Developer's Guide

Motorola g20
Cellular Engine
Module Description

98-08901C66-G

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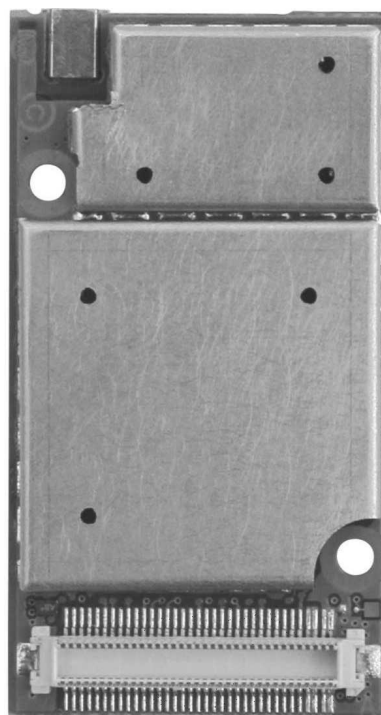
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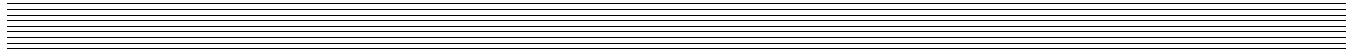©Copyright 2005 Motorola, Inc.

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REV052604

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REVISION HISTORY

Revision	Date	Purpose
O	30 June 2003	Initial release
A	05 November 2003	Minor corrections to the manual
B	15 February 2004	Updated book version
		Updated section 2.3, Product Specifications
		Updated section 2.5, Regulatory Approvals
		Updated section 3.2.3.1, On/Off Signal
		Updated Waking up the DTE diagram in section 3.2.4.2, DCE/DTE Connectivity
		Updated section 3.3.3.1, SIM Connection
		Added section 3.3.5.3, Antenna Detect
		Updated section 3.4.1.1, Analog Input
		Removed 2 g20 models
C	1 March 2004	Updated Table 13 - g20 Interface Connector Pin Assignments
D	July 2004	Updated section 3.2.1, Power Supply Design
		Updated section 3.2.1.1, Power Supply RF Filtering
		Updated section 3.2.3.1, On/Off Signal
		Updated section 3.2.3.2, Ignition Signal
		Updated section 3.2.4.1, General
		Updated section 3.3.1, RS232
		Updated section 3.3.1.1, RS232 Levels
		Updated section 3.3.1.2, RS232 Connection
		Updated section 3.3.2, USB
		Updated section 3.3.2.1, USB Connection
		Updated section 3.3.3.1, SIM Connection
		Updated section 3.3.5.3, Antenna Detect
		Updated section 3.4.1.1, Analog Input
		Updated section 3.4.2, Digital Audio Interface
		Updated section 3.5, Antenna

Revision	Date	Purpose
		Updated table in section 4.2 and added notes, Pin Assignments
		Update section 6.1, Customer Assistance
E	October 2004	Updated section 3.3.3.1, SIM Connection, and changed Figure 13
		Updated section 3.4.2, Digital Audio
F	March 2005	Updated section 3.2.3, Turning the Unit On/Off
		Updated section 2.8.2, Antenna Installation
G	April 2005	New sections: "LIMITATION OF LIABILITY" on page 2 and "WARRANTY NOTIFICATION" on page 3

MOTOROLA

g20 Cellular Engine
Module Description

CONTENTS

HARDWARE DESCRIPTION

CONNECTOR PIN ASSIGNMENTS

MECHANICAL DESCRIPTION

SERVICE SUPPORT

INDEX

LIST OF FIGURES

LIST OF TABLES

PREFACE

1.1　SCOPE OF THIS MANUAL

This manual introduces the g20 embedded module and describes the technical details required by the user to successfully integrate the Motorola g20 cellular engine into an original equipment manufacturer (OEM) wireless host device.

We at Motorola want to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

You can reach us by email at: n2cshd@motorola.com.

1.2　WHO SHOULD USE THIS MANUAL

This manual is intended for all members of the integration team who are responsible for integrating the g20 module into the host OEM device, including representatives from hardware, software and RF engineering disciplines.

1.3　APPLICABLE DOCUMENTS

1.3.1　Reference Documents

• g20 Developer's Kit - 9808901C67-D
• g20 AT Commands - 9808901C68-F

1.3.2　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*

GSM Data Adapter for Motorola Handsets, AT command reference, Rev 2, June 9 1997.

ETSI standard SMG31.

GSM 05.02.

ETSI 07.60.

ETSI 0.7.07 Ver. 7.5.0.

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1.5 HOW THIS MANUAL IS ORGANIZED

This manual contains the following chapters:

- **Chapter 1** contains this Preface.
- **Chapter 2** introduces the g20 unit and provides important safety instructions.
- **Chapter 3** provides a detailed hardware description of the blocks and components comprising the g20.
- **Chapter 4** describes the pin assignments for g20 connectors.
- **Chapter 5** describes mechanical requirements for the g20 unit.
- **Chapter 6** provides contact information for Motorola Service Support and Customer Assistance.

1.6 LIMITATION OF LIABILITY

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1.7   WARRANTY NOTIFICATION

Motorola guarantees to you, the original purchaser, the Personal Communicator and accessories which you have purchased from an authorised Motorola dealer (the "Products"), to be in conformance with the applicable Motorola specifications current at the time of manufacture for a term of [1] year from date of purchase of the Product(s) (Warranty Term).

You must inform Motorola of the lack of conformity to the applicable specifications of any of the Products within a period of two (2) months from the date on which you detect a defect in material, workmanship or lack of conformity and in any event within a term not to exceed the Warranty Term, and must immediately submit the Product for service to Motorola's Authorised Repair or Service Center. Motorola shall not be bound by Product related statements not directly made by Motorola nor any warranty obligations applicable to the seller.

A list of the Motorola Call Center numbers is enclosed with this Product.

During the Warranty term, Motorola will, at its discretion and without extra charge, as your exclusive remedy, repair or replace your Product which does not comply with this warranty; or failing this, to reimburse the price of the Product but reduced to take into account the use you have had of the Product since it was delivered. This warranty will expire at the end of the Warranty Term.

This is the complete and exclusive warranty for a Motorola Personal Communicator and accessories and in lieu of all other warranties, terms and conditions, whether express or implied.

Where you purchase the product other than as a consumer, Motorola disclaims all other warranties, terms and conditions express or implied, such as fitness for purpose and satisfactory quality.

In no event shall Motorola be liable for damages nor loss of data in excess of the purchase price nor for any incidental special or consequential damages* arising out of the use or inability to use the Product, to the full extent such may be disclaimed by law.

This Warranty does not affect any statutory rights that you may have if you are a consumer, such as a warranty of satisfactory quality and fit for the purpose for which products of the same type are normally used under normal use and service, nor any rights against the seller of the Products arising from your purchase and sales contract.

(*)including without limitation loss of use, loss of time, loss of data, inconvenience, commercial loss, lost profits or savings.

1.7.1   HOW TO GET WARRANTY SERVICE?

In most cases the authorised Motorola dealer which sold and/or installed your Motorola Personal Communicator and original accessories will honour a warranty claim and/or provide warranty service. Alternatively, for further information on how to get warranty service please contact either the customer service department of your service provider or Motorola's call Center at the telephone numbers below for your country.

1.7.2   CLAIMING

In order to claim the warranty service you must return the Personal Communicator and/or accessories in question to Motorola's Authorised Repair or Service Center in the original configuration and packaging as supplied by Motorola .Please avoid leaving any supplementary items like SIM cards. The Product should also be accompanied by a label with your name, address, and telephone number; name of operator and a description of the problem. In the case of vehicular installation, the vehicle in which

the Personal Communicator is installed should be driven to the Authorised Repair or Service Center, as analysis of any problem may require inspection of the entire vehicular installation.

In order to be eligible to receive warranty service, you must present your receipt of purchase or a comparable substitute proof of purchase bearing the date of purchase. The phone should also clearly display the original compatible electronic serial number (IMEI) and mechanic serial number [MSN]. Such information is contained with the Product.

You must ensure that all and any repairs or servicing is handled at all times by a Motorola Authorised Service Center in accordance with the Motorola Service requirements

In some cases, you may be requested to provide additional information concerning the maintenance of the Products by Motorola Authorised Service Centers only, therefore it is important to keep a record of any previous repairs, and make them available if questions arise concerning maintenance

1.7.3   CONDITIONS

This warranty will not apply if the type or serial numbers on the Product has been altered, deleted, duplicated, removed, or made illegible. Motorola reserves the right to refuse free-of-charge warranty service if the requested documentation can not be presented or if the information is incomplete, illegible or incompatible with the factory records.

Repair, at Motorola's option, may include reflashing of software, the replacement of parts or boards with functionally equivalent, reconditioned or new parts or boards. Replaced parts, accessories, batteries, or boards are warranted for the balance of the original warranty time period. The Warranty Term will not be extended. All original accessories, batteries, parts, and Personal Communicator equipment that have been replaced shall become the property of Motorola. Motorola does not warrant the installation, maintenance or service of the products, accessories, batteries or parts.

Motorola will not be responsible in any way for problems or damage caused by any ancillary equipment not furnished by Motorola which is attached to or used in connection with the Products, or for operation of Motorola equipment with any ancillary equipment and all such equipment is expressly excluded from this warranty.

When the Product is used in conjunction with ancillary or peripheral equipment not supplied by Motorola, Motorola does not warrant the operation of the Product/peripheral combination and Motorola will not honour any warranty claim where the Product is used in such a combination and it is determined by Motorola that there is no fault with the Product. Motorola specifically disclaims any responsibility for any damage, whether or not to Motorola equipment, caused in any way by the use of the Personal Communicator, accessories, software applications and peripherals (specific examples include, but are not limited to: batteries, chargers, adapters, and power supplies) when such accessories ,software applications and peripherals are not manufactured and supplied by Motorola.

