MILLTRONICS

ENVIRORANGER ERS 500
USER GUIDE
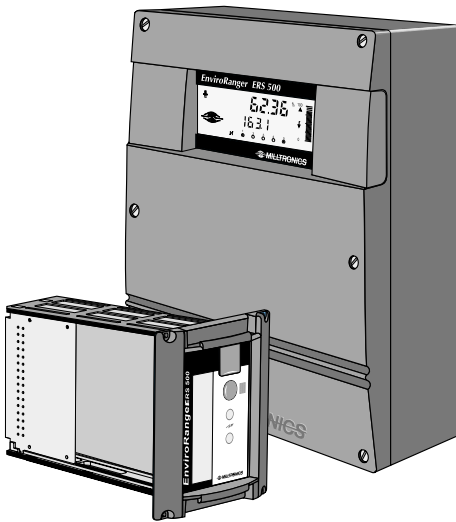
ENVIRORANGER ERS 500

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. Only qualified personnel are authorized to install and operate this equipment. Qualified personnel are defined as persons authorized to commission, ground, and tag circuits, equipment, and systems 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.

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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 User Guide…

This is the first in the series 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

Examples

This manual contains many examples of EnviroRanger configurations in an attempt to expose the flexibility of the instrument. These examples represent only one way to solve the application. There are generally two or more alternate ways to solve the application.

In all cases substitute your own application details for any example.

If the examples provided do not solve your application check the Parameter Reference to get a full understanding of the options available.

Using this Manual

Using the EnviroRanger

The EnviroRanger has two modes of operation: program and run.

Program Mode

Program mode allows the programmer to change parameter values and alter the way the unit operates.

Notes:
- If the unit has been programmed and is in normal operation then putting it in program mode will de-energize all control relay outputs. You should bypass the EnviroRanger while programming it.
- After changing the programming, test the EnviroRanger before allowing it to control alarms and pumps.

To enter Program mode from Run mode:

Rack and Panel Mount Units
1. Press the program button on the front of the device
2. Look for the program icon on the display (▦)
   Press ▦ and then ⭗

Wall Mount Units
1. Press ▦ and then ⭗

If the EnviroRanger is idle in Program mode for more than 5 minutes, then Run mode is entered automatically.

For information on the individual programming parameters see the EnviroRanger Parameter Reference (PL-603).

Run Mode

Run mode detects material level and provides control functions. The EnviroRanger automatically starts up in the Run mode when power is applied.

To return to Run mode from Program mode, press ▦.

"----" is displayed briefly while the measurement reading is calculated and verified. Reading level and other data is displayed and any relays are operated based on the unit's programming.

While the unit is in Run mode you can view system status. This information is shown on the LCD on the front of the unit or can be accessed remotely using communications software.

Display

Wall Mount

Rack or Panel Mount
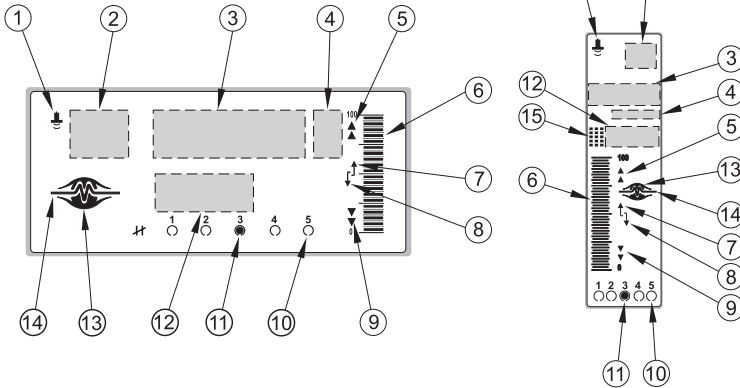
	Program Mode	Run Mode
1	index type (see below)	index type (see below)
2	index	index
3	parameter value	primary reading
4	units	units
5	auxiliary function	hi and hi hi alarm designation
6	n/a	level display
7	scroll access tag	filling display
8	scroll access tag	emptying display
9	n/a	lo and lo lo alarm designation

10	relay # programmed
	flashing = unavailable
		relay # programmed
		flashing = unavailable

11	relay # activated	relay # activated
12	parameter number	auxiliary reading
13	n/a	normal operation:
14	n/a	failsafe operation:
15	program mode	programming enabled

There are also some special icons used to indicate the type of index (item 1 above) being edited in program mode:

Icon	Index Type
	measurement point
	relay
	secondary index
mA	mA input or output

Dolphin Plus

> **Note:**
> Dolphin Plus is ordered separately from Milltronics.
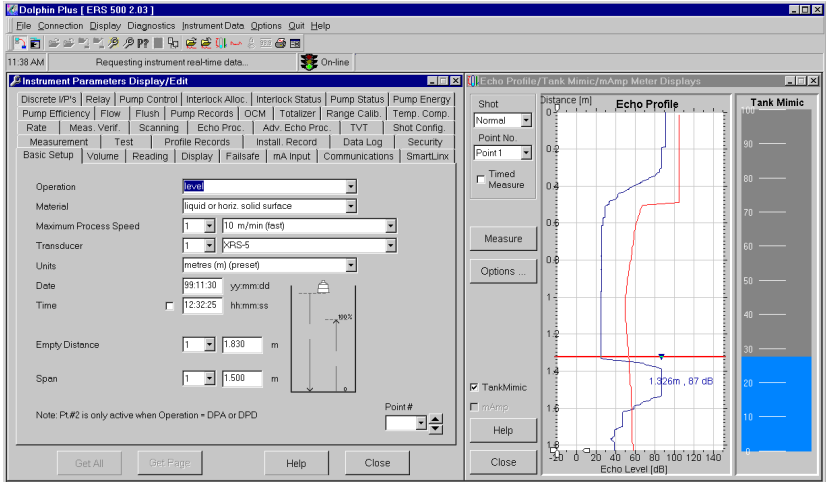
Button	Result
	communicate with instrument–toggle
	monitor communications
	send parameter set to instrument
	save parameter set to file
	open the quick start wizard
	open the tabbed parameters window
	find a parameter in the tabbed parameters window
	toggle program mode and run mode
	open the reporting windows
	load an echo profile from a file
	save the current echo profile to a file
	open the vertical echo profile and tank mimic window
	open the horizontal echo profile window
	take a measurement with the current transducer
	open the reading values (distance measurement) window
	print current echo profile
	open the Echo Info Editor window

Hand Programmer

Note:
The hand programmer is ordered separately from Milltronics.
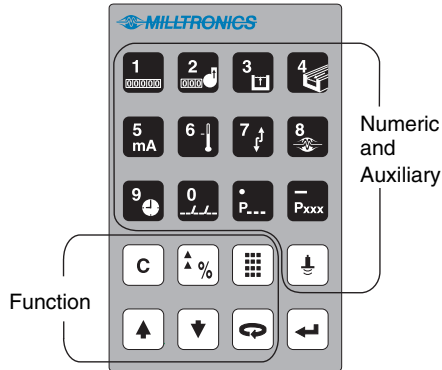
Key	Programming Mode	Run Mode
1	1	8-digit Totalizer (toggle)
2	2	Pump Running Time
3	3	Head
4	4	Flow based on Head
5	5	mA Output
6	6	Temperature
7	7	Rate of Change
8	8	Failsafe Time Left
9	9	Time
0	0	Date
P...	Decimal Point (TVT left)	Parameter Value
Pxxx	Negative Value (TVT right)	Material Level (P731)
↧	Fire Transducer	Distance
⊞	Run Mode	Program Mode (Key 1)
%	Units or %	Units or % (Program Mode (Key 2))
↩	Next Display Field	Pause Display Toggle
▲	Increase Value	Next Index
▼	Decrease Value	Previous Index
↵	Enter Value	
C, ↵	Clear to Preset	

Readings in Run Mode

When the EnviroRanger is in run mode the values displayed can be changed by using keys on the hand programmer.

All readings are shown in the Auxiliary field except for the totalizer and P920.

Press this Key	Function	P#
[↕ %]	Toggle Readings between percent and units	P920
	Level Space or Distance1	
	0 to 100% 100 to 0%	
[2] + [1] [2] [3] [4] [5]	Accumulated pump running hours2 for numbered pump	P310
[2] + [1] [2] [3] [4] [5]	Hold number key for five seconds to display the number of accumulated pump starts[2] for numbered pump	P311
[1]	8-digit totalizer, uses index and reading areas, press again to toggle, P737 sets default	P322, P323,
	Used for OCM and Pumped Volume.	P920
[3]	Head measurement	P926
[4]	Instantaneous flow based on head (OCM)	P925
[5]	mA Output value	P203
[6]	Temperature	P664
[7]	Rate of level change	P707
[8]	Failsafe Time Left (in %). When the Reading is updated, this value (Auxiliary Reading) resets to 100 and begins to decrease until the next valid measurement is made. If the Failsafe Time Left reaches 0, "LOE" flashes in the Reading display.	
[8]	Hold for four seconds to show echo confidence	P805
[9]	Time (hh:mm)	P009
[0]	Date (dd:mm or mm:dd as P736)	P008
[P...] + ###	Display the value of the entered parameter which is global or indexed by transducer	typed number
[Pxxx]	Auxiliary reading, displays parameter specified in P731	P731
[⏚]	Distance	P923

Status Parameters

Use the status parameters listed an the next page to view the operating status of the EnviroRanger. You can do this with Dolphin Plus or the hand programmer, or from a remote SCADA system.

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1 Distances less than 0.3m (12") from the transducer face cannot be reliably measured so a 0% reading cannot be achieved during "distance" operation.

2 If the associated relay is programmed for pump control.

Parameter		Values
P149	Energy Override Status	0 – no override 1, 2, 3 – override on
P169	Flow Condition	0 – normal operation 1 – overflow state 2 – underflow state
P186	Pump Low Efficiency Counter	Shows number of times pump has failed to meet the efficiency threshold
P203	mA Output Value	0 to 22 – Current mA output
P254	Scaled mA Input Value	0 to 9999 – Current mA input after scaling
P275	Scaled Discrete Input Value	Shows current value of discrete input, values vary by DI function
P322	LCD Total Low	The last four digits of the totalizer
P323	LCD Total High	The first four digits of the totalizer
P341	Run Time	The number of days the EnviroRanger has been operating
P342	Start Ups	The number of times power has been cycled
P424	Trigger State	0 – normal 1 – activated
P434	Trigger Status	1 – trigger asserted 2 – trigger negated
P452	Number of Entries	Number of entries in the indexed data log
P510	Pump Failed Status	0 – normal 1 – fault
P515	Pump Remote Control Status	0 – local 1 – remote
P519	Power Failure Status	0 – normal 1 – power failure
P520	Pump Available	0 – not available 1 – available
P664	Temperature	Current temperature measured by transducer
P707	Rate Value	Current rate of material level change
P708	Volume Rate Display	Current rate of material volume change
P729	Scan Time	Seconds since last level scan
P806	Echo Strength	Strength of primary echo
P920	Reading Measurement	Current primary reading
P921	Material Measurement	Current level from P007–Span
P922	Space Measurement	Empty space above the material level
P924	Volume Measurement	Current volume value, if programmed
P925	Flow Measurement (OCM)	Current flow value, if OCM programmed
P926	Head Measurement (OCM)	Current level, if OCM programmed
P927	Distance Measurement	Distance from transducer face to material

Note:
When in run mode the EnviroRanger only displays global parameters in the auxiliary field. Use program mode to display other parameter values.

Controlling the Display

When the EnviroRanger is in run mode there are many different parameters and variables that you can track on the display (see Display on page 10).

If a value is too long for the LCD the value "EEEE" is shown.

To adjust the primary reading so that it fits on the 4-digit LCD use:
- P060 Decimal Position to set the maximum number of decimals
- P061 Convert Reading to scale the reading to something that will fit
- P062 Offset Reading to shift the reading up or down by a fixed amount

Example
To reference the displayed level to sea level, enter the distance in Units (P005), between Empty (P006) and sea level. (Enter a negative value if Empty is below sea level.)
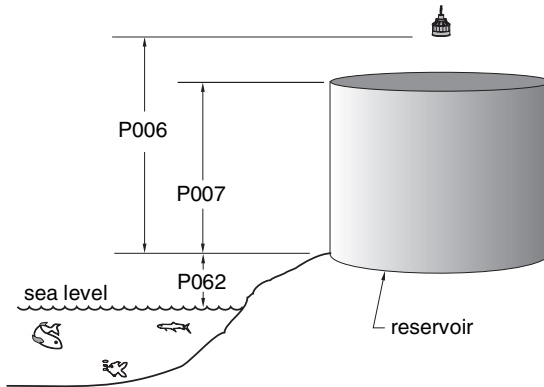
Auxiliary Reading

The Auxiliary Reading area of the LCD is useful for displaying parameter values while leaving the primary reading on the screen.

Note:
The parameters that can be shown in the auxiliary reading field are those indexed as global, by transducer, or by level point.

Setting the Default Auxiliary Reading
To see the same variable in the auxiliary reading area all the time, set up the default. For example, if you want to leave the level reading on the screen and view the echo confidence in the auxiliary reading field, you would program the following parameter:

Parameter	Index	Value	Description
P730	G	805	Auxiliary field defaults to P805

Setting a Specific Auxiliary Reading

You can set up a second auxiliary reading that is displayed when you press
![Pxxx] in run mode. For example, if you want to view the current temperature
when you press the ![Pxxx] key, program the following parameter:

Parameter	Index	Value	Description
P731	G	912	Shows P912–Transducer Temperature

Multiple Readings

During "differential" or "average" Operation (P001 = 4 or 5), the display
scrolls sequentially through Point Numbers 1, 2, and 3. Point Number 3
represents the difference between or average of Point Numbers 1 and 2.

To change the speed at which the numbers scroll:

Parameter	Index	Value	Description
P732	G	5	Hold each value for 5 seconds

Optional Features

The EnviroRanger comes as a base unit with many different optional
features available. These optional features change the way that parameters
are indexed.

For example, when the Dual Point feature is added to the base unit then all
transducer-related parameters become indexed by two rather than one. So,
P004 becomes indexed by two rather than global for the unit.

Likewise, when a discrete input option card is installed P500 changes from
being indexed by 8 to being indexed by 16.

Sometimes the addition of an optional feature will create a primary index
where one did not exist previously. If you look for the mark icon on the LCD
you can tell whether you are changing a primary or secondary index.

For example, when the Dual Point feature is added to the base unit then all
OCM characterization curves change from one index to two indexes. In this
case the primary index is the transducer and the second index is the
characterization breakpoints.

See Parameter Indexing on page 18 for more information about primary and
secondary indexes.

Programming the EnviroRanger

To meet the needs of any given application the ERS 500 must be correctly programmed. Parameters are described in the Parameter Reference (PL-603) and sample applications are given throughout this manual.

Starting Program Mode

Entering program mode has the following effects:

- all operating data is retained in memory
- alarm relay status is held at last known values
- control relays are de-energized (unless affected by parameter alteration)
- discrete inputs are detected but not acted on

The Run mode is automatically re-entered if the unit is left unattended in the program mode for an extended period (approximately 5 minutes).

Rack or Panel Mount

To enter program mode on a rack or panel mount unit press the program button on the front of the unit (shown at right).

The program icon (▦) appears when the unit can be placed in program mode.
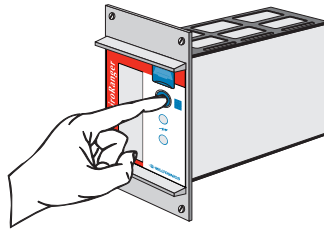
Wall Mount

The wall mount has no program button, it is always ready for program mode. Aim the hand programmer and press the program keys.
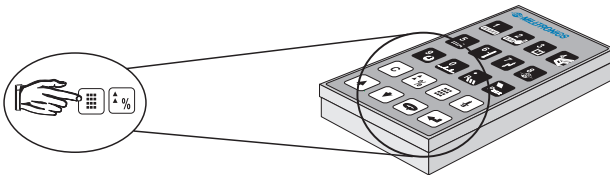
The program button allows multiple units to be installed close together and still be programmed one at a time. Disable nearby units to avoid inadvertent programming when using the infrared handheld programmer

Note:
Unless otherwise noted, each valid key press should produce a change in the LCD, look for this when programming the unit.

Parameter Indexing

Parameters are indexed if they can apply to more than one input or output. The index value defines to which input or output the particular parameter value relates. Indexed parameters contain a value for each index, even if that index is not used.

index field

rack or panel display shown
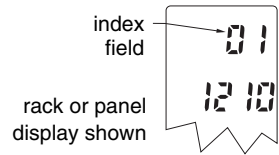
For example, to change the Relay Control Function (P111) for relay three you must ensure that "03" is displayed in the index field before you change the parameter value.

In this manual index values are shown in brackets after the parameter number. For example P111[3] refers to parameter 111 index value 3.

> **Notes:**
> - Transducer parameters are indexed only if Operation (P001) is set to "Difference" (value=4) or "Average" (value=5) on the base unit.
> - Transducers are always indexed when the dual point option is enabled.
> - An indexed transducer is commonly referred to as a Point (short for measurement point). The term Point Number refers to indexed transducers.
> - To set all indexed values for a given parameter to the same value use index "0".
> - The number of index values can change for a parameter when optional features are installed such as dual point software or a discrete I/O option card. The examples in this manual assume a base unit unless noted otherwise.

To access the index of a particular parameter:
1. Press ⏎ **once**
2. Enter the parameter number
3. Press ⏎ **twice**
4. Press the number of the required index, **or**
5. Press ⬆ or ⬇ to scroll through the available values

> **Note:**
> When dealing with indexed parameters it is critical to ensure that you set the values accurately. Take extra time to ensure that the correct index value is being changed for each parameter value.

Parameter Indexes

Most parameters used on Milltronics instruments are indexed. Indexing allows a parameter to relate to more than one input or output. For example, many parameters are indexed by measurement point while others are indexed by relay output or discrete input.

Programming

An index that relates to an input or output is called a Primary Index.

Examples of primary indexes are:
P111[3] = 52 means:
P111 (Relay Control Function) for relay 3 is set to value 52
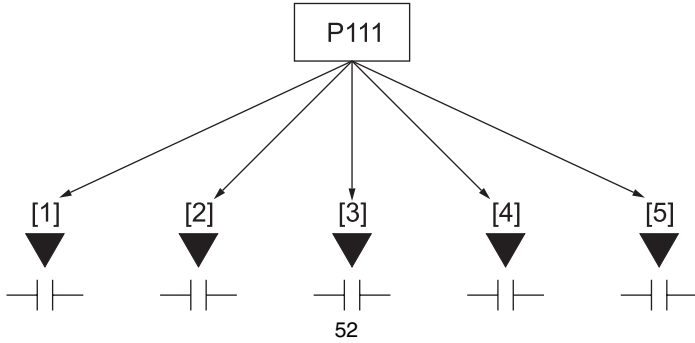
Sometimes a parameter requires a second index to allow for multiple values on an indexed input or output. For example a measurement point which calculates a reading on volume can require characterization breakpoints. These breakpoints are given on a secondary index (the primary index relates to the transducer input).

On some older Milltronics products the primary index is called a point.

An index that relates to a previously indexed parameter is called a secondary index.

Examples of secondary indexes are:
P054[1,5] = 1.6m means:
P054 (Breakpoint Levels) for breakpoint 5 on transducer 1 is set to 1.6m
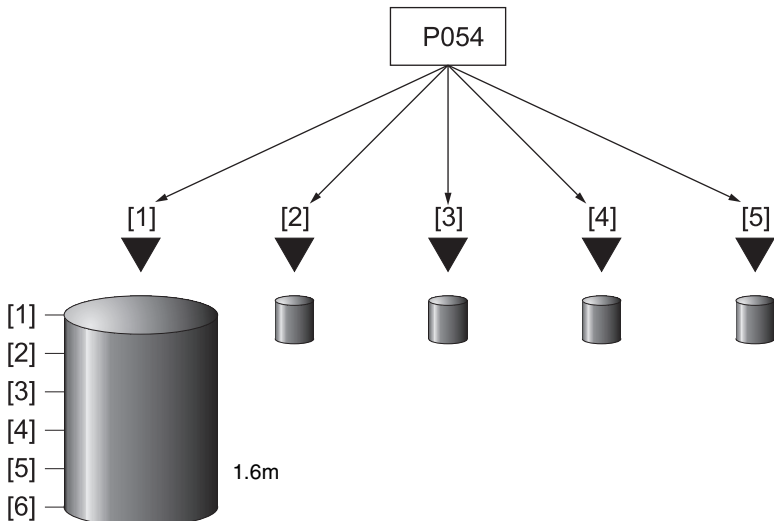
The way that indexes are handled in the memory map depends on the data access method used. When you are changing a secondary index ➔ is shown on the LCD: On some older Milltronics products the secondary index is called a mark.

Changing Parameters (Dolphin Plus)

Dolphin Plus is the primary method of changing EnviroRanger parameters. Most examples in this manual use the icons from the hand programmer but nearly all functions are also available through Dolphin Plus. The Dolphin Plus software is available separately from Milltronics.

Changing Parameters (Hand Programmer)

1. From Run mode, press ▦ and then ⊶ to put the unit into Program mode.

Note:
If Parameter Value alteration is not permitted, access the Lock parameter (P000) and enter the security code, (see Programming Security).

2. Press ⊕ to select the Parameter Number field (see page 10)

3. Type the Parameter Number (e.g. 110)
When you type the third digit the value for that parameter is shown

4. For lower numbered parameters, such as 007, you can type the number "7" and then press ⊕ to show that parameter.

5. Type the new value, and press ↵.
The EnviroRanger interprets the value and either accepts it, or replaces it with a valid value. See the Parameter Reference for descriptions of values.

The "?" icon indicates that the EnviroRanger has accepted the value but that it conflicts with other values entered. Double-check your programming.

By default the scroll keys (▲ or ▼) only show the Quick Start parameters and any that have been changed. Use P733 to allow all parameters to be scroll-accessed.

Security

The Lock parameter, P000, secures the EnviroRanger against parameter changes. The unit can still be put into program mode when locked, and parameter values can be viewed, but no parameter values can be changed.

Set P000 to "1954" to enable programming.

Because the lock parameter uses a fixed value as the password you should use other means to secure the EnviroRanger. P000 is most useful as a way of ensuring that someone has the product information (manuals or Dolphin Plus) before programming the instrument.

Simulation
P000–Lock also controls how simulations affect control relays. By default control relays are unaffected by simulation levels but if P000 is set to -1 then they react to the simulated level. See Simulation on page 101 for details on running a simulation.

Using Units or Percent (%)

Many parameters can be viewed in either measurement units (P005) or percent. View the parameter and then press the ▲% key to toggle between units and percent. The LCD shows the current measurement type, either units (m, mm, ft, etc.) or percent (%).

Percent is also available when showing flow and volume with 100% based on the parameter that defined the maximum.

Measurement	Maximum
Volume	P051
Flow	P604

Special Parameters

View Only
Parameter Values that are for status only and cannot be altered.

Global
Parameter values common for all inputs and outputs on the EnviroRanger.

When a global parameter is accessed, the index display automatically disappears. When a non-global parameter is accessed, the index display reappears showing the last index number.

