

# RF401-Series & RF430-Series

## Spread Spectrum Radio Modems



The RF401-series and RF430-series radios can be used for general purpose wireless data communications and support point-to-point and point-to-multipoint datalogger communications. Spread spectrum radios can serve as a field modem/radio while connected to the datalogger or as a base station modem/radio while connected to a PC. They can also serve as a standalone RF router/repeater.

Spread spectrum radios spread the normally narrow-band information signal over a relatively wide band of frequencies. This allows the communications to be more immune to noise and interference from RF sources such as pagers, cellular phones and multipath.<sup>1</sup> The RF401-series and RF430-series radios reduce susceptibility to RF interference from other spread spectrum devices by providing user-selectable frequency hopping patterns.

### Features

- Individual FCC license not required<sup>2</sup>
- Up to one mile transmission range when using inexpensive omnidirectional antennas (shown). Up to 10 mile transmission range when using higher gain directional antennas at ideal conditions (please note that line-of-sight obstructions and RF interference will affect transmission distance)
- 25-channel frequency-hopping radio
- Built-in simplified and advanced setup menus for configuring port modes, network/radio addresses, protocol, hop table, and power saving modes; settings stored in non-volatile memory
- Setup that allows different addresses for multiple dataloggers in a point-to-multipoint network
- Reduced power consumption by the datalogger, as the radios perform “packet address filtering”
- Greater immunity to interference and RF collisions by using RF retries
- Ability to have standalone RF router/repeaters (up to 8 repeaters)
- Faster communication due to elimination of some of the small “link state packets”



The RF401 shown above has a 15730 antenna that attaches directly to the radio. This omnidirectional antenna should reside inside a building or enclosure. It has a knuckle joint that can be oriented at right angles.

### Powering the Radio

#### *Base Station (radio connected to PC)*

If an RF401-series radio is used at the base station, the #15966 wall charger supplies 12 Vdc power to the radio. The RF430-series radio is powered by the PC through its USB port.

#### *Field Station (with datalogger)*

At the field station, an RF401-series radio is typically powered by the datalogger through its CS I/O port. The #14291 Field Cable can also be used to connect the radio to an appropriate 12 Vdc power supply. The field cable is required for the following situations:

- RF401-series radio connected to the datalogger's RS-232 port instead of the CS I/O port
- RF430-series radio used at the field station (RF430-series radios do not have a CS I/O port)
- Datalogger purchased before December 1997

#### *Non-Datalogger Remote Site*

Radio-to-MD485 networks and radio-to-phone networks require a power supply with a null modem port at the non-datalogger site. An A100 adapter used with a PS100 or PS200 power supply provides this capability. The power supply battery is recharged via a wall charger or a solar panel.

<sup>1</sup>The operating frequency band of these radio modems may be shared with other non-licensed services such as cordless telephones and with licensed services including emergency broadcast and air-traffic control.

<sup>2</sup>Spread spectrum radios, like all FCC Part 15 devices, are not allowed to cause harmful interference to licensed radio communications and must accept any interference that they receive. Most Campbell Scientific users operate in open or remote locations where interference is unlikely. If there is a problem, interference can be reduced using methods such as moving the device, reorienting or using a different type of antenna, or adding RF shielding.

## Radios

### RF401 series

The RF401 series can serve as a field modem/radio while connected to the datalogger or as a base station modem/radio while connected to a PC's RS-232 port. The RF401 series consists of the following models:

- **RF401 915 MHz Spread Spectrum Radio**—transmits data to another RF401 radio, an RF430 radio, a CR206(X) datalogger, or an AVW206 interface. The 915 MHz frequency is used in the US/Canada.
- **RF411 922 MHz Spread Spectrum Radio**—transmits data to another RF411 radio, an RF431 radio, a CR211(X) datalogger, or an AVW211 interface. The 922 MHz frequency is used in Australia/Israel.
- **RF416 2.4 GHz Spread Spectrum Radio**—transmits data to another RF416 radio, an RF432 radio, a CR216(X) datalogger, or an AVW216 interface. The 2.4 GHz frequency is used worldwide.

### RF430 series

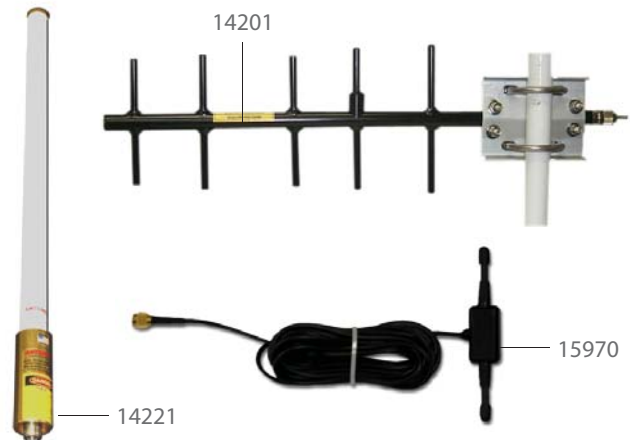
Usually, the RF430-series radio connects to a PC's USB port to serve as a base station modem/radio. The RF430 series may also connect to the datalogger's RS-232 port to serve as a field modem (requires a null modem cable and a field power cable). The RF430 series consists of the following models:

- **RF430 915 MHz Spread Spectrum Radio**—transmits data to another RF430 radio, an RF401 radio, or a CR206(X) datalogger. The 915 MHz frequency is used in the US/Canada.
- **RF431 922 MHz Spread Spectrum Radio**—transmits data to another RF431, an RF411 radio, or a CR211(X) datalogger. The 922 MHz frequency is used in Australia/Israel.
- **RF432 2.4 GHz Spread Spectrum Radio**—transmits data to another RF432, an RF416 radio, or a CR216(X) datalogger. The 2.4 GHz frequency is used worldwide.



The RF430-series radios have a USB port instead of a CS I/O port. They were developed for use with laptops or PCs that do not have an RS-232 port.

## Antennas\*



Above are antennas used with the RF401, RF411, RF430, and RF431 radios. The RF401 shown on page one has a 15730 whip antenna.

### RF401, RF411, RF430, or RF431 Antennas

The following are inexpensive antennas that can transmit short distances (up to 1 mile). They must reside in an environmental enclosure or building:

- **14310**—straight 0-dBd, ¼-wave, whip antenna with 3.2" length. RPSMA connector attaches directly to the radio; no antenna cable is needed.
- **14204**—0 dBd, ½-wave, whip antenna with joint that's adjustable from 0° to 90°. RPSMA connector attaches directly to the radio; no antenna cable is needed.
- **15970**—1 dBd, dipole antenna with window or wall mount. Antenna comes with a 10-foot cable that has an RPSMA connector, which attaches to the radio; an additional cable is not needed.
- **15730**—0 dBd, ¼ wave whip antenna with joint that's adjustable from 0° to 90°. RPSMA connector attaches directly to the radio; no antenna cable is needed.
- **15731**—straight, 0 dBd, ¼ wave whip, antenna with 3" length. RPSMA connector attaches directly to the radio; no antenna cable is needed.

The following are higher gain, outdoor antennas. Their type N female connector attaches to an antenna cable that's purchased separately (see *Antenna Cables*):

- **14221**—3 dBd omnidirectional antenna with mounting hardware. The 14221 is suitable for base station use where it needs to communicate with multiple stations located in different directions.
- **14201**—9 dBd, Yagi antenna with mounting hardware. This directional antenna is intended for longer transmission distances.

\*Only the FCC-approved antennas listed in this document can be used with the RF401-series and RF430-series radios. Call one of our Applications Engineers for help in choosing an antenna.

### RF416 or RF432 Antennas

The following are inexpensive antennas that can transmit short distances (up to 1 mile). They must reside in an environmental enclosure or building:

- 16005—0 dBd, ½-wave whip antenna with joint that's adjustable from 0° to 90°. An RPSMA connector attaches directly to the radio; no antenna cable is needed.
- 17480—1 dBd, dipole antenna with window or wall mount. Antenna comes with a 10-foot cable that has an RPSMA connector, which attaches to the radio; an additional cable is not needed.

The following is a higher gain, outdoor antenna:

- 16755—13 dBd Yagi antenna with mounting hardware. Its type N female connector attaches to an antenna cable that's purchased separately (see *Antenna Cables*).



The 16005 antenna has an articulating knuckle joint that can be oriented vertically or at right angles.

## Antenna Cables/Surge Protectors for Outdoor Antennas

*Recommended for cable lengths less than 10 ft*

- COAXRPSMA-L—Low-loss RG58 antenna cable with reverse polarity SMA (RPSMA) connector and type N male connector. Specify length, in feet, after the L.

*Recommended for cable lengths greater than 10 ft and/or use with lightning protection*

- COAXNTN-L—Low-loss RG8 antenna cable with type N male to type N male connectors (requires 14462 or 16982). Specify length, in feet, after the L.
- 14462—Surge suppressor kit for 900 or 922 MHz RPSMA radios. Includes one COAXRPSMA-L1.5. Requires the COAXNTN-L cable.
- 16982—Surge suppressor kit for 2.4 GHz radios. Includes one COAXRPSMA-L1.5. Requires the COAXNTN-L cable.

## Demo Kit

Customers may test their radio communications onsite by using the 21107 900 MHz Spread Spectrum Demo Kit; contact Campbell Scientific for more information.

## Mounting Brackets

- 14162—Mounting bracket kit that attaches the radio to the backplate of an environmental enclosure.
- CM230—Adjustable Angle Mounting Kit that secures an outdoor antenna to a mast or pipe with a 1.3-in to 2.1-in outer diameter.



