AirLink XR Series

Hardware User Guide

SIERRA WIRELESS®

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.

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Note: Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. Sierra Wireless modems may be used at this time.

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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Corporate and product information	Web: sierrawireless.com

Revision History

Revision number	Release date	Changes
1	March 2021	Created
2	May 2021	General update

Contents

1: Introduction to the XR Series

This hardware user guide is for Sierra Wireless® AirLink® XR Series 5G High Performance Multi-Network routers. Features and specifications described in this user guide apply to all variants of the XR Series unless otherwise noted.

As part of the AirLink Performance series, AirLink XR Series routers are purpose-built to provide secure, always-on connectivity for mission-critical and business applications in public safety, transit and field services.

Seamless integration with the AirLink Management Service (ALMS) enables simplified, remote and real-time insight and control of connected mobile assets and mission-critical applications, and supports vehicle tracking, telemetry and asset management applications.

This document applies to XR Series routers, including XR90 and XR80.

Note: Throughout this document, "XR" (if used by itself) refers to all XR Series routers.

Key Features

- 5G (non-mmWave) >2 Gbps with 4G/3G fallback
- Optional expansion cartridges (cartridge includes cellular radio module and Ethernet port)
- Wi-Fi:
  - XR90—Dual independent 4×4 MIMO Wi-Fi 6
  - XR80—5×4 MIMO Wi-Fi 6
- Ethernet (LAN/WAN):
  - Main router ports: 1×5 Gbps, 2×1 Gbps
  - XP cartridge(s) port: 1×1 Gbps
- Direct vehicle bus (CAN bus) interface (OBD-II (J1979)/J1939))
- 5 configurable GPIOs
- USB-C connector: USB 3.1 Gen 1 (SuperSpeed 5 Gbps)
- Assisted GNSS with inertial navigation and dead reckoning
  - Precision mobile events reporting (via NMEA/TAIP streaming) at 1 second intervals allows for detailed network and connectivity analysis.
- Active link policies to optimize WAN connections for quality, cost, and performance

Router features and functionality are configured locally via the XR router's AirLink OS user interface or remotely via ALMS. For details, refer to [3] AirLink OS User Guide.

Description

1— LEDs (see LED Behavior on page 41)
2— Auxiliary I/O (see Step 7—I/O Configuration (Optional) on page 31)
3— DC power (see Router Power Connector on page 26)
4— LPWA antenna (see Step 4—Connect the Antennas on page 20)
5— Dual mini-SIM 2FF card slots (see Step 2—Insert the SIM Cards on page 15)
6— Ethernet 1 (5 Gbps) RJ-45 port (see Ethernet on page 52)
7— Ethernet 2 (1 Gbps) RJ-45 port (see Ethernet on page 52)
8— Ethernet 3 (1 Gbps) RJ-45 port (see Ethernet on page 52)
9— RS-232 Serial connector RJ-45 port (see Serial Port on page 53)

10— Reset button (see Configuration Reset on page 47)
11— USB type-C locking port (see USB on page 52)
12— XP1 Expansion Cartridge (see Step 1—Connect Optional XP Cartridge(s) on page 14)
13— XP1 Ethernet (1 Gbps) RJ-45 port (see Ethernet on page 52)
14— XP2 Expansion Cartridge (see Step 1—Connect Optional XP Cartridge(s) on page 14)
15— XP2 Ethernet (1 Gbps) RJ-45 port (see Ethernet on page 52)

16— GNSS antenna connector (see Step 4—Connect the Antennas on page 20)
17— Wi-Fi A antenna connectors (1–4) (see Step 4—Connect the Antennas on page 20)
18— Wi-Fi B antenna connectors (1–4) (see Step 4—Connect the Antennas on page 20)
19— Bluetooth antenna connector (see Step 4—Connect the Antennas on page 20)
20— XP2 cartridge cellular antenna connectors (1–4) (see Step 4—Connect the Antennas on page 20)
21— XP1 cartridge cellular antenna connectors (1–4) (see Step 4—Connect the Antennas on page 20)

Figure 1-1:   XR90 Connectors, LEDs and SIM Card Holder

Figure 1-2: XR80 Connectors, LEDs and SIM Card Holder

1— LEDs (see LED Behavior on page 41)
2— Auxiliary I/O (see Step 7—I/O Configuration (Optional) on page 31)
3— DC power (see Router Power Connector on page 26)
4— LPWA antenna (see Step 4—Connect the Antennas on page 20)
5— Dual mini-SIM 2FF card slots (see Step 2—Insert the SIM Cards on page 15)
6— Ethernet 1 (5 Gbps) RJ-45 port (see Ethernet on page 52)
7— Ethernet 2 (1 Gbps) RJ-45 port (see Ethernet on page 52)
8— Ethernet 3 (1 Gbps) RJ-45 port (see Ethernet on page 52)
9— RS-232 Serial connector RJ-45 port (see Serial Port on page 53)

10— Reset button (see Configuration Reset on page 47)
11— USB type-C locking port (see USB on page 52)
12— XP1 Expansion Cartridge (see Step 1—Connect Optional XP Cartridge(s) on page 14)
13— XP1 Ethernet (1 Gbps) RJ-45 port (see Ethernet on page 52)

14— GNSS antenna connector (see Step 4—Connect the Antennas on page 20)
15— (XR80 Wi-Fi routers only) Wi-Fi antenna connectors (1–5) (see Step 4—Connect the Antennas on page 20)
16— Cellular antenna connectors (1–4) (see Step 4—Connect the Antennas on page 20)
17— XP cartridge cellular antenna connectors (1–4) (see Step 4—Connect the Antennas on page 20)

Installed View (Right-side cartridge)
(XR80—"XP" / XR90—"XP2")

Front View

Back View

1— RJ-45 Ethernet (1 Gbps) port (see Ethernet on page 52)
2— Cellular antenna connectors (1–4) (see Step 4—Connect the Antennas on page 20)
3— Interface connector
4— Mounting screws (M4, captive screws)

Figure 1-3:   Cellular Cartridge ("XP"/"XP1"/"XP2")

Power Consumption

Table 1-1: Power Consumption

Scenario	XR80				XR90	
	Non-Wi-Fi	Non-Wi-Fi + Cartridge[a]	Wi-Fi	Wi-Fi + Cartridge[a]	1 cartridge[a]	2 cartridges[a]
Standby	55 mW					
Max power	19 W	28 W	45 W	54 W	51 W	60 W

a.   While in operation, each cartridge consumes 9 W (nominal).

Accessories

Table 1-2 lists accessories that are included with the XR router or are available for purchase from Sierra Wireless.

Table 1-2: XR Series Accessories[a]

Part	Part Number	Description
Included with XR router purchase		
Locking DC power cable	5305791	Length—3 m (10 ft)
Quick Start Guide	XR90—5305868 XR80—5306266	Basic setup and usage instructions
LPWA antenna	6001358 or Part number pending[b]	1×1 LTE paddle antenna for embedded LPWA cellular radio 1×1 LTE cable antenna for embedded LPWA cellular radio
Available for separate purchase from Sierra Wireless		
Universal AC power adapter	6001372	Voltage input: 100–240 VAC Current output: 1.3 A
AirLink Antennas	For XR Series antenna packages, visit www.sierrawireless.com and search for "AirLInk Antennas".	5G sub-6 GHz, 2.4 GHz, and 5 GHz Wi-Fi antennas for various XR Series configurations.
I/O Cable	6001004	AUX I/O 8-pin data cable
OBD-II (J1979) Y-cable	6001204	Vehicle bus cable
J1939 Y-Cable	6001192	Vehicle bus cable
RS-232 serial cable (RJ45 to single DB9)	5305841	Serial cable—RJ45 to single DB9 cable
RS-232 serial cable (RJ45 to dual DB9)	5305842	Serial cable—RJ45 to dual DB9 cable
MG90/MP70 to XR Series Antenna Adapter	Part number pending[b]	Cable adapter to use existing MP70/MG90 6-in-1 antennas with XR routers. • 10-in-1 FAKRA (4×Cell + GNSS + 5×Wi-Fi) to 1-to-6 SMA (2×Cell + GNSS + 3×Wi-Fi) 18" cable adapter *Note: Cellular performance—Existing 4G antenna's performance will be sub-optimal with the XR router's 5G radio due to the 6 GHz frequency.* *Note: Wi-Fi performance—XR router performance will be sub-optimal due to differing Wi-Fi MIMO configurations.*
Mounting bracket	6001350	Mounting bracket for easy vehicle installation and removal Includes bracket, screws, nuts, standoffs, etc.

a. Subject to change.
b. Pending future part availability

Warranty

The XR router includes a 3-year warranty, and has optional 1 and 2-year warranty extensions (to 4 years and 5 years, respectively).

For additional warranty details, refer to the Sierra Wireless End-User Warranty for AirLink Products, available at sierrawireless.com.

2: Installation and Startup

This chapter describes:
* How to connect, install and power on the XR Series router
* Front panel LEDs
* I/O functionality

Note: Field wiring and connections in hazardous locations must be connected as per applicable Class II electrical codes.

Note: The XR router installation must be done by a qualified technician.

Out of Box—Quick Start

One year of access to AirLink Management Service (ALMS) is included in the XR router's purchase price. Use ALMS to register, configure, manage and monitor your XR router (or XR router fleet).

Refer to [4] AirLink XR90 Quick Start Guide/[5] AirLink XR80 Quick Start Guide) for instructions on registering and preconfiguring your XR router.

Tools and Materials Required

* Phillips screwdriver—#1
* Hex wrench (Allen key)—3 mm (if installing/removing XP cartridges)
* Wrench—8 mm (if installing an optional bracket mount)
* SIM card(s) provided by your mobile network operator for your 5G cellular modem(s)—XR routers support 1–2 5G cellular modems (SKU-dependent).
* Power supply—See Table 1-2 on page 11 for part numbers. (Note— A DC power cable is supplied by Sierra Wireless.)
* Multi-element antenna(s) appropriate for your XR router. See Table 1-2 on page 11 for suggested antennas, and Table 2-1/Table 2-2 on page 22 for FAKRA antenna connector details.
* Optional:
  · RJ45 to DB9 cable for RS-232 port. See Serial Port on page 53 for details.
  · 8-pin auxiliary I/O connector cable
  · OBD-II (J1979) or J1939 vehicle bus cable

Caution: *The XR router is rated for use in extreme environments. If the XR router is to be used in these environments, make sure to use cables designed and specified for this use to avoid cable failure.*

Installation Overview

Typical installations are performed as follows:

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

Important: *The default local AirLink OS password is printed on the XR router label (Figure 3-5 on page 65).*
- *Before installation, make sure to record the default password and store it in a secure place.*
- *For security, make sure to change the password after logging in to the AirLink OS.*
- *If the XR router is later reset to factory defaults, the password may also be reset to the default. For*
    details, see Reset to Factory Default or Custom Template Settings on page 47.

Step 1—Connect Optional XP Cartridge(s)

The XR Series base unit supports connection of optional XP expansion cartridges (2 for XR90, 1 for XR80) .

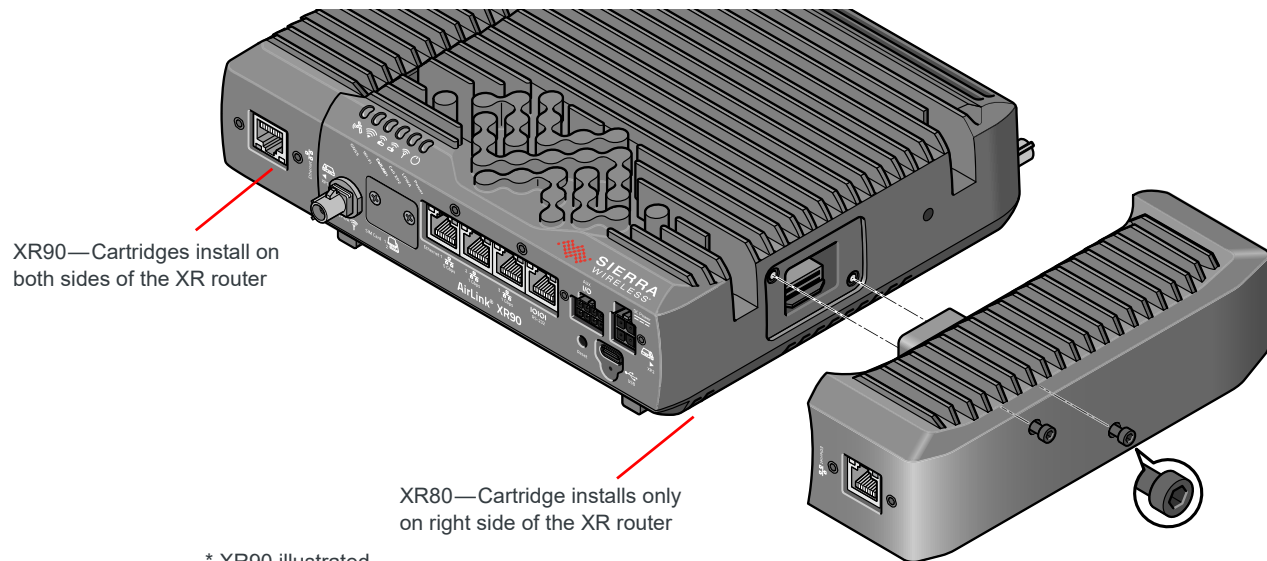To install optional cartridge(s):

1. Use a Phillips #1 screwdriver to remove the cartridge cover panel.
(Note—If the panel is equipped with Allen (Hex) head screws, use a 3 mm Allen key.)
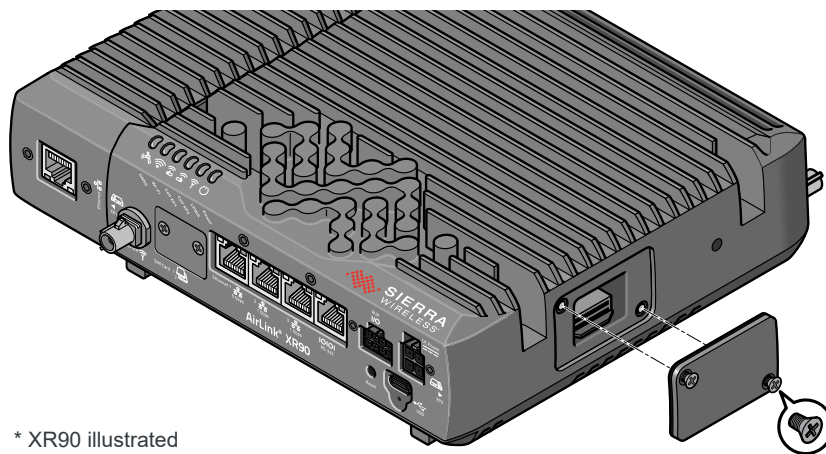
* XR90 illustrated

Figure 2-1: Removing Cartridge Cover Panel

2. Position the cartridge beside the XR router, with the antenna connectors facing the rear. (Note—XP cartridges can be installed on either side of the XR router,)

XR90—Cartridges install on both sides of the XR router

XR80—Cartridge installs only on right side of the XR router

* XR90 illustrated

Figure 2-2: Installing an Optional XP Cartridge

3. Carefully push the cartridge into the XR router.

4. Use a 3 mm Allen key to tighten the cartridge's captive mounting screws.

> **Important:** *Make sure to tighten the XP cartridge screws as recommended in Screw Specifications. Under-tightening screws can lead to improper operation.*

Step 2—Insert the SIM Cards

The XR router has two mini-SIM (2FF) card slots located behind a removable plate on the front of the XR router as shown in Figure 2-3 on page 16. By default, the SIMs correspond to the cellular modules as follows:
- XR90:
  - SIM 1 (Upper slot)—XP1 cartridge radio module
  - SIM 2 (Lower slot)—XP2 cartridge radio module
- XR80:
  - SIM 1 (Upper slot)—Internal radio module
  - SIM 2 (Lower slot)—XP cartridge radio module

> *Note: SIM slot assignments are software-configurable in the AirLink OS.*

If the SIM card(s) are not already installed, insert them before connecting any external equipment or power to the XR router.

To install the SIM card(s):

1. Remove the SIM card cover—Use a #1 Phillips screwdriver.
(Note—The cover uses 'captive' screws.)

2. Orient the SIM card(s), as shown in Figure 2-3. (Upper SIM—Gold contacts face-down; Lower SIM—Gold contacts face-up)

3. Gently slide the SIM cards into their slots until they click into place.

   (To remove a SIM card, press it in until it clicks, then release it. Gently grip the SIM card and pull it out.)
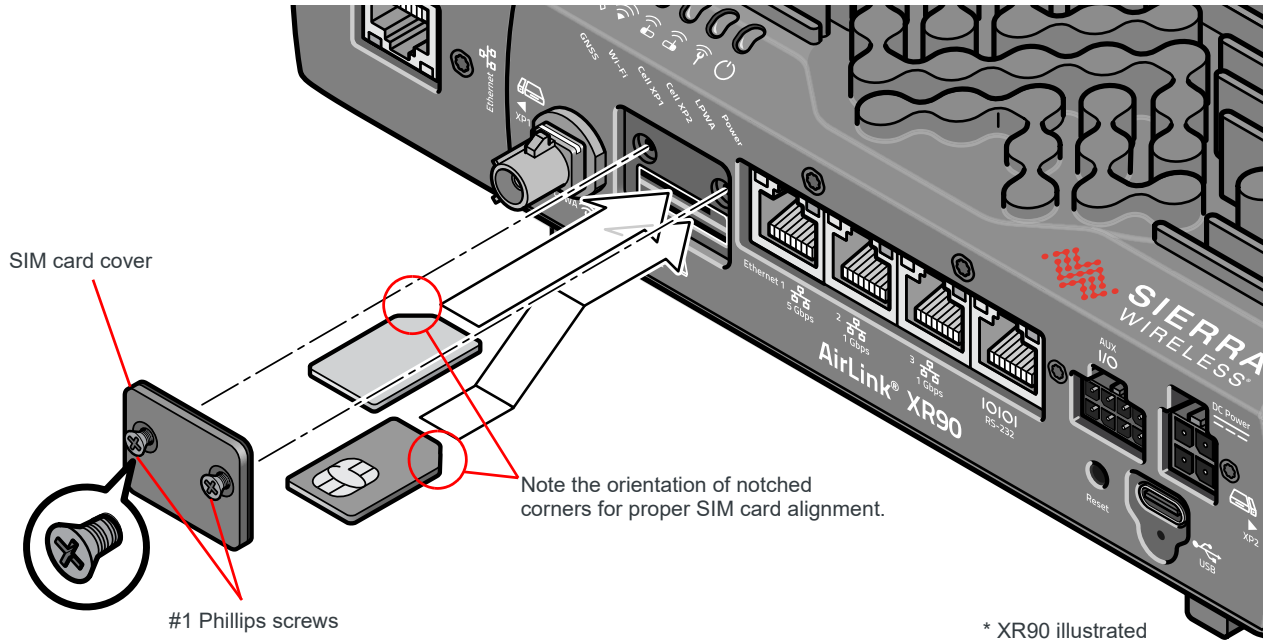

Figure 2-3: Installing the SIM Cards

4. Replace the SIM card cover.

Important: *Do not over-tighten the screws (see Screw Specifications on page 54). This could strip the threads inside the XR router, which will prevent the cover from re-attaching.*

Step 3—Mount and Ground the Router

The XR router can be mounted directly onto a flat surface, or attached to a mounting bracket to allow easy mounting/dismounting on flat or vertical surfaces.

Sierra Wireless strongly recommends that you always ground the router using the unpainted mounting hole (grounding point) shown in Figure 2-7 on page 19.

