LTE910CFX v1.00 CAT1 Worldwide Embedded Cellular Modem Manual

JANUS REMOTE COMMUNICATIONS

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DISCLAIMER

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1 APPLICABILITY TABLE

Product	Part Number
LTE910CFX	v1.00

2 REFERENCES

2.1 Janus Document List

Janus Application Note 117 - FOTA (Firmware Over The Air)

2.2 Telit Document List

The modem uses Telit LE910C1-WWXD cellular module.

Please refer to Telit's website at www.telit.com for the latest information on the LE910C1 module family.

Telit LE910Cx AT Commands Reference Guide

Telit LE910C1 Hardware Design Guide

Telit IP Easy User Guide

Telit Single SKU AT Command Application Note

3 OVERVIEW

3.1 Introduction

The User Manual for the 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 Modem. The Modem differences are highlighted in this manual for design considerations for future model placement.

3.2 Preview

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

3.2.1 Functional Description

Cellular
- LTE CAT1

GNSS Functionality
- • GPS, GLONASS, Beidou, Galileo, QZSS

UART
- 115200 bps default supporting all 7 standard RS232 signals

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

Physical Dimensions
- Length and width of all devices are equal
- Heights of different devices will vary
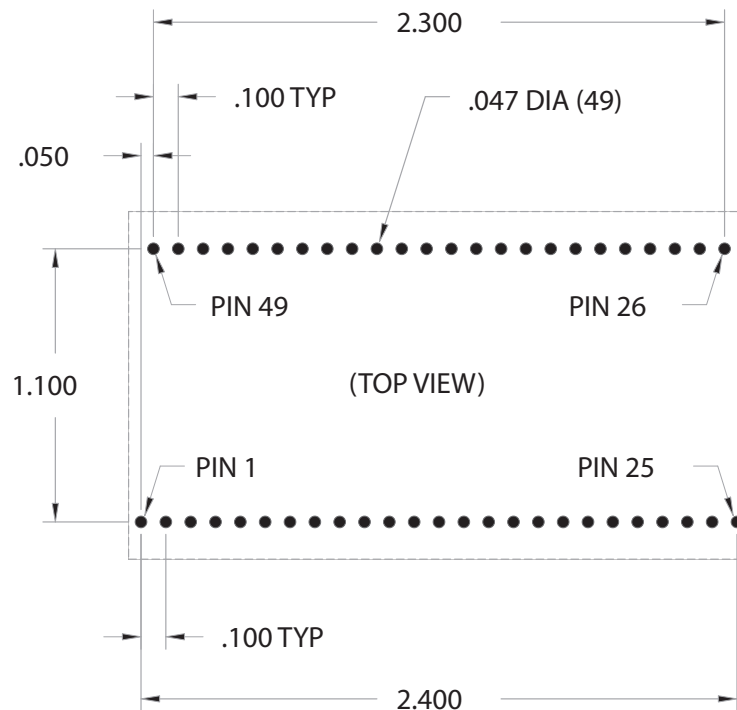
3.3 Features

- Multi-Band Support
- LTE (4G) Bands: B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B19, B20, B26, B28
- UMTS (3G) B1, B2, B4, B5, B8, B19
- GSM (2G) Bands: B2, B3, B5, B8
- LTE Output Power: 23dBm (Power Class 3)
- GSM Output Power: 33dBm (Power Class 4)
- LTE: DL: Up to 10 Mbps, UL up to 5Mbps
- GNSS (Global Navigation Satellite System) includes GPS, GLONASS, Beidou and Galileo
- Control via standard and extended AT command set
- SIM application Tool Kits 3GPP TS 51.014
- 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: 2.5 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
- Dual locking SIM Card Sockets (3FF 'micro')
- Cellular and GNSS antenna connections via Hirose U.FL miniature RF connectors

3.4 Block Diagram
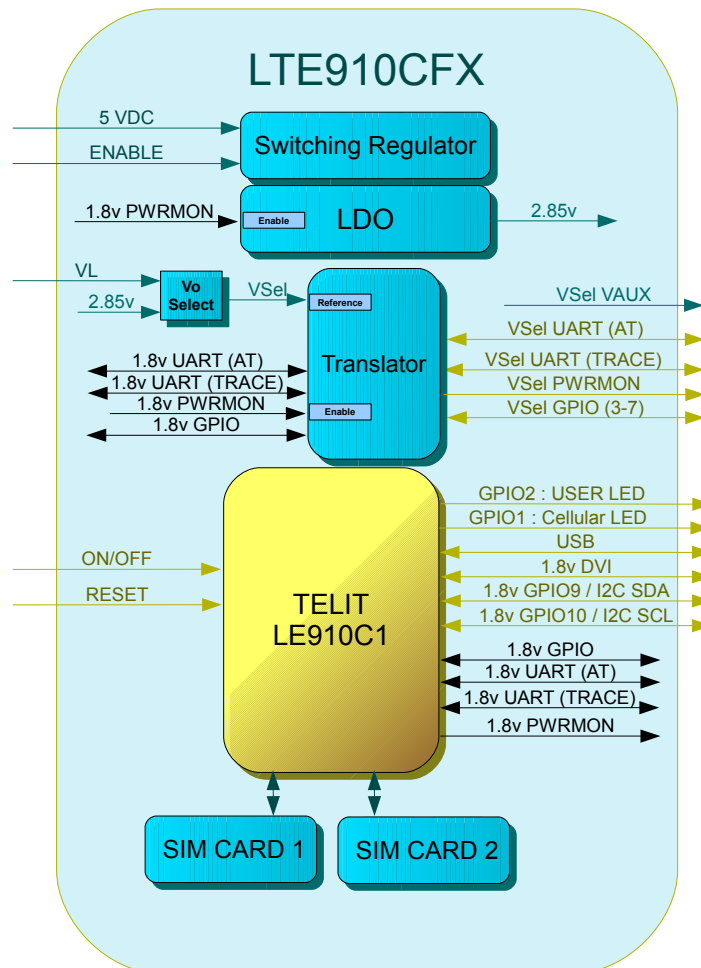
Figure 1 LTE910CFX v1.00 Block Diagram

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The certification of LTE devices for use on the Verizon Wireless network REQUIRES that the end user implement an automated FOTA procedure on their devices that would allow the cellular module firmware to be updated if required.

