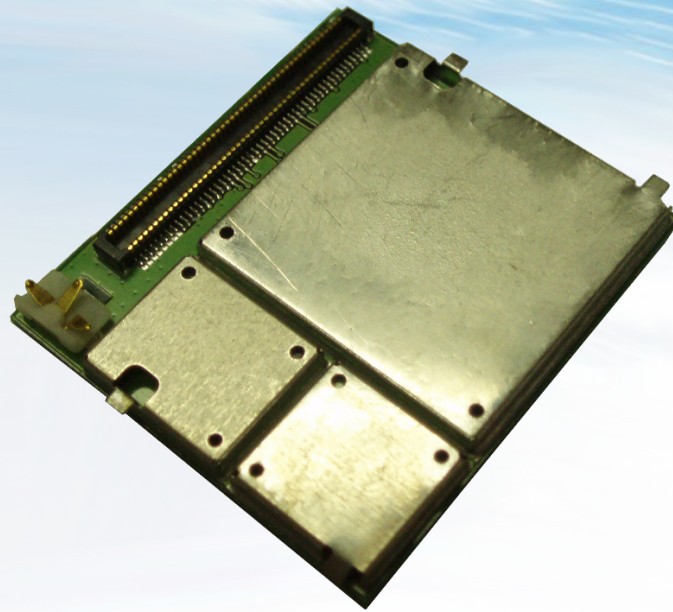


CNN0301IG001

# HS 3001



## Integration Guide

Version: 1.04



01 July, 2013

# General

## TERMS OF USE OF NEW MATERIALS - PLEASE READ CAREFULLY

From time to time, Novatel Wireless, in its sole discretion, may make available for download on its website ([www.nvtl.com](http://www.nvtl.com)), or may transmit via mail or email, updates or upgrades to, or new releases of, the firmware, software or documentation for its products (collectively, 'New Materials'). Use of such New Materials is subject to the terms and conditions set forth below, and may be subject to additional terms and conditions as set forth in Novatel Wireless's Technical Support Policy (posted on its website) and/or any written agreement between the user and Novatel Wireless.

All New Materials are provided AS IS. Novatel Wireless makes no warranty or representation with respect to the merchantability, suitability, functionality, accuracy or completeness of any such New Materials. The user of such New Materials assumes all risk (known or unknown) of such use. Novatel Wireless reserves all rights in such New Materials. The user shall have only a revocable and limited license to use such New Materials in connection with the products for which they are intended. Distribution or modification of any New Materials without Novatel Wireless's consent is strictly prohibited.

IN NO EVENT WILL NOVATEL WIRELESS BE RESPONSIBLE FOR ANY INCIDENTAL, INDIRECT, CONSEQUENTIAL OR SPECIAL DAMAGES AS A RESULT OF THE USE OF ANY NEW MATERIALS. NOVATEL WIRELESS 'S MAXIMUM LIABILITY FOR ANY CLAIM BASED ON THE NEW MATERIALS SHALL NOT EXCEED FIFTY U.S. DOLLARS (\$50).

## Version Verification

Please ensure you have the latest version of this document by downloading it from [www.nvtl.com](http://www.nvtl.com)

# Copyright

© 2013 Novatel Wireless. All rights reserved. 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 Novatel Wireless.

Novatel Wireless and the Novatel Wireless logo are either registered trademarks or trademarks of Novatel Wireless M2M, Inc. in the United States.

251 Renner Pkwy

Richardson, TX 75080 USA

Phone: (972) 633-4400

Fax: (972) 633-4444

Email: [info@nvtl.com](mailto:info@nvtl.com)

[www.nvtl.com](http://www.nvtl.com)

# Warranty Information

[Revised: 11/11/2010]

This warranty applies to (a) products sold directly by Novatel Wireless M2M, unless a different warranty is specified in a written agreement between Novatel Wireless M2M and the purchaser; and (b) products sold to end users through a distributor authorized by Novatel Wireless M2M, but only where the authorized distributor does not provide a separate warranty on such products, and Novatel Wireless M2M has agreed to provide this warranty to such end users. If you purchased the product from an authorized distributor, please check whether this warranty from Novatel Wireless M2M, or a separate warranty from the distributor, applies to your purchase. This warranty does not apply to any (i) accessories or batteries for the products; or (ii) demonstration samples or prototypes of the products. Unless otherwise provided in a written agreement between Novatel Wireless M2M and the purchaser, all such accessories, batteries, samples or prototypes are provided by Novatel Wireless M2M AS IS without any warranty of any kind.

Novatel Wireless M2M warrants to the original purchaser of the product from Novatel Wireless M2M or its authorized distributor (as applicable) that, for a period of one (1) year from the date of shipment of the product from Novatel Wireless M2M, the product hardware will be substantially free from defects in material or workmanship under normal operation, and the product firmware will perform substantially in accordance with the product documentation provided by Novatel Wireless M2M. Novatel Wireless M2M does not warrant that (a) the product hardware or firmware will meet the purchaser's requirements; (b) the operation of the product hardware or firmware will be uninterrupted or error-free; or (c) the product, when integrated in, or combined with, other products or software not supplied by Novatel Wireless M2M, will continue to perform substantially in accordance with the product documentation. This limited warranty is for the benefit of the original purchaser, and is not transferable.

During the warranty period, Novatel Wireless M2M, at its expense and in its sole discretion, will repair the product, or replace the product with a corresponding or equivalent product, if it is determined to have a covered defect, provided that the purchaser first notifies Novatel Wireless M2M (directly or through its authorized distributor from which the product was purchased) of any such defect, furnishes Novatel Wireless M2M with a proof of purchase (if required), requests and obtains a return merchandise authorization (RMA) number from Novatel Wireless M2M, and returns the product under that RMA to Novatel Wireless M2M (or, at Novatel Wireless M2M's option, to its authorized distributor), with the shipping charges being prepaid by purchaser. If, upon reasonable examination of the returned product, Novatel Wireless M2M does not substantiate the defect claimed by purchaser, or determines that the defect is not covered under this limited warranty, Novatel Wireless M2M will not be required to repair or replace the product, but may instead reship the product to the purchaser (or, at Novatel Wireless M2M's option, to its authorized distributor where the product can be made

available to purchaser), in which case the purchaser shall be responsible for paying Novatel Wireless M2M's cost for reshipping the product to purchaser (or to Novatel Wireless M2M's authorized distributor), and Novatel Wireless M2M's usual charges for unpacking, testing, and repacking the product for reshipment to purchaser (or to Novatel Wireless M2M's authorized distributor). Purchaser shall bear the risk of loss or damage in transit to any product returned by purchaser to Novatel Wireless M2M, or any returned product not found to be defective or covered under this warranty, and reshipped by Novatel Wireless M2M to purchaser (or to Novatel Wireless M2M's authorized distributor). In the event Novatel Wireless M2M repairs or replaces a defective product covered by this limited warranty, the repaired or replacement product will be covered under this limited warranty for the remainder of the original warranty period on the defective product, or a period of ninety (90) days, whichever is longer. If Novatel Wireless M2M is unable to repair or replace a defective product covered by this limited warranty, Novatel Wireless M2M will provide to purchaser a credit or a refund (at Novatel Wireless M2M's option) of the original purchase price (excluding taxes and shipping charges). Any returned and replaced product, or any product for which Novatel Wireless M2M has furnished a credit or a refund, becomes the property of Novatel Wireless M2M.

Novatel Wireless M2M shall not have any obligation to provide any firmware bug fixes, upgrades or new releases except as may be necessary to correct any covered defect of which purchaser notifies Novatel Wireless M2M in writing during the warranty period. Novatel Wireless M2M, from time to time and in its sole discretion, may make available for download on its website ([www.nvtl.com](http://www.nvtl.com)), or may provide via email, certain firmware bug fixes, upgrades or new releases for the product. Download and use of any such bug fixes, upgrades or new releases is subject to all of the applicable terms and conditions of Novatel Wireless M2M's technical support policy as posted and updated on its website.

Novatel Wireless M2M shall have no obligation under this limited warranty for (a) normal wear and tear; (b) the cost of procurement of substitute products; or (c) any defect that is (i) discovered by purchaser during the warranty period but for which purchaser does not request an RMA number from Novatel Wireless M2M, as required above, until after the end of the warranty period, (ii) caused by any accident, misuse, abuse, improper installation, handling or testing, or unauthorized repair or modification of the product, (iii) caused by use of any materials not supplied by Novatel Wireless M2M, or by use of the product other than in accordance with its documentation, or (iv) the result of electrostatic discharge, electrical surge, fire, flood or similar causes.

The purchaser (or its customers, as applicable) shall be solely responsible for the proper configuration, testing and verification of the Novatel Wireless M2M product prior to deployment in the field, and for ensuring that any end user product or system into which the Novatel Wireless M2M product is integrated or incorporated operates as intended and meets the requirements of purchaser (or its customers). Novatel Wireless M2M shall have no responsibility whatsoever for the integration, configuration, testing, verification, installation, upgrade, support or maintenance of any such end user product or system, or for any liabilities, damages, costs or expenses associated therewith.

Novatel Wireless M2M'S SOLE RESPONSIBILITY AND PURCHASER'S SOLE REMEDY UNDER THIS LIMITED WARRANTY SHALL BE FOR Novatel Wireless M2M TO REPAIR OR REPLACE THE PRODUCT (OR IF REPAIR OR REPLACEMENT IS NOT POSSIBLE, PROVIDE A CREDIT OR REFUND OF THE PURCHASE PRICE) AS PROVIDED ABOVE. Novatel Wireless M2M 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 Novatel Wireless M2M 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 Novatel Wireless M2M HAS BEEN ADVISED OF THE POSSIBILITY OR LIKELIHOOD OF SUCH DAMAGES.

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.

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.

# Regulatory Compliance

## FCC CERTIFICATION

Novatel Wireless M2M certifies that the Enabler HS 3001 CDMA Radio Module (FCC ID: MIVCNN0301) complies with the RF requirements applicable to broadband PCS equipment operating under the authority of 47 CFR Part 24, Subpart E and Part 22 Subpart H of the FCC Rules and Regulations. This certification is contingent upon installation, operation and use of the Enabler HS 3001 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 Enabler HS 3001 module meets the maximum permissible exposure (MPE) limits for general population / uncontrolled exposure as defined in Section 1.1310 of the FCC Rules and Regulations.

The Enabler HS 3001 module is designed for use in a variety of host units, "enabling" the host platform to perform wireless data communications. However, there are certain criteria relative to integrating the modem into a host platform such as a PC, laptop, handheld, monitor and control unit, etc. that must be considered to ensure continued compliance with FCC compliance requirements.

## Important Information for Canada/USA OEM Integrators

This section provides guidance for using the Enabler HS 3001 in host devices through the FCC Permissive Change process. When utilizing the permissive change process, Novatel Wireless, the grantee, is responsible for all integrations and must be consulted on all regulatory matters involving the Enabler HS 3001.

The Enabler HS 3001 module is granted with FCC/IC modular approval for mobile<sup>1</sup> applications, and may be installed as a standalone<sup>2</sup> transmitter in final products meeting the following conditions. If the following conditions are followed, it may be used in final products without additional FCC/IC certification. Otherwise, additional FCC/IC approvals must be obtained.

---

<sup>1</sup>Mobile Device Definition – FCC defines as a transmitting antenna located at a distance  $\geq$  20cm from the user.

<sup>2</sup>Standalone is defined as a single transmitter transmitting as opposed to 2 or more transmitters transmitting simultaneously.

- The antenna connected to the Enabler HS 3001 module must be installed to provide at least 20 cm separation from the human body at all times.
- The Enabler HS 3001 module and transmitter antennas must not be co-located with any other transmitter or antenna within a host device.
- The transmitter antenna used with the Enabler HS 3001 module must not exceed the following levels:
  - Band Class 0: the maximum gain is 2.2 dBi.
  - Band Class 1: the maximum gain is 8 dBi.
- To comply with the aspects of KDB996369, strict adherence to the design parameters in Section 4.1.1.3 Antenna And RF Signal Trace must be observed. Section 4.1.1.3 provides PCB RF trace design guidelines for the coplanar microstrip between the Enabler HS 3001 RF compression pads and the U.FL style coaxial connector.
- A label containing the FCC and Industry Canada IDs must be permanently affixed to the exterior of the host device into which the Enabler HS 3001 module is installed. The label may also be under a panel or battery pack if it is readily accessible and cannot be separated from the host device itself. The label must contain a statement similar to the following;
  - This device contains FCC ID: MIVCNN0301
  - This equipment contains equipment certified under IC: 4160A-CNN0301

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

If the Enabler HS 3001 module is intended for use in a portable<sup>1</sup> device, the OEM integrator is responsible to design the product to comply with RF exposure, and must work with Novatel Wireless (the grantee) to satisfy FCC/IC SAR requirements. Refer to FCC OET Bulletin 65 Supplement C for information about FCC RF exposure compliance requirements for mobile and portable devices.

The system user manuals and other documentation must clearly indicate operating conditions that must be observed to ensure compliance with FCC/IC RF exposure guidelines and also include appropriate caution and warning statements and information.

The host device containing the Enabler HS 3001 module may also require compliance to FCC Part 15 Subpart B - Unintentional Radiators.

---

<sup>1</sup>Portable Device Definition - FCC defines as a transmitting antenna located at a distance  $\leq$  20cm from the user.



## FCC NOTICE TO USERS

Novatel Wireless M2M has not approved any changes or modifications to this device by the user. Any changes or modifications could void the users authority to operate the device. See 47 CFR Sec. 15.21. The device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. See 47 CFR Sec. 15.19.

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

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

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

The label should contain wording such as:

Contains FCC ID: MIVCNN0301

*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.*

## Industry Canada

IC: 4160a-CNN0301 MODEL NUMBER: CNN0301

This device complies with Industry Canada licence-exempt RSS standard(s). 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 HS 3001 module without any additional FCC certification the installation must meet the following conditions:

- The system antenna(s) connected to the Enabler HS 3001 module must be installed to provide at least 20 cm separation from the human body during normal operation.
- The system antennas must not be co-located with any other transmitter or antenna.
- The system antenna(s) used with the Enabler HS 3001 module must not exceed the following levels:
  - Band Class 0: the maximum gain is 0 dBi.
  - Band Class 1: the maximum gain is 8 dBi.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Afin d'utiliser le Enabler HS 3001 module sans aucune certification de d'Industrie Canada supplémentaire l'installation doit satisfaire aux conditions suivantes:

- L'utilisation du système connectée au module de Enabler HS 3001 doit être installée pour fournir la séparation d'au moins 20 cm du corps humain pendant une opération normale.
- Les antennes du système ne doivent pas être colocalisés avec un autre émetteur ou antenne.
- L'utilisation du système utilisée avec le module de Enabler HS 3001 ne doit pas dépasser les niveaux suivants:
  - Groupe classe 0: le gain maximal est 0 dBi.
  - Groupe classe 1: le gain maximal est 8 dBi.

## ROHS COMPLIANCE

As a part of Novatel Wireless M2M's corporate policy of environmental protection, Novatel Wireless M2M takes every step to ensure that the HS 3001 modules are designed and manufactured to comply to the European Union Directive 2002/95/EC for the Restriction of Hazardous Substances (RoHS).

## NCC NOTICE

減少電磁波影響，請妥適使用」

NCC ID: CCAF133G0170T1

# 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 HS 3001 product to open flames.
- Ensure that liquids do not spill onto the devices.
- Do not attempt to disassemble the product: Doing so will void the warranty. This product does not contain consumer-serviceable components.

The Enabler HS 3001 module may not be used in an environment where radio frequency equipment is prohibited or restricted in its use. This includes aircrafts, airports, hospitals, and other sensitive electronic areas.