Parameter Reset

To set any parameter back to the factory default:
- Display the appropriate parameter number
- Display the appropriate index value (if required)
- Press $\boxed{\text{c}}$
- Press $\boxed{\leftarrow}$

Use Master Reset (P999) to reset all parameters to "original" values before initial system installation, following a software upgrade, or whenever complete reprogramming is required. Use Dolphin Plus to store and retrieve parameter groups.

When the dual point option is enabled P999 is indexed by transducer. Use index "00" to reset the entire EnviroRanger.

Displays

The following displays are shown when the EnviroRanger cannot display a number.

Display	Meaning
	parameter has not been set
	all values not same when viewing index 0
EEEE	value too large for 4-digit display

Programming

Planning Considerations

Review the Application

When reviewing the application into which the unit will be installed, note the:
- Pump control system inputs and outputs
- Use of other control and reporting functions (OCM, gate control, rake control, report by exception, data logging)
- Dimensions wet well or reservoir (especially if pumped volume will be used)
- Maximum measurement distance required (determines transducer needed)
- Communication type required (modem, industrial communication network)

Design the Control Scheme

Choose the most appropriate pump control strategy from those available. See Appendix C–Pump Control Reference on page 121 for a description of the EnviroRanger pump control strategies and options.

Map the Control Scheme to EnviroRanger
Once the control scheme is designed, map its requirements to the EnviroRanger's parameters.

Be aware of the EnviroRanger's abilities:
- Level measurement points (base: 1, optional: 2)
- Relay outputs (5)
- Discrete inputs (base: 8, optional: 16)
- mA inputs (base: 1, optional: 3 or 5)
- mA outputs (base: 0, optional: 2 or 4)
- Serial communications type (base: RS-232, optional: RS-485)
- Communications protocol (base: Modbus, optional: Remote I/O, Profibus, DeviceNet)

Install the EnviroRanger

Mount and wire the ERS 500 as detailed in the Installation Guide (PL-601).

Program the EnviroRanger

Use this manual with the EnviroRanger Parameter Reference (PL-603) to determine the best method of programming the EnviroRanger to satisfy the control scheme.

Use either Dolphin Plus or a hand programmer to set the parameter values to those required.

Test the Installation

Test the inputs and outputs as in Testing the Configuration on page 101.

Document the Installation

Use Dolphin Plus to record your parameter values for later reference.

Planning

Starting Measurement

The start up state of the EnviroRanger depends on whether or not it has the dual point optional feature installed. See Appendix D–Updating Software on page 127 for details on installing the dual point option.

Single Point (Base)

The EnviroRanger starts in distance mode with the transducer preset for the XPS-10 and an empty distance of 5 meters. Change the following parameters to reflect your application parameters.

Parameter	Index	Value	Description
P001	G	1	Operation = level
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	104	Transducer = XPS-15
P005	G	1	Units = meters
P006	G	12	Empty = 12m
P007	G	10	Span = 10m

Average or Differential

To enable average or differential operation with a base EnviroRanger set P001 to 4 or 5 and connect two transducers of the same type. All of the relevant parameters then become indexed by the correct number, one of:

Index	Description
2	indexed by transducer 1 or 2
3	indexed by level measurement
	1 = transducer 1
	2 = transducer 2
	3 = calculated level (average or difference)

Dual Point (Optional)

Support for two transducers is an optional feature available at additional cost from Milltronics. See Appendix D–Updating Software on page 127 for information on ordering and enabling optional features.

The EnviroRanger starts in an "OFF" state and does not take level measurements. To set up measurement you must configure the basic parameters described below.

If your application uses two measurement points then you have to provide the basic information for each measurement point separately:

Parameter	Index	Value	Description
P001	1	1	Operation = level
	2	6	Operation = OCM
P002	1	1	Material = liquid
	2	1	
P003	1	2	Maximum Process Speed = medium
	2	3	Maximum Process Speed = fast
P004	1	104	Transducer = XPS-15
	2	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	1	12	Empty = 12m
	2	4	Empty = 4m
P007	1	11	Span = 11m
	2	3.5	Span = 3.5m

Average or Differential

To enable average or differential operation with an EnviroRanger that has the dual point option installed set P001[3] to 4 or 5 and connect two transducers. All of the relevant parameters then become indexed by the correct number, one of:

Index	Description
2	indexed by transducer 1 or 2
3	indexed by level measurement
	1 = transducer 1
	2 = transducer 2
	3 = calculated level (average or difference)

Response Rate

Choosing the response rate of the device is important because it influences its accuracy. Use the slowest rate that will still keep pace with the application.

The response rate is also important if any functions are tied to the filling or emptying indicators.

Dimensions

The dimensions of the wet well or reservoir (except empty and span) are only important if you require volume.

Volume is required if you want to report the level value in terms of volume or if you are using the pumped volume function to report pumped volume or report pump efficiencies.

Failsafe

The failsafe parameters are used to ensure that if no valid level reading is available then the devices controlled by the EnviroRanger default to an appropriate state.

By default, if an error condition is detected then the display and relay status are held at their last "known" values and the Failsafe Timer (P070) is activated. If the Failsafe Timer expires and the unit is still in an error condition then P071–Failsafe Material Level determines the level reading.

Control the reaction of the EnviroRanger to extended error conditions by configuring parameter P071–Failsafe Material Level and ensure that the fail state is optimal for your application.

Control the reaction of each relay by using P129–Relay Failsafe. See Relay Failsafe on page 31 for more information.

If Failsafe Operation activates frequently, see Appendix B–Troubleshooting on page 111.

EnviroRanger User Guide

Starting Measurement

Relays

Relays are the primary means of controlling external devices such as pumps or alarms. The ERS 500 comes with extensive control and alarm functions.

Communication is also available using:
- mA input / output (see page 41)
- Modbus communications (see page 99)
- SmartLinx industrial bus communications (see page 100)

Terminology

The following terms are used when talking about relay states:

Tripped   when a setpoint value is passed that function is tripped (P112, P113, P114, P115, P146)

Activated   when an event's setpoint is tripped that event is **activated**

Asserted   when a control or alarm function is activated that function is **asserted (**P100, P110, P111)

Energized   when a function is asserted it either **energizes** or **de-energizes** the relay (P118, P119)

Contacts   when the relay is energized or de-energized the contacts are then opened or closed. This relates to the form type of the relay

Each term refers to a specific piece of the EnviroRanger software and has parameters associated with it.

Relay States

The relays on the EnviroRanger are completely programmable to allow for any control scheme.

Rack or Panel Mount	Wall Mount
Relay 1 to 4–NO (Form A)	Relay 1 to 4–NO (Form A)
Relay 5–NC (Form B) see note	Relay 5–NO / NC (Form C)

Notes:
On the rack or panel mounts, relay 5 is a Form B (NC) but is reversed during operation so that it is programmed as a Form A (NO). This means its default state changes based on whether the instrument has power:

Power	Relay 5
on	NO (Form A)
off	NC (Form B)

Parameters

There are a few parameters that change the way relays react during normal conditions:

P100–Preset Applications
Sets the EnviroRanger to a preset application. These preset applications allow you to quickly set up the EnviroRanger with a minimum number of parameters.

P111–Relay Control Function
Sets the default state differently, depending on whether the relay is programmed as an alarm or a control.

P111–Alarm Functions
When an alarm function is asserted the relay contacts open. When the instrument is operating normally (no alarms) the relay contacts are closed.

P111–Control Functions
When a control function is asserted the relay contacts close. When the instrument is at rest (no controls operating) the relay contacts are open.

P118–Relay Output Logic
The other parameter that affects how relays react, P118–Relay Output Logic, is used when you need to reverse the logic (normally-open to normally-closed or visa versa).

P129 – Relay Failsafe
This parameter changes the way individual relays react to a failsafe condition on the instrument.

Relay Wiring Test

You can also test the wiring in your application by forcing a relay control function using P119–Relay Logic Test. This parameter allows you to force the condition that controls a relay, such as a level alarm or pump control setpoint, and ensure that all the relay programming and wiring is working correctly (i.e. "on" does what you think it should, as does "off").

Use P119 as a final test once all of the relay programming is done.

Relay Activation

The flexibility of the relay functions, shown below, ensures that the EnviroRanger can support any relay wiring scheme. This flexibility also means that there is some complexity in the relay parameters. Use the following as a guide to the most common parameters.

Setpoint is Tripped

When a setpoint is reached the corresponding action is taken. The setpoint can be an "on" or "off" setpoint related to a process variable or a timed setpoint based on interval and duration.

P112–Relay "on" Setpoint
P113–Relay "off" Setpoint
P114–Relay "duration" Setpoint
P115–Relay "interval" Setpoint
P116–Dead Band

Function is Asserted

The function associated with the relay setpoint is asserted. This is based on both the setpoint state and other timing requirements (P132–Pump Start Delay, P133–Pump Power Resumption Delay, and P645–Relay Duration).

P100–Preset Applications
P110–Level Source
P111–Relay Control Function
P129–Relay Failsafe

Relay Logic is Modified

Normally alarm relays are energized and control relays are de-energized. This can be reversed using P118–Relay Output Logic.

P118–Relay Output Logic
P119–Relay Logic Test

Relay Contact Changes State

The final step in the process is that the relay changes state. You should see a change in state of any connected equipment.

See also Testing the Configuration on page 101.
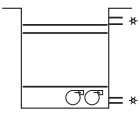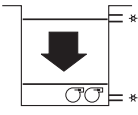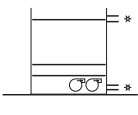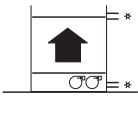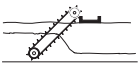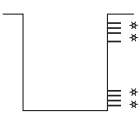
Relay Failsafe

Use P129–Relay Failsafe to adjust the way that individual relays react to a failsafe condition. Relays can be set to:

OFF	control is by P071–Failsafe Material Level
HOLd	keeps the relay in the current state
dE	de-energizes the relay (default for pump controls)
En	energizes the relay

Preset Applications

The preset applications that come with the EnviroRanger set up the relay parameters to predetermined values. These values are shown below:

Value	#	Parameters affected				
Off	0	All relays set "off"				
Wet Well 1	1	Pump down with the following level settings:				
		Parameter	Relay #			
			1	2	3	4	5
		P111	52	52	1 (H)	1 (L)	0
		P112	70%	80%	90%	10%	–
		P113	20%	20%	85%	15%	–
Wet Well 2	2	Pump down with the following level and rate settings:				
		Parameter	Relay #			
			1	2	3	4	5
		P111	52	52	1 (H)	1 (L)	0
		P112	80%	80%	90%	10%	–
		P113	20%	20%	85%	15%	–
		P121	1				
		Because the pumps are started by rate you must change P703 to appropriate values.				
Reservoir 1	3	Pump up with the following level settings:				
		Parameter	Relay #			
			1	2	3	4	5
		P111	52	52	1 (H)	1 (L)	0
		P112	30%	20%	90%	10%	–
		P113	80%	80%	85%	15%	–
Reservoir 2	4	Pump up with the following level and rate settings:				
		Parameter	Relay #			
			1	2	3	4	5
		P111	52	52	1 (H)	1 (L)	0
		P112	20%	20%	90%	10%	–
		P113	80%	80%	85%	15%	–
		P121	1				
		Because the pumps are started by rate you must change P702 to appropriate values.				
Screen (P001=4 only)	5	Differential control of a screen or rake:				
		Parameter	Relay #			
			1	2	3	4	5
		P110	3	1	2	3	0
		P111	50	1 (H)	1 (L)	1 (H)	–
		P112	80%	90%	10%	90%	–
		P113	20%	85%	15%	10%	–
Alarms	6	General alarms at four setpoints:				
		Parameter	Relay #			
			1	2	3	4	5
		P111	1 (H)	1 (L)	1 (HH)	1 (LL)	0
		P112	80%	20%	90%	10%	–
		P113	75%	25%	85%	15%	–

Discrete Inputs

The discrete inputs on the EnviroRanger allow the unit to be more flexible by interlocking control functions with external conditions.

Use the discrete inputs to:

Report Overflow / Underflow
Using an alternate measurement technology, such as the CLS 100 capacitance point level sensor. See on page 33 for details.

Report Power Failure
And keep the EnviroRanger from attempting to run the pumps during the power outage. See Reporting Power Failure on page 35 for details.

Determine Pump Control Source
Using a switch to determine how the pumps are controlled. See Determining Pump Control Source on page 36 for details.

Report and Reset Pump Status
Using connections on the pumps to detect when there is a failure. See Reporting Pump Status on page 33 for details.

Store and Forward Frequency Inputs
Interpret frequency inputs as a scaled value and make that value available to SCADA systems. See Configuring Frequency Inputs on page 39

Store and Forward Totalized Inputs
Totalize discrete input pulses and make the total available to SCADA systems. See Configuring Totalizer Inputs on page 40.

Report any Other Event
You can use a discrete input to report on any external event by setting up a report by exception to trigger from the discrete input. See Report by Exception on page 53.

Reporting Pump Status

Used to confirm a pump's operation and to remove it from the duty schedule if it is not operating correctly.

The interlock events that can remove a pump from the duty schedule are3 a failure to start or a pump fault. Both are explained below.

_____

3 A pump efficiency event can also remove a pump from the duty schedule. See also, Pump Efficiency on page 51.

Failure to Start

Wire the EnviroRanger to the motor control circuit so that it reports the status of the pump starter. This input is used to determine if the pump is runs when the EnviroRanger tells it to. You can also use an inline flow switch to report the pump running status.

To configure discrete input number five to report the running status of the pump connected to relay three, do the following:

Parameter	Index	Value	Description
P270	5	2	Use DI 5 as NO
P503	3	5	Set relay 3 to interlock with DI 5
P504	3	4	Wait 4 seconds for drive to spin up

This set up will watch the pump control associated with relay three and ensure that the state of discrete input five (P275[5]) changes when the pump is commanded to run.

If the discrete input does not show a change four seconds after the pump is commanded to run then that pump is removed from the duty cycle until the fault condition is reset. This condition is reset by setting P510–Pump Failed Status to zero "0".

Fault

Use P505–Pump Fault "A" Allocation or P506–Pump Fault "B" Allocation. The EnviroRanger can handle up to two fault conditions per pump. These interlocks are watched continuously and can report a failure, and remove a pump from the duty schedule, even when that pump is not running.

To configure discrete input numbers three and four to report both "Fault A" and "Fault B" do the following:

Parameter	Index	Value	Description
P270	3	3	Use DI 3 as NC
P270	4	3	Use DI 4 as NC
P505	2	3	Set relay 2 to Fault "A" on DI 3
P506	2	4	Set relay 2 to Fault "B" on DI 4

The status parameters are latched and must be reset before the pump(s) will resume operation.

Use P510–Pump Failed Status to determine if a pump has failed and either…

- P513–Pump Fault "A" Status, or
- P514–Pump Fault "B" Status

…to determine if it was due to a pump fault.

Discrete Inputs

Pump Reset

There are three ways to reset a pump failure state:

P510–Pump Failed Status
Place the EnviroRanger in program mode and view P510. This parameter will show "1" if any of the pumps are in a failed state.

To reset an individual pump, set P510[r] to "0" where "i" represents the index of the pump's relay.

To reset all of the pumps, set P510[0] to "0".

Reset push button connected to a Discrete Input
To make resetting the pumps easier, attach a push-button to a discrete input and program it with P509–Pump Reset Allocation. This allows an operator to reset the pumps without using the hand programmer or Dolphin Plus.

Through Communications
Use the built in Modbus register map to review the pump control and status words at registers R41,400 to R41,404. Each register relates to one of the relays. If bit 16 of a register is set to "1" then that pump has failed. You can use a Modbus write operation to reset that bit back to "0". See the EnviroRanger Communications Reference (PL-602) for details.

Reporting Power Failure

Used to keep the EnviroRanger from running the pumps when a power failure occurs and the EnviroRanger is supplied with backup power but the pumps are not.

In this situation if the EnviroRanger attempts to run the pumps any efficiency, run status, or fault interlocks will erroneously flag all of the pumps as failed and remove them from the pump sequence. This results in no pumps being available until a reset is performed.

Use P502–Power Failure Allocation to detect a power failure event and ignore pump interlocks. To set discrete input eight to detect a power failure condition do the following:

Parameter	Index	Value	Description
P270	8	3	Use DI 8 as NC
P502	G	8	Use DI 8 as power failure detection

Determining Pump Control Source

Used to determine from where a pump is controlled. Generally, pumps are controlled from a manual switch, the EnviroRanger's pump control algorithms, or from a remote SCADA system.

You can use discrete inputs to determine which control source runs the pumps.

Hand Example

The following example shows a Rack mounted EnviroRanger wired for a hand / off / auto switch connected to discrete input #1 and a pump connected to relay #1. Control is set to "hand" and the pump is currently switched off.
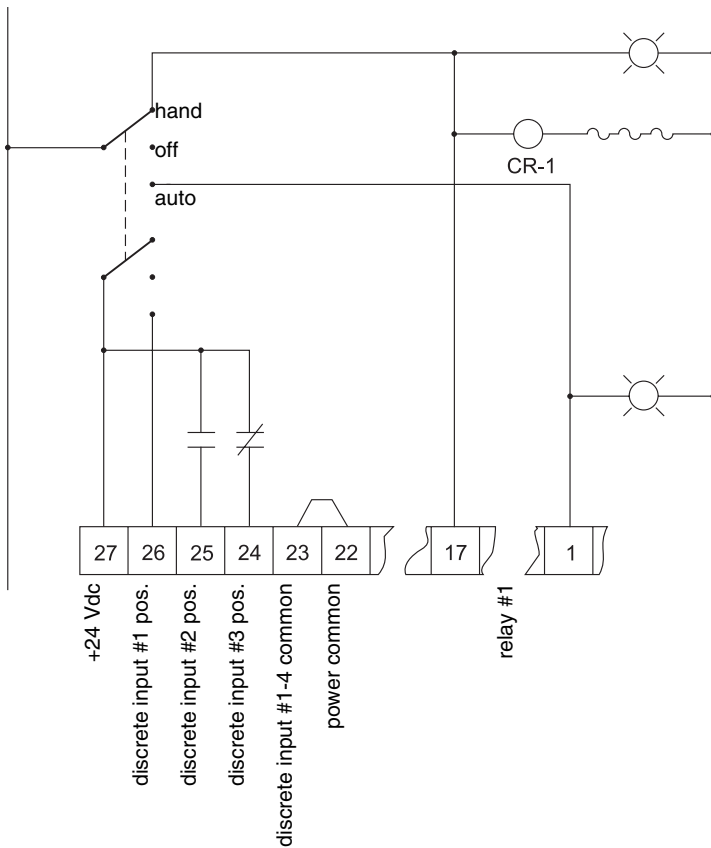
Auto Example

The following example shows a Rack mounted EnviroRanger wired for a hand / off / auto switch connected to discrete input #1 and a pump connected to relay #1. Control is set to "auto" with the EnviroRanger controlling the pump through the relay.
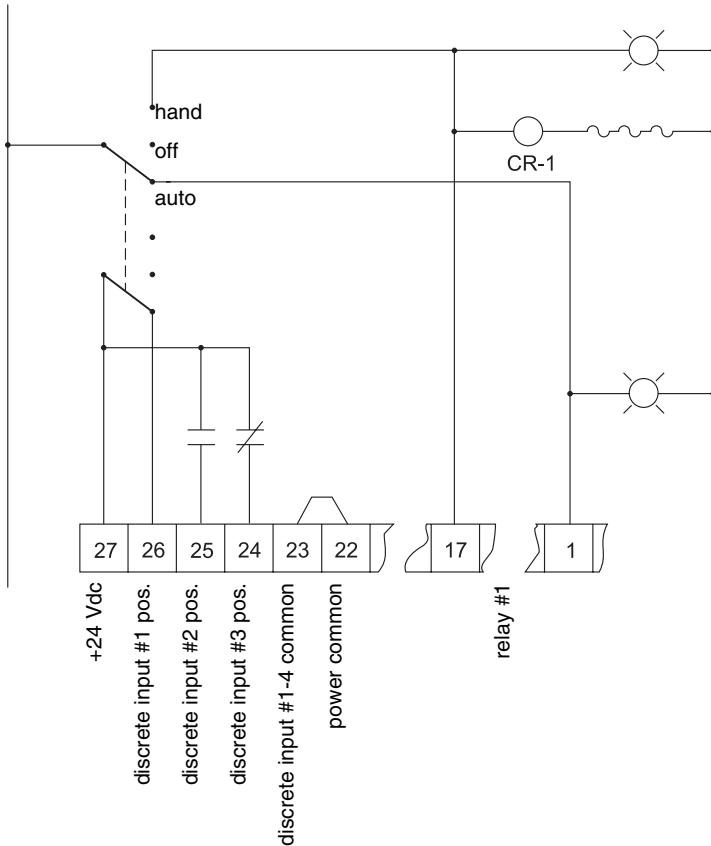
Manual Override Switch

- Use P500–Pump Auto Allocation to determine which discrete input is connected to the Auto / Manual switch.

Note:
For P500–Pump Auto Allocation, 1 is the normal state (pump in auto mode) and 0 is the exception state (pump in manual mode).

Remote Control

- Use P501–Pump Remote Control Allocation to determine the discrete input used to determine remote control (available / not available).

You can use the Pump Control Source (P520 to P524) parameters to find out from where a pump can be controlled. Use:

- P520–to determine if the pump is available
- P521–to determine if the pump is in "local–auto"
- P522–to determine if the pump is in "local–manual"
- P523–to determine if the pump is in "remote–auto"
- P524–to determine if the pump is in "remote–manual"

> **Note:**
> Parameters P521 to P524 are mutually exclusive. Only one of these
> parameters will ever be set to "1" at a time.

See the Parameter Reference (PL-603) for parameter details.

Wiring the Discrete Inputs

The discrete input contacts are either normally-open or normally-closed
when the system state is normal. The normal state refers to standard
operation with the EnviroRanger sensing the material level and controlling
the pumps.

> **Example:**
> The normal state for a pump is "operational" and the contacts on the
> discrete input are wired as normally-open.

See the EnviroRanger Installation Guide (PL-601) for complete details on
wiring the discrete inputs.

Program the Discrete Input Logic

The P270 series of parameters allows for control over the discrete input.

If the DI is…	Set P270 to…
Normally Open	P270 = 2
Normally Closed	P270 = 3

The current value of the discrete input is reported in P275:

P275 is…	The EnviroRanger is in…
0	Normal State
1	Exception State

> **Example:**
> The pump interlock is programmed to return "0" for the normal state and
> "1" for the fault state.

Discrete Inputs

Test the Interlock

Once wired and programmed, test the interlocks to verify operation.

Use P270–Discrete Input Function to force the input "on" (value = 1) or "off" (value = 0) and verify that the unit responds as expected.

Testing the interlocks is part of a complete system test as described in Testing the Configuration on page 101.

Configuring Frequency Inputs

Devices which provide a frequency input, such as some wind gauges, can be connected through discrete inputs seven or eight and scaled to a value. This value is then available through communications to a SCADA system.

