CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Data Storage and Retrieval Peripherals
Wireless, remote, hard-wired, direct, or two-way communication

Transmit data from a remote site to an office PC, or view and collect data during an on-site visit.

Campbell Scientific Communication Peripherals

Campbell Scientific offers a full line of data storage and retrieval peripherals. Whether you want to collect data during a site visit, contact your datalogger via telemetry, or both, our data storage and retrieval peripherals have wide operating temperature ranges allowing their use in extreme, remote environments.
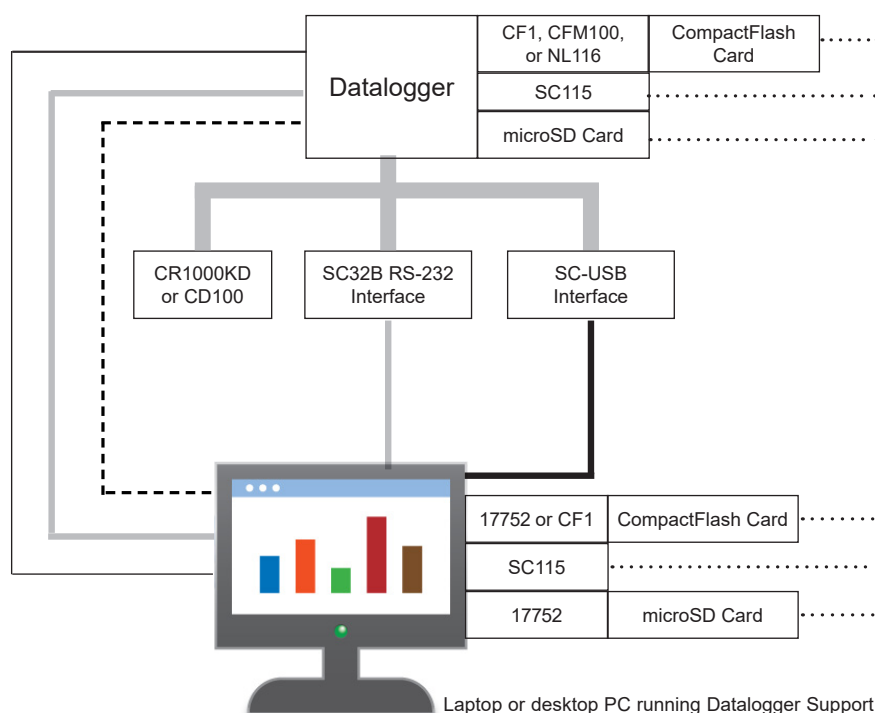
This station for the National Estuarine Research Reserve (NERR) in Virginia transmits data using a satellite transmitter.

To determine the best data storage and retrieval method for your application, you should consider:

> **Accessibility of Site**—a dependable telemetry device that transmits data to a base station's computer is preferable for a site that is difficult to access. On the other hand, if your site is essentially in your backyard, you may want to collect data with a portable handheld device or laptop.

> **Availability of Service**—prior to the purchase of any equipment, you should determine if the appropriate coverage for cellular phones, RF systems, or satellite systems is available for your site. The use of telephones or the Internet requires that phone lines or an Internet connection be available within a few miles of the site.

> **Quantity of Data Collected**—this affects the transmission duration. For some telemetry devices, a long transmission length will significantly impact the current drain, and perhaps service costs.

> **Frequency of Data Collection**—if you need near real-time data, a telemetry device is indicated. If you only need to collect data every few weeks, you may prefer an on-site device.

To help you determine the best data storage and retrieval method for your application, this document describes our on-site and telemetry peripherals. For a quick comparison of devices, we recommend you review the telemetry comparison table on page 6 and the compatibility charts on pages 7 and 8.

On-Site Peripherals

Key

·········	Interrogate on-site or transport to PC
——	10873 RS-232 cable
——	SC12 cable
——	17648 USB cable
- - - -	SC929 cable
– – – –	2755 USB cable

Datalogger — CF1, CFM100, or NL116 — CompactFlash Card

Datalogger — SC115

Datalogger — microSD Card

CR1000KD or CD100

SC32B RS-232 Interface

SC-USB Interface

17752 or CF1 — CompactFlash Card

SC115

17752 — microSD Card

Laptop or desktop PC running Datalogger Support Software (see Software Support section on pg 5)

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External Data Storage Devices

These products are used to backup data, increase the datalogger's storage capability, or retrieve data from the datalogger's memory during a site visit.