Do not operate RF devices in an environment that may be susceptible to radio interference resulting in danger, specifically;

- Areas where prohibited by the law.
  - Follow any special rules and regulations and obey all signs and notices. Always turn off the host device when instructed to do so, or when you suspect that it may cause interference or danger.
- Where explosive atmospheres may be present.
  - Do not operate your modem in any area where a potentially explosive atmosphere may exist. Sparks in such areas could cause an explosion or fire resulting in bodily injury or even death. Be aware of and comply with all signs and instructions.
- Users are advised not to operate the modem while they are at a refueling point or service station.
  - Users are reminded to observe restrictions on the use of radio equipment in fuel depots (fuel storage and distribution areas), chemical plants or where blasting operations are in progress.
- Areas with a potentially explosive atmosphere are often but not always clearly marked.
  - Potential locations can include gas stations, below deck on boats, chemical transfer or storage facilities, vehicles using liquefied petroleum gas (such as propane or butane), areas where the air contains chemicals or particles, such as grain, dust or metal powders, and any other area where you would normally be advised to turn off your vehicle engine.
- Near Medical and life support equipment.
  - Do not operate your modem in any area where medical equipment, or life support equipment may be located, or near any equipment that may be susceptible to any form of radio interference. In such areas, the host communications device must be turned off. The modem may transmit signals that could interfere with this equipment.
- On an aircraft, either on the ground or airborne.
  - In addition to FAA requirements, many airline regulations state that you must suspend wireless operations before boarding an airplane. Please ensure that the host device is turned off prior to boarding an aircraft in order to comply with these regulations. The modem can transmit signals that could interfere with various onboard systems and controls.

- While operating a vehicle
  - The driver or operator of any vehicle should not operate a wireless data device. Doing so will detract from the driver or operator's control and operation of that vehicle. In some countries, operating such communication devices while in control of a vehicle is an offense.

## 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. Novatel Wireless M2M 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.

Novatel Wireless M2M strongly recommends that all installations, hookups, transmissions, etc., be performed by persons who are experienced in the fields of radio frequency technologies. Novatel Wireless M2M 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 Novatel Wireless M2M shall not be responsible for installations or transmissions that fall outside of the parameters set forth in this publication.

Novatel Wireless M2M 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.

# Table of Contents

---

- 1 Introduction ..... 1**
  - Technical Specifications ..... 3
  - Reference Documents ..... 5
  - Typical Usage ..... 5
  - Contacting Novatel Wireless M2M ..... 5
  
- 2 Module Power ..... 6**
  - Operating Power ..... 7
    - Typical Input Current ..... 7
  
- 3 Interfaces ..... 8**
  - Module Mounting To Host Board (Reference) ..... 9
  - Mounting Tab Soldering Guidelines ..... 12
  - Connectors ..... 13
  - RF Board-to-Board Connector Option ..... 13
  - I/O Connector Pin Assignments ..... 13
  - Specific Absorption Rate (SAR) Guidelines ..... 16
    - SAR Compliance ..... 17
  
- 4 Hardware Design Guidelines ..... 18**
  - Advanced Tips For An RF-Friendly Layout ..... 19
    - Ground Plane ..... 19
    - Thermal Relief ..... 20
    - Modem Mounting Tabs ..... 22
    - Antenna And RF Signal Trace ..... 23
    - Engineering Layer Stack-up And Impedance ..... 25
    - VBAT Input ..... 25
  - Audio Reference Design ..... 26

---

Audio Schematics .....	27
Control Connector Signal Descriptions And Functions .....	29
Module Power (PINS 87, 89, 91, 93, 95, 97, 99) .....	29
Modem Power-on And Recovery Techniques .....	30
Power Switch Logic Detect (Pin 85) .....	30
ON/OFF (PIN 37) .....	30
Phone On - PON (PIN 35) .....	31
Internal Power Switch .....	32
Voltage Reference - VREG_MSME1.8 (PIN 77) .....	33
USB (PINS 1, 3, 5, 7) .....	33
General Purpose Input/Output Interface .....	33
RTC Sleep .....	34
Serial Interfaces And Handshake (Pins 11, 13, 15, 17, 19, 21, 23, 25) .....	35
UART 2 (Pins 27, 29) .....	36
Digital Audio Interface (Pins 12, 14, 16, 18) .....	36
Digital Audio Configuration .....	36
Digital Audio Data Format .....	36
32 KHz Output (PIN 56) .....	37
Analog-to-Digital Inputs (PIN 44 And 74) .....	37
Handset Microphone Input (PINS 65, 67) .....	38
Handset Microphone BIAS Output (PINS 53, 63) .....	38
Handset Speaker Output (PINS 71, 73) .....	38
Headset Microphone Input (PIN 55) .....	38
Headset Speaker Output Left And Right (PINS 57, 59) .....	39
Headset Detect (PIN 47) .....	39
Circuit Protection .....	39
<b>5 USB Driver Installation .....</b>	<b>41</b>
USB Driver Installation (Windows XP) .....	42



# 1

## Introduction

---

Technical Specifications

Reference Documents

Typical Usage

Contacting Novatel Wireless M2M



The HS 3001 modem is a compact, wireless OEM module that uses the Code Division Multiple Access (CDMA) international communications standard to provide two-way wireless capabilities. The HS 3001 module is a fully approved CDMA device, enabling application-specific, two-way communication and control.

The small size of the HS 3001 module allows it to integrate easily into the application and packaging.

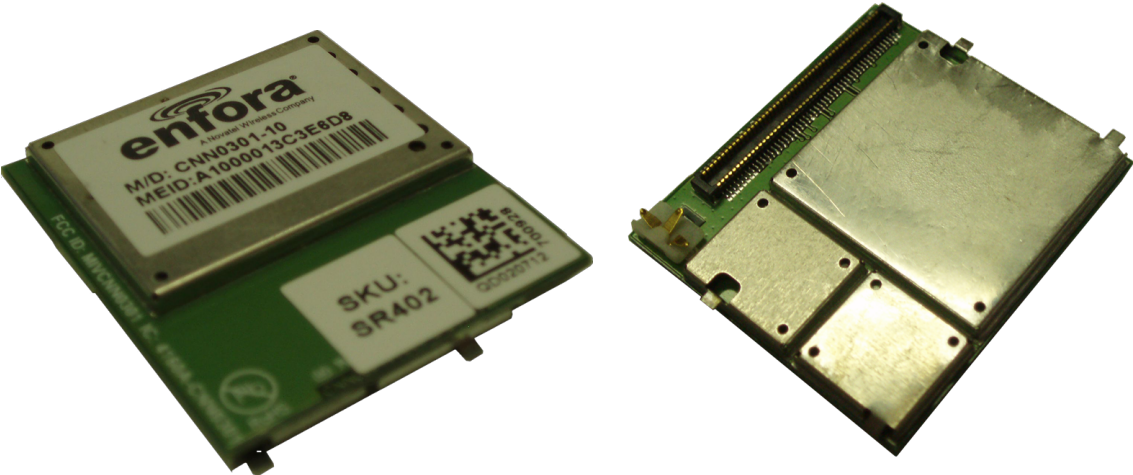


Figure 1-1 HS 3001 Module

# Technical Specifications

## Housing

- Size (L x W x H): 28.0 mm x 25.0 mm x 4.50 mm
- Weight: 4.13 grams

## Interfaces

- Host Interface: Serial Interface
- Data input/output interface: 100 position 0.4 mm pitch connector (Molex P/N 55909-1074)
- Primary serial port: V.24 protocol, 1.8V levels, UART implementation, Hardware flow control
- USB port: USB serial port and USB Debug (USB Debug is Novatel Wireless M2M Use only)
- GPIO: Up to 8 GPIO
- Audio: Analog and Digital audio
- Voice: Supports Handset and Headset audio interfaces
- Antenna Interface: B2B Spring contact
- Command protocol: Novatel Wireless M2M Packet API, CDMA AT Command set
- Reference clock: 32 kHz output reference clock (accessible via 100-pin connector)
- ADC: 2 ADC inputs
- UART2: 2.85 V
- Logic:
  - UART1
  - PCM
  - Digital Audio
  - GPIO
  - PWON
  - Power Control

## Outputs

- Handset earphone outputs (EARP, EARN pins)
- Headset 32  $\Omega$  stereo outputs (HSOL, HSOR pins)

## Mechanical: Storage And Transportation

- Transportation vibration, packaged: ASTM D999
- Drop, packaged: ASTM D775 method A, 10 drops

## Application Interface

- USB: 3.4V
- VBUS: 5.0V
- Mic Bias Out: 1.8V @ 1.5 mA max.
- Audio Mic Inputs: 1.0 Vp-p  $\pm$ 12%
- Ear Audio Out: 1.11 - 1.40 VRMS into 32  $\Omega$  (1.25 VRMS typical)
- Headset Out L&R: 0.531 to 0.668 VRMS into 16  $\Omega$  (0.595 VRMS Typical)

## Power

- Electrical Power: 3.4 to 4.4 Vdc (vbat)  
Supply Vripple must be less than 25 mV across all frequencies
- Peak currents and average power dissipation: Refer to the Operating Power table in the Technical Specifications for peak currents and average power dissipation for various modes of operation.

## Radio Features

- CDMA Sensitivity (Typical):  $\leq$  -108 dBm
- Frequency bands: BCO-800 MHz -US Cell, BC1-1900 MHz - US PCS
- Radio Mode: CDMA 1xRTT, 153 kbps FL/RL
- Chipset: Qualcomm QSC1110

## Audio Features

- Headset Microphone biasing
- Handset Microphone biasing
- Headset Plug/Unplug detection
- Handset microphone input (MICIN, MICIP pins)
- Headset microphone input (HSMIC pin)

## Environmental

- Compliant Operating Temperature: -20  $^{\circ}$ C to 60  $^{\circ}$ C (CDMA Spec Compliant)
- Operating Temperature: -30  $^{\circ}$ C to 70  $^{\circ}$ C
- Storage Temperature: -40  $^{\circ}$ C to 85  $^{\circ}$ C
- Humidity: Up to 95% non condensing
- Emissions: FCC 47 CFR Parts 2,15,22 & 24

## Mechanical: Operational

- Operational vibration Random IEC60068-2-64 / MIL-STD-202G Method 214A  
50-2000 Hz, 7.56 GRMS, 3 Axis, 8 Hours per axis

## Packet Data Transfer

- Protocol CDMA 1xRTT (153 kbps UL and DL)
- Short Message Services Text, MO/MT

## Regulatory

- Agency approvals FCC Certification  
Industry Canada

## Reference Documents

- CNN0301AT001 - HS 3001 AT Command Reference
- CNN0301TG001 - HS 3001 Transition Guide
- ENF0000SD001 - HDK Guide
- CNN0301AN001- Using Digital Audio on the HS 3001

## Typical Usage

The following applications can use the HS 3001 module for transmitting/receiving data/voice:

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

## Contacting Novatel Wireless M2M

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 Novatel Wireless M2M, visit the Support page on the Novatel Wireless M2M web site:

[www.nvtl.com](http://www.nvtl.com)

# 2

## Module Power

---

Operating Power

# Operating Power

The HS3001 module requires an in/out voltage of 3.4V to 4.4V. The supply ripple must be less than 25mV across all frequencies.

## Typical Input Current

Typical Results @ 3.6 V, 20 deg C, with 1000  $\mu$ F at connector input on V<sub>BAT</sub> and RF terminated into a 50  $\Omega$  resistive load. Traffic Data Rate: Full

Band	Mode	Avg (mA)	Peak (mA)	Notes
BC0	RC3, 3.6 V Max Power 23.5 dBm	540	590	RC3= Radio Config 3
BC0	RC3, 3.6 V, TX=0 dBm	180	180	
BC1	RC3, 3.6 V Max Power 23.5 dBm	600	680	
BC1	RC3, 3.6 V, TX=0 dBm	230	230	
Both	Idle-Slot Cycle Index=2, Sleep=3	<2.0	80	Modem registered; peak during network activity
Both	Sleep (not registered)	0.9		
Both	Shutdown	0.03	0.08	For minimum current draw in shut down mode, we recommend you shut down the modem by either sending AT\$OFF (AT\$OFFDLY must be >0) or by sending a pulse on PON line (pin 35), and then setting the ON/OFF line (pin 37) low to remove power from the device.

# 3

## Interfaces

---

Module Mounting to Host Board (Reference)

Mounting Tab Soldering Guidelines

Connectors

RF Board-to-Board Connector Option

I/O Connector Pin Assignments

Specific Absorption Rate (SAR) Guidelines

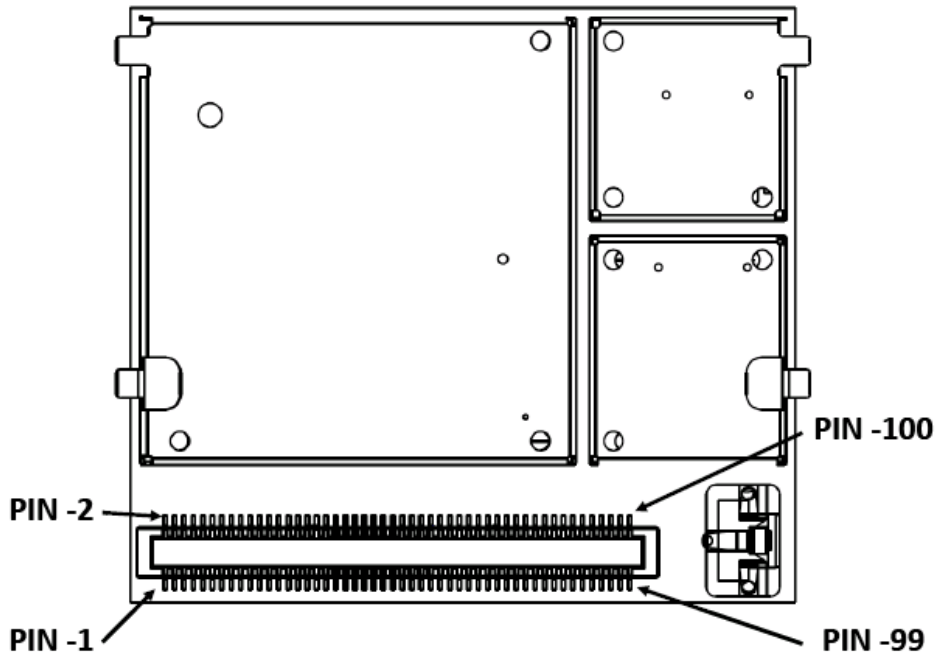


Figure 3-1 Pin 1 Reference, 100-Pin I/O Connector

## Module Mounting To Host Board (Reference)

Solder the module to a PCB using the mounting tabs provided. These tabs provide circuit grounding for the module.



Do not add solder paste to mounting pads, RF connector, or shield pads. The only portion recommended for thermal relief is along the outer edge of each pad, where you would place a soldering iron. The rest of the pad should be solid flood to the copper ground underneath the module. (See Figure 5) This is critical for helping heat dissipation.