To configure discrete input seven as a wind guage do the following:

Parameter	Index	Value	Description
P270	7	5	Selects frequency input
P271	7	0	Do not apply a 0Hz offset
P272	7	120	Wind speed at maximum frequency
P273	7	15.0	Output frequency at max. wind speed
P274	7	0	No damping applied

This example shows a simple frequency input. Below are examples of more complex inputs where a value of 0Hz still reads a value and where a positive frequency should read 0.

Scaling Frequency Inputs

Minimum Frequency = 0

To set discrete input 8 to report a scaled frequency range from 12 to 24 with a maximum input frequency of 10KHz, use the following settings:

Parameter	Index	Value
P271	8	12
P272	8	24
P273	8	10
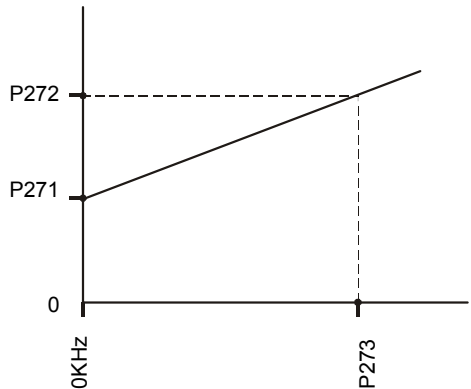
Minimum Frequency > 0

To set discrete input 8 to report a scaled frequency range from 0 to +12 with a minimum frequency input of 5KHz and a maximum input frequency of 10KHz use the following settings.
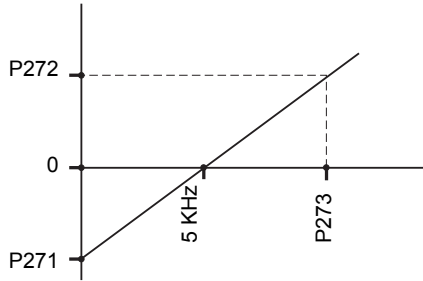
Parameter	Index	Value
P271	8	-12
P272	8	12
P273	8	10

Configuring Totalizer Inputs

To totalize pulses detected on discrete input number 8 and multiply every pulse by 4, do the following:

Parameter	Index	Value	Description
P270	8	4	Selects pulse input
P272	8	4	Add 4 to total for every pulse
P275	8		Shows the total

mA Loops

Use the EnviroRanger's mA inputs and outputs to integrate it with older equipment.

The base instrument does not come with mA output. This is available on optional cards:

Card Name	Description	Parameter Index
2mAI / 2mAO	2 mA inputs	3
	2 mA outputs	2
4mAI	4 mA inputs	5
4mAO	4 mA outputs	4

Note:
When a mA input parameter is accessed, a "mA" symbol appears in the upper left of the LCD display screen.

mA Input

The mA input can be used as a level measurement or passed on to a SCADA system.

To pass the mA input on to a SCADA system, read the value from the appropriate communication registers. See the EnviroRanger Communications Reference manual for details.

To use mA Input number one as the first level reading, set these parameters:

Parameter	Index	Value	Description
P004	1	250	Transducer = mA input 1
P250	1	2	Scale = 4 to 20 mA
P251	1	0	4 mA = 0% of span
P252	1	100	20 mA = 100% of span
P253	1	0	Do not damp the input signal

To use mA input number two as the second level reading, set these parameters:

Parameter	Index	Value	Description
P004	2	251	Transducer 2 = mA input 2
P250	2	2	Scale = 4 to 20 mA
P251	2	0	4 mA = 0% of span
P252	2	100	20 mA = 100% of span
P253	2	0	Do not damp the input signal

Calibration

Only calibrate the mA inputs if you installed the option card in the field. Any mA inputs shipped from the factory are already calibrated.

Calibrating 4 mA Input
1. Connect a trusted 4 mA source to the mA inputs on the terminal block
2. Put the EnviroRanger into program mode
3. View P260–mA Raw Input to see if it reads 4.0
   If the reading is correct, then do nothing
   If the reading is incorrect then continue
4. View P261–4 mA Trim
5. Press ⏎
6. L.CAL is shown on the LCD

The unit is now calibrated for 4 mA.

Calibrating 20 mA Input
1. Connect a trusted 20 mA source to the mA inputs on the terminal block
2. Put the EnviroRanger into program mode
3. View P260–mA Raw Input to see if it reads 20.0
   If the reading is correct, then do nothing
   If the reading is incorrect then continue
4. View P262–20 mA Trim
5. Press ⏎
6. H.CAL is shown on the LCD

The unit is now calibrated for 20 mA.

mA Output

Use mA output to send a measurement to another device.

To configure the mA output to correctly send a 4 to 20 mA signal scaled from 10% to 90% of span off of the second transducer, do the following:

Parameter	Index	Value	Description
P200	1	2	set to 4 to 20 range
P201	1	1	send mA proportional to level reading
P202	1	2	base mA on level point 2
P210	1	10	set 4 mA at 10% of span4
P211	1	90	set 20 mA at 90% of span5
P219	1	0	set failsafe action as 0 mA

Calibrating 4 mA Output
1. Connect the mA receiving device to the EnviroRanger
2. Put the EnviroRanger into program mode
3. Set P911–mA Output Value to 4.0

---

4 If the level reading drops below 10% of span then the mA output will drop below 4 mA.

5 If the level reading rises above 90% of span then the mA output will rise above 20 mA.

mA Loops

4. View the mA level on the receiving device
5. If there is a discrepancy, use P214–4 mA Output Trim to correct the value
    Press ⌈▲%⌉ and then ⌈▲⌉ or ⌈▼⌉ to increase or decrease the trim.
6. Repeat until the mA level on the receiving device equals 4.0 mA

    The unit is now calibrated for 4 mA for the receiving device.

Calibrating 20 mA Output
1. Connect the mA receiving device to the EnviroRanger
2. Put the EnviroRanger into program mode
3. Set P911–mA Output Value to 20.0
4. View the mA level on the receiving device
5. If there is a discrepancy, use P215–20 mA Output Trim to correct the value
    Press ⌈▲%⌉ and then ⌈▲⌉ or ⌈▼⌉ to increase or decrease the trim.
6. Repeat until the mA level on the receiving device equals 20.0

    The unit is now calibrated for 20 mA for the receiving device.

Verifying the mA Range
To verify that the external device can track the entire 4 to 20 mA range that the EnviroRanger sends, do the following:

1. Use P920 to put the EnviroRanger into Simulation mode (see Simulation on page 101)
2. Run the simulation through one complete fill / empty cycle
3. View P911–mA Output Value to verify that it tracks to the simulation
4. View the mA value reported on the external equipment to verify that it also tracks to the simulation

mA Loops

Volume

Volume is used in two situations:

To calculate and display volume instead of level
This allows you to program all setpoint parameters in terms of volume units rather than level units.

To calculate pumped volume
This allows you to:
- Totalize the volume of material that is pumped out of the wet well
- Set an alarm on pump efficiency

Readings

When using volume, readings are given in arbitrary units specified in P051.

The default is 100, which gives a reading in percent of total. Use whatever units you want here. If the value will be too large for the 4-digit LCD then use a larger unit.

For example, if your wet well has a maximum capacity of 250,000 liters then you would use the value 250.0 for P051 and indicate that the reading is in 1000's of liters.

Tank Shape and Dimensions

There are a large number of common tank shapes to select from. If possible, use one of these. Each tank shape uses the Empty distance (P006) in its calculations of volume.

Some tank shapes also require extra dimensions to calculate the volumes. Do not estimate these values, they must be correct to ensure the accuracy of your volume calculations.
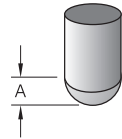
To configure volume for a tank with a half-sphere bottom do the following:

Parameter	Index	Value	Description
P050	1	4	selects the correct tank shape
P051	1	100	sets maximum volume at 100 (percent)
P052	1	1.3	sets "A" to 1.3m

Notes:
- The default reading changes to a range from 0 to 100 (the value in P051).
- Empty (P006) is still measured to the bottom of the tank, not the top of "A."

Characterization Chart

If you cannot use a pre-defined tank then use one of the universal tank shapes and program the characterization curve.

Do the following:
1. Plot a volume to height chart. Usually a tank supplier will provide this chart. However, if you have a custom-built wet well then you will need access to complete drawings of the well or accurate measurements.
2. Enter the curve values from this chart into P054 and P055.
3. Ensure extra points are added around sharp transitions in the wet well volume such as steps in the well wall.

Note:
The end points in the curve are 0,0 (fixed) and the point defined by P007–Span and P051–Maximum Volume.

Example Chart

Volume

Parameter	Index	Value	Description
P054	1	0.0	Determines the head (level) breakpoints at which the volumes are known.
	2	0.8	
	3	2.0	
	4	3.5	
	5	4.1	
	6	4.7	
	7	5.1	
	8	5.2	
	9	5.3	
	10	5.4	
	11	5.5	
	12	5.6	
	13	6.0	
	14	7.2	
	15	9.0	
P055	1	0.0	Determines the volumes which correspond to the level breakpoints. The universal calculations interpret between the breakpoints to produce an accurate model of the volume at all level readings. Use P050 = 9 for linear approximation P050 = 10 for curved approximation Linear approximation is uses a linear algorithm, curved approximation uses a cubic spline algorithm.
	2	2.1	
	3	4.0	
	4	5.6	
	5	5.9	
	6	6.3	
	7	6.7	
	8	7.1	
	9	7.8	
	10	8.2	
	11	8.8	
	12	9.2	
	13	10.9	
	14	12.0	
	15	14.0	

Volume

Alarms

Level

The most common type of alarm is the level alarm. Use this alarm to warn you when your process is in danger of being upset due to high or low levels.

Generally, the four alarms used are Hi, Hi Hi, Lo, and Lo Lo. There are also 3Hi and 3Lo but these are handled by the overflow and underflow alarms. See Handling Flow Events on page 95. These alarms can also be handled by alternate technologies such as floats or capacitance switches for better backup reliability. For more information on using alternate technologies as backup devices see Discrete Input Example on page 96.

Set the Common Parameters
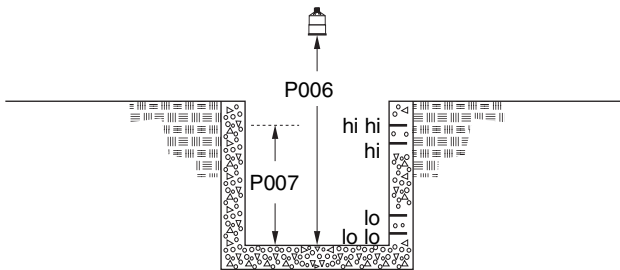
Prerequisite: You must know the details of your application and substitute the values for the sample values provided. If you are bench testing the unit then set your test values to be the same as the sample values.

Parameter	Index6	Value	Description
P001	G	1	Operation = level
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	G	1.8	Empty = 1.8m
P007	G	1.4	Span = 1.4m

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6 This example assumes a base, single measurement, unit. If your EnviroRanger has optional dual point software installed then some parameters are indexed by two.

Setting Simple Level Alarms

To set relay 5 to a standard level alarm (HiHi, Hi, Lo, LoLo) do the following:

Parameter	Index	Value	Description
P111	5	1	Set P111, indexed to relay, to the value "1" for level alarm
			1. Press $\boxed{\overset{\wedge}{\%}}$ to display the Auxiliary Function symbol
			2. Press $\boxed{\blacklozenge}$ or $\boxed{\blacktriangledown}$ as required to scroll to the alarm designation ($\blacktriangle$, ▲, ▼, or ▼)
			3. Press $\boxed{\hookleftarrow}$ to enter the value.
P112	5	1.2m	Set the "on" setpoint
P113	5	1.15m	Set the "off" setpoint

Available designations are:

Alarm	Designation
Hi Hi	▲
Hi	▲
Lo	▼
Lo Lo	▼

Rate

Rate alarms can trigger an alarm if the wet well is filling/emptying too quickly.

Setting a Filling Rate Alarm

Parameter	Index	Value	Description
P111	5	4	These settings trip the alarm when the reservoir is filling faster than 1m per minute and reset it at 0.9m per minute.
P112	5	1m	
P113	5	0.9m	

Setting an Emptying Rate Alarm

Parameter	Index	Value	Description
P111	5	4	These settings trip the alarm when the reservoir is emptying faster than 10% of span per minute and reset the alarm when emptying falls to 5%.
P112	5	-10%	
P113	5	-5%	

Bounded Range

Use the bounded range alarms to detect when the level is inside or outside of the range. By using a bounded range alarm you can effectively put two level alarms (high and low) on one relay.

Setting an Out of Bounds Alarm

Parameter	Index	Value	Description
P111	5	3	These settings do the following:
P112	5	1.3	
P113	5	0.3	
P116	5	0.05	

trips alarm	resets alarm
above 1.35m	below 1.25m
below 0.25m	above 0.35m

Setting an In Bounds Alarm

Parameter	Index	Value	Description
P111	5	2	These settings do the following:
P112	5	1.3	
P113	5	0.3	
P116	5	0.05	

trips alarm	resets alarm
below 1.25m	above 1.35m
above 0.35m	below 0.25m

Pump Efficiency

Pumped efficiency is calculated on the draw down of the application. The EnviroRanger assumes that the inflow to the system is constant and compares the resultant draw down of the wet well with the rated capacity of the pump. If you are using volume then you can take the rated capacity of the pump from the pump's documentation. If you do not know the pump's rated capacity then follow the steps in Determining a Pump's Rated Capacity, described below.

Parameter	Index	Value	Description
P111	5	8	alarm on pump efficiency event
P180	2	80	% of P183 to tag a pump efficiency problem
P181	2	180	time to calculate pumped efficiency
P183	2	3	3 m per minute rated capacity
P185	2	2	set action to alarm and pump removal

Determining a Pump's Rated Capacity

When you are using level to test a pump's efficiency it is difficult to estimate the draw down rate from the rated volume of the pump. Instead, allow the wet well to fill at least five times and check P182–Pump Measured Capacity to find the average value.

P182 is updated every time a pump down cycle is finished, so do not record the value until the "off" setpoint (P113) is reached. P182 will hold it's value until the next time the pump is run. Note that with multiple pumps in a alternate duty assist (lead / lag) cycle the pump you are tracking probably will not run every time the wet well is pumped out.

Time of Day

Use the time of day alarm to trip an alarm relay at the same time, and for the same duration, every day.

Parameter	Index	Value	Description
P111	5	9	alarm on time of day
P146	5	14:30	set for 2:30 p.m. every day
P114	5	5	set to alarm for five minutes

Cable Fault

Activates an alarm if transducer cable circuit enters a shorted or opened state.

Parameter	Index	Value	Description
P111	5	7	alarm on transducer cable fault
P110	5	1	alarm on transducer 1

Temperature

Use the temperature alarm to activate an alarm when the temperature reaches the "on" setpoint P112. This alarm uses the same setpoint parameters as the level alarms (P112 and P113) and can be set as a high alarm (P112 > P113) or a low alarm (P112 < P113). This shows a high alarm.

Parameter	Index	Value	Description
P111	5	5	alarm on temperature
P112	5	45	"on" setpoint at 45 °C
P113	5	43	"off" setpoint at 43 °C
P110	5	1	take the temperature reading from transducer one

The temperature source can be the temperature sensor built into the transducer or an external TS-3, as set by P660.

Pump Failure

The pump failure alarm activates when any pump interlock shows a failure. The setpoint for this alarm is the state of P510–Pump Failed Status. When that parameter is set to "1" on any index the pump failure alarm is activated. The alarm is reset when the status of P510 is reset. See Discrete Inputs on page 33 for details.

Power Failure

The power failure alarm activates when a discrete input detects a power failure. In this situation the power mains to the pumps are cut off but the EnviroRanger is still running. See Discrete Inputs on page 33 for details.

Loss of Echo (LOE)

Parameter	Index	Value	Description
P111	5	6	These settings trip the alarm when 0.5 minutes (30 seconds) pass without a valid echo being detected.
P070	G	0.5	

Clock Failure

Parameter	Index	Value	Description
P111	5	10	Triggers an alarm on relay 5 if the clock fails.

Report by Exception

Use report by exception to have the EnviroRanger alert a SCADA system or HMI to a defined event. These alerts can be sent through a modem or a direct RS-232 or RS-485 connection using the built in Modbus protocol.
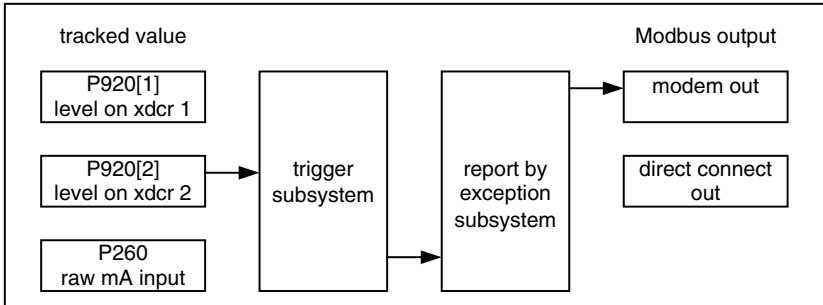
Relays are not affected by the trigger subsystem. See Relays on page 29 for details on programming relays.

When reporting an exception the EnviroRanger can assume the role of a Modbus master or a Modbus slave.

Reporting as a Modbus Master

When the ERS contacts a remote system and initiates communication it is acting as a Modbus master. The following is a description of how a report gets generated and sent when the ERS is configured as a Modbus master.

1. **The watched variable passes the trigger setpoint**
   For example P920–Reading. (Setting a Trigger on page 55).

2. **A trigger is generated**
   For example trigger number five.

3. **The trigger then initiates any related reporting (or data logging) events**
   For example report number three. (Programming the Report on page 55).

4. **The report dials the modem, if required, to make the connection**
   For example a modem connected through port 2. (Connection on page 58).

5. **The EnviroRanger sends the report as a Modbus master**
   For example a remote SCADA system acting as a slave on a specific modem.

In this configuration it is critical to have the dialled system set as a Modbus slave because a Modbus master will ignore the commands of another Modbus master. For example, to set port two (terminal block) the EnviroRanger as a Modbus master for sending reports:

Direct Connection

Parameter	Index	Value	Description
P770	2	5	Sets port 2 as Modbus RTU master

Modem Connection

Parameter	Index	Value	Description
P770	2	2 to 5	Any Modbus protocol
P783	2	5	Overrides P770 for the duration of the modem connection

See the SCADA system documentation on configuring communications.

Reporting as a Modbus Slave

When the ERS contacts a remote system and waits for communication it is acting as a Modbus slave. The following is a description of how a report gets generated and sent when the ERS is configured as a Modbus slave.

1. **The watched variable passes the trigger setpoint**
    For example P920–Reading (Setting a Trigger on page 55).

2. **A trigger is generated**
    For example trigger number five.

3. **The trigger then initiates any related reporting (or data logging) events**
    For example report number three (Programming the Report on page 55).

4. **The report dials the modem, if required, to make the connection**
    For example a modem connected through port 2 (Connection on page 58).

5. **The ERS waits for the Modbus master to request and clear the report**
    For example a remote SCADA system configured to react to a connection by scanning the reports on the EnviroRanger, pulling any existing reports, and then clearing them. In this configuration it is critical to have the dialled system set as a Modbus master which can detect the dial-up connection so that it knows when to request the report data. For example, to set port two (terminal block) the EnviroRanger as a Modbus slave for sending reports:

Direct Connection

Parameter	Index	Value	Description
P770	2	3	Sets port 2 as Modbus RTU slave

Modem Connection

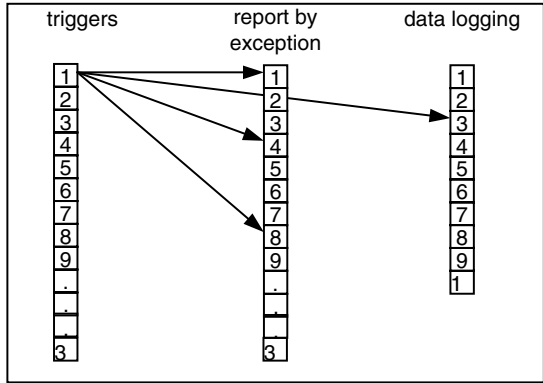| Parameter	Index	Value	Description
P770	2	2 to 5	Any Modbus protocol
P783	2	3	Overrides P770 for the duration of the modem connection

See the SCADA system documentation on configuring communications.

Setting a Trigger

A trigger is required to create the event that is reported. Up to 32 different triggers can be set, each tracking a different variable.

You must configure at least one trigger to initiate a report by exception. One trigger can also initiate multiple actions, both reports and data log operations.

To set trigger number five to generate an event when the level reaches 1.0m, do the following:

Parameter	Index	Value	Description
P420	5	920	Sets a trigger to watch P920–Reading and activate a trigger when the parameter value rises past 1.0. The trigger is reset when the value falls below 0.9.
P421	5	1	
P422	5	1.0	
P423	5	0.9	

Trigger states are reported in P424.

Note:
If you are watching a global parameter (one with no index) then P421 must be set to "1".

Programming the Report

In this example we define report number three to issue when trigger number 5 is activated.

Parameter	Index	Value	Description
P470	G	1	Sets the ERS to unit id "1"
P471	G	2	Communicates through port 2, the terminal block
P481	3	920	Reports P920
P482	3	1	Reports transducer 1
P483	3	17	Report 2 decimal places and force secondary index of 1
P484	3	5	Uses trigger #5 to generate exception
P485	3	1	Reports on trigger activation

When this report is issued it will be sent out through communications port 2, the RS-232 port on the terminal block. That port can be connected directly to a Modbus slave device, or to a modem. Examples of both are provided.

Typical Reports

You can configure the EnviroRanger to report on any parameter. Typical parameters to watch are:

Report by Exception

Parameter to watch (P420)	Values
P169–Flow Condition	0 – normal operation 1 – overflow state 2 – underflow state
P186–Pump Low Efficiency Counter	Shows number of times pump has failed to meet the efficiency threshold
P203–mA Output Value / Transducer	0 to 22 – Current mA output
P254–Scaled mA Input Value	0 to 9999 – Current mA input after scaling
P275–Scaled Discrete Input Value	Shows current value of discrete input, values vary by DI function
P452–Number of Entries	0 to 5000 – Current number of log entries
P453–Log Status	0 – inactive / full 1 – active, trigger activated 2 – active, trigger negated
P510–Pump Failed Status	0 – normal 1 – fault
P515–Pump Remote Control Status	0 – local 1 – remote
P519–Power Failure Status	0 – normal 1 – power failure
P520–Pump Available	0 – not available 1 – available
P664–Temperature	Current temperature measured by transducer
P707–Rate Value	Current rate of material level change
P708–Volume Rate Display	Current rate of material volume change
P805–Echo Confidence	Confidence value of short:long shots
P806–Echo Strength	Strength of primary echo
P911–mA Output Value	0 to 25 mA
P914–mA Input Value	0 to 24 mA
P920–Reading Measurement	Value of the current reading
P921–Material Measurement	Level of material
P922–Space Measurement	Distance from material to P007–Span
P923–Distance Measurement	Distance from material to transducer face
P924–Volume Measurement	Current volume (if used)
P925–Flow Measurement	Current OCM flow (if used)
P926–Head Measurement	Current OCM head (if used)
P927–Distance Measurement	As P923 but allows percent

Report on Discrete Input

Before configuring the report you must configure the discrete input. See Discrete Inputs on page 33.