Failure to implement an automated FOTA procedure violates the certification requirements of the cellular modem and may result in units becoming unusable on the cellular network in the future. Your end device must support the firmware over the air update for the cellular modem

You may use your own FOTA system to update the cellular modem firmware over the air. You may also be able to use the Verizon Wireless FOTA system, and FOTA services may be available from other 3rd party vendors.

To inquire about Verizon Wireless FOTA system information and technical specifications, contact VZW.FOTA-Services@VerizonWireless.com

4 INTERFACES
4.1 Interface Voltage Selection

The LTE910CFX 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.

The VL_IN signal can be applied or changed to a different level within the 1.5V to 5.5V operational range after the unit is powered, but once applied the VL_IN voltage should not be removed unless the unit is turned off.

If no external reverence is applied to the VL_IN pin, the I/O interface will default to a 2.85V level. In this case the VL_IN pin 30 should be pulled low.

Truth Table:

VL_IN:	Ground	1.5v - 5.5v
I/O level:	2.85v	1.5v - 5.5v

Affected I/O:
1. UART (AT, TRACE)
2. GPIO (3-7)
3. VAUX*
4. GNSS Antenna Bias Voltage

*VAUX Adjustment allows feedback as well as legacy access if previously utilizing a plug in implementation with VAUX as the reference.

Note to pay attention of these changes so there are no adverse effects on a previous 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

Baud rate can be controlled with the AT+IPR command. Default setting is 115200 baud.

Note: If you are not using hardware handshaking, RTS must be connected to GROUND for proper communications when flow control is not used.

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.

Although an external source for the level translation can be used, VAUX can be used as the reference instead.
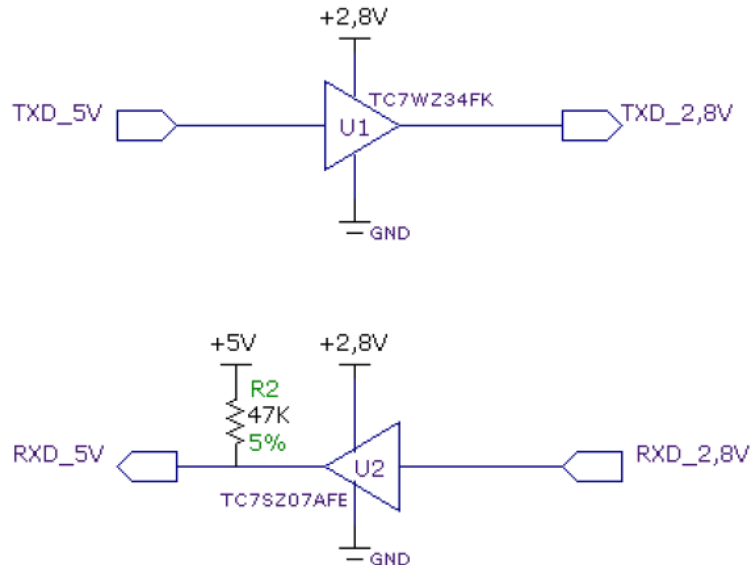
Figure 2 UART Level Translation Example

However, because some 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 Modems. The LTE910CFX is equipped with interface voltage adjustment, negating the need for translation.

4.2.2 USB Port

The 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 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 Modem turned on, power sequencing issues may occur.
Note: You must implement the USB interface in order to locally update module firmware.

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4 Interfaces continued

4.2.2 USB Port continued

4.2.2.1 USB Connection Diagram

When VBUS_ENABLE is HIGH the VBUS 5.0v signal will be passed to USB_VBUS, (pin 29) turning the USB ON.
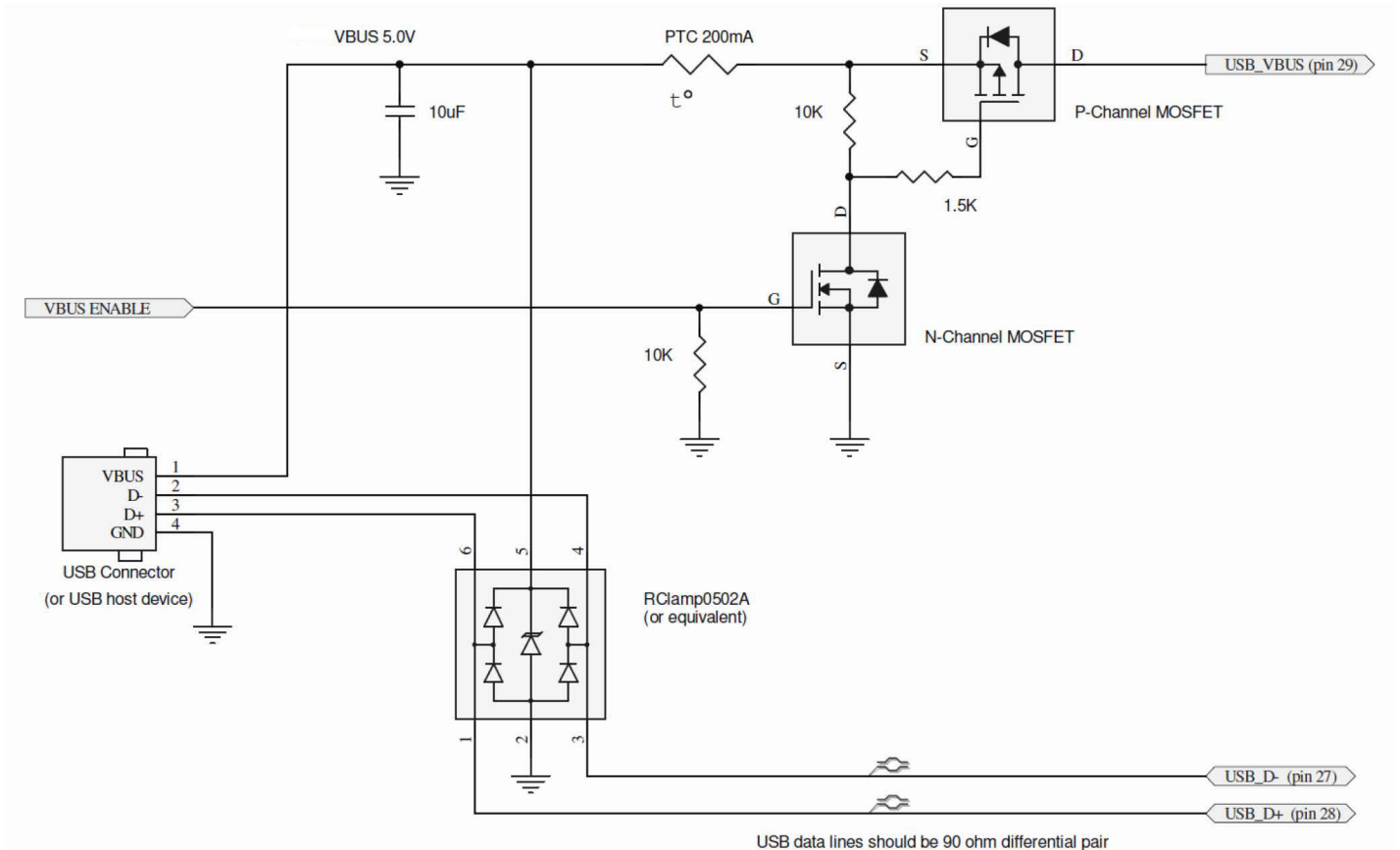
Figure 3 USB Connection Diagram

