USER MANUAL

V1.1

XL SERIES

BASIC PROGRAMMING GUIDE

D40-02 0615

YSI

a xylem brand

CONTENTS & WARRANTY

This user manual is a BASIC programming guide for the XL Data Logger Series (H-350XL, H-500XL, H-522+, H-522) . For more information, updated manuals, brochures, technical notes, and supporting software on the XL Series, please refer to waterlog.com or contact your sales representative.

For additional assistance, please contact us at +1.435.753.2212 or sales@waterlog.com

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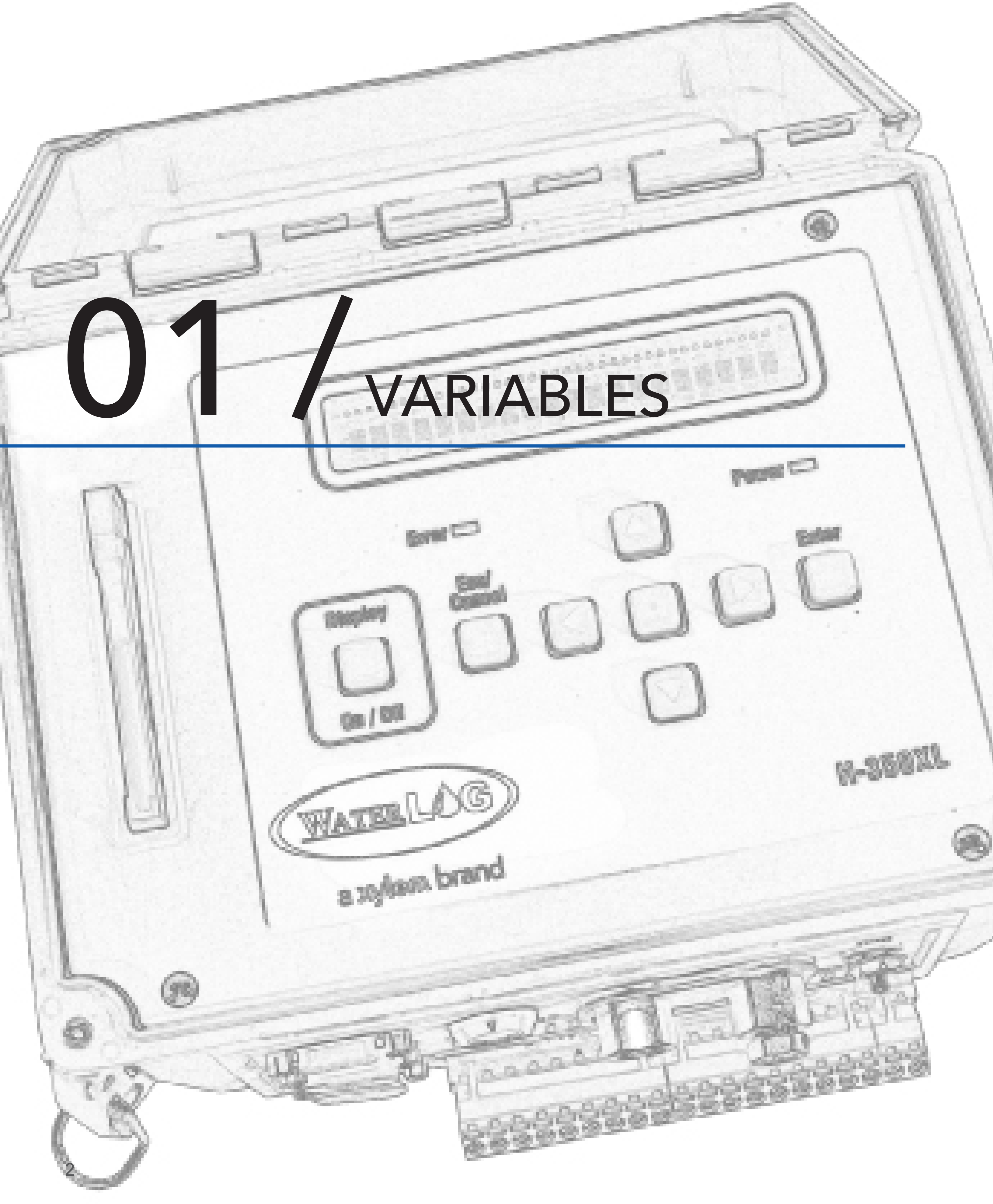
01 / VARIABLES



The WaterLOG® XL™ series data loggers have a built in BASIC interpreter for handling specialized operations outside the normal use of the data logger. Since this BASIC interpreter is specific to the XL™ series of data loggers it is called XL-BASIC. XL-BASIC handles many of the standard BASIC commands, but also provides accesses to the I/O and other features of the XL™ series data logger.

Basic 1 to Basic 5

There are five basic programs that can be called anytime the system is collecting data to log or to send to the GOES radio, etc. To execute one of the five programs, select it from the source list just as "Stage" or "Ana1" is selected. Each XL-BASIC program has a defined variable that will be used as a return value for the function that caused the XL-BASIC program to execute. For example, as the system processes the data to log, it looks at the source column1. Column 2 is normally time and a time stamp is placed in this column. If column 3 source was set to "Basic1", then the Basic 1 program would execute and the value in variable "Basic1" would be placed in the third column.

A BASIC program is written using a standard text editor on a PC and then loaded into the XL™ series data logger. Each BASIC program must be 8K bytes or less in size. The size of the program includes all commands, comments, remarks and spacing. If the size of the file becomes too big, then cut down on the remarks, spacing, or break the tasts into two separate programs.

Variables

The system is limited on RAM, and to keep the operation of the BASIC programming simple, only predefined variables will be used. All variables types will be double precision floating point variables. All standard system variables will be accessible to the XL-BASIC interpreter plus some generic variables used only by the XL-BASIC interpreter system. In the program, the variables may be upper or lower case. Below, they are shown in lower case.

