

LTE910CF CAT3 Embedded Cellular Modem User Manual



JANUS REMOTE
COMMUNICATIONS

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1 APPLICABILITY TABLE

Product	Part Number
LTE910CF	v1.00
LTE910CF	v3.00

2 REFERENCES

2.1 Telit Document List

LTE910CF

Our modem uses Telit module LE910.

Please refer to Telit's website at www.telit.com for the latest information on the LE910 Module.

Telit_LE910_AT_Commands_Reference_Guide

Telit_LE910_Hardware_User_Guide

3 OVERVIEW

3.1 Introduction

The User Manual for the Plug-In Modem devices is intended to illustrate how users can integrate and implement the features of each communication version of the device. The common factors are explained in detail, as well as special considerations and diagrams for each module. The module differences are highlighted in this manual for design considerations for future model placement.

3.2 Preview

The Plug-In Modems are self-contained, multi-band, globally capable, M2M communication devices designed to provide a comprehensive solution to application problems for our M2M customers. They utilize the proven technology of Telit's certified modules for their core communications engines.

3.2.1 Functional Description

GPS Functionality

- An internal GPS solution is available via Telit AT command interface

Cellular

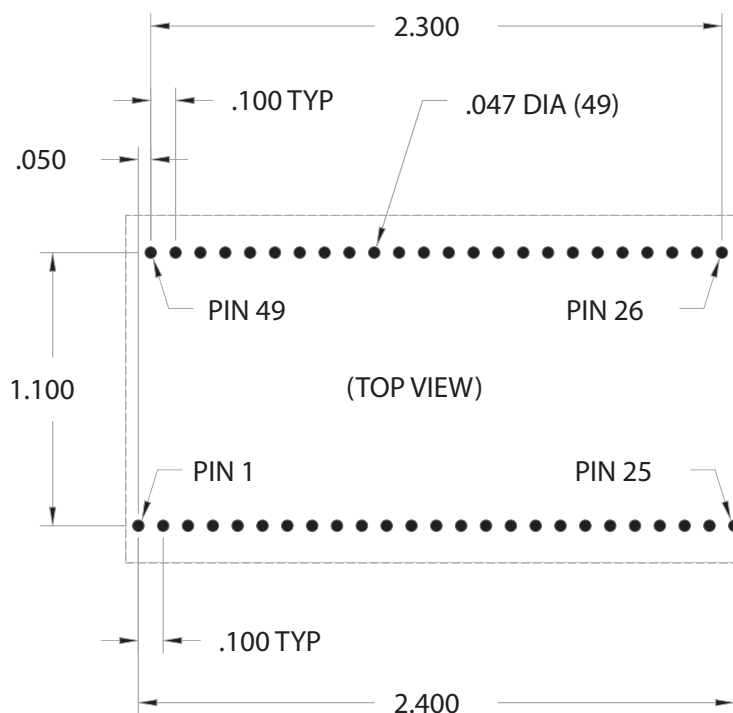
- LTE/HSPA/UMTS/EDGE/GPRS/GSM

USB

- HS/FS USB 2.0 Device (480Mb/s)

Physical Dimensions

- Length and width of all Plug-In devices are equal
- Heights of different devices will vary



3 OVERVIEW continued

3.3 Features

LTE910CF v1.00 (AT&T)

- Quad-Band Support
 - LTE Band 700 (B17), 850 (B5), AWS1700 (B4), 1900 (B2)
 - UMTS/HSPA+ Band 850 (B5), 1900 (B2)
 - GSM/GPRS/EDGE Band 850/1900
- Output Power
 - Class 4 (2W, 33dBm) @ GSM 850/900
 - Class 1 (1W, 30dBm) @ GSM 1800/1900
 - Class E2 (0.5W, 27dBm) @ EDGE 850/900
 - Class E2 (0.4W, 26dBm) @ EDGE 1800/1900
 - Class 3 (0.25W, 24dBm) @ UMTS
 - Class 3 (0.2W, 23dBm) @ LTE
- Data
 - UMTS: DL: Up to 384Kbps, UL: Up to 384Kbps
 - HSPA: DL: Up to 42Mbps, UL: Up to 5.76 Mbps
 - LTE: DL: Up to 100Mbps, UL: Up to 50Mbps

LTE910CF v3.00 (Verizon)

- Dual-Band Support
 - LTE Band 1700 (B4), 700 (B13)
- Output Power
 - Class 3 (0.2W, 23dBm) @ LTE
- Data
 - LTE: DL: Up to 100Mbps, UL: Up to 50Mbps

Features for Both v1.00 & v3.00

- Control via standard and extended AT command set
- SIM application Tool Kits 3GPP TS 51.014
- SIM access profile
- IP stack with TCP/UDP protocol support
- SMS Support
- Through hole for screw mount
- Dimensions: 2.5" x 1.4" x 0.325"
- Operational Temperature Range: -40°C to 85°C
- Internal Switching Regulator:
 - Input Voltage Range: 4.75 to 5.25Vdc (5Vdc nominal)
 - Supply disable via terminal input pin
- Variable logic level (UART/GPIO)
 - Adjustable from 1.8 - 5.0Vdc
 - Defaults to 2.85v
- SIM Card
 - Standard locking SIM card socket
- Cellular, Rx Diversity & MIMO DL 2x2, and GPS/GLONASS via Hirose U.FL miniature RF connector

3.4 Block Diagram

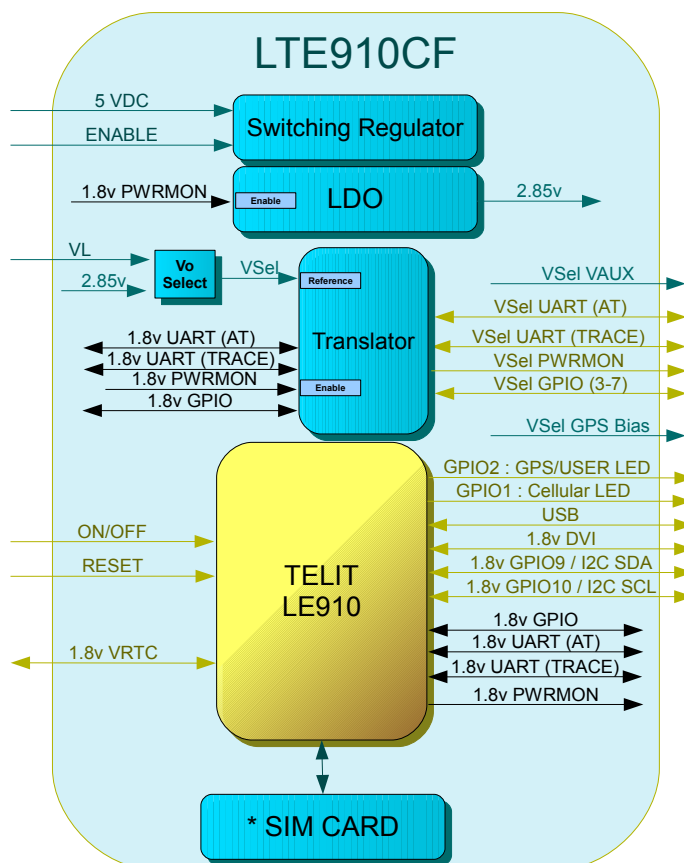


Figure 1 LTE910CF Block Diagram

4 INTERFACES

4.1 Interface Voltage Selection

The LTE910CF is equipped with a variable voltage interface solution. This allows the user to match the device to the system's level without extra hardware. Once a voltage has been injected, the unit will swap to the chosen voltage immediately for the affected I/O.

