OPERATOR'S MANUAL

CR1000 Measurement and Control System Overview

Revision: 11/06

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CR1000 Overview

The CR1000 provides precision measurement capabilities in a rugged, battery-operated package. The CR1000 includes CPU and analog and digital inputs and outputs. The on-board, BASIC-like programming language includes data processing and analysis routines. PC200, PC400, or LoggerNet software provides program generation and editing, data retrieval, and real-time monitoring.

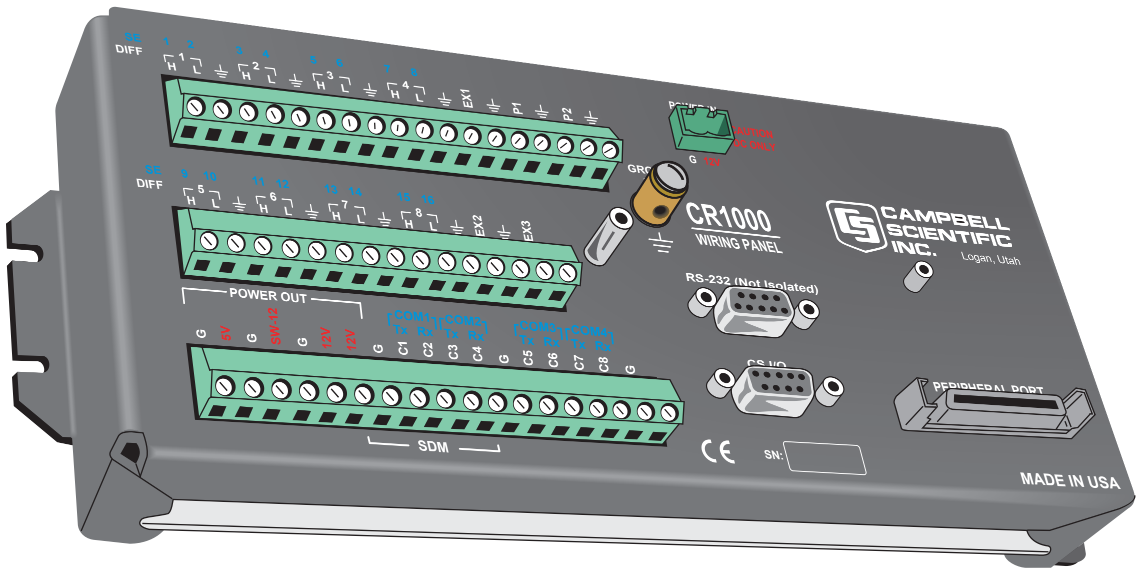


FIGURE OV1-1. CR1000 Measurement and Control System

OV1. Physical Description

Figure OV1-2 shows the CR1000 panel and the associated program instructions. The details of the measurement instructions can be found in Section 7.

OV1.1 Measurement Inputs

OV1.1.1 Analog Inputs (SE 1-16, DIFF 1-8)

There are 8 differential or 16 single-ended inputs for measuring voltages up to ±5 V. A thermistor installed in the wiring panel can be used to measure the reference temperature for thermocouple measurements, and a heavy copper grounding bar and connectors combine with the case design to reduce temperature gradients for accurate thermocouple measurements. Resolution on the most sensitive range is 0.67 µV

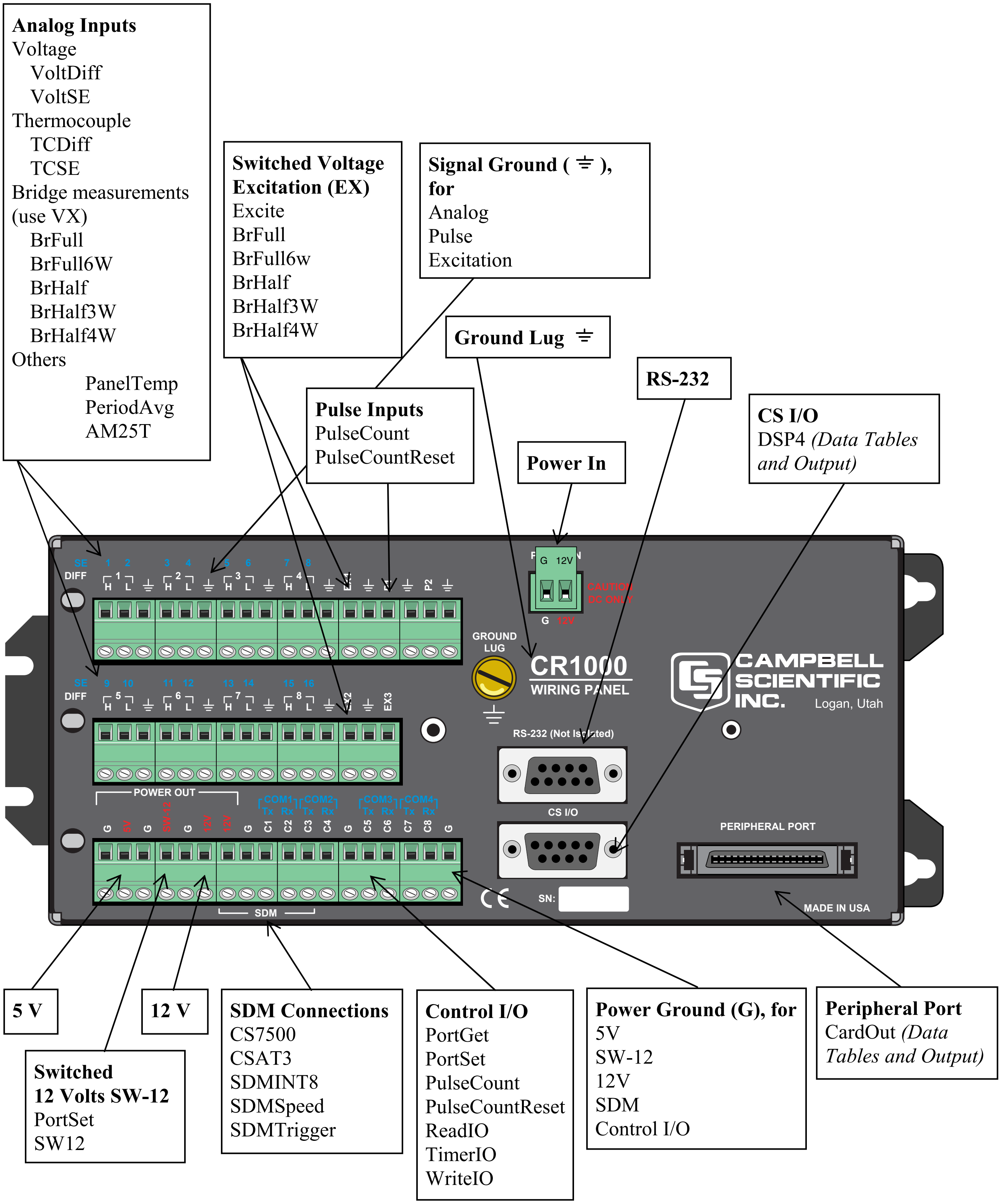


FIGURE OV1-2. CR1000 Wiring Panel and Associated Instructions

OV1.1.2 Signal Grounds (⏚)

Signal Grounds (⏚) should be used as the reference for Single-ended Analog inputs, Pulse inputs, Excitation returns, and sensor shield wires. Signal returns for the Pulse inputs should use the ⏚ terminals located next to the Pulse inputs.

OV1.1.3 Power Grounds (G)

Power Grounds (G) should be used as the returns for the 5V, SW12, 12V, and C1-C8 outputs. Use of the G grounds for these outputs with potentially large currents will minimize current flow through the analog section, which can cause Single-ended voltage measurement errors.

OV1.1.4 Ground Lug (⏚)

The large ground lug is used to connect a heavy gage wire to earth ground. A good earth connection is necessary fix the ground potential of the datalogger and to send to earth transients that come in on either the G or ⏚ terminals or are shunted to ground via the spark gaps protecting other inputs.

OV1.1.5 Power In (G and 12V)

The G and 12V terminals on the Power In connector plug are for connecting power from an external battery to the CR1000. These are the only terminals that can be used to input battery power; the other 12V and SW-12V terminals are output only.

OV1.1.6 Switched 12 Volts (SW-12)

The SW-12 terminal provide an unregulated 12 volts that can be switched on and off under program control.

OV1.1.7 Switched Voltage Excitation (EX E1-3)

Three switched excitation channels provide precision programmable voltages within the ±2.5 Volt range for bridge measurements. Each channel will source up to 2.5 mA at voltages up to ±2.5 Vdc.

OV1.1.8 Digital I/O (C1-8)

There are 8 digital Input/Output channels (0 V low, 5 V high) for frequency measurement, pulse counting, digital control, and triggering. In addition to the individual channel digital I/O functions, there are several groups of channels that can be used for other functions.

The Synchronous Device for Measurement (SDM) connections C1, C2, and C3 along with the 12 volt and ground terminals are used to connect SDM sensors and peripherals.

The COM groupings can be used for serial I/O communication and Intelligent Sensor input.

OV1.1.9 Pulse Inputs (P1-2)

Two Pulse input channels can count pulses from high-level (5 V square wave), switch closure, or low-level A/C signals.

OV1.2 Communication and Data Storage

OV1.2.1 Peripheral Port

The peripheral port is for attaching data storage or communication peripherals. Both the CFM100 and NL115 modules plug onto the peripheral port and have a slot for a Type I or Type II CompactFlash® card (Section 2.1.2). The NL115 also supports Ethernet communications.

CAUTION Removing a card from the CFM100 or NL115 while the card is active can cause garbled data and can actually damage the card. Always press the button to disable the card for removal before switching off the CR1000 power.

OV1.2.2 CS I/O

All Campbell Scientific communication peripherals connect to the CR1000 through the 9-pin subminiature D-type socket connector located on the front of the Wiring Panel labeled "CS I/O" (Figure OV1-3). Table OV1-1 gives a brief description of each pin.

TABLE OV1-1. Pin Description

ABR = Abbreviation for the function name.
PIN = Pin number.
O = Signal Out of the CR1000 to a peripheral.
I = Signal Into the CR1000 from a peripheral.

PIN	ABR	I/O	Description
1	5 V	O	5V: Sources 5 VDC, used to power peripherals.
2	SG		Signal Ground: Provides a power return for pin 1 (5V), and is used as a reference for voltage levels.
3	RING	I	Ring: Raised by a peripheral to put the CR1000 in the telecommunications mode.
4	RXD	I	Receive Data: Serial data transmitted by a peripheral are received on pin 4.
5	ME	O	Modem Enable: Raised when the CR1000 determines that a modem raised the ring line.
6	SDE	O	Synchronous Device Enable: Used to address Synchronous Devices (SDs), and can be used as an enable line for printers.
7	CLK/HS	I/O	Clock/Handshake: Used with the SDE and TXD lines to address and transfer data to SDs. When not used as a clock, pin 7 can be used as a handshake line (during printer output, high enables, low disables).
8	+12 VDC		
9	TXD	O	Transmit Data: Serial data are transmitted from the CR10X to peripherals on pin 9; logic low marking (0V) logic high spacing (5V) standard asynchronous ASCII, 8 data bits, no parity, 1 start bit, 1 stop bit, 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 115,200 baud (user selectable).

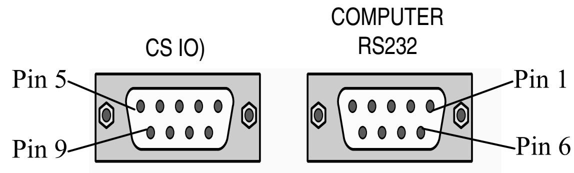


FIGURE OV1-3. Serial Communication Interfaces

OV1.2.3 Computer RS-232

The CR1000 RS-232 port is not isolated.

Direct connection of the CR1000 to a PC is most conveniently done through the "Computer RS-232" port (Figure OV1-3). Table OV1-2 gives a brief description of each "Computer RS-232" pin.

The Computer RS-232 port is a DCE device when connected to a PC with a serial cable. It also doubles as a DTE device when connected to a modem device through a null-modem cable. (DTR function is on pin I, Ring is an input).

Maximum input = ± 25V
Minimum Output = ± 5V
Typical Output = ± 7V

NOTE Serial communications is not reliable over cable greater than 50 feet in length.

TABLE OV1-2. Computer RS-232 Pin-Out

ABR = Abbreviation for the function name
PIN = Pin number
O = Signal Out of the CR1000 to a RS-232 device
I = Signal Into the CR1000 from a RS-232 device

PIN	ABR	I/O	Description
1	DTR	O	data terminal ready
2	TX	O	asynchronous transmit
3	RX	I	asynchronous receive
4			not connected
5	GND		ground
6		O	connected to pin
7	CTS	I	clear to send
8	RTS	O	request to send
9	RING	I	ring

The CR1000 is supplied with a six foot 9-pin to 9-pin serial cable and a 9- to 25-pin adapter to facilitate connection to a PC RS-232 port.

OV1.3 Power Supply and AC Adapter

The CR1000 requires a separate 12 V power supply. The PS100 power supply has a 7 amp hour battery with built-in charging regulator. Optional adapters for AC power are available. Charging power can also come from a 17-28 VDC input such as a solar panel.

OV2. Memory and Operating Concepts

OV2.1 Memory

The CR1000 has two MB Flash EEPROM that is used to store the Operating System. Another 128 K of Flash is used to store configuration settings. A minimum of 2 MB SRAM (4 MB optional) is available for program storage (16K), operating system use, and data storage. The size of available memory may be seen in the status file. Additional data storage is available by using a compact flash card in the optional CFM100 Compact Flash Module or NL115 Ethernet Interface and Compact Flash Module.

OV2.2 Programming

The CR1000 program directs how and when the sensors are measured and data are stored. The program is created on a computer and sent to the CR1000. The CR1000 can store a number of programs in memory. Campbell Scientific has two software applications that create CR1000 programs: ShortCut and the CRBasic Editor.

For many applications ShortCut is a good place to start. With ShortCut you select the sensors to measure, the units to report the measurements in, and the data to output. ShortCut supports most of the sensors sold by Campbell Scientific as well as generic measurements. The CR1000 programs created by ShortCut are generally clear and provide a good example of CRBasic code for those who wish to write CR1000 programs themselves.

For those that have the need or inclination to tackle more complex programs, the CRBasic Editor is used to create and edit the CRBasic programs that the CR1000 runs. Section 4 provides an introduction to CRBasic Programming. The CRBasic Editor has syntax highlighting and online help for the CR1000 instruction set described in Sections 5-12.

ShortCut is included with PC200, PC400 and LoggerNet and is available for free from the Campbell Scientific web site. The CRBasic Editor is included in PC400 and LoggerNet.

OV2.3 Instruction Execution within the Datalogger

The execution of instructions within the datalogger is accomplished using three separate task types: measurement, SDM, and processing. As it is named, the measurement task handles measuring the signals received on the datalogger's wiring panel, as well as outputting signals for control of other devices. The measurement and control hardware is manipulated on a rigidly timed sequence. The SDM task handles the measurement and control of most SDM devices.

The processing task converts the raw signals read by the datalogger into numbers representing engineering units, performs calculations, stores data, makes the decisions to actuate controls, and performs serial I/O communication.

Measurement Task	SDM Task	Processing Task
• Analog Measurements • Excitation • Read Pulse Counters • Read Control Ports (GetPort) • Set Control Ports (SetPort • VibratingWire • PeriodAvg • CS616 • Calibrate	• All SDM instructions, except SMDSIO4 and SCMIO16	• Processing • Output • Serial I/O • SDMSIO4 • SDMIO16 • ReadIO • WriteIO • Expression evaluation and variable setting in measurement and SDM instructions

The datalogger can execute these tasks in either pipeline or sequential mode. When a program is compiled the datalogger evaluates the program and determines which mode to use. This information is included in a message returned by the datalogger and is displayed by the support software. CRBasic's precompiler returns a similar message. A program can be forced to run in sequential mode by placing the SequentialMode instruction in the declarations section of the program.

OV2.3.1 Pipeline Mode

In pipeline mode, the measurement task, SDM task, and processing task are three separate functions. In this mode the three tasks may operate simultaneously. The measurement tasks are scheduled to take place at exact times and with the highest priority when the datalogger starts each scan. This results in a more precise timing of measurements, and may be more efficient with processing and power consumption. However, this prescheduling of measurements means measurement instructions must be executed every scan, and because multiple tasks are taking place at the same time, the sequence in which the instructions are executed may not be in the exact order in which they appear in the program. For these reasons, conditional measurements are not allowed in pipeline mode. Also note that because of the precise execution of measurement instructions, processing for the measurements in the current scan (including update of public variables and output to data tables) is delayed until all measurements are completed.

