MILLTRONICS

ENVIRORANGER ERS 500
COMMUNICATIONS REFERENCE

Instruction Manual PL-602   January 2001

ENVIRORANGER ERS 500

33456020
Rev. 1.1

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

Copyright Siemens Milltronics Process Instruments Inc. 2000. All Rights Reserved	Disclaimer of Liability
This document is available in bound version and in electronic version. We encourage users to purchase authorized bound manuals, or to view electronic versions as designed and authored by Siemens Milltronics Process Instruments Inc. Siemens Milltronics Process Instruments Inc. will not be responsible for the contents of partial or whole reproductions of either bound or electronic versions.	While we have verified the contents of this manual for agreement with the instrumentation described, variations remain possible. Thus we cannot guarantee full agreement. The contents of this manual are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement. Technical data subject to change.

MILLTRONICS® is a registered trademark of Siemens Milltronics Process Instruments Inc.

Contact SMPI Technical Publications at the following address:

Technical Publications
Siemens Milltronics Process Instruments Inc.
1954 Technology Drive, P.O. Box 4225
Peterborough, Ontario, Canada, K9J 7B1
Email: techpubs@milltronics.com

For the library of SMPI instruction manuals, visit our Web site: **www.milltronics.com**

Table of Contents

About the EnviroRanger ERS 500…

The EnviroRanger is intended for advanced water and wastewater applications. This device can handle virtually all of your pump control and level monitoring needs – often replacing expensive PLCs and integrating into a SCADA system for a fraction of the cost of competitive systems.

The EnviroRanger is programmable.
It can be configured for nearly any water or wastewater application, control up to five pumps, gates, or alarms – and can communicate its status by way of direct serial connection, modem, or industrial communication network.

The EnviroRanger is flexible.
It can take discrete input from pumps or other devices to modify its operation, and can also time events to maximize efficiency or minimize cost.

The EnviroRanger is upgradeable.
Its basic features can be further enhanced with any of the following:

Hardware Upgrades
- I/O Analog Cards
- RAM memory
- Discrete inputs

Software Upgrades
- Dual Point
- Data Logging

About the Communications Reference…

This is the third of four manuals in the ERS library.

Manual	Uses
User Guide (PL-600)	Learn how to program the unit Example applications Principles of operation
Installation Guide (PL-601)	Outline diagrams Wiring diagrams Installation requirements
Communications Reference (PL-602)	MODBUS register mapping Modem configuration
Parameter Reference (PL-603)	Parameter values Parameter uses

About Symbols…

The following symbols are used in the EnviroRanger manuals:

Symbol	Meaning
∿	Alternating current
⎓	Direct current
⏚	Earth (ground) terminal
⏚	Protective conductor terminal
⚠	Caution (refer to instructions)
▦	Program button on front of instrument
◿	Infra-red communication port on front of instrument
💻	RJ-11 communications port
🚫	no co-axial cable connections

About Configuring ERS 500 Parameters…

The primary configuration of the EnviroRanger uses Milltronics **Dolphin Plus** software and a serial connection to the device.

Configuring the EnviroRanger with the optional **Hand Programmer** is also possible. This method is not recommended for complex installations.

As a rule of thumb, if your application falls into one of the pre-configured applications outlined in the EnviroRanger User Guide, then use the hand programmer. If your application is more complex, we suggest you use Dolphin Plus. To purchase a copy of Dolphin Plus, contact your Milltronics representative.

Shortcuts

The following table lists central information with associated sections and page numbers.

For information on	Refer to Section	On Page
How to wire the communications ports and configure the ports	Wiring Guidelines	9
How to set up a typical modem	Setting up the Modems	45
Modbus registers	Modbus Register Map	19
Troubleshooting the Modbus error responses	Error Handling	48
Troubleshooting communication problems	Troubleshooting	51

About EnviroRanger Communication Systems...

The EnviroRanger is an integrated level and pump controller that communicates component and system status to a Supervisory Control and Data Acquisition (SCADA) system, using a serial device such as a radio modem, leased line, or dial up modem.

radio modem

EnviroRanger Wallmount unit

dial-up modem

leased line modem
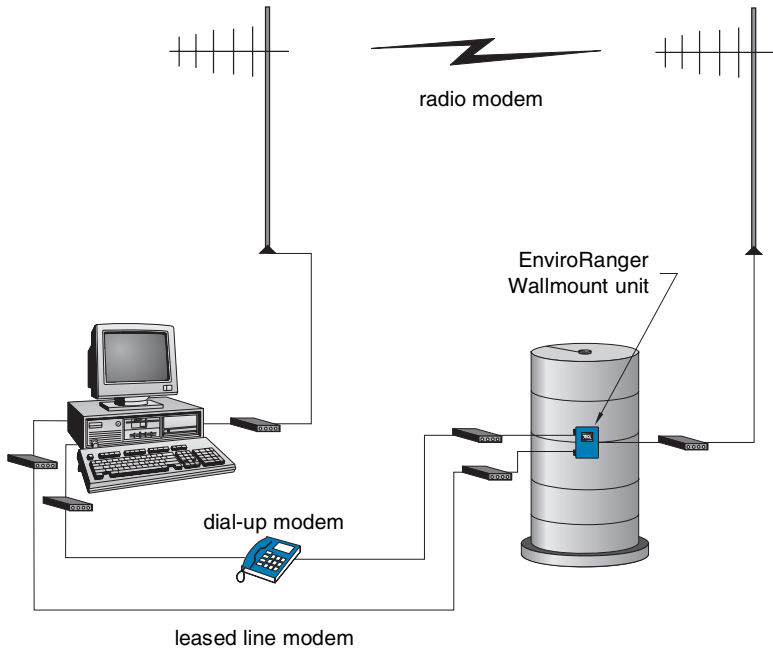
The standard ERS 500 supports the following two communication protocols:

Dolphin
Dolphin is a proprietary Milltronics protocol designed to be used with Dolphin Plus. For more information on Dolphin Plus, or to obtain a copy of the software, contact your Milltronics representative.

Modbus
Modbus is an industry standard protocol used by SCADA and HMI systems, and uses the EnviroRanger's RS-232 ports to communicate. For a description of the Modbus protocol, contact your local Schneider representative.

Optional SmartLinx® cards

The standard EnviroRanger unit may also be enhanced with Milltronics' SmartLinx® communication modules that provide an interface to popular industrial communication systems.

This manual only describes the built-in communications. For more information on SmartLinx, please consult the appropriate SmartLinx manual.

Installation

Wiring Guidelines

- the maximum length for RS-232 is 15 meters (50 feet).
- the RJ-11 cable maximum length is 3 meters
- RS-485 maximum length is 1,220 meters (4,000 feet)
- use 24 AWG (minimum)
- use good quality communication grade (shielded twisted pairs) cable that is recommended for RS-232 for ports 1 and 2.
- run the communication cable separately from power and control cables. (Do not tie wrap your RS-232 or RS-485 cable to the power cable or have them in the same conduit.)
- use shielded cable and connect to ground at one end only
- follow proper grounding guidelines for all devices on the bus

Improper wiring and incorrect choice of cables are two of the most common causes of communication problems.

Ports 1, 2, and 3

Port	Rack or Panel Mount	Wall Mount
1	RS-232 port (RJ-11 modular telephone jack) is on the unit's front and is generally used with a laptop computer.	RS-232 port (RJ-11 modular telephone jack) is on the motherboard and is generally used with a laptop computer.
2	RS-232 port is on the terminal block. This port is generally used with a modem but can also be used with a direct connector to HMI.	
3	Connections for the RS-485 port are on the terminal block and are used to multidrop multiple devices.	Connections for the RS-485 port are on the optional I/O cards and are used to multidrop multiple devices.

Port 1: RS-232 RJ-11 Jack

The RJ-11 port is inside the enclosure of the Wall mount, and on the face of the rack and panel units (see below).

RJ-11 Port
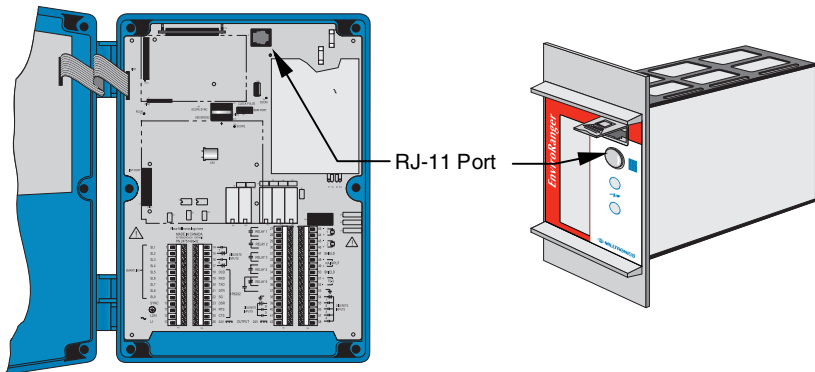
To connect the unit using RS-232 to a PC, use the cable as shown:

computer DB-9 (male)

RJ-11 on
EnviroRanger

RJ-11 jack

modular cable with RJ-11 plugs
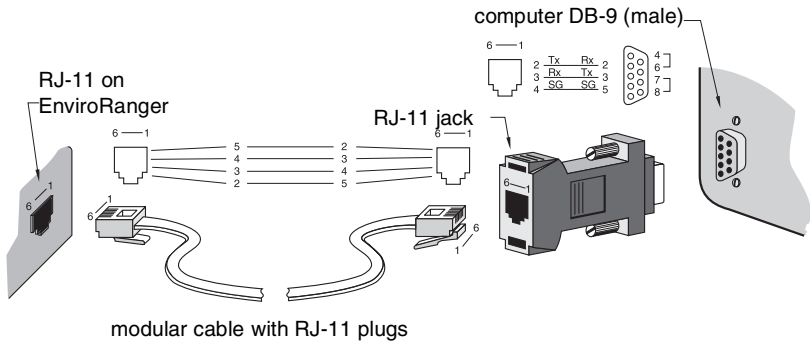
Note:
Jumper pins 4-6 and 7-8 at the DB-9.

