TURO T-617 CTD/pH

WATER QUALITY ANALYSER

OPERATOR'S MANUAL

T U R O T E C H N O L O G Y P T Y L T D

Revision A2

CONTENTS

1. Introduction

The T-617 Water Quality Analyser is a robust multi-parameter field instrument which can be used for real time water quality measurements or for remote operation using a built in data logger.

1.1 General Description

The instrument consists of a multi-sensor probe and a reader unit which can both store and display the data. The probe and reader unit have been designed to be compact, light weight and easy to use. Data is transferred to the reader unit using serial communications giving reliable, interference free measurements. The reader unit controls the operation of the instrument, provides easy access to the data, control, memory and calibration functions. The reader unit contains a real time clock and all stored data includes the date and time of measurement. Both stored data and calibration information can be easily down loaded to a computer using the Turo data transfer programs.

The T-617 comes with an auxiliary battery lead (optional) for connecting the instrument to an external power supply during extended periods of remote logging and a storage container to protect the sensors while the instrument is in storage.

1.2 Specifications

1.2.1 Reader Unit:

Display:	Two lines 16 character alphanumeric LCD.
Memory:	Remote logging - 3171 samples. Real time (Using the STORE key) - 890 samples. Data Tag information for STORE samples - 50 tags. Each one of these samples represents a suite of data of each parameter (conductivity high, conductivity low, salinity, depth, temperature and pH). All samples include date and time. Memory is backed up by lithium battery to guard against main battery failure.
Sample Rate:	1 per minute to 1 per day in Standard Logging Mode 1 per second in Fast Logging Mode Display update, 2 seconds
Communications:	Baud rate 4800, 8 data bits, 0 parity, 2 stop bits.
Power:	Battery pack containing 8 "C" size cells. Memory backup voltage supplied by ½ AA lithium cell.
Case:	Impact resistance polycarbonate; waterproof display, keypad, connectors and case.
Dimensions:	Reader/Logger Unit 130 mm x 95 mm x 190 mm Probe (excluding cable) 280 mm long, 47 mm diameter
Weight:	Reader/Logger Unit 1.6 kg Probe (excluding cable) 500 gm

1.2.2 Sensors

Temperature

Range:	-2 - 50ºC
Accuracy:	±0.05ºC
Resolution:	0.01ºC
Type:	pt 100 platinum element

Conductivity

High Range:	0 - 80 ms/cm
Accuracy:	±0.05 ms/cm
Resolution:	0.02 ms/cm
Low Range:	0-8000 us/cm
Accuracy:	±5 us/cm
Resolution:	3 us/cm
Type:	Four electrode cell

Salinity

Range:	0 - 60 ppt
Accuracy:	±0.05 ppt
Resolution:	0.02 ppt
Type:	See Appendix 1 - Conversions Used

Depth

Range:	0 - 100 m or 0 - 150 m
Accuracy:	±0.5% of full scale
Resolution:	0.1 m
Type:	Dual active silicone strain gauge
Cable length:	3 m or 10 m. Other lengths made to order.
Dimensions:	47 mm diameter, 280 mm long

pH (optional)

Range:	0 - 14
Accuracy:	±0.03
Resolution:	0.01
Type:	Combination silver/silver chloride type with sintered Teflon* junction

1.3 Description of Reader Unit

The reader unit is housed in a tough, durable, high impact polycarbonate case with a keypad and alpha-numeric display mounted on the front panel. The side of the case has three connectors. The top connector is used for data output, the second for connecting an external power supply and the third is the sensor connector. Each connector is provided with a protective cap which screws over the connector. The connectors also have a polarising pin so that incorrect connection cannot be made. Inside the reader unit a CPU controls the operation of the instrument, memory stores data and 8 C size alkaline batteries power the instrument.

1.3.1 Connector Pins

The connector pins on the reader unit connectors are numbered in clockwise order from the polarising pin (see figure 1). The following table lists the purpose of each pin on the connectors.

	Communications	**Auxiliary Power**	**Sensor**
Pin 1	Ground	Negative	Ground
Pin 2	RS232 out	Positive	Data
Pin 3	RS232 in	not used	+12V

