Datataker

DT300
Rainfall Logger

DT350
Rainfall and Water Level Logger

A DATA ELECTRONICS USER'S MANUAL

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5 Operation from a Computer

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Introduction

The DT300 and DT350

Data Electronics' *DT300 Rainfall Logger* measures

- rainfall (in millimetres) from a single tipping-bucket rain gauge

and intelligently logs (records) the readings to its internal memory.

Data Electronics' *DT350 Rainfall and Water Level Logger* measures

- rainfall (in millimetres) from a single tipping-bucket rain gauge
- water level (in centimetres) from a continuous-type liquid level sensor

and intelligently logs (records) the readings to its internal memory. It can perform both these functions at the same time.

Both loggers are designed for battery-powered operation in remote locations and can be left unattended for extremely long periods, limited only by the main power supply provided to the logger. The lithium backup battery supplied with each logger has a life of five years.

This Manual

This user's manual

- presents the capabilities of the DT300 and DT350;
- describes essential concepts and terminology relating to the operation of the loggers;
- takes you through the steps required to prepare the loggers for use;
- describes in detail the complete operation of the loggers.

To do this, the manual is divided into three main parts:

- **Part A**, "Essential Information", contains important background information about the loggers.
- **Part B**, "Initial Set Up", covers installation and first-time configuration of the loggers.
- **Part C**, "Operation", explains in detail the two ways of operating the loggers (from the front panel and from a computer), powering the loggers, and RS-232 communication with a computer (directly, and by modem).

In addition, detailed technical information is provided in the appendixes.

Where differences exist between the DT300 and DT350, they are made clear in the text.

Assumptions

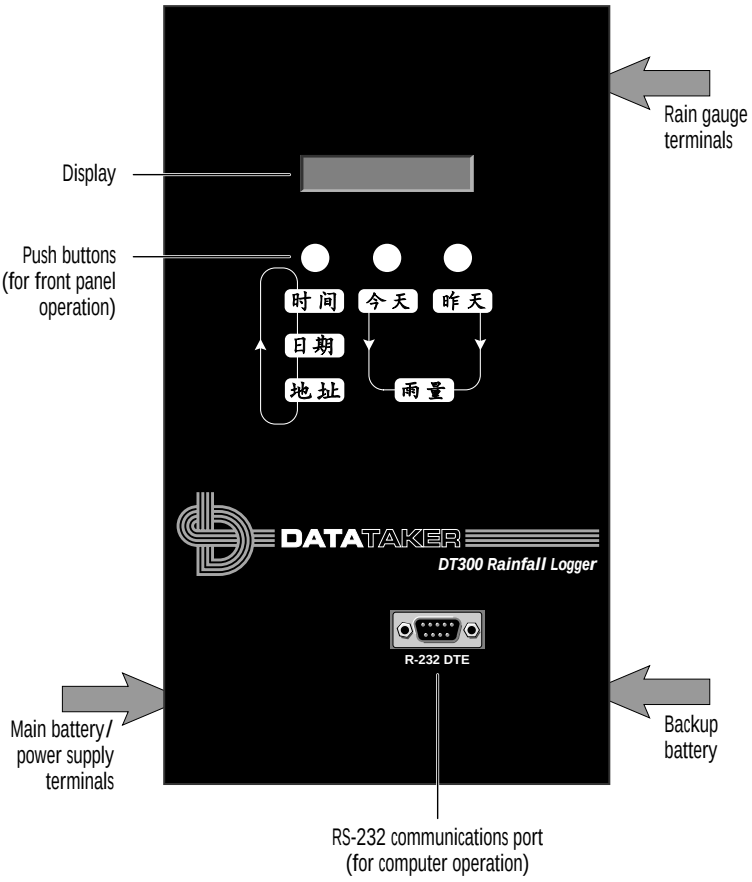
This manual assumes you have basic knowledge about

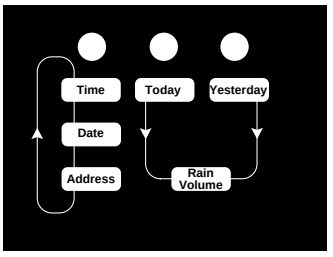
- data acquisition and logging
- tipping-bucket rain gauges
- water level sensors (continuous type)
- computers (IBM® or compatible, in particular)
- RS-232 communication.

Although you can communicate with the loggers using any type of computer (running appropriate communications software), this manual assumes you are using an IBM or compatible computer.

Overview of the DT300 & DT350

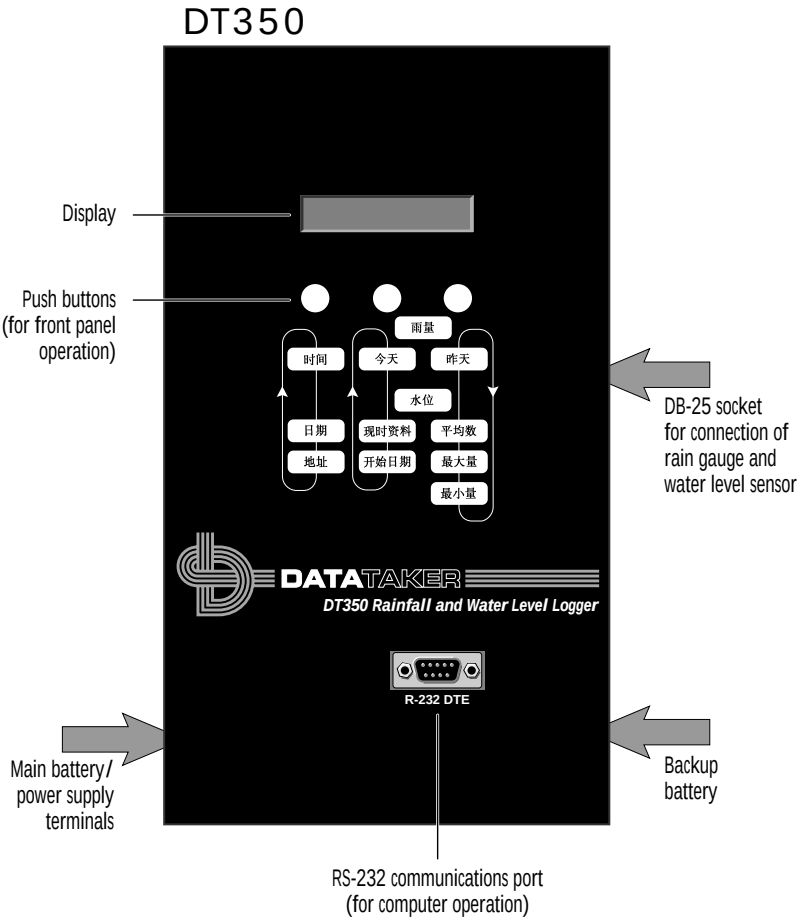
DT300

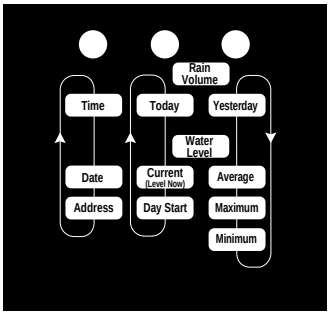




DT300 Button functions (English)

DT350





DT350 Button functions (English)

Part A

Essential Information

1 DT300 & DT350 — Essential Information

This section presents preliminary information you'll need to be familiar with to operate the DT300 Rainfall Logger, and the DT350 Rainfall and Water Level Logger.

It is divided into five topics:

1-1 Introduction — a quick overview of the loggers.
1-2 Terminology — terms that are specific to the DT300 and DT350.
1-3 Operating Principles — some important concepts to be aware of when using the loggers.
1-4 Powering the DT300 and DT350 — fundamental power supply issues including conserving the main battery, battery alert messages, and battery maintenance records kept by the loggers.
1-5 RS-232 Communications — an introduction to communicating with the loggers from a computer.

Table 1 (overleaf) summarises the capabilities of the loggers. It shows which operations can be done from the logger front panel and which can be done from a computer connected to the logger.

1-1 Introduction

Functions

The DT300 Rainfall Logger has a single function:

- **To monitor rainfall from a tipping-bucket rain gauge.**
  If rain is detected, the DT300 measures the amount that falls within a particular period of time and stores the reading in its internal memory.

The DT350 Rainfall and Water Level Logger has two functions, which it can perform concurrently:

- **To monitor rainfall from a tipping-bucket rain gauge (same as DT300).**
- **To measure water level as detected by a continuous-type liquid level sensor with digital output.**
  The DT350 constantly monitors the water level and can display an instantaneous readout of the level (in centimetres above sea level).
  In addition, the logger performs two automatic operations:
  - It takes level readings every five minutes, from which it calculates and stores the *change* in level between consecutive readings (called *differential* values).
  - It stores the *actual* level reading every hour.

All data accumulated in the loggers can be downloaded to a computer via an RS-232 communications link. In addition, today's and yesterday's data can be reviewed on the display mounted in the logger's front panel.

Each logger can be configured, and its memory cleared, from the buttons mounted on its front panel or from a computer connected to it.

Always Working

The DT300 and DT350 are always working. They only stop taking measurements and logging if the main power supply voltage drops to 9.4VDC (battery failure mode, described later), when the user puts them into battery replacement mode (also described later), or if the main power supply fails unexpectedly.

Power

The loggers are designed to be powered from a 10.6–14.4VDC source (a battery or a DC mains adaptor, for example).

They monitor and record several power supply situations, and provide alerts and reminders so that the operator can ensure continuity of logging.

In addition, in poor power supply conditions (less than 9.4VDC), the loggers warn the operator and then enter "battery failure mode" (one of the loggers' two low power modes) as a precaution against corrupting all user data. In battery failure mode, all monitoring and logging ceases to conserve remaining battery energy until the supply is returned to an acceptable level (by fitting new batteries, for example). Battery failure mode is explained in detail in section 6-5.

The loggers are supplied with a lithium backup battery that maintains all logged data whenever the main power supply is low or being replaced.

Intelligent Logging

To conserve the main battery:

- The DT300 and DT350 enter "sleep mode" (the other low power mode) when they are not taking measurements or logging them. Sleep mode is described in section 1-4.