Tthe 17752 typically reads data stored on CompactFlash or microSD cards, but it can read many different types of memory cards.

› **One MicroSD card**—read by the card slot that is integrated into a CR6 or CR1000X datalogger

› **SC115 Memory Drive**—stores 2 GB of data. One end connects with the datalogger's CS I/O port for retrieving data, and the other end connects with a PC's USB port for downloading data.

› **CFM100 and NL116 modules**—store data on one CompactFlash® (CF) card; the NL116 also supports Ethernet communications. Both the CFM100 and NL116 attach to the peripheral port on a CR3000 datalogger.

› **One Type I, II, or III PC-card**—read by the PCMCIA card slot that is integrated into the CR9000X datalogger.

› **17752 Reader/Writer**—allows data stored on a CF or MicroSD card to be read by the USB port on a PC.

› **CF1 CompactFlash Adapter**—inserts into the PCMCIA card slot on a CR9000X datalogger or PC allowing the datalogger or PC to receive CF cards.

Direct Connect to Laptop or PC

SC32B CS I/O Interface

The datalogger's USB and/or RS-232 port allows the datalogger to be directly connected to the PC (no interface required). On the CR300-series, CR3000, and CR9000X, the RS-232 port is electrically isolated. Isolation is not provided by the RS-232 port on the CR800-series, CR6, and CR1000X dataloggers.

Alternatively, the datalogger can be connected to a PC using the datalogger's CS I/O port. When connecting to the datalogger's CS I/O port, a device that converts the CMOS logic levels of the datalogger to the RS-232 logic levels used by the PC is required. The following devices accomplish this:

› **SC32B interface**—connects with the PC's 9-pin serial port via an SC12 CS I/O cable and an RS-232 cable. The interface also provides optical isolation.

› **SC-USB interface**—connects with the PC's USB port using an SC12 CS I/O and a USB cable. The interface also provides optical isolation.

› **SC115 interface**—connects with the PC's USB port either directly or via the supplied cables. The interface is not electrically isolated.

› **SC929 cable**—attaches directly to the 9-pin serial port on a battery-powered laptop. It does not provide electrical isolation, and draws approximately 100 mA from the datalogger.

Field Displays

Datalogger Keyboard Displays

Datalogger keyboard displays allow users to check the datalogger's status, display or plot sensor readings and stored values, enter numeric data or change port/flag state, and download programs. They consist of a 128 by 64 pixels backlit LCD graphical or eight-line numeric display and 16-character keyboard.

› **Integrated keyboard display**—provided on the CR850 and CR3000 dataloggers.

› **CR1000KD portable keyboard display**—used with our CR6, CR1000X, and CR800, and may be carried from station to station in a datalogger network.

Mountable Displays

Campbell Scientific CD100 can be mounted in an enclosure lid allowing data entry and display without opening the enclosure.

It provides the same functionality and operation as the CD1000KD. The CD100 has a 16-character keypad and can show eight lines by 21 characters (64 by 128 pixels).

The CR1000KD and CD100 (left) support custom menus that allow customers to set up choices within the datalogger program.

Vibrating-Wire Analyzer

Campbell Scientific's **VWANALYZER** is field ready to quickly measure a sensor, save data, and communicate results with custom PDF reports and spreadsheet output. Measurements are geo-located with the integrated GPS allowing the **VWANALYZER** to verify locations and direct you to your sensors. It has a large color display and uses VSPECT technology to provide the best measurement possible.