Port 2: RS-232 Terminal Block

Rack or Panel Mount

The terminal blocks of the Rack and Panel units use pins 37 to 44 for RS-232 port 2.

cable shield

37	DCD
38	Rx
39	Tx
40	DTR
41	signal ground
42	DSR
43	RTS
44	CTS
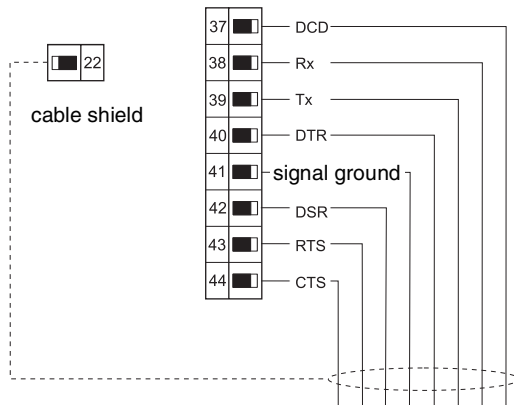
You can use terminal block 46 for the cable shield; however, block 47 and 48 are the power supply so use caution.

Rack or Panel to PC Connection

To connect the terminal block to a computer that does not use a flow control, use the following connection:
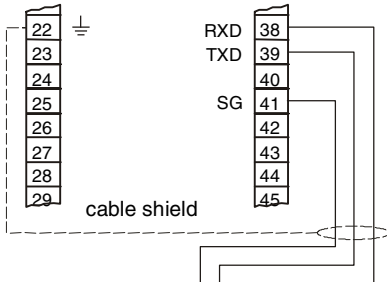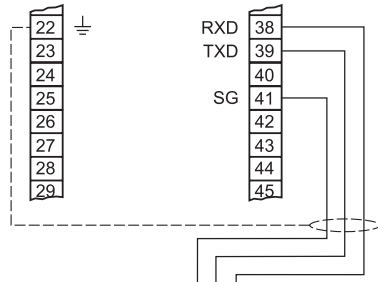
9-Pin D-shell RS-232 to PC (Female)   25-Pin D-shell RS-232 to PC (Female)

Rack or Panel to Modem Connection

To connect the terminal block to a modem that does not use a flow control, use the following connection:
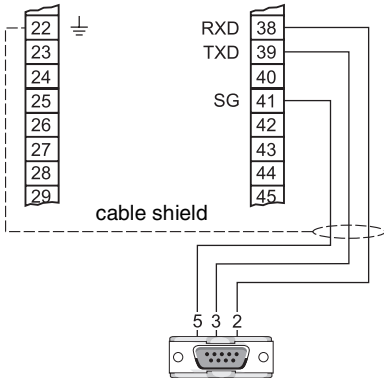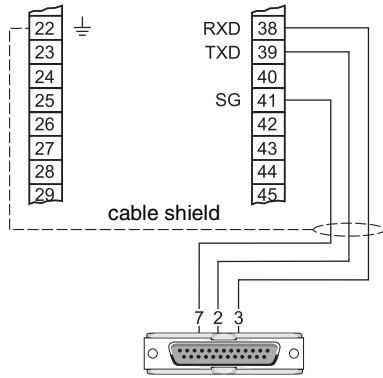
9-Pin D-shell RS-232 to Modem (Male)   25-Pin D-shell RS-232 to Modem (Male)

Note:

Modems switch Tx and Rx, therefore, connect Tx directly to Tx and Rx directly to Rx when wiring a modem.

With Hardware Flow Control (Rack or Panel Mount)

To connect the terminal block to an external modem using hardware flow control, use the following connection:

9-Pin D-shell RS-232 to Modem (Male) with hardware flow control

25-Pin D-shell RS-232 to Modem (Male) with hardware flow control
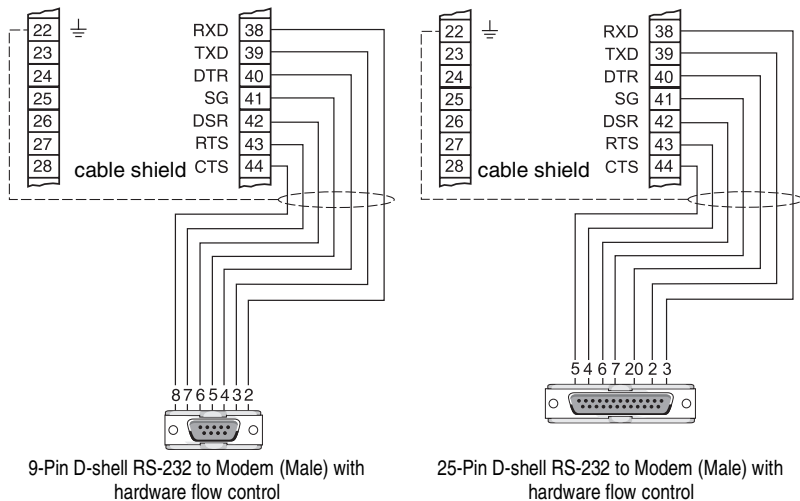
Note:
Many industrial modems do not support hardware flow control, such as the DATA-LINC DLM4100. Only use hardware flow device if required.

Wall Mount
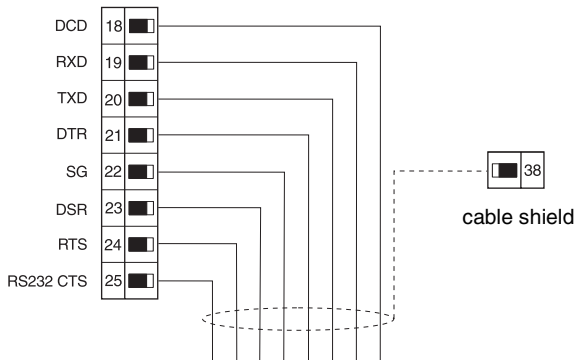
Wall Mount to PC Connection

To connect the terminal block to a computer that does not use a flow control:
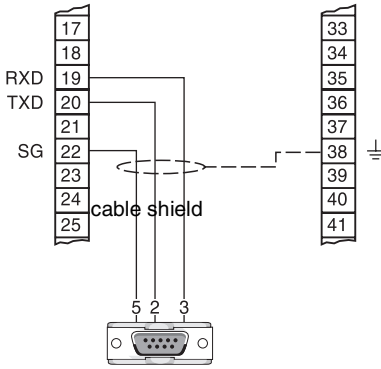
9-Pin D-shell RS-232 to PC (Female)
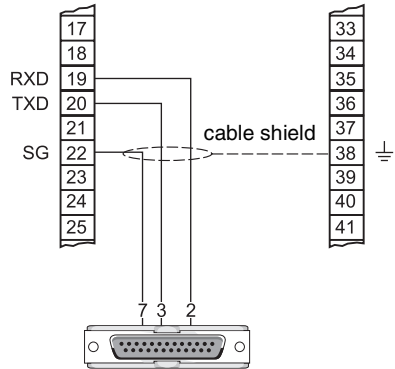
25-Pin D-shell RS-232 to PC (Female)

Wall Mount to Modem Connection

To connect the terminal block to a modem that does not use a flow control:
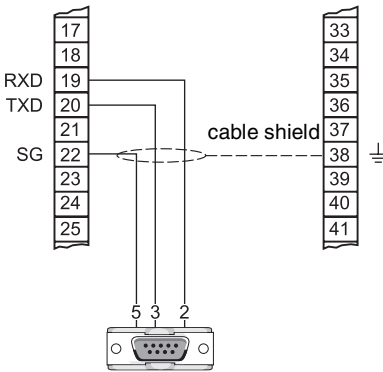
9-Pin D-shell RS-232 to Modem (Male)
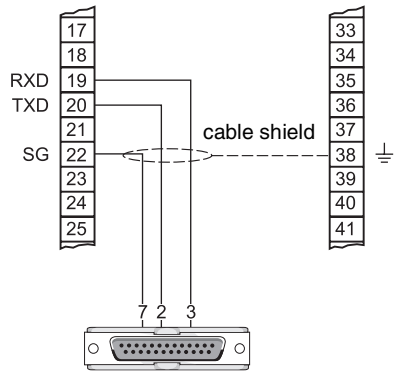
25-Pin D-shell RS-232 to Modem (Male)

With Hardware Flow Control (Wall Mount)

To connect the terminal block to a modem that uses a flow control.
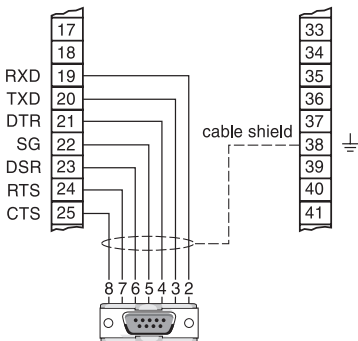
9-Pin D-shell RS-232 to Modem (Male)
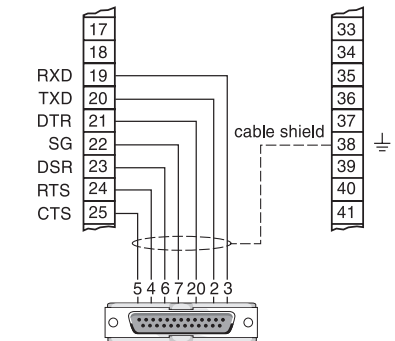
25-Pin D-shell RS-232 to Modem (Male)

