G30 Hardware User Guide

1VV0300919 Rev.0 – 2011-05-04

Making machines talk.

APPLICABILITY TABLE

PRODUCT
G30

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1. Introduction

1.1. Scope

This manual provides the electrical, mechanical and environmental requirements for properly integrating the G30 module in a host application.
This manual gives a complete set of hardware features and functions that may be provided by G30. The availability of any feature or function, which is described in this manual, depends on the hardware revision and software version of a specific G30 model.
The parameters and values provided in this manual are defined under typical conditions. These values may vary when subject to different conditions, such as SW version, network status, application settings and environmental conditions.

1.2. Audience

This manual is intended for all members of the integration team who are responsible for integrating the G30 module into the host OEM device, including representatives from hardware, software and RF engineering disciplines.

1.3. Contact Information, Support

This section provides contact information for any possible queries that may arise, for example:

- Have questions?
- Having trouble getting the Developer Board set up?
- Technical questions?
- Configuration questions/problems?
- Technical operating problems?
- Need documentation?

For general contact, technical support, to report documentation errors and to order manuals, contact Telit Technical Support Center (TTSC) at:

TS-EMEA@telit.com
TS-NORTHAMERICA@telit.com
TS-LATINAMERICA@telit.com
TS-APAC@telit.com

Alternatively, use:

http://www.telit.com/en/products/technical-support-center/contact.php

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

http://www.telit.com

To register for product news and announcements or for product questions contact Telit Technical Support Center (TTSC).

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.3.1. Required Query Information

Every new call/problem report, directly from a Direct Customer or from a distributor, should be directed to the help desk email address noted previously. It is recommended to report each individual issue in a separate email. The following information is required when reporting a problem:

- Customer name and address
- Customer contact information for this request, including:
  – Name
  – Telephone
  – Fax number
  – Mobile number
  – Email address
- Product name (G30)
- Software version of the unit (ATI8 command) or model number
- PCB version (located on the PCB near the RF connector)
- Severity of the problem
- Problem description, including:
  – Operator name
  – Type of SIM card (for example, Test, Pre-paid, or 3v)
  – Setup Configuration (such as Developer Board, handset, host, connections, and so on)
  – Detailed scenario from startup
  – Log of all the commands and the responses, beginning from startup
- Answers to the following questions:
  – Was the same scenario tested on the Developer Board and the PC to reproduce the problem?
  – How many units do you have, and how many of them have this problem?
  – How often does the problem recur?

In addition to the information requested above, send the following AT commands and the HyperTerminal log with the responses:

- **AT+CMEE=2** // to get textual error message
- **AT+CPIN?** // to get SIM card status
- **AT+CREG?** // to see if the TXVR is registered to the network
- **AT+CSQ** // to get the signal strength (RX level)
- **AT+CGSN** // to read the IMEI number of the unit
- **ATI8I9** // to get the software version of the TXVR

- **AT+CMER=0,0,1,1** // to get messages and indicators from the handset display to the DTE

1.4. Testing a Standalone Unit

This section describes how to perform a G30 functionality test, whose purpose is to:

- Introduce the user to the G30
- Explain how to work with the G30 unit
- Describe how to evaluate basic G30 features

The test setup provides a wide platform through which a G30 unit can be evaluated. The specific test procedure described below covers only a few of the G30's many features. Using this setup, you can perform several additional tests on the G30.
The test is performed using two modems, one of which is the G30. The modems communicate with each other through a single computer, which also controls their operation.
The test requires knowledge about the operation of the G30 Developer's Kit, terminal applications and AT commands. Refer to relevant documentation for assistance.
To perform the test, you need the following:

- A G30 OEM cellular engine unit
- A G30 Developer's Kit
- A desktop or laptop computer, which includes:
  – A free serial communications port (RS232)
  – A connected and active line modem (internal or external)
  – A terminal application (such as HyperTerminal)

1.4.1. Test Setup

To Setup the G30 Test

Follow this procedure (see following figure) to set up your equipment before performing the test:

1. Verify that the computer you intend to use for the test is equipped with a working line modem

   You can use a second G30 unit instead of the line modem. When doing so, you must repeat the setup procedure that follows for the additional G30.

2. Set up the G30 and the Developer Board as described in "Initial Setup" in " Developer Board and Interfaces Description" in the "G30 Developer's Kit Guide"
3. Verify that the G30 has adequate reception from the local GSM network
4. Connect the Developer Board's RS232 port to the computer's serial port
5. Open a terminal application window (such as HyperTerminal) and configure it to operate with the serial port occupied by the **G30**
6. Open a second terminal window and configure it to operate with the serial port occupied by the **line modem**

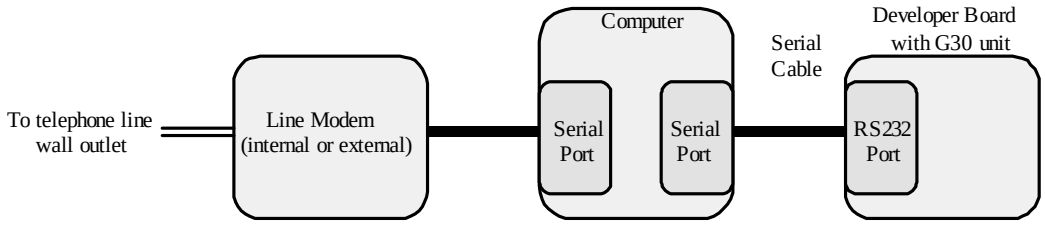

Figure 1-1: Test Setup

1.4.2. Test Procedure

To Perform the G30 Test

Follow the procedure below to perform the G30 test:

1. Verify that the line modem is functioning and communicating with the computer by entering the AT command **at** in the modem's terminal window

   This common AT command prompts a properly working modem to reply **OK**.

2. Verify that the G30 is functioning and communicating with the computer by performing the following AT commands in the G30 terminal window:

- **ati7 —** prompts G30 identification

  The G30 will reply **G30 OEM Module**.

- **ati8 —** prompts the G30 software version

3. Make a CSD call from the G30 to the line modem or the reverse using the **atd** and **ata** commands in the appropriate window
4. Verify that a connection between the two modems is established
5. Select any file to transfer between the two modems

   The file can be any existing file, or a new file created specifically for the test.

6. Send the file either from the G30, or to the G30, through the terminal application using the terminal application's send/receive file options
7. When the file transfer is complete, use the **ath** command in any of the terminal windows to terminate the call

   This step completes the test. You can now continue to perform additional tests using the same setup, or change the setup as required.

1.5. Document Organization

This manual contains the following chapters:

- **Chapter 1** — introduces the G30 unit and provides important safety instructions, support and contact information.
- **Chapter 2** — provides a detailed hardware description of the blocks and components comprising the G30.
- **Chapter 3** — provides a hardware interface description for G30 connectors.
- **Chapter 4** — provides electrical and environmental specifications.
- **Chapter 5** — provides mechanical specifications for G30.
- **Chapter 6** — provides acronyms, abbreviations and the document's revisions log.

1.6. Text Conventions

Danger – This information MUST be followed or catastrophic equipment failure or bodily injury may occur.

Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.

Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.7. Related Documents

- G30 Developer's Kit Guide
- G30 AT Commands Reference Guide

1.8. Regulatory Requirements

The Federal Communications Commission (FCC) requires application for certification of digital devices in accordance with CFR Title 47, Part 2 and Part 15. This includes MPE calculation. As the G30 modem is not a standalone transceiver but is an integrated module, the G30 cannot be tested by itself for EME certification. It is, however, the integrator's responsibility to have the completed device tested for EME certification.

CAUTION:

Unauthorized repairs or modifications could result in permanent damage to the equipment and void your warranty and your authority to operate this device under Part 15 of the FCC Rules.

1.9. Regulatory Statement (Safety)

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any cellular terminal or mobile incorporating the G30 module. Manufacturers of the cellular terminal are advised to convey the following safety information to users and operating personnel, and to incorporate these guidelines into all manuals supplied with the product. Failure to comply with these precautions violates safety standards of design, manufacture and intended use of the product. Telit assumes no liability for customer failure to comply with these precautions.

- G30 module must be powered by a Limited Power Source (LPS - as defined by EN-60950-1:2006 section 2.5)
- G30 module should not be assembled when voltage is supplied (applicable for 70 pin connector model only)
- G30 module must be operated at the voltages described in the technical documentation
- G30 module must not be mechanically nor electrically changed. Use of connectors should follow the guidance of the technical documentation
- G30 module is designed to meet the EMC requirements of EN 301 489-07
- When integrating the G30 module into a system, Telit recommends testing the system to EN 301 489-07
- You must not remove any label from the G30 module
- Systems using the G30 module are subject to mandatory EMC/RF/Safety (including EME) testing under R&TTE directive 1999/5/EC (to://www.newapproach.org/Directives/). Other directives, such, 2002/95/EC (RoHS), WEEE Directive 2002/96/EC should also apply to a system using the G30 module.

1.10. FCC Notice to Users

Telit has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment. See 47 CFR Sec. 15.21. 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. See 47 CFR Sec. 15.19(3).
If your mobile device or accessory has a USB connector, or is otherwise considered a computer peripheral device whereby it can be connected to a computer for purposes of transferring data, then it is considered a Class B device and the following statement applies:
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 the receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.

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.
(2) This device must accept any interference received, including interference that may cause undesired operation.

1.11. Precautions

Interface connector and some of the module circuits are not shielded. Be sure to take appropriate precautionary measures in order to avoid ESD while handling the module. ESD can damage the G30 modules. Integrators need to design ESD protection on all external interfaces.

1.12. Antenna and Transmission Safety Precautions

1.12.1. User Operation

Do not operate your unit when a person is within 8 inches (20 centimeters) of the antenna. A person or object within 8 inches (20 centimeters) of the antenna could impair call quality and may cause the phone to operate at a higher power level than necessary.

IMPORTANT:

The unit must be installed in a manner that provides a minimum separation distance of 20 cm or more between the antenna and persons and must not be co-located or operate in conjunction with any other antenna or transmitter to satisfy FCC RF exposure requirements for mobile transmitting devices.

To comply with the FCC RF exposure limits and satisfy the categorical exclusion requirements for mobile transmitters, the requirements described in the following section, "Antenna Installation", must be met.

1.12.2. Antenna Installation

- The antenna installation must provide a minimum separation distance of 20 cm from users and nearby persons and must not be co-located or operating in conjunction with any other antenna or transmitter.
- Antenna installation should be done by a professional installer and should meet all FCC requirements as given in FCC part 15.
- Combined cable loss and antenna gain
  - R&TTE requirements
    - 900 MHz GSM band: The combined cable loss and antenna gain must not exceed 4.08 dBi

- 1800 MHz DCS band: The combined cable loss and antenna gain must not exceed 9.47 dBi
- FCC requirements
  - 800 MHz cellular band: The combined cable loss and antenna gain must not exceed 2.85 dBi
  - 1900 MHz PCS band: The combined cable loss and antenna gain must not exceed 2.5 dBi

OEM installers must be provided with antenna installation instruction and transmitter operating conditions for satisfying RF exposure compliance.

1.12.3. Section 15.203 - Antenna Requirements

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

1.13. Standards

Electromagnetic Compatibility: Principles and Applications by David A Weston, published by Marcel Dekker, Inc., 270 Madison Avenue, New York, NY 10016 USA.
GSM 07.07 - prETS 300 916, Digital cellular telecommunication system (Phase 2+); AT command set for GSM Mobile Equipment (ME), Version 5.2.0 or higher, Reference RE/SMG-040707QR1.
GSM 07.05, Digital cellular telecommunication system (Phase 2+); Use of Data Terminal Equipment - Data Circuit terminating; Equipment (DTE-DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS), Version 5.3.0, August, 1997, Reference TS/SMG-040705QR2.
GSM 03.40, Digital cellular telecommunication system (Phase 2+); Technical realization of the Short Message Service (SMS) Point-to-Point (PP), Version 5.3.0, July 1996, Reference TS/SMG-040340QR2.
GSM 04.11 Digital cellular telecommunication system (Phase 2+); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface, Version 5.1.0, March 1996, Reference TS/SMG-030411QR.
GSM 03.38, Digital cellular telecommunication system (Phase 2+); Alphabets and language-specific information, Version 5.3.0, July 1996, Reference TS/SMG-040338QR2.
GSM 11.10-1, Digital cellular telecommunication system (Phase 2); Mobile Station (MS) Conformance specification; Part 1: Conformance specification. Draft pr ETS 300 607-1, March 1998, Reference RE/SMG-071110PR6-1.
GSM Specifications are orderable from Global Engineering Documents, 15 Inverness Way

East, Englewood, Colorado 80112-5704 USA 303-792-2181 800-624-3974.
ETSI Standard PCS - *11.10-1*.
GSM 02.30 Supplementary services.
GSM 03.90 USSD stage 2.
GSM 11.14 SIM toolkit.
ITU-T *V.25ter*
G30 AT Command Reference Guide,
ETSI standard SMG31.
GSM 05.02.
ETSI 07.60.
ETSI 0.7.07 Ver. 7.5.0.

1.14. General Safety

1.14.1. Remember!. . . safety depends on you!

The following general safety precautions must be observed during all phases of operation, service, and repair of the equipment described in this manual. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Telit assumes no liability for the customer's failure to comply with these requirements. The safety precautions listed below represent warnings of certain dangers of which we are aware. You, as the user of this product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

1.14.2. Ground the instrument

To minimize shock hazard, the equipment chassis and enclosure must be connected to an electrical ground. If the equipment is supplied with a three-conductor AC power cable, the power cable must be either plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter. The three-contact to two-contact adapter must have the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable must meet International Electrotechnical Commission (IEC) safety standards.

1.14.3. Do not operate in an explosive atmosphere

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

1.14.4. Do not service or adjust alone

Do not attempt internal service or adjustment unless another person, capable of rendering first aid is present.

1.14.5. Keep away from live circuits

Operating personnel must:

- not remove equipment covers. Only Factory Authorized Service Personnel or other qualified maintenance personnel may remove equipment covers for internal subassembly, or component replacement, or any internal adjustment
- not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed
- always disconnect power and discharge circuits before touching them

1.14.6. Do not substitute parts or modify equipment

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of equipment. Contact Telit for service and repair to ensure that safety features are maintained.

1.14.7. Dangerous procedure warnings

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed. You should also employ all other safety precautions that you deem necessary for the operation of the equipment in your operating environment.
Warning example:

WARNING:

Dangerous voltages, capable of causing death, are present in this equipment. Use extreme caution when handling, testing,
and adjusting.

1.15. Caring for the Environment

The following information is provided to enable regulatory compliance with the European Union (EU) Directive 2002/96/EC Waste Electrical and Electronic Equipment (WEEE) when using Telit equipment in EU countries.

1.15.1. Disposal of Telit equipment in EU countries

Please do not dispose of Telit equipment in landfill sites.
In the EU, Telit in conjunction with a recycling partner will ensure that equipment is collected and recycled according to the requirements of EU environmental law.
Please contact the Telit Technical Support Center (TTSC) for assistance.

1.15.2. Disposal of Telit equipment in non-EU countries

In non-EU countries, dispose of Telit equipment in accordance with national and regional regulations.

1.15.3. Turkey

1.15.3.1. Limitation of Liability

The Products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body; in other applications intended to support or sustain life; for the planning, construction, maintenance, operation or use of any nuclear facility; for the flight, navigation, communication of aircraft or ground support equipment; or in any other application in which the failure of the Product could create a situation where personal injury or death may occur. If CUSTOMER should use any Product or provide any Product to a third party for any such use, CUSTOMER hereby agrees that TELIT is not liable, in whole or in part, for any claims or damages arising from such use, and further agrees to indemnify and hold TELIT harmless from any claim, loss, cost or damage arising from such use.

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2. General Product Description

The G30 is the newest member of Telit's embedded cellular modules family.
Designed with quad band GSM capabilities, which supports four GSM bands - 850/900/1800/1900 MHz, and with GPRS multislot class 10, G30 can operate on any GSM/GPRS network to provide voice and data communications.
The G30 is similar to a condensed cellular phone core, which can be integrated into any system or product that needs to transfer voice or data information over a cellular network. Thus, it significantly enhances the system's capabilities, transforming it from a standalone, isolated product to a powerful high-performance system with global communications capabilities.
The G30 is designed as a complete GSM communications solution with all the controls, interfaces and features to support a broad range of applications:

- A powerful audio interface
- A large set of indicators and control signals
- Several advanced power-saving modes
- A variety of serial communications solutions.

All these features and interfaces are easily controlled and configured using a versatile AT command interface that provides full control over the G30 operation.
The G30 comes with several hardware configurations (models) that gives the development engineer the option to select the best cost effective solution for their application.
The hardware configuration is the combination of the following factors:

- User interface: 81 pin LGA interface for solder mounting, or 70 pin connector interface with screw mounting
- Memory: 64Mb/16Mb or 128Mb/32Mb Flash/PSRAM internal memory
- RF Interface: U.FL connector or SMT pad (part of the LGA module)
- SIM interface: External SIM card interface, or internal Embedded SIM (eSIM)

The G30 series was designed for Zero time, Zero effort integration, getting you to market faster than ever. The G30 features both an 81 pin LGA interface form factor and an optional 70-pin B2B connector for various design possibilities. The optional connectorized platform maintains the same mounting design as the award winning G24 module, so you can leverage the G30's rich feature set but remain with your connectorized design. The G30 Series also shares a unified software interface with the G24 family, including compatible AT commands and TCP/IP stacks.

2.1. Product Specifications

IMPORTANT:

For safety regulations and requirements, see "Regulatory Requirements", "Regulatory Statement (Safety)" and "Antenna and Transmission Safety Precautions" in "Introduction".

NOTE:

Telit reserves the right to change the specifications without prior notice.

