Developer's Guide

Motorola c18 Cellular Engine Module Description

98-08901C63-C

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REVISION HISTORY

Revision	Date	Purpose
O	June 2003	Initial Release
A	November 2003	Changes to some features
B	February 2005	Minor changes
C	December 2005	The following AT commands were removed from this book: ATS24, ATS99, ATS100 and MSCTS. These commands are now located in the c18 AT Commands Reference Guide.

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c18 Cellular Engine Module Description

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PREFACE

1.1 SCOPE OF THIS MANUAL

This manual introduces the c18 embedded module and describes the technical details required by the data terminal equipment (DTE) team to successfully integrate the Motorola c18 cellular engine into a 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 DTE integration team who are responsible for integrating the c18 module into the host device, including representatives from hardware, software and RF engineering disciplines.

1.3 DISCLAIMER

This guide provides advice and guidelines for integration teams. Responsibility for use of the information contained herein lies entirely with the integrator. 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 specification.

1.4 APPLICABLE DOCUMENTS AND STANDARDS

1.4.1 Documents

- c18 Developer's Kit – 9808901C64-A
- c18 AT Commands – 9808901C65-O

1.4.2 Standards

- IS95B Phase I, Phase II
- CDMA 2000 R.0
- IS98D Phase I, Phase II
- CDG-27: 13Kbps variable rate vocoder specification
- TSB-74: Physical layer for 13K Vocoder
- IS637A: Short Message Service (SMS)

- IS683A: Over-the-Air Activation
- IS801: Position Determination Service
- IS707A: AT Commands.

1.5 TRADEMARKS

MOTOROLA and the Stylized M Logo are registered in the U.S. Patent and Trademark Office. All other product or service names are the property of their respective owners.

1.6 HOW THIS MANUAL IS ORGANIZED

This manual contains the following chapters:

- **Chapter 1** contains this Preface.
- **Chapter 2** introduces the c18 unit and provides important safety instructions.
- **Chapter 3** provides a detailed hardware description of the blocks and components comprising the c18.
- **Chapter 4** describes the pin assignments for c18 connectors.
- **Chapter 5** describes the mechanical requirements for the c18 unit.
- **Chapter 6** provides contact information for Motorola Service Support and Customer Assistance.
- **Appendix A** lists suggested c18 mating connectors.
- **Appendix B** provides a pinout comparison for c18, g18 and g20 modules.
- **Appendix C** describes hardware requirements for CDG2 and field testing.

INTRODUCTION

2.1 GENERAL DESCRIPTION

The Motorola c18 is an embedded module that supports both AMPS and CDMA 1X technology, and is designed for integration in other devices. The c18 provides advanced data features as well as outstanding voice capabilities.

The c18 modem supports the following modes of operation:

- CDMA 1X embedded module package with voice, data, fax and short message service (SMS) support
- CDMA 1X packet data communication in 800/1900 MHz bands
- AMPS mode in 800 MHz band
- aGPS on networks with E911 support

The c18 is designed to support a range of subsidiary services associated with navigation, emergency services, road tolls, security systems (such as car alarms and fire alarms), as well as integrated standard voice/data communication.

Applications where data modules can provide these benefits include automotive telematics, mobile computing, asset management, remote utility meter reading, street light control, home security, vending and copy machine management, fleet management, ATM security, POS connectivity, household appliance monitoring and control, display systems, load management, and more. To support this flexibility, the same functionality is offered in several different configurations. aGPS capability is also provided in an additional configuration.

The c18 modem relies on system software for basic operational instructions and on configuration parameter values to meet modem and network interface requirements.

The c18 is designed for use in a system environment comprising a CDMA/Amps mobile radio network with one or more radio operators per country.

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
1X	Platform 1X
ACK	Acknowledgement from the radio that the test command was successful
ADB	Application Development Board (former name for the Developer Board)
ADC	Analog-to-digital converter
AGND	Audio ground; analog audio ground
aGPS	Assisted Global Positioning System (GPS)
BOM	Bill of materials
c18a	Full c18 OEM model
c18c	c18 CDMA800-only model
CDMA	Code Division Multiple Access

Table 1. Terms and Abbreviations *(Continued)*

Acronym/Term	Definition/Description
CSD	Circuit Switch Data
DCE	Data Communication Equipment (such as modems)
DTE	Data Terminal Equipment (such as terminals, PCs and so on)
ESD	Electrostatic discharge
ESN	Electronic serial number
EVRC	Enhanced Variable Rate CODEC
GHz	Gigahertz
GND	Electrical ground
GPIO	General Purpose Input Output
KHz	Kilohertz
LPF	Low-pass filter
mA	Milliampere
MHz	Megahertz
MSN	Motorola Serial Number
N/A	Not applicable
NC	Not connected
PA	Power amplifier
PCS	Personal Communications System
PCS	PCS band; also known as CDMA 1900
PD	Pull-down resistor
PU	Pull-up resistor
RF	Radio frequency
RMS	Root mean square
R-UIM	Removable User Identity Module
SCI	Slot Cycle Index
SW	Software
TBD	To be determined
TBR	Timer Base Registration
ZIF	Zero Insertion Force

2.3 PRODUCT SPECIFICATIONS

Table 2. Product Specifications

Product Features	
Operating systems:	• CDMA 1X 800/1900 MHz • AMPS 800 MHz • aGPS
Data Features	
CDMA1X high-speed data:	Max BR 153.6 Kbps
CSD:	Max BR 14.4 Kbps
CDMA data:	• IS707: Max BR 14.4 Kbps • IS95B: Max BR 64 Kbps
SMS:	MT/MO Text mode
Fax:	Class 2 Group 3
Voice Features	
Analog audio	
Differential analog audio lines	
Vocoder 8K EVRC	
DTMF support	
Audio control: echo cancellation, noise suppression, side tone and gain control	
Physical Characteristics	
Dimensions (L x W x H):	• Full OEM: 80.2 x 40.0 x 8.7 mm • Without PCS band support: 80.2 x 40.0 x 7.6 mm
Mounting:	Four 2.3 mm Ø holes
Weight:	25 grams
Environmental	
Operational temperature:	-20°C to +60°C
Functional temperature:	-25°C to +70°C
Storage temperature:	-40°C to +85°C
Thermal shock:	-40°C to +80°C (24 hours total)
ESD:	Antenna protection for 20 KV
Flammability	UL 94V0
Shock:	• MIL-STD-810E Method 516.4 Proc. I; 18 shocks 40 G; half-sine 6 - 9 msec • 2500 Gs; 0.00075 second pulse
Vibration:	Random: NAVMAT P9492, 8 Grms MIL-STD-810E Method 514.4, Category I

Table 2. Product Specifications *(Continued)*

Performance	
Operating voltage:	3.6 to 4.5 V DC
Current consumption:	CDMA: • Talk (TX/RX): 740 mA Max • Receive: 110 mA Max • Standby (IS-95): < 5 mA for SCI2; TBR = 30 minutes • Standby (CDMA 1X): < 3.7 mA for SCI2; TBR = 30 minutes AMPS: • Talk (TX/RX): 940 mA Max • Standby Mode: 55 mA Max OFF Current: < 5µA **Legend:** • SCI: Slotted Cycle Index • SCI2: Paging slots every 5.12 seconds • TBR: Timer Base Registration
TX output power:	• Digital: +24 dBm @ RF port • Analog: +27.5 dBm @ RF port
RX sensitivity:	• Digital: < -104 dBm for 0.5% BER • Analog: < -116 dBm for 12 dB SINAD
Origination rate*:	Within 2% of benchmark unit
Termination rate*:	Within 2% of benchmark unit
Dropped call rate*:	Within 2% of benchmark unit
System acquisition time*:	Best in Class for given network and route
Mechanical	
External display characteristics:	• Serial display supported for Developer's Kit only • 96 x 64 pixels • EL backlighting • Monochrome display
External keypad support	
SAR rating:	c18 has a SAR mobile exclusion statement
Interfaces	
Connectors:	• 70-pin, 0.5mm pitch (same as for g20) • 36-pin ZIF (same as for g18) • 28-pin DIN (same as for g18) • One RF MMCX jack (female) 50 Ohm supporting aGPS, 800, 1900 bands • One RF MMCX jack (female) 50 Ohm for aGPS active antenna (optional)
Serial:	• RS232 • USB
R-UIM:	Internal and external R-UIM hardware support

Table 2. Product Specifications *(Continued)*

Data Support	
Circuit-switch data/fax call:	Up to 14.4 Kbps, assuming ONC support
IS2000 revision 0 high-speed data:	• Simultaneous forward and reverse rate of 153.6 Kbps • Maximum forward rate of 153.6 Kbps (with a reverse rate of 9.6 Kbps) • Maximum reverse rate of 153.6 Kbps (with a forward rate of 38.4 Kbps) • Asynchronous
IS707A CDMA data:	14.4 Kbps Asynchronous Data and Group 3 Fax
RS232/USB:	Dynamic communication configuration
CDMA data:	• IS707A: 14.4 Kbps • IS95B: 64 Kbps
SMS:	MO and MT
Supplementary Service	
Call diverting	
Call forwarding	
Call hold, waiting and multiparty	
Missed-call indicator	
Call barring (depends on service provider)	
Emergency and Location	
FCC E911 Location Mandate using aGPS/AFLT	
Control/Status Indications	
Wakeup in	
Wakeup out	
Other Features	
TTY connectivity	
Phone and date book	
Over-the-air activation	
AT Command Set	
IS 707A AT commands	
Motorola proprietary AT commands	
Accessories	
Firmware data loader	
Data logger	
Developer’s Kit	

Note

Specifications are subject to change without prior notice.

* Specifies goals and not minimum values.

2.4 MODELS DESCRIPTION

Motorola offers the c18 in several models. The full functionality and variety of user interfaces for the c18a1 model is described in this section. Other models are derivatives of the c18a1 full-functionality model for bands or connectors that are not applicable.

The c18c model described in Table 3 is an example of an optional model that can be derived from the generic c18a model.

Table 3. c18 Models

Model	Operating Bands	Interface Connectors	aGPS Option
c18a	• CDMA 800/1900 MHz • AMPS 800 MHz • GPS 1575 MHz	• 70-pin, 0.5mm pitch, board-to-board • 36-pin ZIF connector • 28-pin DIN board-to-board connector • MMCX RF connector • MMCX GPS connector • R-UIM connector	Yes
c18c	CDMA 800 MHz	• 70-pin, 0.5mm pitch, board-to-board • MMCX RF connector	No

2.4.1 Basic Model Overview

This section provides an overview of the various c18 integrated wireless modem models, along with their physical and electrical characteristics, their features and functional capabilities, and details about the data-exchange network over which they communicate. It also provides sample configurations.

2.4.1.1 c18a1 Full OEM Configuration

Figure 1 shows the configuration for the packaged module, which measures 40 mm x 80.2 mm x 8.7 mm.

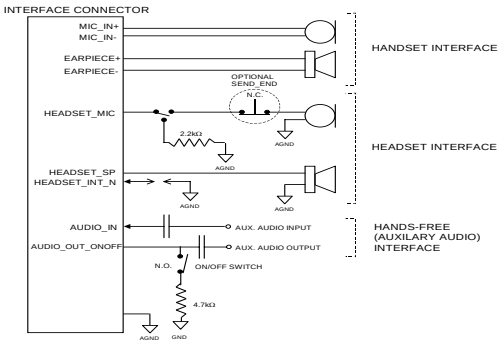


Figure 1. c18a1 Full OEM Configuration – Top View

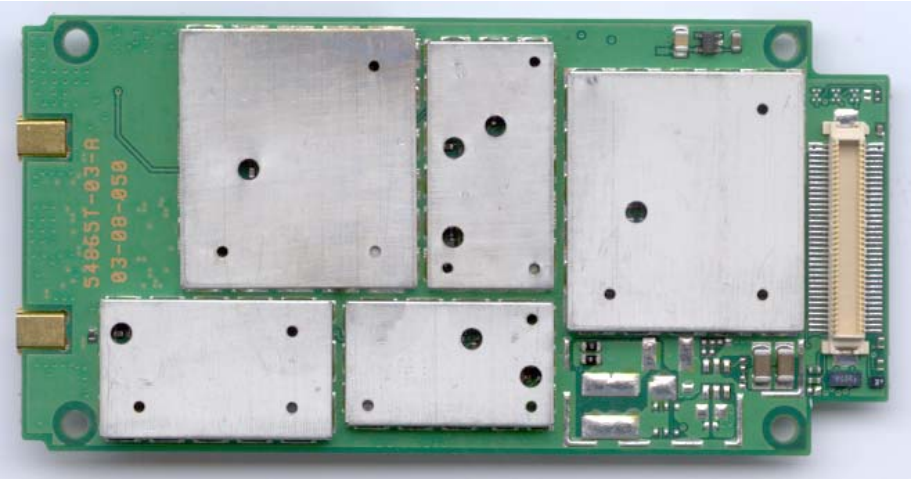


Figure 2. c18a1 Full OEM Configuration – Bottom View

2.5 REGULATORY APPROVALS

2.5.1 Compliance and Regulations

2.5.1.1 Product Compliance

Table 4. Product Compliance

Approvals	Comments
TTY compliance	
FCC E911 Location Mandate	
CDMA 2000 R. 0 – P REV 6 Market Required Features	
IS95B Phase I Mandatory	
IS95B Phase II Mandatory	
IS95B Optional Access Entry Hand-off	
IS95B Optional Access Probe Hand-off	
IS95B Optional High-speed Data (64K downlink)	
CDG-27: 13 Kbps variable rate Vocoder specification	
TSB-74: Physical layer for 13K Vocoder	
IS98D: Minimum mobile performance standard	Phase I and Phase II

Table 4. Product Compliance *(Continued)*

Approvals	Comments
IS637A: Short Message Service	
IS683A: Over-the-air activation	
IS801: Position Determination Service (required to support AFLT and aGPS)	

2.5.1.2 Regulations Compliance

Table 5. Regulations Compliance

Approvals	Comments
USA FCC	IHDT56CW1
Canada DOC	IC: 109O-CW1
CTIA	Required for North America
CDG Stage 1 and 2	Nortel, Motorola Contact Customer Support for an updated CDG2 manufacturers list
Operator Type Approvals: • North America • ROW	 • VZW • TBD

2.5.2 Regulatory Requirements

The Federal Communications Commission (FCC) requires application for certification of digital devices in accordance with Part 22 and Part 24. This includes Electromagnetic Energy Exposure (EME) testing. As the c18 modem is not a standalone transceiver but is an integrated module, the c18 cannot be tested by itself for EME certification. It is, however, the integrator's responsibility to have the completed device tested for EME certification.

2.5.3 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 c18 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 c18 must be operated at the voltages described in the technical documentation.
2. The c18 must not be mechanically nor electrically changed. Use of connectors should follow the guidance of the technical documentation.

3. Systems using the c18 are subject to mandatory EMC testing under directive 89/336/EEC. Other directives, such as the LVD directive 73/23/EE, may also apply to a system using the c18 module.

2.6 SAFETY PRECAUTIONS

Caution

c18 modules are not ESD protected. ESD preventive measures must be taken when handling the modules. Integrators should design ESD protection on all external interfaces.

Warning

When using the headset earpiece, verify the audio level as a safety precaution and limit the maximum voltage by the serial resistor. See “Headset Interface” on page 33.

2.6.1 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. In addition, it may expose that person to RF energy in excess of that established by the FCC RF Exposure Guidelines.

Warning

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.

To comply with the FCC RF exposure limits and satisfy the categorical exclusion requirements for mobile transmitters, the requirements described in this manual must be met.

2.6.2 Antenna Installation

Output power listed is conducted at antenna terminals. This OEM module transmitter operates with external vehicle-mounted antennas. OEM installers must follow the antenna installation instructions of the antenna manufacturer, and must meet transmitter operating conditions for satisfying RF exposure compliance. In addition, the following conditions must be met:

- The antenna installation must provide a minimum separation distance of 20 cm from users and nearby persons, and must not be co-located or operated in conjunction with any other antenna or transmitter.
- The combined cable loss and antenna gain must not exceed +6.1 dBi. The total system output must not exceed 1.5 Watts ERP (Cellular)/3.0 Watts EIRP (PCS) to qualify for the categorical exclusion requirements of 2.1091.

3.1 c18 BLOCK DIAGRAM DESCRIPTION AND OPERATION OVERVIEW

This chapter describes the basic blocks comprising the c18 module and the connectivity options for the module.

3.1.1 c18 Block Diagram

Figure 3 shows a block diagram for the c18 module:

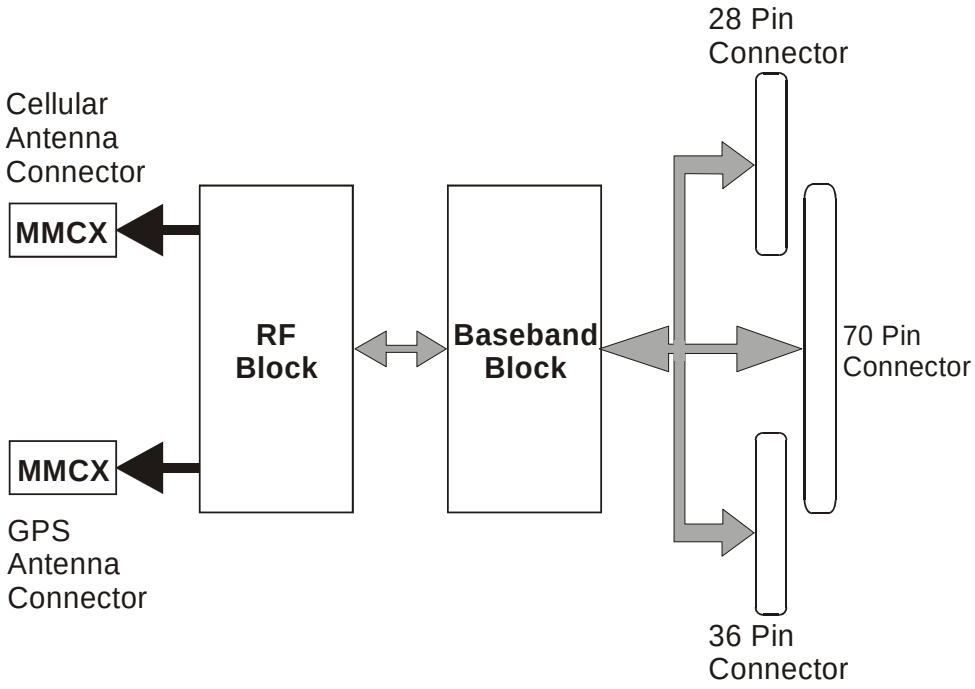


Figure 3. c18 Block Diagram

The c18 is a cellular radio based on the Qualcomm MSM5100 chipset. The call-processing protocol and the voice DSP are located within the Baseband block. The RF block transmitter and receiver support 800/1900MHz CDMA and 800MHz AMPS. In addition, the E911 FCC requirement for Assisted GPS (aGPS) is also supported.

c18 module interfaces use the following three types of connectors:

- 70-pin, 0.5mm pitch, board-to-board connector
- 36-pin ZIF (Zero Insertion Force) connector
- 28-pin DIN connector

The RF output ports are MMCX-type, 50-ohm matched connectors, as follows:

- Cellular antenna connector for 800/1900 MHz and passive aGPS
- GPS antenna connector that supports an aGPS active antenna

3.1.2 RF Block

This section describes the c18 RF block. Figure 4 shows the RF block diagram:

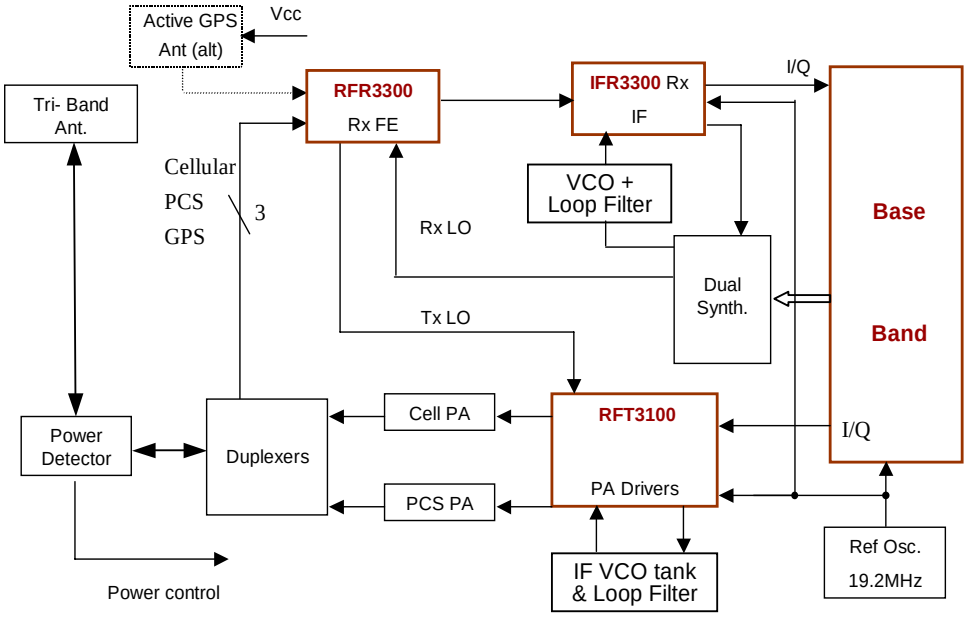


Figure 4. RF Block Diagram

3.1.2.1 Receiver Path

The receiver uses a superhetrodyne architecture, which down-converts to an IF frequency and then to the baseband. The received signal enters either the passive tri-band antenna, which supports cellular 800 MHz/1900 MHz and aGPS, or the active GPS antenna, which supplies the required bias voltage for the active antenna circuitry. The signal is directed via the appropriate duplexer to the programmable RFR3300 IC, where it undergoes preamplification (three LNAs, with one for each band) before being down-mixed to the IF frequency of 183.6MHz and filtered. From there, the signal enters the IFR3300 IC, where it is amplified to the required level with AGC circuitry, quadrature down-converted to baseband, filtered and sampled. The sampled signal is then fed to the DSP section.