Note: See the Mechanical Specifications on page 61 for the XR router's dimensions, including mounting hole positions.

The XR router should not be mounted in the driver's area of the vehicle or in areas where it can distract the driver. Mount it in accordance with accepted after-market practices and materials.

While mounting the XR router, make sure the power source is OFF (e.g. power cord is disconnected, vehicle ignition is off, etc.).

Mounting recommendations and requirements:
- Provide easy access to connect all components (cables, antennas, accessories, etc.) and perform maintenance—leave sufficient space in front of, behind, and above the unit.
Typical locations for vehicle installations include under the deck lid or on the floor-board of the vehicle's equipment storage.
- Cables must not be constricted, close to high electrical currents, or exposed to extreme temperatures.
- Make sure front panel LEDs are easily visible.
- Make sure the installed XR router has adequate airflow to dissipate heat.
- Protect the XR router from direct exposure to the elements (sun, rain, dust, etc.).
- Protect the XR router from contact with people, cargo, tools, equipment, etc.

Note: If the XR router is vehicle-mounted, it should not be in the driver's area of the vehicle or in areas where it can distract the driver. Mount it in accordance with accepted after-market practices and materials.

The XR router has 4 mounting holes, as shown in Figure 2-4. For mounting screw specifications, see Screw Specifications on page 54.

Mounting holes

150.5 mm

112.4 mm

Use this mounting hole to ground the XR router
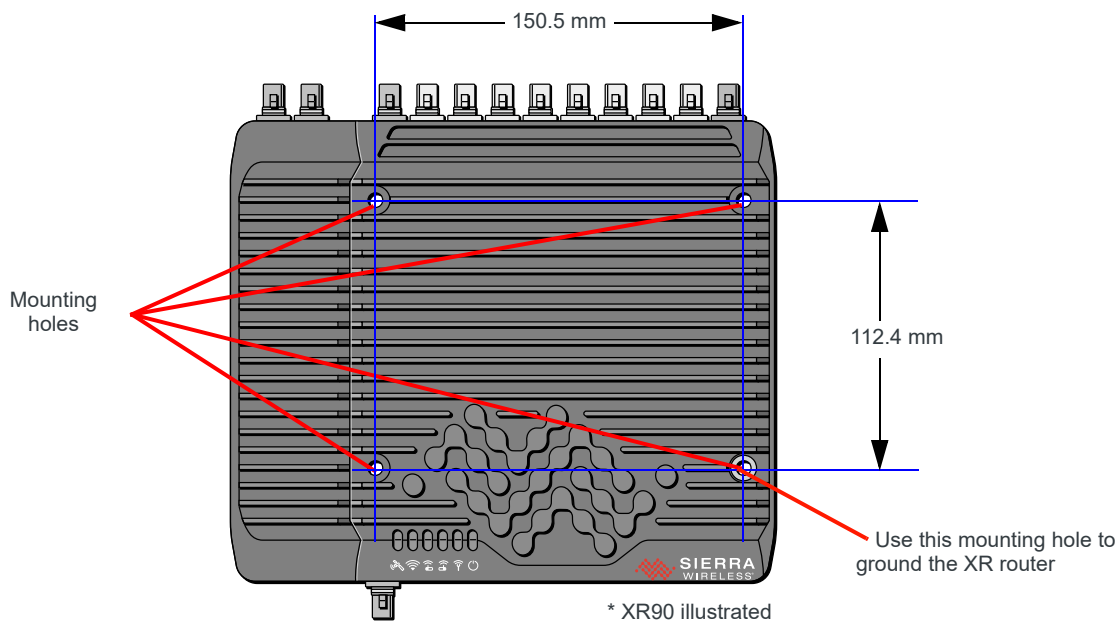
* XR90 illustrated

Figure 2-4: XR Router Mounting Holes

Note: When mounting the XR router in a location that could be exposed to rain (e.g. in a vehicle door panel, which would expose the XR router when the door is opened), mount the XR router facing left to right. (i.e. antenna and other ports are inserted from the side), as shown in Figure 2-5.
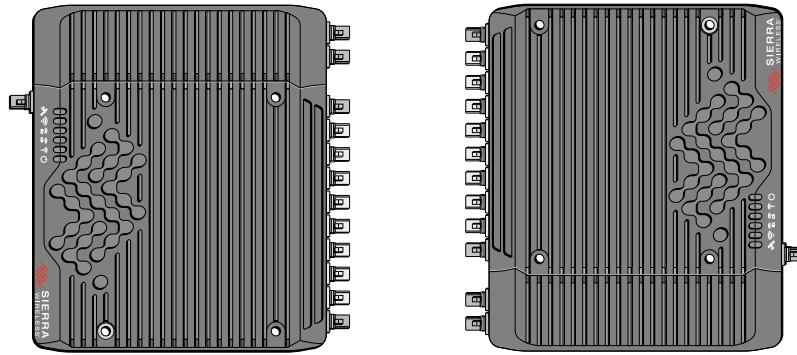
* XR router with one cartridge illustrated

Figure 2-5: Recommended Orientations for Inclined/Vertical Mounting

Flat Surface Mount

To mount the XR router on a flat surface, use M5 pan head screws with split washers (for details, see Screw Specifications).

Bracket Mount

An optional quick mounting bracket (Part #6001350, available from Sierra Wireless) allows the XR router to be easily mounted/dismounted.

Router positioning pins

230.0 mm

230.0 mm

Secure with thumbscrews

Router positioning pins should be used for these holes (recommended)

Secure with M5 screws (all four corners)
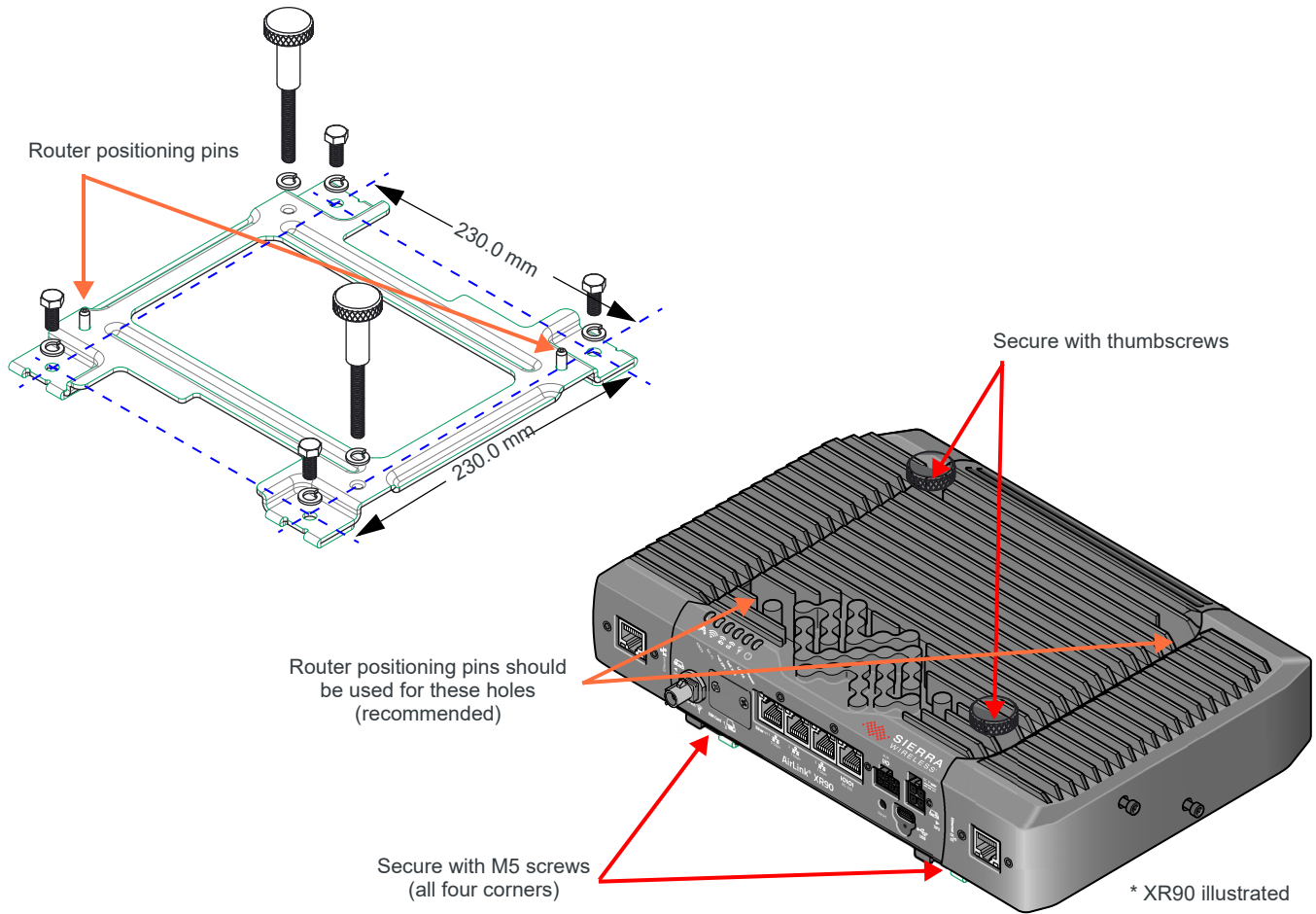
* XR90 illustrated

Figure 2-6: XR Series Bracket Mounting Installation Example

Attach the bracket to the mounting surface and install the XR router:

1. Position the bracket on the mounting surface.

2. Secure the bracket with the four supplied M5 hex-head screws.

3. Position the XR router on the bracket— the bracket's positioning pins fit into two of the XR router's mounting holes. For best results, the module should be grounded (see Grounding the Router, below)), so use the holes indicated in Figure 2-6 for positioning pins and thumbscrews (one thumbscrew uses the unpainted mounting hole).

4. Secure the XR router using the two supplied thumbscrews in the remaining mounting holes.

Grounding the Router

For DC installations with a fixed "system" ground reference, Sierra Wireless strongly recommends always grounding the XR router to the system ground reference.

To ensure a good grounding reference, either:
- Attach the XR router to a grounded metallic surface
- Connect one end of a short 18 AWG or larger gauge wire to the unpainted mounting hole (see Figure 2-7) and connect the other end to your main grounding point. (e.g. for a vehicle-mounted XR router, ground to the vehicle chassis)
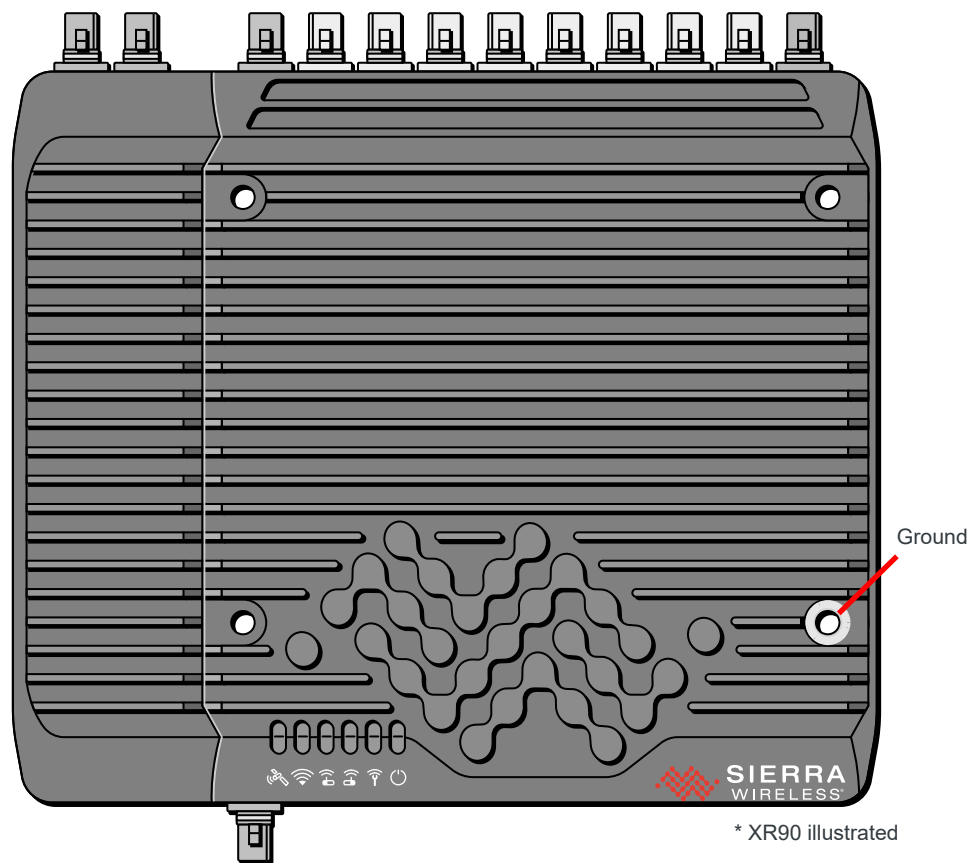

Ground

* XR90 illustrated

Figure 2-7: Ground Connector

Cabling—Best Practices

Cable Routing for Vehicle Installations

Sierra Wireless recommends separating the XR router's antenna, data and power cables from other wiring in the vehicle, and routing them away from sharp edges.

Cable Strain Relief for High-Vibration Installations

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

Place the cable strain relief within 200 mm (8") of the XR router to reduce the mass of cable supported by the XR router's connectors (power, antenna, etc.) under vibration. Ideally, the strain relief mounting for the cables should be attached to the same object as the XR router, so both the XR router and cables vibrate together. Strain relief should be mounted such that it does not apply additional stress on the connectors (i.e. the cables should not be taut and should not pull the connectors at an angle).

Cable Management

Proper cable management eliminates unnecessary installation complications, allows for ease of maintenance, and prolongs cable longevity.

The following practices are recommended for cable installation:
- Label all cables that attach to the XR router. For example: "GNSS", "Wi-Fi A", "Ethernet to Device X", etc.
- Protect the cables using a proper cable conduit.
- Secure each cable connected to the XR router via a permanent fixture.

Step 4—Connect the Antennas

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

The XR router uses FAKRA connectors for all antenna connections (Cellular, LPWA, Wi-Fi, Bluetooth, GNSS).

An antenna adapter (pending future availability) can be used to convert cellular and Wi-Fi antenna units from MG90 or MP70 XR routers for use with XR routers. (See Accessories on page 11.)

1— LPWA antenna
2— GNSS antenna connector
3— Wi-Fi A antenna connectors (1–4)
4— Wi-Fi B antenna connectors (1–4)
5— Bluetooth antenna connector
6— XP2 cartridge cellular antenna connectors (1–4)
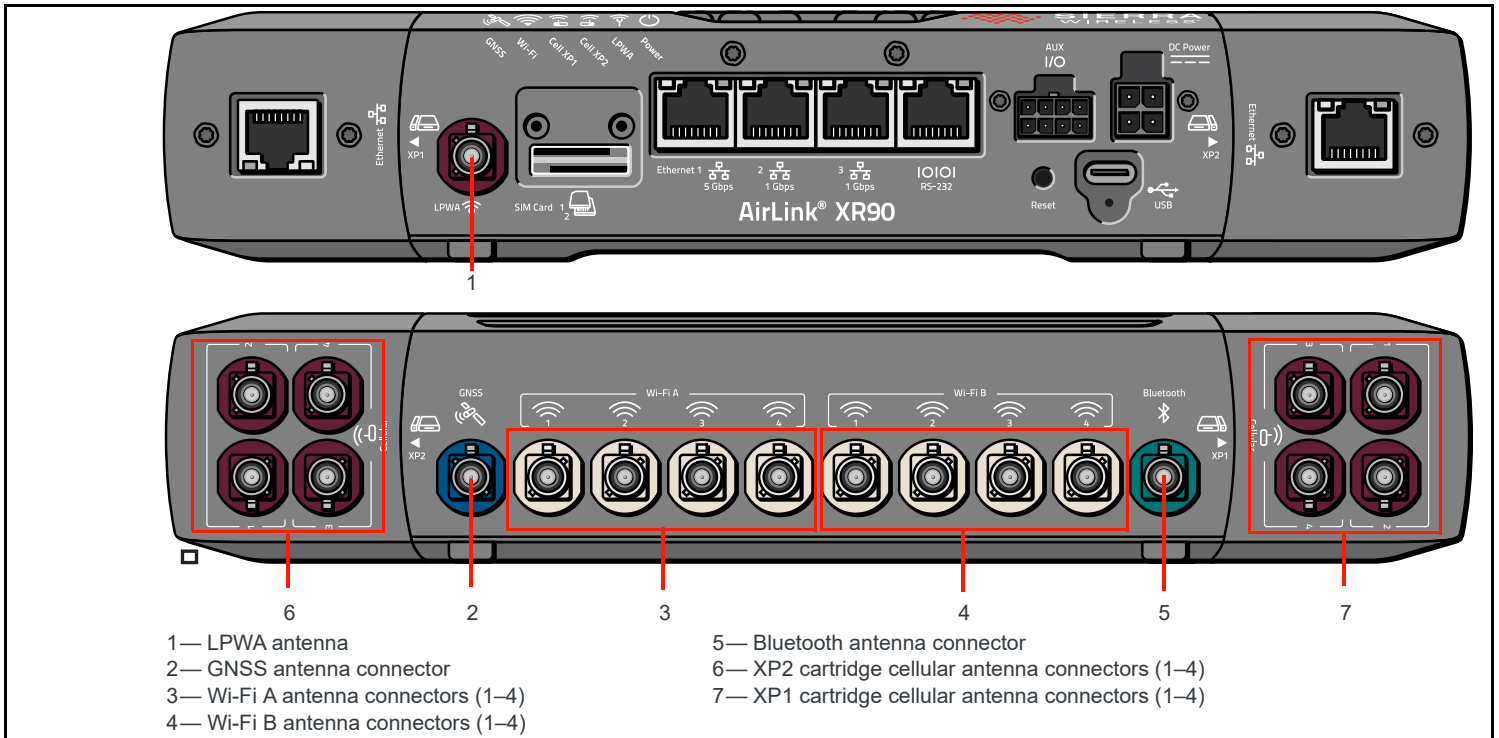7— XP1 cartridge cellular antenna connectors (1–4)

