

**INSTRUCTION MANUAL**  
**MULTI OUTPUT DRY TRANSDUCER**  
**MODEL WL3100**

QUALITY SYSTEM  
**ISO**  
**9001**  
2000  
CERTIFIED

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**I HYDROLOGICAL SERVICES STANDARD WARRANTY TERMS**

WARRANTY, DISCLAIMER AND LIMITATION OF LIABILITY:

We warrant this product to be free from defects in material and workmanship for a period of three years from the date of shipment hereof or its total rated life, whichever first occurs. During the warranty period, we will repair or replace this product if it is returned to us with shipping charges prepaid and we determine it to be defective. This warranty shall not apply if this product has been subjected to misuse, negligence, accidents, or misapplied, or modified or repaired by unauthorised persons, or improperly installed, and we shall not be liable to any person for personal injury or property damage caused by such a product.

All other warranties, express and implied, including warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE, are disclaimed. All other remedies and liabilities, including incidental, consequential, and special damages, losses, and expenses, are excluded.

Note: It is Hydrological Services' policy to support all of our products. If design or workmanship problems arise after this statutory warranty period we request that you contact us.

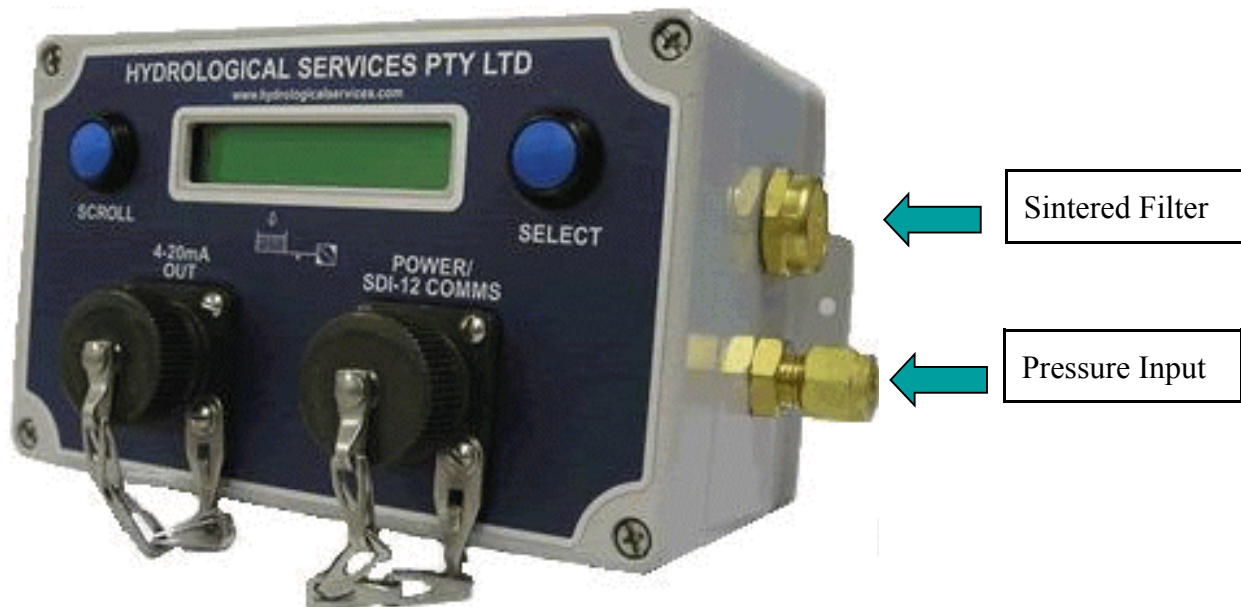
MULTI OUTPUT DRY TRANSDUCER WL3100

**II GENERAL**

The Hydrological Services Multi Output Dry Transducer model WL3100 is a low power, computerized dry transducer designed for field operation to enable measurement of water level. The internal CMOS circuitry enables the WL3100 to output measured levels in absolute format on an LCD display or as a 4-20mA, RS232 or SDI-12 signal.

The SDI-12 output allows multiple connection to a single data logging recorder, transmitting at 1200 baud over distance up to 60 metres (200 ft).

When used in conjunction with an Hydrological Services Dry Bubble Unit, Model HS-23 or the HS-55 Compressor Unit, it allows the measurement of water head to a fine degree of accuracy and repeatability.



**Note: All units are factory calibrated over their full operating temperature and pressure range in our Environmental Chamber and Ruska Pressure Calibrator. A calibration certificate is supplied with each Sensor.**

### **III SPECIFICATION**

#### **a) SPECIFICATION - Mechanical**

Enclosure:	Aluminium diecast weatherproof enclosure IP65
Dimensions:	180 x 105 x 100 mm
Weight:	1.2 kg
Isolation Diaphragm	316 Stainless Steel
Operating range:	0-5, 0-10, 0-15 , 0-20, 0-30 metres water head ( Imperial units also available up to 100 feet range).
Over pressure:	2.67 x ranges
Operating Temperature:	-40 °C to +80 °C (-40 °F to +176 °F) (Excluding LCD Display)
Humidity :	100 % non condensing
Overall Accuracy:	±0.02 % F.S. BSL
Long Term Stability:	Typically ±0.05 % F.S./annum
Pressure Connection:	1/4" Tube
Sensor Vent:	Sintered Filter
Calibration:	Over full range against water head.

#### **b) SPECIFICATION - Electrical**

Operating Voltage:	9.6 to 16VDC operation ie. from SDI-12 +12 volt supply
Current Loop Operating Voltage:	9V to 30V DC for 4-20mA current loop drive ( used as a 2-wire current loop transducer)
Insulation:	Greater than 100MΩ at 500 V DC
LCD Backlight	Powered via SDI-12 port (9.6 to 16 VDC)
LCD Operating Temperature:	-20 °C to 60 °C (-4 °F to 140 °F)

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Display:	Water Level, 4-20mA range, time and date.
Parameters:	User selectable via push buttons on the pressure transducer housing
LCD Operation:	LCD display is standard with auto shutdown after 35 seconds idle.
Power Consumption:	Low standby power < 20 microamps (excluding 4-20mA loop & LCD)
Operating Power:	10mA from SDI-12 supply while taking a measurement and 0.5mA between measurements.
Options:	All options are user programmable via the SDI-12 interface and saved in an on board EEPROM.
Units:	Metric or Imperial scaling (selectable)
Output:	RS232, SDI-12 and 4-20mA output.

