CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

CR3000
Micrologger®

A Portable,

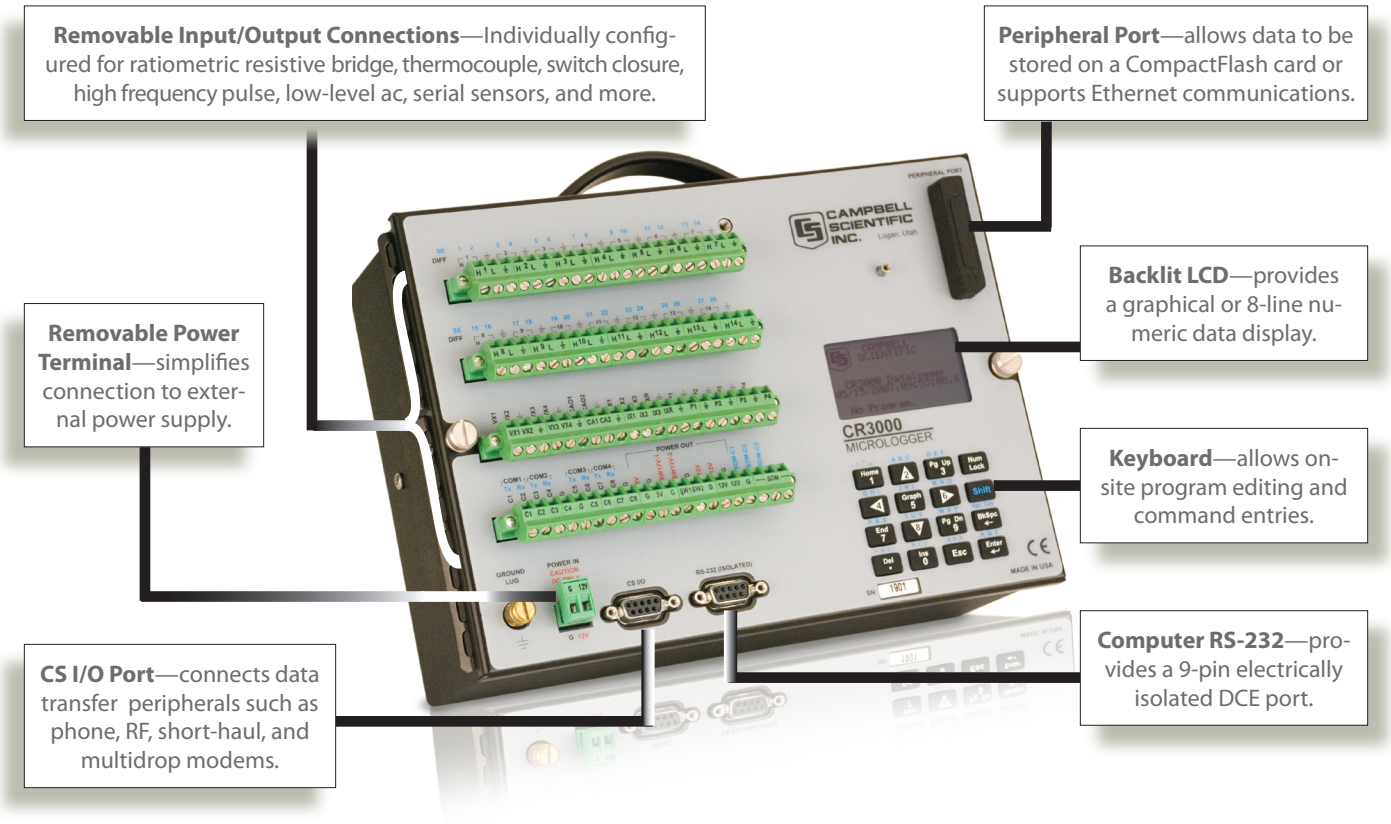
Rugged, Powerful

Data Acquisition

System

CR3000 Micrologger®

The CR3000 Micrologger® is a compact, rugged, powerful datalogger. Housed in a portable, self-contained package, the Micrologger consists of measurement and control electronics, communication ports, keyboard, display, power supply, and carrying handle. The CR3000's low power requirements allow extended field use from a dc voltage source.