Product Features	
Operating systems:	GSM 850/GSM 900 DCS 1800/PCS 1900
Physical Characteristics	
Size (with 3 mm connector):	24.4x40x.3.5mm
Mounting:	SMT (LGA module) or two Ø2.4 mm holes (70 pin connector interface model)
Weight:	<6 grams
Environmental	
Operational temperature:	-30°C to +85°C
Storage temperature:	-40°C to +85°C
Performance	
Operating voltage:	3.3 - 4.2 V
Current consumption:	In AT mode: < 1.6 mA @ DRX9 (Sleep mode)
Maximum Tx output power:	GSM 850/GSM 900: Power class 4 (33 ± 2dBm) DCS 1800/PCS 1900: Power class 1 (30 ± 2 dBm) GSM 850/GSM 900: GPRS 2 slot up (33 ± 2 dBm) DCS 1800/PCS 1900: GPRS 2 slot up (30 ± 2 dBm)
Interfaces	
Connectors:	81 pins LGA interface or via a single 70 pin connector RF U.FL or via SMT pads
SIM Card:	External SIM connectivity 1.8 V / 3.0 V SIM Card support Embedded SIM

Connectivity:	UART: BR from 2400 bps to 230400 bps Auto BR up to 230400 bps I^2C (Master, M2M Zone only): I2S or SPI (Master data logging only, AT command selection)
RTC supply:	RTC supply output/Backup voltage supply input
Reset:	External Reset input
Data Features	
GPRS:	Multislot Class 10 DL up to 85.6 Kbit/s UL up to 42.8 Kbit/s Mobile station class B CS1 to CS 4 supported Internal TCP/IP Embedded FTP
CSD:	CS data calls (Transparent / Non-Transparent) up to 9.6 kbps Modem type V.32, V.110
SMS:	MO/MT Text and PDU modes Cell broadcast (SMS CB) Reception of SMS during circuit-switched calls Reception of SMS via GSM or GPRS
Voice Features	
Telephony	
Digital/Analog audio	
Headset Mode	
Handset Mode	
Hands Free Mode	
Ringer Mode	Supporting Midi files
Vocoders	EFR/HR/FR/AMR

DTMF support	
Audio control:	Echo canceller, noise reduction, side tone and gain control, Tx / Rx digital filter control
GSM Supplementary Service	
Call Hold/Resume (CH)	
Call Waiting (CW)	
Multi-Party (MTPY)	
Call Forwarding (CF)	
Call Divert	
Explicit Call Transfer (ECT)	
Call Barring (CB)	
Call Completion to Busy Subscriber (CCBS)	
Advice of Charge (AoC)	
Calling Line Identification Presentation (CLIP)	
Calling Line Identification Restriction (CLIR)	
Connected Line Identification Presentation (COLP)	
Unstructured Supplementary Services Data (USSD)	
Network Identify and Time Zone (NITZ)	

Character Set	
GSM	GSM default alphabet (GSM03.38)
HEX	Character strings consist only of hexadecimal numbers from 00 to FF; e.g. "032FE6" equals three 8-bit characters with decimal values 3, 47 and 230; no conversions to the original ME character set shall be done
IRA	International Reference Alphabet (ITU-T T.50)
8859-1	ISO 8859 Latin 1 character set
UCS2	16-bit universal multiple-octet coded character set (USO/IEC10646); UCS2 character strings are converted to hexadecimal numbers from 0000 to FFFF. Only the strings found in quotation marks are UCS2 coded, the rest of commands or responses, remains in IRA alphabet
AT Command Set	
GSM 07.05	
GSM 07.07	
Legacy Motorola proprietary AT commands	

Table 2-1: G30 Product Specifications

2.2. Regulatory and Approvals

- R&TTE
- GCF
- FCC/CE
- PTCRB
- IC
- RoHS
- Anatel Brazil

2.2.1. European Union Directives Conformance Statement

Hereby, Telit declares that this product is in compliance with

- The essential requirements and other relevant provisions of Directive 1999/5/EC
- All other relevant EU Directives

The above gives an example of a typical Product Approval Number.

IMPORTANT:

The following paragraphs must be addressed by the integrator to ensure their host is in compliance to the G30 FCC grant and/or the FCC grant of the host device.

2.2.2. CFR 47 Part 15.19 specifies label requirements

The following text may be on the product, user's manual, or container.
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.

2.2.3. CFR 47 Part 15.21 Information to user

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

2.2.4. CFR 47 Part 15.105 Information to the user

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE:

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.

3. Hardware Interface Description

The following paragraphs describe in details the hardware requirements for properly interfacing and operating the G30 module.

3.1. Architecture Overview

The figure below illustrates the primary functional components of the G30.

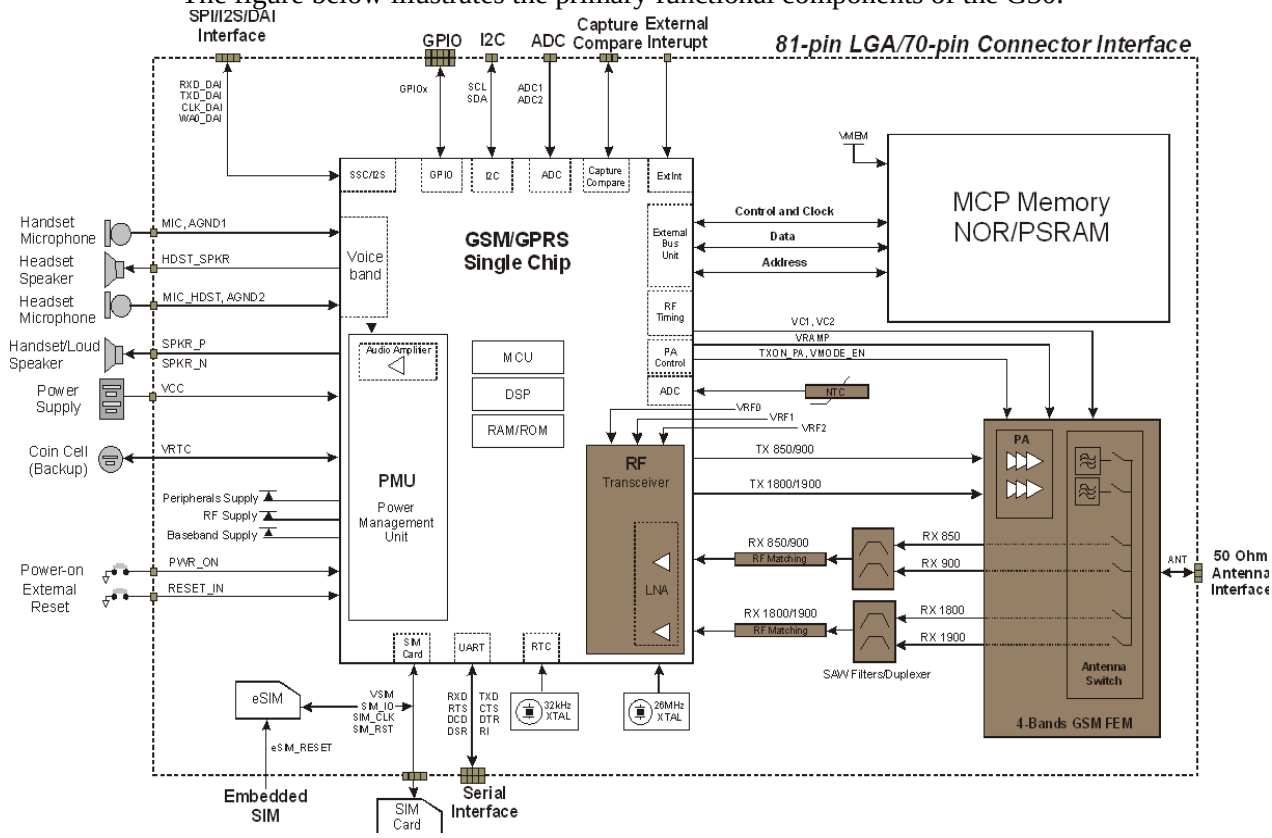


Figure 3-1: G30 Block Diagram

The G30 consists of the following blocks:

3.1.1. Baseband

The baseband IC is combined with the RF transceiver and the power management unit (PMU).
This chipset provides all baseband and low power RF band functionality for GPRS/GSM, and includes:

- Micro-controller Unit (MCU) for system and user code execution.
- Digital Signal Processor (DSP) for voice and data processing.
- Serial communications interfaces.
  - UART
  - SPI for data logging/I2S
  - SIM card
  - I^2C (via M2M Zone Platform)
- Power Management IC (PMIC).
  - Internal regulators
  - External VRTC regulator
  - Voltage reference (applies for 70 pin connector interface model only)
- Analog audio interface management.
  - Handset
  - Headset
  - Hands Free
- General purpose and dedicated A/D signals.
  - A/D
  - Voltage sensor
  - Temperature sensor
- Real Time Clock (RTC) subsystem.
- RF transceiver.

The G30 base band system provides all necessary interfaces for hardware or software designing and debugging, which are available by means of the 81 board to board pads or the 70 pin connector interface.

3.1.2. RF Block

The G30 RF section is designed with minimum discrete parts, making it more reliable.
The RF block consists of:

- RF Transceiver/Receiver block in the same single chip IC as the MCU
- 2 Rx Filters
- RF power amplifier and Front End Module in single chip IC

3.2. Operating Modes

G30 incorporates several operating modes. Each operating mode is different in the active features and interfaces.
The following table summarizes the general characteristics of the G30 operating modes and provides general guidelines for operation.

Mode	Description	Features
Not Powered	VCC supply is disconnected. VRTC is disconnected.	The G30 is Off. Any signals connected to the interface connector must be set tri-state.
RTC Mode	Valid VRTC supply. VCC supply is disconnected.	The G30 Interfaces are Off. Only the internal RTC timer is operating. Any signals connected to the interface connector must be set tri-stated.
Off Mode	Valid VCC supply. RESET_IN signal is enabled (low).	The G30 Interfaces are Off. Only the internal RTC timer is operating. Any signals connected to the interface connector must be set tri-stated. In this mode, the G30 waits for PWR_ON signal to turn ON.
Idle Mode	RESET_IN signal is disabled (high). CTS and DSR signals are enabled (low).	The G30 is fully active, registered to the GSM network and ready to communicate. This is the default power-up mode.
Sleep Mode	RESET_IN signal is high. CTS signal is disabled.	The G30 is in low power mode. The application interfaces are disabled, but, G30 continues to monitor the GSM network.
CSD call or GPRS data	RESET_IN signal is high. TXEN signal is high.	A GSM voice or data call is in progress.When the call terminates, G30 returns to the last operating state (Idle or Sleep).

Table 3-1: G30 Operating Modes

3.3. Power Supply

The G30 power supply must be a single external DC voltage source of 3.3V to 4.2V. The power supply must be able to sustain the voltage level during a GSM transmit burst current surge, which may reach 2.0A.
The G30 interface contacts for the main power supply, are described in the following table. All these contacts must be used for proper operation.

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	Signal Name	Description
65, 67-77	**1-4**	GND	Main ground connection for G30 module.
78, 79	**5-8**	VCC	DC supply input for G30 module. V_{IN} = 3.3 V to 4.2 V I_{RMS} = 350 mA during multislot transmission I_{MAX} = 2 A during transmit bursts

Table 3-2: Power supply Signals

3.3.1. Power Supply Design

Special care must be taken when designing the power supply of the G30. The single external DC power source indirectly supplies all the digital and analog interfaces, but also directly supplies the RF power amplifier (PA). Therefore, any degradation in the power supply performance, due to losses, noises or transients, will directly affect the G30 performance.
The burst-mode operation of the GSM transmission and reception, draws instantaneous current surges from the power supply, which causes temporary voltage drops of the power supply level. The transmission bursts consume the most instantaneous current, and therefore cause the largest voltage drop. If the voltage drops are not minimized, the frequent voltage fluctuations may degrade the G30 performance.
The following figure illustrates the power supply behavior during GSM transmission.

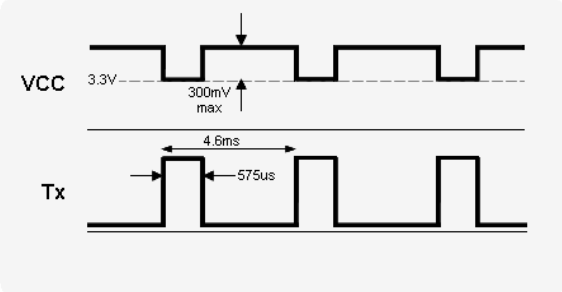


Figure 3-2: Transmission Power Drops

NOTE:

1 TX slot is shown.

It is recommended that the voltage drops during a transmit burst will not exceed 300mV, measured on the G30 interface connector. In any case, the G30 supply input must not drop below the minimum operating level during a transmit burst. Dropping below the minimum operating level may result in a low voltage detection, which will initiate an automatic power-off.
To minimize the losses and transients on the power supply lines, it is recommended to follow these guidelines:

- Use a 1000 uF, or greater, low ESR capacitor on the G30 supply inputs. The capacitor should be located as near to the G30 interface connector as possible.
- Use low impedance power source, cabling and board routing.
- Use cabling and routing as short as possible.
- Filter the G30 supply lines using filtering capacitors, as described in the following table.

Capacitor	Usage	Description
1000 uF	GSM Transmit current serge	Minimizes power supply losses during transmit bursts. Use maximum possible value.
10 nF, 100 nF	Digital switching noise	Filters digital logic noises from clocks and data sources.
8.2 pF, 10 pF	1800/1900 MHz GSM bands	Filters transmission EMI.
33 pF, 39 pF	850/900 MHz GSM bands	Filters transmission EMI.

Table 3-3: Recommended Power supply filtering

3.3.2. Power Consumption

The following table specifies typical G30 current consumption ratings in various operating modes. The current ratings refer to the overall G30 current consumption over the VCC supply.

Parameter	Description	Conditions	Min	Typ	Max	Unit
I_{OFF}	RTC mode				90	µA

Parameter	Description	Conditions		Min	Typ	Max	Unit
I_{IDLE}	Idle mode					28	mA
I_{SLEEP}	Low power mode	DRx	9			1.6	mA

Table 3-4: G30 Current Ratings

3.4. Power On/Off Operation

The G30 power on and off process includes two primary phases, which are indicated at the interface connector by the hardware input signal RESET_IN, and the output signal CTS.
The RESET_IN is usually an input signal to the G30, and its main function is to initiate HW reset to the G30. However, this signal can also serve as "live indication" signal, and indicate whether G30 is powered on or off.

NOTE:

When RESET_IN is used as "Live Indication", verify that the signal is connected to an input device (via a input buffer), with NO pull-up or pull-down resistors.

When this signal is enabled (low), G30 is powered-off. When it is disabled (high), G30 is powered-on.
The CTS signal indicates the serial communications interface (UART) status. When this signal is high, the G30 serial interface is disabled. When it is low, the serial interface is enabled, and G30 is ready to communicate.
When G30 is powered on, and after the CTS is enabled (Low) and once all G30 internal tests are done, the G30 initiates a "SIM READY" message via the UART serial interface.
For more information, refer to "G30 AT Commands Reference Manual".

IMPORTANT:

Applying voltage to ADC lines before power up is forbidden and may cause G30 power up issues.

Do not operate the G30 out of its electrical or environmental limits. Refer to the specifications chapter for details of these limits.

3.4.1. Turning the G30 On

When the G30 power supply is stable above the minimum operating level and G30 is powered off, only the internal RTC timer is active.
When G30 is turned on, by any of the methods described below, it will first perform an automatic internal system-test, during which basic functions are verified. The system-test duration is typically 1600 milliseconds. When the system-test has completed G30 resumes normal operation.
During the internal system-test process G30 may toggle several interface signals, which are visible to the application. These signals do not represent any valid state or data, and should be ignored by the customer application until the system-test has completed.

3.4.2. Power Supply Turn-on

When connecting the power supply for the first time, or when reconnecting it after a power supply loss, G30 will power-on. The G30 is turned-on automatically when external power is applied above the minimum operating level.
The following figure illustrates the G30 power on upon application of a power supply.

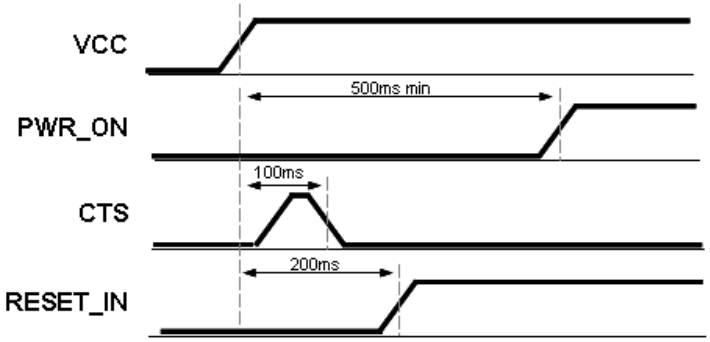


Figure 3-3: Power Supply Turn-on

3.4.3. Turning the G30 On Using PWR_ON

The PWR_ON input signal is set high by an internal pull-up resistor whenever a power supply is applied to G30. Therefore, it is recommended to operate this signal using an open collector/drain circuit connection.
Asserting the PWR_ON signal low for a minimum of 600 milliseconds (0.6 seconds) and a maximum of 1.5 seconds will cause the G30 to turn-on.
Asserting the PWR_ON signal low for more than 1.5 seconds may cause the G30 to interpret the signal as a power-off command, and turn off immediately after turning on.
The following figure illustrates the power-on process using the PWR_ON signal.

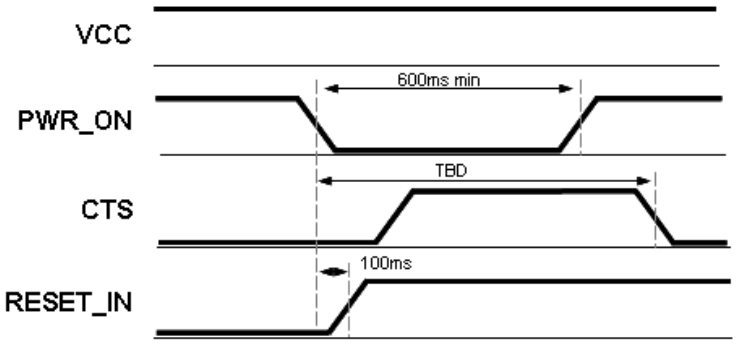


Figure 3-4: PWR_ON Power On Timing

3.4.4. Turning the G30 Off

There are several ways to turn the G30 off:

- Asserting the PWR_ON signal low for a minimum of 3 seconds.
- Low power automatic shut down.
- AT command.

3.4.5. Turning the G30 Off Using PWR_ON

The PWR_ON signal is set high using an internal pull up resistor when power is applied to G30. Asserting the PWR_ON signal low for a minimum of 3 seconds will turn G30 off. This will initiate a normal power-off process, which includes disabling of all applications interfaces (UART, SIM card, audio, etc.) and closing the network connection.
The following figure illustrates the power-off timings when using the PWR_ON signal.

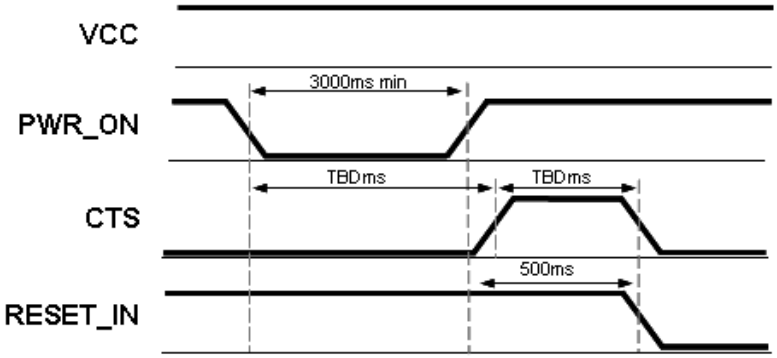


Figure 3-5: PWR_ON Power Off Timing

3.4.6. Power Loss shut down

A low power shut down occurs when G30 senses the external power supply is below the minimal operating limit. The module will respond by powering down automatically without notice.
This form of power-down is not recommended for regular use since the unexpected power loss may result in loss of data.

3.4.7. Turning the G30 Off Using AT+MRST

The AT+MRST command initiates a G30 system reset operation, which powers off the G30. This command emulates the PWR_ON signal operation for power off.

3.5. Low Power Mode

The G30 incorporates an optional low power mode, called Sleep Mode, in which it operates in minimum functionality, and therefore draws significantly less current. During low power mode the G30 network connection is not lost. G30 continues to monitor the GSM network constantly for any incoming calls or data.
During low power mode, all of the G30 interface signals are inactive and are kept in their previous state, prior to activating low power mode. To save power, all the G30 internal clocks and circuits are shut down, and therefore serial communications is limited.