**Note:** Proprietary adapter cable needs to be used for RS232 comms via the SDI-12 port. Current drawn from current loop drive is only that which is needed to drive the 4-20mA loop. See section XII for power requirement details.

Battery Backup :	Internal microprocessor operation as well as data integrity is guaranteed by a factory fitted lithium battery for 3 years minimum.
Full Scale :	Full scale range is dependant upon transducer specified ( i.e 5, 10, 15, 20, 30) metres
Resolution :	Fixed 1mm (Metric) Fixed 0.01 ft (Imperial)

IV INSTALLATION

Before connecting the power to the pressure transducer, you need to connect the instrument line to the pressure transducer as follows:

1. Undo the nut and remove the ferrules from inside the fitting.
2. Place the nut through the tube and then place the ferrules as shown in the figure2.

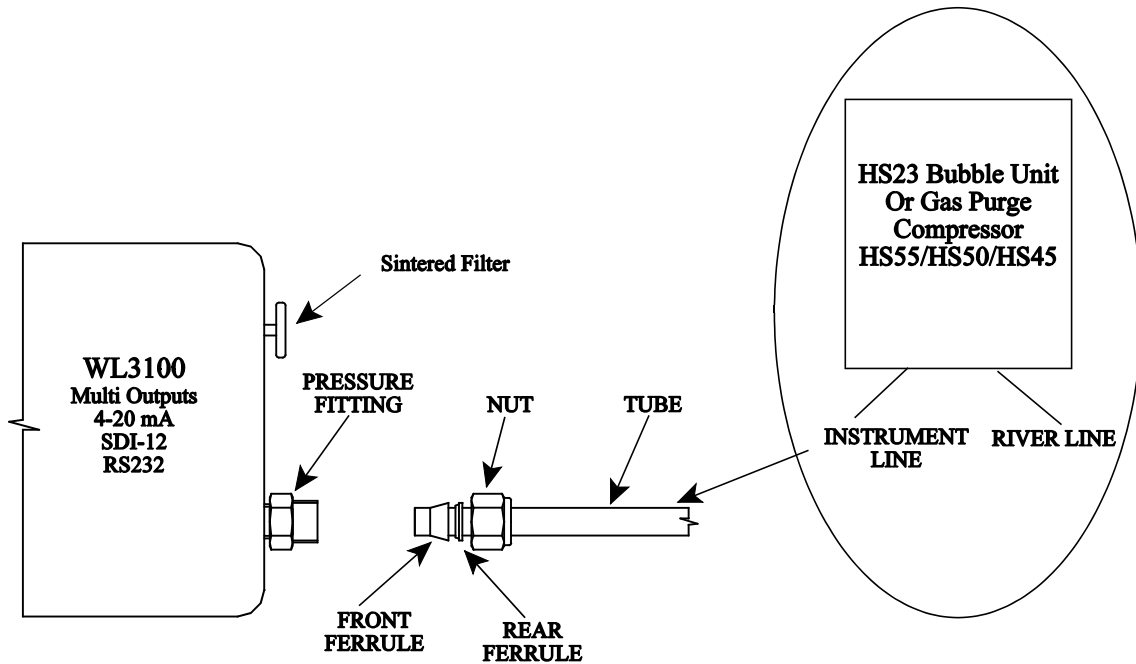


Figure2: Pressure Transducer Installation- Part (a)

3. Tighten the nut as shown in the figure3 below.

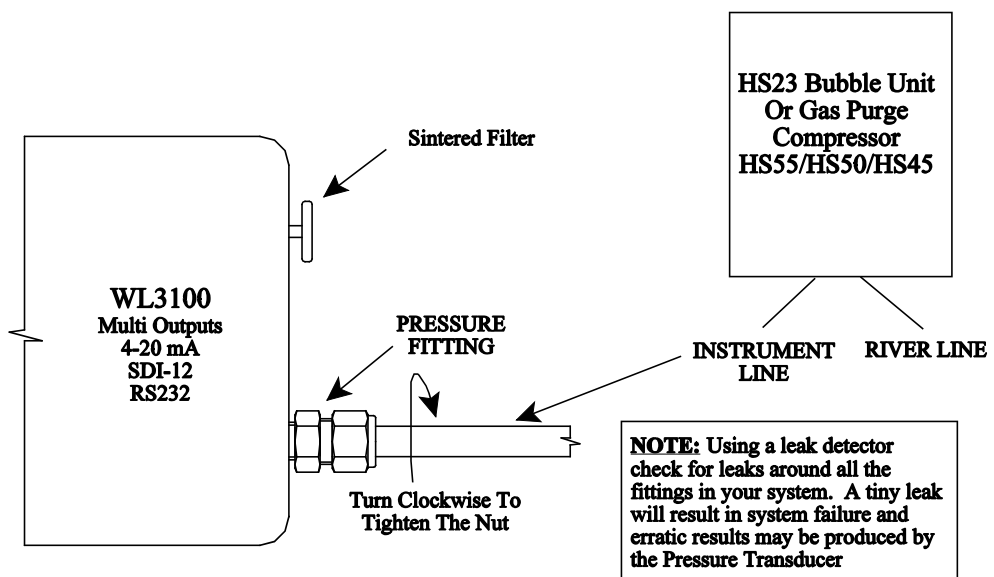


Figure3: Pressure Transducer Installation- Part (b)

4. Using a leak detector, check for leaks.

5. You are ready now to connect the power and run your WL3100.

**Note:** A pressure leak anywhere in the system will affect your level reading and produce erratic results.

## **V OPERATION**

The WL3100 Multi Output Dry Transducer powers up and takes a measurement at the following times :

- C When the “Level” is displayed on the LCD, a reading is taken every 12 seconds and the Level on the LCD is updated.
- C When the 4-20mA current loop has power applied, a reading is taken every 12 seconds. The 4-20mA current loop is updated at the same time.
- C When the SDI-12/RS232 interface requests a measurement using the ‘M’ or ‘C’ commands.
- C When the LCD menu “Continuous Meas” is set to YES, measurements are continuously taken..