OV2.3.2 Sequential Mode

In sequential mode the instructions are executed in the sequence they appear in the program. Sequential mode can be slower than pipeline mode since it does only one step of the program at a time. After a measurement is made the result is converted to a value determined by the processing included in the instruction, and then the datalogger proceeds to the next instruction. Because of this step-by-step instruction execution, conditional measurements are allowed in sequential mode. The exact time at which measurements are made may vary if other measurements or processing are made conditionally, if there is heavy communications activity or other interrupts (e.g., inserting a CF card).

OV2.3.3 Slow Sequence Scans

The datalogger allows for one or more scans that are run outside of the instructions placed between the Scan/NextScan instructions in the main program. These scans, referred to as slow sequence scans, typically run at a slower rate than the main scan. Up to four slow sequences can be defined in a program (slow sequences are declared with the SlowSequence instruction).

Instructions in a slow sequence scan are executed whenever the main scan is not active. When running in pipeline mode, slow sequence measurements will be spliced in after measurements in the main program, as time allows. Because of this splicing, the measurements in a slow sequence may actually span across multiple main program scan intervals. In sequential mode, all instructions in the slow sequences are executed as they occur in the program (see Task Priority, below).

OV2.3.4 Task Priority

When considering the information above regarding pipeline and sequential mode, you must also consider that some sequences in the program may have higher priorities than other sequences in the program, and that measurement tasks generally take precedence over all others. In addition, the priority of sequences is different for pipeline mode and sequential mode.

When running in pipeline mode, measurement tasks have priority over all other tasks. Measurements in the main program have the highest priority, then background calibration, followed by any measurements in slow sequences that may be defined. The execution of processing tasks are handled by a task sequencer, and all tasks are given the same priority. When a condition is true for a task to start running it is put in a queue (this true condition can be based on time, the triggering of WaitDigTrig, the expiration of a Delay instruction, or a ring on a COM port triggering communication). Because all tasks are given the same priority, the task is put at the back of the queue. Every 10 msec (or faster if a new task is triggered) the task currently running is paused and put at the back of the queue, and the next task in the queue begins running. In this way, all tasks are given equal processing time by the datalogger. The only exception to this task switching queue is when a measurement task is triggered. In most instances the processing task and the measurement task should be able to run in parallel. However, if the datalogger is unable to complete a measurement when the task sequencer is executing, the task will be interrupted until the measurement is made.

When running in sequential mode, the datalogger uses a queuing system for processing tasks similar to the one used in the pipeline mode. The main difference when running a program in sequential mode is that there is no prescheduled timing of measurements; instead, all of the instructions are run in the order they occur in the program. A priority scheme is used to avoid conflicting use of measurement hardware. In this scheme the main scan has the highest priority and prevents other sequences from using measurement hardware until the main scan is completed (including processing). Other tasks, such as processing from other sequences and communications, can occur while the main sequence is running. Once the main scan has finished other sequences have access to measurement hardware with the order of priority being the background calibration sequence followed by the slow sequences in the order they are declared in the program. Note that Measurement tasks have priority over other tasks such as processing and communication to allow accurate timing needed within most measurement instructions, e.g. integrations.

OV2.4 Data Tables

The CR1000 can store individual measurements or it may use its extensive processing capabilities to calculate averages, maxima, minima, histograms, FFTs, etc., on periodic or conditional intervals. Data are stored in tables such as listed in Table OV2-1. The values to output are selected when running ShortCut or when writing a datalogger program directly.

Table OV2-1. Typical Data Table

TOA5	Fritz	CR1000	1079	CR1000.Std.1.0	CPU:TCTemp.CR1	51399	Temp	
TIMESTAMP	RECORD	RefT_Avg	TC_Avg(1)	TC_Avg(2)	TC_Avg(3)	TC_Avg(4)	TC_Avg(5)	TC_Avg(6)
TS	RN	degC	DegC	DegC	DegC	DegC	DegC	DegC
		Avg	Avg	Avg	Avg	Avg	Avg	Avg
10/28/2004 12:10	119	23.52	23.49	23.49	23.5	23.49	23.5	23.5
10/28/2004 12:20	120	23.55	23.51	23.51	23.51	23.51	23.51	23.52
10/28/2004 12:30	121	23.58	23.52	23.53	23.53	23.53	23.53	23.53
10/28/2004 12:40	122	23.58	23.53	23.54	23.54	23.54	23.54	23.54

OV2.5 PakBus® Communication with the CR1000

The CR1000 uses the PakBus network communications protocol. PakBus increases the number of communications and networking options available to the datalogger. In addition to communicating via its RS-232 and/or CS I/O ports, the CR1000 can also communicate via the digital I/O COM ports.

Some of the advantages of PakBus are:

- Routing – the CR1000 can act as a router, passing on messages intended for another logger. PakBus supports automatic route detection and selection.

- Short distance networks with no extra hardware – A CR1000 can talk to another CR1000 over distances up to 30 feet by connecting 3 wires between the dataloggers: transmit, receive, and ground. A PC communicating with one of these loggers (e.g. via a phone modem or RF to the CS I/O port) can be routed through that datalogger to the other datalogger.

- Datalogger to datalogger communications – Special PakBus instructions simplify transferring data between dataloggers for distributed decision making or control.

All devices that send or receive messages in a PakBus network must have a unique PakBus Address. The CR1000 default PakBus address is 1. In a PakBus Network each datalogger must be set to a unique address before it is installed in the network. To communicate with the CR1000, the PC software (e.g., LoggerNet) must know the CR1000's PakBus address.

OV2.6 Set up: Device Configuration Utility or Keyboard Display

When you receive a new CR1000 from Campbell Scientific it should be set to the default PakBus address, 1. If you only have one PakBus datalogger, or will only communicate with the CR1000 with a direct RS-232 or telephone modem connection, there may be no need to change the address.

However, if a CR1000 has been in use or someone has borrowed it, you may need to check what the address is or to set it or some other setting. While there are a number of ways to do this, the two most basic are to use the Device Configuration Utility or the Keyboard display.

OV3. Device Configurator

The Device Configuration Utility (DevConfig) sets up dataloggers and intelligent peripherals before those devices are deployed in the field and before these devices are added to networks in Campbell Scientific datalogger support software such as LoggerNet or PC400. Some key features of DevConfig include:

- DevConfig only supports direct serial connections between the PC and devices.

- DevConfig can send operating systems to supported device types.

- DevConfig can set datalogger clocks and send program files to dataloggers.

- DevConfig allows you to determine operating system types and versions

- DevConfig provides a reporting facility where a summary of the current configuration of a device can be shown on the screen and printed. This configuration can also be saved to a file and used to restore the settings in the same or a replacement device.

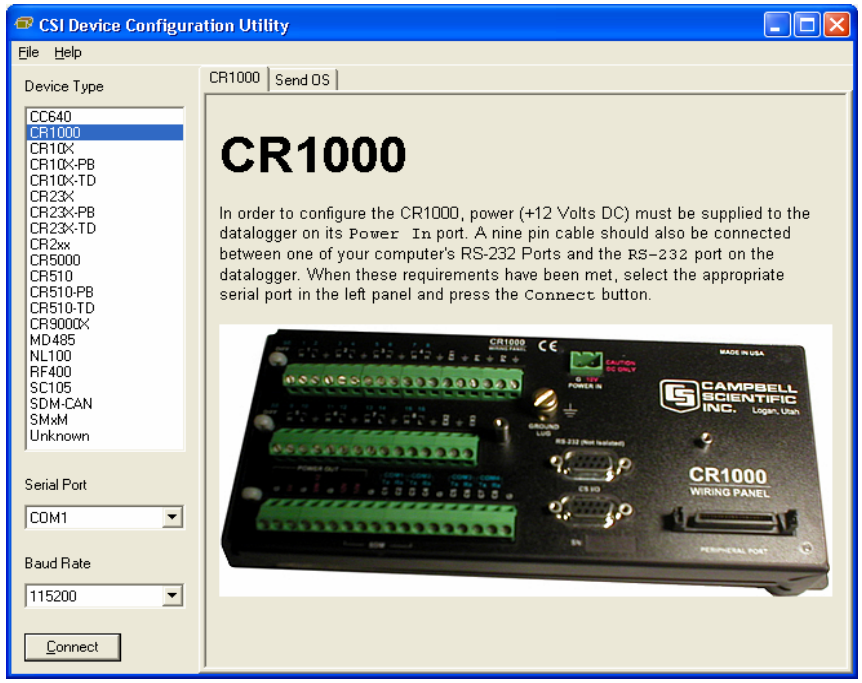
- Some devices may not support the configuration protocol in DevConfig, but do allow configurations to be edited through the terminal emulation screen.

- Help for DevConfig is shown as prompts and explanations on its main screen. Help for the appropriate settings for a particular device can also be found in the user's manual for that device.

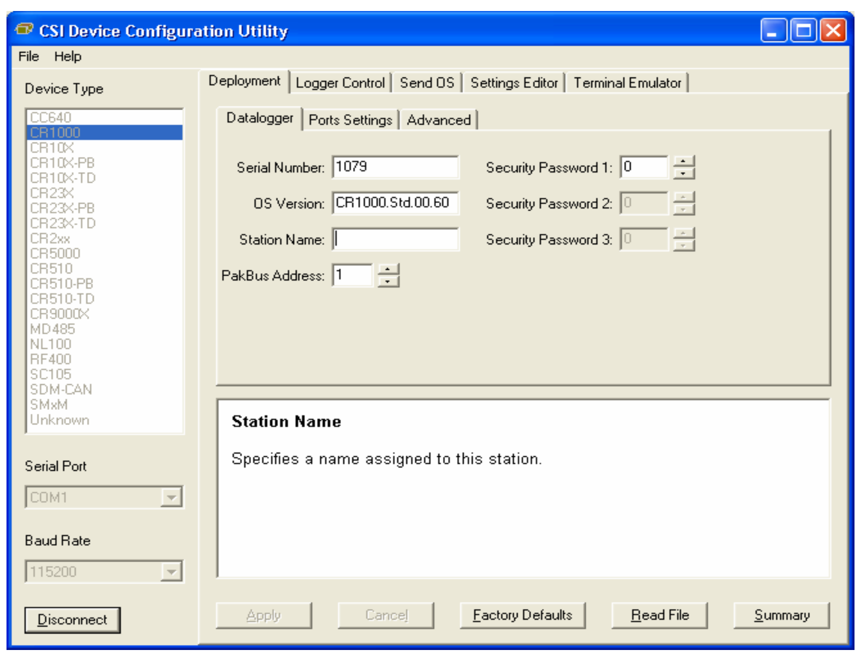
- Updates to DevConfig are available from Campbell Scientific's web site. These may be installed over top of older versions.

OV3.1 Main DevConfig Screen

The DevConfig window is divided into two main sections: the device selection panel on the left side and tabs on the right side. After choosing a device on the left, you will then have a list of the serial ports (COM1, COM2, etc.) installed on your PC. You'll be offered a choice of baud rates only if the device supports more than one baud rate in its configuration protocol. The page for each device presents instructions about how to set up the device to communicate with DevConfig. Different device types will offer one or more tabs on the right.



When the user presses the Connect button, the device type, serial port, and baud rate selector controls become disabled and, if DevConfig is able to connect to the CR1000, the button will change from "Connect" to "Disconnect". The Display will change to:



OV3.2 Deployment Tab

The Deployment Tab allows the user to configure the datalogger prior to deploying it.

OV3.2.1 Datalogger

Serial Number displays the CR1000 serial number. This setting is set at the factory and cannot be edited.

OS Version displays the operating system version that is in the CR1000.

Station Name displays the name that is set for this station.

PakBus Address allows you to set the PakBus address of the datalogger. The allowable range is between 1 and 4094. Each PakBus device should have a unique PakBus address. Addresses >3999 force other PakBus devices to respond regardless of their respective PakBus settings. See the PakBus Networking Guide for more information.

Security:

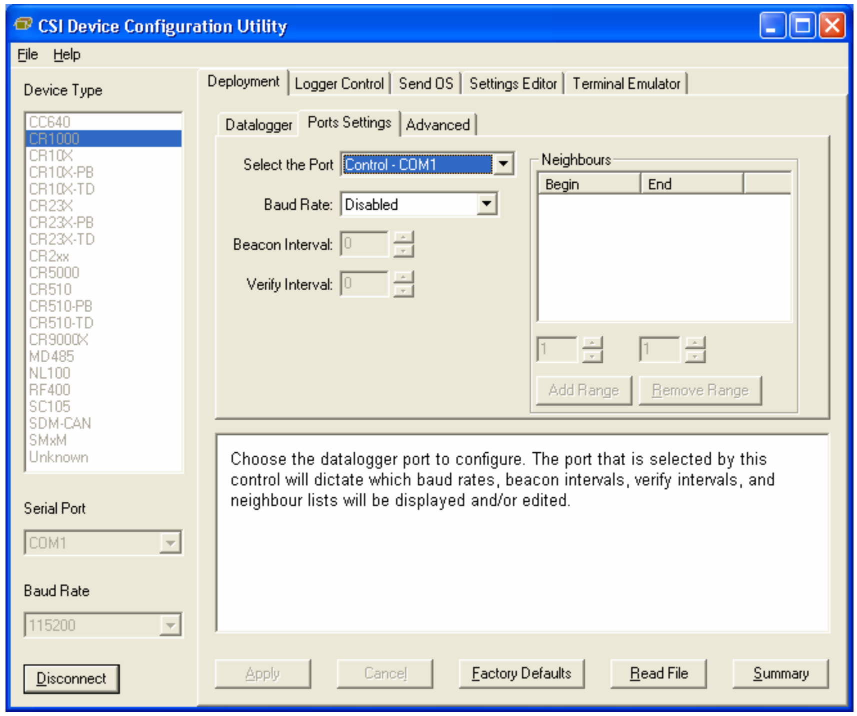
Up to three levels of security can be set in the datalogger. Level 1 must be set before Level 2 can be set, and Level 2 must be set before Level 3 can be set. If a level is set to 0, any level greater than it will also be set to 0 (e.g., if Level 2 is 0, Level 3 is 0). Valid security codes are 1 through 65535 (0 is no security). Each level must have a unique code. Functions affected by each level of security are:

Security Password 1 When this level is set, collecting data, setting the clock, and setting variables in the Public table are unrestricted, requiring no security code. If the user enters the Security1 code, the datalogger program can be changed or retrieved or variables can be set in the Status table.

Security Password 2 When this level is set, data collection is unrestricted, requiring no security code. If the user enters the Security2 code, the datalogger clock can be changed and variables in the public table can be changed. If the user enters the Security1 code, non-read-only values in the status table can be changed and the datalogger program can be changed or retrieved.

Security Password 3 When this level is set, all communication with the datalogger is prohibited if no security code is entered. If the user enters the Security3 code, data can be collected from the datalogger. If the user enters the Security2 code, data can be collected, public variables can be set, and the clock can be set. If the user enters the Security 1 code, all functions are unrestricted.

OV3.2.2 Ports Settings



Selected Port specifies the datalogger serial port to which the beacon interval and hello setting values will be applied.

Beacon Interval sets the interval (in seconds) on which the datalogger will broadcast beacon messages on the port specified by Selected Port.

Verify Interval specifies the interval (in seconds) at which the datalogger will expect to have received packets from neighbors on the port specified by Selected Port. A value of zero (default) indicates that the datalogger has no neighbor list for this port.

Neighbors List, or perhaps more appropriately thought of as the "expected neighbors list", displays the list of addresses that this datalogger expects to find as neighbors on the port specified by Selected Port. As you select items in this list, the values of the **Begin** and **End** range controls will change to reflect the selected range. You can add multiple lists of neighbors on the same port.

Begin and End Range are used to enter a range of addresses that can either be added to or removed from the neighbors list for the port specified by Selected Port. As you manipulate these controls, the Add range and Remove Range buttons will be enabled or disabled depending on the relative values in the controls and whether the range is present in or overlaps with the list of address ranges already set up. These controls will be disabled if the **Verify Interval** value is set to zero.

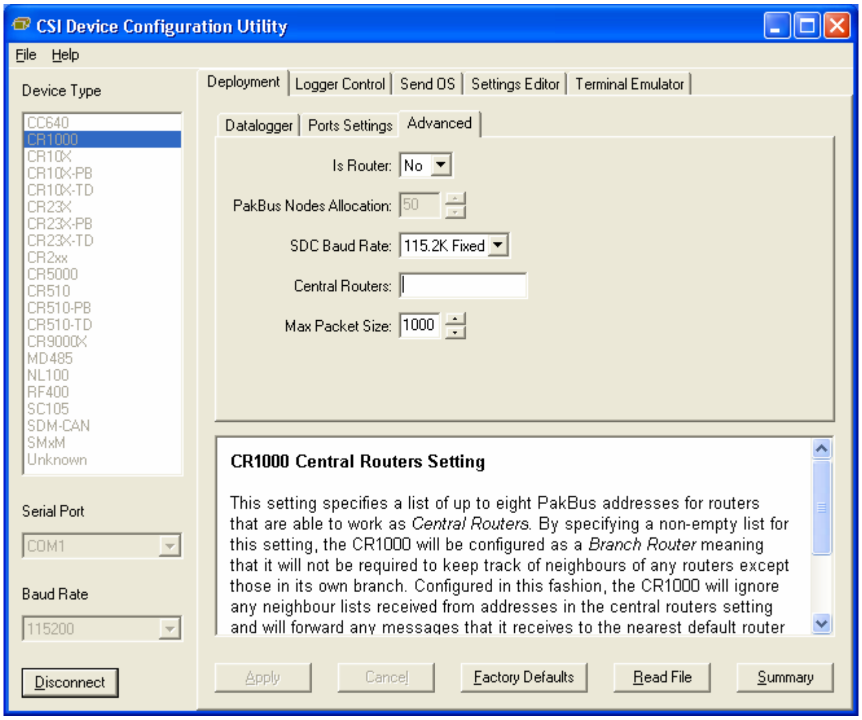
Add Range will cause the range specified in the **Begin** and **End** range to be added to the list of neighbors to the datalogger on the port specified by Selected Port. This control will be disabled if the value of the **Verify Interval** is zero or if the end range value is less than the begin range value.