Figure 2-8: XR90 Connectors, LEDs and SIM Card Holder

1— LPWA antenna
2— GNSS antenna connector
3— Wi-Fi antenna connectors (1–5)
    (On XR80 Wi-Fi routers only)
4— Cellular antenna connectors (1–4)
5— XP cartridge cellular antenna connectors (1–4)
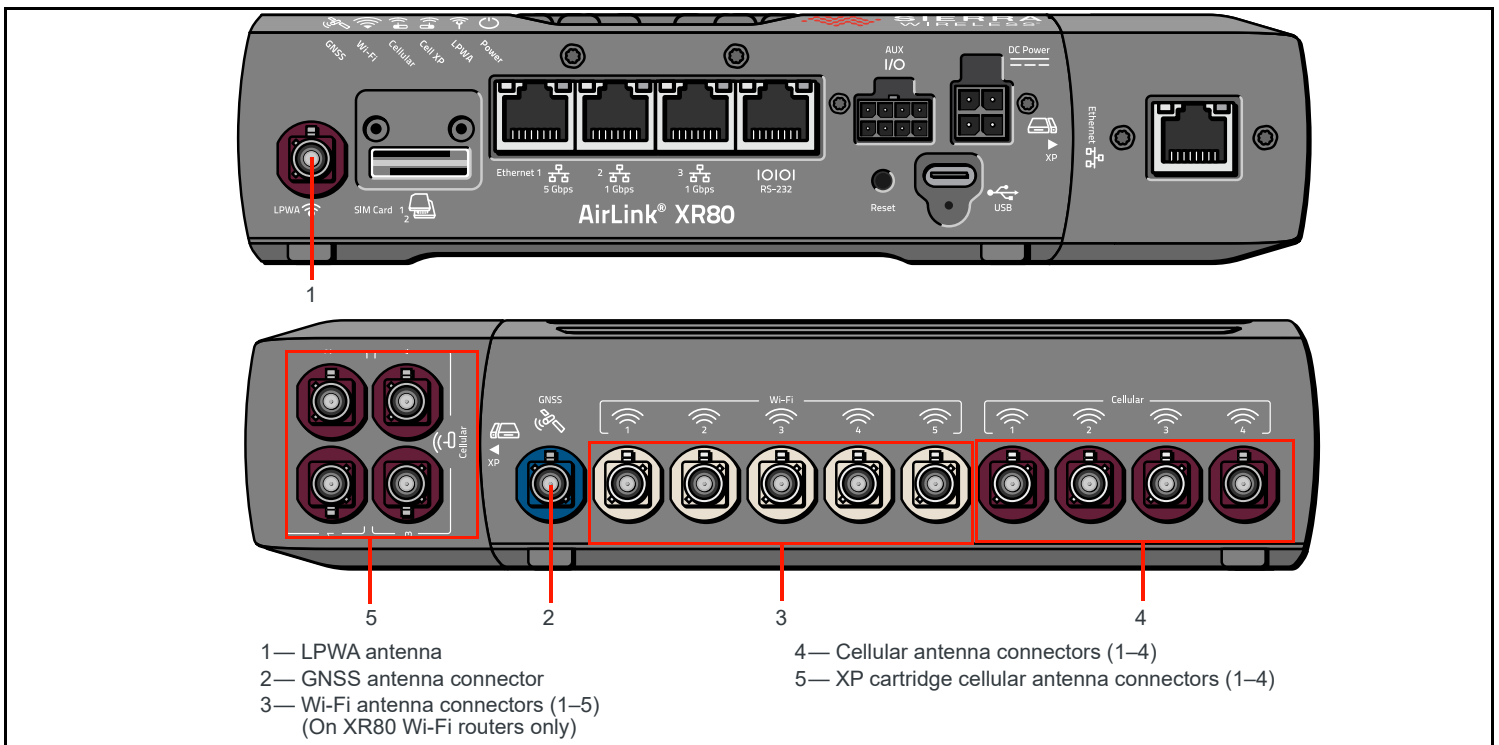
Figure 2-9: XR80 Connectors, LEDs and SIM Card Holder

Table 2-1: XR90 FAKRA[a] Antenna Connector Types

Panel	Module	Connectors	Color		Key	Description
Front	Radio	LPWA	Claret-Violet (Purple)		D	Low power wide area radio used for Sierra's out-of-band management solution
XP1	Radio	Cellular 1–4	Claret-Violet (Purple)		D	5G cellular radio (four antenna cables required)
XP2	Radio	Cellular 1–4	Claret-Violet (Purple)		D	5G cellular radio (four antenna cables required)
Rear	Wi-Fi	Wi-Fi A 1–4	Beige		I	Tri-band Wi-Fi. For details, see Wi-Fi on page 57.
Rear	Wi-Fi	Wi-Fi B 4–1	Beige		I	Tri-band Wi-Fi. For details, see Wi-Fi on page 57.
Rear	GNSS	GNSS	Signal-Blue (Blue)		C	GNSS
Rear	Bluetooth	Bluetooth	Water-Blue (Teal)		Z	Bluetooth

a. The antenna's female FAKRA connectors are color-coded to match the XR router's male FAKRA connectors, and the connectors are 'keyed' to ensure only the correct antenna types are connected. (e.g. purple female FAKRA connectors will not connect to the XR router's beige Wi-Fi male FAKRA connectors)

Table 2-2: XR80 FAKRA[a] Antenna Connector Types

Panel	Module	Connectors	Color		Key	Description
Front	Radio	LPWA	Claret-Violet (Purple)		D	Low power wide area radio used for Sierra's out-of-band management solution
Rear	Radio	Cellular 1–4	Claret-Violet (Purple)		D	5G cellular radio (four antenna cables required)
XP	Radio	Cellular 1–4	Claret-Violet (Purple)		D	5G cellular radio (four antenna cables required)
Rear	Wi-Fi[b]	Wi-Fi 5–1	Beige		I	Dual-band Wi-Fi (five antenna cables required). For details, see Wi-Fi on page 57. *Note: Wi-Fi connectors are only on Wi-Fi-enabled XR80s.*
Rear	GNSS	GNSS	Signal-Blue (Blue)		C	GNSS

a. The antenna's female FAKRA connectors are color-coded to match the XR router's male FAKRA connectors, and the connectors are 'keyed' to ensure only the correct antenna types are connected. (e.g. purple female FAKRA connectors will not connect to the XR router's beige Wi-Fi male FAKRA connectors)
b. Included only on XR80 Wi-Fi routers

For regulatory requirements concerning antennas, see Regulatory Information on page 66.

Note: When selecting and installing the antennas, you must follow the maximum dBi gain guide-lines specified by the radio communications regulations of the Federal Communications Commission (FCC), Industry Canada, or your country's regulatory body.

To install the antennas:

1. For vehicle installations, mount the antenna unit(s) on the vehicle (typically multi-element units):
   - If installing new antenna unit(s):
     - Follow the antenna unit's recommended installation instructions.
     - Use appropriate cable strain relief. (See Cable Management on page 20.)
     - When mounting antenna unit(s) containing WAN/WLAN cellular antennas, make sure there is at least 20 cm between the antenna(s) and the user or bystanders during normal operation.
     - If the unit includes a GNSS antenna, make sure it has a good view of the sky (at least 90°).
   - If converting an existing MG90 or MP70 antenna unit for use with XR90 or XR80:
     - Connect the antenna cables to the SMA connectors on the antenna adapter.

Note: If single-element antennas are installed, see Table A-1 on page 68 for recommended antenna separation.

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2. Connect the cables from the antenna units to corresponding connectors on the XR router:
   a. On the rear panel:
      - If expansion cartridge(s) are used, connect the corresponding cellular antenna's four purple female FAKRA connectors to the cartridge's "Cellular 1–4" male FAKRA connectors.
      - If used, connect the GNSS antenna's blue female FAKRA connector to the "GNSS" male FAKRA connector.
      - XR90 routers:
        - Connect the first Wi-Fi antenna's four beige female FAKRA connectors to the "Wi-Fi A 1–4" male FAKRA connectors.
        - Connect the second Wi-Fi antenna's four beige female FAKRA connectors to the "Wi-Fi B 4–1" male FAKRA connectors.
        - If used, connect the Bluetooth antenna's teal female FAKRA connector to the "Bluetooth" male FAKRA connector.
      - XR80 Wi-Fi routers:
        - Connect the Wi-Fi antenna's five beige female FAKRA connectors to the "Wi-Fi 1–5" male FAKRA connectors.
        - Connect the main cellular antenna's four purple female FAKRA connectors to the XR router's "Cellular 1–4" male FAKRA connectors.
   b. On the front panel, connect a single cellular antenna's purple female FAKRA connector to the "LPWA" male FAKRA connector. (Note—If using an LPWA cellular paddle antenna that attaches directly to the connector, make sure the antenna is not subjected to lateral forces that could damage the connector.

Otherwise, a cabled antenna available from third party antenna vendors should be used.)

Note: If the antenna units are located away from the XR router, keep cables as short as possible to minimize loss. Route the cables to protect them from damage or being snagged or pulled. There should be no binding or sharp corners in the cable routing. Excess cabling should be bundled with appropriate strain relief, and not pull on the XR router connectors.

For recommended antenna separation, see Antenna Separation on page 68.

Step 5—Connect the Data Cables

The XR router includes several required and optional connections on the front panel.

Note—Left-side cartridge (XP1) available only on XR90 routers

1— Ethernet 1 (5 Gbps) RJ-45 port (see page 52)
2— Ethernet 2 (1 Gbps) RJ-45 port (see page 52)
3— Ethernet 3 (1 Gbps) RJ-45 port (see page 52)
4— RS-232 Serial connector RJ-45 port (see page 53)
5— Auxiliary I/O (Aux I/O) (see Step 7—I/O Configuration (Optional) on page 31)
6— USB type-C locking port (see page 52)
7— Expansion cartridge (XP1) Ethernet (1 Gbps) RJ-45 port (see page 52)
8— Expansion cartridge (XP or XP2) Ethernet (1 Gbps) RJ-45 port (see page 52)
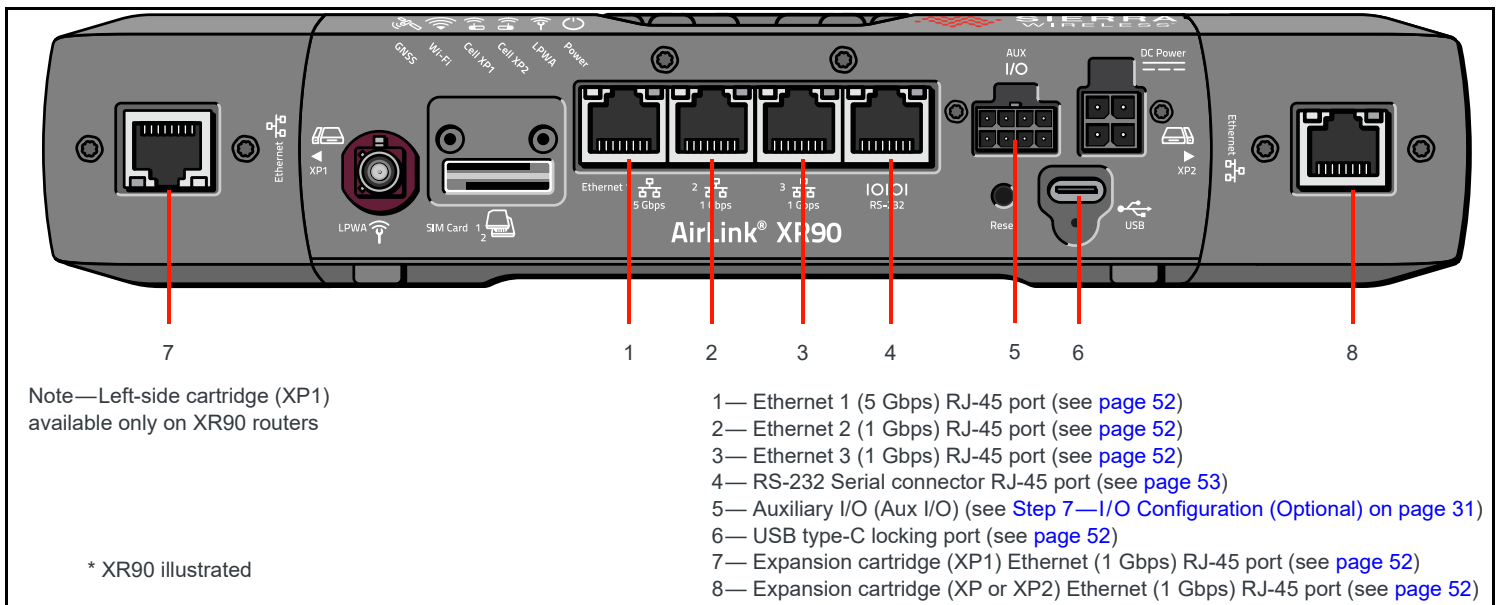
* XR90 illustrated

Figure 2-10:   Data Cable and Accessory Connectors

To connect data cables and accessories to ports on the XR router's front panel:

1. Connect at least one Ethernet cable to the XR router from a computer to enable access to the XR router's AirLink OS—by default, all ports are enabled for LAN connection.

    See Ethernet on page 52 for cable requirements.

    After the XR router is set up, specific Ethernet ports can be reconfigured in the AirLink OS for WAN use (Network > General > Mode).

2. Optionally, in the RS-232 serial port, insert a supported RJ45 to DB9 cable (available from Sierra Wireless (see Table 1-2 on page 11) or other vendors), and then connect appropriate device(s) to the port.

    The port supports a 4-wire and 2-wire serial interface. See Serial Port on page 53 for cable requirements.

---

3. Optionally, in the AUX I/O 8-pin port, insert an Auxiliary I/O data cable. For details, see Step 7—I/O Configuration (Optional) on page 31.

4. Optionally, in the USB type-C locking port, connect a supported USB cable/device (e.g. USBnet (Windows Ethernet) adapter, USB-serial adapter). For USB port details, see USB on page 52.

   a. Plug the USB cable/device into the USB port.

   b. If using a USB locking cable, tighten the jack screw finger-tight.

Step 6—Prepare Power Connection

The XR router can be powered via:
- DC power cable—The XR router is provided with a 3 meter (10 ft.) DC power cable.
- AC power adapter—An optional AC adapter is available from Sierra Wireless—see Table 1-2 on page 11.

If the optional AC adapter is being used to power the XR router, go to Step 7—I/O Configuration (Optional).

If the DC power cable is being used to power the XR router, continue with this step.

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

Operating Voltage

The XR router's operating voltage range is 7–36 V.

By default, the XR router is factory-configured with low voltage standby mode enabled and the standby voltage set to 9 V.

If low voltage standby mode is enabled, the startup voltage must be greater than the configured standby voltage, otherwise the XR router will boot and enter standby mode. After booting, if the operating voltage drops below the standby voltage (for a configured duration (delay)), the XR router enters standby mode.

To disable/enable low voltage standby mode, or to change the settings (e.g. to allow the XR router to operate at a lower voltage without entering standby mode, or to change the delay value), use the AirLink OS (System > MCU > Voltage Threshold).

For more information, refer to [3] AirLink OS User Guide.

Fusing

For DC installations, Sierra Wireless recommends fusing the power input using a 15–20 A (max), fast blow fuse, recommended to have no more than ±10% derating over the operating temperature range.

Router Power Connector

Pin 4 (Green) GPIO

Pin 3 (White) Ignition Sense

4 3

2 1

Pin 2 (Black) Ground

Pin 1 (Red) Power

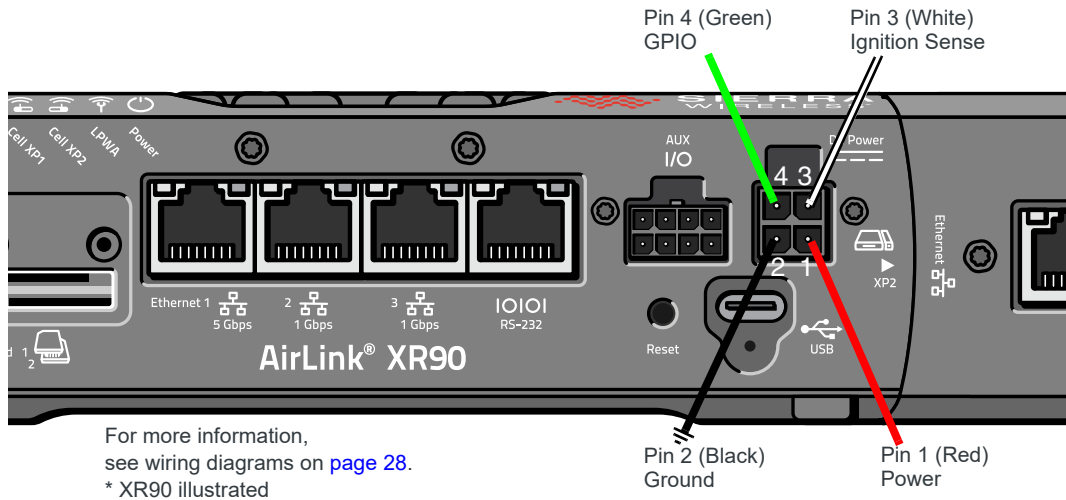For more information,
see wiring diagrams on .
* XR90 illustrated

Figure 2-11: DC Power Cable Connections (Colors indicate DC cable wire colors.)

Table 2-3: XR Router Power Connector Pin and DC Power Cable Wires

Pin	Name	DC Cable Wire Color	Description	Type
1	Power	Red	Main power supply for XR router *Note: To use a control line (such as a vehicle ignition line) to turn the XR router on/off, Sierra Wireless strongly recommends that you connect the control/ignition line to Pin 3 (Ignition Sense) and apply continuous power on Pin 1.*	PWR
2	Ground	Black	Main XR router ground	PWR
3	Ignition Sense	White	Enables the XR router power state to be controlled by vehicle ignition. The XR router is: • On, when this pin is connected to power through a vehicle's ignition, or tied to pin 1 (Power) • Off or in standby, when the pin is either open-circuit or grounded For correct telemetry operation in vehicle installations, this pin must be connected to the vehicle ignition. *Note: Sierra Wireless recommends always connecting this pin to the vehicle ignition and, if required, disable ignition in the AirLink OS (System > MCU > Power Management) so the XR router does not shut down when the vehicle ignition is turned off.* *Note: If the pin is not connected to vehicle ignition, it MUST be tied to the power supply (pin 1). (For example, in the optional AC adapter cable, pin 3 is tied to pin 1 inside the cable.)*	I

Table 2-3: XR Router Power Connector Pin and DC Power Cable Wires (Continued)

Pin	Name	DC Cable Wire Color	Description	Type
4	GPIO	Green	General purpose input/output—Typical uses include: • User configurable digital input/output—Connect to a switch, relay, or external device. • Analog input to detect low voltage. For more information, see Step 7—I/O Configuration (Optional) on page 31.	I/O

Vehicle Installations

For vehicle installations, the XR router's power supply cable must be connected to the vehicle's fuse box, and installed along the vehicle wall, always inside the vehicle cabin and must not cross the vehicle's firewall protection. Always follow the vehicle manufacturer's recommendations for electrical accessories connections. All components used in the electrical connection to the vehicle should be UL Listed or equivalent.

For operating voltage details (including software configuration) and fusing recommendations, see Operating Voltage on page 25 and Fusing on page 25.

DC Voltage Transients

The XR router has built-in protection against vehicle transients including engine cranking (down to 5.0V) and load dump (up to 200V), so external power conditioning circuits are not needed. For details, see Industry Certification for Vehicles on page 48.

Connect the XR Router to a Vehicle's Electrical System

For vehicle installations, connect the XR router to the vehicle's electrical system:

1. Make sure the vehicle is turned off.
2. Remove the key from the ignition.
3. Disconnect the vehicle's battery:
   a. Disconnect the negative terminal **first**.
   b. Disconnect the positive terminal.
4. Connect the black (Ground) wire on the DC power cable to the vehicle chassis.
5. Make sure the XR router is grounded. (See Step 3—Mount and Ground the Router on page 16.)
6. Use a 15–20 A, fast blow fuse, recommended to have no more than ±10% de-rating over the operating temperature range, to connect the red (Power) wire on the DC power cable to the vehicle's fuse box. (See Figure 2-12.)
7. Connect the white wire (Ignition Sense) on the DC power cable to the ignition signal from the vehicle.
8. Connect the DC power cable to the XR router.
9. Reconnect the vehicle's battery:
   a. Connect the positive terminal **first**.
   b. Connect the negative terminal.

Wiring Diagrams (Vehicle Installation Wiring Methods)

Table 2-4 summarizes typical vehicle installation wiring methods. Refer to the methods for wiring diagrams and details for connecting the supplied DC cable to your power supply.