## **VI ERROR CONDITIONS**

If the WL3100 Multi Output Dry Transducer is unable to take a reading (fault condition or loss of +12VDC supply from SDI-12 port), then an error condition is indicated by :

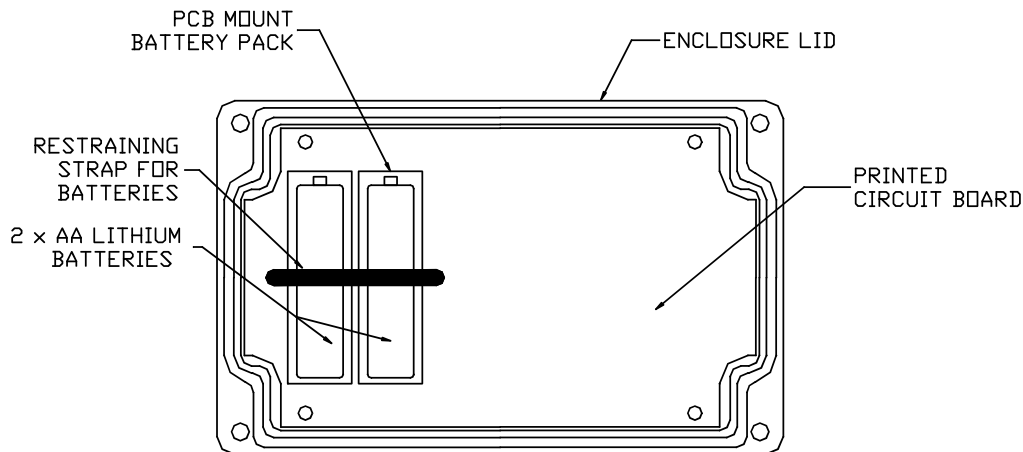
- C The LCD displaying “Error” as the water level.
- C The 4-20mA current loop increasing to 24mA (indicating the error condition).
- C An SDI-12 measurement request will return “9999.999” as the “level”

All of these readings are outside the normal measurement range.

## VII MAINTENANCE

The WL3100 Multi Output Dry Transducer requires no maintenance, however all connected mechanical equipment should be periodically checked for cleanliness and ease of operation.

Batteries should be replaced when required (Expected operating life is 3 years minimum).



**Figure 4:** <sup>INSIDE VIEW</sup> Internal Battery Replacement

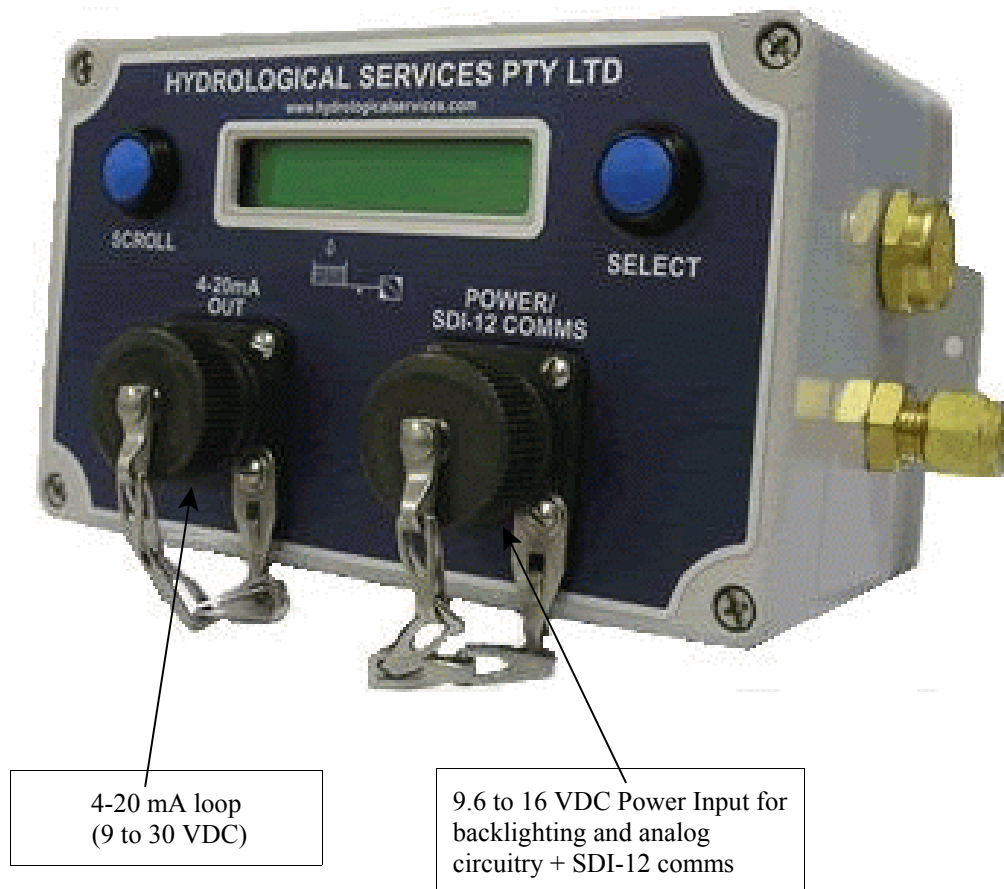
### Internal Batteries Replacement Instruction:

1. Loosen the 4 screws on the enclosure lid
2. Remove the lid
3. Cut restraining strap
4. Remove and replace batteries one at a time, ensuring polarity is correct, so that processor is not interrupted (only use 3.6v Lithium AA batteries)
5. Fit a new restraining strap (150mm cable tie)
6. Replace enclosure lid ensuring a proper fit
7. Tighten the 4 screws

VIII EXTERNAL POWER

Even though the Multi Output Dry Transducer has an internal lithium battery, **an analog measurement can only be made if +12VDC (9.6V to 16VDC) power is connected via the SDI-12 port.** This supplies power to the analog measurement circuitry.

An adequate 12VDC (9 to 30VDC) battery and charger option should be used if the 4-20 mA current loop is to be powered continuously and independently of the telemetry module or data logging equipment.