4 Interfaces continued
4.3 Power Supply

The Modem's power supply accepts input voltages from 2.5Vdc to 5.25Vdc and requires a nominal current sourcing capacity of 5W.

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

The LTE modulation schemes used in the modem can result in very dynamic current requirements, with current spikes exceeding 500mA during transmission bursts. LDO (low-drop-out) linear supplies or switching supplies with very fast transient response capabilities are recommended.

On Board Regulator

This Modem is designed with a switching regulator to power the cellular radio. The regulator can receive an input voltage of 2.5 to 5.25Vdc.
Note: The regulator input is capable of withstanding 6Vdc Maximum. This is outside the recommended operating voltage of the Modems but but is helpful to know when designing input transient circuitry.

Modem 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

The DVI audio interface (pins 21-24) is not currently supported by the firmware on these modules.

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	5
5	DSR	UART - Data Set Ready	Output	N/A	N/A	5
6	CTS	UART - Clear to Send	Output	N/A	N/A	5
7	RING	UART - Ring Indicator	Output	N/A	N/A	5
8	DCD	UART - Data Carrier Detect	Output	N/A	N/A	5
9	TXD	UART - Receive Line	Input	N/A	N/A	5
10	DTR	UART - Data Terminal Ready	Input	N/A	N/A	5
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	5
14	TRACE_RX	Debug UART - Receive Line	Input	N/A	N/A	5
15	GPIO_2	General Purpose I/O - User LED	Bi-Direction	N/A	N/A	5
16	GPIO_1/STATUS	General Purpose I/O - Status LED	Bi-Direction	N/A	N/A	5
17	SERVICE	Unused	N/A	N/A	N/A	2
18	PWRMON	Power Monitor Output	Output	N/A	N/A	5
19	ON_OFF	Toggle Cellular Radio On Off State	Input	N/A	PULL-UP to 1.8V	1
20	RESET	Reset Cellular Radio	Input	N/A	PULL-UP to 1.8V	1
21	DVI WAO	DVI Word Alignment	Bi-Direction	N/A	N/A	5
22	DVI RX	DVI Received Data	Input	N/A	N/A	5
23	DVI TX	DVI Transmitted Data	Output	N/A	N/A	5
24	DVI CLK	DVI Data Clock	Bi-Direction	N/A	N/A	5
25	GROUND	Supply Reference	Power	N/A	N/A	
26	GROUND	Supply Reference	Power	N/A	N/A	
27	USB_D-	USB Differential Data (-)	Bi-Direction	N/A	N/A	
28	USB_D+	USB Differential Data (+)	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	N/A	3
31	GPIO_9	General Purpose I/O	Bi-Direction	INPUT	N/A	
32	GPIO_10	General Purpose I/O	Bi-Direction	INPUT	N/A	
33	GPS_RX	Unused	N/A	N/A	N/A	2
34	GPS_TX	Unused	N/A	N/A	N/A	2
35	GPS_RESET	Unused	N/A	N/A	N/A	2
36	GPIO_7	General Purpose I/O	Bi-Direction	INPUT	N/A	5
37	GPIO_6	General Purpose I/O	Bi-Direction	INPUT	N/A	5
38	GPIO_5	General Purpose I/O	Bi-Direction	INPUT	N/A	5
39	GROUND	Supply Reference	Power	N/A	N/A	
40	GPIO_4	General Purpose I/O	Bi-Direction	INPUT	N/A	5
41	GPIO_3	General Purpose I/O	Bi-Direction	INPUT	N/A	5
42	Legacy GPIO_2	Unused	N/A	N/A	N/A	2
43	Legacy GPIO_1	Unused	N/A	N/A	N/A	2
44	DAC	Unused	N/A	N/A	N/A	2
45	ADC2	Unused	N/A	N/A	N/A	2
46	ADC1	Analog to Digital Converter	Analog Input	N/A	N/A	5
47	VRTC	Unused	N/A	N/A	N/A	2
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 Modem.
2. Not implemented.
3. VL_IN should be grounded if not being used.
4. RTS must be connected to GROUND if flow control is not used.
5. Refer to the electrical specifications for I/O levels.

4 Interfaces continued
4.6 VRTC

VRTC (pin 47) pin should be left unconnected.

The modem supports the RTC via the SUPPLY pins; the internal RTC will be maintained when in Power Saving Mode (PSM).

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 and temperature monitor indication.

4.7.1 Using a GPIO Pin as INPUT
The GPIO pins, 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 modem.

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

4.7.3 Cellular Status LED (GPIO1)
The Cellular LED output is used to drive an external LED to give feedback on the current operation. See figure 4 for recommended connection of an LED. For the LTE910CFX, this is an alternate function of GPIO1 and must be set via the AT#GPIO command. The defalt status indication is defined below.