Features

- Program execution rate of up to 100 Hz
- 16-bit analog to digital conversions
- 16-bit microcontroller with 32-bit internal CPU architecture
- Temperature compensated real-time clock
- Background system calibration for accurate measurements over time and temperature changes
- Gas Discharge Tube (GDT) protected inputs
- Data values stored in tables with a time stamp and record number
- 4 Mbytes data storage memory
- Battery-backed SRAM and clock that ensure data, programs, and accurate time are maintained while the CR3000 is disconnected from its main power source
- Serial communications with serial sensors and devices supported via I/O port pairs
- PakBus®, Modbus, DNP3, TCP/IP, FTP, and SMTP protocols supported

Operating System/Logic Control

The on-board operating system includes measurement, processing, and output instructions for programming the datalogger. The programming language, CRBasic, uses a BASIC-like syntax. Measurement instructions specific to bridge configurations, voltage outputs, thermocouples, and pulse/frequency signals are included. Processing instructions support algebraic, statistical, and transcendental functions for on-site processing. Output instructions process data over time and control external devices.

Transient Protection

Gas Discharge Tube (GDT) protects the inputs from electrical transients. The CR3000 is CE compliant under the European Union's EMC Directive, meeting ESD, EMC, Fast Transient standards.

Operating Temperature Ranges

Standard operating range is -25° to +50°C; an extended range of -40° to +85°C is available. Battery bases have different temperature ranges (see Battery Base Options).

Input Output Terminals

Analog Inputs
Twenty-eight single-ended (14 differential) channels measure voltage levels with 16-bit resolution on five software selectable voltage ranges.

Pulse Counters
Four 24-bit pulse channels measure switch closures, high frequency pulses, or low-level ac.

Switched Excitation Outputs
Four switched voltage and three switched current outputs provide precision excitation for ratiometric sensor/bridge measurements.

Digital I/O Ports
Eight ports have multiple functions including digital control output, interrupt, pulse counting, switch closure, frequency/period measurements, edge timing, or SDI-12 communication. Three additional ports are dedicated for measuring SDM devices.

The I/O ports can be paired as transmit and receive. Each pair has 0 to 5 V UART hardware that allows serial communications with serial sensors and devices. An RS232-to-logic level converter may be required in some cases.

Continuous Analog Outputs
Two continuous analog outputs provide voltage levels to displays or proportional controllers.

Peripheral Port
One 40-pin port interfaces with the NL115 Ethernet Interface and CompactFlash Module, the NL120 Ethernet Interface, or the CFM100 CompactFlash Module.

RS-232 Port
The RS-232 port is for connecting a PC, serial sensor, or RS-232 modem. The PC attaches to the CR3000 via an RS-232 cable—no interface required. This port isolates the PC's electrical system from the datalogger, thereby protecting against ground loops, normal static discharge, and noise.

CS I/O Port
Many communication peripherals connect with the CR3000 via this port. A PC may connect with this port via an SC32B, SC-USB, or SC115 interface.

Power Connections
The continuous 5 V and 12 V terminals are for connecting sensors and non-Campbell Scientific peripherals. Two switched 12 V terminals are program controlled.

Data Storage Capacity

The CR3000 provides 2 MB of flash memory for the Operating System and 4 MB of battery-backed SRAM for CPU usage, program storage, and data storage. Data is stored in a table format. The storage capacity of the CR3000 can be increased by using a CompactFlash® card.

Communication Protocols

The CR3000 supports the PakBus, Modbus, DNP3, TCP/IP, FTP, and SMTP communication protocols. With the PakBus protocol,networks have the distributed routing intelligence to continually evaluate links. Continually evaluating links optimizes delivery times and, in the case of delivery failure, allows automatic switch over to a configured backup route.

The Modbus RTU protocol supports both floating point and long formats. The datalogger can act as a slave and/or master.

The DNP3 protocol supports only long data formats. The dataloggers are level 2 slave compliant, with some of the operations found in a level 3 implementation.

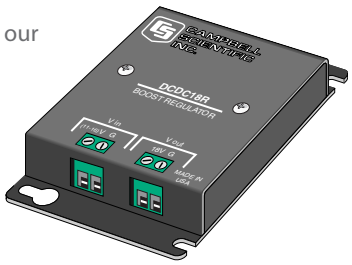
The TCP/IP, FTP, and SMTP protocols provide TCP/IP functionality when the CR3000 is used in conjunction with an NL240, NL200, NL115, or NL120.