Table 1-1: Main BASIC Program Variables

Variable Name	Type	Description
basic1	Read / Write	These variables are used to return values from Basic program 1 to 5, to the menu option calling the BASIC program. These variables are initialized to 0.0 when scanning is enabled, and will retain any modifications between scans. On return, the value will depend on the users BASIC program.
basic2		
basic3		
basic4		
basic5		

The basicx Variable

This is not a separate variable, but is actually an indirect link to one of the normal basic variables 1 to 5. A program can return a value using the variable associated to the location number where the basic program is loaded. For example, a program loaded into basic program location 1 must use the variable basic1 as the return variable. Now a program can use the name basicx as the return variable which allows the program to be loaded in any program location. If loaded into program location 3, when the program updates the basicx variable, it is actually updating the variable basic3.

VARIABLES

General Purpose Variables

Table 1-2: General Purpose Variables

Variable Name	Type	Description
a to z	Read / Write	26 General purpose variables initialized to 0.0 when scanning is enabled. Any value changes will be retained between program execution and between scans.

Standard Input Variables

Table 1-3: Standard Input Variables

Variable Name	Type	Description
Stage	Read / Write	The last measured stage value is returned. (Only available on the H-350XL and the H-510XL)
LastStage	Read / Write	The stage value measured on the previous scan will be returned. (Only available on the H-350XL)
PtTemp	Read / Write	The last measured PtTemp value is returned. (Only available on the H-350XL)
PSI	Read / Write	The last measured PSI value is returned. (Only available on the H-350XL)
AnaX	Read / Write	The last measured value for analog channel X (X=1 to 4) is returned.
Freq	Read / Write	The last measured freq value is returned.
Digio1	Read / Write	The last measured input state for digital channel 1 is returned.
Digio2	Read / Write	The last measured input state for digital channel 2 is returned.
Counts	Read / Write	The last measured count value is returned.
Totcnt	Read / Write	The last measured total count value is returned.
Countrate	Read / Write	The current count rate on the counter input.
Encodr	Read / Write	The last measured encoder input value is returned.
Tscans	Read / Write	The total scans value is returned
SdiAP	Read / Write	The last measured value for the selected SDI-12 variable is returned A = address 0 to 9, P = parameter 1 to 9
FntXX	Read / Write	The last calculated value for function XX is returned. (XX = 01 to 40)
BasicX	Read / Write	The value of one program can be used in other programs. (X = 1 to 5)

Note: Standard input variables are normally read only, but may also be assigned a new value directly in the XL-BASIC program regardless of the variables corresponding hardware input condition. Be aware that based on system configuratin, the input variable could be updated by the system after the variable was set by the XL BASIC program. Writing to these variables should be avoided or only used in advanced applications. For example, in the following segment of code, the second line makes the first line useless.

```
measure(ana1)     Measurement analog input 1 now and update its variable
ana1 = 12.34      Sets variable ana1 to 12.34 regardless of the voltage on analog 1
```