To conserve memory:

- The DT300 and DT350 only log rainfall in the presence of rain. When there is no rain, no logging takes place and therefore no memory is used. Then when you retrieve rainfall data from the loggers in tabular format (described later), they automatically derive when any periods of no rainfall occurred and incorporate these into the final rainfall log.
- The DT350 compresses water level data as it is stored, so that small level change values take up less memory than large level change values.

Operation

There is little to do to operate the DT300 and the DT350. After installing the logger and its sensor(s) you configure it, allow it to collect data, then finally retrieve the data. While it is logging you can review and retrieve data, and change some settings.

Each logger can be operated from either the buttons and the display on its front panel (not all operations are available from the front panel — see section 4), or from a computer connected to the logger via an RS-232 link (explained in section 5).

1-2 Terminology

This section describes terms that apply to the DT300 and DT350 in general, followed by those specific to rainfall logging and water level logging.

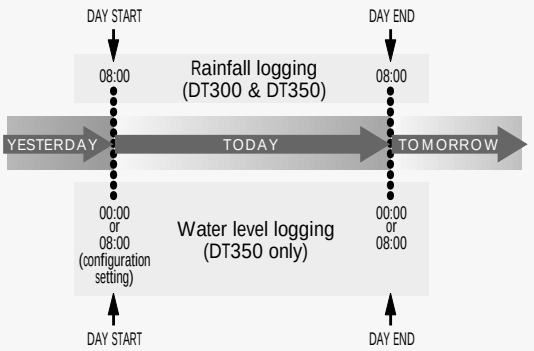
Day Start, Day End

For rainfall measurements, both the DT300 and DT350 start their day at 08:00 (8:00am).

For water level measurements, you may choose whether the DT350 starts its day at 00:00 (midnight) or at 08:00. Thus, for the DT350, day start for water level monitoring may not be the same as day start for rainfall monitoring.

Day end occurs 24 hours after day start.

Day Start, Day End, Today and Yesterday



Today, Yesterday

As shown in the figure above, "today" for the logger begins at day start this morning and ends 24 hours later.

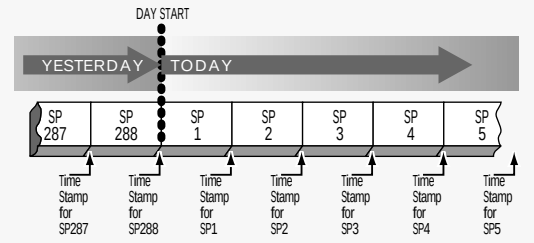
"Yesterday" ends at today's day start and began 24 hours earlier.

Sample Period

The loggers take readings regularly and automatically. The time interval at which these regular readings occur is the "sample period".

The loggers' sample period can be set to either one minute or five minutes. Sample periods are contiguous, and they are synchronised to the logger's clock. The first sample period of a new day starts exactly on the hour (00:00 or 08:00). Data is logged at the *end* of every sample period.

Sample Periods
and
Time Stamps



Be sure to read the topic "Making Changes: Nothing is Lost" in section 1-3 for important information about the sample period.

Table 1:

DT300 & DT350 Functions

			DONE FROM… FRONT PANEL	DONE FROM… COMPUTER	COMMAND
DATA LOGGING	Log rainfall	DT300 DT350	DT300 & DT350 are always logging		
	Log water level (differential readings every 5 minutes; absolute reading every hour)	DT350	DT350 is always logging		
DATA REPORTING	**Rainfall**				
	Get today's rainfall	DT300 DT350	✓	✓	RAINTODAY
	Get yesterday's rainfall	DT300 DT350	✓	✓	RAINYESTERDAY
	Get today's hourly rainfall summaries	DT300 DT350	✓		
	Get the DT300's current rainfall address	DT300	See "CONFIGURATION"	✓	ADDRESS
	Get the DT350's current rainfall address	DT350	See "CONFIGURATION"	✓	RAINADDRESS
	Copy the contents of the DT300's rainfall memory to a computer in raw format	DT300	✓	✓	DUMP
	Copy the contents of the DT350's rainfall memory to a computer in raw format	DT350		✓	DUMPRAIN
	Copy the contents of the logger's rainfall memory to a computer in tabular format	DT300 DT350		✓	UNLOAD
	Water Level (DT350 only)				
	Get water level at day start	DT350	✓	✓	LEVELATSTARTOFDAY
	Get yesterday's water level — average	DT350	✓	✓	LEVELAVE
	Get yesterday's water level — maximum	DT350	✓	✓	LEVELMAX
	Get yesterday's water level — minimum	DT350	✓	✓	LEVELMIN
	Get current water level	DT350	✓	✓	LEVELNOW
	Get the current water level address	DT350	See "CONFIGURATION"	✓	LEVELADDRESS
	Copy the contents of the logger's water level memory to a computer in raw format	DT350		✓	DUMPLEVELS
	Both (DT350 only)				
	Copy the contents of the DT350's rainfall & water level memories to a computer in raw format	DT350	✓	✓	DUMPALL
CONFIGURATION	Enter/leave configuration mode	DT300 DT350	✓		
	Report logger configuration: DT300 & DT350 – station ID, ROM version, date, time, sample period, bucket size, BatFail, BatDate, BatNew, current rainfall address DT350 only – current water level address, water level sensor type, reference height	DT300 DT350	✓	✓	CONFIG
	Set time (set hours & minutes)	DT300 DT350	✓	✓	TIME=
	Set date (set year, month & day)	DT300 DT350	✓	✓	DATE=
	Clear rainfall memory / water level memory / both		✓	✓	See "Memory" below
	Set water level sensor type (Gray, BCD or Binary)	DT350	✓	✓	SETLEVELTYPE=
	Set day start for water level logging (00:00 or 08:00)	DT350	✓	✓	SETDAYSTART=
	Set reference height	DT350	✓	✓	SETREFERENCE=
	Set baud rate for RS-232 communication	DT300 DT350	✓		
	Set station ID	DT300 DT350	✓	✓	STATION=
	Set sample period	DT300 DT350	✓	✓	PERIOD=
	Set bucket size	DT300 DT350	✓	✓	BUCKET=
MAINTENANCE	**Memory**				
	Clear DT300 rainfall memory	DT300	✓	✓	CLEARLOGGER
	Clear DT350 rainfall memory	DT350	✓	✓	CLEARRAIN
	Clear water level memory	DT350	✓	✓	CLEARLEVELS
	Clear rainfall & water level memory	DT350	✓	✓	CLEARALL
	Main Battery				
	Enter/leave main battery replacement mode	DT300 DT350	✓		
	Set BatFail and BatDate to the logger's time & date (initialisation command only)	DT300 DT350		✓	SETBATTERYFAIL
	Get time & date of last main battery failure (BatFail)	D T300 DT350		✓	BATTERYFAIL
	Get time & date of last main battery replacement (BatDate)	DT300 DT350		✓	BATTERYDATE
	Get time & date of new main battery replacement (BatNew)	DT300 DT350		✓	BATTERYNEW
	Set expected life of main battery (BatLife, months)	DT300 DT350		✓	SETBATTERYLIFE=
	Other				
	About…	DT300 DT350		✓	VER
For manufacturer's use only	Get diagnostics	DT300 DT350		✓	DIAGNOSTICS
	Get previous diagnostics 1, 2, 3, 4 or 5	DT300 DT350		✓	DIAGNOSTICS 1,2,3,4,5
	Get diagnostics 6: minimum & maximum internal logger temperatures	DT300 DT350		✓	DIAGNOSTICS 6
	Get device characteristics	DT300 DT350		✓	TESTØ

Time and Date Stamps

The loggers know the time and date of every measurement they make — they "stamp" each reading with the current time and date (see figure above). When you retrieve data from the loggers, the time and date are attached to each reading.

NOTE Periods of No Rainfall
Although sample periods in which no rain falls are not logged (they take up no memory), the loggers insert them into the final rainfall log when you download it to a computer in tabular format (described later). Therefore, your unloaded rainfall log is always contiguous — all sample periods are present and in the correct order.

Rainfall Memory and Water Level Memory

The internal memory of the DT350 is divided into separate areas for logging rainfall data and water level data: a 30KB (kilobyte) "rainfall memory" and an 80KB "water level memory".

The DT300 contains 30KB of rainfall memory only.

Address Numbers

Both loggers keep a count of the number of sample periods for which rain fell since their rainfall memories were last cleared. This count is the "current rainfall record address".

In addition, the DT350 keeps a count of the number of water level readings logged since the water level memory was last cleared. This count is the "current water level address".

These addresses can not be set by the user. They can only be read from the logger's display or from a computer connected to the logger, and are intended to be used for checking the validity and continuity of records by monitoring their regular increase on, say, a weekly or monthly basis.

Don't confuse these addresses with the logger's station ID (see next item).

If memory wraps (explained in section 1-3), the logger's address numbers continue to increase to a maximum of 65535 and then begin counting again from zero.

Station ID

For identification purposes, you are able to assign a unique "station ID" number to each logger — a five-digit number in the range 00000 to 59999 inclusive.

The station ID can be set and read from the logger's front panel or from a computer connected to the logger.

Settings and Parameters

When you configure the DT300 or DT350, you change its internal settings — time, date, station ID, and so on.

Some of these settings are actually a sequence of parameters — components of the settings which can be altered individually. For example, the date setting comprises year, month and day parameters.

Today's Rainfall, Yesterday's Rainfall

"Today's rainfall" is the amount of rain (measured in millimetres, mm) that has fallen so far today — that is, from 08:00 until the present time today.

In other words, it is a running total of the rain that has fallen in each sample period today (including the current sample period), starting with the sample period that began at 08:00.

"Yesterday's rainfall" is the total amount of rain (measured in mm) that fell between 08:00 yesterday and 08:00 today.

Bucket Size

Each logger counts tips of the rain gauge's bucket and, to provide rainfall data in millimetres of rain, you must tell the logger how many millimetres of rain the bucket holds before it tips. This is the "bucket size" you set when configuring the logger.

For example, if the logger counts 8 tips in a particular sample period and its bucket size is set to 0.1mm, it records that 8 x 0.1mm = 0.8mm of rain fell during that sample period.

You can set the logger's bucket size to any value from 0.1mm to 1.0mm in 0.1mm increments. The default bucket size is 0.1mm.

NOTE Remember that the bucket size you set in the logger *MUST* match the size of the actual bucket used in the rain gauge, otherwise the logger's output (mm of rainfall) will not be valid.