3.1.2.2 Transmit Path

The transmitter also uses a superhetrodyne architecture in which the signal is up-converted from baseband to IF and then to the transmit frequency. The IQ baseband signals enter the RFT3100 IC, which quadrature up-converts to the IF frequency and then to the transmit frequency using a single side-band up-converter, in order to eliminate the need for expensive IF filtering circuitry. The signal is amplified to the required power level using the AGC circuitry. The signal is then fed into the power amplifiers via Tx cleanup filters, which preserve the spectral purity. From there, the signal passes to the appropriate duplexer. The signal then enters the power detection circuitry, which comprises a directional coupler and a detector. The power detection circuitry feeds voltage proportional to the transmitted signal power back to the logic circuitry, thereby enabling proper power control.

3.1.2.3 Frequency Generation

There are three RF frequencies generated to enable frequency conversions within the radio:

- Front-end-down and Front-end-up Conversion LO Frequency: The frequency plan is designed so that the Rx front-end-down conversion LO and the Tx front-end-up conversion LO are the same frequency, which is generated in the dual synthesizer IC. This LO is fed into the RFR3300 IC, where it drives the down-convert mixers and from where it is also redirected to the RFT3100 IC, where it drives the single sideband up-convert front-end mixers. The basic synthesizer frequency is around 2 GHz, which supports the 1.9GHz band. The internal divide-by-two circuitry within the RFR3300 is able to produce one-half the LO frequency to support the 800MHz band as well.
- The frequency required for the quadrature down-convert LO (translating the signal from IF to baseband) is generated from the dual-synthesizer IC, as well as from an on-chip VCO in the IFR3300 IC.
- The quadrature up-convert LO (translating the signal from baseband to IF) is generated from an on-chip synthesizer on the RFT3300 IC, as well as from an external VCO and loop filter circuitry.

All frequency generation uses a common 19.2MHz x-stall reference oscillator.

3.1.2.4 Baseband

This section describes power management, digital processing, memory and external interface requirements.

Figure 5 shows the baseband block diagram:

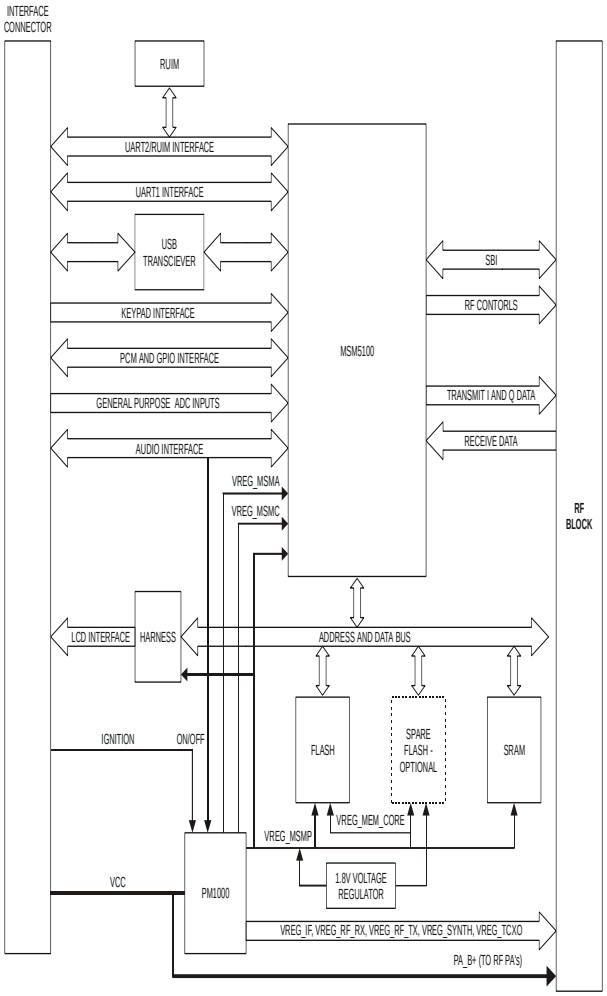


Figure 5. Baseband Block Diagram

3.1.2.4.1 Power Management

The power management block consists of the PM1000, which supplies most of the required regulated voltages, as well as a separate LDO that supplies the FLASH core.

3.1.2.4.2 Digital Processing

The MSM5100 block performs all digital processing for the c18 module. This block contains the following module peripherals:

- UART1
- UART2
- R-UIM
- Keypad
- USB
- CODEC
- General-purpose A/D converter

3.1.2.5 Memory Block

The memory block consists of SRAM and Flash components. The c18 module contains 2 MB of SRAM and 8 MB of flash memory. The module can accommodate an additional 8 MB flash, if required.

3.1.2.5.1 External Interfaces

The c18 module interfaces contain a USB transceiver, filters, an external interface connector (a 70-, 36- or 28-pin connector, depending on the model), audio circuitry and a harness IC, which provides the interface to the serial LCD modules and additional GPIOs.

3.2 POWER SUPPLY AND CURRENT CONSUMPTION

The c18 is designed to operate from a single voltage source. The module obtains its voltage supply via four VCC and four GND pins (models with a 70-pin or 36-pin interface connector), or via two VCC and two GND pins (models with a 28-pin connector). The source voltage must be between 3.6 V DC and 4.5 V DC (4.0 V nominal) on the c18 interface connector pins (across the VCC and GND pins). To be able to function at the lowest supply voltage, it is important to compensate for any losses in the power supply lines and user PCB. The voltage source must be capable of providing sufficient current to the module (approximately 1 A). If additional loads are driven by the voltage source (such as backlights, LCD, and so on.), an additional current load should be accommodated.

GND pins are used as power and signal ground pins. All signals, except audio signals, are referenced to GND. All single-ended audio signals are referenced to AGND. See “Audio Interfaces” on page 31.

3.2.1 Current Consumption

In order to correctly design the power supply or battery for the c18, integrators should take into account the current consumption of the c18 in its various operating modes. The c18 is a CDMA phone that transmits in continuous mode. Table 6 lists the maximum current for each mode supported by the c18 module.

Table 6. Current Consumption

Mode	Current Consumption		
	IS95 A/B	1X	AMPS
Talk	740 mA	740 mA	940 mA
Receive	110 mA	110 mA	55 mA
Standby	5 mA*	< 3.7 mA*	55 mA
Off	< 5 µA		

* For SCI2, TBR = 30 minutes.

3.3 c18 OPERATING MODES

The c18 has four input pins, OPT1, OPT2, AUDIO IN and USB_VBUS, which define the c18 mode of operation.

Table 7 summarizes the available operating modes on the c18.

Table 7. c18 Modes of Operation

Mode	Pin Name				Notes
	OPT1	OPT2	AUDIO IN	USB_VBUS	
RS232 (8 W) + analog audio	0	1	1	0*	* Pull-down resistor is not required
USB + analog audio	1	1	1	> 4.0 V	
USB + RS232	1	1	0	> 4.0 V	Required for CDG2 certification
Flashing	Shorted to OPT2	Shorted to OPT1	1		Non-standard mode used for special flashing

Note: 1: The default state. The c18 contains internal pull-up resistors. Configuration pins can be left open.
0: Requires external 10kΩ pull-down resistor.

Note

Other combinations of pin states are not supported and should not be used.

OPT1 and OPT2 signals are not available on models using a 28-pin interface connector. In this case, the communication mode depends on the model. Some models are supplied with a hardware RS232 preset mode, models without such a preset may be used for USB communication only.

For more information about pin locations, see “Connector Pin Assignments” on page 41.

3.4 TURNING THE UNIT ON/OFF

This section describes the methods available to turn the c18 unit on and off.

3.4.1 On/Off Circuitry

The unit does not power-up automatically by connecting the power. There are two ways to turn on the c18 unit:

- Using the AUDIO_OUT_ONOFF pin
- Using the Ignition pin

It is recommended to use the AUDIO_OUT_ONOFF line to power-on or power-off the c18.

Caution

The module should not be turned off by removing the supply voltage. If the c18 is powered off by disconnecting the power to the unit, the c18 module does not shut down properly and does not complete the deregistration procedure from the network.

3.4.2 Turning the Unit On/Off Using the AUDIO_OUT_ONOFF Pin

The c18 module can be turned on or off using the AUDIO_OUT_ONOFF line (pin #53 on the 70-pin connector, pin #14 on the 36-pin ZIF connector and pin #17 on the 28-pin DIN connector). The AUDIO_OUT_ONOFF line has dual functions, as follows:

- It serves as an audio output.
- It serves as an on/off signal.

It is internally pulled high, to approximately VCC -0.6V.

To turn the modem on, the AUDIO_OUT_ONOFF signal should be pulled to GND through a 4.7K resistor for a minimum of two seconds. The signal should then be released, and the module will begin the power-up sequence. During the next six to seven seconds, the module does not communicate (for example, it does not respond to AT commands if configured for RS232 communication). For a detailed description of UART signals at power-up, see “UART1” on page 27.

Note

When using this signal as audio output, make sure to decouple the load with a capacitor. Connecting a load directly without the capacitor alters proper module functionality. For more details concerning the audio interface, see “Hands-free Audio (Auxiliary Audio) Interface” on page 33.

To turn the module off, the AUDIO_OUT_ONOFF signal should be pulled to GND through a 4.7K resistor for a minimum of two seconds. The signal should then be released. This initiates the power-down sequence, which includes deregistration from the network. The process takes approximately three to eight seconds (typically five seconds). After the module has powered down, the voltage supply can be disconnected from the module.

Caution

The module should not be turned off by removing the supply voltage. If the c18 is powered off by disconnecting the power to the unit, the c18 module does not shut down properly and does not complete the deregistration procedure from the network.

The timing for these processes is shown in Figure 6 and Figure 7 below.

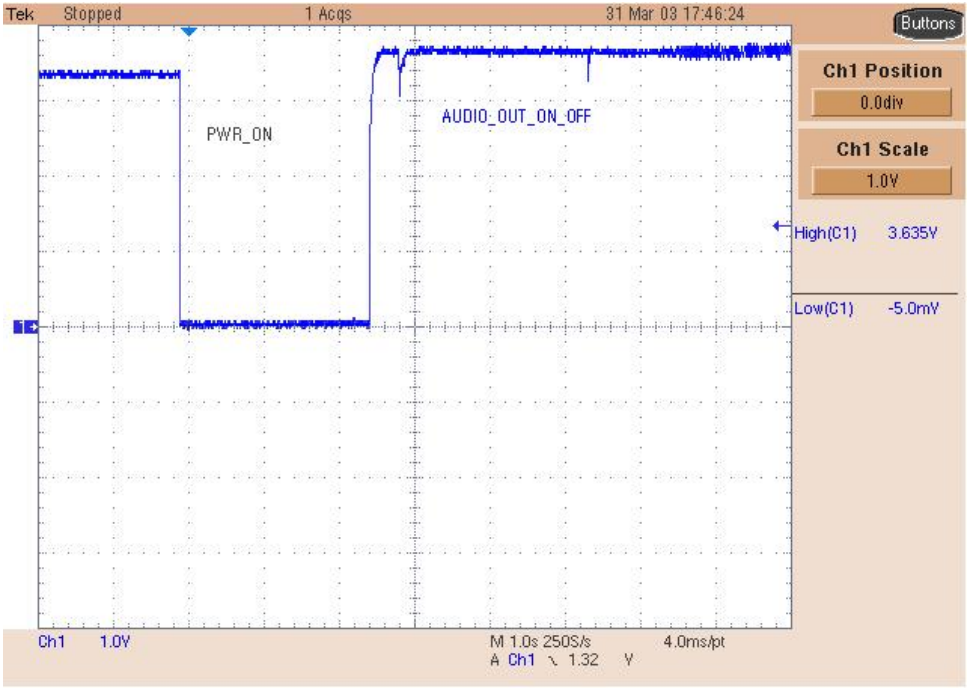


Figure 6. Powering On the c18 Power Using the AUDIO_OUT_ONOFF Pin

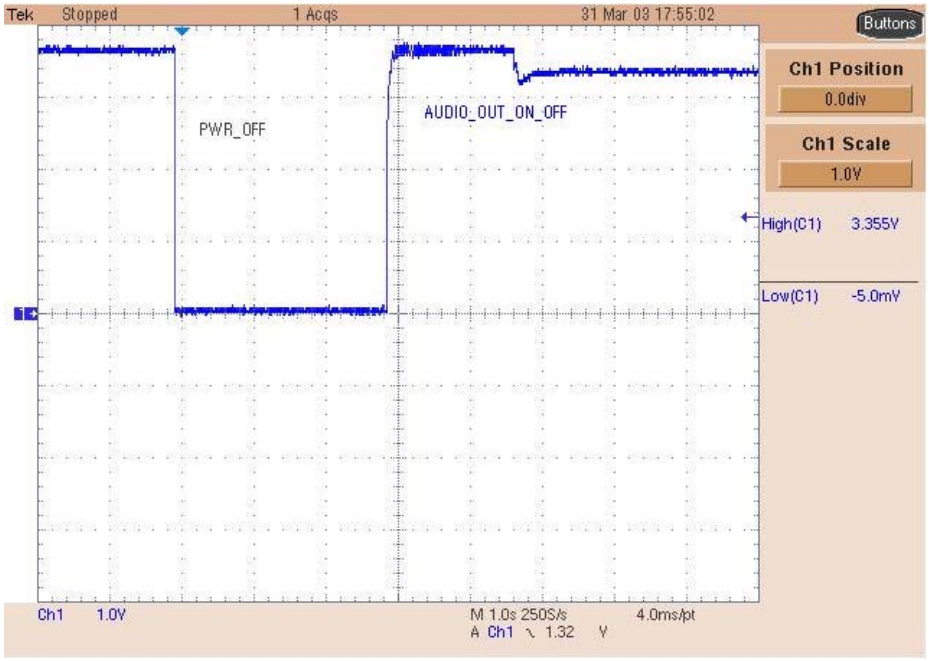


Figure 7. Powering Off the c18 Using the AUDIO_OUT_ONOFF Pin

3.4.3 Turning the Unit On Using the Ignition Pin

An alternative way to power-up the module is to connect the Ignition line to a 12 V input (for example, a car battery). Releasing the Ignition line causes the module to power-down after a timeout period in the flex as determind by the operator, provided that the module is not in the midst of a call and that no keys have been pressed. If the module was involved in a call, the module turns off after a timeout period defined by flex, after the call ends.


Note

The c18 module does not enter power-save modes when the Ignition line is asserted high.

The Ignition line is used to turn on the c18 unit, and is primarily used for units connected to a mobile device, where current consumption is not a major concern. When the Ignition line rises, the unit turns on. The Ignition line is also used to turn the unit on when power is connected to the unit (for example, the Ignition line in a car kit).


Note

For proper Ignition line functioning, c18 VCC must be 4.0V or higher. Proper Ignition line functioning is not guaranteed at less than 4.0V VCC.

3.5 SLEEP MODE OPTIONS

This section describes c18 Sleep mode options.

3.5.1 c18 Awakens the DTE from Sleep Mode

In order to awaken the DTE from Sleep mode (or to block the DTE from entering Sleep mode), the c18 (DCE) changes its WAKE_OUT line state prior to sending data, thereby prompting the DTE to exit Sleep mode. The following compatibility issues apply:

- **For g18 compatibility:**

  To wake up the DTE, the c18 changes the WAKE_UP line state to low for the time interval designated by the ATS102 command (the default is 30 ms). After that time, the WAKE_UP line changes its state back to IDLE (high). See Figure 8 for reference.

- **Pin assignments:**
  - g18:
    - In the g18, the WAKE_OUT and WAKE_IN functions are on the same physical line called WAKE_UP.
    - On the 36-pin connector, the WAKE_UP pin is J10-15.
    - On the 28-pin connector, the WAKE_UP pin is J11-9.
    - On the 70-pin connector, WAKE_UP function goes to the WAKE_IN_N pin J1-16.
    - On the 70-pin connector, WAKE_OUT_N pin J1-26 is not functional.

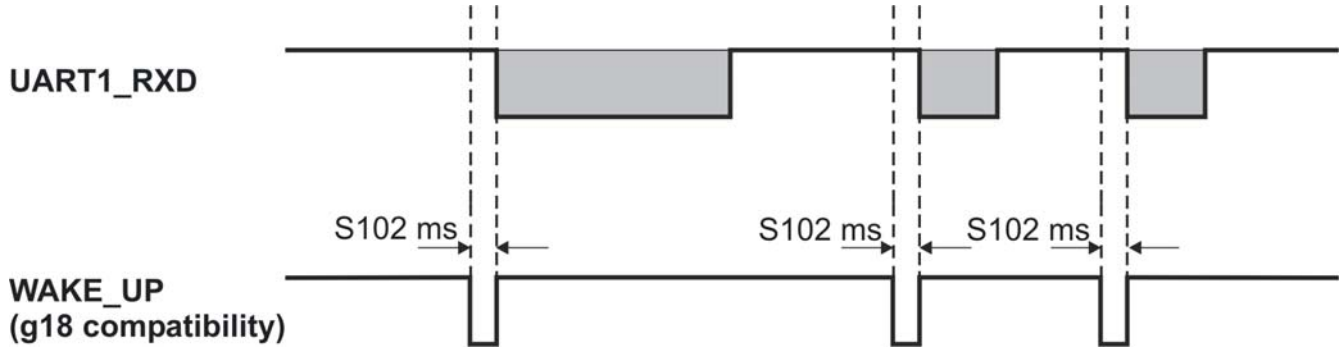


Figure 8. Waking Up the DTE when the c18 Should Send Data

3.5.2 c18 Exiting from Sleep Mode

When the c18 senses communication activity on its Rx data line, it exits Sleep mode. Entering Sleep mode again depends on the activity of the network and the activity of the RS232 lines.

