Spread Spectrum Radio Modems
Models RF401, RF411, RF416

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.[1] The RF401, RF411, and RF416 radios reduce susceptibility to RF interference from other spread spectrum devices by providing user-selectable frequency hopping patterns.

The RF401-series spread spectrum radio modems can be used for general purpose wireless data communications and support point-to-point and point-to-multipoint datalogger communications. They can serve as a field modem/radio while connected to the data-logger or as a base station modem/radio when connected to a computer.

The modems have three protocol settings: "Transparent", "PB Aware", and "PB Node". The "PB Aware" and "PB Node" protocols are intended for PAKBUS® networks. The radio must be set to the "Transparent" protocol if it will be used in a network containing an RF400, RF410, or RF415 radio[2].

Features

- Individual FCC license not required[3]

- 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 (call about repeater capability)

- 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"

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[1]*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.*

[2]*The RF400, RF410, and RF415 were retired in May 2005.*

[3]*RF401-series modems, 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   915 MHz Spread Spectrum Radio that transmits data to another RF401 radio or a CR206 logger*. The 915 MHz frequency is used in the US/Canada. Standard temperature range is -25° to +50°C.

  -XT   Extended temperature testing (-55° to +85°C)

RF411   922 MHz Spread Spectrum Radio that transmits data to another RF411radio or a CR211 logger*. The 922 MHz frequency is used in Australia/Israel. Standard temperature range is -25° to +50°C.

  -XT   Extended temperature testing (-55° to +85°C)

RF416   2.4 GHz Spread Spectrum Radio that transmits data to another RF416 radio or a CR216 logger*. The 2.4 GHz frequency is used worldwide. Temperature range is -25° to +50°C.

Antennas and Antenna Accessories

Omnidirectional antennas are normally used at the base station and nearby stations. Yagi antennas are needed at distant stations or other special cases. Call one of our Applications Engineers for help in choosing an antenna. Only the following FCC approved antennas can be used.

RF401 and RF411 (900 MHz) Antennas

Indoor

14310   0 dBd, omnidirectional ¼ wave whip, straight 3.2". RPSMA connector attaches directly to the radio; no antenna cable is needed.

14204   0 dBd, omnidirectional ½ wave whip, jointed, adjustable from 0° to 90°. RPSMA connector attaches directly to the radio; no antenna cable is needed.

15970   1 dBd, dipole, window/wall mount. Supplied with a 10-foot RG-174 cable with an RPSMA connector that attaches to the radio.

15730   0 dBd, omnidirectional ¼ wave whip, right angle, adjustable from 0° to 90°. RPSMA connector attaches directly to the radio; no antenna is cable needed.

15731   0 dBd, omnidirectional ¼ wave whip, straight, 3". RPSMA connector attaches directly to the radio; no antenna cable is needed.

The 15970 has adhesive backing to allow it to adhere to a wall, rear-view mirror, or other suitable flat non-conductive surface.

The 14203 is suitable for base station use where it needs to communicate with multiple stations located in different directions.

Outdoor, Omnidirectional

14203   3 dBd with cable clamp mounts. Its type N female connector attaches to an antenna cable (COAXRPSMA-L or COAXNTN-L).

14221   3 dBd with rugged FM2 antenna mounts. Its type N female connector attaches to an antenna cable (COAXRPSMA-L or COAXNTN-L).

Outdoor, Yagi

14201   9 dBd, with mounts. Its type N female connector attaches to an antenna cable (COAXRPSMA-L or COAXNTN-L).

The 14201 Yagi antenna is intended for longer transmission distances.

The factory default settings for the on-board spread spectrum radio of a CR200-series datalogger do not match the settings for the RF401-series radios; therefore, the logger and radio must be reconfigured before communications can take place. The "Quick Reference Guide for Setting Up RF401-to-CR206 Communications" application note provides more information (see www.campbellsci.com/app-notes).

RF416 (2.4 GHz) Antennas

Indoor, Omnidirectional

16005	0 dBd, ½ wave whip articulating. An RPSMA connector attaches directly to the radio; no antenna cable is needed.

Outdoor, Yagi

16755	13 dBd with mounts. Its type N female connector attaches to an antenna cable (COAXRPSMA-L or COAXNTN-L).