NOTE Be sure to read "Making Changes: Nothing is Lost" in section 1-3 for important information about changing the bucket size.

Rainfall Log

The "rainfall log" is all of the rainfall data that has accumulated in the logger's rainfall memory since the last time it was cleared. It can be retrieved from the logger in either of two formats: "raw" or "tabular".

Raw Format

In raw format, the data is returned in rows of 16 bytes, exactly as it exists within the logger's memory. Each row is prefixed by an address. All data and addresses are in hexadecimal (base 16) format.

Raw format does *not* include records of zero rainfall.

The rainfall log can be retrieved from the logger in raw format by using the logger's front-panel buttons, or by sending the DUMP (DT300) or DUMPRAIN (DT350) command from a computer connected to the logger. For the DT350, it can also be retrieved along with the water level log using the DUMPALL command. These methods are explained in part C of this manual.

Tabular Format

Data in tabular format appears as one row of data (one record) for each sample period, as shown below.

Tabular format includes records of zero rainfall.

Each row (record) contains
- the date
- the time (when the sample period ended)
- the rainfall measurement for that sample period, in millimetres
- information character(s) to indicate that certain events occurred during the sample period (see "Information Characters" below).

Here's part of a typical rainfall log in tabular format:

Date ⇓	Time ⇓	Rain (mm) ⇓	Info. ⇓
96/07/02	14:20	3.9	S
96/07/02	14:25	0.2	C
96/07/02	14:30	0.0	
96/07/02	14:35	2.7	
⇓	⇓	⇓	⇓

Information Characters

If one or more of the following events occur during a sample period, that sample period's row/record of the tabular rainfall log contains information characters (in the Info. column) to remind you of the event:

C	The logger was cleared.
B	The bucket size was changed (the new bucket size is also provided).
S	The sample period was changed.
T	The time (or date) was changed.
F	The logger shut down unexpectedly because the main power supply was suddenly removed without the logger being in a safe mode (battery replace mode or battery failure mode; described later), or the logger shut down due to a failing battery (entered battery failure mode; described later).
I	Total battery failure (main power and backup battery).
R	The logger was put into battery replacement mode.

Retrieving the Rainfall Log

The rainfall log is retrieved using the following commands:

	Raw Format	Tabular Format
DT300	DUMP	UNLOAD
DT350	DUMPRAIN	UNLOAD

In addition, for the DT350, the rainfall log can be retrieved together with the water level log in raw format using the DUMPALL command.

Reference Height
(DT350 Only)

The DT350 is designed to present water level readings on its display as *real* values — that is, as true heights above sea level or some other datum. So when you use the buttons on the logger's front panel to view water level data, the reading shown on the display is in true centimetres above sea level or other datum.

This requires that you calibrate the DT350 by telling it the height above sea level of the *lowest point of the* water level sensor mechanism. This is the "reference height". When you request a water level measurement on the logger's display, the DT350 adds the reference height to the sensor reading and displays the result.

In other words, the reference height for a particular installation is the true height of the water above sea level that produces zero output or minimum deflection from the sensor. For example, in the case of a float-type sensor installed at a particular location, the reference height is the height of the water at that location which would allow the float to settle to its lowest position.

NOTE If you move the water level sensor to a new location so that its minimum height changes, you must alter the reference height setting accordingly.

NOTE This reference height adjustment is applied to yesterday's and today's water level readings only (whether obtained via the logger's front panel or via computer). It is *not* applied to data in the water level log.

Water Level Sensor Type
(DT350 Only)

Water level sensors used with the DT350 must provide one of the following outputs:
- 14-bit Gray code (range 0–163.83 metres)
- 4-digit BCD numerals (3 digits 0–9, 1 digit 0–3 unsigned; range 0–39.99 metres)
- 14-bit binary (14 bits unsigned; range 0–163.83 metres)

You select the appropriate encoding when configuring the logger (described in section 4-2).

Water Level Log
(DT350 Only)

The DT350 measures water level at the end of every sample period (one minute or five minutes). From these readings, the logger performs two automatic operations every hour (one hour is the "water level logging period"):

- It calculates and stores the change in level between consecutive 5-minute readings (thereby producing 12 *differential values* every hour).
- It stores the actual level reading it takes at the end of every hour. This reading is *NOT* adjusted for reference height.

Then, at the end of every hour, the logger stores the 12 differential values and the one actual value as shown in the format shown in the figure "DT350 Hourly Water Level Record". These hourly records comprise the "water level log".

The water level log can be retrieved from the logger using the DUMPLEVELS command, or retrieved along with the rainfall log using the DUMPALL command.

Appendix 1 contains specific details about compressing the water level data as it is logged.

1-3 Operating Principles

From the moment a main battery or power supply is connected, the DT300 and DT350 begin counting bucket tips (if a rain gauge is connected) and, for the DT350, measuring river height (if a water level sensor is connected).

Even with no sensors connected, the loggers wait in readiness, constantly sampling the sensor terminals.

Every Sample Period

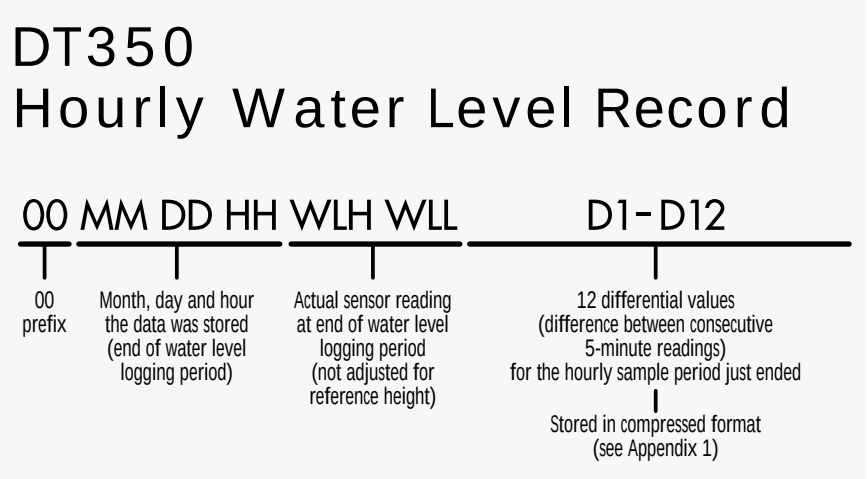
At the end of every sample period (one minute or five minutes), the DT300 and DT350 total the number of bucket tips for that sample period and log this value. They then begin counting tips for the next sample period, and so on. If *no* rain falls within the sample period, no data is stored (and hence no memory space is used). Put another way, a reading is stored for a particular sample period only if rain falls during the sample period. The memory of a DT300 or DT350 installed in a desert would take many, many years to fill.

Also at the end of every sample period, the DT350 takes a water level reading and temporarily stores this in preparation for its hourly logging operation (described earlier in "Water Level Log").

Every Day

At the end of every "rainfall day" (that is, at 08:00), the DT300 and DT350 total the number of bucket tips for the day just ended and store this as yesterday's total.

At the end of every "water level day", the DT350 calculates the average, maximum and minimum water level for the previous 24 hours and stores these values for one day.



Making Changes: Nothing is Lost

The loggers continue to count and log while they are being configured. Therefore, for example, rainfall data collected while you alter a logger's time, date, sample period or bucket size — and during the first sample period after making the alteration — may be misleading and should be interpreted cautiously.

This is because

- altering any of the time, date or sample period settings causes a logger to shorten the sample period during and after the alteration, in order to re-synchronise the sample periods to 08:00;
- altering a logger's bucket size setting causes the rainfall total for that sample period to be made up of counts from different-sized buckets.

  Changing the actual, physical bucket before or after you change a logger's bucket size setting will also lead to inaccuracies *until the next sample period after BOTH the actual bucket and the setting have been changed*.

The DT300 inserts information characters in the rainfall log to indicate any setting changes that occurred and in which sample periods they occurred.

Unexpected Values

The DT300 and DT350 count and log every bucket tip, no matter what is happening to them (except if the main power supply is disconnected or low). So when you review data from a logger, be aware that an "unexpected" value in a sample period is probably due to changes you have made to the logger's time, date, sample period or bucket size settings during the logging session, or power failure/disconnection.

For this reason, we advise you to *record any changes you make and when you made them* so you can later correlate these details with any unexpected values in the rainfall log.

The rainfall log's information characters will also assist here.

Daily Totals are Always Correct

Because the loggers count every tip of the rain gauge, the daily totals (today's and yesterday's) are always correct even though some of the sample periods may have been shortened.

The only exception to this is the case where the logger is set to a bucket size of, say, 0.1mm and you change the size of the actual bucket in the rain gauge to, say, 0.2mm *and* rain causes the new bucket to tip while the logger is still set to the lower size. Instead of one tip of 0.2mm, the logger only adds one tip of 0.1mm to that sample period's total. *Therefore, whenever possible, change the bucket size when it's not raining.*

Again, making notes of any changes and especially *when* you made them will be of great benefit when you later analyse the rainfall log.

Memory Wrap

When data completely fills the rainfall and water level memories, new data is not discarded — it automatically *replaces* the oldest data in memory. This is called "memory wrap".

In practice, it is difficult to estimate when memory wrap will occur. This is because of

- the unpredictability of rainfall and water level changes;
- the way the loggers work to optimise memory use — for example, storing no data when there is no rainfall, using one byte (instead of two) to store the tip count when there are less than 128 tips in a sample period, only recording a time stamp for the first sample period in a series of non-zero (that is, "wet") sample periods.

However, here are some guidelines:

Rainfall Memory Wrap

For the DT300 and DT350 with their 30KB rainfall memory, the worst-case (that is, shortest) time before memory wrap occurs is seven days. This is a theoretical extreme (one minute sample periods alternating rain/no rain, logging more than 127 tips every sample period) and is unlikely to occur in practice.

The examples below are more realistic. They are based on a five-minute sample period and less than 127 tips per sample period (with the exception of the second part of Example 1).

- **Example 1: Tropical Location**
  One two-hour period of continuous rain every day — the logger's memory takes 1,140 days to fill (over three years).
  And if one hour of every two is a deluge (over 127 tips per sample period), the logger's memory takes 800 days to fill (over two years).
- **Example 2: Arid Location**
  One hour of light rain every week — the logger's memory takes 14,000 days to fill (over 38 years).
- **Example 3: Very Wet Location**
  Continuous drizzle 24 hours every day — the logger's memory takes 110 days to fill (almost 4 months).