3.5.3 c18 Sleep Mode on RS232

This section describes the c18 OEM unit (based on the MSM5100 chipset) sleep mode according to RS232 functionality.

In sleep mode ATS24>0, the current consumption is as follows:

- with SCI=2 is 5-6 MA
- with SCI=1 is 12-13 MA

3.5.3.1 Wakeup Timing and Procedure

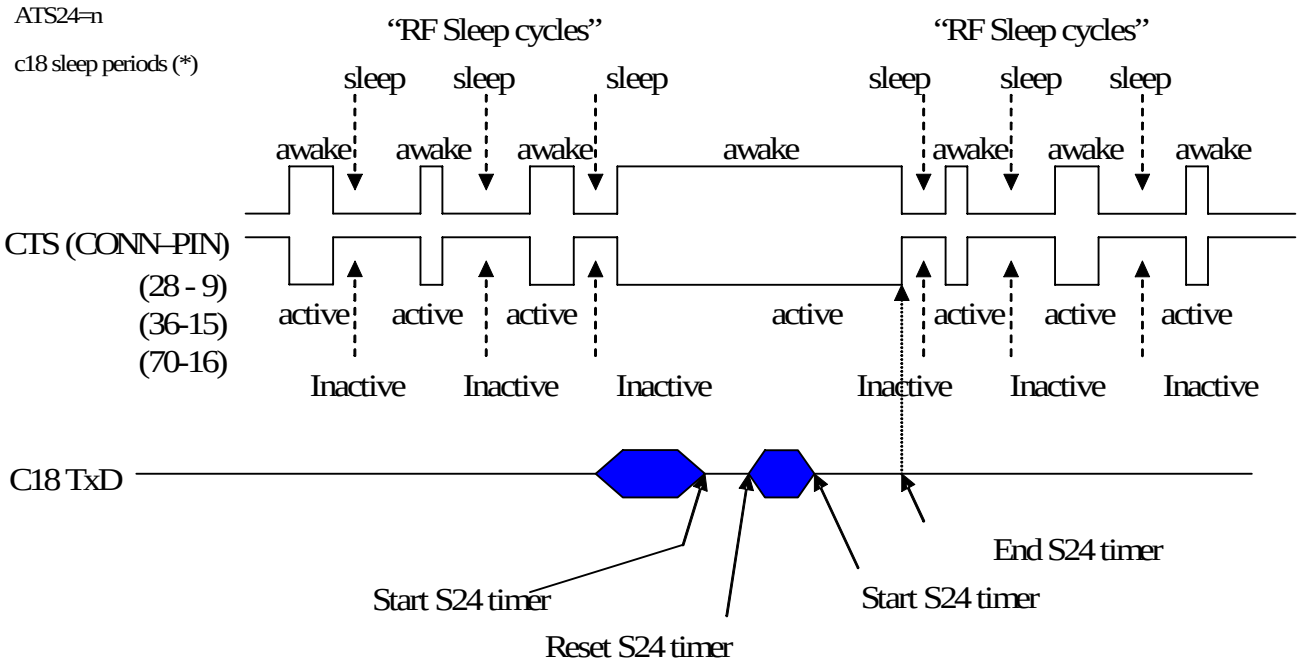
If the c18 has no accessories, c18 is able to go to sleep mode (current save mode). In Sleep mode the radio is switched to minimum activity. The clock is removed from the RF section and it reduced from 19.2MHz to 32KHz in the Logic section. The unit is sensing the activity by going out of this mode in a periodic sequence. In any case of an incoming call the unit will go out of Sleep mode. Going to sleep mode will not terminate a 1x section. During sleep mode period the RS232 is not responding to any command from the DTE device (UART is disabled and no respond will be received via the RXD line). In order to wake up the unit, the host needs to communicate with the c18 as follow:

Two options will be available to wake up the c18.

3.5.3.1.1 Option 1:(AT+MSCTS=0)

At the beginning of your work, activate the sleep mode by sending ATS24=n (n=1,2,3,4 seconds). To disable sleep mode use ATS24=0. Verify that AT+MSCTS? Gives zero. The c18 will de-assert the CTS any time that the unit goes to sleep and assert

the CTS when it is awaken. When TxD/RxD data is present, the c18 will exit sleep mode, when the TxD/RxD data transmission ends, the c18 will wait S24 seconds and go back to sleep mode.



(*) "c18 sleep periods" use as representation only for the Main Clock Status

Figure 9. Sleep Mode Timing

Note

- ATS24 factory default value is "0", this value is not saved in the NV. The value of ATS24 can be changed but will be lost after power recycling.
- DTE should look for active CTS before sending data (HW flow control).
- DTE's UART should not send any character to c18, if CTS is inactive, otherwise that character might be lost. If the DTE processor handles the flow control, and not its UART, and there is a gap between checking the CTS state and sending the start bit, c18 might set CTS inactive during this gap, and character send to c18 might be lost.

3.5.3.1.2 Option 2: (AT+MSCTS=1)

At the beginning of your work activate the sleep mode by sending ATS24=n (n=1,2,3,4 seconds) and set AT+MSCTS=1. Any time that the DTE want to send data. The DTE will pull WAKE_UP line to low, wait 30 ms (wakeup time required for the C18)

and than start to send data. The WAKE_UP line should be remain low during all the sending data period, When the WAKE_UP line is low the CTS is activated and the c18 is not allowed to enter sleep mode.

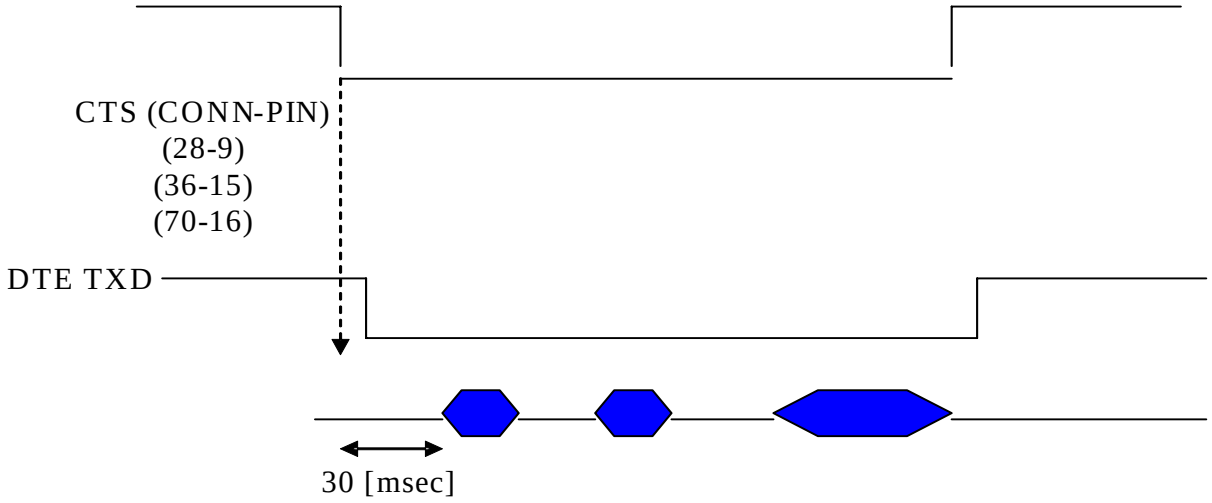


Figure 10. Wake the c18 when DTE is ready to send data

3.5.3.1.3 Wake up the DTE

At the beginning of your work activate the sleep mode by sending ATS24=n (n=1,2,3,4 seconds). The c18 will give a wakeup pulse for data sent to DTE in packet mode and in CSD mode. When C18 is awake and want to send data to DTE, C18 will configure WAKE_UP line as output and then activate (poll to LOW) the WAKE_UP line to interrupt DTE. After S99 [msec] from WAKE_UP activation, C18 will deactivate (bring to HIGH) the WAKE_UP line. Only then the C18 will start it data transmission. The value of S99 is determined by ATS99 (default value is 30 [msec]). When C18 data transmission ends, the C18 start S100 Timer, during this Timer any new TxD data block will not generate a new WAKE_UP pulse. The new data will transmit immediately without delay.

If the new TxD data block will arrive after the S100 Timer expired. The new TxD data block will be delayed for duration of S99 [msec]. During this delay period, the C18 will generate a pulse in on the WAKWE_UP line, with exact S99 [msec] duration.

After the pulse ends the C18 will transmit the new TxD data block.

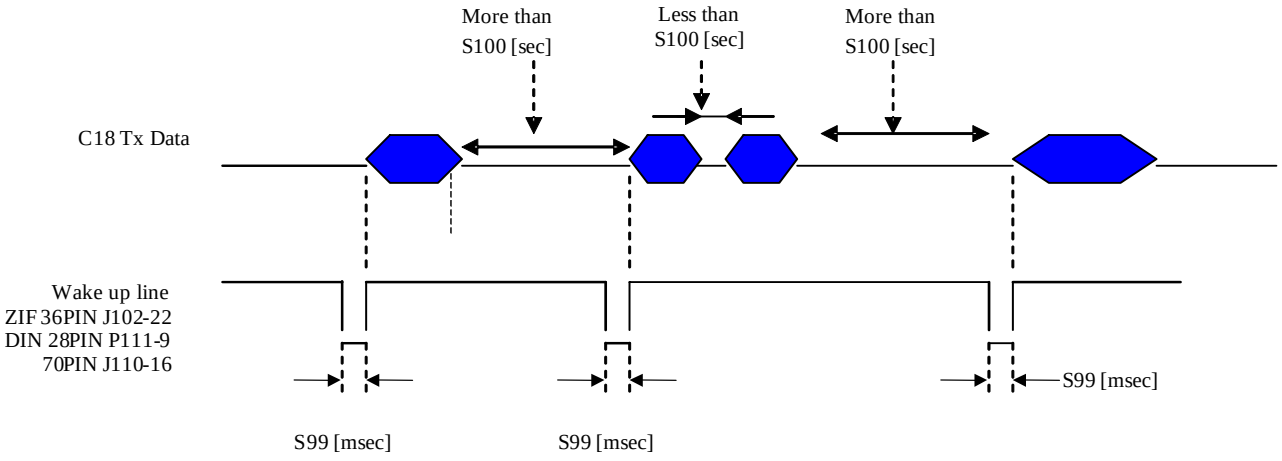


Figure 11. Wake the DTE when Data is present using the WAKE_UP line

Note

The c18 will generate a wake up pulse whenever asynchronous data is sent to DTE.

3.6 INTERFACES

c18 modules have one or two female MMCX RF connectors (J30 and J31) and an external interface connector. The external interface connector uses one of the following configurations, depending on the c18 model in use:

- 70-pin, 0.5mm pitch, board-to-board connector (J1)
- 36-pin ZIF connector (J10)
- 28-pin DIN connector (J11)

Figure 12 and Figure 13 show the top and bottom view of the c18 module, respectively.

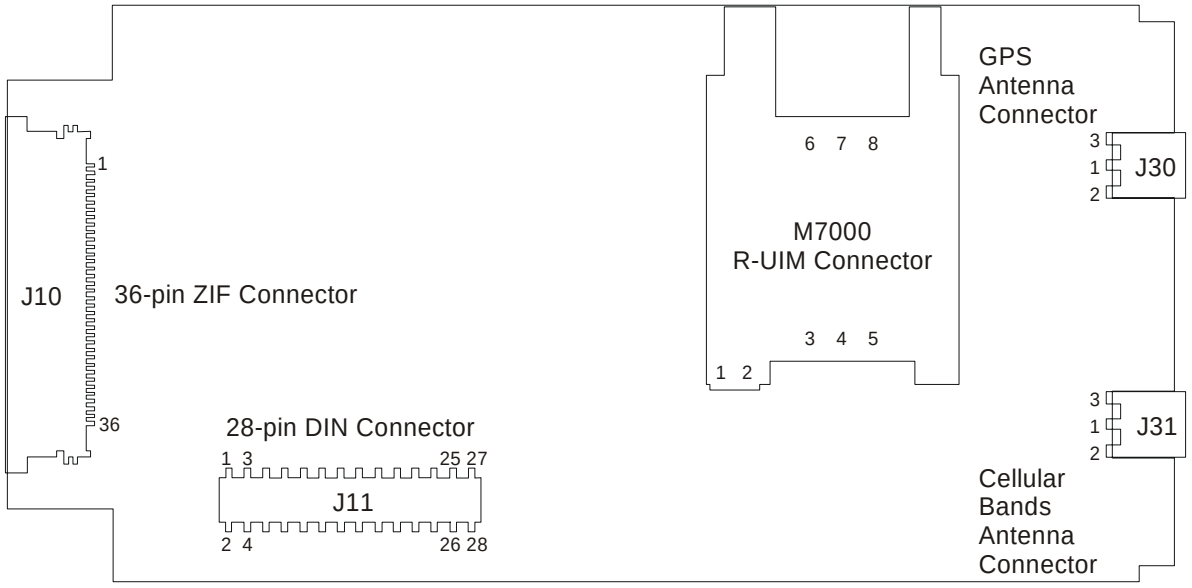


Figure 12. c18 Pinout – Top View

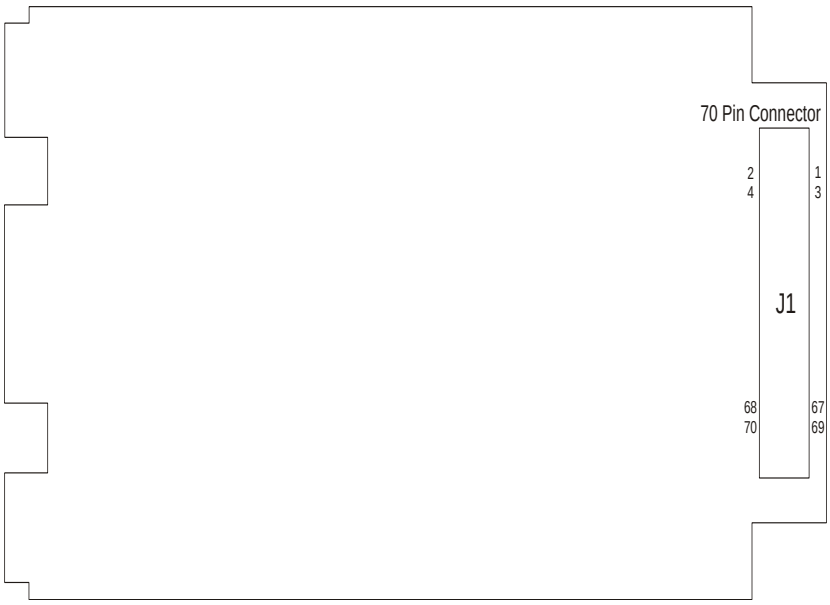


Figure 13. c18 Pinout – Bottom View

For the connector pin assignments, see “Connector Pin Assignments” on page 41.

3.6.1 Interface Connectors

Table 8 summarizes the interfaces and features supported by the c18 module.

Table 8. c18 Interface Connectors

Interface/Function	Connector Type			Remarks
	28-pin	36-pin	70-pin	
UART1 (eight wires)	√	√	√	
USB	√	√	√	
UART2 (four wires)	√	√	√	Hardware supported.
Keypad	–	–	√	
LCD	–	–	√	
Keypad backlight	–	–	√	
LCD backlight	–	–	√	
Eluminance enable	–	–	√	
Hands-free (auxiliary) audio	√	√	√	

Table 8. c18 Interface Connectors *(Continued)*

Interface/Function	Connector Type			Remarks
	28-pin	36-pin	70-pin	
Handset audio	–	–	√	
Headset audio	–	–	√	
Wake In	–	–	√	
Wake Out	–	–	√	
Wakeup	√	√	–	Bi-directional.
External R-UIM	√	√	√	Hardware supported.
GPS antenna power	√	√	√	
Ignition	√	√	√	
OPT 1 and 2	–	√	√	
Reset out	–	–	√	
Vibrator	–	–	√	
ADC inputs (1 and 2)	–	–	√	
Digital audio	–	–	√	Hardware supported.
GPIO1	–	–	√	Shared with digital audio.
GPIO2	–	–	√	Shared with digital audio.
GPIO3	–	–	√	Shared with digital audio.
GPIO4	–	–	√	Shared with digital audio.
GPIO5	–	√	√	
GPIO6	–	–	√	
GPIO7	–	–	√	
GPIO8	–	–	√	
GPIO9	–	√	√	

3.6.2 UART1

The c18 UART interface supports data-rates of up to 230 Kbps. **The default data-rate is 19.2 Kbps**. Figure 14 shows the UART1 interface.

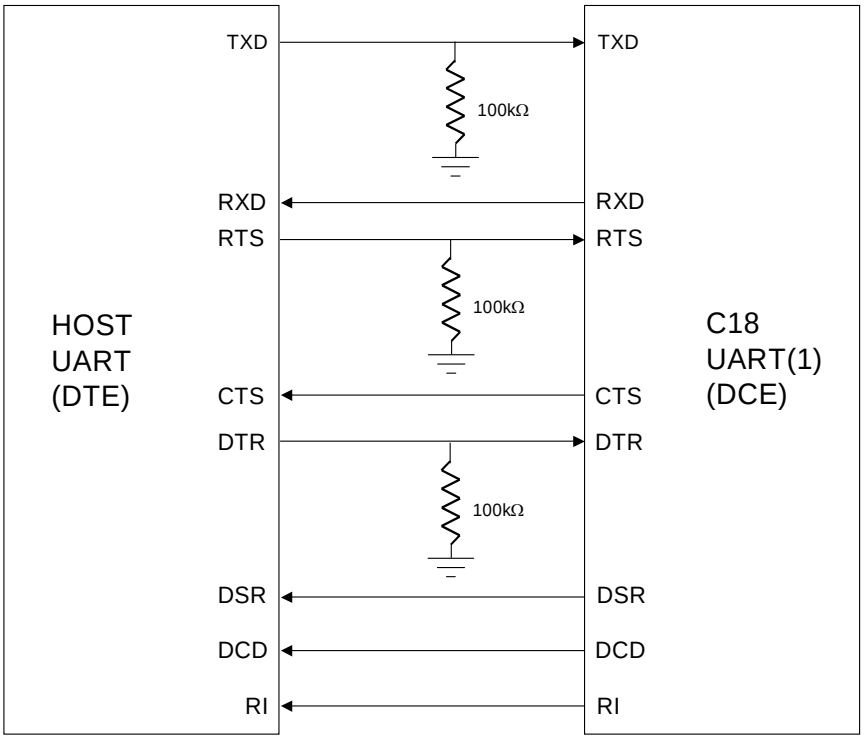


Figure 14. UART1 Interface

UART signals are low CMOS-level signals (0 to 2.8 V) that can be connected directly to the host UART. c18 input signals (such as TXD, RTS and DTR signals) are buffered, making them capable of receiving signal levels up to 5.0 V. Signals are referenced to the GND.