This is controlled via the VL IN signal, in which a user may inject a chosen interface voltage to utilize. This swap is done via a break-before-make mechanism when changing to or from the default voltage level, allowing for on the fly voltage changes if necessary.

The VL IN signal contains a 7M Ohm pull down resistor, and the operation of the voltage selection can be referenced as follows:

Truth Table:

VL IN	Floating	Ground	1.5v - 5.5v
VSelect	2.85v	2.85v	1.5v - 5.5v

Affected I/O:

1. UART (AT, TRACE)
2. GPIO (3-7)
3. VAUX
4. GPS Bias Voltage

VAUX Adjustment allows feedback as well as legacy access if previously utilizing a plug in implementation with VAUX as the reference. GPS Bias Voltage adjustment allows migration to a voltage that specific antennas may require that is higher than the default 2.85v.

Note to pay attention of these changes so there are no adverse effects on a previous Plug in Modem implementation.

4 INTERFACES

4.2 Serial Interface

4.2.1 UART Serial Port

The serial interface is a CMOS level UART. Default Communications settings for this port are as follows:

- Baud Rate: 115.2 kbps
- Bits: 8
- Stop Bits: 1
- Parity: None
- Hardware Handshaking: Yes

The LTE910CF does not support autobaud, and must be changed via the AT+IPR command. It is defaulted to 115200 bps

Note: If you are not using Hardware Handshaking, please note that RTS must be connected to GROUND for proper communications where flow control is unused.

4.2.1.1 UART Level Translation

The electrical limits for the UART are listed in the electrical characteristics section. Please be aware of these limits, as operating outside of them may damage the unit. If the limits must be exceeded, level translation can be used.

An example of basic translation for RXD/TXD only is found below.

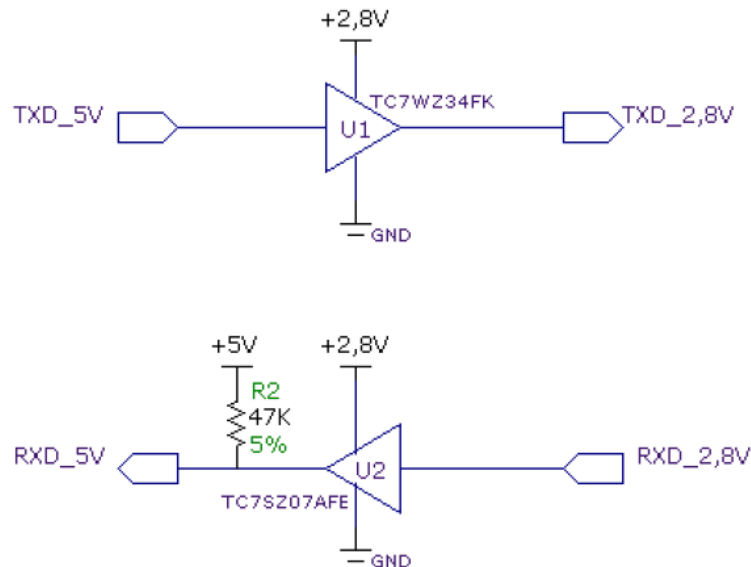


Figure 2 UART Level Translation Example

Although an external source for the level translation can be used, VAUX can be used as the reference instead. However, because some Plug-In Modems require AT commands to control VAUX, PWRMON may be used as an enable to an external reference. Do not use PWRMON directly as the reference.

Note that the UART Level Translation example remains in this guide for legacy purposes when designing a system for multiple Plug in Modems. The LTE910CF is equipped with interface voltage adjustment, negating the need for translation.

4.2.2 USB Port

The Plug-In modems that are USB ready include an integrated universal serial bus (USB) transceiver, compliant with USB 2.0 specifications. High data rates for the USB enabled modems are only available over the USB interface, as the UART has a maximum baud rate of <1Mbps. In order for proper power-up of the Plug-In Modems, the USB_VBUS line MUST be disconnected until the unit is otherwise fully powered and on. If the USB_VBUS line is attached and powered before the main power is brought up and the module turned on, power sequencing issues may occur.

Note: You must implement the USB interface in order to locally update radio firmware for CDMA/EV-DO applications.

4 Interfaces continued

4.2.2 USB Port continued

4.2.2.1 USB Connection Diagram

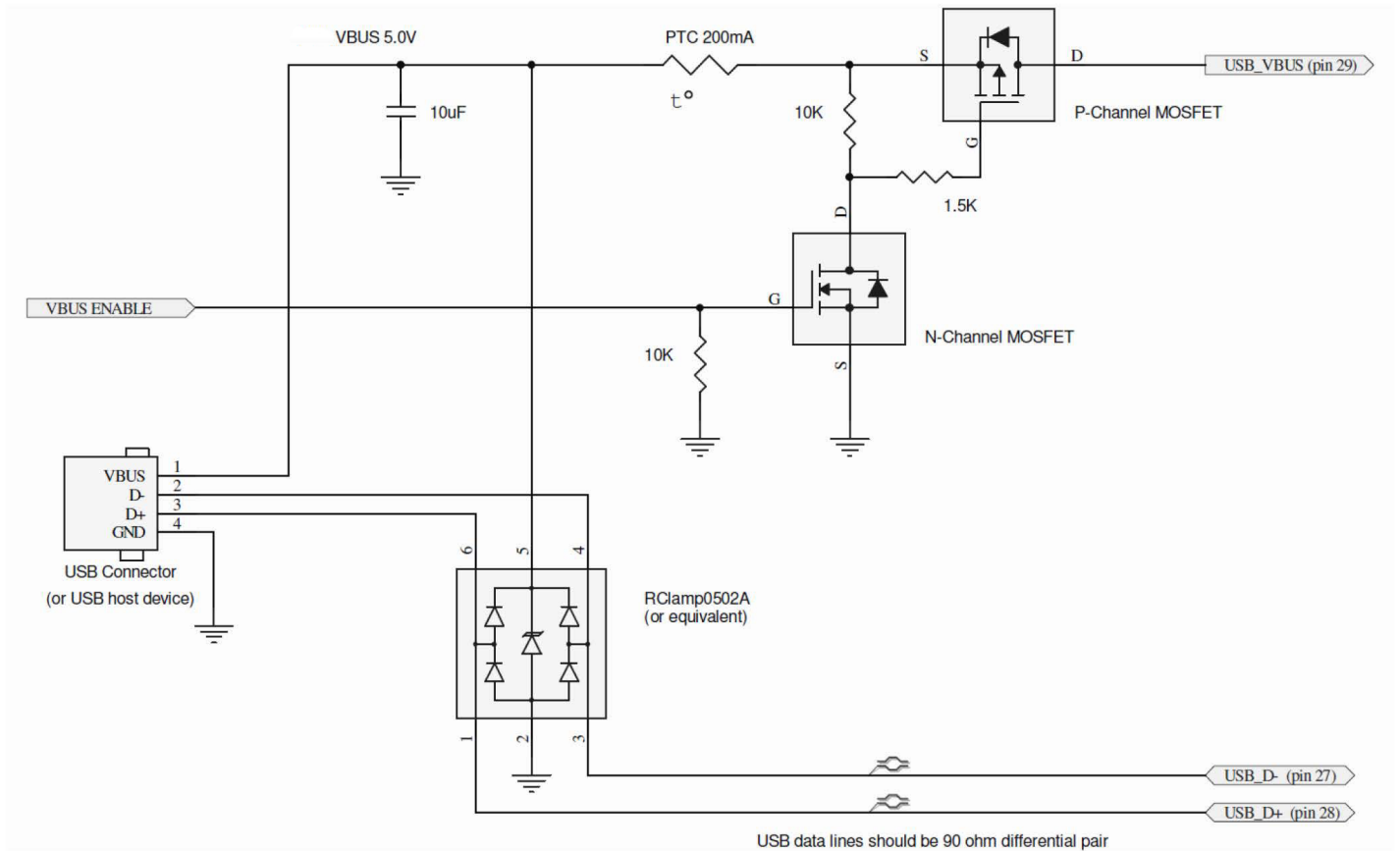


Figure 3 USB Connection Diagram

4 Interfaces continued

4.3 Power Supply

The module's power supply accepts input voltages from 4.75Vdc to 5.25Vdc and requires a nominal current sourcing capacity of 5W (maximum 10W).