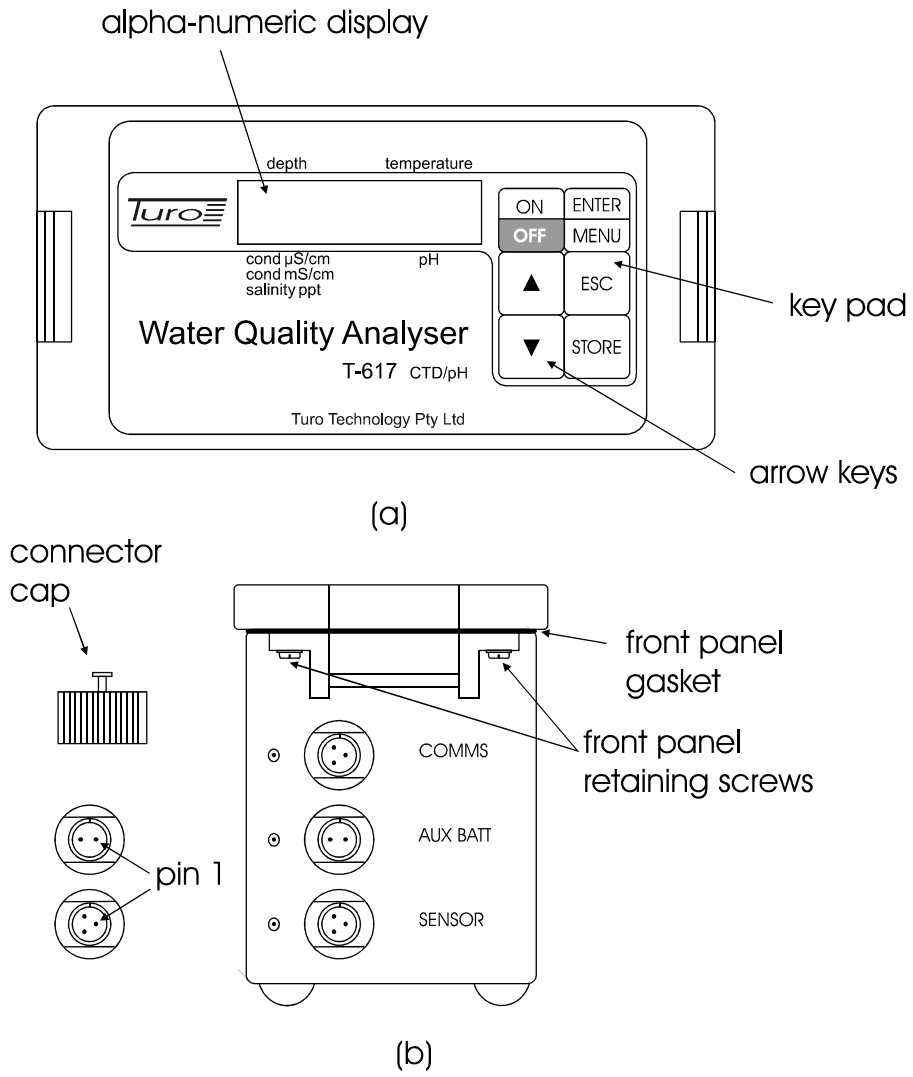


Figure 1: Reader unit for the T-617 a) Top view showing key pad and alphanumeric display b) End view showing connectors.

1.4 Description of Probe

The probe assembly consists of sensor, cable and connectors. The body of the probe is made of PVC with a PVC sensor guard. The interface cable is permanently connected to the probe body to eliminate the need for underwater connectors. In the event of the cable being cut, the probe has a waterproof seal between the cable connection and the electronics package. At the other end of the cable is a corrosion and water resistant connector for attaching the assembly to the reader unit.

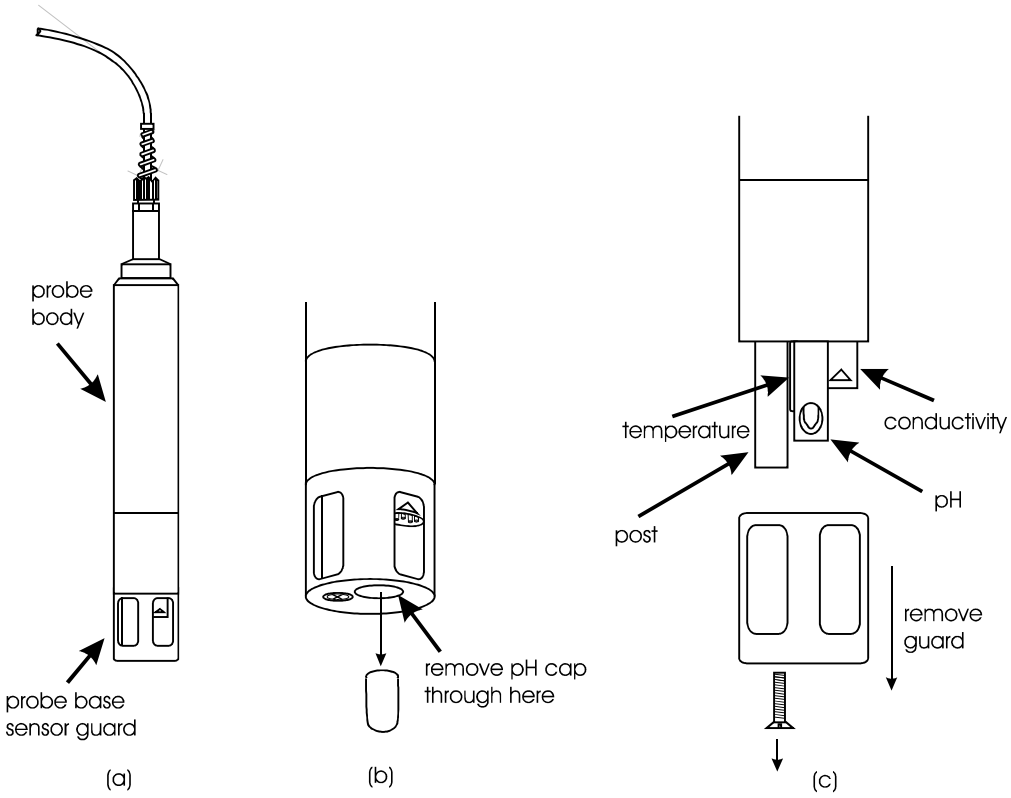


Figure 2: a) Complete probe assembly. b) Removal of the pH cap is through the hole in the bottom of the sensor guard. c) Access to the sensors requires the sensor guard to be removed by undoing the retaining screw.

The conductivity and pH sensors can be removed for servicing. However, the whole unit must be **thoroughly dry** before these sensors are removed. A cotton bud can be used to dry the spaces in between the sensors.