Port 3: RS-485

Rack and Panel Mount

The RS-485 port for the Rack and Panel is on the terminal blocks.
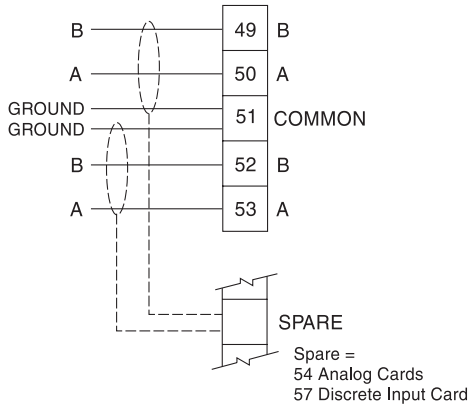
Wall Mount

The RS-485 port for the Wall Mount is on the optional I/O card.
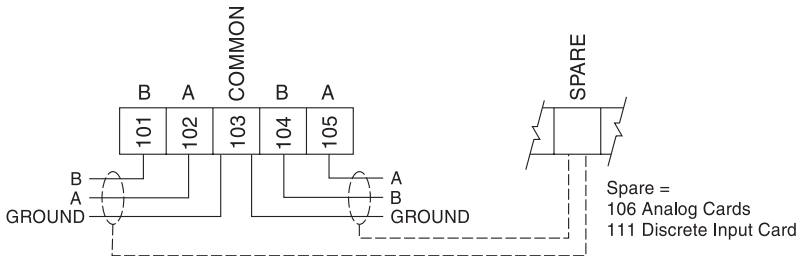
Configuring Communication Ports (Parameters)

The 11 parameters listed are indexed to the three communication ports, unless otherwise noted: An asterisk (*) identifies the preset value.

Port	Description
1	RS-232 port (RJ-11 modular telephone)
2	RS-232 port on terminal block
3	The RS-485 port for the rack and panel is on the terminal blocks. The RS-485 port for the wall mount is on the optional I/O card.

Notes:
- The RS-485 port is available on an optional I/O card.
- For parameters 770 to 780, port 3 and index 3 is only available if there is an optional I/O card present.

Installation

P770 Port Protocol

The communications protocol used between the ERS and other devices.

Primary Index	communications port		
Values	0	*	Communications port disabled (preset for port 3)
	1	*	Milltronics "Dolphin" protocol (preset for port 1)
	2		Modbus ASCII slave serial protocol
	3	*	Modbus RTU slave serial protocol (preset for port 2)
	4		ModBus ASCII master
	5		ModBus RTU master

The ERS supports Milltronics' "Dolphin" format (www.milltronics.com), and the internationally recognized Modbus standard in both ASCII and RTU formats. Other protocols are available with optional SmartLinx cards.

Report by Exception
If a modem is installed, P770 (Port Protocol) defines protocol for incoming calls. If a slave is currently connected, and a master needs to make an outgoing call, the slave will not be preempted. If the EnviroRanger is the master, it will hang up after exceptions are sent.

P771 Network Address

The unique identifier of the EnviroRanger on the network.

Primary Index	communications port
Values	Range: 0 to 9999
	Preset: 1

For devices connected with the Milltronics protocol this parameter is ignored. For devices connected with a serial Modbus slave protocol, this parameter is a number from 1-247. The network administrator must ensure that all devices on the network have unique addresses. Do not use the value "0" for Modbus communications as this is the broadcast address and is inappropriate for a slave device.

P772 Baud Rate

The communication rate with the master device.

Primary Index	communications port		
Values	4.8		4800 baud
	9.6	*	9600 baud (preset and only option for port 3)
	19.2	*	19,200 baud (preset for port 2)
	115.2	*	115,200 baud (preset for port 1)

This specifies the rate of communication in Kbaud. Any value may be entered but only the values shown below are supported. The baud rate should reflect the speed of the connected hardware and protocol used.

P773 Parity

The serial port parity.

Primary Index	communications port		
Values	0	*	No Parity (only option for port 3)
	1		Odd Parity
	2		Even Parity
	3		Mark Parity (=1)
	4		Space Parity (=0)

Ensure that the communications parameters are identical between the EnviroRanger and all connected devices, as many modems default to N-8-1.

P774 Data Bits

The number of data bits per character.

Primary Index	communications port	
Values	Range: 5 to 8	
	Preset: 8 (only option for port 3)	
	8	Modbus RTU
	7 or 8	Modbus ASCII
	7 or 8	Dolphin Plus

P775 Stop Bits

The number of bits between the data bits.

Primary Index	communications port
Values	Range: 1 or 2
	Preset: 1 (only option for port 3)

P776 Port Flow Control

The flow control used on the serial port.

Primary Index	communications port		
Values	0	*	No flow control
	1		RTS/CTS (Hardware flow control)

The ERS only supports hardware flow control (RTS/CTS) for port 2. Select flow control only if your connected device requires it.

P777 Key up Delay

The delay between asserting RTS and transmitting the first data bit.

Primary Index	communications port
Values	Range: 0-3000 milliseconds
	Preset: 0

This delay is built into the protocol for older radio modems that do not buffer data and require "key up" time. Consult your modem documentation.

P778 Modem Available

Sets the EnviroRanger to use an external modem on the RS-232 port.

Primary Index	communications port		
Values	0	*	No modem connected
	1		Answer only
	2		Dial only
	3		Answer / Dial

Note:
For Report by Exception to send reports, either 2 or 3 must be selected.

P779 Modem Inactivity Timeout

Sets the time that the unit will keep the modem connected with no activity.

Primary Index	communications port		
Values	Range: 0-9999 seconds		
	0	*	No timeout

To use this parameter, ensure that P778 (Modem Available)=1. Ensure that the value is low enough to avoid unnecessary delays when an unexpected disconnect occurs but long enough to avoid timeout while you are still legitimately connected. This parameter value is ignored by the Modbus Master Drivers as they automatically disconnect when done.

Hanging Up
If the line is idle and the P779 Modem Inactivity Timeout expires, then the modem is directed to hang up the line. Ensure that P779 is set longer than the standard polling time of the connected master device. 0 disables the inactivity timer.

Installation

P782 Parameter Index Location

Determines where index information is stored for the parameter access area for the Modbus register map.

Primary Index	Global		
Values	0	*	Global
	1		Parameter-Specific

Global (0)
The primary and secondary index values are global (they affect all of the parameter access area at once) and stored in:

- primary index – R43,999
- secondary index – R43,998

Parameter-Specific (1)
The primary and secondary index values are encoded into the format words found between R46,000 and R46,999. Each format word corresponds with the R44,000-series number in the parameter access map. For example, the format register R46,111 corresponds to the parameter P111 and the value is stored in R44,111. If Modbus protocol (P770 = 2 or 3) is not used this parameter is ignored.

Modbus Register Map

The memory map of the EnviroRanger occupies the Modbus holding registers (R40,001 and up). A description of the types of data is on the following pages. The table legend is at the bottom of the table. This map is used when protocol is Modbus Slave ASCII or Modbus Slave RTU. The table legend is located at the end of the table.

Register Map for Most Common Data

Legend	
Type	The type of data held in the group of registers.
Start	The first register to hold the referenced data.
Data Type	The possible values of the data in the register. SeeData Types on page 41 for more information.
Description	The type of data held in the individual registers.
#R	The number of registers used for the referenced data.
Read/Write	Indicates whether the register is readable, writeable or both.

Type	Description	Start	#R [1]	Data Type	Read/Write
Map ID	Register Map Type	40,063	1	0/1	R/W
ID	Milltronics Product Code	40,064	1	1	R
Single Parameter Access (SPA)		R40,090	7	see appendix A	
Date and Time	YYYY	41,000	1	1970 to 2069	R/W
	MM	41,001	1	1 to 12	R/W
	DD	41,002	1	1 to 31	R/W
	Hh	41,003	1	00 to 23	R/W
	Mm	41,004	1	00 to 59	R/W
	Ss	41,005	1	00 to 59	R/W
	time zone	41,006	1	-2400 to 2400	R/W
Point Data	Reading (3)[2]	41,010	3	-20,000 to 20,000	R
	Volume (2)[3]	41,020	2	-20,000 to 20,000	R
	Temperature (2)	41,030	2	-50 to 150	R
I/O	Discrete Inputs (8 or 16)[4]	41,070	1	Bit Mapped	R
	Relay Outputs (5)	41,080	1	Bit Mapped	R/W
	mA Input (1, 3, or 5)[5]	41,090	5	0000 to 20,000	R
	mA Output (2 or 4)[6]	41,110	4	0000 to 20,000	R/W
	Frequency Input (2)	41,130	2	0000 to 20,000	R
	Pulse Count Input (2)	41,140	4	UINT32	R

1 Maximum registers shown; fewer may be used depending on options installed.

2 Available as reading 1, reading 2, and Average or Difference when in either Standard or Dual Point Mode. In Standard Mode, point 2 and 3 are only available if P001 = Average or Difference. In Dual Point Mode, reading 1 and reading 2 are always available. Point 3 is only available if P001[3]= Average or Difference.

3 2nd volume available in Dual Point Mode only.

4 Indexed by 8 as standard, may vary with Optional cards installed.

5 1 Index is standard, may vary with Optional cards installed.