Table 2-4: Vehicle Installation Wiring Methods Summary

Installation Method	Description
Vehicle Installation—Recommended Basic Method on page 28	XR router operates while engine is running. Optional delayed shutdown can be used to maintain network connection for short periods while the engine is shut off.
Vehicle Installation—Timer-Driven Activation	XR router wakes periodically for a configured duration, then returns to standby mode.
Vehicle Installation—Shore Power	XR router continues operating when engine is shut off, via shore power supply, such as in a maintenance bay.

Vehicle Installation—Recommended Basic Method

For most vehicle installations, Sierra Wireless recommends connecting the white Ignition Sense wire to the vehicle's ignition switch, as shown in Figure 2-12.
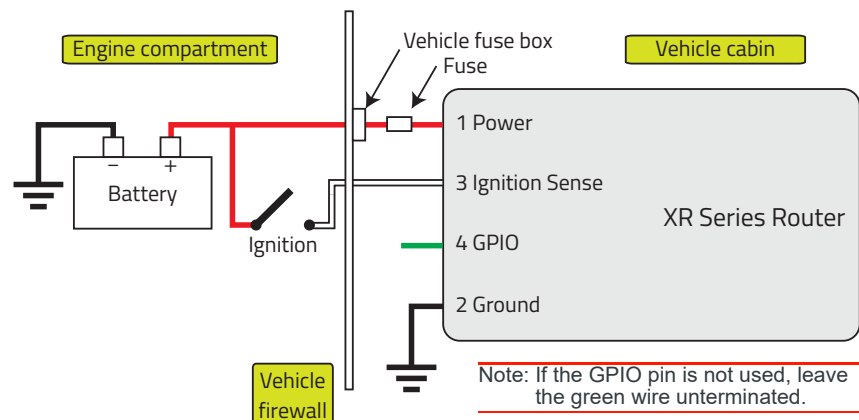

Figure 2-12: Vehicle Installation Wiring Diagram—Recommended Basic Method

This installation method allows the XR router to operate with the vehicle:
- When the vehicle ignition is off, the XR router is in standby mode.
- Optionally, a delayed shutdown can be configured to keep the XR router on for a specified time after the vehicle's ignition shuts off, For example, a delayed shutdown is especially useful for maintaining a network connection while the vehicle's engine is shut off for short periods, such as in a delivery vehicle. For more information, refer to [3] AirLink OS User Guide.

Connect the DC cable's wires as follows:
- Red (Pin 1—Power)—Connect to the power source. Include a 15–20 A, fast blow fuse, recommended to have no more than ±10% derating over the operating temperature range, in the input power line. Sierra Wireless recommends using a continuous (unswitched) DC power source. Connect the power through the vehicle's fuse box.
- Black (Pin 2—Ground)—Connect to the vehicle battery's negative terminal, or ground. For details, see Step 3—Mount and Ground the Router on page 16.

- White (Pin 3—Ignition Sense)—Sierra Wireless recommends connecting the white wire to the vehicle ignition to turn on the XR router (or wake from standby mode), or to turn off the XR router (or enter standby mode).

> **Important:** *To protect the XR router, do not remove the power source (e.g. do not disconnect the power cable) while the router is on. Uncontrolled shutdowns may result in unexpected operations/behavior when power is reapplied. For example, telemetry data could be lost, which will adversely impact ALMS Advanced Mobility Reporting (AMR) reports.*

- Green (Pin 4—GPIO)—Leave the green wire (GPIO) unconnected if GPIO functionality is not required. Otherwise, connect the GPIO as described in Step 7—I/O Configuration (Optional) on page 31.

Vehicle Installation—Timer-Driven Activation

For installation in vehicles where the XR router must be active at specific time intervals (e.g. to report vehicle status), the vehicle ignition can be connected to the XR router's I/O pin (as shown in Figure 2-13) and a timer can be configured in the AirLink OS to turn the XR router on at the required interval for a configured duration (e.g. 20 minutes once every 24 hours when the ignition is off). When the duration expires, the XR router switches to standby mode. For more information, refer to [3] AirLink OS User Guide.
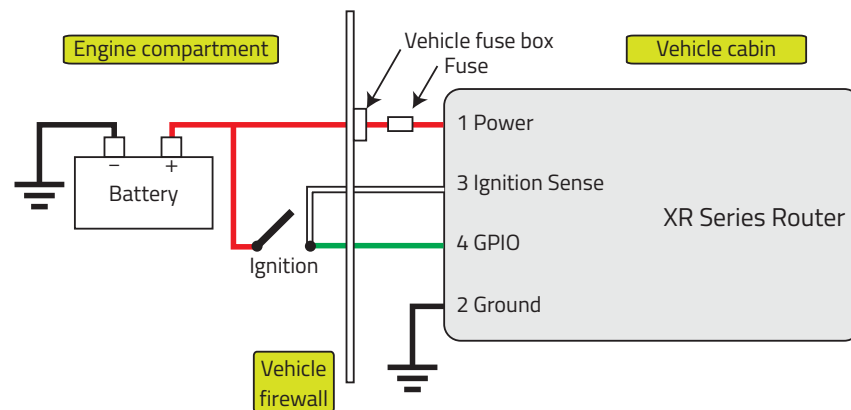

Figure 2-13: Vehicle Installation Wiring Diagram—Timer-driven Activation

Connect the DC cable's wires as follows:
- Red (Pin 1—Power)—Connect to the power source. Include a 15–20 A, fast blow fuse, recommended to have no more than ±10% de-rating over the operating temperature range, in the input power line. Sierra Wireless recommends using a continuous (unswitched) DC power source. Connect the power through the vehicle's fuse box.
- Black (Pin 2—Ground)—Connect to the vehicle battery's negative terminal, or ground. For details, see Step 3—Mount and Ground the Router on page 16.
- White (Pin 3—Ignition Sense)—Connect to the vehicle ignition to enable accurate ALMS Advanced Mobility Reporting (AMR) (e.g. trip reports) and improve reliability of the GPS anti-jitter feature,

  and

  Disable ignition in the AirLink OS (System > MCU > Power Management) so the XR router does not shut down (or enter standby mode) when the vehicle ignition is turned off.

- Green (Pin 4—GPIO)—Connect to the vehicle's ignition.

Vehicle Installation—Shore Power

A shore power supply can be used to operate the XR router while the vehicle ignition is off and the vehicle is in a facility with a shore power supply (e.g. parked in a maintenance bay), as shown in Figure 2-14.
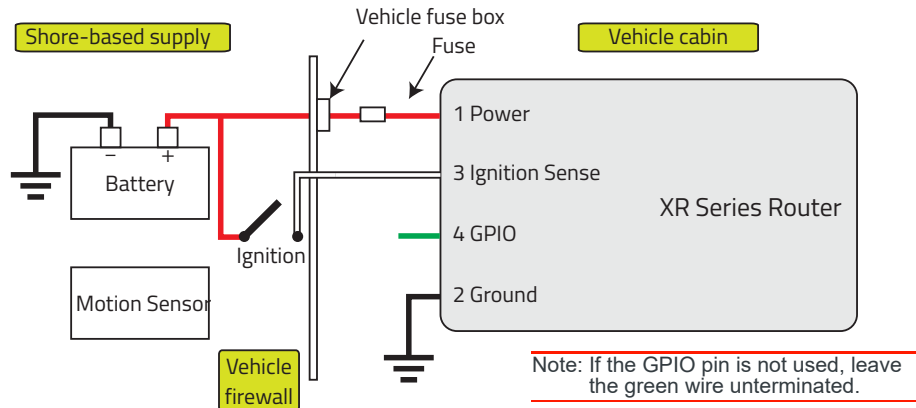

Figure 2-14: Vehicle Installation Wiring Diagram—Shore Power

Connect the DC cable's wires as follows:
- Red (Pin 1—Power)—Connect to the power source. Include a 15–20 A, fast blow fuse, recommended to have no more than ±10% de-rating over the operating temperature range, in the input power line. Sierra Wireless recommends using a continuous (unswitched) DC power source. Connect the power through the vehicle's fuse box.
- Black (Pin 2—Ground)—Connect to the vehicle chassis ground. For details, see Step 3—Mount and Ground the Router on page 16.
- White (Pin 3—Ignition Sense)—Connect to the vehicle ignition to enable accurate ALMS Advanced Mobility Reporting (AMR) reporting (e.g. trip reports) and improve reliability of the GPS anti-jitter feature,

  and

  Disable ignition in the AirLink OS (System > MCU > Power Management) so the XR router does not shut down (or enter standby mode) when the vehicle ignition is turned off.
- Green (Pin 4—GPIO)—Leave unconnected if GPIO functionality is not required. Otherwise, connect the GPIO as described in Step 7—I/O Configuration (Optional) on page 31.

Fixed Installations

For operating voltage details (including software configuration) and fusing recommendations, see Operating Voltage on page 25 and Fusing on page 25.

Wiring Diagram (Fixed Installation Basic Wiring Method)

For fixed installations without I/O, connect the wires as shown in Figure 2-15.
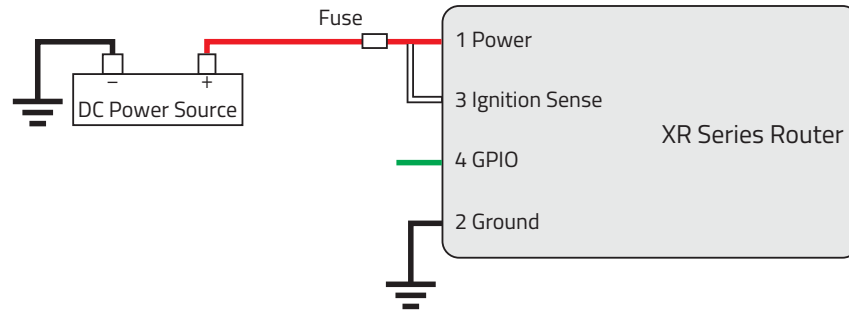

Figure 2-15: Fixed Installation Wiring Diagram—Basic Method (no I/O)

Connect the DC cable's wires as follows:
- Red (Pin 1—Power)—Connect to the power source. Include a 15–20 A, fast blow fuse, recommended to have no more than ±10% derating over the operating temperature range, in the input power line. Sierra Wireless recommends using a continuous (unswitched) DC power source.
- Black (Pin 2—Ground)—Connect to ground. For details, see Grounding the Router on page 19.
- White (Pin 3—Ignition Sense)—Tie to the red wire (Power) before the fuse (i.e. on the XR router side of the fuse).
- Green (Pin 4—GPIO)—Leave unconnected if GPIO functionality is not required. Otherwise, connect the GPIO as described in Step 7—I/O Configuration (Optional) on page 31.

Step 7—I/O Configuration (Optional)

The XR router has five I/O pins available for digital input/output configuration:
- Power connector—Pin 4 (GPIO)
- Auxiliary I/O connector[1]—Pins 2, 3, 6, and 7 (Digital and/or analog inputs)

For details on configuring, monitoring and interacting with these I/Os, refer to [3] AirLink OS User Guide.

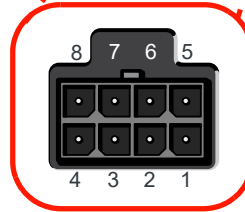1. Configurable in a future firmware release.
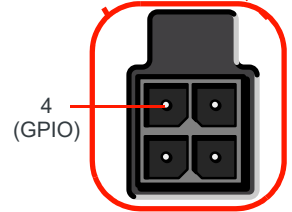
I/O Pins
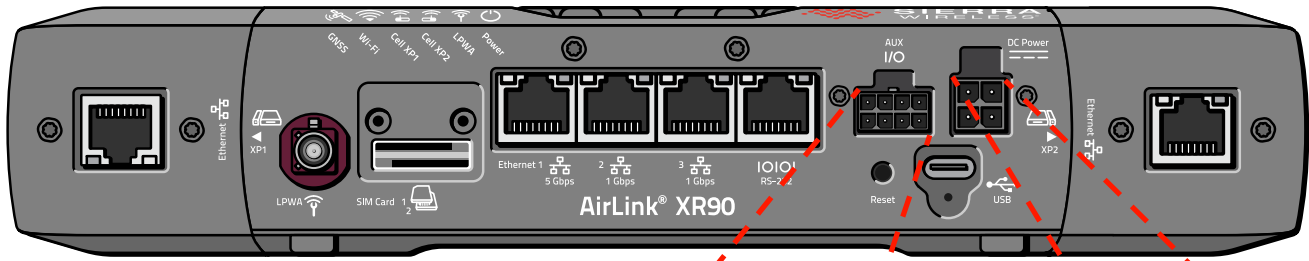
* XR90 illustrated

Auxiliary I/O Connector Pin Functionality

Pin 8 GND	Pin 7 DIG$_{IN2}$ / A$_{IN2}$	Pin 6 DIG$_{IN3}$ / A$_{IN3}$	Pin 5 CAN-L[a]
Pin 4 CAN-H[a]	Pin 3 DIG$_{IN4}$	Pin 2 DIG$_{IN5}$	Pin 1 GND

a. Reserved for vehicle bus cable. See page 72.
Do not use with the Aux I/O cable.

Auxiliary I/O Connector

4
(GPIO)

DC Power Connector

Figure 2-16: I/O Pin-out for Auxiliary I/O Connector and Power Connector

Table 2-5: I/O Pin-out Configuration[a]

Location	Pin— Wire Color	I/O Functionality					Other Functionality
		Digital In	Analog In	Digital Out	Pull-up	GND	
Power Connector (DC Power Cable, included)	4—Green	✔	✔	✔	✔	–	–
Aux I/O Connector (I/O Cable, SKU# 6001004)	6—Yellow	✔	✔	–	✔	–	–
	7—Gray	✔	✔	–	✔	–	–
	2—Orange	✔	–	–	✔	–	–
	3—Purple	✔	–	–	✔	–	–
	1—Black	–	–	–	–	✔	–
	8—Black	–	–	–	–	✔	–
	4—NC	–	–	–	–	–	✔ (CAN-H)
	5—NC	–	–	–	–	–	✔ (CAN-L)

a. GPIOs will be configurable in a future software update.

You can use these pins as:
- Pulse counters—See Figure 2-17 on page 33.
- Digital inputs—See Digital Input on page 34.

- High side pull-ups/dry contact switch inputs—See High Side Pull-up / Dry Contact Switch Input on page 35.
- Analog inputs
  (See Table 2-11 on page 38 and Figure 2-22 on page 38.)
- Low side current sinks—See Low-Side Current Sink Output on page 35.
- Digital outputs/open drains—See Digital Output/Open Drain on page 36.

Note: The I/O pins can be configured in the AirLink OS or ALMS to either (a) trigger standby mode, or (b) sink current or to pull up the voltage.

Note: During bootup, the I/O settings remain in their default state—the internal pull-up resistor is disabled, and output current sink switch is open. After bootup, any custom I/O settings are applied. This may take approximately 30 seconds after the XR router is restarted or powered on.

You can use the I/O pins in conjunction with events reporting to configure the XR router to send a report when the state of the monitored gateway changes, for example when a switch is opened or closed.

Pulse Counter

Note: GPIOs will be configurable in a future firmware release.

You can connect any GPIO pin to a pulse counter.

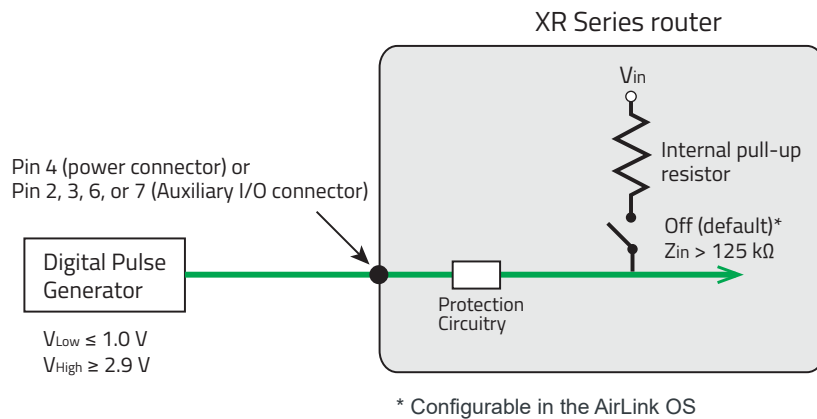*Note: The digital pulse counter is not available in Standby mode.*

Figure 2-17: Digital Input / Pulse Counter

Maximum frequency: 140 Hz

Duty cycle: 20–80%

Note: Values may vary, depending on signal noise.

Table 2-6: Pulse Counter

Pull-up	State	Minimum	Typical	Maximum	Units
Off	Low	—	—	1.0	V
	High	2.9	—	Vin	V

Digital Input

Note: GPIOs will be configurable in a future firmware release.

Any GPIO pin can be used as a digital input to detect the state of a switch (such as a vehicle ignition), or to monitor an external device (such as a motion detector, a remote solar panel, or a remote camera).

The power connector GPIO (pin 4) digital input can also be used with the standby timer. While in Standby mode, the digital input will act as a wakeup function to wake the XR router for a configured length of time. (Note that the digital inputs on the I/O connector do not have this functionality.)
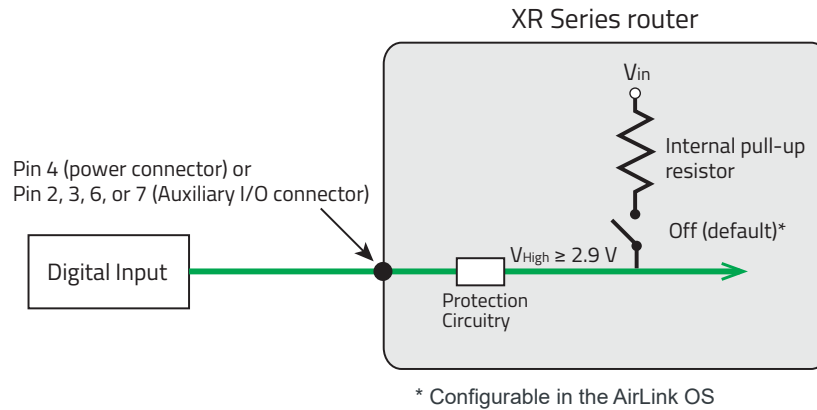

Figure 2-18: Digital Input

Table 2-7: Digital Input

Pull-up	State	Minimum	Typical	Maximum	Units
Off	Low	—	—	1.0	V
	High	2.9	—	V_{in}	

High Side Pull-up / Dry Contact Switch Input

Note: GPIOs will be configurable in a future firmware release.

You can connect any GPIO pin to a dry contact switch, such as an alarm relay. While in Standby mode, the dry contact switch input will not be acted upon if it changes state.
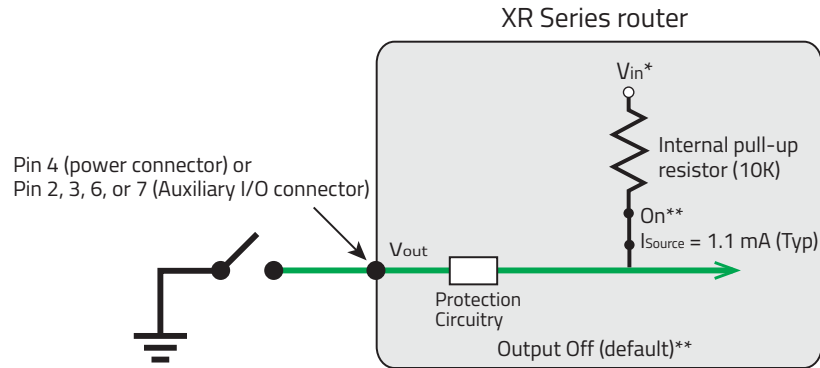
*Depending on the load, this value can range from Vin to Vin - 2.5 V.