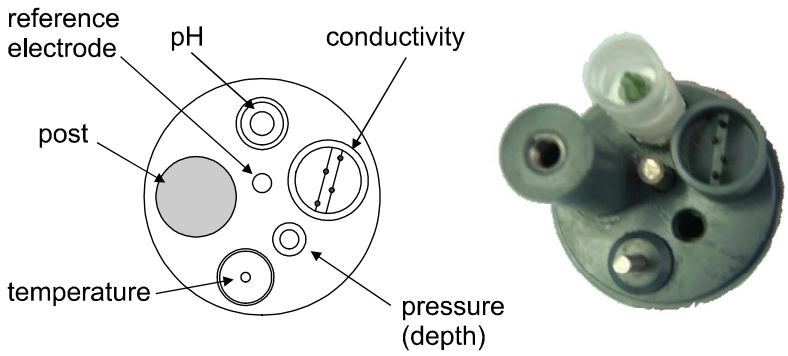


Figure 3: End view of probe (without protective sensor guard) showing position of sensors.

1.4.1 Temperature Sensor

The temperature sensor consists of a pt 100 platinum element, housed in a stainless steel sheath for robustness and corrosion resistance. The temperature sensor requires little maintenance however the temperature measurement is used for calculating the temperature correction of the conductivity sensor and so it is important that the temperature sensor is properly calibrated.

1.4.2 Conductivity Sensor

The conductivity is measured using a 4 electrode bridge. The four electrode system uses automatic compensation to overcome any build up of contamination on the electrodes. The electrodes are made from fine platinum and are coated with platinum black to enhance the long term stability and sensitivity of the sensor. The coating should last for a long period of time if it is not mechanically removed, however, the coating can be replaced using the optional platiniser or by returning the sensor to TuroTechnology Pty Ltd.

1.4.3 pH Sensor

The pH sensor consists of a glass pH electrode and an external reference electrode. The sensor only requires maintenance if there is a build up of contamination on the electrodes and/or the reference becomes blocked or depleted of electrolyte.

2. Assembly

The T-617 comes already assembled. The only construction required is to connect the probe assembly to the reader unit and, if necessary, connecting the external power supply.

2.1 Connecting the Probe Assembly

To attach the probe assembly, first unscrew the knurled connector cap from the SENSOR connector of the reader unit. The connector cap is attached to the reader unit by a chain so that it can be replaced whenever the probe assembly is disconnected. To connect the probe assembly, align the locating pin on the reader unit with the slot on the cable connector and push the cable connector into the reader unit sensor connector then screw home the retaining ring.

2.2 Connecting an External Power Supply

For extended remote logging, the reader unit batteries can be supplemented by connecting the unit to an external 12 Volt dc power supply such as a car battery or solar panel. To connect the external power, first attach the external battery lead to the reader unit. To do this, unscrew the knurled connector cap from the AUX BATT connector of the reader unit. align the locating pin on the reader unit with the slot on the cable connector and push the cable connector into the reader unit connector then screw home the retaining ring. The connector cap is attached to the reader unit by a chain so that it can be replaced whenever the external power is disconnected. Connect the red terminal clamp to the positive terminal of your power supply and the black clamp to the negative terminal.

3. Operation

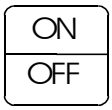
The T-617 comes already assembled. The only construction required is to connect the probe assembly to the reader unit and, if necessary, connecting the external power supply.

If the pH sensor has a cap over it, the cap should be removed prior to operation. The cap should be carefully PULLED OFF, DO NOT ATTEMPT TO UNSCREW IT, **see section 6 for IMPORTANT INFORMATION.**

3.1 Operating Instructions

The following is provided as a quick reference for operation of the instrument. To gain maximum performance and reliability from the T-617, make sure that you read and understand the entire user manual before operating the instrument.

The instrument is switched on or off by pressing the center of the ON/OFF key.



When the unit is switched on, the display will briefly show the serial number of the instrument and the version number of the software loaded in the reader unit. If the probe is connected, the display will then automatically begin to show the value of readings from the probe. The parameters displayed will be temperature, depth and if the optional pH sensor is fitted, then the display will also show the pH reading. Also one of the conductivity related parameters (high range conductivity or low range conductivity or salinity) will be displayed. Press the **arrow** keys to scroll the display through these conductivity related parameters.

From here, the main menu is entered by pressing the **ENTER/MENU** key. If the sensor is not connected, the main menu is entered automatically when the instrument is turned on. To scroll through the main menu options, press the **arrow** keys. To select a menu item, press the **ENTER** key. You can back out of any point in the menu without changing the current settings by pressing the **ESC** key.

The menu options are as follows:

	Option	
1.	SET CLOCK	Change current time and date
2.	CHECK BATTERY	Display Battery Voltage
3.	LCD CONTRAST	Alter display contrast
4.	PANEL LIGHT	Switch display light on or off
5.	CALIBRATION	Calibrate the sensors
6.	PRINT CONSTS	Down load calibration constants to a computer
7.	STORE DAT OUT	Down load store data to computer
8.	CLR STORE MEMORY	Clear data entered using the **STORE** key
9.	SET LOGGER	Enter a logging program
10.	SW LOGG OFF	Halts Logging to memory
11.	LOGG DAT OUT	Down load logged data to computer
12.	DAT PORT OFF	Displayed data is output thru COMMS Port
13.	PRBE S/N	If available, serial number of probe is displayed.
14.	DISP T= °C OR °F	
15.	DISP D= Metres or DISP D= ft/ins	
16.	PWR SAVE: ON/OFF	

Notice that main menu options 1, 5 and 9 require that all data be cleared from memory. You will be asked for conformation before memory is cleared.