6 1 Index is standard, may vary with Optional cards installed

Register Map

Type	Description	Start	#R [1]	Data Type	Read/Write
Alarms	Global Alarms	41,200	1	Bit Mapped	R/W
Pump Control	Control and Status (5)	41,400	5	Bit Mapped	R/W
	Pump Faults (5)	41,410	5	Bit Mapped	R
	Pump on Setpoint (5)	41,420	5	0000 to 10,000	R/W
	Pump off Setpoint (5)	41,430	5	0000 to 10,000	R/W
	Pumped Volume (2)[3]	41,440	4	UINT32	R
	Pump Hours (5)	41,450	10	UINT32	R
	Pump Starts (5)	41,470	5	0000 to 10,000	R
	Pump Capacity (5)	41,480	5	0000 to 20,000	R
Parameter Access		43,998 to 46999			R/W
Report by Exception	Unit ID	49,250	1	0000 to 9999	R/W
	Exception Number	49,251	1	1 to 32	R
	Exception Type	49,252	1	0 or 1	R
	Exception Year	49,253	1	1970 to 2069	R
	Exception Month	49,254	1	1 to 12	R
	Exception Day	49,255	1	1 to 31	R
	Exception Hour	49,256	1	00 to 23	R
	Exception Minute	49,257	1	00 to 59	R
	Exception Second	49,258	1	00 to 59	R
	Value	49,259	2	UINT32 or float controlled by format	R
Data Logs	Last Logged Information	49,500-49,559			R
	Reset Logs	49,668-49,676			R/W
	Data Record Access	49700-49,706			R/W
	Log statistics Access	49,710-49,717			R/W
Alarms	Last Alarm	49,720-49,724			R/W
	Alarm reset	49,730			R/W

The EnviroRanger was designed to make it easy for master devices to get useful information via Modbus. This chart gives an overview of the different sections. A more detailed explanation of each section follows below.

UINT32 Order (R40,062)

This determines the format of unsigned, double-register integers (UINT32).

0 indicates that the most significant word (MSW) is given first
1 indicates that the least significant word (LSW) is given first

See UINT32 on page 41 for more information.

Map ID (R40,063)

This value identifies the register map used by the EnviroRanger. See P782 Parameter Index Location on page 18 and Parameter Access (R43,998 – R46,999) on page 30 for details.

Product ID (R40,064)

This value identifies the Milltronics device type. For the EnviroRanger, the value is 1.

Date and Time (R41,000 – R41,006)

The date and time can be read or written in registers 41,000 to 41,005 as defined in the Register Map.

Example: If you are located in Toronto, Canada and would like to set the date and time to February 14, 2001, 1:30 p.m. and 42 seconds, you would write the following:

Register	Value	Description
R41,000	2001	Year
R41,001	2	Month
R41,002	14	Day
R41,003	13	Hour
R41,004	30	Minutes
R41,005	42	Seconds
R41,006	-5	Time zone

Note:
- The time zone register (R41,006) is not required. It is used as a reference and does not affect the operation of the EnviroRanger.
- The Data Logs and the Alarm Logs do not use this date/time stamp format.

Point Data (R41,010 – R41,031)

Measurement point data contains the current reading on the instrument. This is the same as shown on the device's LCD for reading, volume and temperature for each measurement point. The reading is based on the unit's operation, and could be level, distance, OCM flow, or volume. See the EnviroRanger Parameter Reference manual (PL-603) for details.

The measurement registers are 41,010 to 41,012. The EnviroRanger uses 41,010 when configured with a single transducer and 41,010 to 41,012 when configured with two transducers (P111=4 or 5 only). Two transducers can create three readings because they can generate an average or differential reading (R41,012) as well as the two level readings (R41,010 and R41,11).

The available registers are:

Data	Registers	Parameter
Reading	41,010 to 41,012	P920
Volume	41,020	P924
Temperature	41,030 and 41,031	P912

The reading is expressed as a percentage of full scale, multiplied by 100:

Reading	Value
0	0.00%
5000	50.00%
7564	75.64%
20,000	200.00%

Note:
These values may contain numeric data for inoperative or malfunctioning points; refer to the alarm area (R41,200) for the operational status of the measurement points.

Input/Output (R41,070 – R41,143)

The EnviroRanger has discrete inputs, mA inputs, mA outputs and relay outputs. Details for each I/O type follow.

Discrete Inputs (R41,070)

This table shows the current status of the discrete inputs. Only register 41,070 is used.

Discrete Input	Data Address
1	41,070, bit 1
2	41,070, bit 2
3	41,070, bit 3
4	41,070, bit 4
5	41,070, bit 5
6	41,070, bit 6
7	41,070, bit 7
8	41,070, bit 8
9	41,070, bit 9
10	41,070, bit 10
11	41,070, bit 11
12	41,070, bit 12
13	41,070, bit 13
14	41,070, bit 14
15	41,070, bit 15
16	41,070, bit 16

Notes:
- If discrete inputs 7 or 8 are defined as frequency or pulse, then the data address is undefined.
- Discrete inputs 9 through 16 are only available if the optional discrete input card is installed.

Relay Outputs (R41,080)

This table shows the current status of the relays. A reading of "0" means that the relay function is not asserted and a "1" means that it is asserted. For example, a "1" for a pump relay means that the pump is running.

Relay	Data Address
1	41,080, bit 1
2	41,080, bit 2
3	41,080, bit 3
4	41,080, bit 4
5	41,080, bit 5

Values are written to control a relay only if the Relay Control Function (P111) is set to "communications" (65). See the Parameter Reference.

mA Input (R41,090-41,094)

The mA input is scaled from 0 to 2,000 (0 to 20mA multiplied by 100). This displayed in P254, index by input. The registers used for the optional I/P card are shown below:

Auxiliary I/P card	Register
None, 4AO, 8DI	41,090
2 AI/2AO	41,090-41,092
4 AI	41,090-41,094

mA Output (R41,110-41,113)

The mA output is scaled from 0 to 2,000 (0 to 20 mA multiplied by 100). This is displayed in P911. The registers used for the optional I/P card are shown below:

Auxiliary O/P card	Register
None, 4AI, 8DI	None
2 AI/2AO	41,110-41,111
4 AO	41,110-41,113

Frequency Input (R41,130 – R41,131)

The frequency input is scaled from 0 to 20,000 (0 to 200% multiplied by 100).

Only discrete inputs 7 and 8 can act as frequency inputs, and they must be set using Discrete Input Function (P270 = 4 or 5):

DI	Register
7	41,130
8	41,131

If discrete inputs 7 or 8 are not defined as frequency inputs, the value in this register is undefined.

Pulse Counter (R41,140 – R41,143)

The pulse counter holds the current total for the associated discrete input. Two registers are used to hold the integer value because the totals can

become very large. See Unsigned Double Precision Integer (UINT32) on page 41 for more information.

The EnviroRanger LCD cannot display the precise count, (it has four digits), However, the value that is available through communications is accurate.

Only discrete inputs 7 and 8 can act as pulse counters, and they must be set using Discrete Input Function (P270 = 4):

DI	Registers
7	41,140, 41,141
8	41,142, 41,143

Global Alarms (R41,200)

These alarms are global to the EnviroRanger and can be detected through Modbus.

Bit #	Description	Remote Access
1	Underflow (P169=2)	Read only
2	Overflow (P169=1)	Read only
3	Power Loss (P519=1)	Read only
4-15	Reserved	
16	Global Pump Reset Control	Write only

Note:
Refer to the Parameter Reference manual for more details on how these alarms are triggered and reset.

Pump Control (R41,400 – R41,474)

Only relays set for pump control (P111 = 50 to 56) are available. These registers have no effect on relays programmed for other uses.

Register Map

Control and Status Word (R41,400 – R41,404)

Each Pump relay has a corresponding control and status word listed in the following registers.

Pump Relay	Register
1	41,400
2	41,401
3	41,402
4	41,403
5	41,404

Read and write the bits individually using a SCADA or HMI tool. When appropriate, the corresponding EnviroRanger parameter is listed. See the EnviroRanger Parameter Reference manual (PL-603) for full parameter details.

Bit #	Description	Read / Write
1	Pump available (P520)	Read only
2	Pump in Local Auto (P521)	Read only
3	Pump in Local Manual (P522)	Read only
4	Pump in Remote Auto (P523)	Read only
5	Pump in Remote Manual (P524)	Read only
6	Local Auto discrete input	Read only
7	Run Status discrete input	Read only
8	Fault A discrete input	Read only
9	Fault B discrete input	Read only
10	Reserved	
11	Pump Relay State	Read only
12	Remote Control Enable (P515)	Read / Write
13	Remote Auto	Read / Write
14	Remote Start	Read / Write
15	Remote Stop	Read / Write
16	Pump Failed (P510)	Read / Write

For a full description of what these functions do, refer to the Parameter Reference manual.

Status (Read Only) Bits

Pump Available (bit 1)
Indicates whether the pump is available to the EnviroRanger pump control routines. Mirrors the value of P520.

When operating normally pumps are always available. The pump can become unavailable if it is put into "manual" mode, if there is a detected pump fault through the discrete inputs, or if there is a power failure to the pumps.

0 = no
1 = yes

Pump in Local Auto (bit 2)
Indicates that the indexed pump is exclusively controlled through the EnviroRanger pump control algorithms. Mirrors the value of P521.

0 = no
1 = yes

Pump in Local Manual (bit 3)
Indicates that the indexed pump is exclusively controlled from a discrete input. Usually a three-way (on-off-auto) switch mounted near the EnviroRanger is used to put the unit into Local Manual mode and to control the pump. Mirrors the value of P522.

0 = no
1 = yes

Pump in Remote Auto (bit 4)
Indicates that control of the indexed pump is from the EnviroRanger pump control algorithms. See the EnviroRanger Parameter Reference manual (PL-603) for a description of the pump control algorithms. The remote system can put the pump into manual mode. This is done by writing to bits 12 and 13 of the Status and Control register. Mirrors P523.

0 = no
1 = yes (b12=1, b13=1)

Pump in Remote Manual (bit 5)
Indicates that the indexed pump is exclusively controlled through communications from a remote system. This is done by writing to bits 12 and 13 of the Status and Control register.

