Sierra Wireless FX30S

User Guide

41110485
Rev 2

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Safety and Hazards

Do not operate the Sierra Wireless modem in areas where blasting is in progress, near medical equipment, near life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the Sierra Wireless modem **MUST BE POWERED OFF**. The Sierra Wireless modem can transmit signals that could interfere with this equipment.

The driver or operator of any vehicle should not operate the Sierra Wireless modem while in control of a vehicle. Doing so will detract from the driver or operator's control and operation of that vehicle. In some states and provinces, operating such communications devices while in control of a vehicle is an offence.

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Contents

1: Introduction to the FX30S

The Sierra Wireless® FX30S, a small, rugged, programmable Internet of Things (IoT) gateway, runs the secure Legato® Application Framework, and a long-term support Linux® operating system. You can use the FX30S as a simple USB modem, but its full potential is realized when you use it as an embedded cellular platform for IoT applications. With Serial, USB, I/O interfaces, and IoT Expansion cards, the FX30S can connect to many machines and infrastructures. The Linux-based Legato framework enables you to use efficient low-level C programming to write IoT applications for any connected machine.

Key Features

- Penta-band HSPA+
- RS232/RS-485 Serial port
- USB 2.0
- mini-SIM slot
- Three configurable I/Os
- Internet of Things (IoT) slot
- GNSS (GPS/Galileo/GLONASS)
- Legato support
- Ultra low power mode

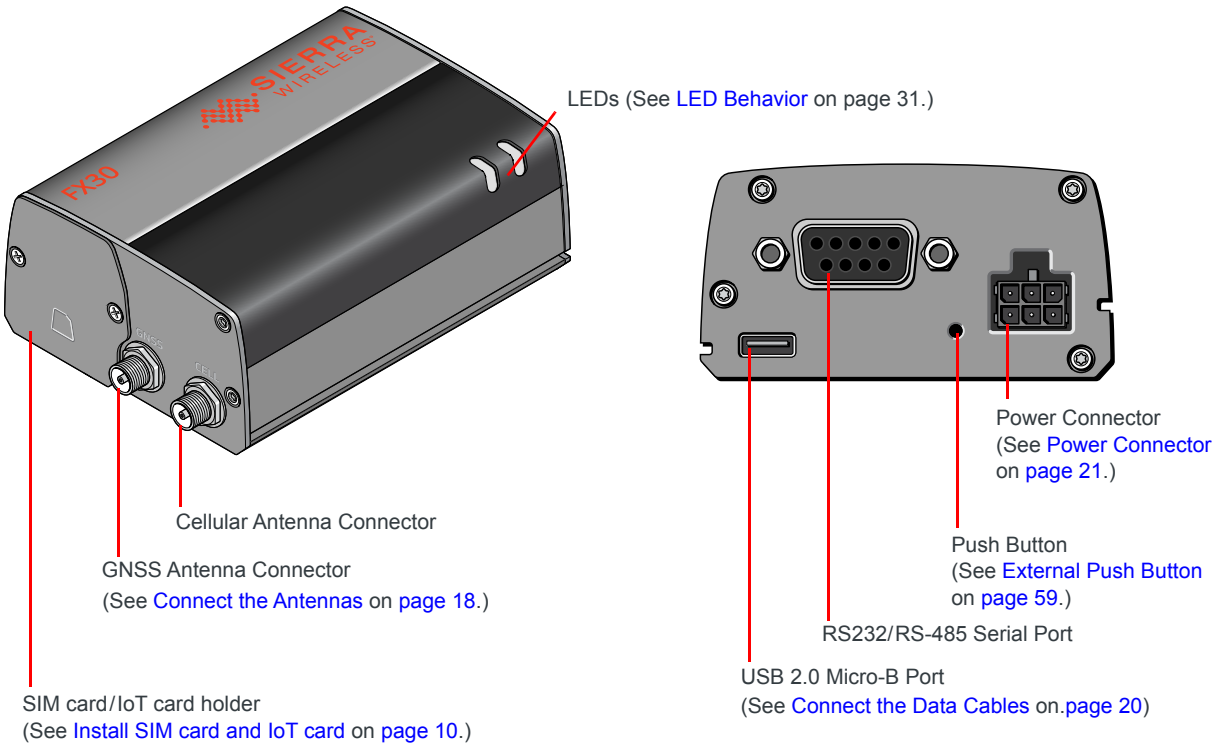


Figure 1-1: FX30S Connectors, LEDs and SIM Card Holder

Power Modes

FX30S has three power modes:

- Off
- Ultra Low Power
- Active

For more information on power modes and power consumption, see Power Modes on page 56 and Power Consumption on page 58.

Accessories

The following items come with the FX30S gateway:

- DC power cable
- Mounting bracket

You can order the following items separately from Sierra Wireless:

- Universal AC power adapter
  - Voltage input: 100– 240 VAC
  - Current output: 1.5 A
- Compatibility bar (useful if you are replacing a Fastrack Supreme or a Fastrack Xtend)
- Range of GNSS and cellular antennas

Commonly available standard accessories you may want:

- 35 mm DIN rail clips

Warranty

The FX30S comes with a 3-year warranty.

Reference Documents

Document Number	Title	Location
4116440	WP75xx/WP8548 Product Technical Specification	source.sierrawireless.com
4118047	WPx5xx AT Command Reference	source.sierrawireless.com
4117166	IoT Expansion Card Design Specification	http://mangoh.io
n/a	Legato information	legato.io

2: Installation and Startup

This chapter shows how to connect, install and start the Sierra Wireless FX30S. It also describes the front panel LEDs and I/O functionality.

Note: The FX30S must be installed by a qualified technician.

Tools and Materials Required

- mini-SIM card (provided by your mobile network operator)
- #1 Phillips screwdriver
- Laptop computer
- AC adapter or DC power cable
- micro-B USB cable
- Cellular antenna
- Optional:
  - GNSS antenna
  - 9-pin connection cable for the RS232 port

Installation Overview

The steps for a typical installation are:

1. Insert the SIM card and optional IoT Expansion card.
2. Mount and ground the FX30S.
3. Connect the antennas.
4. Connect the data cables.
5. Connect the power and I/O.
6. Check the FX30S operation.
7. Use the FX30S.

The following sections describe these steps in detail. Read these sections carefully before performing the installation.

Step 1—Insert the SIM Card and Optional IoT Card

The Sierra Wireless FX30S has one mini-SIM (2FF) card slot.

If the SIM card has not already been installed, insert the SIM card into the gateway before connecting any external equipment or power to the FX30S.

To install the SIM card:

1. Use a Phillips screwdriver to remove the cover.
2. Orient the SIM card, as shown in Figure 2-1. The gold contacts on the SIM card face up.
3. Gently slide the SIM card into the slot until it clicks into place.

   To remove the SIM card, press it in, and release it. Gently grip the SIM card and pull it out.

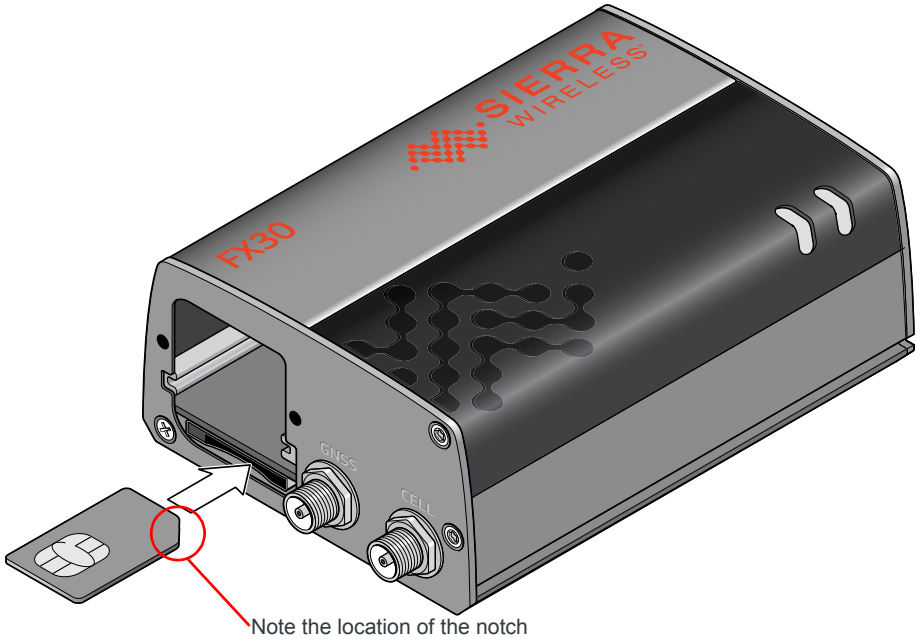


Figure 2-1: Installing the SIM card

4. Replace the cover.

The FX30S has a slot for an Internet of Things (IoT) Expansion card that provides a standard hardware interface for sensors, network adapters and other IoT technologies. Using Legato, you can design host applications for the IoT Expansion Card. For more information, see Internet of Things (IoT) Expansion Card on page 62.

To install an IoT Expansion card:

1. Use a Phillips screwdriver to remove the SIM card/IoT Expansion card cover.
2. Orient the IoT Expansion card as shown in Figure 2-2 and slide the card into the IoT slot.
3. Replace the cover.

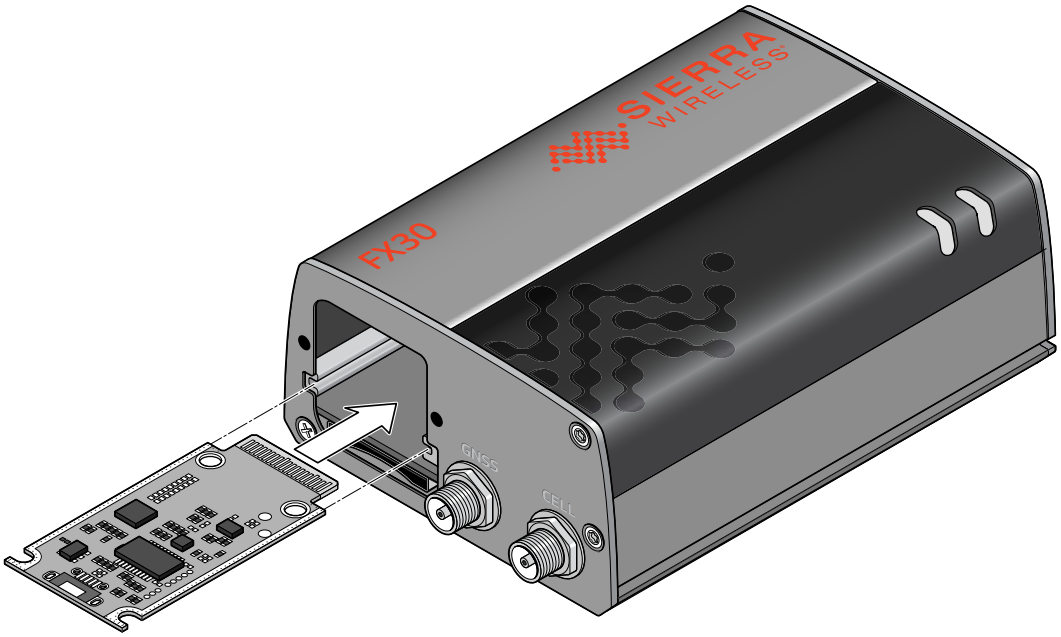


Figure 2-2: Installing the IoT Expansion card

Step 2—Mount and Ground the FX30S Chassis

You can flat mount the FX30S or mount it on a DIN rail. An optional compatibility bar allows you to use existing mounting holes if you are replacing a Fastrack Supreme or a Fastrack Xtend programmable gateway. See Replacing existing Fastrack Supreme or Fastrack Xtend Device on page 16.

Mount the FX30S where:

- There is easy access for attaching the cables.
- Cables will not be constricted, close to high amperages, or exposed to extreme temperatures.
- The front panel LEDs are easily visible.
- There is adequate airflow.
- It is away from direct exposure to the elements such as sun, rain, dust, etc.

You can mount the FX30S:

- On a flat surface (page 13)
- On a DIN Rail (page 16)

Flat Mount

To mount the FX30S on a flat surface:

1. Attach the bracket to the mounting surface, using the attachment points shown in Figure 2-3.

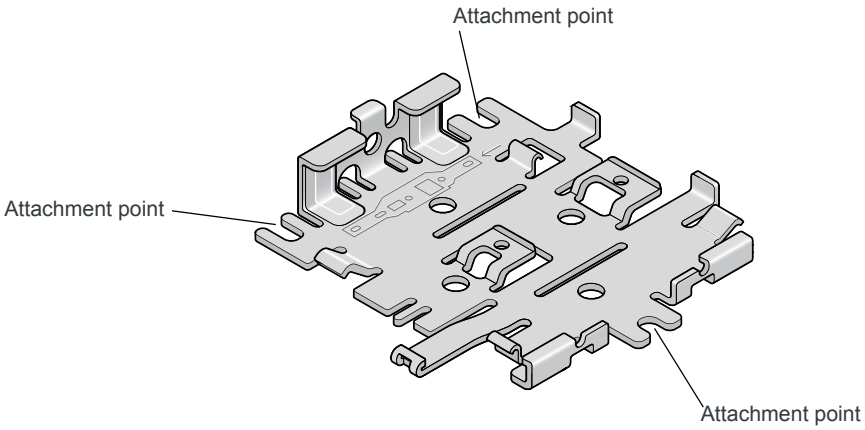
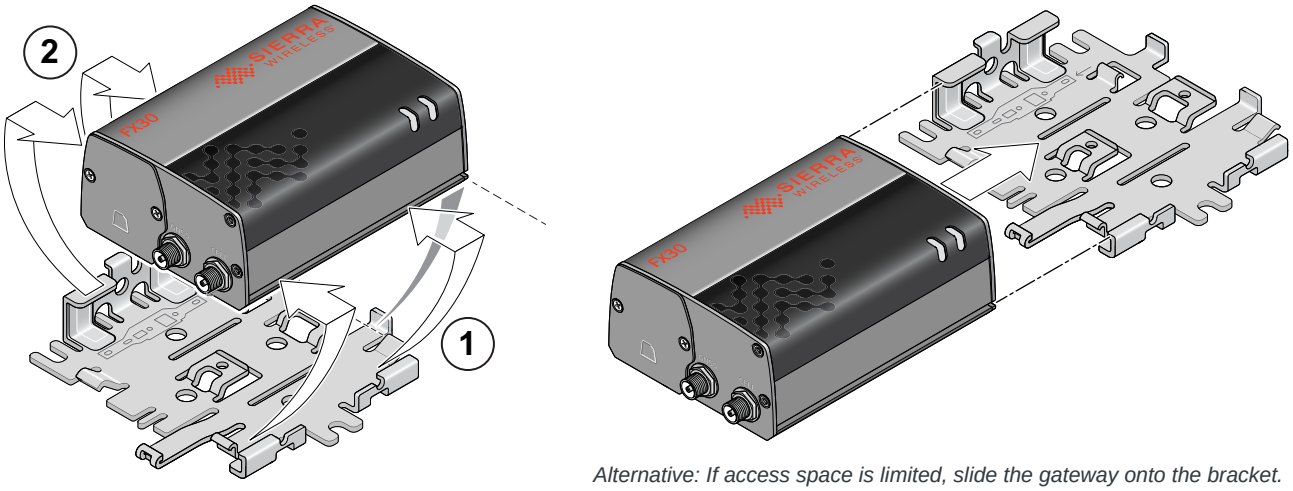


Figure 2-3: Mounting Bracket, showing attachment points

2. Snap or slide the FX30S onto the bracket.



Recommended: Snap the gateway onto the bracket.