To configure trigger 24 to use discrete input six:

Parameter	Index	Value	Description
P420	24	275	Sets a trigger to watch P275 – Scaled Discrete Input
P421	24	6	Value and activate a trigger when the parameter value
P422	24	0.9	rises past 0.9. The trigger is reset when the value falls
P423	24	0.1	below 0.1.

The parameter P275 reports 1 or 0 but the trigger doesn't activate until the value **passes** the setpoint. So setpoint values of 1.0 and 0.0 will not work.

Discrete inputs 7 and 8 can also be configured as pulse counters or frequency inputs. When set up as these types of input they then have a range of values from 0 to 9999 and can activate a trigger based on other setpoints.

Modbus Communications

To use report by exception you must have another system (Modbus master or slave) available to receive the data from the EnviroRanger. This system must be configured to accept multiple register writes (Modbus function code 16).

To configure the ERS as a slave for incoming calls but as a master for outgoing calls use these parameters:

Parameter	Index	Value	Description
P770	2	3	Modbus RTU slave for incoming calls
P783	2	5	Modbus RTU master for outgoing calls

Note:
The EnviroRanger will not interrupt a slave session to issue a report when communications is configured through a modem (P778 • 0).

Modbus Registers

The information sent in a report is held in registers R49250 to R49259. Set your SCADA system to expect this data when a report is generated.

Register	Parameter	Description
R49250	P470	EnviroRanger identifier (set to 0 to reset report)
R49251	P484	Report being sent
R49252	P485	Trigger state which caused the report
R49253	N/A	Year
R49254	N/A	Month
R49255	N/A	Day
R49256	N/A	Hour
R49257	N/A	Minute
R49258	N/A	Second
R49259	P481, P482, P483	Reported value

See the Communications Reference for details on the Modbus register map.

Resetting the Report

EnviroRanger as Modbus Master
The EnviroRanger resets the report after it is sent to the remote slave.

EnviroRanger as Slave
The remote master must write a zero ("0") to R49250.

Connection

Different communications ports can act as independent master and slave devices. For example, if you have an option card installed, which gives you the RS-485 connection, then you can have port 2 (RS-232) act as a Modbus master for reporting exceptions and still use port 3 (RS-485) as a Modbus slave connected to a SCADA system.

Direct Connection

See the Installation Guide (PL-601) and the Communications Reference (PL-602) for details on directly connecting the EnviroRanger to a Modbus device.

Dial Out

The EnviroRanger can act as either a Modbus master and slave when connected through a modem. This allows the EnviroRanger to report exceptions to a Modbus slave system and also provides data as a slave when queried by a remote master.

First, to set the EnviroRanger up to communicate with the correct protocol:

Parameter	Index	Value	Description
		2	Modbus ASCII unsolicited slave
P770	2	3	Modbus RTU unsolicited slave
		4	Modbus ASCII master
		5	Modbus RTU master

Then, set up the common modem parameters:

Parameter	Index	Value	Description
P772	2	9.6	Data rate of 9600 baud
P773	2	0	No parity, common setting
P774	2	8	8 data bits, common setting
P775	2	1	1 stop bit, common setting
P776	2	0	No hardware flow control
P777	2	0	No "key up" delay
P778	2	1	Communicate through a modem
P779	2	30	Keep connection open for 30 seconds of silence, then hang up
P782	2	0	Index parameter values globally, see the Communications Reference (PL-602) for details

Use these settings to use phone number 1 to call a Modbus slave device:

Parameter	Index	Value	Description
P783	1	5	When connecting, act as a Modbus master
P784	1	1	Use tone dialling
P785	1	18005551212	Dial 1-800-555-1212
P786	G	3	Try each number three times before moving on to the next one
P787	G	2	Cycle through the numbers twice before giving up
P788	G	5	Wait 5 seconds between dialling attempts (P786)
P789	G	45	Wait 45 seconds before timing out the dialling attempt

Use this to define the communications once a connection is established:

Parameter	Index	Value	Description
P473	G	247	Send data to node 247 (change to suit)
P474	G	1500	Start data at R41,500
P475	G	3	Try sending data 3 times
P476	G	3000	Wait 3 seconds for timeout

Notes:
- To enable only one dial out telephone number, set P786 = 9999, and P787 = 0.
- You can define up to eight phone numbers in P785.

Polling for an Exception Report

The EnviroRanger can also act as a simple slave device. For details see the Communications Reference (PL-602).

Data Logging

Use data logging to keep track of a parameter value on regular intervals or on trigger events. Up to 10 data logs can be configured and each log can hold up to 5000 entries.

When started with a trigger, data logging proceeds like this:
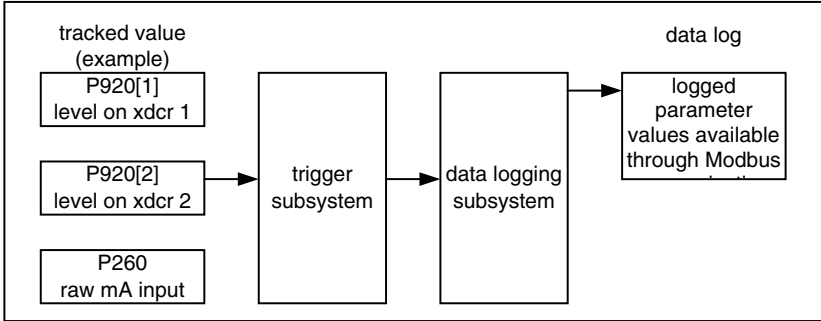
Setting a Trigger

A trigger is required to create the event that is reported. Up to 32 different triggers can be set, each tracking a different variable.

You must configure at least one trigger to initiate a report by exception. One trigger can also initiate multiple actions, both reports and data log operations.
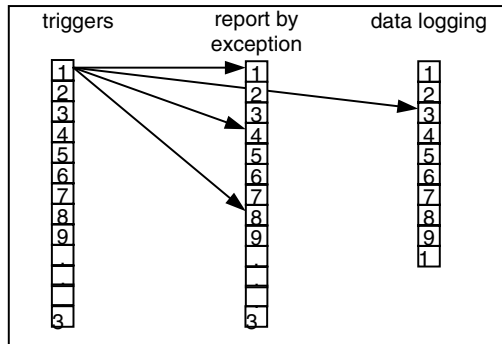
To set trigger number five to generate an event when the level reaches 1.0m:

Parameter	Index	Value	Description
P420	5	920	Sets a trigger to watch P920–Reading and activate a trigger when the parameter value rises past 1.0. The trigger is reset when the value falls below 0.9.
P421	5	1	
P422	5	1.0	
P423	5	0.9	

Trigger states are reported in P424.

Note:
If you are watching a global parameter (one with no index values) then P421 must be set to "1".

Periodic Trigger

To set trigger number two to trip periodically, do the following:

Parameter	Index	Value	Description
P420	2	009	
P421	2	1	Sets a trigger to watch P009–Time and activate a trigger
P422	2	00:00	every hour. This trigger value is reported in P424.
P423	2	01:00	

This will set up a log that can run unattended for over 200 days before requiring purging. A quarterly schedule for pulling data from a remote system, such as a remote OCM flow monitor, ensures that no data is lost. If your data can be averaged over a longer period you can increase P423 to 2 hours and wait an entire year before collecting the data.

Logging the Data

Once the trigger system is set up then you must define what data will be logged when the event is triggered. To track the measured level on transducer one in data log three set the following:

Parameter	Index	Value	Description
P440	G	1	Enables data logging
P441	3	920	Tracks parameter 920
P442	3	1	Tracks transducer 1 (primary index)
P443	3	1	Store the instantaneous value
P444	3	2	Use a fill and stop log
P445	3	2	Use trigger #2 to store data
P446	3	1	Store data when trigger is initially tripped

Results

Once the triggers are set up the data will be logged in the EnviroRanger RAM. This RAM is backed up with a battery in case of power outage. If long power outages are expected ensure that your battery is changed often to reduce the chances of losing data.

Any time the unit is without power or in program mode values are not logged. This can result in gaps in the data log time stamps or unusual values on averaged logs.

Reading Values through Modbus

To read the data logs you must program your Modbus master device to write requests into the handshaking area and then read the results.

See the EnviroRanger Communications Reference (PL-602) for details on using Modbus communications.

Data Log Status Information

Each log has associated status information that shows how many entries are in the log so that you can use the handshaking area to pull them out.

Each log has four pieces of data on it:

Entry	Log	Registers
value	1	R49500, R49501
time stamp	1	R49502, R49503
trigger state	1	R49504
number of entries	1	R49505
value	2	R49506, R49507
time stamp	2	R49508, R49509
trigger state	2	R49510
number of entries	2	R49511
…	…	…
value	10	R49553, R49554
time stamp	10	R49555, R49556
trigger state	10	R49557
number of entries	10	R49558

To determine the start register for a log, use the following formula:
((Log number * 6) – 6) + 49,500 = start register

1. Read the number of entries in the appropriate log register (see table above).

2. Write the requested log number and entry number:

Register	Value	Description
R49700	3	Requests log 3
R49701	857	Requests log entry 857

3. Read the logged value from registers R49702 and R49703 in UINT32 format.

4. Loop through steps 2 and 3 until all of the entries are read.

Reading Values through Parameters

Arbitrary logged values are only available with Modbus communications. To read them with a SCADA or HMI system see Logging the Data on page 62.

You can read some averages and maximum and minimum values through the LCD or Dolphin Plus.

Reading the Last Value

To read the most recent value added to the data log view P450. To find out when that data log was taken, view P451. The value shown is the time of the trigger, the date portion of the time stamp is not available through the LCD. To get the date value of the time stamp use Modbus communications. See the EnviroRanger Communications Reference (PL-602) for details.

Reading an Average

Averages are only available if the trigger for that data log is periodic (P420 = 9). See Periodic Trigger on page 62 for more information.

To read an average from the logged values, do the following:

1. Set P454 to the appropriate log value. For example, to read an average from log 3, set P454 to "3".

2. Set P455 to the average you want:

Average Calculated On	P455 =
current hour	1
current day	2
current week	3
current month	4
previous hour	5
previous day	6
previous week	7
previous month	8
previous 60 minutes	9
previous 24 hours	10

3. View P456 for the current averaged value.

This value is continuously updated when the EnviroRanger is in Run mode. Reading the average will give you the calculated average for that time period. The logging period must be shorter than the averaged period to get a reasonable result.

Reading the Maximum Logged Value

View P458 to see the largest logged value.

Reading the Minimum Logged Value

View P457 to see the smallest logged value.

Data Logging

Pump Control

Setting a Pump Down (Wet Well) Group

Sets a group of three pumps to pump down a wet well.
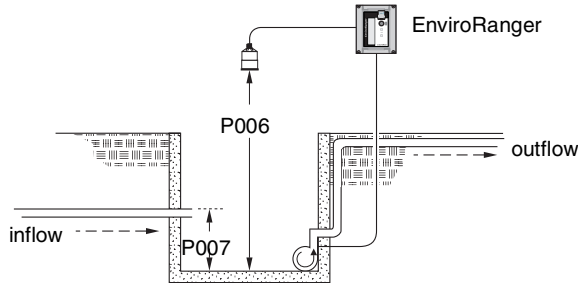
Set the Common Parameters

Prerequisite: You must know the details of your application and substitute the values for the sample values provided. If you are bench testing the unit then set your test values to be the same as the sample values.

Parameter	Index[7]	Value	Description
P001	G	1	Operation = level
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	G	1.8	Empty = 1.8m
P007	G	1.4	Span = 1.4m

Set Relays to "Alternate Duty Assist"

0	Index	Value	Description
P111	1	52	Sets the pump relays (index 1, 2, and 3) to "alternate duty assist".
P111	2	52	
P111	3	52	

Set the "On" Setpoints

Parameter	Index	Value	Description
P112	1	1.0m	Sets the three setpoints for the pump relays. The first cycle will use these setpoints. Subsequent cycles rotate the setpoints among the pumps.
P112	2	1.1m	
P112	3	1.2m	

Set the "Off" Setpoints

Parameter	Index	Value	Description
P113	0	0.5m	0 sets all relays at once, **including any alarm relays**.

---

7 This example assumes a base, single measurement, unit. If your EnviroRanger has optional dual point software installed then some parameters are indexed by two.
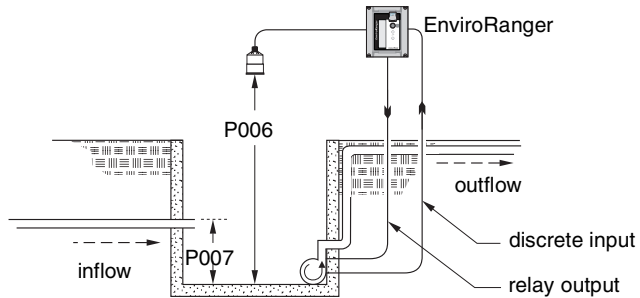
Setting a Pump Up (Reservoir) Group

Sets a group of three pumps to pump up a reservoir.
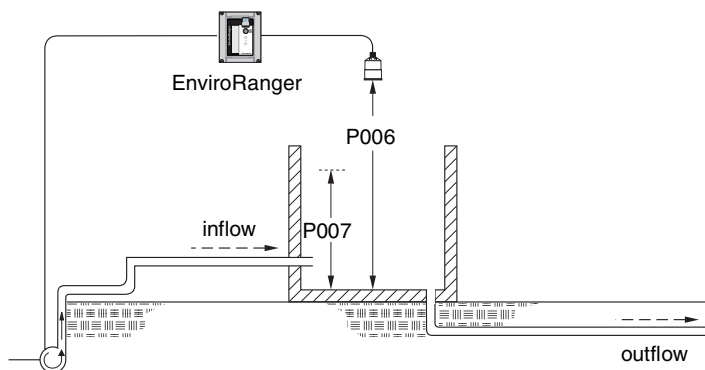
Set the Common Parameters

Prerequisite: You must know the details of your application and substitute the values for the sample values provided. If you are bench testing the unit then set your test values to be the same as the sample values.

Parameter	Index[8]	Value	Description
P001	G	1	Operation = level
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	G	1.8	Empty = 1.8m
P007	G	1.4	Span = 1.4m

Set Relays to "Alternate Duty Assist"

Parameter	Index	Value	Description
P111	1	52	Sets the pump relays (index 1, 2, and 3) to "alternate duty assist".
P111	2	52	
P111	3	52	

Set the Relay "On" Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The first cycle will use these setpoints. Subsequent cycles rotate the setpoints among the pumps.
P112	2	0.3m	
P112	3	0.2m	

---

8 This example assumes a base, single measurement, unit. If your EnviroRanger has optional dual point software installed then some parameters are indexed by two.

Set the Relay "Off" Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index 0 all five relays are set at the same time, **including any alarm relays**. Use index 0 with caution.

Note:
Optional parameters found on page 71.

Pump Control Interlocks

Parameter	Index	Value	Description
P111	1	52	Sets the pump relays (index 1, 2, and 3) to "alternate duty assist".
P111	2	52	
P111	3	52	
P505	1	3	Sets discrete inputs 3, 4, and 5 as the inputs for the pumps attached to relays 1, 2, and 3 respectively.
P505	2	4	
P505	3	5	

These values will ensure that any pump reporting a failure is removed from the pumping rotation. For more information on pump interlocks and discrete inputs see Discrete Inputs on page 33.

See also Appendix C–Pump Control Reference on page 121.

Other Pump Control Algorithms

Set the Relays to "Alternate Duty Backup"

Parameter	Index	Value	Description
P111	1	53	Sets the pump relays (index 1, 2, and 3) to "alternate duty backup".
P111	2	53	
P111	3	53	

Set the Relay "On" Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The first cycle will use these setpoints. Subsequent cycles rotate the setpoints among the pumps.
P112	2	0.3m	
P112	3	0.2m	

Set the Relay "Off" Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index 0 all five relays are set at the same time, **including any alarm relays**. Use index 0 with caution.

Note:
Optional parameters found on page 71.

Set the Relays to "Fixed Duty Assist"

Parameter	Index	Value	Description
P111	1	50	Sets the pump relays (index 1, 2, and 3) to "fixed duty assist". Multiple pumps can run simultaneously.
P111	2	50	
P111	3	50	

Set the Relay "On" Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The setpoints remain "attached" to the pump relays.
P112	2	0.3m	
P112	3	0.2m	

Set the Relay "Off" Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index 0 all five relays are set at the same time, **including any alarm relays**. Use index 0 with caution.

Set the Relays to "Fixed Duty Backup"

Parameter	Index	Value	Description
P111	1	51	Sets the pump relays (index 1, 2, and 3) to "fixed duty backup". Only one pump will ever run at one time.
P111	2	51	
P111	3	51	

Set the Relay "On" Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The setpoints remain "attached" to the pump relays.
P112	2	0.3m	
P112	3	0.2m	

Set the Relay "Off" Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index 0 all five relays are set at the same time, **including any alarm relays**. Use index 0 with caution.

Pump Control

Set the Relays to "Alternate Duty Service"

Parameter	Index	Value	Description
P111	1	54	Sets the pump relays (index 1, 2, and 3) to "service
P111	2	54	ratio duty assist".
P111	3	54	
P122	1	25	Sets the ratio to:
P122	2	50	25% - pump one 50% - pump two
P122	3	25	25% - pump three

Set the Relay "On" Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The first
P112	2	0.3m	cycle will use these setpoints. Subsequent cycles
P112	3	0.2m	rotate the setpoints among the pumps.

Set the Relay "Off" Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index 0 all five relays are set at the same time, **including any alarm relays**. Use index 0 with caution.

Note:
Optional parameters found on page 71.

Set the Relays to "First In First Out (FIFO) Assist"

Parameter	Index	Value	Description
P111	1	56	Sets the pump relays (index 1, 2, and 3) to "FIFO duty
P111	2	56	assist".
P111	3	56	

Set the Relay "On" Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The first
P112	2	0.3m	cycle will use these setpoints. Subsequent cycles
P112	3	0.2m	rotate the setpoints among the pumps.

Set the Relay "Off" Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index 0 all five relays are set at the same time, **including any alarm relays**. Use index 0 with caution.

Pump Control

Optional Pump Controls

Starting Pumps by Rate of Level Change

Parameter	Index	Value	Description
P112	1	1.35	Starting pumps by rate allows all setpoints to be set higher to save money by pumping from the highest safe level of the wet well.
P112	2	1.35	
P112	3	1.35	
P113	1	0.5m	
P113	2	0.5m	Notice that all indexed relays for both P112 and P113 are set to the same levels.
P113	3	0.5m	
P121	1	1	
P121	2	1	The pumps will start on 20 second intervals until the rate set in P703 is met.
P121	3	1	
P132	G	20.0	

Use this function when there are multiple pumps that should be controlled by rate of level change rather than setpoints. Pumping costs can be less because only the highest "on" setpoint needs to be programmed and this results in a lower difference in head to the next wet well which, in turn, results in less energy being used to pump out the well.

When the first "on" setpoint is reached the pumps will start, one by one, until the material level rate of change at a the same or greater than the value in:

- P703–Emptying Indicator (pump down applications)
- P702–Filling Indicator (pump up applications)

The delay between pump starts is set by P132–Pump Start Delay.

In Single Point Mode, there is one pump by rate control available that affects all pumps. In Dual Point Mode, a single pump by rate control can be set up for each of the three available level points (if Operation is set for difference or average P001 = 4 or 5).

Notes:
- All pump control relay "on" and "off" setpoints must be set to the same value.
- If the level is within 5% of Span (P007) of the "off" setpoint then the next pump is not started.

Rotating Pumps by Service Ratio

Prerequisite: the pump relays must be set to a "service ratio" value (P111 = 54 or 55).

Parameter	Index	Value	Description
P122	1	1	These values will start pump 2 50% of the time and pumps 1 and 3 25% of the time each.
P122	2	2	
P122	3	1	

Notes:
- The EnviroRanger will not sacrifice other pumping strategies to ensure that the ratio is held true.
- If the pump relays are set to the same value then the ratio equals 1:1 and all pumps are used equally (preset).

When more than one pump is assigned a Pump Service Ratio value (in any time units) and a pump start is required (Relay Setpoint "on", P112), the pump with the least running hours (with respect to the assigned ratio values) is started. Conversely, when a pump stop is required (Relay Setpoint "off" (P113), the pump with the most running hours (as compared to the assigned ratio values), stops.

Totalizing Pumped Volume

Prerequisite: the volume of the wet well or reservoir must be known.

Parameter	Index	Value	Description
P001	G	7	Operation = pumped volume
P002	G	1	
P003	G	2	
P004	G	102	These parameters are "as above."
P005	G	1	
P006	G	1.8	
P007	G	1.4	
P050	G	1	Tank volume is "flat-bottom"
P051	G	17.6	Max volume is 17.6 m^3 or 17,600 liters
P111	1	52	Sets relays 1, 2, and 3 as a pump group using Alternate Duty Assist control.
P111	2	52	
P111	3	52	
P112	1	1.0	
P112	2	1.2	Sets the "on" setpoints for the pump group.
P112	3	1.4	
P113	0	0.2	Sets the "off" setpoints for all relays.

Run Mode
1. Press ⊞ to enter Run mode.
2. Press 🔢 to display the pumped volume on the totalizer.
3. Press 🔲 to display the current level in the auxiliary reading area.

Setting Independent Failsafe Controls

Independent failsafe controls allow you to vary an individual relay from the global failsafe controls programmed in P070 to P072. In the example the global failsafe controls are set to "hold" and relay 5 is set to trigger an alarm bell.

Parameter	Index	Value	Description
P071	G	HOLd	Keep level at last known value
P129	5	dE	De-energize relay 5, and trigger alarm

Pump Control

Setting a Pump to Run On

Sometimes it is important to pump below the normal "off" setpoint. In these cases use P130–Pump Run-On Interval and P131 Pump Run-On Duration to control this event.

In the example the pump connected to relay number 3 is set to pump for an extra 60 seconds every 5 times it is triggered.

Parameter	Index	Value	Description
P130	3	5	Wait for relay 3 to pump 5 times and then run-on
P131	3	60	Run-on for 60 seconds

Note:
P130 counts when the indexed relay is tripped, not the number of pump cycles. If the indexed relay only trips once every 4 pump cycles then the actual interval of the run-on will be 20 pump cycles, or 5 cycles of relay number 3.

Setting the Pump Start Delays

The pump start delay ensures that all of the pumps do not start at once to avoid power surges. There are two parameters used here, P132–Pump Start Delay and P133–Pump Power Resumption Delay. The default is 10 seconds but you can increase this if your pumps take longer to spin up.

In the example the delay between pumps is set to 20 seconds and the delay of the first pump is set to 30 seconds.

Parameter	Index	Value	Description
P132	G	20	Wait at least 20 seconds between pump starts
P133	G	30	Wait for 30 seconds when power is restored

Setting the Pump Exercising Interval

Use pump exercising on slow wet wells or when one pump is outside of the normal duty schedule. See Appendix C–Pump Control Reference on page 121 for details on the pump control algorithms.

When the pump remains idle for the number of hours specified it pumps any liquid in the well down to the "off" setpoint.

In the example pump relay 3 is set to exercise every 48 hours if it has not run due to normal operation.