To control the pumps use bits 14 and 15.

0 = no
1 = yes (b12=1, b13=0)

Auto / Manual Discrete Input (bit 6)
Indicates the current status of any discrete input that is allocated to this pump for Local Auto operation.

0 = pump is in manual mode
1 = pump is in local auto mode

Run Status Interlock (bit 7)
Indicates if the pump running interlock is active (the pump is running).

0 = no
1 = yes

Register Map

Pump Relay State (bit 11)
Status of the pump.

This bit reports the status of the pump relay. The pump control function can be asserted (pump running) or not (pump idle).

0 = pump not asserted
1 = pump asserted

Control (Read / Write) Bits

Control bits can be set by writing the desired value. The value can also be read to determine the current status of the functions and operations of the EnviroRanger. For example, the EnviroRanger can be in four different states of operation: Remote Manual, Remote Auto, Local Auto, and Local Manual. These control bits are used to switch modes. Also, when the EnviroRanger is in the remote manual mode, the control bits can start and stop the pumps.

Remote Control Enable (bit 12)
Sets the EnviroRanger to accept commands from a remote system.

If there is a discrete input configured as a local / remote switch (P501 $\neq$ 0), then this value becomes read only and it mirrors the value of the switch. If there is no discrete input configured (P501= 0), then this bit is writeable. It then must be set to "1" to allow for remote control of the pump through the subsequent control bits. As preset, this value is writeable.

The EnviroRanger can always provide data to remote systems but requires the setting of this bit to accept remote control of the referenced pump relay.

0 = pump in local only
1 = pump available for remote control

Remote Auto / Manual (bit 13)
Sets the EnviroRanger control algorithms on or off.

The remote control enable bit (12) must be set to "1" before writing this bit.

0 = Manual	all control functions must come from the remote system
1 = Auto	control algorithms work normally but can be overridden by the remote system

Remote Start (bit 14)
Sends a command to the indexed pump to start.

This is a momentary control bit. Write "1" to the bit to issue the command. Do not read the bit. The bit always displays "0".

Both the remote control enable bit (12) and the remote auto / manual bit (13) must be set to "1" before writing this bit.

1 = pump commanded to start

Remote Stop (bit 15)
Sends a command to the indexed pump to stop.

This is a momentary control bit. Write "1" to the bit to issue the command. Do not read the bit. The bit always displays "0".

Both the remote control enable bit (12) and the remote auto / manual bit (13) must be set to "1" before writing this bit.

1 = pump commanded to stop

Pump Failed Status (bit 16)
Reports on the status of the indexed pump with the value from P510 and allows the alarm to reset.

P510 is a latched parameter. It is set to 1 as soon as a pump error event is detected by the EnviroRanger and must be reset to 0 before the pump will be included in the control algorithms. See the EnviroRanger Parameter Reference manual (PL-603) for more information on P510.

0 = normal operation
1 = pump failed

Pump Faults (R41,410 – 41,414)

Each Pump relay has a corresponding fault word listed as follows.

Pump Relay	Register
1	41,410
2	41,411
3	41,412
4	41,413
5	41,414

Each relay has four bits that correspond to fault status as follows:

Bit #	Description	Read / Write
1	Pump Fault A (P513)	Read only
2	Pump Fault B (P514)	Read only
3	Pump Run Status Fault (P511)	Read only
4	Pump Low Flow Fault (P512)	Read only

To read the fault bits:

0 = normal	no fault condition exists and the pump is operating normally
1 = fault	a fault is detected and the pump is removed from the pump rotation and will not run (not guaranteed for pump low flow fault)

Pump Fault "A"
Indicates that the pump is reporting a fault through a discrete input.

Pump Fault "B"
Indicates that the pump is reporting a fault through a discrete input.

Pump Run Status Fault (P511)
Indicates that the pump is reporting a fault through a discrete input.

Pump Low Flow Fault (P512)
Indicates that the calculated rate for the pump is not meeting the capacity setpoint. This usually indicates that the pump is not working properly.

Pump "on" Setpoint (R41,420 – R41,424)

The "on" setpoint level (P112) for the referenced pump relay.

The setpoint is scaled from 0 to 10,000 (0 to 100% of span multiplied by 100). So 54.02% is shown in the register as 5402.

Pump "off" Setpoint (R41,430 – R41,434)

The "off" setpoint level (P113) for the referenced pump relay.

The setpoint is scaled from 0 to 10,000 (0 to 100% of span multiplied by 100). So 54.02% is shown in the register as 5402.

Pumped Volume (R41,440 – R41,443)

The pumped volume registers hold the current total for all of the pumps associated with a level point. These registers are available only if operation is set to pumped volume (P001 = 7).

These volumes can become very large. Therefore, two registers are used to hold the value. See Unsigned Double Precision Integer (UINT32) on page 41 for more information.

The value in the registers is given as an integer value but must be interpreted as having the number of decimals set in P633 LCD Totalized Decimal Position (0 to 3). Ensure that your software accounts for these decimal places before you report the pumped volume totals.

Pump Hours (R41,450 – R41,454)

The number of running hours for the referenced pump relay. The hours are given to three decimal places, so the integer must be divided by 1000 to get the correct value. For example 12,340 represents 12.34 hours.

This value comes from parameter P310. See the EnviroRanger Parameter Reference manual (PL-603) for details.

Pump Starts (R41,470 – R41,474)

The number of pump starts for the referenced pump relay.

This value comes from parameter P311. See the EnviroRanger Parameter Reference manual (PL-603) for details.

Pump Capacity (R41,480 – R41,484)

The calculated pump capacity for the referenced pump relay. The value is scaled from 0 to 20,000 (0 to 200% multiplied by 100).

This value comes from parameter P182. See the EnviroRanger Parameter Reference manual (PL-603) for details.

Parameter Access (R43,998 – R46,999)

Parameter values are given as integers in the range of registers from R44,000 to R44,999. The last three numbers of the register correspond to the parameter number.

Parameter Register #	Format Register #	Parameter #
44,000	46,000	P000
44,001	46,001	P001
44,002	46002	P002
…	…	…
44,999	46,999	P999

Usually, the parameters are all read / write.

Note:
- Parameters P000 and P999 are read only. If P000 is set to "lock activated" then all of the parameters are read only.
- Parameter P999 (Master Reset) cannot be used via Modbus.
- See Data Types on page 41 for a description of the different types of data associated with different parameters.

Each parameter register has a corresponding format register that holds the format information required to interpret the value. See Format Words on page 33.

Parameter Indexing

Many parameters are indexed. Some indexed parameters affect multiple I/O devices.

The following is known as a primary index.

P111 is the Relay Control Function. This parameter determines how a relay is controlled by the EnviroRanger (used as an alarm, for pump control, etc.).

Because there are five relays on the EnviroRanger, P111 is indexed by five to allow each relay to be programmed independently.

A few parameters also have a secondary index. While a secondary index is important for setting up the EnviroRanger, it is almost never needed through remote communications.

Indexing the Parameter Access Area

Because each parameter has only one register in which to communicate its value, the index(es) for the parameter must be known to interpret the information in the register correctly.

For example, the value returned in register R44,111 is useless unless you know to which relay it refers. See Relay Function Codes (P111 Only) on page 44 for details on P111 values.

To determine the index values, the primary and secondary index must be read or write. There are two methods of handling these index values described in the following paragraphs: Global Index Method and Parameter Specific Index Method.

Reading Parameters

To read parameter values, follow the steps listed in either the Global or the Parameter Specific Index Method that follow. You must be able to program your HMI or SCADA system before completing these methods.

Global Index Method (P782 = 0)

Global format method sets index values for all parameters simultaneously. Use this method to read multiple values set to the same index values.

1. Write the primary index value into R43,999.

    This is a value between 0 and 40 which specifies the input or output indexed by the parameter.

    Examples are:
    - Transducer 1 is index 1
    - Discrete input 8 is index 8
    - Relay 5 is index 5

2. Write the secondary index value into R43,998.

    This is a value between 0 and 40 that specifies the secondary index on the parameter. This value is usually 0.

3. Write the desired format value into the appropriate format register. Because the primary and secondary indexes are already specified, these portions of the format word are ignored and only the last digit is significant.

    See Format Registers on page 33 for details.

4. Read the value from the appropriate parameter register.

    Types of values are:
- Numeric Values, on page 41
- Bit Values, on page 41
- Split Values, on page 42
- Text Messages, on page 43
- Relay Function Codes (P111 Only), on page 44

    A value of 22,222 indicates that an error has occurred. Specify a different format type and try again.

Parameter Specific Index Method (P782 = 1)

The Parameter Specific index method sets the index values for each parameter independently. Use this method to read multiple parameters with different index values.

1. Write the primary index, secondary index, and data format values into the appropriate format register.

    For example, to read the following information
- measured level (P921)
- in units with three decimal places
- from transducer one
- send the integer value
- 01008 to register 46,921. Send integer value "28". the leading zeros are assumed (see Format Registers on page 33 for details)

2. Read the value from the appropriate parameter register (the example uses 44,921).

    Types of values are:
- Numeric Values on page 41
- Bit Values on page 41
- Split Values on page 42
- Text Messages on page 43
- Relay Function Codes (P111 Only) on page 44

    A value of 22,222 indicates that an error occurred. Specify a different format type and try again.

Writing Parameters

The method of writing parameters is similar to the method of reading them. Become familiar with Reading Parameters, page 31, before attempting to write any parameters.