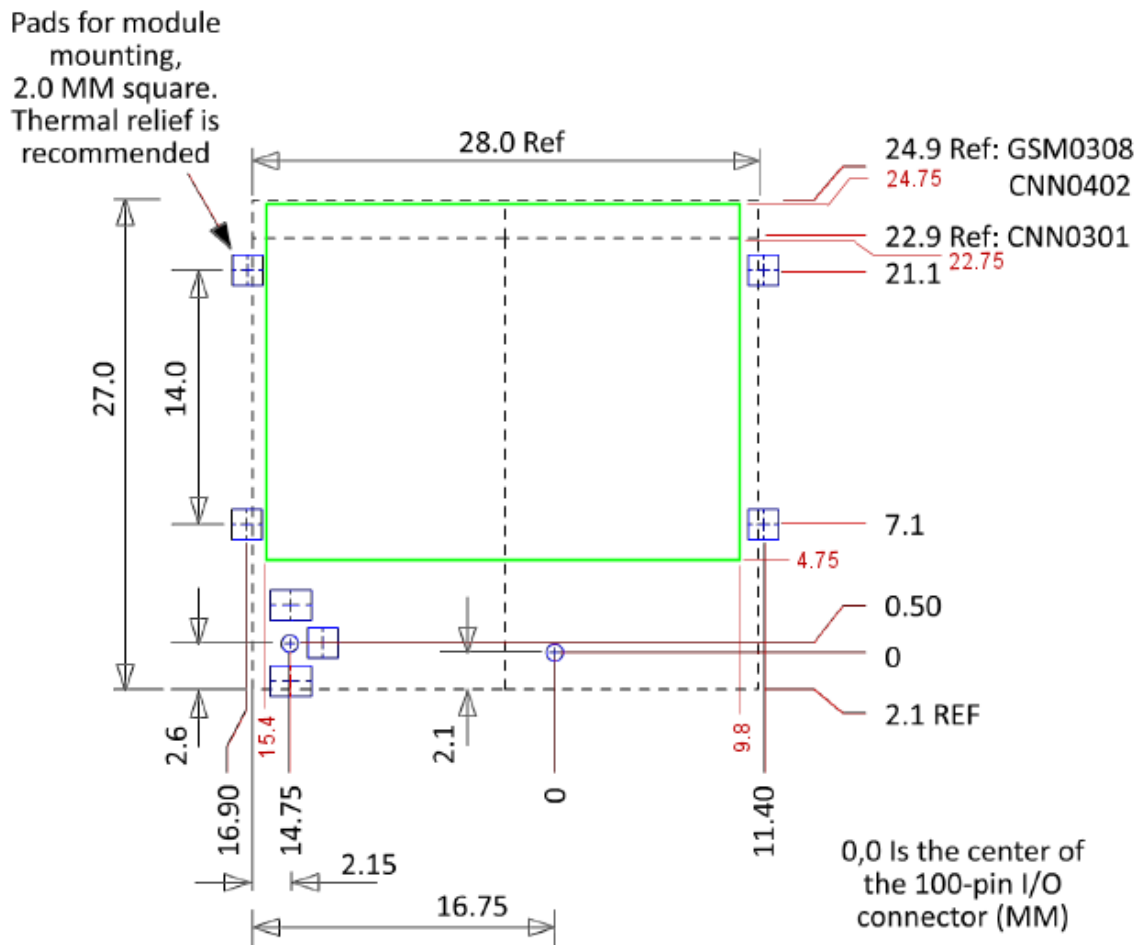
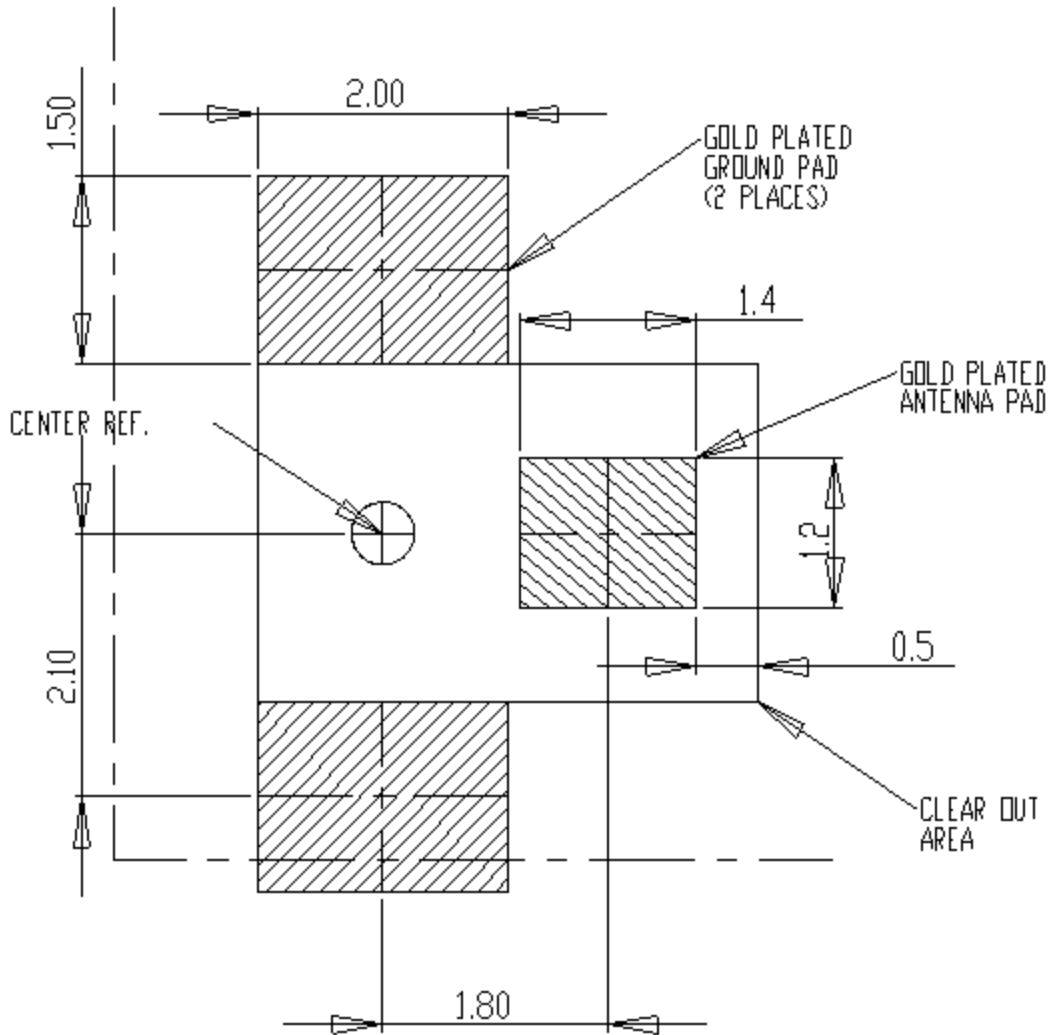


Figure 3-2 Host Board Layout

# BOARD-TO-BOARD RF PADS ON HOST



DETAIL A  
SCALE 15 : 1

Figure 3-3 Host Pads for Board-To-Board RF Connector

# Mounting Tab Soldering Guidelines

Do not apply excessive solder during module mounting. Solder bridging to internal components can occur if you use an overly large iron tip and hold it against the vertical shield walls while applying solder at the junction between the iron and the module. Coverage of the outer  $\frac{3}{4}$  of the tab is sufficient for securing the module. Please see the diagram below:

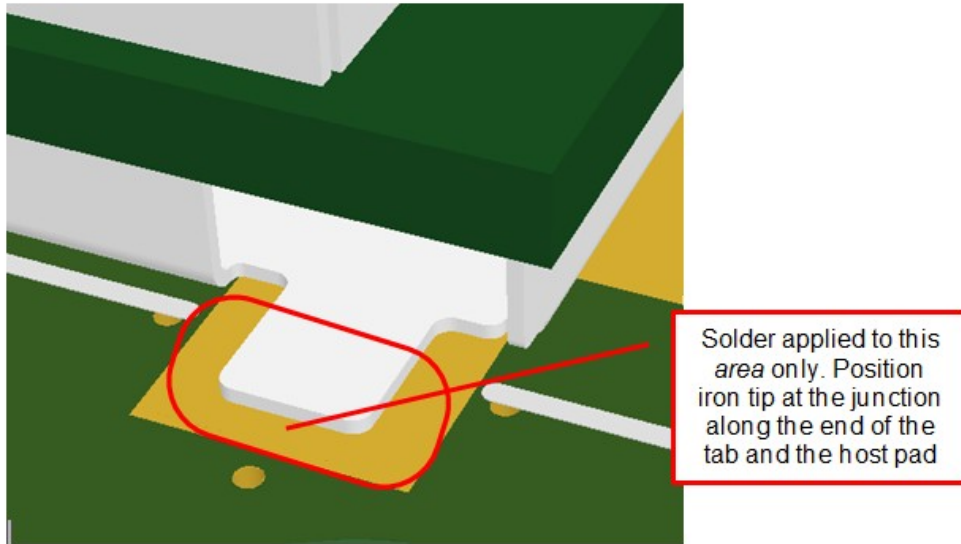


Figure 3-4 Module Tab Soldering

The iron tip should not exceed the size of that shown below for the Metcal SSC-x36A series tip.



Figure 3-5 Recommended Tip Size

# Connectors

On the Modem: 100-Pin I/O Connector, Plug, SMT, Dual Row, 0.4 mm Pitch

- Novatel Wireless M2M PN = CON-1040-0100
- Molex PN = 55909-1074

On the Host: 100-Pin I/O Connector, Socket, SMT, Dual Row, 0.4 mm Pitch (Mate to module)

- Novatel Wireless M2M PN = CON-1040-0101
- Molex PN = 51338-1074

The mated height of the two connectors is 1.50 mm.

## RF Board-to-Board Connector Option

On The Modem:

Novatel Wireless M2M PN = CON-0009-0006

Sunridge PN = MCE-15A-G01

No connector required on the host PCB.

## I/O Connector Pin Assignments

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

Pin	Function	Description	Notes
01	VBUS	USB Power	
02	GND	Ground	
03	VBUS	USB Power	
04	GND	Ground	
05	USB_DP	USB Data (+)	
06	Reserved	N/A	was LED sink on GSM0308
07	USB_DM	USB Data (-)	
08	Reserved	N/A	was current sink for LED A on GSM0308
09	Reserved	N/A	was ID_USB on GSM0308
10	Reserved	N/A	was VRWLED on GSM0308
11	UART_RTS	UART RTS	
12	PCM_DIN	Digital Audio I/F Data In	
13	UART_CTS	UART CTS	

Pin	Function	Description	Notes
14	PCM_CLK	Digital Audio Clock	
15	UART_RX	UART1 RX (Output)	
16	PCM_SYNC	Digital Audio Interface Sync	
17	UART_DTR	Data Terminal Ready	
18	PCM_DOUT	Digital Audio I/F Data Out	
19	UART_DCD	Data Carrier Detect	
20	Reserved	N/A	was GPIO 18 on GSM0308
21	UART_TX	UART1 TX (input)	was SPI_MOSI on GSM0308
22	Reserved	N/A	was GPIO 15 on GSM0308
23	UART_RING	UART_RING	
24	Reserved	N/A	was GPIO 16 on GSM0308
25	UART_DSR	Data Set Ready	
26	Reserved	N/A	was GPIO 14 on GSM0308
27	UART2_TX	UART 2 TX	was reserved on GSM0308
28	Reserved	N/A	was GPIO 17 on GSM0308
29	UART2_RX	UART 2 RX	
30	Reserved	N/A	was GPIO 13 on GSM0308
31	Reserved	N/A	
32	Reserved	N/A	was GPIO 20 on GSM0308
33	Reserved	N/A	
34	Reserved	N/A	was GPIO 9 on GSM0308
35	PON	"Phone on" - Use the momentary low function to activate. See section 4.2 for details.	was PWR_CTL on GSM0308
36	Reserved	N/A	
37	ON/OFF	Power Control Switch Input High = Modem ON Low/Float = Modem OFF See section 4.2 for details.	was RESET on GSM0308
38	Reserved	N/A	
39	Reserved	N/A	
40	Reserved	N/A	
41	Reserved	N/A	
42	Reserved	N/A	

Pin	Function	Description	Notes
43	Reserved	N/A	
44	ADC2	Analog In #2	was reserved on GSM0308
45	Reserved	N/A	
46	Reserved	N/A	
47	HSDETECT	Headset Detect	
48	Reserved	N/A	
49	Reserved	N/A	
50	Reserved	N/A	
51	Reserved	N/A	
52	Reserved	N/A	
53	HSMICBIAS	Headset Microphone Bias	Connected internally to pin 63
54	GND	Ground	
55	HSMIC	Microphone (+)	
56	CLK32K_BUF	Buffered 32.678 kHz clock output (not XTAL)	
57	HSOL	Headset Out Left (+)	
58	GPIO 4	General Purpose IO	
59	HSOR	Headset Out Right (+)	
60	GPIO 3	General Purpose IO	
61	Reserved	N/A	was HSOVMID on GSM0308
62	GPIO 2	General Purpose IO	
63	MICBIAS	Microphone Bias	Connected internally to pin 53
64	GPIO 1	General Purpose IO	
65	MICIP	Microphone differential input (+)	
66	GPIO 7	General Purpose IO	
67	MICIN	Microphone differential input (-)	
68	GPIO 5	General Purpose IO	
69	GND	Ground	
70	GPIO 6	General Purpose IO	
71	EARP	Handset speaker (+)	
72	GPIO 8	General Purpose IO	
73	EARN	Handset speaker (-)	
74	ADCIN	Analog In #1	

Pin	Function	Description	Notes
75	GND	Ground	
76	Reserved	N/A	was SIM VDD on GSM0308
77	VRIO	Reference Voltage (< 5 mA) for external interfaces	
78	Reserved	N/A	was SIM CLK on GSM0308
79	Reserved	N/A	
80	Reserved	N/A	was SIM RST on GSM0308
81	Reserved	N/A	
82	Reserved	N/A	was SIM IO on GSM0308
83	Reserved	N/A	was VBACKUP on GSM0308
84	Reserved	N/A	was SIM Detect on GSM0308
85	PSLOGIC	Power Switch Logic Select	was VBAT on GSM0308
86	GND	Ground/Power Return/Shield	
87	VBAT	Power Input	
88	GND	Ground	
89	VBAT	Power Input	
90	GND	Ground	
91	VBAT	Power Input	
92	GND	Ground	
93	VBAT	Power Input	
94	GND	Ground	
95	VBAT	Power Input	
96	GND	Ground	
97	VBAT	Power Input	
98	GND	Ground	
99	VBAT	Power Input	
100	GND	Ground	

Table 3-11/O Connector Pin Assignments

## Specific Absorption Rate (SAR) Guidelines

Portable RF exposure evaluation must be completed on host devices that provide  $\leq 20.0$  cm of separation distance between the transmitter antenna and the end user.

## Portable Device Definition

FCC defines as a transmitting antenna located at a distance  $\leq 20\text{cm}$  from the user.

## Mobile Device Definition

FCC defines as a transmitting antenna located at a distance  $\geq 20\text{cm}$  from the user.

## SAR Compliance

European and US certification bodies require that you test Specific Absorption Rate (SAR). SAR is a measure of energy absorbed by organic tissue over a specific time. The factors that affect SAR readings are:

- output power
- frequency of the radiation
- proximity to antenna
- antenna counterpoise
- duty cycle

Early in the physical design stage of the UE, the antenna and the mechanical engineering design teams must collaborate on the design to ensure that they can meet the SAR requirements. Carefully reading and understanding the FCC requirements can help designers choose the antenna type, the antenna location, and the industrial design of the UE. The placement and characteristics of the main antenna are the most critical factors affecting SAR performance.



# 4

## Hardware Design Guidelines

---

Advanced Tips for an RF-Friendly Layout

Audio Reference Design

Control Connector Signal Descriptions and Functions

Circuit Protection

Use the following guidelines to successfully implement your PCB layout to obtain the best performance, the lowest possible EMI emissions, the maximum thermal conduction, the highest mechanical integrity, and the best voice quality. The HS 3001 module is a compact, high performance design, yet it is easy to interface into the final product. To experience 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, you should try to use these sound engineering principles.

---

## Advanced Tips For An RF-Friendly Layout

Use the following tips for an RF-friendly layout:

### Ground Plane

To ensure the lowest possible EMI emissions and maximum thermal conductivity, Novatel Wireless M2M recommends that you solder all metal tabs on the cellular module shield down onto a continuous ground plane that runs under the entire module. Provide ample ground vias around the metal tabs to create a low impedance ground. Minimize the number of I/O and power traces and vias under the cellular module to allow for as much ground plane as possible. Great care should also be taken to avoid any shorting or coupling of vias that might be placed under the radio module and have them masked.