Water Level Memory Wrap

For the DT350 with its 80KB water level memory, the worst-case (that is, shortest) time before memory wrap occurs is three months. This is based on two-byte differential reports every five minutes — see "Water Level Record Format 4" in appendix 1).

The best-case (that is, longest) time before memory wrap occurs is nine months. This is based on two-bit differential reports every five minutes — see "Water Level Record Format 1" in appendix 1).

See appendix 1, "DT350 Memory Usage", for a more thorough discussion of this topic.

Hourly Rainfall Summaries

Every hour beginning from 08:00, the DT300 and DT350 automatically total the rainfall for the one-hour period just ended.

Using the buttons and display on the front panel of the logger, you can review these hourly totals in sequence at any time during the day. Each total is labelled with the hour at which it ends. When you begin the review, the logger totals the rain that has been recorded so far in the current hour and displays this information first. Then, with successive button presses (described in section 4-1.4), each previous hourly total is displayed ending with the first hour of the rainfall day.

These summaries are only stored for the current day. At 08:00 each day, the previous day's hourly summaries are deleted in preparation for the new day's summaries.

Water Level Sampling

(DT350 Only)

The DT350 takes water level samples according to its sample period setting — every one minute or five minutes. But, to reduce the effect of transitory disturbances (a wave, for example), each of these readings is derived by taking five samples three seconds apart (beginning at the end of each sample period) and averaging them.

That is, the water level measurement made at the end of each sample period is actually the average of five readings taken over 12 seconds.

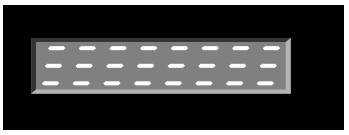
NOTE When an instantaneous water level is requested (using the logger's buttons or the LEVELNOW command), this averaging process is not used. Instead, the logger makes a simple one-off measurement.

Resolution and Limits

Clock and Calendar

The DT300 and DT350 maintains its own internal clock and calendar. Time is displayed as hours and minutes and the internal clock can be set to the nearest minute.

The clock/calendar is valid until 08:00 on 31 December 2024. Beyond that moment, the loggers can not represent time and date reliably — return the logger to the manufacturer for fitting of a new ROM (Read-Only Memory) chip. To warn you when the logger's time and date have exceeded this time and date, the panel-mount display fills with flashing hyphens whenever the logger wakes.



After 08:00 on 31 December 2024

Tip Limit Per Sample Period

In one sample period (no matter which length), the logger counts bucket tips to a maximum of 4,096 and then wraps the count to begin again at zero.

Using a 0.1mm bucket, this allows up to 409.6 mm of rain to be measured *in any one sample period* before wrap occurs. In practice, this maximum is very unlikely to be exceeded even within the longest sample period of five minutes.

Reporting Water Level (DT350 only)

The DT350 reports water level data to centimetre resolution as follows:

- Water level data transferred to computer — metres to centimetre resolution (for example, 234.56 metres)
- Water level data viewed on the logger's display — centimetres (for example, 23456 centimetres)

The DT350 reports water level within the following ranges:

- Water level data transferred to computer — –999.99 metres to 9999.99 metres
- Water level data viewed on the logger's display — –99999 centimetres to 999999 centimetres

1-4
Powering the DT300 and DT350

This topic is a general introduction to powering the DT300 and DT350 loggers. More details are provided in section 6, “Power”.

Two Power Sources

The loggers require two power sources; a main power supply and a backup battery.

Main Power Supply

The loggers are designed to derive their main power from a 10.6–14.4VDC 10Ah source (a battery or a DC mains adaptor, for example).

You connect the main supply by flying leads to screw terminals on the logger’s circuit board (described in part B of this manual).

Backup Battery

In addition to the main power supply, each logger is provided with a 3.6V lithium battery for backup power. This “backup battery” is soldered directly to the logger’s circuit board.

The backup battery maintains the configuration settings and data stored in the logger, and keeps the clock and calendar running, whenever power is not available from the main supply (while a main battery is being replaced, for example).

Whenever the logger is powered from a good main supply, you can replace the backup battery without risk of losing any data or configuration settings (soldering is required).

Battery Life

Backup Battery Life

The backup battery has a life of at least 3 years.

Main Battery Life

If you use a battery as the logger’s main power supply, we recommend that it be able to provide the required 10Ah for a minimum of 12 months, because this period is a logical maintenance interval.

Beware of connecting a partly-charged main battery. This is because the logger always assumes that any newly-connected main battery has a life of at least 12 months (the default value, which can be altered — described later), and uses this figure to calculate the New Battery Replacement date. Hence the New Battery Replacement date (and display warning) will not accurately reflect the true battery life remaining.

Recharging Batteries

You may recharge a lead-acid main battery while it is connected to the logger, but only from a good quality (that is, low noise) solid state charger that is rated as suitable for 12V lead-acid batteries.

WARNING ***The charger open-circuit (off load) terminal voltage must not exceed 15.0VDC.***

Alkaline and lithium batteries are not rechargeable.

Power Monitor and Automatic Shutdown: Battery Failure Mode

The DT300 and DT350 monitor the voltage at their main supply terminals, even in sleep mode. If the voltage falls below 9.4V, the logger automatically enters “battery failure mode”:

- If awake, the logger flashes a “battery failure” alert for 10 seconds and then carries out a controlled shutdown.
- If asleep, the logger simply carries out a controlled shutdown.

The controlled shutdown ensures that all existing logged data is safely stored, including data from the current sample period.

Battery failure mode is described fully in section 6-2.

Battery Conservation: Sleep Mode

To conserve battery power, the DT300 and DT350 spend most of the time “asleep”. That is, the logger’s display is turned off and much of its internal circuitry is shut down.

However, during sleep mode, the loggers continue to count bucket tips, measure water levels (DT350 only) and monitor the RS-232 port for incoming transmissions.

Waking the Logger

Once asleep, only the following events cause the logger to wake:

- Any of the three buttons on the logger’s front panel is pressed.
- The logger receives a DCD (Data Carrier Detect) or RI (Ring Indicator)signal via its RS-232 port (more details in section 1-5). The display does not turn on in this case (unless the battery replacement or battery fail alerts are active).
- A scheduled measurement, calculation or logging operation becomes due (for example, at the end of every sample period). The logger wakes momentarily (except the display, which stays off unless the battery replacement or battery failure alerts are active) to carry out the operation. Because the display is not turned on during this momentary operation, the user is unaware of it happening and the logger appears to be asleep.

Returning to Sleep

The logger returns to sleep as follows:

- **Immediately**
  The logger goes back to sleep immediately after
  - momentarily waking at the end of every sample period to make its scheduled measurements;
  - its DCD input goes low (see section 1-5).

  And if the main battery is due to be replaced, the logger stays awake for an additional 5 seconds to flash its replace main battery warning before returning to sleep.
- **After 10 Seconds**
  The logger automatically goes back to sleep 10 seconds after waking
  - if no front-panel button has been pressed for 10 seconds and its DCD input is low (no RS-232 activity);
  - if the logger is in battery failure mode. (The battery failure alert flashes for 10 seconds, then the logger goes to sleep.)

Always Awake when Connected Directly to a Computer — Except when using DeTerminal

When connected to a modem, the logger wakes automatically to receive an RS-232 communication (initiated by the logger's DCD or RI line going high) and returns to sleep when the line goes low. But when connected directly to a computer, the logger stays awake as long as it is connected and the computer is turned on (that is, as long as the logger's DCD input is held high).

RECOMMENDATION *Therefore, to maximise the life of the logger's main battery, avoid long periods of direct connection to a powered computer.*

NOTE There are communications software packages which, when quit, let the logger sleep even though the computer is connected and running. Data Electronics' "DeTerminal" is one of these.

Table 2: Power Supply Alerts

Alert		Cause/ Trigger	When Seen	Alert Duration
StArtUP 1 FLASHING MESSAGE	BOTH BATTERIES FAILED Both batteries — main *and* backup — were disconnected or became discharged for at least 10 seconds prior to this power-up. Therefore any data remaining in memory is corrupt, and all settings have been returned to their default values.	Logger was completely unpowered (no main battery or backup battery power for at least 10 seconds) prior to this power-up.	When main power supply re-applied.	10 seconds
- - - - - - - - STEADY HYPHENS	MAIN BATTERY FAILED Main battery was disconnected or discharged prior to this power-up. Backup battery OK. Log(s) incomplete (ended with the last valid sample period prior to main battery failure).	Main battery disconnected or discharged.	When main power supply re-applied.	10 seconds
- - - - - - - - FLASHING HYPHENS	MAIN BATTERY DUE FOR REPLACEMENT	BatNew date ≥ today's date.	Every time logger wakes (button press, RS-232 communication, and end of every sample period) until main battery is replaced.	5 seconds
bAt FAI L FLASHING MESSAGE	MAIN BATTERY FAILURE IS IMMINENT	Main supply voltage <9.4V.	When logger detects main supply voltage <9.4V. (Logger then enters battery failure mode.)	10 seconds

Power Supply Alerts

The DT300 and DT350 use their front-panel displays to alert you to four main power supply occurrences:

- Both batteries failed (main and backup batteries).
- Main battery failed.
- Main battery is due for replacement.
- Main battery failure is imminent.

They are summarised in Table 2 and discussed in detail in section 6-4.

Power Supply Records

The DT300 and DT350 maintain four useful records concerning their main power supplies:

- Time and date of the last main battery failure (BatFail)
- Time and date of the last main battery replacement (BatDate)
- Expected life of main battery (BatLife)
- Recommended time and date for replacing the main battery (BatNew)

They are shown in the figure "Power Supply Records" below, summarised in Table 3, and explained in detail in section 6-4.