Battery Base Options

Alkaline Base
The alkaline base includes 10 D-cell batteries that provide a 10 Ah rating at 20°C. Operating temperature range is -25° to +50°C.

Rechargeable Base
This base includes an internal 7-Ah sealed rechargeable battery that can be charged via a vehicle, solar panel, or ac wall charger. Operating temperature range is -40° to +60°C.

When using vehicle power, our DCDC18R Boost Regulator is used to increase the vehicle's supply voltage to charging levels required by the CR3000.



Low-Profile Base (no battery)
The low-profile base requires a user-supplied dc source. It is preferred when the system's power consumption needs a larger capacity battery or when it's advantageous for the Micrologger to be thinner and lighter.

Communication Options

To determine the best option for an application, consider the accessibility of the site, availability of services (e.g., cellular phone or satellite coverage), quantity of data to collect, and desired time between data-collection sessions. Some communication options can be combined—increasing the flexibility, convenience, and reliability of the communications.

iOS Devices, Android Devices, and PDAs

An iOS device, an Android device, our Archer-PCON Field PC, or a user-supplied PDA can be used to view and collect data, set the clock, and download programs. To use an iOS or Android device, go to the Apple Store or Google Play and purchase our LoggerLink Mobile Apps. User-supplied PDAs require either PConnect or PConnectCE software.

With an IP67 sealed rating, the Archer Field PC is completely sealed against dust and water.

External Data Storage Devices

A CFM100 or NL115 module can store the CR3000's data on an industrial-grade CompactFlash (CF) card. The CR3000 can also store data on an SC115 2-GB Flash Memory Drive.

Direct Links

A PC or laptop can be connected directly to the datalogger's RS-232 port (no interface required). This port provides electrical isolation. Alternatively, the PC or laptop can be connected to the CR3000's CS I/O port via an SC32B, SC-USB, or SC115 interface.

Keyboard Display

The CR3000's integrated keyboard display is used to program the datalogger, manually initiate data transfer, and display data. It displays 8 lines x 21 characters (64 x 128 pixels) and has a 16-character keyboard. Custom menus are supported allowing customers to set up choices within the datalogger program that can be initiated by a simple toggle or pick list

Telephone Networks

The CR3000 can communicate with a PC using landlines, cellular CDMA, or cellular GPRS transceivers. A voice synthesized modem enables anyone to call the CR3000 via phone and receive a verbal report of real-time site conditions.

Mountable Display

The CD295 can be mounted in an enclosure lid, which allows customers to view the CR3000's data on-site without opening the enclosure. It displays one real-time value, a description, and units.

Internet and IP Networks

Campbell Scientific offers several interfaces that enable the CR3000 to communicate with a PC via TCP/IP.

Multidrop Interface

The MD485 intelligent RS-485 interface permits a PC to address and communicate with one or more dataloggers over a single cable. Distances up to 4000 feet are supported.

Short Haul Modems

The SRM-5A RAD Short Haul Modem supports communications between the CR3000 and a PC via a four-wire unconditioned line (two twisted pairs).

Radios

Radio frequency (RF) communications are supported via narrow-band UHF, narrow-band VHF, spread spectrum, or meteor burst radios. Line-of-sight is required for all of our RF options.

Satellite Transmitters

Our NESDIS-certified GOES satellite transmitter provides one-way communications from a Data Collection Platform (DCP) to a receiving station. Campbell Scientific also offers an Argos transmitter that is ideal for high-latitude applications.

This station for the National Estuarine Research Reserve (NERR) in Virginia transmits data via our GOES satellite transmitter.

Enclosures

An ENC12/14, ENC14/16, or ENC16/18 enclosure can house the CR3000. A CR3000 housed in a weather-resistant enclosure can collect data under extremely harsh conditions.

Channel Expansion

Synchronous Devices for Measurement (SDMs)

SDMs are addressable peripherals that expand the datalogger's measurement and control capabilities. For example, SDMs are available to add control ports, analog outputs, pulse count channels, interval timers, or even a CANbus interface to the system. Multiple SDMs, in any combination, can be connected to one datalogger.

Multiplexers

Multiplexers increase the number of sensors that can be measured by a datalogger by sequentially connecting each sensor to the datalogger. Several multiplexers can be controlled by a single datalogger.

Besides SDMs and multiplexers, Campbell Scientific offers the LLAC4, which increases the number of available low-level ac inputs. It can be used to measure up to four anemometers, and is especially useful for wind profiling applications.