Power Supply

A good understanding of the load transients is required in order to meet the power requirements of a cellular radio. Power supply design, thermal management and layout are outside the scope of this document. Please refer to power supply manufacturers for product documentation and design application notes.

Cellular Load Transients

Cellular radios use a mix of modulation schemes including, but not limited to, TDMA and CDMA. In GSM/GPRS systems the transmission and reception of data is achieved via Time Division Multiple Access (TDMA). TDMA transmission is made up of RF bursts that cause 2A current pulses at the supply input of the cellular radio. These current pulses occur at a frequency of 216 Hz and can persist for 1.2 to 2.4ms.

On Board Regulator

This Plug-In module is designed with a switching regulator to power the cellular radio. The regulator can receive an input voltage of 4.75 to 5.25VDC.

Note: The regulator input is capable of withstanding 6VDC Maximum. This is outside the recommended operating voltage of the Plug-In modules but but is helpful to know when designing input transient circuitry.

Plug-In Module Input Supply Requirements

The current values are given in average units due to the pulsed nature of the transmission scheme. It is recommended that your supply source the full peak current value of the transmission pulse in order to maintain proper cellular operation. The use of bulk output capacitors on your supply allows for a less powerful supply.

4.4 Audio Interface

4.4.1 LTE910CF

The 910CF modules use a DVI audio interface which will not work with the analog audio interface of the other Plug-In modems. The LTE910CF supports PCM master mode and can use a CODEC to convert the interface to analog. Below is a block diagram based on DVI and the max 9867 CODEC with GPIO 9 and 10 being used for I2C control of the CODEC.

Please refer to the referenced DVI Application Notes for full information and example schematics utilizing the MAX9867 Audio CODEC.

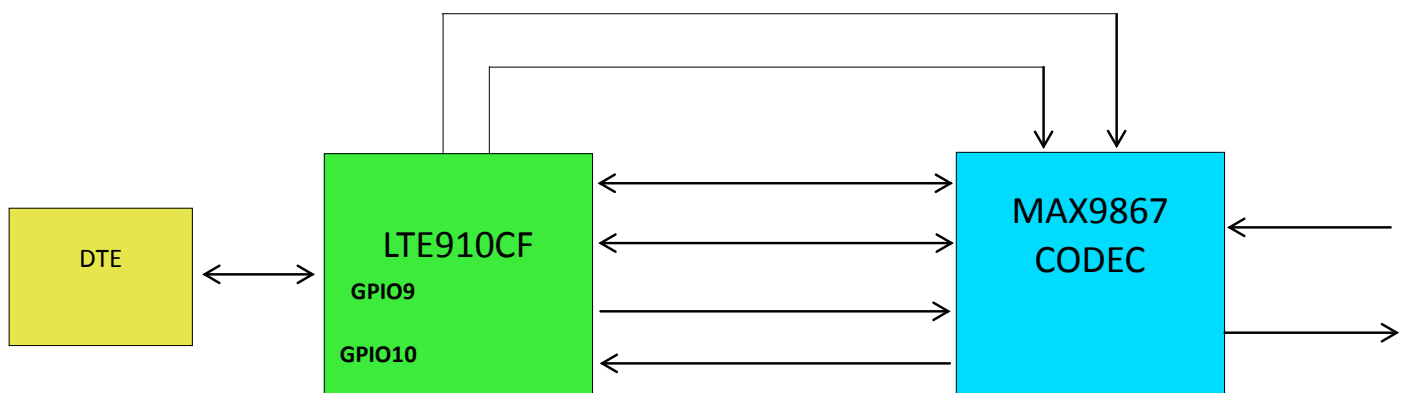


Figure 4 DVI Block Diagram

4 Interfaces continued

4.5 Plug-In Pin-Out

PIN	PIN NAME	DESCRIPTION	STANDARD I/O SIGNAL	POWER-ON STATE	PULL TYPE	NOTE
1	SUPPLY	Positive Supply Input	Power	N/A	N/A	
2	SUPPLY	Positive Supply Input	Power	N/A	N/A	
3	ENABLE SUPPLY	Enable/Disable Supply	Input	N/A	PULL-UP to Vin: 681k	1
4	RXD	UART - Transmit Line	Output	N/A	N/A	6
5	DSR	UART - Data Set Ready	Output	N/A	N/A	6
6	CTS	UART - Clear to Send	Output	N/A	N/A	6
7	RING	UART - Ring Indicator	Output	N/A	N/A	6
8	DCD	UART - Data Carrier Detect	Output	N/A	N/A	6
9	TXD	UART - Receive Line	Input	N/A	N/A	6
10	DTR	UART - Data Terminal Ready	Input	N/A	N/A	6
11	RTS	UART - Request to Send	Input	N/A	N/A	4
12	GROUND	Supply Reference	Power	N/A	N/A	
13	TRACE_TX	Debug UART - Transmit Line	Output	N/A	N/A	6
14	TRACE_RX	Debug UART - Receive Line	Input	N/A	N/A	6
15	USER LED	USER LED	Output	N/A	N/A	6
16	CELLULAR LED	Cellular Status	Output	N/A	N/A	6
17	SERVICE	Unused	N/A	N/A	N/A	5
18	PWRMON	Power Monitor Output	Output	N/A	PULL-DOWN:1M	6
19	ON_OFF	Toggle Cellular Radio On Off State	Input	N/A	PULL-UP to VTRC: 47k	1
20	RESET	Reset Cellular Radio	Input	N/A	PULL-UP: 47k	1
21	DVI_WAO	DVI Word Alignment	WCLK	N/A	N/A	6
22	DVI_RX	DVI Received Data	SDIN	N/A	N/A	6
23	DVI_TX	DVI Transmitted Data	SDOUT	N/A	N/A	6
24	DVI_CLK	NDVI Data Clock	BCLK	N/A	N/A	6
25	GROUND	Supply Reference	Power	N/A	N/A	
26	GROUND	Supply Reference	Power	N/A	N/A	
27	USB_D-	USB Differential Data (-)	CMOS Bi-Direction	N/A	N/A	
28	USB_D+	USB Differential Data (+)	CMOS Bi-Direction	N/A	N/A	
29	USB_VBUS	USB Supply	Power	N/A	N/A	
30	VL_IN	Interface Voltage Reference	Analog Input	N/A	PULL-DOWN: 7M	3
31	I2C_SDA	I2C Data	CMOS Bi-Direction	INPUT	N/A	
32	I2C_SCL	I2C Clock	CMOS Bi-Direction	INPUT	N/A	
33	GPS_RX	Unused	N/A	N/A	N/A	5
34	GPS_TX	Unused	N/A	N/A	N/A	5
35	GPS_RESET	Unused	N/A	N/A	N/A	5
36	GPIO_7	General Purpose I/O	Bi-Direction	INPUT	N/A	6
37	GPIO_6	General Purpose I/O	Bi-Direction	INPUT	N/A	6
38	GPIO_5	General Purpose I/O	Bi-Direction	INPUT	N/A	6
39	GROUND	Supply Reference	Power	N/A	N/A	
40	GPIO_4	General Purpose I/O	Bi-Direction	INPUT	N/A	6
41	GPIO_3	General Purpose I/O	Bi-Direction	INPUT	N/A	6
42	GPIO_2	Unused	N/A	N/A	N/A	5
43	GPIO_1	Unused	N/A	N/A	N/A	5
44	DAC	Unused	N/A	N/A	N/A	5
45	ADC2	Unused	N/A	N/A	N/A	5
46	ADC1	Analog to Digital Converter	Analog Input	N/A	N/A	6
47	VRTC	Cellular Radio External RTC Supply	Power	N/A	N/A	
48	VAUX	Reference Voltage	Analog Output	N/A	N/A	
49	GROUND	Supply Reference	Power	N/A	N/A	