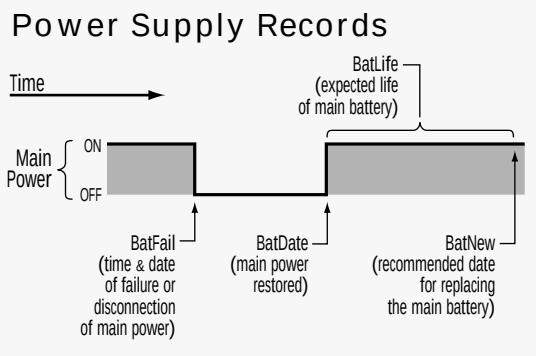


Table 3: Power Supply Records

Record		READ by Sending...	SET by Sending...	
BatFail Last Battery Failure	Time & date of the end of the last sample period before main power supply disconnection or failure	BATTERYFAIL↵	Initialise BatFail and BatDate by sending SETBATTERYFAIL↵ (sets BatFail & BatDate to logger's current time & date; logger re-calculates BatNew)	
BatDate Last Battery Replacement	Time & date of last main power supply re-connection	BATTERYDATE↵		
BatLife Battery Life	Expected life of main battery (months)		SETBATTERYLIFE=nn↵	Set by user (default = 12) Updates BatNew
BatNew New Battery Replacement	Recommended time & date for replacing main battery	BATTERYNEW↵		Logger calculates: BatNew = BatDate + BatLife Display Alert: Flashing hyphens when BatNew ≥ today's date

Safe Data: Battery Replacement Mode

If a logger's main power supply is disconnected at certain times during the operating cycle (in particular, at the moment a logger writes data to its internal memory), it is possible for the rainfall log to become corrupted.

To safeguard against this, the logger has a "battery replacement mode". Once you put the logger in this mode, you can safely remove and replace the main battery (or power supply) without endangering the stored data.

Use of battery replacement mode is explained in section 6-1.

NOTE Similarly, it is also safe to disconnect the main power supply when the logger is is battery failure mode (see section 6-5).

1-5 RS-232 Communications

Both the DT300 and DT350 have an RS-232 interface to enable communication with a computer (called the "host" computer) or a Data Electronics' Memory Card Interface (MCI). The RS-232 connection can be

- via a pair of modems, using one communications cable (also called a "comms cable" or "serial cable") between the logger and its modem, and a second comms cable between the computer and the other modem;
- via one comms cable connected directly between the logger and the computer (or MCI).

You use this link to supervise the logger *from* the computer, and to transfer logged data *to* the computer or card reader.

The DT300 and DT350 are typical DTE (Data Terminal Equipment) devices. The front panel is fitted with a male DE-9 connector (9-pin D-shaped connector).

Communications Cables

Communication with the logger requires the following cables:

- If a pair of modems is to be used between the logger and the computer — two *straight-through* RS-232 comms cables.
- If the logger is to be connected directly to the computer (no modems) — one special comms cable, a type of *null-modem* cable, called a *DT300/350 comms cable* in this manual.

Appendix 3, "DT300 and DT350 RS-232 Serial Port", contains details of these cables.

WARNING Be sure to use the correct cable. A cable that is incorrectly wired can cause the logger to remain awake unnecessarily and therefore waste the main battery.

Protocol and Handshaking

The loggers use

- XON/XOFF software flow control;
- DCD (Data Carrier Detect), DTR (Data Terminal Ready) and RI (Ring Indicator) handshaking to wake the logger, identify the device and manage the flow of data (see "RS-232 Management" in appendix 3).

Requirements for Waking the DT300 and DT350

The communications software you use must be able to wake the loggers. Here's how to do it:

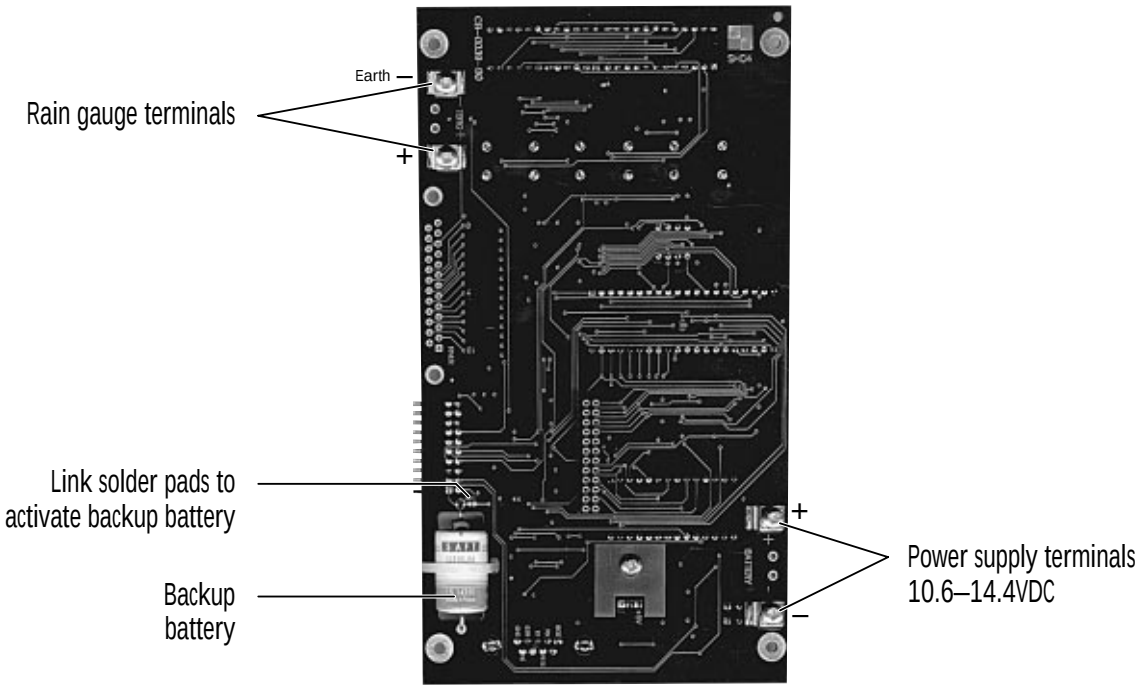
- **Logger to Computer**
  When a logger is connected directly to the computer (no modem), the communications software you use must be capable of raising the computer's DTR output because this is how the logger is awakened and kept awake. (The DT300/350 comms cable connects the computer's DTR output to the logger's DCD input, thereby controlling the logger's sleep mode.)

  Data Electronics' DeTerminal is one software package that does this. In addition, DeTerminal lowers DTR at the end of a communication session (when you quit DeTerminal), allowing the logger to go to sleep.
- **Logger to Modem**
  When a logger is connected to a modem (straight-through comms cable), the logger wakes on receipt of an RI signal from the modem and raises the DTR line to logical 1. The modem responds by raising the DCD line, which holds the logger awake and enables communication with the modem.

This is discussed in more detail in "RS-232 Management" in appendix 3.

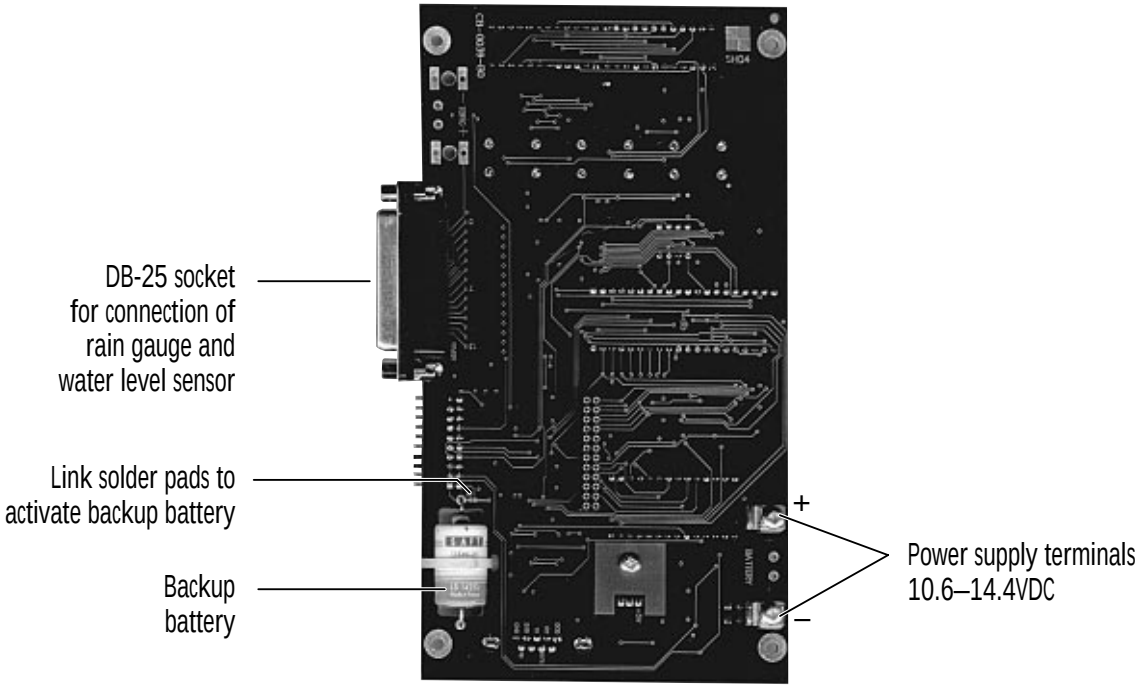
NOTE When using DeTerminal software to communicate with the DT300 or DT350, *ensure that DeTerminal's wake mode is OFF*. (Wake mode is toggled on/off by pressing the ALT F2 key combination.) DeTerminal's wake mode is a different function to that described above (raising the computer's DTR) and is not supported by the DT300 or DT350.

DT300 Connections



Rear view of DT300 circuit board

DT350 Connections



Rear view of DT350 circuit board

Part B

Initial Set-Up

Set up the DT300 Rainfall Logger and the DT350 Rainfall and Water Level Logger for their first use as described in this part.

You must firstly install the logger (section 2), then carry out initial configuration (section 3).

Checklist

To set up and operate a DT300 or DT350 you need

- the DT300 or DT350 module — this consists of a circuit board (including lithium backup battery) and a front panel;
- a 10.6–14.4VDC power supply with flying leads to connect to the screw terminals on the logger's circuit board;
- a tipping-bucket rain gauge and/or a continuous-type water level sensor;
- DT350 only: cable and a DB-25 plug to connect the rain gauge (2-wire) and/or water level sensor (up to 14-wire) to the logger;
- a soldering iron and solder to activate the lithium backup battery;
- an enclosure to house the logger module and the main battery — ideally, the enclosure should be weatherproof, robust and lockable, with a weatherproof entry for the cable from the rain gauge;
- fixings to mount the rain gauge, water level sensor and the enclosure, and to mount the logger module inside the enclosure;
- a computer and appropriate RS-232 communications software;
- a communications link between the computer and your logger (this can be any RS-232 medium — a cable, telephone modems or radio modems, for example);
- this manual.