The reader unit can be turned off without losing any of the instrument settings. If the logger is activated, the unit will continue to record measurements even if the reader unit is turned off.

To check the date and time with the display in real time, press the **ENTER** key. The date and time will appear on the LCD for approximately 3 seconds, then it will return to the original display.

3.2 Display Contrast

When the instrument is used in the field, variations in ambient light and temperature may make the display difficult to read. This can be remedied by adjusting the display contrast.

To make this adjustment press one of the arrow keys to enter the main menu and continue to press the arrow keys until the message 3) LCD CONTRAST appears then press enter. Now press the up or down **arrow** keys until the display is easier to read then press **ENTER** or **ESC** to return to the main menu.

3.3 Using the Reader Unit Memory

The reader unit has two separate memories: the store memory and the logger memory. The logger memory can hold up to 2135 readings and the store memory can hold up to 600 readings. Once stored, the data can then be down loaded into a computer via the Turo software or printed at a later date.

The store memory is used to hold spot measurements. To store a reading while in the field simply press the **STORE** key. The data will be down loaded in the order in which it is stored so keep a record of the site at which each measurement was made so that the data can be easily analysed.

The store memory has a site tagging facility that allows the user to tag each site with 16 character alpha- numeric name.

To tag data hold down the store key, then use arrow keys to call up the appropriate flashing letter or number. When this is achieved press ENTER to go to the next desired letter and so on. If the operator does not require the use of all the characters, use the arrow keys to find the blank and press ENTER until the flashing space bar has come to the end of the line. All data stored will be under this header tag and will be seen when displayed or

printed. There are 50 tags available to the user and each tag includes Date and Time.

The T-617 can also be programmed to take measurements at regular intervals and store the results in the logger memory.

The fastest sample rate in Standard Logging Mode is 1 per minute.

In Fast Logging Mode the sample rate is 1 per second.

3.3.1 Programming the Reader Unit

To program the logger for a measurement routine, perform the following steps:

1. Enter the main menu, select 9 SET LOGGER and press **ENTER**. If the logger memory is empty and the logger disarmed, the message -SET START TIME- will be displayed with a date displayed underneath.

   If there is data in the logger memory, the message CLEAR LOGGER will appear on the display. Press **ENTER** to clear the memory or **ESC** to return to the main menu. If there is a current logging routine, the message DISARM LOGGER will appear. Press **ENTER** to reprogram the logger or **ESC** to return to the main menu.

   If the logger memory is empty and the logger disarmed (see 3. below), the message –FAST LOG (Y) **ENT** or (N) **ESC** appears. If **ENTER** is pressed the unit will immediately commence to log at approximately once every second. This is the Fast Logging Mode. If **ESC** is pressed the message SET START TIME will be displayed with a date displayed underneath. This will set up the Standard Logging Mode.

2. The first step in programming the logger is to set the date and time at which you wish logging to commence. When you first start the SET LOGGER routine, a date will be displayed with the day shown as a flashing number. Use the **arrow** keys to change the day and then press **ENTER**. The month will now begin to flash. Use the **arrow** keys to set the appropriate month and press **ENTER** then, in a similar fashion, set the desired year and press **ENTER**. The display

will then show the time at which logging is to commence and the number corresponding to the hour will be flashing. The time is displayed in 24 hour time in the format HH:MM where HH is the hour and MM is the minute. Use the **arrow** keys to set the required hour and then press **ENTER**, set the required minutes, and press **ENTER** again. The message -SET STOP TIME- will now be displayed. This is the date and time at which logging will stop and is set in the same manner as the start time.

3. When the start and stop times have been set, you will be asked to set the sample rate. The sample rate is changed by again pressing the **arrow** keys to scroll through the available choices. When the desired sample rate is displayed press **ENTER**. The message CLEAR LOGGER MEM? Y)-ENTER, (N)- ESC. If the **ENTER** key (CLEAR LOGGER MEM) is pressed existing data will be cleared and new data will be stored at the beginning of memory. If **ESC** is pressed the existing logged data will remain and new data will be stored contiguously from the last data point. The message LOGGER ARMED will be briefly displayed and the instrument then automatically returns to the main menu.

The instrument is now programmed and can be switched off. The logger will automatically switch on at the programmed logging times. When the sample has been taken, the instrument will automatically shut down again until the next sample time has arrived.

To halt the logging process, select 10) SW LOGGER OFF from the main menu. You will then see the message CONFIRM (ENT/ESC) press **ESC** to continue logging or **ENTER** to stop the logging routine.

3.3.2 Clearing Reader Unit Memory.

To erase data from the memory, enter the main menu and, using the **arrow** keys, scroll to 8 CLEAR MEMORY then press **ENTER**. Use the **arrow** keys to select the store memory or the logger memory and press **ENTER**. You are then asked to confirm that you really want to delete the data in memory, if so press **ENTER** or else press **ESC**.

3.4 Down Loading Data

Data stored in the T-617 can be down loaded to a computer and then stored, graphed or printed out using most popular applications. The data can also be sent directly to a printer. When the data is down loaded, it includes a header, as shown in figures 4 and 5 below, indicating whether the data is from the logger or store memory and is preceded by the calibration coefficients.