1.7.4   WHAT IS NOT COVERED BY THE WARRANTY

This warranty is not valid if the defects are due to damage, misuse, tampering, neglect or lack of care and in case of alterations or repair carried out by unauthorised persons.

The following are examples of defects or damage not covered by this product warranty

1. Defects or damage resulting from use of the Product in other than its normal and customary manner.

2. Defects or damage from misuse, access to incompatible sources, accident or neglect.

3. Defects or damage from improper testing, operation, maintenance, installation, adjustment, unauthorised software applications or any alteration or modification of any kind.

4. Breakage or damage to antennas unless caused directly by defects in material or workmanship.

5. Products disassembled or repaired other than by Motorola in such a manner as to adversely affect performance or prevent adequate inspection and testing to verify any warranty claim.

6. Defects or damage due to range, coverage, availability, grade of service, or operation of the cellular system by the cellular operator.

7. Defects or damage due to moist, liquid or spills of food.

8. Control unit coil cords in the Product that are stretched or have the modular tab broken.

9. All plastic surfaces and all other externally exposed parts that are scratched or damaged due to customer normal use.

10. Leather cases (which are covered under separate manufacturer's warranties).

11. Products rented on a temporary basis.

12. Periodic maintenance and repair or replacement of parts due to normal wear and tear.

Note

The talk-time, stand-by time and total life cycle of a Motorola rechargeable battery for your Personal Communicator will depend on usage conditions and network configurations. As a consumable product, the specifications indicate that you should be able to obtain optimum performance for your Motorola Personal Communicator within the first six months from date of purchase and up-to (200) charges(Optimum Performance Time).

The warranty for Motorola rechargeable batteries becomes void if (i) the batteries are charged other than by Motorola approved battery chargers specified for the charging of the battery, (ii) any of the seals on the battery are broken or show evidence of tampering, (iii) the battery is used in equipment or service other than the cellular telephone equipment for which it is specified.

Depending on operating conditions and your usage habits, wear and tear might take place of components including mechanical problems related to Product housing, paint, assembly, sub-assemblies, displays and keyboards and any accessories which are not part of the Product's in-box configuration. The rectification of faults generated through wear and tear and the use of consumable items like batteries beyond their Optimum Performance Time as indicated in the product manual is considered to be your responsibility and therefore Motorola will not provide the free Warranty repair service for these items

1.7.5   INSTALLED DATA

Please make and retain a note of all data you have inserted into your Product for example names, addresses, phone numbers, user and access codes, notes etc before submitting your Product for a Warranty service as such data may be deleted or erased as part of the repair or service process.

Please note if you have downloaded material onto your Product, for example ring tones, ring tunes, screensavers, wallpaper, games etc these may be deleted or erased as part of the repair process or testing process. Motorola shall not be responsible for such matters. The repair or testing process should not affect any such material that was installed by Motorola on your Product as a standard feature.

1.7.6   OUT OF WARRANTY REPAIRS

If you request Motorola to repair your Product any time after the Warranty term or where this warranty does not apply due to the nature of the defect or fault, then Motorola may in its discretion carry out such repairs subject to you paying Motorola its fees for such a repair or it may refer you to an authorised third party to carry out such repairs.

INTRODUCTION

2.1 GENERAL DESCRIPTION

The g20 is Motorola's newest family of embedded cellular products. Motorola continues its tradition of excellence by introducing this new cellular engine family for GSM/GPRS communications, consisting of the d10, the d15 and the g18.

The new module is similar to a condensed cellular phone core, and can be integrated in any system or product that needs to transfer voice or data information. Thus, it significantly enhances the system's capabilities, transforming it from a standalone, isolated product to a powerful component connected to communication nets.

The new g20 is extremely small in dimensions, yet packed with a host of highly-advanced features designed to facilitate fast and easy integration with OEM user products. It significantly shortens the development process for OEM developers, thanks to its wide range of built-in applications, and minimizes the product's time to market.

The g20 module is ideally suited for the automotive, telemetry, security, insurance and EPOS industries, for delivery and handheld terminals, and for PDA markets.

2.2 TERMS AND ABBREVIATIONS

This section provides definitions for terms and acronyms used in this document.

Table 1. Terms and Abbreviations

Acronym/Term	Definition/Description
AOC	Advice of Charge
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)
DSP	Digital Signal Processor
DSR	Data Set Ready
DTE	Data Terminal Equipment (such as terminals, PCs and so on)
DTMF	Dual-Tone Multi-Frequency
DTR	Data Terminal Ready
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

Table 1. Terms and Abbreviations *(Continued)*

Acronym/Term	Definition/Description
ESD	Electrostatic Discharge
ETSI	European Telecommunication Standards Institute
FCC	Federal Communications Commission (U.S.)
FTA	Full Type Approval
GCF	GSM Certification Forum
GPIO	General Purpose Input/Output
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
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
PCM	Pulse Code Modulation
PCS	Personal Communication System (also known as GSM 1900)
PDA	Personal Data Assistant
PDU	Packet Data Unit
PLL	Phase-locked Loop
PTCRB	PCS-1900 Type Certification Review Board (GSM North America)
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
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
USSD	Unstructured Supplementary Services Data
VCC	Voltage Common Collector
VSWR	Voltage Standing Wave Ratio

2.3   PRODUCT SPECIFICATIONS

Table 2. Product Specifications

Product Features	
Product Features	
Operating systems:	EGSM: 900/1800 MHz GSM: 850/1900 MHz
Physical Characteristics	
Size (F3003 - F3004):	45.2 x 24.4 x 6.7 mm height refer to the distance between the customer's board and the g20 top level
Size (F3012 - F3013):	45.2 x 24.4 x 6.2 mm height refer to the distance between the customer's board and the g20 top level
Mounting:	Two Ø2.4 mm holes
Weight:	11.9 grams
Environmental	
Operational temperature:	-20°C +70°C
Functional temperature:	-30°C +85°C
Storage temperature:	-40°C +85°C
Performance	
Operating voltage:	Voltage: 3.0 - 4.2 V
Current consumption:	< 2.5 mA @ DRX9 (Idle mode)
Tx power:	• 0.8 W, 850 MHz • 2 W, 900 MHz • 1 W, 1800/1900 MHz
Interfaces	
Connectors:	• Single 70-pin, board-to-board • RF MMCX
SIM Card:	• Local SIM connectivity • 32K SIM • 1.8/3.0 V

Serial:	• RS232:
	    • BR from 300 bps to 115 Kbps
	    • Auto BR from 300 bps to 115 Kbps
	• USB
	    • 12 Mbps USB specifications, Rev. 1.1

Data Features	
GPRS:	• Multi-slot class 8 (4 down; 1 up) • Max BR 85.6 Kbps • Class B GSM 07.10 multiplexing protocol • Coding scheme CS1-CS4
CSD:	Max BR 14.4 Kbps
SMS:	• MO/MT Text and PDU modes • Cell broadcast
FAX Class 1	

Table 2. Product Specifications *(Continued)*

Voice Features
Telephony
Digital audio
Differential analog audio lines
Vocoders EFR/ER/FR/AMR
DTMF support
Audio control: echo cancellation, noise suppression, side tone and gain control

GSM Supplementary Service
USSD Phase II
Call forwarding
Call hold, waiting and multiparty
Call diverting
Missed-call indicator
AOC
Call barring

Character Set
UTF8
UCS2

Control/Status Indicators
GPRS coverage
Wakeup
TX enable
Reset
Antenna Detect

Features over RS232
Embedded TCP/IP stack
STK Class II

Emergency and Location
FCC E911 Phase II Location Mandate using EOTD

AT Command Set
GSM 07.05
GSM 07.07
Motorola proprietary AT commands

Accessories
Firmware data loader
Data logger
Developer Kit

Note

Specifications are subject to change without prior notice.

2.4   MODELS DESCRIPTION

Table 3 lists the available g20 models.

Table 3. g20 Models

Model	Operating Bands	Interface Connectors	Serial Interface
F3003	GSM 850/1900	• 70-pin 3 mm stacking height connector • MMCX RF connector	USB/RS232
F3004	EGSM 900/1800	• 70-pin 3 mm stacking height connector • MMCX RF connector	USB/RS232

2.5   REGULATORY APPROVALS

The following regulatory approvals apply for the g20 module:

- FCC
- DOC
- PTCRB
- R&TTE
- EMC
- GCF

2.6   REGULATORY REQUIREMENTS

The Federal Communications Commission (FEC) requires application for certification of digital devices in accordance with CFR Title 47, Part 2 and Part 15. This includes Electromagnetic Energy Exposure (EME) testing. As the g20 modem is not a standalone transceiver but is an integrated module, the g20 cannot be tested by itself for EME certification. It is, however, the integrator's responsibility to have the completed device tested for EME certification.

2.7   REGULATORY STATEMENT

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 g20 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. Motorola assumes no liability for customer failure to comply with these precautions.

13. The g20 must be operated at the voltages described in the technical documentation.

14. The g20 must not be mechanically nor electrically changed. Use of connectors should follow the guidance of the technical documentation.

15. The g20 is designed the meet the EMC requirements of ETS 300 342.

16. When integrating the g20 into a system, Motorola recommends testing the system to ETS300342-1.

17. The g20 meets the safety requirements of EN60950.

18. Systems using the g20 are subject to mandatory EMC testing under directive 89/336/EEC (see item 3 above). Other directives, such as the LVD directive 73/23/EE, may also apply to a system using the g20 module.

2.8   SAFETY PRECAUTIONS

2.8.1   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 to satisfy FCC RF exposure requirements for mobile transmitting devices.