Software

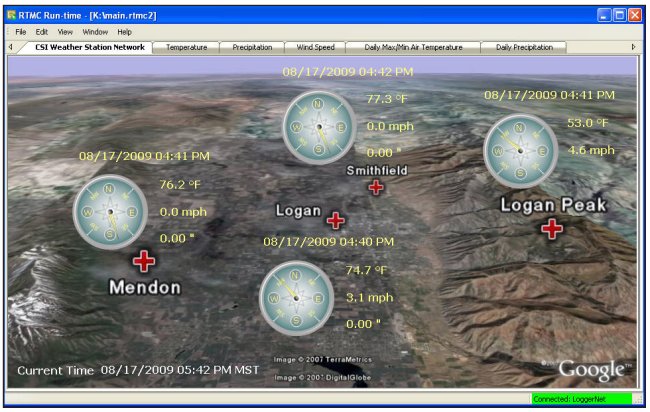
Starter Software

Our easy-to-use starter software is intended for first time users or applications that don't require sophisticated communications or datalogger program editing. SCWin Short Cut generates straight-forward CR3000 programs in four easy steps. PC200W allows customers to transfer a program to, or retrieve data from a CR3000 via a direct communications link.

At www.campbellsci.com/downloads, you can download starter software at no charge. Our Resource CD also provides this software as well as PDF versions of our brochures and manuals.

Datalogger Support Software

Our datalogger support software packages provide more capabilities than our starter software. These software packages contains program editing, communications, and display tools that can support an entire datalogger network.

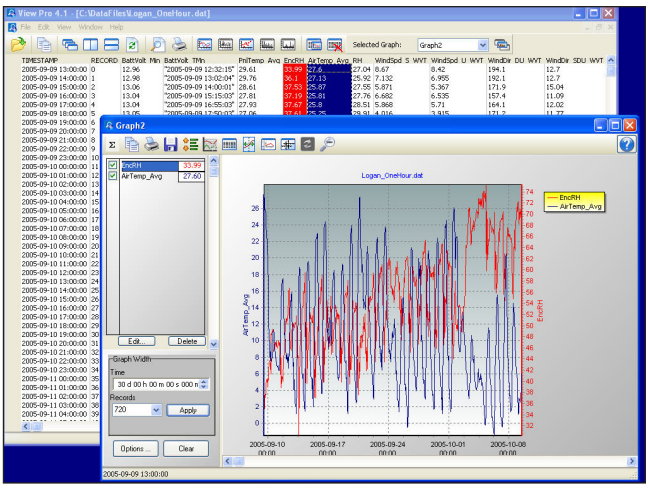


RTMC, a program for displaying the datalogger's data, is bundled with LoggerNet and RTDAQ. Customers may also purchase the RTMCRT and RTMC Web Server clients, which use forms created in the developer mode of RTMC.

PC400, our mid-level software, supports a variety of telemetry options, manual data collection, and data display. For programming, it includes both Short Cut and the CRBasic program editor. PC400 does not support combined communication options (e.g., phone-to-RF) or scheduled data collection.

RTDAQ is an ideal solution for industrial and real-time users desiring to use reliable data collection software over a single telecommunications medium, and who do not rely on scheduled data collection. RTDAQ's strength lies in its ability to handle the display of high speed data.

LoggerNet is Campbell Scientific's full-featured datalogger support software. It is referred to as "full-featured" because it provides a way to accomplish almost all the tasks you'll need to complete when using a datalogger. LoggerNet supports combined communication options (e.g., phone-to-RF) and scheduled data collection.



Both LoggerNet and RTDAQ use View Pro to display historical data in a tabular or graphical format.

Applications

Open Path Eddy Covariance Systems

The open path eddy covariance systems measure sonic sensible heat flux, momentum flux, and the flux of other scalars between the atmosphere and earth's surface.

For eddy covariance applications, the CR3000 can measure the EC150 Open-Path CO_2 Analyzer, CSAT3A Sonic Anemometer, and KH20 Krypton Hygrometer then compute fluxes on-line.

The system consists of a CR3000 datalogger, fast response three-dimensional sonic anemometer, and fast response scalar sensors. An independent measurement of temperature and humidity from a slow response sensor is also used to calculate background meteorological variables. Horizontal wind speed and direction are computed by the datalogger from the three-dimensional measurements of wind made by the sonic anemometer.