Cellular Status Indication

LED Status	Device Status
Off	Cellular radio is off
Off	On/Searching
Slow Blinking (0.3 sec on / 2.7 sec off)	Registered
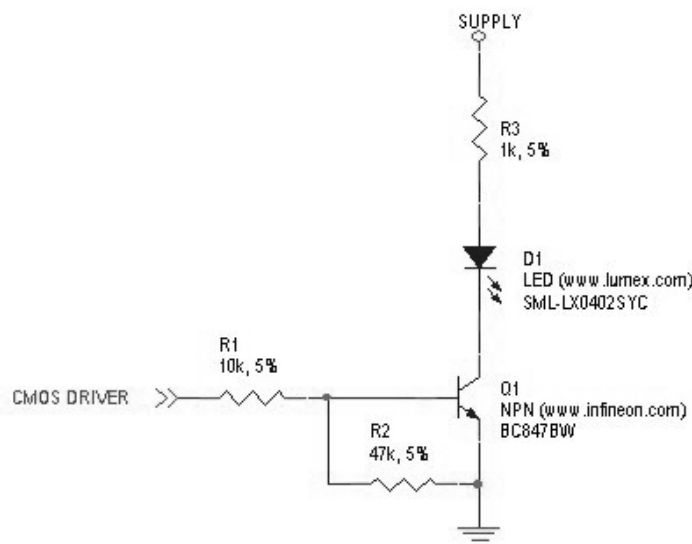
Figure 4 LED Indicators Diagram

4.7.4 User LED (GPIO2)

The modem has GPIO2 connected to the User LED pin. The user application can use this to control an LED or act as an additional GPIO. See figure 4 for recommended connection of an LED.

4.7.5 12C

The I2C interface is an alternate function of the modem's GPIO pins. The I2C SCL clock and I2C SDA data signals are assigned using the AT#I2CRD and AT#I2CWR commands.

To maintain compatability with legacy modems the GPIO 9 (SDA) and GPIO 10 (SCL) pins should be used. These pins 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 for use as an I2C bus.

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

4.8 Analog to Digital Converter

Pin 46 is connected directly to the Telit module ADC pin. It has a 0 to 1.8v range with 10 bit resolution. Use the command AT#ADC=1,2<cr> to read the ADC. The returned value is expressed in millivolts.

ADC	Description
ADC1	Analog to digital converter input

4.9 Internal Interfaces

4.9.1 ENABLE 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 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.
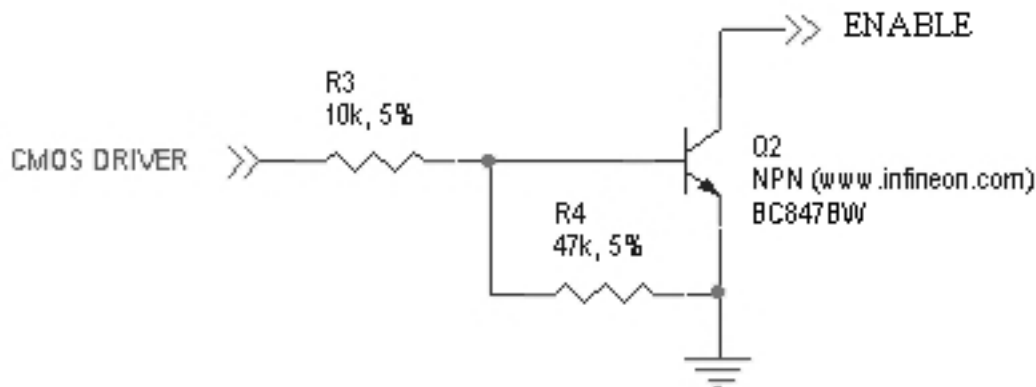4. The regulator is operational 2mS after active state is entered.

Figure 5 Enable Pin

4.9.2 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.*
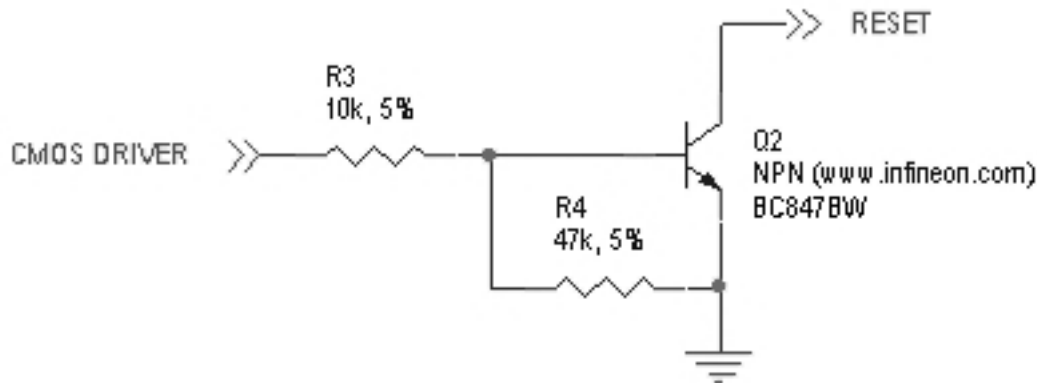
Figure 7 Reset Pin Diagram

4.9.3 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 Modem, the ON_OFF input must be tied low for 5 seconds then released.*
5. *To turn OFF the Modem, the ON_OFF input must be tied low for 3 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 Modem by floating or bringing them low. If this is not done, power sequencing issues may occur.*
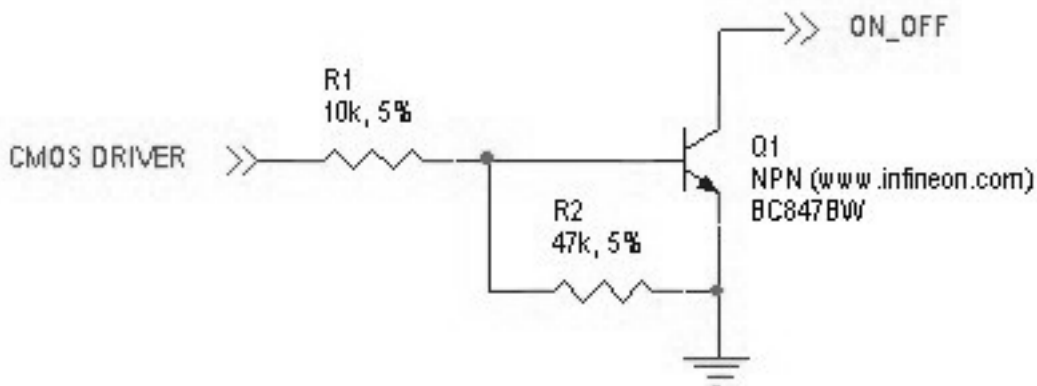
Figure 8 On / Off Pin Diagram

4 Interfaces continued
4.9 Internal Interfaces continued

4.9.4 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 LTE910CFX, this will cause the VAUX output to remain active.*

4.9.5 VAUX

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

When PWRMON is HIGH, VAUX will be ON. When PWRMON is LOW, VAUX will be OFF. On the LTE910CFX, the VAUX signal voltage will match to the VL IN voltage if utilized.