**Figure5:** External Power Connections

**IX LCD SCREEN**

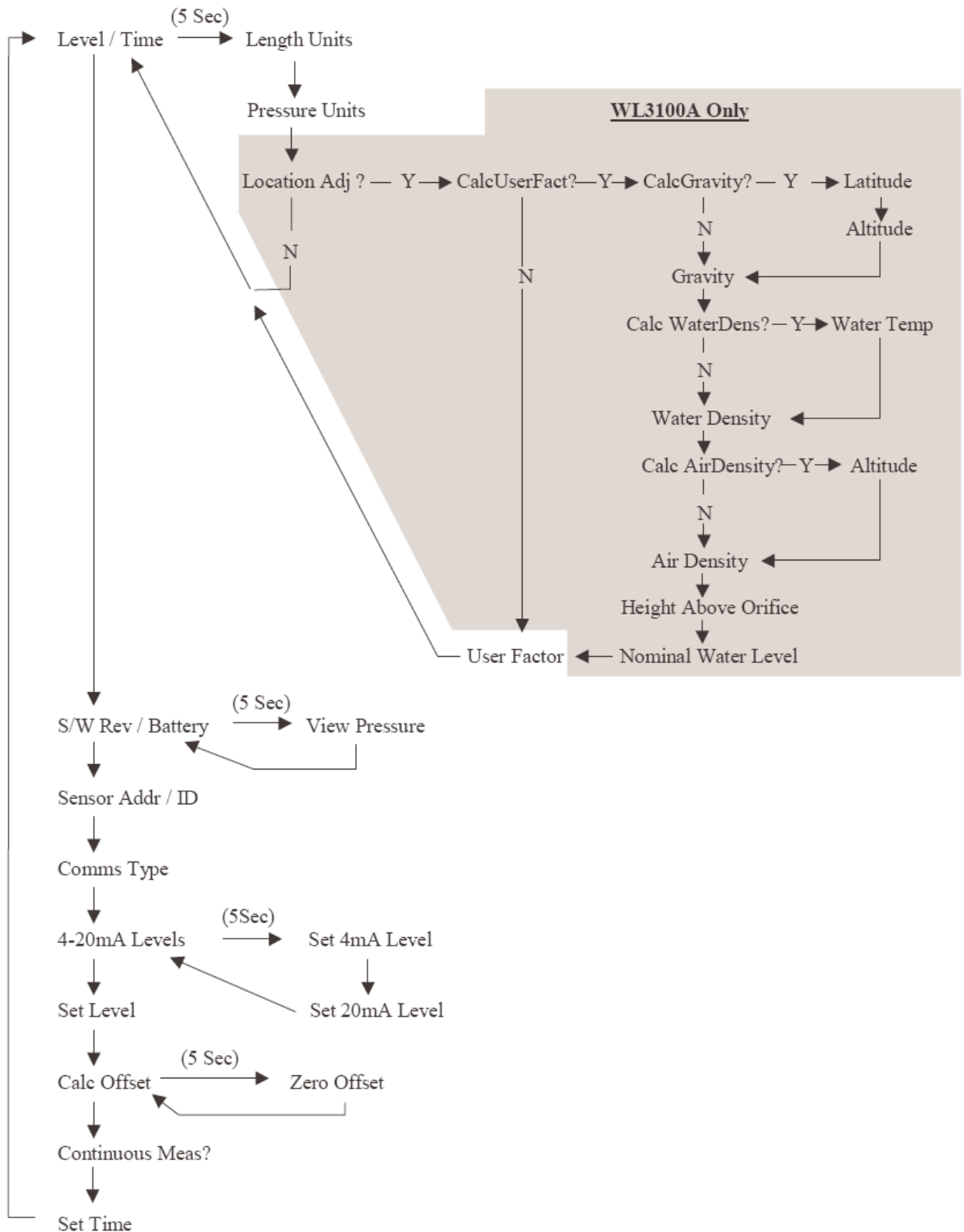
There are 9 main LCD screens available. Some screens display internal data and some allow parameters to be changed. The screens are:

<b>LCD SCREEN</b>	<b>DESCRIPTION</b>
01:23 10-Aug-04 Level 9.392 m	Display time, date and present river level
WL3100 S/W 4.2 Battery: OK	Display model, S/W Rev and internal lithium battery condition
Sensor Addr: 2 Sensor ID: 12345	Display Sensor SDI-12 address and 5 digit ID
Comms Type: SDI-12	Allows the comms type to be selected SDI-12 or RS232
4-20mA Level: 0.0-10.0 m	Indicates the 4mA Level and the 20mA Level
Set Level: 12.392 m	Allows the present River Level to be preset - internally calculates an offset
Calc Offset: 0.003 m	Displays the internally calculated offset generated through the previous Set Level
Continuous Meas ? Yes	Yes => the river level is continuously measured. No=> the river level is only measured when requested.
Set Time: 01:23 10-Aug-04	Allows the present time and date to be set

**Note:** When the River Level is “Set”, the difference between the user entered River Level, and the raw data measured from the transducer is calculated. This calculated offset is saved into non-volatile memory, and is added to the raw transducer level each time a measurement is taken. In this way all calculations are made transparent to the operator.

A measurement of the river level is initiated when a button is pressed (LCD is on) OR when “Continuous Meas” is set to Yes and +12V is present OR when 4-20mA current is present, OR when an SDI-12 Measure command is received.

There are many other menu items that allow fine tuning of the calibration if this is required, as well as changing units of measurement (m/ft) and pressure (psi/kPa). Please note the menu tree on the next page should be examined carefully before embarking through it.



**Menu Tree**

Normally the “Scroll” button is used to step to the next menu item indicated by an arrow. However, when a time (eg. 5 Sec) is indicated above an arrow, the “Select” button is pressed for the indicated time to access the configuration menu item.

**X RS 232/SDI-12 SELECTION**

The SDI-12 protocol has very strict timing requirements. The operator may use the SDI-12 to RS232 adaptor cable and then communicate using RS232 from a PC. The "RS232" option must be selected via the LCD and pushbuttons. In this mode all of the timing/break requirements of the SDI-12 are removed. Commands may be typed from a terminal program such as "Hyperterm". (See Appendix B for details of the SDI-12 to RS232 converter)

**Note** you must use 1200 baud, 7 bits, even parity and no handshaking.

If using an SDI-12 logger you must select the SDI-12 option via the LCD and pushbuttons.

**XI SDI-12 V1.2 COMPLIANT COMMAND SET**

<b>Name</b>	<b>Command</b>	<b>Response</b>
Break	Continuous spacing for at least 12 milliseconds	None
Acknowledge Active	a!	a<CR><LF>
Send Identification	aI!	allccccccmmmmmmvvvxxx...xx<CR><LF> (Refer Note 1.)
Change Address	aAb!	b<CR><LF>
Address Query	?!	a<CR><LF>
Start Measurement	aM!	atttn<CR><LF> (Refer Note 2)
Send Data	aD0!	a<value><CR><LF>
Continuous Measurement	aR0!	a<value><CR><LF> (Refer Note 3)
Start Verification	aV!	atttn<CR><LF> (Refer Note 4)
Start Concurrent Measurement	aC!	atttnn<CR><LF> (Refer Note 2)

**Note 1.**

**a12HydrServWL31001.212345<CR><LF>**

```
-- -----
| | | | |
| | | | | --- 5 digit Sensor ID (eg 12345)(as set in aX4 command)
| | | | | ----- S/W Revision (eg 4.4)
| | | | | ----- Model (WL3100)
| | | | | ----- Company ID (HydrServ)
| | | | | ----- SDI-12 Version V1.2 Compliant
| | | | | ----- Unit Address
-----
```

**Note 2.**

The measurement command “M” and the concurrent command “C” will both return a time “ttt” of 012 indicating that the measurement will be ready in 12 seconds. Do not request data within this 12 second window, or an empty reply will be received. (In accordance with the SDI-12 protocol.) When an “M” command is in progress, the dry transducer will issue a service request “a<CR><LF>” when the measurement is complete and ready for a data request. (Again, in accordance with the SDI-12 protocol)

**Note 3.**

The Continuous Measurement command returns the present River Level. If the LCD command “Continuous Meas ?” is set to “Yes” then the river level is continuously measured when 12V is present and so the aR0! returns the river level without having to issue an aM! Measure command.