Alternative: If access space is limited, slide the gateway onto the bracket.

Figure 2-4: Attaching the FX30S to the bracket

Optional—Mounting in a High Vibration Environment

If you are mounting the FX30S in a high vibration area, Sierra Wireless strongly recommends using two nylon cable ties to secure the FX30S on the bracket.

To secure the FX30S on the bracket:

1. Thread the ties into the holes on one side of the bracket and out the holes on the other side of the bracket, as shown in Figure 2-5 on page 14.

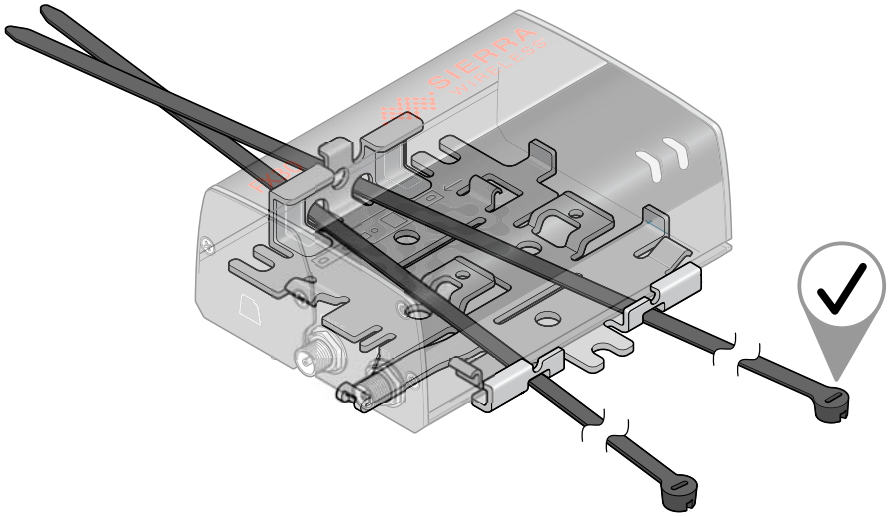


Figure 2-5: Inserting the cable ties

2. Wrap the ties around the FX30S and insert the pointed ends of the ties into the blunt ends.

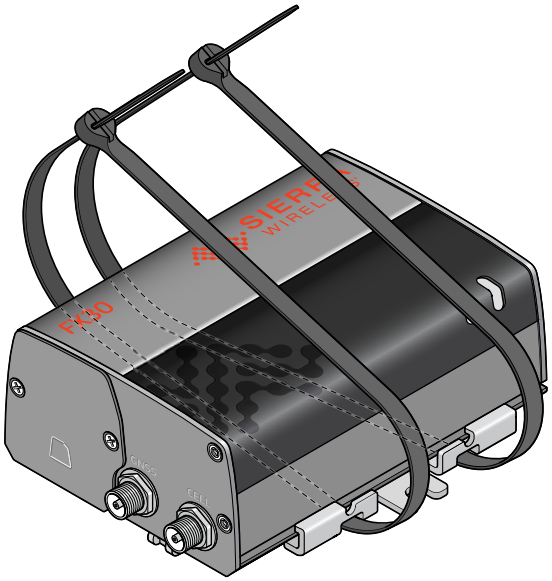


Figure 2-6: Inserting the ends of the ties

3. Tighten and secure the ties around the FX30S and trim off the excess length of the ties.

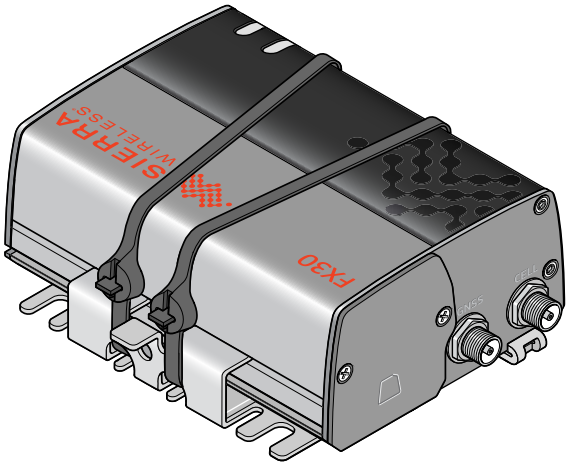


Figure 2-7: Cable ties tightened and trimmed

4. You are now ready to flat mount the FX30S in a high vibration environment. If you are mounting it on a DIN rail, see Mounting on a DIN Rail on page 16.

Mounting on a DIN Rail

To mount the FX30S in a DIN rail:

1. Attach the DIN rail clips to the bracket as shown in Figure 2-8.

   If you are mounting the FX30S on its edge, attach one DIN rail clip to the side of the bracket.

   If you are mounting the FX30S horizontally or vertically, attach two DIN rail clips to the bottom of the bracket.

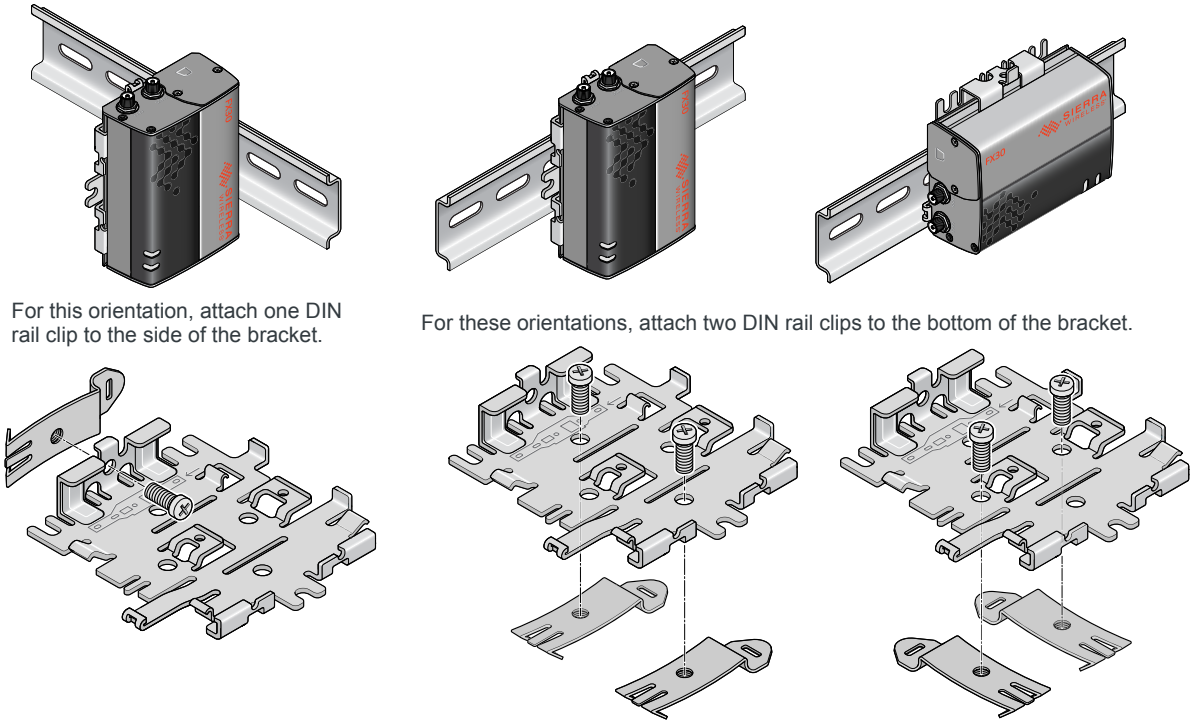


Figure 2-8: Attaching the DIN rail clips

2. Slide or snap the FX30S onto the bracket, as shown in Figure 2-4.
3. If the DIN rails are in a high vibration environment, see Optional—Mounting in a High Vibration Environment on page 14.
4. Attach the FX30S to the DIN Rail. See Figure 2-8.

Replacing existing Fastrack Supreme or Fastrack Xtend Device

If you are going to be mounting the FX30S in a location where you previously had a Fastrack Supreme or a Fastrack Xtend mounted, attach the compatibility bar to the bracket. The compatibility bar is available from Sierra Wireless.

Note: Adding the compatibility bar does not change the height of the gateway + mounting bracket. See Figure 3-4 on page 55.

To attach the compatibility bar to the bracket:

1. Note the large and small raised tabs on the bracket. Each tab has a small hole in the center of the raised portion. Also note the large and small rectangular openings in the compatibility bar. See Figure 2-9.

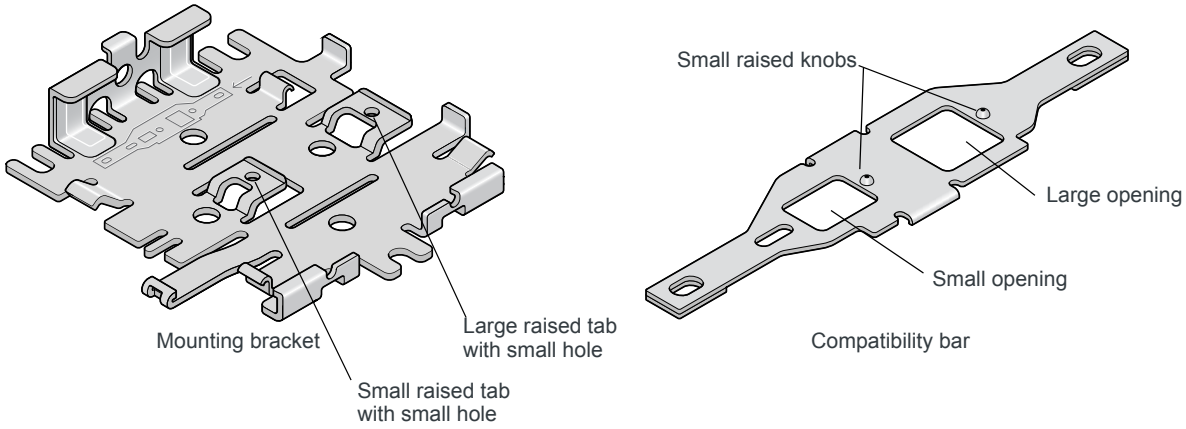


Figure 2-9: Mounting bracket and compatibility bar

2. Orient the mounting bracket and the compatibility bar as shown in Figure 2-10.

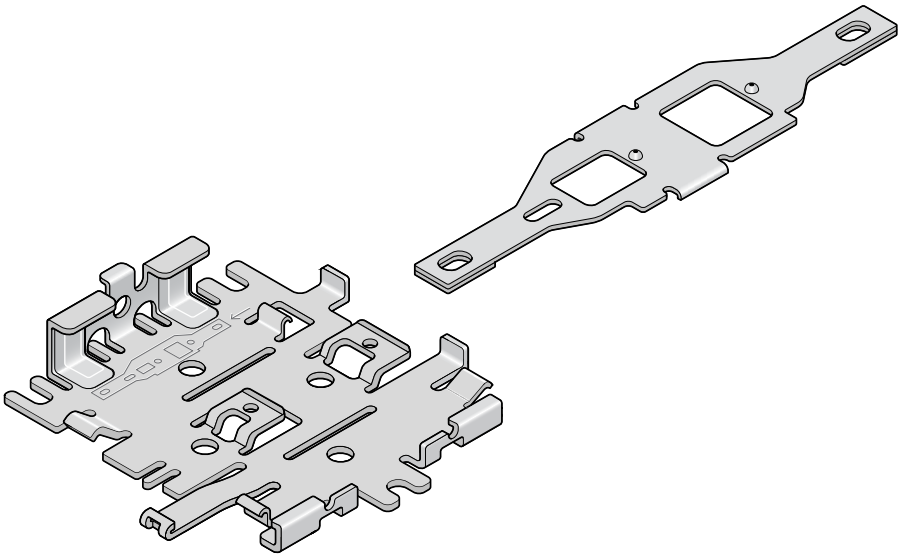


Figure 2-10: Mounting bracket and compatibility bar orientation

3. Place the compatibility bar on top of the bracket, so that the tabs on the bracket are inside the openings in the bar, and slide the bar into place. When fully secure, the knobs on the bar should be inside the small holes on the tabs.

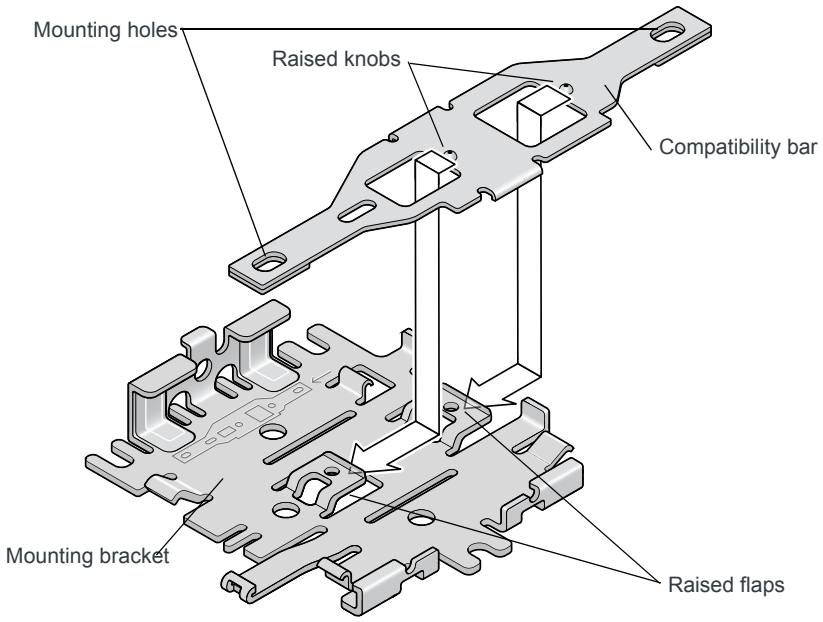


Figure 2-11: Attaching the compatibility bar

4. The mounting holes in the adapter bar match the existing mounting holes for the Fastrack Supreme or Fastrack Xtend.

For DC installations (with a fixed “system” ground reference), Sierra Wireless recommends always grounding the FX30S chassis to this system ground reference.

To ensure a good grounding reference, attach the FX30S to a grounded metallic surface.

Step 3—Connect the Antennas

Warning: *This gateway is not intended for use close to the human body. Antennas should be at least 8 inches (20 cm) away from the operator.*

The FX30S has two SMA female antenna connectors:

- Cellular antenna connector
- GNSS antenna connector

  GNSS bias supports 3.15 V antennas

For regulatory requirements concerning antennas, see Maximum Antenna Gain on page 64.