IMPORTANT: To comply with the FCC RF exposure limits and satisfy the categorical exclusion requirements for mobile transmitters, the following requirements must be met:

2.8.2   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.
- The combined cable loss and antenna gain must not exceed +9.9 dBi and total system output must not exceed 1.5 W ERP (Cellular) / 3.0 W EIRP (PCS) to qualify for categorical exclusion requirements of 2.1091. OEM installers must be provided with antenna installation instruction and transmitter operating conditions for satisfying RF exposure compliance.

3.1   G20 BLOCK DIAGRAM DESCRIPTION AND OPERATION OVERVIEW

This chapter describes the basic blocks comprising the g20 module and the connectivity options for the module.

3.1.1   g20 Block Diagram

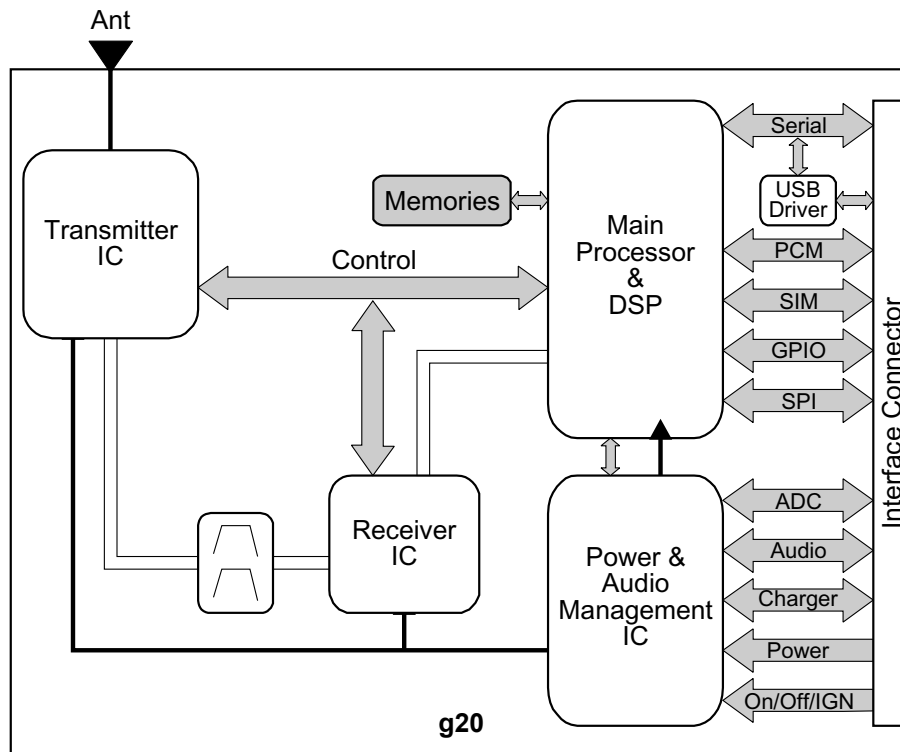Figure 1 shows a block diagram for the g20 module:

Figure 1. g20 Block Diagram

The g20 consists of the following blocks:

• **Power and Audio Management IC:** This block is responsible for the power on/off process, analog audio drivers, internal regulators, realtime clock activities, and the battery charging process. When an On command is received, this IC wakes up the internal regulators and controls the reset process. This activity turns the unit on. When an Off command is received, this IC sends the request to the main processor, which in turn shuts down the unit in an orderly fashion. During shutdown, the unit is disconnected from the network, all tasks are terminated and the regulators are shut down. The on/off inputs (On/Off and Ignition) are always on, even when the unit is off.

- **Main Processor and DSP:** This block is responsible for all the main tasks in the unit. It contains the following components:
  - Main processor
  - DSP for controlling speech options
  - UART
  - USB block
  - Digital audio driver
  - SIM card
  - Two SPI buses (one internal and one externally accessible)
  - Main clock (26 MHz)
  - Address/data buses
  - RF PLL
  - Controller to the RF ICs, which is the heart of the unit

  This module provides the following connectivity:

  - Address/data bus
  - UART to the user connector
  - USB via a USB driver to the user connector
  - Digital audio (PCM) to the user connector
  - SIM card interface
  - SPI to the user connector
  - SPI to control the RF ICs
  - Control signals to the power amplifier IC
  - Handshake with the Power and Audio Management IC
  - General I/O to the user connector
- **Receiver Block:** This block is an RF block that contains all the receiver channels. It contains the following components:
  - Front filters
  - LNAs
  - Mixers
  - VCOs
  - I/Q outputs
  - Control signals
- **Transmitter Block:** This is an RF block that contains all the transmitter channels. It contains the following components:
  - Power amplifiers
  - Power control loop
  - Antenna switch
  - Harmonic filter
  - Input buffers
  - Control signals
  - Antenna connection

3.1.2   Basic RS232 and Analog Audio Connectivity

The following basic g20 connectivity requirements apply for UART (RS232) and analog audio connections (see Figure 2 for reference):

- The RS232 is connected via eight pins to the g20.
- The SIM card is connected via five pins to the SIM driver of the g20.
- The microphone is connected via two pins to the g20 (Mic and Mic Ground).
- The Speaker is connected via two differential lines to the g20.
- The power supply is connected via eight pins (four VCC and four Ground) to the g20.
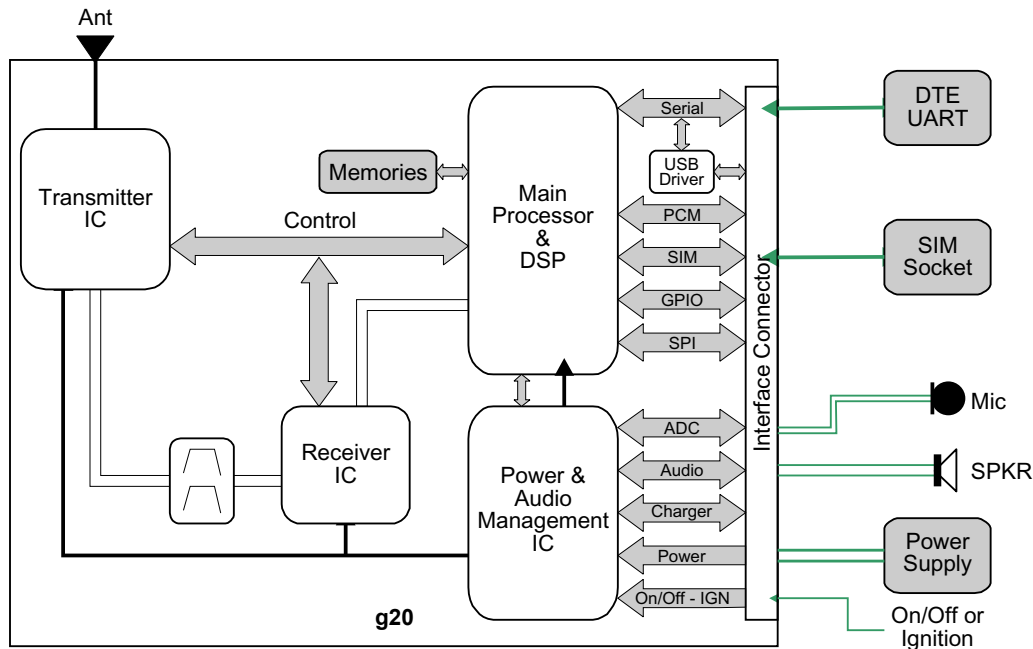- The On/Off or Ignition pin is connected.

Figure 2. Basic RS232 and Analog Audio Connectivity

3.1.3   Basic RS232 and Digital Audio Connectivity[*]

The following basic g20 connectivity requirements apply for UART (RS232) and digital audio connections (see Figure 3 for reference):

- The RS232 is connected via eight pins to the g20.
- The SIM card socket is connected via five pins to the SIM driver of the g20.
- The DTE DSP is connected via four pins to the g20 (PCM).
- The power supply is connected via eight pins (four VCC and four Ground) to the g20.
- The On/Off or Ignition pin is connected.

[*] Support for this feature depends on the current g20 release.
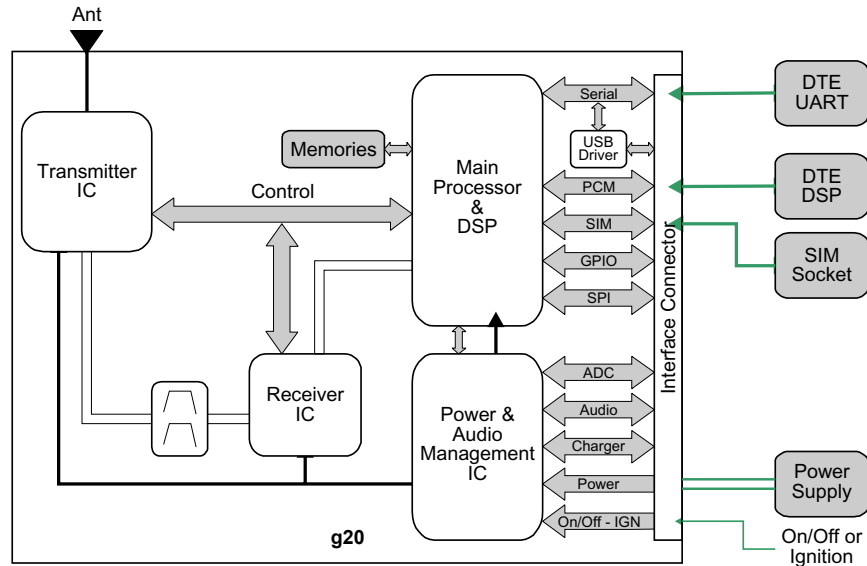
Figure 3. Basic RS232 and Digital Audio Connectivity

3.1.4   Additional Recommended Connections

Additional g20 connectivity options are described below (see Figure 4 for reference):

• A USB connector that is connected via three lines to the g20. In this case, when USB is used, the DTE UART should be in tri-state (high impedance).

• An SPI block that is connected via five pins to the g20 (for debug accessibility).