Note

All unused UART input signals, or input signals that can become disconnected (such as those for cable removal), should be pulled down. The suggested pull-down resistor is a 100kΩ resistor.

Table 9 lists the UART1 interface signal definitions.

Table 9. UART1 Signal Definitions

Line Name	Line Function	Definition
UART1_TXD	Transmitted data	Data line from DTE (PC) to c18 (DCE).
UART1_RXD	Received data	Data line from c18 (DCE) to DTE (PC).
UART1_RTS	Request to send	By setting this line to logical 1, the DTE asks the c18 (DCE) if it is ready to receive data.
UART1_CTS	Clear to send	When it is ready to receive data, the c18 sets this line to logical 1 following the RTS.

Table 9. UART1 Signal Definitions *(Continued)*

Line Name	Line Function	Definition
UART1_DTR	Data terminal ready	The DTE sets this line to logical 1 when it is ready for communication with the DCE (c18).The c18 thereby recognizes that it is connected to an active DTE.
UART1_DSR	Data set ready	By setting this line to logical 1, the c18 indicates to the DTE that a connection has been established with the other side, and that data can now be sent.
UART1_RI	Ring indicator	Using this line, the c18 indicates to the DTE (PC) that there is an incoming call.
UART1_DCD	Data carrier detect	Using this line, the c18 indicates to the DTE (PC) that it has received a carrier signal from the other end of the line.

For standard RS232 communications, such as that required when connecting to a PC, the UART signals must be driven through an RS232 transceiver.

In order to configure the c18 to communicate through UART1, RS232 mode or RS232 + USB mode should be selected by setting the configuration pins (OPT1, OPT2, AUDIO_IN and USB_VBUS). See “c18 OPERATING MODES” on page 17.

If the required mode of communication was set on power-up, the module does not respond to AT commands until the power-up sequence completes. This sequence can take six to seven seconds, and is indicated by the UART1_CTS signal being high. After power-up completes, the module asserts the UART1_CTS signal low, indicating that the module is ready to communicate and receive AT commands.

If the module has been powered up but not configured for RS232 mode, entering RS232 mode is fast. It is indicated by the UART1 CTS signal going low.

3.6.3 UART2

UART2 can support up to a four-wire interface. Two UART2 signals (RXD and CTS) are shared with R-UIM signals (UIM DATA and UIM CLK). For this reason, only one of these interfaces can be used at a time. Figure 15 shows the UART2 interface.

Note

UART2 is hardware supported.

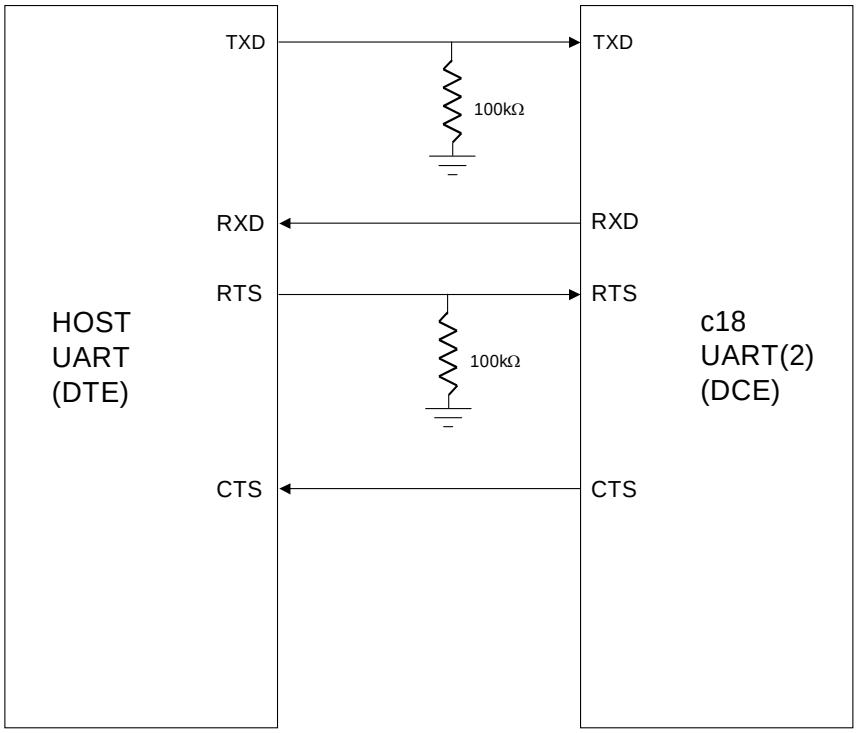


Figure 15. UART2 Interface

Note

All unused UART input signals or input signals that can become disconnected (such as those for cable removal) should be pulled down. The suggested pull-down resistor is a 100kΩ resistor.

3.6.4 USB

The c18 module operates as a full-speed USB device. The interface connector contains USB interface signals, for example, VBUS, D+ and D-. The module contains an integrated USB transceiver, thus eliminating the need for an external one. Integrators should only add an external "B" series receptacle to ensure proper connectivity.

After module power-up, the user should wait for six to seven seconds before attempting to establish USB communication, since the module is unable to communicate at that time.

The following operating systems are supported for USB communication: Windows 2000 and Windows XP.

3.6.5 Removable-User Identity Module (R-UIM) Interface

The c18 has optional internal and external R-UIM interfaces. Two R-UIM signals (UIM DATA and UIM CLK) are shared with UART2 signals (RXD and CTS). For this reason, only one of these interfaces can be used at a time. The interface supports 3V cards.

Note

R-UIM is hardware supported.

Table 10 provides the internal R-UIM (J101) card-socket pinout.

Table 10. Internal R-UIM Pinout (J101)

Pin #	Pin Name	Signal Function
1	GND	–
2	UIM_CR_DET	Card detect
3	UIM_CLK	Card clock
4	UIM_RESET	Card reset
5	UIM_PWR	Card supply voltage
6	UIM_DATA	Data I/O
7	UIM_PWR (UIM_VPP)	Programming voltage
8	GND	

The external R-UIM interface is wired to the interface connector. Table 11 provides the pinout for the external R-UIM interface.

Table 11. External R-UIM Pinout

Pin Name	Signal Function
GND	
UIM_CR_DET	Card detect
UIM_CLK	Card clock
UIM_RESET	Card reset
UIM_PWR	Card supply voltage
UIM_DATA	Data I/O
UIM_PWR (UIM_VPP)	Programming voltage
GND	

It is recommended that the total trace length between the board-to-board connector pins on the c18 and the pins of the external card holder not exceed 100 mm.

Caution

Before removing the SIM card or inserting a new one, ensure that the c18 module has been powered down. (See “Turning the Unit On/Off” on page 18.) Otherwise, there is risk of damaging the card or losing data stored on the card.

3.7 AUDIO INTERFACES

c18 has three analog audio interfaces, including:

- Handset interface
- Headset interface
- Hands-free (auxiliary) interface

These interfaces are internally muxed. Therefore, only one interface can be active at a time. The hands-free (auxiliary audio) interface is available for all three types of interface connectors. The handset and headset interfaces are supported only on c18 models that use the 70-pin connector.

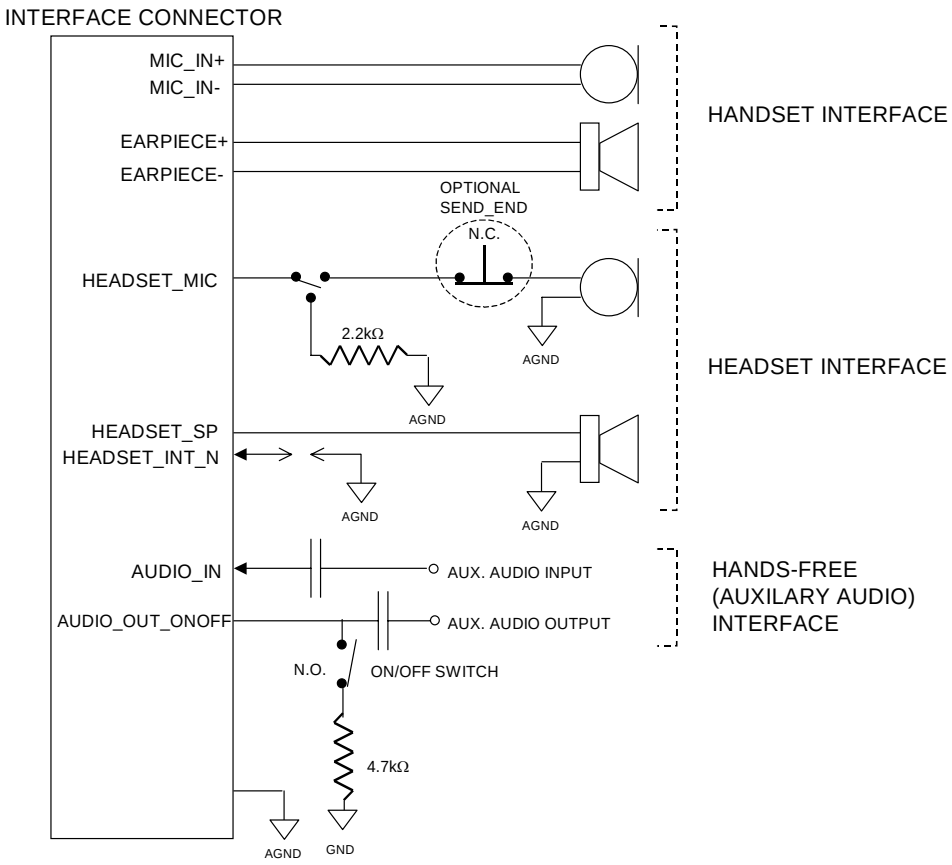


Figure 16. Audio Interfaces

3.7.1 Handset Interface

This differential interface is intended for handset-like applications. The c18 module contains all biasing circuitry. Therefore, no external components are needed, except for an active condenser microphone and a 32Ω earpiece. Figure 17 shows the handset interface with biasing circuitry:

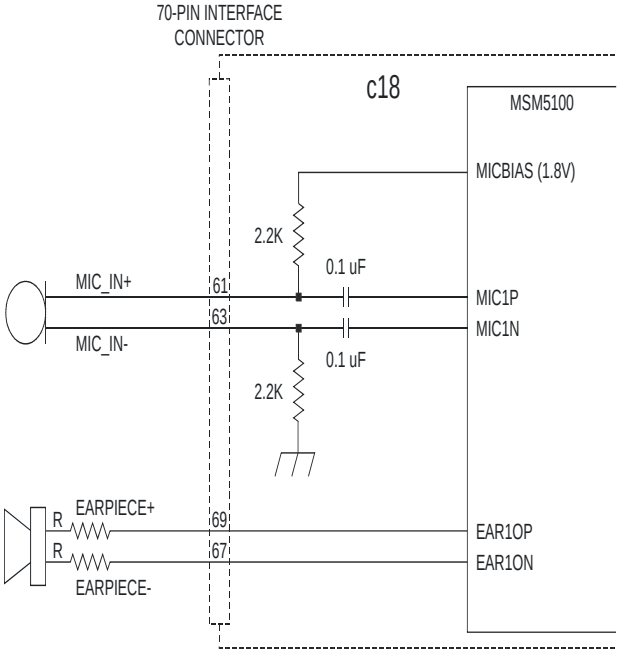


Figure 17. Handset Audio Interface

The microphone bias source provides 1.8V DC bias (typical), 1 mA. MIC_IN lines should be routed together and kept as short as possible, in order to minimize noise pickup.

The output power for the differential earpiece output is typically 35 mW for a full-scale +3dBm0 sine wave into a 32Ω speaker. The integrator should connect the earpiece speaker through two resistors (with a value of R) for safety compliance, as shown in the figure above.

The resistors purpose is to limit the maximum sound level that can be created by the speaker. The value of R depends on the type of earpiece and its mounting. A value between 0 and tens of Ohms can be expected.

3.7.2 Headset Interface

This interface is single-ended, with both the input and output referenced to analog ground (AGND). The interface is intended for headsets with an active condenser microphone and a 32Ω speaker. The HEADSET_INT_N interrupt line should be used to detect that the headset is plugged in, and to ensure that the c18 selects the required audio path. HEADSET_INT_N is internally pulled up (27 K), and should therefore be shorted to the ground when the headset is connected to the module.

An optional (normally closed) switch can be used for answering/ending (SEND/END) an incoming call from the headset. The c18 monitors the HEADSET_MIC signal DC level, in order to define the state of the SEND/END switch. Be sure to pull down the microphone input when the headset is unplugged from the c18. Figure 18 shows the headset interface:

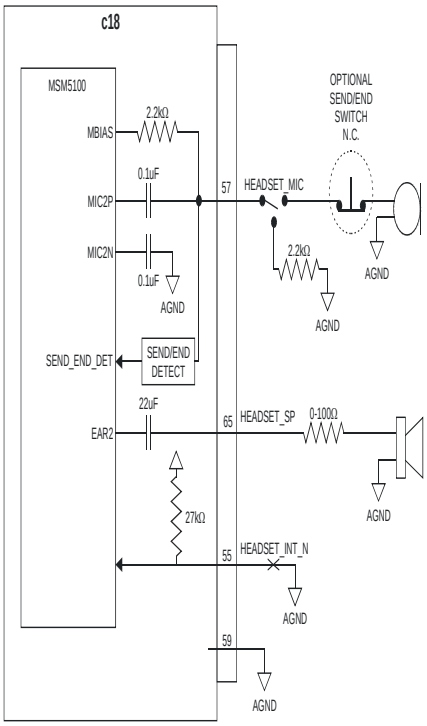


Figure 18. Headset Interface

The output power for the single-ended headset earpiece output is typically 8.8 mW for a full-scale +3dBm0 sine wave into a 32Ω speaker. The integrator should prepare a resistor in series with the headset earpiece (on HEADSET_SP line), in order to provide a means for limiting the maximum output level and to ensure safety compliance.

3.7.3 Hands-free Audio (Auxiliary Audio) Interface

This single-ended interface is intended for car-kit-like applications. Because the audio output is used as an on/off signal (with DC bias on it), an external capacitor should be used (1μF or more), as shown in Figure 19.

All maximum hands-free audio levels specified in this document refer to the 1kH sine wave with a 10kΩ load on the AUDIO_OUT_ONOFF output and a volume set to audio level 3. This load represents input impedance of an amplifier typically used in a car kit. There is no significant change in the audio levels for loads with an impedance higher than 10 kΩ. The module is capable of driving lower impedances as well, down to 600 Ω, but at lower audio levels. For example, the output signal level under the same conditions, but with a 600Ω load is around 300 mVp-p (instead of 1.06 Vp-p with a 10kΩ load).

Muting the external audio circuitry connected to the AUDIO_OUT_ONOFF signal is suggested, in order to reduce "pops" from occurring due to the AUDIO_OUT_ONOFF transitions that occur when the ON/OFF switch is pressed or released. The simplified way to do this is shown in Figure 19.

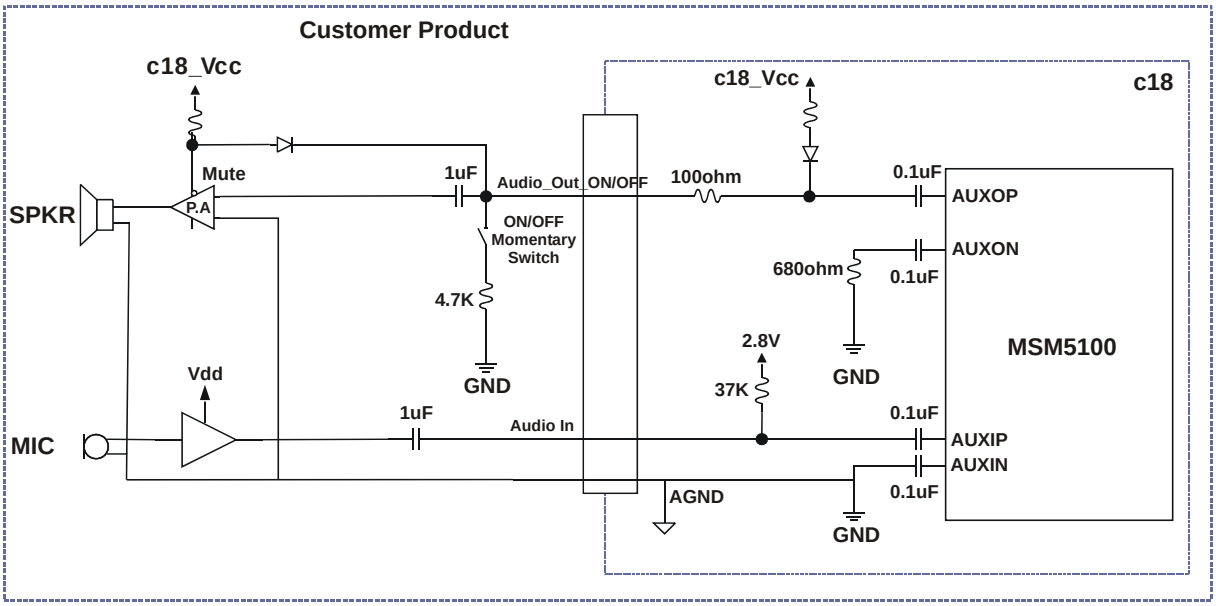


Figure 19. Hands-free Audio Connectivity

3.7.4 Analog Ground

For optimal audio performance, all audio circuits external to the c18 should be referenced to the Analog Ground (AGND) pin. The connection between AGND and GND is implemented inside the c18 module.

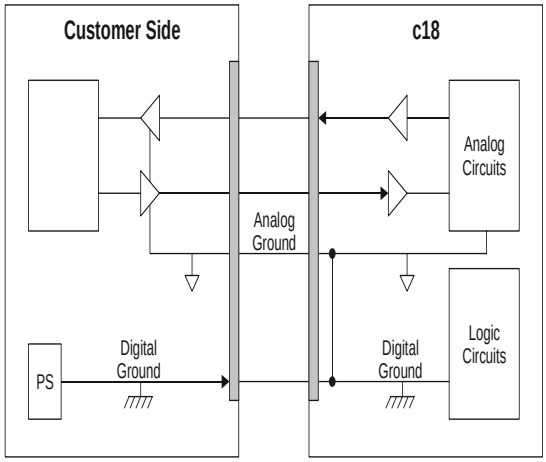


Figure 20. GND to AGND Connectivity

Note

The maximum allowed AGND current is 0.2 A.

3.7.5 Digital Audio Interface

Digital audio signals can be used as general-purpose I/Os when the digital audio interface is not needed. Table 12 lists the c18 digital audio interface signals.

Table 12. Digital Audio Interface Signals

Signal Name	70-pin Connector Pin Number	Description
PCM_DIN_GPIO1	18	PCM input to c18
PCM_DOUT_GPIO2	20	PCM output from c18
PCM_CLK_GPIO3	22	PCM Clock signal
PCM_FS_GPIO4	24	PCM Sync signal

Note

Althogh Digital Audio is hardware supported, it is not supported in the current software release.

3.8 ANTENNA

This section describes the available RF antenna connectors and their requirements.

3.8.1 RF Connectors

Two female MMCX antenna connectors are provided for RF input/output in the c18 module:

- Cellular Bands Antenna Connector (J31)
- GPS Antenna Connector (J30)

Both RF connectors (J30 and J31) are 50-ohm connectors with VSWR less than 2:1. Figure 21 shows the c18 module's antenna connectors.