Remove Range will remove the range specified by the values of the **Begin** and **End** controls from the list of neighbors to the datalogger on the port specified by Selected Port. This control will be disabled if the range specified is not present in the list or if the value of **Verify Interval** is set to zero.

Help is displayed at the bottom of the Deployment tab. When you're finished, you must **Apply** to send the settings to the datalogger. The Summary window will appear and you can **Save** or **Print** the settings for your records or to use them as a template for another datalogger.

Cancel causes the datalogger to ignore the changes. **Read File** gives you the opportunity to load settings saved previously from this or another similar datalogger. If you load settings from a file, the changes will not actually be written to the datalogger until you click **Apply**.

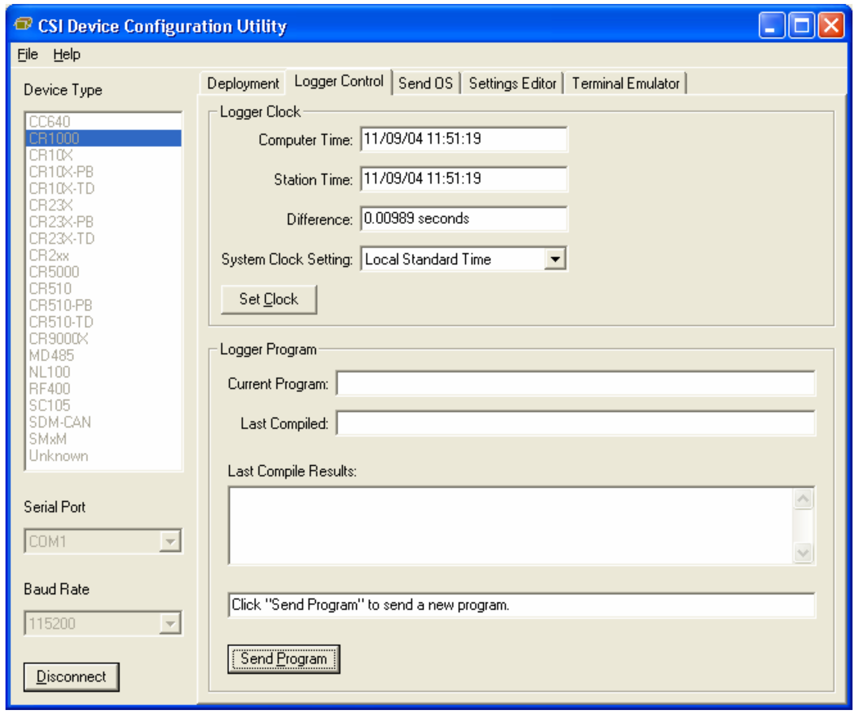
OV3.2.3 Advanced



Is Router allows you to control whether the datalogger will act as a PakBus router.

PakBus Nodes Allocation Specifies the amount of memory that the CR1000 Allocates for maintaining PakBus Routing information. This value represents roughly the maximum number of PakBus Nodes that the CR1000 will be able to track in its routing tables.

OV3.3 Logger Control Tab



The clock in the PC and the datalogger will be checked every second and the difference displayed. The **System Clock Setting** allows you to configure what offset, if any, should be used with respect to standard time (Local Daylight Time or UTC, Greenwich mean time). The value selected for this control will be remembered between sessions. Clicking the **Set Clock Button** will synchronize the station clock to the current computer system time.

Current Program displays the current program known to be running in the datalogger. This value will be empty if there is no current program.

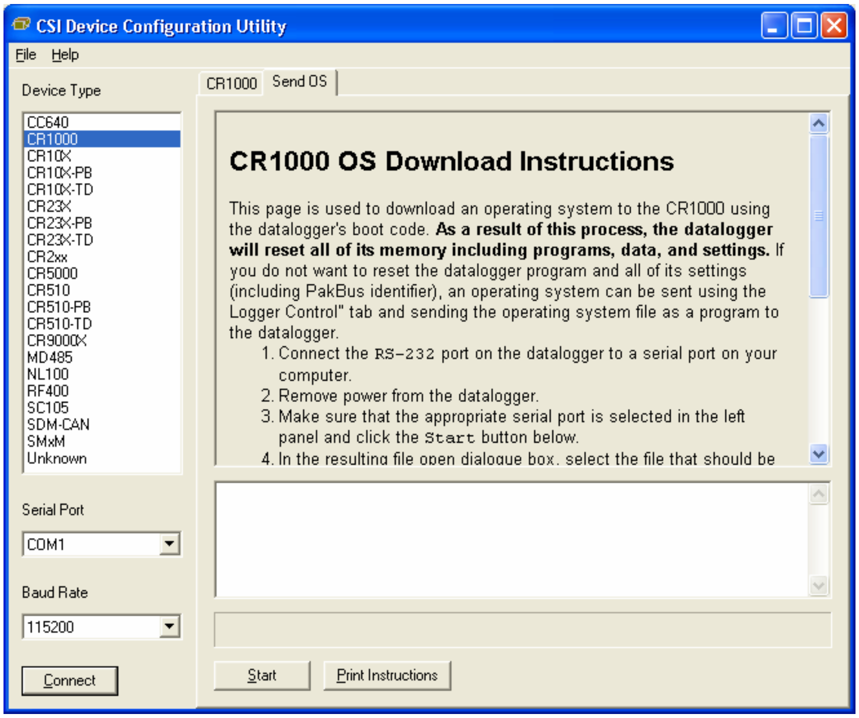
The **Last Compiled** field displays the time when the currently running program was last compiled by the datalogger. As with the Current Program field, this value will be read from the datalogger if it is available.

Last Compile Results shows the compile results string as reported by the datalogger.

The **Send Program** button presents an open file dialogue from which you can select a program file to be sent to the datalogger. The field above the button will be updated as the send operation progresses. When the program has been sent the Current Program, Last Compiled, and Last Compile Results fields will be filled in.

OV3.4 Send OS Tab - Downloading an Operating System

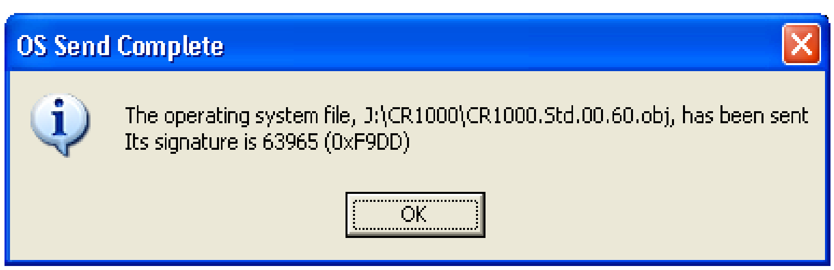
DevConfig can send operating systems to all Campbell Scientific devices with flash replaceable operating systems. An example for the CR1000 is shown below:



The text at right gives the instructions for downloading the OS. Follow these instructions.

When you click the **Start** button, DevConfig offers a file open dialog box to prompt you for the operating system file (*.obj file). When the CR1000 is then powered-up, DevConfig starts to send the operating system:

When the operating system has been sent, a message dialog will appear similar to the one shown below:

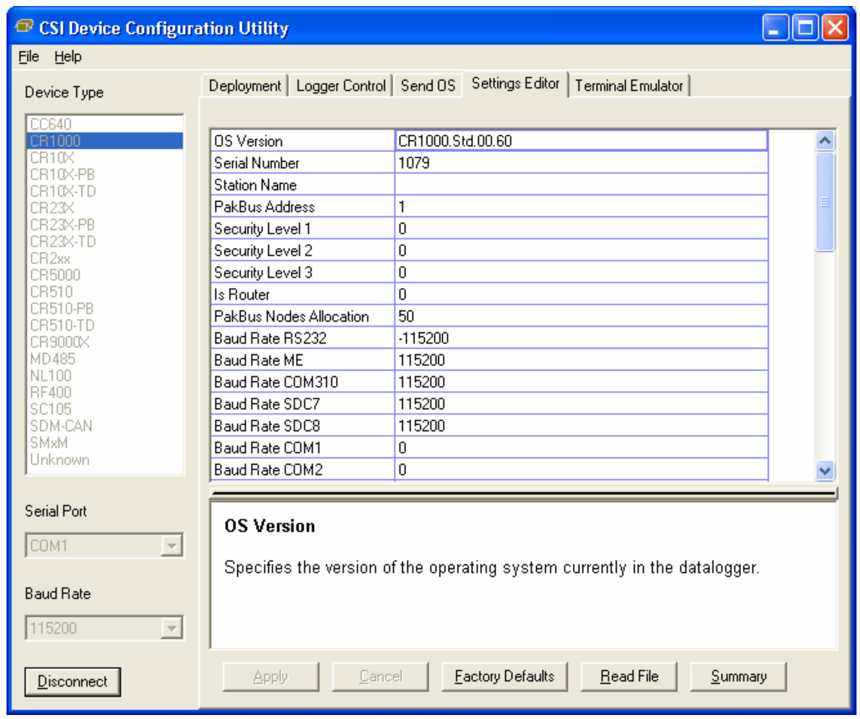


The information in the dialog helps to corroborate the signature of the operating system sent. For devices such as the CR10X (especially those with extended memory) that can take a long time to reset following an OS download, text warns you against interrupting the memory test.

OV3.5 Settings Editor Tab

The CR1000 has a number of properties, referred to as "settings", some of which are specific to the PakBus protocol. PakBus is discussed in more detail in the PakBus Networking Guide available from the Campbell Scientific website (www.campbellsci.com).

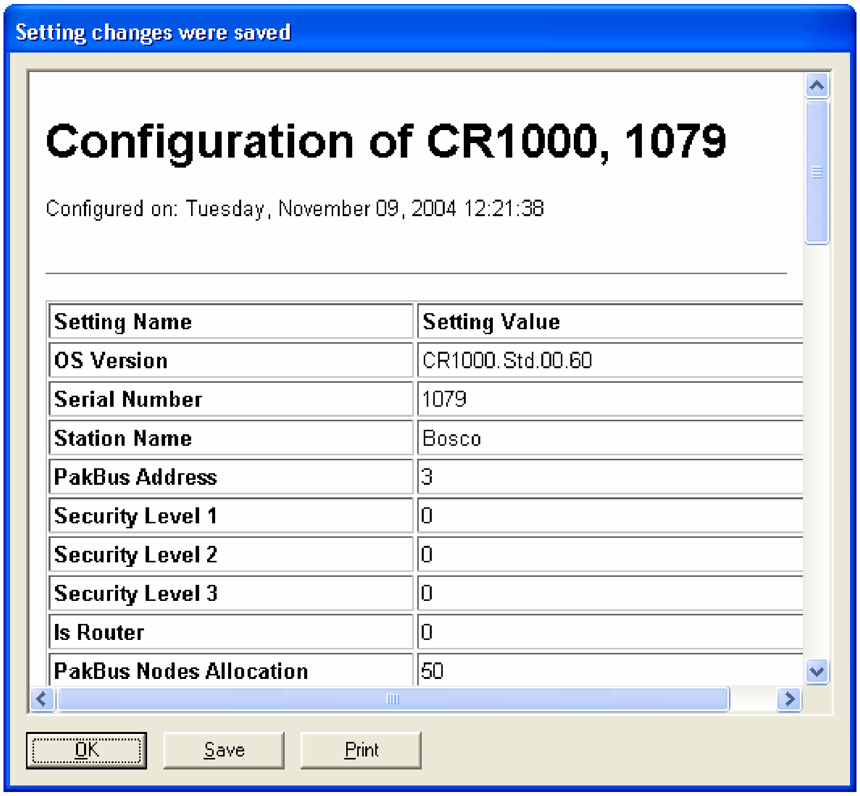
The **Settings Editor** tab provides access to most of the PakBus settings, however, the **Deployment** tab makes configuring some of these settings a bit easier.



The top of the Settings Editor is a grid that allows the user to view and edit the settings for the device. The grid is divided into two columns with the setting name appearing in the left hand column and the setting value appearing in the right hand column. You can change the currently selected cell with the mouse or by using the up arrow and down arrow keys as well as the Page Up and Page Down keys. If you click in the setting names column, the value cell associated with that name will automatically be made active. You can edit a setting by selecting the value, pressing the F2 key or by double clicking on a value cell with the mouse. The grid will not allow read-only settings to be edited.

The bottom of the Settings Editor displays help for the setting that has focus on the top of the screen.

Once you have changed a setting, you can **Apply** them to the device or **Cancel**. These buttons will only become enabled after a setting has been changed. If the device accepts the settings, a configuration summary dialogue will be shown that will give the user a chance to save and/or print the settings for the device:

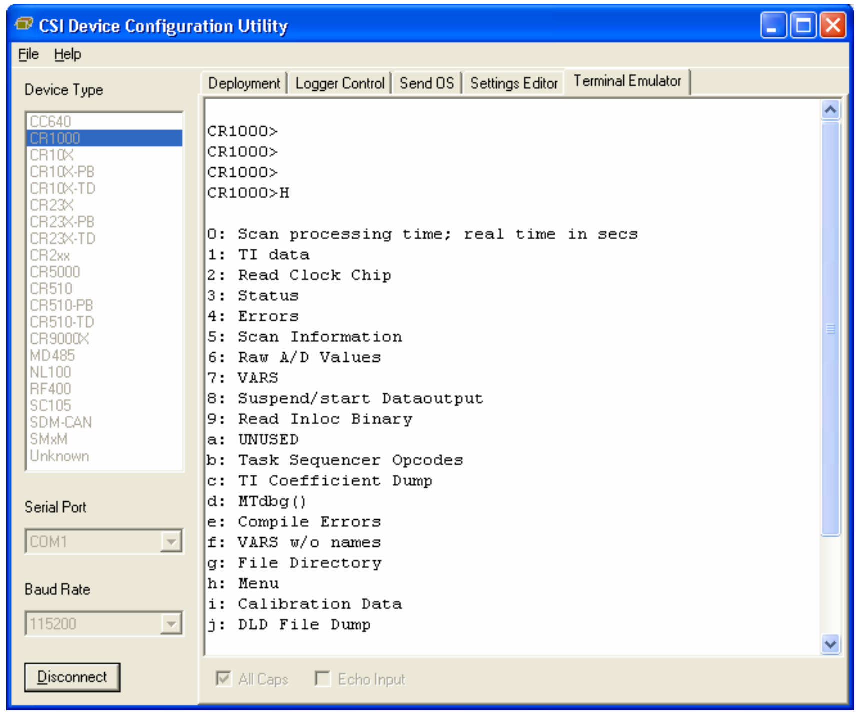


Clicking the **Revert to Defaults** button on the Settings Editor will send a command to the device to revert to its factory default settings. The reverted values will not take effect until the final changes have been applied. This button will remain disabled if the device does not support the DevConfig protocol messages.

If, after changing a setting or clicking the **Summary** button, you clicked **Save** on the summary screen to save the configuration, you can use the **Read File** button to load those settings. The settings from the saved file are immediately sent to the device and, if they're accepted, you can then **Apply** them.

OV3.6 Terminal Tab

The Terminal tab offers a terminal emulator that can be used to access the CR1000 Terminal Mode. Press "Enter" several times until the CR1000 terminal mode prompt: "CR1000>" is returned. Terminal mode commands consist of a single character and "Enter". For example, sending an "H" and "Enter" will return a list of the terminal commands.



OV4. Quick Start Tutorial

OV4.1 Software Products for the CR1000

PC200W Starter Software supports a direct connection between the PC and the CR1000, and includes Short Cut for Windows (Short Cut) for creating CR1000 programs. PC200W provides basic tools for setting the datalogger's clock, sending a program, monitoring sensors, and manually collecting and viewing data. CR1000 support was added to PC200W in Version 3.0. PC200W is available at no charge from the Campbell Scientific website.

PC400 Datalogger Support Software (mid-level software) supports a variety of telecommunication options, manual data collection, and data display. PC400 includes Short Cut and the CRBasic Program Editor for creating CR1000 programs. PC400 does not support combined communication options (e.g., phone-to-RF), PakBus® routing, or scheduled data collection.