Note: The antenna should not exceed the maximum gain specified in RF Exposure on page 64. In more complex installations (such as those requiring long lengths of cable and/or multiple connections), you must follow the maximum dBi gain guidelines specified by the radio communications regulations of the Federal Communications Commission (FCC), Industry Canada, or your country’s regulatory body.

To install the antennas:

Note: Take extra care when attaching the antennas to the SMA connectors. Finger tight (approximately 0.6–0.8 Nm 5–7 in-lb.) is sufficient and the max torque should not go beyond 1.1 Nm (10 in-lb.).

1. Connect the cellular antenna to the SMA cellular antenna connector.
   Mount this antenna so there is at least 20 cm between the antenna and the user or bystander.
2. If used, connect a GNSS antenna to the SMA GNSS antenna connector.
   Mount the GNSS antenna where it has a good view of the sky (at least 90°).

Note: If the antennas are located away from the gateway, keep the cables as short as possible to prevent the loss of antenna gain. Route the cables so that they are protected from damage and will not be snagged or pulled on. There should be no binding or sharp corners in the cable routing. Excess cabling should be bundled and tied off. Make sure the cables are secured so their weight will not loosen the connectors from the gateway over time.

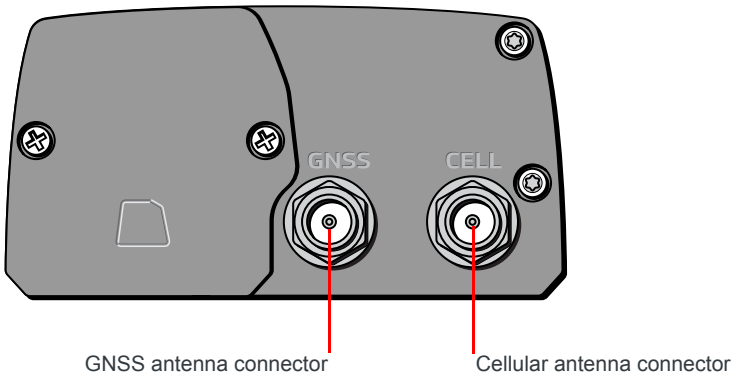


Figure 2-12: Antenna Connectors

Step 4—Connect the Data Cables

The FX30S has two ports for connecting data cables:

- USB (Micro-B)
- Serial (DB9)

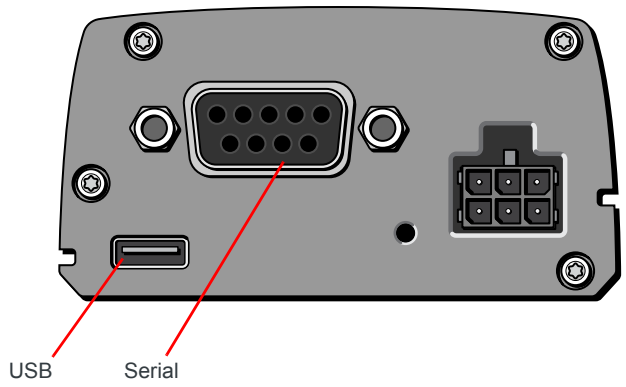


Figure 2-13: Connectors for data cables

Cabling Concerns

Separate the antenna, data, and power cables from other wiring and route away from sharp edges.

Cable Strain Relief

Sierra Wireless recommends using cable strain relief for installations in high-vibration environments.

Place the cable strain relief within 200 mm (8") of the FX30S to reduce the mass of cable supported by the power connector under vibration. Ideally, the strain relief mounting for the DC cable should be attached to the same object as the gateway, so both the gateway and cable vibrate together. The strain relief should be mounted such that it does not apply additional stress on the power connector, i.e. the cable should not be taut and should not pull the power connector at an angle.

Step 5—Connect the Power and I/O

The Sierra Wireless FX30S comes with a 1.5 meter (about 5 ft.) DC power cable. For more information on the DC power cable, see page 66. You can also purchase an optional AC adapter.

Warning: *Electrical installations are potentially dangerous and should be performed by personnel thoroughly trained in safe electrical wiring procedures.*

The FX30S supports an operating voltage of 4.75–32 V.

Fusing

The Sierra Wireless DC power cable has a 3 A fuse installed in the cable. If that cable is used, no additional fusing is required.

Power and I/O Connections

Table 2-1 describes the functions for the pins on the FX30 power connector.

Figure 2-14: DC Power Cable Connections

Table 2-1: Power Connector Pin and DC Cable Wires

Pin	Function	Associated DC Cable Wire Color	Description
1	Power	Red	(20 AWG + Fuse) Main power supply for device Fuse: Slow-blow 3 A, 250 V (5 × 20 mm) *Note: If you want to turn the FX30S on/off using a control line, Sierra Wireless strongly recommends that you connect the on/off line to Pin 3 and apply continuous power on Pin 1.*
2	Ground	Black	(20 AWG) Main device ground

Table 2-1: Power Connector Pin and DC Cable Wires

Pin	Function	Associated DC Cable Wire Color	Description
3	On/Off	Yellow	(28 AWG) On/Off: Control line to turn the gateway on and off. Pin 3 must be connected: either to the input power source or to an on/off switch. The FX30S is off when this pin is low, but you also have to option to monitor this pin using GPIO 24, and holding the power on while a Legato-designed application executes. For more information, see OFF Mode on page 56.
4	IO 1	Brown	Digital input Wake from Low Power Active State[a]
			Internal pull-up control
5	IO 2	Green	Digital input Wake from Low Power Active State
			Internal pull-up control
			Analog input
6	IO 3	Orange	Digital input
			Internal pull-up control
			Digital output

Note: See Table 3-10, WP8548 Radio Module Interface Mapping, on page 59 for the radio module GPIO and Linux interface mapping of pins 3 to 6.

a. For more information on power modes, see Power Modes on page 56.

Wiring Diagrams

In the following diagrams, *FX30* refers to either FX30 and FX30S.

Always On Installation

For an Always On application, connect the wires as shown in Figure 2-15.

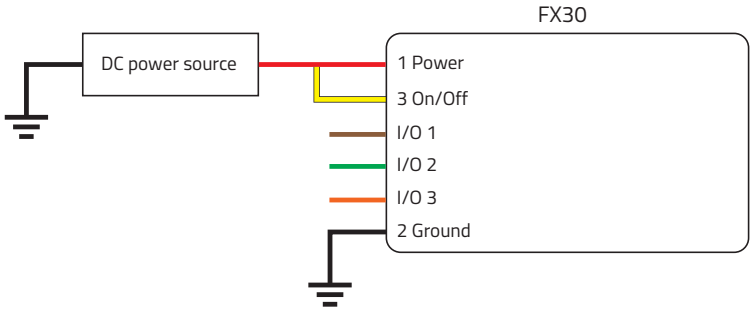


Figure 2-15: Always on installation

- Pin 1 (Power)—Use the red wire in the DC cable to connect Pin 1 to the power source.
- Pin 2 (Ground)—Use the black wire in the DC cable to connect Pin 2 to ground. See also Step 2—Mount and Ground the FX30S Chassis on page 12.
- Pin 3 (On/Off)—Connected to power
- Optional—I/O 1, I/O 2, and I/O 3

Note: See Table 3-10, WP8548 Radio Module Interface Mapping, on page 59 for the radio module GPIO and Linux interface mapping of pin 3, I/O 1, I/O 2, and I/O 3.

On/Off Installation

For an On/Off application, connect the wires as shown in Figure 2-16 or Figure 2-17.

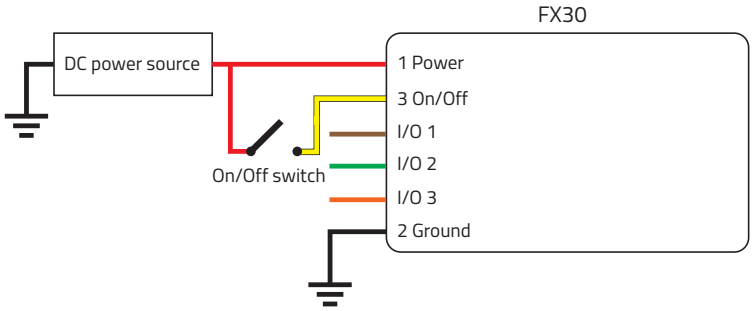


Figure 2-16: On/Off Installation with switch

- Pin 1 (Power)—Use the red wire in the DC cable to connect Pin 1 to the power source.

- Pin 2 (Ground)—Use the black wire in the DC cable to connect Pin 2 to ground. See also Step 2—Mount and Ground the FX30S Chassis on page 12.
- Pin 3 (On/Off)—Connect to an on/off switch

  Pin 3 must be connected.
- Optional—I/O 1, I/O 2, and I/O 3

An On/Off installation may also use a sensor with an open-collector NPN or PNP transistor. The transistor is the switch to turn the FX30S on or off, as shown in Figure 2-17.

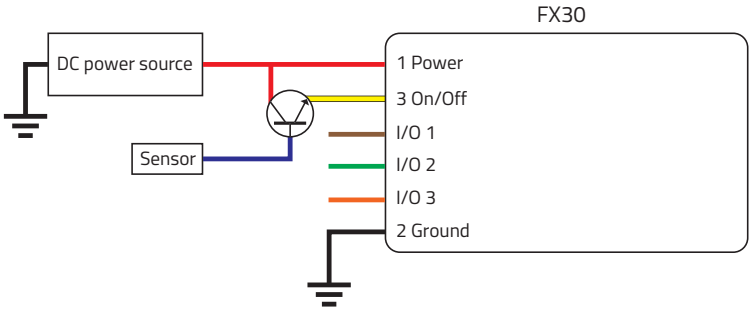


Figure 2-17: On/Off Installation (with sensor and NPN transistor switch)

- Pin 1 (Power)—Use the red wire in the DC cable to connect Pin 1 to the power source and the collector pin of the transistor.
- Pin 2 (Ground)—Use the black wire in the DC cable to connect Pin 2 to ground. See also Step 2—Mount and Ground the FX30S Chassis on page 12.
- Pin 3 (On/Off)—Connect to the emitter pin of the transistor

  Pin 3 must be connected.
- Optional—I/O 1, I/O 2, and I/O 3

Note: See Table 3-10, WP8548 Radio Module Interface Mapping, on page 59 for the radio module GPIO and Linux interface mapping of pin 3, I/O 1, I/O 2, and I/O 3.

Installation with I/O Input Triggered by Standby Mode

If you have an installation where you want to use the I/O to monitor an external device such as a motion detector or gate sensor, refer to Figure 2-18. If desired, you can use Legato to program the I/O line to wake the gateway from ultra low power mode for a specific length of time.

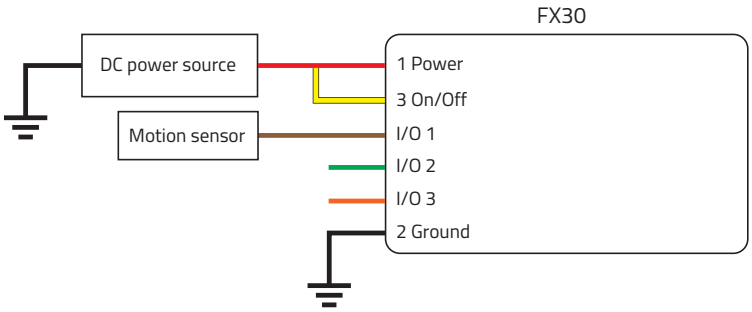


Figure 2-18: Fixed Installation with I/O

- Pin 1 (Power)—Use the red wire in the DC cable to connect Pin 1 to the power source.
- Pin 2 (Ground)—Use the black wire in the DC cable to connect Pin 2 to ground. See also Step 2—Mount and Ground the FX30S Chassis on page 12.
- Pin 3 (On/Off)—Connected to power

  Pin 3 must be connected.
- I/O 1—configured for digital input
- Optional—I/O 2 and I/O 3

Note: See Table 3-10, WP8548 Radio Module Interface Mapping, on page 59 for the radio module GPIO and Linux interface mapping of pin 3, I/O 1, I/O 2, and I/O 3.

I/O Configuration

The Sierra Wireless FX30S power connector has three pins you can use for I/O configuration:

- I/O1—Digital input only; allows wakeup from ultra low power mode
- I/O2—Digital and analog input; allows wakeup from ultra low power mode
- I/O3—Digital input and digital output

Note: See Table 3-10, WP8548 Radio Module Interface Mapping, on page 59 for the radio module GPIO and Linux interface mapping of the I/O pins.

Note: The IoT Expansion Card has four GPIO pins that you can program using Legato. For details, refer to the IoT Expansion Card Design Specification.

I/O Pins

You can use the I/O pins as:

- Digital inputs
  (See Table 2-2 on page 27 and Figure 2-19 on page 27.)
- High side pull-ups/dry contact switch inputs
  (See Figure 2-20 on page 28.)

- Analog inputs
  (See Table 2-3 on page 29 and Figure 2-22 on page 29.)
- Low side current sinks
  (See Figure 2-23 on page 29.)
- Digital outputs/open drains
  (See Table 2-4 on page 30 and Figure 2-24 on page 30.)

Note: The I/O pin functionality is programmable in Legato applications.

Digital Input

Digital input is available on I/O1, I/O2, and I/O3 on the power connector.

Note: To use I/O3 as a digital Input, GPIO56 (that drives I/O3 when used as a digital output) must be low.

You can connect any of these pins to a digital input to detect the state of a digital sensor or pulse counter.

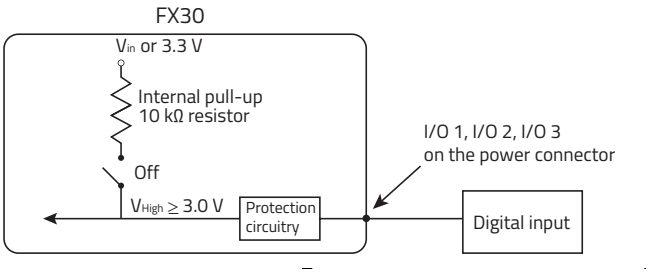


Figure 2-19: Digital Input

Note: When using a digital input, the pull-up should be Off.

Table 2-2: Digital Input

Pull-up	State	Minimum	Typical	Maximum	Units
Off	Low	—	—	1.0	V
	High	3.0	—	Vin	V

High Side Pull-up / Dry Contact Switch Input

The three external I/O pins on the FX30 power connector have a high side pull-up available. This high side pull-up can be driven low using a dry contact switch or NPN/PNP transistor.

To use I/O3 as a high side pull-up/switch input, GPIO56 (that drives I/O3 when used as a digital output) must be low.

Note: For this use case, the pull-up must be enabled.