**Note 4.**

aV!            Initiate Verify Command

Test the lithium battery.

The Multi Output Dry Transducer returns a0001<CR><LF> indicating that there is 1 measurement available and it will be ready in 0 seconds. When the Data command aD0! is issued the dry transducer will reply with :

a+o<CR><LF>

```
|
----- Lithium Battery Condition (0=> Battery OK : 1=> Battery Low)
```

## XII SPECIAL COMMANDS

aXn! Return data associated with command 'n'. The multi output dry transducer will reply with a0001<CR><LF> **The aDO! command must be issued to get the actual data.**

aXn+xxxx! Set parameter for command 'n'. The multi output dry transducer will reply with a0001<CR><LF> **The aDO! command must be issued to get the actual data.**

### Set/Get Current Value

aX0! Get the river level (River level from last measurement).  
aX0+0012.345! Set the river level to +12.345 m (or ft).

### Get Multi Output Dry Transducer Pressure

aX1! Get the Pressure. eg. +0004.524 psi (or kPa)

### Get/Set the 4mA Level

aX2! Get the 4mA Level.  
aX2+0002.5! Sets the 4mA Level to 2.5m (or ft)  
When the water level is 2.5m then the 4-20mA loop will pass 4mA

### Get/Set the 20mA Level

aX3! Get the 20mA Level.  
aX3+0020.0! Sets the 20mA Level to 20.0m (or ft)  
When the water level is 20.0m then the 4-20mA loop will pass 20mA

### Set/Get ID Number

aX4! Get the dry transducer ID.  
aX4+12345! Set the dry transducer ID. Acceptable values 0-65535. This value appears in the Identify command.

### Set/Get Time

aX5! Get the dry transducer Time.  
aX5+0135! Set the dry transducer Time to 01:35 (24 hour clock)

### Set/Get Date

aX6! Get the dry transducer Date.  
aX6+011204! Set the dry transducer Date to 1-Dec-2004.

Set/Get the User Factor

aX7!           Get the User Factor.  
aX7+0.705373! Set the User Factor to 0.705373 m/psi

Increment the 4mA Calibration

aX96+00!     Examine the present 4mA Calibration without altering it.  
                  (This also saves the calibration)  
aX96+05!     Increment the 4mA Calibration by 5 steps  
(This should be done while accurately measuring the current on the 4-20mA loop)  
(If the calibration is changed, always finish by sending aX96+00! to save it)

Increment the 20mA Calibration

aX97+00!     Examine the present 20mA Calibration without altering it.  
                  (This also saves the calibration)  
aX97+03!     Increment the 20mA Calibration by 3 step  
(This should be done while accurately measuring the current on the 4-20mA loop)  
(If the calibration is changed, always finish by sending aX97+00! to save it)

Set/Get the Lo Pressure (NOTE: This command could destroy the factory calibration)

aX98!           Get the value used to set the Low Pressure.  
aX98+0000.702! Set the Low Pressure to 0.702 psi (or kPa)  
                  (Perform a measure aM! before setting the low pressure - see note below)

Set/Get the Hi Pressure (NOTE: This command could destroy the factory calibration)

aX99!           Get the value used to set the High Pressure.  
aX99+0016.317! Set the High Pressure to 16.317 psi (or kPa)

The normal sequence of setting the Lo or Hi pressure would be :

(NOTE : Accurate pressure measuring equipment is required for this procedure)

1. Set the pressure to the Lo end of the scale and measure with accurate equipment
2. Perform a measure aM!
3. Perform a Get Pressure aX1! and then Get Data aD0!
4. If the pressure is different to that measured, perform a Set Lo (or Hi) Pressure
5. Repeat steps 2, 3 and 4 for Lo pressure until the returned value matches the value on the accurate measuring equipment.
6. Increase the pressure to the Hi end of the scale and repeat steps 1 to 5 for Hi pressure until the returned value matches the value on the accurate measuring equipment

### **XIII FIELD SETUP PROCEDURE**

1. Install the WL3100 Multi Output Dry Transducer as per mechanical installation procedures.
2. Press either of the two push buttons on the dry transducer to activate the LCD display.
3. Use the scroll button to scroll through the menu to “Set Level” and press the select button.
4. Use the select button to move the blinking cursor to the desired digit position (that needs to be changed), and use the scroll button to increment the value. When the rightmost digit is at the desired value press the select button to save the value. Press select button again to start with the left most digit again.
5. After the select button is used to save a value ie. Water level, date, etc., then pressing the scroll button will continue to step you through the menu as before.
6. The 4-20mA current loop will be continuously updated as the various parameters are changed.
7. The 4mA water level and the 20mA water level can be set separately. (See the menu tree structure in the LCD Operation section)
8. The various parameters may also be set by the SDI-12 “special command” set, via the SDI-12 Input connection, or the RS-232 connection if a laptop is available using a simple terminal emulation program whereby ASCII characters are typed (adhering to the SDI-12 Ver 1.2 protocol). **Note:** If the commands are being typed by the operator, the “Comms Type” must be set to RS232. In this mode the strict SDI-12 timing is ignored. An adapter cable needs to be used in this mode. See section III B.