LoggerNet Datalogger Support Software (full-featured software) supports combined telecommunication options, data display, and scheduled data collection. The software includes Short Cut and CRBasic for creating CR1000 programs, and tools for configuring, trouble-shooting, and managing datalogger networks.

OV4.1.1 Options for Creating CR1000 Programs

1. Short Cut is a program generator that creates a datalogger program in four easy steps, and a wiring diagram for the sensors. Short Cut supports the majority of sensors sold by Campbell Scientific, and is recommended for creating straightforward programs that measure the sensors and store data.

2. The CRBasic Editor is a program editor used to create more complex CR1000 programs. Short Cut generated programs can be imported into the CRBasic Editor for adding instructions, or for functionality not supported by Short Cut.

For those users of CR10X dataloggers who are switching to CR1000 dataloggers, the Transformer Utility can be used to convert a CR10X program to a CR1000 program, which can be imported into the CRBasic Editor. Because of differences in program code, not all CR10X programs can be fully converted by the Transformer. The Transformer Utility is included with PC400 and LoggerNet software.

OV4.2 Connections to the CR1000

Campbell Scientific Power Supplies are described in Section 1.3. When connecting power to the CR1000, first remove the green power connector from the CR1000 front panel. Insert the positive 12V lead into the terminal labeled "12V", and the ground lead into the terminal labeled "G". Double-check the polarity before plugging the green connector into the panel.

Connect the white serial cable (PN 10873, provided) between the port labeled "RS-232" on the CR1000 and the serial port on the computer. For computers that have only a USB port, a USB Serial Adaptor (PN 17394 or equivalent) is required.

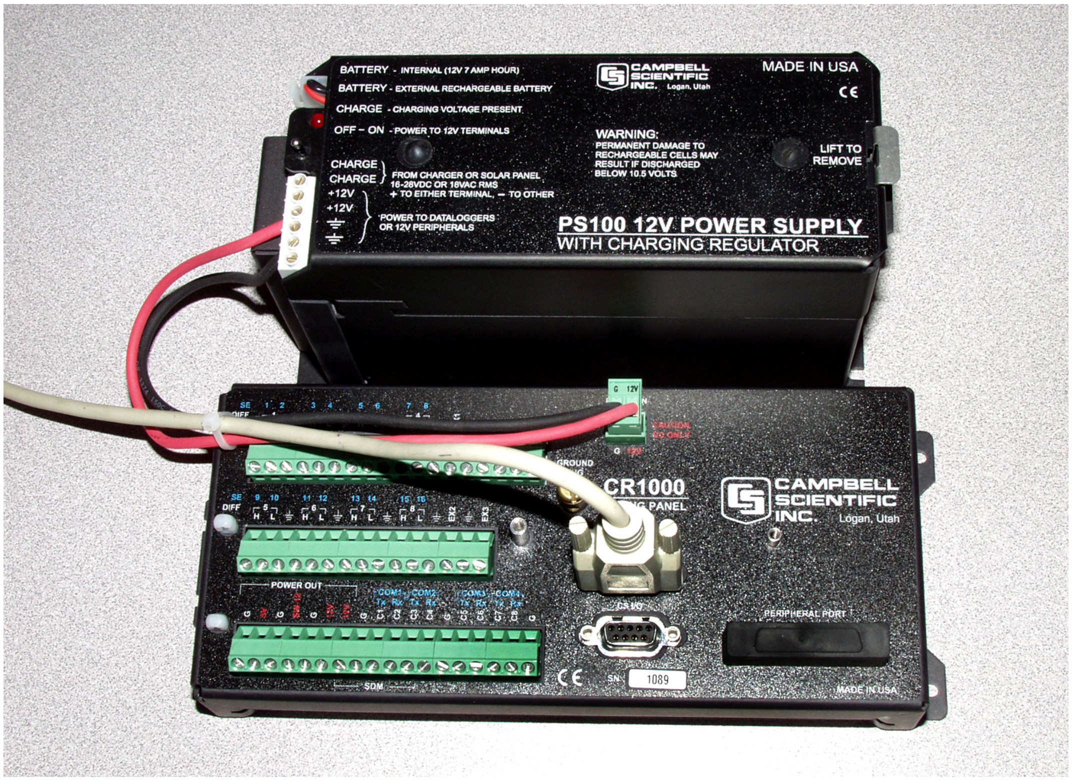


FIGURE OV4-1. Power and RS-232 Connections

OV4.3 Setting the CR1000 PakBus Address

The CR1000 default PakBus address is 1 (Section OV2.5). Unless the CR1000 is used in a network, there is no need to change the Pakbus address, or any of the other default settings. To change settings, the Device Configuration Utility (DevConfig) is used, as described in Section 0V3.

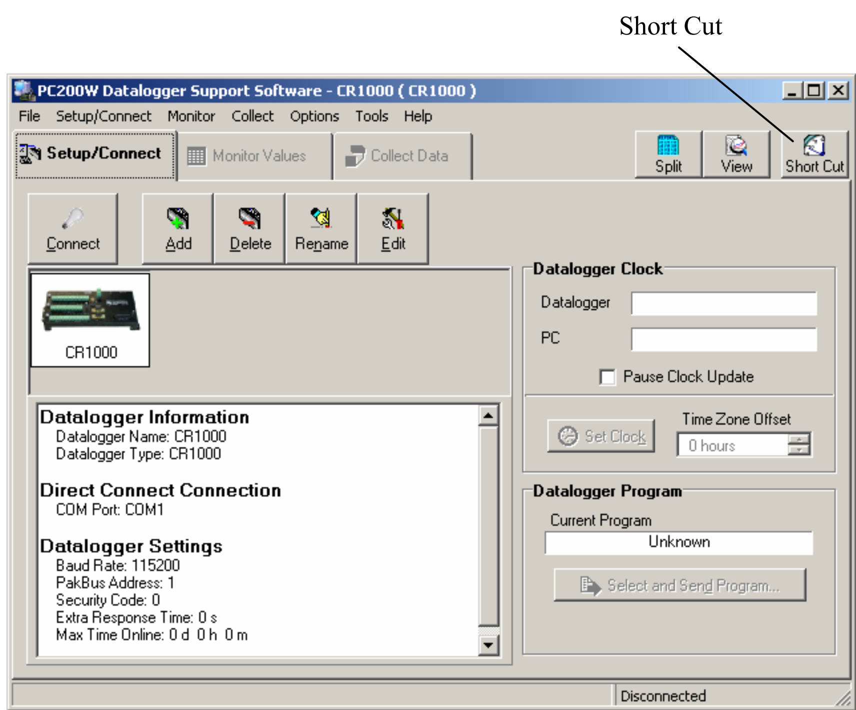
OV4.4 PC200W Software

This Quick-Start tutorial prompts the user through the process of programming the CR1000, monitoring sensor measurements, collecting data, and viewing data using the PC200W software.

When PC200W is first started, the EZSetup Wizard is launched. Click the **Next** button and follow the prompts to select the **CR1000**, the **COM** port on the computer that will be used for communications, **115200** baud, and **Pakbus Address 1**. When prompted with the option to **Test Communications** click the **Finish** button.

To change a setting in the datalogger setup, select that datalogger from the main window, and click the **Edit** button. If a datalogger was not added with the Wizard, click the **Add** button to invoke the Wizard.

After exiting the EZSetup wizard, the **Setup/Connect** window appears, as shown below. The Current Datalogger Profile, Datalogger Clock, and Datalogger Program features of PC200W are integrated into this window. Tabs to the right are used to select the **Monitor Values** and **Collect Data** windows. Buttons to the right of the tabs are used to run the **Split**, **View**, and **Short Cut** applications.

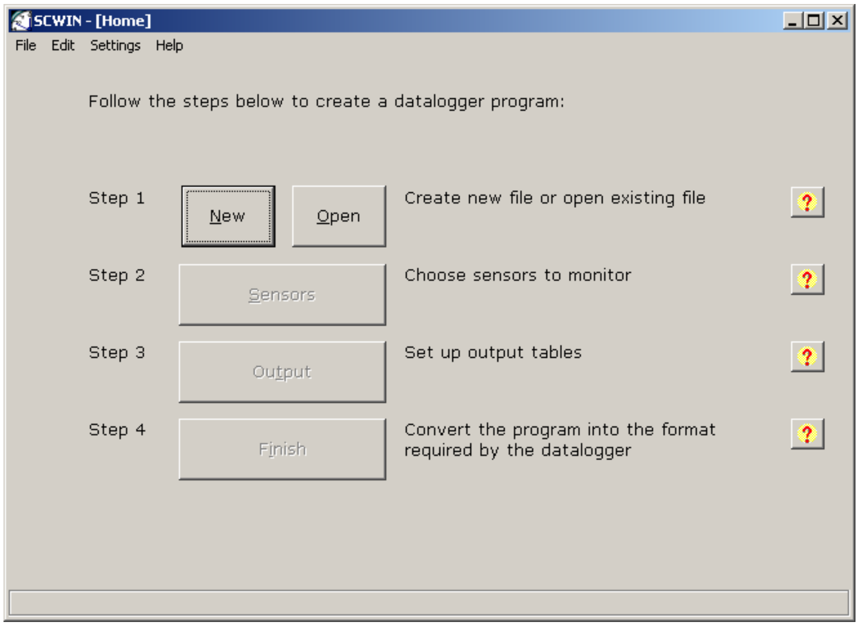


OV4.4.1 Creating a CR1000 Program using Short Cut

Objective: Every one second, measure air temperature in degrees C with a Type T thermocouple, and store one-minute average Battery Voltage, Panel Temperature, and Thermocouple temperature.

NOTE A Type T Thermocouple is included with CR1000, packaged with the screwdriver. The thermocouple consists of a pair of 5-inch wires with blue/red insulation, soldered together at one end.

Click on the **Short Cut** button to display the **Home** screen, as shown below.



Each of the four steps has a button with a **?** for accessing Help. Use the Help in conjunction with the steps outlined below:

Step 1: Create a New File

Step 1 is to open a new or existing file. From the **Home** page, click the **New** button. Use the drop-down list box to select the **CR1000**. Enter a 1 second Scan Interval and click **OK** to complete Step 1.

Step 2: Select the Sensors

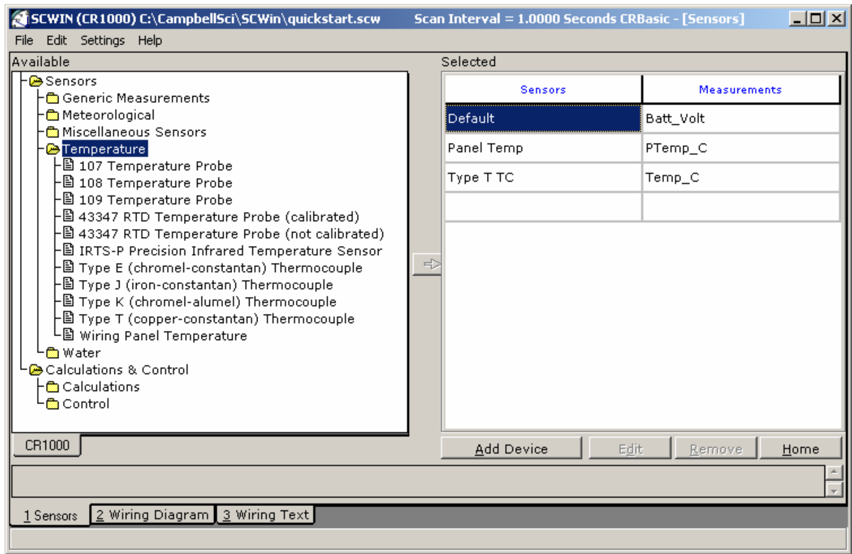
A Type T thermocouple consists of two wires of dissimilar metals (copper and constantan) soldered together at one end. The soldered end is the measurement junction; the junction that is created when the thermocouple is wired to the CR1000 is the reference junction.

When the two junctions are at different temperatures, a voltage proportional to the temperature difference is induced into the wires. The thermocouple measurement requires the reference junction temperature to calculate the measurement junction temperature.

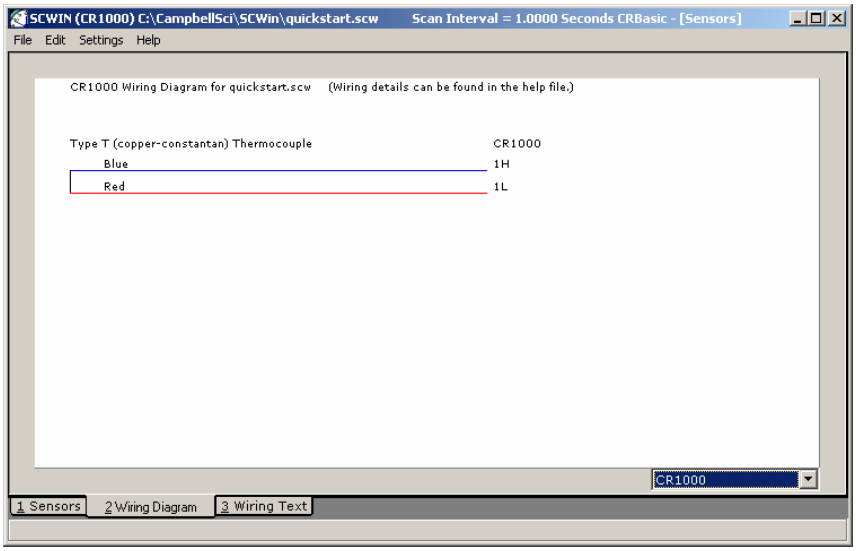
Step 2 is to select the sensors to be measured. From the Home page, click the **Sensors** button. The Sensors worksheet is divided into two sections: the Available sensors tree and the Selected sensors table, as shown below. The sensors you want to measure are chosen from the Available sensors tree.

Double click on the **Temperature** application group to display the available sensors. Double click on the **Wiring Panel Temperature** sensor to add it the selected sensors table. Click **OK** on the next screen to accept the PTemp_C label.

Double click on the **Type T thermocouple**, change the number to 1 and click **OK**. On the next screen, make sure Ptemp_C is selected for the Reference Temperature Measurement, and click **OK** to accept the Temp_C label.



Click on the **Wiring Diagram** tab to view the sensor wiring diagram, as shown below. Wire the Type T Thermocouple (provided) to the CR1000 as shown on the diagram. Click the **Sensors** tab and the **Home** button to return to the Home page to continue with Step 3.



Step 3: Output Processing

Step 3 is to define the output processing for the sensor measurements. From the Home page, click the **Output** button.

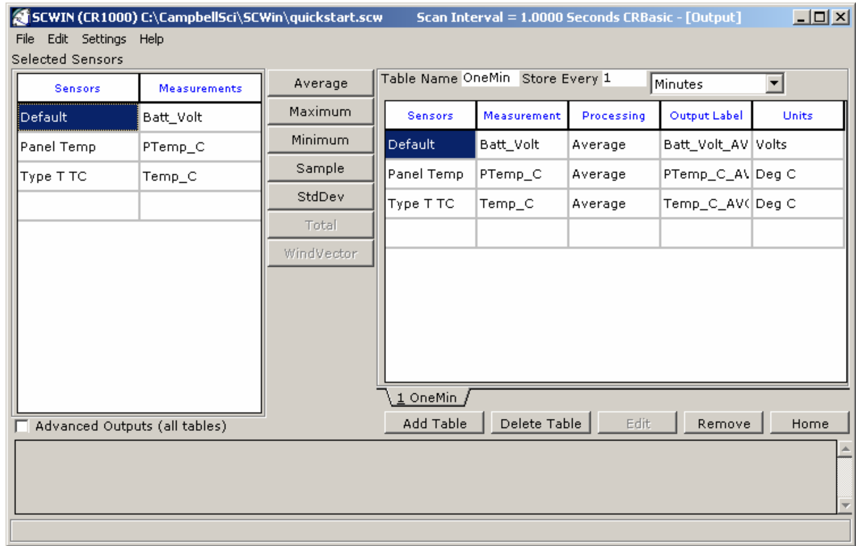
The Output screen has a list of Selected Sensors on the left, and Output Tables on the right. The default is for two Tables, Table1 and Table2. Both Tables have a **Store Every** field and the drop-down list box that are used to set the interval at which data will be stored.

The objective for this exercise calls for a one-minute output processing. To remove Table2, Click on the **Table2** tab to activate it, and click the **Delete Table** button.

The **Table Name** field is the name that will be used for the Table in which the output will be stored. Change the default Name of Table1 to OneMin, and change the interval to 1 minute.