3.5.1. Activating Low Power Mode

By default, the G30 powers on in Idle mode. In this mode the G30 interfaces and features are functional and the module is fully active.
Low power mode is activated by the ATS24 command. The value set by this command determines the inactive state duration required by G30, in seconds, after which G30 will enter sleep mode.

For example:

ATS24 = 1 activates low power mode after 1 second of inactivity.

ATS24 = 5 activates low power mode after 5 seconds of inactivity.

ATS24 = 0 disables low power mode (default).

The following figure illustrates the ATS24 command operation.

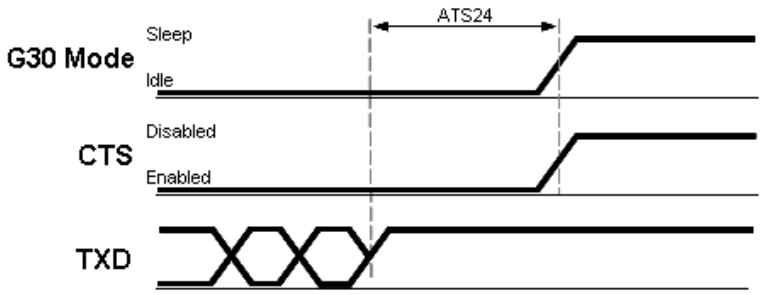


Figure 3-6: ATS24 Operation

IMPORTANT:

G30 will not enter low power mode in any case when there is data present on the serial interface or incoming from the GSM network or an internal system task is running. Only when processing of any external or internal system task has completed, and G30 is inactive for the duration of ATS24, it will enter low power mode.

3.5.2. Serial Interface During Low Power Mode

During low power mode the G30 serial interfaces are disabled. This is indicated by the CTS signal high state.

The G30 wakes up periodically from low power mode to page the GSM network for any incoming calls or data. After this short paging is completed, G30 returns to low power mode. During this short awake period, the serial interfaces are enabled and communications with the module is possible.

The CTS signal is alternately enabled and disabled synchronously with the network paging cycle. CTS is enabled whenever G30 awakes to page the network. This indicates the G30 serial interfaces are active (see the following figure).

Figure 3-7: CTS Signal During Sleep Mode

The periodical enabling and disabling of the CTS signal during low power mode can be controlled by the AT+MSCTS command.
Setting AT+MSCTS=1 permanently disables the serial interface during low power mode, even during a network page by G30. The CTS signal is disabled, and therefore the serial interfaces are blocked.

3.5.3. Terminating Low Power Mode

Terminating the low power mode, or wake-up, is defined as the transition of the G30 operating state from Sleep mode to Idle mode. There are several ways to wake-up G30 from low power mode as described below.

IMPORTANT:

During power saving mode the G30 internal clocks and circuits are disabled, in order to minimize power consumption. When terminating the power saving mode, and switching to Idle mode, G30 requires a minimal delay time to reactivate and stabilize its internal circuits before it can respond to application data.
This delay is typically of 15 milliseconds, and is also indicated by the CTS signal inactive (high) state. The delay guarantees that data on the serial interface is not lost or misinterpreted.

3.5.3.1. Temporary Termination of Low Power Mode

Temporary termination of low power mode occurs when G30 switches from Sleep mode to Idle mode for a defined period, and then returns automatically to Sleep mode.
Low power mode may be terminated temporarily by several sources, some of which are user initiated and others are initiated by the system.

3.5.3.2. Using the WKUPI signal

The WKUPI signal is an active low input that is set high by default. By asserting this signal low the application can wake-up G30 from low power mode and switch to Idle mode.
G30 will remain in Idle mode, awake and fully active, as long as WKUPI signal remains low. When this signal is disabled and set high again, G30 will return to Sleep mode automatically, according to the ATS24 settings (see the following figure).

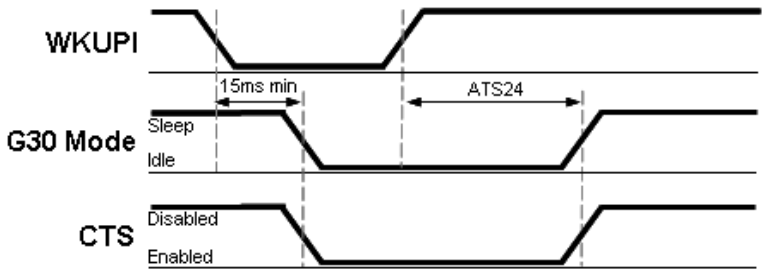


Figure 3-8: WKUPI Signal Operation

The WKUPI signal is the recommended method to temporarily wake-up G30 from low power

mode. It provides the application full control of the G30 operating mode and guarantees that data on the serial interface will not be lost or misinterpreted.
The WKUPI signal must be used to wake up G30 from low power mode if the serial interface has been disabled by the AT+MSCTS command.

3.5.3.3. Incoming Network Data

During low power mode, G30 continues monitoring the GSM network for any incoming data, message or voice calls.
When G30 receives an indication from the network that an incoming voice call, message or data is available, it automatically wakes up from low power mode to alert the application. When G30 has completed to process all the tasks related to the incoming data, it will automatically return to low power mode according to the ATS24 settings.
Depending on the type of network indication and the application settings, G30 may operate in several methods, which are configurable by AT commands, to alert the application of the incoming data:

- Enable the WKUPO signal to wake-up the application from low power.
- Send data to the application over the serial interface.
- Enable the serial interface's Ring Indicator (RI) signal.

3.5.3.4. Data on the Serial interface

While G30 is temporarily awake in Idle mode, data may be transmitted on the serial interface. In case data is being transmitted in any direction, G30 will not return to low power mode. This is regardless of the original wake-up reason or source. G30 will remain awake while data is transferred.
Only when the serial interface transfer is completed and the data has been processed, G30 will return to low power mode automatically, according to the ATS24 settings (seethe following figure).

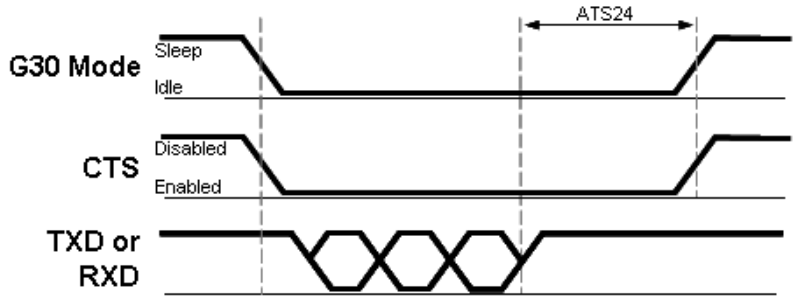


Figure 3-9: Serial Interface Data

3.5.3.5. Permanent termination of Low Power Mode

The G30 low power mode is enabled and disabled by the ATS24 command.
To permanently terminate the G30 low power mode, the ATS24 = 0 command must be used. Setting ATS24 = 0 disables the currently active low power mode and switches G30 to Idle mode.
G30 will not return to low power mode until an ATS24 > 0 commands is set again.
This command can be sent only when the serial interface is active.

In case the serial interface is disabled, it must first be activated before sending this command. To reactivate the serial interface, a temporary termination of the low power mode is required, as described in Temporary Termination of Low Power Mode.
Following the temporary low power mode termination, the serial interface will activate and the ATS24 = 0 command can be received by G30.

3.6. Real Time Clock

G30 incorporates a Real Time Clock (RTC) mechanism that performs many internal functions, one of which is keeping time. The RTC subsystem is embedded in the PMU and operates in all of the G30 operating modes (Off, RTC, Idle, Sleep), as long as power is supplied above the minimum operating level.
The G30 time and date can be set using the following methods:

- Automatically retrieved from the GSM network.
  In case G30 is operated in a GSM network that supports automatic time zone updating, it will update the RTC with the local time and date upon connection to the network. The RTC will continue to keep the time from that point.
- Using the AT+CCLK command.
  Setting the time and date manually by this AT commands overrides the automatic network update.
  Once the time and date are manually updated, the RTC timer will keep the time and date synchronized regardless of the G30 operating state.

When the power supply is disconnected from G30 and no voltage is supplied to the VRTC pin, the RTC timer will reset and the current time and date will be lost. On the next G30 power-up the time and date will need to be set again automatically or manually.

NOTE:

A 47uF capacitor should be connected between ground and VRTC signal (pin 62 of the 81-pin LGA interface/pin 60 of the 70-pin connector).

3.7. Serial Interfaces

G30 includes three completely independent serial communications interfaces, which may be used by the application for several purposes.

3.7.1. UART

The G30 UART is a standard 8-signal bus. The primary UART is used for all the communications with G30 - AT commands interface, GPRS data and CSD data, programming and software upgrades.
The UART signals are active low CMOS level signals. For standard RS232 communications with a PC, an external transceiver is required.
G30 is defined as a DCE device, and the user application is defined as the DTE device. These definitions apply for the UART signals naming conventions, and the direction of data flow, as described in the following figure.

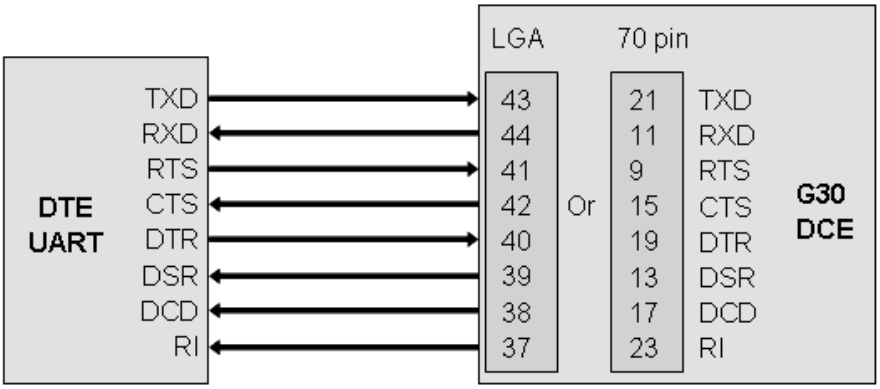


Figure 3-10: UART Interface Signals

The G30 UART supports baud rates 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, and 230400 bps.
Auto baud rate detection is supported for baud rates up to 230400 bps.
All flow control handshakes are supported: hardware, software, or none.
Parity bit and Stop bit definitions are also supported.
The UART default port configuration is 8 data bits, 1 stop bit and no parity, with hardware flow control and auto baud rate detect enabled.

IMPORTANT:

The G30 UART will not send data over the serial interface in case the DTR and/or RTS input signals are disabled (set high). Therefore, regardless of the handshake method, it is still required to enable these signals for proper operation, by asserting them low.

When G30 receives a call, the RI signal (Ring Indication), initiates pulse indication to the host. The RI behavior is shown in the following figure.

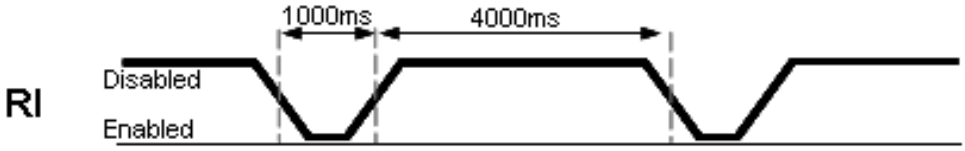


Figure 3-11: RI Behaviour When Receiving A Call

3.7.2. Serial Peripheral Interface (SPI)

The G30 provides a synchronous SPI-compatible serial interface, used for data logging only, implemented with the synchronous serial controller hardware block of the G30. The SPI is a master-slave protocol: the module runs as a SPI master device.
The SPI interface includes basically the following signals to transmit and receive data and to synchronize them:

- MOSI (master output, slave input) signal which is an output for the module while it runs as SPI master;
- MISO (master input, slave output) signal which is an input for the module while it runs as SPI master;
- Clock signal which is an output for the module while it runs as SPI master;
- Optional chip select signal which is an output for the module while it runs as SPI master;
- Input Interrupt request SPI_IRQ.

NOTE

The SPI interface is internally connected to the I^2S digital audio interface, and is controlled by means of software settings. Hence SPI interface is available only if the I^2S digital audio interface is disabled.

The SPI interface can be used as a data event logger by connecting SPI signals to an external SPI-UART dedicated interface, and enabling the data logging interface by SW.

NOTE:

In case that the M2M zone platform is being used, the SPI interface can be configured as GPIOs, disabling the I^2S digital audio and SPI interface.

The board to board pins related to SPI interface description are given in the following table:

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	G30 Signal Name	G30 I/O	Function	Remarks
7	62	SPI_IRQ	I	SPI Interrupt Input	Generic digital interfaces voltage domain. Output driver class C. PU/PD class B. Value at reset: T/PD.
			I/O	Capture/Compare	
			I/O	GPIO	
60	68	SPI_MOSI	O	SPI sync data (MOSI) Short to pin 5	Generic digital interfaces voltage domain. Output driver class D. PU/PD class B. Value at reset: T.

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	G30 Signal Name	G30 I/O	Function	Remarks
63	**70**	SPI_CS	O	SPI chip select Short to pin 58	Generic digital interfaces voltage domain. Output driver class D. PU/PD class B. Value at reset: T.
45	**66**	SPI_CLK	O	SPI Clock Short to Pin 57	Generic digital interfaces voltage domain. Output driver class D. PU/PD class B. Value at reset: T.
61	**64**	SPI_MISO	I	SPI sync data (MISO) Short to pin 55	Generic digital interfaces voltage domain. Output driver class D. PU/PD class B. Value at reset: T.

Table 3-5: SPI Interface Connections

3.7.3. Flashing and Data Logging

In the event of logging or reflashing the module SW, the host must provide access to several I/O lines especially when using the 81 pin LGA interface version.
The G30 SPI interface is used for data logging, and therefore, it is recommended that the host application will have the ability to support it.
In addition, in order to support G30 SW upgrade, the host application must have access to the G30 UART signals (TXD, RXD only).
In order to support both data logging, and SW upgrade, it is recommended to use a single

header connector that will contain all required signals with additional SPI indication, VCC and GND signals.

NOTE:

When a header can't be implemented due to engineering constrains (lack of place), the host application should support sufficient soldering pads or test points for wire-up.

It is recommended to implement the above in accordance with the following table:

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	G30 Signal Name	Application Header Connector Pin out 
68-77	**1-4**	GND	1
78-79	**5-8**	VCC	9
7	**62**	SPI_IRQ	10
27	**25**	RESET_IN	3
45	**66**	SPI_CLK	2
60	**68**	SPI_MOSI	8
61	**64**	SPI_MISO	6

63	**70**	SPI_CS	4
43	**21**	TXD	5
44	**11**	RXD	7
		SPI connection indication*	11
		Flashing connection indication**	12

Table 3-6: Data Logging and SW Upgrading Application Connector

NOTE:

* SPI connection indication - Input pin for the host, indicate that SPI logger device is attached and the SPI pins are routed to external logger pins. The host must verify that all pins for SPI and PCM should be TRI state from the host application when pin 11 is 'L' state. The host will implement an external 100K pull up resistor on pin 11.

** Flashing connection indication - Input pin for the host, indicate that flashing device is attached and the UART RXD/TXD pins are now connected to external device for reflashing. The host must verify that the UART RXD/TXD pins are left open from the host application when pin 12 is 'L' state. The host will implement an external 100K pull up resistor on pin 12.

Recommended application connector: SAMTEC TSM-106-02-S-DV-LC 12 pin.

3.7.4. I²C Bus Interface

The module provides an I²C bus interface which includes a serial data line and a clock line on the board to board pins. The G30 I²C acts as master only. The I²C bus interface is available to the user only with M2M Zone Platform.
The I²C signals are pulled-up, using internal 4.7 kOhm resistors.

NOTE:

Do not connect any pull-up resistors when using signals as I²C interface.

The I²C Bus interface can only be activated by M2M Zone Platform. Otherwise, the I²C signals are configured as GPIOs.

The board to board pins related to I²C bus interface description is given in the following table:

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	G30 Signal Name	G30 I/O	Function	Remarks
33	34	GPIO4/SCL	O	I^2C bus clock line	I^2C interface voltage domain. PU drain. Value at reset: T/OD.
			I/O	GPIO	
34	32	GPIO3/SDA	I/O	I^2C bus data line	I^2C interface voltage domain. PU drain. Value at reset: T/OD.
			I/O	GPIO	

Table 3-7: I2C Interface Connections

3.8. SIM Interface

The G30 incorporates a SIM interface, which conforms to the GSM 11.11 and GSM 11.12 standards, that are based on the ISO/IEC 7816 standard. These standards define the electrical, signaling and protocol specifications of a GSM SIM card.
Both 1.8 V and 3 V SIM types are supported; activation and deactivation with automatic voltage switch from 1.8 V to 3 V is implemented.
G30 is designed to support two SIM card options with the same SIM signals: External SIM card, or an on board Embedded SIM (eSIM), depending on the G30 model.
The following table details the SIM interface signals.

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	Signal Name	Description
20	48	VSIM	2.85V/1.8V Supply to the SIM
21	44	SIM_RST	Active low External SIM reset signal
22	52	SIM_IO	Serial input and output data
23	46	SIM_CLK	Serial 3.25 MHz clock
59	50	SIM_PD_n	Active low SIM card presence detection

4	56	eSIM_RESET	Active low Embedded SIM reset signal

Table 3-8: SIM Interface Signals

3.8.1. External SIM Card

G30 does not incorporate an on-board SIM card tray for SIM placement. The external SIM must be located on the user application board, external to the G30. The G30 SIM interface includes all the necessary signals, which are routed to the interface connector, for a direct and complete connection to an external SIM.
G30 supports dynamic detection of the SIM card, through a dedicated SIM detection signal. G30 will detect a SIM card insertion or removal upon power up or during operation by the transitions on the SIM_PD_N signal.

3.8.1.1. External SIM Connection

The following figure illustrates a typical external SIM interface connection to G30. This connection type is implemented on the G30 Developer Board, using an FCI SIM tray.

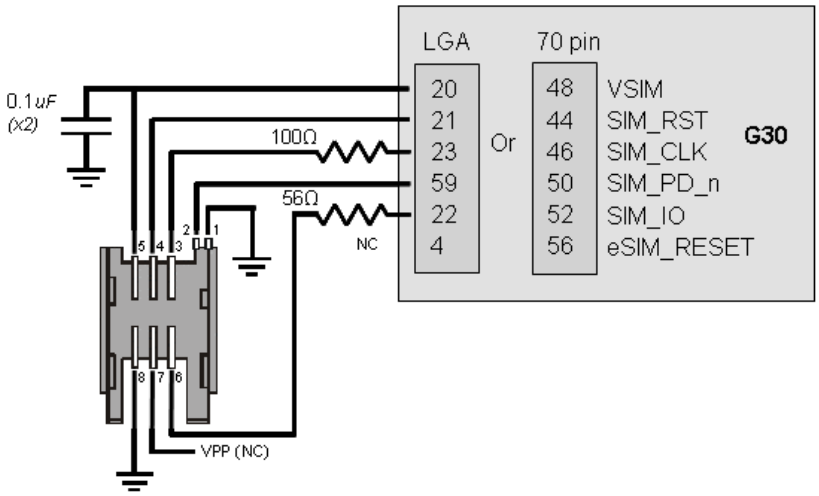


Figure 3-12: G30 External SIM Interface

3.8.1.2. External SIM Design Guidelines

The SIM interface and signals design is extremely important for proper operation of G30 and the SIM card. There are several design guidelines that must be followed to achieve a robust and stable design that meets the required standards and regulations.