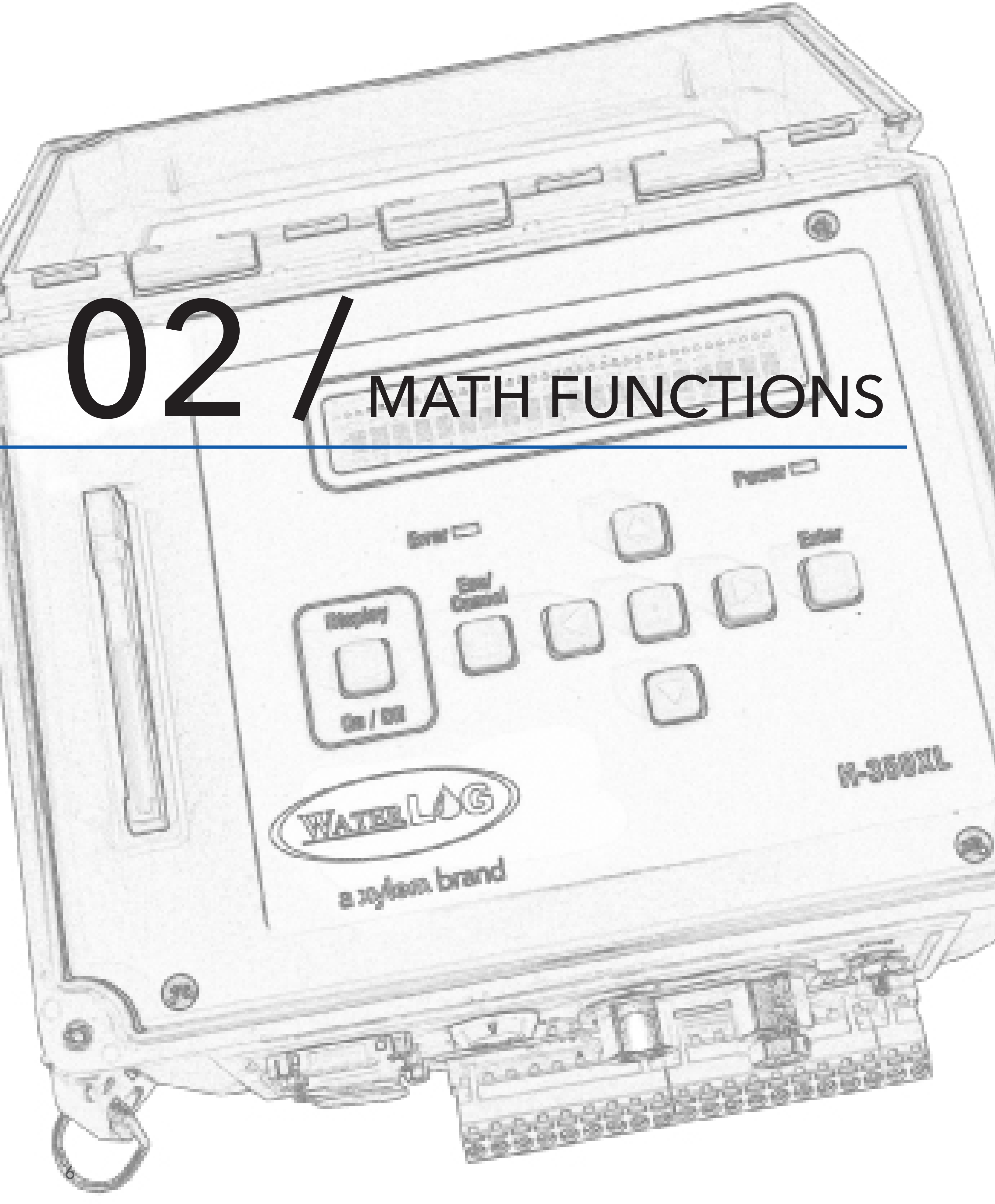
Read Only Variables

Table 1-4: Read Only Variables

Variable Name	Type	Description	
Date	Read Only	The date is returned in the format YYMMDD.0000	
Time	Read Only	The time is returned in the format HHMMSS.0000	
seconds	Read Only	Return the current seconds in the format SS.0000	
minutes	Read Only	Return the current minutes in the format MM.0000	
hours	Read Only	Return the current hours in the format HH.0000	
day	Read Only	Return the current day in the format DD.0000	
month	Read Only	Return the current month in the format MM.0000	
year	Read Only	Return the current year in the format YY.0000	
Batt	Read Only	The current battery voltage reading is returned	
minbatt	Read Only	Return the minimum battery voltage measured since option was reset	
maxbatt	Read Only	Return the maximum battery voltage measured since option was reset	
tankpsi	Read Only	Return H-355 tank PSI if an H-355 is connected	
linepsi	Read Only	Return H-355 line PSI if an H-355 is connected	
purgepsi	Read Only	Returns H-355 purge PSI setting	
purgedur	Read Only	Returns H-355 purge duration setting	
bubrate	Read Only	Returns H-355 bubble rate setting	
Purge	Read Only	Returns H-355 purge status,	0 = bubbler communication error 1 = request for purge accepted 2 = already purging
Resets	Read Only	Returns the number of times the system has reset	
LogvalX	Read Only	Returns the value associated to a log column when the column is setup to perform some function on the data like calculating the average, etc. The 'X' is the log column 01 to 25	

Note: The read only variables may be read but should not be written. Trying to set of write on of these variables to some value will have no affect, and the program will continue on under normal operation. If one of these variables is set to some value and then read again, the value returned will not be the value set by the program, but will be a value based on the function behind the variable.

02 / MATH FUNCTIONS



Basic Math Operations

Table 2-1: Basic Math Operations

Operations	Description
+, -, *, /.	Standard math operators
%	Modulo divide, returns the remainder from the standard division
^	Power operation, X^Y is X raised to the power of Y. For example 2^8 = 256

Trigonometry Operations

Table 2-2: Trigonometry Operations (Degrees)

Operations		
sin(x)	cos(x)	tan(x)
asin(x)	acos(x)	atan(x)

Table 2-3: Trigonometry Operations (Radians)

Operations		
sinr(x)	cosr(x)	tanr(x)
asinr(x)	acosr(x)	atanr(x)

Logarithmic Operations

Table 2-4: Trigonometry Operations (Degrees)

Operations	
log(x)	ln(x)

Misc Function Operations

Table 2-5: Trigonometry Operations (Degrees)

Operations	Description
abs(x)	Absolute value of x
int(x)	Integer portion of x
sqrt(x)	Square root of x
int(x)	Integer portion of x
h377f(anaX)	Convert voltage on analog channel X to a temperature in degrees (f) based on math equation for a model H-377 temperature probe.
h377c(anaX)	Convert voltage on analog channel X to a temperature in degrees (c) based on math equation for a model H-377 temperature probe.

03 / XL-BASIC COMMAND SUMMARY

Program Flow / Control Commands

Table 3-1: Program Flow / Control Commands

Command	Description
REM	Add remarks to the program for documentation
DELAY (xxxx)	Delay or wait for xxxx milliseconds, 1 to 65000
GOSUB xxxx	Go to a subroutine at line number ‘xxxx’
RETURN	Return from the subroutine
GOTO xxxx	Go to line number ‘xxxx’
For / TO / NEXT	Loop commands
IF / THEN	Conditional program execution
END	End marker for all programs

Sensor Input Commands

Table 3-2: Sensor Input Commands

Command	Description
MEASURE (xxxx)	Take a new measurement from the selected input
VXON	Turn on the 5.0 volt excitation
VXOFF	Turn off the 5.0 volt excitation
P12VXON	Turn on the 12 volt excitation. (Hardware Rev N and newer only)
P12VXOFF	Turn off the 12 volt excitation. (Hardware Rev N and newer only)
SETDIG1	Set digital I/O 1 high
SETDIG2	Set digital I/O 2 high
CLEARDIG1	Clear digital I/O 1 to a low state
CLEARDIG2	Clear digital I/O 2 to a low state
CURRENTLOOP(a)	Set the 4 to 20 mA current output level to ‘a’

Com Port Commands

Table 3-3: Com Port Commands

Command	Description
OPENCOMx	Open RS-232 Com Port x for Input and Print operations. (x = 1 to 3)
CLOSECOMx	Turn off com port x (x = 1 to 3)
FLUSHCOMx	Clear our the input buffer for Com Port x (x = 1 to 3)
PRINT	Send text and data to com port 1
PRINT2	Send text and data to com port 2
PRINT3	Send text and data to com port 3
PRINT4	Send text and data to com port 4. This is the RS485 port and it will turn on automatically as needed. This port has no input options.

XL-BASIC COMMAND SUMMARY

Com Port Commands continued...