**XIV POWER CONSUMPTION**

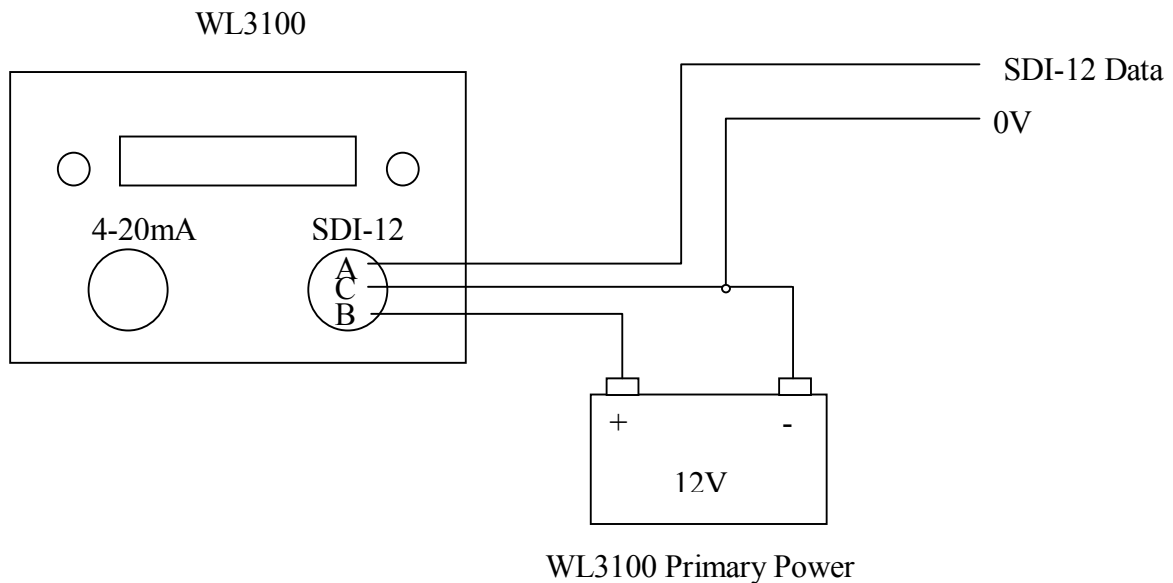
There are several different power supply options and the current consumption depends on which option is used. **NOTE :** Analog measurements cannot be taken unless SDI-12 power is available.

	<b>NO EXTERNAL POWER - NO ANALOG MEASUREMENT</b>	<b>SDI-12 12V POWER (ALLOWS ANALOG MEASUREMENT)</b>		<b>ACTIVE 4-20 mA LOOP CURRENT</b>
Mode	Internal Lithium Battery	Internal Lithium Battery	SDI-12 Power	
Asleep	3 to 30 F A	0	Stays awake when 12V is present <3mA continuous (not measuring)	4-20 mA
RS232 Comms	< 2 mA for 45 sec	0	17 mA for 1.5 sec (while measuring) < 3 mA for 45 sec (other commands)	4-20 mA
SDI-12 Comms	< 2 mA for 20 sec	0	17 mA for 1.5 sec (while measuring) <3 mA for 20 sec (other commands)	4-20 mA
LCD on	< 8 mA for 30 sec	0	<80 mA @ 12V (Backlighting)	4-20 mA

**XV WIRING DETAILS**

**Primary Power and SDI-12**

SDI-12 Connector (4 Pin Male)	Signal Description
A	SDI-12 Data
B	+12V DC (9.6V to 16V)
C	Gnd (0V DC)
D	Not Connected



**NOTE:** The +12V DC Power on this connector, powers the Analog Measurement Circuitry and the LCD Backlighting.

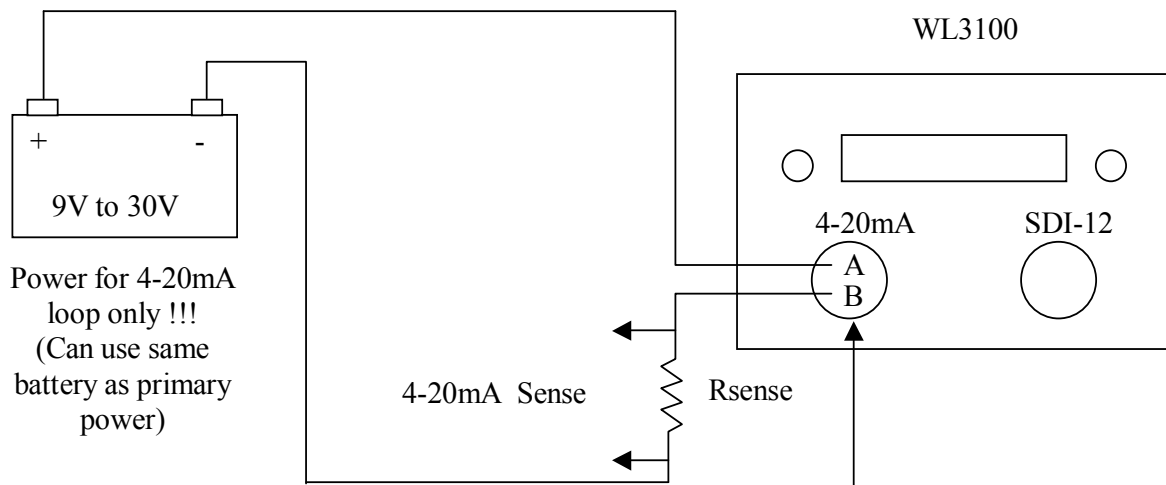
The easiest way to see if +12V is present is to press one of the WL3100 buttons and check that the backlighting comes on.

**Analog measurements cannot be taken unless this +12V DC power is present.**

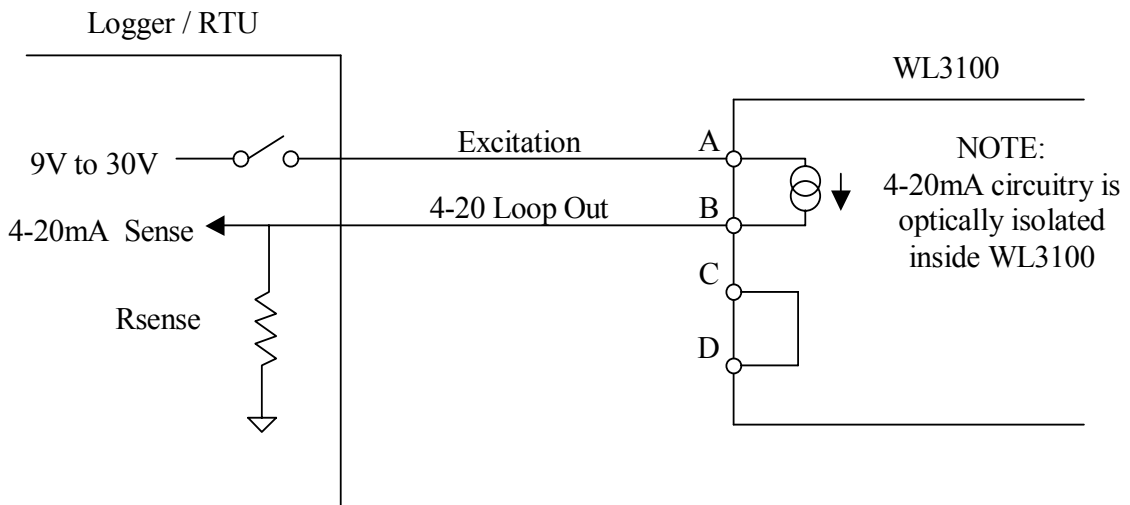
**4-20mA Interface**

4-20mA Connector (4 Pin Female)	Signal Description
A	Excitation
B	4-20mA loop out
C	Internally linked to D
D	Internally linked to C