An example of a good ground structure and pad layout follows:

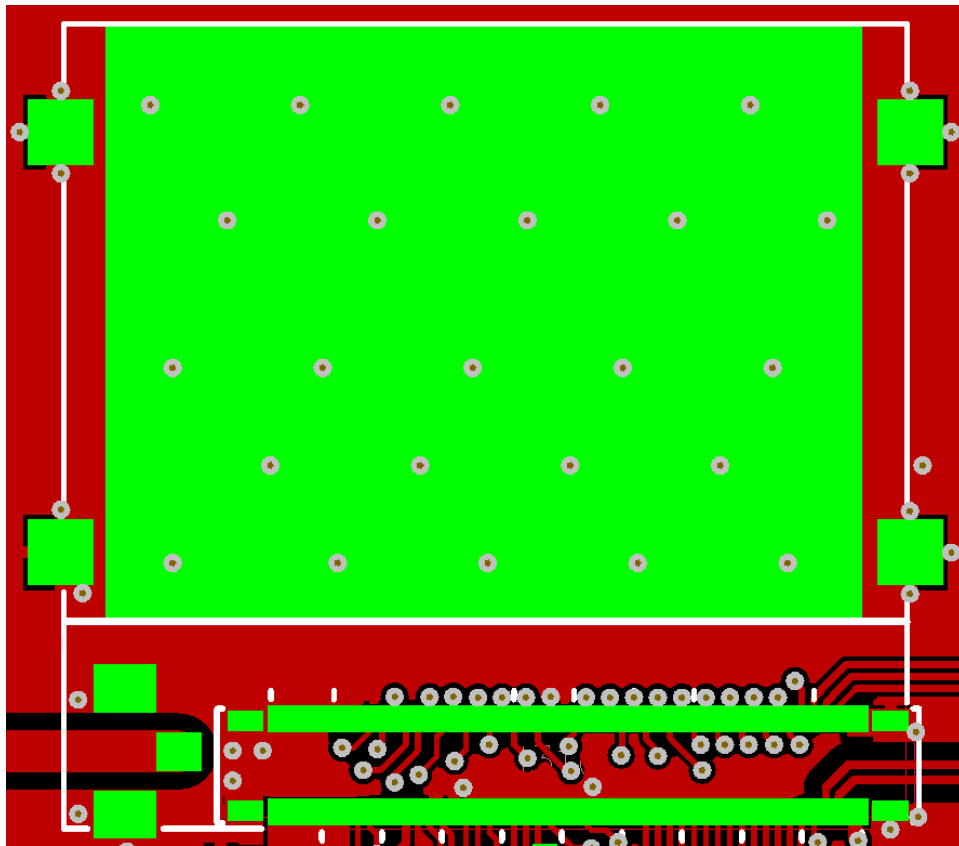


Figure 4-1 Example of good ground plane for CDMA modules

## Thermal Relief

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

For example, a large thermal relief can serve the purpose for general applications such as low current, low speed data lines, DC connections, and audio-frequency applications. However, you should avoid such thermal relief structures for applications involving high current and/or high-frequency (such as those using the cellular module). Depending on the frequency of operation, the long narrow thermal relief traces between the pad and the ground plane act like an RF choke. These RF chokes become higher impedance at harmonics of the fundamental frequency making it problematic for high-frequency suppression. This can make it difficult to pass type approval testing.

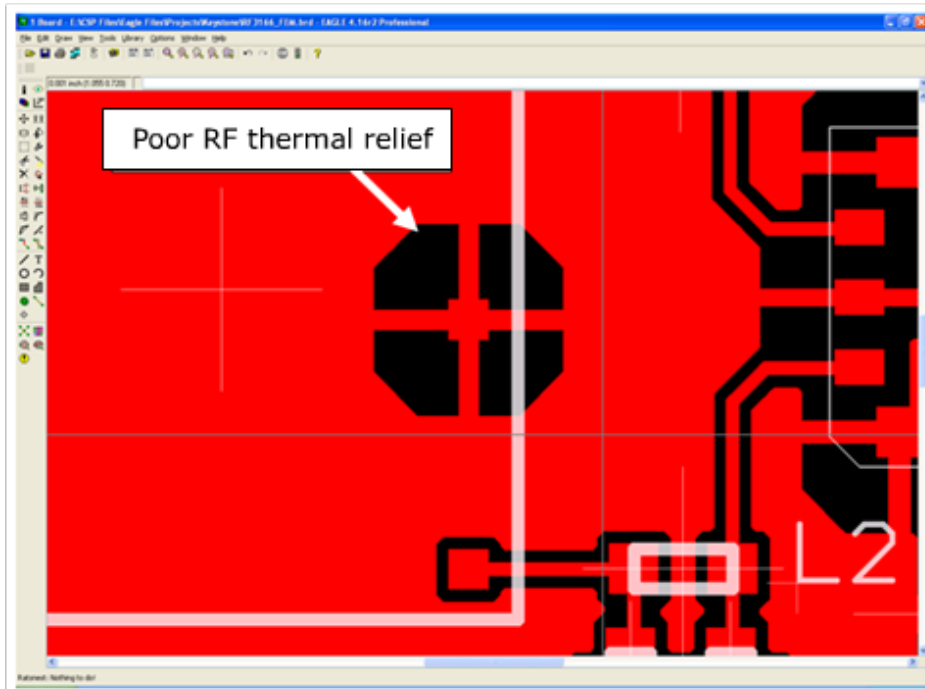


Figure 4-2 Example of a POOR RF Thermal Relief

If thermal relief is necessary, use short, fat traces. This will still provide a solderable connection, while providing a better RF connection. Making the traces shorter also allows for a more continuous ground plane due to less copper being removed from the area. We also recommend that you have ground vias around all thermal relief of critical ground pins such as the five cellular shield tabs.

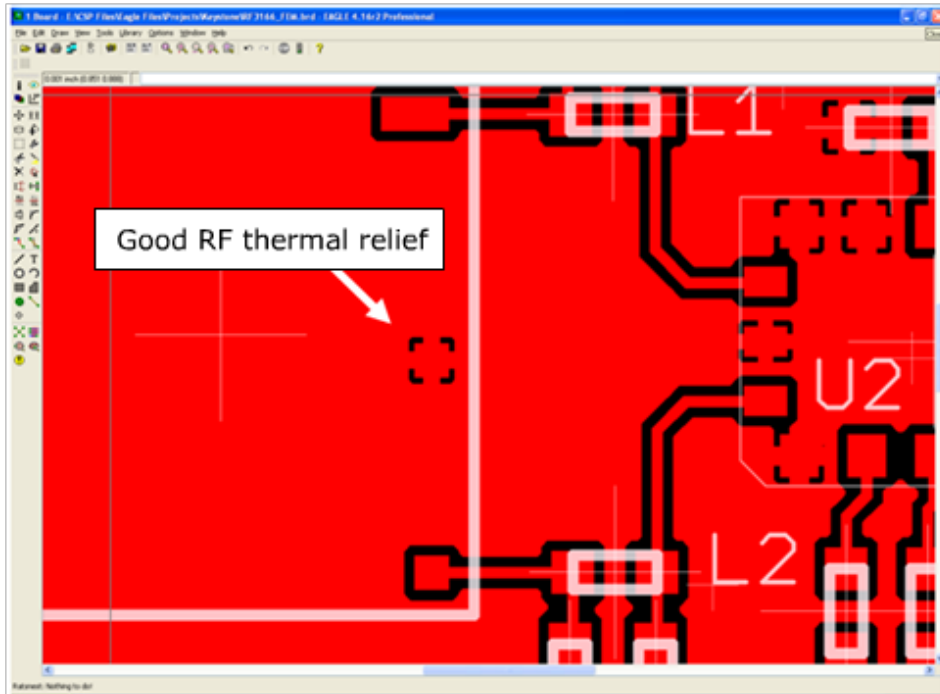


Figure 4-3 Example of a GOOD RF Thermal Relief

## Modem Mounting Tabs

Soldering the tabs on the module is an important part of the assembly of the module and host board. The following figure shows an ideal ground structure for the tabs. One half of the pad is covered with a solid ground. This allows for a low impedance connection while still providing some thermal relief for the soldering process. While soldering the tabs, apply slight pressure (approximately 500 grams of force) to the module to flex the tabs and place the module as close to the host as possible.

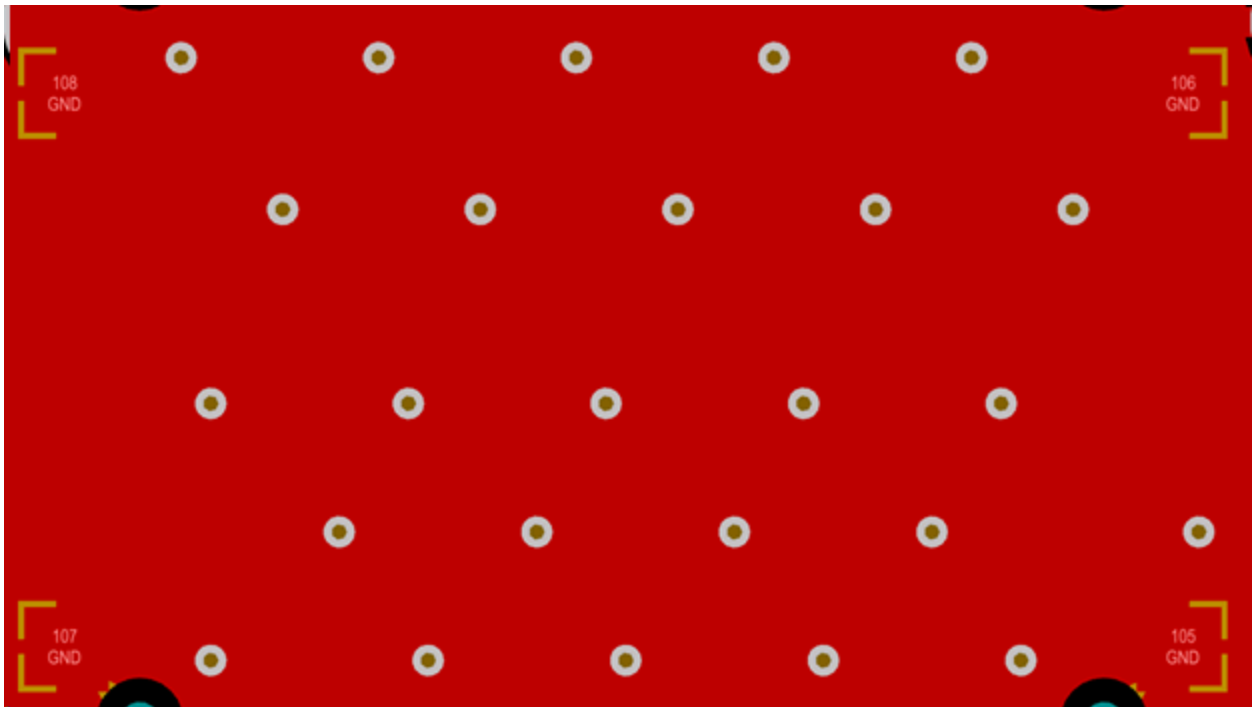


Figure 4-4 Modem Tabs - Ideal Ground Structure

## Antenna And RF Signal Trace

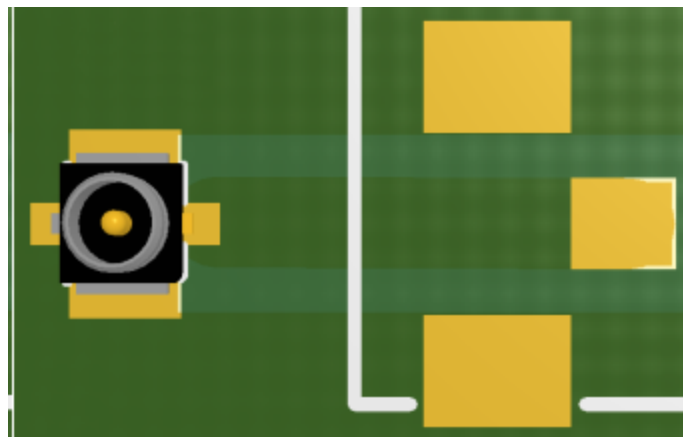
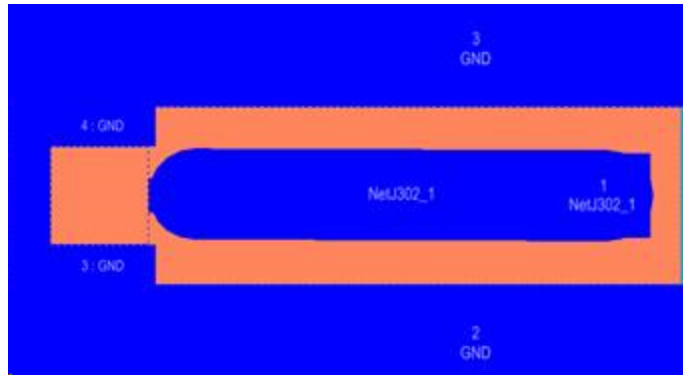
The PCB trace that feeds the RF output port must be designed for a 50 ohm characteristic impedance. The RF trace should be coplanar, or routed into internal layers to keep the top layer continuous around and underneath the cellular module. Provide ample ground vias around the RF contacts, the RF trace,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

For minimum RF emissions due to the fundamental frequency of operation, the cellular module works best with an antenna load that has a VSWR of 1.5:1 or better. The antenna should not have gain at the harmonic frequencies, otherwise, the conducted harmonics could get amplified to a point where the product no longer passes type approval. However, for applications where antenna quality is less than ideal, we recommend that you 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, you may use a low-reactance capacitor to bridge the Pi structure.

The RF cable going between the cellular module and the antenna is very lossy; therefore, you should keep the length of this cable as short a possible.

The following design parameters are for the coplanar microstrip between the Module RF compression pads and the U.FL style coaxial connector.

The coplanar waveguide microstrip details are shown below.



## Engineering Layer Stack-up And Impedance

Layer	Line Width/Space (mil)	Control Impedance ( $\Omega$ )
L1	51.18/24 mil	50 $\pm$ 10%
L1		1 oz +plating
CORE 0.3 11.81mil		
L2		1 oz
PP 3313 3.3003mil CORE 0.6 23.62mil PP 3313 3.3198mil		
L3		1 oz
CORE 0.3 11.81mil		
L4		1 oz +plating

Overlap THK: 1.47 mm Material : FR4 IT-180A

Finish THK: 1.6  $\pm$  0.16 mm

Layer	LW/LS(mil)	Calculate Value ( $\Omega$ )	H1(mil)Er1 H2(mil)Er2
L1	55/22.09 mil $\pm$ 5%	50.6 (coplanar waveguide)	43.3 $\pm$ 5% 4.24
L3	Ground		

## $V_{BAT}$ Input

The HS 3001  $V_{BAT}$  input can have a relative high current draw that can fluctuate rapidly, especially when transmitting at max power and burst mode. The  $V_{BAT}$  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 laying out the connections to the cellular module interface connector, it is tempting to use traces of the same width as the connector pins. However, this is a very compact connector and traces of that width will not have sufficient copper. Similar to the discussion on thermal relief, the use of narrow traces to connect the  $V_{BAT}$  pins to the source voltage can act like a high impedance and cause a significant voltage droop when higher currents are required.

If the  $V_{BAT}$  drops too low, the cellular modules will reset. To minimize the trace loss, use a larger trace that spans several pins. Any concern about solderability can be mitigated by using a solder mask with cutouts for the individual pins as shown in the figure below. The layout should provide sufficient trace width over the entire trace from the Enable modules all the way to the source of the  $V_{BAT}$  voltage. Any transitions between layers for this trace should use multiple vias.



Even the best layout will have some impedance from the source to the cellular module; therefore, sufficient bulk decoupling capacitance is required at the Vbat input to the cellular module. If necessary, you may use up to two 1000  $\mu$ F, low ESR, tantalum capacitors to provide the desired decoupling. If used, the capacitors should be located very close to the cellular interface connector  $V_{BAT}$  pins. Any thermal relief used on these capacitors should comply with the information given above to provide the lowest possible impedance. The grounding of these capacitors is critical. Therefore, it should be a low impedance and should use multiple vias to the internal ground plane close to the capacitor.

It is highly recommended to have the battery voltage be set at 3.8 Volts (the approximate midpoint between 3.4 Volt and 4.4 Volt) to avoid any negative side effects related to transmit power of the radio module caused by high voltage drops due to high current draw on the Vbat line.