- Using the SIM detection signal, SIM_PD_N, is mandatory in case the SIM card is accessible to the user and may be removed during G30 operation. To avoid any damage to the SIM or G30, the SIM interface signals must be deactivated before the SIM card contacts are mechanically removed from the SIM tray contacts. Therefore, the SIM_PD_N detection signal must be disabled before the SIM is removed from its tray.
- The SIM should be located, and its signals should be routed, away from any possible EMI sources, such as the RF antenna and digital switching signals.

- The SIM interface signals length should not exceed 100 mm between the G30 interface connector and the SIM tray. This is to meet with EMC regulations and improve signal integrity.
- To avoid crosstalk between the SIM clock and data signals (SIM_CLK and SIM_DIO), it is recommended to rout them separately on the application board, and preferably isolated by a surrounding ground plane.
- The SIM card signals should be protected from ESD using very low capacitance protective elements (zener diodes, etc.).
- The G30 interface does not support SIM programming through the VPP signal. This signal should not be connected to G30.

3.8.2. Embedded SIM

The G30 incorporates an Embedded SIM (depending on G30 model).
Embedded SIM (e.g. eSIM or chip SIM), is a secured micro controller IC, with the same pinout interface, and the same operation as an external SIM card.
The eSIM main advantage is it robustness, making it an ideal solution for the M2M, and automotive application.
Since an eSIM is actually an IC soldered on the G30, it can withstand wider temperature range than a regular external SIM card that is usually made of plastic, and gets twisted and bowed at high temperature, causing disconnection inside the SIM tray.
For the same reason, the eSIM is more durable to vibration then a regular external SIM card. Hard vibration on an application with a SIM card socket may result in with an intermitted connection between the SIM card socket and the SIM card.

NOTE:

When Embedded SIM is used, it is recommended to connect the SIM_PD_n signal to ground. However, in case the SIM detection is disabled by SW (+MSMPD command), this signal can be left disconnected.

3.8.3. eSIM Connection

The following figure illustrates a typical eSIM interface connection to G30.

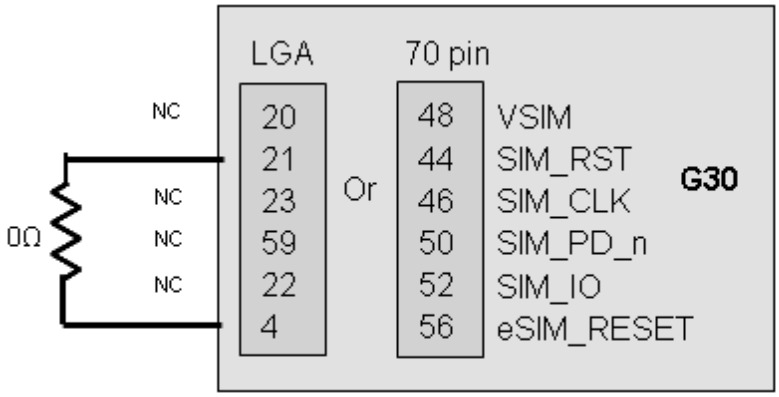


Figure 3-13: G30 eSIM Interface

NOTE:

When Embedded SIM is used, SIM_RST signal must be connected to eSIM_RESET signal via an optional 0 ohm resistor.

3.9. Audio Interface

The G30 audio interface supports several audio devices and operating modes.
The audio interface's operating modes, active devices, amplification levels and speech processing algorithms are fully controlled by the host application, through advanced programming options and a versatile AT commands set.
The G30 supports the following audio devices:

- Two single-ended and biased mono analog microphone inputs for use in a variety of modes.
- A single differential mono analog speaker output for use in a variety of modes.
- A digital serial interface using I^2S coding.
- A single-ended mono analog speaker output for use in a variety of modes.

The following figure shows the audio interface topology:

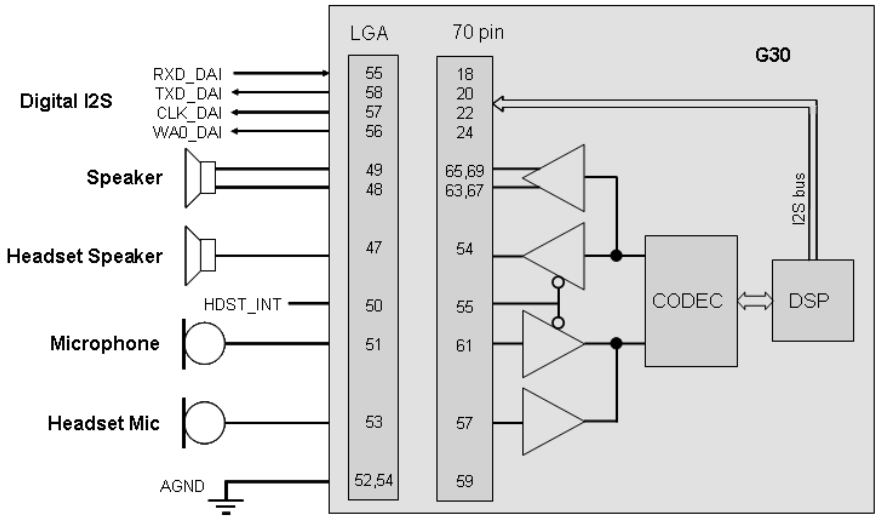


Figure 3-14: Audio Interface Topology

3.9.1. Handset Microphone Port

The handset microphone port is the G30 power-up default active audio input for voice calls. It is located on pin 51 at the G30 81 pin LGA interface, named MIC.
It is designed as a single-ended input and should be referenced to the G30 analog ground.
The microphone input includes all the necessary circuitry to support a direct connection to an external microphone device. It incorporates an internal bias voltage of 2.0V through a 3kΩ resistor, and has an impedance of 1kΩ.
The following figure shows the microphone circuit and the following table gives the microphone specifications.

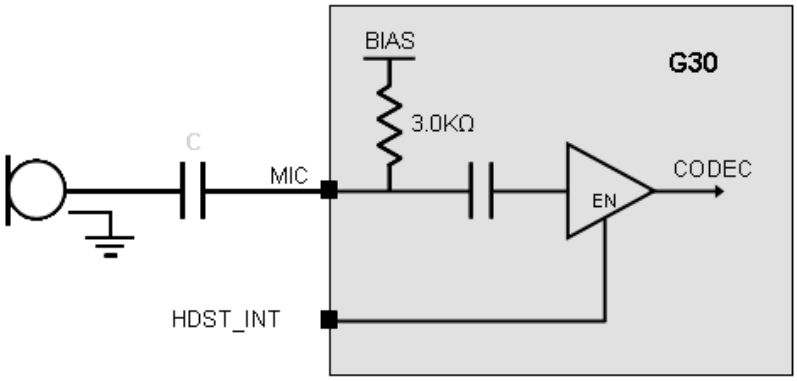


Figure 3-15: Handset Microphone Circuit

IMPORTANT:

The microphone circuit design depends on the type of microphone device.
A series capacitor is required in case a passive microphone is used, or the application provides a separate bias voltage to an active microphone circuit.The internal G30 biasing circuit may also be used with an active microphone, which corresponds to the microphone port specifications.

Parameter	Conditions	Min	Typ	Max	Unit
Input Voltage	No load AT+MMICG=0			2.0	V_{PP}
Gain	Programmable in 3 dB steps	0		45	dB
AC Input Impedance			1		kΩ
Bias voltage	R_{BIAS} = 3.0 kΩ I_{BIAS} = 1 mA	1.8	2.0	2.2	V
Bias Current				1	mA

Table 3-9: Handset Microphone Port Specifications

3.9.2. Headset Microphone Port

The headset microphone port is designed for use with, but not limited to, a headset audio device. It is located at pin 53 on the G30 81 pin LGA interface, named MIC_HDST.

It is designed as a single-ended input and should be referenced to the G30 analog ground.
The microphone input includes all the necessary circuitry to support a direct connection to a headset microphone device. It incorporates an internal bias voltage of 2.0V through a 3.0kΩ resistor, and has an impedance of 1kΩ.
The following figure shows the microphone circuit and the next table gives the microphone specifications.

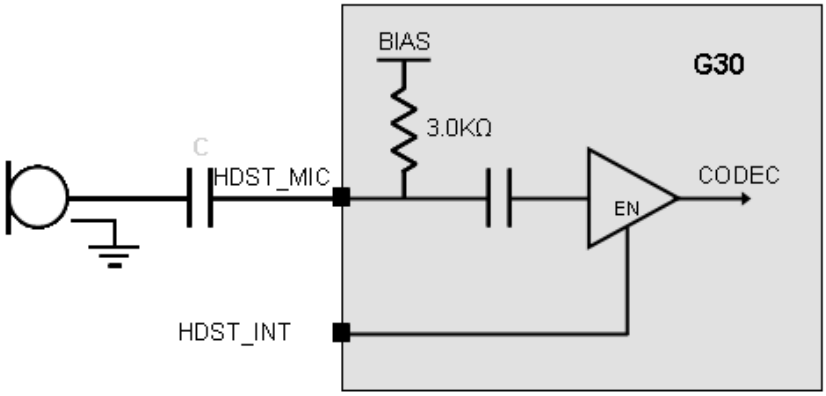


Figure 3-16: Headset Microphone Circuit

IMPORTANT:

The headset microphone circuit design depends on the type of microphone device.
A series capacitor is required in case a passive microphone is used, or the application provides a separate bias voltage to an active microphone circuit.
The internal G30 biasing circuit may also be used with an active microphone, which corresponds to the headset microphone port specifications.

Parameter	Conditions	Min	Typ	Max	Unit
Input Voltage	No load AT+MMICG=0			2.0	V_{PP}
Gain	Programmable in 1 dB steps	0		45	dB
AC Input Impedance			1		kΩ
Bias voltage	R_{BIAS} = 3.0 kΩ I_{BIAS} = 1 mA	1.8	2.0	2.2	V
Bias Current				1	mA

Table 3-10: Headset Microphone Port Specifications

3.9.3. Differential Speaker (Handset) Port

The analog differential speaker port is the G30 power-up default active output for voice calls and DTMF tones. It is located at pins 48 and 49 on the G30 81 pin LGA interface, named SPKR_N and SPKR_P respectively.
It is designed as a differential output with 8Ω impedance, but may also be used as a single-ended output referenced to the G30 analog ground.
The differential speaker output is used for the handset audio path.
The following figures show a differential speaker circuit and a single-ended speaker circuit and the next table gives the speaker specifications.

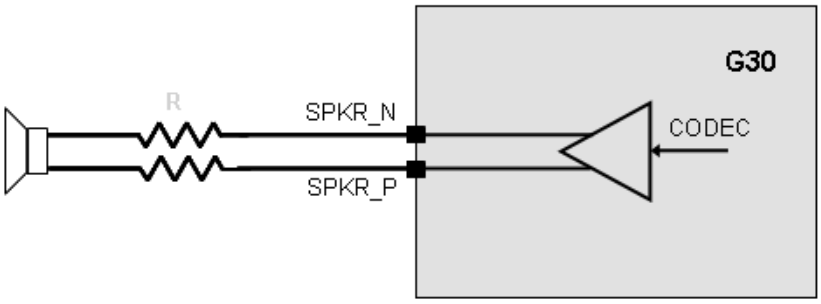


Figure 3-17: Differential Speaker Circuit

IMPORTANT:

For safety regulations it is important to place series resistors on the speaker output lines, as illustrated in the following figure. The resistors value should be R = 0Ω at the design stage, but may be changed to a different value during audio safety testing, in case speaker level limitation is required.

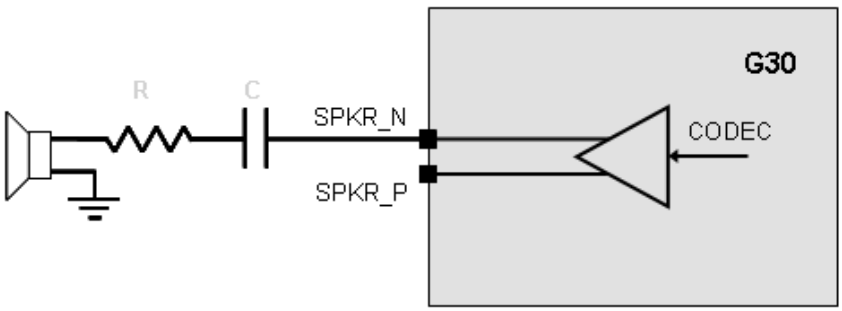


Figure 3-18: Single-ended Speaker Circuit

IMPORTANT:
When implementing a single ended speaker design, it is required to place a series capacitor and resistor on the speaker output line, as illustrated in figure 3-17.
The capacitor should be of low tolerance with values of C = 10-22 uF.

The resistor value depends on the speaker application:
- For a handset device, the resistor value should be R = 0Ω at the design stage, but may be changed to a different value during audio safety testing, in case speaker level limitation is required.
- For a headset device, safety regulations require the resistors value to be $R \geq 2R_L\Omega$, where R_L is the speaker impedance (e.g. 32Ω).
For example, when using a 32Ω speaker the series resistance would be $R \geq 64\Omega$.

Parameter	Conditions	Min	Typ	Max	Unit
Output Voltage	No load Single ended			2.7	V_{PP}
Gain	Programmable in 3 dB steps	-15		+9	dB
AC Output Impedance			8		Ω
DC Voltage			VCC/2		V
THD	8 Ω load 300 Hz - 4 kHz			1	%
Isolation	Speech, f> 4 kHz	60			dB

Table 3-11: Speaker Port Specifications

3.9.4. Mono Speaker (Headset) Port

The mono speaker port can be used for voice calls and DTMF tones. It is located at pin 47 on the G30 81 pin LGA interface, named HDST_SPK.
It is designed as a single-ended output with 32Ω impedance, referenced to the G30 analog ground.
The following figure shows the headset speaker circuit and the next table gives the headset speaker specifications.

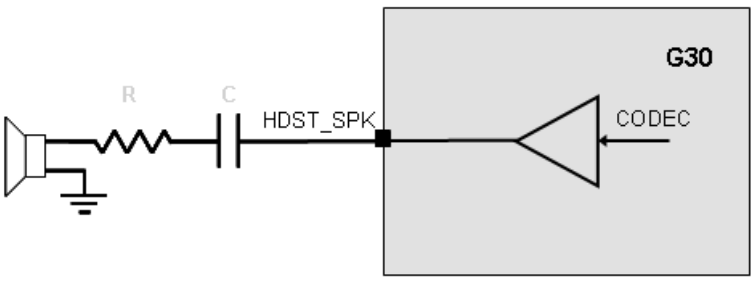


Figure 3-19: Mono Speaker (Headset) Circuit

IMPORTANT:

When implementing a single ended loudspeaker design, it is required to place a series capacitor and resistor on the alert output line, as illustrated in figure 3-18.
The capacitor should be of low tolerance with values of C = 10-22 uF.
The resistor value should be R = 0Ω at the design stage, but may be changed to a different value during audio safety testing, in case that alert level limitation is required.

Parameter	Conditions	Min	Typ	Max	Unit
Output Voltage	No load Single ended			2.05	V_{PP}
Gain	Programmable in 3 dB steps	-18		0	dB
AC Output Impedance			32		Ω
DC Voltage			1.8		V
THD	32 Ω load 300 Hz - 4 kHz			1	%
Isolation		60			dB

Table 3-12: Mono Speaker Port Specifications

3.9.5. Headset Detection

The G30 operates by default in the basic audio mode with the differential speaker (handset) audio path, for DTMF tones, speech, rings, and alert tones active.
The headset (mono speaker) path is an alternate audio path in basic mode. It is designed for, but not limited to, a personal hands-free audio device, a headset, using the headset microphone input device and the headset speaker output device. When this path is selected, the differential speaker is disabled, and all the audio sounds are passed through to the headset path.
The HDST_INT signal is used to switch between handset and headset audio paths in basic audio mode. This signal is set high by default at power up. Asserting the HDST_INT signal low enables the headset audio path and disables the handset path. Setting this signal high will disable the headset path and enable the handset path.
The G30 supports dynamic switching between the handset and headset audio paths, during operation and call handling.

IMPORTANT:

The HDST_INT signal does not operate in advanced audio mode. This signal's functionality is overridden by the AT+MAPATH command settings.

3.9.6. Digital Audio Interface

The G30 digital audio interface is a serial Pulse Code Modulation (PCM) bus, which uses linear 2's compliment coding. G30 is the PCM bus master, supplying the clock and sync signals to the application.
The G30 digital interface is a 4 signal PCM bus, which includes a bit clock output signal for the bus timing, a frame sync output signal for audio sampling timing, and serial data input and output signals.

IMPORTANT:

The PCM bus signals are shared internally by the analog audio interface and the digital audio interface. Therefore, when using the analog audio interface the PCM bus signals must be tri-stated or disconnected at the interface connector.

The digital audio interface supports 2 types of audio data formats, which define the PCM bus configuration and data rates:

- Normal I^2S mode.
- PCM mode.

The PCM bus configuration is defined by the audio data format that is sounded through the digital audio path, as described in the following table.

Audio Mode	Frame Sync Sampling	Bit Clock
PCM	8 kHz	144 kHz
I^2S	8 kHz	512 kHz

Table 3-13: Digital Audio Modes

NOTE:

Switching between Audio Modes is done using AT+MAI2SY command. For detailed information, refer to G30 AT Commands Reference Manual.

3.9.7. Voiceband Audio

This digital voice audio format is used for speech during voice calls and for mono rings and alerts.
The I^2S bus signal's configuration for voiceband audio is:

- I^2S_CLK - 512 kHz serial clock
- I^2S_FS - 8 kHz bit-wide frame-sync
- I^2S_DOUT - 16-bit linear audio data output
- I^2S_DIN - 16-bit linear audio data input

The bnext figure illustrates the I^2S bus format.

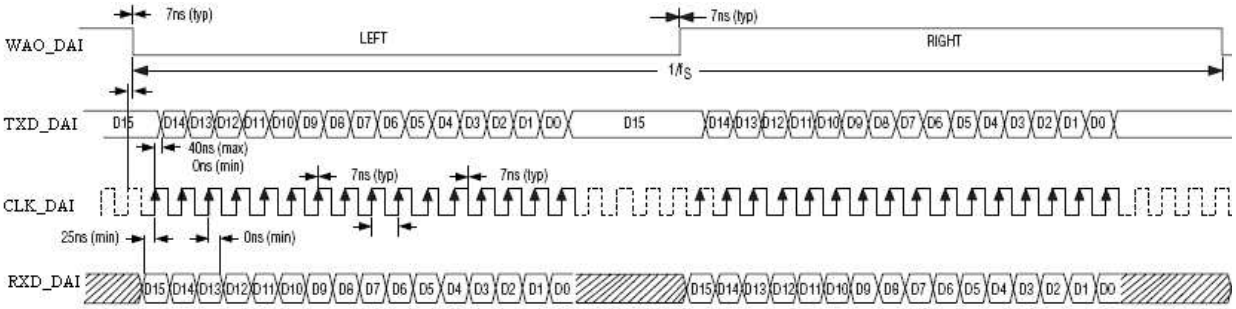


Figure 3-20: I2S BUS Format

The PCM bus signal's configuration for voiceband audio is:

- PCM_CLK - 144 kHz serial clock
- PCM_FS - 8 kHz bit-wide frame-sync
- PCM_DOUT - 16-bit linear audio data output
- PCM_DIN - 16-bit linear audio data input

The 16-bit serial data is transferred in both directions after each sync signal's falling edge. The sync signal pulse duration is two clock periods, after which the serial data is transferred in both directions for 16 consecutive clock periods.