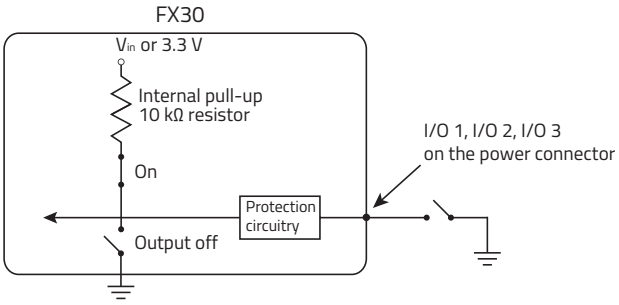


Figure 2-20: High Side Pull-up / Dry Contact Switch Input

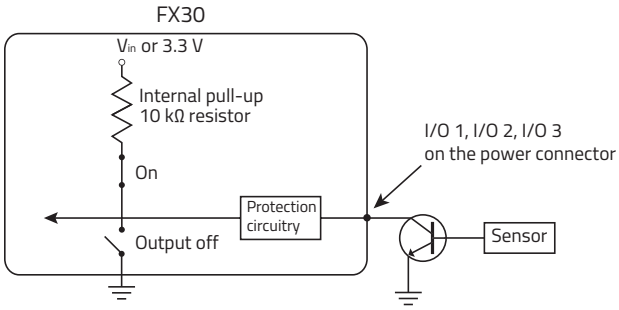


Figure 2-21: High Side Pull-up / Sensor and Transistor Input

Analog Input

Analog input is available on I/O2 on the power connector and on the IoT interface.

You can connect any of these pins to an analog gauge. As an analog input (voltage sensing pin), the gateway monitors voltage changes in small increments. This allows you to monitor equipment that reports status as an analog voltage.

The pin detects inputs of 0V–10 V (or 0V–5 V when the lower ADC range is selected). When used with a sensor to transform values into voltages, the pin can monitor measurements like temperatures, pressures or the volume of liquid in a container.

Note: The option to select the ADC voltage range has not been implemented in the current release.

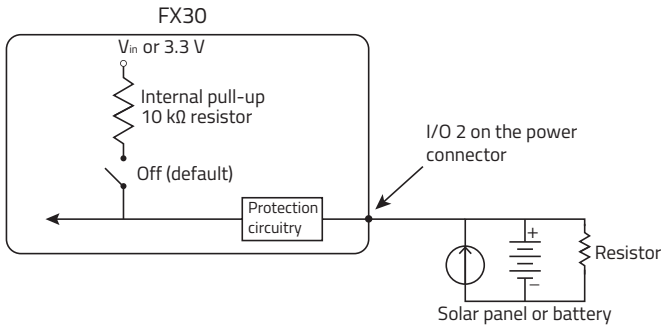


Figure 2-22: Analog Input

Note: When using an analog input, the pull-up should be Off.

Table 2-3: Analog Input

Pull-up		Minimum	Typical	Maximum	Units
Off	**Analog Input Range**	0	—	5 or 10[a]	V
	Analog Input Precision	—	< 10 for 0–10 V ADC range 5 for 0–5 V ADC range	25	mV

a. Depending on the ADC range selected.

Low Side Current Sink Output

Low side current sink output, for example to drive a relay, is only available using I/O3 on the power connector.

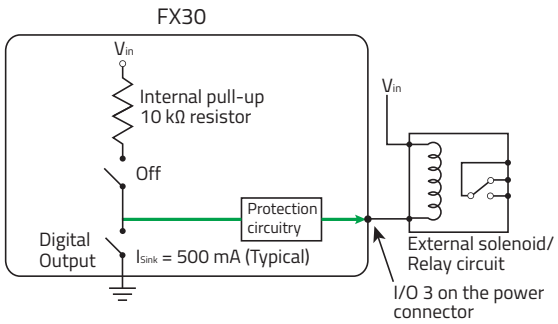


Figure 2-23: Low Side Current Sink

Note: When using low side current sink output, the pull-up should be Off.

The I/O can typically sink 400 mA, but this can vary depending on factors such as temperature.

Digital Output/Open Drain

Digital output/open drain is only available using I/O3 on the power connector.

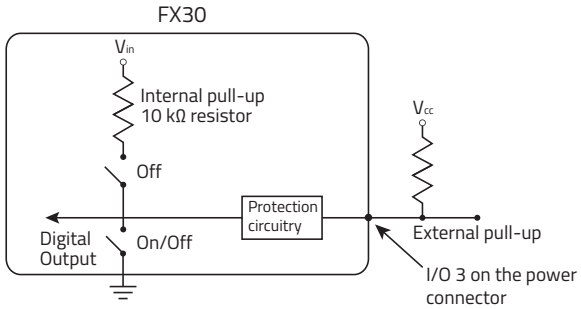


Figure 2-24: Digital Output/Open Drain

Note: To provide voltage on the digital output, either use the internal pull-up or add an external pull-up.

Table 2-4: Digital Output / Open Drain

Pull-up	State	Minimum	Typical	Maximum	Units	Comments
Off	Off	Open Circuit	—	—	—	—
	Active Low	—	—	0.5	V	5 mA, ≤ 5 V

Step 6—Check the FX30S operation

1. On initial power up, the Power LED is red. When the processor boots up, the LED turns amber (by default). The Power LED can be controlled by Legato applications.

   If the Power LED does not turn on, ensure that the:
   - Power connector is plugged in and supplying voltage of 4.75 V or greater.
   - On/Off (pin 3) is connected to the battery or power source. (See Step 5—Connect the Power and I/O on page 21 for details.)

LED Behavior

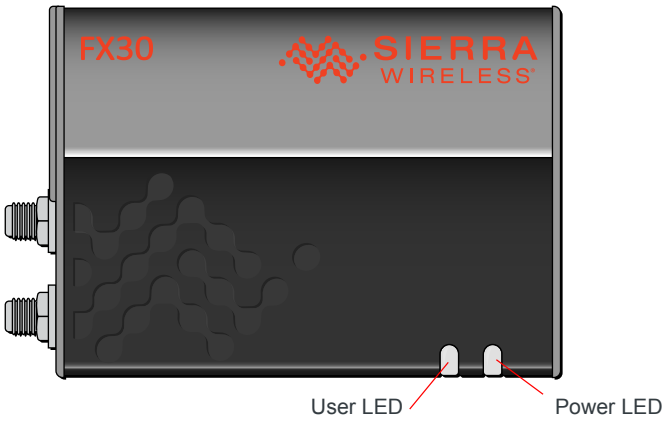


Table 2-5: LED Behavior

LED	Color/Pattern	Description
Power (Default Behavior) *Note: Based on three GPIOs. To define the behavior of this LED, see Power LED on page 60.*	**Off**	No power or input voltage ≥ 32 VDC or ≤ 4.75 VDC
	Solid Red	Gateway is powered on, not attached to cellular network.
	Solid Amber	Attached to cellular network.
User *Note: Based on two GPIOs. To define the behavior of this LED, see User LED on page 60.* *Note: You can write Legato applications to define User LED behavior.*	**Possible colors:** • Red • Green • Amber	User-defined behavior

Step 7—Use the FX30S

You can use the FX30S as:

- A USB modem (Use AT commands to configure)
- An embedded cellular platform for IoT applications (Use AT commands, Linux shell commands, or Legato to configure/program. See page 34.)

Set the Serial Port Mode

You can configure the serial port in either RS232 or RS-485 mode using Linux commands.

Note: Before executing these commands, ensure that the UART is set correctly. If the UART is not set correctly, you will not see serial data. To configure the UART for a particular service, see *Enable/Disable UART on page 39.*

You can configure the serial port in either RS232 or RS-485 mode. To change the serial port mode, use the following Linux command:

`./rs485.py /sys/devices/platform/msm_serial_hsl.0/rs_mode <NEW MODE>`

where `<NEW MODE>` is either:

- 0—RS232 (default)
- 1—RS485

For example, to change the mode to RS-485: `./rs485.py /sys/devices/platform/msm_serial_hsl.0/rs_mode 1`

Note: The rs_mode setting is not persistent, and will return to the default setting (RS232) when the gateway is reset.

Note: In release R14.0.2.001 and newer, the rs485.py script is available by default in the root file system in /usr/bin.
For your reference, the contents of the rs485.py script appear below.

```
#!/usr/bin/env python

import sys

fn = sys.argv[1]
if len(sys.argv) > 2:
    value = sys.argv[2]
else:
    value = None

ttyFile=open('/dev/ttyHSL0')

if value is None:
    sysfsFile = open(fn, 'r')
    print sysfsFile.read().strip()
else:
    sysfsFile = open(fn, 'w')
    sysfsFile.write(value)
```

To query the serial mode status, use:

`./rs485.py /sys/devices/platform/msm_serial_hsl.0/rs_mode`
which will return either RS232 or RS485.

By default, the RS-485 termination resistor is disabled. To enable or disable the RS-485 termination resistor, use the following Linux command:

```
./rs485.py /sys/devices/platform/msm_serial_hsl.0/
rs485_term <NEW MODE>
```

Where <NEW MODE> is either:

- 0—RS-485 termination resistor is disabled (drives GPIO63 high; the termination resistor is active low) (default)
- 1—RS-485 termination resistor is enabled (drives GPIO63 low)

For example, to enable the RS-485 termination resistor: `./rs485.py /sys/devices/platform/msm_serial_hsl.0/rs485_term 1`

To query the termination resistor status, use:

```
./rs485.py /sys/devices/platform/msm_serial_hsl.0/
rs485_term
```

which will return either `DISABLED` or `ENABLED`.

To make the rs485.py script executable, use the following command:

```
chmod a+x rs485.py
```

Default port settings

Serial:

- /dev/ttyHSL0
- 115200 8N1
- No flow control

AT commands:

- /dev/ttyAT
- 38400 8N1
- No flow control

USB0 serial:

- /dev/ttyUSB0
- 9600 8N1
- No flow control

Note: The FX30S does not support PPP.

Setup for AT Commands

To send AT Commands to the FX30S:

1. Connect the USB port to the computer.
2. Install the USB drivers for WP Series modules, available from: http://source.sierrawireless.com/devices/fx-series/FX30/ (in the Software section under Windows drivers).
3. Connect to the virtual COM port named “Sierra Wireless AT Commands Port”.

Using the FX30S as a USB modem

You can use the FX30S as a USB bitpipe modem based on the Qualcomm proprietary RMNET interface. This can be done through AT commands using AT!SCACT to open and close the data session. For more information and a detailed example, see Appendix B on page 70.

Using the FX30S as an Embedded Platform for IoT Applications

To configure or program the FX30S, you can use:

- AT Commands
- Linux Shell Commands on page 42
- Legato Application Framework on page 42

AT Commands

Note: Ensure that your computer is set up to issue AT commands to the FX30S. (See Setup for AT Commands.)

The radio module for the FX30S is the Sierra Wireless AirPrime® WP8548. Useful radio module AT commands include:

- Test AT command interface: `AT` should answer OK
- Get device information: `ATI`
- Get SIM status: `AT+CPIN?`
- Enter SIM PIN code: `AT+CPIN=XXXX`
- Configure APN: `AT+CGDCONT=1,"IP","xxxxxx.xxx"`
- Check APN configuration: `AT+CGDCONT?`
- Check signal quality: `AT+CSQ`
- Check network registration: `AT+CREG?`
- Check GPRS network registration: `AT+CGREG?`
- Check operator selected: `AT+COPS?`
- Check for PDP context status: `AT+CGACT?`
- Check for modem status: `AT!GSTATUS?`
- Open a LWM2M session to connect AirVantage: `AT+WDSS=1,1`

For a complete list of AT Commands for the WP8548 radio module, refer to the *WPx5xx AT Command Reference* (document number 4118047).

In addition, the AT Commands in Table 2-6 are specific to the FX30S.

Note: Parameters in angled brackets < > are mandatory. Parameters in square brackets [ ] are optional.

Table 2-6: FX30S AT Commands

Command	Description
GPIO AT Commands	
AT!FWD?GPIO Reads the current value of any input or output GPIO.	To Query: AT!FWD?GPIO,<GPIO #> where <GPIO #> is any available GPIO, i.e.: 2,7,8,13,21–25,32–66 *Note: GPIO59 and 63 are unavailable for Read and Write via AT commands.* Returned values are: • 0 (low) or 1 (high) • ERROR if invalid GPIO# Example: `AT!FWD?GPIO,2` `1` `OK` `AT!FWD?GPIO,10` `ERROR`
AT!FWD=GPIO Sets the value of any configured output GPIO.	To set: AT!FWD=GPIO,<GPIO #>,<value> where: • <GPIO #> is any GPIO set as an output. i.e.: 32, 43–66 8,13,25,33,42 only valid if set as output • <value> is either 0 (low) or 1 (high) Returned values are: • OK (if GPIO is set as requested) • ERROR (if invalid GPIO # or value) Example: `AT!FWD=GPIO,43,1` `OK` `AT!FWD=GPIO,2,1` `ERROR`

Table 2-6: FX30S AT Commands

Command	Description
AT!FWD?GPIOCFG Displays the direction and pull settings for exported GPIOs, as read from sysfs. If the GPIO is not exported, this command reports “NOT SET”. It does not export the GPIO.	To query: AT!FWD?GPIOCFG,<GPIO #> where <GPIO #> is any available GPIO, i.e. 2,7,8,13,21-25,32-66 Returned values are: • NOT SET (if GPIO has not been exported) • DIRECTION: <IN|OUT> • PULL: <UP|DOWN> (if GPIO has been exported) • ERROR (if invalid GPIO #) Example: `AT!FWD?GPIOCFG,2` `DIRECTION: IN` `PULL: UP` `OK` `AT!FWD?GPIOCFG,8` `NOT SET` `OK` `AT!FWD?GPIOCFG,10` `ERROR`
AT!FWD=GPIOCFG Configures the direction and optionally the pull setting for any configurable GPIO. This command exports a GPIO if it is not currently exported. Setting is runtime configurable only—this setting is NOT persistent through reboot.	To set: AT!FWD=GPIOCFG,<GPIO #>,<direction>[,<pull>] AT!FWD=GPIOCFG,<GPIO #>,<direction>[,<value>] where: • <GPIO #> is any configurable GPIO 8,13,25,33,42 • <direction> is either IN or OUT (case insensitive) • <pull> (optional) is either UP or DOWN (case insensitive) and only valid if <direction> is IN • <value> (optional) is either 0 or 1 to set the initial output value of the pin; it is only valid if <direction> is OUT. If omitted, a default value of 0 is used. Returned values are: • OK (if GPIO is configured as requested) • ERROR (if invalid GPIO #, direction or optional pull or value) Example: `AT!FWD=GPIOCFG,8,OUT` `OK` `AT!FWD=GPIOCFG,8,OUT,1` `OK` `AT!FWD=GPIOCFG,13,IN,UP` `OK` `AT!FWD=GPIOCFG,8,INPUT` `ERROR`
USB AT Commands	

Table 2-6: FX30S AT Commands

Command	Description
AT!FWD=USBMAC Sets the USB MAC address	To set: AT!FWD=USBMAC,<MAC address> *Note: Do not enter a MAC address with the first octet being a multicast (odd) number. Otherwise, a random MAC address could be assigned to the network adapter.* Returned values are: • OK (if USB MAC address is set as requested) • ERROR (if invalid MAC address) Example: AT!FWD=USBMAC,aa:3d:21:4b:a3:5a OK AT!FWD=USBMAC,49:12:fb:8e ERROR
AT!FWD?USBMAC Reads the USB MAC address in use for the interface	To query: AT!FWD?USBMAC Returned values are: • <value> (the USB MAC address) • ERROR (if usb0 interface does NOT exist) Example: AT!FWD?USBMAC aa:3d:21:4b:a3:5a OK
Device Query AT Commands	
AT!FWD?DEVTYPE Queries the device type	To query: AT!FWD?DEVTYPE Returned values are: • FX30 (if device type is Ethernet device) • FX30S (if device type is Serial device) • unknown (if device type is unknown) Example: AT!FWD?DEVTYPE FX30 OK