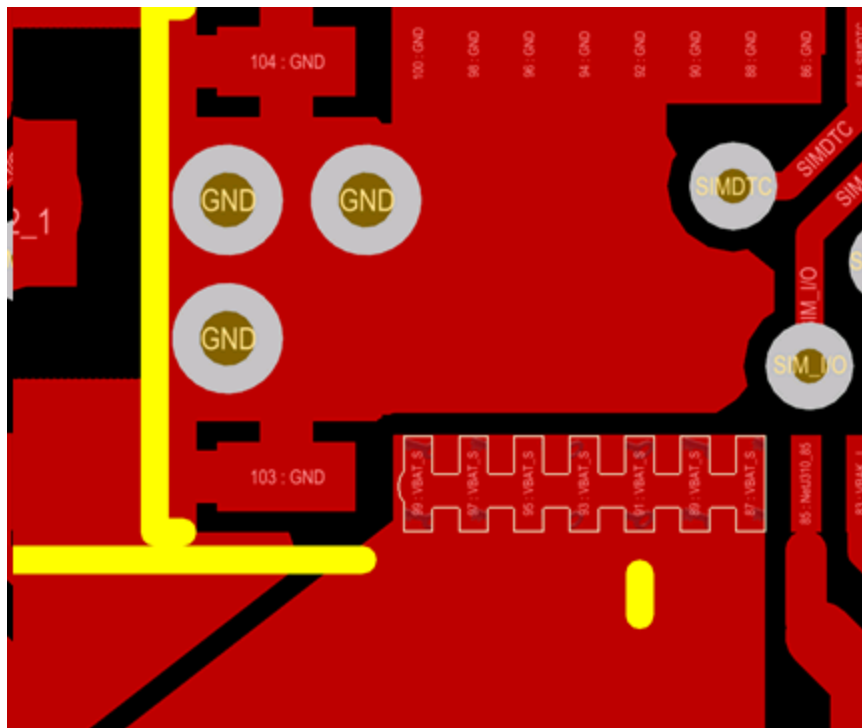


Figure 4-5 Example of GOOD  $V_{BAT}$  layout

## Audio Reference Design

The audio quality is dependent on the circuit design and layout. As an aid to obtaining good audio quality, we included a reference design below.

# Audio Schematics

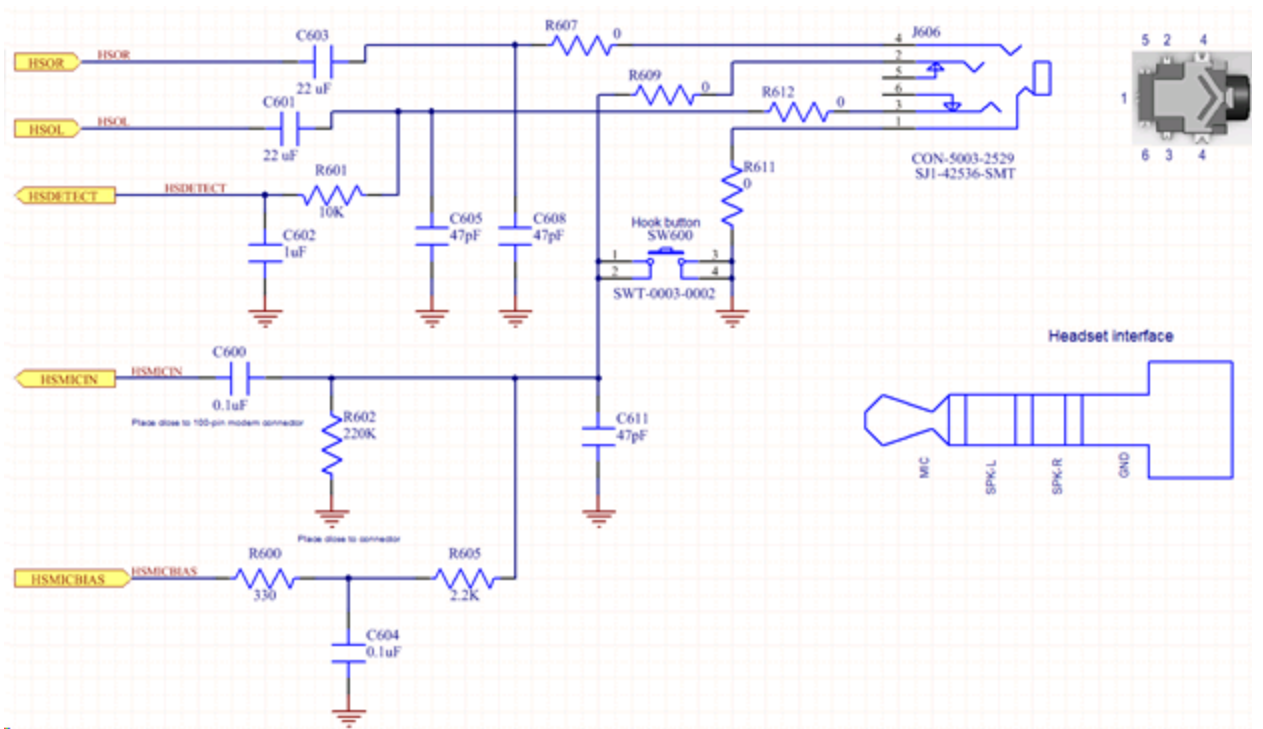
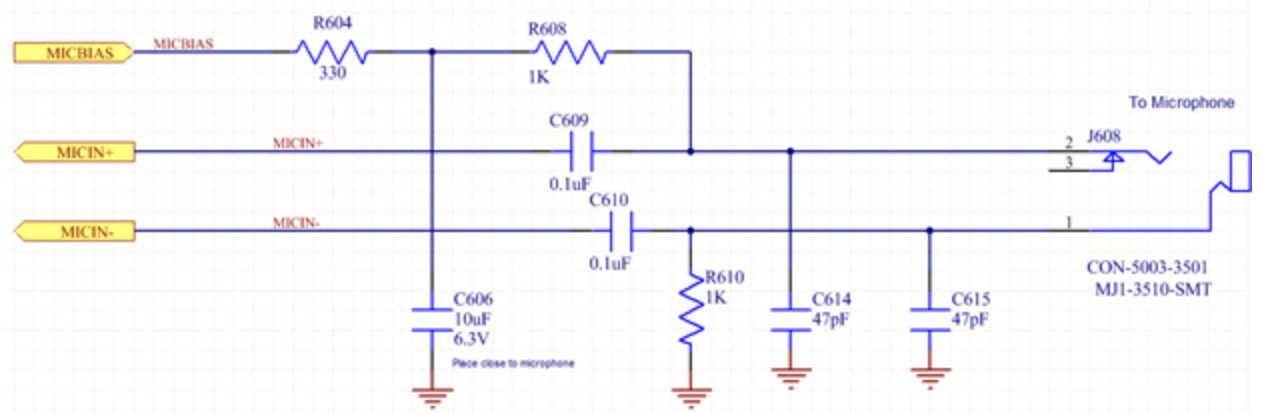
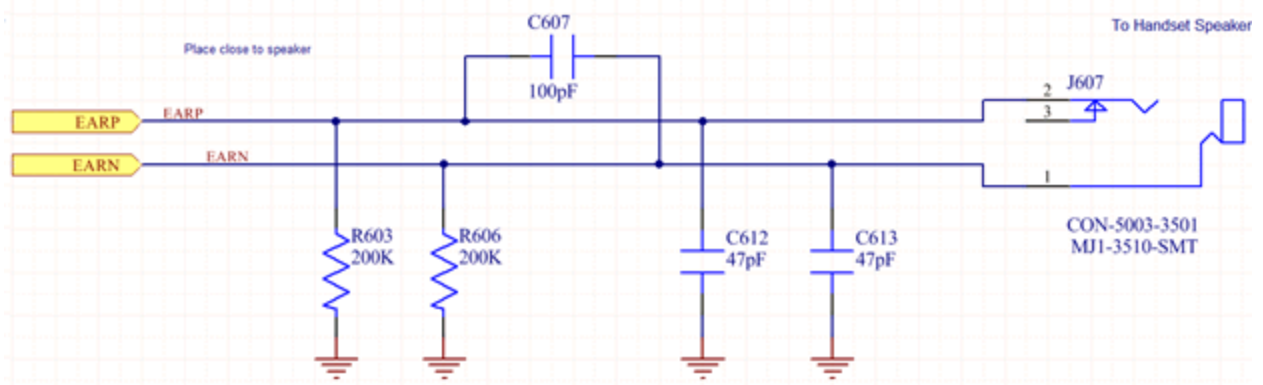


Figure 4-6 Audio Reference Design Schematic

# Control Connector Signal Descriptions And Functions

Unless otherwise noted in the following sections, all digital signals will reference the following specifications:

Parameter	Parameter/Conditions	Comments	MIN	TYP	MAX	UNIT
V <sub>IH</sub>	High level Input voltage		1.17		1.83	V
V <sub>IL</sub>	Low level Input voltage		-0.3		0.63	V
V <sub>SHYS</sub>	Schmitt hysteresis voltage		15			mV
I <sub>L</sub>	Input leakage current	V <sub>DDX</sub> = Max V <sub>IN</sub> = 0 V to V <sub>DDM</sub>			200	nA
V <sub>OH</sub>	High level output voltage	I <sub>OUT</sub> = I <sub>OH</sub>	1.35		1.8	V
V <sub>OL</sub>	Low level output voltage	I <sub>OUT</sub> = I <sub>OL</sub>	0		0.45	V
I <sub>OH</sub>	High level output voltage		3			mA
I <sub>OL</sub>	Low level output voltage	CMOS, at pin rated drive strength			3	mA
C <sub>IN</sub>	Input Capacitance				5	pF

## Module Power (PINS 87, 89, 91, 93, 95, 97, 99)

The HS 3001 module uses a single voltage source of V<sub>CC</sub> = +3.4 V to 4.4 V.

VBAT	Parameter/Conditions	Min (mA)	Typ (mA)	Max (mA)	Units
Main Battery Supply	Voltage In Regulation	3.4		4.4	Vdc
Peak Current	1000 µF on Host at Module Connector		600mA	680mA	mA



The uplink burst will cause strong ripple on the voltage lines and should be filtered effectively. We recommend that 1000 µF of capacitance be placed as close to the modem I/O connector 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.

## Modem Power-on And Recovery Techniques

The HS 3001 provides module integrators with improved modem power-on and recovery techniques, while maintaining backwards compatibility to Enabler IIIG integrations. The addition of an internal power switch and an input power-on logic select pin allows users the flexibility to maintain backwards compatibility or select different power-on options. This internal power switch also allows integrators the flexibility of not supplying an external power switch. Pin 37, previously a reset pin, has been replaced with a device power ON/OFF pin. This pin controls the internal power switch.

Pin 85 (PSLOGIC) allows users to select the default behavior of the ON/OFF control (Pin 37). Once power is applied via the internal power switch, Pin 35 (PON) is used like a phone on/off switch.

### Power Switch Logic Detect (Pin 85)

Pin 85 is a hardware input pin used to determine the functionality of the ON/OFF pin (Pin 37). If Pin 85 is tied to VBAT, Modem ON/OFF (Pin 37) defaults to high when open circuit, and the modem power switch will be ON. If Pin 85 is left open, Modem ON/OFF (Pin 37) defaults to low when open circuit and the modem will be OFF (requires ON/OFF to be driven high to power on).



We do not recommend externally connecting Pin 85 to ground.

---

### ON/OFF (PIN 37)

Pin 37 is the ON/OFF control input for the modem's internal power switch. When it is high, the modem's power switch will be ON. When it is low, the modem power will be OFF.

In order for the device to power on, pin 35 must be tied low or pulled low after power has been applied. The device will not power on if it is left floating.



Pin 35 PON (Power On) is a signal input and is the normal method for turning the modem ON or OFF. However, Pin 35 cannot turn the modem on if Pin 37 is low, because the modem will not have power applied to it. `offdly=0` only affects the powering off of the device, not power on.

Parameter	Min	Typ	Max	Units
Enable Threshold Voltage	1.5		$V_{BAT}$	V
Enable Input Current	1.5			$\mu A$
Pulldown approximately $1M\Omega$ .				



The modem may not completely shut down/reset even with a mechanical power switch or this circuit implemented if the modem's I/O lines have another source of power that applies voltage to the modem.

To alleviate this situation, make sure that the interface circuitry is set to tri-state or as an input. If this is not possible, you may need additional hardware to shunt high impedance lines to ground during these situations.

The un-switched power source must be capable of supporting the inrush current required by the bulk capacitance. The enable switch can be soft-started via voltage ramp or modulation to reduce the peak current as needed.



**DO NOT USE** a Modem Power Switch as a routine shutdown or reset. This technique for shutting down the modem does not properly deregister the modem from the network. The carrier may impose penalties if a fleet of equipment does not routinely follow a proper deregistration process. If you wish to use this method routinely, you should gracefully detach from the network first. This can be done by sending `AT$OFF`.

## Phone On - PON (PIN 35)

This input signals the modem to start and is equivalent to a "phone power button".

A falling-edge on this Active-Low input will switch-ON or switch-OFF the module. The firmware controlled OFF function will deregister the modem from the network before shutting the modem OFF.

This input has a “weak pull-up” resistor internal to the module. If users want the modem to automatically come on when power is applied, they can tie this line low.

If RTC Sleep is required, then the PON line must be floated to allow the internal resistor to pull the line high.

Controlling the PON signal must only be performed by an open collector/open drain device. If controlling this signal from a microprocessor’s I/O pin, the PON can be pulled low when the I/O is configured to be an output and floated high by reconfiguring the pin to be an input.



The AT\$OFFDLY Command controls the OFF Delay. A value of 0 disables the PON line from turning the module off. 0 is the default value. To enable the module to switch-OFF via PON you must set AT\$OFFDLY to a value other than 0. The valid range is 100 to 1000 milliseconds.

## Internal Power Switch

The modem has an internal power switch that supplies the modem operating power when ON.

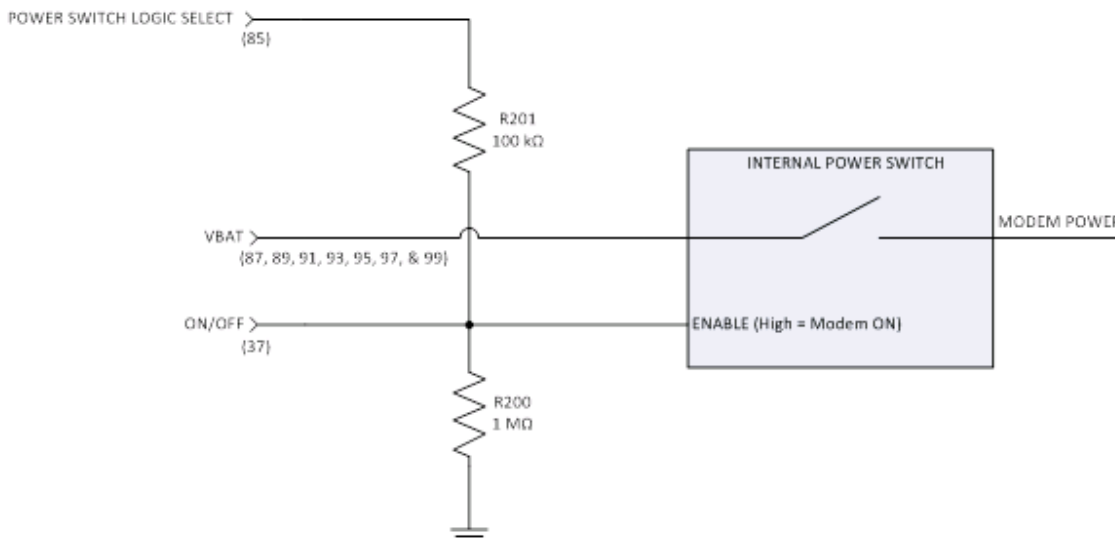


Figure 4-7 Internal Power Switch

## Voltage Reference - VREG\_MSME1.8 (PIN 77)

To be used as a voltage reference source ONLY. Do not connect current loads to this pin. When driving external circuitry, this pin should be decoupled to ground with at least a 0.1  $\mu$ F capacitor at the output. This pin can be left open if not driving external circuitry. Noise induced on this pin will affect the performance of the baseband.

## USB (PINS 1, 3, 5, 7)



As part of integrated products carrier certification, most carriers require access to the USB diagnostic port to control the module for testing. If the integrator has not already brought out the USB interface, it is recommended that the USB interface be routed to test points on the device, at a minimum. It will be acceptable to temporarily wire a USB connector for purposes of testing during carrier certification.

### 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	3.4	3.6	Vdc
	Low	0.0	0.1	0.3	Vdc
Transceiver D+/- Leakage Current		-2		2	$\mu$ A



USB D+/- should be routed differentially for 90 ohms impedance. Take care not to route the USB near sensitive circuitry.