There are three supported antenna port configurations, as follows:

- A single-port solution that supports CDMA1X/AMPS/GPS bands (with a passive antenna) using the J31 connector.
- A single-port solution that supports CDMA1X/AMPS bands only using the J31 connector.
- A dual-port solution in which the J31 connector is used to support CDMA1X/AMPS only, and the J30 connector is used to support the GPS band (with an active or passive antenna).

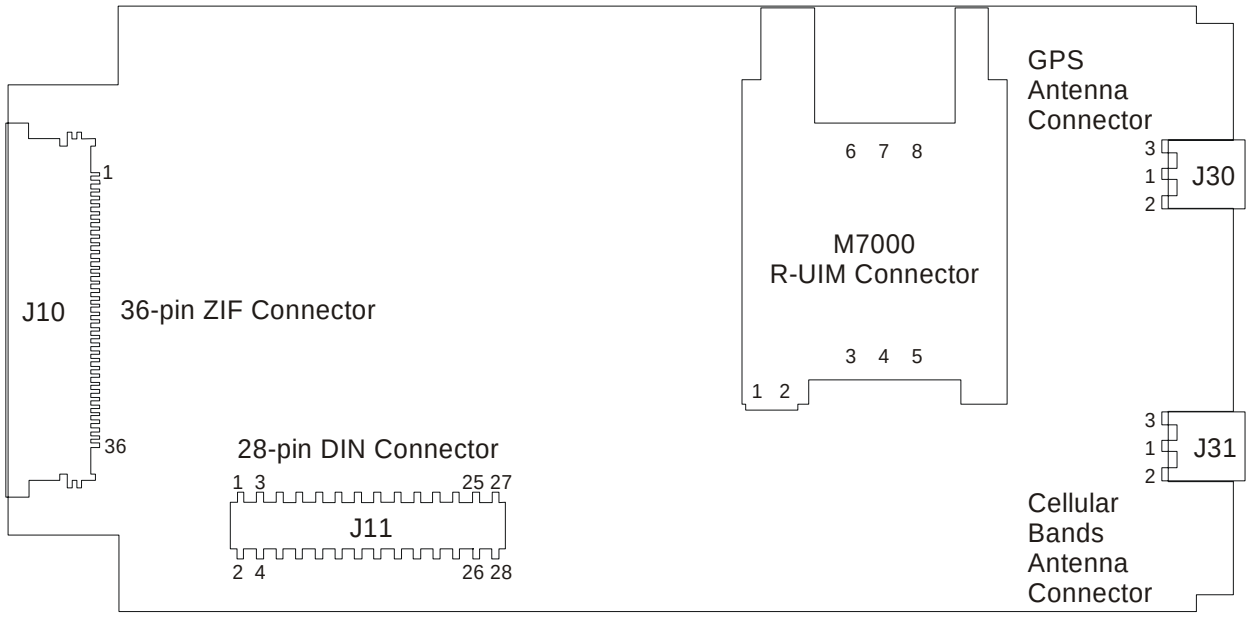


Figure 21. Antenna Connectors

3.8.1.1 Cellular Bands Antenna Connector

J31 covers two cellular bands, 800 MHz and 1900 MHz, as well as the GPS band, 1575 MHz, for passive aGPS.

3.8.1.2 GPS Antenna Connector

J30 is a GPS connector that provides the RF connection to the GPS receiver, as well as a user-defined DC voltage for an active GPS antenna, which may be required in some configurations to increase sensitivity.

The DC voltage is provided by the user on the GPS_ANT_PWR pin on any of the three interconnects, and is routed to J30 via an RF choke to decouple it from the RF signal.

3.9 DISPLAY INTERFACE

This section describes the c18 display interface and its requirements.

3.9.1 Serial LCD

The c18 has an interface for connecting a serial 96x64 LCD. The interface is available only on c18 models using the full-featured 70-pin interface connector. Table 13 describes the pin attributes for the LCD.

Table 13. LCD Pins

Pin #	Pin Name	Description
56	LCD_DATA	Data for serial LCD. Data comes from an 8-bit parallel-to-serial converter.
58	LCD_CLK	LCD clock rate: 9.6 MHz.
54	LCD_CS_N	Chip-select signal (active low).
60	LCD_RS	Register-select signal. When RS=1, Data is sent on the LCD_DATA line. When RS=0, Command is sent on the LCD_DATA line.
25	RESOUT_N	Reset out from the modem MSM5100 (active low).

3.9.2 Backlights

3.9.2.1 KEYB_DRV

The KEYB_DRV output is intended to be a driver for backlight LEDs in handset-like applications. KEYB_DRV is an open drain output used to sink the current. Therefore, the backlight LEDs' anode should be tied to VCC and the cathode to the c18 KEYB_DRV pin. By default, the c18 enables this driver on power-up.

Note

This feature is available only on c18 models using a 70-pin interface connector.

An external driver should be implemented if higher drive currents are required.

Figure 22 shows KEYB_DRV output connectivity:

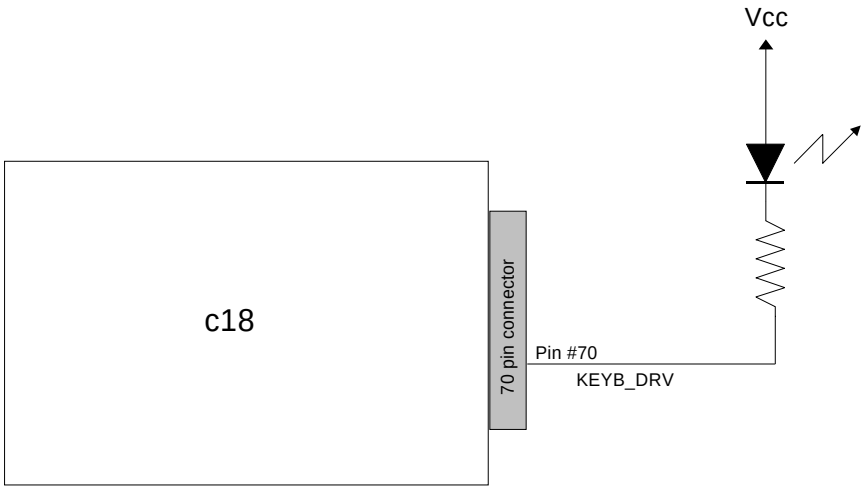


Figure 22. KEYB_DRV Output Connectivity

3.9.2.2 BL_SINK

The c18 BL_SINK output is an open drain current sink. Therefore, the LEDs' anode must be tied to VCC and the cathode to the c18 BL_SINK pin. The programmable current sink operates between 0 mA and 40 mA in 16 steps through the SBI register DRV_LCDSEL. The default current is set to 0 mA. These programmable currents are used to control the brightness of the LCD backlight.

Like the keyboard backlight driver, when the sink current is programmed for 0 mA (default), the open drain output is at a high impedance state.

Note

This feature is available only on c18 models using a 70-pin interface connector.

An external driver should be implemented if higher drive currents are required.

This driver is hardware supported.

Figure 23 shows BL_SINK output connectivity:

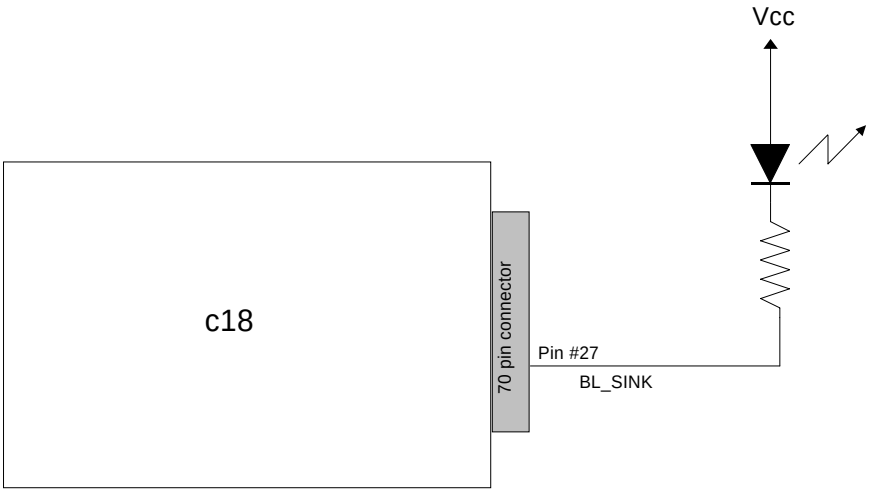


Figure 23. BL_SINK Output Connectivity

3.9.3 LCD_EL_EN

The c18 provides support for controlling an electro-luminescent (EL) lamp. The output enables four levels of intensity control.

3.9.4 Keypad

The keypad interface consists of eight pins, which can be used to connect a matrix keypad and other control buttons (such as volume up/down). Each pin asserts an interrupt if pulled low. All keypad lines have internal pull-ups.

3.9.5 General-purpose A/D Converter - GPADC

The c18 has two general-purpose ADC inputs, ADC1 and ADC2. The GPADC is located in the MSM5100 block. It is intended to digitize DC signals corresponding to analog parameters, such as battery voltage and temperature.

Table 14 lists the GPADC specifications.

Table 14. GPADC Specifications

Parameter	Min	Typ	Max	Units	Comments
Resolution		8		Bits	
Full-scale error			+/-1	LSB	
Offset error			+/-6	LSB	
Channel isolation		50		dB	At DC
Full-scale input range	GND		Vref		*
3dB input bandwidth		2.65		MHz	Source resistance = 50 Ω
Input serial resistance		5		KΩ	
Input capacitance		12		pF	

* Vref can be software configured to 0.62 V, 1.24 V, 1.86 V or 2.5 V.

Note

This feature is hardware supported.

3.9.6 GPIO

Table 15 describes the c18 GPIO pins.

Table 15. GPIO Pin Description

Pin Name	Pin # (70-pin Connector)	Pin # (36-pin Connector)
PCM_DIN_GPIO1	18	Not applicable
PCM_DOUT_GPIO2	20	Not applicable
PCM_CLK_GPIO3	22	Not applicable
PCM_FS_GPIO4	24	Not applicable
GPIO5	29	35
ENT_MUTE_GPIO6	37	Not applicable
GPIO7_SP_MUTE	39	Not applicable
FOOTSWITCH_GPIO8	41	Not applicable
GPIO9	66	36

Note

GPIO is hardware supported.

3.9.7 Vibrator

The vibrator pin on the 70-pin interface connector (pin #43) is used to silently alert the user of an incoming call by turning on a small DC motor. An enabled vibrator line supplies a maximum current of 85 mA at 1.3 V +/- 25%.

CONNECTOR PIN ASSIGNMENTS

4.1 70-PIN CONNECTOR PINOUT

Table 16 shows the pin assignments for c18 models using a 70-pin interface connector. The legend below applies to this table.

Legend:

PU: Contains an internal pull-up resistor.

PD: Contains an internal pull-down resistor.

(PU): An external pull-up resistor is required.

(PD): An external pull-down resistor is required.

Table 16. 70-pin Connector Pinout

Pin #	Signal Name	Signal Level [V]	I/O	Description
1	GND	–	–	Power GND.
2	GND	–	–	Power GND.
3	GND	–	–	Power GND.
4	GND	–	–	Power GND.
5	VCC	3.6 – 4.5	–	Supply voltage 4.0V DC nominal.
6	VCC	3.6 – 4.5	–	Supply voltage 4.0V DC nominal.
7	VCC	3.6 – 4.5	–	Supply voltage 4.0V DC nominal.
8	VCC	3.6 – 4.5	–	Supply voltage 4.0V DC nominal.
9	UART1_RTS	2.8	I – (PD)	5V tolerant. Should be pulled down externally (100 K) when not used.
10	USB_VBUS	4.4 – 5.25	I	5V nominal.
11	UART1_RXD	2.8	O	From OEM to PC.
12	USB_D+	3.3	I/O	USB D+
13	UART1_DSR	2.8	O – PD	Data Set Ready

Table 16. 70-pin Connector Pinout *(Continued)*

Pin #	Signal Name	Signal Level [V]	I/O	Description
14	USB_D-	3.3	I/O	USB D-
15	UART1_CTS	2.8	O	Clear to Send
16	WAKE_IN_N	2.8	I – PU	Signal used by the external equipment (for example, a terminal) to wake up the c18 from Sleep mode.
17	UART1_DCD	2.8	O – PD	Data Carrier Detect
18	PCM_DIN_GPIO1	2.8	I or I/O – PU	General-purpose I/O with internal pull-up.
19	UART1_DTR	2.8	I – (PD)	5V tolerant. Should be pulled down externally (100 K) when not used.
20	PCM_DOUT_GPIO2	2.8	O or I/O – PU	General-purpose I/O with internal pull-up.
21	UART1_TXD	2.8	I – (PD)	5V tolerant (from PC to OEM). Should be pulled down externally (100 K) when not used.
22	PCM_CLK_GPIO3	2.8	I/O – PU	General-purpose I/O with internal pull-up.
23	UART1_RI	2.8	O – PD	Ring Indicator
24	PCM_FS_GPIO4	2.8	I/O – PU	General-purpose I/O with internal pull-up.
25	RESOUT_N	2.8	O	Reset out (from MSM5100). Some devices external to the c18 may require a reset signal (for example, an LCD).
26	WAKE_OUT_N	2.8	O – PD	Signal used to wake up the external equipment (for example, a terminal).
27	BL_SINK	2.8	O – Sink	LCD backlight sink signal that is capable of a sink up to at least 36 mA.
28	KEYSENSE0_N	2.8	I – PU	Active-low, level-sensitive interrupt input with internal pull-up (keypad).
29	GPIO5	2.8	I/O – PU	General-purpose I/O with internal pull-up in user configuration.
30	KEYSENSE1_N	2.8	I – PU	Active-low, level-sensitive interrupt input with internal pull-up (keypad).

Table 16. 70-pin Connector Pinout *(Continued)*

Pin #	Signal Name	Signal Level [V]	I/O	Description
31	UART2_RTS	2.8	I – (PD)	5V tolerant (from OEM to PC). Should be pulled down externally (100 K) when not used.
32	KEYSENSE2_N	2.8	I – PU	Active-low, level-sensitive interrupt input with internal pull-up (keypad).
33	UART2_TXD	2.8	I – (PD)	5V tolerant (from PC to OEM). Should be pulled down externally (100 K) when not used.
34	KEYSENSE_INT0_N	2.8	I – PU	Active-low, level-sensitive interrupt input with internal pull-up (keypad).
35	GPS_ANT_PWR	3 or 5	I	External power for active GPS antenna.
36	KEYSENSE_INT1_N	2.8	I – PU	Active-low, level-sensitive interrupt input with internal pull-up (keypad).
37	ENT_MUTE_GPIO6	2.8	O – PD	ENT_MUTE or general-purpose I/O with internal pull-down.
38	KEYSENSE_INT2_N	2.8	I – PU	Active-low, level-sensitive interrupt input with internal pull-up (keypad).
39	GPIO7_SP_MUTE	2.8	I/O or O	General-purpose I/O.
40	KEYSENSE_INT3_N	2.8	I – PU	Active-low, level-sensitive interrupt input with internal pull-up (keypad).
41	FOOTSWITCH_GPIO8	2.8	I/O – PU	FOOTSWITCH input or general-purpose I/O.
42	KEYSENSE_INT4_N	2.8	I – PU	Active-low, level-sensitive interrupt input with internal pull-up (keypad).
43	VIBRATOR	1.3	O	Vibrator drive 1.3 V +/- 25% @ 85 mA.
44	UIM_RESET	2.8	O	R-UIM reset.
45	ADC1	2.5	I	Analog input to AD converter.
46	UART2_CTS_UIM_CLK	2.8	O – PU	UART2 CTS or R-UIM clock.
47	ADC2	2.5	I	Analog input to AD converter.
48	UIM_PWR_PH	2.8	O	R-UIM power/power hold (power status indicator).

Table 16. 70-pin Connector Pinout *(Continued)*

Pin #	Signal Name	Signal Level [V]	I/O	Description
49	LCD_EL_EN	2.8	O	EL lamp driver control signal (turns EL lamp on or off and controls its intensity).
50	UIM_CR_DET	2.8	I – PU	UIM sense detection.
51	IGNITION	12	I	Ignition.
52	UART2_RXD_UIM_DATA	2.8	O or I/O – PU	UART2 RX or R-UIM data I/O.
53	AUDIO_OUT_ONOFF	1.06 Vp-p	O	Analog audio output and on/off. DC-biased (VCC -0.6 V).
54	LCD_CS_N	2.8	O	Chip-select for serial LCD.
55	HEADSET_INT_N	2.8	I – PU	Interrupt when inserting a headset jack.
56	LCD_DATA	2.8	O	Serial LCD Data.
57	HEADSET_MIC	40 mVp-p	I	Headset microphone input (RMS).
58	LCD_CLK	2.8	O	Serial LCD Clock.
59	AGND	–	–	Analog audio GND.
60	LCD_RS	2.8	O	LCD register-select.
61	MIC_IN+		I – PU	Microphone input (+), with serial 0-ohm chip for g20 compatibility. Biased to 1.8 V.
62	OPT1	2.8	I – PU	Operation mode select 1.
63	MIC_IN –		I – PD	Microphone input (-), with serial 0-ohm chip for g20 compatibility.
64	OPT2	2.8	I – PU	Operation mode select 2.
65	HEADSET_SP	8.8 mW maximum	O	Single-ended headset speaker output. 32-ohm load, 1.02 kHz.
66	GPIO9	2.8	I/O – PU	General-purpose I/O with internal pull-up.
67	EARPIECE –		O	Differential (-) earpiece output. Low impedance (32Ω), 35 mW maximum, common mode 1.2 V.
68	AUDIO_IN	1.28 Vp-p	I – PU	Analog audio in. Input impedance: > 10 kΩ.

Table 16. 70-pin Connector Pinout *(Continued)*

Pin #	Signal Name	Signal Level [V]	I/O	Description
69	EARPIECE+		O	Differential (+) earpiece output. Low impedance (32Ω), 35 mW maximum, common mode 1.2 V.
70	KEYB_DRV	2.8	O – Sink	Current sink for keypad LED backlight (up to at least 36 mA).

Note

All identical names for 70/36/28-pin connectors correspond to the same signal.

All UART names are referenced to PC, as the c18 is a DCE device.

4.2 36-PIN ZIF INTERFACE CONNECTOR

Table 17 shows the pin assignments for c18 models using a 36-pin ZIF interface connector**.**

Table 17. 36-pin ZIF Connector Pinout

Pin #	Signal Name	Signal Level [V]	I/O	Description
1	USB_VBUS	4.4 – 5.25	I	USB power, 5.0V nominal.
2	USB_D+	3.3	I/O	USB D+ signal.
3	USB_D-	3.3	I/O	USB D- signal.
4	UART1_TXD	2.8	I	5V tolerant (from PC to OEM).
5	UART1_RXD	2.8	O	From OEM to PC.
6	UART1_DTR	2.8	I	5V tolerant.
7	UART1_DCD	2.8	O	Data Carrier Detect
8	UART1_RTS	2.8	I	5V tolerant.
9	UART1_CTS	2.8	O	Clear to Send
10	UART1_DSR	2.8	O	Data Set Ready
11	UART1_RI	2.8	O	Ring Indicator
12	UART2_TXD	2.8	I	5V tolerant (from PC to OEM).
13	AUDIO_IN	1.28 Vp-p	I	Analog Audio_In. Input impedance: greater than 10kΩ.
14	AUDIO_OUT_ONOFF	1.06 Vp-p	I/O	Analog Audio_Out and on/off.