**Typical 2 Wire 4-20mA Interface**



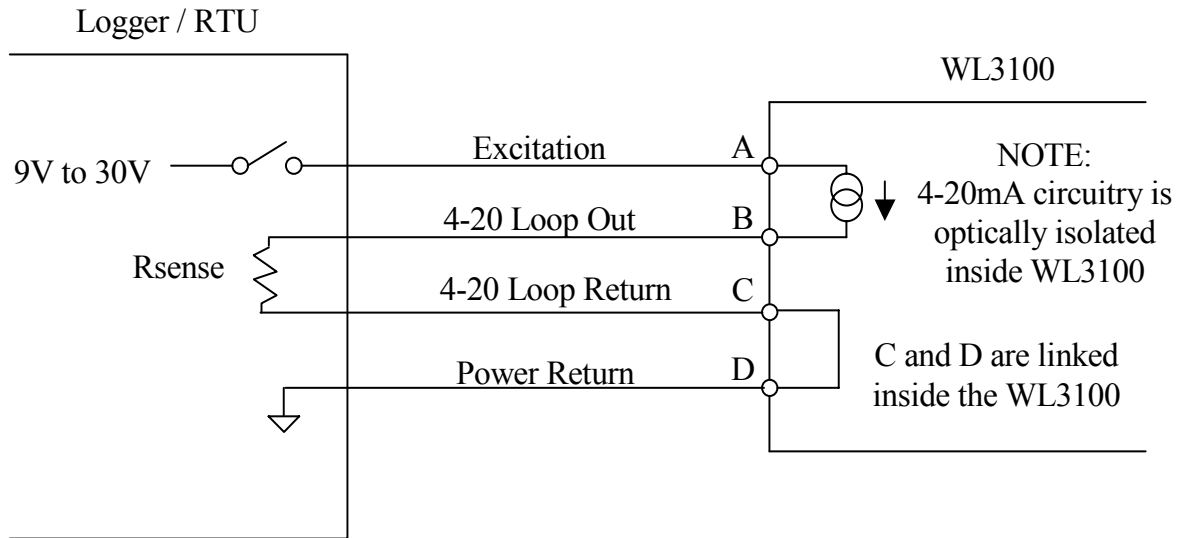
NOTE:  
4-20mA circuitry is  
optically isolated  
inside WL3100



NOTE:  
4-20mA circuitry is  
optically isolated  
inside WL3100

**2 Wire Interface**

Typical 4 Wire 4-20mA Interface



4 Wire Interface

**XVI APPENDIX A (FINE TUNING)**

The WL3100 Software Rev 5.5 has many enhancements to improve the performance. These include :

- Measures pressure in psi or kPa - factory calibrated.
- Displays water level in m or ft.
- User scaling factor to take into account local conditions such as gravity, water density, etc.
- Ability to calculate gravity, water density, air density and user factor.
- Factory calibration of the 4mA and 20mA current end points.
- Adjustable 4mA and 20mA water levels.
- Negative levels for the 4mA and 20mA levels - to match the site gauge readings.
- Display of the internally calculated water level offset + ability to zero this offset if required

The WL3100 measures gauge pressure and applies temperature compensation to correct for errors in the transducer. The measured pressure is converted to a water level through a “User Factor”. Adjustment of this “User Factor” allows for variations introduced by the equipment location in the world, as well as local conditions.

$$\text{Water Level} = \text{Pressure} \times \text{User Factor} + \text{Offset}$$

The User Factor is a function of gravity, water density, air density, equipment height above the orifice, and nominal water level.

(Note that gravity is itself a function of latitude and altitude)

