DRAFT 1 (31.3.03)

MOTOROLA

g20 Cellular Engine Module Description

Developer's Guide

98-08901C66-O

DRAFT 1 (31.3.03)

MOTOROLA

g20 Developer's Kit

Developer's Guide

98-08901C67-O

REVISION HISTORY

Revision	Date	Purpose

MOTOROLA

g20
Developer's Kit

CONTENTS

March 2003
98-08901C67-O

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PREFACE

1.1 SCOPE OF THIS MANUAL

This manual introduces the g20 Developer's Kit, and describes the technical details required by the data terminal equipment (DTE) team to successfully integrate the Motorola g20 cellular engine into an original equipment manufacturer (OEM) wireless host device. With the help of this manual, the DTE team can use the Developer's Kit to conduct a full series of test and evaluation procedures on the g20, as well as perform application development.

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: GSM support-BSH015@email.mot.com.

1.2 WHO SHOULD USE THIS MANUAL

This manual is intended for all members of the DTE OEM integration team who will use the g20 Developer's Kit, including representatives from hardware, software and RF engineering disciplines.

1.3 DISCLAIMER

This guide provides advice and guidelines to OEM teams. Responsibility regarding how the information is used lies entirely with the OEM. Statements indicating support provided by, or offered by, Motorola are subject to change at any time.

Motorola reserves the right to make any changes to this manual.

1.4 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 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.

1.5 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.

1. The g20 must be operated at the voltages described in the technical documentation.
2. The g20 must not be mechanically nor electrically changed. Use of connectors should follow the guidance of the technical documentation.
3. The g20 is designed the meet the EMC requirements of ETS 300 342.

4. When integrating the g20 into a system, Motorola recommends testing the system to ETS300342-1.
5. The g20 meets the safety requirements of EN60950.
6. 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.

1.6 SAFETY

1.6.1 User Operation

Do not operate your telephone when a person is within eight inches (20 centimeters) of the antenna. A person or object within eight inches (20 centimeters) of the antenna could impair call quality and may cause the phone to operate at a higher power level than necessary, as well as expose that person to RF energy in excess of that established by the FCC RF Exposure Guidelines.

IMPORTANT: The telephone must be installed in a manner that provides a minimum separation distance of 20 cm or more between the antenna and persons in order 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 requirements described in the section that follows must be met.

1.6.2 Antenna Installation

- A minimum separation distance of 20 cm must be maintained between the antenna and all persons.
- The effective radiated power of the transmitter must be less than 1.5 Watts ERP (2.45 Watts or 33.9 dBm EIRP). This requires that the combination of antenna gain and feed line loss does not exceed 11 dBi.

1.7 APPLICABLE DOCUMENTS

g20 Cellular Engine Module Description: 9808901C66-O

g20 AT Commands: 9808901C68-O

1.8 HOW THIS MANUAL IS ORGANIZED

This manual contains the following chapters:

- **Chapter 1** contains this Preface.
- **Chapter 2** introduces the g20 Developer's Kit and provides important safety instructions.
- **Chapter 3** describes the Developer Board and its components in detail, including connectors, jumpers, DIP switches and LED indicators. It also includes a set of Quick Start procedures for first-time use.
- **Chapter 4** provides a mechanical description of the Developer Board.
- **Chapter 5** provides contact information for Motorola Service Support and Customer Assistance.
- **Chapter 6** includes schematic diagrams of the g20 Developer's Kit as well as a complete parts list.
- **Errata** provides a correction to the Developer Board.

INTRODUCTION

2.1 GENERAL DESCRIPTION

The g20 Developer's Kit is intended for evaluating the g20 module, as well as for developing and testing software applications for it.

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
ADC	Analog to Digital Converter
CMOS	Complementary Metal Oxide Semiconductor
CODEC	Coder-Decoder
DTE	Data Terminal Equipment (such as terminals, PCs and so on)
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
IGN	***WHAT DOES THIS STAND FOR?***
IRQ	Interrupt Request
LED	Light-Emitting Diode
MMCX	Multimedia Communications Exchange
PCM	Pulse Code Modulation
RF	Radio Frequency
SIM	Subscriber Identity Module
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
UUT	Unit Under Test

2.3 SAFETY PRECAUTIONS

Most Developer Board circuits are not shielded. Be sure to take appropriate precautionary measures in order to avoid ESD while handling the kit. ESD can damage the Developer Board and/or the g20 module attached to it.

DEVELOPER BOARD AND INTERFACES DESCRIPTION

3.1 GENERAL

The g20 Developer Board is designed to support the hardware and software development and validation of the g20 GSM/GPRS data module. The Developer Board provides a peripheral platform to operate the g20 as a standalone product, and to easily access the g20 interface connector signals.

The Developer Board has the following functions:

- Serves as a mounting platform for the g20 module
- Supplies the g20 module with supply voltage
- Provides standard communication interfaces (USB and RS232)

Kit Number: FTN8121A

Board Number: 8487653U01

Revision: P3

Figure 1 shows the Developer Board and some of its accessories with the g20 module attached to it: ***PLEASE PROVIDE GRAPHIC***.

Figure 1. Developer Board with Accessories

3.1.1 Developer Board Features

The Developer Board provides the following features to facilitate software and hardware development:

- Output of all g20 connector signals to a large header connector for debugging
- Host-systems connector
- AC, battery and DC power supplies for board operation
- LED indicators for critical signals
- Display and keypad for phone operation
- USB and RS232 serial interfaces
- Secondary RS232 interface using the SPI bus
- Digital audio interface
- Analog audio interface for speaker, alert speaker, microphone and headset
- SIM card connector
- Switches and jumpers for controlling board operation

3.1.2 Developer Board Connectivity

Figure 2 shows the Developer Board and its components:

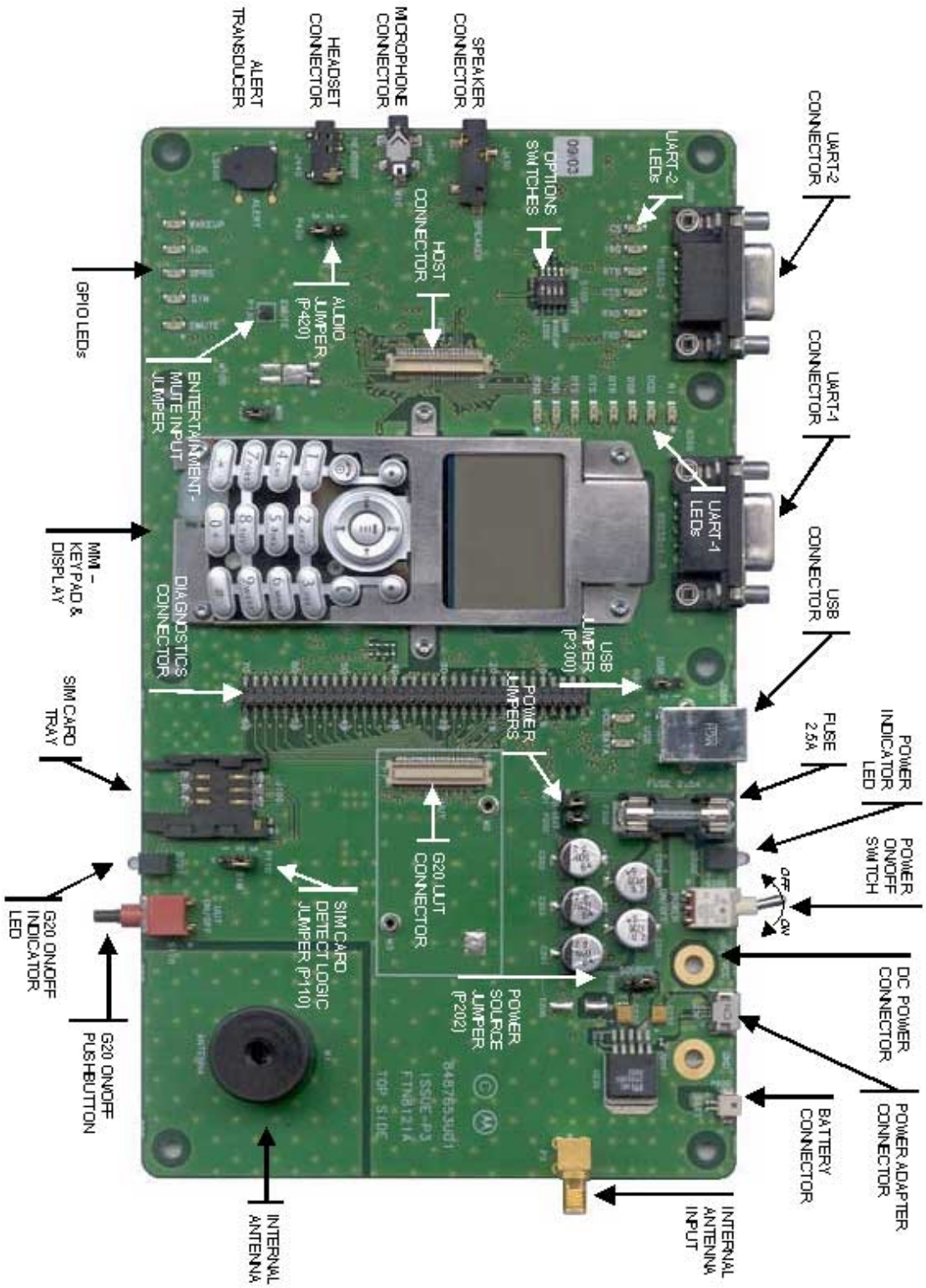


Figure 2. Developer Board Components

3.1.3 Quick Start

This section describes a series of Quick Start procedures for first-time use of the Developer Board.

3.1.3.1 g20 Connection

Open the top cover of the Developer Board and insert the g20 in its designated position. The g20 should connect to the 70-pin connector, labeled UUT (P1), and its holes should be aligned with the spacers on the Developer Board.

Fasten the g20 to the Developer Board spacers using two M2x0.4x6 mm screws provided with the kit. ***PLEASE PROVIDE GRAPHIC***.

Figure 3. Mounting the g20 Module

3.1.3.2 Antenna Connection

Connect the on-board antenna cable to the g20 antenna connector. Connect the RF Out output to the Internal antenna input using the supplied cable. ***PLEASE PROVIDE GRAPHIC***.

Figure 4. Attaching the RF Cable

Note

While working, you can keep the box closed.

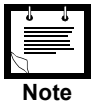
3.1.3.3 Power Connection

The Developer Board can be powered using either a wall-mounted adapter, a DC power supply or a battery cell.


Note

Only the adapter option is covered in this section. See “Power Connections” on page 15., when using other power methods.

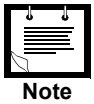
Connect the adapter to the wall outlet and to the Developer Board adapter connector (J230) labeled Adapter.


Note

The power source selection jumper, labeled Source, must be in the correct position for adapter operation (pins 1-2 shorted).

3.1.3.4 Serial Connection

The USB and RS232 serial interfaces are available for PC communications. If a PC connection is required, connect either an RS232 cable with a male D-Type connector to the labeled UART1 connector, or a USB cable with a B-Type connector to the labeled USB connector.


Note

When using a USB interface, be sure the USB jumper (P300) position reflects the g20 version being used. See “USB” on page 11..

3.1.3.5 Audio Connection

The Developer Board has several available audio configurations:

- Hands-free audio using the speaker and microphone
- Digital PCM audio
- Personal headset audio


Note

Only the headset audio option is covered in this section. See “Audio Interface” on page 21. when using other audio options.

Connect the supplied headset to the headset connector (J440) labeled Headset.

3.1.3.6 SIM Card Connection

Insert a SIM card into the SIM tray (J100).


Note

When using a SIM card, be sure the SIM jumper (P110) position reflects the g20 version being used. See “SIM Card” on page 23. for more details.

3.1.3.7 Default Switches and Jumper Settings

The Developer Board jumpers and switches are initially configured to comply with this Quick Start operation mode. If different settings are necessary, refer to the relevant section for details about the required switch or jumper settings.

3.1.3.8 Operating the g20

After completing the initial setup, turn on the Developer Board power by switching the power switch (S200) to its on position, and turn on the g20 by depressing the on/off switch (S110) or by depressing the on/off button on the keypad.

3.2 COMMUNICATIONS INTERFACES

The g20 Developer Board includes three different serial interfaces:

- RS232
- USB
- SPI

The RS232 and USB ports are multiplexed within the g20, and therefore cannot be operated simultaneously. Their default connection is RS232. The SPI interface is used for debugging.

Each of these serial interfaces is described in the sections that follow.

3.2.1 RS232

The RS232 serial port is the primary interface to the g20 UUT via the J350 connector. This port is denoted by the RS232-1 marking beside the 9-pin, D-type connector.

The UUT RS232 signals are active-low CMOS-level signals (0-2.7 V), which are converted by the Developer Board to standard RS232 levels for PC communications.

Table 2. RS232-1 Connector Pinout (J350)

Pin #	Description	DTE I/O
1	DCD	In
2	RXD	In
3	TXD	Out
4	DTR	Out
5	Ground	
6	DSR	In
7	RTS	Out
8	CTS	In
9	RI	In

Note

The RS232 connector pin names are DTE-oriented.

3.2.2 USB

The USB interface operates according to the g20 UUT configuration. The Developer Board has a complete USB transceiver circuit to support USB communications for g20 units that do not include a USB driver of their own. The Developer Board USB interface can be overridden manually when using a g20 unit that does include its own USB driver interface.

Table 3. USB Connector Pinout (J3)

Pin #	Description
1	VCC
2	D-
3	D+
4	Ground

The USB jumper (P300) located next to the USB connector selects between the Developer Board USB interface and the UUT USB interface. By changing the jumper position, the USB_VBUS signal is diverted to the selected driver (in the g20 or on the Developer Board) and operates it.

Table 4. USB Selection (P300 Jumper)

P300 Jumper Position			Selected Mode	USB Source
1	2	3		
●	●		g20	g20 driver
	●	●	EVB (Developer Board)	EVB driver
			USB disconnected	

3.2.3 SPI

The Developer Board includes a secondary 4-wire RS232 interface, which is connected to the g20 internal SPI bus through the J500 connector. This interface is used to debug applications. This port is denoted by the RS232-2 label next to the 9-pin D-type connector.

On the Developer Board, the g20 SPI interface is converted to standard RS232 signals for PC communications. The conversion process uses the RS232 interface as a second slave on the internal g20 SPI bus, and communicates with it as such. SPI read and write operations are performed normally, using the CS and IRQ signals provided by the conversion circuit. The IRQ signal is connected to a g20 IRQ pin.

Table 5. RS232-2 Connector Pinout (J500)

Pin #	Description	DTE I/O
1	Unused	
2	RXD	In
3	TXD	Out
4	Unused	
5	Ground	
6	Unused	
7	RTS	Out
8	CTS	In
9	Unused	

Note

The RS232 connector pin names are DTE-oriented.

3.3 CONNECTORS DESCRIPTION

All the Developer Board connectors are marked by their reference number and by a pin-1 indicator. Table 6 describes the available connectors on the Developer Board.

Table 6. Connectors

Reference	Connector	Description
P1	g20 UUT	g20 UUT (unit under test) connector
J1	Host	Emulates the g20 connector for host systems
P100	Diagnostics	Debug header connector (70-pin)
J300	USB	USB B-type connector
J350	RS232-1	Primary RS232 to PC
J500	RS232-2	Secondary RS232 for debugging (SPI)

Table 6. Connectors *(Continued)*

Reference	Connector	Description
J430	Speaker	Hands-free system speaker jack
J460	Microphone	Hands-free system microphone jack
J440	Headset	Headset jack
J201	VCC	Developer Board DC power supply
J200	GND	Developer Board common ground
P600	Battery	Battery connector
J230	AC adapter/charger	Wall-mount adapter connector (CE bus compatible)
J100	SIM card	SIM card socket with detection
P2	Antenna connector	SMA connector for g20 antenna
M1	RF Antenna	RF antenna
DS800	Display	Display pads

3.3.1 UUT Interface Connector

Table 7 lists the pin names and functions available for g20 interface connectors. All pin numbers and functions are identical for the P1, J1 and P100 connectors on the Developer Board.