4.10 RF Interface

There are two RF interfaces on the Modem for a cellular antenna and a GNSS antenna.

The specifications and requirements for these are as follows:

4.10.1 LTE910CFX 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. (See Section 6.4.1 SIM card)

4.12 Header Interface Mounting Options

The Modems' 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 Modem, 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 LTE910CFX allows for the use of a #4 machine screw to help keep a socketed Modem in place where environmental variables may cause problems otherwise. If the user wishes to have a stand-off underneath the Modem 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

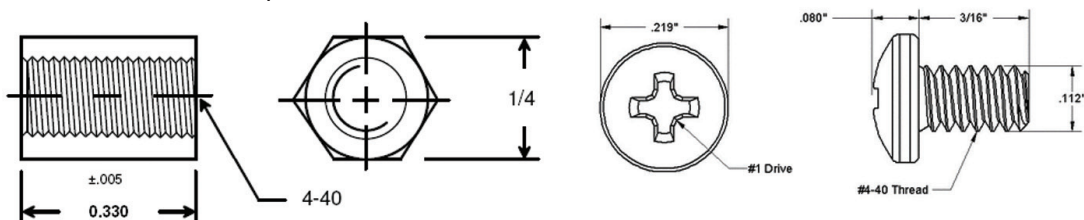4-40 3/16" Pan Head Phillips Machine Screw: MC-0357-G

Figure 9 Screw Diagram

5 LTE910CFX 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 (-)	2.5	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 Consumption [1, 2, 3]

Mode		Average (mA)	Mode Description
Switched Off			
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)
IDLE mode			
AT+CFUN=1	LTE	13	Normal mode: full functionality of the module
	WCDMA	15	
AT+CFUN=4		11	Disabled TX and RX; module is not registered on the network
AT+CFUN=5	LTE	2 to 6	Depends on paging cycle
	WCDMA	2	
Operative mode			
LTE Data call		190	Channel BW 5MHz, RB=1, TX=0dBm
LTE Data call	Max power	500	Channel BW 5MHz, RB=1, TX=22dBm
WCDMA HSDPA	Max power	440	WCDMA data call (RMC, TX = 23dBm)

Note 1:These figures are derived from the component data sheets including the Telit Hardware User Guide. Per Telit, "The reported values are an average among all the product variants and bands for each network wireless technology." Results can vary depending network conditions.
Note 2: Values are calculated based on 5.0 volt supply voltage and on-board power supply efficiency.
Note 3: Values do not include GNSS operation or GNSS antenna bias requirements.

5.1.4 I/O Levels

5.1.4.1   1.8v Standard Interface Levels (GPIO 1,2,3)

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   VL=5.0v UART Interface Levels)

Parameter	Min	Typ	Max	Unit	Note
Input Voltage High - Vih	0.7*VL	-	5.5	Volt	1
Input Voltage Low - Vil	0	-	0.3*VL	Volt	1
Output Voltage High - Voh	VL - 0.1	-	VL	Volt	1, 2
Output Voltage Low - Vol	0	-	0.1	Volt	1, 2
Typical Current Source = 100uA/1uA					

5.1.4.3   VL=3.3v UART Interface Levels

Parameter	Min	Typ	Max	Unit	Note
Input Voltage High - Vih	2.0	-	5.5	Volt	1
Input Voltage Low - Vil	0	-	0.8	Volt	1
Output Voltage High - Voh	VL-0.1	-	VL	Volt	1, 2
Output Voltage Low - Vol	0	-	0.1	Volt	1, 2

5.1.4.4   ADC Input Levels

Parameter	Min	Typ	Max	Unit	Note
Input Voltage Range	0	-	1.8	Volt	
AD Conversion	-	-	10	Bits	
Input Resistance	1M	-	-	Ohm	
Input Capacitance	-	1	-	pF	

5.1.4.5   Reset Pin Input Levels

Parameter	Min	Typ	Max	Unit	Note
Input Voltage High - Vih	-	1.2	VIN	Volt	3
Input Voltage Low - Vil	0	-	-	Volt	3

5.1.4.6   ON_OFF Pin Input Levels

Parameter	Min	Typ	Max	Unit	Note
Input Voltage High - Vih	-	1.2	-	Volt	3
Input Voltage Low - Vil	0	-	-	Volt	3

Notes:
1. *See Nexperia 74LVC2T45 data sheet for other input and output voltage conditions*
2. *CMOS load: 100uA*
3. *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.*

5.1.5 LTE Cellular 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.
Impedance	50Ω
Input Power	> 33 dBm(2 W) peak power in GSM
	> 24 dBm average power in WCDMA & LTE
VSWR Absolute Max	≤ 10:1
VSWR Recommended	≤ 2:1
Placement	Certification requires that the antennas be located at least 20 cm from the modem.

Maximum Antenna Gain (dBi)

This radio transmitter has been approved by the indicated agency to operate with the maximum permissible gain indicated.

FCC and ISED

Band (MHz)	Max.gain (dBi)
850	3.62
1900	8.51
1700	5.50
900	7.38
700	6.64
600	N/A
2600	9.01

RED

Band (cellular designation)	Max.gain (dBi)
GSM 900	6.00
DCS 1800	11.80
WCDMA Band VIII	8.90
WCDMA Band I	12.30
LTE FDD 1	12.80
LTE FDD 7	13.00
LTE FDD 8	9.40
LTE FDD 20	9.20
LTE FDD 28	9.30
Omnidirectional	4.00

FCC - Federal Communications Commission (US)
ISED - Innovation, Science and Economic Development (Canada)
RED - Radio Equipment Directive (Europe)

Notes:
- Information derived from Telit LE910Cx Hardware Design Guide

5.1.6 LTE910CFX GNSS: GPS and GLONASS Antenna Specifications:

5.1.6.1 Antenna Requirements

Parameter	Description	Note
Input Voltage Range	2.85v or VL IN	1
Frequency Range	1559.0 to 1610.0 MHz	
Gain	17dB typical	
Impedence	50Ω	
VSWR	$\leq$ 3:1	
Current Consumption	30mA Max, 20mA Typ.	