Notes:

1. It is required that this input be controlled by an Open Collector/Drain Output. Do not use an external pull-up resistor; a pull-up is included internal to the module.
2. Not currently implemented
3. VL Input may be floating or grounded if not being used.
4. RTS must be connected to GROUND if flow control is not used.
5. Not used on the LTE910CF
6. Refer to the electrical specifications for I/O levels

4 Interfaces continued

4.6 VRTC Details

The VRTC pin brings out the real time clock supply, which is separate from the rest of the part. This allows only the RTC to be ON when all other parts of the device are OFF. A backup capacitor can be added to this pin to increase RTC autonomy while powering the device from a battery. The CDMA910CF cannot take advantage of the VRTC functionality.

No devices should be powered from this pin.

Equations:

$$C = 3600 * [(Btime * IRTC)/(VRTC - VRTCmin)]$$

$$Btime = [C * (VRTC - VRTCmin)/(IRTC * 3600)]$$

Where:

VRTC – The Starting voltage of the capacitor (Volt)

VRTCmin – The minimum voltage acceptable for the RTC circuit. (Volt)

IRTC (Ampere) – The current consumption of the RTC circuitry when VBATT = 0

Btime - Backup Time (Hours)

C = Capacitor value (Farads)

Values for the GSM865CF/CDMA864CF/UMTS864CF

VRTC = 2.05v Nominal

VRTC minimum input voltage to function = 1.1v

IRTC = 10uA nominal

Values for the LTE910CF

VRTC = 1.8v Nominal

VRTC minimum input voltage to function = 1.1v

IRTC = 2uA nominal

Values for the EVDO910CF

VRTC = 3.1v Nominal

VRTC minimum input voltage to function = 2.0v

IRTC = 1.1uA nominal

Values for the CDMA910CF

VRTC = N/A

VRTC minimum input voltage to function = N/A

IRTC = N/A

For Example, using the LTE910CF numbers:

Btime = 96 hours (4 days)

C = 1.0F

4 Interfaces continued

4.7 GPIO Details

GPIO are configurable as input, output, and alternate function. Configuration is controlled by AT commands. Alternate functions include cellular status, ALARM pin function, temperature monitor indication and wakeup indication.

4.7.1 Using a GPIO Pad as INPUT

The GPIO pads, when used as inputs, can be connected to a digital output of another device and report its status, provided this device has interface levels compatible with the Voltage levels of the GPIO of the module.

4.7.2 Using a GPIO Pad as OUTPUT

The GPIO pads, when used as outputs, can drive CMOS digital devices or compatible hardware. When set as outputs, the pads have a push-pull output.

4.7.3 Analog to Digital Converter

ADC	Description
1	Analog to digital converter input

4.7.4 I2C

The I2C interface is an alternate function of the modem's GPIO, for the LTE910CF, those two signals are designated for GPIO 9 (SDA) and GPIO 10 (SCL) and are 1.8V logic level to match the DVI interface for easy usage with a codec. The signals are not pulled up on the Plug-In module and must be pulled up externally as they may also be used as spare GPIO.

Please reference the Telit AT Command Guide for details on the I2C commands.

4.7.5 ENABLE Pin

Input Logic State	Description
High-Z	Active state
0	Shutdown

Notes:

1. It is required that this input be controlled by an open collector/drain output. Do not use an external pull-up resistor, a pull-up to VIN is included internal to the Modem.
2. The ENABLE pin is offered as a means to turn off the on-board regulator for when a full power cycle is needed or an ultra low power state is required. The ENABLE pin is not intended to be used as a means of turning the Modem off. use the ON/OFF pin to turn the Modem on or off.
3. Shut down state must be held for 10ms before returning to active state.
4. The regulator is operational 2mS after active state is entered.

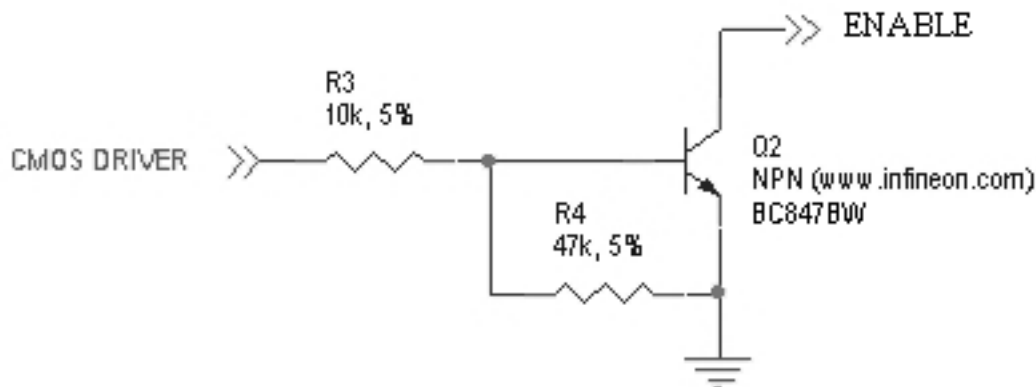


Figure 5 Enable Pin

4 Interfaces continued

4.7 GPIO Details continued

4.7.6 RESET Pin

Input Logic State	Description
High-Z	Active state
0	Reset state

Notes:

1. It is required that this input be controlled by an open collector/drain output. Do not use an external pull-up resistor, a pull-up is included internal to the Modem.
2. The RESET pin is offered as a means to reset the Modem when and if the Modem becomes unresponsive. The RESET pin is not intended to be used as a means of turning the Modem off. Use the ON/OFF pin to turn the Modem on or off.
3. RESET state must be held for at least 200ms before returning to active state.

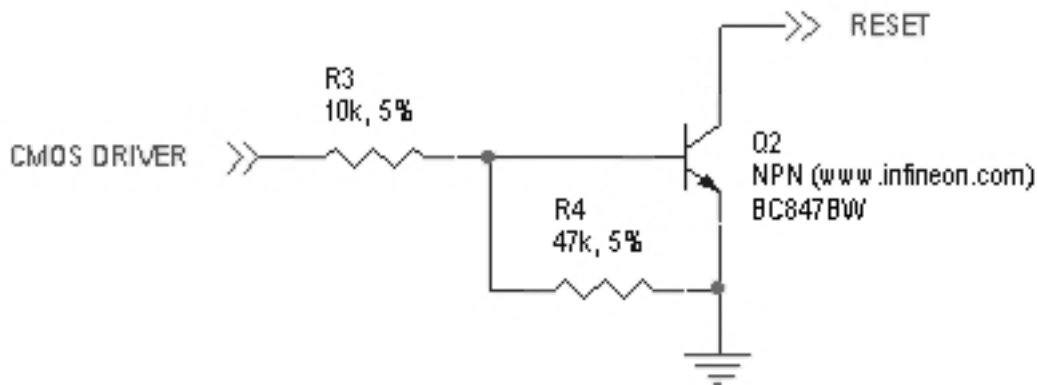


Figure 6 Reset Pin Diagram

4.7.7 ON/OFF Pin

Input Logic State	Description
High-Z	Modem turned ON or OFF after input returns to this state.
0	Toggle Modem ON or OFF

Notes:

1. It is required that this input be controlled by an open collector/drain output. Do not use an external pull-up resistor, a pull-up is included internal to the Modem.
2. The ON/OFF pin is offered as a means to power-on and power-down the Modem. When the Modem powers-down it informs the cell tower that it is powering down and will not be communicating with the tower any more. This is considered a controlled power-down.
3. After toggling the power state of the Modem, wait until PWRMON indicates chosen state before toggling the power state again.
4. To turn ON the plug-in module, the ON_OFF input must be tied low for 5 second then released.
5. To turn OFF the plug-in module, the ON_OFF input must be tied low for 2 seconds then released.
6. Optionally the Modem may be powered-down with the use of AT commands.
7. It is required to stop driving terminal inputs high when turning ON the Plug-In module by floating or bringing them low. If this is not done, power sequencing issues may occur.