Table 7. g20 Connectors Pinout

Pin #	Pin Name	Pin #	Pin Name
1	GND	2	GND
3	GND	4	GND
5	VCC	6	VCC
7	VCC	8	VCC
9	RTS_N	10	USB_DET
11	RXD_N	12	Not connected
13	DSR_N	14	Not connected
15	CTS_N	16	WAKEUP_IN_N

Table 7. g20 Connectors Pinout *(Continued)*

Pin #	Pin Name	Pin #	Pin Name
17	DCD_N	18	PCM_DIN
19	DTR_N	20	PCM_DOUT
21	TXD_N	22	PCM_CLK
23	RI_N	24	PCM_FS
25	RESET_N	26	WAKEUP_OUT_N
27	BL_SINK	28	KBC1_N
29	CHRG_DIS	30	KBC0_N
31	CHRG_SW	32	KBR0_N
33	CHRG_STATE	34	KBR1_N
35	CHRG_DET_N	36	KBR2_N
37	ENT_MUTE	38	KBR3_N
39	TX_EN_N	40	KBR4_N
41	ANT_DET	42	KBR5_N
43	VIB_OUT	44	SIM_RST_N
45	CHRG_TYP	46	SIM_CLK
47	THERM	48	SIM_VCC
49	GPRS_DET_N	50	SIM_PD
51	IGN	52	SIM_DIO
53	ON_OFF_N	54	LCD_CS
55	HDST_INT_N	56	LCD_DATA
57	HDST_MIC	58	LCD_CLK
59	MIC_GND	60	LCD_RS
61	MIC	62	SPI_IRQ_N
63	ALRT_N	64	SPI_DIN

Table 7. g20 Connectors Pinout *(Continued)*

Pin #	Pin Name	Pin #	Pin Name
65	ALRT_P	66	SPI_CLK
67	SPKR_N	68	SPI_DOUT
69	SPKR_P	70	SPI_CS

3.4 POWER CONNECTIONS

Developer Board power can be supplied from a DC power source, an AC power adapter or a battery. The same power source is used for the UUT and the board peripherals.

The Developer Board includes three jumpers for controlling the power supply:

- **P202:** AC adapter or battery power source selection
- **P201:** Connects/disconnects the Developer Board peripherals from the power supply
- **P200:** Connects/disconnects the g20 from the power supply

Each power supply option is described in the sections that follow.

3.4.1 DC Power Source Operation

When using a DC power supply, the power source is applied to connectors J201 (VCC) and J200 (Ground). The DC voltage applied through this connection should not exceed the recommended operational limits of 3V-4.2V. In all cases, the DC source input is protected from over voltage and reverse polarity, and includes a 2.5A protective fuse.

The supplied DC input connectors must be attached to the Developer Board in order to use the DC power source. The two connectors should be screwed into their appropriate positions (J201, labeled VCC, and J200, labeled GND). Use the red connector for VCC and the black one for GND. Connect the DC power source to these connectors using banana plugs, alligator clamps or wire.

Caution

It is recommended to remove jumper P202 when using the DC power source. In any case, the DC power source should not be used when other sources are connected.

3.4.2 AC Adapter Operation

When using an AC adapter, the adapter is connected to J230. The adapter supplies a constant 4.5 V, which is regulated to a nominal 4.1 V on the Developer Board.

Table 8. J230 Connector Pinout

Pin #	Pin Name
1	GND
2	Detection circuit
3	VCC

3.4.3 Battery Operation

The Developer Board supports a battery power supply. The battery used must be a 3.6V lithium-ion cell, corresponding to Motorola part number 0189727L01.

When using a battery as the main power source, the AC adapter input operates as a battery charger, which connects to an on-board battery charging circuit.

Table 9. P600 Connector Pinout

Pin #	Pin Name
1	VCC
2	GND

3.4.4 Power Source Selection

The Developer Board AC adapter and battery power inputs include a selection jumper (P202) that diverts either the regulated AC adapter power or the battery power to the board.

Table 10. Power Source (P202 Jumper)

P202 Jumper Position			Selected Mode	Power Source
1	2	3		
●	●		Adapter	AC Adapter
	●	●	Battery	LiIon Battery
			Adapter and battery disconnected	DC power only

Note

The DC power source input is independent of the other power inputs, and does not pass through this selection jumper. Nevertheless, it is still recommended to disconnect the P202 jumper when using the DC source.

3.5 SWITCHES AND JUMPERS

Table 11 describes the available switches and jumpers on the Developer Board.

Table 11. Switches and Jumpers

Reference	Switch/Jumper	Description
S200	Board on/off	Developer Board on/off switch
S110	g20 on/off	g20 UUT on/off push button switch
S100	Options switch	Four switches for Developer Board options
P420	Audio	Analog/digital audio-selection jumper
P201	EVB	Peripheral power input jumper
P200	UUT	g20 UUT power input jumper
P202	Source	Power source selection jumper
P110	SIM	SIM card detect logic selection jumper
P300	USB	USB driver source selection jumper
P130	EMUTE	Entertainment mute connection point

3.6 LED INDICATORS

Table 12 describes the LED indicators available on the Developer Board. Each LED is marked on the board by the function it represents.

Table 12. LED Indicators

Group	LED	Reference	Description
GPIO	WAKEUP	D704	Wake-up in/out
	IGN	D702	Ignition input
	GPRS	D710	GPRS coverage indication
	SIM	D703	SIM card reset indication
	UUT	D701	g20 reset signal
	PWR	D200	Developer Board power indicator
	EMUTE	D708	Entertainment mute indicator
SPI	CS	D741	SPI chip-select output
	IRQ	D745	SPI IRQ input
USB	VCC	D760	USB VBUS
	DATA	D761	USB D+
RS232-1	RXD	D722	DTE receive data
	TXD	D721	DTE transmit data
	RTS	D724	Request to send
	CTS	D723	Clear to send
	DTR	D725	Data terminal ready
	DSR	D726	Data set ready
	DCD	D727	Carrier detect
	RI	D728	Ring indicator

Table 12. LED Indicators *(Continued)*

Group	LED	Reference	Description
RS232-2	RXD	D743	DTE receive data
	TXD	D742	DTE transmit data
	CTS	D744	Clear to send
	RTS	D745	Request to send

3.7 MMI

The Developer Board includes a man-machine interface (MMI), complete with display and keypad. The signals from the display and keypad are directly connected to the UUT interface.

3.7.1 Display

The grayscale display (DS800) is not a standalone component, and includes a complete assembly in which it is housed, along with other necessary parts.

Table 13. Display Connector Pinouts (DS800)

Pin #	Description
1	Chip select
2	Reset
3	Register select
4	Serial clock
5	Serial data
6	Supply
7	Supply
8	Ground
9	Vout

3.7.2 Keypad

Table 14 describes the Developer Board keypad layout.

Table 14. Keypad Functions

Pad Reference	Function	Alternate
S803	1	Punctuation
S802	2	ABC
S820	3	DEF
S801	4	GHI
S805	5	JKL
S804	6	MNO
S806	7	PQRS
S817	8	TUV
S811	9	WXYZ
S809	0	+
S810	Star (*)	
S815	Pound (#)	
S814	Send	
S813	End	On/Off
S819	Menu	
S822	Right	
S823	Left	
S818	Up	
S816	Down	
S812	Soft Right	
S808	Soft Left	

3.8 AUDIO INTERFACE

The Developer Board includes analog and digital audio interfaces. The audio interface contains a hands-free speaker and microphone, a headset, and an alert speaker.

3.8.1 Speaker

The differential speaker interface is designed as a car-kit hands-free speaker. The Developer Board uses an audio amplifier to amplify the speaker audio output to desired levels. The speaker connector (J430) is labeled SPEAKER. The speaker output is 8 ohms matched.

Table 15. Speaker Connector Pinout (J430)

Pin #	Description
1	Not connected
2	Speaker positive output
3	Speaker negative output
4	Not connected

3.8.2 Microphone

The microphone interface is designed as a car-kit hands-free microphone. The microphone connector (J460) is labeled MIC.

Table 16. Microphone Connector Pinout (J460)

Pin #	Description
1	Ground
2	Microphone audio-in
3	Ground
4	Ground
5	Ground

3.8.3 Audio Source Selection

Microphone and speaker audio can be routed through two different sources: the g20 audio amplifiers or the g20 digital audio interface. The Developer Board includes a CODEC that converts the g20 digital audio data to analog audio signals.

The P420 jumper selects the speaker and microphone source, as indicated in Table 17.

Table 17. Audio Source (P420 Jumper)

P420 Jumper Position			Selected Mode	Audio Source
1	2	3		
●	●		Digital audio	CODEC audio I/O
	●	●	Analog audio	G20 audio I/O
			Audio disconnected	

3.8.4 Headset

The headset interface is designed as a portable phone audio interface, and is similar to the headset interface. The headset connector (J440) includes a speaker, microphone and a detection signal. The speaker and microphone signals are directly connected to the g20 audio signals.

The purpose of the detection circuit is to switch the g20 headset audio paths on and off, whenever a headset connection is detected. Headset detection is made whenever a headset plug is inserted into the jack. This action disables the g20 microphone and speaker, and routes the audio signals to the headset.

Table 18. Headset Connector Pinout (J440)

Pin #	Description
1	Ground
2	Headset-detect switch
3	Speaker audio-out
4	Microphone audio-in
5	Ground

3.8.5 Alert Speaker

The Developer Board includes an on-board transducer for alert audio sounds (LS400), which is labeled ALERT. The transducer is connected directly to the g20 differential alert outputs. The alert transducer is similar to the alert speaker, which sounds the g20 MIDI signals.

Table 19. Alert Transducer Pinout (LS400)

Pin #	Description
1	Alert audio inverted output
2	Alert audio positive output
3	Alert audio inverted output
4	Alert audio inverted output

3.9 DEVELOPER BOARD PERIPHERALS

This section describes the connectors for peripheral devices that can be used with the Developer Board.

3.9.1 SIM Card

The SIM card connector (J100) is external to the UUT, but is connected directly to it, similar to an internal SIM. The UUT can accept 1.8V and 3V SIM cards.

Table 20. SIM Connector Pinouts (J100)

Pin	Description
1	Ground
2	Presence detect
3	Clock
4	Reset
5	VCC
6	Serial data I/O
7	VPP
8	Ground

The SIM card supports both active-high and active-low detection configurations. Jumper P110 is used to select between these configurations.

Table 21. SIM Detection Logic (P110 Jumper)

P110 Jumper Position			Selected Mode
1	2	3	
●	●		Active-low
	●	●	Active-high
			Not active

3.9.2 Entertainment Mute

The Developer Board includes an entertainment-mute logic circuit that is responsible for muting a car radio whenever the phone is in use (for example, incoming calls, dialing, and so on).

The entertainment-mute logic circuit includes an ENABLE input that is both a g20 signal and an open-collector MUTE output. This circuit is connected to jumper P130 for host systems.

Note

The entertainment-mute operation is not currently supported by the g20.

3.9.3 LEDs Logic and Control

The Developer Board includes LED indicators for critical signals. A 3.0V regulator powers the LEDs, and an on/off switch controls their operation. The switch is located in the S100 switch array, and is labeled LED. Turning the switch on and off enables or disables all LED activity, respectively.

The Developer Board power LED and the g20 on/off LED are always active and cannot be disabled.

3.9.4 ADC Test Logic

The g20 has two ADC pins. The g20 charger and temperature monitor currently occupy these pins. The Developer Board includes optional resistors for ADC testing. These resistors, two for each ADC signal, can be used to set a specific voltage across the ADC signal.

The G20 has a 47K-ohm internal pull-up resistor at each ADC input, as shown in Figure 5.

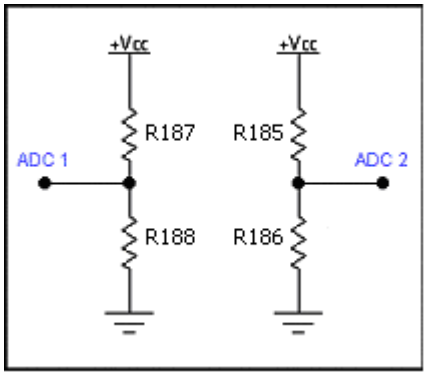


Figure 5. ADC Test Logic

3.9.5 Ignition

The Developer Board contains an on/off switch that is connected to the g20 UUT ignition circuit. The switch is located in the S100 switch array, and is labeled IGN. Turning the switch on applies the UUT supply on the Ignition input pin.

3.9.6 Wakeup

The Developer Board includes a wakeup switch that toggles the g20 WAKEUP_IN_N signal. The switch is located in the S100 switch array, and is labeled WAKEUP.

3.9.7 AC Adapter Detection Circuit

The g20 charger module includes a detection logic circuit for detecting charger presence and type. The detection circuit is internal to the g20 module. However, the Developer Board does contain the necessary routing from the g20 UUT to the AC adapter connector.

Two g20 signals are used for this detection:

- **AD1:** ADC signal for charger type detection
- **CHRG_SW:** Charger rate control

These detection signals are present to provide compatibility with the phone. They may be removed in future versions.

3.10 ANTENNA CONFIGURATION

An antenna (internal or external) must be connected to the Developer Board for adequate GSM reception. You can connect the g20 to either the on-board internal antenna or to an external antenna. Two RF connectors on the Developer Board, labeled INT ANT and EXT ANT, are used for this purpose. The EXT ANT connector has an internal extension cable with MMCX termination, which must be connected to the g20 RF connector. The INT ANT connector is an on-board connection to the Developer Board internal antenna.

When using the internal antenna option, the additional RF cable supplied in the Developer's Kit must be connected between the EXT ANT and INT ANT connectors. When using the external antenna option, an external antenna or antenna application must be connected to the EXT OUT connector. (The connection cable is not included.)

3.11 TEST POINTS

Table 22 describes the available test points on the Developer Board.

Table 22. Test Points

Reference	Function
TP400	Alert speaker positive signal
TP401	Alert speaker inverted signal

3.12 ELECTRICAL SPECIFICATIONS

Table 23 describes the electrical specifications OF the Developer Board.

Table 23. Electrical Specifications

Parameter	Min	Typ	Max	Units
DC power supply	3.0	3.6	4.2	V
Adapter power supply	4.4	4.6	12	V
Battery power supply	3.0	3.6	4.2	V
Off current	---	36	46	uA
On current	8.1	8.33	8.45	mA
Active current peripherals off	12.7	13	---	mA
Active current peripherals on*	13.1	---	190	mA

* Depends on the active peripherals (LEDs, UART, USB, and so on) in use.

MECHANICAL DESCRIPTION

4.1 MECHANICAL REQUIREMENTS FOR MOUNTING THE G20 MODULE

The size of the g20 module is 45.2 x 24.4 x 6 mm. Two 2.4 mmØ holes are provided to accommodate M2 screws or #1-64 UNC 2A machine screws. Torque to 2 inches per pound. Refer to Figure 6 below for mounting requirements:

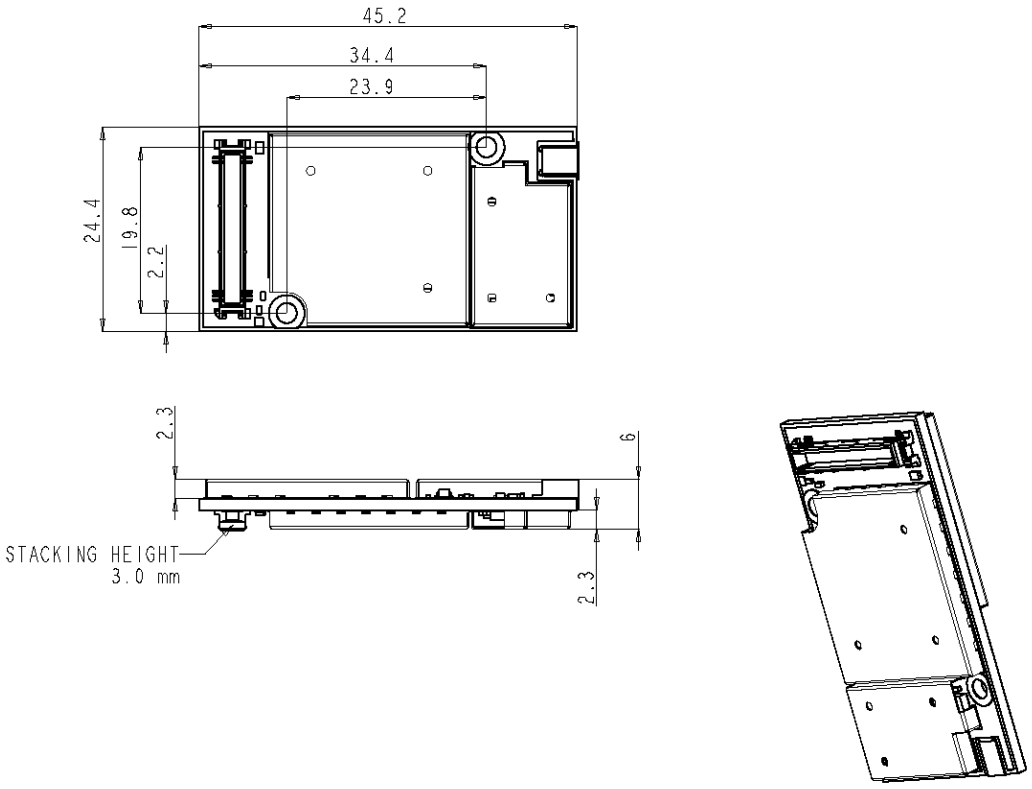


Figure 6. Mechanical Mounting Requirements

SERVICE SUPPORT

5.1 WEB PAGES

PLEASE PROVIDE DETAILS FOR THIS SECTION.