Figure 4. Additional g20 Connectivity

98-08901C66-G

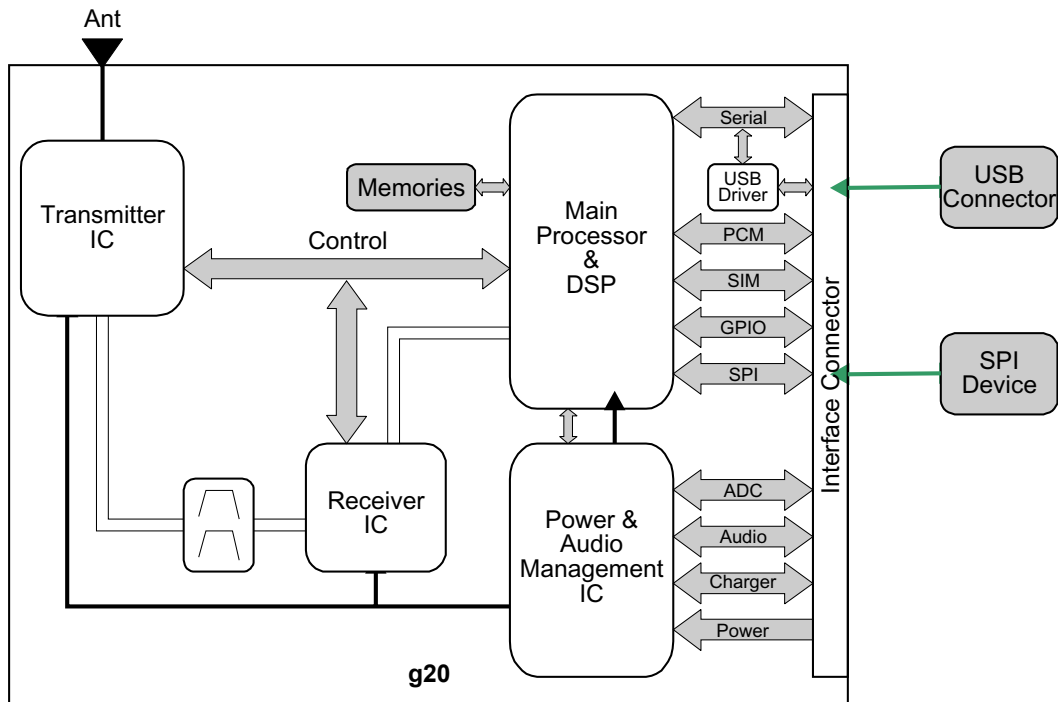## 3.2 POWER SUPPLY AND CURRENT CONSUMPTION

This section describes the following power-related considerations for the g20:

- Power supply design
- g20 current consumption
- Turning the unit on/off
- Sleep mode options

3.2.1 Power Supply Design

The following power supply design considerations apply to the g20:

- The g20 is designed to operate between 3.0 V to 4.2 V on the g20 input (after all losses). In order to reduce battery power consumption, it is important to verify power supply line and regulator losses in the PCB.
- The g20 is a GSM/GPRS phone that transmits in 0.5 ms pulses every 4.6 ms. The peak current is approximately 2.0 A.
- When the power supply is lower than 2.85 V, the g20 software determines that the battery is low and disconnects the unit.
- When the voltage is greater than 4.25 V, the g20 software detects an over voltage condition and does not allow the unit to establish a call.
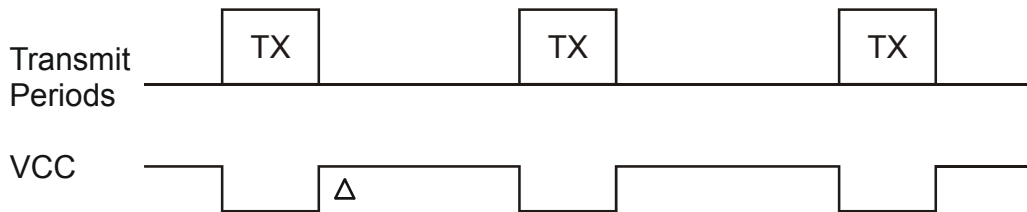- The VCC line typically drops during TX periods.

Figure 5. VCC Signal During TX Periods

To minimize the Δ, it is recommended to use lines that are as short as possible, and to place a 1000uF capacitor (or the maximum possible) in the g20 VCC input. (When a battery is used, there is no need for a large capacitor.)

It is recommended to keep the Δ less than 0.3 V.

Note The power supply should be able to drive at least 2.5 A at 3 V DC.

3.2.1.1 Power Supply RF Filtering

It is recommended to add RF filtering to the DC lines.

Use 100nF, 39pF, 22pF or 8.2pF capacitors in parallel to the power supply lines (close to the g20 connector). The following capacitor requirements apply:

- 100nF is for filtering logic data noise (clocks, serial communications, and so on).
- 39pF is used for 850/900 bands.
- 22pF is used for 900 band.
- 8.2pF is used for 1800/1900 bands.

The appropriate capacitor value(s) should be selected according to the GSM band used by the customer.

3.2.2 g20 Current Consumption

In order to design the power supply correctly and to calculate the battery life, you should take into account the current consumption of the g20 when operating in different modes.

Table 4. g20 Current Consumption

Mode	Current Consumption (mA RMS)
g20 in Sleep mode (camped and Sleep-mode enabled)	< 2.5 mA, RMS @ DRX9, Typical 2.2 mA < 4.5 mA, RMS @ DRX2, Typical 3.5 mA
g20 during search time	< 40 mA, RMS, Typical 25 mA, RMS
g20 off	< 100 uA – Typical 25 uA
g20 during a call	
GSM 900	@ Power level #5 < 350 mA, Typical 270 mA @ Power level #10, Typical 160 mA @ Power level #19, Typical 135 mA
GSM 850	@ Power level #7 < 250 mA, Typical 185 mA @ Power level #10, Typical 160 mA @ Power level #19, Typical 135 mA
DCS 1800	@ Power level #0 < 300 mA, Typical 220 mA @ Power level #10, Typical 160 mA @ Power level #19, Typical 135 mA
PCS 1900	@ Power level #5 < 300 mA, Typical 240 mA @ Power level #10, Typical 160 mA @ Power level #19, Typical 135 mA

Note

DRX2/9 is the rate used by the base station to query the mobile station. The network operator sets this parameter.

3.2.3 Turning the Unit On/Off

Two different mechanisms are available to turn the g20 on and off:

- On/Off signal (Pin 53)
- Ignition signal (Pin 51)

Note

The g20 power-on and power-off timing may vary slightly, depending on the software version.

3.2.3.1   On/Off Signal

The on/off signal is an active-low toggle switch. After power is applied to the g20, the on/off signal is pulled high to VCC by an internal 200KΩ resistor.

To turn the g20 on, the on/off signal should be pulled low for a minimum of 800 ms (T1). This will initiate the power-on process, which lasts about five seconds, after which the g20 is ready to communicate.

To turn the g20 off, the on/off signal should be pulled low for a minimum of two seconds. This will initiate the power-off process, which lasts about eight seconds, after which the g20 will shut down. The g20 can be turned off only if at least 10 seconds have elapsed since the last power on.

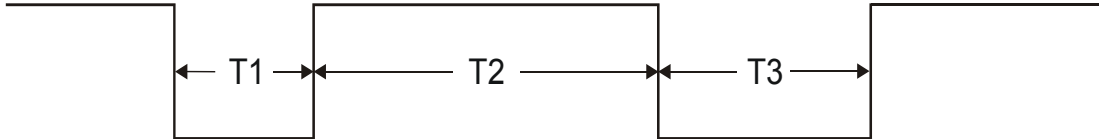Figure 6 shows the timing diagram for the on/off signal.

Figure 6. On/Off Signal Timing Diagram

In Figure 6, the following timing requirements apply:

* T1 minimum = 800 ms.
* T2 minimum = 10 seconds.
* T3 minimum = 2 seconds.

3.2.3.2   Ignition Signal

The ignition signal turns the g20 on and off, depending on its logic state.

To turn the g20 on, the ignition signal must be pulled high. This initiates the power-on process, which lasts about five seconds, after which the g20 is ready to communicate. The g20 remains active for the duration of the ignition signal remaining high.

To turn the g20 off, the ignition signal must be pulled low. This initiates the power-off process, which may last up to 30 seconds, after which the g20 will shut down. The ignition signal must remain low for the duration of the power-off process, until the g20 shuts down. Otherwise, the power-off process may be interrupted or may not complete.

3.2.4   Sleep Mode Options

This section describes how the g20 can be awakened by the DTE and vice-versa.

The DCE (g20) and the DTE can incorporate a sleep mechanism in their application in order to conserve battery life.

Sleep mode enables the g20 to be awakened when the DTE wants to communicate with it. Conversely, it also enables the DTE to be awakened by the g20 when the g20 wants to communicate with it. The g20 will not enter sleep mode if the USB is connected.

3.2.4.1   General

* The g20 Sleep Mode option can be enabled or disabled using ATS24.
* Sleep mode is activated by sending ATS24 = n, where n = 1, 2, 3 or 4 seconds. (To disable Sleep mode, send ATS24=0.)
* The g20 drops the CTS (h/w Flow Control) when it is in Sleep mode.
* The g20 does not enter Sleep mode when data is present on TXD or RXD lines.
* At the end of the TXD (meaning, the TXD buffer is empty), the g20 waits n seconds (as defined in ATS24 = n) before entering Sleep mode.