Meteorology

The CR3000 is used in long-term climatological monitoring, meteorological research, and routine weather measurement applications.

Sensors the CR3000 can measure include:

- RH sensors
- cup, propeller, and sonic anemometers
- wind vanes
- tipping bucket rain gages
- pyranometers
- ultrasonic ranging sensor
- thermistors, RTDs, and thermocouples
- barometers
- cooled mirror hygrometers

Wind Profiling

Our data acquisition systems can monitor conditions at wind assessment sites, at producing wind farms, and along transmission lines. The CR3000 makes and records measurements, controls electrical devices, and can function as PLCs or RTUs. Because the Micrologger has its own power supply (batteries, solar panels), it can continue to measure and store data and perform control during power outages.

Typical sensors for wind assessment applications include, but are not limited to:

- cup, propeller, and sonic anemometers (up to 10 anemometers can be measured by using two LLAC4 peripherals)
- wind vanes
- thermistors, RTDs, and thermocouples
- barometers
- pyranometers

Photo courtesy RADTech Ltd. UK

A Campbell Scientific datalogging system monitors this offshore wind farm located between Rhyl and Prestatyn in North Wales at about 7 to 8 km out to sea.

Agriculture and Agricultural Research

The versatility of the CR3000 allows measurement of agricultural processes and equipment in applications such as:

- plant water research
- canopy energy balance
- machinery performance
- plant pathology
- crop management decisions
- food processing/storage
- frost prediction
- irrigation scheduling
- integrated pest management

Air Quality

The CR3000 can monitor and control gas analyzers, particle samplers, and visibility sensors. It can also automatically control calibration sequences and compute conditional averages that exclude invalid data (e.g., data recorded during power failures or calibration intervals).

The CR3000 can be used in networks of dataloggers that continuously monitor air quality.

Road Weather/RWIS

Our fully NTCIP-compliant Environmental Sensor Stations (ESS) are robust, reliable weather stations used for road weather/RWIS applications. A typical ESS includes a tower, CR3000, two road sensors, remote communication hardware, and sensors that measure wind speed and direction, air temperature, humidity, barometric pressure, solar radiation, and precipitation.

Soil Water

The CR3000 is compatible with soil water blocks, matric water potential sensors, Time-Domain Reflectometery (TDR) systems, self-contained water content reflectometers, and tensiometers. These soil water instruments are used extensively to monitor water content and matric potential in applications requiring knowledge of soil water inventory or movement.

Vehicle Testing

This versatile, rugged datalogger is ideally suited for testing cold and hot temperature, high altitude, off-highway, and cross-country performance. The CR3000 is compatible with our SDM-CAN interface and GPS16X-HVS receiver.

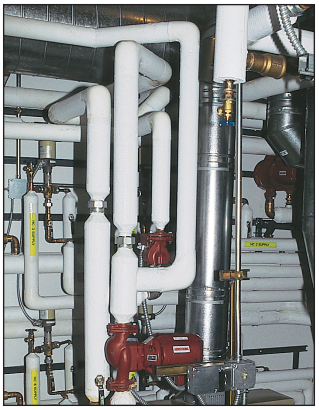
Vehicle monitoring includes not only passenger cars, but airplanes, locomotives, helicopters, tractors, buses, heavy trucks, drilling rigs, race cars, and motorcycles.

The CR3000 can measure:

- Suspension—strut pressure, spring force, travel, mounting point stress, deflection, ride
- Fuel system—line and tank pressure, flow, temperature, injection timing
- Comfort control—ambient and supply air temperature, solar radiation, fan speed, ac on and off, refrigerant pressures, time-to-comfort, blower current
- Brakes—line pressure, pedal pressure and travel, ABS, line and pad temperature
- Engine—pressure, temperature, crank position, RPM, time-to-start, oil pump cavitation
- General vehicle—chassis monitoring, road noise, vehicle position and speed, steering, air bag, hot/cold soaks, wind tunnels, traction, CANbus, wiper speed and current, vehicle electrical loads

Other Applications

- Stuctural or fatigue analysis
- Wireless sensor/datalogger networks
- Water quality
- Water level/flow
- Mesonet systems
- Avalanche forecasting, snow science, polar, high altitude
- HVAC Systems
- Aerospace/aviation



The CR3000 can monitor and control pumps, fans, and starter motors in an HVAC system.