2 Installation

Follow the steps in this section — in the order in which they're presented — to install the DT300 Rainfall Logger or the DT350 Rainfall and Water Level logger. Then go to section 3 to learn how to configure the logger ready for its first use.

2-1
Activate the Backup Battery

The loggers are supplied with their lithium backup battery in place, but disconnected.

To activate the backup battery:

a) Use a soldering iron and solder to form a bridge across the two small solder pads (labelled LINK) beside the + end of the backup battery.

   The location of the pads is shown in the "Connections" figures on the previous page.

The instruction above is for making the *initial* connection of the backup battery to a logger — that is, to a logger that has not yet been powered in any way. To *replace* the backup battery of a logger that has already been powered, configured and logging, see section 6.3).

2-2
Select the Location and Mount the Logger

Wherever possible, locate the logger indoors so that the front-panel buttons, the display and the RS-232 port can be accessed comfortably and the power supply can be serviced readily. Ensure adequate access for the cable from the rain gauge and/or water level sensor.

The logger is designed to be mounted vertically, out of direct sunlight and away from moisture. Therefore we recommend the use of a weatherproof, lockable, steel cabinet.

2-3
Connect the Sensor(s)

DT300 To connect the tipping-bucket rain gauge, you connect the two wires from the gauge to the screw terminals on the rear of the logger's circuit board.

DT350 To connect the tipping-bucket rain gauge and the water level sensor, you solder their wires to a single DB-25 plug, which you then insert into the DB-25 socket on the side of the logger's circuit board.

The rain gauge terminals are designed for voltage-free, normally-open operation only.

DT300 Only

Connect the Rain Gauge

a) Connect the two wires from the rain gauge to the screw terminals marked + and – on the rear of the logger's circuit board (see the figure "DT300 Connections" at the beginning of part B of this manual).

Each terminal is fitted with a rectangular clamp/guide plate under the screw head. Slide each wire between this plate and the base of the terminal, then tighten the screw.

NOTE If one side of the rain gauge is grounded, connect the ground side to the – (uppermost)terminal. This will minimise possible ground-loop problems which may arise when, say, a computer is connected to the logger.

DT350 Only

Connect the Rain Gauge

a) If you're using a tipping bucket rain gauge with the DT350, feed its two wires into the enclosure.

b) Solder them to pin 23 (or 11 or 24) and pin 12 (or 25 or 13) of the DB-25 sensor connector as shown in appendix 2 "DT350 Sensor Connector Specifications".

NOTE If one side of the rain gauge is grounded, connect the ground side to pin 12 (or 25 or 13). This will minimise possible ground-loop problems which may arise when, say, a computer is connected to the logger.

Connect the Water Level Sensor

c) If you're using a water level sensor with the DT350, feed its wires into the enclosure.

d) Solder the sensor's signal wires to pins 2–8 and 15–21 of the DB-25 sensor connector (see appendix 2).

Connect the sensor's least significant bit to pin 21 and continue in sequence down the connector.

NOTE The DT350 assumes unused water level inputs to have the value 1 (high). Therefore, if the water level sensor has fewer than 14 bits, solder the unused high-order bits to ground when assembling the DB-25 plug.
This situation also occurs when the sensor cable is not connected to the DT350.

e) Solder the sensor cable's screen to ground (pins 1, 14, 9, 22, 10, 12, 25, or 13).

Insert the Sensor Connector

f) Plug the sensor connector you've just assembled into the DB-25 socket on the right-hand side of the DT350 circuit board.

2-4
Connect the Main Power Supply

The instructions in this section are only for the *INITIAL* connection of power to the DT350 — that is, to a previously un-powered logger. (If the logger has been in use already and contains stored data, go to section 6-1 of this manual for a complete description of the procedure for replacing the main supply without losing data.)

To connect the main power supply (a battery or a mains adaptor, for example):

a) Connect the supply's leads to the BATTERY screw terminals on the rear of the logger's circuit board (see the figure "DT350 Connections" at the beginning of part B). *The polarity is important — connect the supply positive to the terminal marked +, and the supply negative to the terminal marked –.*

   Each terminal is fitted with a rectangular saddle clamp. Slide each wire between the base and the saddle of the terminal, then tighten the screw.

b) If applicable, turn the power supply on.

   When power is first applied, the logger displays the following message, which verifies that power has been applied:

3 Initial Configuration

Next, follow the steps in this section to configure the DT300 or DT350 ready for its first use.

3-1 Set Time & Date

Having mounted the logger and connected the sensor(s) and batteries, you now set the logger's time and date to the actual time and date of the location where the logger is installed.

You must do this so that your records accurately reflect what really happened at a particular time on a particular date at the logger's location.

To set the logger's time and date:

a) Follow the steps in sections 4-2.1 to 4-2.3 of this manual to set the time and date from the logger's front panel, or use the commands in sections 5-2.18 and 5-2.19 to set the time and date using a computer connected to the logger.

3-2 Change Default Settings (Optional)

The loggers have the following default settings:

Day start (rainfall & water level logging)	08:00 hours
Baud rate	1200
Station ID	00000
Sample period	5 minutes
Bucket size	0.1 millimetres
Battery life record (BatLife)	12 months
Water level sensor type (DT350 only)	Gray
Reference height (DT350 only)	0000.00 metres

To change any of these, do so now by referring to the front panel configuration instructions in section 4-2 or the appropriate computer commands in section 5-2 of this manual — except for BatLife and reference height, which are discussed in the next two topics.

3-3
Initialise Battery Records

Because the DT300 and DT350 are supplied with both main power and the backup battery disconnected, you must initialise the last battery failure record (BatFail) and the last battery replacement record (BatDate) to the logger's current time and date. You do this to make BatFail, BatDate and the resulting new battery replacement record (BatNew) accurate and meaningful. (These records were introduced under "Main Battery Records" in section 1-4.)

Also, if the logger becomes completely unpowered at any time in the future (that is, with no backup battery and no main power supply), you must carry out this procedure again once power is reinstated.

Here is the procedure:

a) Make sure that the logger has a main power supply connected and turned on.

b) Set time and date, and change any default settings as described in topics 3-1 and 3-2.

c) If you have not already done so, connect a computer to the logger's RS-232 port (see 5-1) in preparation for sending commands to the logger. (You can only do the following steps from a computer.)

d) If you want the logger's BatLife record to have a value other than the default (12 months), set it now using the SETBATTERYLIFE= command as explained in section 5-2.30 of this manual.

NOTE If the logger is powered from an "unlimited" supply (for example, a mains adaptor, not a battery), we recommend that you set BatLife to its maximum value of 99 so that the BatNew (New Battery Replacement date) alert does not appear on the logger's display. (Actually, it will appear 99 months after the last battery replacement date, BatDate.)

e) Finally, initialise the logger's main battery records by sending the SETBATTERYFAIL command as described in section 5-2.26.

3-4
Set Reference Height (DT350 Only)

If you are using a DT350 to measure water level, set the reference height now as described in section 4-2.8 (from the logger's front panel) or section 5-2.22 (from a computer).

DT300

DT350

DT300

DT350

Part C

Operation

This section explains in detail the two ways of operating the DT300 and DT350 loggers — from the front panel, and from a computer connected to the logger.

From the Logger's Front Panel

Using the three push buttons and the display on the logger's front panel you can

- view the logger's time, date and rainfall record address;
- view today's and yesterday's summary rainfall data;
- view today's and yesterday's summary water level data (DT350);
- copy all the data stored in the logger's rainfall memory to a computer via the RS-232 port;
- copy all the data stored in the logger's rainfall and water level memories to a computer via the RS-232 port (DT350);
- view and configure most of the logger's internal settings;
- clear the rainfall log (DT300);
- clear the rainfall log, the water level log, or both (DT350);
- put the logger in battery replacement mode.

From a Computer

You can link a computer running communications software to the logger's RS-232 port by cable, modems and even satellite. Then, using commands from the computer, you can

- obtain today's and yesterday's summary data;
- copy the rainfall log to the computer via the logger's RS-232 port (DT300);
- copy the rainfall log, the water level log, or both logs to the computer via the logger's RS-232 port (DT350);
- view and configure most of the logger's internal settings;
- clear the rainfall log (DT300);
- clear the rainfall log, the water level log, or both (DT350);
- view and set the logger's battery records;
- view general and diagnostic information about the logger.

4 Operation from the Front Panel

The logger front panel contains an 8-digit display, three press buttons and an RS-232 communications connector.

Four Operating Modes

The DT300 and DT350 have four modes of operation:

- Normal mode — logging, reporting today's and yesterday's summary data, and copying both logs to computer
- Configuration mode
- Battery replacement mode
- Battery failure mode

Operating Mode 1: Normal Mode

In normal mode, the DT300 and DT350 spend most of the time asleep: the display and other functions are inactive while the DT300 counts bucket tips, and the DT350 counts bucket tips and measures water level as scheduled. Then, at the end of each period, the loggers store the results in memory.

In normal mode, you can wake a logger by pressing any of the three buttons on the front panel. These enable you to view the logger's internal settings and today's and yesterday's summary data, and send the logs via the RS-232 port. These operations are described in section 4-1 below and summarised in the figures "Operation from the Front Panel: DT300 Normal Mode" and "Operation from the Front Panel: DT350 Normal Mode" overleaf.

You can also wake the logger by pressing the two outer buttons simultaneously (that is, by pressing both buttons at the same time). This special button action puts the logger into configuration mode.

Operating Mode 2: Configuration Mode

In configuration mode, the logger is awake and the three buttons are used to view and modify most of the logger's internal settings, as well as clear the logs. This is explained in section 4-2 below and summarised in the figures "Operation from the Front Panel: DT300 Configuration Mode" and "Operation from the Front Panel: DT350 Configuration Mode".

You know when the logger is in configuration mode — one of the parameters on the display flashes.

The logger does not stop logging when you put it in configuration mode. It continues to count and log while you view and alter its settings. In particular, when you alter parameters like time, date, bucket size or sample period, the logger immediately records the time and counts so far in the sample period, changes the internal settings as required, and then begins another short sample period of suitable length to re-synchronise itself with the current sample period timing. In short, no data is lost, and when you use the UNLOAD command to retrieve the rainfall log in tabular format, an information character is included to indicate the time and type of event.