INPUT	Get numeric values from com port 1
INPUT2	Get numeric values from com port 2
INPUT3	Get numeric values from com port 3
INPUTDELAY (x)	Set how long to wait for input on the serial ports, or keypad
DIGITS (x)	Set the number of digits to the right of the decimal point to display

Built-in Display / Keypad Commands

Table 3-4: Built-in Display / Keypad Commands

Command	Description
DISPLAY	Send text and data to the local display
DISPCLEAR	Clear the local display
DISPCURSER(x)	Set the curser position for the local display to ‘x’
DISPOFF	Turn off the local display
INKEY	Get a key press input from the local display
LEDON	Turn on the Error LED
LEDOFF	Turn off the Error LED

Data Card and File Commands

Table 3-5: Data Card and File Commands

Command	Description
OPENFILE	Open a data file for WRITEFILE operations
WRITEFILE	Write text and data to the open data file
CLOSEFILE	Close the data file

H-355 Bubbler Commands

Table 3-6: H-355 Bubbler Commands

Command	Description
SETBUBBLERT(x)	Set the H-355 bubble rate to ‘x’ bubbles per minute
SETPURGEPSI(x)	Set the H-355 purge pressure to ‘x’ PSI
SETPURGEDUR(x)	Set the H-355 purge duration to ‘x’ seconds

Miscellaneous Commands

Table 3-7: Miscellaneous Commands

Command	Description
POKE(a,d)	Set system address ‘a’ equal to ‘d’
PEEK(a)	Read system address ‘a’
WRITESDI “string”	Send text and data to the SDI-12 port using SDI-12 timing and retries
PRINTSDI “string”	Send text and data to the SDI-12 port one time only, no retries
GETSDIDATA “string”	Send a measurement command as a text string to the SDI-12 port and collect the data for that command
SETTIMEOUT(x)	Set the system timeout time to x seconds
SCANRT()	Get the current scan rate in seconds, a 15 minute rate would be 900
SETSCANRATE(x)	Set the scan rate to x where x is in seconds from 0 to 86399

04 / LANGUAGE COMMAND DESCRIPTIONS

Except for functions that have parameters using parentheses, all commands should be followed by a space. Normally keeping only one command on a line will make the program easier to read and understand. This also will cut down on programming errors. Commands may be entered in either upper or lower case.

Program Flow / Control Commands

Table 4-1: Program Flow / Control Commands

Command	Description
REM	This is a 'Remark' command. This is used to document the program and is used the same as in standard BASIC. Any text after the 'REM' command will be ignored until the next line. It is always a good practice to document the program. This helps explain the purpose of the program and documents any special operations of the program. Program flow should always be documented so it can be easily followed in debugging.
DELAY(####)	Delay #### milliseconds, where #### is 0 to 65000 Example: Delay (1000) Rem delay for 1.0 seconds
GOSUB ####	Go to a subroutine indicated by #### where #### is a numeric label at the beginning of a line (no alpha characters. See the GOTO command for more information on the label limitations). There should be a return statement at the end of the subroutine. There can be 5 nested GOSUB sections. Example: gosub 2000 end 2000 print "this is a subroutine" return
RETURN	Each subroutine must end with a return statement. See the gosub command.
GOTO####	Go to a different part of the code indicated by #### where #### is a numeric label at the beginning of a line (no alpha characters). There is no automatic return operation like the gosub uses. There must be a space between the command and the line number label. There may be up to 50 numeric labels in a program. Labels must be whole numbers in the range of 0000 to 9999. Example: goto 1000 end 1000 print "code execution continues here"
FOR / TO / NEXT	This is a "For To" loop with the following form: For var = start value TO end value Command(s) NEXT Example: for x = 1 to 10 Print x Next The start value and end value must be whole numbers with the start value less than the end value. There can be 5 nested FOR / TO / NEXT sections.

Program Flow / Control Commands Continued...

<table>
<tr><td>IF / THEN</td><td>IF condition THEN action. Condition is a logical expression that evaluates to true or false. If the condition is true then the desired action is executed. Valid conditional operators are:
<table>
<tr><th>Operator</th><th colspan="2">Example</th></tr>
<tr><td><</td><td>a < b</td><td>a less than b</td></tr>
<tr><td>></td><td>a > b</td><td>a greater than b</td></tr>
<tr><td><=</td><td>a <= b</td><td>a less than or equal to b</td></tr>
<tr><td>>=</td><td>a >= b</td><td>a greater than or equal to b</td></tr>
<tr><td>==</td><td>a == b</td><td>a equal to b</td></tr>
<tr><td>!=</td><td>a != b</td><td>a not equal to b</td></tr>
</table>
Example: if stage>10 then print “stage is greater than 10”
Most commands can be used after the THEN statement. A few possiblilies are listed below:
Then goto####
Then gosub####
Then measure(x)
Then delay(#)</td></tr>
<tr><td>END</td><td>All programs should end with this statement.</td></tr>
</table>

Sensor Input / Misc I/O Functions

Table 4-2: Sensor Input / Misc I/O Functions

Command	Description
MEASURE(x)	Measure selected input. Some inputs are normally only measured once per scan in order to speed program execution, and to make sure all secondary actions using the input value do so using the same value, as a second measure operation may result in slightly different values. If it is desirable to measure an input again, then this command must be used. Inputs that normally only get measured only once per scan are the analog inputs, the stage input, the PtTemp input the PSI input, and the SDI-12 inputs. Other input variables like battery or seconds will be updated each time they are used. x = Ana1 to Ana4, Stage, PtTemp, psi, SDIap, FntXX etc.
VXON	Turns the 5.0 volt excitation on
VXOFF	Turns the 5.0 volt excitation off
P12VXON	Turns on the 12 volt excitation if it was off. (only valid on Hardware Rev N and newer. On older revisions, the 12 volt excitation was always on)
P12VXOFF	Turns off the 12 volt excitation if it was on. (only valid on Hardware Rev N and newer. On older revisions, the 12 volt excitation was always on)
SETDIGx	Set digital output x (1 to 2) to a high state. The digital I/O must be configured as an output or this will have no affect.

Sensor Input / Misc I/O Functions Continued...

CLEARDIGx	Turn off digital output x (1 or 2) Example: if stage>10 then setdig1
CURRENTLOOP(x)	Sets the 4 to 20 mA output current to ‘x’ where ‘x’ is between 4 and 20. Values grater than 20 will result in an output of 20 mA and values less than 4 will result in an output level of 4 mA.