Following the 16-bit data transfer, the serial input and output data signals inactivate until the next sync pulse, which occurs every 125 µS (8 kHz). It is recommended the serial data signals will be High-Z during the inactive period.

The next figure illustrates the PCM bus format of the voiceband audio configuration.

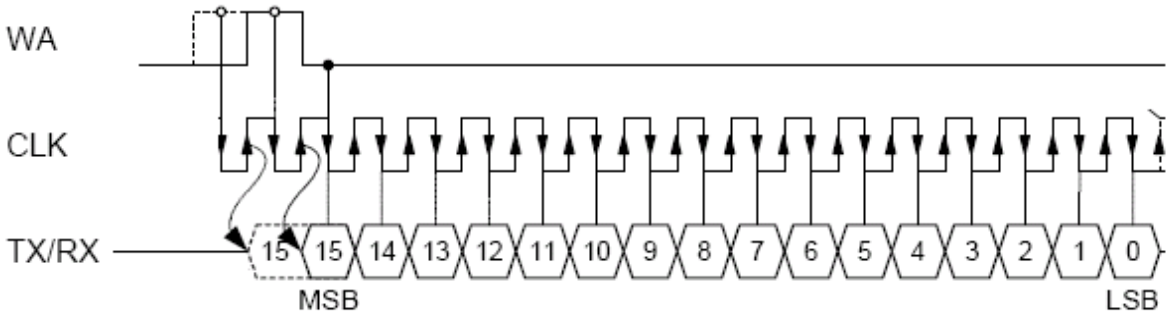


Figure 3-21: Voiceband Mode PCM Bus Coding Format

3.9.8. Operating Modes

The G30 audio interface includes 2 modes of operation. Each operating mode defines the audio input and output devices to be used for each audio sound type and their programmable settings.

3.9.8.1. Basic Mode

Basic audio mode is the G30 default power-up audio configuration. Several audio paths are

available in this mode, and their settings can be programmed through the AT command set. The following table describes the available audio paths in Basic mode.

Audio Path	Input Signal	Output Signal	Description
Handset	MIC	SPKR_N, SPKR_P	Default audio path for speech and DTMF tones and ring.
Headset	HDST_INT	HDST_SPK	Alternate path for headset device. Enable by setting HDST_INT interface signal low.
Digital	PCM_DIN	PCM_DOUT	Enable digital path by AT+MADIGITAL=1

Table 3-14: Basic Mode Audio Paths

3.9.8.2. Advanced Mode

Advanced audio mode utilizes G30's unique set of AT commands for advanced audio programming. The expanded AT command set enables to define a specific audio path and setting, which are not part of the default configuration, for each type of audio sound (speech, DTMF tones, rings and alerts).
Unlike basic audio mode, which provides predefined audio paths, the advanced audio mode provides full control over the G30 audio interface and its parameters, and differentiates between each type of audio sound.
The following table describes the advanced mode audio programming features. These features are only a part of the complete advanced audio AT command set.

Command	Description
AT+MAPATH	Sets the input device for voice, and the output devices for voice, DTMF tones, rings and alerts.
AT+MAFEAT	Enables and disables the speech processing algorithms - Echo suppression, noise suppression and sidetone.
AT+MAVOL	Sets the gain (amplification) level of the selected analog output device.
AT+MMICG	Sets the gain (amplification) level of the selected analog input device.
AT+MMICV	Sets the MIC bias voltage.

AT+MADIGITAL	Switches between analog and digital audio paths.

Table 3-15: Advanced Mode Commands

3.9.9. Audio Programming Interface

The G30 incorporates a unique audio programming interface, through AT commands, which controls the following audio features:

- Audio Path - Defines the input and output devices for speech, DTMF tones, rings and alerts.
- Audio Gain - Defines the amplification (gain) level for input and output audio devices.
- Audio Algorithm - Defines the speech processing features for voice calls.

The next figure describes the audio programming interface options, which are defined by AT commands.

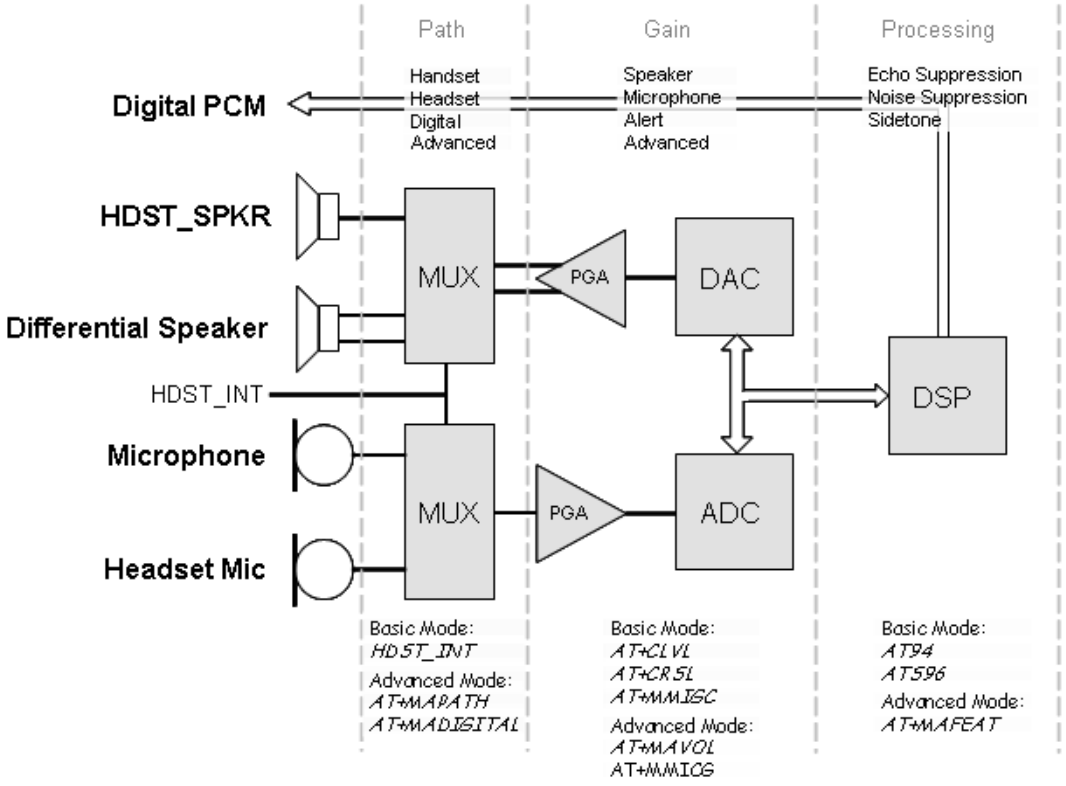


Figure 3-22: Audio Programming Interface

3.9.9.1. Audio Algorithms

The G30 audio interface features advanced speech processing algorithms for echo suppression, noise suppression and side-tone feedback.
Enabling or disabling the algorithms can be configured separately for each audio path and operating mode through the AT command interface.

The G30 also supports full rate (FR), half rate (HR), enhanced full rate (EFR) and adaptive multi-rate (AMR) speech coding algorithms, which are used by the GSM network. These algorithms are configured and operated by the GSM network provider.
The next table gives the speech processing features.

Feature	AT Command		Default Setting	Description
	Basic	Advanced		
Echo Suppression	ATS96	AT+MAFEAT	Disabled	Controls the echo and noise suppression.
Noise Suppression				
Sidetone	ATS94	AT+MAFEAT	Enabled	Controls the sidetone.

Table 3-16: Speech Processing Features

3.9.9.2. Gain Control

The amplification (gain) level for each input and output device can be configured through AT commands. Both basic and advanced audio modes provide AT commands to set the desired gain levels for each audio path and audio sound type.
The following table gives the gain control features.

Device	Gain Command		Default Gain	Description
	Basic	Advanced		
Microphone	AT+MMICG	AT+MMICG	8	Sets input speech gain level.
Headset Microphone			8	Sets input speech gain level.
Mono Speaker	AT+CLVL	AT+MAVOL	4	Sets voice and DTMF gain.
Differential Speaker	AT+CRSL		4	Sets rings and alerts gain.

Table 3-17: Gain Control Features

3.9.10. Audio Design

The audio quality delivered by G30 is highly affected by the application audio design, particularly when using the analog audio interface. Therefore, special care must be taken

when designing the G30 audio interface. Improper design and implementation of the audio interface will result in poor audio quality.
Poor audio quality is a result of electrical interferences, or noises, from circuits surrounding the audio interface. There are several possible sources for the audio noise:

- Transients and losses on the power supply
- EMI from antenna radiations
- Digital logic switching noise

Most of the audio noise originates from the GSM transmit burst current surges (217 Hz TDMA buzz), which appear on the main power supply lines and antenna, but also indirectly penetrate the internal application's supplies and signals. The noises are transferred into the G30's audio circuits through the microphone input signals and then are amplified by the G30's internal audio amplifiers.
To minimize the audio noise and improve the audio performance the microphone and speaker signals must be designed with sufficient protection from surrounding noises.
The following guidelines should be followed to achieve best audio performance:

- Reference the microphone input circuits to the G30 AGND interface signal.
- If using single-ended audio outputs, they should be referenced to the G30 AGND interface signal.
- Keep the audio circuits away from the antenna.
- Use RF filtering capacitors on the audio signals, as described in table 3-4.
- The audio signals should not be routed adjacent to digital signals.
- Isolate the audio signals by a surrounding ground plane or shields.
- Filter internal supplies and signals that may indirectly affect the audio circuits, from noises and voltage drops.

3.9.10.1. Analog Ground

The G30 interface incorporates a dedicated analog ground contacts, AGND pads 52, 54 (of the 81 pin LGA interface), which are internally connected to the G30's ground. The AGND signal is intended to provide a separate ground connection for the application's external audio devices and circuits.
This signal provides an isolated ground connection directly from G30, which is separated from the noisy digital ground of the application. It is recommended to connect this signal to analog audio devices and circuits used by the application. Using a separate analog ground minimizes audio noises and improves the audio circuit's immunity from external interferences.

3.10. A/D Interface

The G30 includes 3 Analog to Digital Converter (ADC) signals with 12-bit resolution, for environmental and electrical measurements. The ADC signals measure an analog DC voltage level on their inputs which is converted to a 12-bit digital value for further processing by G30 or the user application.
The A/D signals operation and reporting mechanism is defined by the AT+MADCM command. Each A/D can be defined to provide several reports:

- A single measurement.
  A single A/D measurement will take place and will be reported upon activation of the AT command.

- An automatic periodical measurement.
  The A/D measures its input signal at a rate that is defined by the user application. Every measurement will generate an unsolicited message over the serial interface.
- An automatic periodical measurement with predefined limits.
  The A/D measures its input signal at a rate that is defined by the user. The user also defines upper and/or lower limits for the A/D measurements. Each measurement is compared to these limits, and an unsolicited message is generated only if these limits are exceeded.

IMPORTANT:

In case the defined periodical measurement rate is equal to, or shorter than, the defined sleep mode delay settings (ATS24), G30 will not enter low power mode.

Applying voltage to ADC lines before power up is forbidden and may cause G30 power up issues.

If some ADC signals are not used, a 47 kOhm pull-down resistor to GND must be connected for each of the unused ADC lines.

3.10.1. Power Supply A/D

The main power supply (VCC) is constantly monitored internally by the G30 through a dedicated A/D signal, which is not accessible on the interface connector.
The measured VCC level can be read and monitored by the user application through the AT+MADCM command, which returns the measured VCC level in Volts times 1000.
For example, a measured supply level of 3.65 Volts will be presented as 3650 by the MADCM command.

IMPORTANT:
During GSM transmissions the power supply may suffer voltage drops. This can cause frequent and wide changes in the power supply A/D measurements. This should be taken into account when designing and operating the G30 power supply A/D interface.

The following table gives the supply A/D specifications.

Parameter	Conditions	Min	Typ	Max	Unit
Measurement Range		3.0		5.18	V
Resolution			10		mV

Table 3-18: Supply A/D Specifications

3.10.2. General Purpose A/D

The G30 provides 2 general purpose A/D (GPAD) signals for customer application use. Each

A/D signal can monitor a separate external voltage and report its measured level independently to the application, through the AT command interface.
The GPAD signals measure a DC voltage level of 0 - 1.92 V, which is converted internally to a 12-bit digital value. The user application can monitor the A/D voltage level through the AT+MADCM command, which returns the measured DC level in Volts times 100.
For example, a measured analog DC level of 1.75 Volts will be presented as 175 by the MADCM command.
The following table gives the GPAD specifications.

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	G30 Signal Name	G30 I/O	Function	Remarks
36	**37**	ADC1	I	Analog-to-Digital Converter Input	Resolution: 12 bits Voltage span: 0V-1.92V
35	**43**	ADC2	I	Analog-to-Digital Converter Input	Resolution: 12 bits Voltage span: 0V-1.92V.

Table 3-19: GPAD Specifications

3.11. Controls and Indicators Interface

The G30 incorporates several interface signals for controlling and monitoring the module's operation. The following paragraphs describes these signals and their operation.
The following table gives a description of the controls and indicators signals.

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	G30 Signal Name	G30 I/O	Function	Remarks
27	**25**	RESET_IN	OC	External reset input	External reset signal voltage domain.
-	**27**	VREF	O	Reference voltage supply (Typ. 2.85V)	Max current source 30mA.
62	**60**	VRTC	I/O	Real Time Clock Supply Output/Input	VRTC = 2.0 V (typical) 2mA Connect a 47uF capacitor to ground.
14	**26**	WKUPO	I/O	GPIO (M2M Zone only)	Generic digital interfaces

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	G30 Signal Name	G30 I/O	Function	Remarks
			O	Wake-Up Out	voltage domain. Output driver class F. PU/PD class B.
25	**16**	WKUPI	I/O	Interrupt	Generic digital interfaces voltage domain. Output driver class C. PU/PD class B.
			I	Wake-Up In	
13	**41**	ANT_DET	I/O	GPIO (M2M Zone only)	Generic digital interfaces voltage domain. Output driver class F. PU/PD class B.
			O	Antenna Detect	
16	**49**	GPRS	I/O	GPIO (M2M Zone only)	Generic digital interfaces voltage domain. Output driver class F. PU/PD class B.
			O	GPRS	
80	**28**	GPIO1	I/O	GPIO	Generic digital interfaces voltage domain. Output driver class F. PU/PD class B. Value at reset: T.
81	**30**	GPIO2	I/O	GPIO	Generic digital interfaces voltage domain. Output driver class F. PU/PD class B.
34	**32**	GPIO3/SDA	I/O	I^2C bus data line (M2M Zone only)	I^2C interface voltage domain. PU drain.
			I/O	GPIO	
33	**34**	GPIO4/SCL	O	I^2C bus clock line (M2M Zone only)	I^2C interface voltage domain. PU drain. Value at reset: T/OD.
			I/O	GPIO	

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	G30 Signal Name	G30 I/O	Function	Remarks
1	36	GPIO5	I/O	GPIO	Generic digital interfaces voltage domain. Output driver class F. PU/PD class B.
2	38	GPIO6	I/O	GPIO	Generic digital interfaces voltage domain. Output driver class F. PU/PD class B.
5	40	GPIO7	I/O	GPIO	Generic digital interfaces voltage domain. Output driver class F. PU/PD class B.
6	42	GPIO8	I/O	GPIO	Generic digital interfaces voltage domain. Output driver class F. PU/PD class B.
12		GPIO9	I/O	GPIO	Generic digital interfaces voltage domain. Output driver class F. PU/PD class B.

Table 3-20: Controls and indicators

3.11.1. Reset

To reset the module, RESET_IN must be used (see Table 3-21). This pin performs an external reset, also called hardware reset. Driving the RESET_IN pin low causes an asynchronous reset of the entire device except for the Real Time Clock block (RTC). The device then enters its power-on reset sequence.

NOTE:

As an external reset input, it is recommended that RESET_IN signal will be connected via a push button, or an open-drain transistor, or an open-collector transistor. In this way, when RESET_IN signal is not used, It will be at High-Z state. In any case, it is forbidden to connect this signal directly to any input voltage level.

3.11.2. VREF Reference Regulator

The G30 incorporates a regulated voltage output, VREF. The regulator provides a 2.85V output for use by the customer application. This regulator can source up to 30 mA of current to power any external digital circuits.

IMPORTANT:
The VREF regulator is powered from the G30's main power supply, and therefore any current sourced through this regulator originates from the G30 VCC supply. The overall VCC current consumed by G30 is directly affected by the VREF operation. The G30 current consumption rises with respect to the current sourced through VREF.

The following table gives the VREF specifications.

Parameter	Conditions	Min	Typ	Max	Unit
V_{OUT}	I_{OUT} = 30 mA	-3%	2.8	+3%	V
I_{OUT}				30	mA
Load regulation				7	mV
Line regulation				10	mV
PSRR	50 Hz - 20 kHz		35		dB

Table 3-21: VREF Specifications

3.11.3. VRTC

The G30 incorporates a real time block and is operated by the VRTC power located on pin 62 of the 81-pin LGA interface, or pin 60 of the 70-pin connector interface. For detailed explanation, refer to “Real Time Clock”.

NOTE:

A 47uF capacitor should be connected between ground and VRTC signal (pin 62 of the 81-pin LGA interface/pin 60 of the 70-pin connector).

3.11.4. Wakeup Out

Some applications incorporate their own power saving mode, in which they operate with minimal functionality, including disabling of interfaces and serial communications.
The wakeup-out (WKUPO) signal is an active low output, which is designed to support a low power mode feature in the host application. This signal is used by G30 to indicate that it requires to communicate with the host application through the serial interface, due to an incoming call or data, or an unsolicited event. Applications that incorporate a low power mode should use this signal as an indication to switch from low power mode to normal operation, and activate the serial interface.
The wakeup-out mechanism, using the WKUPO signal, is controlled by 2 AT commands (see figure 3-22):

- ATS102 - Defines the delay time in milliseconds that G30 will wait, after asserting the WKUPO signal low, before sending data on the serial interface. This delay is required to allow the application enough time to reactivate from low power mode and switch to normal mode.
  If ATS102=0, which is the default value, the WKUPO signal and mechanism is disabled.
  In case the serial interface incorporates hardware flow control signals, the data will be sent according to their state, after the ATS102 delay time has expired.

- ATS100 - Defines the application minimal wakeup duration, in seconds, for a single wakeup event. This time definition is required to avoid frequent unnecessary wakeup events and consequent ATS102 delays.
  The application may return to low power mode after the serial interface has been inactive for the duration set by ATS100. This duration is measured from the last data sent or received on the serial interface.