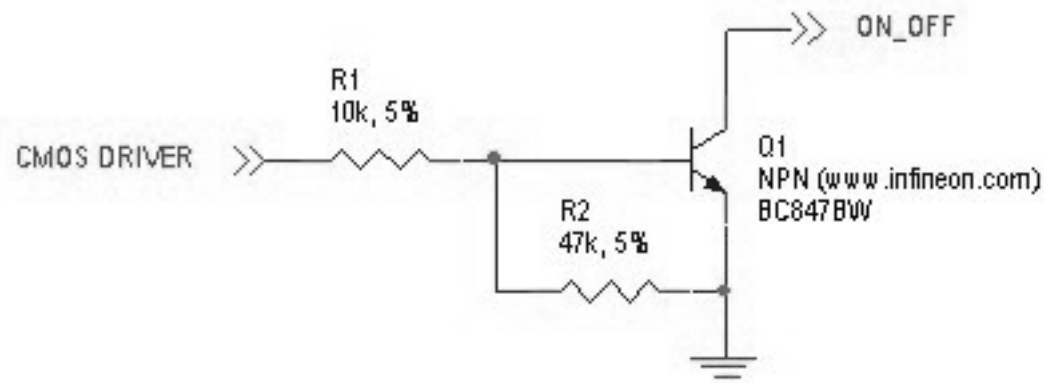


Figure 7 On / Off Pin Diagram

4 Interfaces continued

4.7 GPIO Details continued

4.7.8 PWRMON Pin

Output Logic State	Description
0	Modem powered-down
1	Modem powered-on

Notes:

1. Used in conjunction with ON/OFF pin to control power-on and power-down state.
2. During a power down, it is required to stop driving terminal inputs high by floating or bringing them low. If this is not done, the PWRMON output will not transition low. On the GSM865CF and LTE910CF, this will cause the VAUX output to remain active.

4.7.9 VAUX

A regulator power supply output that is provided in order to supply small devices from the module itself.

When PWRMON is HIGH, VAUX will be ON. When PWRMON is LOW, VAUX will be OFF. On the LTE910CF, the VAUX signal voltage will match to the VL IN voltage if utilized.

4.8 User LED

The LTE910CF comes equipped with GPS functionality that is built into the cellular radios. However, the cellular radios have no GPS status output for driving an LED. Instead, this module has GPIO2 connected to the User LED pin of the Modem. The user application can use this to control an LED or act as an additional GPIO. See figure 10 for recommended connection of an LED.

4.9 LED Status Indicators

The LED Status output is used to drive an external LED to give feedback on the current operation. See figure 10 for recommended connection of an LED. For the LTE910CF, this is an alternate function of GPIO1 and must be set via the AT#GPIO command. The status is defined below.

4.9.1 Cellular LED Status (LTE910CF)

LED Status	Device Status
Permanently Off	Cellular radio is off
Permanently On	On/Searching
Slow Blinking (0.3 sec on / 2.7 sec off)	Registered
Fast Blinking (0.5 sec on / 0.5 sec off)	Shutting down

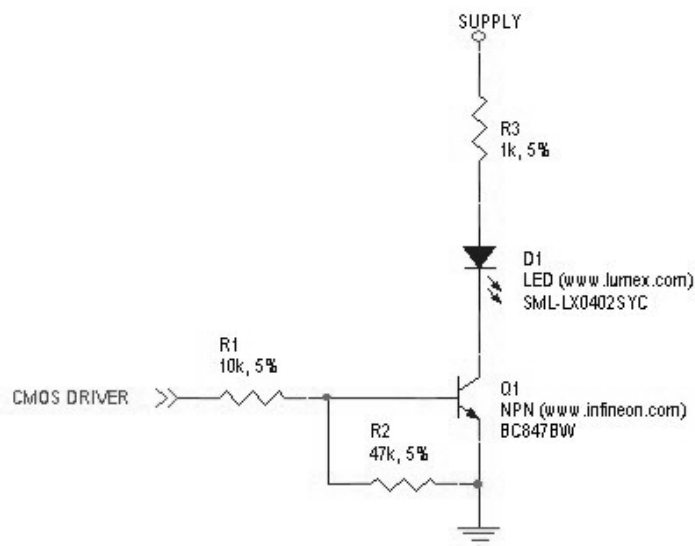


Figure 8 LED Indicators Diagram

4 Interfaces continued

4.10 RF Interface

There are three RF interfaces on the LTE910CF. A cellular, GPS, and MIMO/RX diversity connector. The specifications and requirements for these are as follows:

4.10.1 LTE910CF Antenna Interface

Type: Hirose U.FL - MALE (Part Number: U.FL-R-SMT(10))

Pin	Description
Center Pin	RF signal
Outer Conductor	Signal ground

4.11 SIM Card Interface

The SIM Card Interface allows the Modem to accept the subscriber card provided by the cellular telephone provider. It can accommodate a 1.8v or 3.0v SIM card.

4.12 Header Interface Mounting Options

The Plug-In Modules' header pin length has been chosen to allow for direct solder mount to a PCB of standard thickness. If the user wishes to socket the Plug-In Module, they may do so as well by using the below part numbers for reference:

Samtec 25 pin header: TSM-125-04-L-SV-A

Samtec 24 pin header: TSM-124-04-L-SV-A

Mating Samtec 25 pin connector: SLW-125-01-G-S

Mating Samtec 24 pin connector: SLW-124-01-G-S

Please note there are no Samtec SMT single row mating connectors. The only mating connector available is the above listed THT version.

4.13 Screw Mounting

The LTE910CF allows for the use of a #4 machine screw to help keep a socketed module in place where environmental variables may cause problems otherwise. If the user wishes to have a stand-off underneath the module to help alleviate possible stress from mounting hardware, below are the Janus part numbers and associated drawings for an available solution.