Com Port Commands

Table 4-3: Com Port Commands

Command	Description
OPENCOM1	Turn on the RS232 drivers for com port 1, initialize I/O buffers making it available for the ‘print’ and ‘input’ commands
CLOSECOM1	Turn off the RS232 drivers for com port 1
FLUSHCOM1	Clear out the input buffer for Com 1
OPENCOM2	Turn on the RS232 drivers for com port 2 and enable it to work with the print2 command
CLOSECOM2	Turn off the RS232 drivers for com port 2
FLUSHCOM2	Clear out the input buffer for Com 2
OPENCOM3	Turn on the RS232 drivers for com port 3 and enable it to work with the print3 command
CLOSECOM3	Turn off the RS232 drivers for com port 3
FLUSHCOM3	Clear out the input buffer for com 3
PRINT	Print text or data to the standard output which is com port 1. Any text listed between quotes will be sent directly to the serial port. Example: print “this is a test” This sends the test message out the serial port and terminates the messge with a carriage return and a line feed. To suppress the carriage return and line feed, use a comma `,’ at the end of the message. Example: print “this is a test”, Data may also be printed on the same line using the comma `,’ or the semicolog `;’ as follows: Example: print “stage = ”,stage rem line 1 print “stage = ”,stage,” temp = ”,PtTemp rem line 2 print “stage = “;stage,” temp = ”,PtTemp, rem line 3 The first line is terminated with the carriage return line feed. This is because there is no comma or semicolon formatting character after the variable stage. In the second example the two data values are separate based on the spaces inside the quotes, and the line is again terminated with a carriage return line feed because of the lack of a comma or semicolon. In the last example the first value is formatted to 8 characters, (due to using the line `;’ option)

Com Port Commands Continued...

PRINT (continued)	and the second value is printed using no extra spaces, and the line is NOT terminated since it ends with a comma. Normally ASCII text is sent out the serial port but at times it may be necessary to send special control codes, for example to initialize a serial display. To send out a single character control code in HEX format use a ‘&’ character as a prefix to the HEX data. The HEX data is in the range of 00 to FF. Print &hh Where & indicates to the system a two character hex value follows, and the hh is the hex value from 00 to FF. Example: print &0D sends a carriage return print &0A sends a line feed
PRINT2	Same as print except the output is to com port 2
PRINT3	Same as print except the output is to com port 3
PRINT4	Same as print except the output is to com port 4, the RS-485 port.
INPUT	Waits for a numeric value to be entered on comport 1. If no input is received within the timeout period defined by the INPUTDELAY command, then program execution continues and the variable used with the command can be used to print a prompt to the user. Example: opencom1 input “Enter First Value ”,a input “Enter Second Value”,b print ”Sum = “,a+b end
INPUT2	Waits for a numeric value to be entered on comport 2. See the INPUT command for more information.
INPUT3	Waits for a numeric value to be entered on comport 3. See the INPUT command for more information.
INPUTDELAY(x)	Set a timeout delay for serial input operations. The range is 1 to 60000 milliseconds. The default is 10000 or 10 seconds.
DIGITS(#)	Set the number of digits to display to the right of the decimal point. The default value is 2, and the range is 0 to 6. This option is used by the PRINT, PRINT2, PRINT3 commands, the DISPLAY command, and the WRITESDI and PRINTSDI commands. Example: print 5.00000 (prints 5.00 (default set to 2)) digits(5) print 5.00000 (prints 5.00000) digits(0) Print 5.00000 (prints 5)

Built-in Display / Keypad Commands

Table 4-4: Built-in Display / Keypad Commands

<table>
<tr><th>Command</th><th>Description</th></tr>
<tr><td>DISPLAY</td><td>Basically the same as print except the output is to the local display. The curser will be left at the end of the printed string. Also no carriage returns or line feeds will be sent at the end of the string as they would clear the display. If the display is not turned on before this command is used, then the display will be turned on automatically.</td></tr>
<tr><td>DISPCLEAR</td><td>Clear all text from the display and position the curser at the home position. If the display is not turned on before this command is used, then the display will be turned on automatically. Using this command is an easy way to turn on the display.</td></tr>
<tr><td>DISPCURSER(##)</td><td>Position the curser at position ## where ## is 00 to 19. This allows a message to be displayed once, and some portion of the screen updated as needed without having to redisplay the whole screen.
Example:
<pre>
dispclear
display “Battery Volts = “
for x = 1 to 1000
dispcurser(16)
display batt
next
dispoff
end
</pre></td></tr>
<tr><td>DISPOFF</td><td>Turn off the display now. If this command is not used, the display will turn off automatically when the system has no more tasks to perform.</td></tr>
<tr><td>INKEY</td><td>Wait for a key to be pressed on the built in key pad. If no key is presed within 30 seconds, a 0.00 is returned and program execution continues. The following table lists the values that will be returned for the different key presses.
<table>
<tr><th>KEY</th><th>VALUE</th><th>KEY</th><th>VALUE</th></tr>
<tr><td>Right</td><td>1.0</td><td>Up</td><td>10.0</td></tr>
<tr><td>Enter</td><td>2.0</td><td>Left</td><td>20.0</td></tr>
<tr><td>Down</td><td>4.0</td><td>Cancel</td><td>40.0</td></tr>
<tr><td>Dot</td><td>8.0</td><td>On / Off</td><td>80.0</td></tr>
</table>
Example:
<pre>
dispopen
dispclear
display “If Raining Press ENT”
x = inkey
if x=2.0 then goto 100
dispoff
end

100
digits(0)
openfile “B:SERVICE.LOG”
writefile “Date “;date,
writefile “ Time “;time,
writefile”   Currently raining”
closefile
dispoff
end
</pre></td></tr>
</table>

Built-in Display / Keypad Commands continued...

LEDON	Turn on the Error LED. Note the LED will not turn on if the display is not turned on.
LEDOFF	Turn off the Error LED.

Data Card and File Commands

Table 4-5: Data Card and File Commands

Command	Description
OPENFILE "filename"	This command opens a file based on the parameter "filename". The "filename" parameters specifies if the file will be on the internal data card or the external data card, and the name of the file. The format for the filename follows the DOS file format where a drive is also specified. A drive letter of 'A' refers to the external card and a drive letter of 'B' refers to the internal card. Only one file may be opened at a time. Valid examples are as follows: A:\testfile.txt B:\service.log
WRITEFILE	This command is used to write data or text to the already opened file on the internal or external data card. This works basically the same as the PRINT command, except the output is to the open file.
CLOSEFILE	Closes the file opened using the OPENFILE command.