** Configurable in the AirLink OS

Figure 2-19: High Side Pull-up / Dry Contact Switch Input

Table 2-8: High Side Pull-up / Dry Contact Switch Input

	Minimum	Typical	Maximum	Units	Comments
Source Current (I_{Source})	0.6 (V_{in} = 7 V)	1.1 (V_{in} = 12 V)	3.5 (V_{in} = 36 V)	mA	Maximum current the voltage input can provide (depends on V_{in})
V_{out}	V_{in} - 2.5	—	V_{in}	V	The voltage on Pin 4 when the high side pull-up is enabled (depends on V_{in} and power consumption)

Low-Side Current Sink Output

Note: GPIOs will be configurable in a future firmware release.

The power cable GPIO pin can be connected to a low-side current sink output, for example to drive a relay.

XR Series router

V$_{in}$

Internal pull-up resistor

Off

Protection Circuitry

I$_{Sink}$ = 500 mA (Typ)*

V$_{in}$

External solenoid/relay circuit

Pin 4 (power connector)
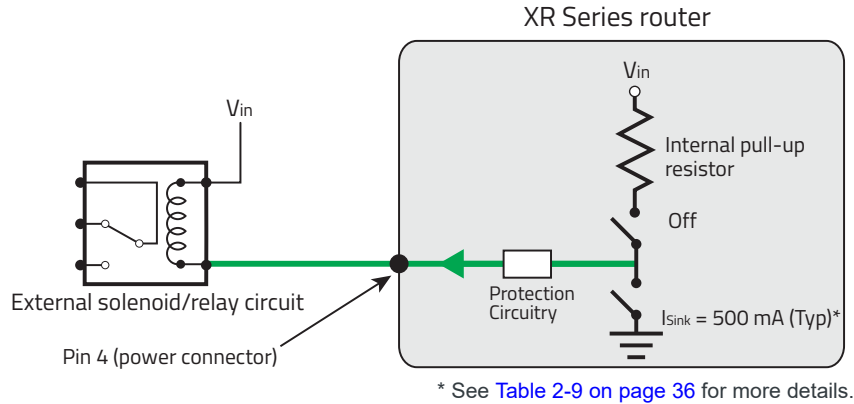
* See Table 2-9 on page 36 for more details.

Figure 2-20: Low Side Current Sink

If using the low-side switch, make sure to keep the internal pull-up disabled.

Table 2-9: Low Side Switch Operational Ranges (Recommended)

State	Minimal	Typical	Maximum	Units	Comments
On	300 (@ 70°C)	500 (@ 25°C)	950 (@ -30°C)	mA	Sink Current (I$_{Sink}$)

Note: The XR router protection circuitry has a high-impedance (~200 kΩ) path to ground. If the GPIO is connected to 12 V, there will be a small current flow (~100 μA) into the GPIO during bootup. This flow is countered if the internal pull-up resistor (10 kΩ) becomes active, and only after bootup. Depending on your application, you may need to install an external pull-up resistor (10 kΩ) to nullify the small input current flow for the first 30 seconds during bootup.

Note: If the GPIO stops working, the overcurrent protection circuitry may have been triggered, which disables the affected GPIO. To re-enable the GPIO, remove the cause of the overcurrent.

Digital Output/Open Drain

Note: GPIOs will be configurable in a future firmware release.

The power cable GPIO can be connected to a digital output/open drain, for example to drive an external digital input.
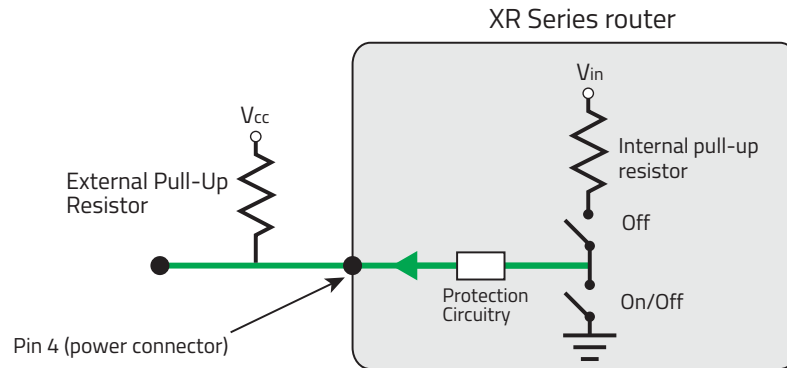
XR Series router

Figure 2-21: Digital Output / Open Drain

Table 2-10: Digital Output / Open Drain

Pull-up	State	Minimum	Typical	Maximum	Units	Comments
Off	Off	Open Circuit	—	—	—	—
	Active Low	—	—	0.5	V	5 mA $\leq$ 5 V

Analog Input

Note: GPIOs will be configurable in a future firmware release.

Three GPIOs are available for use as analog inputs:
- Power connector pin 4 (GPIO)
- Auxiliary I/O connector pins 6 and 7

Any analog input GPIO can be connected to an analog sensor. As an analog input (voltage sensing pin), the XR router monitors voltage changes in small increments. This enables monitoring of equipment that reports status as an analog voltage.

When used with a sensor to transform values into voltages, an analog input GPIO can monitor measurements like temperatures, sensors, or input voltage.

Supported theoretical input voltages (referenced to ground) are:
- Power connector GPIO: 0–36V
- Auxiliary I/O GPIOs: Either 0–5V or 0–10V. The AirLink OS is used to select the monitored voltage range. For low input voltages, 0–5 V provides better accuracy.

Note: The lowest guaranteed detectable voltage for each analog input is 0.5V (voltages from 0–0.5V are not detected accurately).
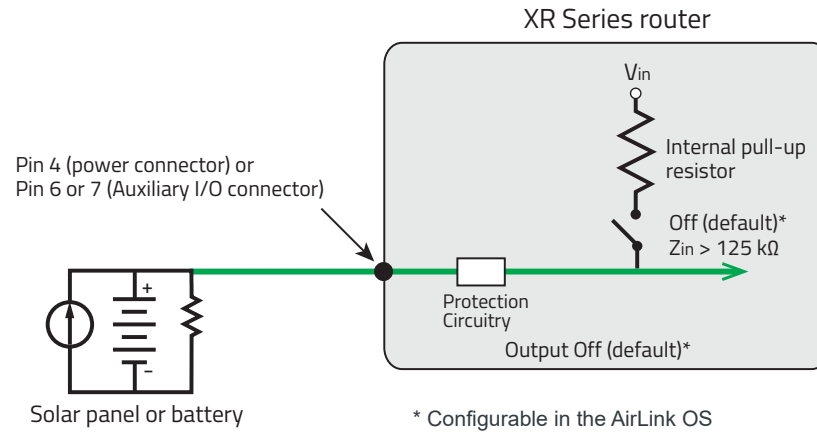

XR Series router

Pin 4 (power connector) or
Pin 6 or 7 (Auxiliary I/O connector)

V_{in}

Internal pull-up resistor

Off (default)*
$Z_{in} > 125$ kΩ

Protection Circuitry

Output Off (default)*

Solar panel or battery

* Configurable in the AirLink OS

Figure 2-22: Analog Input

Table 2-11: Analog Input Specifications

Pull-up	Specification	Min	Typ	Max	Units	Comments
Off	Input range	0.5	—	Power (pin 4): 36	V	Input voltage will cap at the maximum (i.e. over-voltage will be limited to the maximum)
				Aux I/O (pins 6/7): 5 or 10	V	Maximum is software-selectable. Low range (0–5) provides greater accuracy than high range (0–10)
	Input accuracy	-1.5%	0.50%	1.5%	—	—

Data sampling is handled by a dedicated microprocessor. In order to filter noisy signals, twenty measurements are taken over a 250 ms interval. The measurements are averaged to generate a sample. If the change since the last sample is significant, a notification is sent to the CPU for updating the current value displayed in the AirLink OS and for use by Events Reporting.

Changes are considered significant if the change is 200mV or more (when the range of monitored voltage is 0–5 V) or 350 mV or more (when the range of monitored voltage is 0–10 V). If there has not been a significant change to the parameter being monitored, the CPU reads a sample every 2.5 minutes, which detects small changes.
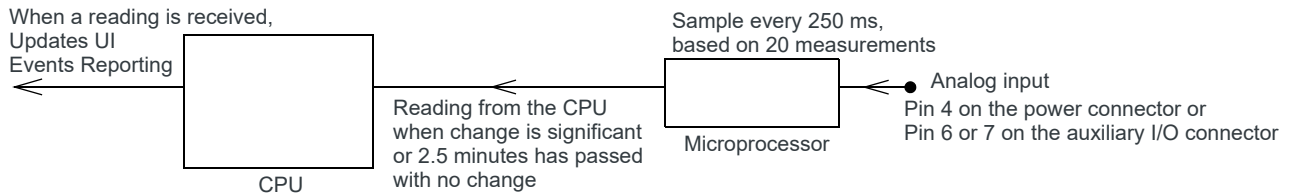

When a reading is received,
Updates UI
Events Reporting

CPU

Reading from the CPU when change is significant or 2.5 minutes has passed with no change

Sample every 250 ms, based on 20 measurements

Microprocessor

Analog input
Pin 4 on the power connector or
Pin 6 or 7 on the auxiliary I/O connector

Figure 2-23: Analog Input Sampling and Reading

Note: The same method is used to sample the input voltage and the internal board temperature for Events Reporting. The significant changes are 300 mV for the input voltage and 1°C for the board temperature.

Step 8 (Optional)—Connect the Vehicle Bus Cable

For vehicle installations, the XR router collects vehicle data through an OBD-II (J1979) or J1939 connection from the vehicle's diagnostic port to the XR router's Aux I/O port. (Cables for both connection types are available separately from Sierra Wireless. See Vehicle Bus Cables on page 72.)

After Vehicle Data Collection is enabled in the AirLink OS, the XR router sends data to ALMS.

Note: The XR router does not require a separate scanner for reporting of vehicle telemetry data. Do not connect an additional scanner or other device to the vehicle bus during normal operation. When doing vehicle maintenance that requires connecting a diagnostic tool, it is recommended to disable Vehicle Data Collection on the XR router.

To connect the XR router with a vehicle bus cable:

1. Ensure that both the XR router and the vehicle are powered off.
2. Locate the OBD-II (J1979) or J1939 port in the vehicle. The OBD-II port is an electrical socket most commonly located under the vehicle dashboard on the driver's side near the center console.
3. Attach the OBD-II (J1979) or J1939 connector on the cable to the port in the vehicle.
4. Route the cable through the vehicle to where the XR router is mounted.
5. Connect the 8-pin connector on the vehicle bus cable to the Auxiliary I/O port on the XR router.
6. Power on the XR router. Check that the Power, GNSS, and all cellular LEDs indicate expected states (see LED Behavior on page 41).
7. Configure the XR router to enable accurate reporting of vehicle telemetry, vehicle behavior, and dead reckoning—for details, refer to [3] AirLink OS User Guide.

Dead Reckoning Calibration

The XR router's inertial sensors must be calibrated before dead reckoning can function. Calibration begins automatically when the XR router is turned on for the first time in a vehicle, or (only if necessary) after the XR router is:
*   powered off
*   shut down to OFF mode
*   rebooted
*   disconnected and reinstalled in a different orientation.

For optimal calibration, the vehicle should:
*   be driven in open-sky conditions, with a good GPS signal
*   undergo several left and right turns
*   be stopped and started several times in a straight line—braking for and accelerating away from stop signs, for example.

The calibration process can take from 5–20 minutes once the vehicle is in motion, depending on driving conditions.

The XR router's dead reckoning calibration status is shown via:
- Power LED—If Dead Reckoning is enabled and a satellite fix is available, the LED will solid green if calibrated, or solid yellow if not calibrated.
- AirLink OS—DR CALIBRATION Status is shown under Services > Location.

Recalibration after Router Reinstallation

If the XR router's installation orientation is changed or the XR router is moved to a new installation location (e.g. moved to a different vehicle), dead reckoning must be recalibrated:
- If the XR router is installed in a different vehicle and connected to the vehicle's OBD-II (J1979) or J1939 port, the XR router detects that the VIN has changed and dead reckoning recalibration occurs automatically.
- Otherwise (i.e. the installation orientation is changed, or installed in new location without connecting to an OBD-II (J1979) or J1939 port):

    a. In the AirLink OS, go to Services > Location and change the GNSS Firmware Selection Mode to Manual.

    b. Install the GNSS Only firmware.

    c. Change the GNSS Firmware Selection Mode back to Automatic. The XR router reloads the Dead Reckoning firmware and automatically recalibrates.

Step 9—Power on the Router

The XR router's factory default configuration enables it to establish a WAN connection if an appropriate SIM card is installed and the APN is configured correctly.

Note: Additional configuration is always recommended.

To power on the XR router:

1. Apply power to the system—turn on the ignition (if wired to vehicle's electrical system) or connect the optional AC power adapter to the front panel DC power connector.

    The XR router powers up in approximately 60 seconds.
    - If the LEDs begin flashing in sequence, a XR router update is in progress. DO NOT REMOVE POWER.
    - While turning on, the Power LED is solid yellow, then turns solid green when powered up, and other LEDs begin to display their regular behavior. For more information on the LED patterns see LED Behavior on page 41.

Note: The first time the XR router is powered on (i.e. a new XR router being used for the first time), it uses an available Internet connection to connect to AirLink Management Service (ALMS), completes its registration, and applies any preconfiguration that was done when the XR router was registered with ALMS (for details, refer to [4] AirLink XR90 Quick Start Guide/[5] AirLink XR80 Quick Start Guide).

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2. If the XR router does not start automatically:

   a. Make sure:
   - The power connector is plugged in and supplying sufficient voltage. (The XR router will boot in standby mode if the voltage is too low—see Operating Voltage on page 55 for details.)
   - Ignition Sense (pin 3) is connected to the battery or power source (see Step 6—Prepare Power Connection on page 25 for details).

   b. Press (< 5 seconds) and release the Reset button on the front panel.

3. Test the XR router—Connect a test device (for example, a PC) to the XR router LAN via Ethernet—use any Ethernet port (Ethernet 1–3) on the router. (All ports are factory configured for LAN access.)

   For configuration/usage instructions, refer to [3] AirLink OS User Guide.

The XR router is now ready for use.

LED Behavior

Main Unit LEDs
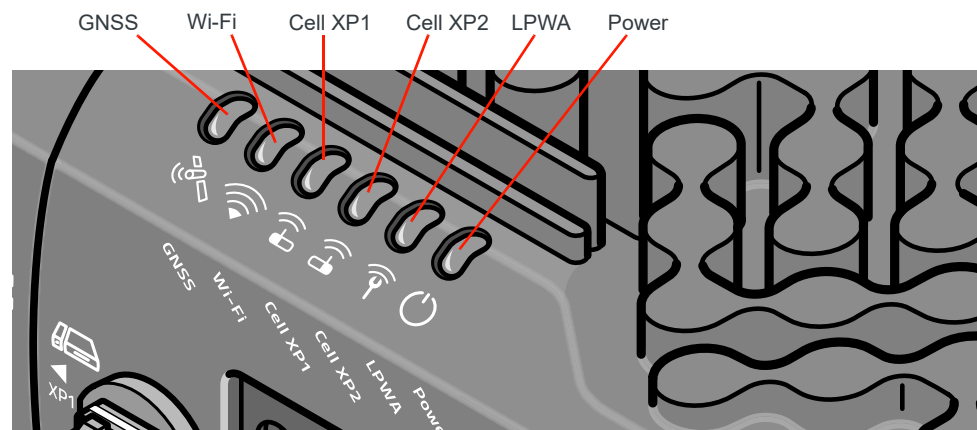
Figure 2-24: XR90 LED Status Indicators (front panel)
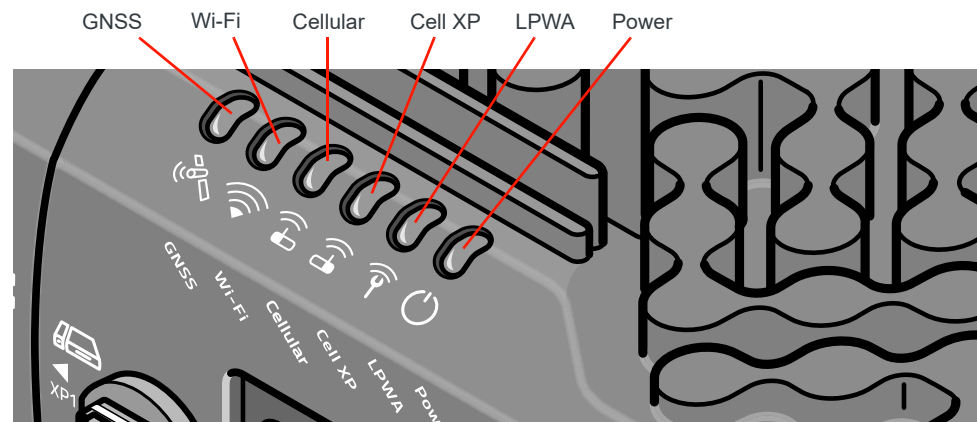
Figure 2-25: XR80 LED Status Indicators (front panel)

Table 2-12: LED Behavior

LED	Color/Pattern[a]	Description
GNSS	**Solid Green**	Satellite fix available and Dead Reckoning[b] is calibrated[c] or Satellite fix available and Dead Reckoning is disabled
	Solid Yellow	Satellite fix is available and Dead Reckoning is not calibrated
	Solid Red	Searching for a satellite fix
	Fast Flashing Red	(Forthcoming) GNSS antenna is open or shorted. *Note: Antenna may appear to be connected, but current draw is too high or too low.*
	Slow Flashing Red	(Forthcoming) GNSS antenna is disconnected. *Note: Current draw is below predefined threshold.*
	Off	GNSS is off/disabled
Wi-Fi	**Green and fast pulse off with activity**	STA connected (good signal) with traffic *Note: If AP also has traffic at same time, LED displays the STA status (i.e. displaying a connected Depot is the priority).*
	Slow Flashing Green	STA enabled but not connected, and no AP is enabled.
	Yellow and fast pulse off with activity	STA connected (fair signal) with traffic *Note: If AP also has traffic at same time, LED displays the STA status (i.e. displaying a connected Depot is the priority).*
	Red and fast pulse off with activity	STA connected (poor signal) with traffic *Note: If AP also has traffic at same time, LED displays the STA status (i.e. displaying a connected Depot is the priority).*
	Purple and fast pulse off with activity	AP with traffic, and STA enabled but no connection or AP with traffic, and STA disabled
	Off	No Wi-Fi enabled (no AP, no STA)

Table 2-12: LED Behavior (Continued)

LED	Color/Pattern[a]	Description
(XR90) **Cell XP1 Cell XP2** (XR80) **Cellular CellXP**	**Green and fast pulse off with activity**	4G/3G connected to APN with good connection (equivalent to 4–5 bars). Pulsing off for activity.
	Slow Flashing Green	4G/3G connecting
	Purple and fast pulse off with activity	5G connected to APN with good connection (equivalent to 4–5 bars). Pulsing off for activity.
	Slow Flashing Purple	5G connecting
	Yellow and fast colored pulse with activity	Yellow indicates connected to APN with fair connection (equivalent to 2–3 bars). During activity, RAT (5G or 3G/4G) is indicated by an alternate LED pulse color: • Green pulse—4G/3G • Purple pulse—5G
	Red and fast colored pulse with activity	Red indicates connected to APN with poor connection (equivalent to 1 bar). During activity, RAT (5G or 3G/4G) is indicated by an alternate LED pulse color: • Green pulse—4G/3G • Purple pulse—5G
	Slow Flashing Red	No network connection
	Off	No expansion cartridge installed
LPWA	**Green and fast pulse off with activity**	LPWA connected to APN and ALMS with good connection (equivalent to 4–5 bars). Pulsing off for activity.
	Slow Flashing Green	Connecting
	Yellow and fast pulse off with activity	Connected to APN and ALMS with fair connection (equivalent to 2–3 bars). Pulsing off for LPWA activity.
	Red and fast pulse off with activity	Connected to APN and ALMS with poor connection (equivalent to 1 bar). Pulsing off for activity.
	Slow Flashing Red	No network connection
	Off	LPWA module powered off

Table 2-12: LED Behavior (Continued)

LED	Color/Pattern[a]	Description
Power ⏻	**Solid Green**	XR router operating normally with ignition on
	Fast Flashing Green	XR router is rebooting after Reset button pressed for <5 seconds (or reset from the AirLink OS)
	Solid Yellow	• XR router is booting or • XR router is thermally throttled—one or more of CPU, cellular radio, and Wi-Fi radio has exceeded threshold. When operating temperature returns to normal, LED returns to solid green.
	Fast Flashing Yellow	XR router is rebooting and being reset to factory defaults, after Reset button is pressed for 20–40 seconds
	Solid Red	Power is present, but XR router is not running (e.g. ignition is off, XR router is in standby mode, etc.) *Note: If the XR router is in standby mode, the Power LED will be solid red only if the AirLink OS Standby LED setting is enabled (System > MCU > Power Management), otherwise the LED will be Off. (By default, the setting is enabled.)*
	Fast Flashing Red	XR router is rebooting and being reset to the default template, after Reset button pressed for 5–20 seconds
	Slow Flashing Red	XR router is not operating because operating temperature range is exceeded (i.e. thermal shutdown).
	Fast Alternating Flashing Yellow / Red	Reset button held > 40 seconds, canceling the reset action and rebooting normally when released. (i.e. if pressing reset >5 seconds and decide that XR router should do a regular reboot (not a reset to default template or factory defaults, continue pressing Reset until LED alternates Yellow and Red flashes.)
	Off	• No power or • XR router is in standby mode and the AirLink OS Standby LED setting is disabled (System > MCU > Power Management).
ALL LEDS	**Yellow LED chase**	Software update in progress (e.g. XR router firmware update, radio module firmware update, etc.) **Important:** *Do not turn off the power while the update is in progress.*

a. Patterns:
   Fast flash—0.2 seconds on, 0.2 seconds off or other color;
   Slow Flash—0.25 seconds on, 0.75 seconds off or other color;
   Fast pulse—0.5 seconds on, 0.2 seconds pulse off or other color
   Slow pulse—0.5 seconds on, 0.1 seconds pulse off or other color
   Chase—LEDs light for 0.2 seconds each from left to right, continuously
b. Dead reckoning is enabled by default, but can be disabled in the AirLink OS.
c. Dead reckoning calibration occurs occasionally during driving and takes several minutes to complete.