4-40 Hex Female Stand-off: MC-0356-G

4-40 3/16" Pan Head Phillips Machine Screw: MC-0357-G

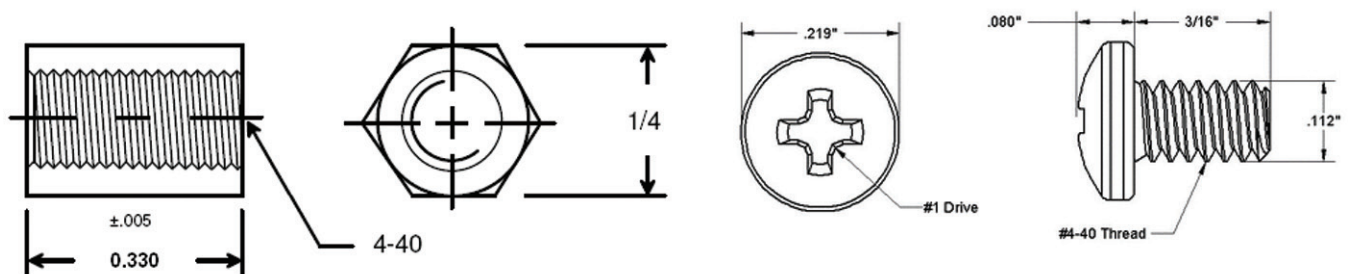


Figure 9 Screw Diagram

5 LTE910CF TECHNICAL SPECIFICATIONS

5.1 Electrical Specification

5.1.1 Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Note
VIN (DIGITAL INPUTS 2.85V CMOS)	-0.5	-	3.35	Volt	
VIN (DIGITAL INPUTS 1.8V CMOS)	-0.3	-	3.1	Volt	
VIN (Digital Inputs VL Selected)	-0.3	-	5.5	Volt	
Storage Temperature	-40	-	85	°C	
Supply (+) referenced to Supply (-)	0	-	6	Volt	

Operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions is not implied. Exposure to Absolute Maximum Rating conditions for extended periods of time may affect device reliability.

5.1.2 Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit	Note
Temperature	-40	-	85	°C	
Supply (+) referenced to Supply (-)	4.75	5.0	5.25	Volt	
VL IN Selection	1.8	-	5.0	Volt	
VAUX Output	-	2.85	-	Volt	1
VAUX Current	-	-	100	mA	1

Note: 1. When VL IN is utilized, VAUX will match VL.

5.1.3 Power Supply

Mode	Average (mA)	Mode Description
POWERED DOWN		
Terminal Disabled	≤ 15μA	Terminal disabled (ENABLE SUPPLY = 0)
Cellular Radio Off	0.4	Cellular module powered but switched off via ON_OFF pin (PWRMON=0)

Mode	Average (mA)	Mode Description
AT+CFUN=1		Idle, no call in progress. full functionality of the module.
WCDMA	16	
GSM	16	
LTE	16	
AT+CFUN=4	12	Disabled TX and RX; module is not registered on the network
AT+CFUN=5	1.5	CFUN=5 full functionality with power saving; Module registered on the network and can receive incoming calls and SMS

* except external active GPS antenna.

* Data taken with USB disconnected.

5 LTE910CF TECHNICAL SPECIFICATIONS continued

5.1 Electrical Specification continued

5.1.4 I/O Levels

5.1.4.1 1.8v Standard Interface Levels (DVI, I2C, USER LED)

Parameter	Min	Typ	Max	Unit	Note
Input Voltage High - Vih	1.5	-	1.9	Volt	
Input Voltage Low - Vil	0	-	0.35	Volt	
Output Voltage High - Voh	1.6	-	1.9	Volt	
Output Voltage Low - Vol	0	-	0.2	Volt	
Typical Current Source/Sink = 100uA/1uA					

5.1.4.2 2.85v Standard Interface Levels (UART, GPIO)

Parameter	Min	Typ	Max	Unit	Note
Input Voltage High - Vih	1.85	-	2.85	Volt	
Input Voltage Low - Vil	0	-	0.99	Volt	
Output Voltage High - Voh	2.45	-	2.85	Volt	
Output Voltage Low - Vol	0	-	0.4	Volt	
Typical Current Source = 100uA/1uA					

5.1.4.3 VL IN Selected Interface Levels (UART, GPIO)

Parameter	Min	Typ	Max	Unit	Note
Input Voltage High - Vih	VL*0.65	-	VL	Volt	
Input Voltage Low - Vil	0	-	VL*0.35	Volt	
Output Voltage High - Voh	VL-0.4	-	VL	Volt	
Output Voltage Low - Vol	0	-	0.4	Volt	

5.1.4.4 Cellular LED and USER LED Output Levels

Parameter	Min	Typ	Max	Unit	Note
Output Voltage High - Voh	1.6	-	1.9	Volt	
Output Voltage Low - Vol	0	-	0.2	Volt	
Typical Current Source = 100uA					

5.1.4.5 ADC Input Levels

Parameter	Min	Typ	Max	Unit	Note
Input Voltage Range	0	-	1.2	Volt	
AD Conversion	-	-	10	Bits	
Input Resistance	1M	-	-	Ohm	
Input Capacitance	-	1	-	pF	

5.1.4.6 Reset Pin Input Levels

Parameter	Min	Typ	Max	Unit	Note
Input Voltage High - Vih	1.5	-	1.9	Volt	
Input Voltage Low - Vil	0	-	0.35	Volt	

It is required that this input be controlled by an Open Collector/Drain Output. Do not use an external pull-up resistor; a pull-up is included internal to the Modem.

5 LTE910CF TECHNICAL SPECIFICATIONS continued

5.1 Electrical Specification continued

5.1.5 LTE Cellular Antenna Specifications:

5.1.5.1 LTE910CF v1.00 (AT&T)

Parameter	Description
Frequency Range	Depending on frequency bands provided by the network operator, the customer should use the most suitable antenna for those frequencies.
Bandwidth	GSM850: 70Mhz GSM1900 (PCS): 140Mhz WCDMA 1900 (B2): 140Mhz WCDMA 850 (B5): 70Mhz LTE 1900 (B2): 140Mhz LTE 1700 (B4): 445Mhz LTE 850 (B5): 70Mhz LTE 700 (B17): 42Mhz
Impedance	50Ω
Input Power	>33 dBm (2W) peak power in GSM >24 dBm Average power in WCDMA & LTE
VSWR Absolute Max	≤ 10:1
VSWR Recommended	≤ 2:1

5.1.5.2 LTE910CF v3.00 (Verizon) Antenna Specifications

Parameter	Description
Frequency Range	Depending on frequency bands provided by the network operator, the customer should use the most suitable antenna for those frequencies.
Bandwidth	LTE 1700 (B4): 445Mhz LTE 700 (B13): 41Mhz
Impedance	50Ω
Input Power	>24dBm Average Power
VSWR Absolute Max	≤ 10:1
VSWR Recommended	≤ 2:1

5.1.6 LTE910CF GPS/GLONASS Antenna Specifications:

5.1.6.1 Antenna Specifications

Parameter	Description	Note
Input Voltage Range	2.85v or VL IN	1
Frequency Range	1575.42± 2 MHz	
Gain	=< 15dB overall at the connector (Antenna and LNA included).	
Impedance	50 ohm	
VSWR	TBD	
Current Consumption	30mA Max, 20mA Typ.	

Note: 1. When VL IN is utilized, GPS Bias Voltage will match VL.