H-355 Bubbler Commands

Table 4-6: H-355 Bubbler Commands

Command	Description
SETBUBBLERT(x)	Sets the H-355 bubble rate to value x. The bubble rate may be set between 30 and 120. A value less than 30 will result in a bubble rate of 30, and a value greater than 120 will result in a bubble rate of 120.
SETPURGEPSI(x)	Sets the H-355 purge pressure in PSI to value x. The PSI value may be set between 15 and 80. A value less than 15 will result in a purge pressure of 15, and a value greater than 80 will result in a purge pressure of 80.
SETPURGEDUR(x)	Sets the H-355 purge duration time in seconds to value x. The duration value may be set between 30 and 240. A value less than 30 will result in a purge duration of 30, and a value greater than 240 will result in a purge duration of 240.

Miscellaneous Commands

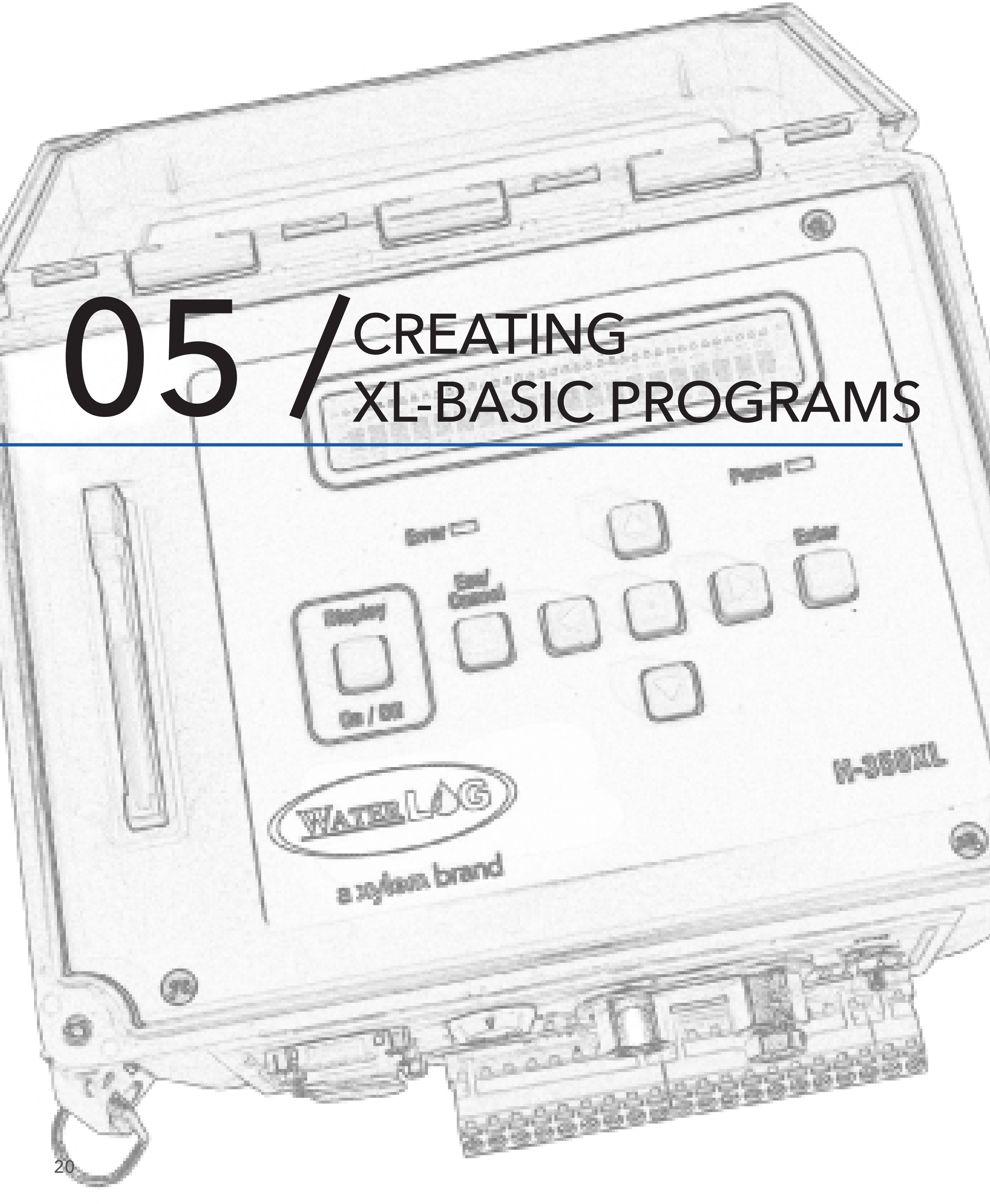
Table 4-7: Miscellaneous Commands

Command	Description
POKE(&adrs,&hh)	Poke hex address adrs with hex data hh. Example: poke(&1000,&01)
PEEK(&adrs)	Peek hex address adrs Example: r = peek(&1000)

Miscellaneous Commands continued...

WRITESDI	This command is used to send text out the SDI-12 port to smart sensors. The command is preceded with a standard SDI-12 break. If the response is not recognized, then normal ADI-12 retries will be sent. Normally the first character of the string is the address of the sensor the message is meant for. If this address matches a standard SDI-12 address that has been redirected to a serial port, then this command will be sent out the serial port and not the SDI-12 port. The string format for this command is similar to the 'PRINT' command. Example: writesdi "0I!"
PRINTSDI	This command is used to send text out the SDI-12 port to smart sensors. Proper SDI-12 timing is used, but the command is only sent one time. No retries are sent if the response is not recognized. This is always sent out the SDI-12 port—even if the address has been redirected. The string format for this command is much the same as the 'PRINT' command. Example: printsdi "0I!"
GETSDIDATA "string"	This command is normally used to send a measurement command as a text string out the SDI-12 port to smart sensors, and then collect the data from the sensor and store it in variables a to i. This allows the logger to collect data from sensors that have addresses other than the ten allowed for in the normal menu options. The command is preceded with a standard SDI-12 break. If the response is not recognized, then normal SDI-12 retries will be sent. Example: getsdidata "aM!"
SETTIMEOUT(x)	This command is used to set the system timeout period. It can be set from 15 to 600 seconds.
SCANRT()	This command gets the current scan rate in seconds. Example: a = scanrt()
SETSCANRT(x)	This command is used to change the scan rate. This may be used to speed up the scan rate based on some predefined condition. For example, if the stage is greater than some level, then scan at a faster than normal rate. Example: if stage>10 then setscanrt(300)

05 / CREATING XL-BASIC PROGRAMS



XL-BASIC programs are created using text editors like NOTEPAD that comes with most PC's, or the "EDIT" program on most older PC's. Word processors in normal mode will NOT work as they will add several formatting codes to the text. Some word processors have a mode for editing basic text files and should work fine.