Parameter	Index	Value	Description
P134	3	1	Set pump exercising on for this relay
P114	3	60	Run the pump for 60 seconds
P115	3	48	Run the pump if it has been idle for 48 hours

Reducing Wall Cling

Use the Wall Cling parameter to randomly alter the "on" and "off" setpoints over a range. This eliminates the ridge of material that builds up at the setpoint that can give false echoes. This may increase the number of days between trips to clean the wet well. In the example a range of 0.5 meters is used to vary the setpoint. The randomly-selected setpoints are always "inside" the "on" and "off" setpoints.
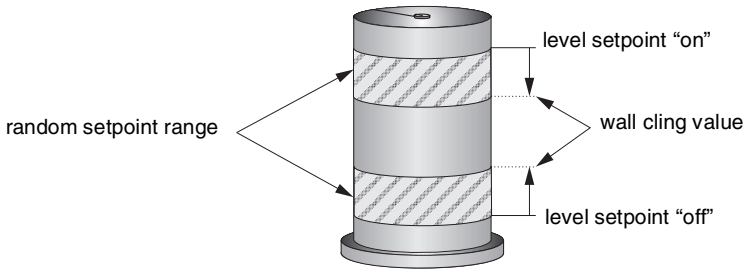
Parameter	Index	Value	Description
P134	3	1	Set pump exercising on for this relay
P114	3	60	Run the pump for 60 seconds
P115	3	48	Run the pump if it has been idle for 48 hours

Grouping Pumps

You can group pumps and use the same pumping algorithm separately on each group. If you specify different pumping algorithms then the pumps are already grouped by algorithm and you do not need to use this parameter. Use this only when four pumps are using the same algorithm and you want to split them into two groups.

In this example, pumps one and two can operate as a group and pumps three and four can operate as another group.

Parameter	Index	Value	Description
P137	1	1	Groups pumps 1 and 2
P137	2	1	
P137	3	2	Groups pumps 3 and 4
P137	4	2	

Saving Energy

Pumps can use different setpoints at different times of the day to account for variable energy costs.

The following example illustrates high energy cost usage reduction and/or elimination by using the EnviroRanger Pump Energy Cost Reduction features on a wet well (pump down application).
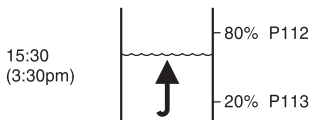
15:30 (3:30pm)		80% P112 — 20% P113	**Normal Operation** Uses the standard "on" and "off" setpoints (P112 / P113). Energy cost is at minimum.
16:30 (4:30pm)		80% P112 — 20% P113	**Peak Lead time (P143 = 60 minutes)** Pumps down the wet well regardless of the Relay "on" Setpoints. This ensures that the wet well starts the high cost period at the pumps' "off" setpoint. Energy cost is at minimum.
17:30 (5:30pm)		90% P144 80% P112 60% P145 20% P113	**Peak Start Time (P141 = 17:30)** Starts using the energy savings setpoints (P144 and P145). Energy cost is at maximum.
21:30 (9:30pm)		90% P144 80% P112 60% P145 20% P113	**Peak End Time (P142 = 21:30)** Returns to normal setpoints (P112 and P113). Energy cost returns to minimum.
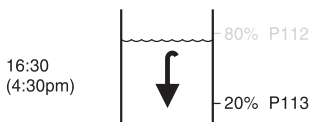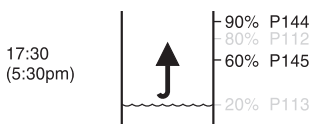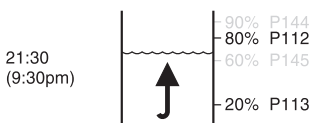
Generally, you would cascade the timing of the pump downs so that the wells farthest from the treatment facility would begin first and the entire system would push material through during the low cost period.

Note:
When the Peak "on" Setpoint is not reached, no energy is used during the "high cost" period. If the Peak "on" Setpoint is reached, the Wet Well is only pumped down to 60%, thereby minimizing "high cost" energy usage.

Parameter	Index	Value	Description
P140	G	2	Sets the unit to allow time of day setpoints
P141	1	17:30	Starts the first high cost period at 5:30 pm
P142	1	21:30	Ends the first high cost period at 9:30 pm
P143	G	60	Sets the pump down to happen 60 minutes before the high cost period
P144	1	90	Sets the high cost "on" setpoint as 90%
P145	1	60	Sets the high cost "off" setpoint as 60%
P148	G	3	Sets discrete input 3 as the override switch

Setting Aeration

A relay set to Aeration is controlled by time and could control a fan to ventilate an area or a bubbler to aerate liquids.

Parameter	Index	Value	Description
P111	4	62	Sets relay 4 as aeration
P114	4	10	Assert the function for 10 minutes
P115	4	6	Assert the function every 6 hours

Setting a Flush Valve

A flush valve is used to stir up sediment on the bottom of the well during pumping so that it doesn't accumulate. These parameters will control any relays set with P111 = 64–Flush Valve.

Most sets of parameters will work with only one or two changes, however, for these parameters to work all of them must be set to a value.

In this example the flush valve is connected to relay 4 and the watched pump is on relay 1.

Parameter	Index	Value	Description
P170	G	1	Watch relay 1 to count pump cycles
P171	G	3	Open the flush valve for 3 cycles
P172	G	10	Use the flush value every 10 cycles
P173	G	120	Open the flush valve for 120 seconds

Testing Pump Efficiency

The EnviroRanger can measure pump efficiency by measuring the draw down in the wet well when the pumps start. This method has been proven to be accurate to within 5% of an electromagnetic flow meter for pumped volume calculations.

This allows you to monitor your pumps for efficiency and take action if one or more of them have problems.

In this example the pumps are set to trigger an alarm event when they drop below 70% efficiency.

Parameter	Index	Value	Description
P180	1	70	Sets all three pumps to a 70% threshold before a low efficiency event is recorded
P180	2	70	
P180	3	70	
P181	G	120	Calculates volume over 120 seconds
P183	1	3750	Sets the rated capacity in litres per minute of the three pumps, assumes that the volume parameters are used
P183	2	3750	
P183	3	6500	
P184	1	3	Takes the action defined below when the third low efficiency event is recorded
P184	2	3	
P184	3	3	
P185	1	2	Trigger alarms and remove pump from duty schedule (P510=1, P512=1)
P185	2	2	
P185	3	2	

Some volume parameters that would make sense for the pump efficiency example would be:

Parameter	Index	Value	Description
P050	G	1	Flat, level bottom
P051	G	65000	Maximum volume in litres

Pump Control

Relay Controlled by Communications

A relay can be controlled directly by a remote system through communications. No other control schemes can be used with a relay configured this way. Communications can be used to force status of some control relays, such as pumps. See the Communications Reference (PL-602) for details.

To enable this:

Parameter	Index	Value	Description
P111	5	65	Sets relay 5 as controlled by communications

Relay Controlled by Time

A relay can be controlled by time setpoints (P114 and P115).

To enable this:

Parameter	Index	Value	Description
P111	4	65	Sets relay 5 as controlled by time
P114	4	10	Assert the function for 10 minutes
P115	4	24	Assert the function every 24 hours

Tracking Pump Usage

You can find out how much an individual pump has been used by viewing the pump records parameters.

To view this information…	View this parameter…
Current run time	P309
Total pump hours	P310
Total pump starts	P311
Total pump run on occurrences	P312

Pump Control

Gate Control

Setting a Gate (Penstock) Control

Set the Common Parameters

Prerequisite: You must know the details of your application and substitute the values for the sample values provided. If you are bench testing the unit then set your test values to be the same as the sample values.

Parameter	Index	Value	Description
P001	G	1	Operation = Level
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	G	1.8	Empty = 1.8m
P007	G	1.4	Span = 1.4m

Set Relay 1 (Open Gate)

Relay 1 is wired to the "open" connections on the gate control. When relay 1 is energized the gate moves up.

Parameter	Index	Value	Description
P111	1	63	Sets relay 1 to energize (open gate) when the level is below 45% of the span (0.63m). The gate will open for 0. minute (6 seconds) and this cycle will happen once per 0.02 hours (1 minute, 12 seconds) until the level is above 45%.
P112	1	45%	
P113	1	----	
P114	1	0.1	
P115	1	0.02	

Gate Control

Set Relay 2 (Close Gate)

Relay 2 is wired to the "close" connections on the gate control. When relay 2 is energized the gate moves down.

Parameter	Index	Value	Description
P111	2	63	Sets relay 2 to energize (close gate) when the level is above 55% of the span (0.77m). The timing (P114, P115) of relay 2 is set from the relay 1 setpoints.
P112	2	55%	
P113	2	----	

Note:

Care must be taken to adjust P114 and P115 for proper proportional integral (PI) control without overshoot or cycling. P114 is equivalent to proportional band (P). P115 is equivalent to reset (I).

The transducer can also be placed upstream from the gate to control upstream head.

Rake (Screen) Control

Screens or rakes are mounted on the inflow channel of the wastewater treatment plant to prevent debris from clogging the equipment. When material builds up on the screen a level differential is created with the water level higher in front of the screen than behind it. When this differential reaches the programmed setpoint the EnviroRanger activates a relay to run mechanical rakes to clean the screen and ensure a steady flow into the treatment process.

Setting a Rake Control
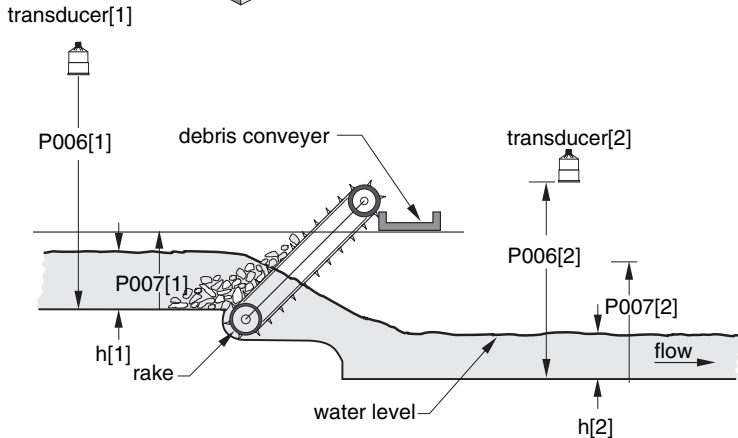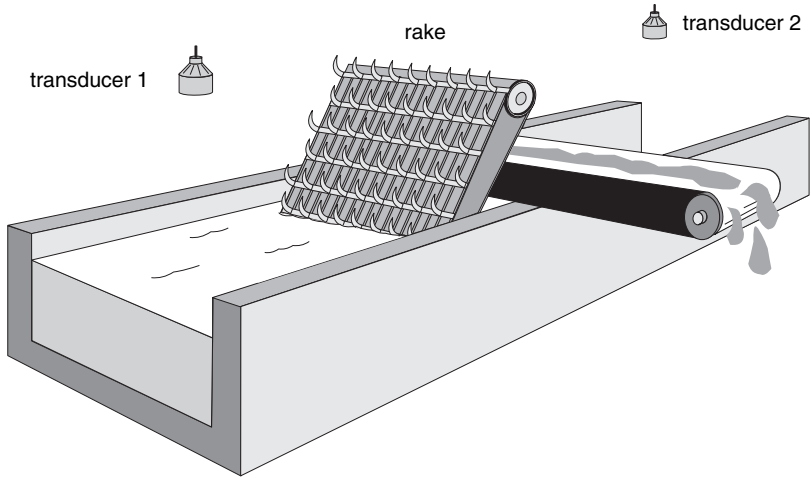
Level difference (point 3) = h[1]–h[2]

Setting the Common Parameters

Prerequisite: You must know the details of your application and substitute the values for the sample values provided. If you are bench testing the unit then set your test values to be the same as the sample values.

Parameter	Index	Value	Description
P001	G	4	Operation = Differential
P002	G	1	Material = liquid
P003	1,2	2	Maximum Process Speed = medium
P004	1,2	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	1	1.8	Empty = 1.8m
	2	2.2	Empty = 2.2m
P007	1	1.4	Span = 1.4m
	2	1.4	Span = 1.4m

Set Relay 1 (Operate Rake)

Parameter	Index	Value	Description
P110	1	3	Starts the rake when the difference between the two levels rises above 0.4m and stop the rake when the difference falls below 0.1m.
P111	1	50	
P112	1	0.4	
P113	1	0.1	

Set Relays 2 to 4 (Level Alarms)

Parameter	Index	Value	Description
P110	2	1	Sets relay 2 as a high level alarm for transducer 1 with an "on" setpoint of 1.3m and an "off" setpoint of 1.2m.
P111	2	1	
P112	2	1.3	
P113	2	1.2	
P110	3	2	Sets relay 3 as a low level alarm for transducer 2 with an "on" setpoint of 0.2m and an "off" setpoint of 0.4m.
P111	3	1	
P112	3	0.2	
P113	3	0.4	
P110	4	3	Sets relay 4 as a "rake failure" alarm as it uses the differential level point (3) with an "on" setpoint of 1.0m and an "off" setpoint of 0.9m.
P111	4	1	
P112	4	1.0	
P113	4	0.9	

External Totalizers and Flow Samplers

External totalizers are simple counters which count the number of relay "clicks" produced by the EnviroRanger. This is generally used to keep track of OCM or pumped volume totals. Note that both of these values are also stored in the EnviroRanger and are available through communications.

Flow samplers are devices which take a sample of liquid when triggered by a relay "click." These samples are used to monitor water quality over time. Flow samplers can be driven by OCM volume or by time depending on the application requirements.

Relay Contacts

Pumped volume is calculated at the end of the pump cycle. Totalized volume given through a relay set up for totalizer (P111[r]=40) will be given in bursts at this time. Both the open and closed times for the relay contact are provided by P645 and are preset to 0.2 seconds. Partial units are added to the next pump cycle.

Example
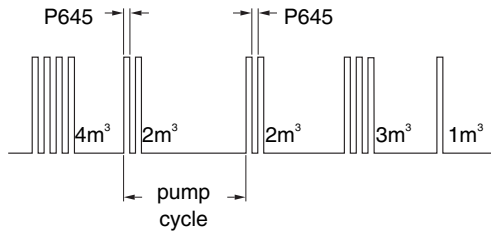
The example shows a relay set up to make 1 contact for every cubic metre (m^3) of liquid.

Totalizer

Use the totalizer to provide relay contact to an external counter using:

$$1 \text{ Contact per } 10^{P640} \text{ units}$$

P640 is preset to "0" so the default number of contacts for a pumped volume cycle is equivalent to the number of volume units.

The source of units varies depending on the operation:

Operation	Units Source Parameter
OCM (P001=6)	P604–Maximum Flow, or P608–Flowrate Units
Pumped Volume (P001=7)	P051–Max Volume

Flow Sampler

Based on Volume

To trigger a flow sampler relay based on flow use P111[r]=41 and set the other parameters appropriately:

$$1 \text{ Contact per P641} \times 10^{P642} \text{ units}$$

Operation	Units Source Parameter
OCM (P001=6)	P604–Maximum Flow, or P608–Flowrate Units

By using a mantissa (P641) and an exponent (P642) the relay contacts can be based on a volume other than a multiple of ten.

Based on Time

To trigger a flow sampler based on time use P111[r]=60. When controlling a flow sampler by time you also have to set:

Parameter	Usage
P114	Sets the "duration" of the relay contact, usually short
P115	Sets the "interval" of the relay contact, usually long
P645	Normally not used, but sets the minimum relay contact

Open Channel Monitoring (OCM)

There are three ways of defining an OCM installation depending on your Primary Measuring Device (PMD):

Dimensional (P600=2,3,6,7)
is provided for some common weir and flume types. For these PMDs the dimensions (P602) are entered directly.

- BS-3680 / ISO 1438/1 Thin plate V notch weir on page 85
- BS-3680 / ISO 4359 Rectangular Flume on page 86
- Palmer Bowlus Flume on page 87
- H Flume on page 88

Exponential (P600=1)
is provided for most other weir and flume types. For these PMDs the exponent provided by the manufacturer is entered. Flow is calculated using the exponent (P601) and the maximum values (P603 and P604).

- Standard Weirs on page 89
- Parshall Flume on page 90
- Leopold Lagco on page 91
- Cut Throat Flume on page 92

Universal (P600=4,5)
is provided to accommodate any installation not covered by the first two types. For all other PMDs the head-to-flow curve can be plotted based on known breakpoints, usually supplied by the PMD manufacturer.

- Typical Flow Characterization on page 92
- Example Flumes on page 93
- Example Weirs on page 93

Set the Common Parameters

Dimension examples on next page.
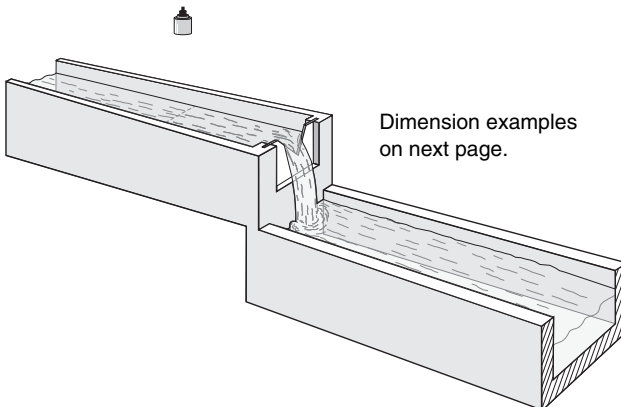
These "Quick Start" parameters are required for all installations.

Parameter	Index	Value	Description
P001	G	6	Operation = OCM
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	G	1.8	Empty = 1.8m
P007	G	1.0	Span = 1.4m
P801	G	0.8	Range Extension to avoid "LOE"

Setting Zero Head

Many PMDs start flowing higher than the traditional empty distance of the application. You can account for this in two ways:

1. Use P605 Zero Head to have OCM calculations ignore levels below that value. Possible head = P007 - P605.

> **Note:**
> P603 is preset to P007 and is not updated when P605 is used. Ensure you set P603 to the correct value when using P605.
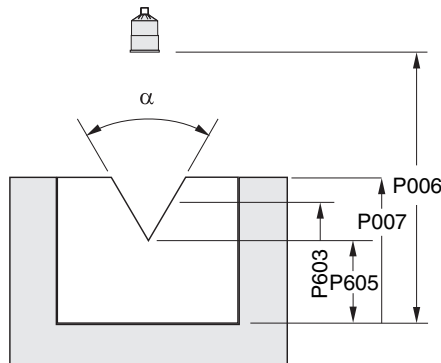
2. Use P801 Range Extension to ignore readings below the artificially-short Empty distance (P006).
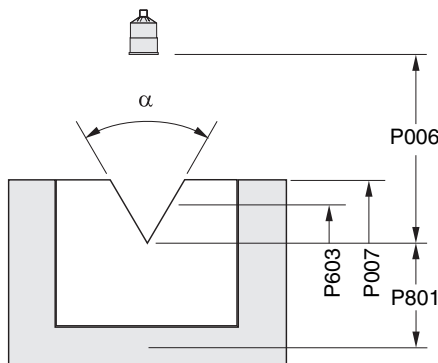
The examples on the following pages show both methods.

Setting Totalized Volume

To display the totalized volume on the LCD use the following parameters:

Parameter	Index	Value	Description
P737	G	2	Show the eight digit totalizer in the primary display

Direct Support

BS-3680 / ISO 1438/1 Thin plate V notch weir
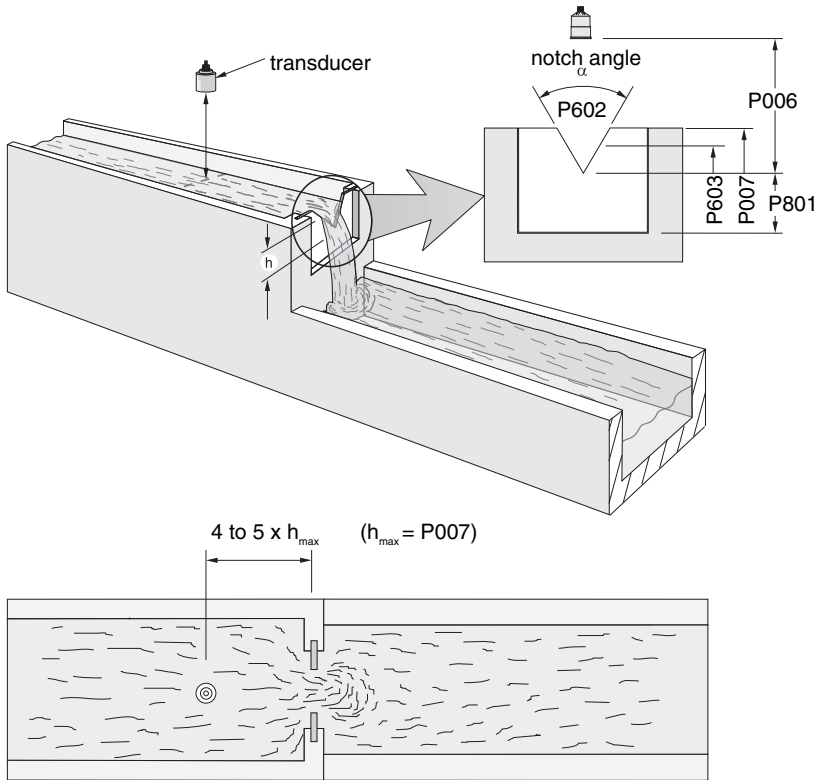
Parameter	Index	Value
P600	G	7–ISO 1438/1 V Notch Weir
P602	1	Notch angle
(view only)	2	Discharge coefficient (Ce)
P603	G	Maximum Head (preset to P007)
P801	G	Range Extension
P608	G	Flowrate Units

BS-3680 / ISO 4359 Rectangular Flume
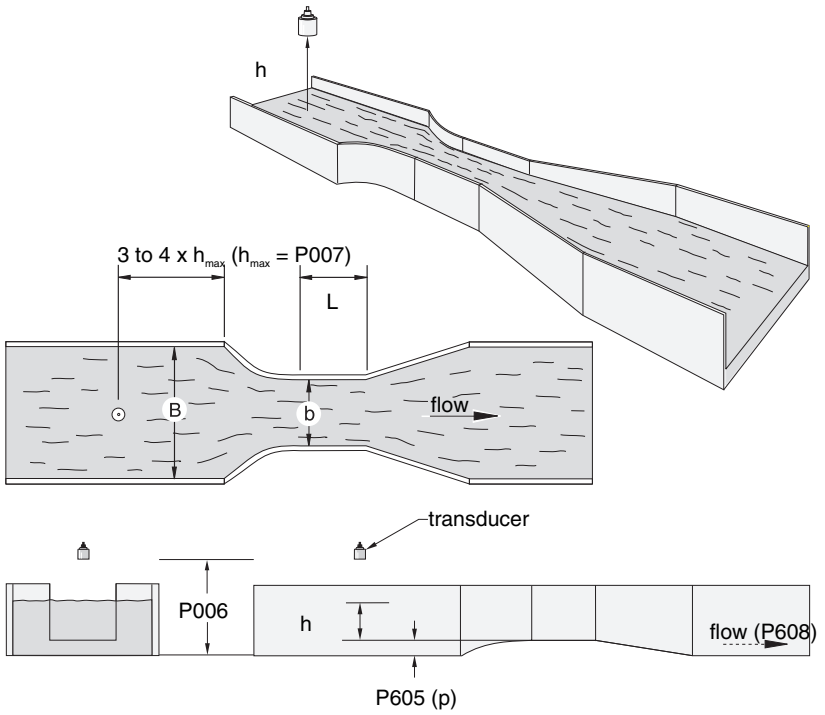
Parameter	Index	Value
P600	G	6–ISO 4359 Rectangular Flume
P602	1	Approach width (B)
	2	Throat width (b)
	3	Hump Height (p)
	4	Throat length (L)
(view only)	5	Velocity coefficient (Cv)
(view only)	6	Discharge coefficient (Cd)
(view only)	7	Cross sectional area
P605	G	Zero Head
P608	G	Flowrate Units

