



**Manual
Water Depth Probe
With MicroLogger
Model 8007**

Revision History

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1 Introduction

The UNIDATA Model 8007WDP is an instrument designed for measurement of water levels in bores, wells, sumps, tanks and any other application requiring long term, accurate, self-powered water level measurement and data collection. The WDP is available in 10m, 20m, 50m and 100m ranges.

The effective lifetime of the instrument is indefinite provided the instrument is not subject to abuse. The cable that is fitted to the instrument is a Kevlar reinforced cable with a polyurethane jacket – this cable has a lifetime that is limited only by the abuse (cuts, nicks, crimping, UV exposure) that the cable may be subject to. Either Unidata or our authorized Indian agent can replace the cable.

The instrument is capable of operating over 5 years without servicing. A service interval of 5 years for battery replacement is expected. However there may be situations where the instrument may be installed in heavily silted applications and the sensor may require cleansing at more frequent intervals.

Calibration and test certification is supplied with instrument. Every DWLR is calibrated by an automated computer controlled system that prints out the calibration certificate.

1.1 Overview and Features

- The instrument is designed for use in typical down-hole applications encountered in well and bore monitoring. The instrument materials have been selected for durability and the housing and cable have been designed to withstand arduous physical conditions.
- The instrument has been designed for ease of use. Installation of the instrument consists of lowering the instrument to the required depth and attachment of the cable grip to an appropriate point on the surface. Retrieving the data consists of attaching a notebook type PC or handheld PC to the communications connector located at the top of the cable and selecting 'Data Retrieve' on the supplied software package.
- All instrument materials in contact with water consist of chemically inert materials (stainless steel and polyurethane). These materials would not normally contaminate water unless extremely high temperatures or alkaline compounds were present in the water.
- All materials on the instrument are non corrosive (AISI 316 Stainless steel is a marine grade stainless steel and the cable and molding are polyurethane).
- The water level measurement technique is to use a pressure sensor to determine the water level using the hydrostatic measurement method. Temperature compensation algorithms are used in the down-hole WDP processor to compensate for different water temperatures.
- The water level measurement technique is to use a pressure sensor to determine the water level using the hydrostatic measurement method. Temperature compensation algorithms are used in the down-hole WDP processor to compensate for different water temperatures.
- The instrument is fitted with a vented connection cable with allows the inside of the down-hole instrument housing to compensate for atmospheric pressure.
- The instrument circuitry and processor firmware is calibrated at the factory and designed so that no settling time is required.

- The batteries in the WDP are replaceable. The down-hole housing must be brought to the surface and the housing disassembled using a standard screwdriver. The battery pack in the instrument is connected with a plug in connector. The WDP batteries are designed to allow the instrument to operate for 5 years continuously (at 1-hour measurement intervals) without failure. When the batteries are removed data can be lost however the instrument can be powered externally via the connection cable so that data integrity can be guaranteed while batteries are replaced. Unidata recommends that normally the data be retrieved prior to battery replacement.
- The instrument can be programmed to collect data at intervals of 5 seconds to 1 week in 5-second intervals.
- The recordings can be set to start at a specific time and hence can be set to start at the first instant of a preferred time. For example once a system has been configured and is ready to use at 14h27 the operator could instruct the system to start at 15h00 or 15h30 or any other time.

1.2 Applications

The instrument is intended for economically recording water level in water wells, water bores, artesian well systems, water tanks, water sumps and other water level related applications with high accuracy. It is designed for unattended operation with no external power requirements. The instrument is particularly useful for remote sites where data may be required to be collected for up to X months without power or regular attendance.

The instrument can be programmed to collect data at intervals of 5 seconds to 1 week in 5-second intervals.

1.3 Models

The WDP is available in 10m, 20m, 50m and 100m ranges. The model numbers are;

Model	Range
8007WDP/10	0 - 10 metres
8007WDP/20	0 - 20 metres
8007WDP/50	0 - 50 metres
8007WDP/100	0 - 100 metres

1.4 System components

Your WDP system consists of:

- Model 8007WDP Unidata Water Depth Probe and Data Logger including the specified cable length (special lengths are available to order) and weatherproof plug.
- Model 6603DT <<SQL>> Drying Tube and Desiccant.
- Model XXXX Stainless Steel Cable Grip.