Ethernet LEDs

Each Ethernet connector has two LEDs that indicate speed and activity. When looking into the connector:

- Activity—The right LED indicates the link status:
  - Solid Amber—Link
  - Blinking Amber—Activity
  - Off—No link
- Connection Speed—The left LED indicates the Ethernet connection speed:
  - Ethernet 1:
    - Solid Green—1–5 Gbps (i.e. Gigabit or greater)
    - Off—10/100 Mbps
  - Ethernet 2, Ethernet 3, Cartridge Ethernet:
    - Solid Green—1000 Mbps (Gigabit)
    - Off—10/100 Mbps
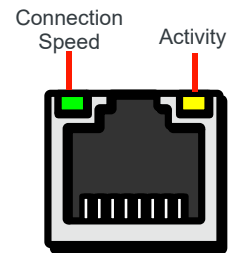
Step 9—Software Configuration

You can configure the XR router using:

- AirLink OS (the XR router's web interface)
- AirLink Management Service (cloud-based application)

Configure locally with AirLink OS

To access the AirLink OS:

1. Connect to the XR router through a LAN connection (e.g. a configured Ethernet port or Wi-Fi connection).

2. Open a browser window and enter https://airlink./ or 192.168.1.1, and bypass any certificate notifications in your browser.

Note: It takes the XR router from 1 to 2 minutes to respond after power up.
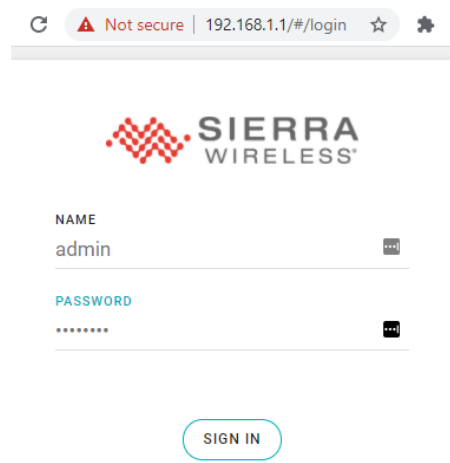
Figure 2-26: AirLink OS login window

3. Enter the default administrator User name and Password and click SIGN IN.
   - User Name: *admin*
   - Password: *(printed on the XR router label)*

Note: For system security, ensure that you change the default password as soon as possible.

4. Configure the XR router as required—for details, refer to [3] AirLink OS User Guide.

Configure and Monitor Remotely with AirLink Management Service

AirLink Management Service (ALMS) allows remote management of all your routers from one user interface.

Some of its features include:
- Centralized, remote monitoring for all your AirLink routers
- Continuous status monitoring of important health data such as signal strength
- Location monitoring, including world map views
- Complete ALEOS reporting and configuration, including historical views of ALEOS information
- Configure individual routers or use templates to perform batch configurations of your AirLink routers
- Single-click over-the-air firmware updates to all your routers
- Compatible with all carriers or mobile network operators

Note: To create an ALMS account, visit www.sierrawireless.com/products-and-solutions/routers-gateways/alms/register.

To configure your XR router:

1. Open a browser window, connect to AirVantage (e.g. na.airvantage.net, eu.airvantage.net), and log in to ALMS. Your ALMS account Dashboard is displayed.

2. Select Monitor > Systems to display your registered devices.

3. Find your XR router in the list, then click the router name to display the system details.

4. Click the Configuration button to display the configuration interface.

5. Make and save any required configuration changes. These changes will be applied to the XR router the next time it connects to ALMS.

For help with ALMS, view the user guide at doc.airvantage.net/alms.

Rebooting/Resetting the Router

The XR router can be rebooted or reset using hardware and software methods.
Supported reboot/reset methods include:
- Hard reboot
- Reset configuration to custom template
- Reset configuration to factory defaults

Hard Reboot

To perform a hard reboot of the XR router using:
* Hardware—On the front of the unit, press the Reset button and release in <5 seconds.
* AirLink OS—Go to System>Admin>Reboot and click REBOOT NOW.

The XR router will reboot and the Power LED pattern will be fast flashing green until the XR router is operating normally.

Configuration Reset

The XR router's configuration can be reset to a custom (user-defined) template or to factory defaults. The reset functionality (type and activation method) are configured through the AirLink OS.

Set Configuration Reset Functionality

To define the Reset functionality:

1. In the AirLink OS, go to System>Admin>Reset Settings.

2. Select the RESET CONFIGURATION TYPE to use when a configuration reset is performed:
   - Use Factory Defaults—XR router will be reset to the standard factory configuration. All user customizations will be lost.
   - Use Custom Template—XR router will be reset to the customized configuration in the CURRENT TEMPLATE (e.g. a template containing fleet-standardized settings). To use a different template, click SET TEMPLATE and load a different file.

3. Select the reset activation method:
   - Reset allowed via AirLink OS and the XR router's Reset button—Select (enable) RESET BUTTON.
   - Reset allowed via AirLink OS only—Deselect (disable) RESET BUTTON.

4. Click Save.

Reset to Factory Default or Custom Template Settings

To reset the XR router to the configured RESET CONFIGURATION TYPE using:
* AirLink OS:

   a. Go to System>Admin>Reset Settings and click RESET SETTINGS.

   b. Click RESET SETTINGS to confirm.
* XR router Reset button (if enabled)
   - Reset to template—Press the Reset button and release after 5–20 seconds.
   - Reset to factory defaults—Press the Reset button and release after 20–40 seconds.

> **Important:** *If Reset is pressed > 5 seconds and you do not want to reset to a template or to factory defaults,* **continue holding** *the Reset button for > 40 seconds and then release. The XR router will do a normal hard reboot and no configurations will change.*

3: Router Specifications

This chapter describes the XR Series router specifications, RF band and Tx power specifications, Wi-Fi support, and mechanical specifications.

Certification and Interoperability

Note: Certifications listed below are achieved, in progress, or pending.

Table 3-1: Certification and Interoperability Specifications

Emissions/ Immunity	• FCC • IC • CE (Including EMC Test case for vehicle installation EN301489) • RCM
Safety	• CB Scheme • UL 60950
Industry Certification for Vehicles	• EN 50155 (Rolling stock) • E-Mark (72/245/EEC, 2009/19/EC) • ISO7637-2 for 12 V/24 V systems • SAE J1455 (Shock & Vibration)
Environmental Compliance	• RoHS 2011/65/EU (RoHS 2) • WEEE • REACH • Prop 65 (California)
GSM/UMTS Certifications	• PTCRB • GCF-CC • RED

Reliability

• MTBF (Ground Benign, 25°C):
  · XR90 with one XP cartridge—166,514 hours (19.0 years)
  · XR80 Wi-Fi—186,228 hours (21.3 years)
  · XR80 non-Wi-Fi—208,379 hours (23.8 years)
• MTBF calculations are performed per Telcordia "Reliability Prediction Procedure for Electronic Equipment" document number SR-332, Method 1, Issue 3

Environmental Testing

Table 3-2: Environmental Testing Specifications

Test Method	Category	Description
MIL-STD-810G Test method 514.6 Composite Wheeled Vehicle	Vibration	Frequency range: 10 Hz–150 Hz Spectrum level: 2.24G on all axes for 8 hours/axis Operating mode: powered on
MIL-STD-810G Test method 516.6-I Procedure I—Functional Shock	Mechanical Shock	Half-sine 40G, 15–23 ms, (±X, ±Y, ±Z directions, 10 times per axis) Operating mode: powered on

SAE J1455 (Shock and Vibration) for heavy-duty vehicles	Shock/Vibration/Electrical	• 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 3

MIL-STD-810G Test methods 501.5, 502.5	Temperature	Rugged category: -30° to +70°C 2-hour soak each temp high/low 3 cycles ramp $\leq$ 3°C/minute Operating mode: powered on
MIL-STD-810G Test method 507.5	Humidity	10×48-hour cycles: • 4-hour ramp to 60°C (95% humidity), hold 8 hours • 4-hour ramp down to 30°C (85% to 95% relative humidity), hold 21 hours • 1-hour ramp down to 20°C, hold 4 hours • 1-hour ramp up to 30°C, hold 5 hours Operating mode: powered on
IEC 60529	Water Resistance[a]	Subject to spraying water. Water sprayed at an angle up to 60° on either side of the vertical for 10 minutes. Operating mode: unpowered
IEC 61000-4-2	Electrostatic Discharge	±2 kV, ±4 kV, ±6 kV, ±8 kV (Contact and Air) ±15 kV (Air at antenna connector) Operating mode: powered on
IEC 60068-2-32	Free Fall Test	1 m drop height 6 drops onto concrete, 2 per axis: X, Y, Z Operating mode: unpowered *Note: Test conducted with FAKRA connectors protected by a bracket.*
IEC 60068-2-70 Part 2, Test Xb	Marking	The markings are rubbed with water for 10 cycles, then with lubricating oil for 10 cycles. Operating mode: unpowered
ISTA 2A 2001 Test categories 1, 4, 5, 6	Package	*Note: Pending testing.* In shipping packaging. Cargo vibration and drop test.

a. Ingress Protection (IP) rating—IP64

Mobile Network Operator Certification

Note: Certifications listed below are achieved, in progress, or pending.

- AT&T
- Verizon Wireless
- T-Mobile USA
- Bell Mobility
- Rogers
- Telus
- Telstra
- Other major network operators pending

Network Technology

5G sub-6 GHz, LTE Cat-M1, LTE Cat-NB1, LTE-A Pro, LTE, HSPA+

For product-specific lists of supported bands, see Cellular Radio Band Support on page 59.

Host Interfaces

Table 3-3: Host Interface Specifications

Antennas	Antenna connectors (male FAKRA connectors)
	XR90 main unit: 　· LPWA 　· GNSS 　· Wi-Fi A (4 connectors)—Used for Access Point or WAN. 　· Wi-Fi B (4 connectors)—Used for Access Point or WAN. 　· Bluetooth XR80 main unit: 　· LPWA 　· GNSS 　· Wi-Fi (5 connectors)—Wi-Fi equipped XR80 only. Used for Access Point or WAN. 　· Cellular (4 connectors) XP cartridge(s): 　· Cellular (4 connectors)
	Antenna cabling
	• Avoid tight bends • VSWR < 1.3 and 50 Ω for all frequencies listed below:

Antenna Elements	Cable Type	Supported Frequencies (MHz)
4G/5G (All ports)	CS32	617–802
		824–960
		1710–2690
		3300–5925
Wi-Fi (All ports)	CS32	2400–2483
		5150–5835
		5925–7125
GNSS	CS29 FR	1559
		1575.42
		1606

Antenna gain

• Cellular—Refer to [2] Sierra Wireless EM919X/EM7690 Product Technical Specification and [1] Sierra Wireless HL780x Product Technical Specification
• 2.4/5 GHz Wi-Fi=3 dBi
• 2.4 GHz BT=3 dBi

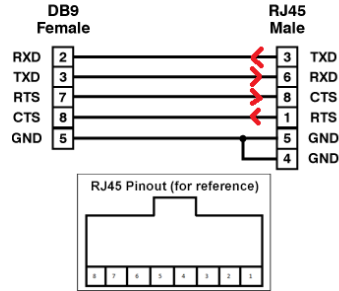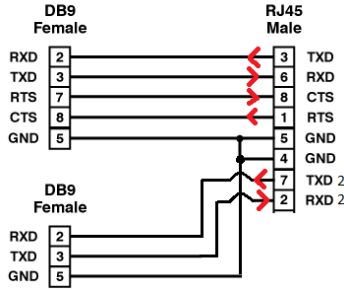**Table 3-3: Host Interface Specifications (Continued)**

USB	*Note: Do not use the USB ports in a potentially explosive environment.* • USB 3.1 Type C (female) port, complies with USB Version 3.1 specification. USB 3.1-compliant Type C cable must be used to ensure correct operation. • USB client and host modes support (software-selectable; default—Client) • Current (Host mode)—4.5 W (5V @ 0.9 A) • Port supports use of USB-C connector with integrated thumbscrew *Figure 3-1: USB Type C Connectors (Locking and Regular)* • The AirLink OS Software Configuration User Guide contains the details of USB mode configuration and driver installation.

Ethernet	• RJ45 Ethernet ports:
	 • Main unit:
	  • 1×5 Gbps (5GBASE-T/2.5GBASE-T/1000BASE-T/100BASE-TX/10BASE-Te)
	  • 2×1 Gbps (10/100/1000 Base-T)
	  • GigE RJ45 Ethernet ports
	 • XP Cartridge(s):
	  • 1×1 Gbps (10/100/1000 Base-T)
	• Cable requirements:
	 • Maximum cable length for any port and cable type: 100 m
	 • Cable categories (recommended minimums):
	  • Cat 5e—Data rates 10/100/1000 Mbps
	  • Cat 6—Data rate > 1 Gbps
	 • 5 Gbps port (i.e. Ethernet 1):
	  • Bundled cables—< 20 m (Cat 5e); 20–100 m (Cat 6A)
	  • Unbundled cables—< 75 m (Cat 5e); 75–100 m (Cat 6)
	 • 1 Gbps ports—< 100 m (unshielded Cat 5e)
	• IEEE 802.3 Ethernet specification for 5 Gbps and 1 Gbps speed (Gigabit Ethernet) with fallback to 100 or 10 Mbps (Cat 5e or Cat 6 cable is required for Gigabit Ethernet)
	• (XR80) IEEE 1588 Precision Time Protocol (PTP) support (planned for future support)
	• Auto-crossover support
	• Configurable link speeds
	• Auto-negotiation detects the speed of the connecting device

Table 3-3: Host Interface Specifications (Continued)

Auxiliary Input	• 8-pin connector providing 4 GPIOs and 2 signals for Vehicle Bus cable. For details, see Step 7—I/O Configuration (Optional) on page 31.
Serial Port	• RJ45 (8-pin) RS-232 (DCE) connector • 1×4-wire serial port via Cisco-compatible (blue) rollover console cable (DB9 to RJ45) or 1×4-wire and 1× 2-wire serial ports via Cisco-compatible dual serial cable **Table 3-4: RJ45 Connector Pin-out** Table and figure below • Used for connecting serial devices and configuration • Complies with the EIA RS-232D specification for DCE equipment • Configurable baud rate (up to 256 kbps) • Configurable to half or full duplex • "Wake-on" functionality[a]— Connected serial device can wake the XR router by asserting RTS serial line (e.g. wakes the XR router when the serial device wants to send data)

Table 3-4: RJ45 Connector Pin-out

Name	Pin	Description	Type
RTS	1	Ready To Send (4-wire port)	OUT
RXD_2	2	Receive Data 2 (2-wire port)	IN
TXD	3	Transmit Data (4-wire port)	OUT
GND	4	Main GND. Connected internally to BOARD GND.	—
GND	5	Main GND. Connected internally to BOARD GND.	—
RXD	6	Receive Data (4-wire port)	IN
TXD_2	7	Transmit Data 2 (2-wire port)	OUT
CTS	8	Clear To Send (4-wire port)	IN

a. Feature planned for future update

SIM Card Interface

The XR router provides a SIM card interface with the following characteristics:
• 2×mini-SIM (2FF) slots—One for each installed 5G radio module
• 1.8 V/3.3 V
• Interface is compliant with the applicable 3GPP standards for USIM.

General Purpose Input/Output

The XR router provides several GPIOs on the following connectors:
* Power connector—1×Configurable I/O pin
* RS-232 DB9 serial connector—4×GPIO. See .

For details, including suggested uses, see .

Power Adapter

The XR router uses a 4-pin power adapter connection:
* Pin 1—Power
* Pin 2—Ground
* Pin 3—Configurable ignition sense
* Pin 4—Configurable GPIO (digital I/O, analog input, current sinking), with a pull-up enable

Reset

The XR router can be reset via hardware (manual reset button on front panel) or software (via the AirLink OS). For details, see .

LEDs

The XR router includes six LEDs:
* GNSS
* Wi-Fi
* Cell XP1 (XR90) or Cellular (XR80)
* Cell XP2 (XR90) or Cell XP (XR80)
* LPWA
* Power

For details, see .

Screw Specifications

* XP cartridge captive screws (M4x52; Allen head ◎)—Torque to 13 ± 1.2 kgf/cm (11.3 ± 1.0 in-lb)
* Cartridge cover plate screws (M4x8; Phillips head ⊕ or Allen head ◎)—Torque to 9.0 ± 0.5 kgf/cm (7.8 ± 0.4 in-lb)
* SIM cover captive screws (M3x6; Phillips head ⊕)—Torque to 6 ± 0.75 kgf/cm (5.2 ± 0.65 in-lb)
* Router mounting screws, customer-supplied. Recommendation: M5, pan head, used with split washers (e.g. Bossard BN 762)
  * Screw length depends on mounting surface material (substrate):
    * Minimum: 35 mm; Typical: 40 mm
    * Example: For direct mounting against a wood surface, use an M5 pan head wood screw with sufficient length to penetrate the wood substrate (e.g. minimum 40 mm, but longer if necessary).
  * Torque specification will vary by screw head/plating/class. For a pan head, Philips/Torx, Zn plated, class 4.5 screw, torque to ~20 kgf/cm (~17.7 in-lb)

Operating Voltage

The XR router has the following operating voltage requirements/features:
- Input voltage: 7–36 V
- The maximum ripple voltage to guarantee analog input accuracy is 100 mVpp.
- Tolerates voltage drop to 5 VDC without resetting during engine cranking (SAE J1113)
- By default, the XR router is factory-configured with low voltage standby mode enabled, which causes the XR router to enter Standby mode when the voltage is < 9 V.