Palmer Bowlus Flume

Plan view

D/2, point of measurement

Side view

transducer

D

P006

P007

P603

P605

Front view
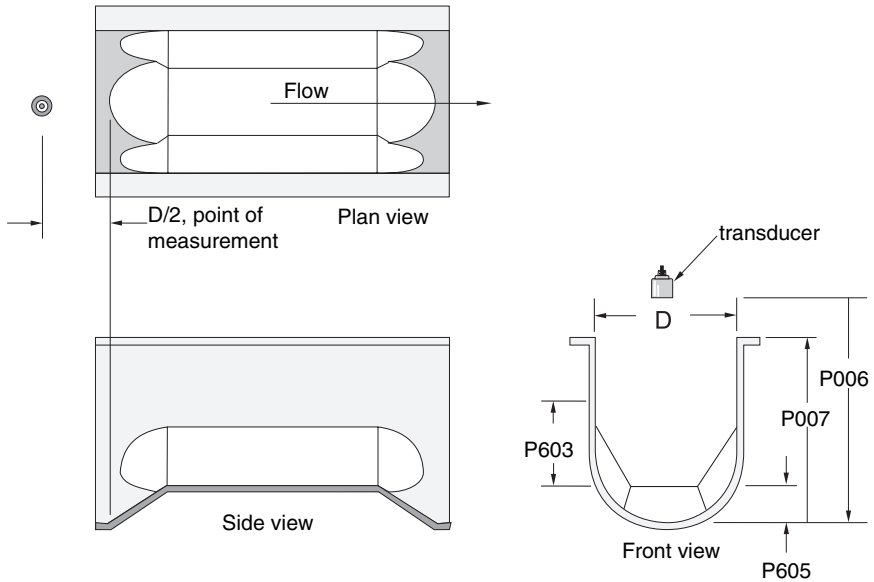
Parameter	Index	Value
P600	G	2–Palmer Bowlus Flume
P602	1	Flume width (D)
P603	G	Maximum Head (preset = P007)
P604	G	Maximum Flow
P605	G	Zero Head
P606	G	Time Units

- Sized by pipe diameter, D
- Flume relief is trapezoidal
- Designed to install directly into pipelines and manholes
- Head is referenced to bottom of the throat, not bottom of the pipe
- For rated flows under free flow conditions, the head is measured at a distance of D/2 upstream from the beginning of the converging section

H Flume

transducer

point of measurement

plan view

front view   side view

P006
P007
D
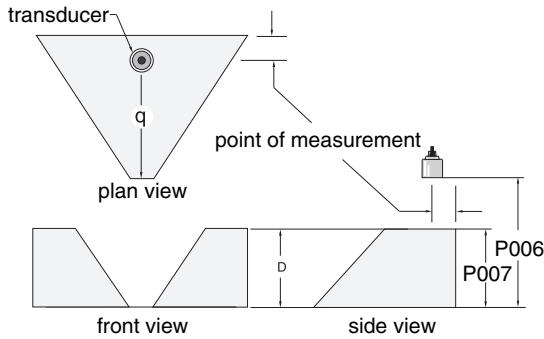
Parameter	Index	Value
P600	G	3–H Flume
P602	1	Flume height (D)
P603	G	Maximum Head (preset = P007)
P604	G	Maximum Flow
P606	G	Time Units

- Sized by maximum depth of flume, D
- Approach is preferably rectangular, matching width and depth for distance 3 to 5 times the depth of the flume
- May be installed in channels under partial submergence (ratio of downstream level to head). Typical errors are:
  - 1% @ 30% submergence
  - 3% @ 50% submergence
- For rated flows under free flow conditions, the head is measured at a point downstream from the flume entrance

Flume Size	Point of Measurement	
(D in feet)	cm	inches
0.5	5	1¾
0.75	7	2¾
1.0	9	3¾
1.5	14	5½
2.0	18	7¼
2.5	23	9
3.0	28	10¾
4.5	41	16¼

- H flumes come with a flat or sloping floor. The same flow table can be used as error is less than 1%.

PMDs with Exponential Flow to Head Function

For Primary Measuring Devices (PMDs) that measure flow by an exponential equation use these parameters. Ensure that you use the correct exponent for your PMD, the values below are samples only.

Standard Weirs

transducer

3 to 4 h_{max}
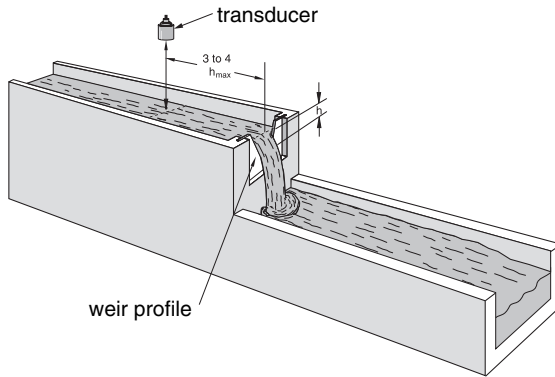
weir profile

Applicable Weir Profiles

V-notch or triangular   suppressed rectangular   cipolleti or trapezoidal   sutro or proportional
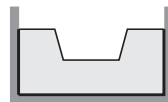
Parameter	Index	Value	
P600	G	1–Exponential Function	
P601	G	**Weir Type**	**Value9**
		V-notch	2.50
		Suppressed rectangular	1.50
		Cipolletti or trapezoidal	1.50
		Sutro or proportional	1.00
P603	G	Maximum Head	
P604	G	Maximum Flow	
P606	G	Time Units	
P801	G	Range Extension	

Non-Applicable Weir Profiles
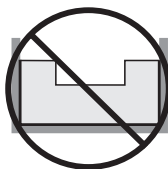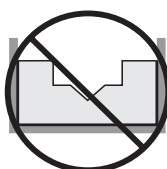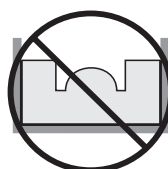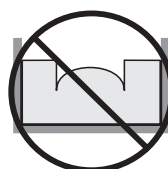
contracted rectangular   compound   Poebing   approximate exponential

---

9 These values are samples only. Consult your weir manufacturer's documentation for the correct flow exponent.

Flows through these weirs can be measured using the universal flow calculation P600 = 4 or 5. See Universal Calculation Support on page 92.

Parshall Flume

Plan View

Front View   Side View
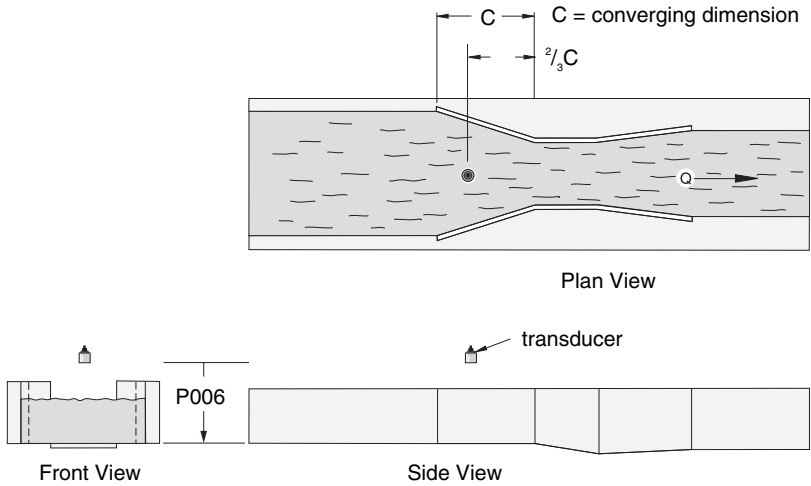
- sized by throat width
- set on solid foundation
- For rated flows under free flow conditions the head is measured at $^2/_3$ the length of the converging section from the beginning of the throat section.

Parameter	Index	Value
P600	G	1–Parshall Flume
P601	G	1.22–1.607 (consult your flume documentation)
P603	G	Maximum Head
P604	G	Maximum Flow (Q)
P606	G	Time Units

Leopold Lagco Flume

throat

plan view

transducer

converging   diverging

point of measurement

P006

P007

P603

0
Head

P605

side view

front view
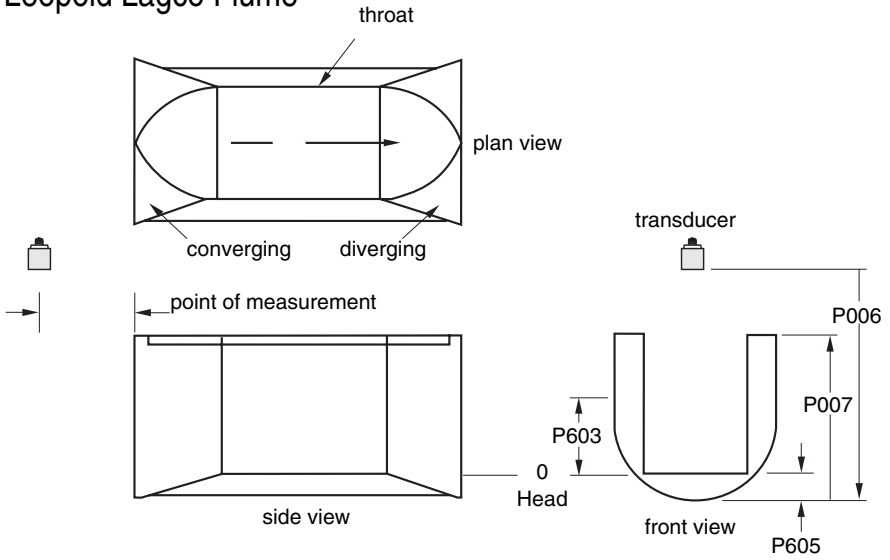
Parameter	Index	Value
P600	G	1–Leopold Lagco Flume
P601	G	1.55
P603	G	Maximum Head (preset P007)
P604	G	Maximum Flow
P605	G	Zero Head
P606	G	Time Units

- Designed to be installed directly into pipelines and manholes
- Leopold Lagco may be classed as a rectangular Palmer-Bowlus flume
- Sized by pipe (sewer) diameter
- For rated flows under free flow conditions the head is measured at a point upstream referenced to the beginning of the converging section. Refer to the following table:

Flume Size (pipe diameter in inches)	Point of Measurement	
	cm	inches
4-12	2.5	1
15	3.2	1¼
18	4.4	1¾
21	5.1	2
24	6.4	2½
30	7.6	3
42	8.9	3½
48	10.2	4
54	11.4	4½
60	12.7	5
66	14.0	5½
72	15.2	6

Cut Throat Flume

Plan View
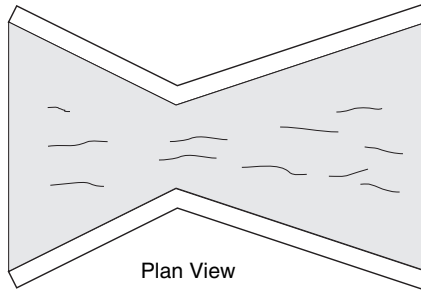
- Similar to Parshall flume except that the floor is flat bottomed and throat has no virtual length.
- Refer to manufacturer's specifications for flow equation and point of head measurement.

Parameter	Index	Value
P600	G	1–Cut Throat Flume
P601	G	1.55
P603	G	Maximum Head (preset P007)
P604	G	Maximum Flow
P606	G	Time Units

Universal Calculation Support

When the primary measuring device (PMD) doesn't fit one of the standard types it can be programmed using a universal characterization. When Universal is selected as the PMD type (P600) then both P610 and P611 must be entered to define the flow.

Two curve types are supported:

- P600 = 4–linear (piecewise linear)
- P600 = 5–curved (cubic spline)

Both are shown in the following chart.

Typical Flow Characterization

Maximums (P603, P604)

Flow (P611)

— linear
— curved
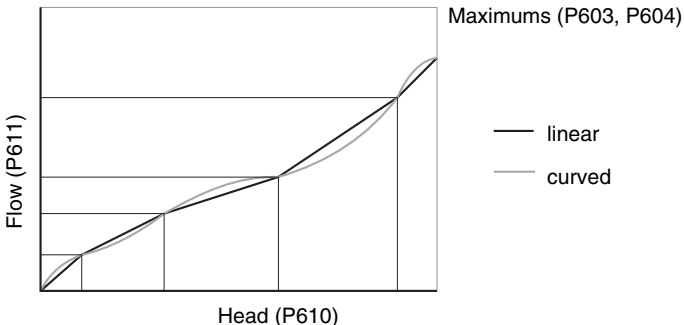
Head (P610)

Characterization is achieved by entering the head (P610) and corresponding flow (P611), either from empirical measurement or from the manufacturer's specification. The more breakpoints that are defined, the more accurate will be the flow measurement. Breakpoints should be concentrated in areas exhibiting the higher degrees of non linear flow. A maximum of 32 breakpoints can be defined. The curve's end point is always specified by the parameters Maximum Head (P603) and Maximum Flow (P604) for a maximum total of 33 breakpoints.

Use as many breakpoints as required by the complexity of your PMD.

See Flow Calculation on page 108 for more information.

Example Flumes

These example flumes would both require a universal calculation.

Trapezoidal
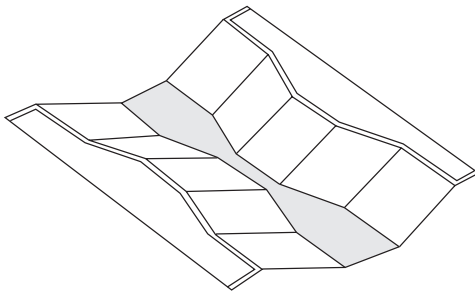
Dual Range (nested) Parshall
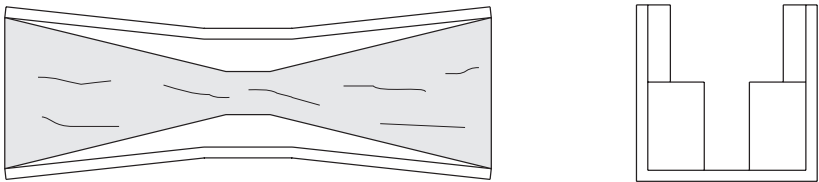
Example Weirs

These weirs could require universal calculation.

contracted rectangular

compound

Poebing

approximate exponential
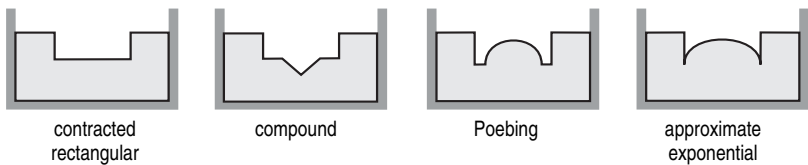
For further information regarding universal flow calculations, see Flow Calculation on page 108.

Handling Flow Events

The overflow / underflow parameters allow the ERS 500 to react to flow conditions caused by storms or other unusual events. When the a flow event is entered, the following actions are taken:

- **Logging starts.** (See Data Logging on page 61).
- **Relays are overridden.** (Described below).
- **Cost Reduction settings are overridden (**See Saving Energy on page 73).
- **Control relays are tripped.** (Relays set with P111 = 61 are tripped).
- **Communications are updated.** (See Communications Reference manual).
- **P169 is updated.** (Described below).

In this example the overflow detection comes from an external device connected through discrete input 5. All pump relays are turned off and OCM is logged on transducer 2.

Parameter	Index	Value	Description
P160	G	2:5	Discrete input five supplies the signal
P163	G	10	Calm the input by 10 seconds
P164	G	360	The overflow can last up to 6 hours
P165	1	2	
P165	2	2	The pump control relays are forced off during the event
P165	3	2	to keep the storm water from upsetting the treatment facility
P165	4	2	
P166	G	2	The overflow is totalized by transducer 2

Setting Input Source

The source for detecting a flow event can be a discrete input, the material level reading, or the material rate of change. Use P160–Overflow / Underflow Level Source to define which input triggers flow events. The parameter is a split value with x as the trigger type and y as the input number.

x	Input	y	Index
1	transducer level – overflow	1	transducer 1
		2	transducer 2
		3	average or difference
2	discrete input – overflow	1 to 8	base
		1 to 16	with 8DI card
3	transducer level – underflow	1	transducer 1
		2	transducer 2
		3	average or difference
4	discrete input – underflow	1 to 8	base
		1 to 16	with 8DI card
5	transducer rate– overflow	1	transducer 1
		2	transducer 2
		3	average or difference
6	transducer rate– underflow	1	transducer 1
		2	transducer 2
		3	average or difference

Flow events are global so you can only set up one even with dual point.

Level Input Example

The advantage of setting an overflow (or underflow) setpoint is that other actions can be triggered off of the overflow and underflow events. This is useful for combined sewer overflow (CSO) reporting.

Note:
For OCM to work on an overflow event, the dual point feature must be installed. This feature is sold separately.

To detect an overflow event, shut down all pumps, and start logging OCM, do the following:

Parameter	Index	Value	Description
P160	1	1:1	Sets an overflow event to be triggered by a level reading of 95% and an overflow reset at 90%.
P161	1	95%	
P162	1	90%	
P165	1	1	Sets relays 1, 2, and 3 to be forced "off" when an overflow event is detected.
P165	2	1	
P165	3	1	
P166	G	2	Sets transducer two as the OCM total.

Discrete Input Example

Discrete inputs cannot directly activate alarm relays. However, discrete inputs can be used to indicate overflow and underflow events and these events can be used to drive control relays and report status through communications.

Note:
You can use discrete inputs for other functions by using the Report subsystem or checking the DI state through communications. See Report by Exception on page 53 or the Communications Reference (PL-602).

Overflow

Parameter	Index	Value	Description
P111	5	61	This setup sets discrete input number 6 to indicate an overflow event. That event triggers control relay number 5.
P160	G	2:6	
P163	G	5.0	
P164	G	360	

Underflow

Parameter	Index	Value	Description
P111	5	61	This sets up discrete input number 6 to indicate an underflow event. That event triggers control relay number 5.
P160	G	4:6	
P163	G	5.0	
P164	G	360	

Rate of Change Example

To configure the rate of change on transducer number two to detect an underflow do the following:

Parameter	Index	Value	Description
P160	G	6:2	Use rate 2 as underflow detection
P161	G	95%	Start at 95% of filling rate
P162	G	90%	End at 90% of filling rate

These rate values are specified as a percentage of P702–Filling Indicator.

Setting Event Results

Once the input is set up to detect the flow event you can change how the relays react during a flow event. Set P165–Overflow / Underflow Relay Action to the required relay state.

Monitoring Flow Events

Flow events can be monitored using the optional data logging feature or by using a report by exception.

To set up data logging see Data Logging on page 61.

To set up a report see Report by Exception on page 53.

To check the immediate status of the instrument, view P169 while in run mode. A value of 1 indicates that there is a flow event going on. A 0 indicates that there is no flow event.

Handling Flow Events

Communications

The EnviroRanger ERS 500 is capable of communicating with most SCADA systems, PLCs, and PCs. The supported protocols are:

- Modbus RTU/ASCII–base unit on RS-232 or RS-485 transport
- Profibus–optional SmartLinx® module
- Remote I/O–optional SmartLinx module
- DeviceNet–optional SmartLinx module

Communication Ports

The EnviroRanger comes with two communication ports on the base unit and one more port available on all of the option cards. These ports are:

Port	Connection	Location		Interface
1	RJ-11 connector	Rack:	front of unit	RS-232
		Panel:	front of unit	
		Wall mount:	inside enclosure	
2	terminal block	Rack:	terminal board	RS-232
		Panel:	terminal board	
		Wall mount:	terminal block	
3	option card	Rack:	terminal board	RS-485
		Panel:	terminal board	
		Wall mount:	option card	

By using RS-485 instead of the more common RS-232 you can run communications cable much farther and you can have multiple slave units on the network, addressed by P771–Network Address.

Modbus

The Modbus protocol is supported in the base unit and is configurable using the Communications parameters, P770 to P782.

To set up communications with a Modbus RTU master device on port 2 using a modem, do the following:

Parameter	Index	Value	Description
P770	2	3	Modbus RTU slave
P771	2	1	Network address, only used for RS-485
P772	2	9.6	Data rate of 9600 baud
P773	2	0	No parity, common setting
P774	2	8	8 data bits, common setting
P775	2	1	1 stop bit, common setting
P776	2	0	No hardware flow control
P777	2	0	No "key up" delay
P778	2	1	Communicate through a modem
P779	2	30	Keep connection open for 30 seconds of silence, then hang up
P782	2	0	Index parameter values globally, see Communications Reference

The master device is expected to dial into the modem attached to the EnviroRanger and request information through Modbus commands. If there is a silent period for longer than 30 seconds, the EnviroRanger will hang up the modem and wait for another call.

SmartLinx

Other protocols are available through optional SmartLinx communications modules. Details on how to install and program these modules are contained in the module's documentation.

Dolphin Plus

Using Dolphin Plus with the EnviroRanger allows you to easily record and compare parameter sets for all the instruments in your company. Dolphin Plus uses a proprietary protocol to communicate with Milltronics instruments. This protocol is called "dolphin" and is set with P770 = 1.

By default the settings for port 1 (RJ-11 connection) and Dolphin Plus match. These settings are:

Parameter	Index	Value	Description
P700	1	1	Dolphin
P772	1	115.2	Data rate of 115.2 Kilo baud
P773	1	0	No parity, common setting
P774	1	8	8 data bits, common setting
P775	1	1	1 stop bit, common setting
P776	1	0	No hardware flow control

Communications

Testing the Configuration

Once you've programmed the unit you must test the device to ensure that it performs to your specifications. This test can be run in simulation mode or by varying the level in the wet well. The latter is preferred as it more accurately represents running conditions. However, if it is not possible to do a physical test, a simulation will ensure that control programming is correct.

Simulation

When in simulation mode, the LCD shows the unit' reaction to level changes but any pump or control relays are held off. Alarm relays are allowed to operate based on the simulation.

To allow pump or control relays to operate on the simulated level, set P000 to -1.

Simulating a Single Measurement

Access the appropriate parameter (Press $\boxed{\leftrightarrow}$ and then Enter the parameter number). Press $\boxed{\underline{\ast}}$; 5 times to overcome Echo Lock (P711), if applicable. The associated Reading is displayed in the Parameter Value field, and any "alarm" relays are set accordingly.

To verify Reading calculations (P920 to P926)...
1. Key in a material level in Units (P005) or % of Span (P007).