Table 2-6: FX30S AT Commands

Command	Description
AT!FWD?ALVER Queries AirLink version	To query: AT!FWD?ALVER The returned value is [release -]xxxxxxx “release” will show if it is a proper release, otherwise the version will be xxxxxxx (the git log SHA in short form) Example: AT!FWD?ALVER 1.0.0.5 OK
Factory Reset AT Commands For instructions on resetting the FX30S to factory default setting, see Reset to Factory Default Setting on page 45.	
AT!FWD=FACTORYRECOVERY Enables or disables the factory default recovery mechanism. *Note: This command does not perform a factory reset. It enables the reset button to perform a factory reset when it is pressed and held.*	To set: AT!FWD=FACTORYRECOVERY,<status> where <status> can be either: ENABLE, DISABLE Returned values are: • OK (if a valid <status> is entered) • ERROR (if an invalid <status> is entered) Example: AT!FWD=FACTORYRECOVERY,DISABLE OK
AT!FWD?FACTORYRECOVERY Queries the current status of the factory default recovery mechanism	To query: AT!FWD?FACTORYRECOVERY Returned values are: • ENABLED (if the factory recovery is enabled) • DISABLED (if the factory recovery is disabled) Example: AT!FWD=FACTORYRECOVERY ENABLED OK

Table 2-6: FX30S AT Commands

Command	Description
Enable / Disable UART	
AT!MAPUART Configure UART 1 & 2 *Note: UART 1 & 2 are disabled by default. A reboot is required for the changes to take effect.*	To set: AT!MAPUART=<service>[,<UART number>] where: • <service> can be: 0—UART disabled 1—AT Command service (Note: Not available for UART 2) 2—Diagnostic Message service 3—Reserved 4—NMEA service 5–13—Reserved 14—RS-485 Linux application (Note: Not available for UART 2) *Note: Option 14 is only available in release R14.0.2.001 or later. Option 14 uses /dev/ttyHSL0 driver. As well, RS-485 will be enabled automatically upon startup.* 15—RS232 with Hardware Flow control: • Linux application (UART 1) *Note: Option 15 is only available in release R14.0.2.001 or later. Option 15 uses /dev/ttyHS0 driver. However, option 17 uses /dev/ttyHSLx driver, where x is the UART number. As well, RS232 with flow control will be enabled automatically upon startup.* 16—Linux console 17—Customer Linux application • <UART number> can be: 1—UART 1 (Default if UART number is not specified) 2—UART 2 Value returned: OK Example: `AT!MAPUART=17,1` OK

Table 2-6: FX30S AT Commands

Command	Description
AT!MAPUART? Query UART Status	To query: AT!MAPUART? Values returned are !MAPUART: <service UART1>,<service UART2> where <service> can be: 0—UART disabled 1—AT Command service 2—Diagnostic Message service 3—Reserved 4—NMEA service 5–13—Reserved 14—RS-485 Linux application (Note: Not available for UART 2) 15—RS232 with Hardware Flow control: • Linux application (UART 1) 16—Linux console 17—Customer Linux application Example: `!MAPUART:17,0` OK

Table 2-6: FX30S AT Commands

Command	Description
AT!FWD?GETAPPINFO Query Legato application info	To query: AT!FWD?GETAPPINFO,<LEGATO APP NAME> Returned values are: • <Legato app name> • status • running processes • app.name • app.md5 • app.version • legato.version *Note: Returned values may be truncated. However, OK will still be returned.* *Note: <Legato app name> is case sensitive. If the name does not match, the command returns [not installed] and ERROR.* Example: `AT!FWD?GETAPPINFO,columbiaAtService` `columbiaAtService` `status: running` `running processes:` `columbiaAtService[565] (565)` `sh[1060] (1060)` `/legato/systems/current/bin/app[1061] (1061)` `app.name: columbiaAtService` `OK`

Linux Shell Commands

You can communicate with the FX30S using Legato shell commands. To connect to the USB port on the Linux shell:

1. Connect the USB port on the FX30S to the computer.
2. Connect an SSH client root@192.168.2.2

   The first time you connect, you are prompted to change your Linux root password.

For more information, refer to the Legato shell documentation on legato.io

Useful Linux commands

Useful Linux commands include:

- Get device information: `cm info`
- Get SIM information: `cm sim`
- Get APN status: `cm data`
- Get modem status: `cm radio`
- Switch to AT mode: `microcom -E /dev/ttyAT`
  <CTRL +x> to escape
- Read GPIO Value: `cat /sys/class/gpio/gpioxx/value`
- Set GPIO: `echo 1 > /sys/class/gpio/gpioxx/value`
- Clear GPIO: `echo 0 > /sys/class/gpio/gpioxx/value`
- Establish a data connection: `cm data connect`
- Check Legato application status: `app status`

For a complete list of Linux commands, see:
http://legato.io/legato-docs/latest/toolsTarget_cm.html

Linux Startup

The supported method of making changes to the Linux startup is to create a Legato application. Changes or additions to the Linux scripts in `/etc/rcS.d` are not supported by Sierra Wireless.

Legato Application Framework

Before building custom applications for the FX30S, you need to become familiar with Legato. The best place to start is legato.io. Click the Build Apps icon. This section contains:

- Concepts
  - Overview—a high-level summary of Legato's approach to application development
  - Develop Apps—the essentials for creating an app from scratch
  - Definition Files—reusable external interfaces and internal content
  - Sample Apps—sample apps for commonly-needed functions
- Tools—Information on Target, Host, and Build tools
- Security— For security reasons:
  - You are prompted to change the Linux root password the first time you attempt to log in to the Linux console.

- By default, all routes on the Ethernet and cellular interfaces are disabled. To reconfigure the firewall to allow these connections, see Reconfiguring the Firewall on page 43.

Other references:

- Download the Legato Reference Manual (PDF) from http://source.sierrawireless.com/resources/legato/referencemanual

Reconfiguring the Firewall

To allow a response on any interface for a device-initiated request:

1. Open the file located at `/etc/iptables.rules`.
   Ignore the comment that the `/etc/iptables.rules` file is generated.

   Note: Do not attempt to configure the firewall using the files `/etc/iptables/rules.v4` and `/etc/iptables/rules.v6`. These are mangOH iptables rules that are not supported by the FX30S.

2. Add the following rule:
   `-A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT`

   Note: The new rule must be added before the DROP rule, as shown below.

```
# Generated by iptables-save v1.4.21 on Thu Nov 10 19:02:24 2016
*filter
:INPUT ACCEPT [189:17812]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [148:22530]
-A INPUT -i rmnet0 -p icmp -m icmp --icmp-type 0 -m state --state ESTABLISHED -j ACCEPT
-A INPUT -i rmnet0 -p tcp -m tcp --sport 53 -m state --state ESTABLISHED -j ACCEPT
-A INPUT -i rmnet0 -p udp -m udp --sport 53 -m state --state ESTABLISHED -j ACCEPT
-A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT
-A INPUT -i rmnet0 -j DROP
-A INPUT -i eth0 -p icmp -j ACCEPT
-A INPUT -i eth0 -p tcp -m tcp --sport 53 -m state --state ESTABLISHED -j ACCEPT
-A INPUT -i eth0 -p udp -m udp --sport 53 -m state --state ESTABLISHED -j ACCEPT
-A INPUT -i eth0 -j DROP
COMMIT
Completed on Thu Apr 27 19:02:24 2017
```

Interface Mapping

Table 2-7: FX30S Interface Mapping to the Linux Interface

FX30S Interface	Linux System
GPIOs	/sys/class/gpio/gpioxx
Ethernet	eth0[a]
USB	usb0[b]
Serial	/dev/ttyHSL0

a. eth0 has a default IP address of 192.168.13.31
b. usb0 is a network interface and has a default IP address of 192.168.2.2

Managing the I/O Interface

To manage the I/O interfaces such as digital and analog I/Os, LEDs, push button, and hardware settings driven by GPIO, you can use AT commands, Linux shell commands, or the Legato Application Framework.

- AT Commands

  See AT!FWD?GPIO and AT!FWD=GPIO documentation on page 35, and I/O mapping in Table 3-10 on page 59.

  As some FX30S GPIOs are driven by an I/O expander, do not use standard AT+WIOR/WIOW AT commands for the FX30S.

  Warning: *Most FX30S GPIOs are preconfigured. Do not use the AT+WIOCFG command! Using this command could make the FX30S inoperable.*

  Here are some AT command examples for GPIOs:

  Table 2-8: AT command examples

To...	Use...
Turn on the green User LED	AT!FWD=GPIO,48,0
Turn off the green User LED	AT!FWD=GPIO,48,1
Read the push button state	AT!FWD?GPIO,7
Read the analog input value (in mV)	AT!MADC?5

- Linux Shell Commands

  See Linux Shell Commands on page 42 and I/O mapping in Table 3-10 on page 59.

Here are some Linux shell command examples for GPIOs:

Table 2-9: Linux shell command examples

To...	Use...
Turn on the green User LED	echo 0 > /sys/class/gpio/gpio48/value
Turn off the green User LED	echo 1 > /sys/class/gpio/gpio48/value
Read the push button state	cat /sys/class/gpio/gpio7/value
Read the analog input value (in µV)	cat /sys/class/hwmon/hwmon0/device/mpp_05

- Legato Application Framework

  For information on using Legato applications to manage GPIOs, refer to: http://legato.io/legato-docs/latest/c_gpio.html

  For information on using Legato applications to manage ADCs, refer to: http://legato.io/legato-docs/latest/c_adc.html

AirVantage IoT Platform

AirVantage IoT platform offers advanced services for device management, connectivity management and for enabling device to cloud applications.

AirVantage Device Management services are available through a web-based operations console providing an intuitive and customizable user interface to configure, monitor, and manage your deployed FX30S:

- Monitoring and Management
- Command and Control
- OTA Firmware Update
- Deployment Configuration
- Legato Application Lifecycle Management

Free and unlimited OTA Firmware Updates are offered with FX30S.

To get started, call your Sierra Wireless reseller or visit: https://airvantage.net/

Reset to Factory Default Setting

To reset the FX30S to the factory default setting:

1. Ensure that the Recovery Activation status is set to Enable. (See Factory Reset AT Commands on page 38.)
2. Upon applying power, press and hold the reset button for about 10 seconds.

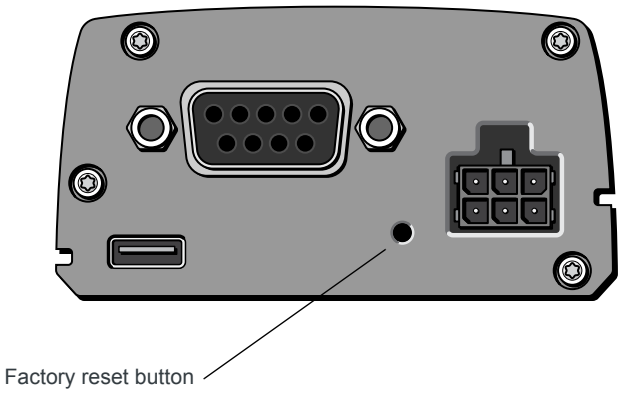


Figure 2-25: Factory reset button

Note: When you reset the gateway to the factory default settings, the root password, if defined, is removed.

3: Specifications

This chapter describes the FX30S gateway specifications.

Table 3-1: Specifications

Certification and Interoperability	**Emissions / Immunity**	• CE (Including EMC Test case for vehicle installation EN301489) • ACMA RCM • FCC • Industry Canada
	Safety	• CB Report IEC 60950-1 • UL Listed
	Industry Certification for Vehicles	• E-Mark UN ECE Regulation No. 10 Rev. 5
	Environmental Compliance	• RoHS 2011/65/EU (RoHS 2) • WEEE • REACH
	GSM/HSPA+ Certifications	• PTCRB • GCF
Environmental Testing	**Vibration (operational)**	MIL-STD-810G, test method 514.6C Category 4 CWV (Composite Wheeled Vehicle)
	Shock (operational)	MIL-STD-810G, test method 516.6
	SAE J1455 (Shock and Vibration) for heavy-duty vehicles	• Vibration: Section 4.10.4.2 Cab Mount • Shock: Section 4.11.3.4 Operational Shock • Electrical: 12 and 24 V systems Section 4.13.1—12 and 24 V Section 4.13.2—SAE J1113-11 Level IV
	Temperature (operational)	MIL-STD-810G, test methods 501.5, 502.5 (-30° to +75°C)
	Temperature (non-operational)	MIL-STD-810G, test methods 501.5, 502.5 (-40° to +85°C)
	Thermal shock	MIL-STD-810G, test method 503.5
	Humidity (operational)	MIL-STD-810G, test method 517.5 95% RH over temperature range of +20°C to + 60°C
	IP rating	IP30
	Drop (non-operational)	ISTA 2A 2001, test categories 1, 4, 5, and 6
Electrostatic discharge (ESD)		8 KV contact discharge, 15 V air discharge
Mobile Network Operator Certification (pending)		• AT&T (planned)

Table 3-1: Specifications (Continued)

Network Technology	**HSPA+ GSM/GPRS/EDGE**	For a list of supported bands, see Table 3-4 on page 52.
Host Interfaces	**Antenna connectors**	• Cellular • GNSS
	USB	• USB 2.0 micro-B connector complies with USB Version 2.0 for high speed operation • Sierra Wireless recommends you: • Use a USB 2.0 cable • Connect directly to your computer for best throughput.
	IoT (Internet of Things) Connector	See Internet of Things (IoT) Expansion Card on page 62.