Register Map

To write parameter values to the EnviroRanger, follow these steps:

Global Index Method (P782 = 0)

1. Write the primary index value into R43,999.

2. Write the secondary index value into R43,998.

3. Write the desired format value into the appropriate format register.

4. Write the value to the appropriate parameter register.

Parameter Specific Index Method (P782 = 1)

1. Write the primary index, secondary index, and data format values into the appropriate format register.

2. Write the value to the appropriate parameter register.

Format Words (R46,000 to R46,999)

Format words are unsigned integers that contain up to three values (described below). The number of values used in the format words depends on the Parameter Index Location (P782) that is used.

Parameter P782 Parameter Index Location, described on page 18, determines which of two methods is used to access the format words: Global Index Method or Parameter Specific Index Method.

Global Index Method (P782 = 0)

Only the final digit of the format word determines the decimal offset (below).

Parameter-Specific Index Method (P782 = 1)

All three decimal fields are used to determine the parameter value's primary index, secondary index, and decimal offset.

Format Registers

Each format register is made up of three decimal fields:

- decimal offset
- secondary index
- primary index

00000

decimal offset (0-9)

secondary index (00-99)

primary index (00-64)
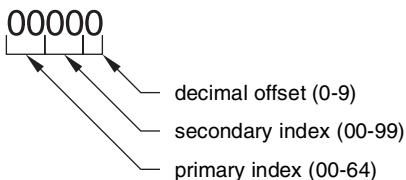
The primary and secondary indices correspond to those that are used by the parameter.

The decimal offset indicates how the remote system must interpret the integer value that is stored in the parameter access register. The following table shows how different parameter values can be shown based on a register value (integer) of "1234."

Decimal	Offset	Example
0	0	1,234
1	-1	12,340
2	-2	123,400
3	-3	1,234,000
4	-4	12,340,000
5	-5	123,400,000
6	+1	123.4
7	+2	12.34
8	+3	1.234
9	Percent	12.34%

Examples of using the format word for both the index values and the decimal offset value are shown below:

Format	P. Index	S. Index	Decimal
00000	00	00	0
01003	01	00	3 right
02038	02	03	3 left
05159	05	15	percent

So, to write these values you can use a decimal offset as follows: format word = (primary index x 1000) + (secondary index x 10) + (decimal).

Time and Date

Because the time and date values do not fit into a single register, these values are indexed on the secondary index.

Index	Date	Time
01	yy – year	hh – hour
02	mm – month	mm – minute
03	dd – day	ss – second

Because the time and date values use three index entries, they cannot be accessed for parameters that already have a primary and secondary index. These parameters are:

- Overflow Logging
- Profile Records
- TVT Shaper

Report by Exception (R49,250-49,259)

Report by exception is a base feature that notifies the host that an exception has occurred as opposed to being polled by the host. The following occurs:

1. The alarm/event triggers the exception.

2. The unit connects to a host.

3. For Modbus Master, a single 'write registers' message is sent indicating:
   a) which event occurred
   b) from which unit
   c) when it occurred
   d) what the associated data is

   For Modbus slave, the host must poll and clear exception.

4. The Modbus master will then stop. The Slave waits for the host to disconnect or times out due to inactivity.

Exceptions-32 different

There can be 32 different exceptions. Both the alarm that triggers the exception and the slave address with the slave 4x register to start writing can be selected. Each exception can report the value of one parameter.

Dialling

- Eight user-programmed numbers up to 16 digits can be dialled.
- The number of attempts can be set from 1 to 9999 or to non-stop.
- Retry and timeout intervals can be set up to 9999 seconds.

Multiple Masters

Modbus and the EnviroRanger do not support multiple masters. If used in a multiple master configuration, an external collision avoidance mechanism must be used (not provided by Milltronics). An example of such a mechanism is a dial up connection to a slave with a single modem.

Registers and Parameters Description

Unit ID

Register 49250	**Reading**
	Four digit ID of the unit generating the report. A value of 0 indicates no report.
	Writing
	Writing a 0 will clear the current exception.
P470	User programmable 4 digit unit ID. 0 will disable the report by exception.

Number

Register 49251	**Read Only**
	Which report generated exception 1-32
P484	Which trigger will generate exception 0 and 1-32

Type

Register 49252	**Read Only**
	1. Transfer was asserted
	2. Transfer was negated
P485	1. Trigger on asserted
	2. Trigger on negation
	3. Trigger on both

Date and Time

Year	R49,253	Year report generated
Month	R49,254	Month report generated
Day	R49,255	Day report generated
Hour	R49,256	Hour report generated
Minute	R49,257	Minute report generated
Second	R49,258	Second report generated

Value

Register 49259	**Read Only**
	The value that is reported
P481, P482, and P483	The parameter, index, secondary index, and format of the value to send

Data Logs (R49,500-49,730)

Data logging is only available with the optional expansion memory. There are 10 user defined data logs (1 to 10) and each data log can hold 5,000 data entries.

There is also an alarm Log, which is Log 0. Any trigger configured as an alarm to be logged (P430) will be logged in this section. Both the rising and trailing edges of the trigger will be logged. This log is not the same as the data logs.

Format of Information

The Data Log section is divided up into several different sections:

Section	Register Range	Description	Reference Parameter
Last Logged Information	49,500 – 49,559	Contains the value, time, trigger state, and number of entries for logs 1 to 10.	P450 – P453
Reset Logs	49,668 – 49,677	Used to reset users logs 1 to 10. Place a 1 in the correct register and the log is cleared.	P447
Data Record Access	49,700 – 49,706	Hand shaking area used to request any record of logs 0 to 10 (this section includes access to the alarm log).	N/A
Log Statistics Access	49,710 – 49,717	Hand shaking area used to request the log statistics for any of the user logs 1 to 10 (does not include the alarm log).	P454 – P 458
Last Alarm Logged	49,720- 49,724	Contains the trigger number, time, and trigger state of the most current alarm. It also contains the total number of entries in the alarm log.	P432-P435
Alarm Reset	49,730	Placing a 1 in this register will reset the alarm log.	P431

Lasted Logged Information (R49,500 – 49,559)

Registers	Description	Range	Units
R49,500-49,501	Value for log 1 (3 decimal places)	Depends on parameter	UINT32
R49,502-49,503	Time for log 1	In seconds from Jan 1, 1970 (see appendix C)	UINT32
R49,504	Trigger state that causes data capture	0 or 1	UINT
R49,505	Number of entries for log 1	0 to 5,000	UINT
R49,506 –49,511	Data for log 27		
R49,512-49,517	Data for log 3		
R49,518 – 49,523	Data for log 4		
R49,524 – 49,529	Data for log 5		
R49,530 – 49,535	Data for log 6		
R49,536 – 49,541	Data for log 7		
R49,542 – 49,547	Data for log 8		
R49,548 – 49,553	Data for log 9		
R49,554 – 49,559	Data for log 10		

---

7 The data for logs 2 through to 10 is the same format as log 1. The data repeats for each log.

Reset Logs (R49668 – R49677)

When a value of 1 is placed in these registers, the corresponding log file is cleared.

Register	Log that is reset
R49,668	Reset log 1
R49,669	Reset log 2
R49,670	Reset log 3
R49,671	Reset log 4
R49,672	Reset log 5
R49,673	Reset log 6
R49,674	Reset log 7
R49,675	Reset log 8
R49,676	Reset log 9
R49,677	Reset log 10

Data Record Access Area (R49,700 – 49,706)

This area of memory provides a method to retrieve any log out of all the log files (Log 0 to 10). It works in a similar way to Single Parameter Access (SPA), in that you provide the log file number and the entry number, and the EnviroRanger will write, the entry number, entry value, entry time, and trigger state into the registers.

Register	Description	Values	Read/write	units
R49,700	Log file number	0 to 10	R/W	UINT
R49,701	Entry number	1 to 5000	R/W	UINT
R49,702-49,703	Entry value	(3 fixed decimal places – see UINT32 section)	R	UINT32
R49,704-49,705	Entry Time	(time since Jan. 1, 1970 – see appendix C)	R	UINT32
R49,706	Trigger state	0 or 1	R	UINT

Register Map

LOG Statistics (R49,710 – R49,717)

This area of memory provides a method to retrieve the statistical information on a data log (Log 1 to 10). It works in a similar way to Single Parameter Access (SPA) in that you provide the log file number and the statistical type (see below), and then the EnviroRanger will write the average, minimum, and maximum value.

Register	Description	Values	Read/write	units
R49,710	Log file number	1 to 10	R/W	UINT
R49,711	Statistical type	0 to 10	R/W	UINT
R49,712-49,713	Average value	(3 decimal places see UNIT32 section)	R	UINT32
R49,714-49,715	Minimum value	(3 decimal places see UNIT32 section)	R	UINT32
R49,716-49,717	Maximum value	(3 decimal places see UNIT32 section)	R	UINT32

The types of statistics are listed below:

Statistics Type (Write Value)
0 – Current Trigger Period Stats
1 – current hour stats
2 – current day stats
3 – current week stats
4 – current month stats
5 – previous hour stats
6 – previous day stats
7 – previous week stats
8 – previous month stats
9 – previous 60 minutes
10 – previous 24 hours

Note:
Statistics Type 9 and 10 require considerable computation; therefore, we do not recommend using them with communications.

Register Map

Last Alarm (R49,720 – 49,724)

This gives the latest alarm information. It also gives the total number of entries in the alarm log.

Register	Description	values	Read/write	Units
R49,720	Last alarm trigger	1-32	R	UINT
R49,721-49,722	Time stamp	Time in seconds from Jan. 1, 1970 (see appendix C)	R	UINT32
R49,723	Trigger state	0 or 1	R	UINT
R49,724	Number of entries	0 to 5000	R	UINT

Alarm Reset (R49,730)
When a value of 1 is placed in this register, the alarm log is cleared.