5.2 CUSTOMER ASSISTANCE

For customer assistance, contact us as directed below:

Helpdesk email: n2cshd@motorola.com

Helpdesk telephone: +972-3-568-4040

SCHEMATICS, PLACEMENT AND PARTS LIST

6.1 SCHEMATICS

This section presents the schematics for the g20 Developer Board.

PLEASE PROVIDE INFORMATION FOR FIGURE CAPTIONS.

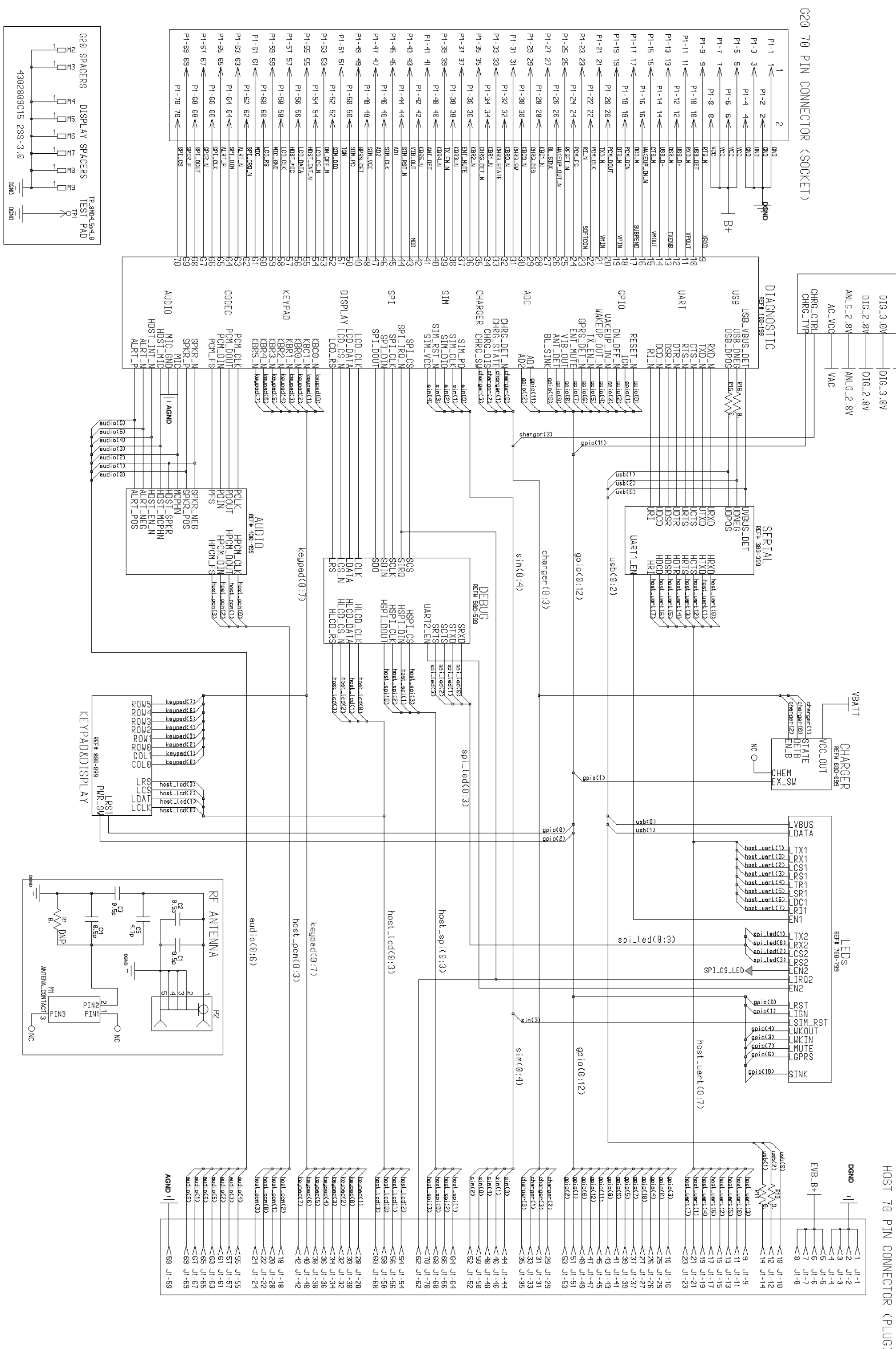


Figure 7.

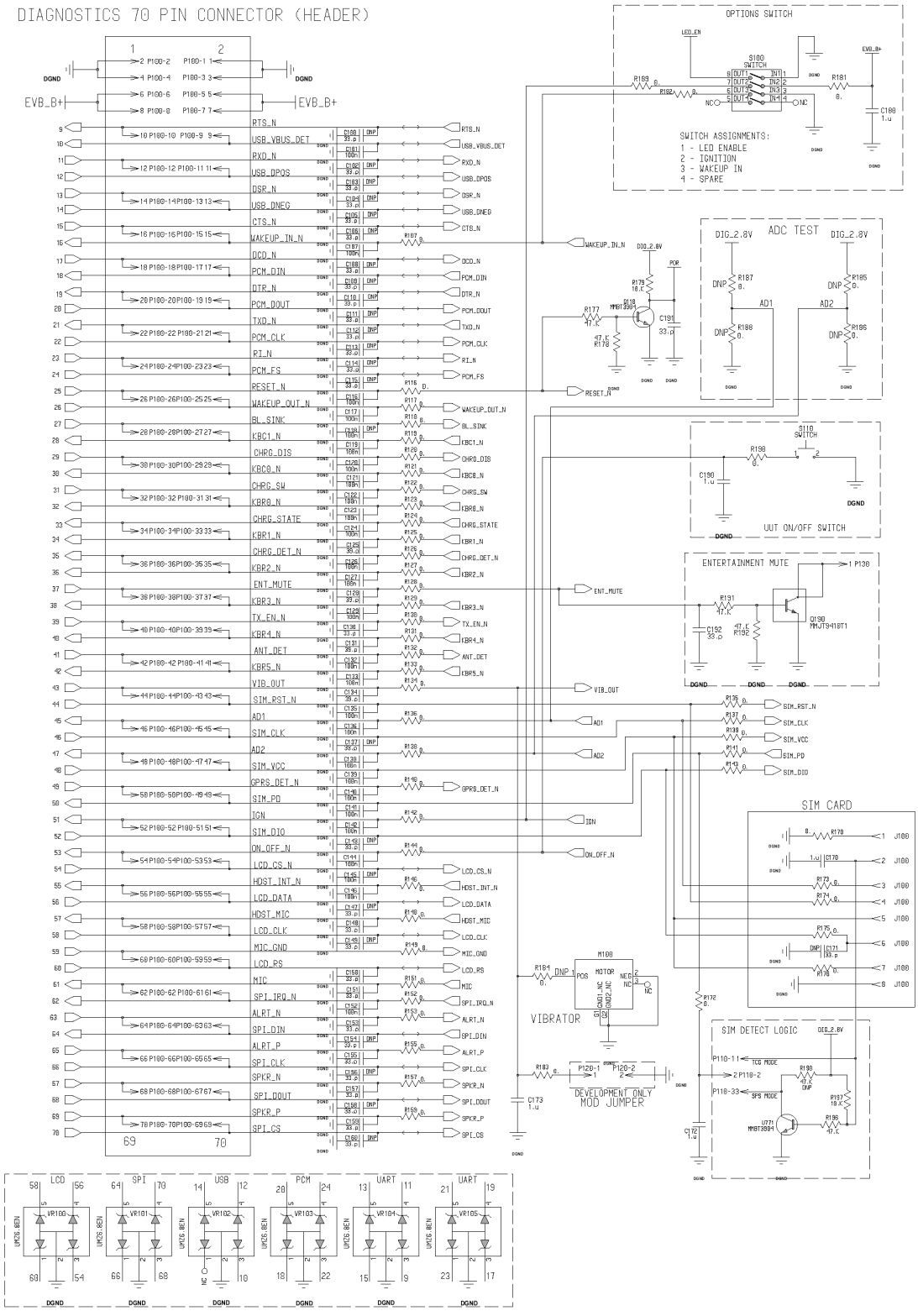

DIAGNOSTICS 70 PIN CONNECTOR (HEADER)
OPTIONS SWITCH
SWITCH ASSIGNMENTS:
1 - LED ENABLE
2 - IGNITION
3 - WAKEUP IN
4 - SPARE
ADC TEST
UUT ON/OFF SWITCH
ENTERTAINMENT MUTE
VIBRATOR
SIM CARD
SIM DETECT LOGIC
DEVELOPMENT ONLY
MOD JUMPER
LCD
SPI
USB
PCM
UART
UART

Figure 8.

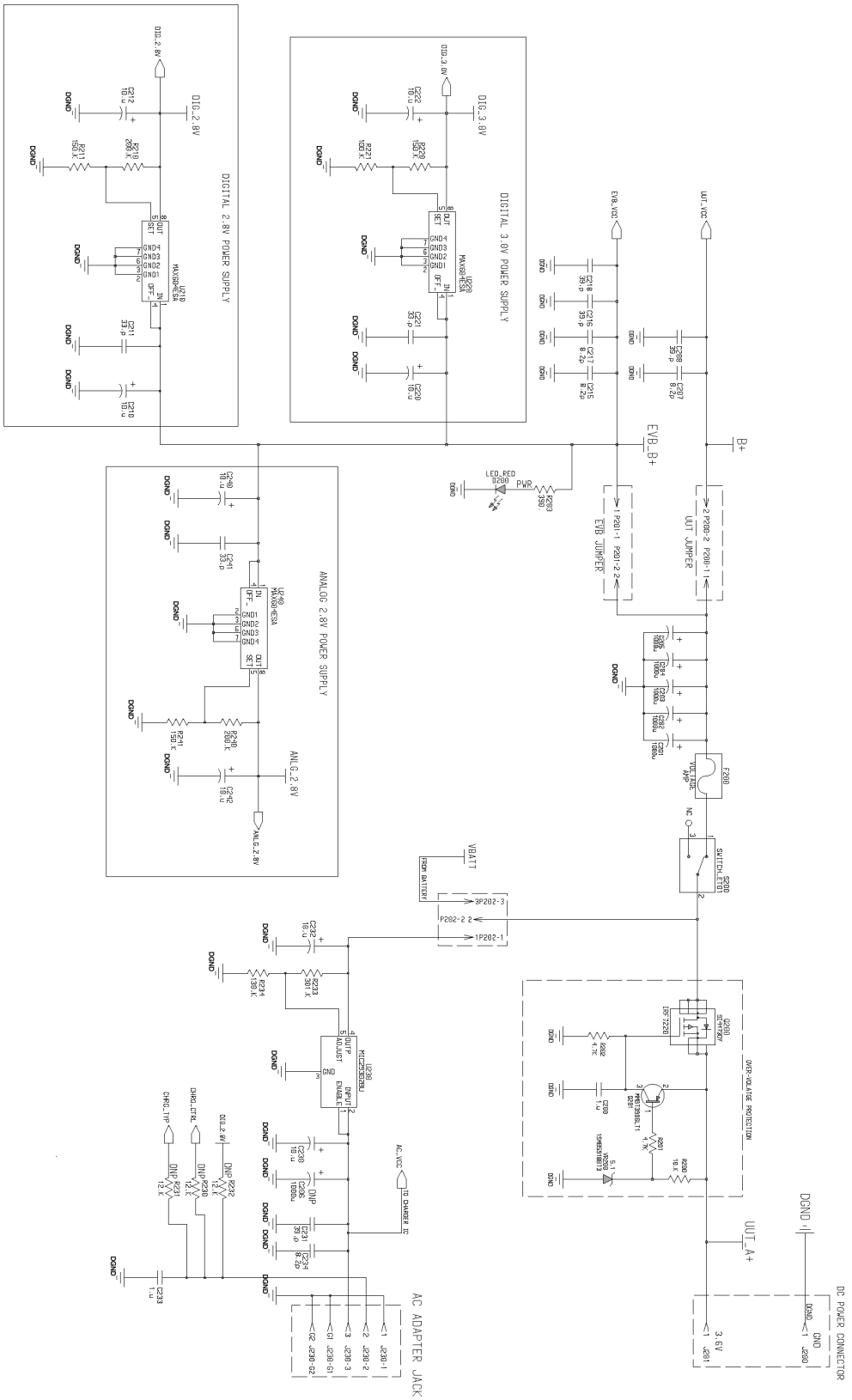

DIGITAL 2.8V POWER SUPPLY
DIGITAL 3.0V POWER SUPPLY
ANALOG 2.8V POWER SUPPLY
EVB_B+
B+
EVB JUMPER
UUT JUMPER
SWITCH_FET
AC ADAPTER JACK
DC POWER CONNECTOR
OVER-VOLTAGE PROTECTION
UUT_A+
DGND

Figure 9.

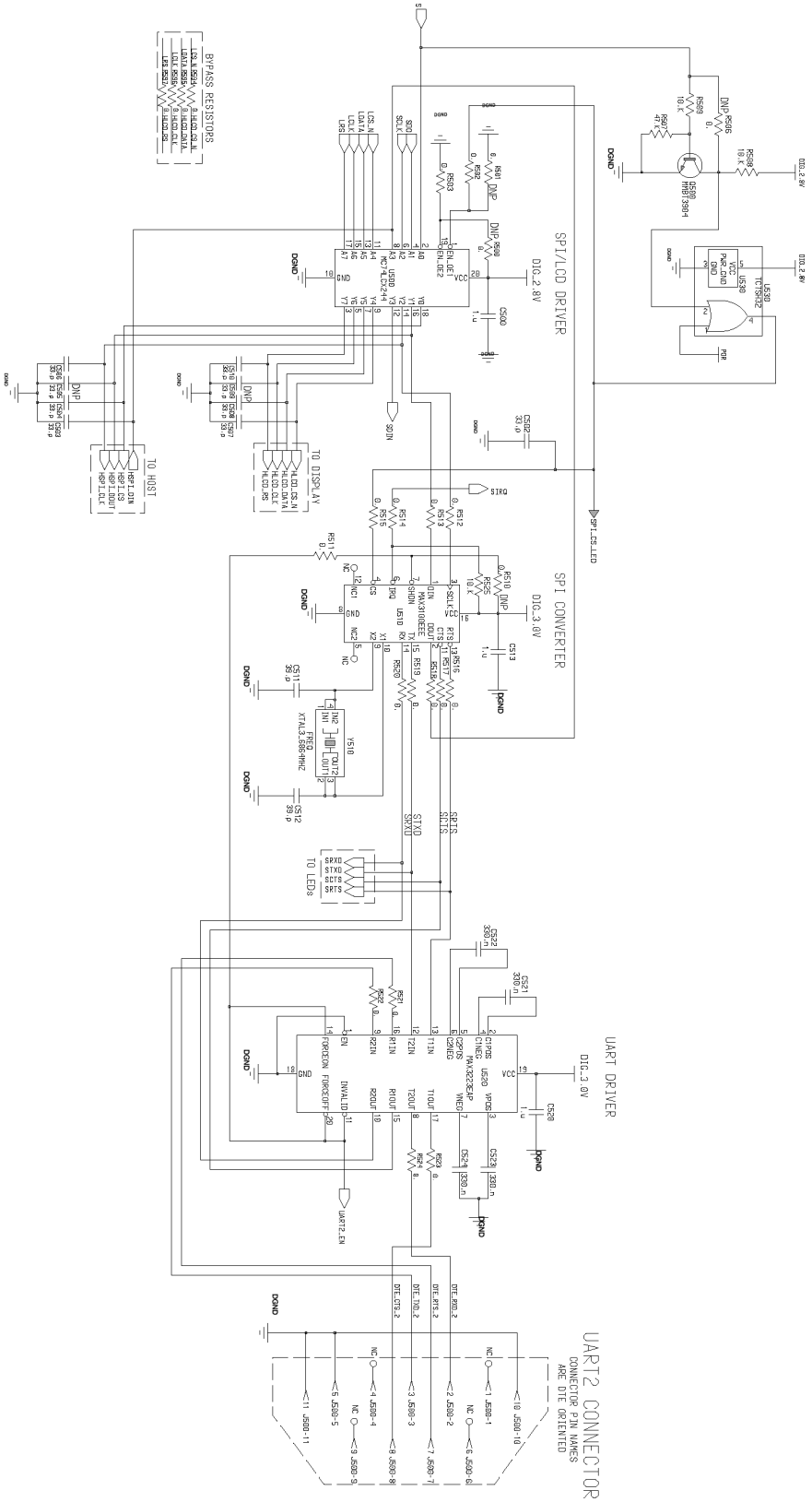
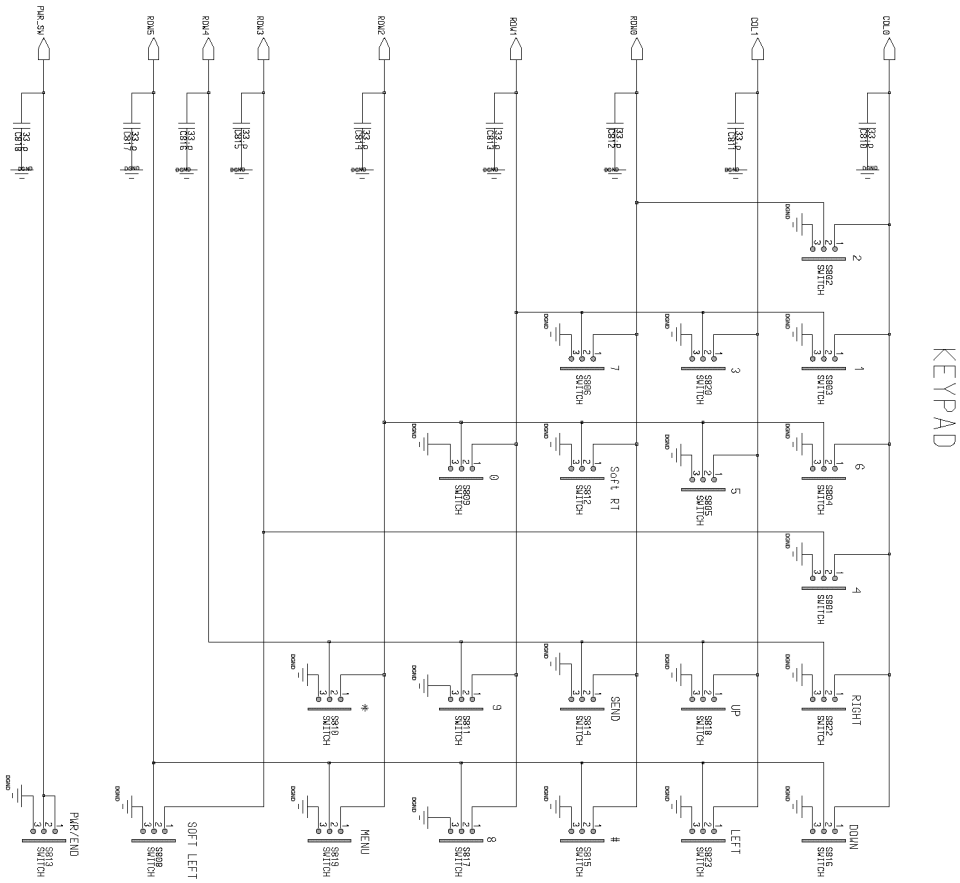