Operating Mode 3: Battery Replacement Mode

When you put the logger in battery replacement mode, it is effectively "frozen" to allow you to disconnect and reconnect the main power supply without losing data or configuration settings. This mode is explained fully in section 6-1.

Operating Mode 4: Battery Failure Mode

As a precaution against losing data from the current sample period, the DT300 and DT350 monitor the voltage at their main supply terminals (even when in sleep mode). If the voltage falls below 9.4V, the logger automatically enters "battery failure mode":

- If awake, the logger flashes a battery failure alert for 10 seconds and then carries out a controlled shutdown.
- If asleep, the logger simply carries out a controlled shutdown.

In battery failure mode, all monitoring and logging ceases to conserve remaining battery energy until the supply is returned to an acceptable level (by fitting new batteries, for example).

The controlled shutdown ensures that all existing logged data is safely stored, including data from the current sample period.

Battery failure mode is described fully in section 6-2.

Display Error Messages

The logger does not accept invalid settings. Moreover, it warns you if, say, you try to set the date to 31 September (September only has 30 days) by showing the letter E flashing in the display.

4-1 Normal Mode

In normal mode, the three buttons on the front panel of the logger allow you to do the following:

DT300

- Basic reporting
  - Time
  - Date
  - Rainfall record address
  - Today's rainfall
  - Yesterday's rainfall
  - Today's hourly rainfall summaries
- Data transfer
  - Copy rainfall data to a computer in raw format

DT350

- Basic reporting
  - Time
  - Date
  - Rainfall record address
  - Today's rainfall
  - Yesterday's rainfall
  - Water level now
  - Water level at day start
  - Water level yesterday — average
  - Water level yesterday — maximum
  - Water level yesterday — minimum
  - Today's hourly rainfall summaries
- Data transfer
  - Copy rainfall and water level data to a computer in raw format

These operations are summarised in the figures overleaf and explained in detail below.

4-1.1 Time Button: Reading Time, Date and Rainfall Record Address

DT300 and DT350

a) Press the Time button once.

The logger displays its current time.

Time

b) Press the Time button again (within 10 seconds of the first press or the logger will go to sleep).

The logger displays its current date.

Date

c) Press the Time button a third time (within 10 seconds of the previous press).

The logger displays its current rainfall record address.

Current rainfall record address

d) Repeated pressing of the Time button cycles you through the three screens above, as indicated by the circular arrow on the logger's front panel.

e) Allow the logger to go to sleep (wait 10 seconds without pressing a button) or continue with more button operations.

4-1.2 Today Button: Reading Today's Rainfall, Current Water Level and Water Level at Day Start

DT300 and DT350

a) Press the Today button.

The logger displays the total rainfall it has recorded so far today (beginning from 08:00), in millimetres.

Today's rainfall

DT350 Only

b) Press the Today button again (within 10 seconds of the first press or the logger will go to sleep).

The logger takes an instantaneous water level reading and displays this value, the *current water level* in centimetres.

Current water level

c) Press the Today button a third time (within 10 seconds of the previous press).

The logger displays the water level reading taken at day start (00:00 or 08:00, set during configuration).

Water level at day start

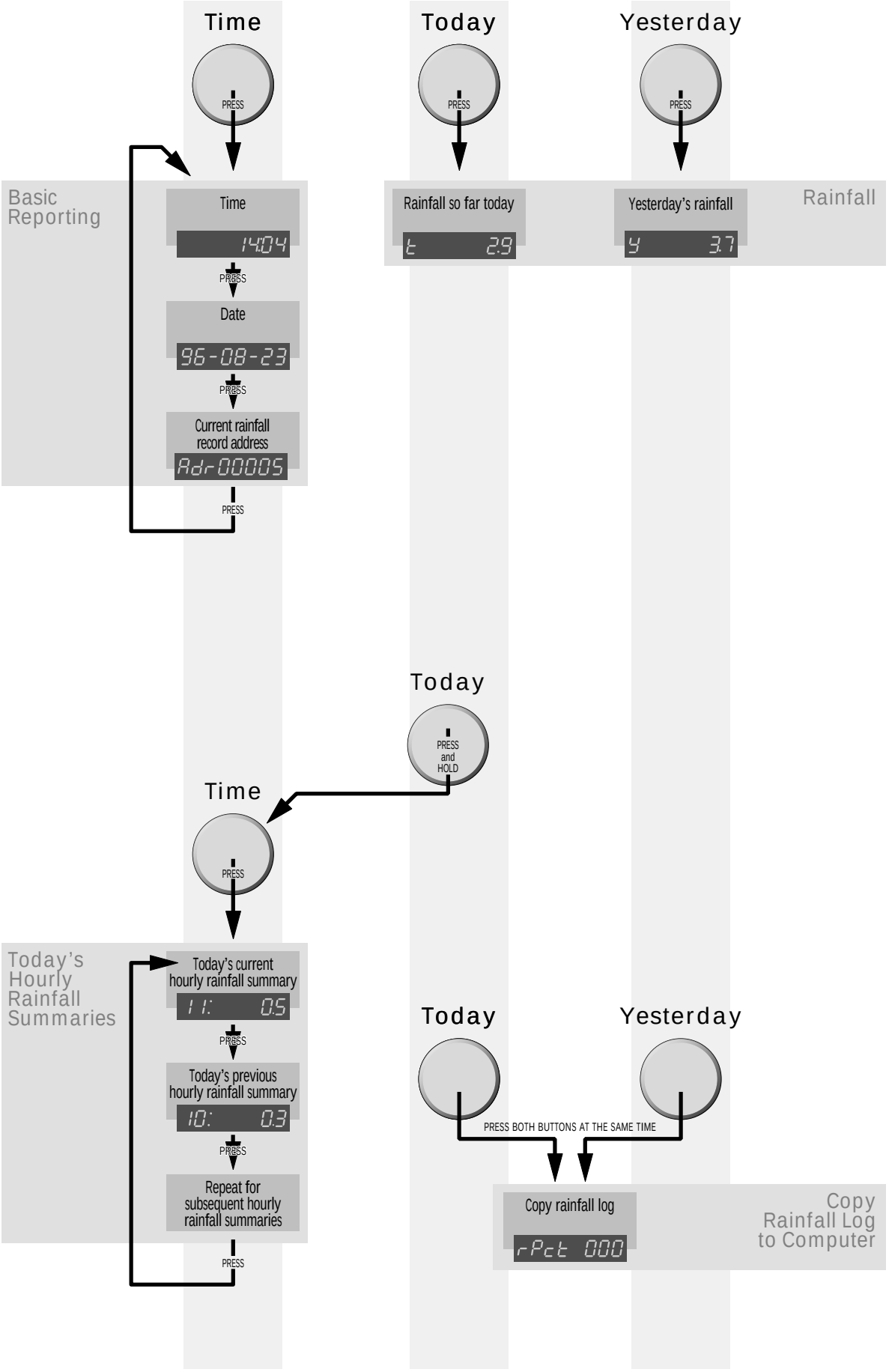
d) Repeated pressing of the Today button cycles you through the three screens above, as indicated by the circular arrow on the logger's front panel.

DT300 and DT350

e) Allow the logger to go to sleep (wait 10 seconds without pressing a button) or continue with more button operations.

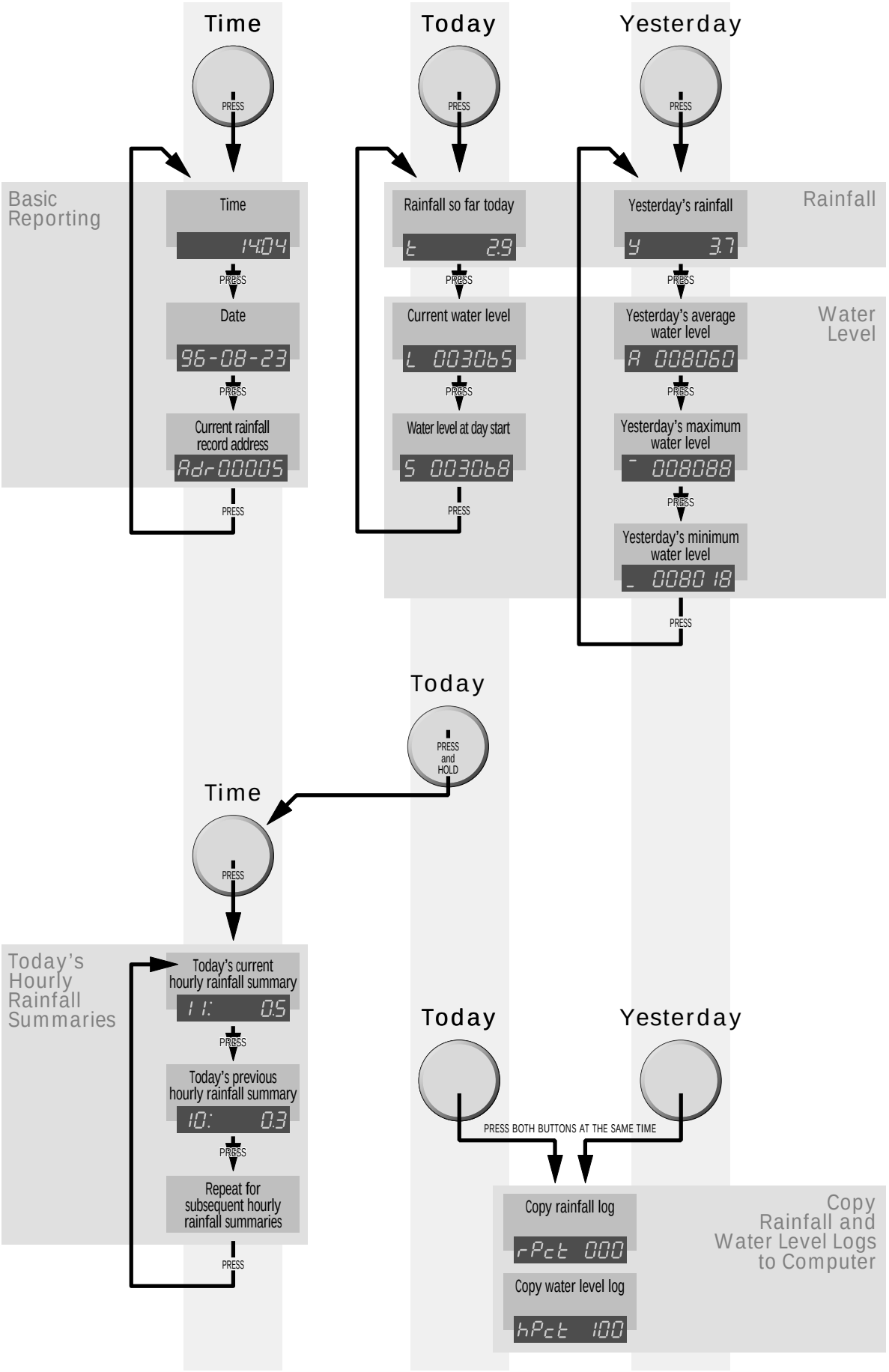
Operation from the Front Panel:

DT300 Normal Mode



Operation from the Front Panel:

DT350 Normal Mode



4-1.3 Yesterday Button: Reading Yesterday's Total Rainfall and Yesterday's Average, Maximum and Minimum Water Levels

DT300 and DT350

a) Press the Yesterday button.