iOS and Android Devices
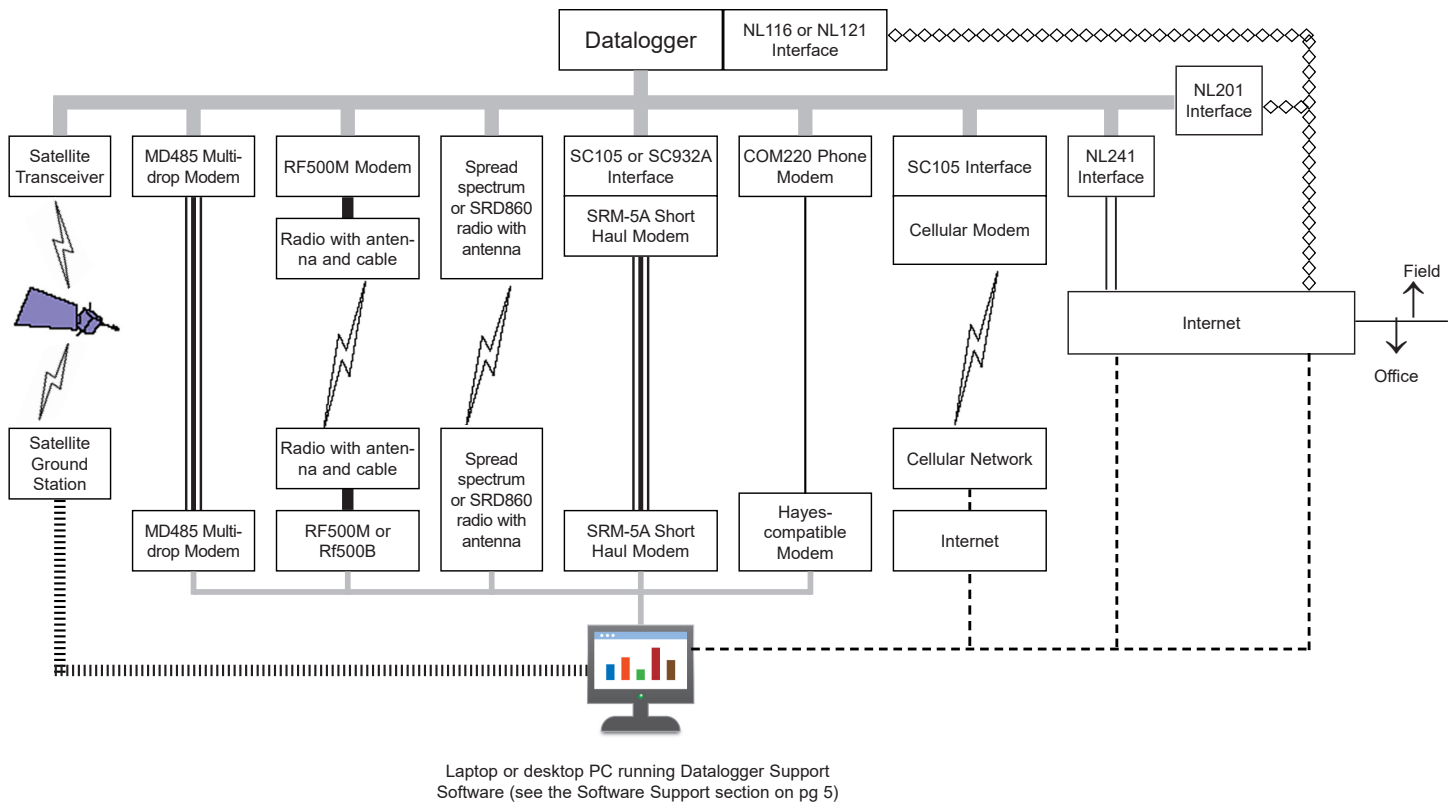
LoggerLink and LoggerNet Mobile Connect apps are available, at no charge, through the Apple Store or Google Play.

› **LoggerLink Apps**—allow an iOS or Android device to communicate with our dataloggers via an IP device. They support viewing and collecting data, setting the clock, and downloading programs.

› **LoggerNet Mobile Connect Apps**—allow an iOS or Android device to connect to any LoggerNet server that is accessible via TCP/IP. The apps can be used to check LoggerNet and the datalogger, view and collect data from individual dataloggers, set the clock, send programs, and change station settings (including variables).

LoggerLink for Android also supports Bluetooth communication using an RS-232-Bluetooth adapter.

Laptop or desktop PC running Datalogger Support Software (see the Software Support section on pg 5)

Key			
▬ SC12 cable*	▬ RF Connection Cable	- - - - Internet connection	⎯⎯ Telephone Line
≡ 2-twisted pair	⚡ Wireless Telemetry	◇◇◇ 10baseT Ethernet Cable	═══ Wi-Fi
▬ RS-232 cable	� Choice of Internet or phone system		

*Assumes connection to the datalogger's CS I/O port. Refer to the device's product brochure to determine the appropriate configuration for connecting to the datalogger's RS-232 port.