BYPASS RESISTORS
SPI/LCD DRIVER
DIG_2.8V
SPI CONVERTER
DIG_3.0V
UART DRIVER
DIG_3.0V
UART2 CONNECTOR
CONNECTOR PIN NAMES ARE DTE ORIENTED
TO HOST
TO DISPLAY
TO LEDs
DGND
SIRQ
SPI_CS_LCD
SCLK
SDIN
SDO
STXD
SRXD
SCTS
SRTS
UART2_EN
DTE_CTS_2
DTE_TXD_2
DTE_RTS_2
DTE_RXD_2

Figure 10.


KEYPAD
COL0
COL1
ROW0
ROW1
ROW2
ROW3
ROW4
ROW5
PWR_SW
SR18
SR17
SR16
SR15
SR14
SR13
SR12
SR11
SR10
SR9
SR8
SR7
SR6
SR5
SR4
SR3
SR2
SR1
SR19
SR20
SR21
SR22
SR23
1
2
3
4
5
6
7
8
9
0
*
#
SOFT LEFT
MENU
SEND
SOFT RT
UP
LEFT
RIGHT
DOWN
PWR/END

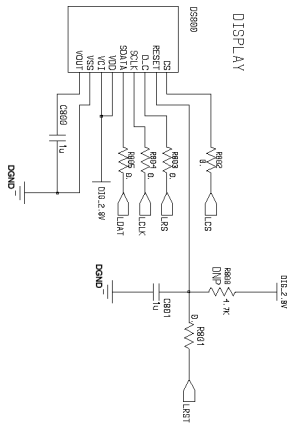

DISPLAY
DS800
RST
D_C
SCLK
SDATA
VDD2
VCI
VSS
VOUT
C800
1u
DGND
R805
0
R804
0
R803
0
R802
0
DTO_2.8V
LDAT
LCLK
LDI
LCS
R808
DNP
1.7K
C801
1u
R801
0
LRST

Figure 11.

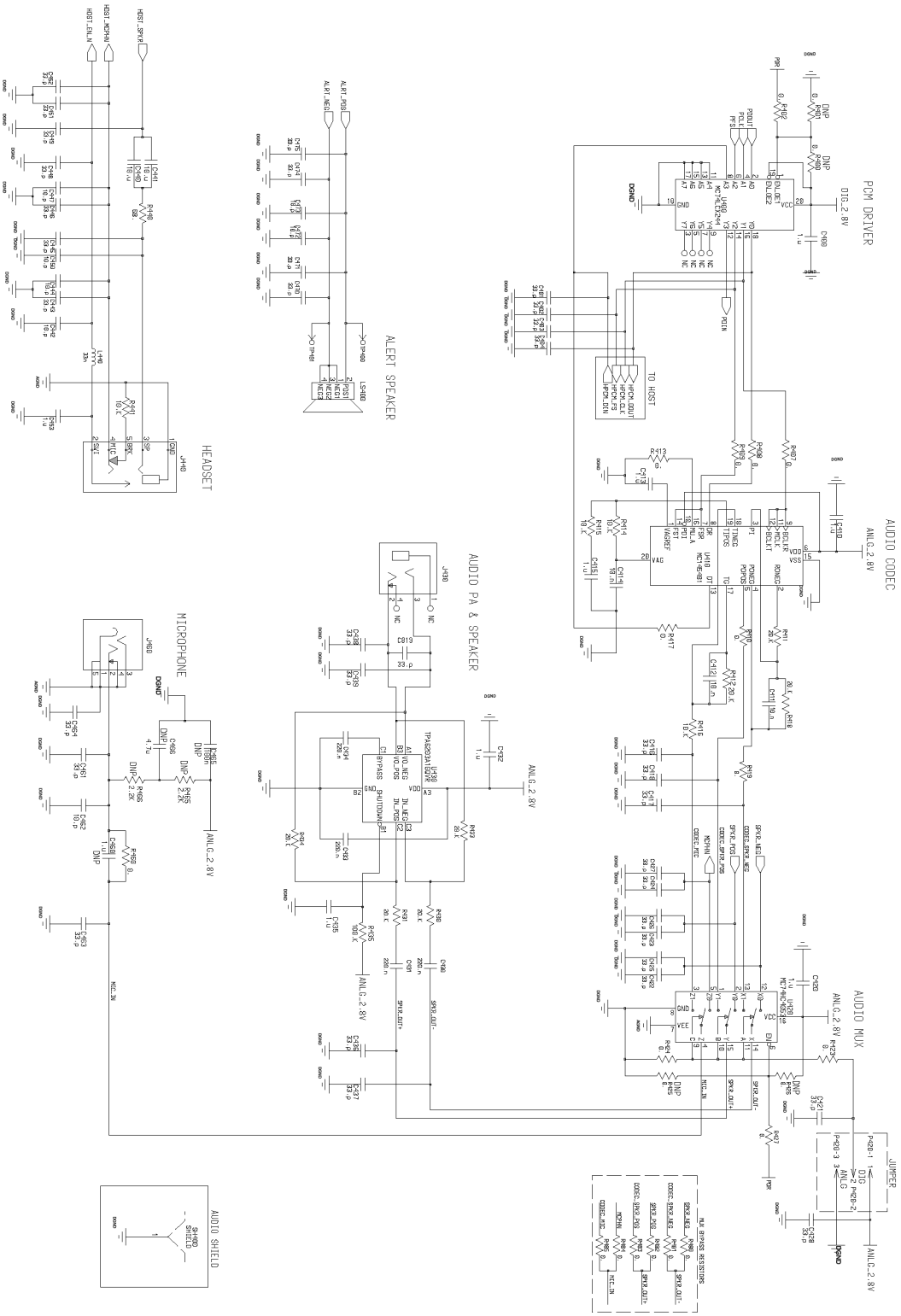

HEADSET
ALERT SPEAKER
AUDIO PA & SPEAKER
MICROPHONE
AUDIO SHIELD
TO HOST
PCM DRIVER
AUDIO CODEC
AUDIO MUX
JUMPER
DIG_2.8V
ANLG_2.8V

Figure 12.

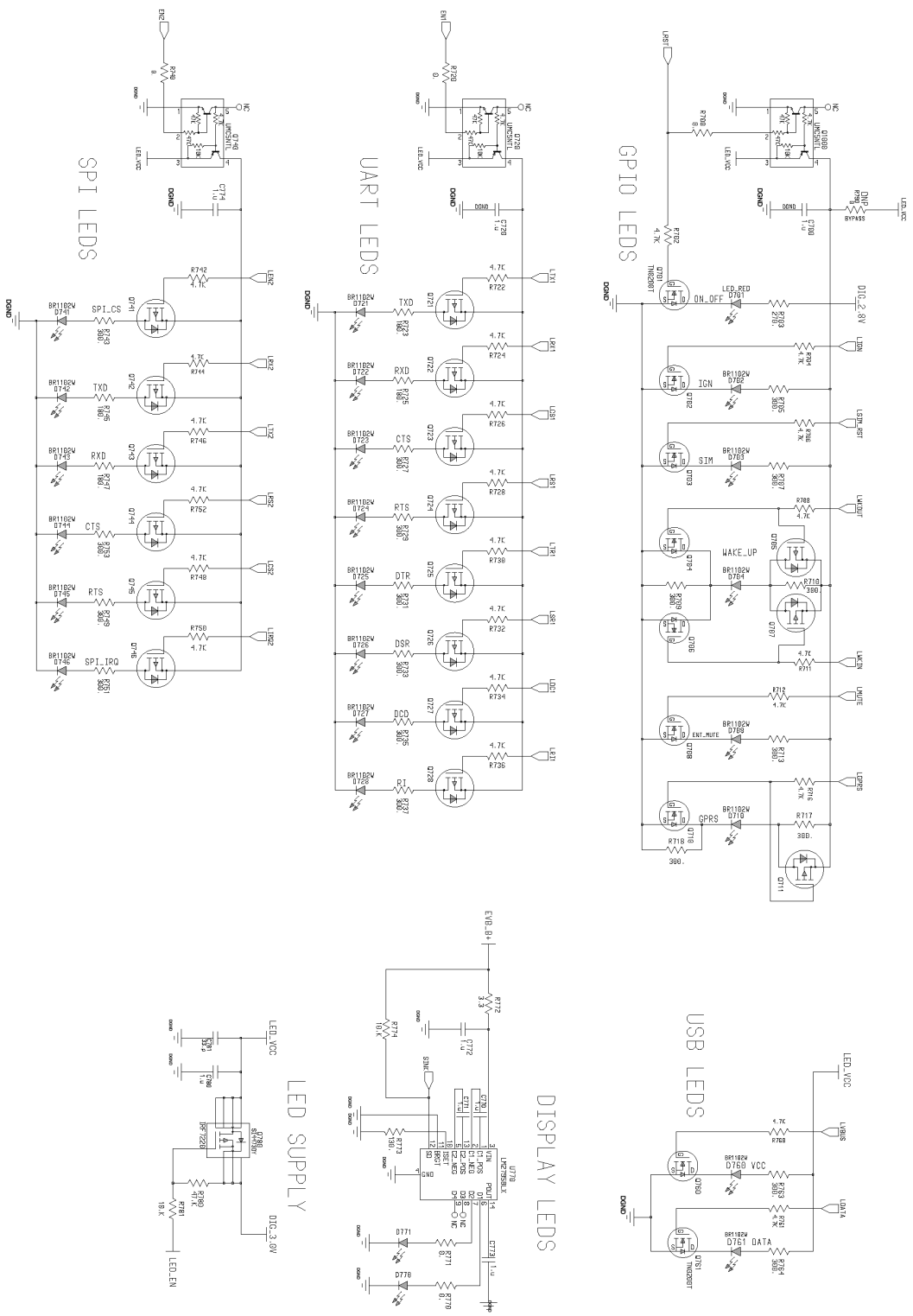

SPI LEDS
UART LEDS
GPIO LEDS
USB LEDS
LED SUPPLY
DISPLAY LEDS
SPI_CS
TXD
RXD
CTS
RTS
SPI_IRQ
DTR
DSR
DCD
RI
LED_RED
ON_OFF
IGN
SIM
WAKE_UP
ENT_MUTE
CPRS
VCC
DATA
LED_VCC
DIG_2.8V
DIG_3.0V
LED_EN

Figure 13.

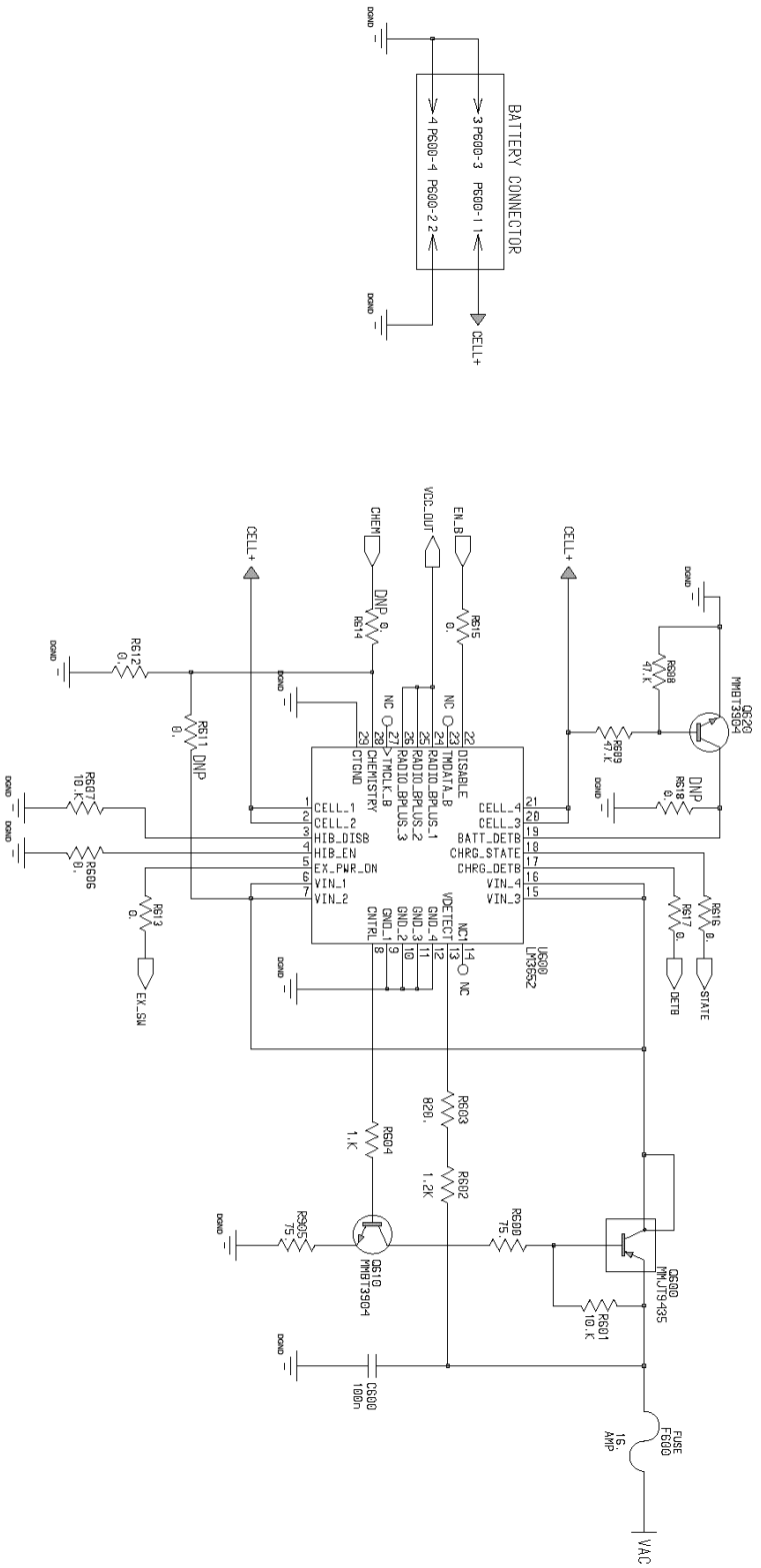

BATTERY CONNECTOR
P600-4
P600-2
P600-3
P600-1
CELL+
DGND
CHEM
VCC_OUT
EN_B
DNP
R614
0.
R615
R612
R611
R608
47K
Q620
MMBT3904
R609
47K
R618
R607
10.K
R606
R613
EX_SW
R616
R617
DETB
STATE
U600
LM3652
CELL_1
CELL_2
HIB_DISB
HIB_EN
EX_PWR_ON
VIN_1
VIN_2
CELL_4
CELL_3
BATT_DETB
CHRG_STATE
CHRG_DETB
VIN_4
VIN_3
CHEMISTRY
CTGND
TMCLK_B
RADIO_BPLUS_3
RADIO_BPLUS_2
RADIO_BPLUS_1
TMDATA_B
DISABLE
CNTRL
GND_1
GND_2
GND_3
GND_4
VDETECT
NC1
NC
R603
820.
R604
1.K
R602
1.2K
R605
75
R610
MMBT3904
R609
75
Q600
MMDT3946
R601
10.K
C600
100n
FUSE
F600
1A
AMP
VAC

Figure 14.