- The DTE uses CTS to send data only when the g20 is awake. The DTE waits when the g20 is in Sleep mode.
- When the g20 is asleep, the CTS line will blink.
- The DTE should drop RTS during the sleep period in order to prevent the loss of data sent by the g20.
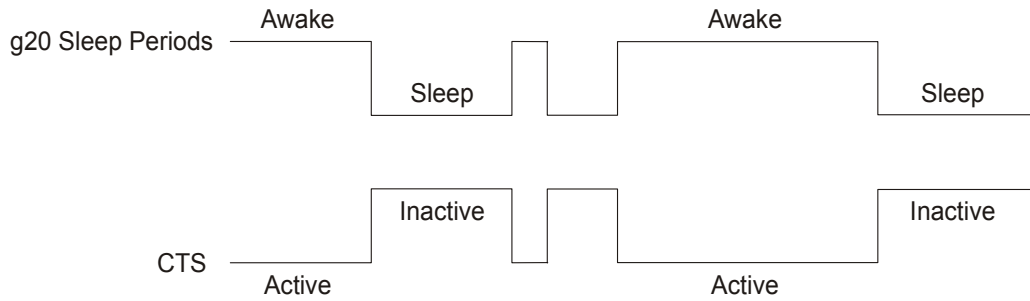
Figure 7. CTS Sleep Mode Timing

3.2.4.2   DCE/DTE Connectivity

Figure 8 shows DCE/DTE connectivity:
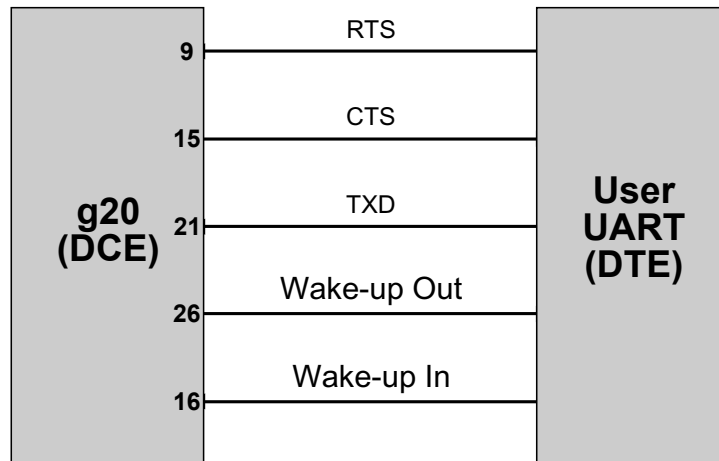
Figure 8. DCE/DTE Connectivity

Waking Up the g20:

The following apply when waking up the g20:

- The Wake-up In line is used to awaken the g20. This input is routed into an Interrupt in the g20.
- Whenever the Wake-up In line is at logic "low", the g20 remains in an awake state.
- When the DTE needs to send data, it should activate this line, wait 30 ms (the wake time required for the g20), and then start sending the data.

- While the DTE is sending data, the wake-up line should remain low, so that the g20 does not enter Sleep mode.
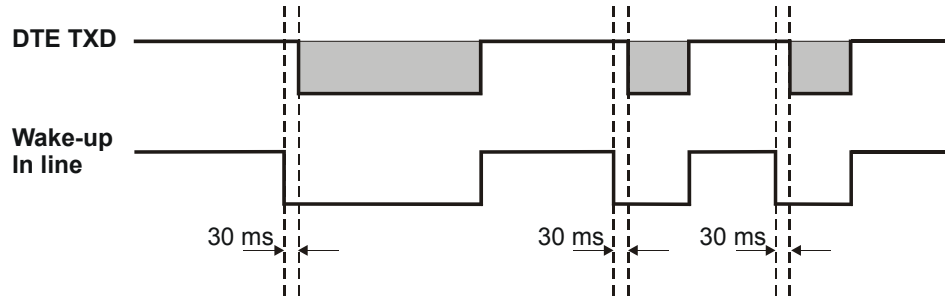
Figure 9. Waking Up the g20 when the DTE wants to Send Data

Waking Up the DTE:

The following apply when waking up the DTE:

- The g20 uses the Wake-up Out line to indicate to the DTE that data is present.
- The DTE should not enter Sleep mode when the Wake-up Out line is low.
- When the g20 has data to send to the DTE, it drops the Wake-up Out line to low.
- The g20 will send the Wake-up Out line #ms to low, as indicated by S102 in Figure 10.
- While the g20 is sending data, the Wake-up Out line remains low.
- After the sending of data is completed, the g20 brings the Wake-up Out line to high.
- The DTE should keep RTS off during this sleep period in order to avoid sending data when it is not ready.

Figure 10. Waking Up the DTE when the g20 wants to Send Data

3.3   COMMUNICATION INTERFACES

This section describes the following four interfaces that are available in the g20:

- RS232
- USB
- SIM
- SPI

3.3.1 RS232

The following apply when using the RS2332 interface of the g20:

- The g20 supports full hardware flow control (8 pins), software flow control (Xon/Xoff) and non-flow control.
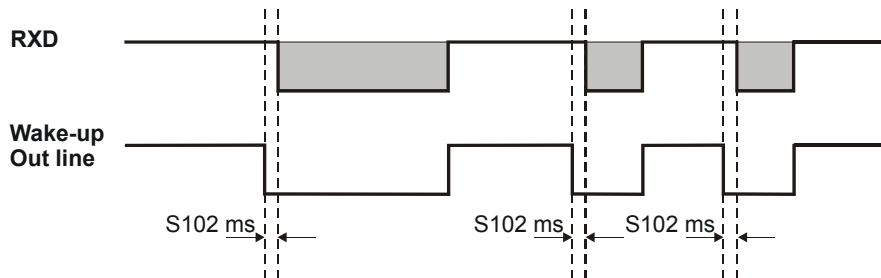- The g20 UART is connected directly to the interface connector.
- The g20 is a DCE device. Applicable line terminology is shown in Figure 11.
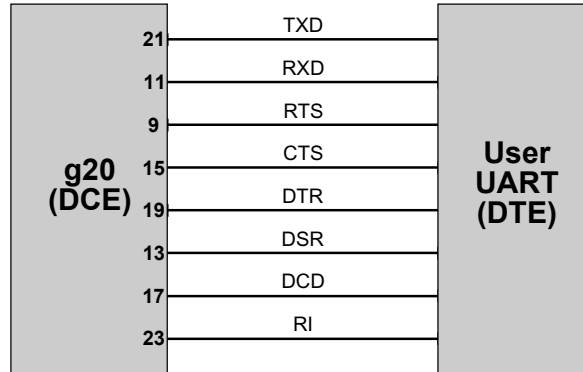
Figure 11. g20 RS232 Interface

3.3.1.1 RS232 Levels

RS232 levels are as follows:

- Vih = 1.95 V minimum, 3.0 V maximum
- Vil = 0.8 V maximum
- Voh = 2.56 V minimum @ 100 uA
- Vol = 0.2 V maximum @ 100 uA

Note
A buffer is required whenever DTE levels do not match g20 levels (not 5V tolerant).

3.3.1.2 RS232 Connection

As shown in Figure 12, the g20 can be connected to the DTE UART using all eight RS232 signals.

The g20 selects its communication channel, RS232 or USB, depending on the state of the USB_VBUS signal (pin 10) at power up. The g20 operates in RS232 mode if the USB_VBUS signal is low at power up and remains low during operation.

The g20 does not support dynamic switching between RS232 and USB channels during operation, and does not support simultaneous operation.

Note
When the g20 is switched off, it is recommended to keep the RS232 signals of the DTE at tri-state or at a low level in order to prevent potential latch-up.

3.3.2 USB

The g20 selects its communication channel, RS232 or USB, depending on the state of the USB_VBUS signal (pin 10) at power up. The g20 operates in USB mode if the USB_VBUS signal is high at power up and remains high during operation. The USB_VBUS signal is the power line of the USB interface, which powers the USB circuitry.

The g20 does not support dynamic switching between RS232 and USB channels during operation, and does not support simultaneous operation

When USB is used, the DTE device must unload (meaning disconnect or place in tri-state) the RS232 lines. Otherwise, the USB may not operate properly.

The USB port is also used to load software into the g20. It is recommended to include connectivity to this port in the user application.

The g20 supports USB 1.1 at a baud rate of 12 Mbps.

3.3.2.1 USB Connection

A USB connection diagram is shown in Figure 12.

Figure 12. g20 USB Connection for g20 Models
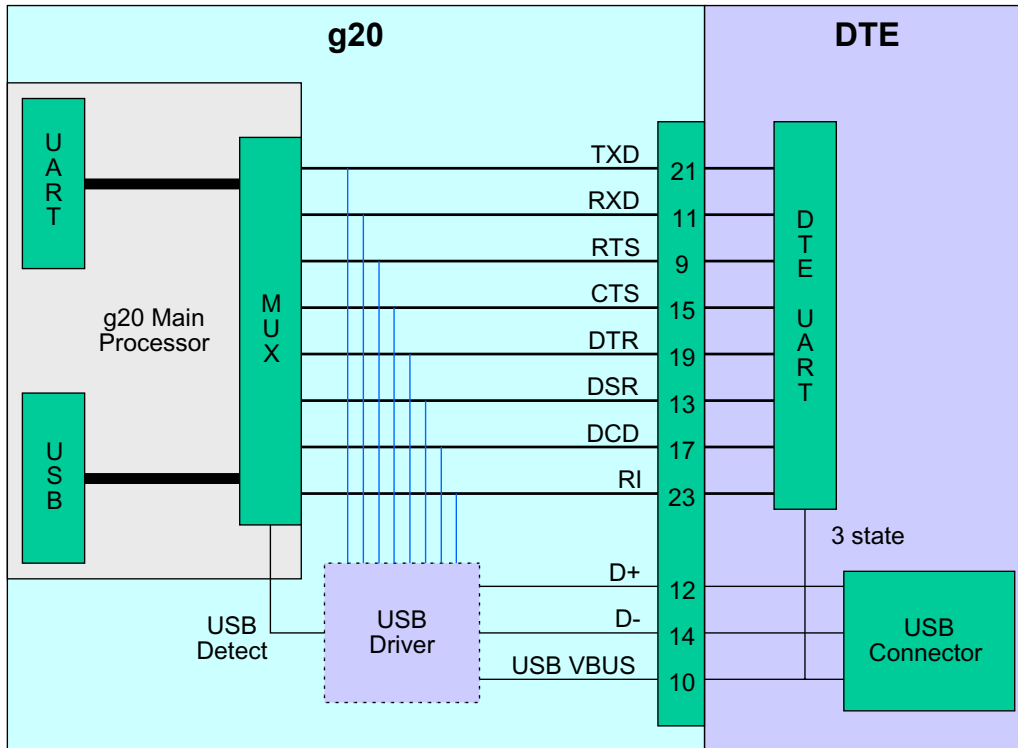
As shown in Figure 12, the g20 USB is connected via three lines to the USB connector in the user application: D+, D- and USB VBUS. When USB VBUS is applied, the g20 detects it and switches the main processor to USB mode.