Table 3-1: Specifications (Continued)

	Serial Port Configurations The FX30S has one serial port that can be configured as a: • 9-pin RS232 serial port that connects directly to most computers or other devices with a standard serial straight-through cable • Half-duplex RS-485 serial interface (See RS-485 Serial Interface on page 50)	
	RS232 Serial Port	Serial port configured for RS232: • RS232/DTR allows for wakeup from Ultra Low Power Mode • Nine wire • Auto shutdown (controlled by DTR line) • Depending on Legato application, supports X-on/X-off • Hardware flow control • Complies with the EIA RS232D specification for DCE equipment • Output driver levels swing from -7 VDC to +7 VDC with normal loading • DB-9 is configured as a DCE device designed for direct connection to a DTE device, such as a computer *Note: If you need to connect to a DCE device, you must use a null modem (cross-over) cable.*

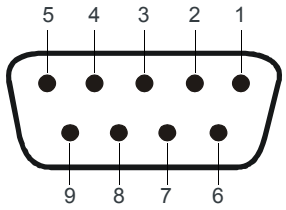


Figure 3-1: DB-9 Female Serial Connector

Table 3-2: RS232 Serial Connector Pin-out

Name	Pin	Description	Type
DCD	1	Data Carrier Detect	OUT
RXD	2	Receive Data	OUT
TXD	3	Transmit Data	IN
DTR	4	Data Terminal Ready	IN
GND	5	Main GND. Connected internally to BOARD GND	GND
DSR	6	Data Set Ready	OUT
RTS	7	Ready To Send	IN
CTS	8	Clear To Send	OUT
RI	9	Ring Indicator	OUT

Table 3-1: Specifications (Continued)

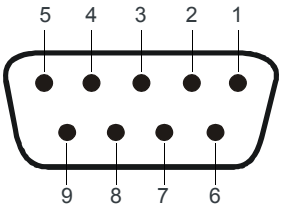
<table>
<tr><td></td><td>RS-485 Serial Interface</td><td>Serial port configured for RS-485:
• Half-duplex (2-wire) interface
• Software-configurable termination resistor
• Maximum baud rate: 115.2 k
• Maximum cable length: 25 meters at maximum baud rate
 

Figure 3-2: DB-9 Female Serial Connector
Table 3-3: RS-485 Serial Connector Pin-out
<table><tr><th>Name</th><th>Pin</th><th>Description</th><th>Type</th></tr><tr><td>RS-485_B</td><td>1</td><td>RS-485 Negative Signal</td><td>Bidirectional</td></tr><tr><td>RS-485_A</td><td>2</td><td>RS-485 Positive Signal</td><td>Bidirectional</td></tr><tr><td>N/A</td><td>3</td><td></td><td>—</td></tr><tr><td>N/A</td><td>4</td><td></td><td>—</td></tr><tr><td>GND</td><td>5</td><td>Ground</td><td>GND</td></tr><tr><td>N/A</td><td>6</td><td></td><td>—</td></tr><tr><td>N/A</td><td>7</td><td></td><td>—</td></tr><tr><td>N/A</td><td>8</td><td></td><td>—</td></tr><tr><td>N/A</td><td>9</td><td></td><td>—</td></tr></table></td></tr>
<tr><td colspan="2">SIM Card Interface</td><td>• Mini-SIM (2FF) SIM card operated at 1.8 V/3.3 V.</td></tr>
<tr><td colspan="2">Input/Output
For more information, see page 25.</td><td>• Configurable I/O
• Wakeup on I/O, serial, or cellular events</td></tr>
<tr><td colspan="2">Power Adapter Pins</td><td>6-Pin connector:
• Power
• Ground
• On/Off
• I/O1
• I/O2
• I/O3</td></tr>
<tr><td colspan="2">LEDs
See LED Behavior on page 31.</td><td>2 LEDs:
• Power
• User configurable</td></tr>
</table>

Table 3-1: Specifications (Continued)

Mechanical Specifications For mechanical drawings, dimensions, and weight, see Mechanical Specifications on page 54.		• Housing—The FX30S is made of ruggedized powder-coated aluminum. • RoHS2—The FX30S complies with the Restriction of Hazardous Substances Directive 2011/65/EU (RoHS2). This directive restricts the use of hazardous materials in the manufacture of various types of electronic and electrical equipment.
Screw Torque Settings		• Mount screws 1.1 N-m (10 in-lb) • Antennas Finger tight (5–7in-lb.) is sufficient and the max torque should not go beyond 1.1 N-m (10 in-lb).
Operating Voltage		4.75 to 32 VDC
GNSS Technology	**Satellite channels available**	Acquisition: 118 Simultaneous tracking: 40
	Support for predicted orbits	Yes
	Predicted orbit CEP-50 accuracy	5 meters
	Constellations	• GPS L1 • Galileo E1 • GLONASS L1 FDMA
	GNSS Message Protocol	NMEA
	Standalone Time to First Fix (TTFF)	• Hot start: 1 second • Warm start: 29 seconds • Cold start: 32 seconds
	Sensitivity	Standalone MS-based tracking sensitivity: -161 dBm Cold start sensitivity: -145 dBm MS-assisted GNSS acquisition sensitivity: -158 dBm

Radio Frequency Bands

Table 3-4: FX30S Supported Radio Frequency Bands

Radio Technology	Band	Frequency (Tx)	Frequency (Rx)
HSPA+	Band 1	1920–1980 MHz	2110–2170 MHz
	Band 2	1850–1910 MHz	1930–1990 MHz
	Band 5	824–849 MHz	869–894 MHz
	Band 6	830–840 MHz	875–885 MHz
	Band 8	880–915 MHz	925–960 MHz
	Band 19	830–845 MHz	875–890 MHz
GSM / GPRS / EDGE	Band 850	824–849 MHz	869–894 MHz
	Band 900	880–915 MHz	925–960 MHz
	Band 1800	1710–1785 MHz	1805–1880 MHz
	Band 1900	1850–1910 MHz	1930–1990 MHz

Table 3-5: GNSS Bands Supported

Band	Frequency
GPS L1	1575.42 MHz
GLONASS L1 FDMA	1602 MHz
Galileo E1	1575.42 MHz

Radio Module Conducted Transmit Power

The following tables provide radio module conducted transmit power specifications.

Table 3-6: WP8548 Conducted Transmit Power (HSPA+)

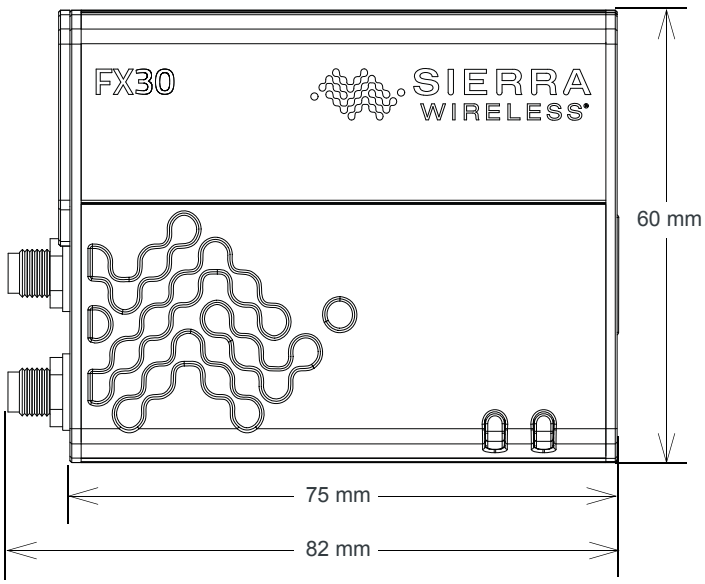
Band	Conducted Tx Power (dBm)	Notes
HSPA+		
Band 1 (IMT 2100 12.2 kbps) Band 2 (UMTS 1900 12.2 kbps) Band 5 (UMTS 850 12.2 kbps) Band 6 (UMTS 800 12.2 kbps) Band 8 (UMTS 900 12.2 kbps) Band 19 (UMTS 850 12.2 kbps)	+23±1	Connectorized (Class 3)

Table 3-7: WP8548 Conducted Transmit Power (GSM)

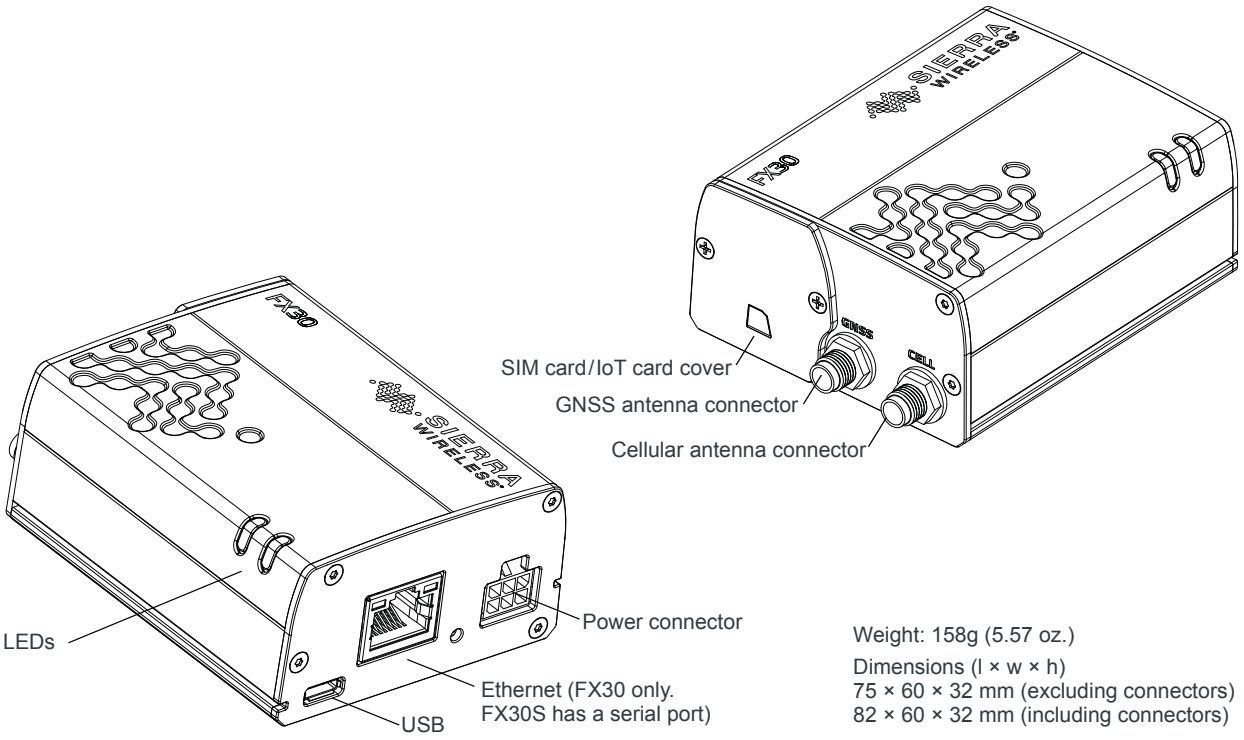
RF Band	Min	Typ	Max	Notes
GSM 850	31	32	33	GMSK mode, connectorized (Class 4, 2 W; 33 dBm)
E-GSM 900	31	32	33	
DCS 1800	28	29	30	GMSK mode, connectorized (Class 1, 1 W; 30 dBm)
PCS1900	28	29	30	
GSM 850	25.5	26.5	27.5	8PSK mode, connectorized (Class E2; 0.5 W; 27 dBm)
E-GSM 900	25.5	26.5	27.5	
DCS 1800	24.5	25.5	26.5	8PSK mode, connectorized (Class E2; 0.4 W; 26 dBm)
PCS1900	24.5	25.5	26.5	

Mechanical Specifications

Top view



End views



Weight: 158g (5.57 oz.)

Dimensions (l × w × h)
75 × 60 × 32 mm (excluding connectors)
82 × 60 × 32 mm (including connectors)

Figure 3-3: FX30S Mechanical Specifications

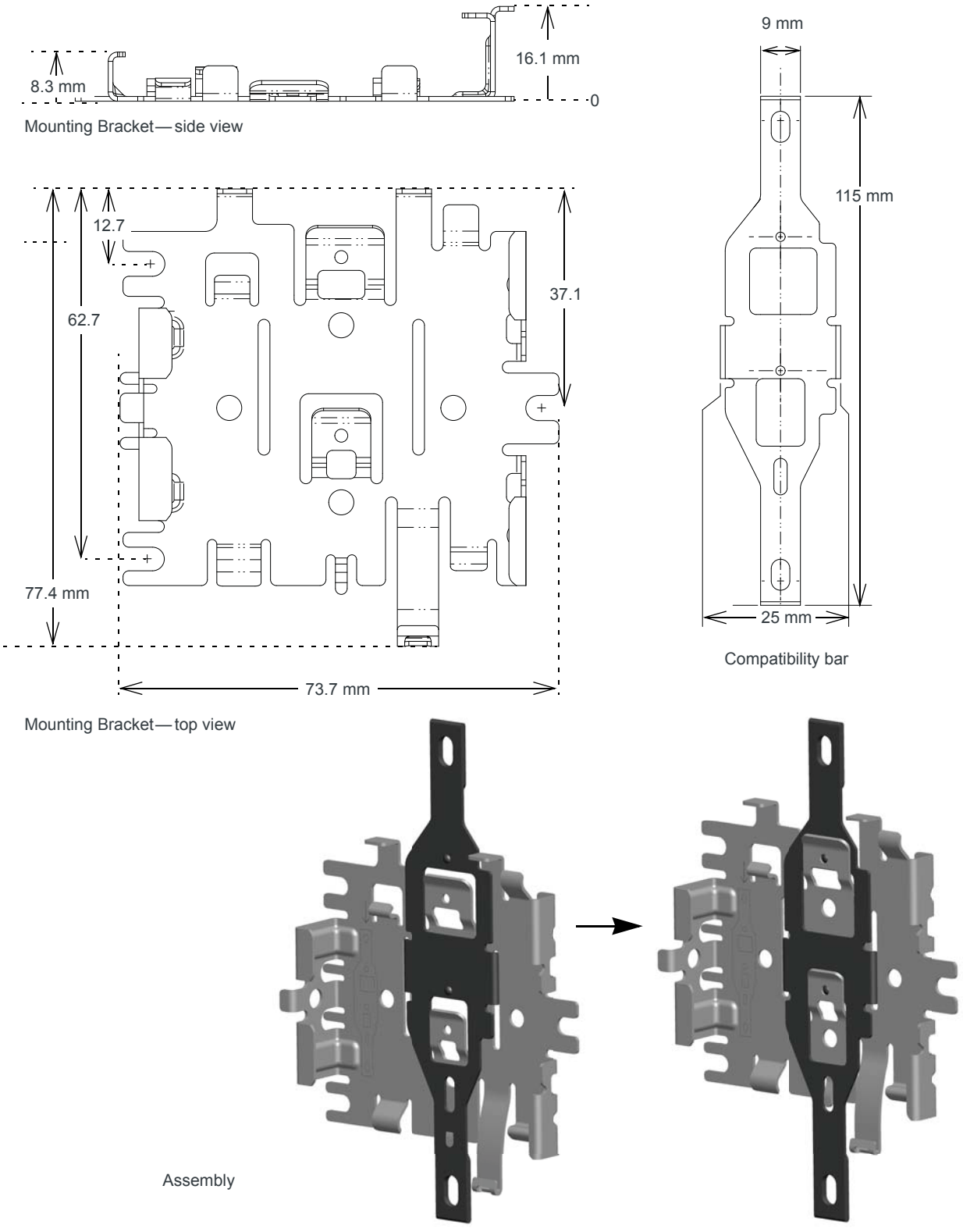
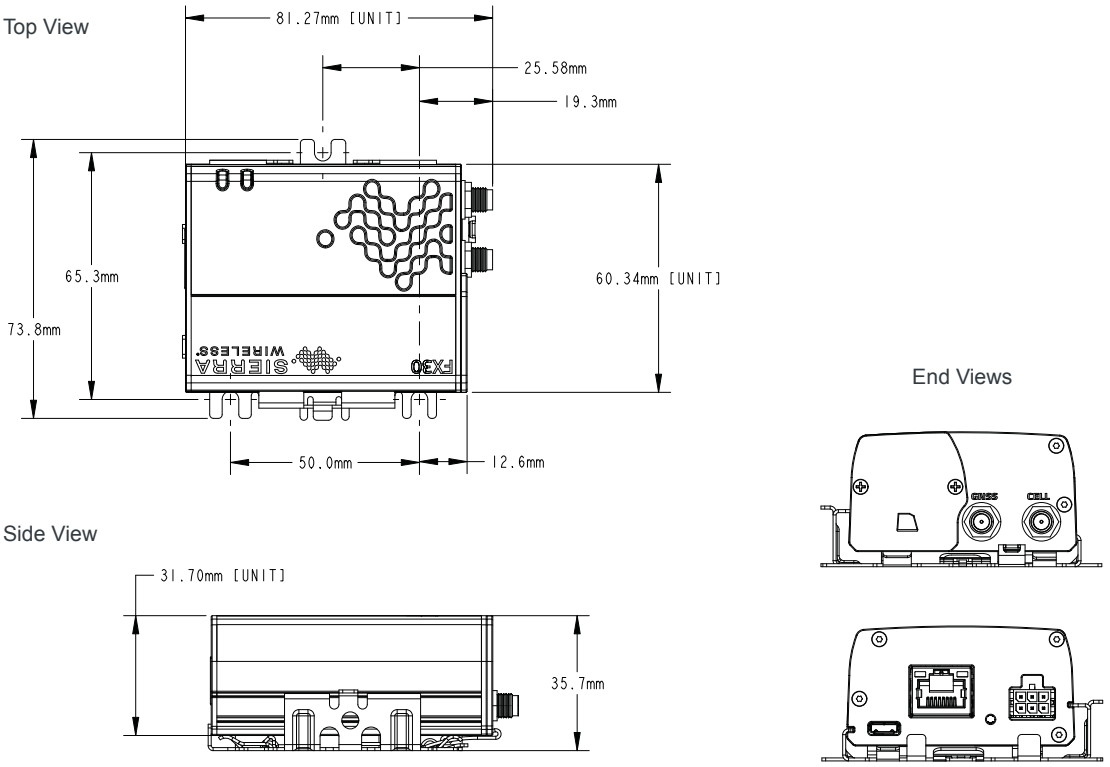


Figure 3-4: Mounting Bracket Mechanical Specifications



Note: “Unit” refers to the gateway itself.