All the parameters recorded are averaged over 10. This enhances the quality of the data by smoothing out any unwanted transients.

```
AUTO LOGGED DATA
TURO MODEL T-617
SERIAL NUMBER: 9999

CAL DATE/TIME    SENSOR              OFFSET         SLOPE
-------------------------------------------------------------
24/01/03 08:11   DEPTH               -14.000         50.800
24/01/03 08:10   TEMPERATURE        2534.000        170.000
24/01/03 08:40   SAL/COND MSCM        13.000      40240.156
24/01/03 08:10   COND USCM           -15.000          3.932
24/01/03 08:11   PH                 5837.338       -601.505
-------------------------------------------------------------

SAM     DATE     TIME    DEPTH    TEMP  COND  COND    SAL    PH
NUM   dd/mm/yy hh:mm:ss    M       C    uscm  mscm    ppt    pH
-----------------------------------------------------------------
   1  24/01/03 08:43:15   -0.02   14.98  0.00     0   0.00  10.00
   2  24/01/03 08:43:18   -0.02   14.98  0.00     0   0.00  10.00
   3  24/01/03 08:43:21   -0.02   14.98  0.00     0   0.00  10.00
   4  24/01/03 08:43:24   -0.02   14.98  0.00     0   0.00  10.00
   5  24/01/03 08:43:27   -0.02   14.99  0.00     0   0.00  10.00
-----------------------------------------------------------------
```

Figure 4: Sample of Logged Data output from the T-617 .

```
STORE KEY DATA
TURO MODEL T-617
SERIAL NUMBER: 9999

CAL DATE/TIME    SENSOR              OFFSET         SLOPE
-------------------------------------------------------------
24/01/03 08:11   DEPTH               -14.000         50.800
24/01/03 08:10   TEMPERATURE        2534.000        170.000
24/01/03 08:40   SAL/COND MSCM        13.000      40240.156
24/01/03 08:10   COND USCM           -15.000          3.932
24/01/03 08:11   PH                 5837.338       -601.505
-------------------------------------------------------------



24/01/03 09:02:48 TAG: TAG NUMBER 1

SAM      DATE      TIME     DEPTH     TEMP   COND   COND     SAL     PH
NUM    dd/mm/yy hh:mm:ss     M         C     uscm   mscm     ppt     pH
-----------------------------------------------------------------------
   1  24/01/03 09:02:53     0.00    14.99   0.02      0    0.01   10.00
   2  24/01/03 09:02:58     0.00    14.99   0.02      0    0.01   10.00
   3  24/01/03 09:03:00     0.00    14.99   0.02      0    0.01   10.00
   4  24/01/03 09:03:02     0.00    14.99   0.02      0    0.01   10.00
-----------------------------------------------------------------------


24/01/03 09:25:48 TAG: TAG NUMBER 2

SAM      DATE      TIME     DEPTH     TEMP   COND   COND     SAL     PH
NUM    dd/mm/yy hh:mm:ss     M         C     uscm   mscm     ppt     pH
-----------------------------------------------------------------------
   1  24/01/03 09:15:55     1.96    19.60   336    0.31    0.15    6.32
   2  24/01/03 09:15:56     1.96    19.60   336    0.31    0.15    6.32
   3  24/01/03 09:15:58     1.96    19.60   336    0.31    0.15    6.32
   4  24/01/03 09:15:59     1.96    19.60   336    0.31    0.15    6.32
-----------------------------------------------------------------------
```

Figure 5: Sample of Store Data output from the T-617 with tags (in this case the tag data entered by the operator is “TAG NUMBER 1”, “TAG NUMBER 2”, etc).

In order to down load the data stored in memory to a computer, you will need a copy of the Turo Data Transfer program or TUROGraph and the purpose built communications cable. To transfer the data by following operations:

1. Connect the 3 pin connector of the communications cable to the COMMS connector of the reader unit, (see figure 1).

Connect the other end of the cable to an RS232 (serial communications) port on your computer.

2. Start your data transfer program and prepare it for receiving data.

3. Switch on the T-617 and select 7) STORE DAT OUT to down load data from the store memory or select 11) LOGGD DAT OUT to down load data from the logger memory or 6) PRINT CONSTS to down load the calibration constants, then press **ENTER**. The unit will then display the message DOWNLOADING DATA and down load data to your computer. When the operation is finished, the instrument will automatically return to the main menu.

3.5 Data Port OFF/ON

When Data Port is ON, displayed data is outputted from the serial communications port. This can be directly linked to a computer where data can be displayed and/or stored onto a disk. The unit also enables:

a) storage of data directly into its memory while outputting data to a P.C. This is accomplished by:

b) Switching the unit ON, then going to the set logging routine. Set up the desired stop/start times and sample rates. Then go to main menu and switch Data Port ON. Do not switch the unit OFF. The unit will immediately transmit data to the serial port and start logging when the start time is reached.

c) Output displayed data only, this is accomplished by:

Switching the unit ON, then go to Data Port ON/OFF on the main menu and press **ENTER**.

3.6 Display Temperature

The operator has the choice of displaying temperature in Centigrade or Fahrenheit. Go to the main menu and using the arrow keys go to 14) DISP T=C or F. Use the ENTER key to change from one unit to the other.

3.7 Display Depth

The operator has the choice of displaying depth in meters or feet. Go to the main menu and using the arrow keys go to 15) DISP D= Meters or Feet/ins. Use the ENTER key to change from one unit to the other.