Register Map

Data Types

The EnviroRanger parameters do not always use integers to hold values. For the convenience of the programmer, those values are converted to and from a 16-bit integer number. This section describes the conversion process. The sections that follow describe where those values are in the discrete I/O and block transfer addresses, and how to get the parameters you need.

Numeric Values

Numeric parameter values are the most common. For example, parameter P920 (Reading) returns a number that represents the current reading (either level or volume, depending on the EnviroRanger configuration).

Numeric values are requested or set in units or percent of span, and may be specified with a number of decimal places.

Numeric values must be in the range -20,000 to +20,000 to be valid. If a parameter is requested and its value is more than +20,000, the number 32,767 is returned; if it is less than -20,000, the number -32,768 is returned. If this overflow happens, decrease the number of decimal places.

If a parameter cannot be expressed in terms of percent of span, or has no meaningful value, the number 22,222 is returned. Try requesting the parameter in units, or refer to the Parameter Reference manual (PL-603) to understand the format and use of the requested parameter.

Bit Values

Bits are packed into registers in groups of 16 bits (1 word). In this manual, the bits are numbered from 1 to16, with bit 1 as the least significant bit (LSB) and bit 16 as the most significant bit (MSB).

16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01

MSB   LSB

Unsigned Double Precision Integer (UINT32)

Large numbers are put into unsigned 32 bit integers. By default, they are set up so that the first word (register) is the most significant word (MSW) and the second word (register) is the least significant word (LSW).

For example, if R41,442 is read as a UINT32, the 32 bits would look like this:

R41,442			R41,443		
16	MSW	1	16	LSW	1
32	32-bit integer value (UINT32)				1

The two registers are read as a 32-bit integer.

The most significant word (MSW) and least significant word (LSW) can be reversed to accommodate some Modbus drivers. See UINT32 Order (R40,062) on page 19 for details.

The position of the decimal place is depended on the register. For more details see the description of the register.

A fixed 3 decimal places means that a number of 234567 in a register means 234.567.

Split Values

Certain parameters are actually a pair of numbers separated by a colon, using this format: xx:yy.

One example is P807, Transducer Noise, where:
xx   = the average noise value in dB.
yy   = the peak noise in dB.

The number which corresponds to xx:yy, either for reading or setting a parameter, is determined by the following formula:

For storing to the Milltronics device:
value = (xx + 128) x 256 + (yy + 128)

For reading from the Milltronics device:
xx   = (value / 256) – 128
yy   = (value % 256) – 128

Where:
% is the modulus operator.

The modulus can be computed by following these steps:
$value_1$ = value / 256
$value_2$ = remainder of $value_1$
$value_3$ = $value_2$ x 256
yy = $value_3$ – 128

It may simplify Parameter to notice:
xx = (most significant byte of value) – 128
yy = (least significant byte of value) – 128

Text Messages

If a Milltronics device parameter returns a text message, that message is converted to an integer and provided in the register. The numbers are shown in the following table:

Number	Text Message as displayed on LCD
22222	Invalid value
30000	Off
30001	On
30002	≡ ≡ ≡ ≡
30003	⌐ ⌐ ⌐ ⌐ (parameter does not exist)
30004	Err
30005	Err1
30006	Open
30007	Short
30008	Pass
30009	Fail
30010	Hold
30011	Lo
30012	Hi
30013	De
30014	En
30015	- - - - (parameter has not been set)
-32768	Value is less than -20,000
32767	Value is greater than 20,000

Relay Function Codes (P111 Only)

If a Milltronics device parameter returns a relay function code, that message is converted to a number and is then provided in the register. The numbers are shown in the following table:

Relay function Code	Number	P111
Off, relay not used	0	0
Undesignated Level Alarm	1	1
Low-Low Level Alarm	2	1 – LL
Low Level Alarm	3	1 – L
High Level Alarm	4	1 – H
High-High Level Alarm	5	1 – HH
In Bounds Alarm	6	2
Out of Bounds Alarm	9	3
Rate of Level Change Alarm	12	4
Temperature Alarm	15	5
Loss of Echo (LOE) Alarm	20	6
Transducer Cable Fault Alarm	16	7
Pump Efficiency Alarm	17	8
Clock Failure Alarm	18	9
Time of Day Alarm	19	10
Pump Failure Alarm	70	11
Power Failure Alarm	71	12
Totalizer	22	40
Flow Sampler	23	41
Fixed Duty Assist	25	50
Fixed Duty Backup	26	51
Alternate Duty Assist	30	52
Alternate Duty Backup	31	53
Service Ratio Duty Assist	35	54
Service Ratio Duty Backup	36	55
First In First Out (FIFO)	40	56
Time	45	60
Overflow	50	61
Aeration	55	62
Gate	60	63
Flush Valve	65	64
Communication	66	65

See the EnviroRanger User Guide for information on P111.

Modems

The Modbus protocol is a modem friendly protocol and works with numerous different modems. This section provides some general guidelines on modems and their connection. For detailed information, see the documentation provided with your modem.

Picking Modems

There are several different types of modems: dial-up, leased line, radio-link and fiber-optic.

Modem types and models have various characteristics. Before purchasing the modem, contact the modem manufacturer and ask if they have experience using the modems with Modbus protocol with no flow control. If so, ask them what settings were required.

Dial-up
Uses a standard analog phone line and dials the number of the receiving modem.

Lease line
Comes in either 2 or 4 wire types and uses special phone lines that are 'leased' from your phone company (or you) and does not require any dialling.

Radio-link
Comes in many different types, but all use radio frequencies for transmitting the information.

Fibre-optic
Uses a fibre-optic line to connect the two modems.

> **Note:**
> The modem to be connected shall be approved to UL 1950, 3rd edition.

Setting up the Modems

In most cases, users do not need to configure their modems using a terminal or PC. The EnviroRanger sends out AT commands to ensure a common setup. To wire the modem in a Rack or Panel unit, see Rack or Panel to Modem Connection on page 11. To wire a Wall Mount, see Wall Mount to Modem Connection on page 13.

Custom Cases

If your modem does not function, then consult your modem manual to turn off "autobauding". Some modem manuals refer to this as "fixed DTE rate operation". A custom save must then be performed as described in the following Custom Save Setup section.

Custom Save Setup

Most modems provide non-volatile memory to store your custom setup so that it is retained after a power loss or modem reset. This is referred to as a *profile* in many modem manuals.

The method for accessing profiles is standard amongst most manufacturers; the basic steps are illustrated in the following example for a hypothetical 'older' modem.

Assume that the modem, by default, uses a variable DTE rate, or it *autobauds*. Since this is not compatible with the EnviroRanger, the DTE rate needs to be changed to fixed, and this needs to be permanent. The steps are:

1. Determine the AT command to make the DTE rate fixed. On some modems this is **ATN0**. On others it may be **AT&B1**.

2. Power the modem down then up again.

3. Hook a terminal or PC up to the modem and send it the command from step 1.

4. Save this setting by sending the modem the **AT&W0** command. This stores your changes into profile number 0.

5. Tell the modem to restore profile 0 on power-up by sending it **AT&Y0**.

6. Cycle the power to the modem and test it with the EnviroRanger.

7. If the modem is still not functioning, do the Example Setup in the following section.

Example Set-up for older or non-standard modems

If turning off autobauding has not fixed the problem do this section. Older or non-standard modems are configured using software, DIP switches, jumpers or a combination of these methods.

DIP switches are normally located at the back of the modem. Jumpers are normally located on the motherboard and require that you remove the cover. Software normally requires you to use a standard terminal program and to connect to the RS-232 port on the modem and send special commands. The most popular command set is called the AT, or Hayes, command set.

Check your modem manual for instructions on how to configure it. If your modem is still not working, set the following:

Master

Modem

- auto answer off (DIP switch?)
- load factory default (DIP switch?)
- no flow control (DIP switch?)
- baud rate = 9600

Modbus RTU Software

- baud rate = 9600
- 8 bit
- no parity
- 1 stop bit
- dial prefix: ATDT
- Initialization command: AT E0 Q0 V1 X0 S0=0 S12=100
- Reset command: ATZ
- Hang-up command: ATH0
- Command response delay: 5 seconds
- Answer Delay: 30 seconds
- Inter-character delay: 55 msecs

Slave

Modem

- auto answer on (DIP switch?)
- Load factory default (DIP switch?)
- no flow control (DIP switch?)
- baud rate = 9600

EnviroRanger

- set P770, point 2 to 3 (Modbus RTU)
- set P771, point 2 to 1 (Network ID 1)
- set P772, point 2 to 9.6 (Baud Rate of 9600)
- set P773, point 2 to 0 (No Parity)
- set P774, point 2 to 8 (8 Data Bits)
- set P775, point 2 to 1 (1 Stop Bit)
- set P776, point 2 to 0 (No Flow Control)
- set P777, point 2 to 0 (0ms Key up Delay)
- set P778, point 2 to 1 (Communications through Modem)
- set P779, point 2 to 300 (Modem Inactivity of 300 seconds)

Error Handling

Modbus Responses

When polled by a Modbus Master, a slave device will do one of the following:

1. Not reply. Which means that something went wrong with the transmission of the message.

2. Echo back the command with the correct response (see the Modbus specification for more details). This is the normal response.

3. Return an Exception Code. This reflects an error in the message.

    EnviroRanger uses the following exception codes:

Code	Name	Meaning
01	Illegal Function	The function code received in the query is not an allowable action for the slave.
02	Illegal Data Address	The data address received in the query is not an allowable address for the slave.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the slave.

Error Handling

Errors can be traced to two general sources:

1. There is an error in transmission.

    or

2. The host tries to do something that is not a valid action.

    In the first case, the EnviroRanger does not respond and the master waits for a 'response time out' error, which causes the master to re-send the message.