> **Note**
>
> The DTE UART loads the USB driver/main processor lines. Therefore, the UART should be kept in tri-state.
>
> USB usage eliminates sleep mode in the g20.

3.3.3   SIM

The g20 includes a SIM card driver, however, it does not contain a SIM socket. SIM signals are routed to the interface connector and include all the functionality required for SIM card operation. The SIM card socket must be located in the customer application, and connected to the g20 interface connector as described in the following section.

3.3.3.1   SIM Connection

Figure 13 shows a g20 SIM connection:
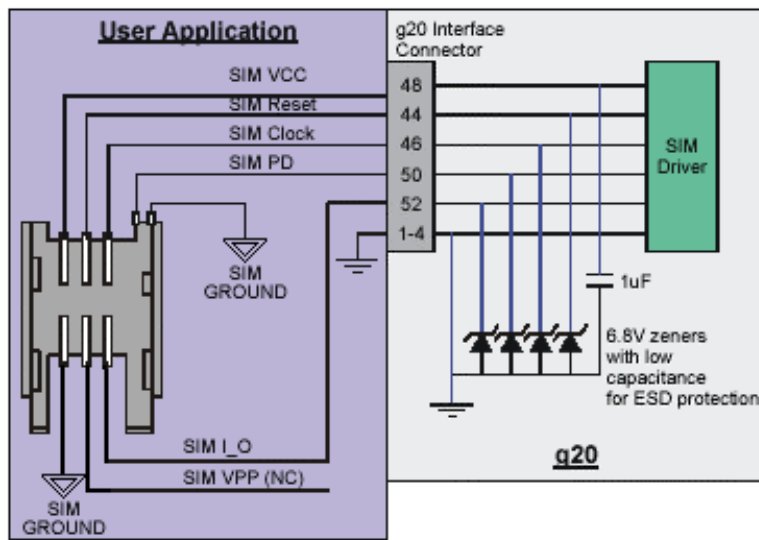
Figure 13. g20 SIM Connection

The following apply for g20 SIM connections:

- The g20 passes all ETSI tests when an external socket is connected to the g20 with lines shorter than 10 cm. Longer signal connections may require additional testing to be performed.
- The g20 supports 3.0V and 1.8V SIM cards.
- The SIM card detect signal, SIM_PD, operates in active low logic.

The SIM card signals must be carefully routed to minimize ESD and EMI susceptibility. The following are guidelines for proper SIM application operation:

- The SIM ground must be connected to the main ground through an inductive element.
- The SIM card socket should be located away from the antenna as far as possible.
- The SIM logic signals, DIO, CLK, RST and PD, may need to be filtered with 10pF capacitors, depending on the application and its distance from the antenna.
- The SIM detect signal, SIM_PD, should be connected to the g20 through a 15uH inductor.
- Low capacitance zener diodes should be placed as close as possible to the SIM card socket contacts, for proper ESD protection.

3.3.4 SPI

The SPI is a standard microprocessor bus used as a g20 debugging port. This port activates a debug option that enables logs to be taken from the g20 while it is operating. It is recommended that this bus be accessible in the user application. In the g20 Developer's Kit, the SPI bus is converted to an RS232 protocol using a special interface circuit. It then uses the standard RS232 port for debugging. Table 5 shows the pins available on the SPI bus.

3.3.4.1 SPI Connection

Table 5. SPI Pinout

Pin #	Name	Function	Input/Output
70	SPI_CS	SPI chip-select	Output
62	SPI_IRQ_N	SPI Interrupt	Input
64	SPI_DIN	SPI MISO input	Input
68	SPI_DOUT	SPI MOSI output	Output
66	SPI_CLK	SPI clock	Output

3.3.5 Unique g20 Interfaces

The g20 contains unique functions (pins) that may be required by selected user applications, such as TX_EN, Antenna Detect, GPRS Detect and Entertainment Mute. Each of these functions is described in the sections that follow.

3.3.5.1 Transmit Enable

This pin indicates when the g20 is transmitting RF in the antenna.

No RF Transmitted   RF Transmission   No RF Transmitted
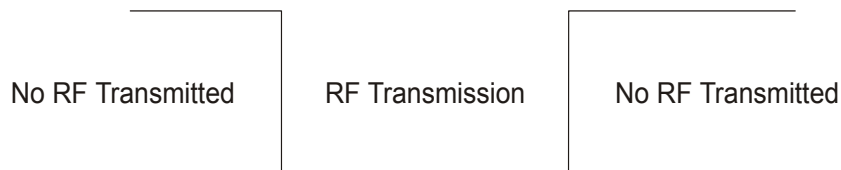
Figure 14. TX_EN Transmission

3.3.5.2 GPRS Coverage Indication

This pin indicates whether or not the g20 is located in an area with GPRS network coverage. This pin can be used to indicate the GPRS coverage status before GPRS section activation has occurred, or before a switch to circuit-switched data is made. The default operation of this signal is active low, meaning this signal is at 0 when GPRS coverage is available. It is possible to switch the signal's polarity to active high using an AT command. Refer to the *g20 AT Commands* document (9808901C68-O) for the AT commands description.

3.3.5.3　Antenna Detect

This pin indicates whether or not the antenna is inserted. This option can be used with antennas with a resistance to ground of less than 100K. The antenna detect circuit detects whether the ohmic resistance of the antenna is 100 Kohm or lower, which is required for the antenna to be detected. If the ohmic resistance is higher than 100 Kohm, the antenna is not detected.

In software versions 34D and later, this signal has been collaborated to match the logic detection threshold of the g20, and exhibits best results when connected back to the g20. A dedicated g20 input signal, pin 37, is available for the antenna detection input. This is to ensure proper operation of the antenna-detect AT command, which enables software indication of the antenna state.

Antenna Not Detected　　　Antenna Detected

Figure 15. Antenna Detect

3.4　AUDIO INTERFACES

The g20 has an analog audio interface and a digital audio interface. Both of these interfaces are described in the sections that follow.

3.4.1　Analog Audio Interfaces

The g20 supports microphone input, headset microphone input, differential speaker output, and a differential alert speaker.

3.4.1.1　Analog Input

The g20 has two different analog inputs, referenced to the microphone ground (pin 59). The g20 contains an analog amplifier with a default gain of 16dB, which can be adjusted in seven steps between 0 and 31dB using the AT+MMICG command. For more details about this command, refer to the *g20 AT Commands* document (9808901C68).

When the default gain of 16dB is used, then the level considerations should be as follows:

• **Headset microphone:** Pin 57 is the headset microphone input. The input for this line can come directly from a headset microphone. In order for the headset microphone to be active, the headset interrupt signal (pin 55) needs to be pulled low. The maximum input to the g20 headset microphone before there is signal distortion in the network is 12 mvRMS.

• **Hands-free microphone:** Pin 61 is the microphone input to the g20. When the headset interrupt signal is not pulled low, this microphone will be active. The maximum input to the g20 microphone before there is signal distortion in the network is 32 mvRMS.

3.4.1.2　Analog Output

The g20 has a differential speaker output and an alert output:

• **Speaker output:** When headset mode is used, the headset speaker should be connected to the SPKR_N signal of the g20. When a differential amplifier is used, both lines should be connected. An 8-ohm speaker can be connected directly to the speaker lines.

• **Alert:** The g20 supports a direct connection for an alert transducer, in order to build a handset from the g20. All the sounds that are transmitted to the alert can be routed to the speaker using the appropriate AT command.

Table 6 shows the SPKR_N output in headset mode for different network signal levels when the g20 is set to the maximum volume level and the headset interrupt is pulled low.

Table 6. Headset Speaker Output at Maximum Volume Level

dBm0	mV RMS	Headset Speaker (mV RMS)
3.14	1111.9	174
0	774.6	165
-5	435.6	132
-10	244.9	72
-15.5	130	39
-16	122.8	36
-17	109.4	32
-20	77.5	24
-25	43.6	5
-30	24.5	4
max	3000	210

The measurements shown in Table 6 apply in the following configuration:
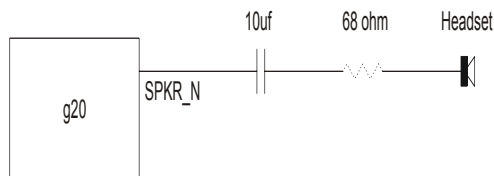
Figure 16. Headset Speaker Output Measurement Configuration

Note

The series resistor value must be at least twice the impedance of the connected headset speaker.

Table 7 shows the output of the SPKR_N signal for different network signal levels when the g20 is set at the maximum volume level and the headset interrupt is not pulled low.

Table 7. SPKR_N Output in Speaker Mode at Maximum Volume Level

dBm0	mV RMS	SPKR_N (mV RMS)
3.14	1111.9	374
0	774.6	267
-5	435.6	148
-10	244.9	83
-15.5	130	45
-16	122.8	42
-17	109.4	37
-20	77.5	26
-25	43.6	14
-30	24.5	7
max	2600	900

Table 8 shows the SPKR_N output at different volume levels, when a 500mV RMS signal is transmitted from the network.