CR3000 Specifications

Electrical specifications are valid over a -25° to +50°C, non-condensing environment, unless otherwise specified. Recalibration recommended every two years. Critical specifications and system configuration should be confirmed with Campbell Scientific before purchase.

PROGRAM EXECUTION RATE

10 ms to one day @ 10 ms increments

ANALOG INPUTS *(SE1-SE28 or DIF1-DIF14)*

14 differential (DF) or 28 single-ended (SE) individually configured. Channel expansion provided by optional analog multiplexers.

RANGES, RESOLUTION: A single A/D conversion has 16-bit basic resolution (Basic Res). A DF measurement with input reversal has 17-bit resolution (twice the resolution of Basic Res).

Range (mV)[1]	DF Res (µV)[2]	Basic Res (µV)
±5000	83.33	167
±1000	16.67	33.4
±200	3.33	6.67
±50	0.83	1.67
±20	0.33	0.67

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

[2]Resolution of DF measurements with input reversal.

ACCURACY[3]:

±(0.04% of reading + offset), 0° to 40°C
±(0.07% of reading + offset), -25° to 50°C
±(0.09% of reading + offset), -40° to 85°C (-XT only)

[3]Accuracy does not include sensor and measurement noise. Offsets are defined as:

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 + 5.0 µV

ANALOG MEASUREMENT SPEED:

Integration Type/ Code	Integration Time	Settling Time	Total Time[5] SE w/ No Rev	Total Time[5] DF w/ Input Rev
250	250 µs	200 µs	~0.7 ms	~1.4 ms
60 Hz[4]	16.67 ms	3 ms	~20 ms	~40 ms
50 Hz[4]	20.00 ms	3 ms	~23 ms	~46 ms

[4]AC line noise filter.

[5]Includes 250 µs for conversion to engineering units.

INPUT NOISE VOLTAGE: For DF measurements with input reversal on ±20 mV input range; digital resolution dominates for higher ranges.

250 µs Integration: 0.4 µV RMS
50/60 Hz Integration: 0.19 µV RMS

INPUT LIMITS: ±5 Vdc

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; ±120 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, -40° to 85°C (-XT only)

ANALOG OUTPUTS *(Vx1-Vx4, Ix1-Ix3, CAO1, CAO2)*

4 switched voltage and 3 switched current outputs sequentially active during measurement. Two continuous outputs.

Channel	Range	Res.	Current Source/Sink	Compliance Voltage
V_x	±5 V	17 mV	±50 mA	N/A
CAO	±5 V	17 mV	±15 mA	N/A
I_x	±2.5 mA	0.08 µA	N/A	±5 V

Vx & CAO ACCURACY:

±(0.04% of setting + 0.5 mV), 0° to 40°C
±(0.07% of setting + 0.5 mV), -25° to 50°C
±(0.09% of setting + 0.5 mV), -40° to 85°C (-XT only)

Ix ACCURACY:

±(0.1% of setting + 0.5 µA), 0° to 40°C
±(0.13% of setting + 0.5 µA), -25° to 50°C
±(0.15% of setting + 0.5 µA), -40° to 85°C (-XT only)

Vx FREQUENCY SWEEP FUNCTION: Switched outputs provide a programmable swept frequency, 0 to 5000 mV square wave for exciting vibrating wire transducers.

PERIOD AVERAGE MEASUREMENTS

Any of the 28 SE analog inputs can be used for period averaging. Accuracy is ±(0.01% of reading+resolution), where resolution is 68 ns divided by the specified number of cycles to be measured.

INPUT AMPLITUDE AND FREQUENCY:

Voltage Gain	Input Range (±mV)	Signal (peak to peak)[6] Min. (mV)	Signal (peak to peak)[6] Max (V)	Min Pulse Width (µV)	Max[7] Freq (kHz)
1	1000	500	10	2.5	200
5	25	10	2	10	50
20	7.5	5	2	62	8
50	2.5	2	2	100	5

[6]With signal centered at datalogger ground.

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

RESISTANCE MEASUREMENTS

MEASUREMENT TYPES: Ratiometric measurements of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Precise, dual polarity excitation for voltage or current excitations eliminates DC errors. Offset values are reduced by a factor of 2 when excitation reversal is used.