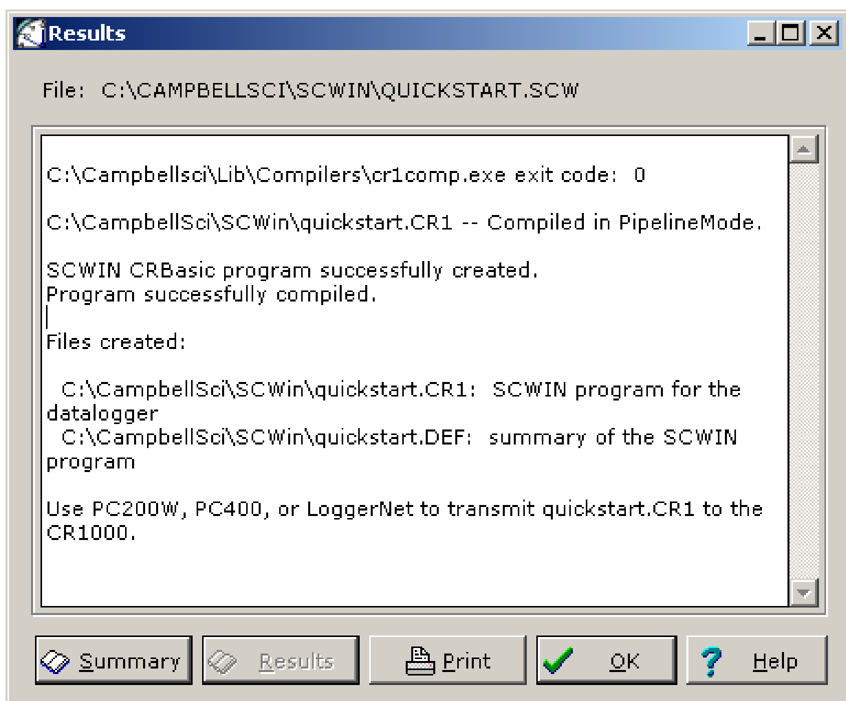
The Selected Sensors list is provided on the left side of the screen. To add a sensor measurement to the Output Table, highlight a measurement and click one of the output buttons; e.g., Average. Select the Default, Panel Temp, and Type T TC sensors and click the **Average** button to add them to the OneMin Table.

Click the **Home** button to continue with Step 4 to complete the program.



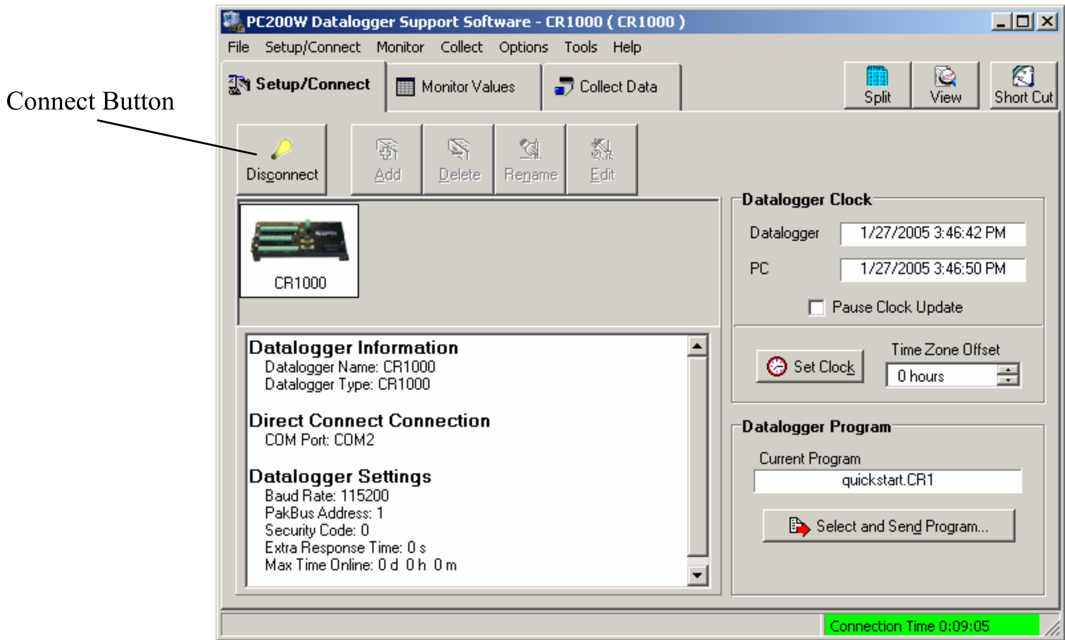
Step 4: Finish

Step 4 is to finish the program. From the Home page, click the **Finish** button. Type in QuickStart for the file name. Any errors the compiler may have detected are displayed, along with the names of the files that were created. The file QuickStart.CR1 is the program file that will be sent to the CR1000, QuickStart.def is a summary of the sensor wiring and measurement labels (click the **Summary** or **Print** buttons to view or print the file). Click the **OK** button and close Short Cut.



OV4.4.2 Configuring the Setup Tab

From the **Setup/Connect** screen, click on the **Connect** button to establish communications with the CR1000. When communications have been established, the text on the button will change to **Disconnect**.



OV4.4.3 Synchronize the Clocks

Click the **Set Clock** button to synchronize the datalogger's clock with the computer's clock.

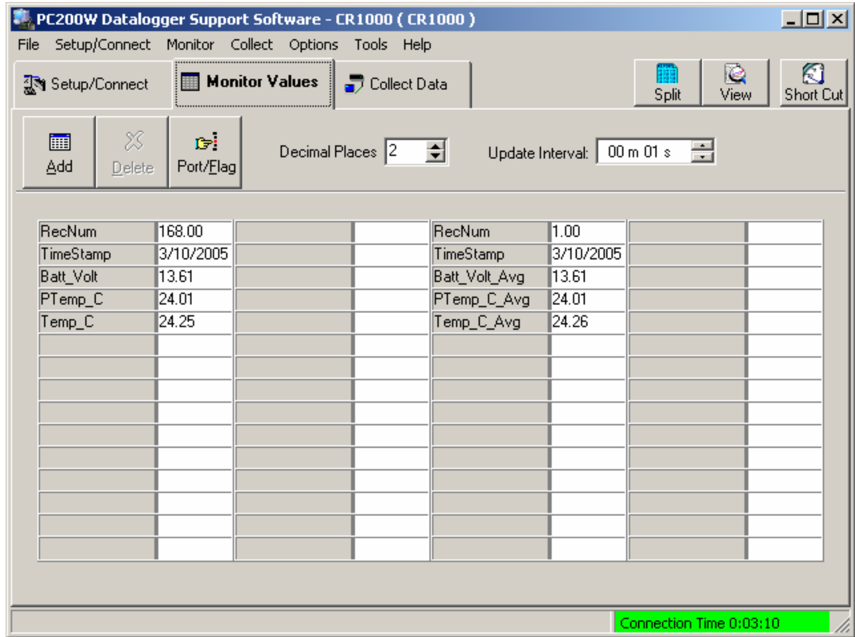
OV4.4.4 Send the Program

Click the **Select and Send Program** button. Navigate to the C:\CampbellSci\SCWin folder and select the file QuickStart.CR1 and click the **Open** button. A progress bar is displayed, followed by a message that the program was successfully sent.

OV4.4.5 Monitor Data Tables

The Monitor Values window is used to display the current sensor measurement values from the Public Table, and the most recent data from the OneMin Table.

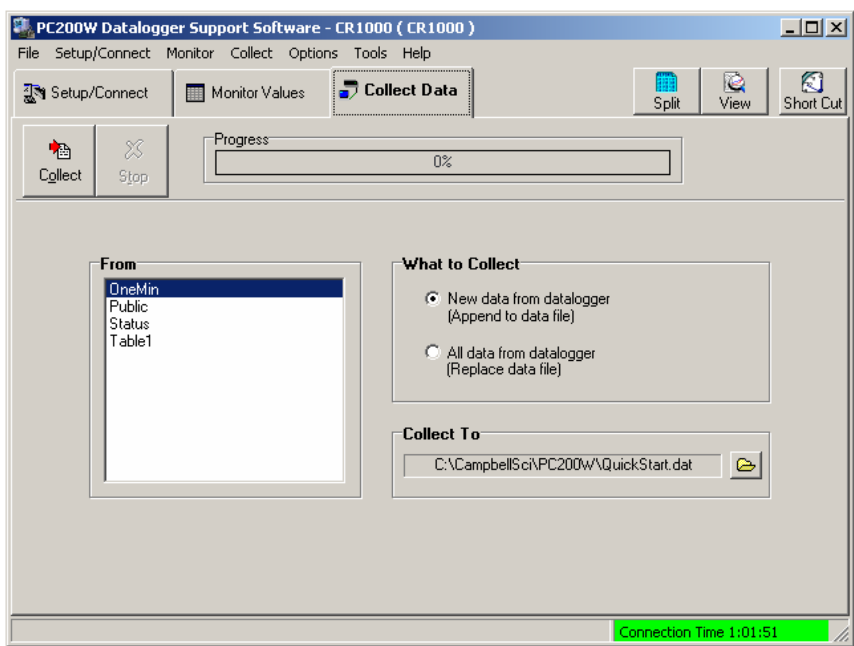
Click on the **Monitor Values** tab. The Public Table is automatically selected and displayed. To view the OneMin Table, click the **Add** button, select the **OneMin** Table, and click the **Paste** button.



OV4.4.6 Collect Data

Click on the **Collect Data** tab. From the Collect Data window you can choose what data to collect, and where to store the retrieved data.

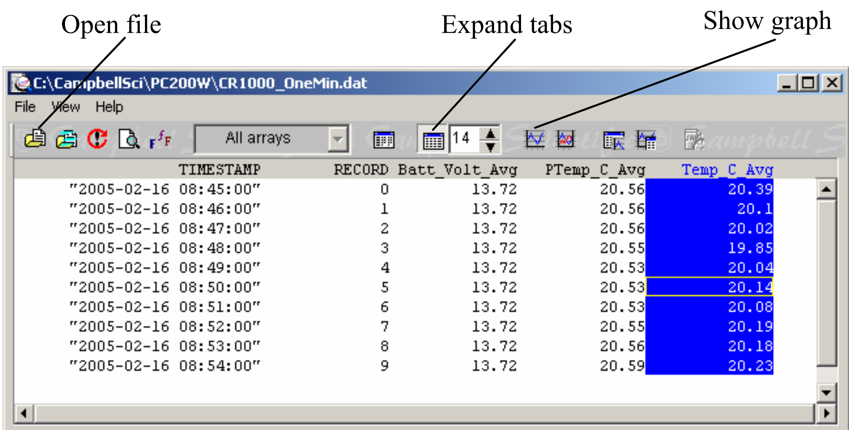
Click on the **OneMin** Table, with the Option **New data from datalogger** selected. Click the **Collect** button and a dialog box appears, prompting for a file name. Click the **Save** button to use the default file name CR1000_OneMin.dat. A progress bar, followed by the message **Collection Complete** is displayed.

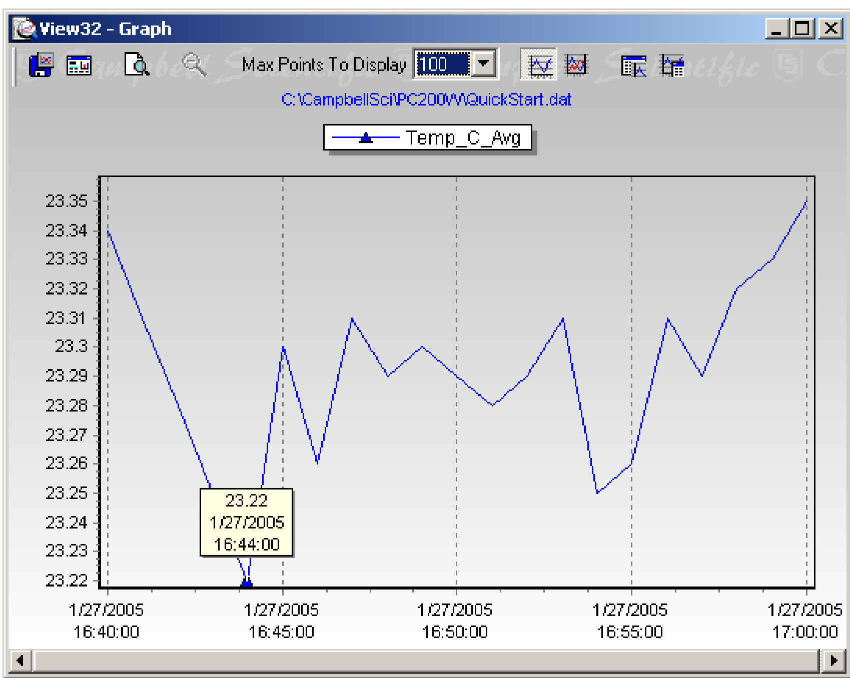


OV4.4.7 View Data

To view the collected data, click on the **View** button (located in the upper right hand corner of the main screen). Options are accessed by using the menus or by selecting the toolbar icons. If you move and hold the mouse over a toolbar icon for a few seconds, a brief description of that icon's function will appear.

To open a data file, click the **Open file** icon, and double click on the file CR1000_OneMin.dat in the PC200W folder. Click the **Expand Tabs** icon to display the data in columns with column headings. To graph thermocouple temperature, click on the data column with the heading Temp_C, then click the **Show Graph, 1 Y axis** icon on the toolbar.





Close the graph and view screens, and close PC200W.

OV4.5 Programming using the CRBasic Program Editor

Those users who are moving from the Edlog Program Editor to the CRBasic Program Editor may find Short Cut to be an excellent way to learn CRBasic. First create a program using Short Cut, then open the file with CRBasic to see how Short Cut created the program. The program file listed below is the Short Cut file QuickStart.CR1 from the tutorial after being imported into the CRBasic editor.

See Section 4 for information on the CRBasic programming.

```
'CR1000

'Declare Variables and Units

Public Batt_Volt
Public PTemp_C
Public Temp_C

Units Batt_Volt=Volts
Units PTemp_C=Deg C
Units Temp_C=Deg C

'Define Data Tables
DataTable(OneMin,True,-1)
    DataInterval(0,1,Min,0)
    Average(1,Batt_Volt,FP2,False)
    Average(1,PTemp_C,FP2,False)
    Average(1,Temp_C,FP2,False)
EndTable

DataTable(Table1,True,-1)
    DataInterval(0,1440,Min,0)
    Minimum(1,Batt_Volt,FP2,False,False)
EndTable

'Main Program
BeginProg
    Scan(5,Sec,1,0)
        'Default Datalogger Battery Voltage measurement Batt_Volt:
        Battery(Batt_Volt)
        'Wiring Panel Temperature measurement PTemp_C:
        PanelTemp(PTemp_C,_60Hz)
        'Type T (copper-constantan) Thermocouple measurements Temp_C:
        TCDiff(Temp_C,1,mV2_5C,1,TypeT,PTemp_C,True,0,_60Hz,1,0)
        'Call Data Tables and Store Data
        CallTable(OneMin)
        CallTable(Table1)
    NextScan
EndProg
```

OV5. Keyboard Display

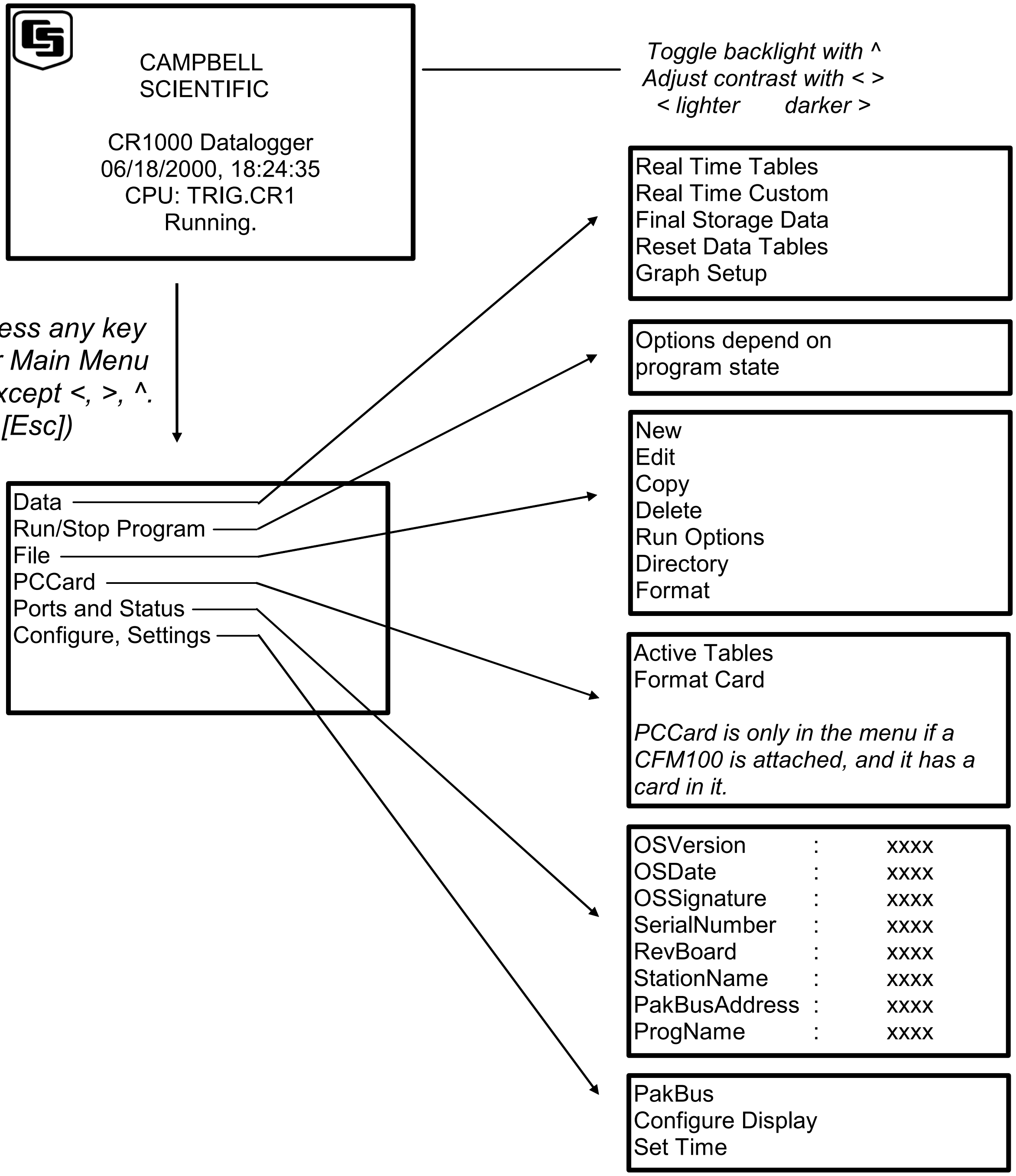
The CR1000 has an optional keyboard display. This section illustrates the use of the CR1000KD.