When creating a basic program file, use a file name that describes the operation of the program. This will help when several files reside in the same folder. Also, the file extension must be .BAS. When the XL™ series data logger looks for files to load for basic programs, it uses the file mask *.BAS so only the .BAS files are listed.

XL-Basic Menu Screens

Menu options are available on both the built in display, and on the PC menu interface to load and test basic programs.

Built-in Menu Structure: XL-Basic Menu

System Setup - >	XL-BASIC Options - >	Load XL-Basic Code?
		Get XL_Basic Code?
		XL - Basic1 = x.xx
		XL - Basic2 = x.xx
		XL - Basic3 = x.xx
		XL - Basic4 = x.xx
		XL - Basic5 = x.xx
		Debug Stepping Off

PC Menu Screen: XL-Basic Options

```
XL-BASIC Code Options          (Esc to Return)

L - Load code : From PC Card to Memory:
G - Get Code: From Memory to PC Card:

       Pgm Number                  Pgm Name            Pgm Value
1 - Test XL-Basic1 :                TMEAS                0.000
2 - Test XL-Basic2 :               STG_AVG               0.000
3 - Test XL-Basic3 :                                     0.000
4 - Test XL-Basic4 :                                     0.000
5 - Test XL-Basic5 :                                     0.000
S - Single Step Mode : Disabled

Enter Option >_
```

CREATING XL-BASIC PROGRAMS

PC Interface View

L - Load Code: From PC Card to Memory

Load XL - Basic Code?

This menu option is used to load XL-BASIC code. Not all five programs have to be loaded. When this option is activated, the system performs the following tasks:

1 - Make sure an external PC card is installed and functional.
2 - Erase all XL-BASIC programs currently loaded into internal memory.
3 - The data logger prompts the user to select a file to load for XL-BASIC program 1.
4 - Using the UP, DOWN, and ENTER key the user selects a file to load.
5 - The data logger prompts for file 2,3,4, and 5 in the same manner until all are loaded.

G - Get Code: From Memory to PC Card

Get XL-Basic Code?

This menu option is used to get XL-BASIC code out of the XL back onto a data card. When this option is used, the system looks for an external data card and copies the XL-BASIC programs in main memory to the external data card.