Table 17. 36-pin ZIF Connector Pinout *(Continued)*

Pin #	Signal Name	Signal Level [V]	I/O	Description
15	WAKE_UP	2.8	I/O	Wakes up the DTE
16	UIM_CR_DET	2.8	I	UIM card sense detection.
17	UIM_PWR_PH	2.8	O	UIM_PWR.
18	UIM_RESET	2.8	O	UIM_RESET.
19	UART2_RXD_UIM_DATA	2.8	O or I/O	UART2 RXD (from OEM to PC) or UIM_DATA_I/O. A software-defined pin.
20	UART2_CTS_UIM_CLK	2.8	O	UART2 CTS or UIM_CLK.
21	IGNITION	12	I	TS (turn on/standby) or ignition.
22	UART2_RTS	2.8	I	Request to Send
23	OPT1	2.8	I	Serial 0Ω resistor to disconnect the pin from the g18 customer product.
24	OPT2	2.8	I	Serial 0Ω resistor to disconnect the pin from the g18 customer product.
25	AGND	–	–	Analog audio GND.
26	GND	–	–	Power ground.
27	GND	–	–	Power ground.
28	GND	–	–	Power ground.
29	GND	–	–	Power ground.
30	VCC	3.6 – 4.5	–	4.0V DC nominal.
31	VCC	3.6 – 4.5	–	4.0V DC nominal.
32	VCC	3.6 – 4.5	–	4.0V DC nominal.
33	VCC	3.6 – 4.5	–	4.0V DC nominal.

Table 17. 36-pin ZIF Connector Pinout *(Continued)*

Pin #	Signal Name	Signal Level [V]	I/O	Description
34	GPS_ANT_PWR	3.0 or 5.0	I	External power for active GPS antenna.
35	GPIO5	2.8	I/O	General purpose I/O.
36	GPIO9	2.8	I/O	General purpose I/O.

Note

All identical names for 70/36/28-pin connectors correspond to the same signal.

All UART names are references to PC, as the c18 is a DCE device.

4.3 28-PIN DIN INTERFACE CONNECTOR

Table 18 shows the pin assignments for c18 models using a 28-pin DIN interface connector.

Table 18. 28-pin DIN Connector Pinout

28-pin Header Pin #	Signal Name	g18 Pin #	Signal Level [V]	I/O	Description
1	VCC	2	3.6 – 4.5	–	4.0V DC nominal.
2	VCC	1	3.6 – 4.5	–	4.0V DC nominal.
3	UIM_RESET	4	2.8	O	UIM_RESET.
4	UART2_RXD_UIM_DATA	3	2.8	O or I/O	UART2 RXD (from OEM to PC) or UIM DATA. A software-defined pin.
5	UIM_CR_DET	6	2.8	I	UIM sense detection.
6	UIM_PWR_PH	5	2.8	O	UIM_PWR.
7	IGNITION	8	12	I	TS (turn on/standby) or ignition.
8	UART1_DTR	7	2.8	I	5V tolerant.
9	WAKE_UP	10	2.8	I/O	Wakes up the DTE
10	UART2_TXD	N/A*	2.8	I	From PC to OEM.
11	GND	12	–	–	Power ground.
12	GND	11	–	–	Power ground.
13	UART1_DCD	14	2.8	O	Data Carrier Detect

Table 18. 28-pin DIN Connector Pinout *(Continued)*

28-pin Header Pin #	Signal Name	g18 Pin #	Signal Level [V]	I/O	Description
14	UART1_RI	13	2.8	O	Ring Indicator
15	USB_D+_28	N/A*	3.3	I/O	USB D+ signal.
16	USB_D-_28	N/A*	3.3	I/O	USB D- signal.
17	AUDIO_OUT _ONOFF	18	1.06 Vp-p	I/O	Analog Audio_Out and on/off.
18	AGND	17	–	–	Analog audio GND.
19	UART2_RTS	N/A*	2.8	I	From OEM to PC.
20	AUDIO_IN	19	1.28 Vp-p	I	Analog Audio_In. Input impedance: > 10kΩ.
21	GPS_ANT_PWR_28	N/A*	3.0 or 5.0	I	External power for the active GPS antenna. Serial 0Ω resistor for disconnection.
22	UART1_DSR	21	2.8	O	Data Set Ready
23	UART2_CTS_UIM_CLK	24	2.8	O	UART2 CTS or UIM_CLK.
24	USB_VBUS_28	N/A*	4.4 – 5.25	I	5V nominal. Serial 0Ω resistor to disconnect USB_VBUS.
25	UART1_RXD	26	2.8	O	From OEM to PC.
26	UART1_TXD	25	2.8	I	5V tolerant (from PC to OEM).
27	UART1_RTS	28	2.8	I	5V tolerant.
28	UART1_CTS	27	2.8	O	Clear to Send

* Signals (functions) unique to the c18 (not supported by the g18).

Note

All identical names for 70/36/28-pin connectors to the same signal.

All UART names are referenced to PC, as the c18 is a DCE device.

Odd/even pin number assignments are flipped between the c18 and the g18, but the physical locations of the functions are identical on the connector. For more details, see “Pinout Comparisons” on page 57.

5.1 MECHANICAL REQUIREMENTS

This section illustrates mechanical requirements for the c18a1 and c18c models.

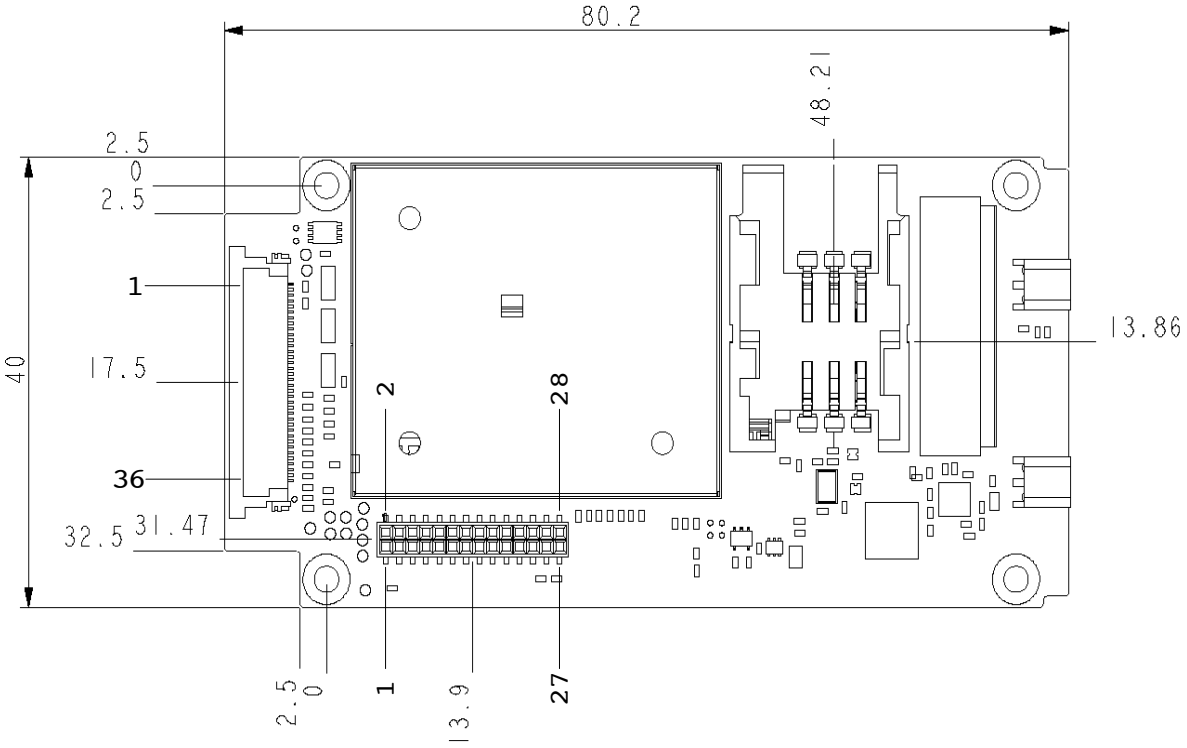


Figure 24. c18a1 Top View

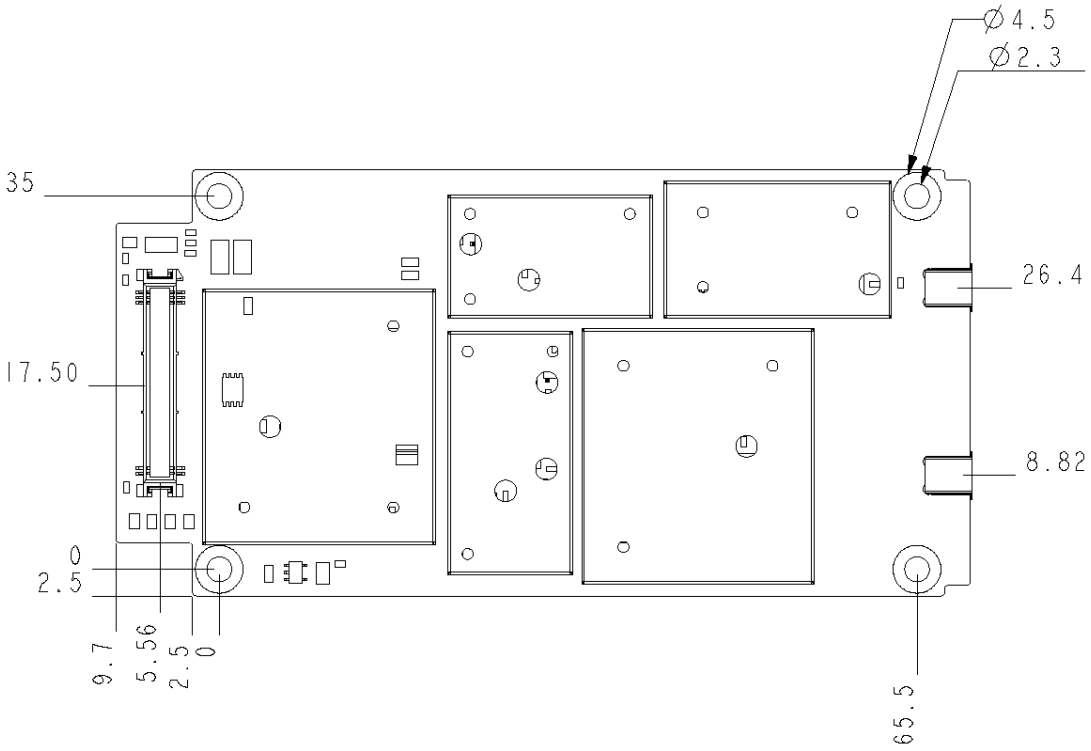


Figure 25. c18a1 Bottom View

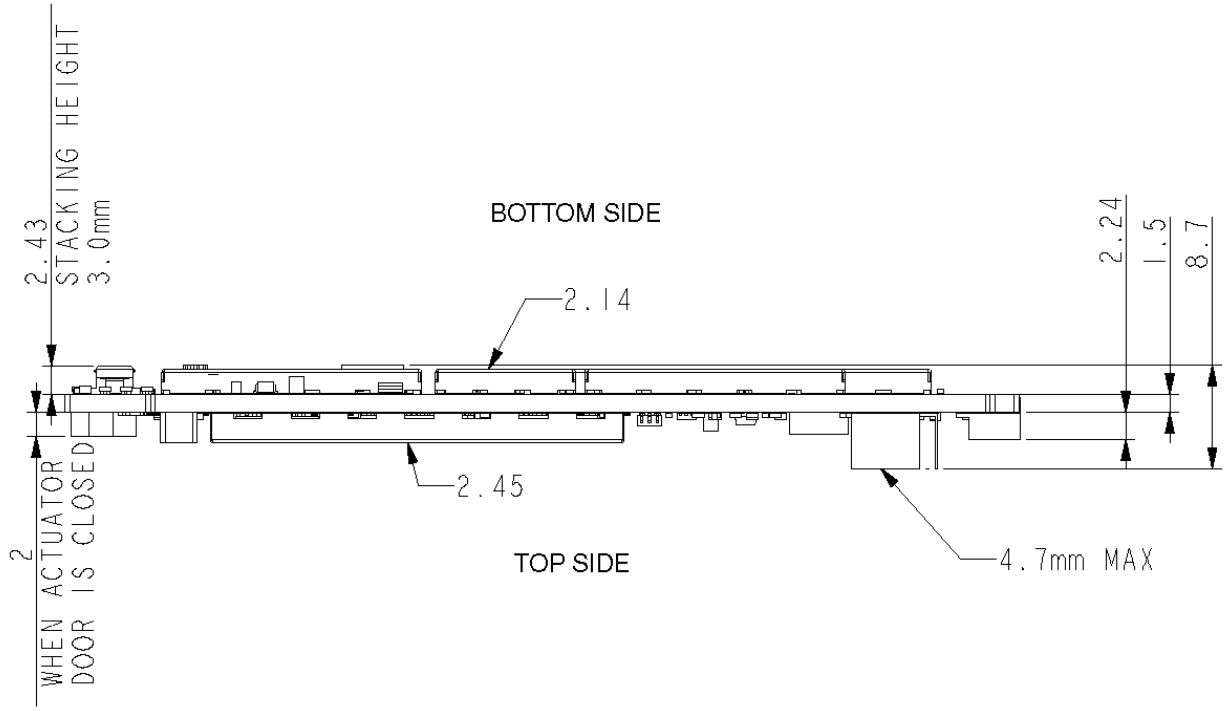


Figure 26. c18a1 Side View

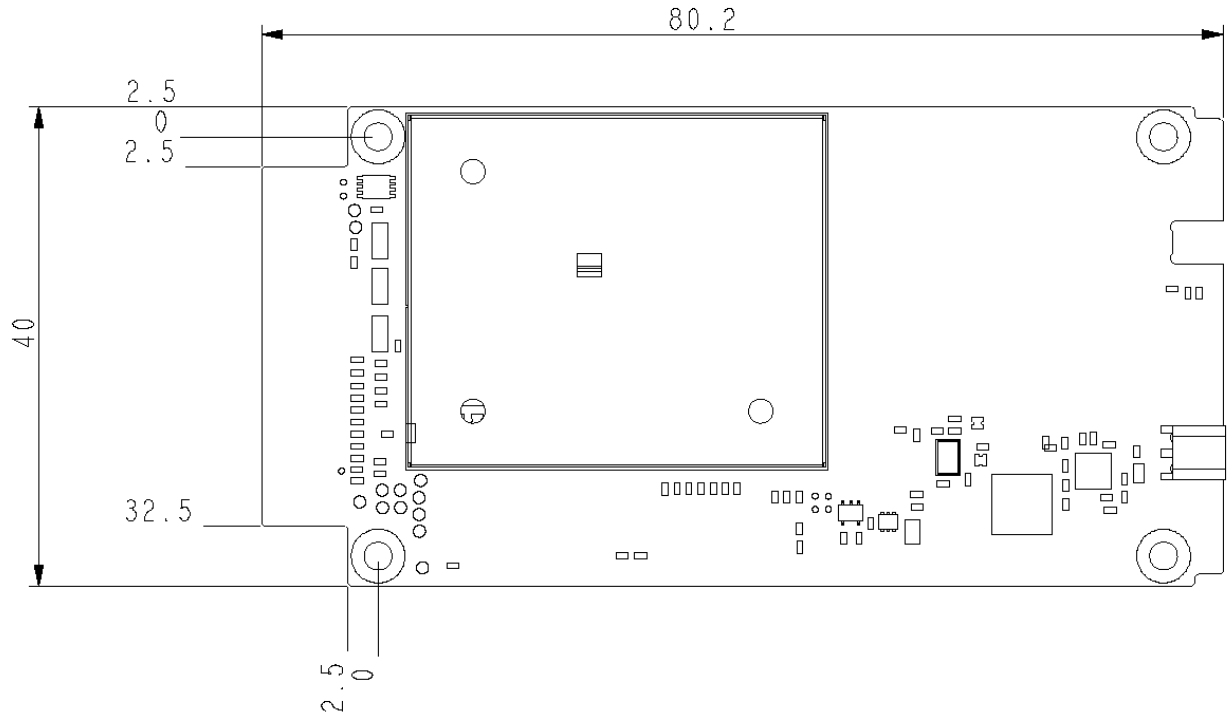


Figure 27. c18c Top View

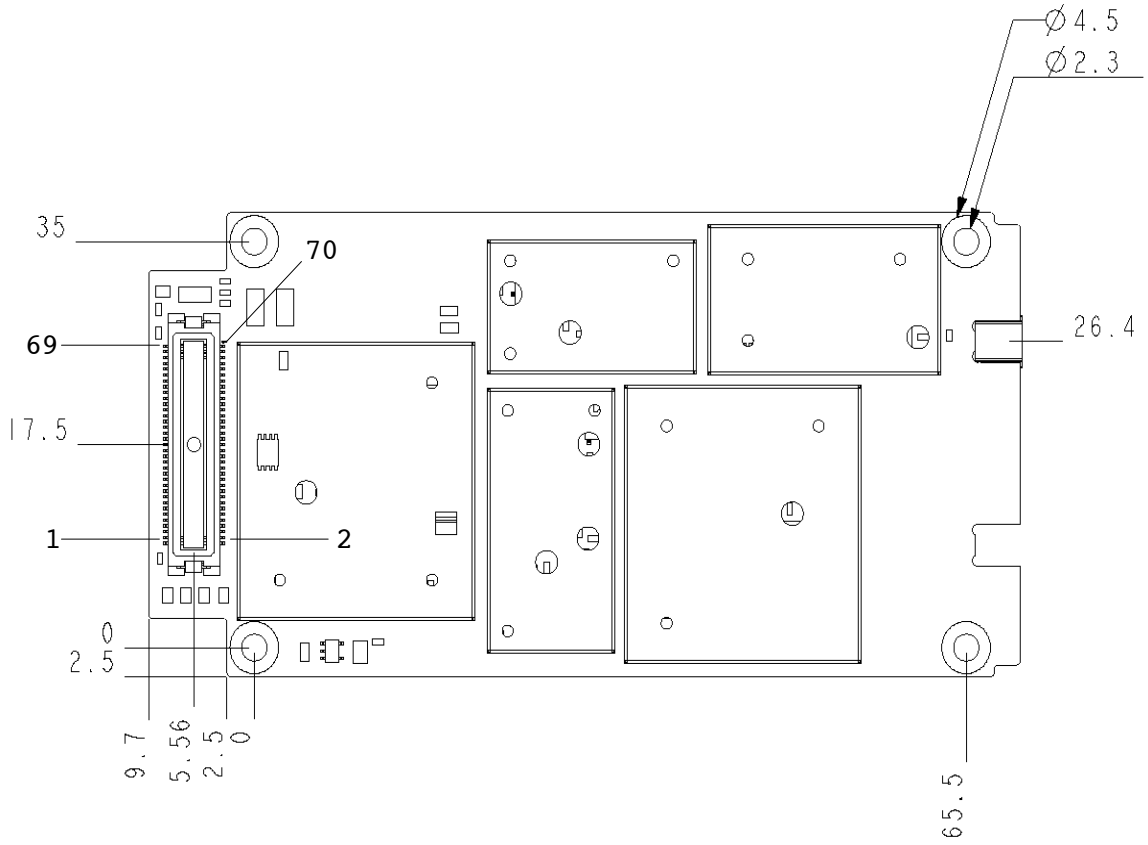


Figure 28. c18c Bottom View

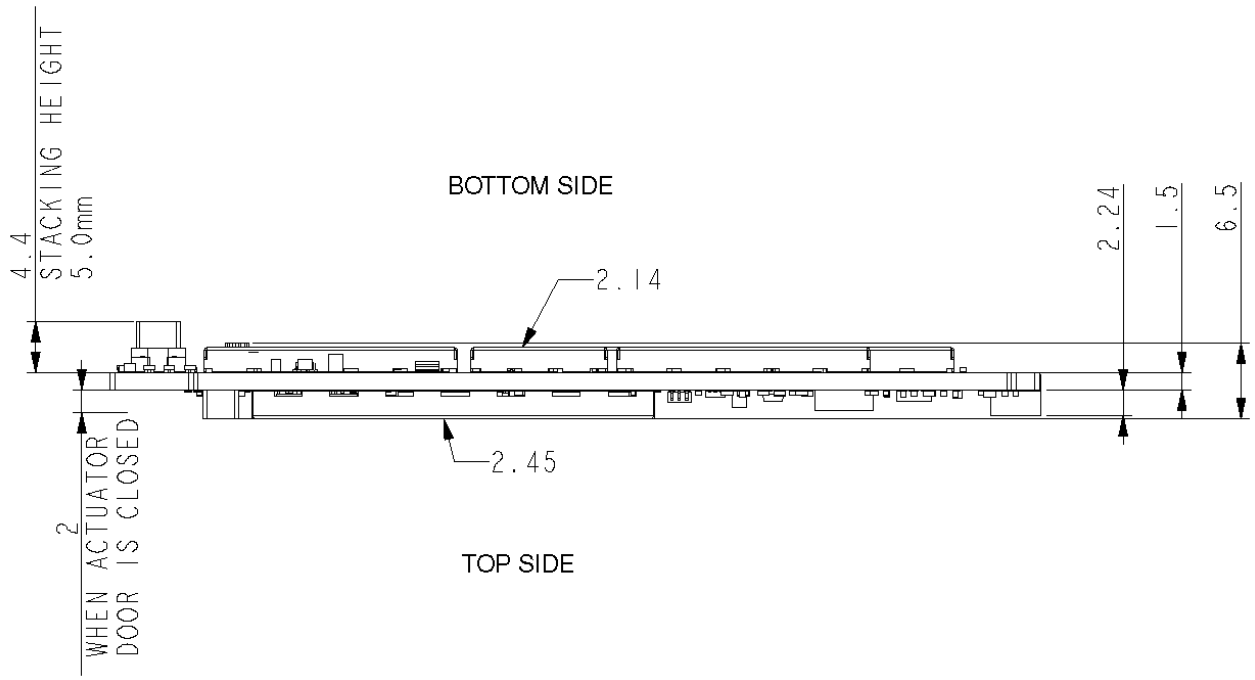


Figure 29. c18c Side View

5.2 ASSEMBLY PRECAUTIONS

The following precautions should be observed when handling c18 modules, assembling them onto the host design, or attaching/ detaching the RF cable:

- Handle with care in order to avoid scratches and bending of shields.
- Use a split washer to prevent screws from loosening while vibrating.
- Limit the washer outside dimensions to the restricted area in order to avoid a short-circuit in the board.

Following the guidelines below to avoid detaching connectors from the board:

- Connect/disconnect the socket perpendicular to the RF connector.
- Avoid pulling the opposite connector/cable using excessive force.
- Support the top of the connector with a chassis or housing.

6.1 CUSTOMER ASSISTANCE

For customer assistance, contact the Motorola help desk as directed below:

Help desk email: n2cshd@motorola.com

Help desk telephone: +972-3-568-4040

Before contacting the Motorola help desk, be sure to gather the following information:

- ESN
- MSN
- Track number
- Kit number
- Model number

This information can be obtained from the c18 labels located on the top and bottom of each module, as shown in Figure 30 and Figure 31 below.

Figure 30. Top Label

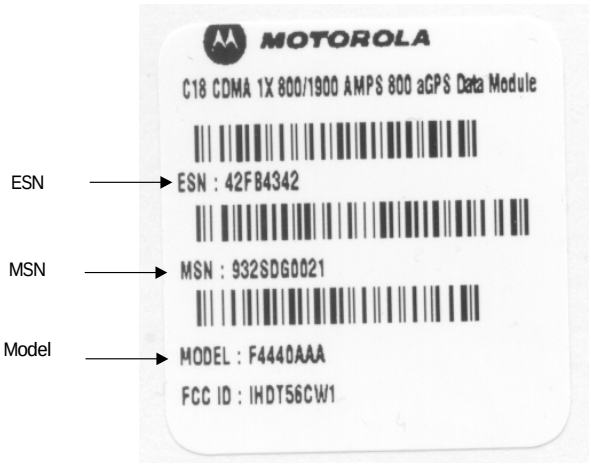


Figure 31. Bottom Label

SUGGESTED CONNECTORS

A.1 SUGGESTED MATING CONNECTORS

Table 19 in this appendix provides a list of the suggested mating connectors for use on the c18.

Table 19. c18 Suggested Mating Connectors

c18 Connector Reference	Motorola Part Number	Manufacturer Part Number	Mating Part (Motorola Part Number)	Mating Part (Manufacturer Part Number)	Manufacturer Contact Information
J1	0987582U01	53748-0708	2887581U01	52991-0708	Molex
J1 (c18c)	0986926J09	DF17B-2.0-070DP-0.5V61	2886925J09	DF17B-3.0-070DS-0.5V61	Hirose
J10	0988716K01	04-6240-036-003-800	0988716K01	04-6240-036-003-800	AVX Kyocera
			3086229J10 (36-pin flex)	FFC0.50A36/ 0050L4.0-4.0-08.0-08.05BBB	Axon
J11	0989043K01	CLP-114-02-L-D-P-TR	2880471L02	FTSH-114-03-L-DV-P-TR	Samtec
J30, J31	0904991M02	82MMCXS50-0-9		11 MMCX-50-1-1/111 – straight OR 16 MMCX-50-1-1 – right angle	Huber Suhner

PINOUT COMPARISONS

B.1 OVERVIEW

The tables in this appendix contain pin-to-pin comparisons for different c18 interface connectors, and their g18 and g20 equivalents. All tables are color-coded to denote the level of compatibility for each of the pins. The legend below applies to all tables in this appendix.

Legend:

No difference:

Some difference:

Difference:

B.2 c18/g18 28-PIN CONNECTOR COMPARISON

Table 20. c18/g18 28-pin Connector Comparison

c18 Pin #	g18 Pin #	c18 Signal Name*	g18 Signal Name	c18 Signal Description
1	2	VCC	VCC (3.0-6.0 V)	4.0V DC nominal (3.6-4.5 V).
2	1	VCC	VCC (3.0-6.0 V)	4.0V DC nominal (3.6-4.5 V).
3	4	UIM_RESET	SIM CR RESET	UIM_RESET.
4	3	UART2_RXD_UIM_DATA	SIM CR I/O DATA	UART2 RXD (from OEM to PC) or UIM DATA.
5	6	UIM_CR_DET	SIM CR DET	UIM sense detection.
6	5	UIM_PWR_PH (3V ONLY)	SIM CR VCC (3/5V)	UIM_PWR/Power Hold (Power Status).
7	8	IGNITION	Turn on/Standby (TS)	TS (Turn on/Standby) or IGNITION.
8	7	UART1_DTR	RS232 – DTR	5V tolerant.
9	10	WAKE_UP	Wake-up/GPRS coverage indicator	
10	9	UART2_TXD	Man test	From PC to OEM.

Table 20. c18/g18 28-pin Connector Comparison *(Continued)*

c18 Pin #	g18 Pin #	c18 Signal Name*	g18 Signal Name	c18 Signal Description
11	12	GND	GND	Power ground.
12	11	GND	GND	Power ground.
13	14	UART1_DCD	RS232 – DCD	
14	13	UART1_RI	RS232 – RI	
15	16	USB_D+_28	RXD UART2	USB D+ signal. Serial 0Ω resistor for disconnection.
16	15	USB_D-_28	TXD UART2	USB D- signal. Serial 0Ω resistor for disconnection.
17	18	AUDIO_OUT _ONOFF	Analog audio out and power on/ off	Analog Audio_Out and on/off (600Ω load impedance).
18	17	AGND	Analog Audio GND	Analog audio GND.
19	20	UART2_RTS	DSC – Enable	From OEM to PC.
20	19	AUDIO_IN	Audio in	Analog Audio_In (Input impedance > 10 kΩ).
21	22	GPS_ANT_PWR_28	DSC – Downlink	External power for the active GPS antenna serial 0Ω resistor for disconnection.
22	21	UART1_DSR	RS232 – DSR	
23	24	UART2_CTS_UIM_CLK	SIM CR CLOCK	UART2 CTS or UIM_CLK.
24	23	USB_VBUS_28	DSC – Uplink	5V nominal. Serial 0Ω resistor to disconnect USB_VBUS.
25	26	UART1_RXD	RS232 – RXD	From OEM to PC.
26	25	UART1_TXD	RS232 – TXD	5V tolerant (from PC to OEM).
27	28	UART1_RTS	RS232 – RTS	5V tolerant.
28	27	UART1_CTS	RS232 – CTS	

* UART names are referenced to PC, as the c18 is a DCE device.

Note

Odd/even pin number assignments are flipped between the c18 and the g18, but the physical locations of the functions are identical on the connector. See “c18, g18 AND g20 PINOUT LOCATIONS” on page 64 for more details.

B.3 c18/g18 36-PIN CONNECTOR COMPARISON

Table 21. c18/g18 36-pin Connector Comparison

Pin #	c18 Signal Name*	g18 Signal Name	c18 Signal Description
1	USB_VBUS	TX ENABLE	USB Power; 5.0V nominal.
2	USB_D+	RXD UART2	USB D+ signal.
3	USB_D-	TXD UART2	USB D- signal.
4	UART1_TXD	RS232 – TXD	5V tolerant (from PC to OEM) input.
5	UART1_RXD	RS232 – RXD	From OEM to PC.
6	UART1_DTR	RS232 – DTR	5V tolerant input.
7	UART1_DCD	RS232 – DCD	
8	UART1_RTS	RS232 – RTS	5V tolerant input.
9	UART1_CTS	RS232 – CTS	
10	UART1_DSR	RS232 – DSR	
11	UART1_RI	RS232 – RI	
12	UART2_TXD	MAN TEST	5V tolerant (from PC to OEM).
13	AUDIO_IN	Analog Audio In	Analog Audio_In (Input impedance >10 KΩ).
14	AUDIO_OUT_ONOFF	Analog Audio Out and On/Off	Analog Audio_Out and on/off.
15	WAKE_UP	Wake Up	
16	UIM_CR_DET	SIM CR DET	UIM card sense detection.
17	UIM_PWR_PH (3V Only)	SIM CR VCC (3/5 V)	UIM_PWR/POWER HOLD (Power Status).
18	UIM_RESET	SIM CR RESET	UIM_RESET.
19	UART2_RXD_UIM_DATA	SIM CR I/O DATA	UART2 RXD (from OEM to PC) or UIM_DATA_I/O.
20	UART2_CTS_UIM_CLK	SIM RC CLOCK	UART2 CTS or UIM_CLK.
21	IGNITION	TS (Turn on/Standby)	TS (Turn on/Standby) or IGNITION.
22	UART2_RTS	DSC ENABLE	

Table 21. c18/g18 36-pin Connector Comparison *(Continued)*

Pin #	c18 Signal Name*	g18 Signal Name	c18 Signal Description
23	OPT1	DSC DOWNLINK	Serial 0Ω resistor to disconnect the pin from the g18 customer product.
24	OPT2	DSC UPLINK	Serial 0Ω resistor to disconnect the pin from the g18 customer product.
25	AGND	Analog Audio GND	Analog audio GND.
26	GND	GND	Power Ground.
27	GND	GND	Power Ground.
28	GND	GND	Power Ground.
29	GND	GND	Power Ground.
30	VCC	VCC (3.0-6.0 V)	4.0V DC nominal (3.6-4.5 V).
31	VCC	VCC (3.0-6.0 V)	4.0V DC nominal (3.6-4.5 V).
32	VCC	VCC (3.0-6.0 V)	4.0V DC nominal (3.6-4.5 V).
33	VCC	VCC (3.0-6.0 V)	4.0V DC nominal (3.6-4.5 V).
34	GPS_ANT_PWR	GPS Antenna PWR (3/5 V)	External power for active GPS antenna.
35	GPIO5	RX for differential GPS RTCM	MSM5100 GPIO_INT30.
36	GPIO9	GPS 1PPS	MSM5100 GPIO_INT26.

* UART names are referenced to PC, as the c18 is a DCE device.

B.4 c18/g20 70-PIN CONNECTOR COMPARISON

Table 22. c18/g20 70-pin Connector Comparison

Pin #	c18 Signal Name	g20 Signal Name	Remarks
1	GND	GND	
2	GND	GND	
3	GND	GND	
4	GND	GND	
5	VCC	VCC	
6	VCC	VCC	
7	VCC	VCC	
8	VCC	VCC	
9	UART1_RTS	RTS_N	
10	USB_VBUS	USB_DET	USB_DET is actually USB_VBUS on g20 models with an integrated transceiver.
11	UART1_RXD	RXD_N	
12	USB_D+	N.C.	N.C. is actually USB_D+ on g20 models with an integrated transceiver.
13	UART1_DSR	DSR_N	
14	USB_D-	N.C.	N.C. is actually USB_D- on g20 models with an integrated transceiver.
15	UART1_CTS	CTS_N	
16	WAKE_IN_N	WAKEUP_IN_N	
17	UART1_DCD	DCD_N	
18	PCM_DIN_GPIO1	PCM_DIN	
19	UART1_DTR	DTR_N	
20	PCM_DOUT_GPIO2	PCM_DOUT	
21	UART1_TXD	TXD_N	
22	PCM_CLK_GPIO3	PCM_CLK	

Table 22. c18/g20 70-pin Connector Comparison *(Continued)*

Pin #	c18 Signal Name	g20 Signal Name	Remarks
23	UART1_RI	RI_N	
24	PCM_FS_GPIO4	PCM_FS	
25	RESOUT_N	RESET_N	
26	WAKE_OUT_N	WAKEUP_OUT_N	
27	BL_SINK	BL_SINK	Different current sink capability.
28	KEYSENSE0_N	KBC1_N	Keypad signals-compatible, but character map tables are different.
29	GPIO5	CHRG_DIS	
30	KEYSENSE1_N	KBC0_N	Keypad signals-compatible, but character map tables are different.
31	UART2_RTS	CHRG_SW	
32	KEYSENSE2_N	KBR0_N	Keypad signals-compatible, but character map tables are different.
33	UART2_TXD	CHRG_STATE	
34	KEYSENSE_INT0_N	KBR1_N	Keypad signals-compatible, but character map tables are different.
35	GPS_ANT_PWR	CHRG_DET_N	
36	KEYSENSE_INT1_N	KBR2_N	Keypad signals – compatible, but character map tables are different
37	ENT_MUTE_GPIO6	ENT_MUTE	
38	KEYSENSE_INT2_N	KBR3_N	Keypad signals-compatible, but character map tables are different.
39	GPIO7	TX_EN_N	
40	KEYSENSE_INT3_N	KBR4_N	Keypad signals-compatible, but character map tables are different.
41	FOOTSWITCH_GPIO8	ANT_DET	
42	KEYSENSE_INT4_N	KBR5_N	Keypad signals-compatible, but character map tables are different.
43	VIBRATOR	VIB_OUT	

Table 22. c18/g20 70-pin Connector Comparison *(Continued)*

Pin #	c18 Signal Name	g20 Signal Name	Remarks
44	UIM_RESET	SIM_RST_N	
45	ADC1	CHRG_TYP	
46	UART2_CTS_UIM_CLK	SIM_CLK	
47	ADC2	THERM	
48	UIM_PWR_PH	SIM_VCC	c18 (3 V only); g20 (3 V/1.8 V).
49	LCD_EL_EN	GPRS_DET_N	
50	UIM_CR_DET	SIM_PD	
51	IGNITION	IGN	
52	UART2_RXD_UIM_DATA	SIM_DIO	
53	AUDIO_OUT_ONOFF	ON_OFF_N	In c18, this line serves as auxiliary audio out too.
54	LCD_CS_N	LCD_CS	
55	HEADSET_INT_N	HDST_INT_N	
56	LCD_DATA	LCD_DATA	
57	HEADSET_MIC	HDST_MIC	
58	LCD_CLK	LCD_CLK	
59	AGND	MIC_GND	
60	LCD_RS	LCD_RS	
61	MIC_IN+	MIC	
62	OPT1	SPI_IRQ_N	
63	MIC_IN-	ALRT_N	
64	OPT2	SPI_DIN	
65	HEADSET_SP	ALRT_P	
66	GPIO9	SPI_CLK	
67	EARPIECE-	SPKR_N	

Table 22. c18/g20 70-pin Connector Comparison *(Continued)*

Pin #	c18 Signal Name	g20 Signal Name	Remarks
68	AUDIO_IN	SPI_DOUT	
69	EARPIECE+	SPKR_P	
70	KEYB_DRV	SPI_CS	

B.5 c18, g18 AND g20 PINOUT LOCATIONS

Figure 32 and Figure 33 show the top and bottom view of the c18 module, respectively, with their pin locations.

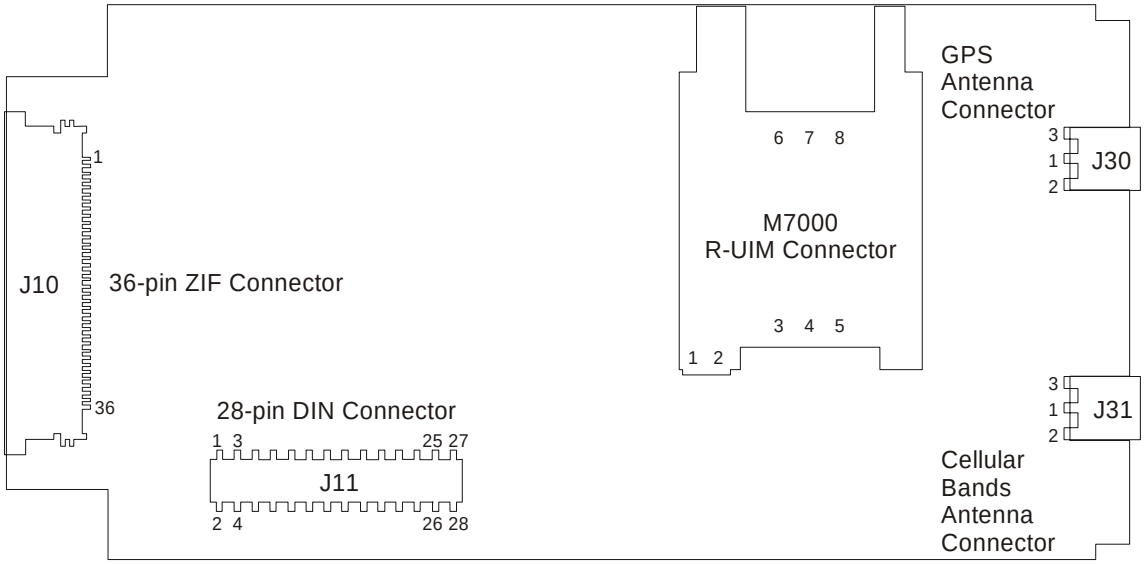


Figure 32. c18 Connector Pin Location – Top View

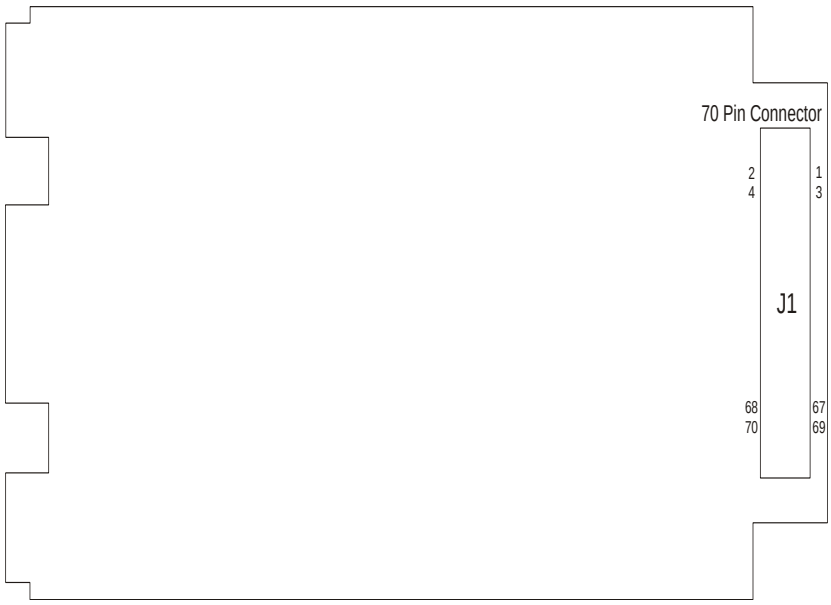


Figure 33. c18 Connector Pin Location – Bottom View

Figure 34 shows the top view of the g18 connector and its pin locations.