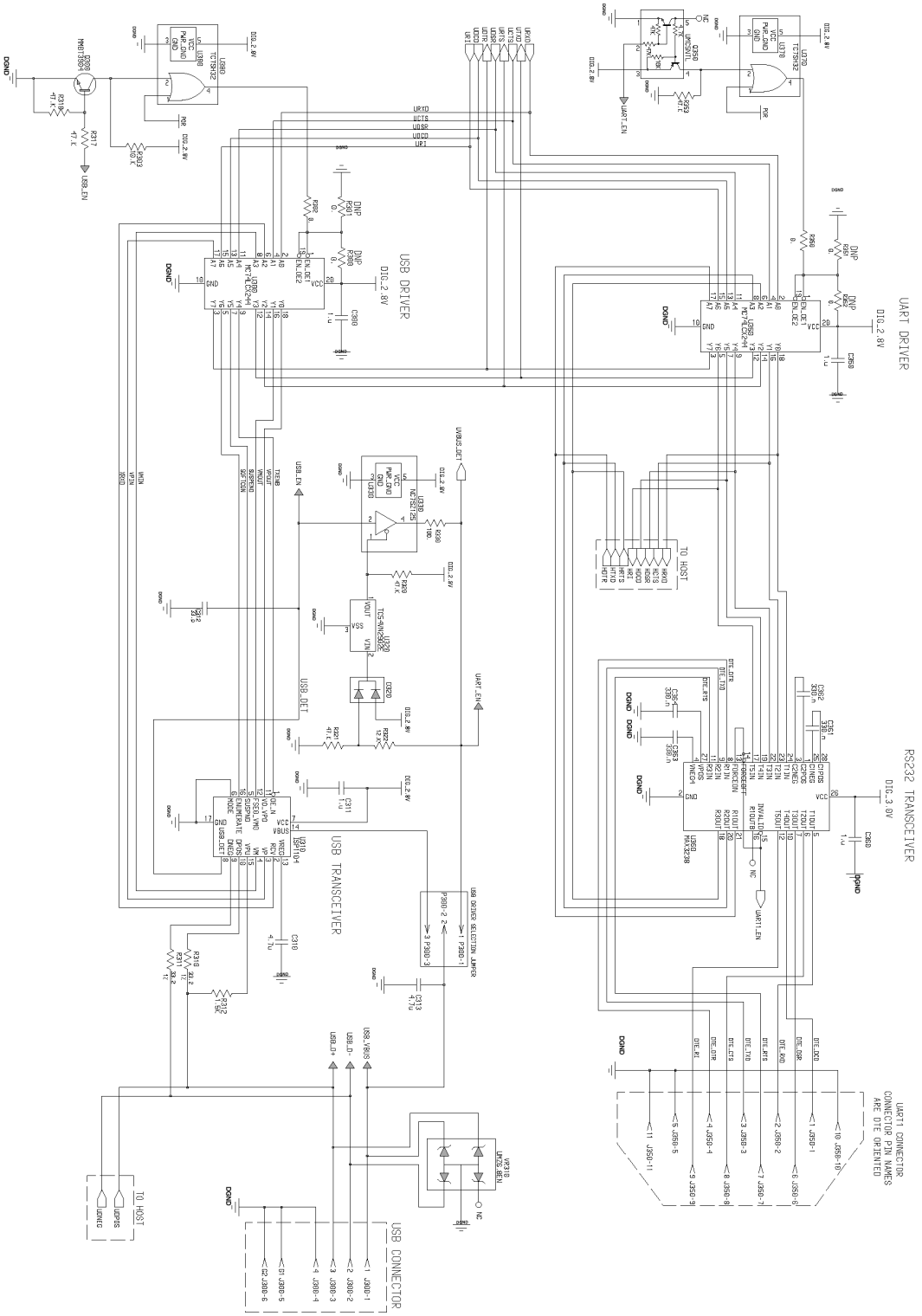

USB DRIVER
UART DRIVER
USB TRANSCEIVER
RS232 TRANSCEIVER
USB CONNECTOR
USB_DET
TO HOST
UART1 CONNECTOR PIN NAMES ARE DTE ORIENTED

Figure 15.

6.2 DEVELOPERS BOARD PLACEMENT

Figure 16 shows the top layout of the Developer Board:

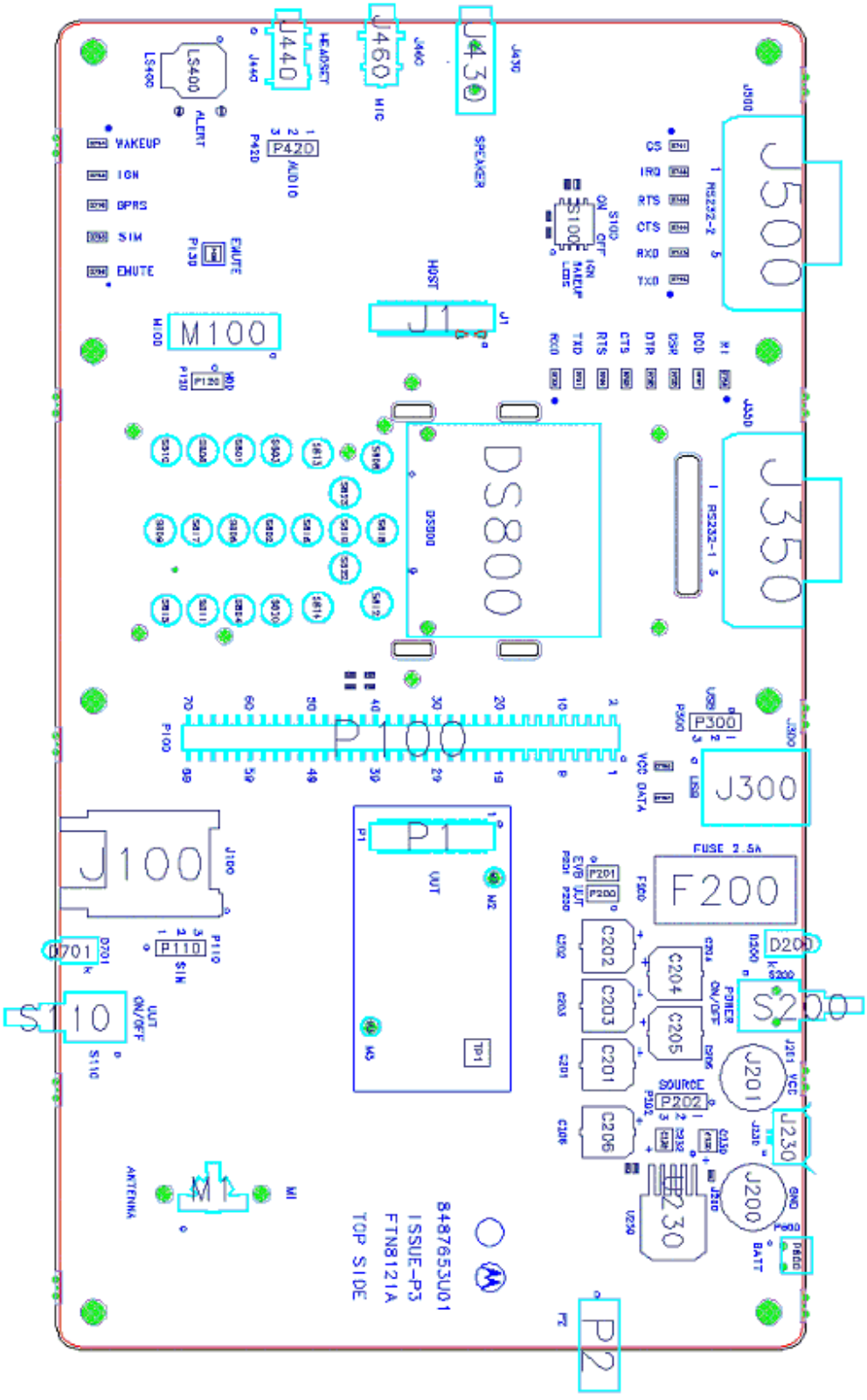


Figure 16. Developer Board Top Layout

Figure 17 shows the bottom layout of the Developer Board:

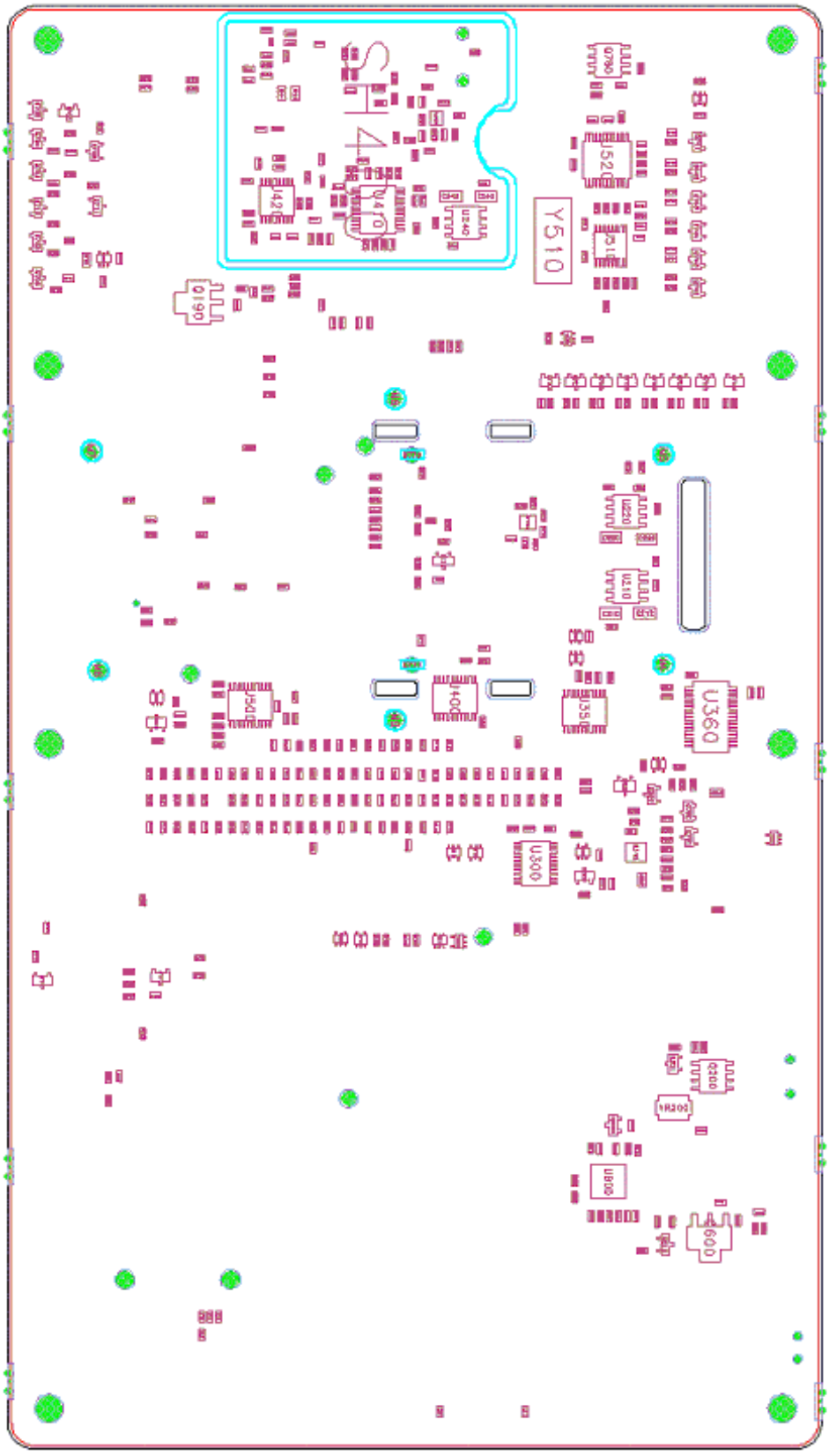


Figure 17. Developer Board Bottom Layout

6.3 DEVELOPER BOARD PARTS LIST

Table 24. Developer Board Parts List

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	Resistors	
R440	0662057A21	RES, 68
R600	0662057A22	RES, 75
R330	0662057A25	RES, 100
R773	0662057A28	RES, 130
R723, R725, R745, R747	0662057A31	RES, 180
R703	0662057A35	RES, 270
R705, R707, R709-10, R713, R717-18, R727, R729, R731, R733, R735, R737, R743, R749, R751, R753, R763, R764	0662057A36	RES, 300
R203	0662057A39	RES, 390
R603	0662057A47	RES, 820
R604	0662057A49	RES, 1K
R602	0662057A51	RES, 1.2K
R312	0662057A53	RES, 1.5K
R465-66	0662057A57	RES, 2.2K
R201-2, R702, R704, R706, R708, R711-12, R716, R722, R724, R726, R728, R730, R732, R734, R736, R742, R744, R746, R748, R750, R752, R760-61, R800	0662057A65	RES, 4.7K
R179, R197, R200, R303, R414-16, R441, R508-9, R525, R601, R607, R774, R781	0662057A73	RES, 10K
R230-32, R322	0662057A75	RES, 12K

Table 24. Developer Board Parts List *(Continued)*

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R411-12, R418	0662057A80	RES, 20 K
R177-78, R191-92, R196, R198, R317-18, R320-21, R353, R507, R608-9, R780	0662057A89	RES, 47 K
R435	0662057A97	RES, 100 K
R1, R10-11, R15-16, R107, R116-144, R146, R148-49, R151-53, R155, R157, R159, R170, R172-76, R181-190, R300-302, R350-352, R400-402, R407-410, R413, R417, R419, R423-27, R460, R480-85, R500-503, R506, R510-524, R594-97, R606, R611-618, R700, R720, R740, R770-771, R801-805	0662057B47	RES, 0
R790	0662057C01	RES, 0
R430-31, R433-34	0662057P20	RES, 20K
R221	0662057P95	RES, 100K
R234	0662057P96	RES, 130K
R211, R220, R241	0662057P97	RES, 150K
R210, R240	0662057P99	RES, 200K
R233	0662057T17	RES, 301K
R310-11	0662057T43	RES, 33.2
R772	0662057W13	RES, 3.3

Table 24. Developer Board Parts List *(Continued)*

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	Fuses	
F200	0904923K01	FUSE
F600	6586221J04	FUSE
	Connectors	
J430	0909032K01	CONN_J
J460	0909399T09	CONN_J
J350, J500	0909672B03	CONN_J
P2	0909908P02	CONN_J
J1	0987547V01	CONN_J
J300	0987583U01	CONN_J
J440	0987837L02	CONN_J
J230	0989601K01	CONN_J
	Capacitors	
C1, C2, C3, C4	2113740F01	CAP, 0.5p
C5	2113740F19	CAP, 4.7p
C207, C215, C217, C234	2113740F25	CAP, 8.2p
C442, C444, C447, C450, C462, C472-473	2113740F27	CAP, 10p
C100, C102-106, C108-115, C130, C137, C143, C147-151, C153-160, C171, C191-192, C211, C221, C241, C312, C401-404, C416-418, C421-428, C436-439, C443, C445-446, C448-449, C451-2, C461, C463-4, C470-471, C474-475, C502-510, C781, C810-819	2113740F39	CAP, 33p

Table 24. Developer Board Parts List *(Continued)*

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C125, C128, C131, C134, C208, C216, C218, C231, C511-12	2113740F41	CAP, 39p
C411-412, C414	2113741F49	CAP, 10n
C101, C107, C116-124, C126-127, C129, C132-133, C135-136, C138-142, C144-146, C152, C465, C600	2113743E20	CAP, 100n
C430-431, C433-434	2113743K16	CAP, 220n
C361-364, C521-524	2113743K17	CAP, 330n
C310, C313, C466	2113928C04	CAP, 4.7u
C440-441	2113928C12	CAP, 10u
C170, C172-173, C180, C190, C200, C233, C300, C311, C350, C360, C400, C410, C413, C415, C420, C432, C435, C453, C460, C500, C513, C520, C700, C720, C770-774, C780, C800-801	2113928P04	CAP, 1u
C230, C232	2311049A57	CAPP, 10u
C210, C212, C220, C222, C240, C242	2311049A72	CAPP, 10u
C201-206	2387572V01	CAPP, 1000u
	Inductors	
L440	2409154M42	IDCTR, 33n
	Shields	
SH400	2604044K01	SHIELD