Table 8. SPKR_N Output when a 500mV RMS Signal is Transmitted

Handset Volume	SPKR_N (mV RMS)
0 (lowest gain)	16
1	22
2	31
3	43
4	61
5	87
6	120
7 (highest gain)	170

Table 9 shows the typical keypad tone levels generated by the g20. These measurements taken with the g20 in handset mode (meaning the headset-detect signal is not pulled low).

Table 9. SPKR_N Output when g20 is in Handset Mode

Handset Volume	SPKR_N (mV RMS)
0	0
1	122
2	172
3	244
4	342
5	482
6	678
7	954

Table 10 shows the keypad tone levels generated by the g20 when in headset mode (meaning the headset-detect signal is pulled low).

Table 10. Headset Speaker Output

Headset Volume	Headset Speaker (mV RMS)
0	0
1	4
2	5.5
3	7.5
4	10.5
5	14
6	19.5
7	27.5

Note

The above measurements apply to the configuration shown in Figure 16.

Table 11 shows the levels of the alert transducer measured on the ALERT_P signal at different ring volumes.

Table 11. Alert Transducer Levels for the ALERT_P Signal

Handset Volume	ALRT_P (mV RMS)
0	87
1	124
2	175
3	250
4	350
5	487
6	680
7	980

3.4.1.3   Audio Circuit Design Considerations

In order to design an audio circuit that produces clear audio, without being affected by the GSM transmission, the following guidelines should be considered when designing the circuit:

• The audio input to the g20 should be referenced to the MIC_GND line of the g20.
• The microphone bias of the g20 for both the microphone and headset is 2.2 V. If a microphone with a different voltage is used, the bias should be as clean as possible, and referenced to MIC_GND. Because most GSM buzz (217Hz TDMA noise) is generated from the microphone path, if a different bias is created, it should be filtered to supply DC only.
• The MIC_GND and GND are connected inside the g20 and should not be connected to the application board.
• Keep the lines of the microphone inputs as short as possible. To filter the lines from RF emission, 39pF capacitors can be used.
• The g20 GND should be connected on all four pins, with two mounting screws to the application ground.
• If possible, the RF cable ground from the g20 should be connected to the GND of the g20.
• The digital lines of the application should never be referenced to the MIC_GND.

3.4.2   Digital Audio Interface

The g20 digital audio interface is a full-duplex SAP (serial audio port) comprised of four signals:

• **PCM_FS:** This pin is used for frame sync output provided by the g20.
• **PCM_CLK:** This pin is used for the clock output provided by the g20.
• **PCM_DIN:** This pin is the serial input to the g20 SAP.
• **PCM_DOUT:** This pin is the serial output of the g20 SAP.

The following conditions apply to the digital audio interface of the g20:

- The g20 SAP works in network mode, with four slots in each frame. Each slot consists of 16-bit data.
- The g20 sends and receives data on the first slot only.
- The frame sync rate is 8 KHz, and the clock rate is 512 KHz.
- The g20 is the master in the SAP network. Therefore, the connected DSP should be configured as a slave.
- Digital audio lines should be connected to Codex or DSP on the application side.

3.5   ANTENNA

The g20 has two models, one for North America Frequency bands (850/1900 MHz), and one for European Bands (900/1800 MHz). The following connection requirements apply for the g20 antenna:

- The g20 is terminated with an MMCX connector, and with 50-ohm impedance in the relevant frequencies.
- The g20 can be connected to any antenna with 50-ohm impedance in the relevant frequency bands.
- The g20 is designed to work on VSWR, up to 2:5:1 The antenna should meet this requirement.

3.5.1   Antenna Performance Recommendations

Table 12 lists the performance recommendations for the g20 antenna.

Table 12. Antenna Performance Recommendations

Frequencies:		
GSM 850	TX	824 – 849 MHz
	RX	869 – 893 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:	0 dBi (unity) gain or greater	
Impedance:	50 Ohm	
VSWR:	Typical: 1.5:1 Worst case: 2.5:1	

3.6   ESD PROTECTION

In general, the g20 does not include embedded ESD protection circuits. This type of protection should be implemented in the customer application. Partial ESD protection is provided, as follows:

- SIM lines are protected up to 3 KV with 6.8 V Zener Diodes.
- VCC input is protected with a 2.2 uF capacitor.
- Ignition input is protected with a 100 nF capacitor.

4.1 CONNECTORS

The g20 has two connectors: the g20 interface connector and the g20 RF connector. Each is described below.

g20 Model Number	g20 70 Pin Connector	Mating Connector	Stacking Height
F3003 - F3004	Molex 53748-0708	Molex 52991-0708	3.0 mm

g20 RF Connector	Mating Connector
Standard MMCX female, Amphenol MMCX6251S5-3GT30G-50, gold plated	Standard MMCX male (connector for cable)

4.2   PIN ASSIGNMENTS

The g20 interface is provided via a 70-pin connector.

Note g20 signals not used by the customer application must be left unconnected.

Do not apply external voltage on any of the g20 logic signals when the g20 is powered off.

The RESET_N output signal (pin 25) is tri-state when the g20 is powered off. It is recommended to place a 10KΩ pull-down resistor on this signal in the customer application to ensure proper logic-level transitions.

Table 13 describes the pin assignments for the g20 interface connector.

Table 13. g20 Interface Connector Pin Assignments

Pin #	Signal Name	Description	I/O	Signal	Level				Inter-nal PU/PD	Active H/L
					Min	Typ	Max	Units		
Power:										
1	GND	Ground		GND						
2	GND	Ground		GND						
3	GND	Ground		GND						
4	GND	Ground		GND						
5	VCC	Power supply	I	DC	3.0	3.6	4.2	V		
6	VCC	Power supply	I	DC	3.0	3.6	4.2	V		
7	VCC	Power supply	I	DC	3.0	3.6	4.2	V		
8	VCC	Power supply	I	DC	3.0	3.6	4.2	V		
GPIO:										
16	WAKEUP_IN_N	Wakeup input	I	Logic		2.775		V	22KΩ PU	L
26	WAKEUP_OUT_N	Wakeup output	O	Logic		2.775		V	69KΩ PD	L
25	RESET_N	Reset signal output	O	Logic		2.775		V		L

Table 13. g20 Interface Connector Pin Assignments *(Continued)*

Pin #	Signal Name	Description	I/O	Signal	Level				Inter-nal PU/PD	Active H/L
					Min	Typ	Max	Units		
53	ON_OFF_N	On/off switch	I	Logic	3.0	3.6	4.2	V	200KΩ PU	L
51	IGN	Ignition input	I	Logic	2.775	3.6	16	V	47KΩ PD	H
39	TX_EN_N	GSM transmit indicator	O	Logic		2.775		V	10KΩ PU	L
41	ANT_DET	Antenna Detection	O	Logic		2.775		V	300KΩ PU	H
49	GPRS_DET_N	GPRS coverage indicator	O	Logic		2.775		V	69KΩ PU	L
37	N.C.	Not connected								
UART:										
21	TXD_N	RS232 TXD	I	Logic		2.775		V	69KΩ PU	L
11	RXD_N	RS232 RXD	O	Logic		2.775		V	69KΩ PU	L
9	RTS_N	RS232 RTS	I	Logic		2.775		V	69KΩ PU	L
15	CTS_N	RS232 CTS	O	Logic		2.775		V	69KΩ PU	L
19	DTR_N	RS232 DTR	I	Logic		2.775		V	69KΩ PD	L
13	DSR_N	RS232 DSR	O	Logic		2.775		V	69KΩ PU	L
17	DCD_N	RS232 DCD	O	Logic		2.775		V	69KΩ PU	L
23	RI_N	RS232 RI	O	Logic		2.775		V	69KΩ PU	L

Table 13. g20 Interface Connector Pin Assignments *(Continued)*

Pin #	Signal Name	Description	I/O	Signal	Level				Internal PU/PD	Active H/L
					Min	Typ	Max	Units		
USB:										
10	USB_VBUS	USB- VCC	I	DC		5		V		
12	USB_D+	USB_D+				3.3		V		
14	USB_D-	USB_D-				3.3		V		
SPI:										
70	SPI_CS	SPI chip-select	O	Logic		2.775		V	69KΩ PU	H
62	SPI_IRQ_N	SPI interrupt	I	Logic		2.775		V	69KΩ PD	L
64	SPI_DIN	SPI MISO input	I	Logic		2.775		V	69KΩ PU	H
68	SPI_DOUT	SPI MOSI output	O	Logic		2.775		V		H
66	SPI_CLK	SPI clock	O	Logic		2.775		V		H
SIM Card:										
50	SIM_PD_N	SIM-presence detect	I	Logic		2.775		V	69KΩ PU	L
48	SIM_VCC	SIM VCC	O	DC	1.8		3	V		
44	SIM_RST_N	SIM reset	O	Logic	1.8		3	V	69KΩ PD	L
52	SIM_DIO	SIM serial data	I/O	Logic	1.8		3	V	22KΩ PU	H
46	SIM_CLK	SIM clock	O	Logic	1.8		3	V	69KΩ PD	H
PCM Audio:										
18	PCM_DIN	Digital audio receive	I	Logic		2.775		V	69KΩ PD	H