  To disable/enable low voltage standby mode, or to change the low voltage limit, change the settings in the AirLink OS (System > MCU > Voltage Threshold) For more information, refer to [3] AirLink OS User Guide.

Power Specifications

Table 3-5: DC Power Supply Specifications

Pin	Name	Specification	Parameter	Minimum	Maximum
1	VCC	Voltage range	VCC	7 V	36 V

Table 3-6: On/Off Control Specifications

Pin	Name	Input Impedance (Typ)	Specification	Parameter	Minimum	Maximum
3	On/Off control, Ignition Sense (Input only)	125 kΩ	Input low state voltage (maximum)	V_{IL}	—	1.0 V
			Input high state voltage (minimum guaranteed)	V_{IH}	2.5 V	V_{in}

*Note: If you do not connect this pin to the ignition, you **MUST** connect it to the positive terminal of your power supply or battery. The XR router looks for a qualified voltage on this pin as part of the power up sequence. If it doesn't see it, the XR router will not turn on. If you are using a Sierra Wireless AC power adapter, the connection is inside the cable.*

Conducted Electrical Transients

- Compliant to ISO 7637-2:2004:
  - Load dump specifications—Test Pulses 5a, 5b
  - Inductive load transient specifications—Test Pulse 1
  - Harness transient specifications—Test Pulses 2a, 2b, 3a, 3b
  - Cranking specification—Test Pulse 4
- Tolerates +200 V/-600 V spikes
- Uninterrupted operation during brownouts down to 5V

GNSS Technology

Table 3-7: GNSS Specifications

Satellite channels	Maximum 48 tracking channels and 2 fast acquisition channels Active antenna support
Constellations	• GPS/DGPS (Differential GPS) • GLONASS • Galileo • BeiDou • QZSS
Protocol	Streamable NMEA 0183 V3.0 and TAIP output
Acquisition time (Time to first fix)	• Hot start: 1 second • Cold start: 30 seconds
Sensitivity	Indoor sensitivity (tracking mode): -162 dBm
Accuracy	Horizontal position accuracy (CEP50%, 24h static, antenna mounted above roof): <2 m
Forwarding	Local and remote forwarding via TCP or UDP
Dead reckoning	Tethered and untethered

Protocols

For supported software protocols (network, routing, etc.), refer to [3] AirLink OS User Guide.

Vehicle Area Networking (LAN)

- Support for all on-board devices (wired and wireless)
    - Wi-Fi 6 on FAKRA
    - 5G Ethernet on RJ45 (1 port)
    - 1G Ethernet on RJ45 (2 ports, plus one 1G Ethernet RJ45 port per expansion cartridge)
    - Bluetooth on FAKRA
    - Serial RS232 on RJ45 (2 ports)
    - USB 3.0 on Type C (female)
- Compatibility
    - Supports Wi-Fi certified devices
    - Supports major operating systems

Security

The XR router can secure all data transmitted to and from the local environment without the need for VPN client software on devices.

* WLAN Security and Authentication
  * WPA3 Personal (Enterprise in future release)/WPA2 Enterprise and Personal
* Firewall and DMZ
* Encryption and VPN
  * IPSec including LAN to LAN, Host to LAN, IKEV2, MOBIKE
  * FIPS-140-2 option
* Authentication and Accounting
  * RADIUS/TACACS+/LDAP integration

Wi-Fi

* Band support:
  * XR90—Wi-Fi 6:
    * 4x4 MIMO (5 GHz) + 4x4 MIMO (5 GHz) + 4x4 MIMO (2.4 GHz)
    * Configurable as AP or STA
  * XR80—Wi-Fi 6:
    * 4x4 MIMO (5 GHz) + 4x4 MIMO (2.4 GHz) + 1x1 (5 GHz, STA Rx only)
    * Configurable as AP and STA concurrently
  * WPA2/3 Enterprise (RSA) with AES encryption
  * 4 SSIDs with separately configurable security, bandwidth, and QOS
  * Up to 128 clients can connect simultaneously

Table 3-8: Wi-Fi Link Speed[a]

Technology	Frequency	MIMO	20 MHz	40 MHz	80 MHz
Wi-Fi 6	2.4GHz	4 × 4	600	1200	—
	5 GHz	4 × 4	600	1200	2400

a. Theoretical maximum performance. Actual data rates may vary.

Table 3-9: Wi-Fi Channels Supported—2.4 GHz Operation

Channel	Frequency (GHz)	Channel Width	
		20 MHz	40 MHz
1	2.412	Y	—
2	2.417	Y	—
3	2.422	Y	Y
4	2.427	Y	Y
5	2.432	Y	Y
6	2.437	Y	Y
7	2.442	Y	Y
8	2.447	Y	Y
9	2.452	Y	Y

Table 3-9: Wi-Fi Channels Supported—2.4 GHz Operation (Continued)

Channel	Frequency (GHz)	Channel Width	
		20 MHz	40 MHz
10	2.457	Y	Y
11	2.462	Y	Y
12	2.467	Y	—
13	2.472	Y	—
14[a]	2.484	Y	—

a. 802.11b only (Japan)

Table 3-10: Wi-Fi Channels Supported—5 GHz Operation

Channel	Freq. (GHz)	Channel Width		
		20 MHz	40 MHz	80 MHz
36	5.180	Y	—	—
38	5.190	—	Y	—
40	5.200	Y	—	—
42	5.210	—	—	Y
44	5.220	Y	—	—
46	5.230	—	Y	—
48	5.240	Y	—	—
52	5.260	Y	—	—
54	5.270	—	Y	—
56	5.280	Y	—	—
58	5.290	—	—	Y
60	5.300	Y	—	—
62	5.310	—	Y	—
64	5.320	Y	—	—
68[a]	5.340	Y	—	—
70[a]	5.350	—	Y	—
72[a]	5.360	Y	—	—
74[a]	5.370	—	—	Y
76[a]	5.380	Y	—	—
78[a]	5.390	—	Y	—
80[a]	5.400	Y	—	—
84[a]	5.420	Y	—	—

Channel	Freq. (GHz)	Channel Width		
		20 MHz	40 MHz	80 MHz
86[a]	5.430	—	Y	—
88[a]	5.440	Y	—	—
90[a]	5.450	—	—	Y
92[a]	5.460	Y	—	—
94[a]	5.470	—	Y	—
96[a]	5.480	Y	—	—
100	5.500	Y	—	—
102	5.510	—	Y	—
104	5.520	Y	—	—
106	5.530	—	—	Y
108	5.540	Y	—	—
110	5.550	—	Y	—
112	5.560	Y	—	—
116	5.580	Y	—	—
118[a]	5.590	—	Y	—
120[a]	5.600	Y	—	—
122[a]	5.610	—	—	Y
124[a]	5.620	Y	—	—
126[a]	5.630	—	Y	—
128[a]	5.640	Y	—	—
132	5.660	Y	—	—
134	5.670	—	Y	—

Channel	Freq. (GHz)	Channel Width		
		20 MHz	40 MHz	80 MHz
136	5.680	Y	—	—
138	5.690	—	—	Y
140	5.700	Y	—	—
142	5.710	—	Y	—
144	5.720	Y	—	—
149	5.745	Y	—	—
151	5.755	—	Y	—
153	5.765	Y	—	—
155	5.775	—	—	Y
157	5.786	Y	—	—
159	5.795	—	Y	—
161	5.805	Y	—	—
165	5.825	Y	—	—
167[a]	5.835	—	Y	—
169[a]	5.845	Y	—	—
171[a]	5.855	—	—	Y
173[a]	5.865	Y	—	—
175[a]	5.875	—	Y	—
177[a]	5.885	Y	—	—
181[a]	5.905	Y	—	—

a. Channels under approval

Table 3-11: Wi-Fi Total Radiated Power (TRP) and Total Isotropic Sensitivity (TIS)

Transmitter				
Frequency	Technology	Bandwidth	Modulation	TRP (dBm/chain)
2.4 GHz	802.11b	20 MHz	1 Mbps	23.3
2.4 GHz	802.11ax	20 MHz	MCS11	14.3
5 GHz	802.11ac	20 MHz	MCS0	23.3
5 GHz	802.11ax	20 MHz	MCS11	14.3

Table 3-11: Wi-Fi Total Radiated Power (TRP) and Total Isotropic Sensitivity (TIS) (Continued)

Receiver				
Frequency	**Technology**	**Bandwidth**	**Modulation**	**TIS (dBm/chain)**
2.4 GHz	802.11b	20 MHz	1 Mbps	-97.3
2.4 GHz	802.11ax	20 MHz	MCS11	-63.3
2.4 GHz	802.11N	20 MHz	MCS7	-76.3
5 GHz	802.11aC	20 MHz	MCS0	-93.8
5 GHz	802.11aC	20 MHz	MCS8	-72.3
5 GHz	802.11aC	20 MHz	MCS10	-65.3
5 GHz	802.11ax	20 MHz	MCS0	-93.8
5 GHz	802.11ax	20 MHz	MCS11	-63.8

Bluetooth Support

Note: Support planned for a future AirLink OS update.

The XR90 provides the following Bluetooth functionality:
• User-selectable Bluetooth 4.x Classic or Bluetooth LE

Cellular Radio Band Support

The radio frequency bands supported by the XR Series vary by installed radio module types. These types can be identified from the FCC IDs printed on the label (Figure 3-5 on page 65) on the bottom of the XR router or viewed in the AirLink OS (Status/ Monitoring > System > Radio Module).

The following table identifies supported bands by radio module type.

For detailed RF and power specifications, refer to [2] Sierra Wireless EM919X/EM7690 Product Technical Specification and [1] Sierra Wireless HL780x Product Technical Specification, available on source.sierrawireless.com.

Table 3-12: Supported Bands (Summary)

Module		Bands Supported	Region
EM9190	Sub-6 GHz	n1, n2, n3, n5, n7[a], n8[a], n12[a], n20[a], n25[a], n28, n38[a], n40[a], n41, n48[a], n66, n71, n77, n78, n79	Global
	LTE	1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29[b], 30[c], 32[b], 34, 38, 39, 40, 41, 42, 43[a], 46, 48, 66, 71	
	HSPA+WCDMA	1, 2, 3, 4, 5, 6, 8, 9, 19	
HL7800[d]	LTE	1, 2[e], 3, 4[e], 5[e], 8, 9[f], 10[f], 12[e], 13[e], 17[g], 18, 19, 20, 25[e], 26[e], 27[h], 28, 66[e]	North America

a. Supported with a future EM firmware upgrade, subject to SKU configuration.
b. Downlink only
c. XR routers can choose to operate B30 as Tx/Rx or Rx only.
d. LPWA module (Cat-M1/Cat-NB1, subject to band-specific footnotes)
e. To ensure FCC compliance near NB band edges, Cat-NB1 supported TX channel ranges do not include outer channels. Refer to [1] Sierra Wireless HL780x Product Technical Specification for details.
f. Will be supported in a future HL7800 release.
g. Cat-NB1 (Cat-M1 will be supported in a future HL7800 release)
h. Cat-M1 (Cat-NB1 will be supported in a future HL7800 release)

Carrier Aggregation

The EM9190 supports LTE-A carrier aggregation and 5G EN-DC (E-UTRAN New Radio - Dual Connectivity). For details, refer to [2] Sierra Wireless EM919X/EM7690 Product Technical Specification.

Conducted Tx Power

EM9190 Conducted Tx Power

Table 3-13: Conducted Tx Power (EM9190)

Band	Conducted Tx Power (dBm)	Notes
5G		
FR1 Sub-6 GHz Bands	+23±1.5	Power Class 3
LTE		
All bands	+23±1	Power Class 3
B41 HPUE	+25±1	Power Class 2 for B41 standalone mode only
UMTS		
All bands (12.2 kbps)	+23.5±1	Connectorized (Power Class 3)

HL7800 Conducted Tx Power

Table 3-14: HL7800 Conducted Tx Max Output Power Tolerances — LTE[a]

LTE Bands	Min	Typ	Max	Units	Notes
All bands	21.5[b]	23	24.5	dBm	Power class 3

a. Under normal operating conditions (25°C)
b. Additional power reduction is applied to the lowest and highest supported channels for each band — for details, refer to [1] Sierra Wireless HL780x Product Technical Specification.

GNSS Supported Bands

Table 3-15: GNSS Bands Supported

Band	Frequency
GPS	1575.42 MHz
GLONASS	1602 MHz
Galileo	1575.42 MHz
BeiDou	1561.098 MHz
QZSS	1176.45–1575.42 MHz

Mechanical Specifications

Table 3-16: Mechanical Specifications

Dimensions	**XR router**	**Width (mm)**	**Length (mm)**	**Height (mm)**	**Weight (kg)**
	XR90 (no XP cartridges)	170	220[a]	53	2.06
	XR90 (+1 XP cartridge)	220	220[a]	53	2.64
	XR90 (+2 XP cartridges)	268	220[a]	53	3.22
	XP cartridge	61	202[a]	53	0.58
	XR80 Wi-Fi	170	220[a]	53	2.00
	XR80 Wi-Fi	170	220[a]	53	1.80

a. Includes antenna connectors

Housing	Ruggedized powder-coated aluminum.
RoHS	Complies with the Restriction of Hazardous Substances Directive (RoHS). This directive restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment.
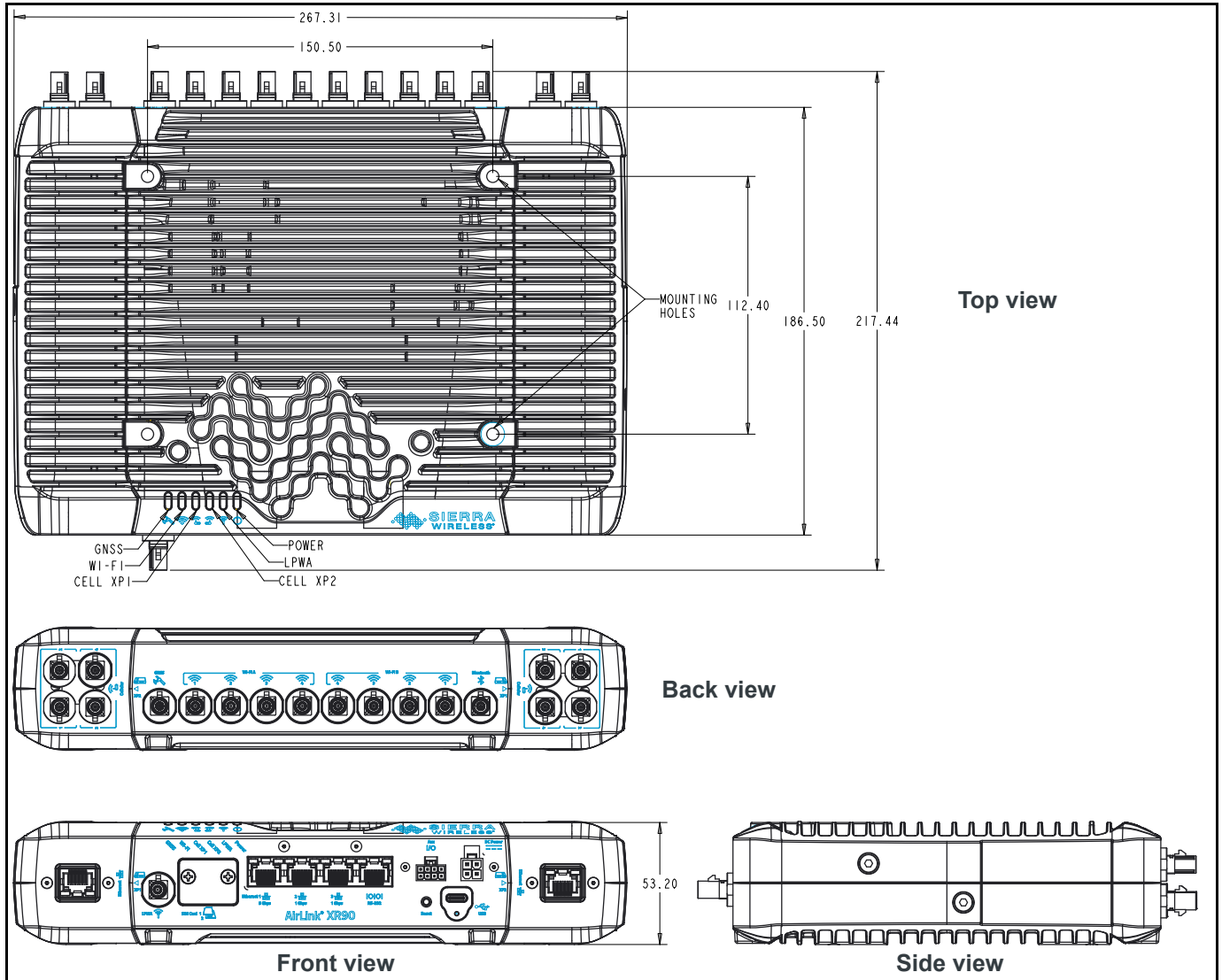
Figure 3-2: XR90 Mechanical Dimensions
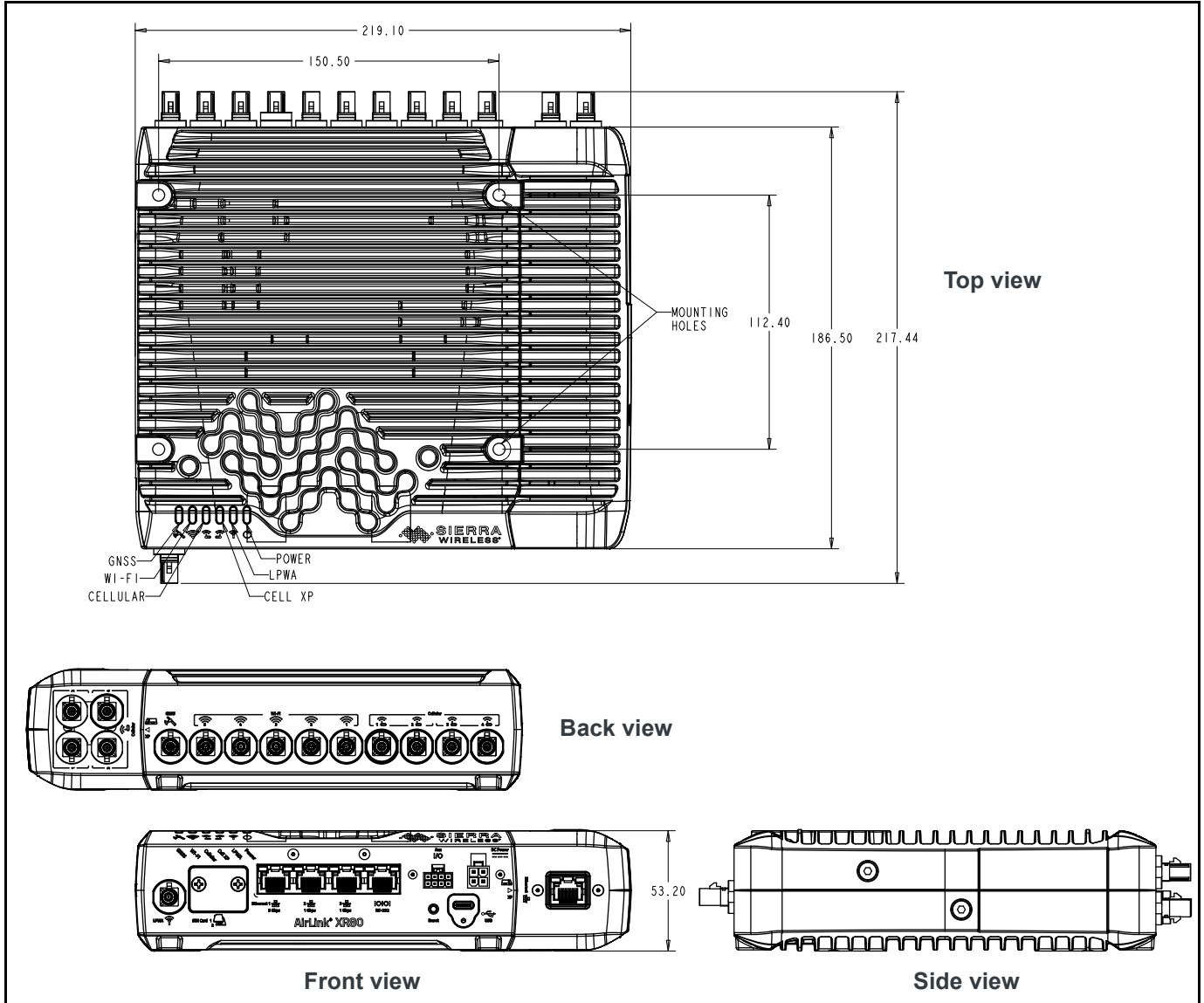
Figure 3-3: XR80 (with Wi-Fi) Mechanical Dimensions
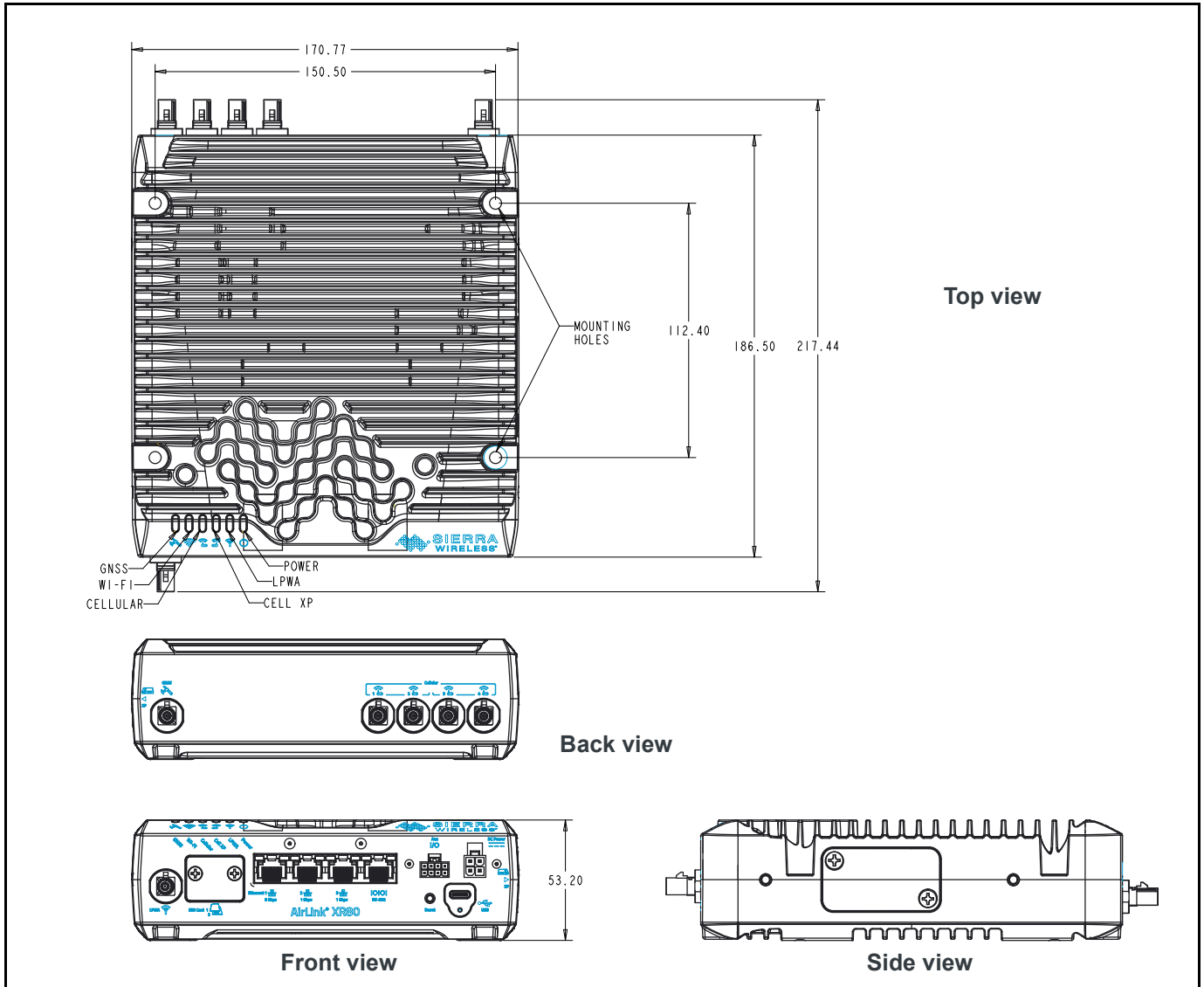
Figure 3-4: XR80 (no Wi-Fi) Mechanical Dimensions