Table 24. Developer Board Parts List *(Continued)*

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	Connectors	
P130	2880001R01	CONN_P
P120, P200-201	2880001R02	CONN_P
P110, P202, P300, P420	2880001R03	CONN_P
P600	2886290J07	CONN_P
P100	2886397J02	CONN_P
P1	2887548V01	CONN_P
J201	2987604U01	CONN_J
J200	2987604U02	CONN_J
	Contacts	
M1	3903920K01	CONTACT
	Switches	
S200	4008241G06	SWITCH_ET01
S110	4008242G05	SWITCH
J100	4009060S03	SWITCH_CONTACT_BLOCK
S100	4080564C02	SWITCH
	Spacers	
M2, M3, M4, M5, M6, M7, M8, M9	4302809C15	SPACER
	LEDs	
D702-704, D708, D710, D721-8, D741-746, D760-761	4805729G44	BR1102W
D770-771	4870370A25	CL-260S-WA
D200, D701	4880304L02	LED_RED
	Transistors	
Q701-704, Q706, Q708, Q710, Q760-761	4809579E16	TN0200T
Q705, Q707, Q711, Q721-728, Q741-746	4809579E18	TP0101T
Q200, Q780	4809807C31	IRF7220
Q350, Q720, Q740, Q1000	4809939C05	UMC5NTL

Table 24. Developer Board Parts List *(Continued)*

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
Q110, Q300, Q500, Q610, Q620, U771	4813824A10	MMBT3904
Q201	4813824A17	MMBT3906
Q600	4813824B11	MMJT9435
Q190	4813824B13	MMJT9410T1
	Diodes	
VR200	4813831A14	SMB5918
D320	4813833C02	MMBD6100
VR100-105, VR310	4886182U05	UMZ6.8EN
	Integrated Circuits	
U510	5102870C15	MAX3100EEE
U201, U220, U240	5104187K10	MAX604ESA
U230	5104187K89	MIC29302BU
U370, U380, U530	5105492X05	TC7SH32
U520	5108428S67	MAX3223EAP
U330	5109522E53	NC7SZ125
U360	5109781E76	MAX3238
U320	5109817F26	TC54VN2902E
U420	5113805B39	MC74HC4053
U410	5113811A56	MC145481
U300, U350, U400, U500	5113837A07	MC74LCX244
U430	5186214J87	TPA6203A1GQVR
U600	5187970L09	LM3652
U310	5187970L15	ISP1104
U770	5187970L20	LM2795BLX
	General	
M100	5987772L02	MOTOR
Y510	4884450T02	XTAL3_6864MHZ
LS400	5087951K01	SPKR

7.1 SWITCH ASSIGNMENTS CORRECTION

The S100 options switch on the Developer Board is labeled incorrectly. Figure 18 shows the correct function of each switch. ***PLEASE PROVIDE A PICTURE WITHOUT CALLOUTS***.

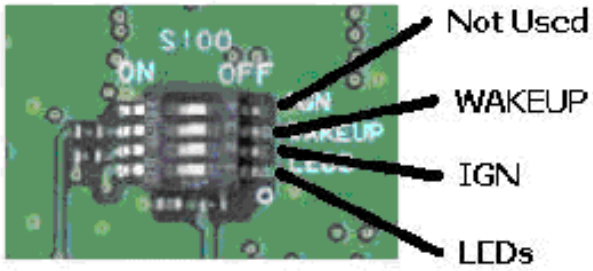


Figure 18. S100 Options Switch Functions

INDEX

REVISION HISTORY

Revision	Date	Purpose

MOTOROLA

g20 Cellular Engine Module Description

CONTENTS

March 2003
98-08901C66-O

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 data terminal equipment (DTE) team 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: GSM support-BSH015@email.mot.com.

1.2 WHO SHOULD USE THIS MANUAL

This manual is intended for all members of the DTE OEM integration team who are responsible for integrating the c18 module into the host OEM device, including representatives from hardware, software and RF engineering disciplines.

1.3 APPLICABLE DOCUMENTS

PLEASE PROVIDE DETAILS FOR THIS SECTION.

1.3.1 Documents

g20 Developer's Kit - 9808901C67-O

g20 AT Commands - 9808901C68-O

1.3.2 Standards

PLEASE PROVIDE DETAILS FOR THIS SECTION.

1.4 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, as well as valuable troubleshooting and programming information.

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	Automatic Output Control
BABT	British Approval Board - Telecommunications
CSD	Circuit-switched Data
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
DTE	Data Terminal Equipment (such as terminals, PCs and so on)
DTMF	Dual-Tone Multi-Frequency
EGSM	Extended Global System for Mobile Communications
EIRP	Effective Isotropic Radiated Power
EMC	***WHAT DOES THIS STAND FOR?***
EOTD	Enhanced Observed Time Difference
EPOS	Electronic Point of Sale
ERP	Effective Radiated Power
ESD	Electrostatic Discharge
FCC	Federal Communications Commission (U.S.)
FTA	Foreign Telecommunication Administration

Table 1. Terms and Abbreviations *(Continued)*

Acronym/Term	Definition/Description
GCF	***WHAT DOES THIS STAND FOR?***
GPIO	General Purpose Input/Output
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
IC	Integrated Circuit
LNA	Low-noise Amplifier
MMCX	Multimedia Communications Exchange
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 CDMA 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
RTS	Request To Send
SAR	Segmentation and Reassembly
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	
Operating systems:	EGSM: 900/1800 MHz GSM: 850/1900 MHz
Physical Characteristics	
Size:	Size: 24.4 x 48.2 x 6.0 mm
Mounting:	Two 2.2 mm holes
Weight:	11.9 grams
Environmental	
Operational temperature:	-20°C +60°C
Functional temperature:	-20°C +70°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:	• 0.6 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	
Voice Features	
Telephony	
Digital audio	
Differential analog audio lines	

Table 2. Product Specifications *(Continued)*

Voice Features (Continued)
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
Antenna detect
TX enable
Reset
Entertainment mute
Features over RS232
Embedded TCP/IP stack
STK Class II
User Application
Application Programming Interface (API)
12 GPIO lines
2 A/D lines
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
F3001	GSM 850/1900	• 70-pin 0.5 mm pitch • MMCX RF connector	RS232
F3002	EGSM 900/1800	• 70-pin 0.5 mm pitch • MMCX RF connector	RS232
F3003	GSM 850/1900	• 70-pin 0.5 mm pitch • MMCX RF connector	USB
F3004	EGSM 900/1800	• 70-pin 0.5 mm pitch • MMCX RF connector	USB

2.5 REGULATORY APPROVALS

The following regulatory approvals apply for the g20 module:

- FTA, FCC, DOC, PTCRB
- R&TTE
- GCF
- EMC
- BABT
- QS9000 manufacturing

2.6 REGULATORY STATEMENT

WE NEED SOURCE MATERIAL FOR THIS SECTION.

2.7 SAFETY PRECAUTIONS

2.7.1 User Operation

Do not operate your telephone 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 telephone 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:

2.7.2 Antenna Installation

- A minimum separation distance of 20 cm needs to be maintained between the antenna and all persons, otherwise a SAR test will be required.
- The transmitter effective radiated power must be less than 1.5 Watts ERP (2.45 Watts or 33.9 dBm EIRP). This requires that the combination of antenna gain and feed line loss does not exceed 11 dBi.

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:

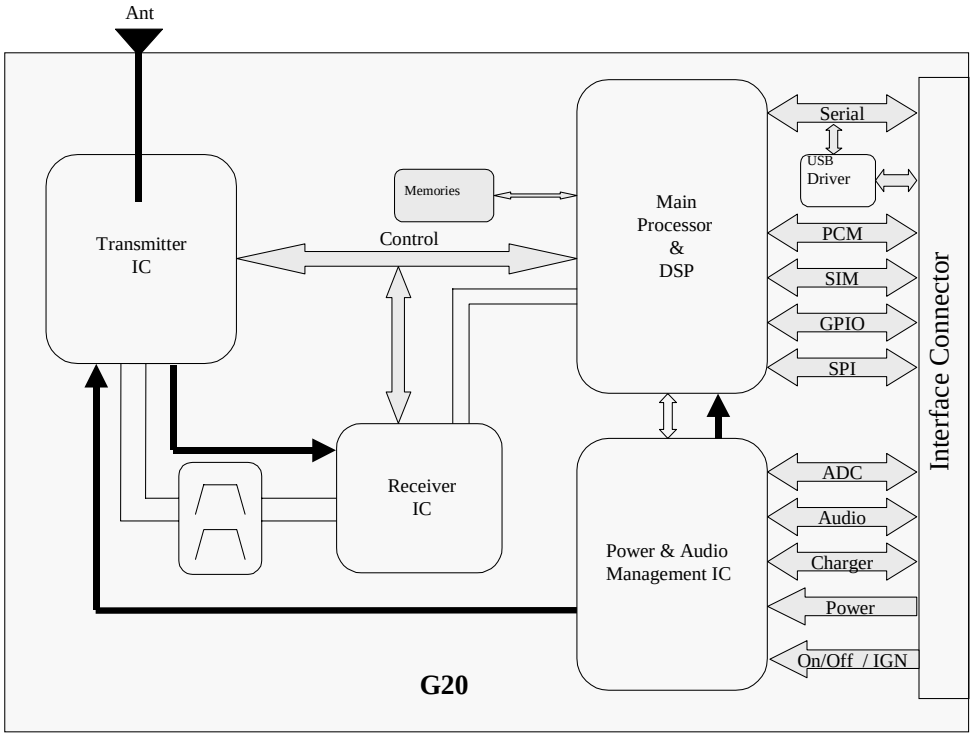


Figure 1. g20 Block Diagram

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. This block 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 an optional 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.

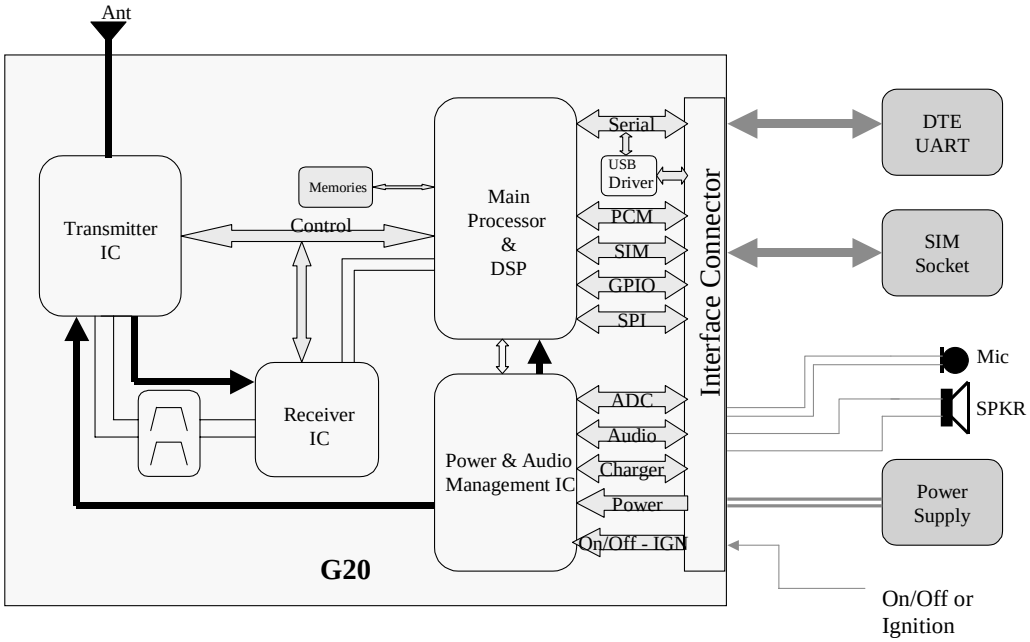


Figure 2. Basic RS232 and Analog Audio Connectivity

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 five 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.

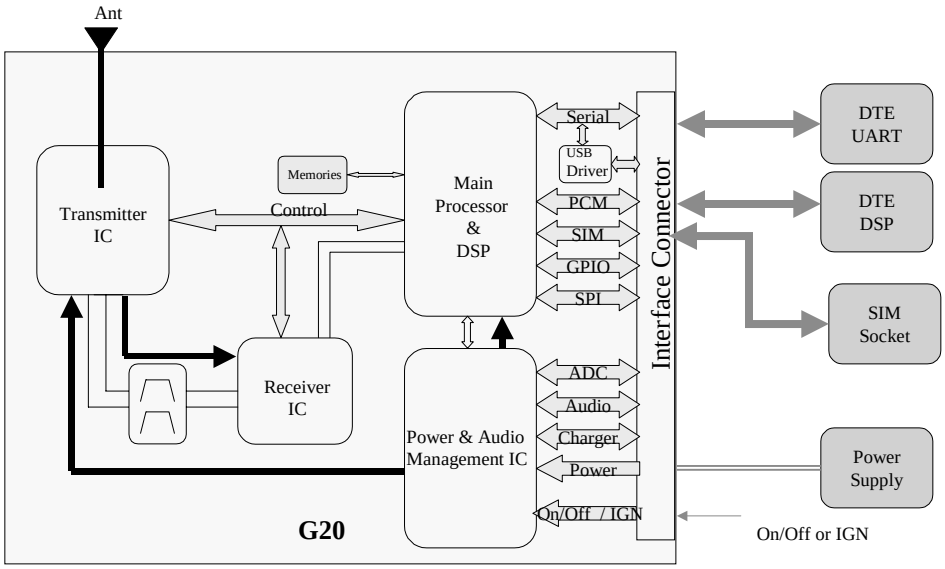


Figure 3. Basic RS232 and Digital Audio Connectivity

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).
- A USB connector that is connected via a USB driver to the g20 (in g20 models without a USB driver). When USB is used, the DTE UART should be in tri-state (high impedance).
- An SPI block that is connected via four pins to the g20 (for debug accessibility).

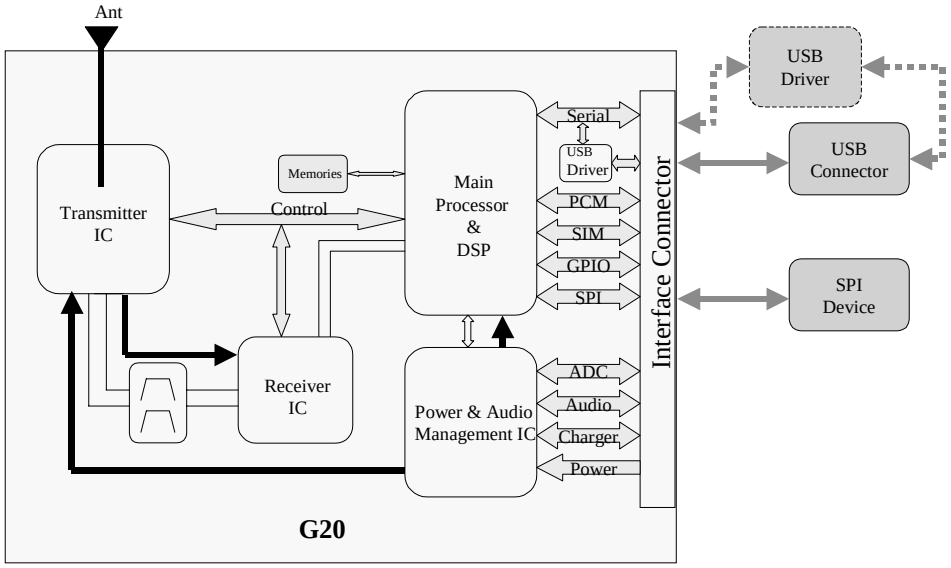


Figure 4. Additional g20 Connectivity

3.1.5 G20 for Handset Configuration

g20 connectivity when using the g20 as a cellular phone engine is described below (see Figure 5 for reference):

- The display is connected via five pins to the g20.
- The keypad is connected via eight pins to the g20.
- The SIM card socket is connected via five pins to the g20 SIM driver.
- The charger is connected via six pins (Interface to National LM3652) to the g20.
- The microphone is connected via two pins (Mic and Mic Ground) to the g20.
- The speaker is connected via two differential lines to the g20.
- The alert device is connected via two differential lines to the g20.
- The vibrator is connected via one pin to the g20.
- The battery is connected to the charger, and the charger is connected to the VCC and Ground pins.