2. Press $\boxed{\leftarrow}$, the calculated Reading is displayed.

3. Verify the calculated Reading.

4. To start a simulation from the level entered, press $\boxed{\blacktriangle}$ or $\boxed{\blacktriangledown}$.

Simulating a Level Cycle

To start a (P920, P921, P922, or P923) simulation (from level = 0)...
Press $\boxed{\leftarrow}$ to simulate level rise and fall at 1% of Span / second. Use the $\boxed{\blacktriangle}$ and $\boxed{\blacktriangledown}$ keys to adjust the simulated rate of rise or fall.

$\boxed{\blacktriangledown}$	Rise at 4% of Span per second (maximum)
$\boxed{\blacktriangle}\boxed{\blacktriangledown}$	Rise at 1 % of Span per second (preset at start of simulation)
$\boxed{\blacktriangle}\boxed{\blacktriangledown}$	Stopped
$\boxed{\blacktriangle}\boxed{\blacktriangledown}$	Fall at 1% of Span per second
$\boxed{\blacktriangle}$	Fall at 4% of Span per second (maximum)

When the level rises to 100% or falls to 0% it reverses direction at the same rate.

Checking Volume Characterization

To confirm universal volume calculations (P050 = 9, 10) are correct:
1. Go to P920
2. Enter a level with a known volume
3. Press Enter
4. Check the returned volume against the manufacturer's chart
5. Change parameters P054 and P055, as required
6. Repeat steps 2 to 5 until the volume curve is verified

Checking OCM Flow Characterization

To confirm universal flow calculations (P600 = 4, 5) are accurate:
1. Go to P925
2. Enter a level with a known flow
3. Press Enter
4. Check the returned volume against the manufacturer's chart
5. Change parameters P610 and P611, as required
6. Repeat steps 2 to 5 until the flow curve is verified

I/O Checkout

Once the unit is installed a test is usually performed to verify the wiring.

Relays
Use P119 to force a state change and verify that the results are as expected (pump starts, alarm sounds, etc.).

Discrete Inputs
Use P270 to force the input value and verify that the results are as expected (pump removed from rotation, overflow event, etc.).

1. Go to P270[d] where n = the discrete input to be tested
2. Set to 0 to force the input off
3. Go to P275[d] to verify that the value is forced
4. Check the state of outputs to ensure that they respond as expected
5. Go to P270[d]
6. Set to 1 to force the input on
7. Go to P275[d] to verify that the value is forced
8. Check the state of outputs to ensure that they respond as expected

For further information see Discrete Inputs on page 33.

mA Input
Use P254 to test the mA input value against a true level. Use a trusted external mA source to generate the signal required for testing and verify the incoming signal with P260. As the mA level is changed ensure that the system responds as expected.

mA Output

Use an external device to test the mA output against the measured level. As the measured level changes ensure the mA level changes accordingly.

Reset for Run Mode

Once testing is complete and the unit is ready for operation it is good practice to clear any pump interlocks. Do this by setting P510[0] to 0.

Application Test

If the application is being tested by varying the material level (preferred) then ensure that none of the control devices are connected (or at least there is no power available to them).

If the application is being tested in simulation mode (and P000 is not -1) then control relays are not energized and they can remain connected.

While the level is being cycled, check the results of the discrete inputs by either closing the circuit externally (preferred) or using P270 Discrete Input Function to force the input on or off. Try all possible combinations to thoroughly test the setup. For each combination run a complete cycle to verify that the pumps operate as expected.

Monitor system performance carefully, under all anticipated operating conditions.

1. When the EnviroRanger performs exactly as required, programming is complete.

2. If alternate Reading units, failsafe action, or relay operation is desired, update the parameters for the new functionality.

3. If the system performance experiences problems, see Appendix B– Troubleshooting on page 111.

If all operating conditions cannot be observed during the System Performance Evaluation, use the level simulation (described earlier) to verify programming.

When a simulation is run, alarm relays will energize based on programming but control relays will not. You can set P000 to value "-1" to trigger the control relays based on the simulated level.

Retest the system every time you adjust any control parameters.

Programming Documentation

With programming complete, record all parameter alterations.

1. If the keypad programmer is used, enter the program mode and scroll to altered parameters (skipping parameters left at preset values). Record all changed parameter values.

2. If Dolphin Plus software is used, save a file to disk. If you require hardcopy use the Dolphin Plus Reports feature to print either the full list or only those parameters changed from factory default.

    For normal operation, return to the Run mode. The EnviroRanger will perform reliably, requiring little or no maintenance.

    Connect (or enable) process control/alarm equipment to the EnviroRanger only after satisfactory performance is verified for all possible operating conditions.

Appendix A–Technical Reference

Transmit Pulse

The transmit pulse consists of one or more electrical "shot" pulses, which are supplied to the Transducer connected to the EnviroRanger terminals. The transducer fires an acoustic "shot" for each electrical pulse supplied. After each shot is fired, sufficient time is provided for echo (shot reflection) reception, before the next (if applicable) shot is fired. After all shots of the transmit pulse are fired, the resultant echoes are processed. The transmit pulse shot number, frequency, duration, delay, and associated measurement range are defined by parameters P803 and P840 to P852.

Echo Processing

Echo processing consists of echo enhancement, true echo selection, and selected echo verification.

Echo Enhancement is achieved by filtering (P821 and P822) and reforming (P823) the echo profile (P810). The true echo (echo reflected by the intended target) is selected when that portion of the echo profile meets the evaluation criteria of Sonic Intelligence™. Insignificant portions of the echo profile outside of the measurement range (Span P006 + Range Extension P801), below the TVT Curve (P830, and P832 to P835), and less than the Confidence Threshold (P804) and Short Shot Floor (P851) are automatically disregarded. The remaining portions of the Echo Profile are evaluated using the Algorithm (P820) and Short Shot Bias (P850). The Echo Profile portion providing the best Echo Confidence (P805), is selected.

True echo verification is automatic. The position (relation in time after transmit) of the "new" echo is compared to that of the previously accepted echo. When the new echo is within the Echo Lock Window (P713), it is accepted and displays, outputs, and relays are updated per the Fuzz Filter (P710) and Rate Parameters (P700 to P703). If the new echo is outside of the Window, it is not accepted until Echo Lock (P711) requirements are satisfied.

Scope Display (P810)

Span (P007) + Range Extension (P801)

TVT Curve

Echo Lock Window

Echo Profile

Near Blanking (P800)

Echo Marker

msec x 100

Dolphin Plus Display

echo marker

echo profile

TVT curve
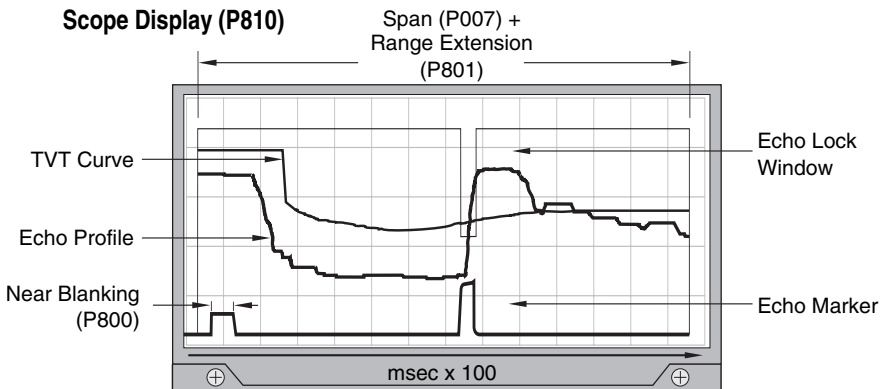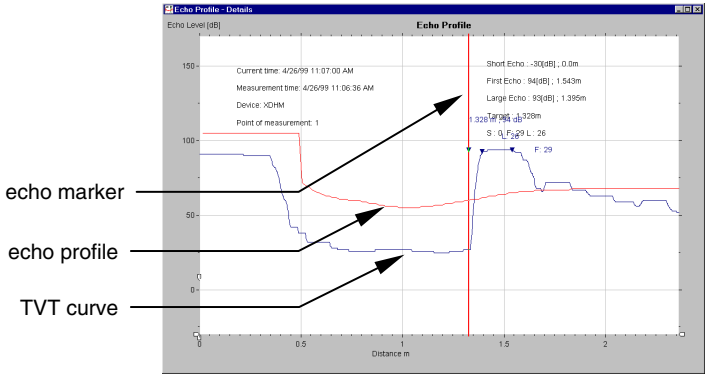
Distance Calculation

To calculate the transducer to material level (object) distance, the transmission medium (atmosphere) sound velocity (P653) is multiplied by the acoustic transmission to reception time period. This result is divided by 2 to calculate the "one way" distance.

Distance = Sound Velocity x Time / 2

The Reading displayed is the result of performing any additional modification to the calculated distance (as determined by Operation P001, Units P005, Volume Conversion, P050 to P054, Reading, P060 to P063, OCM, P600 to P611, and/or Totalizer P622 to P633 parameters).

Sound Velocity

The sound velocity of the transmission medium is affected by the type, temperature, and vapour pressure of the gas or vapour present. As preset, the EnviroRanger assumes the vessel atmosphere is air at 20 °C (68 °F). Unless altered, the sound velocity used for the distance calculation is 344.1 m / s (1129 ft / s).

Variable air temperature is automatically compensated when a Milltronics ultrasonic / temperature transducer is used. If the transducer is exposed to direct sunlight, use a sunshield or a separate TS-3 temperature sensor.

Also, if the temperature varies between the transducer face and the liquid monitored, use a TS-3 temperature sensor, (submerged in the liquid) in combination with an ultrasonic / temperature transducer. Set Temp Source (P660) for "both", to average the transducer and TS-3 measurements.

Atmosphere composition other than air can pose a challenge for ultrasonic level measurement. However, excellent results may be obtained if the atmosphere is homogeneous (well mixed), at a fixed temperature, and consistent vapour pressure, by performing a Sound Velocity Calibration (P651).

The ERS 500 automatic temperature compensation is based on the sound velocity / temperature characteristics of "air" and may not be suitable for the atmosphere present. If the atmosphere temperature is variable, perform frequent Sound Velocity Calibrations to optimize measurement accuracy.

Sound Velocity calibration frequency may be determined with experience. If the sound velocity in two or more vessels is always similar, future calibrations may be performed on one vessel and the resultant Velocity (P653) entered directly for the other vessel(s).

If the sound velocity of a vessel atmosphere is found to be repeatable at specific temperatures, a chart or curve may be developed. Then, rather than performing a Sound Velocity Calibration each time the vessel temperature changes significantly, the anticipated Velocity (P653) may be entered directly.

Scanning

When the ERS is programmed for "differential" or "average" level Operation (P001 = 4 or 5), two transducers must be used. In this case, the transmit pulse is time shared between the transducers via the "Scanner" relay.

When echo processing is complete, (if more than 1 vessel is monitored) the scanning relay changes state to supply the transmit pulse to the other transducer after the Scan Delay (P727).

Scan Delay is automatically set by Maximum Process Speed (P003). When high speed scanning is required (sometimes the case for equipment position monitoring), the Scan Delay may be reduced. Reduce the Scan Delay only as required, otherwise premature scanning relay fatigue could occur.

Volume Calculation

The unit provides a variety of volume calculation features (P050 to P055).

If the vessel does not match any of the 8 preset Tank Shape calculations, a Universal Volume calculation may be used. Use the level/volume graph or chart provided by the vessel fabricator (or create one based on the vessel dimensions). Based on the graph, choose the Universal Volume calculation, and select the level vs. volume breakpoints to be entered (32 max). Generally, the more breakpoints entered, the greater the accuracy.

Universal, Linear (P050 = 9)
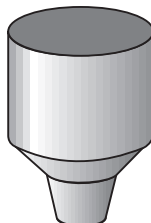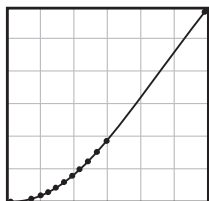
This volume calculation creates a piece-wise linear approximation of the level/volume curve. This option provides best results if the curve has sharp angles joining relatively linear sections.

Enter a Level Breakpoint at each point where the level/volume curve bends sharply (2 minimum).

For combination curves (mostly linear but include 1 or more arcs), enter numerous breakpoints along the arc, for best volume calculation accuracy.

See also: Checking Volume Characterization on page 102.

Universal, Curved (P050 = 10)

This calculation creates a cubic spline approximation of the level/volume curve, providing best results if the curve is non-linear, and there are no sharp angles.
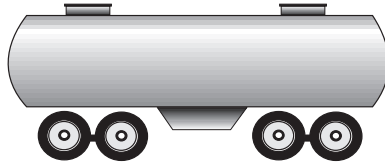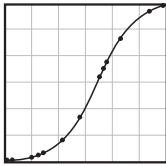
Select at least enough breakpoints from the curve to satisfy the following:
- 2 breakpoints very near the minimum level
- 1 breakpoint at the tangent points of each arc
- 1 breakpoint at each arc apex
- 2 breakpoints very near the maximum level

For combination curves, enter at least 2 breakpoints immediately before and after any sharp angle (as well as 1 breakpoint exactly at the angle) on the curve.

See also: Checking Volume Characterization on page 102.

Flow Calculation

The EnviroRanger provides numerous OCM flow calculation features (P600 to P611).

If the PMD (primary measuring device) does not match any of the 8 preset PMD calculations, or if a PMD is not used, select a Universal Volume calculation. Use the head/flow graph or chart provided by the PMD fabricator (or create one based on the PMD or channel dimensions).

Based on the graph, choose the Universal Flow calculation, and select the head Vs flow breakpoints to be entered (32 max). Generally, the more breakpoints entered, the greater the flow calculation accuracy.

Universal, Linear (P600 = 4)

This flow calculation creates a piece-wise linear approximation of the head/flow curve. This option provides best results if the curve has sharp angles joining relatively linear sections.
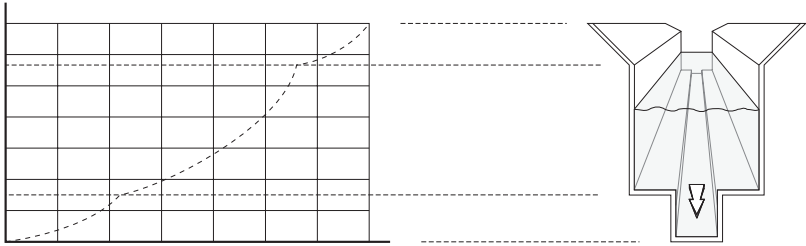
Enter a Head Breakpoint at each point where the head/flow curve bends sharply (2 minimum). For combination curves (mostly linear but include 1 or more arcs), enter numerous breakpoints along the arc, for best flow calculation accuracy.

See also: Checking OCM Flow Characterization on page 102.

Universal, Curved (P600 = 5)

This calculation creates a cubic spline approximation of the head/flow curve, providing best results if the curve is non-linear, and there are no sharp angles.
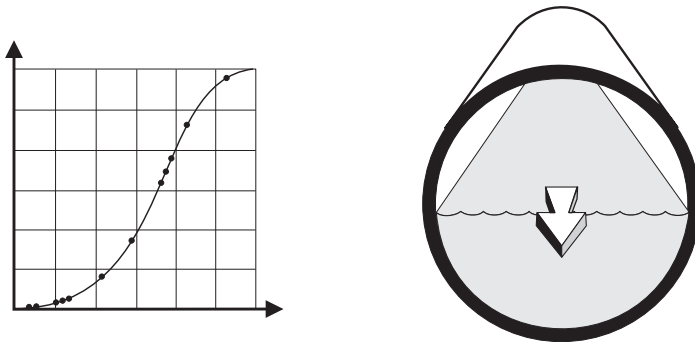
Select at least enough breakpoints from the curve to satisfy the following:
- 2 breakpoints very near the minimum head
- 1 breakpoint at the tangent points of each arc
- 1 breakpoint at each arc apex
- 2 breakpoints very near the maximum head

For combination curves, enter at least 2 breakpoints immediately before and after any sharp angle (as well as 1 breakpoint exactly at the angle) on the curve. See also: Checking OCM Flow Characterization on page 102.

Maximum Process Speed

The EnviroRanger's ability to respond to material level changes is designed to exceed even the most demanding installation requirements.

The Maximum Process Speed setting automatically presets various parameters affecting the EnviroRanger response to material level changes as follows:

Parameter	Values Dependent on Maximum Process Speed (P003)		
(units)	1 (slow)	2 (medium)	3 (fast)
P070 Failsafe Timer (min)	100	10	1
P700 Max Fill Rate (m/min)	0.1	1	10
P701 Max Empty Rate (m/min)	0.1	1	10
P702 Filling Indicator (m/min)	0.01	0.1	1
P703 Emptying Indicator (m/min)	0.01	0.1	1
P704 Rate Filter (option)	4	2	2
P710 Fuzz Filter (% of Span)	100	50	10
P713 Echo Lock Window	(per P701 / P702 and time since last valid measurement).		
P727 Scan Delay (seconds)	5	5	3
P841 Long Shot Number	10	5	2

If any of these parameters are independently altered, a Maximum Process Speed (P003) parameter alteration automatically resets the independently altered value.

Slower Maximum Process Speed (P003) provides greater measurement reliability. Faster independently set Max Fill (P700) and Max Empty (P701) Rates may be impeded by Echo Lock (P711), Scan Delay (P727) and Shot Delay (P728) values.

Appendix B–Troubleshooting

> **Note:**
> Many of the parameters and techniques described here require extensive knowledge of ultrasonic technologies and Milltronics echo processing software. Use this information with caution.

If the setup becomes too confusing use P999 to reset and start again.

Common Problems Chart

Symptom	Cause	Action
Display blank, transducer not pulsing.	No power.	Check power supply, wiring, or power fuse.
No response to programmer.	Obstructed infrared interface, defective programmer, exhausted programmer battery.	Check programmer usage: 15 cm (6") from faceplate pointed at upper target Or, check battery
Displays "Short" and "tb:(#)".	Short circuited transducer cable, or defective transducer at indicated terminal block number.	Repair or replace as necessary.
Displays "Open" and "tb:(#)".	Transducer not connected or connection reversed	Check connection to displayed terminal blocks
	Open circuited transducer cable, or defective transducer at indicated terminal block number.	Repair or replace as necessary.
Displays "LOE".	Weak or non-existent echo.	Relocate and/or re-aim transducer at material.
		Proceed to Measurement Difficulties (page 114).
Displays "Error" and "tb:(#)".	Transducer connected backwards.	Reverse black and white wires on terminal block.
	Transducer connected in "two wire" method.	Do not tie white and shield together, use all three terminal blocks.
	Wrong transducer selected (P004).	Verify transducer type and re-enter value.
Displays "EEEE".	Value too large to display in 4 or 5 characters.	Select larger Units (P005), or lower Convert Reading (P061).
Reading fluctuates while material level is still, (or vice versa).	Incorrect measurement stabilization.	Alter Maximum Process Speed (P003) or damping (P704) accordingly. See Maximum Process Speed on page 110.
Reading is fixed, regardless of the actual material level.	Transducer acoustic beam obstructed, standpipe too narrow, or transducer ringing (reads over 100%).	Relocate and / or re-aim transducer at material level or object.
		Proceed to Measurement Difficulties below.
		See also: Transducer Ringing on page 119.

Troubleshooting

Symptom	Cause	Action
Material level reported is always "off" by the same amount.	Incorrect Empty (zero) reference for level operation (P001 = 1).	See Empty (P006), Reading Offset (P063), Offset Calibration (P650), & Offset Correction (P652).
Measurement accuracy improves as level nears transducer.	Incorrect Sound Velocity used for distance calculation.	Use a transducer with a built-in temperature sensor or a TS-3 temperature sensor.
		See Sound Velocity on page 106.
Reading is erratic, with little or no relation to material level.	True echo too weak or wrong echo being processed.	Relocate and / or re-aim transducer at material.
		Check noise parameters. See Noise Problems on page 112.
Pump relay icon (⬤) is flashing and pump does not run.	Pump has been removed from duty schedule.	Review Reporting Pump Status on page 33 for discrete inputs used as pump interlocks.

Noise Problems

Incorrect readings can be the result of noise problems, either accoustic or electrical, in the application.

The noise present at the input to the ultrasonic receiver can be determined by viewing parameter P807. The display reads ##:##, where the first number is the average noise, and the second is the peak noise. In general, the most useful value is the average noise.

With no transducer attached the noise is under 5 dB. This is often called the noise floor. If the value with a transducer attached is greater than 5 dB, then signal processing problems can occur. High noise decreases the maximum distance that can be measured. The exact relationship between noise and maximum distance is dependent on the transducer type and the material being measured. Any noise level greater than 20 dB is probably cause for concern unless the distance is much shorter than the maximum for the transducer.

Determine the Noise Source

Disconnect the transducer from the EnviroRanger. If the measured noise is below 5 dB, then continue here. If the measured noise is above 5 dB go to Non-Transducer Noise Sources on page 113.

1. Connect only the shield wire of the transducer to the EnviroRanger.

    If the measured noise is below 5 dB, continue with the next step. If the noise is above 5 dB, go to Common Wiring Problems on page 114.

2. Connect the white and black transducer wires to the EnviroRanger.

    Record the average noise.

3. Remove the positive wire of the transducer.

    Record the average noise.

4. Re-connect the positive wire and remove the negative wire.

    Record the average noise.

    Using the table below, determine the appropriate next step. The terms higher, lower and unchanged refer to the noise recorded in the previous steps.

    These are guidelines only. If the suggested solution does not solve the problem, try the other options also.

noise	- removed	+ removed	Go to …
	higher	higher	Reducing Electrical Noise
		unchanged	Common Wiring Problems
		lower	Reducing Acoustical Noise
	unchanged	higher	Reducing Electrical Noise
		unchanged	Contact Milltronics
		lower	Reducing Acoustical Noise
	lower	higher	Common Wiring Problems
		unchanged	Common Wiring Problems
		lower	Reducing Acoustical Noise

Acoustical Noise
To confirm that the problem is acoustical, place several layers of cardboard over the face of the transducer. If the noise is reduced, the noise is definitely acoustical.

Non-Transducer Noise Sources

Remove all input and output cables from the EnviroRanger individually while monitoring the noise. If removing a cable reduces the noise, that cable may be picking up noise from adjacent electrical equipment. Check that low voltage cables are not being run adjacent to high voltage cables, or near to electrical noise generators such as variable speed drives.

Filtering cables is an option but is not recommended unless all other options have been exhausted.

The EnviroRanger is designed to work near heavy industrial equipment such as variable speed drives. Even so, it should not be located near high voltage wires or switch gear.

Try moving the electronics to a different location. Often moving the electronics a few meters farther from the source of noise will fix the problem. Shielding the electronics is also an option, but it should be a last resort. Proper shielding is expensive and is difficult to install properly–the shielding box must enclose the EnviroRanger electronics completely, and all wires must be brought to the box through grounded metal conduit.

Common Wiring Problems

- Make sure that the transducer shield wire is connected at the electronics end only. Do not ground it at any other location.
- Do not connect the transducer shield wire to the white wire.
- The exposed transducer shield wire must be as short as possible.
- Connections between the wire supplied with the transducer, and any customer installed extension wire should be done in grounded metal junction boxes.