Note 1: When VL IN is utilized, GPS bias voltage will match VL.

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	%

JANUS REMOTE COMMUNICATIONS
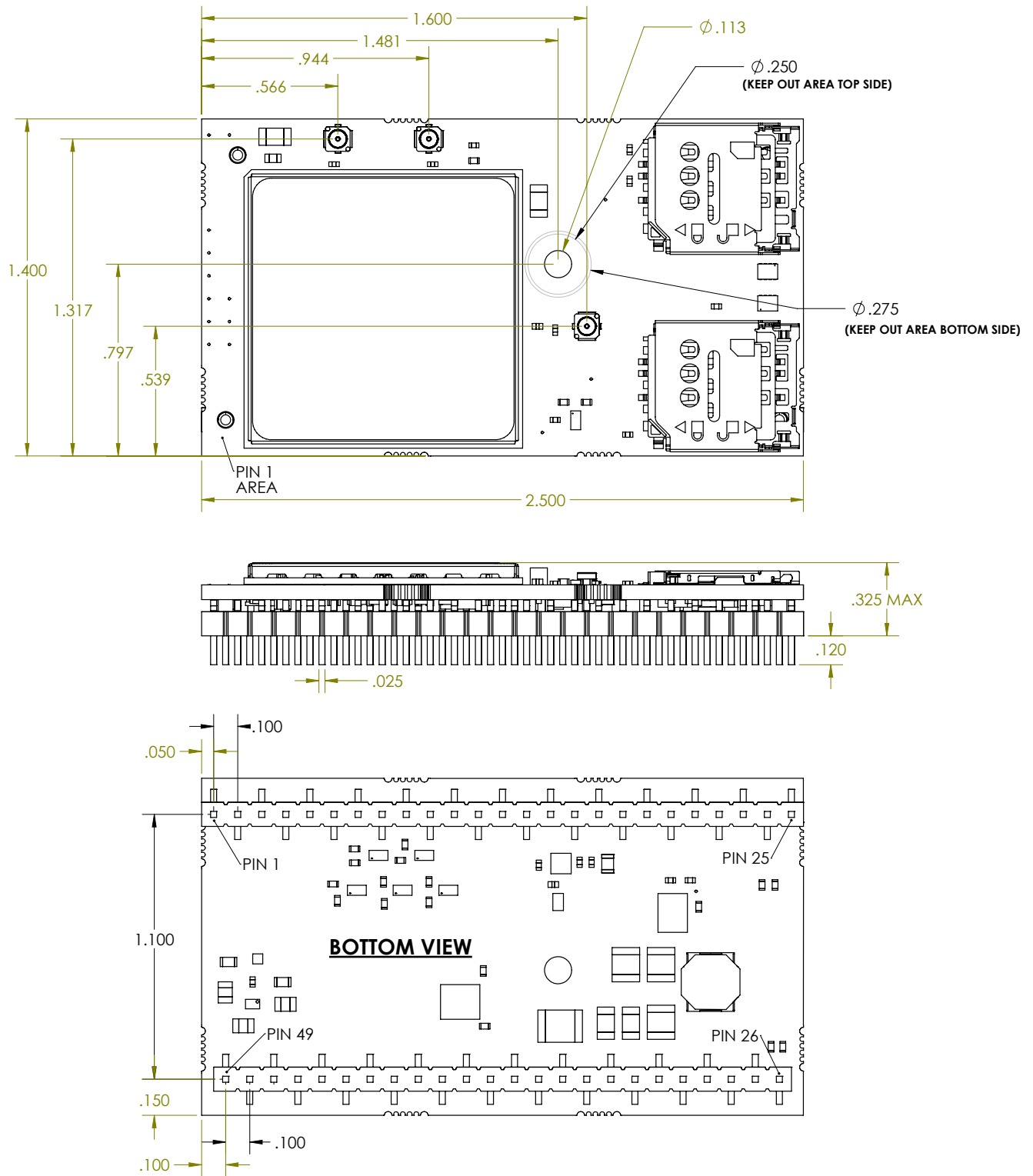
Figure 10 LTE910CFX Mechanical Dimensions

6 Operation
6.1 Powering ON/OFF

6.1.1 Powering ON
Power the Modem ON by pulling the ON_OFF signal (Pin 19) to ground for at least five (5) seconds, then release.

6.1.2 Powering OFF
There are two methods to to turn OFF the Modem under normal circumstances:

- Use the AT shutdown command (AT#SHDN)
- Pull ON_OFF signal (Pin 19) to ground for at least three (3) seconds, then release.

In both instances, power can be removed from the modem once the PWRMON signal goes low.

The normal shutdown procedure can take many seconds to complete. For power sensitive applications, consider using a 'fast shutdown' method to reduce the shutdown time. See the Telit AT Command Guide and the Telit Hardware Design Guide for more information.

Under abnormal circumstances, the modem can be shut down using the RESET input (pin 20).

6.2. Communicating with the Modem

The default configuration of the modem has AT command ports available on the UART interface and the USB interface.

6.2.1 UART Interface
The UART port operates at a the following default parameters:

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

6.2.2 USB Interface
The USB port instantiates two serial modem connections as AT command ports by default. USB drivers are available from Telit or Janus.

6.3 Testing Communications

- The cellular module should always respond to the attention command with 'OK'. Send:

  AT<cr>[1]

  Note 1. "<cr>" designates a carriage return character.

  The module will response with 'OK'.

- Verify the module model. Send:

  AT+CGMM<cr>

  The response should be the Telit module model number.

- Verify the firmware version. Send:

  AT+CGMR<cr>

  The response will be the Telit module's current firmware.