- Model 6603D Adapter cable for connecting the WDP to a computer (9 - pin RS-232) and external battery (if required).
- WDP User's Manual (Manual XXXX).
- WDP Support Software (Model XXXX).



Figure 1 - WDP Components

The instrument needs the following accessories to be effectively deployed:

- A. Cable grip – supplied with each 8007WDP. The cable grip is shown in figure XXX. The cable grip is used to suspend the WDP in the bore or well with a minimum amount of vertical slip or movement.
- B. Connection cable – supplied with each 8007WDP. The connection cable is typically 1 metre longer than the specified WDP measurement range. For example a 20 metre WDP will be supplied with a 21 metre cable.

C. A PC package for data collection, data analysis, data logger programming, data logger maintenance. This is supplied with each WDP.

1.4.1 Optional Accessories

1.4.1.1 Handheld Data Retrieval System

A Data Retrieval System is optional. A portable rechargeable battery powered data retrieval system with software and connection cable allows easy data collection from many remote sites. The data retrieval system is supplied with Windows CE software for data retrieval, WDP battery checking, data display (graphic and tabular formats) and WDP initialization.



Figure 2 - HP Jornada Data Retrieval System

Model	Description
Model 6907C*	12V, 12AH Sealed Lead Acid Battery
Model 6904C*	7W Solar Recharge Panel and Mount
Model 6904D*	12W Solar Recharge Panel and Mount
Model 6603A/5 or 6603A/10	<<SQL>> Connector type 5 or 10 Metre Extension Cable - NON VENTED
Model 6603V/5 or 6603V/10	<<SQL>> Connector type 5 or 10 Metre Extension Cable - VENTED

* Not required for normal use (only for very high sampling rate applications).

1.5 Getting Started

Using the WDP is easy. There are 5 steps to follow.

1. Install the WDP Support Software onto your IBM PC compatible computer. (See section XX).
2. Create a Scheme (WDP program) for the measurement project to be undertaken or select the default scheme (See Section 5.).
3. Install the WDP Instrument on site (See section X).
4. Load (Initialize) the WDP instrument with a scheme (See section X).

And, some time later...

5. Unload (Retrieve) the recorded data from the WDP instrument and process the results. (See section X).

2 Operating Principles

The WDP measures water depth and temperature each scan interval (5 to 600 seconds) and logs the data to whatever requirements you specify, (i.e. 5 seconds to 1 week in 5-second intervals). The measured data are logged and this data is scaled and refined during the software presentation and processing.

MicroLogger - The WDP contains a 128K memory data logger which controls the instrument operation, performs the mathematical corrections for temperature and sensor mechanics and logs the results of its measurements.

- Water depth at the end of the WDP is measured hydrostatically using a Keller AG pressure sensor that is vented to atmospheric pressure.
- Water temperature at the end of the WDP is measured and is used to compensate the Keller AG pressure sensor readings.
- Battery voltage is measured to allow the WDP to stop operating if supply voltage is below certain limits. The operator is also notified of low battery levels.

2.1 Micro Logger Operation

The MicroLogger switches on the WDP instrument once per scan. The scan rate is defined by the user, (see Scheme Editor, section XX). Each time the WDP switched on, it performs the following tasks:

1. Measurement: Each scan interval the MicroLogger switches on the WDP to the pressure sensor output and current temperature. These signals are stored in the MicroLogger memory.
2. Analysis: The MicroLogger then performs data processing and analysis of the pressure sensor readings. The MicroLogger uses the pre-programmed calibration values for a 5 point polynomial curve and the temperature to determine what depth the WDP is reading.
3. Communication: If a computer is connected to the WDP instrument, the MicroLogger established communications via the RS-232 channel. An SDI-12 interrogation sequence will be initialized at this time. Note: RS-232 and SDI-12 communications will occur simultaneously with other operations 1,2 and 4.
4. Data Logging: When the scan occurs at a log interval (from 5 seconds to 1 week) the MicroLogger records the measurement values into it's memory buffer. Here the data remains until the WDP is unloaded into a computer via the RS-232 interface.