3.8 Power Save

The operator has the option of using the power save function to conserve battery power. If the unit is inadvertently left ON the unit will power down after approximately ½ hour conserving the battery. The unit will power up when logging ie taking a sample or the operator switches the unit ON. Using any function within the ½ hour will reset the power up time. If the power save is switched OFF, the unit will stay ON all the time. This function is useful when continuous data is required from the serial port.

4. Calibration

In order to ensure the accuracy of the T-617, the instrument needs to be calibrated on a regular basis as well as after any maintenance has been performed on the probe. The frequency at which calibration is required will depend on the specific application for which the instrument is to be used. The optimum time between calibrations can be established by regularly checking the performance of the instrument in standard solutions. If the T-617 is kept well maintained and calibrated on a regular basis, a single point calibration is sufficient to keep the instrument performing to specification. However, two point calibrations whenever a sensor has had any maintenance.

The calibration procedures require that the probe be immersed in standard solutions. The probe storage container which is supplied with the T-617 is ideal for this purpose as it provides a water tight seal on the probe and minimizes the volume of standard solution required (about 150 ml). Make sure that you rinse both the probe and container before each calibration and between each calibration solution. The standard solutions are available from TuroTechnology Pty Ltd or most major scientific suppliers.

Conductivity measurements require a correction for temperature (this correction is automatically made by the instrument) hence the temperature sensor must be correctly calibrated before you can calibrate either the dissolved oxygen or salinity / conductivity sensors.

To enter the calibration menu, choose option 5) CALIBRATION from the main menu and press **ENTER**. If there is any data in the reader unit memory, the message CLEAR ALL MEM? will appear on the display. Press **ENTER** to clear memory or **ESC** to return to the main menu. Once you have entered the calibration menu, use the **arrow** keys to scroll through the menu and select the sensor which you wish to calibrate by pressing **ENTER**.

If the user mistakenly places the probe into the incorrect solution ie high standard instead of a low standard the message will appear on the LCD display "CALIBRATION ERROR RECAL HIGH & LOW". To remove the message recalibrate the sensor correctly. Note: This does not ensure that the unit is calibrated accurately, but does ensure that a major mistake or error does not occur.

During calibration, the display shows a D number (“Raw Dat = ”). These are the raw numbers from the analogue to digital converter prior to conversion to real units (such as °C temperature or mS/cm conductivity or %sat dissolved oxygen, etc). Calibration coefficients are used to convert the D number to the real units.

4.1 Temperature Calibration

The temperature calibration should vary very little over the lifetime of the instrument however it is worth checking on the accuracy of your temperature measurements before calibrating the dissolved oxygen or salinity sensors.

Temperature calibration is performed at two temperatures. The low temperature must be between 0 and 20 C and the high temperature must be between 30 and 50C. To calibrate temperature, proceed as follows:

1. Select TEMPERATURE from the calibration menu. The message CALIBRATION MENU on the top line and Temperature C will appear on the bottom line, press **ENTER** to calibrate or **ESC** to main menu. The message 0-20C (ENT/ESC) will appear. Press **ENTER** to calibrate the low temperature range or **ESC** to proceed directly to the high range calibration.
2. If you proceed with the low range calibration, the raw data D is displayed. Immerse the probe in a stirred water bath held at a constant temperature between 0 and 20 C and wait until the probe and water bath reach thermal equilibrium. Raw temperature data is displayed on the second line of the LCD display. When the data is stable press enter. Press the **arrow** keys to change the displayed temperature to the correct value then press **ENTER**. The message 30-50C (ENT/ESC) will now appear. Press **ESC** to exit the temperature calibration or **ENTER** to continue with the high temperature range calibration.
3. If you proceed with the high range calibration, the message CAL TEMP ^{O}C 25-50 Press **ENTER** OR **ENTER** will appear. Press **ENTER**, the raw data D is displayed. Immerse the probe in a stirred water bath held at a constant temperature between 25 and 50 C and wait for the probe to

reach a constant temperature. Press the **arrow** keys to change the displayed temperature to the correct value then press **ENTER**. The temperature calibration is now complete.

4.2 Depth calibration

To perform the depth calibration you need to lower the probe to a known depth in the water. This can be done by placing a mark on the probe cable at a measured distance from the bottom of the probe assembly then, making sure that the probe cable is vertical, lower the probe until the mark is at the surface of the water.

1. Select DEPTH from the calibration menu, the message CALIBRATION MENU will appear on the top line and DEPTH M. will appear on the second line will be displayed. Press **ESC** to exit without changing the depth calibration.

2. If you wish to continue, make sure that the probe is above the surface of the water and press **ENTER**, the LCD message will state 0 standard EN/ES press enter to calibrate or ES to calibrate the high range. If ENTER is pressed the raw dat will be displayed on the second line of the LCD display. Press ENTER if the D number is stable. The depth calibration coefficients will then be automatically updated. Submerge the probe to your pre- measured depth and make sure that the cable is vertical. Press the **ENTER key** keys to from 1 to 100 meter points. Press **ENTER** the raw data will be displayed on the second line of the LCD display. When stable press **ENTER** and use the arrow keys to change the display to the correct value then press **ENTER**. The depth calibration is now complete.