The CR1000KD has a few keys that have special functions which are listed below.

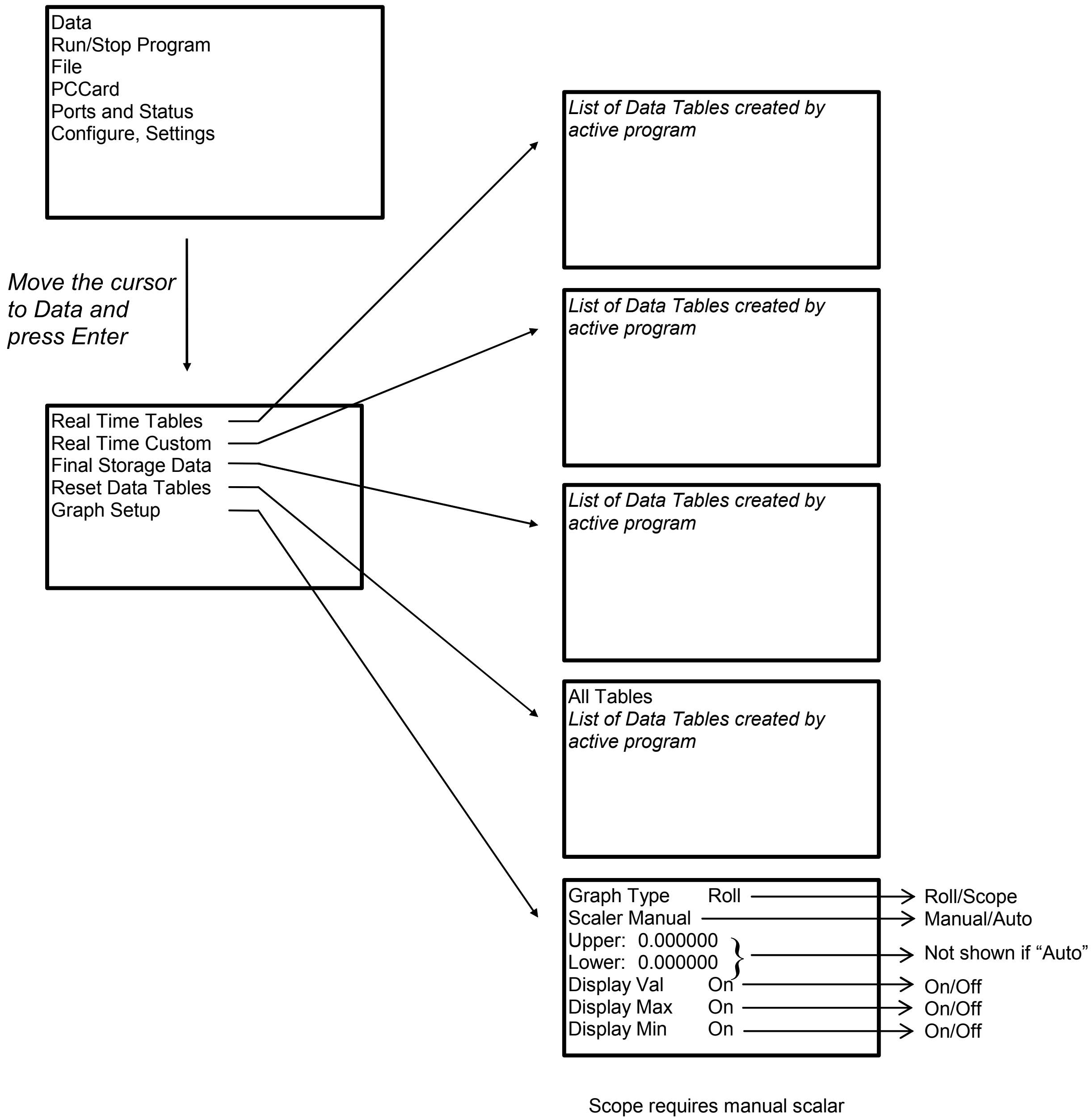
Key	Usage
[2] and [8]	To navigate up and down through the menu list one line at a time
[Enter]	Selects the line or toggles the option of the line the cursor is on
[Esc]	Backs up one level in the menu
[Home]	Moves cursor to top of the list
[End]	Moves cursor to bottom of the list
[Pg Up]	Moves cursor up one screen
[Pg Dn]	Moves cursor down one screen
[BkSpc]	Delete character to the left
[Shift]	Change alpha character selected
[Num Lock]	Change to numeric entry
[Del]	Delete
[Ins]	Insert/change graph setup
[Graph]	Graph

Power Up Screen

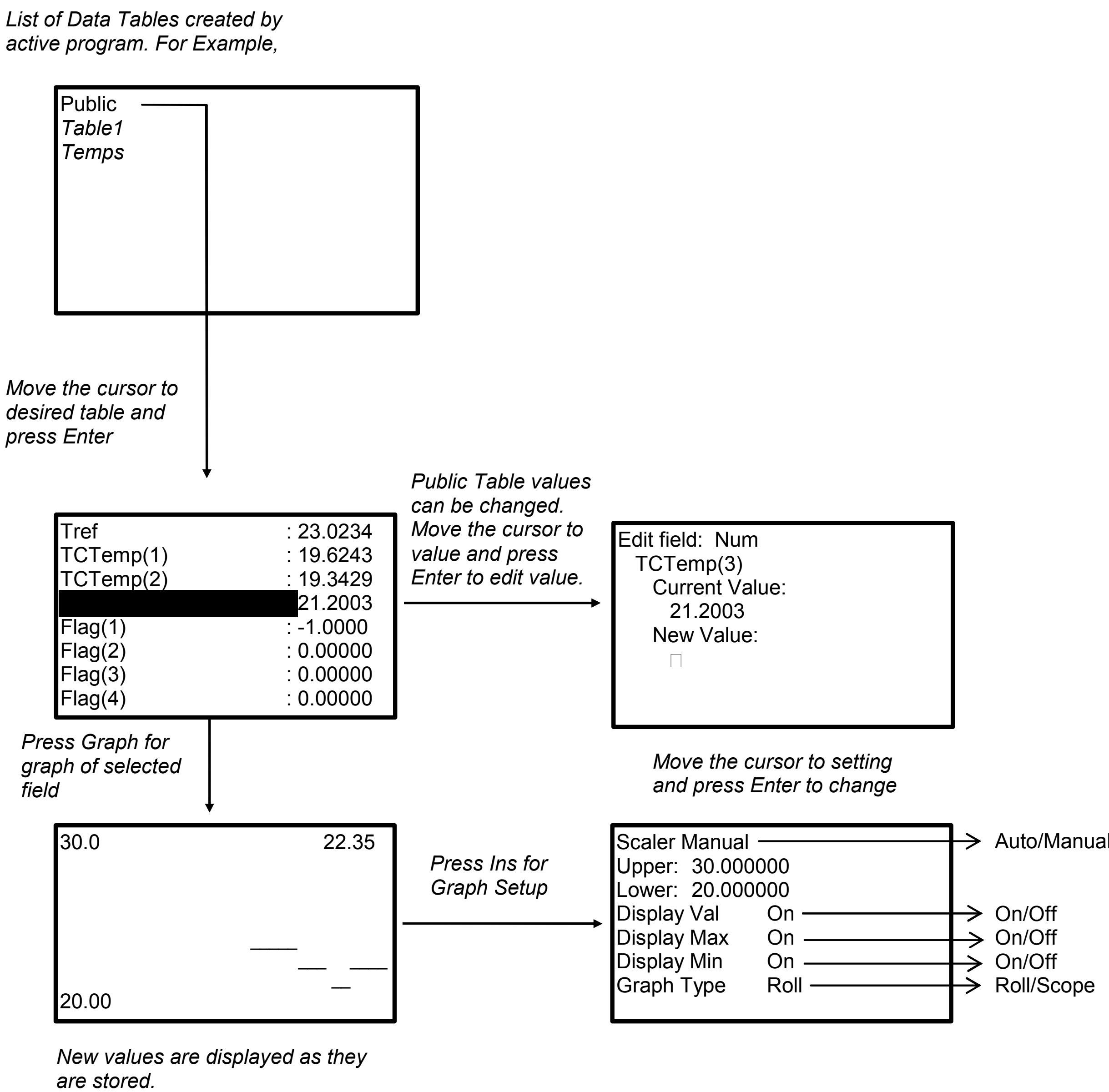
CR1000 Display



OV5.1 Data Display

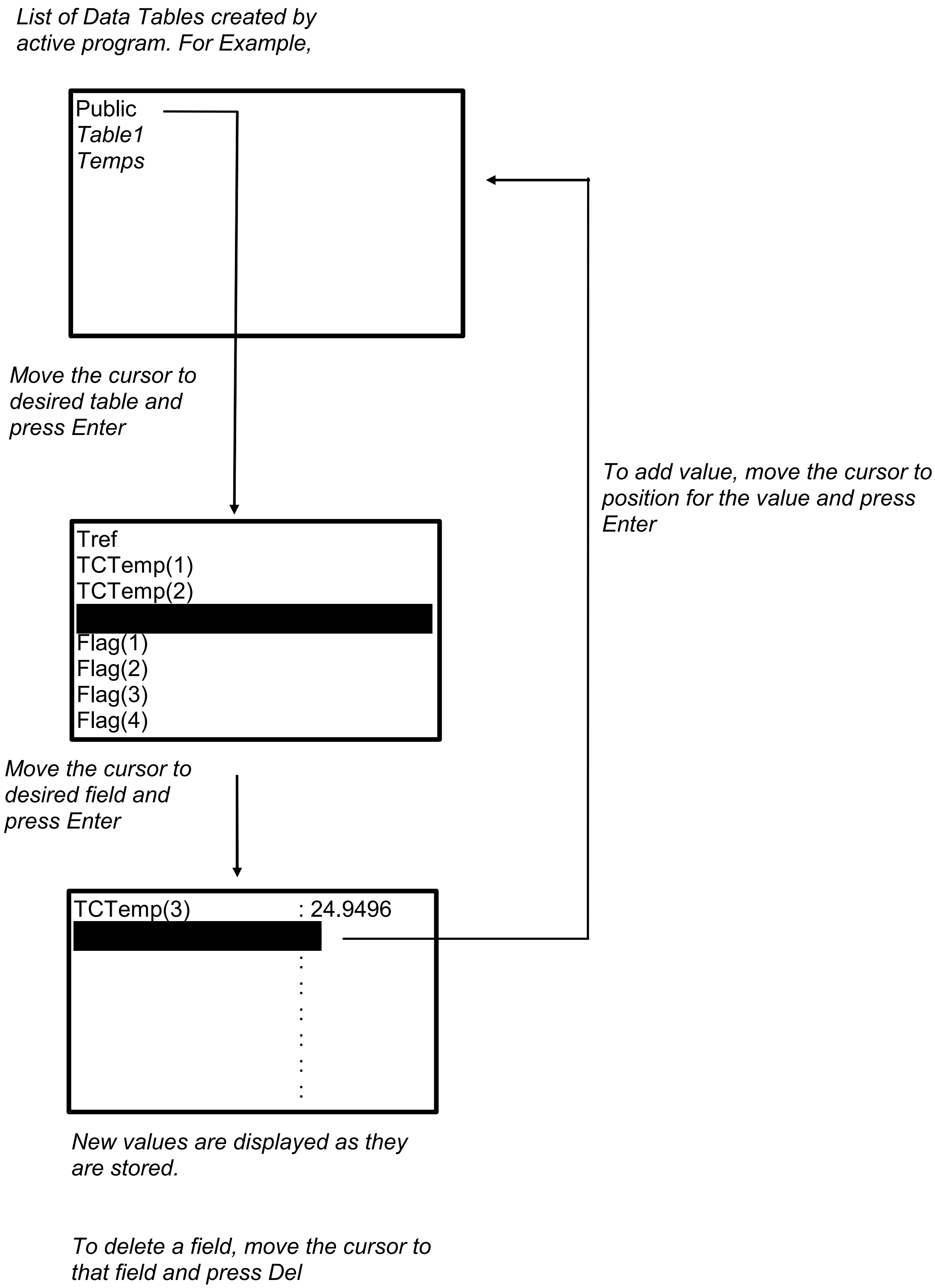


OV5.1.1 Real Time Tables



OV5.1.2 Real Time Custom

The first time you navigate to Real Time Custom you will need to set up the display. The CR1000 will keep the setup as long as the same program is running.



OV5.1.3 Final Storage Tables

List of Data Tables created by active program. For Example:

Table1
Temps

Move the cursor to desired Table and press Enter

Use Home (oldest), End (newest), PgUp (older), PgDn (newer), ←, →, ↑, and ↓ to move around in data table.

TimeStamp	Record	Tref	TC(1)	TC(2)	TC(3)
"2000-01-03 00:12:38"	0			21.934	22.8419
"2000-01-03 00:12:39"	1			21.9173	22.8364
"2000-01-03 00:12:40"	2			21.9229	22.8364
"2000-01-03 00:12:41"	3			21.9173	22.8419
"2000-01-03 00:12:42"	4			21.9173	22.8253
"2000-01-03 00:12:43"	5			21.9118	22.8364
"2000-01-03 00:12:44"	6			21.9173	22.8087
"2000-01-03 00:12:45"	7			21.9173	22.8142
"2000-01-03 00:12:46"	8			21.9395	22.8253
"2000-01-03 00:12:47"	9	24.1242	21.8176	21.9118	22.8308
"2000-01-03 00:12:48"	10	24.1242	21.8342	21.945	22.8364
"2000-01-03 00:12:49"	11	24.1242	21.8453	21.9506	22.8364

5 :2000-01-03 00:12:43
Tref TC(1)

Tref		TC(1)
24.1242	:	21.8786
24.1242	:	21.8786
24.1242		[redacted]
24.1242	:	21.8675
24.1242	:	21.8675
24.1242	:	21.8398

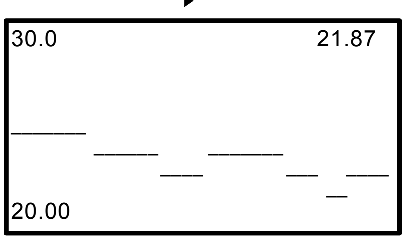
Press Ins for Jump To screen.

Go to Record:
^ [redacted]
v press Ins to edit

Table Size:
1000
Current Record:
759

Use arrow up or down to scroll to the record number wanted, or press Ins and manually type in the record number.