5 LTE910CF TECHNICAL SPECIFICATIONS continued

5.1 Electrical Specification continued

5.1.7 USB Transceiver Specifications

Parameter	Comments	Min	Typ	Max	Unit
USB_VBUS					
Supply voltage		4.5	5.0	5.25	Volt
Input levels for low-/full speed					
Receiver threshold (single-end)		0.8	-	2.0	Volt
Differential input sensitivity	D+ - D- , Vin = 0.8V to 2.5V	0.2	-	-	Volt
Differential common-mode range	Includes VDI	0.8	-	2.5	Volt
Output levels for low-/full speed					
Low	RL = 1.5 kΩ to 3.6 V	-	-	0.3	Volt
High	RL = 15 kΩ to GND	2.8	-	3.6	Volt
Output signal crossover voltage		1.3	-	2.0	Volt
Terminations					
Internal pull-up resistor	VTRM to D+, VTRM to D-	1.425	1.5	1.575	kΩ
Internal pull-down resistor	D+ to GND, D- to GND	14.3	15	24.8	kΩ
High-Z state output impedance	0 V < VDD < 3.6 V; measured at D+ and D- pins to GND	300	-	-	kΩ
Termination voltage	An internal supply voltage, VTRM	3.0	3.3	3.6	Volt
Driver characteristics – full speed					
Transition time:					
Rise time	CL = 50 to 125 pF	4	-	20	ns
Fall time	CL = 50 to 125 pF	4	-	20	ns
Rise/fall time matching		90	-	111	%
Series output resistance	D+, D-	28	33	44	Ω
Driver characteristics – low speed					
Transition time:					
Rise time	CL = 50 to 600 pF	75	-	300	ns
Fall time	CL = 50 to 600 F	75	-	30	ns
Rise/fall time matching		80	-	125	%

5 LTE910CF TECHNICAL SPECIFICATIONS continued

5.2 Mechanical Specification

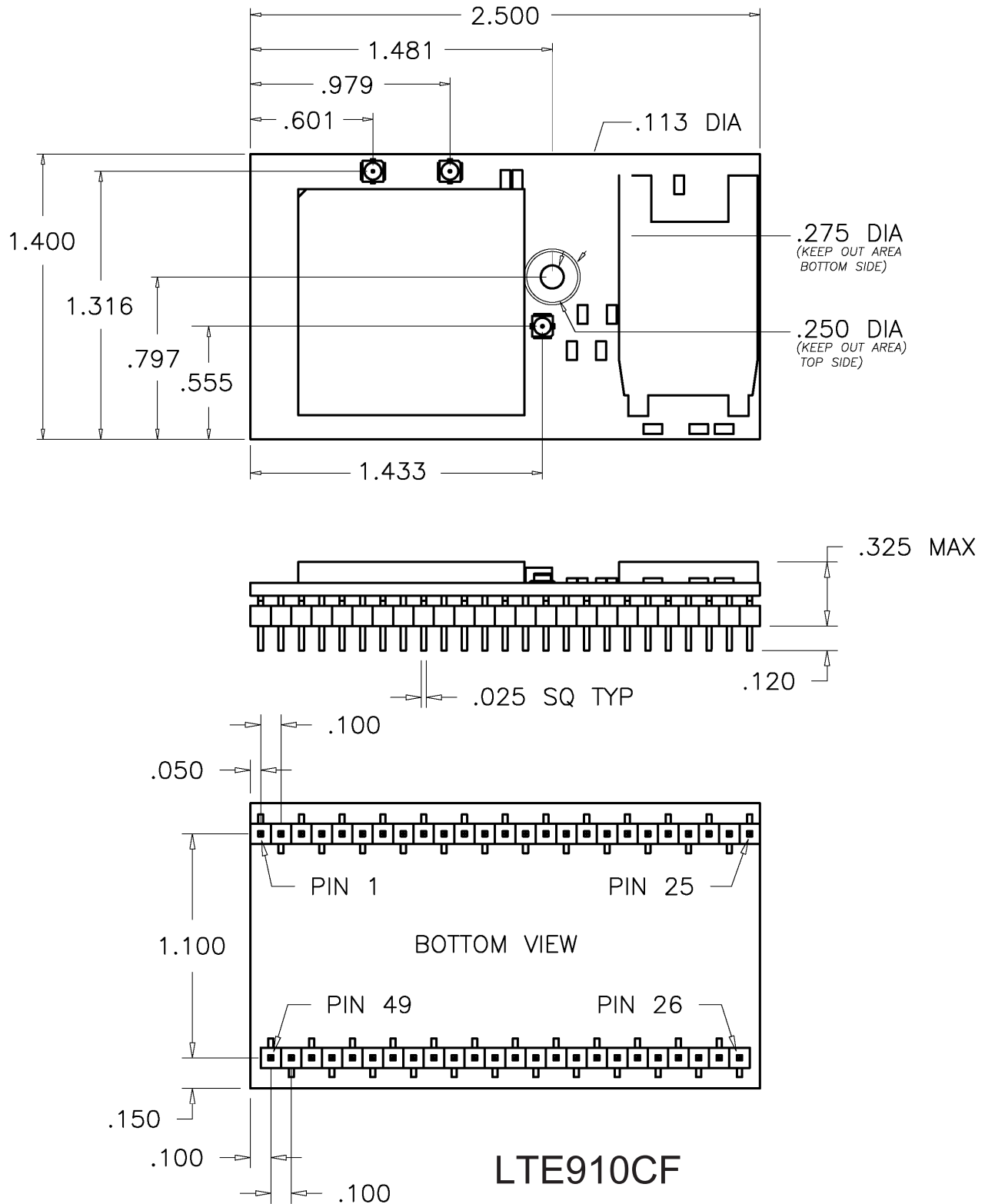


Figure 10 LTE910CF Mechanical Dimensions

5 LTE910CF TECHNICAL SPECIFICATIONS continued

5.3 Setting Up a Terminal Emulator for Use With the LTE910CF Modem

5.3.1 Set Up

To interface with the module, connect the serial interface to a PC and use a terminal emulation program such as Microsoft® Hyperterminal. Set the interface parameters as follows:

- Baud Rate: 115.2 kbps
- Bits: 8
- Stop Bits: 1
- Parity: None
- Hardware Handshaking: Yes

5.3.1.1 Test the Emulator Set Up

- Enter AT<cr> from terminal and wait for OK

Note that Autobaud is not supported on the LTE910CF Modem. If you are utilizing the serial interface and you wish to change the baud rate on the module, you must use AT+IPR. You must also change the rate in the host UART (i.e. HyperTerminal) to match the new baud rate. If these do not match you will not be able to send AT commands to the module through the serial port. The Modem is by default set to 115.2 kbps.

5.3.1.2 Verify Your Terminal and Firmware Version

- Enter AT+CGMM and wait for the response
The response will be the Telit module's model number without a command echo.
- Enter AT+CGMR and wait for the response
The response will be the Telit module's current firmware without a command echo.

Please confirm your model and firmware with the one listed in section 2.1

5.3.2 Powering ON/OFF

5.3.2.1 Turn the module ON through the following method:

- Pull ON/OFF signal (Pin 19) to ground for five (5) seconds, then release.

5.3.2.2 There are two ways to switch OFF the module as described below.

- Use the appropriate AT command (AT#SHDN)
- Pull ON/OFF signal (Pin 19) to ground for three (3) seconds, then release.

5.3 LTE910CF GETTING STARTED continued

5.3 Setting Up a Terminal Emulator for Use With the LTE910CF Modem continued

5.3.3 Setting Up Service – Network Settings

5.3.3.1 Set Up

The network settings for the Modem will vary depending on the cellular carrier you are using. Below are two of the North American Cases for these settings.

- AT#SELINT=2 //use of most recent AT command set
- AT#ENS=1 // Set autoband and enable SIM toolkit.

AT&P0 //Save profile

AT&W //Save settings

If Modem is being used in a different country or with a different carrier please refer to Telit AT command reference document regarding the use of the AT#BND command to set the proper frequency band).

5.3.3.2 Check Network Status (assuming you have a valid SIM card installed)

Enter AT+CGREG? <cr> And wait for response.

Response will be +CGREG:0,1 or +CGREG: 0,5 meaning the device is registered to the home network or roaming, respectively. If response is different than this, please refer to the Telit AT command reference document for more information.

5.3.3.3 Check Signal Quality

Enter AT+CSQ<cr> And wait for response +CSQ:<rss>,<ber>

<rss> Signal Strength
99 Not known or not detectable
0-31 dBm = (rss * 2) -113

Example: A result of 31 indicates -51dBm or greater.