4.3 High Conductivity/Salinity Calibration

The conductivity/salinity sensor is calibrated using solutions with a salinity of 0 ppt (air calibration) and 35 ppt. Conductivity is a parameter derived from the salinity measurement and so calibrating salinity simultaneously calibrates the conductivity measurements. To calibrate the sensor, proceed as follows:

1. First, ensure that the temperature sensor is reading accurately and, if necessary, perform the temperature calibration described above.
2. Select CONDUCTIVITY from the calibration menu, the message Cond ms/cm/Sal. will be displayed. Press **ESC** to exit without changing the calibration.
3. If you wish to continue for low calibration, leave the probe in air, a visual display of the raw data is seen on the second line of the LCD display. When the raw data D is stable press **ENTER**, the salinity calibration coefficient will then be automatically updated.
4. If you wish to continue for an upper calibration, immerse the probe in a solution with a salinity of 30-40 ppt, Press **ENTER**; a visual display of the raw data D is seen on the second line of the LCD display. When the data is stable press **ENTER**, then use the UP/DOWN arrows keys to set the salinity value of the solution that was used and then the calibration coefficient will be automatically updated and the instrument will return to the calibration menu.

4.4 Low Conductivity calibration

1. Select Cond uscm from the main menu press **ENTER** to continue or **ESC** and go to main menu.

2. To proceed with the low conductivity calibration press **ENTER**. Leave the probe in air and press **ENTER** for zero conductivity calibration.

3. If you wish to continue for an upper calibration, immerse the probe in a KCl solution. To prepare the solution, dissolve 0.7459 grams anhydrous KCl in distilled water and make up the solution to 1 litre. This has an electrical conductivity of 1413 umhos/cm. The raw data will be displayed on the second line of the display. When the raw data D is stable press **ENTER**. Then use the UP/DOWN arrows keys to set the conductivity value of the solution that was used and then the calibration coefficient will be automatically updated and the instrument will return to the calibration menu.

Other conductivities can be selected between 500 to 8000 us/cm. It is advisable to use the solution of KCl which has the conductivity of 1413us/cm. The calculation for temperature correction is at its optimum when this value is used. If other standards are used the temperature changes in the sample will cause small changes in the displayed conductivity.

4.5 pH Calibration

The optional pH sensor is calibrated using buffer solutions with a pH of 4 - 7.5 and 8-12. To calibrate the pH sensor, proceed as follows:

1. Select pH from the calibration menu, the message pH will be displayed. Press **ESC** to exit without changing the instruments calibration.

2. If you wish to continue, immerse the probe in a solution of the desired pH between 3.0 and 9.0, Press **ENTER** a visual display of the raw data is seen on the second line of the LCD display. When the data is stable press **ENTER**. Press the **arrow** keys to change the displayed pH to the correct value (whichever was selected between 3.0 and 9.0) then

press **ENTER,** the pH calibration coefficients will then be automatically updated.

3. Rinse the probe in distilled water to remove all traces of the low buffer solution. Immerse the probe in a buffer solution with pH between 6 and 12, press **ENTER** and a visual display of the raw data is seen on the second line of the LCD display. When the data is stable press **ENTER.** Press the **arrow** keys to change the displayed pH to the correct value (whichever was selected between 6 and 12.0) then press **ENTER,** the pH calibration coefficients will then be automatically updated and the instrument will return to the calibration menu.

5. Maintenance

5.1 Reader Unit Maintenance

The reader unit requires little maintenance except to change the batteries as necessary and the connectors are kept clean and dry. When the voltage from the battery pack falls below 7.2 volts, the reader unit display the message BATTERY FLAT then record the date and time at which this occurred. The instrument will then automatically shut down, although any data stored in the memory will be retained. When this occurs, the only way to restart the instrument is to replace the batteries. Ensure that the connector caps are secured onto any connectors which are not in use.

5.1.1 Reset

The system can be RESET if the reader unit fails to function properly (hang up) or exhibiting the following:

- The reader unit will not switch ON or OFF
- LDC display will not display all the characters
- Press keys will not operate reliably

The RESET function is initiated by keeping the **ESC** key depressed while pressing the **ON/OFF** key. The message on the LCD display will ask you if you wish to continue or escape. Press the **ENTER** key for yes. It will then ask you if the unit is fitted with a depth sensor. If there is no depth sensor fitted on the probe press the **ESC** key, if there is a depth sensor then press the **ENTER** key.

The RESET function will not change or clear the calibration constants from the reader unit's memory.

5.1.2 Battery Replacement

The procedure for replacing the reader unit batteries is as follows:

1. Turn off the instrument and place the reader unit face down on a clean dry table and remove the four stainless steel retaining screws under the front panel flange.
2. Turn the unit upright and lift the front panel from the body of the reader unit and place it face down on the lid. Unplug

the battery lead connector (the one with red and black wires) on the printed circuit board.

3. Unscrew the battery carrier retaining screw (the one in the center of the battery pack) and remove the battery carrier.
4. Take out the old batteries and replace with eight new "C" size batteries positioned with the "-" terminals against the spring connectors of the battery pack.
5. Place the battery carrier in the reader unit and tighten the retaining screw. The screw must be firmly secured so that the batteries do not move during deployment of the instrument.
6. Make sure that the rubber gasket on the reader unit lid and the surfaces in contact with it are clean.
7. Replace the printed circuit board connector making sure that it is pushed firmly in place. The connector will only fit if it is oriented correctly.
8. Replace the front panel and the four retaining screws, making sure that you tighten them firmly in a diagonal pattern.