JANUS REMOTE COMMUNICATIONS

6.4.1 SIM Card

All LTE modems require a SIM card. The modem supports 3FF 'micro' size SIM cards. The #SIMSELECT command is used to select the SIM card holder. As shipped from the factory, SIM holder 1 is selected.

The SIM holders do not have a SIM detection switch. You can use the #SIMDET command to simulate the function of a SIM detection switch and enable or disable disable the selected SIM holder:

To disable the selected SIM card, issue the command:

```
AT#SIMDET=0
```

To enable the selected SIM card, issue the command:

```
AT#SIMDET=1
```

Units are shipped from the factory with #SIMDET=1.

SIM holder #2 requires that #ENSIM2 is enabled. While this is the default setting, you can ensure that #ENSIM2 is enabled by issuing the command:

```
AT#ENSIM2=1
```

See the AT Command Guide for more information.

To switch from SIM holder 1 to SIM holder 2, issue the #SIMSELECT command:

```
AT#SIMSELECT=2
```

To switch from SIM holder 2 to SIM holder 1, issue the #SIMSELECT command:

```
AT#SIMSELECT=1
```

If you switch to a SIM holder with no SIM, the module will not recognize when a new SIM is inserted.

Use the #SIMDET command to disable and enable the SIM holder in order to have the module attempt to read the SIM card.

It is suggested that you issue the AT&W command to save the #SIMDET setting in non-volatile memory to be restored following a power cycle or reboot. For example, to save in profile 0, issue the command string:

```
AT&P0&W0
```

See the AT Command Guide for more information.

Note: The current firmware will not save the #SIMSELECT or #SIMDET settings following a #FWSWITCH change. You must re-issue the #SIMSELECT and #SIMDET settings following a #FWSWITCH change. The #ENSIM2 setting will default to enabled.

6.4.1 SIM Card continued
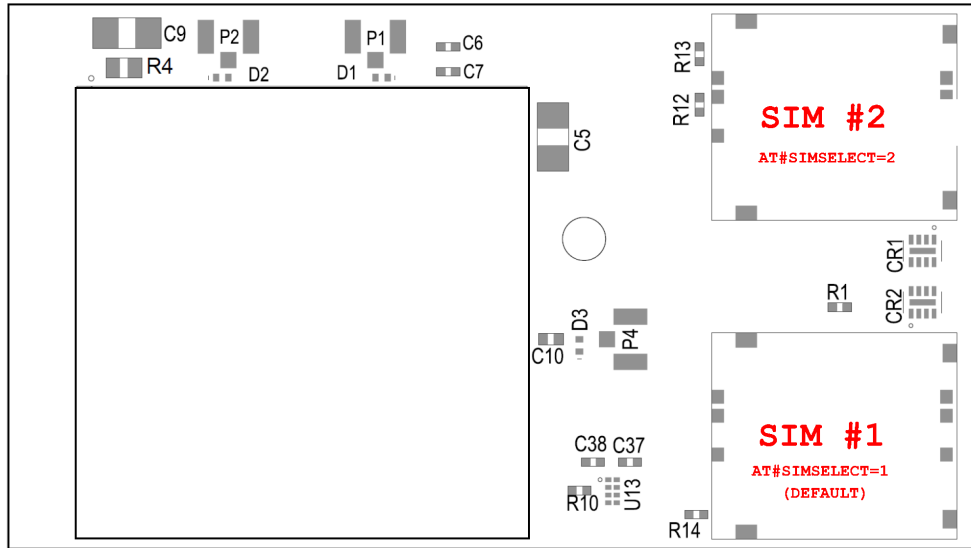
Figure 11 LTE910CFX SIM Selection Diagram

6.4.2 Data Contexts - setting the APN

6.4.2.1 Checking the Data Contexts

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. Normally the device will get an APN from the network and auto-attach. In some cases, you may need to set a different APN.

The data contexts can be checked by entering the following command:

```
AT+CGDCONT?<cr>
```

The module will respond with the current data contex settings.

NOTE: A SIM card must be present to read the data contexts.

The default settings for the LTE Cat.1 modems are as follows:

AT&T centric (#FWSWITCH=0):

```
+CGDCONT: 1,"IPV4V6","m2m.com.attz","",0,0,0,0
+CGDCONT: 4,"IPV4V6","attm2mglobal","",0,0,0,0
```

Verizon (#FWSWITCH=1):

```
+CGDCONT: 1,"IPV4V6","ims","",0,0,0,0
+CGDCONT: 2,"IPV4V6","vzwadmin","",0,0,0,0
+CGDCONT: 3,"IPV4V6","vzwinternet","",0,0,0,0
+CGDCONT: 4,"IPV4V6","vzwapp","",0,0,0,0
+CGDCONT: 5,"IPV4V6","","",0,0,0,1
+CGDCONT: 6,"IPV4V6","vzwclass6","",0,0,0,0
+CGDCONT: 7,"IPV4V6","vzwclass7","",0,0,0,0
```

Bell [Canada] (#FWSWITCH=3) and Australia/Telstra (#FWSWITCH=3):

```
+CGDCONT: 1,"IPV4V6","inet.bell.ca","",0,0,0,0
```

Telus [Canada] (#FWSWITCH=4):

```
+CGDCONT: 1,"IPV4V6","isp.telus.com","",0,0,0,0
```

Worldwide (#FWSWITCH=40):

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

Verizon uses context ID 3 for the default users data connection.
All other carriers usually use context ID 1 for the default users data connection.
Contact your carrier for the appropriate default context ID and APN to use.
See also section 6.8 - Firmware selection

6.4.2.2 Setting the Data Contexts

Cat.M1 devices may require a different APN (Access Point Name) than higher data rate modems (Cat.1, Cat.4, etc.). Make sure you are using an acceptable APN or the device will not register on the network. For example, the general Cat.M1 APN for AT&T is "m2m.com.attz".

To set a data context with this APN, enter the following:

```
AT+CGDCONT=1,"IPV4V6",""m2m.com.attz""<cr>
```

and wait for the "OK" response.

NOTE: Carrier services such as a staic IP address or VPN may require a specialized APN.

6.4.3 Signal Strength

Signal channel can be checked as follows. Enter:

```
AT+CSQ<cr>
```

The default response format will contain two numbers:

```
+CSQ: 17,0
```

The first number is the rssi (received signal strength indication) and the second is ber (bit error rate).