Land-Line and Voice Synthesized Telephone Networks

The COM220 Phone Modem at the datalogger site transmits data over land lines. A Hayes-compatible modem at the calling end is required and surge protection at the datalogger site is strongly recommended.

The COM320 Voice-Synthesized Modem enables anyone to call a datalogger using a telephone and receive a verbal report of real-time site conditions.

Temperature is 82 degrees Fahrenheit
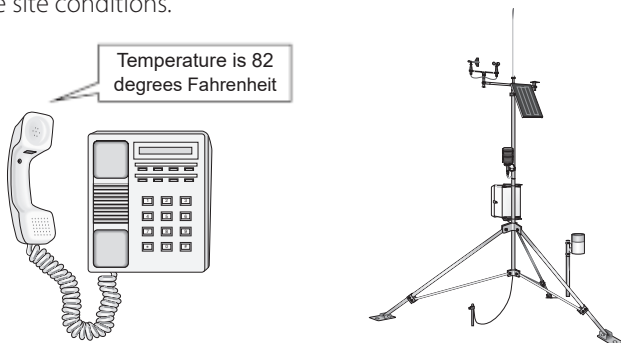
You can use any phone to call a COM320-equipped site and receive a verbal report of site conditions.

Industrial Cellular Gateway

The RV50 is an industrial 4G LTE cellular gateways that is carrier-approved in North America for Verizon, AT&T, T-Mobile USA, Rogers, Bell, and Telus. It provides internet connectivity to any datalogger located within range of a compatible cellular network.

Internet and IP Networks

Our CR6, CR310, CR1000X and CR9000X have an integrated 10/100 Ethernet port that supports Ethernet communications without using a separate interface. The CR6 and CR310 also have a communication option that provides an onboard Wi-Fi modem. Interfaces that support Internet and IP network communications include:

› **NL241 module**—provides Wi-Fi connectivity to our dataloggers and peripherals over standard 802.11b/g/n networks. It also accesses the internal TCP/IP stack of some dataloggers.

› **NL116 and NL121 modules**—support Ethernet communications via the peripheral port on a CR3000 datalogger. They also access the datalogger's internal TCP/IP stack

› **NL201 module**—supports Ethernet communications and provides access to the internal TCP/IP stack of some dataloggers.

Multidrop

The MD485 intelligent RS-485 interface permits a PC to address and communicate with one or more dataloggers over a single CABLE2TP two-twisted pair cable.

Radio Frequency (RF) Networks

Our RF networks transmit data over a radio frequency. Line-of-sight is required for all RF networks.

› **RF320-series UHF/VHF narrowband radios**—transmit data for up to 25 miles, line-of-sight. At the field station and repeater stations, the radio is attached to an RF500M modem. The computer base station should include a radio, PC, and an RF500M modem or RF500B base station. The RF320-series radios require an FCC license.

› **Spread Spectrum and SRD860 radios**—provide communications between a base station computer and several field stations over short distances. An individual FCC license is not required.

Satellite

Our satellite transmitters provide one-way communications from the datalogger site to a receiving station.

› **ST-21 PTT**—uses the Argos system, which is well suited for deployment in high latitudes.

› **Iridium 9522B**—transmits data via the Iridium system, which is ideal for stations at very high-angle latitudes, high-altitude applications, and mobile applications, such as buoys or ships.

› **Hughes9502**—uses Inmarsat Broadband Global Area Network (BGAN) to provide reliable end-to-end IP connectivity.

› **TX321**—supports GOES HDR Version 2, Meteosat SRD, and International DCS operation and is typically used by government agencies and sponsored research organizations that transmit environmental data.