Figure 3-5: FX30S on mounting bracket

Power Modes

The FX30S is designed to handle extremely low power. It has three power modes:

- OFF Mode
- Ultra Low Power Mode on page 57
- Active Mode on page 57

OFF Mode

In Off mode the FX30S application processor, WWAN radio, and low power micro-controller are off. On/Off is controlled by the On/Off Pin 3/GPIO24 and Power Hold/GPIO58.

If no Legato applications are in place for GPIO58 (power hold), the gateway is off when Pin 3 is low and on when Pin 3 is high.

However, the power line from Pin 3 is also connected to GPIO58 (power hold). GPIO58 is low by default. If either Pin 3 or GPIO58 is high, the gateway is on. GPIO24 monitors Pin 3. (See Figure 3-6 on page 57.) This gives you the option to design an application that detects when Pin 3 goes low, and holds the power on temporarily to complete the desired actions prior to the gateway turning off, for example, a graceful shutdown process or a last-gasp type feature.

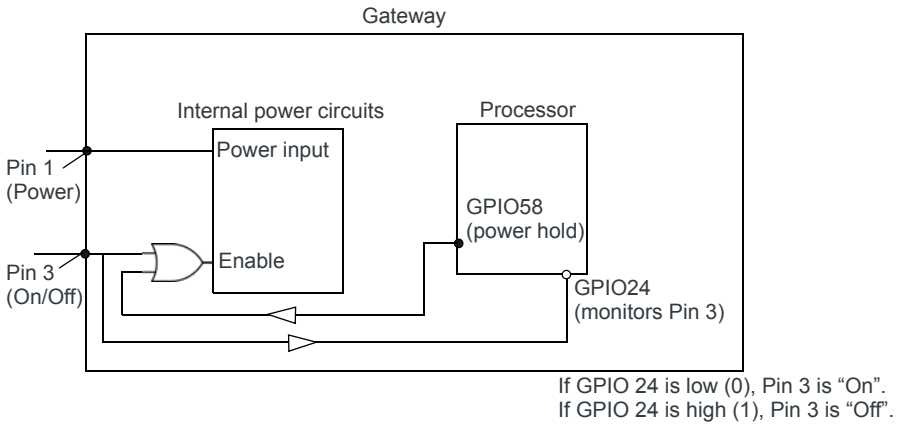


Figure 3-6: FX30S On/Off functionality

Typical wake-up time before network attach is 15 seconds.

Ultra Low Power Mode

In Ultra Low Power Mode (ULPM), the FX30S application processor and WWAN radio are off.

The low power micro-controller monitors the wakeup triggers which are:

- Timer (The timer wakeup must be configured prior to the gateway entering ULPM.) You can use the Legato Timer API or the Legato Power Management tool (pmtool) command to configure wakeup from ULPM.
- Digital Inputs IO1 and IO2 (IO wakeup must be configured prior to the gateway entering ULPM.) You can use the Legato Power API or pmtool command to configure wakeup from ULPM.

FX30S can be put into ULPM using the “pmtool shutdown” Legato command or the Ultra Low Power Mode Legato API.

Typical wake-up time before network attach is 15 seconds.

Active Mode

In Active mode the FX30S application processor is running and the modem is operating in one of the following modes:

- Full function—The application processor is fully functional and the WWAN radio is on; the GNSS radio can be turned on/off.
- Idle—The application processor is fully functional and the WWAN radio is on. The module is registered on the network, but there is no active connection; the GNSS radio can be turned on/off.
- Airplane mode—The application processor is fully functional and the WWAN radio is off; the GNSS radio can be turned on/off. By default the GNSS radio is on.

Depending on the application, you can lower power consumption by disabling the Ethernet interface and GPS bias using GPIO52 and GPIO55 respectively. (See Table 3-10 on page 59.)

Power Consumption

Table 3-8: Power Consumption — Active Mode

Mode	Conditions	Voltage	Max continuous		Burst	
		V	mA	mW	mA	mW
Active Idle	USB and Serial cables are plugged in	24	13	312		
		12	23	276		
		4.5	120	540	133	599
Active Full Function WCDMA	Max Tx power (+23 dBm) USB 57 Mbps Serial connected	24	106	2544	123	2952
		12	205	2460	226	2712
		5	432	2160	525	2625
Active Full Function GSM	Max Tx power (+31 dBm) USB 57 Mbps Serial connected	24	85	2040	204	4896
		12	166	1992	490	5880
		5	357	1785	1260	6300

Table 3-9: Power Consumption — Off and Ultra Low Power Modes

Mode	Conditions	Voltage	Maximum continuous	
		V	µA	µW
Off	On/Off is set to Off	24	104	2496
		12	70	840
		5	20	100
Ultra Low Power	Triggering timer	24	170	4080
		12	118	1416
		5	91	455

WP Radio Module Interface Mapping

Table 3-10 describes the GPIO pins on the WP8548 radio module that are specific to the FX30S. For a complete list of pin-outs for the WP8548 radio module, refer to the *WP75xx/WP8548 Product Technical Specification*.

Table 3-10: WP8548 Radio Module Interface Mapping

Name	Function	WP GPIO/ ADC	Linux Interface	Description
On/Off (Pin 3)	External On/Off Input	GPIO24	/sys/class/gpio/gpio24	High: external On/Off signal is Low (in OFF state) (default) Low: external On/Off signal is High (in ON state) *Note: GPIO58 must be low in order for device to power off.*
IO1 (Pin 4)	Digital Input	GPIO2	/sys/class/gpio/gpio2	High: External I/O1 is low (ground) Low: External I/O1 is high Default is external low.
	Internal Pull-up	GPIO57	/sys/class/gpio/gpio57	High: Enables internal pull-up to 3.3V (default) Low: Disables internal pull-up
IO2 (Pin 5)	Digital Input	GPIO21	/sys/class/gpio/gpio21	High: External I/O2 is low (ground) Low: External I/O2 is high Default is external low.
	Internal Pull-up	GPIO53	/sys/class/gpio/gpio53	High: Enables internal pull-up to 3.3V Low: Disables internal pull-up (default)
	Analog Input	ADC1	/sys/class/hwmon/hwmon0/ device/mpp_05	ADC with 15 bits of resolution
IO3 (Pin 6)	Digital Input	GPIO22	/sys/class/gpio/gpio22	High: External I/O3 is low (ground) Low: External 1/O3 is high Default is external low.
	Internal Pull-up	GPIO54	/sys/class/gpio/gpio54	High: Enables internal pull-up to Vin Low: Disables internal pull-up (Default)
	Digital Output	GPIO56	/sys/class/gpio/gpio56	High: Output transmitter ON—clamps external IO3 to ground Low: Output transmitter OFF—IO3 floats (can be used as input) Default is external low.
External Push Button	Digital Input	GPIO7	/sys/class/gpio/gpio7	High: External Push button is released (default) Low: External push-button is being pushed

Table 3-10: WP8548 Radio Module Interface Mapping

Name	Function	WP GPIO/ ADC	Linux Interface	Description
Power LED *Note: Please note the GPIO polarity when turning on Power LEDs.*	Red Power LED	GPIO49	/sys/class/gpio/gpio49	High: Turns Power LED (Red) ON (default) Low: Turns Power LED (Red) OFF
	Green Power LED	GPIO50	/sys/class/gpio/gpio50	High: Turns Power LED (Green) OFF (default) Low: Turns Power LED (Green) ON *Note: Requires correct setting of GPIO51 to function.*
	Green LED Function	GPIO51	/sys/class/gpio/gpio51	High: Connects GPIO50 to green Power LED Low: Connects WAN Activity signal to green Power LED (default)
	Amber LED	GPIO49 GPIO50 GPIO51	/sys/class/gpio/gpio49 /sys/class/gpio/gpio50 /sys/class/gpio/gpio51	Use combination of: • GPIO49 High • GPIO50 Low • GPIO51 High
User LED	Red User LED	GPIO47	/sys/class/gpio/gpio47	High: Turns User LED (Red) OFF (default) Low: Turns User LED (Red) ON
	Green User LED	GPIO48	/sys/class/gpio/gpio48	High: Turns User LED (Green) OFF (default) Low: Turns User LED (Green) ON
	Amber LED	GPIO47 GPIO48	/sys/class/gpio/gpio47 /sys/class/gpio/gpio48	Use combination of: • GPIO47 Low • GPIO48 Low
Ethernet Disable	Disable Ethernet Port	GPIO55	/sys/class/gpio/gpio55	High: Enables Ethernet controller (default) Low: Disables Ethernet controller
Power Hold	On/Off Override	GPIO58	/sys/class/gpio/gpio58	High: Holds power on even if On/Off is Low (used to control shut-down) (default) Low: Release power hold; On/Off line controls On/Off state
		GPIO32	/sys/class/gpio/gpio32	Reserved; do not use
Note: Do not configure serial port GPIOs. These are configured automatically when RS-485 mode is selected. See RS485 Python Script on page 73.				
Serial port	Disables RS232	GPIO 59		HIGH: Enables RS232 transceiver (required for RS232 mode of operation) LOW: Disables RS232 transceiver (either for RS-485 operation or for power saving)

Table 3-10: WP8548 Radio Module Interface Mapping

Name	Function	WP GPIO/ ADC	Linux Interface	Description
Serial port	Enables RS-485 transmitter	GPIO 60		HIGH: Enables RS-485 transmitter. Should only be enabled when there is an actual character being transmitted (half-duplex) LOW: Disables RS-485 transmitter (for RS232 operation, RS-485 operation in receive mode, or for power saving)
Serial port	Enables RS-485 receiver	GPIO 61		HIGH: Disables RS-485 receiver (for RS232 operation, RS-485 operation in transmit mode with no loop-back, or for power saving) LOW: Enables RS-485 receiver (for RS-485 character reception (half-duplex) or for RS-485 transmit with loop-back)
Serial port	Enables RS-485 termination resistor	GPIO 63		HIGH: Disables the RS-485 termination resistor LOW: Enables the RS-485 termination resistor (should only be used if the serial interface is in RS-485 mode)

Internet of Things (IoT) Expansion Card

The FX30S is compatible with single slot, category 1 (14 mm maximum), power category 1 and 2 IoT Expansion cards. The IoT connector has 38 pins and supports the following interfaces:

- 1 × ADC
- 4 × GPIO
- 1 × I2C
- 1 × PCM
- 1 × SPI
- 1 × UART
- 1 × USB
- 1 × SDIO

For IoT Expansion Card Developers

When developing an IoT Expansion card to use with the FX30S, be aware that the distance between the front SMA end plate and PCA front edge is 1.89 mm.

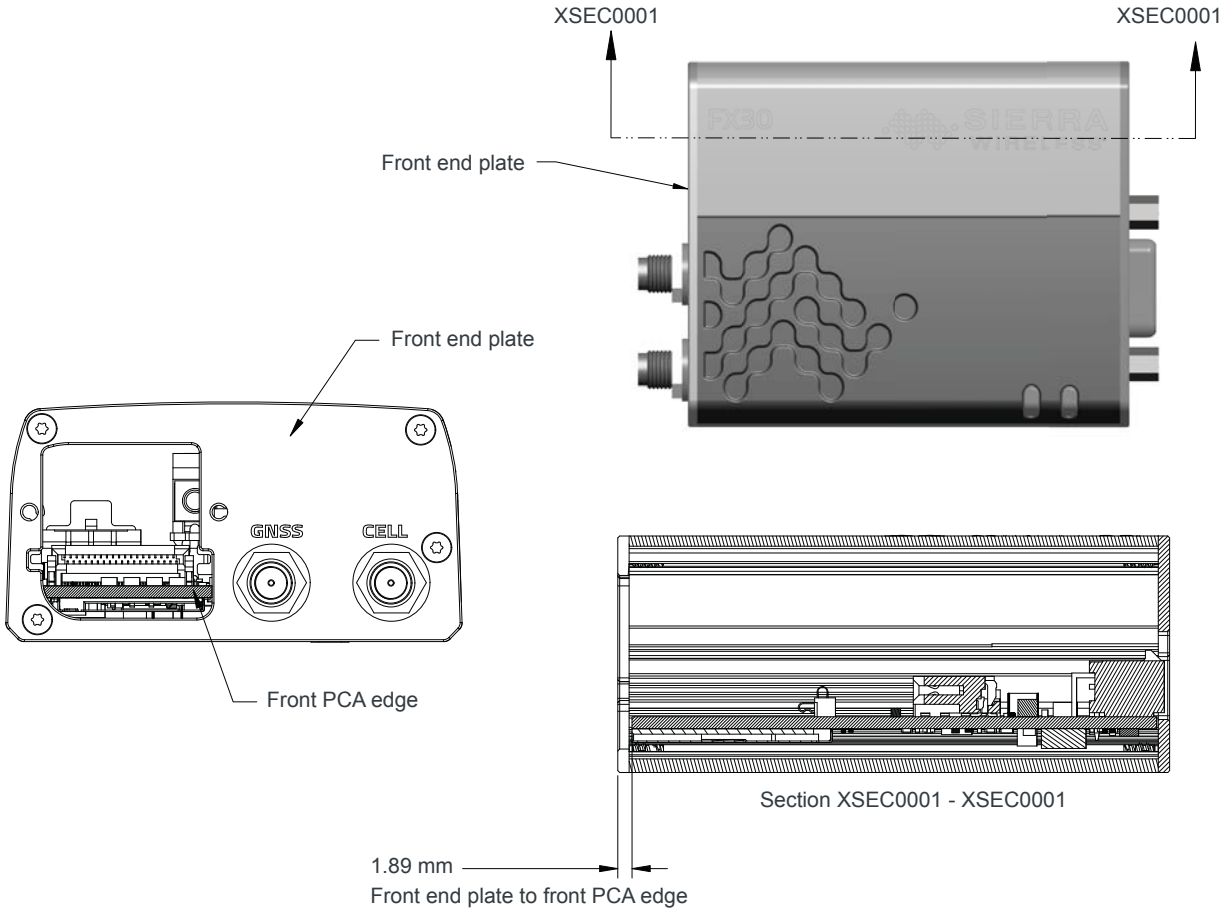


Figure 3-7: IoT Expansion Card Alignment

Pin-out Information

For complete pin-out information, refer to the IoT Expansion Card Design Specification (document number 4117166).