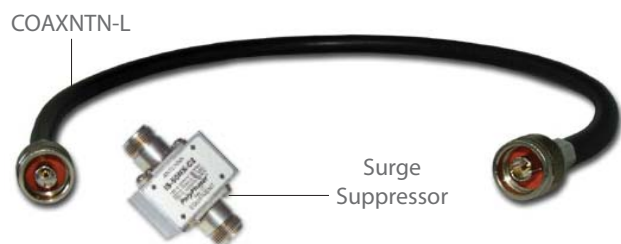
A CM230 supporting a Yagi antenna is attached to the mast of a CM110 tripod. Only the first cross-element of the Yagi antenna is shown

## Compatible Devices

The RF401-series radios are compatible with all of our contemporary dataloggers and most of our retired dataloggers. The RF430 series can attach to any datalogger that has an RS-232 port. Communications with the internal radio of our CR200(X)-series dataloggers may require some settings to be changed; for more information, refer to the RF401-to-CR206 Communications application note at [www.campbellsci.com/app-notes](http://www.campbellsci.com/app-notes).

To increase transmission distance, the RF401-series radios can be combined with our COM210/COM220 phone modems, MD485 Multidrop Modem, and SRM-5A Short Haul Modem. At the non-datalogger site, an A100 adapter fastened to a PS100, PS200, CH100, or CH200 is required.

The RF401-series and RF430-series radios are compatible with the retired RF400-series radios if the RF401-series or RF430-series radios use the Transparent protocol setting. Campbell Scientific does not recommend using RF401-series or RF430-series radios in networks containing RF450 Spread Spectrum Radios.



Radio installations that are susceptible to lightning should use a COAXNTN cable and a 14462 or 16982 surge suppressor kit.

## Specifications

<b>Operating Frequency</b> RF401, RF430: RF411, RF431: RF416, RF432:	910 to 918 MHz 920 to 928 MHz 2.450 to 2.460 GHz	<b>Power:</b>	9 to 16 Vdc
<b>Type:</b>	Frequency Hopping Spread Spectrum (FHSS) Transceiver	<b>Average Current Drain</b> <b>Stand-by:</b>	<1 mA (power-saving options used), 24 mA (RF401, RF411) 36 mA (RF416) 26 mA (RF430, RF431) 40 mA (RF432)
<b>RS-232 Baud Rate:</b>	38.4 k, 19.2k, 9600, 4800, or 1200 bps	<b>Receiving:</b>	<75 mA (RF401, RF411) 75 mA (RF416) 78 mA (RF430, RF431, RF432)
<b>USB Baud Rate<sup>1</sup> (RF430-series only):</b>	38.4 k, 19.2k, 9600, 4800, or 1200 bps	<b>Transmitting:</b>	
<b>Channel Capacity:</b>	65,000 Network Identifiers share 25 hop channels	<b>Operating Temperature Range:</b> <b>Standard:</b> <b>Extended<sup>3</sup>:</b>	-25° to +50°C -55° to +85°C (RF401, RF411, RF430, RF431 only)
<b>Frequency Hopping Patterns:</b>	Six different selectable patterns	<b>LEDs:</b>	Power on, TX, RX, diagnostics
<b>Frequency Control:</b>	Direct FM	<b>RS-232 Connector:</b>	9-pin D female (4 wire: Tx, Rx, CTS, GND)
<b>Receiver Sensitivity</b> RF401, RF411, RF430, RF431: RF416, RF432:	-110 dBm at 10 <sup>-4</sup> bit error rate <sup>2</sup> -104 dBm at 10 <sup>-4</sup> bit error rate <sup>2</sup>	<b>CS I/O Connector<sup>4</sup>:</b>	9-pin D male (RF401-series radios only)
<b>Interference Rejection:</b>	70 dB at pager and cellular phone frequencies	<b>Power Connector:</b>	Barrel plug, center positive 12 V; used to connect the 14291 Field Power Cable or 15966 AC adapter (see <i>Powering the Radio</i> on page 1)
<b>Transmitter Power Output</b> RF401, RF411, RF430, RF431: RF416, RF432:	100 mW nominal 50 mW nominal	<b>Dimensions:</b>	4.75 in. x 2.75 in. x 1.3 in. (12.1 cm x 7.0 cm x 3.3 cm)
<b>FCC ID</b> RF401, RF411, RF430, RF431: RF416, RF432:	OUR9XTREAM OUR-24XSTREAM	<b>Weight:</b>	8 oz. (227 g)
<b>Antenna Connector:</b>	Reverse polarity SMA		

<sup>1</sup>If an RF430-series radio has an operating system prior to OS2, its USB port will only communicate at 38.4 kbps. Therefore, the operating system of an RF430-series radio may need to be updated to a newer version if the network will contain dataloggers that do not support 38.4 kbps (e.g., CR200(X), CR510, CR10X). Operating system updates are available from [www.campbellsci.com/downloads](http://www.campbellsci.com/downloads)

<sup>2</sup>Campbell Scientific protocols will issue retries wherever a bit error occurs.

<sup>3</sup>The push button that allows customers to check/edit programmable settings while the radio is connected to a computer may not operate at temperatures colder than -25°C.

<sup>4</sup>Newer dataloggers provide power to the RF401-series radio on this connector. Dataloggers purchased before December 1997 require the #14291 Field Power Cable.