An rssi value of >=10 in typical applications is fine and you will usually see about 12-20 in normal to good signal, but note that worst case it can be lower, still register and perform normal functions.

5.3.4 Sending an SMS

5.3.4.1 Set Up

SMS (Select Message Service) mode allows you to send a text message (max 160 characters) to a SMS capable subscriber unit.

- Set the SMS mode to text. This must be entered every power cycle.
AT+CMGF=1<cr>
- To enter the receiving subscriber unit phone number and message enter:
AT+CMGS="8885551234"
Wait for response">" then enter message text
Enter "ctrl z" <cr> to end the message

5.3 LTE910CF GETTING STARTED continued

5.3 Setting Up a Terminal Emulator for Use With the LTE910CF Modem continued

5.3.5 Making a Data Call

5.3.5.1 Set Up

Data connections require that the carrier's Access Point Name (APN) be properly set in the data contexts using the AT+CGDCONT command. In LTE modules, some contexts may be assigned for the carrier's use, the default settings are as follows:

LTE910CF V1.00:

```
+CGDCONT: 1,"IPV4V6","", "",0,0
+CGDCONT: 2,"IPV4V6","ims","",0,0
+CGDCONT: 3,"IPV4V6","sos","",0,0
```

Context ID 1 is available for use. Context 1 can be set using the AT+CGDCONT command as follows:

Enter AT+CGDCONT=1,"IPV4V6",<APN> where <APN> contains the carrier's APN, e.g. "m2m.com.attz".

LTE910CF V3.00:

```
+CGDCONT: 1,"IPV4V6","vzwims","",0,0
+CGDCONT: 2,"IPV4V6","vzwadmin","",0,0
+CGDCONT: 3,"IPV4V6","vzwinternet","",0,0
+CGDCONT: 4,"IPV4V6","vzwapp","",0,0
```

Context ID 3 is set to the default APN.

Activate the context as follows:

LTE910CF V1.00: Enter AT#SGACT=1,1

LTE910CF V3.00: Enter AT#SGACT=3,1

Open the socket connection:

Enter AT#SD=1,0,<rPort>,<IPAddr>,0,0,0

Look for response "CONNECT". This opens a remote connection via socket.

<rPort> = the remote host port of the server you are trying to connect to. (0 to 65535)

<IPAddr> = the IP address of the server you are trying to connect to in the format:

"xxx.xxx.xxx.xxx" or a DNS resolvable host name.

At this point a data session is active and data can be sent from the modem to the remote device and visa versa.

To exit the data session and return to command mode, send the break character string "+++" and wait for the OK response.

Enter AT#SH=1 to close the socket.

Note: Depending on your account, some APN's (e.g. a static IP account) may require a username and password when activating the context. In this case context activation would be similar to the following:

Enter AT#SGACT=1,1,"userID","password" where "userID" and "password" contain the appropriate string.

5.3.6 GPS

The GPS data can be acquired over the AT Command port with the following methods.

Method 1:

Send command AT\$GPSSLSR=2,3

Send command AT\$GPSACP<cr>

\$GPSACP can retrieve GPS data at any point when AT&GPSP? returns 1

Method 2:

Configure Unsolicited NMEA Data:

Send command to enable NMEA stream

AT\$GPSNMUN=<enable><gga><gll><gsa><gsv><rmc><vtg><cr>

Select parameter "1" to enable or "0" to disable for your NMEA stream requirements

EXAMPLE: AT\$GPSNMUN=3,1,1,1,1,1,1

Send command AT\$GPSSLSR=2,3

You'll receive a CONNECT and the NMEA stream will begin.

At this point the stream controls the port and requires an escape before AT entry can begin again.

End NMEA Stream:

Enter "+++" (without quotes)

Wait for the OK response

Send command to disable the receiver

AT\$GPSP=0

5.3 LTE910CF GETTING STARTED continued

5.3 Setting Up a Terminal Emulator for Use With the LTE910CF Modem continued

5.3.7 Further Instructions

On utilizing different commands for other applications than those described here, please refer to the reference documents, listed in section 2.1

6 DESIGN CONSIDERATIONS

6.1 Minimum Required Module Pin Connects

HSPA+ Pin Functions

Pin	Signal	Function	Note
1	VBATT	Main power supply	
2	VBATT	Main power supply	
12	GND	Ground	
25	GND	Ground	
26	GND	Ground	
39	GND	Ground	
49	GND	Ground	
9	TXD	Serial data input (TXD) from DTE	
4	RXD	Serial data output to DTE	
11	RTS	Input for request to send signal (RTS) from DTE	2
19	ON/OFF	Input command for switching power ON or OFF(toggle command)	
20	RESET	Reset input	

Note:

1. If the application uses USB as the main interface to the module, this is sufficient to capture any debug or trace data, provided the application can export the diagnostic port externally.
2. RTS must be connected to ground if flow control is not used.

6.2 Debug:

Debug of the Plug-In Modems in production

To test and debug the mounting of the module, we strongly recommend test pads on the host PCB. This will allow verification of the connection between the module itself and the application and to test the performance of the module connecting it with an external computer.

Depending on the customer application, these pads include, but are not limited to the following signals:

- TXD
- RXD
- ON/OFF
- RESET
- GND
- VBATT
- TX_TRACE
- RX_TRACE
- PWRMON
- USB D+
- USB D-
- USB V_BUS
- USB_ID

APPENDICES

Approvals

FCC Certified
CE Certified

Safety Recommendations (for Information only)

Antenna Care and Replacement

Do not use the Modem with a damaged antenna.

Buy the antenna from an approved suppliers list. Using unauthorized antennas, modifications, or attachments could damage the Modem and may violate local RF emission regulations or invalidate type approval.

Abbreviations

3GPP	3rd Generation Partnership Project		
AC	Alternating Current		
ADC	Analog To Digital Converter	ITAR	International Traffic In Arm Regulation
BER	Bit Error Rate	LED	Light Emitting Diode
CD	Carrier Detect	M2M	Machine To Machine
CDMA	Code Division Multiple Access	PBCCH	Packet Broadcast Control Channel
CSD	Circuit Switched Data	PDU	Protocol Data Unit
CTS	Clear To Send	RF	Radio Frequency
DB	Decibel	RI	Ring Indicator
DBFS	Decibels Full Scale	RSSI	Received Signal Strength Indication
DC	Direct Current	RTS	Request To Send
DCE	Data Communications Equipment	RxD	Received Data
DSR	Data Set Ready	SMS	Short Message Service
DTMF	Dual-tone multi-frequency	TTFF	Time To First Fix
DTR	DTE Ready	TxD	Transmitted Data
FDN	Fixed Dialing Number	UICC	Universal Integrated Circuit Card
GPIO	General Purpose Input Output	UMTS	Universal Mobile Telecommunications System
GPRS	General Packet Radio Service	USIM	Universal Subscriber Identity Module
GSM	Global System Mobile	USSD	Unstructured Supplementary Service Data
		VSWR	Voltage Standing Wave Ratio
		WAAS	Wide Area Augmentation System

LTE910CF CAT3 Embedded Cellular Modem User Manual



Ordering Information

Ordering Information	Description
LTE910CF v1.00	LTE Cat.3 Plug-In Modem - GPS Enabled - AT&T
LTE910CF v3.00	LTE Cat.3 Plug-In Modem - GPS Enabled - Verizon

Revision History

Revision	Revision Date	Note
P00	04/08/15	Preliminary LTE910CF Individual Plug-In User Manual
P01	08/03/15	Update to 5.3.5 Making a GPS Data Call
P02	04/13/17	Update Photo and Contact Information
P03	06/21/17	Update Cat 3 Information



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