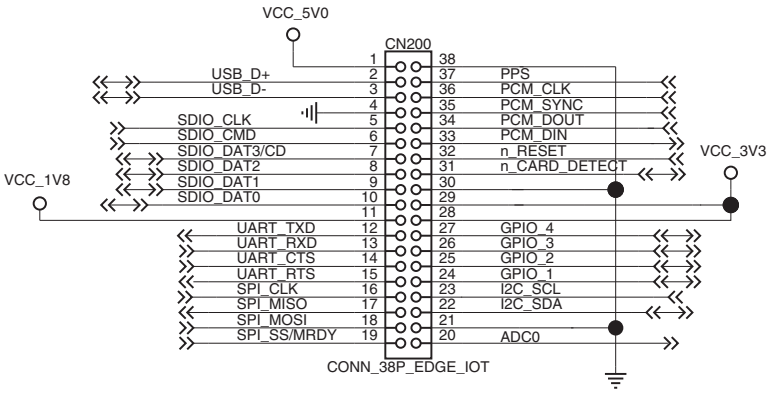


Figure 3-8: IoT Expansion Card Pin Configuration—IoT Expansion Card View

IoT Connector Interface

Table 3-11: IoT Connector Interface

IoT Connector Signal	FX30S Hardware Peripheral	Linux Interface
GPIO1	GPIO 42	/sys/class/gpio/gpio42
GPIO2	GPIO 33	/sys/class/gpio/gpio33
GPIO3	GPIO 13	/sys/class/gpio/gpio13
GPIO4	GPIO 8	/sys/class/gpio/gpio8
Iot_DETECT	GPIO 25	/sys/class/gpio/gpio25
USB	Hub on HSIC WP interface, mounted on ttyUSB0	/dev/ttyUSB0
SDIO	SDIO	/dev/mmcblk0
UART	UART2	/dev/ttyHSL1
SPI	SPI1	/dev/sierra-spi
ADC	ADC0	/sys/class/hwmon0/device/mmp_01 (in uV units)
PCM	PCM	/proc/asound and /dev/snd
I2C	I2C1	/dev/i2c-0

Note: If you develop an IOT card and use the UART in a hardware loop-back mode by connecting the transmit and receive signals, do not configure UART2 in Linux Console mode (AT!MAPUART=16,2).

4: Regulatory Information

Important Information for North American Users

Warning: *This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. Changes or modifications to this device not expressly approved by Sierra Wireless could void the user's authority to operate this equipment.*

RF Exposure

In accordance with FCC/IC requirements of human exposure to radio frequency fields, the radiating element shall be installed such that a minimum separation distance of 20 cm should be maintained between the antenna and the user's body.

Warning: *This product is only to be installed by qualified personnel.*

To comply with FCC/IC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain must not exceed the specifications listed below for the device used.

Maximum Antenna Gain

The antenna gain must not exceed the limits and configurations shown in the following table:

Device	Frequency Band	FCC ID/IC Number N7NWP8 2417C-WP8 Maximum Antenna Gain (dBi)
Sierra Wireless FX30S	2	3
	5	4
	GPRS/EDGE 850	4
	GPRS/EDGE 1900	3

EU

Sierra Wireless hereby declares the Sierra Wireless FX30S device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

The FX30S displays the CE mark.

CE

Warning: *Changes or modifications to this device not expressly approved by Sierra Wireless could void the user's authority to operate this equipment.*

Warning: *This product is only to be installed by qualified personnel.*

Declaration of Conformity

The Declaration of Conformity made under Directive 1999/5/EC is available for viewing at: source.sierrawireless.com/resources/airlink/certification_and_type_approval/FX30_ce_declaration_of_conformity/.

WEEE Notice

If you purchased your Sierra Wireless FX30S in Europe, please return it to your dealer or supplier at the end of its life. WEEE products may be recognized by their wheeled bin label on the product label.

A: Accessories

DC Power Cable (Black Connector)

Table A-1: DC Power Cable

DC Power Cable	
Part Number	2001013
Product Release	2016

Components:

① 1 UL2464 20 AWG × 6 core cable

② 6 × Molex Micro-Fit 3.0™ series female crimp connectors (part number 43030-0001)

③ 1 × Molex Micro-Fit 3.0™ receptacle housing, male, 2×3P Ph: 3.0 mm housing, 250 V, 5 A max, PA65 black UL94V-O (part number 43025-0600)

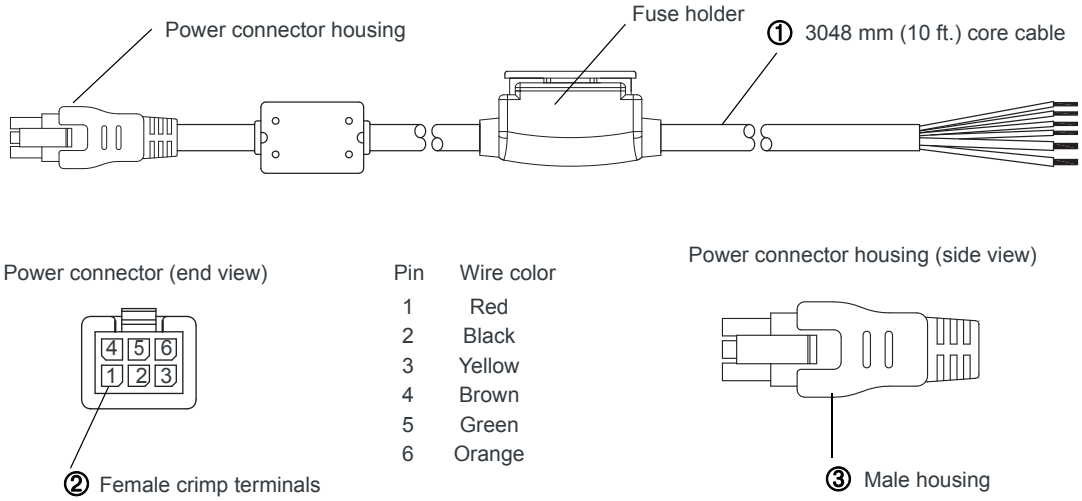


Figure A-1: DC Cable Specifications

AC Power Adapter (Black Connector)

Table A-2: AC Power Adapter

AC Power Adapter	
Part Number	TBC
Product Release	2016

AC Power Adapter Input

Table A-3: Input Specifications

	Minimum	Typical	Maximum
Input			
Input Voltage	90 VAC	100–240 VAC	264 VAC
Input Frequency	47 Hz	50/60 Hz	63 Hz

Note: Input voltage range is 90–264 VAC.
Maximum input current is 500 mA at 100–240 VAC.
Inrush current will not exceed 75 A at 100–240 VAC input and maximum load from a cold start at 25°C.

AC Power Adapter Output

Table A-4: AC Power Adapter Output Specifications

		Minimum	Typical	Maximum	Test conditions
Output Voltage	—	11.4 VDC	12.0 VDC	12.6 VDC	0 ~ 1.5 A loading

Environmental Specifications

Table A-5: AC Power Adapter Environmental Specifications

Operating	
Operating Temperature	0°C ~ 40°C (operates normally)
Relative Humidity	10% ~ 90%
Altitude	Sea level to 2,000 meters
Vibration	1.0 mm, 10–55 Hz, 15 minutes per cycle for each axis (X, Y, Z)
Non-operating	
Storage Temperature	-30°C ~ 70°C

Table A-5: AC Power Adapter Environmental Specifications (Continued)

Relative Humidity	10% ~ 90%
Vibration and Shock	MIL-STD-810D, method 514

Reliability and Quality Control

AC Power Adapter MTBF

When the power supply is operating within the limits of this specification, the MTBF is at least 200,000 hours at 25°C (MIL-HDBK-217F).

Safety Standards

The power supply is certified with the following international regulatory standards:

Table A-6: AC Power Adapter Safety standards

Regulatory Agency	Country or Region	Certified	Standard
UL	USA	Approved	UL60950-1
GS	Europe	Approved	EN60950-1
CE	Europe	Approved	EN60950-1
SAA	Australia	Approved	AS/NZS 60950
CCC	China	Approved	GB4943
CUL	Canada	Approved	CSA C22.2 NO.60950-1

EMC Standards

The power supply meets the radiated and conducted emission requirements for EN55022, FCC Part 15, Class B, GB9254.

Hazardous Substances

- EU Directive 2011/65/EU “RoHS”
- EU Directive 2012/19/EU “WEEE”
- REACH

Energy Efficiency

The AC adapter complies with International Efficiency Levels, as shown in Table A-7.

Table A-7: AC Adapter Energy Efficiency

Supplied Input	No-load Power Consumption	Average Active Mode Efficiency	International Efficiency Level
115 VAC, 60 Hz	Less than 0.1 W	Greater than 85%	VI
230 VAC, 50 Hz	Less than 0.3 W	Greater than 80.4%	V

B: Using the FX30S as a USB Modem

The following instructions provide examples based on Telus service. Substitute the name of your mobile network operator (MNO). Key values and parameters are bolded for emphasis in the examples.

For detailed information about the AT commands used, refer to AirPrime WPx5xx AT Command Reference (4118047) available at source.sierrawireless.com.

To use the FX30S as a USB modem:

1. Ensure that your computer is set up to issue AT commands to the FX30S. (See Setup for AT Commands on page 33.)
2. Connect the radio to the network:
   a. If you have not already done so, install the SIM card. (See Step 1—Insert the SIM Card and Optional IoT Card on page 10.)
   b. Set the MNO's APN using the AT+CGDCONT command. (Most MNOs use Profile number 1. To confirm, check with your MNO.)

      ```
      AT+CGDCONT=1,"IPV4V6","isp.telus.com"
      ```

   c. Check that the profile is correctly set:

      ```
      AT+CGDCONT?
      +CGDCONT: 1,"IPV4V6","isp.telus.com","0.0.0.0",0,0
      ```

   d. Check that the radio is attached and registered on the network.

      ```
      AT!GSTATUS?
      !GSTATUS:
      Current Time:  5699      Temperature: 31|
      Bootup Time:   0         Mode:        ONLINE
      System mode:   WCDMA            PS state:    Attached
      WCDMA band:    WCDMA 1900
      WCDMA channel: 662
      GMM (PS) state:REGISTERED   NORMAL SERVICE
      MM (CS) state: IDLE         NORMAL SERVICE

      WCDMA L1 State:L1M_PCH_SLEEP    LAC:       2B5D (11101)
      RRC State:     DISCONNECTED     UTRAN Cell ID:     0454
      761C (1108 30236)
      RxM RSSI C0:   -80              RxD RSSI C0: -106
      RxM RSSI C1:   -106             RxD RSSI C1: -106

      IMS Reg State: UNKNOWN          IMS Mode:   Not Support
      IMS Srv State: UNKNOWN SMS,UNKNOWN VoIP
      OK
      ```

3. Activate the PDP context:
   a. Use the Profile number prepared in steps 2b and 2c above.

      ```
      AT!SCACT=1,1
      ```

   b. Check the profile is active:

      ```
      AT!SCACT?
      !SCACT: 1,1
      ```

c. Confirm the PDP context is active.

ACTIVE data session:

```
at!gstatus?
!GSTATUS:
Current Time:  7209            Temperature: 33
Bootup Time:   0               Mode:        ONLINE
System mode:   WCDMA           PS state:    Attached
WCDMA band:    WCDMA 1900
WCDMA channel: 662
GMM (PS) state:REGISTERED      NORMAL SERVICE
MM (CS) state: IDLE            NORMAL SERVICE

WCDMA L1 State:L1M_DCH         LAC:         2B5D
(11101)
RRC State:     CELL_DCH        UTRAN Cell ID:     0454
761C (1108 30236)
RxM RSSI C0:   -91             RxD RSSI C0: -106
RxM RSSI C1:   -84             RxD RSSI C1: -106

IMS Reg State: UNKNOWN         IMS Mode:  Not Support
IMS Srv State: UNKNOWN SMS,UNKNOWN VoIP

OK
```

The RMNET interface on the host computer should now become active, and receive an IP address. Data can now flow from the host computer to the radio network.

4. Deactivate the PDP context:

a. Deactivate the active context

```
AT!SCACT=0,1
```

b. Check the profile is deactivated

```
AT!SCACT?
!SCACT: 1,0
```

c. Confirm the PDP context is de-activated.

DE-ACTIVATED data session:

```
at!gstatus?
!GSTATUS:
Current Time:  7227            Temperature: 33
Bootup Time:   0               Mode:        ONLINE
System mode:   WCDMA           PS state:    Attached
WCDMA band:    WCDMA 1900
WCDMA channel: 662
GMM (PS) state:REGISTERED      NORMAL SERVICE
MM (CS) state: IDLE            NORMAL SERVICE

WCDMA L1 State:L1M_PCH_SLEEP   LAC:         2B5D
(11101)
RRC State:     DISCONNECTED    UTRAN Cell ID:
0454 761C (1108 30236)
RxM RSSI C0:   -91             RxD RSSI C0: -106
RxM RSSI C1:   -106            RxD RSSI C1: -106
```

```
IMS Reg State: UNKNOWN          IMS Mode:  Not Support
IMS Srv State: UNKNOWN SMS,UNKNOWN VoIP

OK
```

The RMNET interface on the host computer should now be de-activated. The IP address should no longer be assigned, and data should no longer be flowing.

C: RS485 Python Script

C

For your reference, the contents of the rs485.py script appear below.

```
#!/usr/bin/env python

import sys

fn = sys.argv[1]
if len(sys.argv) > 2:
    value = sys.argv[2]
else:
    value = None

ttyFile=open('/dev/ttyHSL0')

if value is None:
    sysfsFile = open(fn, 'r')
    print sysfsFile.read().strip()
else:
    sysfsFile = open(fn, 'w')
    sysfsFile.write(value)
```

Index