## General Purpose Input/Output Interface

GPIO number	Pin number
GPIO 1	64
GPIO 2	62
GPIO 3	60
GPIO 4	58
GPIO 5	68
GPIO 6	70



GPIO number	Pin number
GPIO 7	66
GPIO 8	72

Each general-purpose signal may be selected as inputs or outputs. The GPIOs can be used independently as a user-specified function.

### Digital I/O Specifications -Baseband Functions

Parameter	Comments	Min	Typ	Max	Units
$V_{IH}$	High level input voltage	CMOS / Schmitt	1.17	1.83	V
$V_{IL}$	low level input voltage	CMOS / Schmitt	-0.3	0.63	V
$V_{SHYS}$	Schmitt hysteresis voltage		100		mV
$I_{IH}$	Input high leakage current 1 2	No pull-down		1	$\mu A$
$I_{IL}$	Input high leakage current 1 2	no pull-up	-1		$\mu A$
$I_{IHPD}$	Input high leakage current 1	with pull-down	3	30	$\mu A$
$I_{ILPU}$	Input high leakage current 2	with pull-up	-30	-3	$\mu A$
$V_{OH}$	High level votage	CMOS, at pin rated drive strength	1.35	1.80	V
$V_{OL}$	Low level votage	CMOS, at pin rated drive strength	0	0.45	V
$I_{OZH}$	3 State leakage current 2	Logic high output		1	$\mu A$
$I_{OZL}$	3 State leakage current 2	Logic low output	-1		$\mu A$
$I_{OZHDP}$	3 State leakage current 2	Logic high output with oull down	3	30	$\mu A$
$I_{OZLPU}$	3 State leakage current 2	Logic high output with pull-up	-30	-3	$\mu A$
$I_{OZHKP}$	3 State leakage current 2	Logic high output with keeper	-20	-3	$\mu A$
$I_{OZLKP}$	3 State leakage current 2	Logic high output with keeper	3	20	$\mu A$
$C_{IN}$	Input Capacitance			7	pF

## 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 the HS 3001 AT command manual for details.

## Serial Interfaces And Handshake (Pins 11, 13, 15, 17, 19, 21, 23, 25)

The pin naming for TX/RX/RTS/CTS/DTR/DSR/DCD/RI is referenced as a DCE. The DTE device should match their input pins to the Novatel Wireless M2M outputs and vice-versa. Additionally, there are AT commands that may need to be executed in order to ensure proper operation. See the chart below.

9 way D Connector Pin Number	Signal	Signal Direction	Novatel Wireless M2M Pin Number	Novatel Wireless M2M AT Command
1	Carrier Detect (CD)	from DCE	19	AT&C
2	Receive Data (RD)	from DCE	15	
3	Transmit Data (TD)	from DTE	21	
4	Data Terminal Ready (DTR)	from DTE	17	AT&D
5	Signal Ground	both		
6	Data Set Ready (DSR)	from DCE	25	
7	Request To Send (RTS)	from DTE	11	AT+IFC
8	Clear To Send (CTS)	from DCE	13	AT+IFC
9	Ring Indicator (RI)	from DCE	23	

The key features of the UART1 in the modem mode are as follows:

- 16C750 compatibility
- Baud rates: 300,600,1200,2400,4800,9600,19200,38400,57600,115200,230400
- Supported data format:
  - Data bit: 8 bits
  - Parity bit: none
  - Stop bit: 1 bit
- Hardware flow control RTS/CTS

The HS 3001 module is designed to be used like a DTE device.

Default settings are 8 data, 1 stop, no parity, and 115200. RTS and CTS may be used for hardware handshaking. DTR may be used to force the modem into AT command mode from online data mode (See AT Command Document, command AT&D). The serial interface is 1.8 V logic. By default, hardware handshaking (AT+IFC) is disabled. If the integrator does not wish to use flow control, disable hardware flow control in the modem using the AT+IFC command.

For a minimal Serial implementation use the following configuration:

- Connect RxData (pin 15) and TxData (pin 21) to the COM port serial data lines.
- Set AT+IFC=0,0 to disable flow control.

Notes:

- Tying DTR (pin 17) and RTS (pin 11) to ground to “spoof” flow control will cause the modem to draw more current.
- We do not recommend leaving DTR (pin 17) and RTS (pin 11) unconnected. If you are not going to use these signals, do one of the following:
  - Pull up DTR (pin 17) and RTS (pin 11) through a 100K resistor; or
  - Tie RTS (pin 11) to CTS (pin 13), and tie DTR (pin 17) to DSR (pin 25) on the modem to loopback the signals.

## UART 2 (Pins 27, 29)

UART2 supports RX and TX only.

Signal	Min	Max
VIH - High-level input voltage	1.85V	3.15V
VIL - Low-level input voltage	-0.3V	0.95V
VOH - High-level output voltage	2.35V	2.85V
VOL - Low-level output voltage	0V	0.45V

## Digital Audio Interface (Pins 12, 14, 16, 18)

This port is only available in Master mode and to be used for PCM digital audio. Below are the settings for

configuring its operation and the interface specification:

### Digital Audio Configuration

The default settings for the digital audio are:

- Mode = Master
- MCSI\_CLK = 2.048 MHz
- Word Size = 16 Bits
- Sync Pulse = 8 KHz
- Frame mode = burst
- Clock edge Sync = rising edge

The following command is required to set the unit up in digital audio mode:

```
AT$voicepth=2
```

This configures the module to use digital audio instead of analog audio.

### 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.

Pin Name	Pin Number	Signal Direction	Description
PCM_RX	12	I	Serial Data Input
PCM_TX	18	O	Serial Data Output
PCM_CLK	14	IO	Serial Clock I/O
PCM_FSYNC	16	IO	Frame Synchronization I/O

## 32 KHz Output (PIN 56)

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.

Parameter	Comments	Min	Typ	Max	Units
Oscillation frequency			32.765		kHz
Duty Cycle		45	50	55	%
Jitter					
Cycle to cycle period				50	ns
				10	ns

## Analog-to-Digital Inputs (PIN 44 And 74)

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

### ADC Specifications

Parameter	Min	Typ	Max	Units	Comments
Resolution					10-bit
Full scale error			2.5%		
Number of input channels		2			
Full scale input range	GND		1.8	V	
Input resistance		1.5		kΩ	S/H resistance
Input capacitance		12.4		pF	S/H capacitor

## Handset Microphone Input (PINS 65, 67)

Parameter	Test Conditions	Min	Typ	Max	Units	Notes
Full scale input voltage	voltage across either MIC 1P and MIC1N, MIC2P and MIC2N	0.89	1.00	1.12	Vrms	± 1dB level error
Input impedance	Difference input impedance	16	20	24	kΩ	
Input impedance	Single ended input impedance	8	10	12	kΩ	
Input offset voltage		5		5	mV	
Input capacitance	At each pin of all inputs			5	pF	

## Handset Microphone BIAS Output (PINS 53, 63)

Parameter	Comments	Min	Typ	Max	Units
MIC bias output voltage			1.8		V
MIC bias output current				1.5	mA
MIC bias voltage accuracy	Minimum load	-3		+3	%
MIC bias output voltage load regulation				30	Ω

## Handset Speaker Output (PINS 71, 73)

Parameter	Test Conditions	Min	Typ	Max	Units	Notes
DAC to EAROP/EARON full-scale output	f = 1.02 Hz, 0 dBm	1.11	1.25	1.40	Vrms	± 1 dB level error
EAROP/EARON output power, 4% or less THD+N	f = 498 Hz, 0 dBm	38.5	48.8	61.3	mW	22 to 20 kHz measurement BW
Output DC level, EAR1OP and EAR1ON with respect to VSS	Input = .999 dBm	1.03	1.05	1.07	V	

## Headset Microphone Input (PIN 55)

Parameter	Test Conditions	Min	Typ	Max	Units	Notes
Full scale input voltage	voltage across pin 55 and ground	0.89	1.00	1.12	Vrms	± 1dB level error
Input impedance	Single ended input impedance	8	10	12	kΩ	
Input offset voltage		5		5	mV	
Input capacitance	At each pin of all inputs			5	pF	

## Headset Speaker Output Left And Right (PINS 57, 59)

Parameter	Test Conditions	Min	Typ	Max	Units	Notes
Both modes - HPH_LP and HPH_RN configured single ended, analog volume control = 0 dB						
DAC to HPH_LP and HPH_RN fullscale output	f = 1.02 kHz, 0 dBm	0.531	0.595	0.668	Vrms	
Output DC level, HPH_LP and HRH_RN wih respect to VSS	Input = 0.999 dBm	1.03	1.05	1.07	V	
Output impedance				0.5	$\Omega$	
Voice Mode - HPH_LP and / or HPH_RN configured single ended, analog volume control = 0 dB						
HPH_LP and HPH_RN output power, 4% or less THD+N	f = 1.02 kHz, 0 dBm	17.6	22.1	27.9	mW	22 to 20 kHz measurement bandwidth
DAC to HPH_LP and HPH_RN output noise level	Input = 0.999 dBm, Fs = 8 kHz or 16 kHz, A-weighted			106	$\mu$ Vrms	
Both modes - HPH_LP and HPH_RN configured differential (HPH_LP/HPH_RN), analog volume control = 0 dB						
DAC to HPH_LP and HPH_RN fullscale output	f = 1.02 kHz, 0 dBFS, 32 $\Omega$ load	1.06	1.19	1.34	Vrms	
DAC to HPH_LP/HPH_RN gain error relative to gain @ -3 dBFS	f = 1.02 kHz, -60 dBFS	-1.2		1.2	dB	Linearty spot check
Output DC level, HPH_P and HPH_N with respect to VSS	Input = .999 dBFS	1.03	1.05	1.07	V	
Output impedance				1.0	$\Omega$	
Voice Mode - HPH_LP and / or HPH_RN configured differential (HPH_LP/HPH_RN), analog volume control = 0 dB						
HPH_LP/HPH_RN output power, 4% or less THD+N	f = 498 Hz, -3 dBFS, 32 $\Omega$	17.6	22.1	27.9	mW	22 to 20 kHz measurement bandwidth
DAC to HPH_LP/HPH_RN output noise level	Input = 0.999 dBFS, Fs = 8 kHz, A-weighted			212	$\mu$ Vrms	22 to 20 kHz measurement bandwidth

## Headset Detect (PIN 47)

The headset detect signal is an active low signal. The signal is low when a headset is inserted.

## 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. Only the USB port has onboard ESD/transient protection. We do not recommend using additional external transient protection for this port as it will cause too much capacitance on the lines.

Generally, ESD protection (typically TVS/Transzorb devices) should be added to all signals that leave the host board. This includes VBAT/VCC.

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



It is your responsibility to protect the module from electrical disturbances and excursions that exceed the specified operating parameters.

---

# 5

## USB Driver Installation

---

USB Driver Installation (Windows XP)

USB Driver Installation (Windows 7)



# USB Driver Installation (Windows XP)

These instructions illustrate how to correctly install the USB drivers in Windows XP using the Novatel Wireless M2M Driver Setup Utility.

1. Run the Novatel Wireless M2M Driver Setup Utility by double-clicking the **Novatel Wireless M2MDriverSetup** executable file.



The Novatel Wireless M2M Driver Setup Utility Extraction window opens.

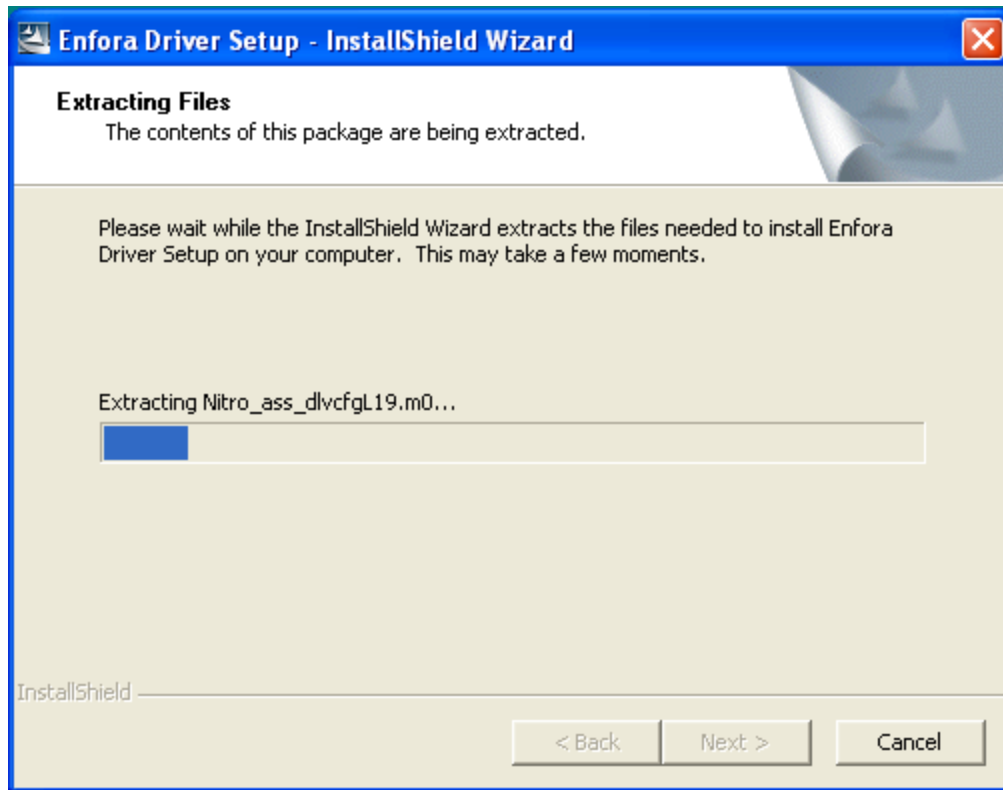


Figure 5-1 Novatel Wireless M2M Driver Setup Utility Extraction

Once the contents have been extracted to memory, the Welcome Window opens.

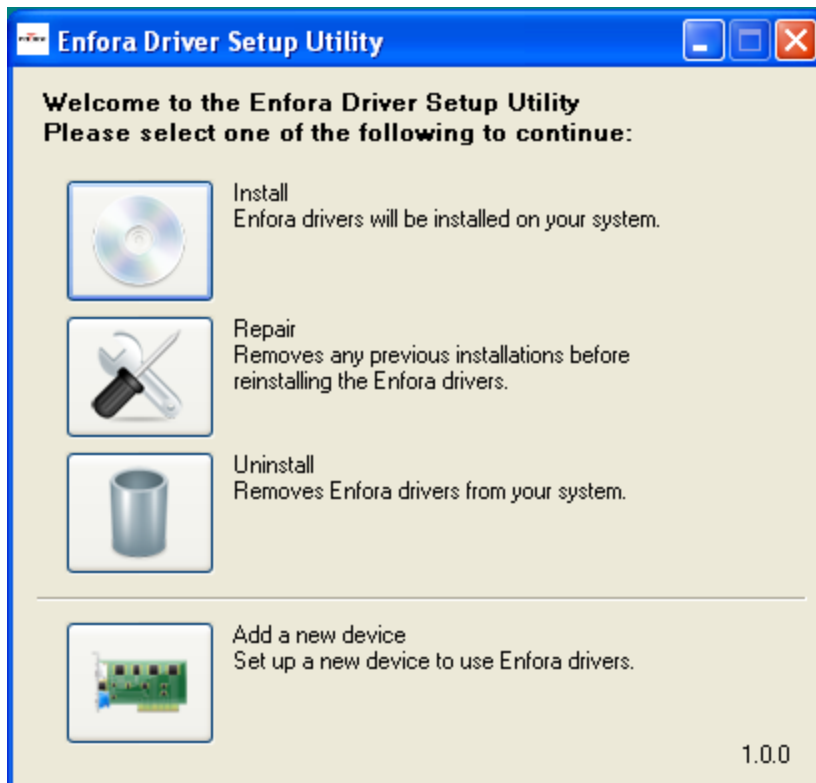


Figure 5-2 Novatel Wireless M2M Driver Setup Utility Welcome

2. To install the drivers, select **Install**.

The Novatel Wireless M2M Driver Setup Utility Window opens.