Table 13. g20 Interface Connector Pin Assignments *(Continued)*

Pin #	Signal Name	Description	I/O	Signal	Level				Inter-nal PU/PD	Active H/L
					Min	Typ	Max	Units		
20	PCM_DOUT	Digital audio transmit	O	Logic		2.775		V	69KΩ PU	H
22	PCM_CLK	Digital audio clock	O	Logic		2.775		V	69KΩ PD	H
24	PCM_FS	Digital audio frame sync	O	Logic		2.775		V	69KΩ PD	H
Display:										
54	LCD_CS	Display chip-select	O	Logic		2.775		V		H
60	LCD_RS	Display register-select	O	Logic		2.775		V		H
56	LCD_DATA	Display serial data	O	Logic		2.775		V		H
58	LCD_CLK	Display serial clock	O	Logic		2.775		V		H
Keypad:										
30	KBC0_N	Keypad column 0	I	Logic		2.775		V	22KΩ PU	L
28	KBC1_N	Keypad column 1	I	Logic		2.775		V	22KΩ PU	L
32	KBR0_N	Keypad row 0	I	Logic		2.775		V	22KΩ PU	L
34	KBR1_N	Keypad row 1	I	Logic		2.775		V	22KΩ PU	L
36	KBR2_N	Keypad row 2	I	Logic		2.775		V	22KΩ PU	L
38	KBR3_N	Keypad row 3	I	Logic		2.775		V	22KΩ PU	L
40	KBR4_N	Keypad row 4	I	Logic		2.775		V	22KΩ PU	L

Table 13. g20 Interface Connector Pin Assignments *(Continued)*

Pin #	Signal Name	Description	I/O	Signal	Level				Internal PU/PD	Active H/L
					Min	Typ	Max	Units		
42	KBR5_N	Keypad row 5	I	Logic		2.775		V	22KΩ PU	L
Audio:										
67	SPKR_N	Speaker inverted	O	Audio	As described in section 3.4.1.2			V		
69	SPKR_P	Speaker	O	Audio	Inverted SPKR_N			V		
63	ALRT_N	Alert speaker inverted	O	Audio	Inverted ALERT_P			V		
65	ALRT_P	Alert speaker	O	Audio	As described in section 3.4.1.2			V		
61	MIC	Microphone input	I	Audio						
59	MIC_GND	Microphone ground		GND						
57	HDST_MIC	Headset microphone	I	Audio						
55	HDST_INT_N	Headset-detect interrupt	I	Logic		2.775		V	270K PU	L
Charger:										
35	CHRG_DET_N	Charger-presence detect	I	Logic		2.775		V		L
33	CHRG_STATE	Charger rate indicator	I	Logic		2.775		V		
31	CHRG_SW	Accessory current control	O	Logic		2.775		V		
29	CHRG_DIS	Charger disable	O	Logic		2.775		V		H

Table 13. g20 Interface Connector Pin Assignments *(Continued)*

Pin #	Signal Name	Description	I/O	Signal	Level				Inter-nal PU/PD	Active H/L
					Min	Typ	Max	Units		
ADC:										
45	CHRG_TYP	Accessory-type detect	I	ADC	0		2.775	V	47KΩ PU	
47	THERM	Temperature measure-ment	I	ADC	0		2.775	V		
Miscellaneous:										
27	BL_SINK	Backlight current sink	I	DC		80	100	mA		
43	VIB_OUT	Vibrator regulator	O	DC		1.3		V		

MECHANICAL DESCRIPTION

5.1   MECHANICAL DETAILS

This section describes the mechanical details for the g20:

Size: 45.2x24.4x6 mm

Mounting: Two 2.4 mmØ holes are provided that accommodate M2 screws or #1-64 UNC 2A machine screws. Torque to 2.6 lb*inch (3kg*cm). Refer to Figure 17 below for mounting requirements.

> **Note** Motorola recommends using a split washer for vibrations.
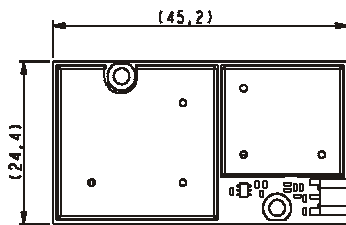
Top View - All Models
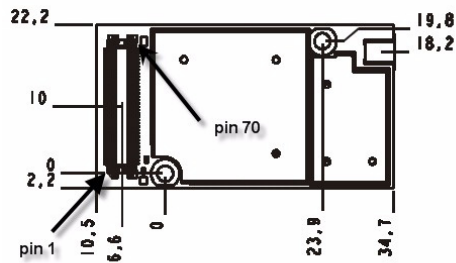
Bottom View - All Models

Side View - All Models
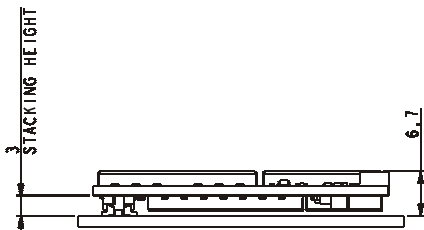
Side View for F3003-F3004 Models

Side View for F3012 & F3013 Models

Figure 17. Mechanical Mounting Requirements

6.1   CUSTOMER ASSISTANCE

This section provides contact information for any possible queries that may arise, such as the following:

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

The GSM/CDMA Data Module Customer Support Center is ready to assist you on integration issues.

A direct customer should use the following email address to contact customer assistance: n2cshd@motorola.com.

An indirect customer should send his requests to his distributor and not to Motorola help desk.

Note

The support services provided by Motorola are subject to the agreement between the customer and Motorola and may be at an additional charge to the customer. Motorola will inform the customer in advance of any such charge.

Every new call/problem report should be directed to the help desk email address noted above. 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 (for example, g20)
- Software version of the unit (ATI8 command) or model number
- PCB version: This information is 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 5v/3v/1.8v)
  - Configuration of the setup (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
ATI3	//	To get the software version of the TXVR
AT\S	//	To get the setting of basic AT commands
AT+CMER=0,0,1,1	//	To get messages and indicators from the handset display to the DTE

6.1.1   Motorola Workflow

The help desk uses the following workflow when responding to new calls:

1. Each new call is registered in the help desk data base.
2. The help desk immediately notifies the customer with the help desk system record number for each issue.
3. A champion is assigned to be responsible for the new call, from arrival to closing.
4. During this time, the champion updates the help desk system with the progress of the resolution process.
5. The champion is the contact to the customer and the engineering team, and coordinates activities that are required to solve the problem.

6.1.2   Service Centers

Motorola Electronics Taiwan PCS

11F, No, 296, Sec. 4, Jen-Ai Road

Taipei, 106, Taiwan, R.O.C

Motorola GmbH

Am Sophienhof 10

D-24941 Flensburg

Germany

Motorola Communications ISRAEL Ltd.

Service Operation

Attention: Shukrun Ofer

3 Krementsky Street

Tel Aviv, Israel 67899

Telephone: (972) 3 5658829

JNB Electronics Pty Ltd.

347 Settlement Road, Thomastown

VIC 3074

Australia

Field service should be coordinated with the Service Manager in Motorola using the following email address: N2CSFS01@motorola.com

6.1.3   Ordering Accessories

The following accessory items are available to aid the developer:

- Standard USB cable, A-type connector to B-type connector
- Standard RS232 cable, 9-pin male connected to the Developer Board

To place an order, contact your Motorola account manager. A list of Motorola account managers is available at www.motorola.com/automotive/telematics/. Then, Click Products > Data Modules > Contact Us.

6.2   TESTING A STANDALONE UNIT

This section describes how to perform a functionality test on a g20 unit. The test is performed in order to:

- Introduce the user to the g20
- Explain how to work with the g20 unit
- Describe how to evaluate basic g20 features

The test setup provides a wide platform through which a g20 unit can be evaluated. The specific test procedure described below covers only few of the g20's many features. Using this setup, you can perform several additional tests on the g20.

The test is performed using two modems, one of which is the g20. The modems communicate with each other through a single computer, which also controls their operation.

The test requires knowledge about the operation of the g20 Developer's Kit, terminal applications and AT commands. Refer to relevant documentation for assistance.

To perform the test, you need the following:

- A g20 OEM cellular engine unit
- A g20 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)

6.2.1   Test Setup

Follow the procedure below 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.[*]

2. Set up the g20 and the Developer Board as described in the Initial Setup section of the g20 Developer's Kit document by doing the following:

    • Verify that the g20 has adequate reception from the local GSM network.

    • Connect the Developer Board's RS232 port to the computer's serial port.

3. Open a terminal application window (such as HyperTerminal) in the computer and configure it to operate with the serial port occupied by the g20.

4. Open a second terminal window and configure it to operate with the serial port occupied by the line modem.
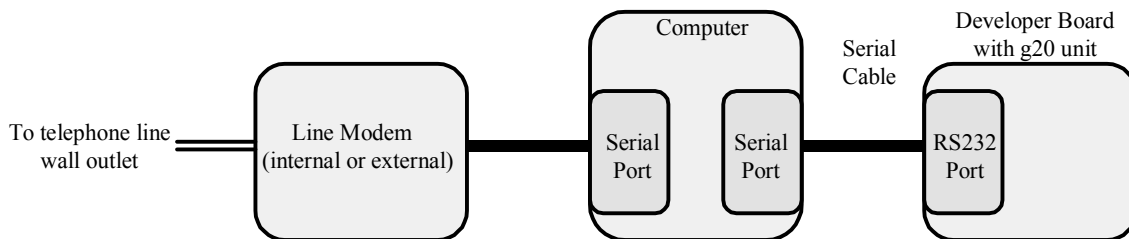
Figure 18. Test Setup

*You can use a second g20 unit instead of the line modem. When doing so, you must repeat the setup procedure for the additional g20.

6.2.2   Test Procedure

Follow the procedure below to perform the g20 test:

1. Verify that the g20 is functioning and communicating with the computer by performing the following AT commands in the g20 terminal window:

    • **ati7:** This prompts g20 identification. The g20 will reply "G20 OEM Module".

    • **ati8:** This command prompts the g20 software version.

2. 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".

3. Make a CSD data call from the g20 to the line modem or vice versa using the "atdt" and "ata" commands in the appropriate window.

4. Verify that a connection between the two modems is established.

5. Select any file to be transferred between the two modems. The file can be any existing file on the computer, or a new file created specifically for the test.

6. Send the file through the terminal application, from the g20 or to it, using the terminal application's send/receive file options.

7. When the file transfer is completed, 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.

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