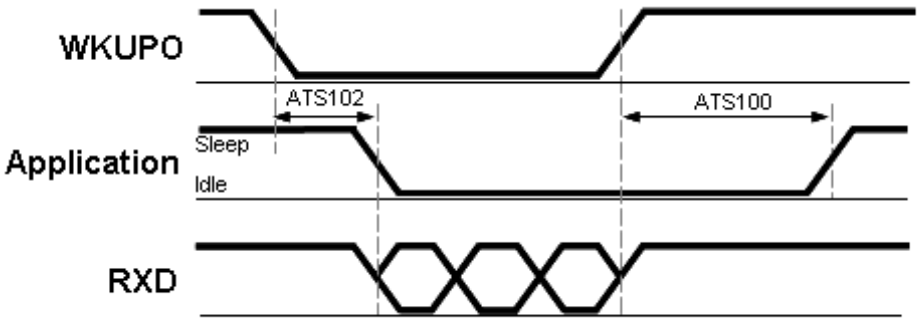


Figure 3-23: WKUPO Operation

The following guidelines apply to the wakeup-out mechanism:

- G30 will set the WKUPO signal low to indicate that in has data to send through the serial interface.
- G30 will start sending the data to the application after the delay defined by ATS102.
- The WKUPO signal will remain low while data is being sent to the host application.
- The host application should keep its serial interface active, and not switch to low power mode, while the WKUPO signal is low.
- G30 will set the WKUPO signal high when it has completed sending the data.
- The application serial interface must stay active, and not switch to low power mode, for the duration set by ATS100, after WKUPO is set high.
- G30 will not set the WKUPO signal low if it needs to send additional data during the ATS100 delay time.
- The application may switch to low power mode after the WKUPO signal is set high and the serial interface has been inactive for the duration set by ATS100.

3.11.5. Antenna Detection

The G30 incorporates an internal antenna detection circuit, which senses the physical connection and removal of an antenna or antenna circuit on the G30 antenna connector. The antenna detection state is reported to the application through the ANT_DET output signal, and

may also be queried by the ATS97 command.
The detection circuit senses DC resistance to ground on the G30 antenna connector.
A DC resistance below 100kohm (±10%) is defined as a valid antenna connection, and the ANT_DET output signal is set high.

NOTE:

Antenna detect indicator is valid after 2 second from power-up only.

3.11.6. GPRS Detection

The GPRS output signal indicates the network GPRS connection status. When G30 is connected to a GPRS network, this signal is enabled. When G30 is not connected to the GPRS network this signal is disabled.

3.11.7. General Purpose I/O

The G30 incorporates 9 general purpose IO signals in the 81 pin LGA interface, or 8 general purpose IO signals in the 70 pin connector interface for the user application. Each GPIO signal may be configured and controlled by AT command. These signals may be used to control or set external application circuits, or to receive indications from the external application.

3.12. Antenna Interface

IMPORTANT:

G30 has two basic hardware models that are differ from one another in the antenna interface. The first uses antenna interface with a U.FL connector, and the second uses RF B2B pads in accordance with the table below.
When a U.FL connector module is used, the RF B2B pads are not connected, but the design guidelines must be followed.

The board to board SMD pad 66 (ANT signal) has an impedance of 50Ω and it provides the RF antenna interface (see table below). The two pads close to the ANT pin (pads 52 and 54) are ground pads and must be used to provide the connection of the RF antenna to the grounding plane.

Pin # (81 pin LGA interface)	Pin # (70 pin connector interface)	G30 Signal Name	G30 I/O	Function	Remarks
66	**NA**	ANT	I/O	RF antenna	50Ω nominal impedance. (Applicable for G30 without U.FL connector model)

65,67	**NA**	GND	N/A	RF isolated Ground	Route Ground according to "RF Recommendation" on page 80.
	NA	ANT	I/O	RF Antenna (U.FL connector)	50Ω nominal impedance. (Applicable for G30 with U.FL connector model)

CAUTION:

A RF keepout area exists near the RF ANT pad of the LGA interface. Verify this area is left in-routed. Any use may result in permanent damage to the module. Special layout design rules must be followed, refer to "Layout Recommendations".

If the module is soldered on a customized board, special care must be taken on the layout design for the RF antenna pad which needs to be designed for 50Ω impedance and suitable copper keep out must be implemented below the RF test point.
The antenna or antenna application must be installed properly to achieve best performance.
The following table gives the antenna interface specifications.

Parameter	Conditions	Specifications
GSM 850	TX	824 - 849 MHz
	RX	869 - 894 MHz
GSM 900	TX	880 - 915 MHz
	RX	925 - 960 MHz
DCS 1800	TX	1710 - 1785 MHz
	RX	1805 - 1880 MHz
PCS 1900	TX	1850 - 1910 MHz
	RX	1930 - 1990 MHz
Gain		For antenna gain refer to "Antenna Installation"
Impedance		50Ω

Parameter	Conditions	Specifications
VSWR		Less than: 2.5:1

Table 3-22: Antenna Interface Specifications

It is the Integrator's responsibility to design the antenna or antenna assembly used with the G30. This will highly affect the RF performance of the G30 (dropped calls, battery consumption etc.). The following guidelines should be followed:

- Make sure that the antenna or antenna assembly matches the Antenna Interface Specifications.
- Use low loss RF cable and connectors keeping cable runs to a minimum.

4. Electrical and Environmental Specifications

4.1. Absolute Maximum Ratings

The following table gives the maximum electrical characteristics of the G30 interface signals.

CAUTION:

Exceeding the values may result in permanent damage to the module.

Description	Name	Limit Values	
		Min	Max
Module Supply (AC Max = 0.35 Vpp)	VCC	-0.15 V	4.5 V
Generic digital interfaces		-0.30 V	3.60 V
I^2C interface		-0.30 V	3.60 V
SIM interface		-0.30 V	3.60 V
RESET_IN signal		0.15 V	2.5 V
Audio pins			
ADC pins		-0.15 V	3.0 V

Table 4-1: Maximum Ratings

4.2. Operating Parameters

4.2.1. Supply/power Pins

Supply Description	Name	Limit Values		
		Min	Typ	Max
Module Supply	VCC	3.3 V	3.8 V	4.2 V
RTC Supply	VRTC	1.86 V	2.0 V	2.14 V

Table 4-2: Input Characteristics

Supply Description	Name	Limit Values		
		Min	Typ	Max
SIM Supply	VSIM	1.75 V	1.80 V	1.85V
		2.76 V	2.85 V	2.94 V
RTC Supply	VRTC	1.86 V	2.00 V	2.14 V
Reference voltage supply	VREF	2.76 V	2.85 V	2.94 V

Table 4-3: Output Characteristics

4.2.2. Digital Pins

Voltage Domain	Parameter	Limit Values			Unit	Remarks
		Min	Typ	Max		
Generic digital interfaces	L-level input	-0.20		0.55	V	Voltage Domain = VIO = 2.85 V
	H-level input	2.05		3.30	V	Voltage Domain = VIO = 2.85 V
I^2C interface	L-level input	-0.30		0.82	V	In accordance with I^2C bus specification.
	H-level input	2.05		3.30	V	In accordance with I^2C bus specification.
	Hysteresis	0.15			V	In accordance with I^2C bus specification.
SIM interface	L-level input			0.37	V	VSIM = 1.80 V
				0.60	V	VSIM = 2.85 V
	H-level input	1.22			V	VSIM = 1.80 V
		1.95			V	VSIM = 2.85 V
RESET_IN signal	L-level input			0.37	V	
	H-level input	1.6			V	

Table 4-4: Input Characteristics

Voltage Domain	Parameter	Limit Values			Unit	Remarks
		Min	Typ	Max		
Generic digital interfaces	L-level output for output driver class B slow		0.00	0.80	V	I_{OL} = +15.0 mA
	L-level output for output driver class B		0.00	0.35	V	I_{OL} = +5.0 mA
	L-level output for output driver class C		0.00	0.35	V	I_{OL} = +4.0 mA
	L-level output for output driver class D		0.00	0.35	V	I_{OL} = +2.0 mA
	L-level output for output driver class E and F		0.00	0.35	V	I_{OL} = +1.5 mA
	H-level output for output driver class B slow	2.05	2.85		V	I_{OH} = -15.0 mA
	H-level output for output driver class B	2.05	2.85		V	I_{OH} = -5.0 mA
	H-level output for output driver class C	2.05	2.85		V	I_{OH} = -4.0 mA
	H-level output for output driver class D	2.05	2.85		V	I_{OH} = -2.0 mA

Voltage Domain	Parameter	Limit Values			Unit	Remarks
	H-level output for output driver class E and F	2.05	2.85		V	I_{OH} = -1.5 mA
I^2C interface	L-level output		0.00	0.40	V	I_{OL} = +3.0 mA
SIM interface	L-level output		0.00	0.20	V	VSIM = 1.80 V I_{OL} = +1.0 mA
			0.00	0.35	V	VSIM = 1.80 V I_{OL} = +1.5 mA
			0.00	0.20	V	VSIM = 2.85 V I_{OL} = +1.0 mA
			0.00	0.35	V	VSIM = 2.85 V I_{OL} = +1.5 mA
	H-level output	1.60	1.80		V	VSIM = 1.80 V I_{OH} = -1.0 mA
		1.45	1.80		V	VSIM = 1.80 V I_{OH} = -1.5 mA
		2.65	2.85		V	VSIM = 2.85 V I_{OH} = -1.0 mA
		2.50	2.85		V	VSIM = 2.85 V I_{OH} = -1.5 mA

Table 4-5: Output Characteristics

Voltage Domain	Parameter	Limit Values			Unit	Remarks
		Min	Typ	Max		
Generic digital interfaces or SIM interface	Pull-up input current for pull class A			-450	uA	
	Pull-up input current for pull class B			-100	uA	
	Pull-up input current for pull class C			-30	uA	
	Pull-down input current for pull class A			450	uA	
	Pull-down input current for pull class B			100	uA	
	Pull-down input current for pull class C			30	uA	

Table 4-6: Pad Pull-up and Pull-down Characteristics

4.2.3. Audio Pins

Parameter	Limit Values			Unit	Remarks
	Min	Typ	Max		
Differential input voltage			1.03	Vpp	
Differential input impedance		50		kΩ	
Input capacitance		5	10	pF	
Signal to distortion	65			dB	
Signal-to-noise ratio	75			dB	Gain stage = +12dB Bandwidth = 300-3900Hz (GSM mode)
	72			dB	Gain stage = +12dB Bandwidth = 300-7000Hz (WAMR mode)
Power supply rejection	66	85		dB	Gain stage = +24dB $U_{VDD}(t)$ = 2.5V+0.15V•sin(2π•1kHz•t)
	62			dB	Gain stage = +18dB $U_{VDD}(t)$ = 2.5V+0.15V•sin(2π•1kHz•t)
	45			dB	Gain stage = +0dB $U_{VDD}(t)$ = 2.5V+0.15V•sin(2π•1kHz•t)
Cross talk (between Rx and Tx channel)			-65	dB	$U_{TX}(t)$ = 1.075V+ $U_{RX}(t)$ = 0.775V•sin(2π•1kHz•t)

Parameter	Limit Values			Unit	Remarks
Cut-off frequency of anti-alias filter	16			kHz	
Absolute gain drift			±2	%	Variation due to change in supply, temperature and life time.

Table 4-7: Audio Transmit Path Characteristics

Parameter	Limit Values			Unit	Remarks
	Min	Typ	Max		
Output voltage of pin VMIC		2.20		V	Settable to: 1.8 V, 2.0 V, 2.2 V typ.
Microphone supply current			2.0	mA	
Power supply rejection of microphone supply		75		dB	Gain stage = +0dB in crosstalk free conditions at board level $U_{VDD}(t)$ = 2.6V+0.10V•sin(2π•1kHz•t)

Table 4-8: Microphone Supply Characteristics

Parameter	Limit Values			Unit	Remarks
	Min	Typ	Max		
Maximum single-ended output voltage	1.65	1.85	2.05	Vpp	Full scale single-ended open circuit voltage.
Internal output resistance		1.7	4	Ω	

Parameter	Limit Values			Unit	Remarks
Output load resistance		16		Ω	
Single-ended output load capacitance			10	nF	
Signal to noise	70	80		dB	Load = 16Ω, Gain stage = +0dB, Input signal = 0dBFS, Code 0, A-weighted
Signal to distortion	60	70		dB	Load = 16Ω, Gain stage = +0dB, Input signal = 0dBFS
	60	70		dB	Load = 16Ω, Gain stage = +0dB, Input signal = -1dBFS
	60			dB	Load = 16Ω, Gain stage = +0dB, Input signal = -6dBFS
Power supply rejection	60	66		dB	Gain stage = +0dB, $U_{VDD}(t)$ = 2.5V+0.15V•sin(2π•1kHz•t)
Passband ripple			0.5	dB	f < 0.45 f_s
Stopband attenuation	50			dB	f > 0.55 f_s
Absolute gain drift			±2	%	Variation due to change in supply, temperature and life time.

Table 4-9: G30 Low Power Single-ended Audio Receive Path Characteristics

Parameter	Limit Values			Unit	Remarks
	Min	Typ	Max		
Maximum differential output voltage		10.4		Vpp	Overdrive Gain stage = +9dB
Output load resistance		8		Ω	
Single-ended output load capacitance			10	nF	
Inductive load			400	uH	Between output pins and GND with series resistance
Signal to noise	70	80		dB	Load = 16Ω, Gain stage = +0dB, Input signal = 0dBFS, Code 0, A-weighted
Signal to distortion	50			dB	Load = 8Ω, 350mW
Power supply rejection	60			dB	1kHz

Table 4-10: G30 High Power Differential Audio Receive Path Characteristics

4.2.4. ADC Pins

Parameter	Limit Values			Unit	Remarks
	Min	Typ	Max		
Resolution		12		Bits	
Differential linearity error			±0.5	LSB	

Parameter	Limit Values			Unit	Remarks
Integral linearity error			±4	LSB	
Offset error			±10	LSB	ADC input = 0V
Absolute gain drift			±2	%	Variation due to change in supply, temperature and life time.
Input voltage span	0		1.92	V	
Throughput rate			4	Hz	With current ADC SW driver.
Input resistance	1			MΩ	With respect to AGND. If mode OFF is selected.
Input resistance in measurement mode	288	480	672	kΩ	With respect to AGND. Variation due to process tolerances and change in supply, temperature, and life time.
Internal voltage	0.46	0.48	0.50	V	With respect to AGND. Variation due to process tolerances and change in supply, temperature, and life time.
Input leakage current			0.1	uA	

Table 4-11: Input Characteristics

4.3. Environmental Specifications

The following table gives the environmental operating conditions of the G30 module.

CAUTION:

Exceeding the values may result in permanent damage to the module.

Parameter	Conditions	Min	Max	Unit
Ambient Operating Temperature		-30	85	°C
Storage Temperature		-40	85	°C
ESD	At antenna connector Contact Air At interface pads/connector		± 8 ± 15 ± 1	KV

Table 4-12: Environmental Ratings

4.4. Application Interface Specifications

The following table summarizes the DC electrical specifications of the application interface connector signals.

IMPORTANT:

Interface signals that are not used by the customer application must be left unconnected. G30 incorporates the necessary internal circuitry to keep unconnected signal in their default state. Do not connect any components to, or apply any voltage on, signals that are not used by the application.

Signals that are defined as "Do Not Use", or DNU, must remain externally unconnected in any case. These signals are reserved for future use.

The following figures give a brief description of the 70 pins connector and the 81 pin LGA interface irrespectively for quick integration.