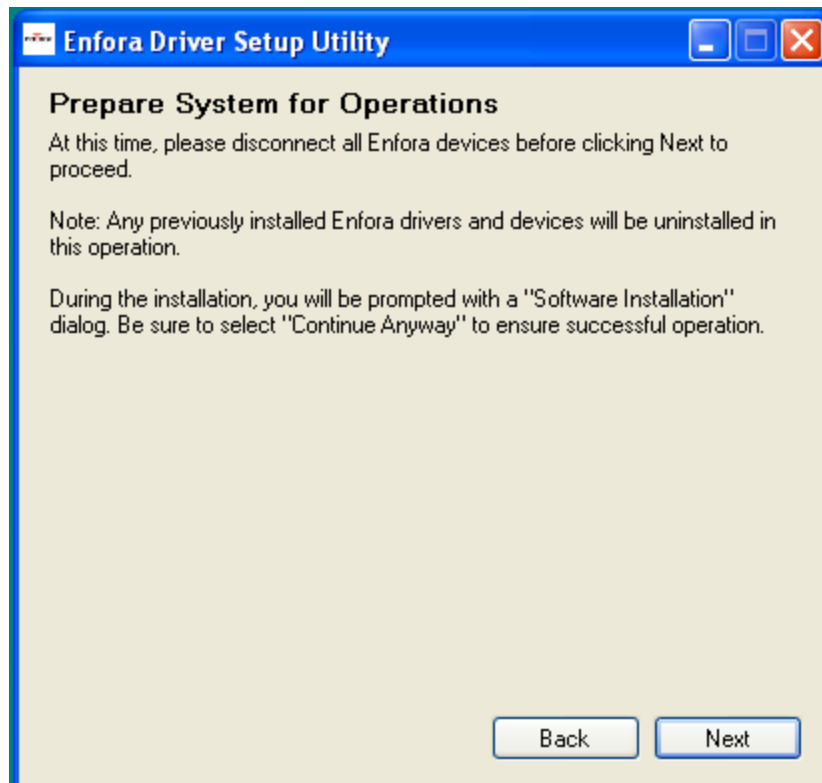


Figure 5-3 Novatel Wireless M2M Driver Setup Utility Prepare System Window

3. Select **Next** to continue.

The Novatel Wireless M2M Driver Setup Utility Installation Window opens while the system installs the drivers.

4. Disconnect any Novatel Wireless M2M devices.

Previous drivers will be removed during this phase.



During the installation, your computer's display may freeze and appear non-responsive. If this occurs, allow the computer to continue working. After 2-3 minutes, the display and installer will resume normal behavior.

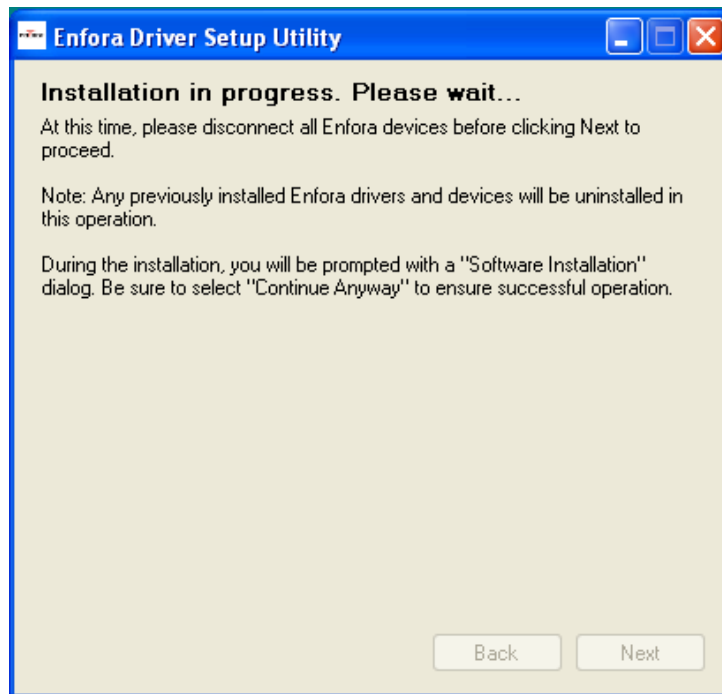


Figure 5-4 Novatel Wireless M2M Driver Setup Utility Installation Window

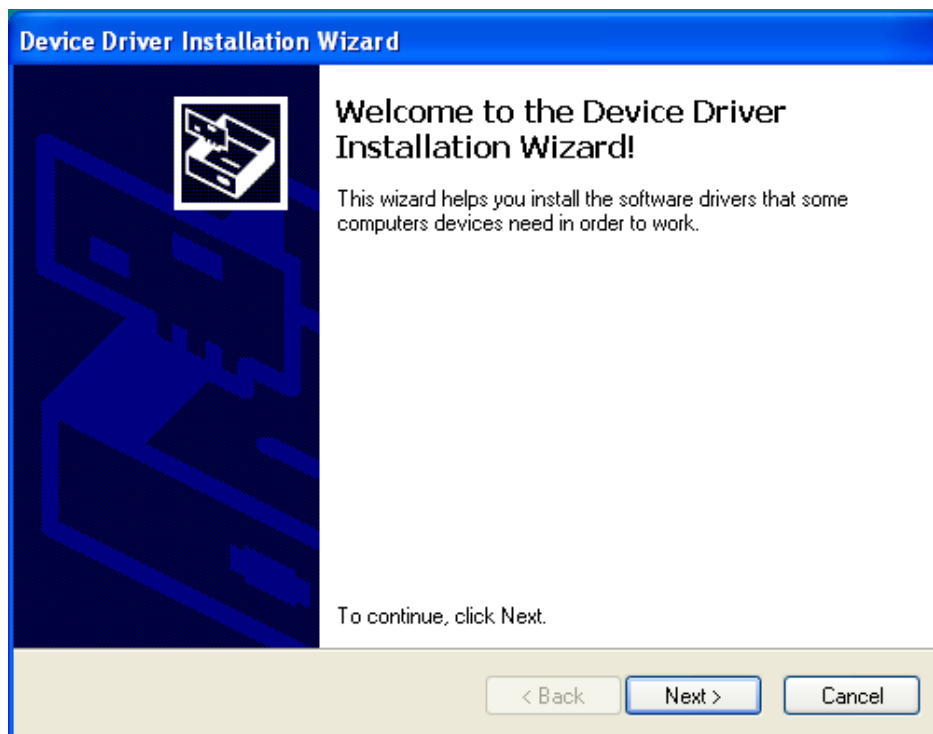


Figure 5-5 Novatel Wireless M2M Driver Setup Utility Driver Installation

5. When prompted to install the device driver, select **Next**.

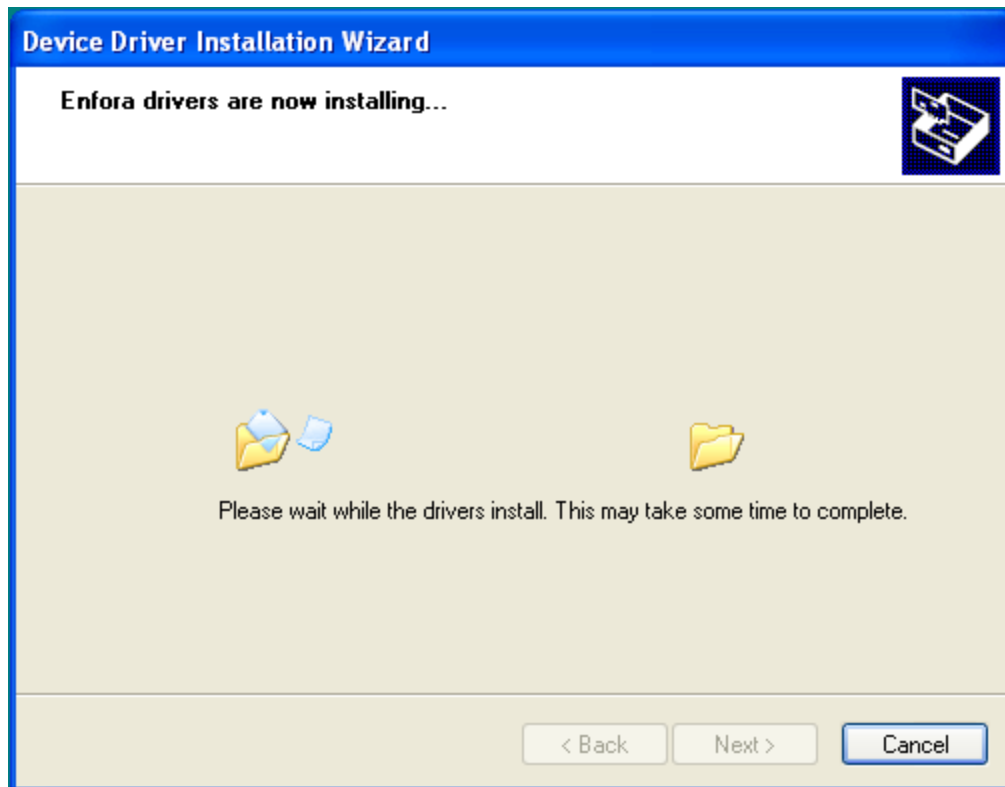


Figure 5-6 Novatel Wireless M2M Driver Setup Utility Driver Installation Progress

You may see the following warning message:



Figure 5-7 Windows Security Window

6. Click **Continue Anyway**.

When installation of the USB drivers is complete, the Completion window opens.

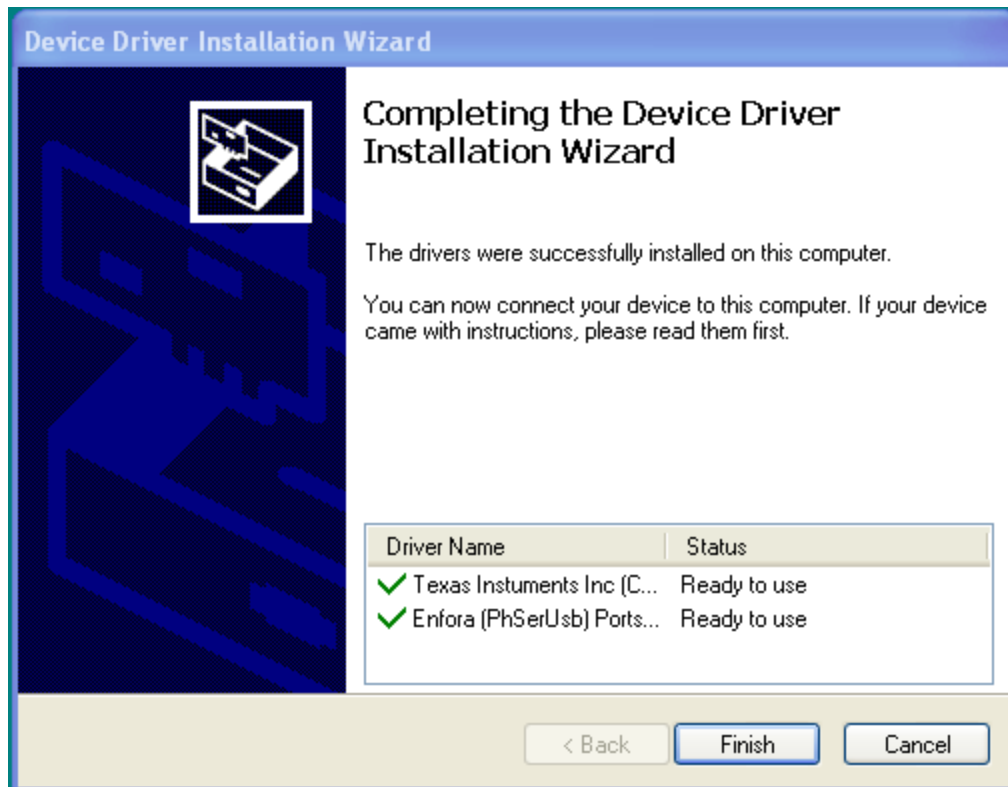


Figure 5-8 Novatel Wireless M2M Driver Setup Utility Driver Install Completion Window

7. Click **Finish**.

When the installation is complete, the list of attached devices will appear within the Attached Devices Window.



Figure 5-9 Novatel Wireless M2M Driver Setup Utility Attached Devices Window

## USB Driver Installation (Windows 7)

These instructions illustrate how to correctly install the USB drivers in Windows 7 using the Novatel Wireless M2M Driver Setup Utility.

1. Run the Novatel Wireless M2M Driver Setup Utility by double-clicking the **Novatel Wireless M2MDriverSetup** executable file.



The Novatel Wireless M2M Driver Setup Utility Welcome window opens.

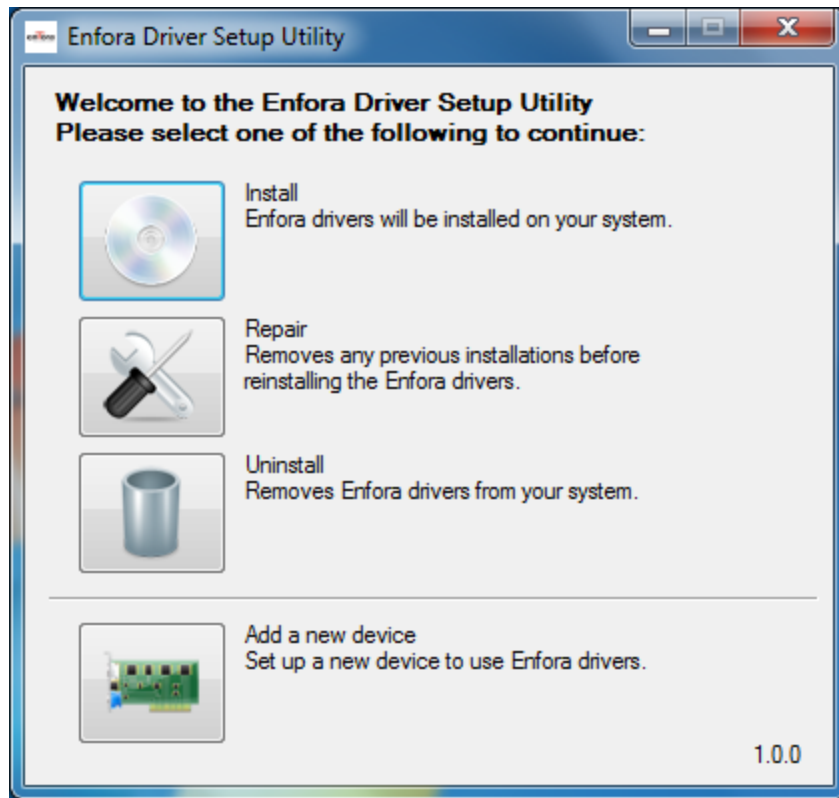


Figure 5-10 Novatel Wireless M2M Driver Setup Utility Welcome Window

Once the contents have been extracted to memory, the Driver Setup Window opens.



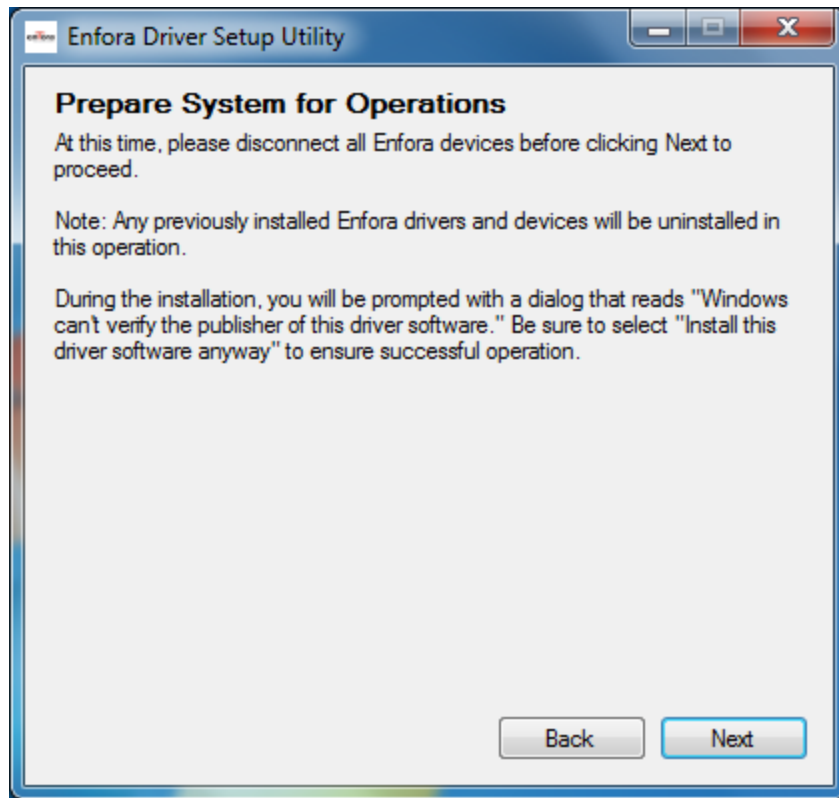


Figure 5-11 Novatel Wireless M2M Driver Setup Utility Preparation Window

2. To install the drivers, click **Install**.

The Novatel Wireless M2M Driver Setup Utility Prepare System Window opens.