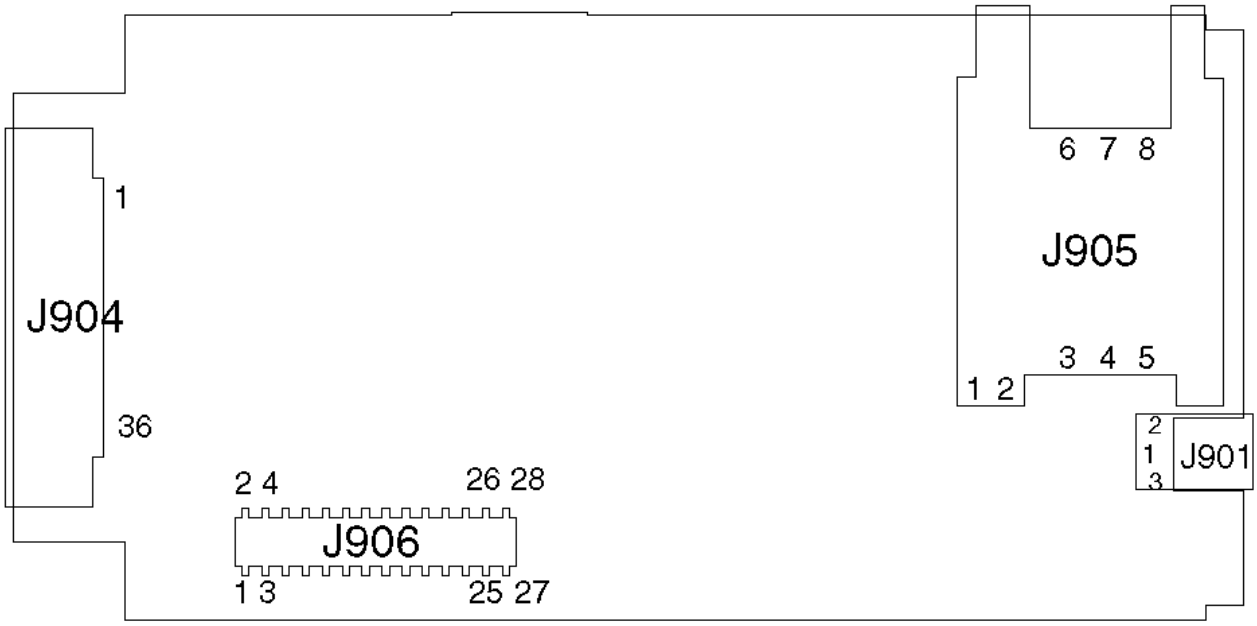


Figure 34. g18 Connector Pin Locations – Top View

Figure 35 shows the top view of the g20 connector and its pin locations.

Figure 35. g20 Connector Pin Locations – Bottom View

HARDWARE REQUIREMENTS FOR CDG2 AND FIELD TESTING

C.1 OVERVIEW

In order to obtain infrastructure approval, equipment containing c18 modules must pass CDG2 testing. The following capabilities must exist to accommodate such testing:

- Capability of sending logs over a second communication channel while the first communication channel is set for AT commands. For this purpose, the c18 supports USB+RS232 mode simultaneously (for supported modes of communication, see “c18 OPERATING MODES” on page 17).
- Integrators must supply the access points and have the ability to support these channels. This includes test points, test connectors and the signals for configuring the c18 in USB+RS232 mode.

C.2 c18 MODELS WITH 36-PIN OR 70-PIN INTERFACE CONNECTORS

In c18 models with 70-pin or 36-pin interface connectors, all pins are available on the interface connector. Integrators should prepare test points or test connectors for the following pins:

For Mode Configuration:

- AUDIO_IN: Must be pulled down with 10kΩ to configure the c18 in USB+RS232 mode.
- OPT1: Must be left open for USB+RS232 mode.
- USB_VBUS: Voltage (> 4 V) from the USB port must be present for configuring USB+RS232 mode.

Note

If the c18 model is hardware configured for RS232 mode, you will have to remove R6203 (10K pull-down resistor). For R6203 location, refer to Figure 36.

To determine whether your specific c18 model is hardware cofigured for RS232 mode, please contact your local sales representative.

For Communication With The Logger:

Customers whose primary application communicates with the c18 via USB should use the following pins for communicating with the logger:

- USB_D+
- USB_D-

Customers whose primary application communicates with the c18 via UART1 should use the following pins for communicating with the logger:

- UART1_TXD
- UART1_RXD
- UART1_CTS
- UART1_RTS

C.3 c18 MODELS WITH A 28-PIN INTERFACE CONNECTOR

c18 models that have a 28-pin interface connector, may be supplied in two configurations:

- With hardware preset for RS232 communication mode
- Without hardware preset for RS232 communication mode

The second configuration enables communicating via USB.

Integrators should prepare test connectors or test points for the following pins:

For Configuration:

- AUDIO_IN: Must be pulled down with 10kΩ to configure the c18 in USB+RS232 mode.
- USB_VBUS: Voltage (> 4 V) from the USB port must be present for configuring USB+RS232 mode (for configuration and communication).
- OPT1: A 10kΩ pull-down resistor (R6203) on the c18 must be removed when using USB+RS232 mode. The location of the R6203 resistor is shown in Figure 36. R6203 is not installed on c18 models that are not hardware configured for RS232 mode.

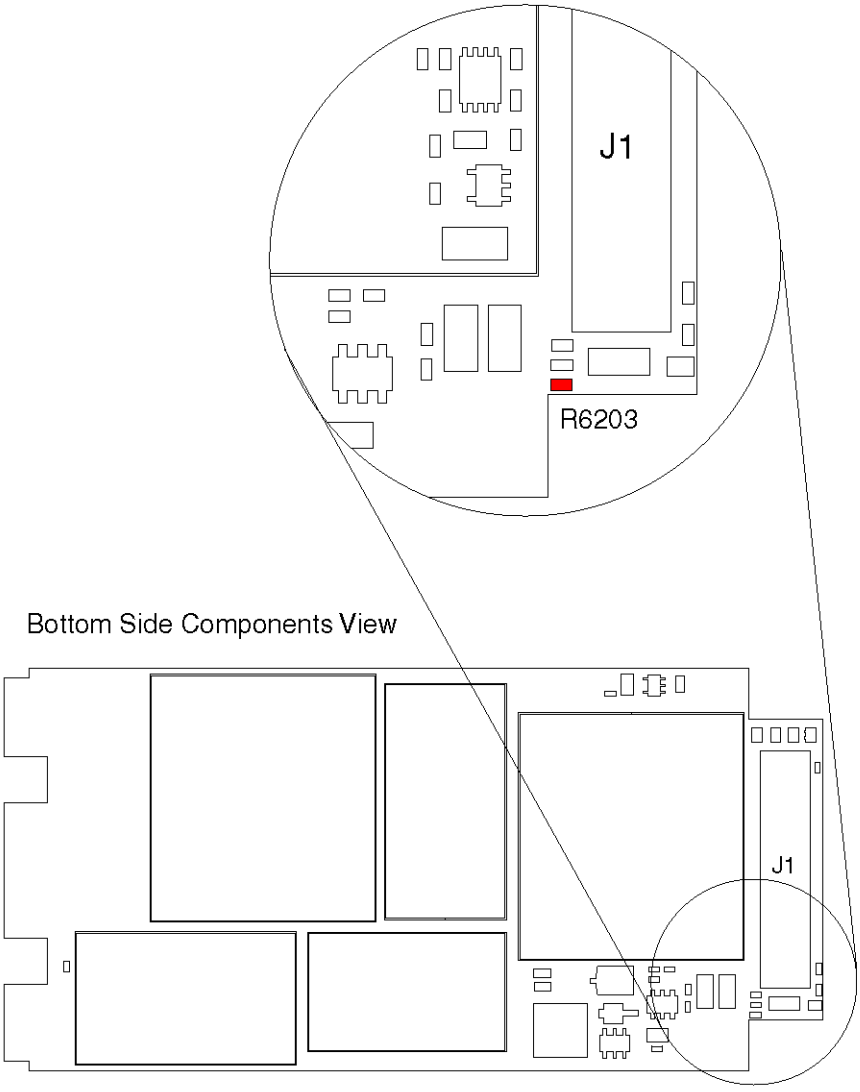


Figure 36. Location of the R6203 Resistor on the c18

Note

R6203 must be put back in place if RS232 mode is to be used when using RS232 28-pin connector.

For Communication With The Logger:

- USB_D+
- USB_D-

The suggested configuration is shown in Figure 37.

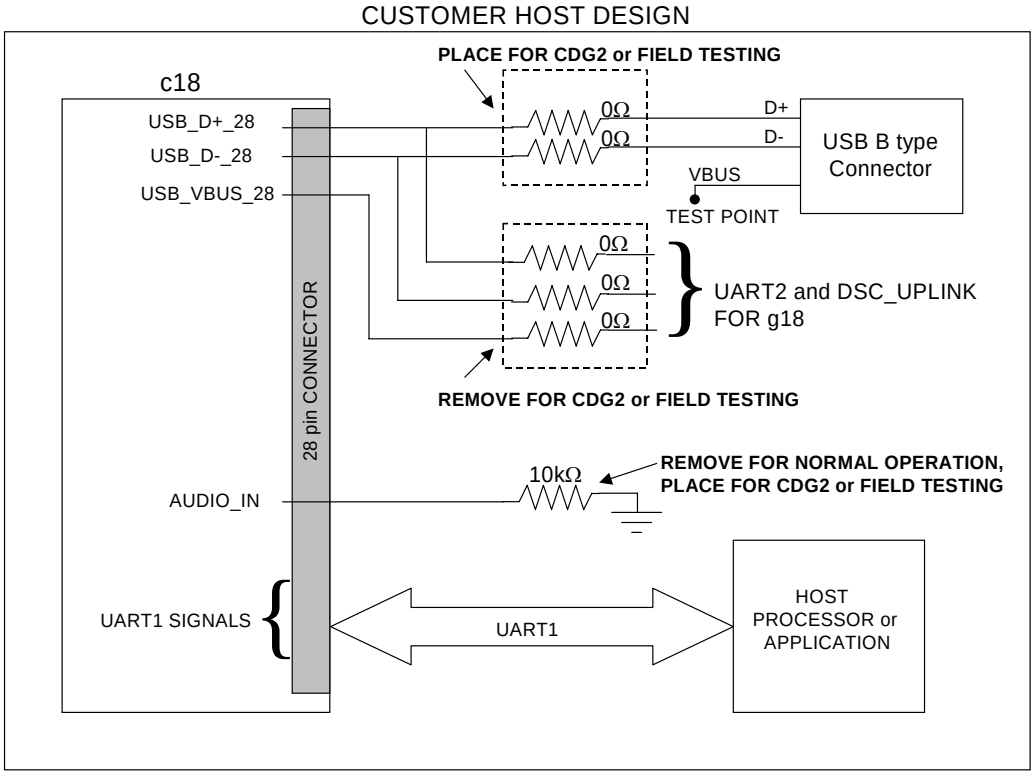


Figure 37. Suggested Configuration for CDG2 Testing

In order to use the setup described above for CDG2 testing, the customer must perform the following modification on the c18 module:

- Solder two 0402 size 0Ω chip resistors (R6801 and R6802) on the c18, at the places shown in Figure 38 below.
- Solder a wire from the USB_VBUS PAD (J10, pin #1) to the VBUS test point shown in Figure 37.

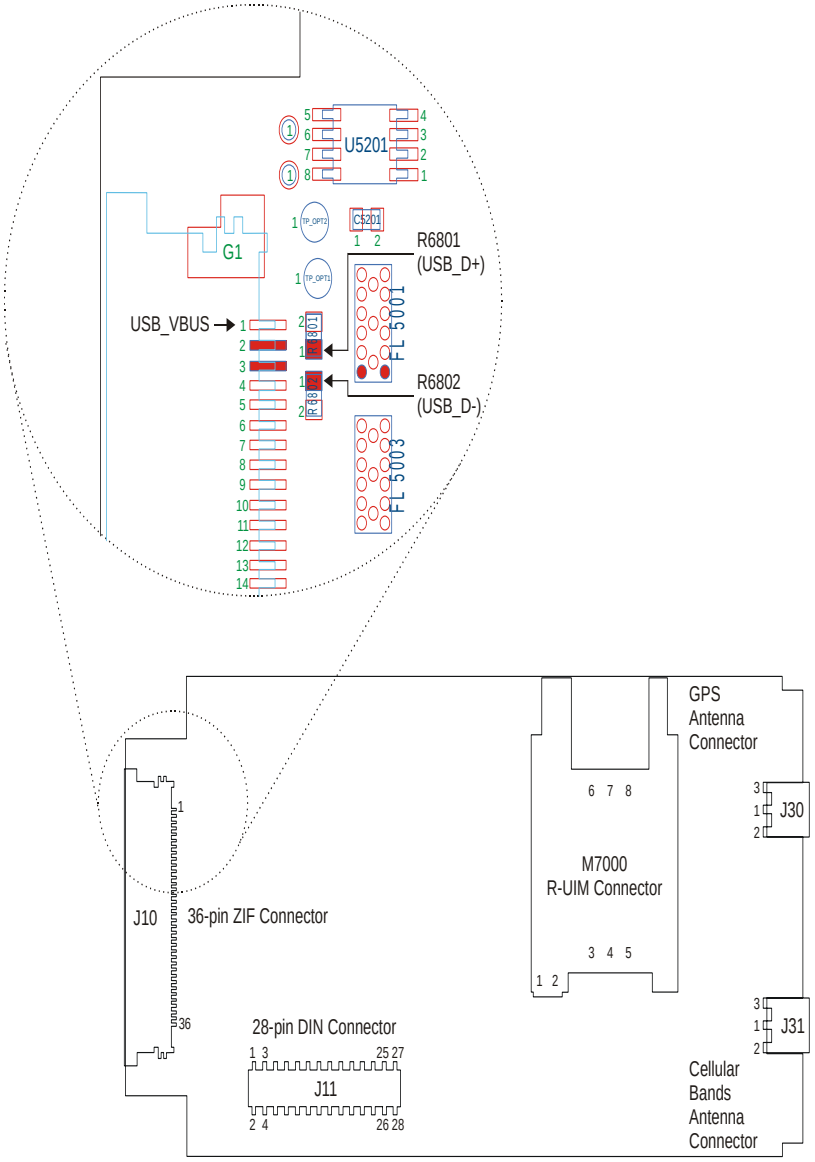


Figure 38. Solder Location for Chip Resistors

Customer applications that have already been completed, which had not implemented the above preparations, will need to access relevant signals on their host boards (such as AUDIO_IN, which is available for the 28-pin connector), or directly on the c18 (using the USB_D+, USB D- and USB_VBUS pins). The location of relevant access points on the c18 is shown in Figure 39.

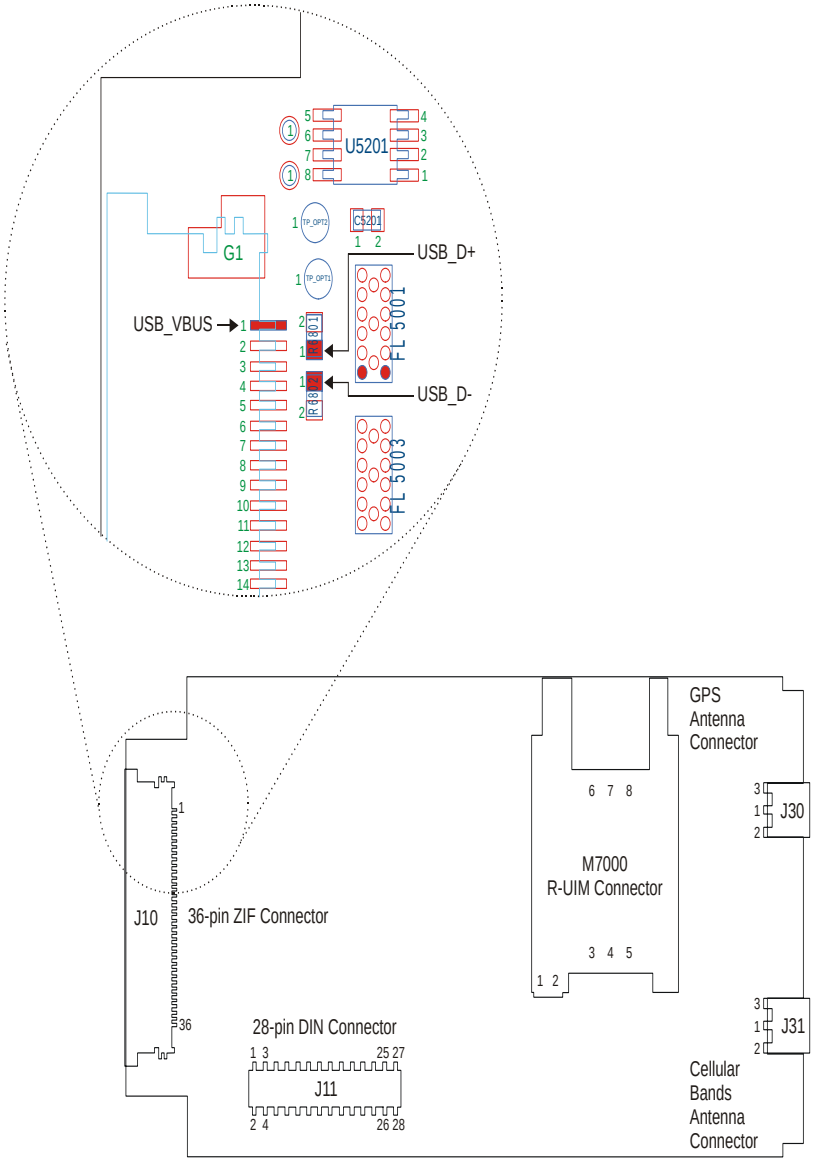


Figure 39. Location of Access Points on the c18

USB_VBUS should be accessed at the pin #1 pad of the 36-pin connector. USB_D+ and USB_D- should be accessed at the pads of the resistors marked in red.

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