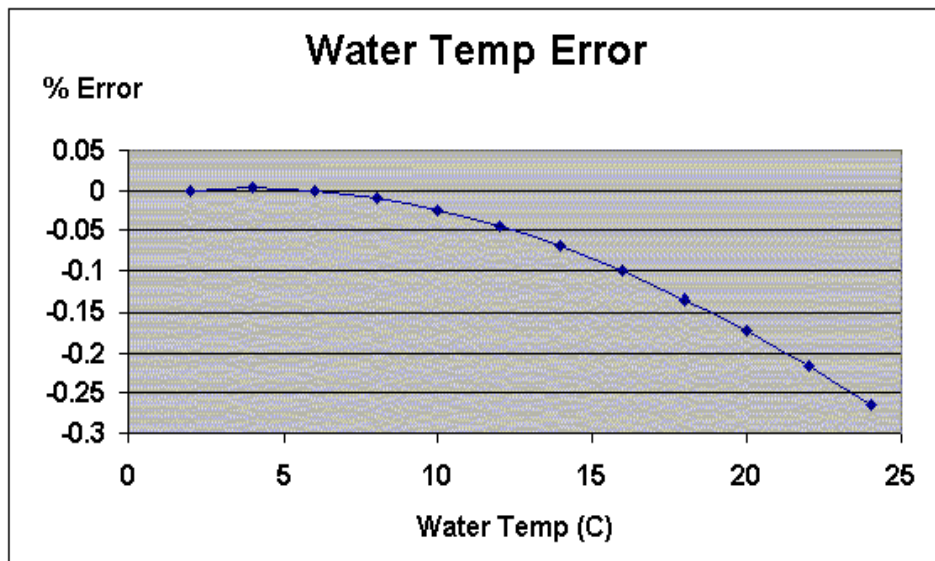
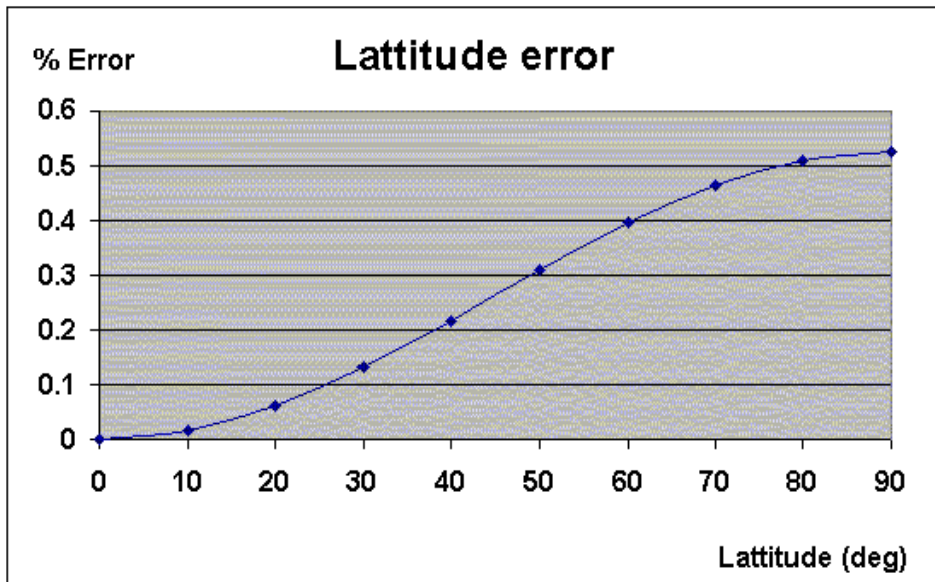
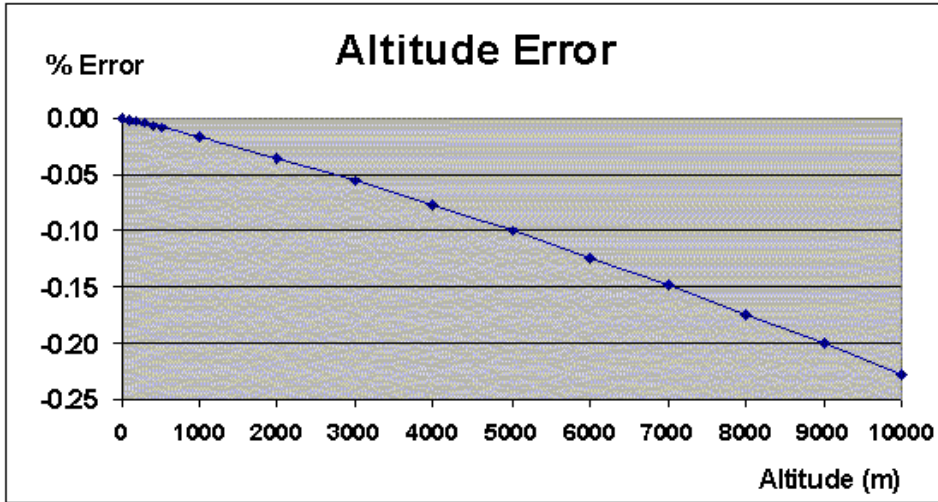
(Note that water density is a function of water temperature)

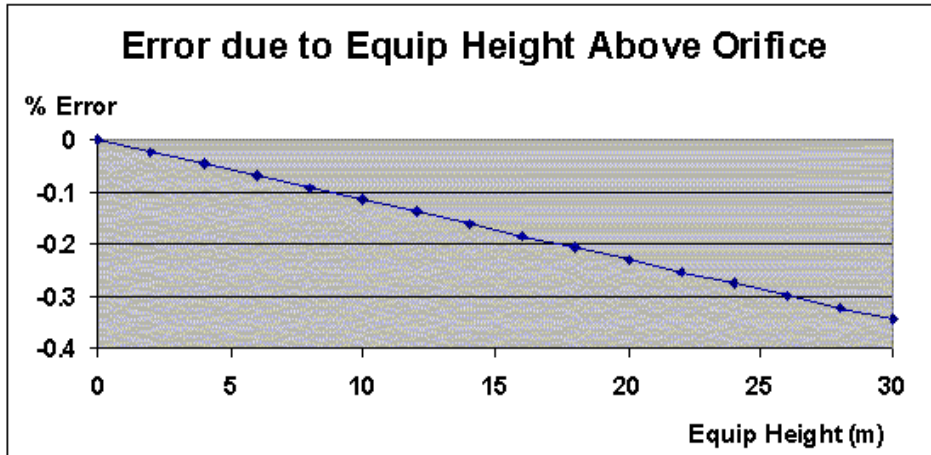
(Note that air density is a function of altitude)

The User Factor may be entered directly into the WL3100, or it can be calculated internally by entering the information listed above (for the WL3100A only). (See the Menu Tree in the LCD Screen section) Various combinations of information may be entered, depending on what is known. For example, the operator could enter the gravity directly - or alternatively the latitude and altitude could be entered and the WL3100A will calculate the gravity for you.

The WL3100 can be configured to measure pressure in psi or kPa - and it can be configured to measure the water height in m or ft. The User Factor is automatically corrected to account for any change in units.

Typical errors that are introduced by the above factors are demonstrated in the graphs on the following pages.





4-20mA

Level

The 4-20mA Level parameters in the enhanced WL3100 sets the water level required to make 4mA and 20mA appear on the 4-20mA interface. That is :

Water Level	4-20mA Current
4mA Level	4.000mA
20mA Level	20.000mA

These levels may be changed by the user by :

1. Use the scroll button to view the 4-20mA Level menu item.
2. Press and hold the select button for 5 seconds until Set 4mA Level appears.
3. Press the select button to make the first digit flash.
4. Press the scroll button to change it. Press select for the next digit etc.
5. When the 4mA Level is complete, press scroll to select the 20mA Level.
6. Repeat steps 3 and 4 to change the 20mA Levels.

#### Calculated Offset

When the “Set Level” function is performed (see the standard manual), the WL3100 calculates an offset between the measured water level and the desired water level. That is :

$$\text{Displayed (desired) Water Level} = \text{Measured Water Level} + \text{Calculated Offset}$$

This calculated offset can now be viewed in the “Calc Offset” menu. (This is for reference only, and serves no other purpose)

If the user wishes to force this offset to 0, then simply press and hold the select button for 5 seconds while “Calc Offset” is displayed.

**XVII APPENDIX B (SDI-12 to RS232 Interface)**

The following schematic is for an SDI-12 to RS232 adapter that can be used for any Hydrological Services SDI-12 transducer.

The adapter will allow a transducer to be connected to a PC, and will communicate on an RS232 port at 1200 Baud, 7 bits and even parity.