Short Haul

The SRM-5A Short Haul Modem supports communications between the datalogger and a computer via a four-wire unconditioned line (two twisted pairs).
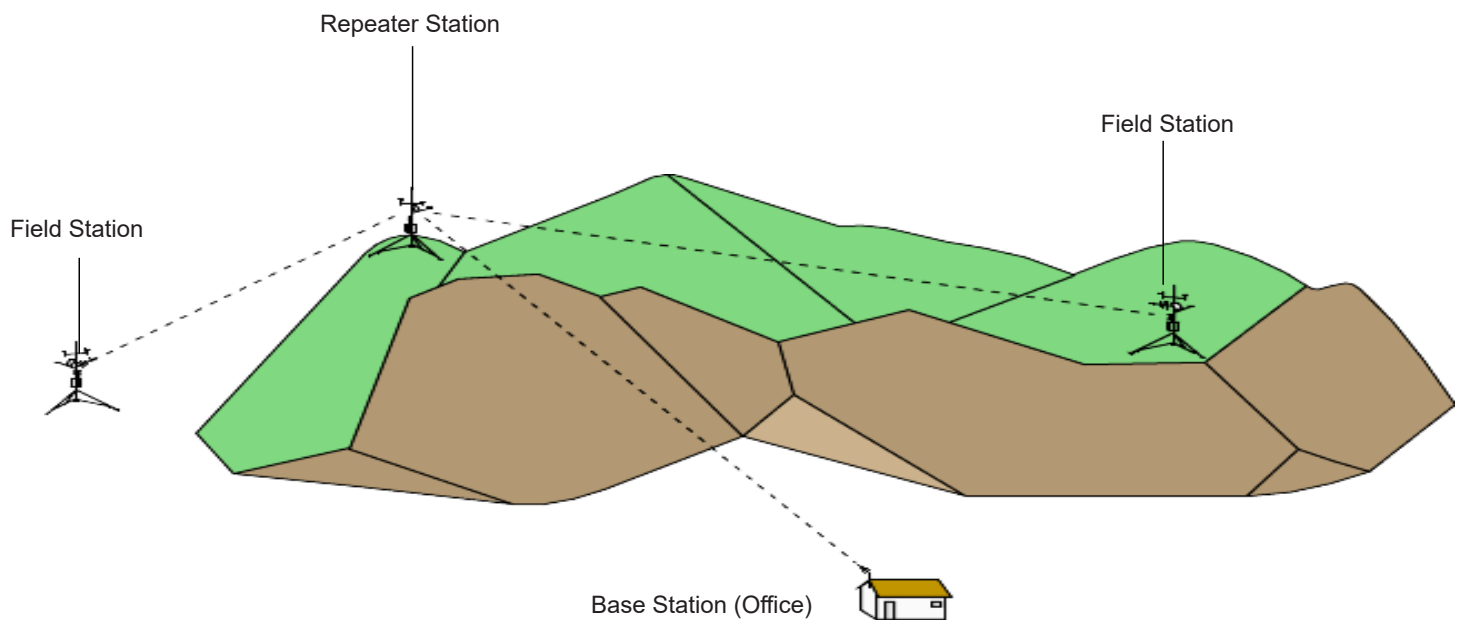
All of our RF networks require line-of-sight transmission. The mountain in this drawing obstructs line-of-sight with the base station. Use of the repeater station allows the base station to receive data from the field stations.

Software Support

The base station computer needs to be running one of our software packages. Our PC200W software is available, at no charge, from our website; it supports direct communications only. PC400, RTDAQ, and LoggerNet software support our direct and telemetry options. LoggerNet also supports scheduled data collection and combining data retrieval methods (e.g., phone-to-radio).

Combining Options

You can increase the flexibility, convenience, and reliability of your application's data storage and retrieval by combining an on-site device with a telemetry device. For example, cellular phone with on-site back-up provided by an microSD card combines an on-site and telemetry device. You can also combine two telemetry methods. Popular telemetry combinations are Ethernet-to-radio, multidrop-to-spread spectrum radio, phone-to-multidrop, Ethernet-to-multidrop, and phone-to-radio.