The rssi can be interpreted as follows:

10-14 Okay

15-20 Good

20+ Excellent.

Anything below 10 would be considered marginal.

A response of 99 indicates no signal.

6.4.4 Registration

Network registration can be checked as follows. Enter:

```
AT+CEREG?<cr>
```

A response of +CEREG:0,1 or +CEREG: 0,5 indicates 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

6.5 Data Communications

The modem incorporates a TCP/IP stack that can be used to directly send data using AT commands. Alternativly, an external host can be used to make a PPP connection.

See the Telit ME910C1 Quick Start Guide for further information

6.5.1 Data Communications - Using the Internal Stack

To send data using the internal stack, a data context must be activated.

Activate the context as follows:

AT&T centric (FWSWITCH=0):

Enter:

```
AT#SGACT=1,1<cr>
```

Verizon (FWSWITCH=1):

Enter:

```
AT#SGACT=3,1<cr>
```

If successful, the modem will respond with an IP address assigned by the carrier. Data can be sent to a host with a socket dial command. Enter:

```
AT#SD=<connid>,0,80,<IPaddr>
```

where <connid> is the user data context and <IPaddr> is a text string (in quotes) containing a dotted IP address or a DNS resovable host name.

The modem will respond with CONNECT and any data entererd thereafter will be sent to the connected host. Enter the escape sequence:

```
+++
```

to suspend the connection.

See the Telit IP Easy User Guide and the Telit AT Commands Guide for more information.

6.5.2 PPP Dialing

In a hosted system (e.g. Linux) the host TCP/IP stack can be used. A PPP connection is initiated using the ATD dialing command. Depending on the script or application performing the PPP connection, you may have to change the numeric digit in the PPP AT dialing command that designates the context to use.

The dialing string for the AT&T centric (#FWSWITCH=0) would be:

```
ATD*99***1#<cr>
```

Where the '1' digit selects the #1 data context set with the +CDGCONT command.

Similarly the dialing string for the Verizon (#FWSWITCH=1) would be:

```
ATD*99***3#<cr>
```

Where the '3' digit selects the #3 data context set with the +CDGCONT command.

Note: If you experience issues maintaining a PPP connection using a Linux host, issue the command:

```
AT#LWM2MSKIP=1
```

to disable LWM2M agents. The module will reboot, and the setting will be stored in NVM.

6.6 SMS

SMS allows you to send a text message (max 160 characters) to a SMS capable unit.

- Set the SMS mode to text. This setting is not persistant; it must be entered every power cycle.

```
AT+CMGF=1<cr>
```

- To enter the receiving subscriber unit phone number and message enter:

```
AT+CMGS="8885551234"<cr>
```

Wait for response ">" then enter message text .

Enter

```
<ctrl-z>
```

to end the message text and send it.

6.7 GNSS

The GNSS system on the Telit module includes support for stand-alone operation with GPS and GLONASS.

It also supports A_GPS (assisted GPS) using C-Plane and SUPL (Secure User Plane Location) archetectures.

A simple example of stand-alone GPS operation follows.

Turn on the GNSS system:

```
AT$GPSP=1<cr>
```

Turn on the antenna bias voltage:

```
AT$GPSAT=1
```

The current GPS fix information can be read using:

```
AT$GPSACP<cr>
```

NMEA data can be continuously streamed. Enter:

```
AT$GPSNMUN=3,1,1,1,1,1,1<cr>
```

This enables multiple NMEA data messages and they will be continuously streamed to the AT command port until an escape sequence ("+++") is entered.

6 Operation continued
6.8 Firmware Selection

LTE910CFX V1.00 uses the Telit LE910C1-WWXD module which has firmware to support multiple carriers

The firmware load can be changed by issuing the command:

```
AT#FWSWITCH=<image_number>,1
```

where <image_number> is

    0 for AT&T centric
    1 for Verizon
    3 for Bell [Canada]
    4 for Telus [Canada]
    40 for Worldwide

The module will automatically reboot with the new firmware image.

Current firmware status can be checked by issuing the command:

```
AT#FWSWITCH?
```

The response will be #FWSWITCH: <image_number>,n

where <image_number> is as described above.

Note that normally different SIM cards will be required for operation under the different carrier versions.
More information can be found in the Telit Single SKU AT Command Application Note.

7 Design Considerations
7.1 Minimum Required Module Pin Connects

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 Modem, 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.

7.2 Debug:

7.2.1 Software debug

You can get more verbose responses to some error conditions by issuing the command:

```
AT+CMEE=2
```

7.2.2 Hardware debug

To test and debug the modem it is recommend to incorporate test pads on the host PCB. This will allow verification of the connection between the modem and the host application. This is especially true of the USB port which provides access for flashing firmware and running diagnostic traces. 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

APPENDICES
Approvals

LTE910CFX v1.00

    FCC: RI7LE910CX-WWX

    PTCRB, AT&T, Verizon, RED pending

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
APN	Access Point Name
BER	Bit Error Rate
CD	Carrier Detect
CDMA	Code Division Multiple Access
CTS	Clear To Send
DB	Decibel
DC	Direct Current
DCE	Data Communications Equipment
DSR	Data Set Ready
DTMF	Dual-tone multi-frequency
DTR	DTE Ready
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GSM	Global System Mobile
HSPA	High Speed Packet Access
LTE	Long Term Evolution
IoT	Internet of Things
LED	Light Emitting Diode
M2M	Machine To Machine
RF	Radio Frequency
RI	Ring Indicator
RSSI	Received Signal Strength Indication
RTS	Request To Send
RxD	Received Data
SMS	Short Message Service
TTFF	Time To First Fix
TxD	Transmitted Data
UICC	Universal Integrated Circuit Card
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiplexing Access

LTE910CFX v1.00 CAT1 Worldwide Embedded Cellular Modem Manual

Ordering Information

Ordering Information	Description
LTE910CFX v1.00	LTE Cat1 Modem - GNSS Enabled - AT&T, Verizon, Worldwide

Revision History

Revision	Revision Date	Note
00	09/29/22	New LTE910CFX v1.00 CAT1 User Manual
01	12/21/22	Updated SIM Card information and PPP Dialing
02	03/09/23	Remove Preliminary Status and update to Antenna Specifications
03	01/18/24	Updated SIM Card and Design Considerations