    In the second case, it depends on what the host tries to do. In general, EnviroRanger will not give an error to the host request. Various actions and the expected outcome are as follows:

*   If the host reads an invalid register, the host will get an undetermined value back.

*   If the host writes an invalid register (a non-existing parameter or a read only parameter), the value will be ignored and no error response will be made. However, the current value will not reflect the desired new value.

- If the host writes a read only register, then the value will be ignored and no error response will be made. However, the current value will not reflect the desired new value.

- If P000 is activated, then the value will be ignored and no error response will be made. However, the current value will not reflect the desired new value.

- If the host attempts to write one or more registers that are out of range, an exception response code 2 or 3 is generated depending if the start address is valid.

- If the host attempts to read one or more registers that are out of range, an exception response code of 2 or 3 is generated.

- If the host used an unsupported function code, an exception response code of 01 should be generated. However, this is not guaranteed and there may be no response.

Error Handling

Troubleshooting

Generally

1. Check to see that:

   - There is power at the unit
   - The LCD is showing the relevant data
   - The device can be programmed using the hand programmer

2. Check the wiring pin outs and verify that the connection is correct.

3. Go over the set-up parameter P770 to P779 and verify that these values match the settings in the computer that you are using to communicate with it.

4. Check that the port you are using on the computer is correct. Sometimes trying a different Modbus driver will solve the problem. An easy stand-alone driver called ModScan32 is available from Win-Tech at www.win-tech.com. We have found that this driver is useful to test communications.

Troubleshooting

Specifically

1. You have set up an EnviroRanger to talk over a modem but you are not getting any communication back to the master.

-   Check that the parameters are set up correctly and that you have configured the correct port. The RS-232 port on the terminal strips of the EnviroRanger is port 2. This means that you must set P770, primary index 2, to the correct settings.

-   Check that you are using the correct wiring diagram. Note that there is a difference between wiring directly to a computer and wiring to a modem. A good check is to use an RS-232 null modem and cable, remove the modems from the picture, and then communicate directly. If this works then the problem is in the modem.

-   Verify that your modem is set up correctly. Milltronics has a series of Application Guides that may help. Please contact your local Milltronics representative for more information on Application Guides.

2. You try to set an EnviroRanger parameter, but the parameter remains unchanged.

-   Some parameters can only be changed when the Milltronics device is not scanning. Try putting the Milltronics device in program mode, using the operating mode function.

-   Try setting the parameter from the keypad. If it can not be set using the keypad, check the lock parameter and set it to 1954.

3. You are testing report by exception but nothing is happening.

-   Is the EnviroRanger in run mode or program mode? The triggers for report by exception will only occur if the unit is in run mode.

Troubleshooting

Appendix A: Single Parameter Access (SPA)

This Appendix was included as a means of giving someone with advanced communication knowledge the power to be able to access any parameter value they would like in any available format.

Built into EnviroRanger is an advanced handshaking area that can be used to read and write single registers to the EnviroRanger. This section performs a similar function as the Parameter access section. The differences are:

1. Advanced section is more powerful and harder to program.

2. Advanced section only gives you access to one parameter at a time.

Mapping

Parameter Read and Write (40,090 – 40,097) is a series of eight registers used for reading and writing parameter values to and from the EnviroRanger. The first three registers are always unsigned integers representing parameters and index values. The second five registers are the format and value(s) of the parameter.

All parameters normally accessed through the hand-held programmer are available through these registers.

Address	Description
40,090	Parameter (integer)
40,091	Primary Index (integer)
40,092	Secondary Index (integer)
40,093	Format word (bit mapped)
40,094	Read value, word 1
40,095	Read value, word 2
40,096	Write value, word 1
40,097	Write value, word 2

Reading Parameters

To read parameters through Modbus do the following steps:

1. Send the parameter, its primary index, and its secondary index (usually 0), and format to registers 40,090 to 40,093.
2. Wait until you can read the written values from the registers (40,090 to 40,093) to confirm that the operation is complete.
3. Read the value from registers 40,094 and 40,095.

Writing Parameters

To set parameters through Modbus do the following steps:

1. Send the parameter, its primary index, and its secondary index (usually 0) to registers 40,090, 40,091, and 40,092.
2. Write the value to registers 40,096 and 40,097.
3. Write the desired format word to register 40,093 to enable the EnviroRanger to interpret the value correctly.

Format Register

Bits	Values	Description
1-8	0-2	Error Code
9-11	0-7	3-bit number representing decimal offset
12	0/1	direction of offset (0 = right, 1 = left)
13	0/1	Numeric format: Fixed (0) or Float (1)
14	0/1	Read or Write of data, Read (0), Write (1)
15	0/1	Word order: Most Significant Word first (0), Least Significant Word first (1)
16		Reserved

For example, to format the level reading so that it is shown in percent with two decimal places shifted left, the format bits would look like this:

Bit Numbers	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01
Bit Values	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	reserved	most significant first	read	fixed format	offset direction to right	decimal offset of 2			no error code							

The value sent to the EnviroRanger is 0001001000000000 binary or 4608 decimal. The value "4608" is sent as an integer to register 40,093 to format the output words 40,094 and 40,095 accordingly.

If the numeric data type is set for integer and the value contains decimal places, they are ignored. In this situation, use the decimal offset to ensure that you have an integer value and then write your code to recognise and handle the decimal offset.

Error Codes

The error codes returned in the format area are 8-bit integers found in the lowest 8 bits of the format word. This allows for 256 potential error codes.

Currently the EnviroRanger has two error codes available.

Values	Description
0	No error
1	Data not available as percent (available as units)
2-255	Reserved

EnviroRanger Communications Reference

Appendix A

Appendix B: Notes on Handling 32 Bit Unsigned Integers

A 16 bit unsigned integer is a number between 0 and 65536. To combine two unsigned 16 bit integers into one unsigned 32 bit integer the formula is:

$X = MSW * 65536 + LSW$

Where:

> X is the 32 bit number
> MSW is the most significant word
> LSW is the least significant word

Example:
If the UINT32 order register (R40,062) is a 0, then the pumped volume would be calculated by the following:

Pumped Volume = R41,440 * 65536 + R41,441
If pumped volume was a floating point, then the formula would be:
Pumped Volume = (R41,440 * 65536 + R41,441) / 1000
This would place the decimal point in the correct place.

Also, note that the 16 bit integers must also be unsigned. If the 16 bit integers are not unsigned then they must be checked to see if they are less than 0. If so, 65536 should be added to them then when they are converted to 32 bit numbers. It would look like the following:

```
Dim Pump_vol, temp1, temp2 as Long
Dim R41440, R41441 as Integer
temp1 = R41440
If R41440 < 0 then temp1=temp1+65536
temp2 = R41441
If R41441<0 then temp2=temp2+65536
Pump_vol = temp1*65536 + temp2
```

Appendix C: Time Stamp Values

The time stamps are all in 32 bit integers that give the number of seconds from January 1, 1970. Below is an algorithm in Basic to convert to year, month, day, hour, minute, second.

```
Sub convert_time(real_time, ryrs,rmon,rday,rhrs,rmin,rsec)

Dim imin, ihrs, iday, iyrs, mday, jday, lday, qday As Long
Dim real_time, rsec, rmin, rhrs, rday, rmon, ryrs As Long
Dim datamon(14)

' real_time = time in seconds from Jan.1, 1970
' ryrs = year (r=real)
' rmon = month
' rday = day
' rmin = minute
' rsec = seconds
' imin, ihrs, iday, iyrs are all intermediate calculations (described below)
' lday = leap day
' qday = quad day
' jday = index counter of days (used to calculate rday)
' datamon = database of the # of days since the beginning of the year


' set up database of # of days since beginning of the year
datamon(1) = 0
datamon(2) = 31
datamon(3) = 59
datamon(4) = 90
datamon(5) = 120
datamon(6) = 151
datamon(7) = 181
datamon(8) = 212
datamon(9) = 243
datamon(10) = 273
datamon(11) = 304
datamon(12) = 334
datamon(13) = 365

'whole minutes since 1/1/70
imin = Int(real_time / 60)

'leftover seconds
rsec = real_time - (imin * 60)

'whole hours since 1/1/70
ihrs = Int(imin / 60)

'leftover minutes
rmin = imin - (ihrs * 60)
```

```
'whole days since 1/1/70
iday = Int(ihrs / 24)

'leftover hours
rhrs = ihrs - (iday * 24)

' whole days since 1/1/68
iday = iday + 365 + 366

' quadyr = 4 yr period = 1461 days
lday = Int(iday / ((4 * 365) + 1))

'days since current quadry began
qday = iday Mod ((4 * 365) + 1)

' if past feb 29 then add this quadyr's leap day to the # of quadyrs (leap
'days) since 1968
If (qday >= (31 + 29)) Then lday = lday + 1

' whole years since 1968
iyrs = Int((iday - lday) / 365)

' days since 1/1 of current year
jday = iday - (iyrs * 365) - lday

' if past 29 and a leap year then add a leap day to the # of whole
If ((qday <= 365) And (qday >= 60)) Then jday = jday + 1

' compute years
ryrs = iyrs + 1968

' estimate month (+1)
rmon = 13

' max days since 1/1 is 365
mday = 366

'mday = # of days passed from 1/1
Do While (jday < mday)
  ' estimated month
  rmon = rmon - 1

  '# elapsed days at first of mon
  mday = datamon(rmon)

  'if past 2/29 and leap year then add leap day month until found
  If ((rmon > 2) And (ryrs Mod 4 = 0)) Then mday = mday + 1

Loop

' compute day of month
rday = jday - mday + 1

End Sub
```

Index

Index

www.milltronics.com

MILLTRONICS

7 M L 1 9 9 8 1 C C 0 1
Printed in Canada