Antenna Cables and Surge Protectors for Outdoor Antennas

Recommended for cable lengths less than 10 ft

COAXRPSMA-L	Low-loss RG58 antenna cable with reverse polarity, SMA 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
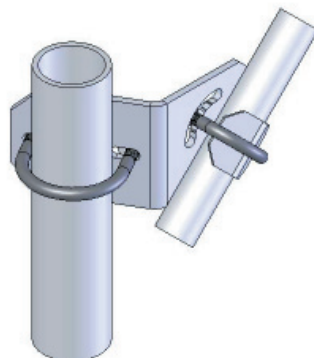
COAXNTN-L	Low-loss RG8 antenna cable with type N male to type N male connectors (requires 14462 or 16982). Specify length, in feet, after the L.
14462	Antenna surge protector kit for 900 MHz radios. Includes one COAXRPSMA-L1.5. Requires the COAXNTN-L cable.
16982	Antenna surge protector kit for 2.4 GHz radios. Includes one COAXRPSMA-L1.5. Requires the COAXNTN-L cable.

Additional Accessories

14291	Optional power cable
CM230	Adjustable Angle Mounting Kit for our outdoor antennas
14162	Mounting bracket kit that attaches the radio to the backplate of an environmental enclosure.
15966	Wall charger for base station radio

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

For the 16755 Yagi antenna, the primary and secondary elements are enclosed in a white cylinder.

The purchase of an antenna cable (COAXRPSMA-L shown) is required for our outdoor antennas.

When using the CM230, fix the declination of the antenna by tightening the u-bolt that mounts on the mast. The inclination is then adjusted with the other set of u-bolts and nuts.

The surge protectors help protect the radios from electrical transients conducted through the antenna cable.

Specifications

Operating Frequency:	910 to 918 MHz RF401, 920 to 928 MHz RF411, 2.450 to 2.460 GHz RF416
Type:	Frequency Hopping Spread Spectrum (FHSS) Transceiver
I/O Data Rate:	9600 bps
Channel Capacity:	65,000 Network Identifiers share 25 hop channels
Frequency Hopping Patterns:	Six different selectable patterns
Frequency Control:	Direct FM
Receiver Sensitivity:	-110 dBm (-104 dBm RF416) at 10^{-4} bit error rate (Campbell Scientific protocols will issue retries wherever a bit error occurs)
Interference Rejection:	70 dB at pager and cellular phone frequencies
Transmitter Power Output:	100 mW nominal (RF401, RF411) 60 mW nominal (RF416)
Antenna Connector:	Reverse polarity SMA
FCC ID:	OUR9XTREAM (RF401, RF411) OUR-24XSTREAM (RF416)
Operating Temperature Range:	-25° to +50°C standard (-55° to +85°C extended option for RF401, RF411 only; please note that 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)
Dimensions:	4.75 x 2.75 x 1.3 inches (12.1 cm x 7.0 cm x 3.3 cm)
Power:	9 to 16 Vdc
Average Current Drain:	<1 mA stand-by (assuming power-saving options used), 24 mA while receiving, <75 mA while transmitting (RF401, RF411) 36 mA while receiving, 75 mA while transmitting (RF416)
LEDs:	Power on, TX, RX, diagnostics
CS I/O Connector:	9-pin "D" Male for all needed communications lines. Newer loggers provide power to the radio on this connector. Older loggers may require optional power cable #14291*
RS-232 Connector:	9-pin "D" Female for TX, RX, CTS, ground RS-232 levels
Power Connector:	Barrel connector, center positive 12 V for use in base station configuration or with older dataloggers (newer loggers provide power to the radio on the CS I/O connector)
Compatible Devices:	21X(L), CR10(X)*, CR800, CR850, CR1000, CR200-series, CR23X, CR3000, CR510, CR7, CR5000, CR500, RAD Modem, and COM210/COM220 (with A100/PS100 at a nondatalogger site). If the protocol is set to "Transparent", the RF401, RF411, and RF416 are compatible with the retired RF400, RF410, and RF415, respectively. Campbell Scientific does not recommend using the RF401-series radios in networks containing FGR-115RC, FGR-115RE, or RF450 radios.

Older wiring panels (CR10 silver or CR10 black with gray terminal strips) will require optional power cable #14291.