5.2 pH Sensor Maintenance

To service the pH sensor it is better to remove the sensor from the probe housing. This done by drying the probe by shaking of excess water and drying as best as possible. Then remove the probe cage by unscrewing the retaining screw situated at the end of the cage and lifting off the cage. Firmly grasp the pH sensor and pull down. DO NOT UNSCREW THE pH SENSOR

Slow response or non-reproducible measurements are signs that the electrodes have become coated or clogged. The glass electrode is susceptible to coating by many substances. The speed of response, normally 95% of the reading in less than 10 seconds, is dramatically changed if a coating is present. Usually a rinse with methyl alcohol will remove any films on the glass and restore the speed of response.

If the methanol rinse does not restore the response, soak the sensor in 0.1 Molar HCl for five minutes. Remove and rinse the sensor with water and place in 0.1 Molar NaOH for five minutes. Remove and rinse again, then

place the sensor in pH 4.0 buffer for 10 minutes. The response should now be improved. Do not use abrasive cleaners as this will destroy the sensor.

After cleaning the sensor, be sure to recalibrate pH.

If cleaning the sensor does not restore performance, the sensor will have to be replaced.

As the electrolyte gel in the reference (half cell) becomes exhausted it can become replaced by water and the pH sensor becomes unstable. Unplug the pH sensor as previously described. An indication if water is present is that the viscosity is low compared with gel. This can be seen though the pH sensor housing. If there is water present either replace with a new pH sensor or return the sensor to Turo for re-gelling.

5.3 Conductivity Sensor Maintenance

To maintain the performance and accuracy of the conductivity / salinity sensor, the electrodes need to be periodically cleaned and if the platinum black coating is damaged, the electrodes will need to be re-platinised.

Inspect the sensor on a regular basis. If there is any evidence of a build up of contamination on the electrodes, then the sensor should be removed and cleaned using the platiniser unit as described below. If the platinum black coating is damaged, the electrodes should be cleaned and then re-platinised. To perform these operations, proceed as follows:

1. To remove the sensor, remove the sensor guard by unscrewing the fastener screw then pull off the cage to expose the sensors. Ensure that the probe and sensors are completely dry. Use a cotton bud to dry the area between the sensors. Pull the conductivity sensor down out of the probe by hand. Do not twist the sensor. Ensure that the vacant sensor socket is kept completely dry.
2. The electrodes should have a sooty black appearance. If they are dirty they can be soaked in 0.1M HCL for 1 to 2 hours NOTE: do not allow acid to touch the connector pins. If this does not restore the stability the electrodes need to be returned to the factory for re-platinising or replaced.

Before installing the conductivity sensor into the probe assembly, make sure that both the sensor and probe assembly are dry. Apply a smear of vacuum grease to the sensor body to ensure that a water tight seal is achieved. The sensor can only be installed with the black dot on the electrode housing pointing to the outside of the probe. Align the sensor and push it into the probe assembly. Be sure to recalibrate the salinity and low conductivity.

6. Storage

When storing the instrument, the pH electrode should be kept moist in a solution of 3M KCl (approximately 22 grams of KCl dissolved in water to make 100 ml of solution). It is advisable to buffer this solution to bring it to approximately pH 5 or 6.

This solution may be contained in either the small pH sensor cap (in some T-617 models) or in the probe storage canister:

- If the T-617 pH sensor has a small cap around it, this simply pushes into place. The solution can be put into this cap for storage of the pH sensor. A small piece of cotton wool inside the cap can be used to absorb the solution, creating a sufficiently damp environment. If this method is used, a drop of clean water should be put into the storage container to keep air around the DO sensor damp.

  CARE SHOULD BE TAKEN when removing or replacing this cap. The cap should be carefully PULLED OFF, DO NOT ATTEMPT TO UNSCREW IT. The glass sensor is EXTREMELY DELICATE and should not be bumped or touched.

  Alternatively, the probe storage canister may be used to hold the storage solution.

- The T-617 comes with a storage canister which clamps onto the probe providing a waterproof seal. Enough storage solution should be put into the canister so that the pH sensor is kept wet. This allows the instrument to be stored and transported with the sensors kept immersed in the storage solution.

7. Appendix 1 - Conversions Used

The conversion between high conductivity and salinity is performed using the Practical Salinity Scale. UNESCO Technical Papers in Marine Science 1983.

The conversion of low conductivity raw data to conductivity referenced to 25 Deg C is performed using constants derived from HANDBOOK OF CHEMISTRY AND PHYSICS, 1963, Chemical Rubber Publishing Company, Page 2691, Conductivity of Standard Solutions using KCl, 0.001 M solution.

8. Appendix 2 - Compliance

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9. Appendix 3 - Part Numbers

Part Number	Description
T-617-001	Probe assembly
T-617-002	Cable assembly
T-611-004A	pH sensor
T-617-005	Conductivity sensor
T-617-006	Depth sensor
T-611-011	Platiniser unit
T-611-012	Platinising solution
T-611-013	Sensor storage solution
T-611-014	pH buffer 4.0 1 litre
T-611-015	pH buffer 10.0 1 litre
T-611-016	Salinity standard 35.00 ppt 1 litre
T-611-018	Battery pack
T-611-019	Battery pack c/w batteries
T-611-020	Front panel membrane
T-617-021	Circuit board
T-611-022	Communications cable
T-611-023	Auxiliary 12V supply cable
T-611-024	Auxiliary 12V Bulk head connector
T-611-025	Communications bulk head connector
T-611-026	Sensor bulk head connector
T-617-027	TuroGraph graphics software