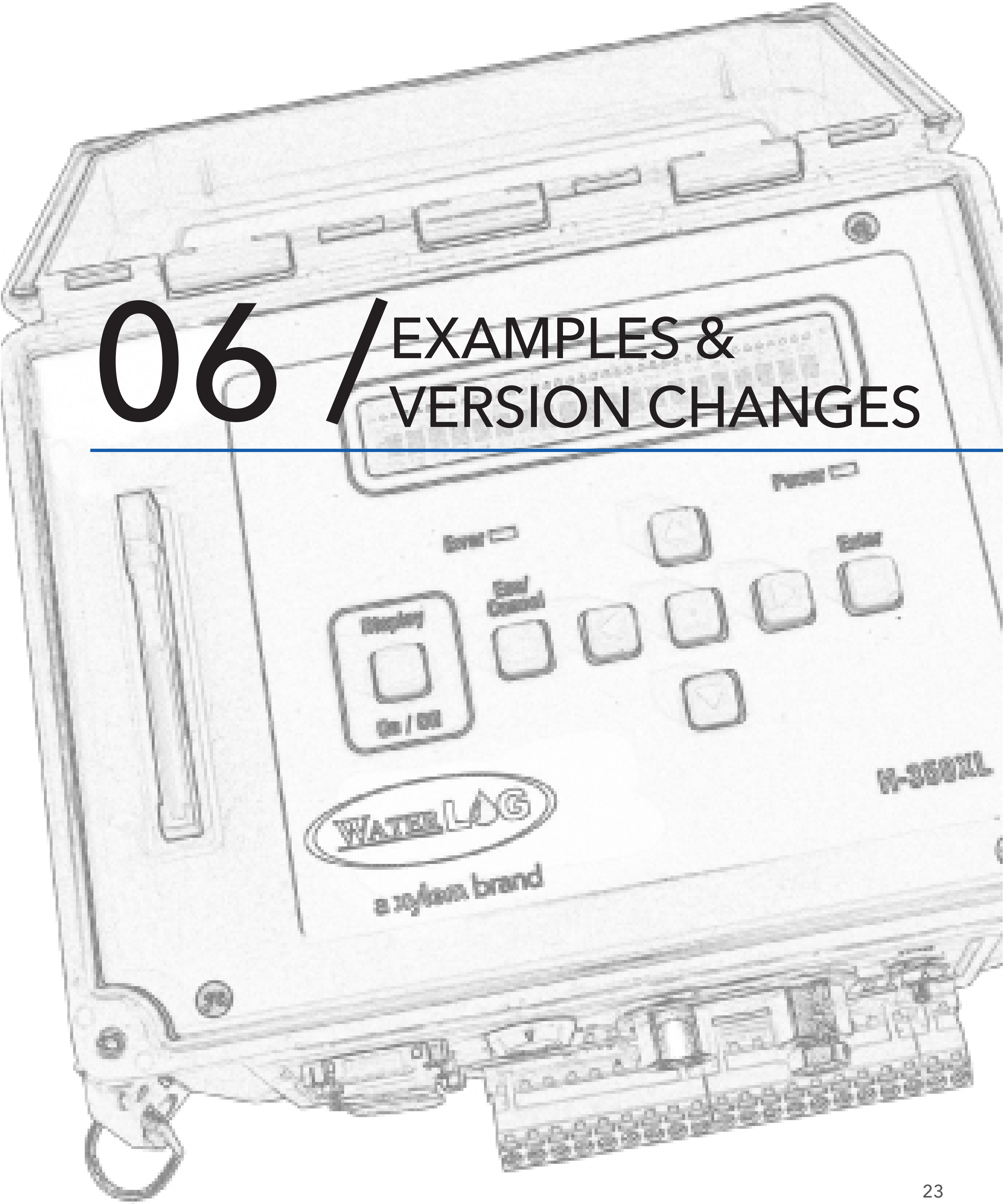
1 - Test XL-Basic 1: Name XX.XX

XL-BASIC1 = XX.XX

This menu option is used to execute the different programs. When the program finishes running, any value associated to the program will be updated and redisplayed. Remember there is a variable for each basic program. The value of the variable is represented by the XX.XX above. The above screen shows Basic Program numbe 1, and programs 2 to 5 look and act the same as this one.

If there is a problem with a program, it may be necessary to 'step' through the program line by line. When the single step mode is enabled, com port 1 is turned on and waits for a program to be executed. When the program is executed, each line of the program is printed to the serial port of the PC. The program then waits for the user to press the PC ENTER key to actually execute the listed line of code. The stepping operation cannot be activated if scanning is on and is automatically turned off when scanning is enabled. In most cases it is best to just use the PC menu to test the XL-Basic programs since it must be connected anyway.

06 / EXAMPLES & VERSION CHANGES



EXAMPLES & VERSION CHANGES

Example XL-BASIC Programs

Example Program #1: Send Formatted Data to Remote Display

This example gives the XL-Basic code for a program that will output the head (pool) and tail gauge heights (measured using SDI-12 Shaft encoders) to a remote display using the RS-232 Com Port 3 of the H-350XL™. All lines that begin with REM are remarks or comments that are used to document the program. These lines are not executed / interpreted by the Basic interpreter. The logging options of the H-350XL™ could have the following columns defined for reporting: Date, Time, SDI11, SDI21, and BASIC1. SDI11 and SDI21 are the shaft encoders used to measure the head and tail gauge levels. BASIC1 would call the XL-Basic program named slbasic1.bas which would output the gauge levels to the remote display. Also note that at the end of the XL-BASIC program the battery voltage is assigned to the variable BASIC1. The battery voltage value will then be logged into the data file once the XL-BASIC program has terminated. This eliminates the need to select Batt as a source in the logging options and it also eliminates an extra column in the data file.

```
REM  XL - BASIC PROGRAM TO DISPLAY STAGE LEVELS (POOL AND TAIL)
REM MEASURED FROM TWO SDI-12 SHAFT ENCODERS TO A IEE 2 X 20
REM REMOTE VACUUM FLUORESCENT DISPLAY CONNECTED TO RS-232 PORT 3.

REM OPEN COM PORT 3 FOR COMMUNICATION
OPENCOM3

REM REMOTE DISPLAY CONTROL COMMANDS
REM  0AH = LF (VERTICAL SCROLL FROM BOTTOM LINE; CURSOR POSITION STAYS)
REM  0DH = CR (RETURN CURSOR TO LEFT MOST POSITION OF CURRENT LINE)
REM  0EH = TURN CURSOR OFF
REM  12H = TURN OFF AUTO CR
REM  14H = RESET DISPLAY

REM REMOTE DISPLAY INITIALIZATION
REM RESET DISPLAY, TURN OFF AUTO CR, TURN CURSOR OFF
PRINT3  &14, &12, &0E

REM PRINT POOL VALUE ON TOP LINE AND TAIL VALUE ON BOTTOM LINE
PRINT3  “POOL = ”, SDI11 +125.25, ” FEET ”
PRINT3  “TAIL   = ”, SDI21+125.25, ”  FEET”;

REM ASSIGN BATTERY VOLTAGE TO BASIC1 VARIABLE FOR LOGGING
BASIC1 = BATT

REM CLOSE COM PORT 3
CLOSECOM3
END
```

Example Program #2: Post Purge Every Scan

It may be desirable to purge more often than once a day as provided by options in the menu interface. The following example shows how to purge from once every scan to once every 'n' scans, where 'n' is set by the user as needed. Make sure this basic program is the last item in the report list. In this case, the purge happens at the end of the scan. This is because the pruge will create a lot of noise on the orifice line and this gives the most amount of time from the purge to the next measurement for the noise to dissipate.

```
REM Program to purge every 4th scan

REM this value sets the number of scans to make before a purge should be done.
REM In this example a purge will be done every 4 scans.
REM If scanning every 15 minutes, then a purge every hour will be done

if a > 4 then a = 4            REM make sure counter is in range
if a < 0 then a = 4

a = a - 1                      REM decrement the counter
if  a == 0 then goto 100       REM if zero then purge
basic1 = 0;
end

100
purge                          REM start purge
basic1 = 1                     REM set status flag to indicate purging

a = 4
end
```

Version Changes

Version changes (available on version 2.07 of the XL series data logger)

- Changes to the 'input' command to not change the variable value if no input was received
- Added 'printsdi' command, print to the SDI-12 port without any retries.
- Added 'p12vxon' command, turn on the 12 volt excite, (only available on newer hardware).
- Added 'p12vxoff' command, turn off the 12 volt excite, (only available on newer hardware).
- Added 'settimeout (x)' command, set the system time out value from 15 to 600 seconds.
- Added 'opencom2', 'print2' and 'closecom2' commands, allowing printing to com port two.
- Added 'logvalx' variable, an indirect variable normally based on a log column function.
- Added 'reset variable, returns the number of times the system has reset.
- Described the 'basicx' variable.

Version changes (available on version 2.10 of the XL series data logger)

- Added input commands for com port 2 and 3
- Added flushcom1, flushcom2, and flushcom3 commands
- updated this document

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2) a leading global water technology company.

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