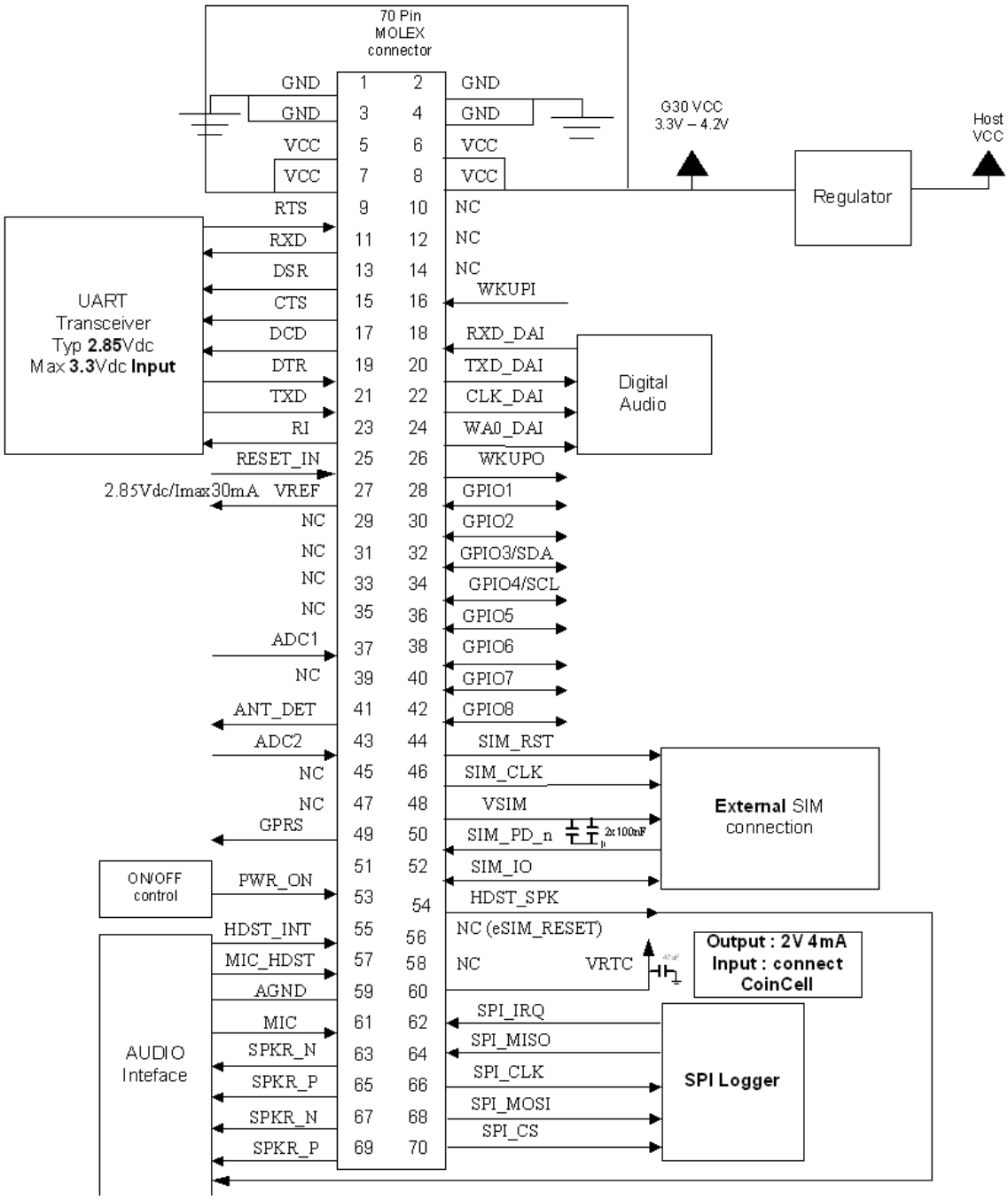


Figure 4-1: G30 - 70 Pin Connector Quick Integration Connections

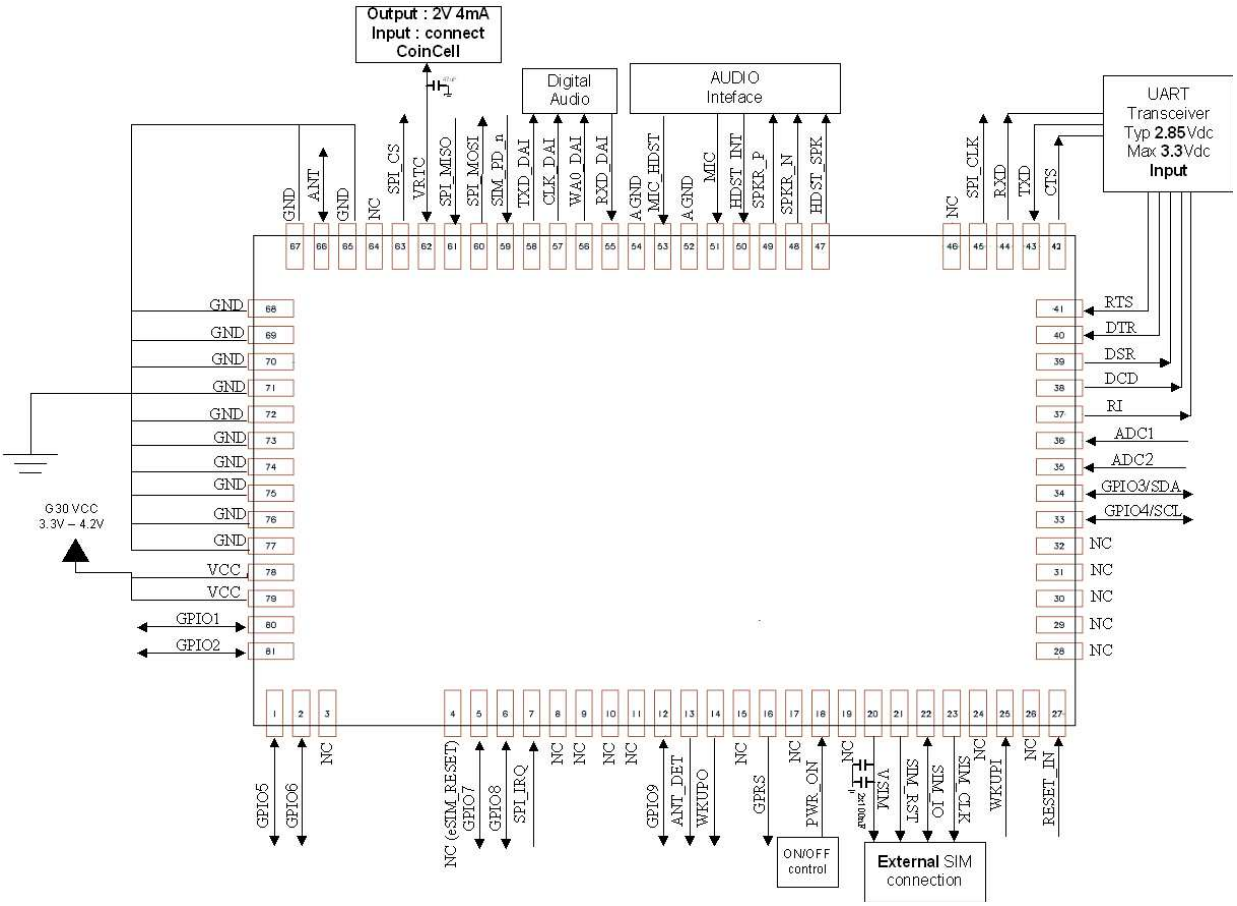


Figure 4-2: G30 - 81 Pin LGA Interface Quick Integration Connections

Note: Refer to "Interface Connector Specifications" on page 74.

Pin No. (81 pin LGA interface)	@70 Pin Conn.	Name	I/O	Function	Value @ Reset	Characteristics (Operating Parameters)
1	36	GPIO5	I/O	GPIO	I H 100K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B.
2	38	GPIO6	I/O	GPIO	I H 100K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B
3	Not Connected					
4	56	eSIM_RESET	I	Embedded SIM reset	T	If eSIM is being used short this pin to pin 21

Pin No. (81 pin LGA interface)	@70 Pin Conn.	Name	I/O	Function	Value @ Reset	Characteristics (Operating Parameters)
5	40	GPIO7	I/O	GPIO	I H 100K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B.
6	42	GPIO8	I/O	GPIO	I H 100K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B.
7	62	SPI_IRQ	I	SPI Interrupt Input		Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class C. PU/PD class B.
			I/O	Capture/Compare		
			I/O	GPIO	I H 100K PU	
8-11	Not Connected					
12		GPIO9	I/O	GPIO	I H 100K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B.
13	41	ANT_DET	I/O	GPIO (M2M Zone only)		Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B.
			O	Antenna Detect	L - No Antenna H - Valid Antenna	
14	26	WKUPO	I/O	GPIO (M2M Zone only)		Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B.
			O	Wake-Up Out	H	
15	Not Connected					
16	49	GPRS	I/O	GPIO (M2M Zone only)		Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B.

Pin No. (81 pin LGA interface)	@70 Pin Conn.	Name	I/O	Function	Value @ Reset	Characteristics (Operating Parameters)
			O	GPRS	L - Valid GPRS connection H - No GPRS connection	
17	Not Connected					
18	53	PWR_ON	I	Power-on/off input	T/PD	RTC interface. (2.0V typ.) Use OC circuit only
19	Not Connected					
20	48	VSIM	O	SIM supply output		VSIM = 1.80 V typical if SIM card = 1.8V type or VSIM = 2.85 V typical if SIM card = 3.0V type
21	44	SIM_RST	O	External SIM reset	L	SIM interface voltage domain (VSIM). Output driver class E. PU/PD class B.
22	52	SIM_IO	I/O	SIM data	H 4.7K PU	SIM interface voltage domain (VSIM). Output driver class E. PU/PD class B.
23	46	SIM_CLK	O	SIM clock	L	SIM interface voltage domain (VSIM). Output driver class E. PU/PD class B.
24	Not Connected					
25	16	WKUPI	I/O	Interrupt		Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class C. PU/PD class B.
			I	Wake-Up In	I H 100K PU	

Pin No. (81 pin LGA interface)	@70 Pin Conn.	Name	I/O	Function	Value @ Reset	Characteristics (Operating Parameters)
26	Not Connected					
27	25	RESET_IN	OC	External reset input	I H 19K PU	External reset signal voltage domain. Use OC circuit only
28-32	Not Connected					
33	34	GPIO4/SCL	O	I^2C bus clock line (M2M Zone only)		I^2C interface voltage domain. PU drain. Value at reset: T/OD.
			I/O	GPIO	I H 100K PU	
34	32	GPIO3/SDA	I/O	I^2C bus data line (M2M Zone only)		I^2C interface voltage domain. PU drain.
			I/O	GPIO	I H 100K PU	
35	43	ADC2	I	Analog-to-Digital Converter Input	L	Resolution: 12 bits Voltage span: 0V-1.92V
36	37	ADC1	I	Analog-to-Digital Converter Input	L	Resolution: 12 bits Voltage span: 0V-1.92V
37	23	RI	O	Ring Indicator	H	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class D. PU/PD class B.
			I/O	GPIO (M2M Zone only)		
38	17	DCD	O	Data Carrier Detect	H	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class B. PU/PD class B

Pin No. (81 pin LGA interface)	@70 Pin Conn.	Name	I/O	Function	Value @ Reset	Characteristics (Operating Parameters)
39	**13**	DSR	O	Data Set Ready	L	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class B slow. PU/PD class A.
40	**19**	DTR	I	Data terminal ready	I H 100K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class C. PU/PD class B.
41	**9**	RTS	I	Ready to send	4.7K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class C.
42	**15**	CTS	O	Clear To Send		Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class E. PU/PD class C.
43	**21**	TXD	I	Transmitted Data	200K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class E. PU/PD class C.
44	**11**	RXD	O	Received Data	T	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class E. PU/PD class C.
45	**66**	SPI_CLK	O	SPI Clock Short to Pin 57	T	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class D. PU/PD class B.
46	**Not Connected**					
47	**54**	HDST_SPK	O	Low power single-ended analog audio output		Used in handset or in headset mode
48	**63,67**	SPKR_N	O	High power differential analog audio output		Used in ring tones or in hands free mode

Pin No. (81 pin LGA interface)	@70 Pin Conn.	Name	I/O	Function	Value @ Reset	Characteristics (Operating Parameters)
49	**65,69**	SPKR_P	O	High power differential analog audio output		Used in ring tones or in hands free mode
50	**55**	HDST_INT	I	Headset detection input		Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class E. PU/PD class B.
			I	External interrupt input		
51	**61**	MIC	I	Headset microphone analog bias		Single ended supply output and signal input for Handset microphone. Used in handset or in hands free mode
52	**59**	AGND1	I	Handset microphone analog reference		Local ground of the Handset microphone
53	**57**	MIC_HDST	I	Headset microphone analog bias		Single ended supply output and signal input for microphone. Used in headset mode
54	**59**	AGND2	I	Headset microphone analog reference		Local ground of the Headset microphone
55	**18**	RXD_DAI	I	I2S receive data Short to pin 61	47K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class D. PU/PD class B.
56	**24**	WA0_DAI	O	I2S word alignment Short to pin 60	T	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class D. PU/PD class B.
57	**22**	CLK_DAI	O	I2S clock Short to pin 45	T	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class D. PU/PD class B.
58	**20**	TXD_DAI	O	I2S transmit data Short to pin 63	T	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class D. PU/PD class B.

Pin No. (81 pin LGA interface)	@70 Pin Conn.	Name	I/O	Function	Value @ Reset	Characteristics (Operating Parameters)
59	50	SIM_PD_n	I	SIM present detect	OD/L	SIM interface voltage domain. Output driver class E. PU/PD class B.
60	68	SPI_MOSI	O	SPI sync data (MOSI) Shorted to pin 56	T	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class D. PU/PD class B
61	64	SPI_MISO	I	SPI sync data (MISO) Shorted to pin 55	47K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class D. PU/PD class B.
62	60	VRTC	I/0	Real Time Clock Supply Output/Input		VRTC = 2.0 V (typical) 2mA Connect a 47uF capacitor to ground.
63	70	SPI_CS	O	SPI chip select Short to pin 58	T	Generic digital interfaces voltage domain (Typ. 2.85V). Output driver class D. PU/PD class B.
64	Not Connected					
65	1,2,3,4	GND	NA	Ground		GND pins are internally shorted between them.
66	N.C	ANT	I/O	RF antenna		50 Ohm nominal impedance
67	1,2,3,4	GND	NA	Ground		GND pins are internally shorted between them.
68	1,2,3,4	GND	NA	Ground		GND pins are internally shorted between them.
69	1,2,3,4	GND	NA	Ground		GND pins are internally shorted between them.
70	1,2,3,4	GND	NA	Ground		GND pins are internally shorted between them.
71	1,2,3,4	GND	NA	Ground		GND pins are internally shorted between them.
72	1,2,3,4	GND	NA	Ground		GND pins are internally shorted between them.

Pin No. (81 pin LGA interface)	@70 Pin Conn.	Name	I/O	Function	Value @ Reset	Characteristics (Operating Parameters)
73	**1,2,3,4**	GND	NA	Ground		GND pins are internally shorted between them.
74	**1,2,3,4**	GND	NA	Ground		GND pins are internally shorted between them.
75	**1,2,3,4**	GND	NA	Ground		GND pins are internally shorted between them.
76	**1,2,3,4**	GND	NA	Ground		GND pins are internally shorted between them.
77	**1,2,3,4**	GND	NA	Ground		GND pins are internally shorted between them.
78	**5,6,7,8**	VCC	I	Voltage Supply Input		VCC pins are internally shorted between them.
79	**5,6,7,8**	VCC	I	Voltage Supply Input		VCC pins are internally shorted between them.
80	**28**	GPIO1	I/O	GPIO	I H 100K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B.
81	**30**	GPIO2	I/O	GPIO	I H 100K PU	Generic digital interfaces (Typ. 2.85V) voltage domain. Output driver class F. PU/PD class B.
	27	VREF	O	Reference voltage supply	2.85V	Max current source 30mA
82-89	**Not Connected**					
RF TP	**Not Connected – Refer to** "RF Recommendation" on page 80**.**					

Table 4-13: Interface Specifications

NOTE:

PU - Pull up, PD - Pull down, I - Input, H - High logic state, L - Low logic state, OC - open collector, O - Output, NA - Not Applicable

5. Mechanical Specifications

5.1. Board Dimensions

The following pictures describe the G30 mechanical characteristics.

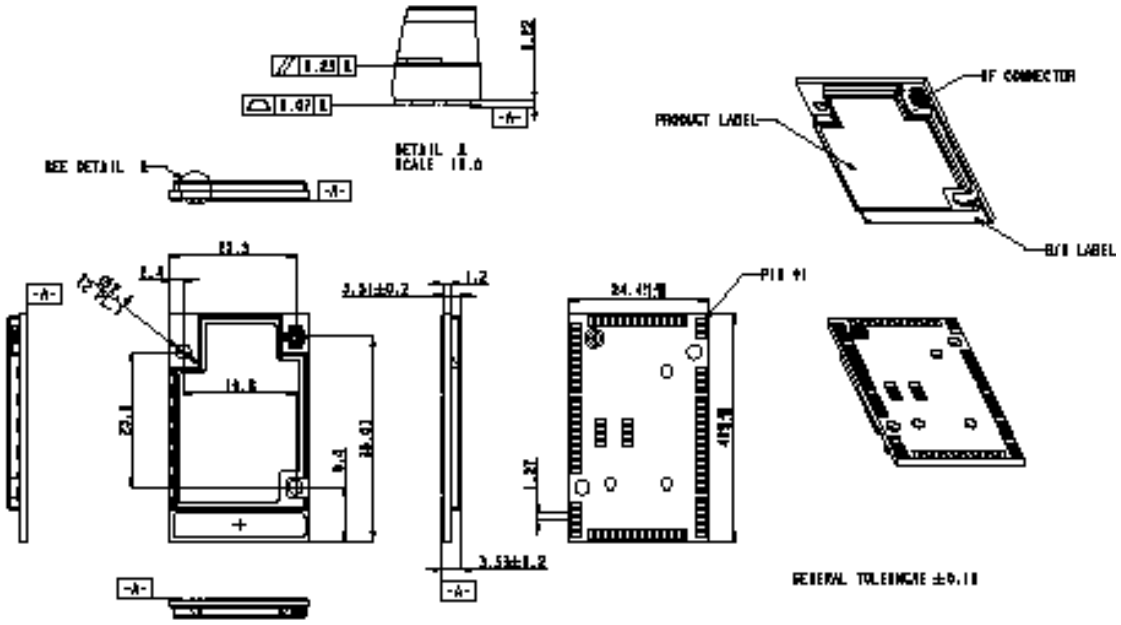


Figure 5-1: G30 Mechanical Characteristics - 81 Pin LGA Interface

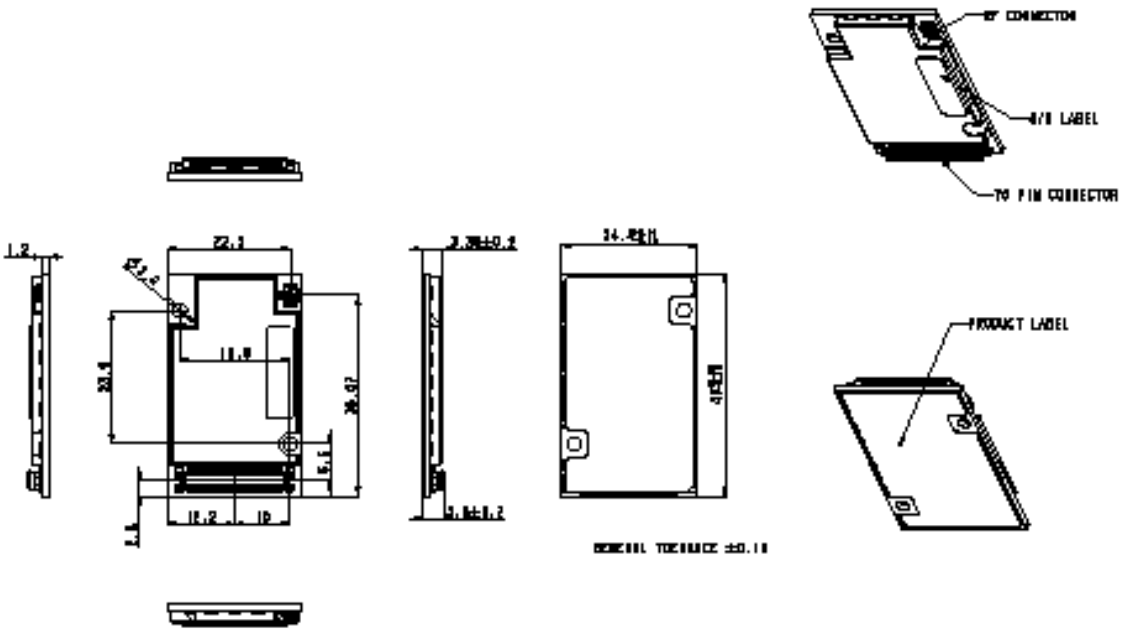


Figure 5-2: G30 Mechanical Characteristics - B2B Connector (70 Pin)

5.2. LGA Tape & Reel Specification

The following picture shows LGA Tape & Reel specification.

Each reel contains 500 units.