VOLTAGE RATIO ACCURACY[8]: Assuming excitation voltage of at least 500 mV, not including bridge resistor errors

±(0.02% of voltage reading + offset)/V_x, 0° to 40°C
±(0.025% of voltage reading + offset)/V_x, -25° to 50°C
±(0.03% of voltage reading + offset)/V_x, -40° to 85°C

[8]Accuracy does not include sensor and measurement noise. Offsets are defined as:

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 + 5.0 µV

ACCURACY WITH CURRENT EXCITATION[9]:

±(0.02% of voltage reading + offset)/I_x, 0° to 40°C
±(0.025% of voltage reading + offset)/I_x, -25° to 50°C
±(0.03% of voltage reading + offset)/I_x, -40° to 85°C (-XT)

[9]Accuracy does not include sensor and measurement noise. Offsets are defined as:

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 + 5.0 µV

PULSE COUNTERS *(P1-P4)*

4 inputs individually selectable for switch closure, high frequency pulse, or low-level AC. Independent 24-bit counters (16.8 x 10^6 counts) for each input.

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 Vdc.

Input Hysteresis: 12 mV RMS @ 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 CONTROL PORTS *(C1-C8, SDM)*

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

HIGH FREQUENCY MAX: 400 kHz

SWITCH CLOSURE FREQUENCY MAX: 150 Hz

EDGE TIMING RESOLUTION: 540 ns

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

OUTPUT RESISTANCE: 330 ohms

INPUT STATE: high 3.8 to 16 V; low -8.0 to 1.2 V

INPUT HYSTERESIS: 1.4 V

INPUT RESISTANCE: 100 kohm with < 6.2 Vdc, 220 ohm with inputs ≥6.2 Vdc

ADDITIONAL DIGITAL PORTS: SDM-C1, SDM-C2, SDM-C3 are dedicated for measuring SDM devices.

SWITCHED 12 V *(SW12V)*

Two independent 12 Vdc 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.

CE COMPLIANCE

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

COMMUNICATION

RS-232 PORTS:
9-pin: DCE (electrically isolated) for computer or non-CSI modem connection
COM1 to COM4: Four independent Tx/Rx pairs on control ports (non-isolated); 0 to 5 Vdc UART
Baud Rate: Selectable from 300 to 115.2k bps.
Default Format: 8 data bits; 1 stop bit; no parity
Optional Format: 7 data bits; 2 stop bits; odd, even parity

CS I/O PORT: Interface with CSI telecommunication peripherals.

SDI-12: Digital Control ports 1, 3, 5, and 7 are individually configurable and meet Standard version 1.3 for datalogger mode. Up to ten SDI-12 sensors are supported per port.

PERIPHERAL PORT: 40-pin interface for attaching CompactFlash or Ethernet peripherals

PROTOCOLS SUPPORTED: PakBus, Modbus, DNP3, FTP, HTTP, XML POP3, SMTP, Telnet, NTCIP, NTP, SDI-12, SDM

SYSTEM

PROCESSOR: Renesas H8S 2674 (16-bit CPU with 32-bit internal core)

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

RTC CLOCK ACCURACY: ±3 min. per year. Correction via GPS optional

RTC CLOCK RESOLUTION: 10 ms

SYSTEM POWER REQUIREMENTS

VOLTAGE: 10 to 16 Vdc

INTERNAL BATTERIES: 10 Ah alkaline or 7 Ah rechargeable base. 1200 mAh lithium battery for clock and SRAM backup typically provides 3 years of back-up.

EXTERNAL BATTERIES: 12 Vdc nominal (power correction is reverse polarity protected.

TYPICAL CURRENT DRAIN: Sleep Mode: 2 mA
1 Hz Sample Rate (one fast SE meas.): 3 mA
100 Hz Sample Rate (one fast SE meas.): 10 mA
100 Hz Sample Rate (one fast SE meas. w/RS-232 communications): 38 mA
Display on: add 1 mA to current drain
Backlight on: add 42 mA to current drain

PHYSICAL SPECIFICATIONS

SIZE: 24.1 x 17.8 x 9.6 cm (9.5 x 7.0 x 3.8 in.); additional clearance required for cables and leads.

WEIGHT:

Base Type	Mass (kg)	Weight (lb)
Low profile	1.6	3.6
Alkaline	3.8	8.3
Rechargeable	4.8	10.7

WARRANTY

3 years against defects in materials and workmanship.

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