XR Router Label

The XR router label (located on the XR router base) includes important information, including:

- Cellular radio module IMEIs and FCC/IC IDs
- Other applicable certifications (e.g. CE, RoHS, UL, etc.)
- Serial number (S/N)
- Default password for AirLink OS
- Registration code used for registering the XR router with ALMS
- QR code containing S/N, IMEIs for installed cellular radio modules, password, SKU, UPC, Registration code

Figure 3-5: Sample XR Router Label

4: Regulatory Information

> **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.*

Important Information for Users in Canada and the United States

Note: Pending FCC and IC certification.

Important Information for Users in the European Union and the United Kingdom

Hereby, Sierra Wireless, Inc. declares that the radio equipment type XR90 5G is in compliance with Directive 2014/53/EU, Directive 2011/65/EU, and UK's Radio Equipment Regulations 2017 and Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012.

The full text of the EU/UK declaration of conformity is available at the following internet address: https://source.sierrawireless.com/resources/airlink/certification_and_type_approval/XR_Series_ce_declaration_of_conformity/

The XR Series router displays the CE and UKCA marks.

CE   UKCA

Indoor Use Restrictions

	AT	BE	BG	CH	CY	CZ	DE	DK	EE	EL	ES
	FI	FR	HR	HU	IE	IS	IT	LI	LT	LU	LV
	MT	NL	NO	PL	PT	RO	SE	SI	SK	TR	

Pursuant to Article 10(10) of Directive 2014/53/EU, the pictogram displayed above will be displayed on the packaging of Sierra Wireless XR Series products that are restricted (in the countries identified) to indoor use only when operating in the 5150–5350 MHz frequency range.

> **Caution:** *To comply with EU regulations limiting human exposure to electromagnetic fields, a minimum separation distance of 28 cm between the antenna and the user's body must be maintained at all times.*

WEEE Notice

If you purchased your Sierra Wireless XR Series router 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

Antenna Separation

When installing single-element antenna units, refer to Table A-1 for recommended antenna separation distances.

Recommended antenna separations are related to band frequency/wavelength.

Table A-1: Recommended Antenna Separation

Service	Frequency (MHz)	Wavelength (λ) (mm)	Antenna Separation Best (=1/2 λ) (mm)	Good (=1/4 λ) (mm)
5G Sub6	600	500	250	125
	650	462	231	115
	700	429	214	107
	750	400	200	100
	800	375	188	94
	850	353	176	88
	900	333	167	83
	950	316	158	79
	1700	176	88	44
	1800	167	83	42
	1900	158	79	39
	2000	150	75	38
	2100	143	71	36
	2200	136	68	34
	2300	130	65	33
	2400	125	63	31
	2500	120	60	30
	2600	115	58	29

Service	Frequency (MHz)	Wavelength (λ) (mm)	Antenna Separation Best (=1/2 λ) (mm)	Good (=1/4 λ) (mm)
5G Sub6	2700	111	56	28
	3300	91	45	23
	3400	88	44	22
	3500	86	43	21
	3600	83	42	21
	3700	81	41	20
	3800	79	39	20
	3900	77	38	19
	4000	75	38	19
	4100	73	37	18
	4200	71	36	18
	4400	68	34	17
	4600	65	33	16
	4800	63	31	16
	5100	59	29	15
	5500	55	27	14
	5900	51	25	13
	—	—	—	—

Table A-1: Recommended Antenna Separation (Continued)

Service	Frequency (MHz)	Wavelength (λ) (mm)	Antenna Separation Best (= 1/2 λ) (mm)	Antenna Separation Good (= 1/4 λ) (mm)	Service	Frequency (MHz)	Wavelength (λ) (mm)	Antenna Separation Best (= 1/2 λ) (mm)	Antenna Separation Good (= 1/4 λ) (mm)
LTE	600	500	250	125	LTE	2200	136	68	34
	650	462	231	115		2300	130	65	32
	700	429	214	107		2400	125	63	31
	750	400	200	100		2500	120	60	30
	800	375	188	94		2600	115	58	29
	850	353	176	88		2700	111	56	28
	900	333	167	83		3400	88	44	22
	950	316	158	79		3500	86	43	21
	1450	207	103	52		3600	83	42	21
	1500	200	100	50		3700	81	41	20
	1700	176	88	44		3800	79	39	20
	1800	167	83	42		5100	59	29	15
	1900	158	79	39		5500	55	27	14
	2000	150	75	38		5900	51	25	13
	2100	143	71	36		—	—	—	—
WCDMA	850	353	176	88	WLAN[a]	2.4G	125	63	32
	900	333	167	83		5.2G	57	29	15
	1700	176	88	44					
	1800	167	83	42					
	1900	158	79	39					
	2100	143	71	36					

a. Wi-Fi/Cellular separation distance should be whichever value (Wi-Fi or Cellular separation) is largest for the applicable band.

DC Power Cable

Table A-2: DC Power Cable

Part Number	399F33-WHAR0749

Components:

① 1 UL2464 16AWGx2C + 20AWGx2C PVC jacked cable

② • 2 Molex female crimp terminals /AWG 18-24, 600V, phosphor bronze tin-plated (part number TY4281TPH-A)
   • 2 Molex female crimp terminals/AWG 16, 600V, phosphor bronze tin-plated (part number TY4281TGH-AE-DH)

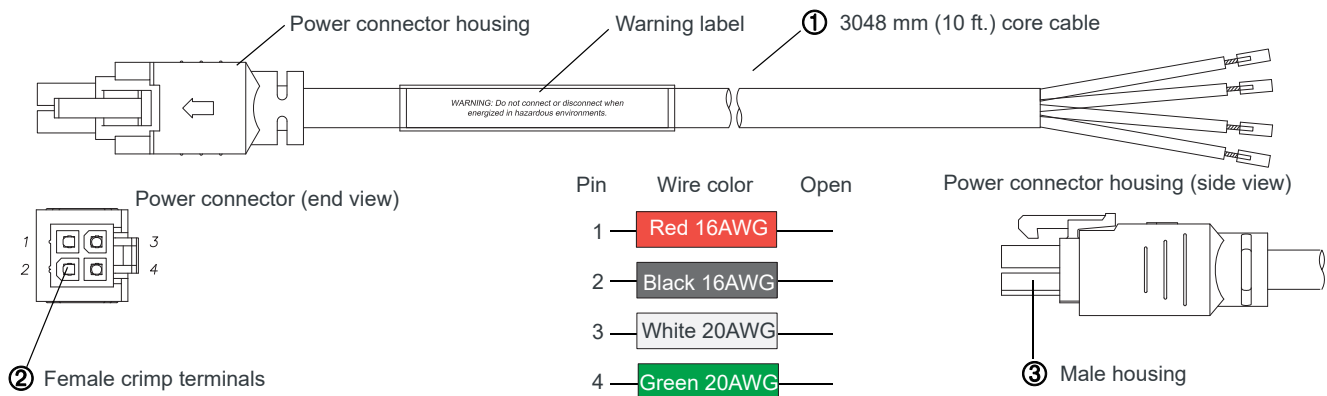③ 1 Molex male 2×2P Ph: 4.2 mm housing, 600V, 13 A max, PA66 black UL94V-O (part number TY4281HN0-2X02-M0-C1)

Figure A-1: DC Cable Specifications

AC Power Adapter (Black Connector)

Table A-3: AC Power Adapter

Part Number	6001372

AC Power Adapter Input

Table A-4: Input Specifications

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

Note: Input voltage range is 90 VAC to 264 VAC. Maximum input current is 2000 mA at 100–240 VAC.Inrush current will not exceed 115 A at 100–240 VAC input and maximum load from a cold start at 25°C.

AC Power Adapter Output

Table A-5: AC Power Adapter Output Specifications

	Minimum	Typical	Maximum	Test conditions
Output Voltage	22.8 VDC	24.0 VDC	25.2 VDC	0 ~ 3.75 A loading

AC Power Adapter Environmental Specifications

Table A-6: 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
Relative Humidity	10% ~ 90%
Altitude	Sea level to 2,000 meters
Vibration and Shock	MIL-STD-810D (Method 514, Procedures X (i.e. I, II, III, and IV))

AC Power Adapter 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 250,000 hours at 25°C (MIL-HDBK-217F).

Note: For XR router MTBF, see Reliability on page 35.

AC Power Adapter Safety Standards

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

Table A-7: AC Power Adapter Safety standards

Regulatory Agency	Country or Region	Certified	Standard
UL	USA	Approved	UL60950-1
CUL	Canada	Approved	CSA C22.2 NO.60950-1
CE	Europe	Meet	EN62368-1
CCC	China	Approved	GB4943

Table A-7: AC Power Adapter Safety standards (Continued)

Regulatory Agency	Country or Region	Certified	Standard
SAA	Australia	Approved	AS/NZS 60950
FCC	USA	Approved	PART 15 CLASS B

AC Power Adapter EMC Standards

The power supply meets the radiated and conducted emission requirements for EN55032, FCC Part 15, Class B, GB9254.

AC Power Adapter Hazardous Substances

- EU Directive 2011/65/EU "RoHS"
- EU Directive 2012/19/EU "WEEE"
- REACH

AC Power Adapter Energy Efficiency

The AC adapter complies with International Efficiency Levels, as shown in Table A-8.

Table A-8: AC Adapter Energy Efficiency

Supplied Input	No-load Power Consumption	Average Active Mode Efficiency	International Efficiency Level
115/230 VAC, 60/50 Hz	Less than 0.21 W	Greater than 88%	VI

Vehicle Bus Cables

The vehicle bus interface cables are shielded and terminated, and designed for use with the AirLink XR Series, MP70, and LX60.

Table A-9: Vehicle Bus Cable Accessories

Part Number	Description	Length	Connector
6001204	MP70, OBD-II (J1979) Y-cable	5 meters	OBD-II
6001192	MP70, J1939 Y-cable	5 meters	Deutsch 9-pin Type I/II

Table A-10: Vehicle Bus Cable Pin-outs

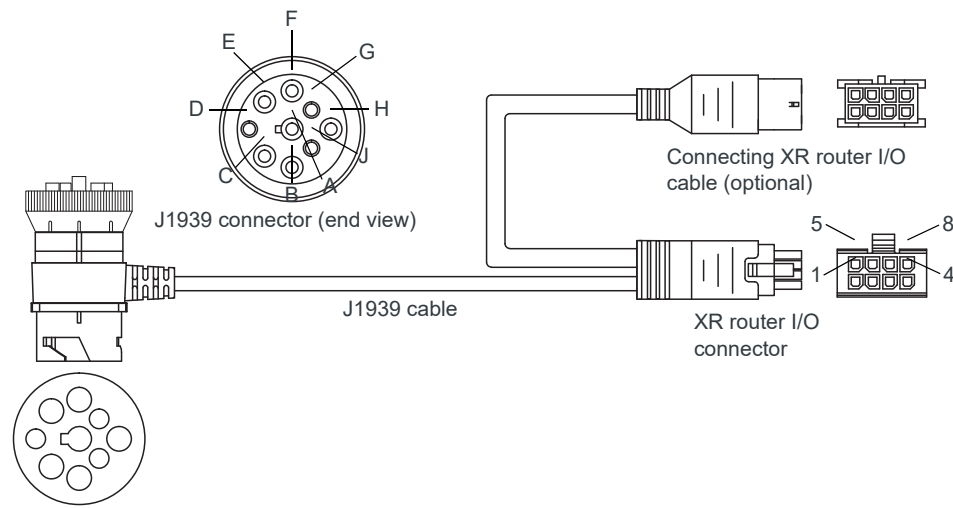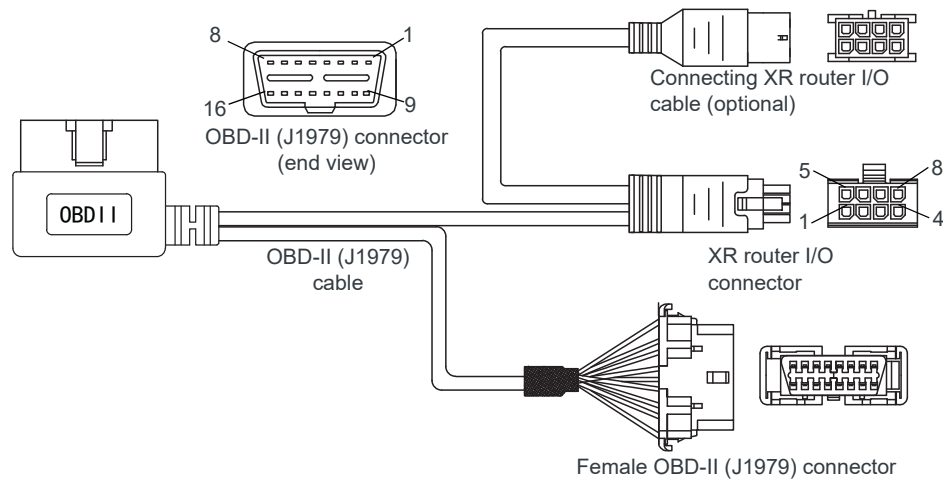| J1939 Pin	ODB-II Pin	MP70 Aux I/O Pin	Function
C	6	4	CAN-H
D	14	5	CAN-L
A	5	8	Ground

Figure A-2: Vehicle Bus Cables

B: References

For more details, several references can be consulted, as described below.

Web Site Support

Check https://source.sierrawireless.com for the latest documentation available for AirLink XR Series routers.

Reference Documents/Pages

[1] Sierra Wireless HL780x Product Technical Specification
Reference #41113770

[2] Sierra Wireless EM919X/EM7690 Product Technical Specification
Reference #41113174

[3] AirLink OS User Guide
Reference page: source.sierrawireless.com/airlinkos

[4] AirLink XR90 Quick Start Guide
Reference #5305868

[5] AirLink XR80 Quick Start Guide
Reference #5306266