  On Milltronics transducers the white wire is negative and the black wire is positive. If the extension wire is colored differently, make sure that it is wired consistently.

  Extension wire must be shielded twisted pair. See the installation manual for specifications.

Reducing Electrical Noise

- Ensure that the transducer cable does not run parallel to other cables carrying high voltage or current.
- Move the transducer cable away from noise generators such as variable speed drives.
- Put the transducer cable in grounded metal conduit.
- Filter the noise source.

Reducing Acoustical Noise

- Move the transducer away from the noise source.
- Use a stilling well.
- Install a rubber bushing between the transducer and the mounting surface.
- Relocate or insulate the noise source.
- Change the frequency of the noise. The EnviroRanger is only sensitive to noise between 25 KHz and 65 KHz.

Measurement Difficulties

If the Failsafe Timer (P070) expires due to a measurement difficulty, "LOE" flashes alternately with the last known Reading. In rare cases, the ERS may "lock on" to a false echo and report a fixed or wrong Reading.

Flashing "LOE" Display

The loss of echo (LOE) display appears when the echo confidence is below the threshold value set in P805 Echo Confidence.

This happens when:
- The echo is lost and no echo is shown above the ambient noise
- Two echoes are too similar to differentiate

If "LOE" is displayed, ensure the:
- Surface monitored is within the transducer maximum range
- Transducer model (P004) matches the transducer used
- Transducer is located and aimed properly
- Transducer is not submerged without a submergence shield

Adjust Transducer Aiming

See the Transducer manual for range, mounting, and aiming details. For optimum performance, adjust transducer aiming to provide the best Echo Confidence (P805) and Echo Strength (P806) for all material levels within the measurement range.

The most efficient method of checking echoes is with Milltronics' Dolphin Plus software.

To display echoes…
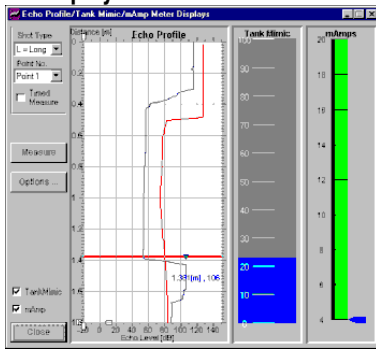
Use Dolphin Plus to graphically display the echo profile at the installation. Interpret the echo profile and change relevant parameters.

To edit parameters…
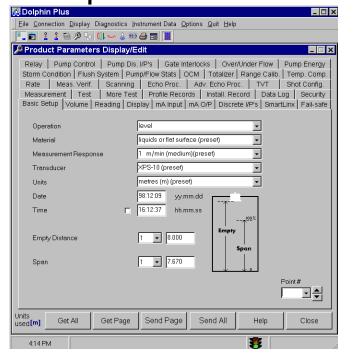
Edit the parameter values. Use F1 to get online help at any time.

To display Echo Confidence in the RUN mode...
Press ![8] and hold for 4 seconds (Failsafe Time Left changes to the Short:Long Confidence display).

To display Echo Confidence in the program mode, access the Echo Confidence (P805) parameter.

To update the value displayed after each aiming adjustment...

Press ⏚ (5 times or more to verify stability and overcome any echo lock P711)

Increase Failsafe Timer Value

Increase the Failsafe Timer (P070) value, if failsafe operation will not be compromised by the larger value.

Try this only if LOE shows for short periods of time.

Install a Transducer with a Narrower Beam

Sometimes the interference echoes from the sides of a vessel can cause the EnviroRanger to lock onto a consistent, incorrect level. Try installing a longer range (narrower beam) transducer, enter the new transducer model (P004), and (if necessary) optimize aiming and frequency again.

Always contact your Milltronics service personnel before selecting a transducer to solve this type of problem.

Use Dolphin Plus to Debug Echo

If a narrower beam transducer is not available, use Dolphin Plus to view live sonic profiles and make adjustments to the Advanced Echo Processing parameters.

If you do not own Dolphin Plus, connect an oscilloscope and use the hand programmer to adjust the same parameters.

Fixed Reading

If the Reading is a fixed value, regardless of the transducer to material surface distance, ensure the:

1. Transducer acoustic beam is free from obstruction.
2. Transducer is properly aimed
3. Transducer is not in contact with any metal object.
4. Material mixer (if used) is operating while the EnviroRanger is operating. If it is stopped, ensure that the mixer blade is not stopped under the transducer.

Obstructions in the Sound Beam

Check for (and remove if present) any acoustic beam obstruction, or relocate the transducer.

If an obstruction cannot be removed or avoided, adjust the Time Varying Threshold (TVT) Curve to reduce the Echo Confidence derived from the sound reflected by the obstruction. Use Dolphin Plus to adjust the TVT curve or use an oscilloscope and a hand programmer to adjust the required parameters. (See Scope Displays, P810 and TVT Shaper, P832).

Standpipe Mountings

If the transducer is mounted on or in a standpipe, grind smooth any burrs or welds on the inside or open end, (the end that opens into the vessel). If the problem persists, install a larger diameter or shorter length standpipe, bevel the inside of the bottom end, or cut the open end of the standpipe at a 45 angle.

See the transducer manual for complete mounting instructions.

For "ST-series" and XPS-10 transducers use the plastic conduit / flange adapter supplied with the unit.

If the mounting hardware is over tightened, loosen it. Over tightening changes the resonance characteristics of the transducer and can cause problems.

Set the EnviroRanger to Ignore the Bad Echo

If the preceding remedies have not fixed the problem, the false echo has to be ignored.

If the Echo is Close to the Transducer
If there is a static, incorrect, high level reading from the EnviroRanger there is probably something reflecting a strong echo back to the transducer. If the material level never reaches that point extend the Near Blanking (P800) to a distance to just past the obstruction.

Adjust the TVT to Ignore the Echo
If increasing Near Blanking is unacceptable then the TVT Curve must be raised in the area of the false echo to ignore the false echo.

Use Dolphin Plus to view live sonic profiles and make adjustments to the TVT curve.

If you do not own Dolphin Plus, connect an oscilloscope and use the hand programmer to adjust the same parameters.

Continue making minor TVT Curve adjustments and taking new measurements while observing the Echo Marker position until the Echo Lock Window repeatedly locks onto the true echo. Verify the false echo is still ignored, regardless of the vessel material level, or empty / fill activity. Finally, ensure that the true material level can still be measured in the area where the TVT was adjusted.

Wrong Reading

If the Reading is erratic, or jumps to some incorrect value periodically, ensure the:

1. Surface monitored is not beyond the EnviroRanger's programmed range or the transducer's maximum range

2. Material is not falling into the transducer's acoustic beam

3. Material is not inside the blanking distance of the transducer

Types of Wrong Readings

If a periodic wrong Reading is always the same value, see Fixed Reading.

If the wrong Reading is random, ensure the material surface to transducer distance is less than the Empty value entered plus 20%. If the material/object monitored is outside this distance, increase Range Extension (P801) as required. This error is most common in OCM applications using weirs.

Liquid Splashing

If the material monitored is a liquid, check for splashing in the vessel. Enter a lower Maximum Process Speed (P003) value to stabilize the Reading, or install a stilling well. (Contact Milltronics or your local distributor).

Adjust the Echo Algorithm

Use Dolphin Plus to view live sonic profiles and make adjustments to the P820 Algorithm parameter. See the Parameter Reference for details.

If you do not own Dolphin Plus, connect an oscilloscope and use the hand programmer to adjust the same parameter.

If the "Area" algorithm is used and narrow noise spikes are evident on the (long shot) Echo Profile, turn the Spike Filter (P821) on and/or widen the Narrow Echo Filter (P822). Also, if the true echo has jagged peaks, use Reform Echo (P823).

If multiple echoes appear on the Echo Profile, typical of a flat material profile (especially if the vessel top is domed), use the "first" Algorithm.

If the Echo Profile repeatedly switches from short to long, adjust the Short Shot Range (P852) to stabilize the "shot" mode used for the echo evaluation. Also, adjust the Short Shot Bias to increase (or decrease the amount of preference given to short shot echoes over long shot echoes.

Should a stable measurement still not be attainable, contact Milltronics or your local distributor.

Transducer Ringing

If the transducer is mounted too tightly, or if it is mounted so that its side touches something, its resonance characteristics change and this can cause problems.

Normal Ring Down

ring down

echo profile

TVT curve

Poor Ring Down

ring down

echo profile

TVT curve
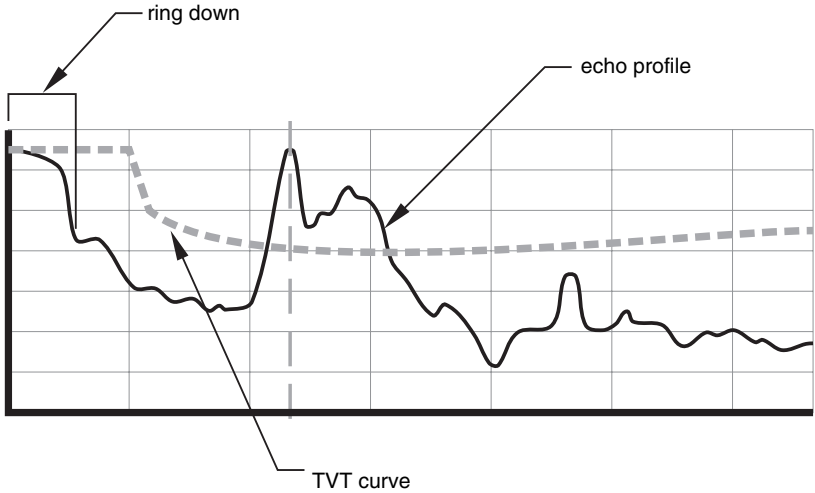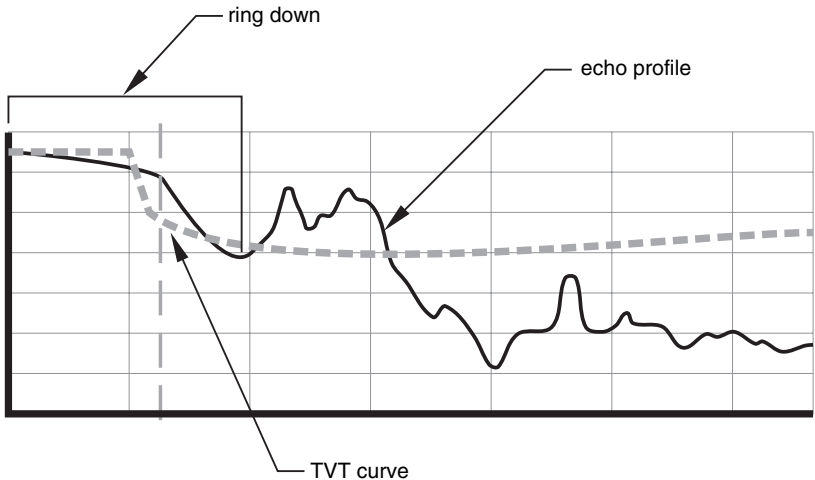
Ring down times that extend past the near blanking area can be interpreted by the EnviroRanger as the material level and are characterized by a steady high level being reported.

EnviroRanger User Guide

Appendix C–Pump Control Reference

The EnviroRanger has the pump control strategies to solve nearly any water / wastewater application. This section details these strategies for engineers requiring in-depth knowledge of the system and how it operates.

Pump Control Options

The various methods of pump control are made up of a combination of two control variables:

Pump Duty
The pump duty indicates in what sequence pumps are started.

Pump Start Method
The start method indicates whether new pumps start and run with any currently running pumps (most common) or whether new pumps start and shut off currently running pumps.

Pump Availability

The way pumps are affected by interlocks depends on a number of parameters, mostly in the P500 series. They can be local or remote meaning that commands to run can come from the EnviroRanger itself or an external system through one of the communication ports. They can be auto or manual meaning that commands to run can come from EnviroRanger's pump control algorithms or from a manual / local switch.

Pump Groups

The EnviroRanger groups pumps that use identical pumping strategies based on the value of P111–Relay Control Function. Generally, one group of pumps corresponds to one wet well or reservoir.

Pump by Rate

To trigger pump starts by the rate of change in material level use P121–Pump by Rate. New pumps are started, one at a time, until the rate setpoint (P702–Filling Indicator, or P703–Emptying Indicator) is reached.

Discrete Inputs

Some pumps can tell the EnviroRanger through contacts that they are running (confirmation) or experiencing a fault.

Pumps can be removed from the rotation if they are not pumping efficiently or they are reporting a failure. Failures are reported using the discrete interlocks provided on the EnviroRanger.

To configure the EnviroRanger to pull a pump out of the rotation based on the discrete input, follow these steps:

1. Wire the discrete inputs for the pumps to the appropriate terminals on the terminal block (see the Installation Guide for terminal block information)

2. Configure the discrete input functions (see page 33)

3. Configure the Pump Interlock Allocation (P500 to P509)

4. Test the setup (see Testing the Configuration on page 101)

Pump Failure

When a pump fails it is automatically taken out of service. To put the pump back into service an operator must go to the location and manually set P510 back to "0" from "1", or a SCADA system must be in place to reset the pump control bits. See the EnviroRanger Communications Reference for details on the Modbus register to use. A reset push-button wired to a discrete input and programmed with P509 allows pump faults to be reset.

Auto / Manual

A pump can be controlled based on an "Auto / Manual" switch connected to a discrete input. The pump is returned to EnviroRanger control as soon as the switch is set back to "auto." This ability is also available through communications so that a remote system can control a pump directly.

Pump Control Algorithms

All of these algorithms can be used to start multiple pumps (assist) or one pump at a time (backup). The EnviroRanger has three main methods of pump control:

Fixed
Starts pumps based on individual setpoints and always starts the same pumps in the same sequence.

Alternate
Starts pumps based on the duty schedule and always leads with a new pump.

Service Ratio
Starts pumps based on user-defined ratio of running time.

Fixed Duty Assist (P111 = 50)

Ties the indexed pump relay directly to the indexed setpoint.

Relay Operation (for P118 = 2)
The relay contact closes at the "on" setpoint and opens at the "off" setpoint. Multiple relay contacts in the pump group can be closed at the same time.

Relay Table
The following table shows relay status when each setpoint is reached.

		Relays		
	index	1	2	3
Setpoints	on 3	On	On	On
	on 2	On	On	Off
	on 1	On	Off	Off
	off 0	Off	Off	Off

Fixed Duty Backup (P111 = 51)

Ties the indexed pump relay directly to the indexed setpoint.

Relay Operation (for P118 = 2)
The relay contact closes at the "on" setpoint and opens at the "off" setpoint.
When a new relay trips the previously closed relay contact opens to shut
down the running pump.

Only one relay contact in the pump group can be closed at any one time.

Relay Table
The following table shows relay status when each setpoint is reached.

		Relays		
	index	1	2	3
Setpoints	on 3	Off	Off	On
	on 2	Off	On	Off
	on 1	On	Off	Off
	off 0	Off	Off	Off

Alternate Duty Assist (P111 = 52)

*Alternates the lead pump each time the material level cycles and runs all
pumps together.*

Relay Operation (for P118 = 2)
The setpoints associated with the relays are grouped so that they can be
rotated.

Setpoint one does not relate directly to relay one. The pumping algorithm
manages the mapping of setpoints to relays.

When pumps are run, they run in parallel.

Relay Table

Cycle 1		Relays		
		1	2	3
Setpoints	on 3	On	On	On
	on 2	On	On	Off
	on 1	On	Off	Off
	off 0	Off	Off	Off
Cycle 2		**Relays**		
		1	2	3
Setpoints	on 3	On	On	On
	on 2	Off	On	On
	on 1	Off	On	Off
	off 0	Off	Off	Off
Cycle 3		**Relays**		
		1	2	3
Setpoints	on 3	On	On	On
	on 2	On	Off	On
	on 1	Off	Off	On
	off 0	Off	Off	Off

Alternate Duty Backup (P111 = 53)

Alternates the lead pump each time the material level cycles.

Relay Operation (for P118 = 2)
The setpoints associated with the relays are grouped so that they can be rotated. Setpoint one does not relate directly to relay one. The pumping algorithm manages the mapping of setpoints to relays. When pumps are run, they can run only one at a time.

Relay Table

Cycle 1		Relays		
		1	2	3
Setpoints	on 3	Off	Off	On
	on 2	Off	On	Off
	on 1	On	Off	Off
	off 0	Off	Off	Off
Cycle 2		**Relays**		
		1	2	3
Setpoints	on 3	On	Off	Off
	on 2	Off	Off	On
	on 1	Off	On	Off
	off 0	Off	Off	Off
Cycle 3		**Relays**		
		1	2	3
Setpoints	on 3	Off	On	Off
	on 2	On	Off	Off
	on 1	Off	Off	On
	off 0	Off	Off	Off

Service Ratio Duty Assist (P111 = 54)

Selects the lead pump based on number of hours each pump has run and the specified ratios that each pump requires. Multiple pumps can run at one time.

Relay Operation (for P118 = 2)

The setpoints associated with the relays are grouped so they can be redistributed based on pump run time ratios. The next pump to start or stop is the one with the required time to actual time ratio.

Over time the number of hours demanded of each pump will conform to the ratios specified. Usually, the ratios are specified in percent values.

To create a grouping of pumps where two pumps make up 50% of the run time and the third pump makes up the other 50% P122 is set to these values:

P122 index	value
1	25
2	25
3	50

Service Ratio Duty Backup (P111 = 55)

Selects the lead pump based on number of hours each pump has run and the specified ratios that each pump requires. Only one pump can run at a time.

This algorithm is the same as Service Ratio Duty Assist except that it will only run one pump at a time. When the next pump in the sequence starts, the previous pump stops.

First In First Out (FIFO) (P111 = 56)

Selects the lead pump based on the "Alternate" duty but uses staggered off setpoints and shuts down pumps based on the "first in, first out" rule.

This algorithm starts pumps in the same way as Alternate Duty Assist but uses staggered "off" setpoints to shut the pumps down. When the first "off" setpoint is reached the FIFO rule shuts down the first pump started. If the pumps started in sequence 2,3,1 then they would be shut down in sequence 2,3,1.

Pump by Rate (P121)

Starts pumps until the level is changing at the rate specified in P702 or P703.

Pumping costs can be less because only the highest "on" setpoint needs to be programmed and this results in a lower difference in head to the next wet well which, in turn, results in less energy being used to pump out the well.

Other Pump Controls

There are a number of other controls available to modify pump behaviour.

Pump Run-on (P130, P131)
Extends the run period for a pump based on the number of pump starts. This allows for the wet well to be pumped lower than usual and reduces sludge build-up on the well bottom.

Pump Exercising (P134)
Runs idle pumps and reduce the chance of seizing.

Wall Cling Reduction (P136)
Varies the "on" and "off" setpoints to keep a fat ring from forming around the walls of the wet well.

Pump Group (P137)
Allows for two different Alternate Duty Assist or Alternate Duty Backup pump groups in the same application.

Energy Savings (P140 to P145)
Modifies pump setpoints based on the time of day to minimize head and run time (and subsequent cost) during high cost periods.

Overflow (P165)
Takes special action (open valve, stop pumps, start all pumps) when a 3Hi alarm (overflow) occurs. This can also be used as a 3Lo alarm (underflow).

Flush Device (P170 to P173)
Operates a flush valve or special flush device based on the number of pump starts, usually to aerate wet well wastewater.

Pump Control Reference

Appendix D–Updating Software

The EnviroRanger can be updated in the field with new code and features.

Updating with Dolphin Plus

To update the software in the EnviroRanger follow these steps.

1. Get a new software file from your Milltronics representative and copy it onto the hard disk of the computer

2. Run Dolphin Plus

3. Select **File** and then **Download flash ROM from file to instrument…**

Enabling New Functions

It is possible to upgrade the current software in your EnviroRanger unit in order to enhance its performance. Several optional features currently exist in the non-volatile memory of the EnviroRanger unit, and can be enabled using Access Codes purchased from Milltronics.

The following items are currently available as Optional Features:

*   **Dual Point**

*   **Data Logging**
    This feature requires an optional memory card.

*   **Auxiliary I/O Cards**
    This feature requires additional Hardware that is purchased separately.

> **Note:**
> You may need to update your software before enabling new features.

Step 1. Get Access Code

Before you can enable a new feature on the EnviroRanger you need to get an access code from Milltronics. This access code is unique to the EnviroRanger and keyed off of the serial number.

When calling Milltronics for the access code have the following information ready:

*   The values from parameters 345 and 346
*   Option(s) that you want to enable

Identification Codes

The method of determining the identification codes depends on the software revision of your EnviroRanger. The software revision is stored in P900. Check this value before continuing.

If P900 is 3.00 or higher …
The identification codes are shown in these parameters:

Parameter	Value
P345	date portion of identification code
P346	numeric portion of identification code

Proceed to Step 2 below.

If P900 is less than 3.00…
You must upgrade the software because your software is not capable of handling the optional features.

Contact Milltronics for a software upgrade, and install it using the instructions at the beginning of this chapter.

Once the software is upgraded…
The identification code is made up of two parts of the serial number shown in parameters 345 and 346. P345 is view only, so you cannot change it, but you must scroll to parameter P346 and enter the numeric portion of the unit's serial number.

The complete serial number is printed on the side of the unit, and is comprised of 9 digits followed by 2 letters. The first 6 digits are a date, and the remaining 3 are the numeric portion. It is important that you find the number that ends with either "SC" or "RY", there may be other numbers on the unit that end with other codes – these are not the unit's serial number.

Example
The serial number **020400101SC** breaks down as follows:

Parameter	Value	Description
P346	101	numeric portion of identification code
P345	020400	date portion of identification code

In this example, the user would enter "101" into P346.

Step 2. Enter Access Code

Parameter	Value
P738	access code provided by Milltronics

The access code is a long sequence of numbers. Type the numbers in with the hand programmer or Dolphin Plus. When using the hand programmer they will scroll off the left of the reading field, this is normal.

If you make an error when entering the number, press $\boxed{c}$ and enter the number again.

Press Enter and the parameter reverts to "0" to indicate that the code was accepted.

"Error" shows on the LCD if the code was not accepted. Ensure that you typed the code correctly. If you still have problems contact your Milltronics representative.

Step 3. Cycle the Instrument (power or P902)

To start using the new functionality of the EnviroRanger you must restart it.

You can do this by either cycling the power or using the watchdog test parameter, P902. To use P902, display that parameter and press $\boxed{\leftarrow}$. In ten seconds the unit will restart and the new functions will be ready to program.

See Optional Features on page 16 for information on how optional functions affect the examples in this manual and the indexing of parameters in general.

Step 4. Reset the Instrument (P999)

Perform a "P999" to reset all parameters and reconfigure the unit. This can be done using the hand programmer or Dolphin Plus. If you have the dual point option enabled, ensure you perform the P999 against both points (index value 00).

Installing Hardware with Software

Some optional features require additional hardware to operate (for example, the data logging feature uses an additional memory card). This hardware does not need to be installed immediately when the Access Code that enables the feature is entered. To activate the feature on a unit in which the Access code has already been installed, power down the unit, install the hardware, and power it up again. The feature will now be available.

Removing Features

Once added a feature cannot be removed.

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