Telemetry Comparison Table

DEVICE	TRANSMISSION DISTANCE OR AREA	CURRENT DRAIN @ 12 Vdc	SERVICE REQUIREMENTS
NL116 or NL121 Ethernet Interface	Worldwide	58 mA typical; 3 mA Ethernet off	Ethernet access
NL201 Ethernet Interface	Worldwide	50 mA active; 2 mA forced standby	Ethernet access
NL241 Wi-Fi Interface	Worldwide	7.5 to 8 mA client mode idle; 65 to 75 mA client mode communicating; 67 mA access point mode idle; 70 mA access point mode communicating; < 1.5 mA standby	Wi-Fi hotspot (access to standard 802.11b/g/n networks)
MD485 Multidrop Modem	4000 ft (can increase distance by using more MD485s or combining with spread spectrum radios, Ethernet, or phone)	1.2 mA standby; 2 to 7 mA communicating	CABLE2TP two-twisted pair cable must be installed between networked dataloggers and base.
RF320-Series Narrowband VHF/ UHF Radios with RF500M modem	Up to 25 miles between stations (line-of-sight); effective distance can be increased using repeaters	25 mA receive standby; <900 mA (transmit 2 W RF power) <1200 mA (transmit 5 W RF power)	FCC-assigned frequency and license. Line-of-sight required.
RF401A/RF411A Spread Spectrum Radios	Up to 16 km (10 miles) with Yagi antenna at ideal conditions; up to one mile with inexpensive omnidirectional antenna (line-of-sight obstructions and interference affect transmission length)	<0.5 mA stand-by; 15 mA receiving; < 80 mA transmitting	Shares frequency with other devices. Not allowed to cause harmful interference to licensed radios. Line-of-sight is required.
RF407/RF412 Spread Spectrum Radios	20 km (12 miles) with Yagi antenna at ideal conditions; up to one mile with inexpensive omnidirectional antenna (line-of-sight obstructions and interference affect transmission length)	Transmit: < 80 mA (250 mW TX Power) Receive: 15 mA Stand-by: < 0.5 mA (depending on power saving mode)	Shares frequency with other devices. Not allowed to cause harmful interference to licensed radios. Line-of-sight is required.
RF422 SRD860 Radio	Up to 5 km (3 miles) depending on antenna (line-of-sight obstructions and interference affect transmission length)	Transmit: < 25 mA (25 mW TX Power) Receive: 15 mA Stand-by: < 0.5 mA (depending on power saving mode)	Shares frequency with other devices. Not allowed to cause harmful interference to licensed radios. Line-of-sight is required.
RF451 Spread Spectrum Radio	20 to 25 miles with Yagi antenna; up to one mile with inexpensive omnidirectional antenna (line-of-sight obstructions and interference affect transmission length)	6 mA sleep mode; 15 mA idle; 40 mA receiving; 650 mA transmitting	Shares frequency with other devices. Not allowed to cause harmful interference to licensed radios. Line-of-sight is required.
SRM-5A Short Haul Modem	7.6 miles	2.2 mA quiescent; 10 to 15 mA active	Dedicated 2-twisted pair cable connects one field station with base.
COM220 Phone Modem	Limitless assuming telephone lines are installed	12 µA quiescent; 30 mA active	If not available at the site, phone lines must be installed.
RV50 Sierra Wireless 4G LTE Cellular Gateway	Dependent on antenna used and LTE, CDMA/EV-DO, and GSM/GPRS/EDGE/WCDMA coverage	1 mA typical enable/ignition sense low 65 to 95 mA typical idle 250 to 300 mA typical active	Network coverage at the datalogger site and account at Verizon, AT&T, T-Mobile USA, Rogers, Bell, or Telus
ST-21 Argos Satellite Transceiver	Worldwide. The amount of data transmitted is latitude dependent. From 448 average bytes per day at the equator to 1792 average bytes per day at the poles.	1.12 mA quiescent, 375 mA transmitting	Must receive formal permission from Service Argos and pay a fee. Data must be used for environmental purposes.
TX321 GOES or Meteosat Transceiver	GOES: North America Meteosat: Europe	<5 mA, idle <100 mA, during GPS fix <2.6, transmit	Need formal permission (see http://noaasis.noaa.gov/DCS/ for GOES or www.eumetsat.int for Meteosat). GOES applications either need to be or sponsored by a U. S. government agencies.
IRIDIUM9522B Satellite Modem	Worldwide (including poles, oceans and airways)	Operating: 333 mA Standby: 125 mA	Needs a SIM card and must pick a service provider and pay a fee.
HUGHES9502 Inmarsat BGAN Satellite IP Terminal	Sites located at ±70° latitude	Transmit: < 1.7 A peak Off, GPIO sleep pin control: < 0.3 mA	Needs a SIM card and must pick a service provider and pay a fee.