2.2 How the WDP Measures Water Depth

The WDP is fitted with a Keller pressure sensor manufactured by Keller AG of Winterthur, Switzerland. The type is a Keller series 9 model PR9S/80567.2-0.5. This pressure sensor is very finely manufactured item but has several sources of error that Unidata have compensated for in the design of the WDP. The two sources of error are temperature errors and mechanical errors. Mathematical algorithms in the MicroLogger software and a precise automated calibration procedure at the factory compensate for both of these. Calibration of the WDP relies on digital modeling of 2,500 pressure and

temperature measurements fitted to a 5-pole polynomial located in the data logger firmware. 50 temperature points are used to read 50 pressure points that then determine the results of a mathematical calibration algorithm. The entire process is automated and is performed on an end to end basis (i.e. on a fully assembled unit connected via the PC data connection) to reduce any possibility of introduced errors. Digital modeling means that each sensor is checked and is compensated not only for temperature variations but also for non-linearity's, hysteresis and other source of error.

The pressure sensor measure water depth uses the water column pressure principle. A column of water exerts a pressure at any depth that is proportional to the depth. The MicroLogger software compensates for the effect on pressure of differing densities of water and a specific SG (density) can be set into the WDP software (See Section XXX).

2.3 Factors Affecting Data Accuracy

Factors that can effect Data Accuracy include:

1. Cable stretch, (elongation). This causes a change in the water depth reading as the instrument moves within the water column. The effect of cable stretch is related to temperature changes in the cable and aging of the cable. Unidata minimizes this by having a Kevlar strength member inserted into the cable - the strength member is tied off onto the instrument. Kevlar has very good strength, aging and temperature properties and assists in minimizing this effect.
2. Cable grip slippage and movement. The effect of cable grip slippage or movement is similar to the above. Installation of the cable grip should be made in such a way that the cable grip is vertical (not twisted) and no other cable grip should be substituted. If the cable slip is suspected of slippage try to eliminate possible causes - these could be;
 - A. Water and oil contamination of the cable jacket.
 - B. Damage to the polyurethane cable sheath.
 - C. Cable grip damage.
 - C. Excessive water surge in the water column causing continual slackening and tightening of the cable grip.
3. Water surge. If the WDP is installed in a small bore well and the well has large surges in water level it is possible for the WDP to 'piston' in the bore as the level of the water changes rapidly.

3 Specifications

1. Overall Accuracy: 0.1% Full Scale. This includes the pressure sensor and data logger. As the WDP uses digital communications there is no effect of the cable on system accuracy.
2. Reproducibility: 0.05%.
3. Operating Temperature: 0 to 50 degrees C.
3. Temperature coefficient: The system is designed for temperature compensation.
4. Long term stability: Not known (check with RG).

5. Overload Pressure - More than 3 times full scale range. Calibration will be effected only when this is exceeded.

6. Burst Pressure - > 300 metres water depth.

7. Settling time: Within seconds of immersion.

8. Over-voltage protection: Zener diode barrier protection is fitted to all signal and power lines. In addition the signals lines have 1.5kV ESD protection.

9. Membrane Material: Stainless Steel (316)

3.1 Datalogger

Resolution of measurement: 16 bits.

Recording resolution: 0.00033 meters (.33 mm).

Built in clock: Accurate to +/- 10 seconds per month.

The hardware, firmware, software recorded data will be Y2K compliant.

Measuring interval: Measuring interval will be preset at 6 hours but is programmable using the DRS from 5 seconds to 1 week in 5-second intervals.

The measuring interval in user adjustable. The recordings can be set to start at a specific time and hence can be set to start at the first instant of a preferred time. For example once a system has been configured and is ready to use at 14h27 the operator could instruct the system to start at 15h00 or 15h30 or any other time.