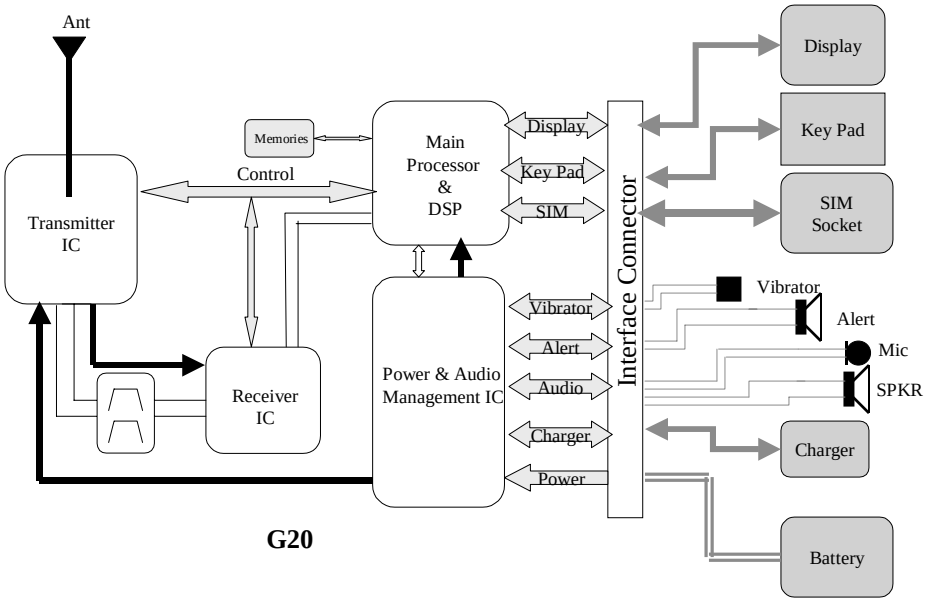


Figure 5. g20 for Handset Configuration

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.

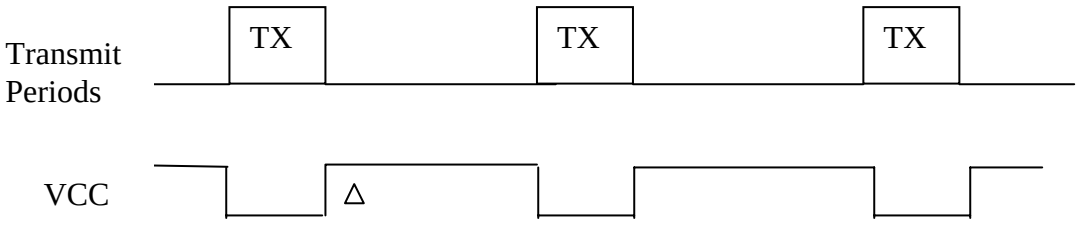


Figure 6. VCC Signal During TX Periods

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.

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). ***MUST ALL THESE CAPACITORS BE USED IN PARALLEL? OR SOME COMBINATION?***

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

Table 4. g20 Current Consumption *(Continued)*

Mode	Current Consumption (mA RMS)
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 line (Pin 51)

3.2.3.1 On/Off Signal

After power is applied to the g20, the on/off signal is pulled high to the VCC by a 200kΩ resistor.

To turn the g20 on, the on/off signal should be pulled low for a minimum of 700 ms.

After the g20 is turned on, the line should be pulled low for a minimum of 1.1 seconds to turn it off. The unit can be turned off only if at least seven seconds have elapsed since turning it on.

Figure 7 shows the timing diagram for the on/off signal.

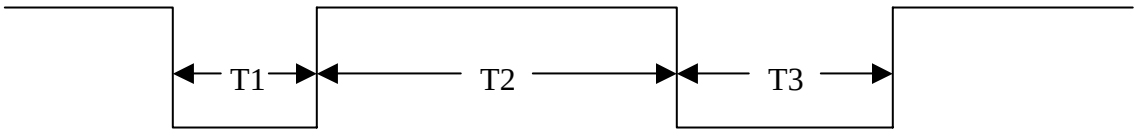


Figure 7. On/Off Signal Timing Diagram

In Figure 7, the following timing requirements apply:

- T1 minimum = 0.7 seconds.
- T2 minimum = 7 seconds.
- T3 minimum = 1.1 seconds.

3.2.3.2 Ignition Line

When the g20 ignition line is held at a high level, the g20 is turned on. When this line is pulled low, the g20 is turned off. In order to protect the line from voltage bounces, the g20 is tuned off only if the line is held low for at least 500 ms.

The high input to the ignition line must be greater than 2.75 V. The line can tolerate up to 40 V.

After the g20 is turned on, the application should wait for DSR before sending data to the g20. The DSR becomes active low eight seconds after the start of T1, or after the ignition line is pulled high. DSR is only valid with UART, and is not valid with USB.

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.

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.
- The DTE should drop RTS during the sleep period in order to prevent the loss of data sent by the g20.

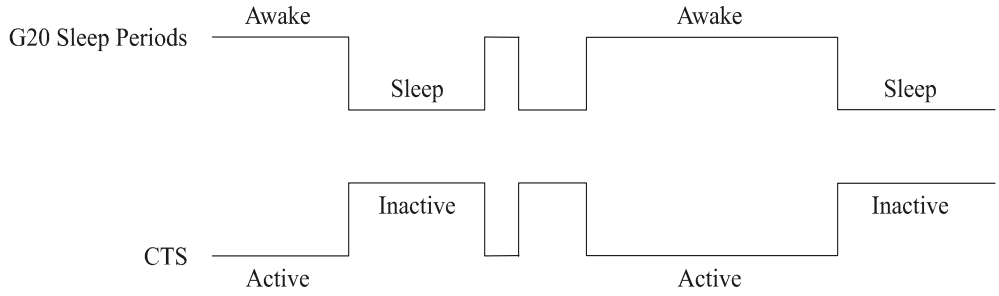


Figure 8. CTS Sleep Mode Timing

3.2.4.2 DCE/DTE Connectivity

Figure 9 shows DCE/DTE connectivity:

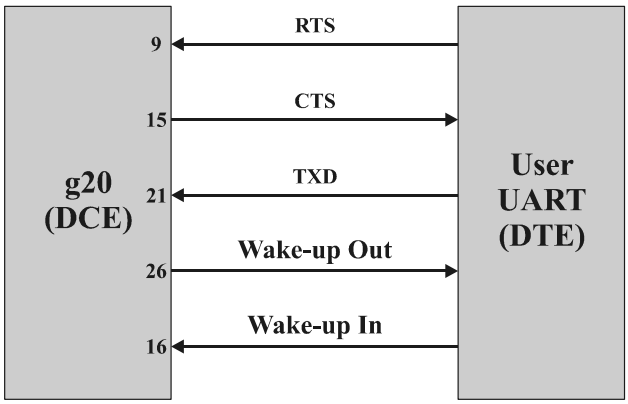


Figure 9. DCE/DTE Connectivity

Waking Up the DCE:

The following apply when waking up the DCE:

- 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.

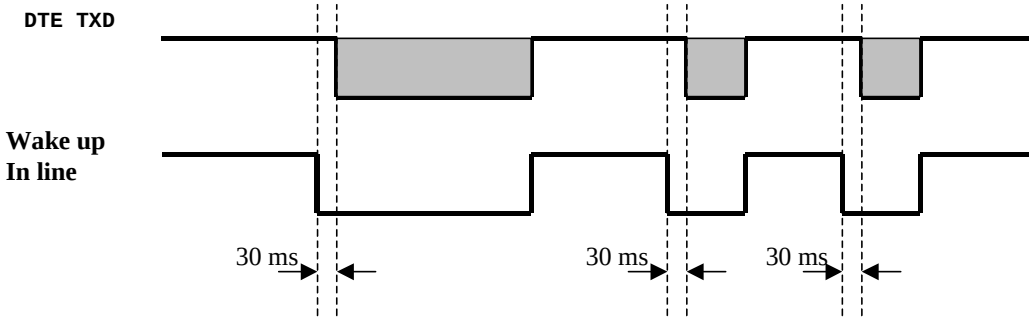


Figure 10. Waking Up the g20 when the DTE Wants to Send Data

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 S10x in Figure 11.

- 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.

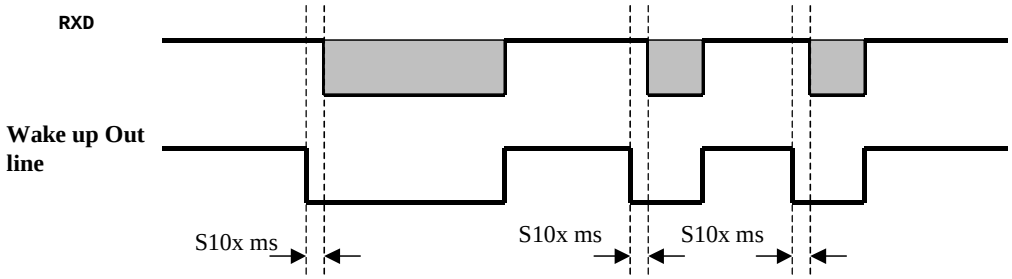


Figure 11. Waking Up the DTE when the g20 Wants to Send Data

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 (9 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 12.

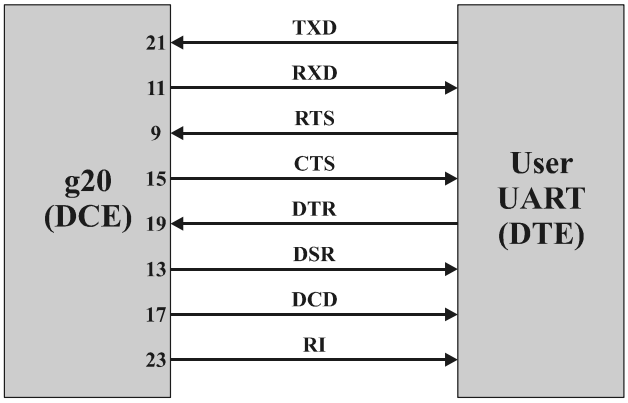


Figure 12. g20 RS232 Interface

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.

3.3.1.2 RS232 Connection

Figure 13 shows an RS232 connection diagram:

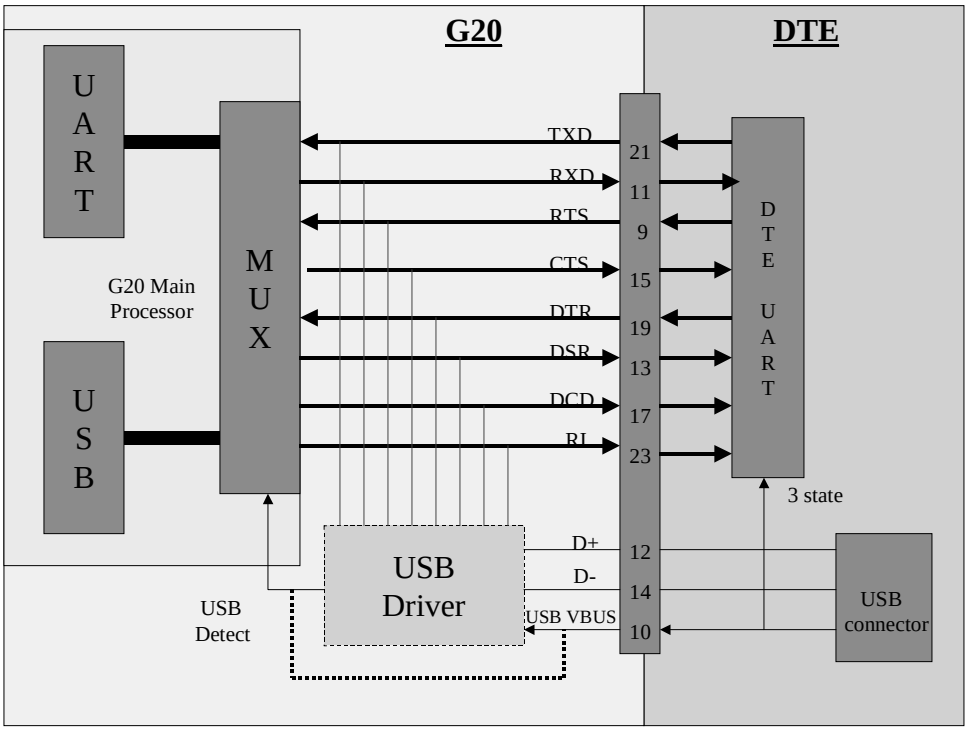


Figure 13. RS232 Connection

The following apply for g20 RS232 connections:

- The g20 can use both UART and USB connectors, but cannot use them both simultaneously.
- When USB is detected (by sensing the USB VBUS signal), the UART is disconnected from the g20 main processor pins and USB functionality is added instead.
- The DTE should unload the RS232 lines when USB is used in order for the USB to function properly.
- RS232 signals are routed directly from the main processor to the connector.

Note

In g20 models without a USB driver (F3001and F3002 models), RS232 signals can be used to connect an external USB driver.

3.3.2 USB

The following apply for g20 USB connections:

- The g20 can use a USB port to communicate with a DTE device.
- 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 USB1.1 at a baud rate of 12 Mbps.
- The g20 supports two basic types, one with a USB driver (models F3003 and F3004), and one with the USB driver removed (models F3001 and F3002).

3.3.2.1 USB Connection

Figure 14 shows g20 connection for g20 models with a USB driver:

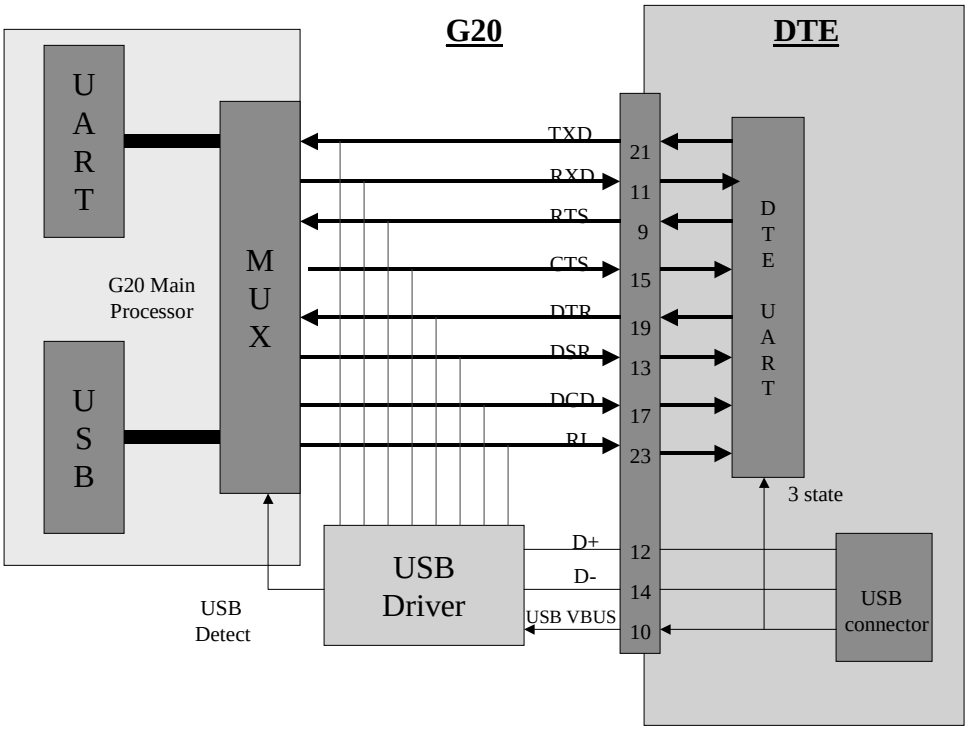


Figure 14. g20 USB Connection for g20 Models with a USB Driver

As shown in Figure 14, 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.

Figure 15 shows g20 USB connection for g20 models without a USB driver, using an external USB driver connection. The circuit shown in this figure can be used by the user application in cases where a USB driver is needed.

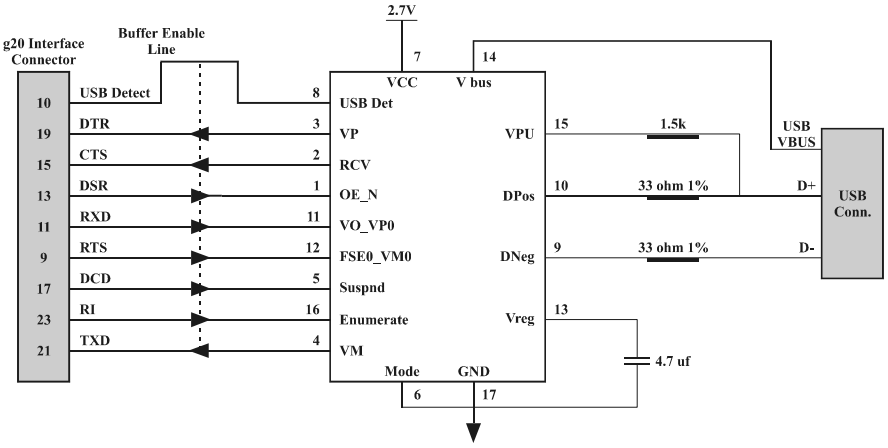


Figure 15. g20 USB Connection for g20 Models without a USB Driver

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.