Telemetry Compatibility Table

DEVICE	CR300 Series	CR800 Series	CR1000X	CR6	CR3000	CR9000X
INTERNET AND IP NETWORKS						
NL116 Ethernet/CF Interface					see note 2	
NL121 Interface					see note 2	
NL201 Interface	see note 3, 4	✓	see note 4	see note 4	✓	see notes 4, 5
NL241 Wi-Fi Interface	see note 3, 6	✓	✓	see note 6	✓	see note 5
MULTIDROP						
MD485 Modem	✓	✓	✓	✓	✓	
RF NETWORKS						
RF320-Series Narrowband UHF/VHF Radios	✓	✓	✓	✓	✓	
RF500M/RF500B Narrowband Modem/Base Station	✓	✓	✓	✓	✓	
RF401A/RF411A Spread Spectrum Radios	✓	✓	✓	✓	✓	see note 7
RF407/RF412 Spread Spectrum Radios	✓	✓	✓	✓	✓	see note 7
RF422 SRD860 Radio	✓	✓	✓	✓	✓	see note 7
RF451 Spread Spectrum Radio	✓	✓	✓	✓	✓	see note 7
SATELLITE						
ST-21 Argos Transceiver		✓	✓	✓	✓	
TX321 GOES or Meteosat Transceiver	✓	✓	✓	✓	✓	
Iridium9522B Satellite Modem and Interface Kit	✓	✓	✓	✓	✓	
HUGHES9502 Inmarsat BGAN Satellite IP Terminal	✓	✓	✓	✓	✓	✓
SHORT HAUL						
SRM-5A Rad Modem		✓	✓	✓	✓	see note 7
TELEPHONE NETWORKS						
COM220 Phone Modem		✓	✓	✓	✓	see note 7
COM320 Voice Synthesizer Phone Modem		✓	✓	✓	✓	
RV50 4G LTE Cellular Gateway	✓	✓	✓	✓	✓	

Notes:
1. To determine compatibility with devices not offered by Campbell Scientific or devices not listed on this chart, refer to the device's product brochure or manual, or contact a Campbell Scientific applications engineer.
2   To be compatible with the NL116 and NL121, the CR3000 must use operating system version 28 or greater.
3   The CR300-series dataloggers are not compatible with the bridge mode functionality of the NL201 and NL241 interfaces.
4. Although compatible, the CR310, CR6, CR1000X, and CR9000X have an onboard Ethernet port and therefore an Ethernet interface is not required.
5. The CR9000X dataloggers are only compatible with the serial server functionality of the NL201 and NL241 interfaces.
6. Although compatible, the CR300-series and CR6 dataloggers have a Wi-Fi communication option that will provide the same Wi-Fi functionality as the NL241.
7. Although compatible, these devices do not support the CR9000X's maximum communication rate. Therefore these devices may not be practical for many CR9000X applications.

Onsite Compatibility Table

DEVICE	CR300 Series	CR800 Series	CR1000X	CR6	CR3000	CR9000X
DIRECT CONNECT						
RS-232 Cable (w/o an interface)	✓	✓	✓	✓	✓	✓
USB Cable (w/o an interface)	✓		✓	✓		
SC32B Interface		✓	✓	✓	✓	✓
SC-USB Interface		✓	✓	✓	✓	✓
SC115 USB Interface		✓	✓	✓	✓	
SC929 CS I/O Cable		✓	✓	✓	✓	✓
FIELD DISPLAYS						
CR1000KD Keyboard Display		✓	✓	✓		
CD100 Mountable Display with Keypad		✓	✓	✓		
iOS DEVICES AND ANDROID DEVICE						
iOS Devices using LoggerLink App	✓	✓	✓	✓	✓	✓
iOS Devices using LoggerNet Mobile Connect App	✓	✓	✓	✓	✓	✓
Android Devices using LoggerLink App	✓	✓	✓	✓	✓	✓
Android Devices using LoggerNet Mobile Connect App	✓	✓	✓	✓	✓	✓
EXTERNAL DATA STORAGE DEVICES						
SC115 Memory Drive		✓	✓	✓	✓	
MicroSD Card			✓	✓		
Type I, II, or III PC Cards						✓
CF1 Adapter with CF Card						✓
CFM100 Module with CF Card					✓	
NL116 Module with CF Card (see note 2)					✓	

Notes:

1. To determine compatibility with devices not offered by Campbell Scientific or devices not listed on this chart, refer to the device's product literature or manual, or contact a Campbell Scientific applications engineer.

2. To be compatible with the NL116, the CR3000 must use operating system version 28 or greater.