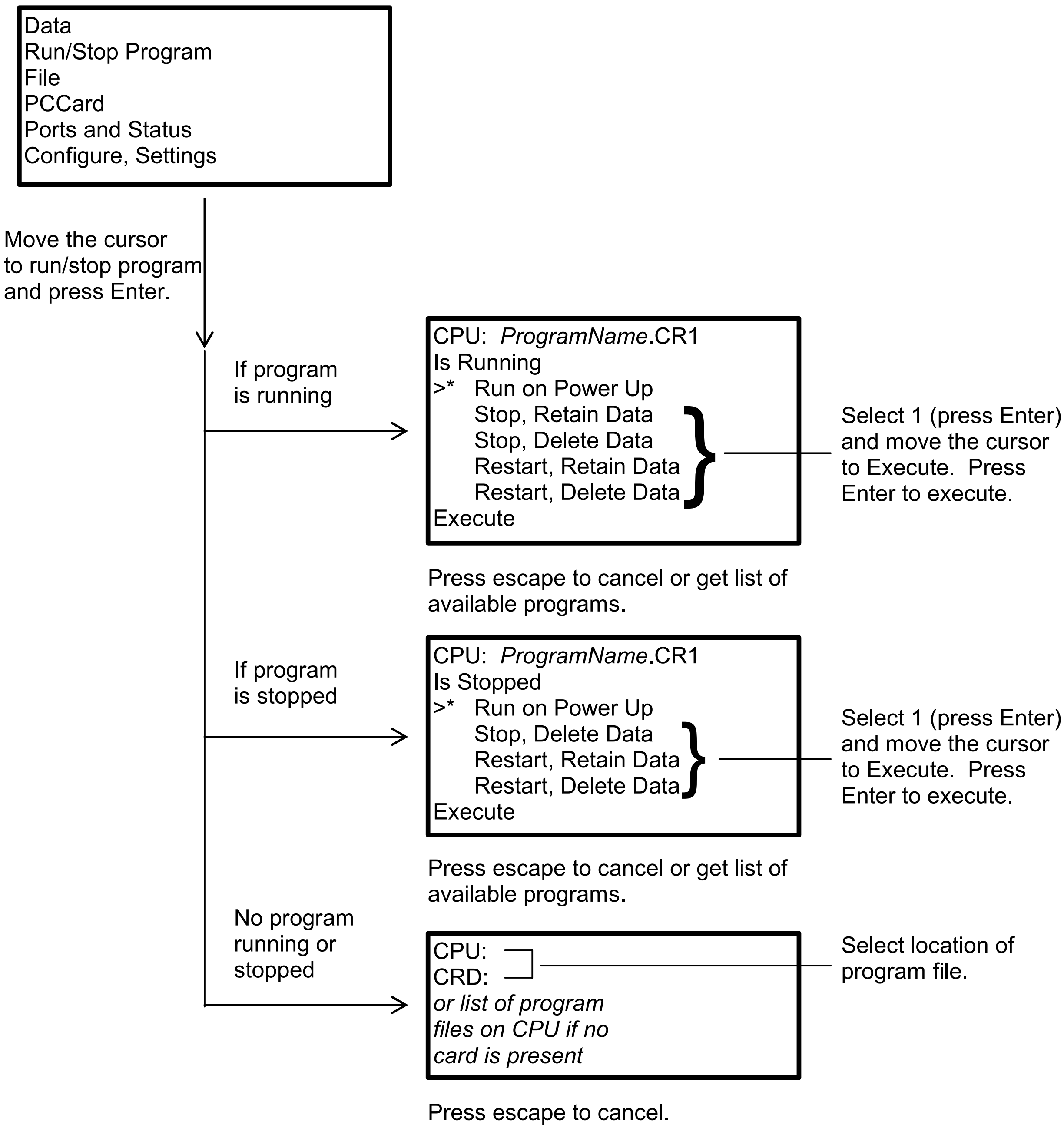
Press Graph for graph of selected field or for full screen display of string data. Use ←, →, PgUp, PgDn to move cursor and window of data graphed.



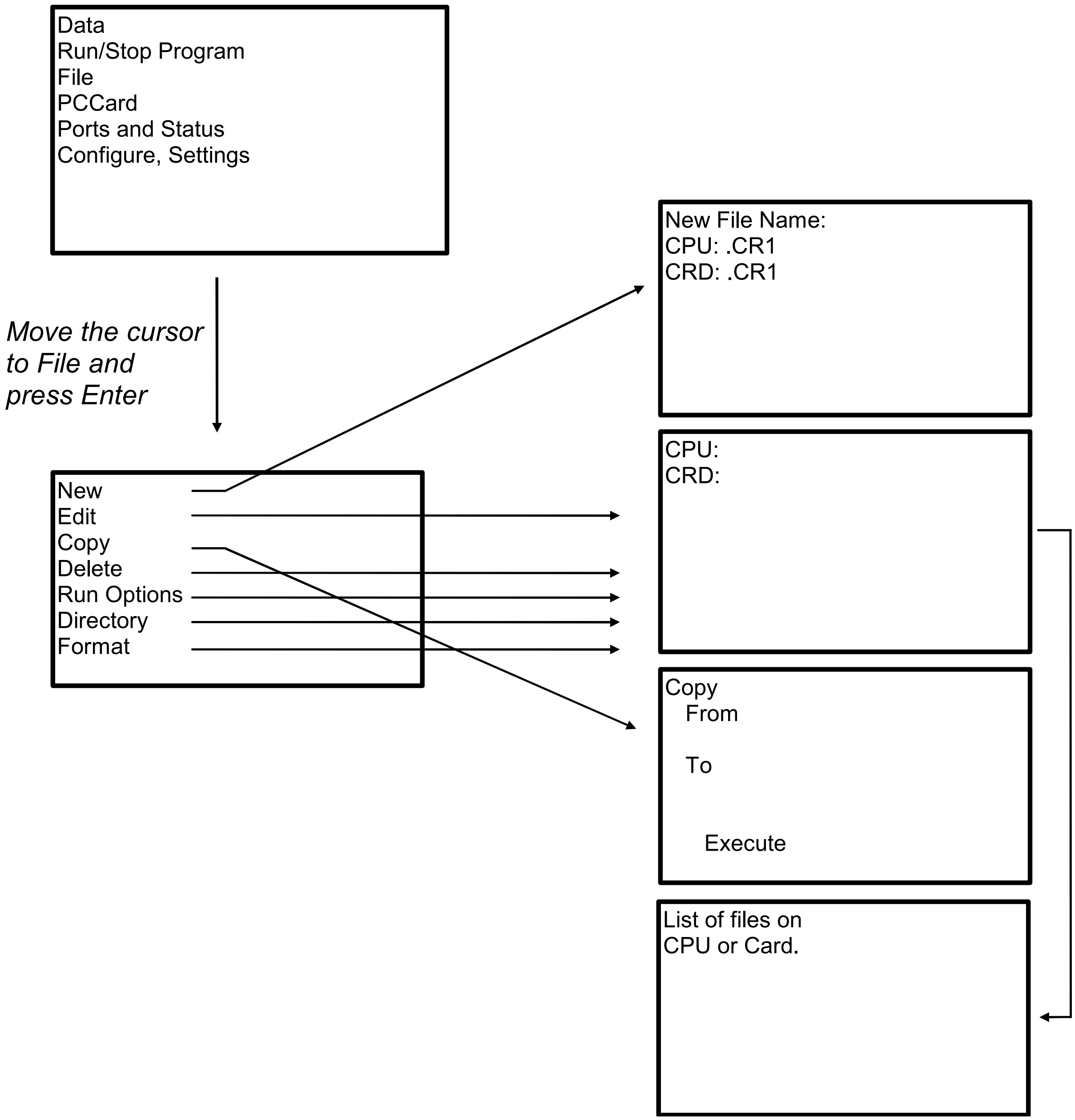
Press Ins for Graph Setup

Scaler Manual
Upper: 30.000000
Lower: 20.000000
Display Val On
Display Max On
Display Min On
Graph Type Roll

OV5.2 Run/Stop Program

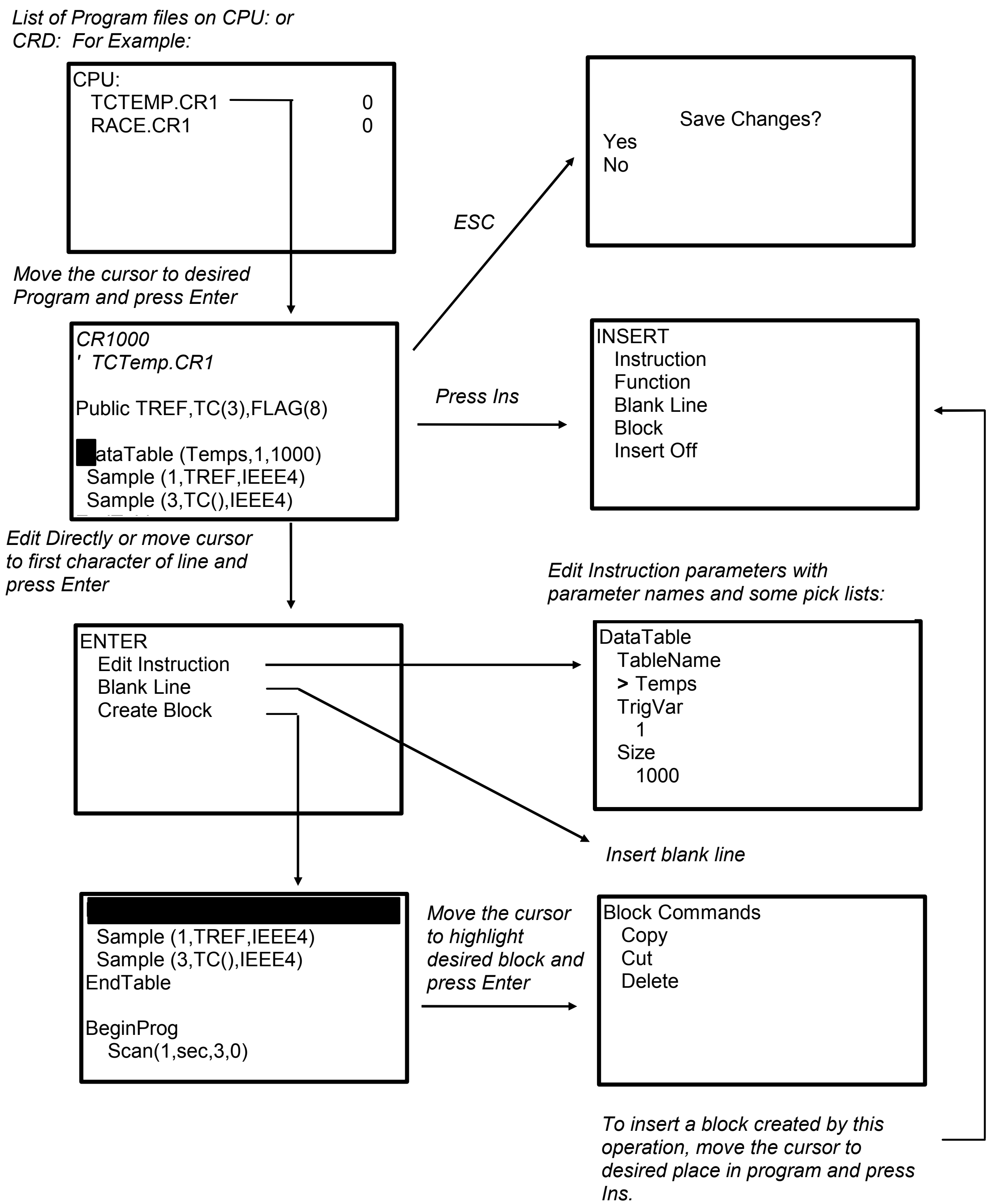


OV5.3 File Display

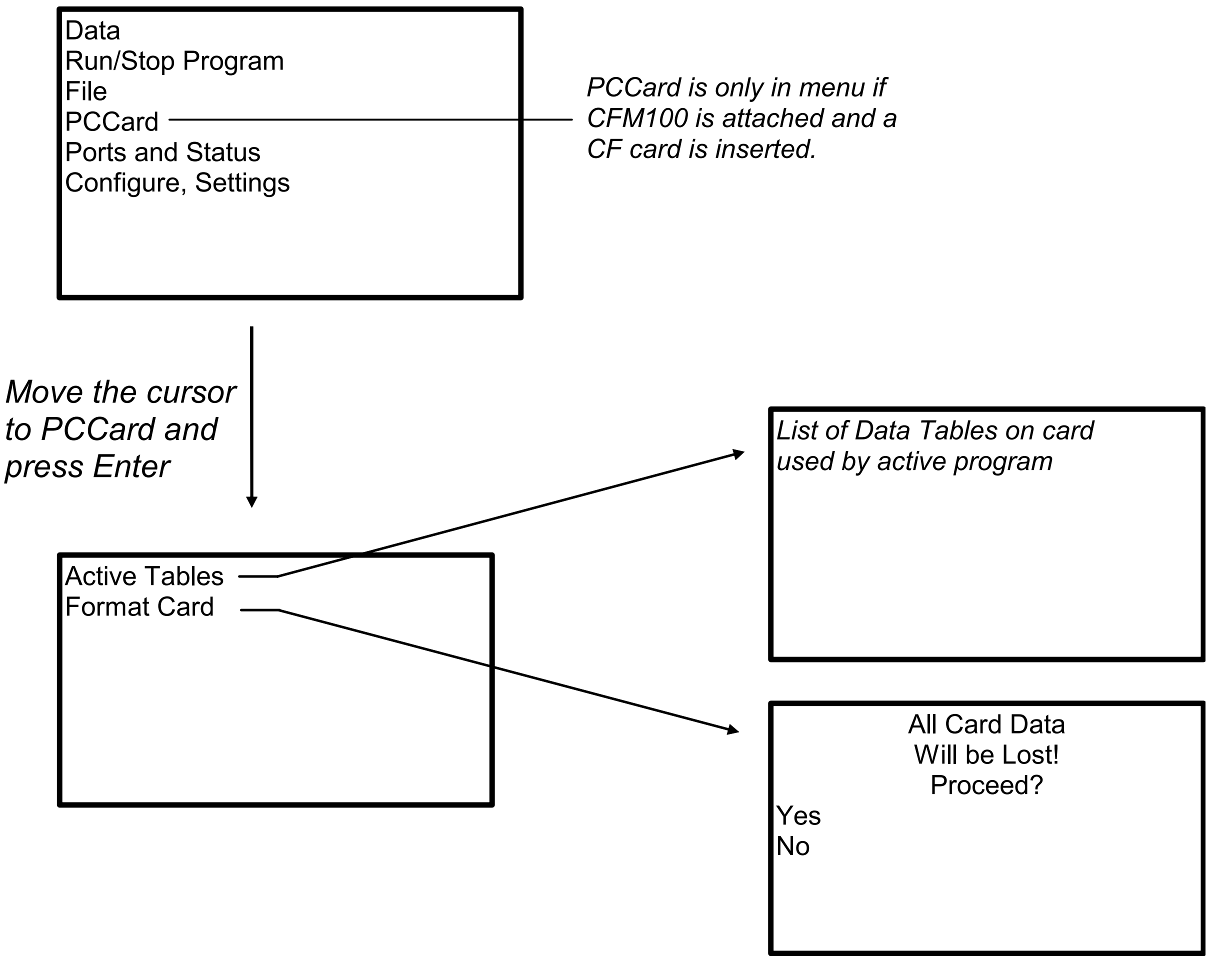


OV5.3.1 File: Edit

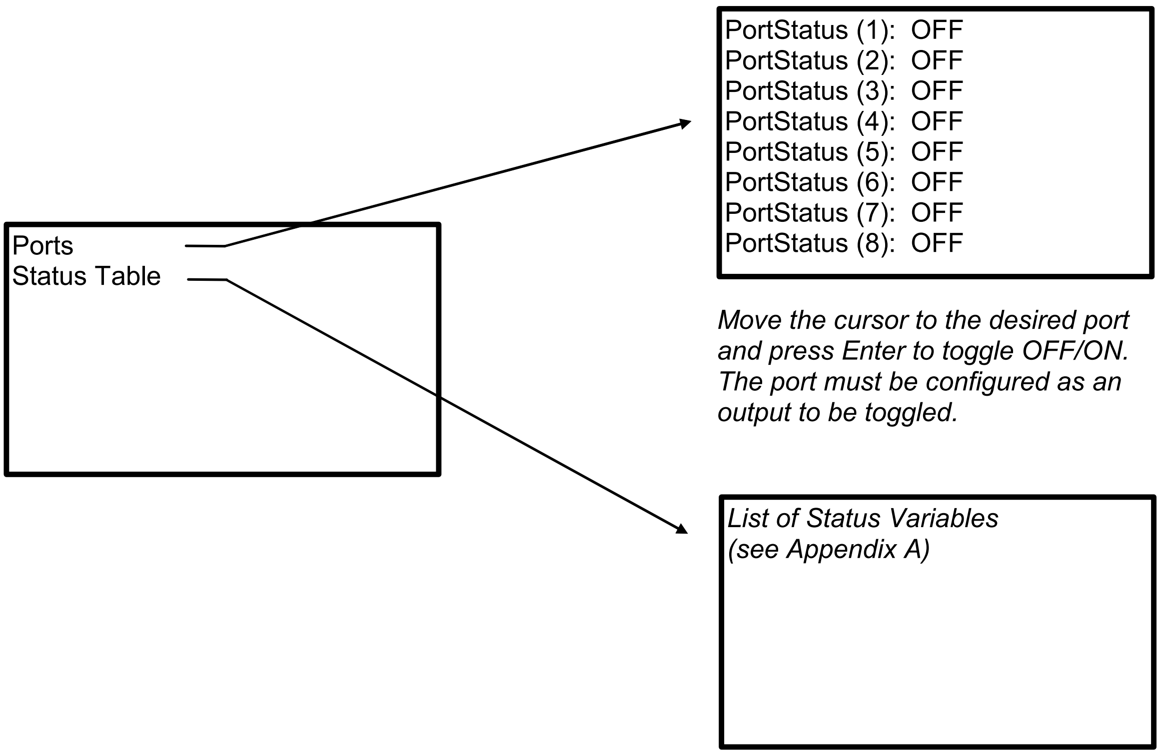
The CRBasic Program Editor is recommended for writing and editing datalogger programs. Changes in the field can be made with the keyboard display.