3.3.3.1 SIM Connection

Figure 16 shows a g20 SIM connection:

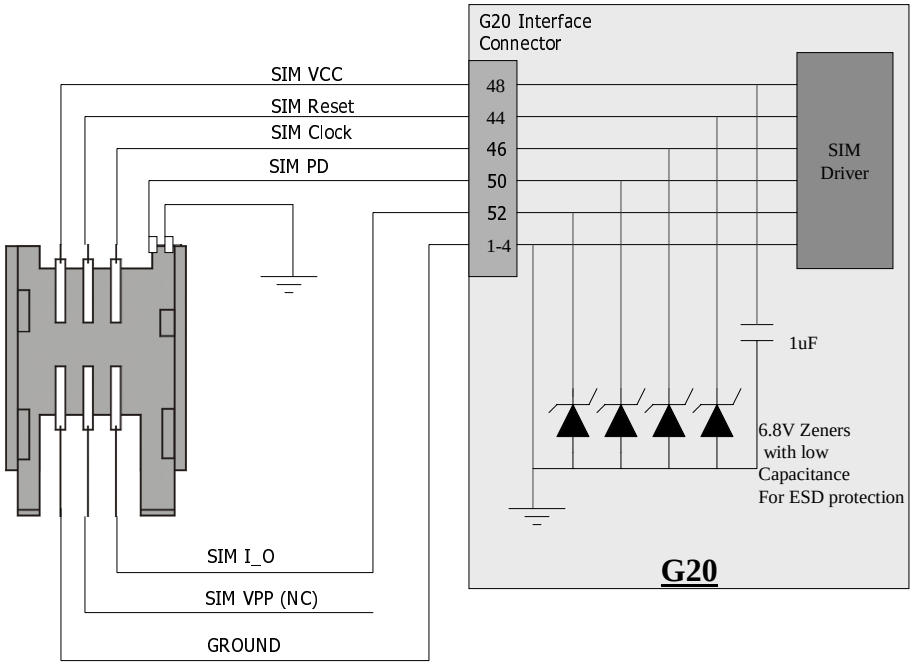


Figure 16. g20 SIM Connection

The following apply for g20 SIM connections:

- The g20 passes all SIM ETSI tests when an external socket is connected to the g20 with lines shorter than 10 cm.
- Longer connections require SIM testing to be performed in the user application.
- The g20 can work with 1.8 V or 3 V SIM cards.
- The g20 provides ESD protection for the SIM lines (6.8V Zener diodes with low capacitance), and for 1uF capacitors to the SIM VCC.
- The SIM_PD (SIM Present Detect) signal is active when it is pulled low.

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 is driven to an SPI/RS232 interface. The SPI is then converted and uses the RS232 port for debugging. 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	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 features certain 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.

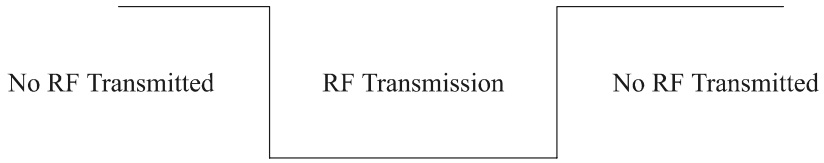


Figure 17. TX_EN Transmission

3.3.5.2 Antenna Detect

This pin indicates whether or not the antenna is inserted. This option was requested by a specific customer and was prepared specifically for their board layout. Thus, this option is not supported by the basic g20 models.

The antenna-detect circuit detects whether the impedance of the antenna is 100 KΩ or lower. The antenna must have a resistance to ground of less than 100 KΩ. in order to be detected.

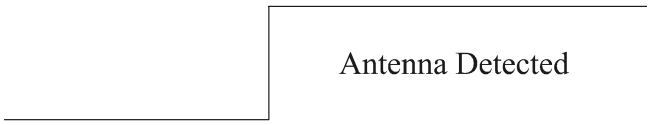


Figure 18. Antenna-detect Circuit

3.3.5.3 GPRS-detect 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.

Figure 19. GPRS-detect Coverage Indication

3.3.5.4 Entertainment Mute

This pin is reserved for future use. It will be dedicated to automotive applications in which there is a need to mute the entertainment radio when there is a cellular call.

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 analog inputs that are referenced to the microphone ground (pin 59):

- **Headset microphone:** Pin 57 is the headset microphone input. Input to this line can be directly from a headset microphone. In order for the headset microphone to be active, the headset interrupt signal (pin 55) must be pulled low. The maximum input to the g20 headset microphone before there is a distortion of the signal in the network is 12 mV RMS.
- **Hands-free microphone:** Pin 61 is the microphone input to the g20. The microphone is active when the headset interrupt signal is not pulled low. The maximum input to the g20 microphone before there is a distortion of the signal in the network is 32 mV RMS.

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. SPKR_N Output when g20 Set to Maximum Volume Level and Headset Interrupt is Low

dBm0	mV RMS	SPKR_N
3.14	1111.9	94
0	774.6	67
-5	435.6	38
-10	244.9	22
-15.5	130	12.5
-16	122.8	12
-17	109.4	11
-20	77.5	8.5
-25	43.6	6.5
-30	24.5	5.5
	3000	250

The measurements shown in Table 6 apply in the following configuration:

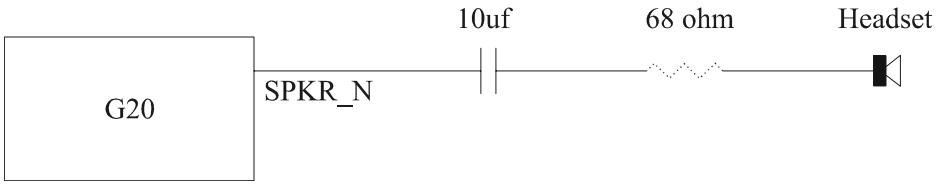


Figure 20. SPKR_N Output Configuration

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 when g20 Set to Maximum Volume Level and Headset Interrupt is Not Low

dBm0	mV RMS	SPKR_N
3.14	1111.9	335
0	774.6	242
-5	435.6	134
-10	244.9	76
-15.5	130	41
-16	122.8	39
-17	109.4	34
-20	77.5	24
-25	43.6	14
-30	24.5	8
max	2900	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
0 (lowest gain)	15
1	20
2	28
3	39
4	55
5	78
6	110
7 (highest gain)	155

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
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 handset-detect signal is pulled low).

Table 10. SPKR_N Output when g20 is in Headset Mode

Handset Volume	SPKR_N
0	0
1	4
2	5.5
3	7.5
4	10.5
5	14
6	19.5
7	27.5

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
0	107
1	153
2	206
3	305
4	424
5	600
6	850
7	1200

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 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 the host.

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 3:1 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 CHARGER INTERFACE

g20 software supports charging circuitry for 3.6 V Lithium Ion batteries on some g20 models. The software interface is designed to work with a charging IC from National Semiconductor, model LM3652. Refer to the schematics chapter in the g20 Developer's Kit for more details about the design of the charging circuitry.

3.7 DISPLAY INTERFACE

The g20 supports a four-level gray-scale display with 96 x 65 pixels. The following five lines should be connected to the display:

- LCD_CS
- LCD_RS
- LCD_DATA
- LCD_CLK
- RESET_N

Use the BL_SINK line for backlighting (display and keypad) when using the display. The backlight sink can provide current up to 100 mA, and can be used as an open drain output for more than 100 mA.

3.8 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.

CONNECTOR PIN ASSIGNMENTS

4.1 CONNECTORS

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

g20 Interface Connector	Mating Connector	Stacking Height
70-pin, 0.5mm pitch, Molex 53748-0708	Molex 52991-0708	3.0 mm

g20 RF Connector	Mating Connector
Standard MMCX female	Standard MMCX male (connector for cable)

4.2 PIN ASSIGNMENTS

The g20 interface is provided via a 70-pin connector. 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				Models with USB Driver/ Alternate Function
					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	

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

Pin #	Signal Name	Description	I/O	Signal	Level				Models with USB Driver/ Alternate Function
					Min	Typ	Max	Units	
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	Wakeup input	I	Logic		2.775		V	
26	WAKEUP_ OUT	Wakeup output	O	Logic		2.775		V	
25	RESET	Reset signal output	O	Logic		2.775		V	
53	ON_OFF	On/off switch	I	DC	3.0	3.6	4.2	V	
51	IGN	Ignition input	I	Logic	2.775	3.6	16	V	
39	TX_EN	GSM transmit indicator	O	Logic		2.775		V	
41	ANT_DET	Antenna-presence detect	O	Logic		2.775		V	
49	GPRS_DET	GPRS coverage indicator	O	Logic		2.775		V	
37	ENT_MUTE	Entertainment mute	O	Logic		2.775		V	
UART:									
21	TXD	RS232 TXD	I	Logic		2.775		V	USB VMIN
11	RXD	RS232 RXD	O	Logic		2.775		V	USB VPOUT
9	RTS	RS232 RTS	I	Logic		2.775		V	USB XRXD
15	CTS	RS232 CTS	O	Logic		2.775		V	USB VMOUT
19	DTR	RS232 DTR	I	Logic		2.775		V	USB VPIN

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

Pin #	Signal Name	Description	I/O	Signal	Level				Models with USB Driver/ Alternate Function
					Min	Typ	Max	Units	
13	DSR	RS232 DSR	O	Logic		2.775		V	USB TXENB
17	DCD	RS232 DCD	O	Logic		2.775		V	USB SUSPEND
23	RI	RS232 RI	O	Logic		2.775		V	USB SOFTCON
USB:									
10	USB_DET	USB-connection detect	I	DC	4.4	5	5.25	V	USB_ VBUS
12	Not connected								USB_D+
14	Not connected								USB_D-
SPI:									
70	SPI_CS	SPI chip-select	O	Logic		2.775		V	
62	SPI_IRQ	SPI interrupt	I	Logic		2.775		V	
64	SPI_DIN	SPI MISO input	I	Logic		2.775		V	
68	SPI_DOUT	SPI MOSI output	O	Logic		2.775		V	
66	SPI_CLK	SPI clock	O	Logic		2.775		V	
SIM Card:									
50	SIM_PD	SIM-presence detect	I	Logic		2.775		V	
48	SIM_VCC	SIM VCC	O	DC	1.8		3	V	
44	SIM_RST	SIM reset	O	Logic	1.8		3	V	

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

Pin #	Signal Name	Description	I/O	Signal	Level				Models with USB Driver/ Alternate Function
					Min	Typ	Max	Units	
52	SIM_DIO	SIM serial data	I/O	Logic	1.8		3	V	
46	SIM_CLK	SIM clock	O	Logic	1.8		3	V	
PCM Audio:									
18	PCM_DIN	Digital audio receive	I	Logic		2.775		V	
20	PCM_DOUT	Digital audio transmit	O	Logic		2.775		V	
22	PCM_CLK	Digital audio clock	O	Logic		2.775		V	
24	PCM_FS	Digital audio frame sync	O	Logic		2.775		V	
Display:									
54	LCD_CS	Display chip-select	O	Logic		2.775		V	
60	LCD_RS	Display register-select	O	Logic		2.775		V	
56	LCD_DATA	Display serial data	O	Logic		2.775		V	
58	LCD_CLK	Display serial clock	O	Logic		2.775		V	
Keypad:									
30	KBC0	Keypad column 0	I	Logic		2.775		V	
28	KBC1	Keypad column 1	I	Logic		2.775		V	
32	KBR0	Keypad row 0	I	Logic		2.775		V	
34	KBR1	Keypad row 1	I	Logic		2.775		V	
36	KBR2	Keypad row 2	I	Logic		2.775		V	

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

Pin #	Signal Name	Description	I/O	Signal	Level				Models with USB Driver/ Alternate Function
					Min	Typ	Max	Units	
38	KBR3	Keypad row 3	I	Logic		2.775		V	
40	KBR4	Keypad row 4	I	Logic		2.775		V	
42	KBR5	Keypad row 5	I	Logic		2.775		V	
Audio:									
67	SPKR_N	Speaker inverted	O	Audio				V	
69	SPKR_P	Speaker	O	Audio				V	
63	ALRT_N	Alert speaker inverted	O	Logic				V	
65	ALRT_P	Alert speaker	O	Audio				V	
61	MIC	Microphone input	I	Audio				V	
59	MIC_GND	Microphone ground ***What goes in I/O column for this pin?***		GND				V	
57	HDST_MIC	Headset microphone	I	Audio				V	
55	HDST_INT	Headset-detect interrupt	I	Logic		2.775		V	
Charger:									
35	CHRG_DET	Charger-presence detect	I	Logic		2.775		V	
33	CHRG_ STATE	Charger rate indicator	I	Logic		2.775		V	
31	CHRG_SW	Accessory current control	O	Logic		2.775		V	

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

Pin #	Signal Name	Description	I/O	Signal	Level				Models with USB Driver/ Alternate Function
					Min	Typ	Max	Units	
29	CHRG_DIS	Charger disable	O	Logic		2.775		V	
ADC:									
45	CHRG_TYP	Accessory-type detect	I	Logic	0		2.775	V	
47	THERM	Temperature measurement	I	Logic	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 inches per pound. Refer to Figure 21 below for mounting requirements.

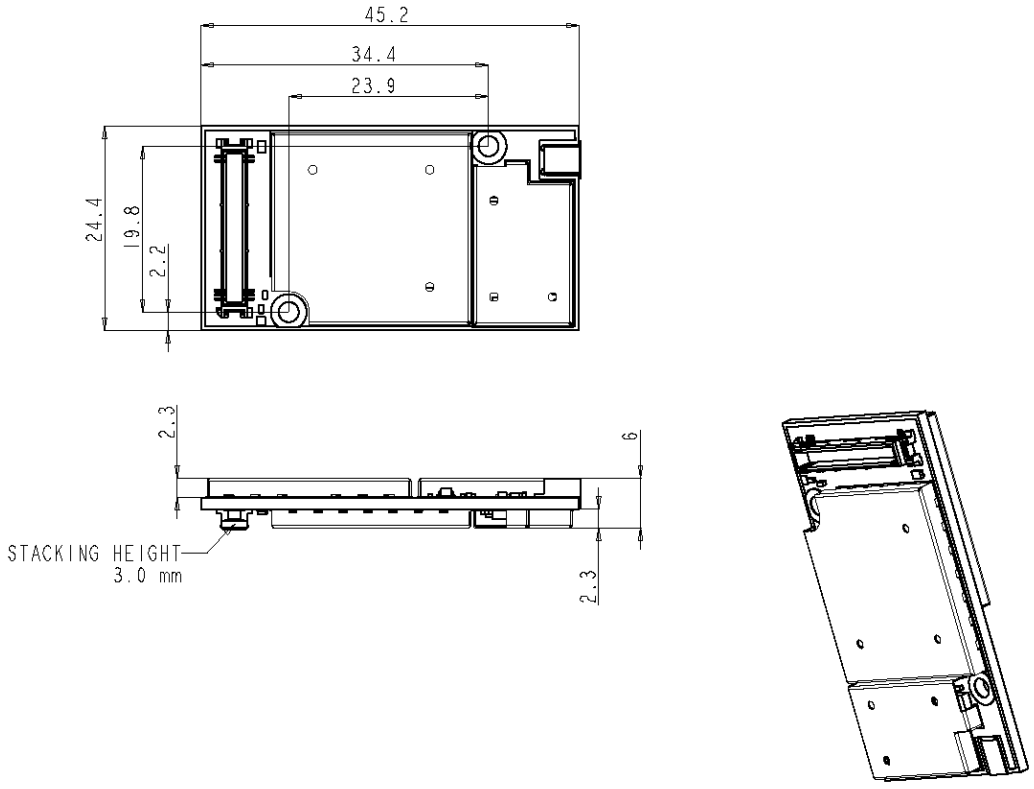


Figure 21. Mechanical Mounting Requirements

SERVICE SUPPORT

6.1 CUSTOMER ASSISTANCE

For customer assistance, contact us as directed below:

Helpdesk email: n2cshd@motorola.com

Helpdesk telephone: +972-3-568-4040

6.2 TESTING A STANDALONE UNIT

PLEASE PROVIDE DETAILS FOR THIS SECTION.

6.3 TROUBLESHOOTING

PLEASE PROVIDE DETAILS FOR THIS SECTION.

6.4 PROGRAMMING

PLEASE PROVIDE DETAILS FOR THIS SECTION.

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