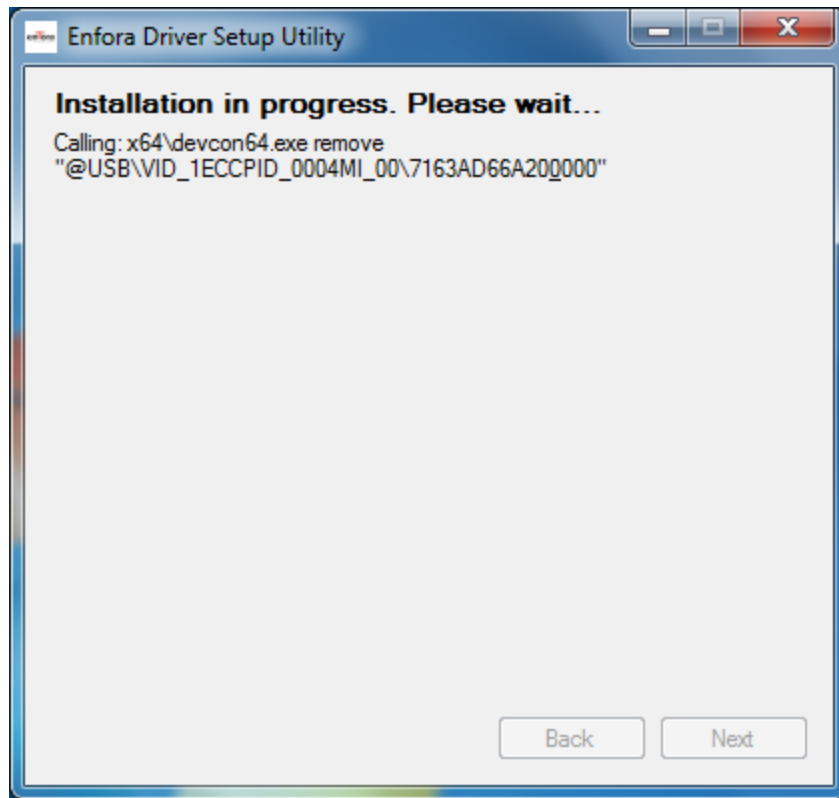


Figure 5-12 Novatel Wireless M2M Driver Setup Utility Installation Window

3. Select **Next** to continue.

The Novatel Wireless M2M Driver Setup Utility Installation Window opens while the system installs the drivers.

4. Disconnect any Novatel Wireless M2M devices.

Previous drivers will be removed during this phase.



During the installation, your computer's display may freeze and appear non-responsive. If this occurs, allow the computer to continue working. After 2-3 minutes, the display and installer will resume normal behavior.

---

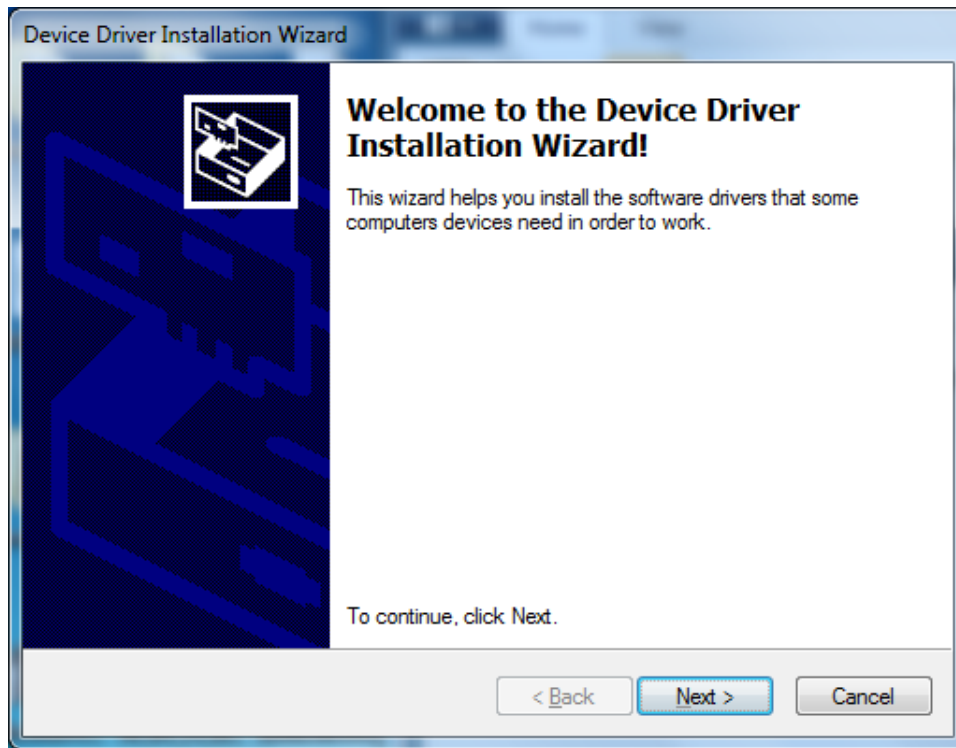


Figure 5-13 Novatel Wireless M2M Driver Setup Utility Driver Installation

5. When prompted to install the device driver, select **Next**.

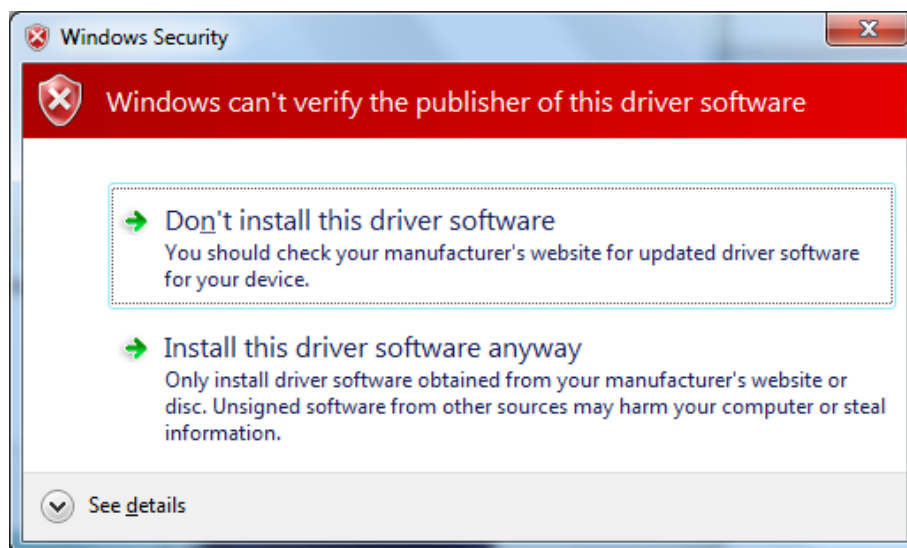


Figure 5-14 Windows Security Window

6. Select **Install this driver software anyway**.

During the driver install phase, you may be prompted to continue or stop installation due to potential compatibility issues.

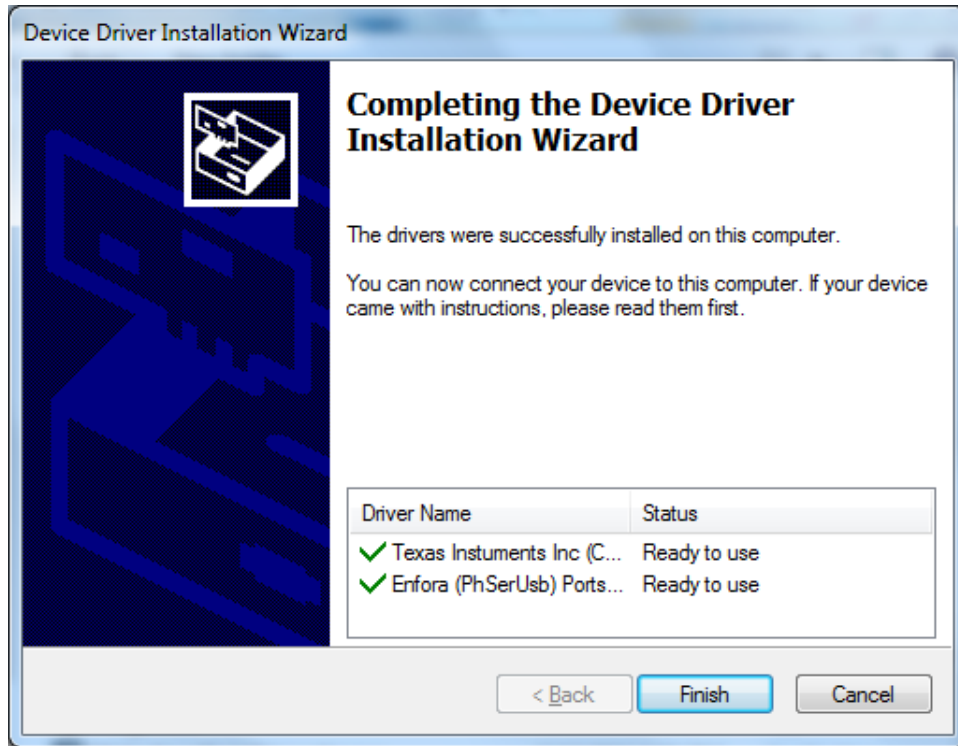


Figure 5-15 Novatel Wireless M2M Driver Setup Utility Driver Install Completion Window

When installation of the USB drivers is complete, the Completion window opens.

7. If there are no errors, click **Finish**.
8. If the status displays an issue, click **Correct issues!**
9. At the "OK to apply fix" prompt, click **Yes**.

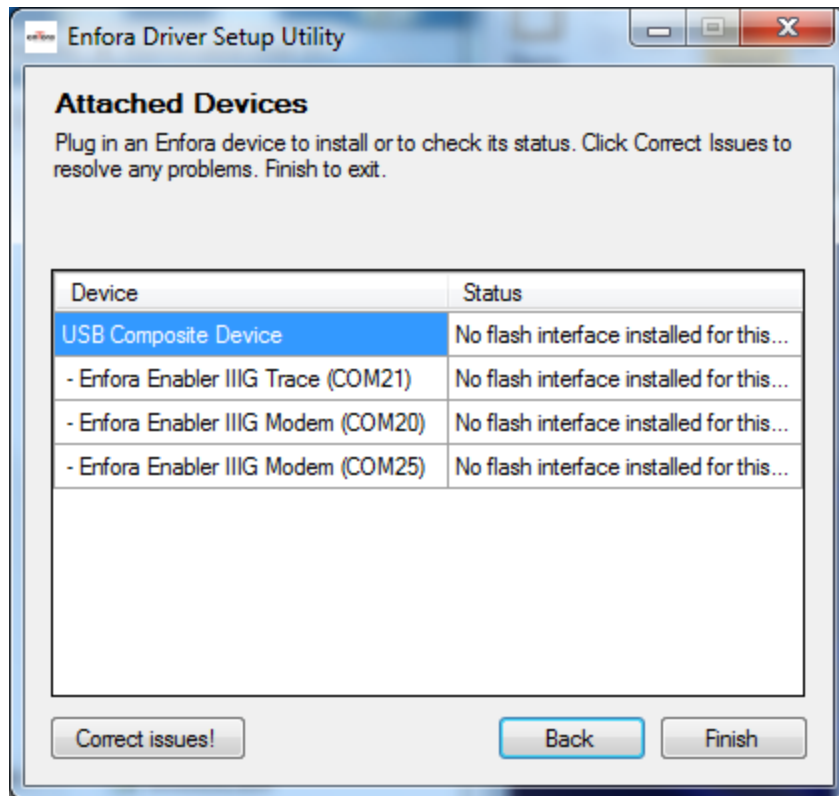


Figure 5-16 Novatel Wireless M2M Driver Setup Utility Attached Devices Window

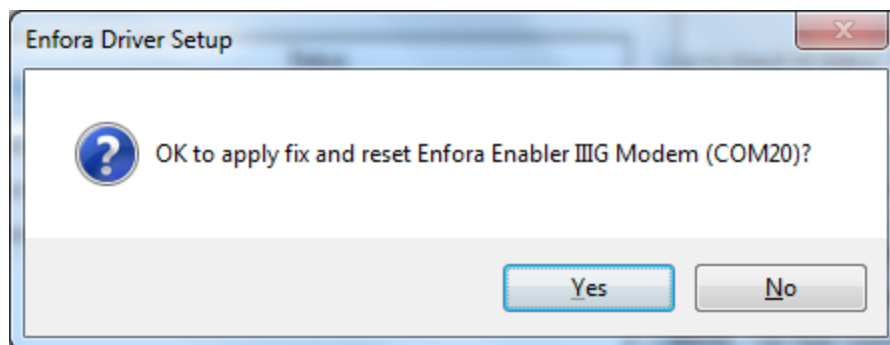


Figure 5-17 Novatel Wireless M2M Driver Setup Utility Apply Fix Window

When the installation is complete, the list of Attached Devices appears within the Novatel Wireless M2M Driver Setup Utility Attached Devices window.

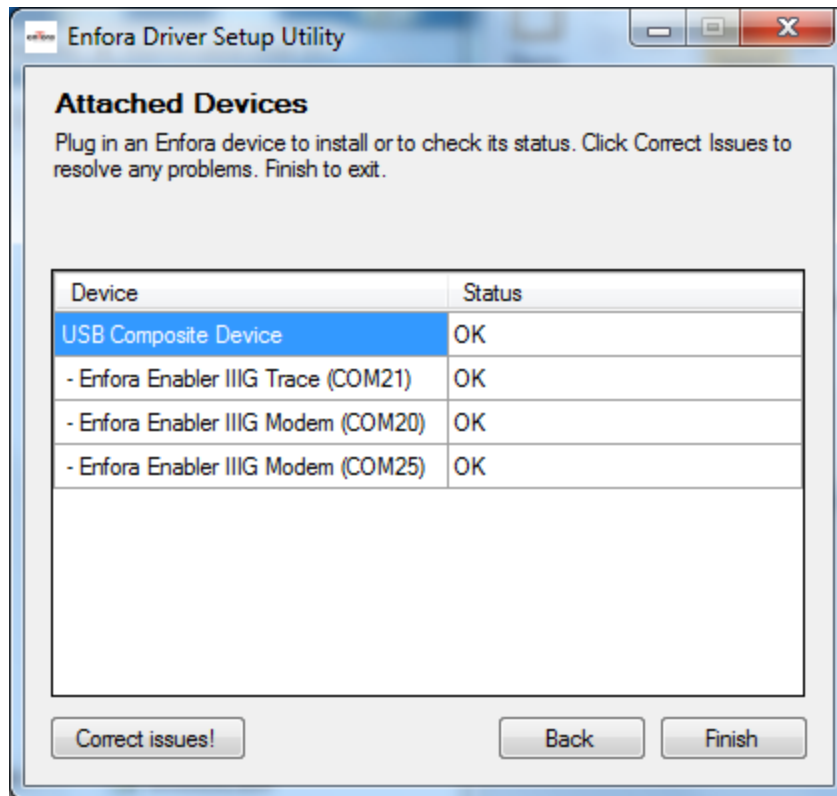


Figure 5-18 Novatel Wireless M2M Driver Setup Utility Attached Devices Window