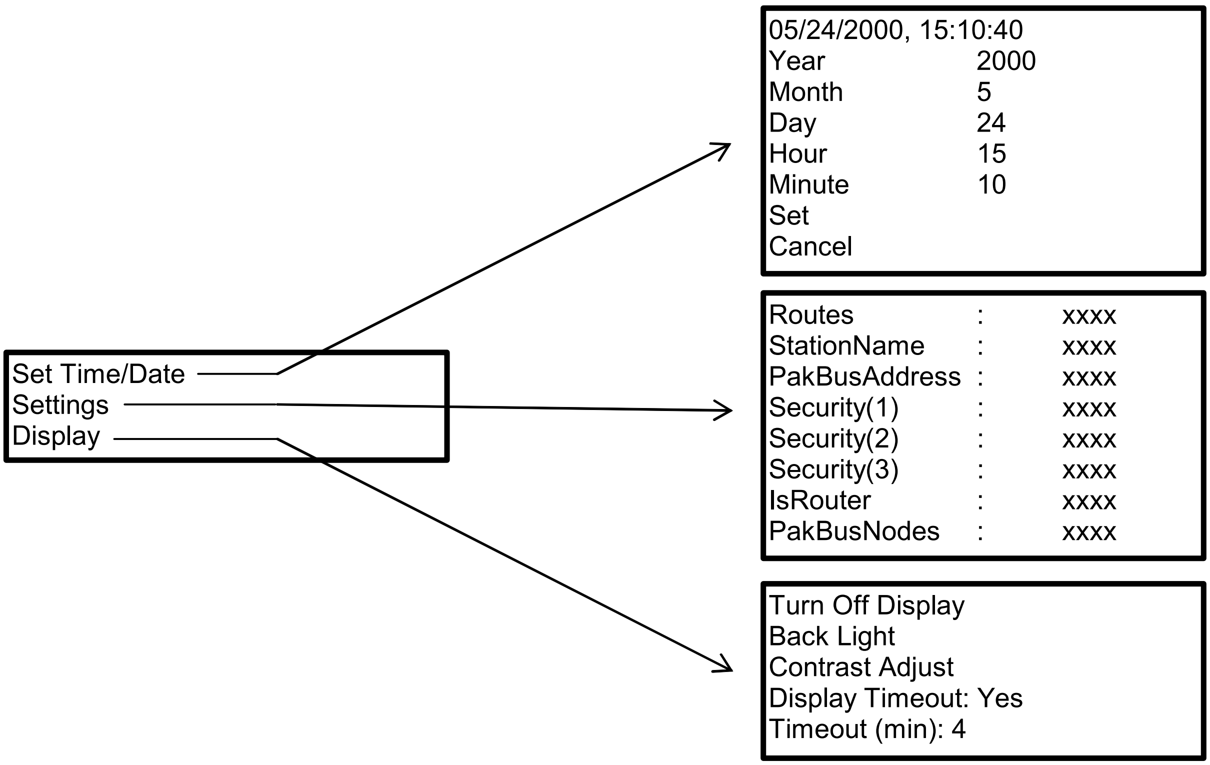
OV5.4 PCCard Display



OV5.5 Ports and Status



OV5.6 Settings



Move the cursor to time element and press Enter to change

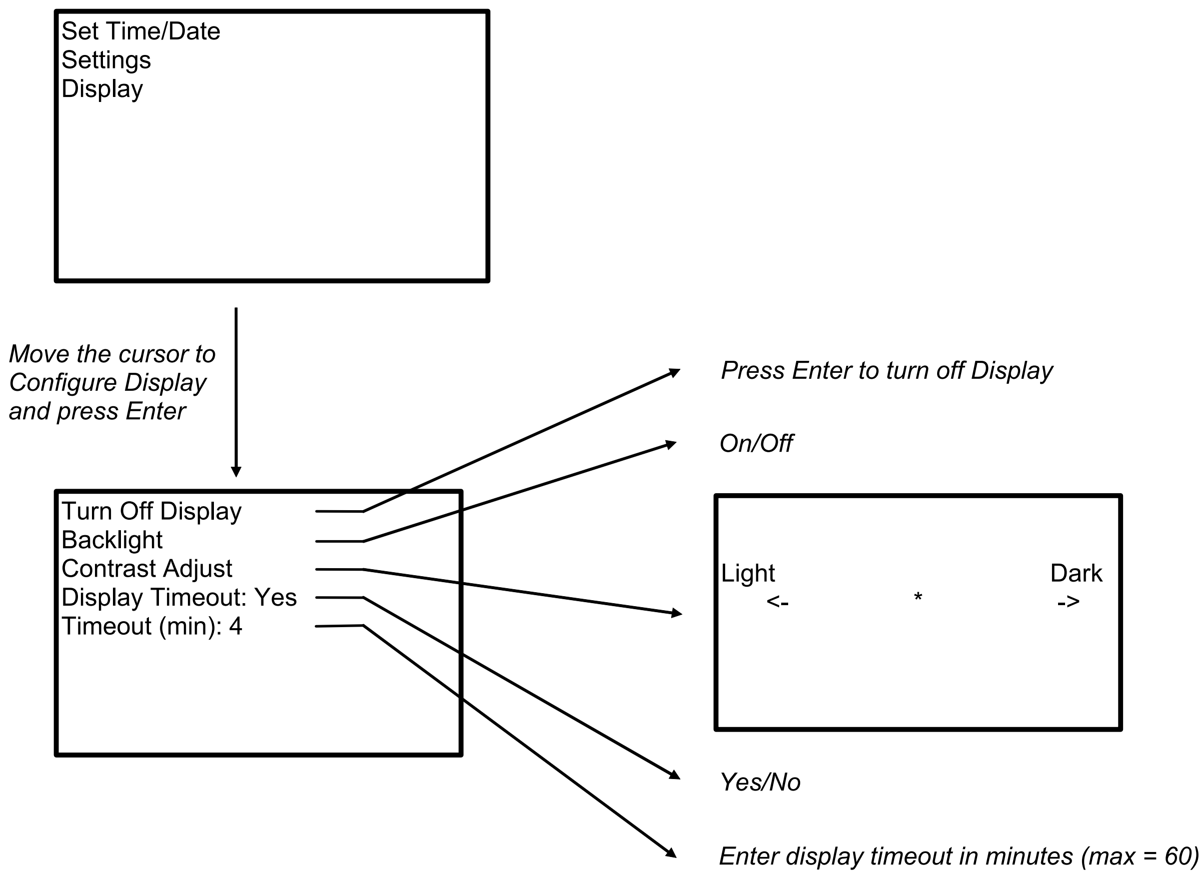
OV5.6.1 Set Time/Date

Move the cursor to time element and press Enter to change it. Then move the cursor to Set and press Enter to apply the change.

OV5.6.2 PakBus Settings

In the Settings menu, move the cursor to the PakBus element and press Enter to change it. After modifying, press Enter to apply the change.

OV5.6.3 Configure Display



OV6. Specifications

Electrical specifications are valid over a -25° to +50°C range unless otherwise specified; non-condensing environment required. To maintain electrical specifications, Campbell Scientific recommends recalibrating dataloggers every two years.

PROGRAM EXECUTION RATE

10 ms to 30 min. @ 10 ms increments

ANALOG INPUTS

8 differential (DF) or 16 single-ended (SE) individually configured. Channel expansion provided by AM16/32 and AM25T multiplexers.

RANGES and RESOLUTION: Basic resolution (Basic Res) is the A/D resolution of a single conversion. **Resolution of DF measurements with input reversal is half the Basic Res.**

	Input Referred Noise Voltage	
Input Range (mV)[1]	*DF Res (μV)*[2]	*Basic Res (μV)*
±5000	667	1333
±2500	333	667
±250	33.3	66.7
±25	3.33	6.7
±7.5	1.0	2.0
±2.5	0.33	0.67

[1]Range overhead of ~9% exists on all ranges to guarantee that full-scale values will not cause over-range.

[2]Resolution of DF measurements with input reversal.

ACCURACY[3]:
±(0.06% of reading + offset), 0° to 40°C
±(0.12% of reading + offset), -25° to 50°C
±(0.18% of reading + offset), -55° to 85°C

[3]The sensor and measurement noise are not included and the offsets are the following:

Offset for DF w/input reversal = 1.5·Basic Res + 1.0 μV
Offset for DF w/o input reversal = 3·Basic Res + 2.0 μV
Offset for SE = 3·Basic Res + 3.0 μV

INPUT NOISE VOLTAGE: For DF measurements with input reversal on ±2.5 mV input range; digital resolution dominates for higher ranges.

250 μs Integration: 0.34 μV RMS
50/60 Hz Integration: 0.19 μV RMS

MINIMUM TIME BETWEEN VOLTAGE MEASUREMENTS: Includes the measurement time and conversion to engineering units. For voltage measurements, the CR1000 integrates the input signal for 0.25 ms or a full 16.66 ms or 20 ms line cycle for 50/60 Hz noise rejection. DF measurements with input reversal incorporate two integrations with reversed input polarities to reduce thermal offset and common mode errors and therefore take twice as long.

250 μs Analog Integration: ~1 ms SE
1/60 Hz Analog Integration: ~20 ms SE
1/50 Hz Analog Integration: ~25 ms SE

COMMON MODE RANGE: ±5 V

DC COMMON MODE REJECTION: >100 dB

NORMAL MODE REJECTION: 70 dB @ 60 Hz when using 60 Hz rejection

SUSTAINED INPUT VOLTAGE W/O DAMAGE: ±16 Vdc max.

INPUT CURRENT: ±1 nA typical, ±6 nA max. @ 50°C; ±90 nA @ 85°C

INPUT RESISTANCE: 20 Gohms typical

ACCURACY OF BUILT-IN REFERENCE JUNCTION THERMISTOR (for thermocouple measurements):
±0.3°C, -25° to 50°C
±0.8°C, -55° to 85°C (-XT only)

ANALOG OUTPUTS

3 switched voltage, active only during measurement, one at a time.

RANGE AND RESOLUTION: Voltage outputs programmable between ±2.5 V with 0.67 mV resolution.

ACCURACY: ±(0.06% of setting + 0.8 mV), 0° to 40°C
±(0.12% of setting + 0.8 mV), -25° to 50°C
±(0.18% of setting + 0.8 mV), -55° to 85°C (-XT only)

CURRENT SOURCING/SINKING: ±25 mA

RESISTANCE MEASUREMENTS

MEASUREMENT TYPES: The CR1000 provides ratiometric measurements of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Precise, dual polarity excitation using any of the 3 switched voltage excitations eliminates dc errors.

RATIO ACCURACY[3]: Assuming excitation voltage of at least 1000 mV, not including bridge resistor error.

±(0.04% of voltage reading + offset)/V_x

[3]The sensor and measurement noise are not included and the offsets are the following:

Offset for DF w/input reversal = 1.5·Basic Res + 1.0 μV
Offset for DF w/o input reversal = 3·Basic Res + 2.0 μV
Offset for SE = 3·Basic Res + 3.0 μV

Offset values are reduced by a factor of 2 when excitation reversal is used.

PERIOD AVERAGING MEASUREMENTS

The average period for a single cycle is determined by measuring the average duration of a specified number of cycles. The period resolution is 192 ns divided by the specified number of cycles to be measured; the period accuracy is ±(0.01% of reading + resolution). Any of the 16 SE analog inputs can be used for period averaging. Signal limiting are typically required for the SE analog channel.

INPUT FREQUENCY RANGE:

Input Range	*Signal (peak to peak)*[4] *Min*	*Max*	*Min. Pulse W.*	*Max*[5] *Freq.*
±2500 mV	500 mV	10 V	2.5 μs	200 kHz
±250 mV	10 mV	2 V	10 μs	50 kHz
±25 mV	5 mV	2 V	62 μs	8 kHz
±2.5 mV	2 mV	2 V	100 μs	5 kHz

[4]The signal is centered at the datalogger ground.

[5]The maximum frequency = 1/(Twice Minimum Pulse Width) for 50% of duty cycle signals.

PULSE COUNTERS

Two 24-bit inputs selectable for switch closure, high frequency pulse, or low-level ac.

MAXIMUM COUNTS PER SCAN: 16.7×10^6

SWITCH CLOSURE MODE:
Minimum Switch Closed Time: 5 ms
Minimum Switch Open Time: 6 ms
Max. Bounce Time: 1 ms open w/o being counted

HIGH FREQUENCY PULSE MODE:
Maximum Input Frequency: 250 kHz
Maximum Input Voltage: ±20 V
Voltage Thresholds: Count upon transition from below 0.9 V to above 2.2 V after input filter with 1.2 μs time constant.

LOW LEVEL AC MODE: Internal ac coupling removes dc offsets up to ±0.5 V.

Input Hysteresis: 16 mV @ 1 Hz
Maximum ac Input Voltage: ±20 V
Minimum ac Input Voltage:

Sine wave (mV RMS)	*Range (Hz)*
20	1.0 to 20
200	0.5 to 200
2000	0.3 to 10,000
5000	0.3 to 20,000

DIGITAL I/O PORTS

8 ports software selectable, as binary inputs or control outputs. C1-C8 also provide edge timing, subroutine interrupts/wake up, switch closure pulse counting, high frequency pulse counting, asynchronous communications (UART), SDI-12 communications, and SDM communications.

HIGH FREQUENCY MAX: 400 kHz

SWITCH CLOSURE FREQUENCY MAX: 150 Hz

OUTPUT VOLTAGES (no load): high 5.0 V ±0.1 V; low <0.1

OUTPUT RESISTANCE: 330 ohms

INPUT STATE: high 3.8 to 5.3 V; low -0.3 to 1.2 V

INPUT HYSTERISIS: 1.4 V

INPUT RESISTANCE: 100 kohms

SWITCHED 12 V

One independent 12 V unregulated sources switched on and off under program control. Thermal fuse hold current = 900 mA @ 20°C, 650 mA @ 50°C, 360 mA @ 85°C.

SDI-12 INTERFACE SUPPORT

Control ports 1, 3, 5, and 7 may be configured for SDI-12 asynchronous communications. Up to ten SDI-12 sensors are supported per port. It meets SDI-12 Standard version 1.3 for datalogger mode.

CE COMPLIANCE

STANDARD(S) TO WHICH CONFORMITY IS DECLARED: IEC61326:2002

CPU AND INTERFACE

PROCESSOR: Hitachi H8S 2322 (16-bit CPU with 32-bit internal core)

MEMORY: 2 Mbytes of Flash for operating system; 2 Mbytes of battery-backed SRAM for CPU usage, program storage and data storage; 4 Mbytes optional

SERIAL INTERFACES: CS I/O port is used to interface with Campbell Scientific peripherals; RS-232 port is for computer or non-CSI modem connection.

PARALLEL INTERFACE: 40-pin interface for attaching data storage or communication peripherals such as the CFM100 module

BAUD RATES: Selectable from 300 bps to 115.2 kbps. ASCII protocol is one start bit, one stop bit, eight data bits, and no parity.

CLOCK ACCURACY: ±3 min. per year

SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc

TYPICAL CURRENT DRAIN:
Sleep Mode: ~0.6 mA
1 Hz Scan (8 diff. meas., 60 Hz rej., 2 pulse meas.)
w/RS-232 communication: 19 mA
w/o RS-232 communication: 4.2 mA
1 Hz Scan (8 diff. meas., 250 μs integ., 2 pulse meas.)
w/RS-232 communication: 16.7 mA
w/o RS-232 communication: 1 mA
100 Hz Scan (4 diff. meas., 250 μs integ.)
w/RS-232 communication: 27.6 mA
w/o RS-232 communication: 16.2 mA

CR1000KD CURRENT DRAIN:
Inactive: negligible
Active w/o backlight: 7 mA
Active w/backlight: 100 mA

EXTERNAL BATTERIES: 12 Vdc nominal; reverse polarity protected.

PHYSICAL SPECIFICATIONS

MEASUREMENT & CONTROL MODULE SIZE: 8.5" x 3.9" x 0.85" (21.6 x 9.9 x 2.2 cm)

CR1000WP WIRING PANEL SIZE: 9.4" x 4" x 2.4" (23.9 x 10.2 x 6.1 cm); additional clearance required for serial cable and sensor leads.

WEIGHT: 2.1 lbs (1 kg)

WARRANTY

Three years against defects in materials and workmanship.

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