Recording capacity

- 60,000 records can be recorded in normal resolution. 30,000 records can be recorded in high resolution.
- A site identification tag or number can be added to the WDP and cannot be modified after data retrieval.
- The memory can be set to roll over (endless loop) or recording can be stopped when the logger is full.
- A change of logger program or logger settings requires a data retrieval first – in this case the data is protected.
- Password protection is optional for the DRS and this prevents accidental erasure of the memory.

Error marking: If the sensor fails the logger normally records a negative depth reading which is a clear indication of failure.

Power Supply

- 'C' size 3.4-volt Lithium battery (x 2).
- The batteries are located in the down-hole instrument housing.
- Unidata supplies these batteries in a special assembly with a connection harness. Competent technicians can replace batteries.

Data Offload Power Use: TBA

Memory type: Static RAM (volatile) with Lithium battery backup. The memory is backed up by the main batteries that have a 5-year life. Retrieval of data must occur before replacement of main batteries.

Communication Interface

- The WDP uses RS-232C for the PC to WDP connection. An optional isolation interface for additional protection for the DRS is available.
- Data Rate (Baud Rate): 300 to 78,600 Bps (bits per second).

The communications protocol used by the Unidata WDP and Unidata Starlog software packages has the following features:

- A. Bi-directional communication
- B. Checksum error checking feature for reception of data from the WDP and transmission of commands to the WDP.
- C. Complete control of all the WDP features including data retrieval, data commands, WDP programming requests etc.
- D. The WDP processor will not accept incorrect commands (i.e. a command that has an erroneous checksum) and the Starlog data retrieval software will not accept data from the WDP that is erroneous (i.e. a data stream that has an incorrect checksum).

The communication system used by the WDP is suitable for the cable length supplied with the WDP. The total maximum cable length is limited to the standard for RS-232C communications (500 feet).

All data packets sent using the Unidata WDP communications protocol include a checksum but no CRC as these is not necessary due to the nature of the protocol and data retrieval software.

3.2 Enclosures

- The data-logger and sensor are enclosed in a corrosion proof 316 stainless steel enclosure.
- All material for this enclosure and all combinations are corrosion proof.
- The WDP is designed for continuous submersion.

3.2.1 Dimension

Diameter: 40 mm.
Length: 600 mm.

3.2.2 Material:

AISI 316 stainless steel.

3.2.3 Mass:

2.1 kg. The cable supplied is flexible within the specified temperature range.

3.2.4 Operating temperature:

0 to 50 degree C.

3.2.5 Humidity:

0 to 100% R.H.

3.2.6 Ingress Protection

IP68 type designed for permanent solution for > 100m.

3.2.7 Above water parts

The cable terminal is provided with a cap that provides IP65 protection and the operating temperature is 0 to 50 deg C with 100% humidity.

3.2.8 Cable entry

The cable entry is molded urethane compound with an expected lifetime in excess of 10 years.

3.3 Cable

- The suspension/connection/vent cable is fitted with a moveable flexible cable grip ("Kellum's" type). This can be attached to a bolt or other fastener.
- The vent tube for the above water section is fitted with a moisture blockage system consisting of a silica gel filled breather apparatus.

The suspension/connection/vent cable has:

- Polyurethane black colour jacket with very good abrasion resistance properties (80A hardness).
- Kevlar strength members
- An incorporated venting tube
- A moisture blocking system for the vent tube termination. The desiccant is field replaceable and can be re-activated by cooking it in a microwave oven.
- The cable is flexible.
- Shielding (90% screen) is fitted to the cable.
- The electrical wires are of sufficient cross section (i.e. resistance) to allow total of 500 feet (150 meters) with reliable data communication.
- The electrical wires are polypropylene insulated.

3.4 Factory Settings

3.5 Battery Duration Table

3.6 Memory Duration Table

4 Installation

4.1 Locating the WDP

- 4.2 Power Considerations
- 4.3 Signal Cable and Connections
 - 4.3.1 Extending the Signal Cable
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