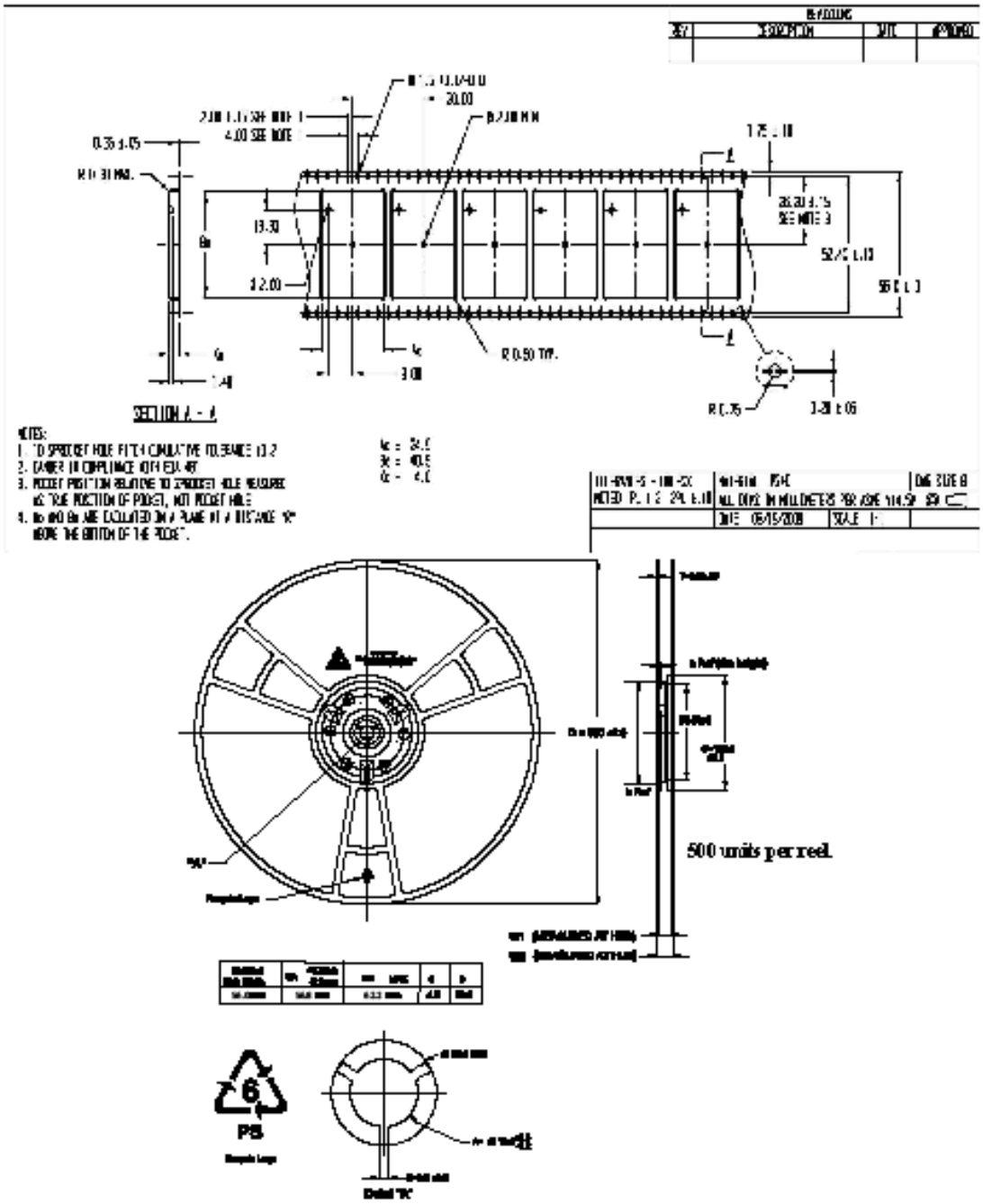


Figure 5-3: LGA Tape & Reel Specification

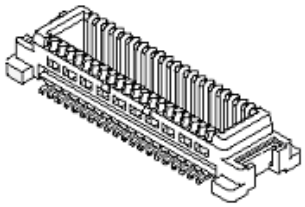
5.3. Interface Connector Specifications

The G30 uses a single 70-pin, 0.5 mm pitch, board to board connector for the application interface.

G30 interface connector option

G30 Connector	Mating Connector	Stacking Height
Molex 53748-0708	Molex 52991-0708	3.0 mm

shows the G30 interface connector.



53748-0708 3.0mm

G30 Interface Connector

The following table describes the G30 interface connector characteristics.

Parameter	53748 (3.0 mm)
Contacts	70
Rows	2
Pitch	0.5 mm
Maximum Current	500 mA
Maximum Voltage	50 V
Contact Resistance	50 mΩ maximum
Insulation Resistance	100 MΩ minimum
Durability	50 mated cycles maximum
Stacking Height	3.0 mm
Mates with	Molex 52991-0708

Table 5-1: Interface Connector Specifications

5.3.1. Mating Connector

The mating connector incorporate the same electrical and mechanical characteristics as the corresponding G30 interface connectors, which are described in table 5-1.

The following figure provides a reference drawing of the mating connectors mechanical dimensions.

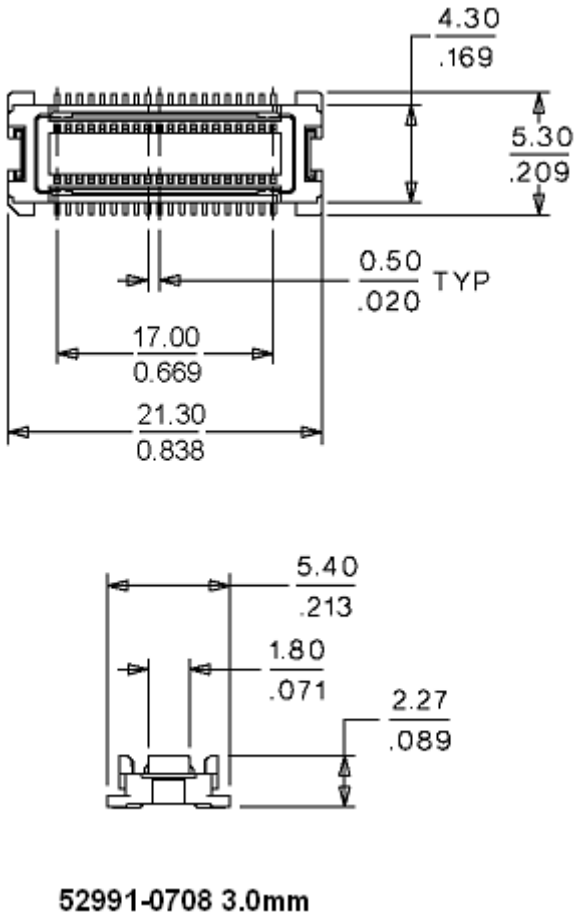


Figure 5-4: Mating Connector Dimensions

For more information on the G30 mating connector, please refer to the Molex web site at http://www.molex.com/molex/index.jsp.

5.4. U.FL Connector Specifications

The G30 uses a standard U.FL receptacle connector for the radio interface.

The following figure shows the U.FL connector dimensions.

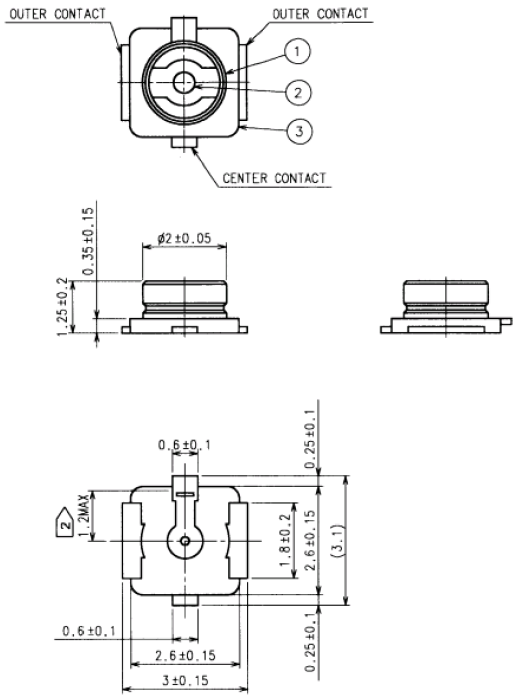


Figure 5-5: U.FL Connector Dimensions

The following table describes the U.FL connector characteristics.

Parameter	Specifications
Characteristic Impedance	50 Ohms
Frequency Range	DC to 6 GHz
VSWR (mated pair)	1.30 max DC to 3 GHz 1.40 max 3 to 6 GHz (cable dependent)
Insertion Loss (connectors only)	0.24 dB max DC to 6 GHz
Rated voltage	60 VAC (rms) - standard receipt (Styles A, B)
Dielectric Withstanding Voltage	200 VAC, 50 Hz for 1 min (at sea level)
Insulation Resistance	500 Megaohms min
Contact Resistance (connectors only)	20 milliohms max (Center) 10 milliohms max (Outer, Plug) 10 milliohms max (Outer, Receptacle)
Durability	30 cycles - standard receipt (Styles A, B)
Disengagement Force	2N min perpendicular 4N min orthogonal
Center Contact Retention force	0.15N min
Tape/Reel Packaging (receptacle)	12mm carrier per EIA-481
Operating Temperature	40°C to + 90°C

Table 5-2: U.FL Connector Specifications

5.4.1. Mating Connector

The RF mating connector should be a standard U.FL plug connector or cable assembly, which corresponds to the G30 U.FL connector specifications.

Only Hirose U.FL mating cable may be mated with G30. A family of Hirose mating cables are available.

Such a cable assembly example is the Hirose U.FL-LP-040 is U.FL-R-SMT, which is illustrated in See U.FL Mating Connector..

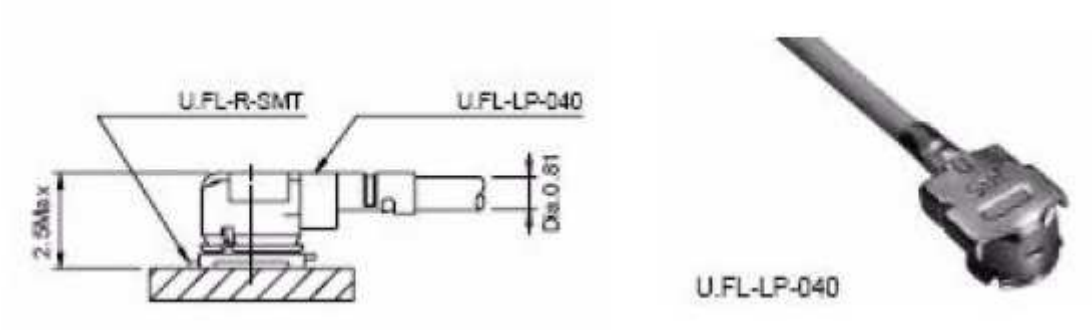


Figure 5-6: U.FL Mating Connector

For more details regarding Hirose mating cable assemblies, refer to http://www.hirose.co.jp/cataloge_hp/e32119372.pdf.

5.5. G30 Mounting

NOTE:

This section applies to G30 70 pin connector Model only.

The G30 incorporates 2 mechanical holes for installing the module onto the application board. The holes are 2.4 millimeters in diameter, which accommodates several types of mechanical elements.

Several mechanical approaches may be applied to mount and fasten G30 to the application board. Using M2 screws with suitable washers to mount the module onto spacers, a bracket or chassis is a recommended design.

WARNING:

Due to shield opening restriction, the spacer diameter must not exceed 3.7mm.

Special attention must be paid to the area surrounding the G30 mounting holes. A grounding pad of 4.4 millimeters in diameter surrounds these holes. The diameter and area of this pad must not be exceeded by any mechanical or electrical element. Several electrical components, which are not shielded, are located near the holes. These components must not be in contact with the mounting elements or with other parts of the application board, and care must be taken to avoid any damage.

The following picture depicts the G30 mounting area.

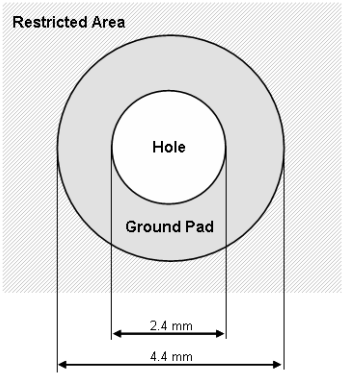


Figure 5-7: G30 Mounting Area

The holes are used for mechanical mounting of G30 to the application board but also for grounding support. Using conductive elements to install G30, significantly improves the overall grounding of the module and therefore improves the G30 performance and stability.

It is required to use screws or other mechanical elements to fasten G30 to the application board, but it is highly recommended to use conductive elements to improve the module's performance.

The preferred mounting screw head types are:

- "Allen" head with a champer - the best choice.
- "Star" head - good.
- "Philips" head - may cause damage to nearby components.

5.6. Layout Recommendation

NOTE:

This section applies to G30 LGA Model only.

5.6.1. Soldering Footprint

The following figure gives a layout recommendation for the G30.

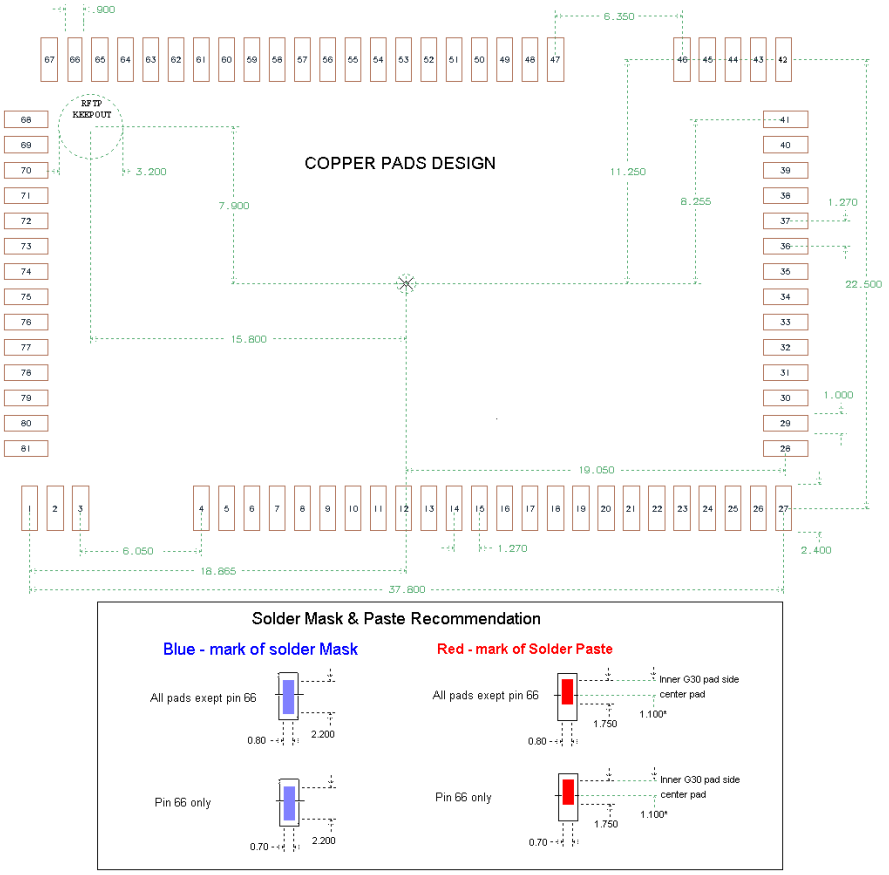


Figure 5-8: G30 Soldering Footprint (Top View)

- Routing signals other then GND (Ground) within inner soldering footprint area of G30 (under G30) is not recommended.
- Vias inside pads are not recommended.
- Verify GND pads are well tied to ground plane layer by vias.

5.6.2. RF Recommendation

NOTE:

The restrictions below are valid for both U.FL connector and RF PAD.

- Avoid ANY routing below RF Test-Point Round circle, and RF pad, Pin-66.
- Keep the RF TP area and its clearance area cleared from Routing and GND (internal layers also), at least 0.45mm below the G30.
- RF PAD must be connected with a 50 ohm controlled impedance Line.

- Keep the RF PAD area cleared from GND (internal layers also), at least 0.45mm below the G30.
- Cover all Pads area with inner GND Layer below the 0.45mm routing clearance.

5.7. Soldering Re-flow

G30 LGA recommended soldering re-flow process is given in thefollowing table and picture.

Classification of regular Pb-Free Assembly Re-flow Profile	
Preheat and Soak	
Temperature minimum (Tsmin)	150°C
Temperature maximum (Tsmax)	200°C
Time (Tsmin to Tsmax) (ts)	60-120 seconds
Average ramp-up rate (Tsmax to Tp)	3°C/second maximum
Liquidous temperature (TL)	217°C
Time at liquidous (t)	60-150 seconds
Peak package body temperature (Tp)	245 + 0°C
Time (tp) within 5°C of the specified classification temperature (TC)	30 seconds
Average ramp-down rate (Tp to Tsmax)	6°C/second maximum
Time 25°C to peak temperature	8 minutes maximum
Number of re-flows	1

Table 5-3: Soldering Re-flow Process

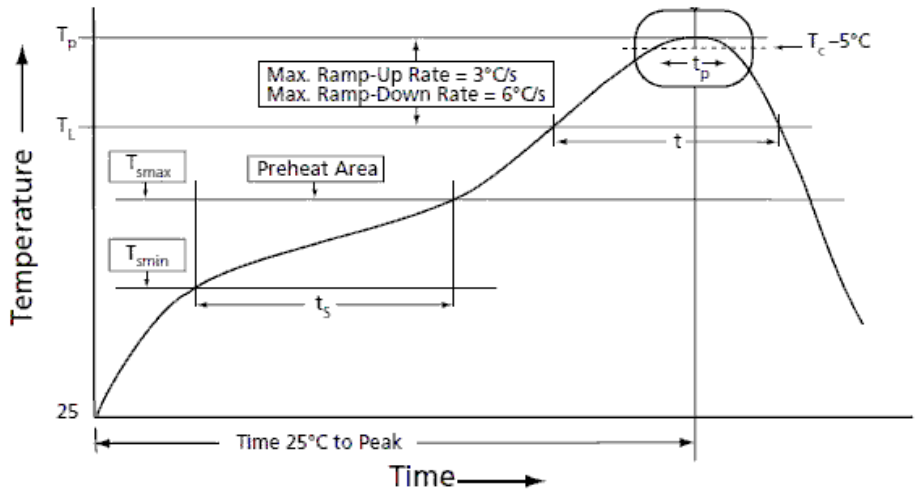


Figure 5-9: Soldering Re-flow Process

NOTE:

Any G30 LGA removal must be performed according to IPC-7711 standard "Rework of Electronic Assemblies" chap 3.9.1 or 3.9.2 regarding “BGA/CSP Removal”. The IPC-7711 can be found at www.ipc.org.

6. Acronyms and abbreviations

AMR	Adaptive Multi Rate
AOC	Advice of Charge
B2B	Board to Board
BR	Baud Rate
bps	Bits Per Second
CSD	Circuit Switched Data
CTS	Clear to Send
DCD	Data Carrier Detect
DCE	Data Communication Equipment (such as modems)
DCS	Digital Cellular System (GSM in the 1800MHz band)
DOC	Department of Communications (Canada)
DRX	Discontinuous Reception
DSP	Digital Signal Processor
DSR	Data Set Ready
DTE	Data Terminal Equipment (such as terminals, PCs and so on)
DTMF	Dual Tone MultiFrequency
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGPRS	Enhanced General Packet Radio Service
EGSM	Extended Global System for Mobile Communications
EIRP	Effective Isotropic Radiated Power
EMC	Electromagnetic Compatibility
EOTD	Enhanced Observed Time Difference
EPOS	Electronic Point of Sale
ERP	Effective Radiated Power
ESD	Electrostatic Discharge
ETSI	European Telecommunication Standards Institute
FCC	Federal Communications Commission (U.S.)
FR	Full Rate
FTA	Full Type Approval
GCF	GSM Certification Forum
GPIO	General Purpose Input/Output
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HR	Half Rate
IC	Integrated Circuit
LNA	Low-noise Amplifier
MMCX	Miniature Micro Coax
MO	Mobile Originated

MT	Mobile Terminated
OEM	Original Equipment Manufacturer
PCB	Printed Circuit Board
PCL	Power Class Level
PCM	Pulse Code Modulation
PCS	Personal Communication System (also known as GSM 1900)
PD	Pull Down
PDA	Personal Data Assistant
PDU	Packet Data Unit
PLL	Phase-locked Loop
PTCRB	PCS-1900 Type Certification Review Board (GSM North America)
PU	Pull Up
R&TTE	Radio and Telecommunications Terminal Equipment
RMS	Root Mean Square
RI	Ring Indicator
RTS	Request To Send
SAR	Specific Absorption Rate
SIM	Subscriber Identity Module
SMS	Short Message Service
SPI	Serial Peripheral Interface
TDMA	Time Division Multiple Access
TIS	Transmitter Isotropic Sensitivity
TRP	Transmitter Radiated Power
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
USSD	Unstructured Supplementary Services Data
VCC	Voltage Common Collector
VSWR	Voltage Standing Wave Ratio

6.1. Document history

Revision	Date	Changes
0	2010-05-04	First issue