The logger displays yesterday's total rainfall in millimetres.

Yesterday's rainfall

DT350 Only

b) Press the Yesterday button again (within 10 seconds of the first press or the logger will go to sleep).

The logger displays yesterday's average water level in centimetres.

Yesterday's average water level

c) Press the Yesterday button a third time (within 10 seconds of the previous press).

The logger displays yesterday's maximum water level in centimetres.

Yesterday's maximum water level

d) Press the Yesterday button a fourth time (within 10 seconds of the previous press).

The logger displays yesterday's minimum water level in centimetres.

Yesterday's minimum water level

d) Repeated pressing of the Yesterday button cycles you through the screens above, as indicated by the circular arrow on the front panel.

DT300 and DT350

e) Allow the logger to go to sleep (wait 10 seconds without pressing a button) or continue with more button operations.

4-1.4 Reading Today's Hourly Rainfall Summaries

Hourly Prefixes

Each hourly rainfall total is prefixed by the hour at which it ends. The day's prefixes are 09 (9:00am, the first prefix for the day), 10, 11, 12, 13 (1:00pm), 14, ..., 23, 24, 01 (1:00am), 02, ..., 07 and 08 (8:00am, the last prefix for the day).

When you request the summaries, the logger firstly displays the amount of rain that has fallen so far in the current period, prefixed by the next hour. For example, if you read the hourly rainfall summaries at 10:26am, the logger will firstly display the total rainfall so far for the current hourly logging period (10:00 to 10:26) prefixed by 11.

With subsequent button presses, the logger displays each previous hour's total ending with the day's first hourly total, which is prefixed with 09.

DT300 and DT350

a) Press *and hold* the Today button.

b) While holding the Today button down, press the Time button.

The logger displays the total rainfall for the current hour, in millimetres.

Hourly rainfall summary

c) Still holding the Today button down, press the Time button again.

The logger displays the total rainfall for the previous hour.

Previous hourly rainfall summary

d) Repeated pressing of the Time button (while holding the Today button down) cycles you back through all the hourly rainfall totals for today.

e) Allow the logger to go to sleep (wait 10 seconds without pressing a button) or continue with more button operations.

4-1.5 Copying the DT300 Rainfall Log to a Computer

This section describes how to use the buttons on the DT300 front panel to send a copy of the rainfall data stored in the logger's memory to its RS-232 port in raw format. A computer running communications software in capture mode, or a serial printer connected to the logger's RS-232 port, can receive the raw rainfall data.

The method described below is one of two ways of retrieving the log from the logger in one operation. (Sending the DUMP command from a computer connected to the logger is the other method.)

You can copy (dump) the raw rainfall log as many times as you wish. The data stays in the logger's memory until you clear it.

Typical times taken for the logger to dump the total contents of its rainfall memory (completely full) in raw format are

1200 baud	15 minutes
9600 baud	3 minutes.

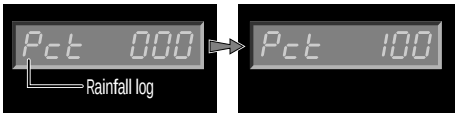
To carry out the dump:

a) Connect a computer to the logger's RS-232 port (see appendix 3) and prepare it to receive a transmission from the logger by running suitable RS-232 comms software.

b) Momentarily press the logger's two right-hand buttons (Today and Yesterday) simultaneously.

This initiates a dump of the entire rainfall log to the DT300's RS-232 port, from where it is automatically transmitted to the waiting computer.

The DT300's display shows the percentage (Pct) of each of the rainfall logs sent, beginning at 000% and ending at 100%.



NOTE If the RS-232 link is not intact (for example, a faulty cable or unsuitable software), pressing the two buttons does nothing.

c) Wait for the log to be sent.

Pressing any button on the logger or sending any character from the computer stops the transmission.

4-1.6 Copying the DT350 Rainfall and Water Level Logs to a Computer

This section describes how to use the buttons on the DT350 front panel to send a copy of the rainfall data and the water level data stored in the DT350's memory to its RS-232 port in raw format. A computer running communications software in capture mode, or a serial printer connected to the logger's RS-232 port, can receive the raw rainfall and water level data.

The method described below is one of two ways of retrieving both logs from the logger in one operation. (Sending the DUMPALL command from a computer connected to the logger is the other method.)

You can copy (dump) the raw rainfall and water level logs as many times as you wish. The data stays in the logger's memory areas until you clear them.

Typical times taken for the logger to dump the total contents of its rainfall memory and water level memory (both completely full) in raw format are

1200 baud	50 minutes
9600 baud	10 minutes.

To carry out the dump:

a) Connect a computer to the logger's RS-232 port (see appendix 3) and prepare it to receive a transmission from the logger by running suitable RS-232 comms software.

b) Momentarily press the logger's two right-hand buttons (Today and Yesterday) simultaneously.

This initiates a dump of the entire rainfall log, followed by the entire water level log, to the DT350's RS-232 port, from where it is automatically transmitted to the waiting computer.

The DT350's display shows the percentage (Pct) of the rainfall then water level logs sent, beginning at 000% and ending at 100%.

NOTE If the RS-232 link is not intact (for example, a faulty cable or unsuitable software), pressing the two buttons does nothing.

c) Wait for the logs to be sent.

Pressing any button on the logger or sending any character from the computer stops the transmission.

4-2
Configuration Mode

This section explains how to use the three buttons on the front panel to configure the DT300 and DT350. The figures overleaf present this information in quick-reference form.

General Procedure

In general terms, here's how you view and change the logger's internal settings using its front panel:

❶Firstly, you enter the configuration mode by pressing the two outer buttons at the same time.

❷Next, you use the left button to select the parameter you wish to view or modify (hours, minutes, year, month,…) — the selected parameter flashes.

❸Then, you use the other two buttons to modify the parameter — the `Today` button increases its setting and the `Yesterday` button decreases its setting.

If you wish to check or change other settings, repeat steps ❷ and ❸ above before going on to step ❹.

If you take longer than 10 seconds between button presses, the logger will go to sleep (changes will be kept) and you'll have to start again from step ❶ to view or modify more parameters.

❹Check all settings by repeatedly pressing the left button.

❺When you're satisfied that all settings are as you want, save them by leaving the configuration mode. You do this either by allowing the logger to go to sleep (don't press any buttons for 10 seconds), or by once again pressing the two outer buttons together. See the next topic "Saving Settings" for more detail.

Saving Settings

There are three ways of saving any changes you make to the logger's settings:

- **Move to the next screen.**
  Any changes you make to the logger's settings are saved at the moment you move to the next screen (for example, when you move from the last time parameter to the first date parameter).
- **Leave the configuration mode manually (by pressing both outer buttons simultaneously).**
  This causes all changes to be saved; even a newly-entered value still flashing on the display.
- **Leave the configuration mode by allowing the logger to go to sleep.**
  This also causes all changes to be saved; even a newly-entered value still flashing on the display.

NOTE To safeguard against accidental clearing of the DT300's rainfall log and the DT350's rainfall and water level logs, there is an exception to the above methods of saving changes: for the clear operations, waiting for the logger to go to sleep when `clr YES` is displayed does *NOT* cause the logger to be cleared. The only ways to clear rainfall memory, clear water level memory or clear both memories together are to

- Move to the next screen (press the left button when `clr YES` is displayed).
- Leave the configuration mode manually (press both outer buttons simultaneously when `clr YES` is displayed).

Changing the Date

We recommend that you take care in setting the logger's date when the day number is about to change to the next day (that is, near midnight). For example, if on 98-08-13 you enter 94-08-14 just *prior* to the logger's time passing through midnight, the logger will increment the date to 94-08-15 at midnight — one day ahead of the real date.

Remember To save any changes you have made, be sure to move to the next setting. That is, to the next screen, not just to the next parameter within a screen.

Remember If you take longer than 10 seconds between button presses, the logger will go to sleep. You then have to re-enter the configuration mode to view or modify other parameters.

4-2.1 Enter Configuration Mode

DT300 and DT350

a) Press the two outer buttons at the same time.

The logger wakes and displays its current time, with the hours flashing ready for you to edit.

4-2.2 Set the Time

DT300 and DT350

a) To alter the hours parameter, use the Today or Yesterday button(s) to choose a new value (00↔23).

b) Press the left button to select minutes. Use the Today or Yesterday button(s) to choose a new value (00↔59).

c) Press the left button to move to the next screen.

This action stores the new time in the logger's memory and selects the next parameter, the year.

4-2.3 Set the Date

DT300 and DT350

The year is selected (flashing).

a) Use the Today or Yesterday button(s) to modify the year value (94↔00↔24).

b) Press the left button to select the month. Use the Today or Yesterday button(s) to modify the month value (01↔12).

c) Press the left button to select the day. Use the Today or Yesterday button(s) to modify the day value (01↔31).

d) Press the left button to move to the next screen.

This action stores the new date in the logger's memory and selects the next parameter, clear rainfall log.

4-2.4 Clear the DT300 Rainfall Log

DT300 Only

The clear rainfall parameter (clr) is selected (no is flashing).

a) Use the Today or Yesterday button(s) to select either no or YES.

WARNING When clr YES is displayed, moving to the next screen or manually leaving the configuration mode (pressing the two outer buttons at the same time) causes the logger's rainfall memory to be erased. Make sure this is what you really want to do before going to the next step.

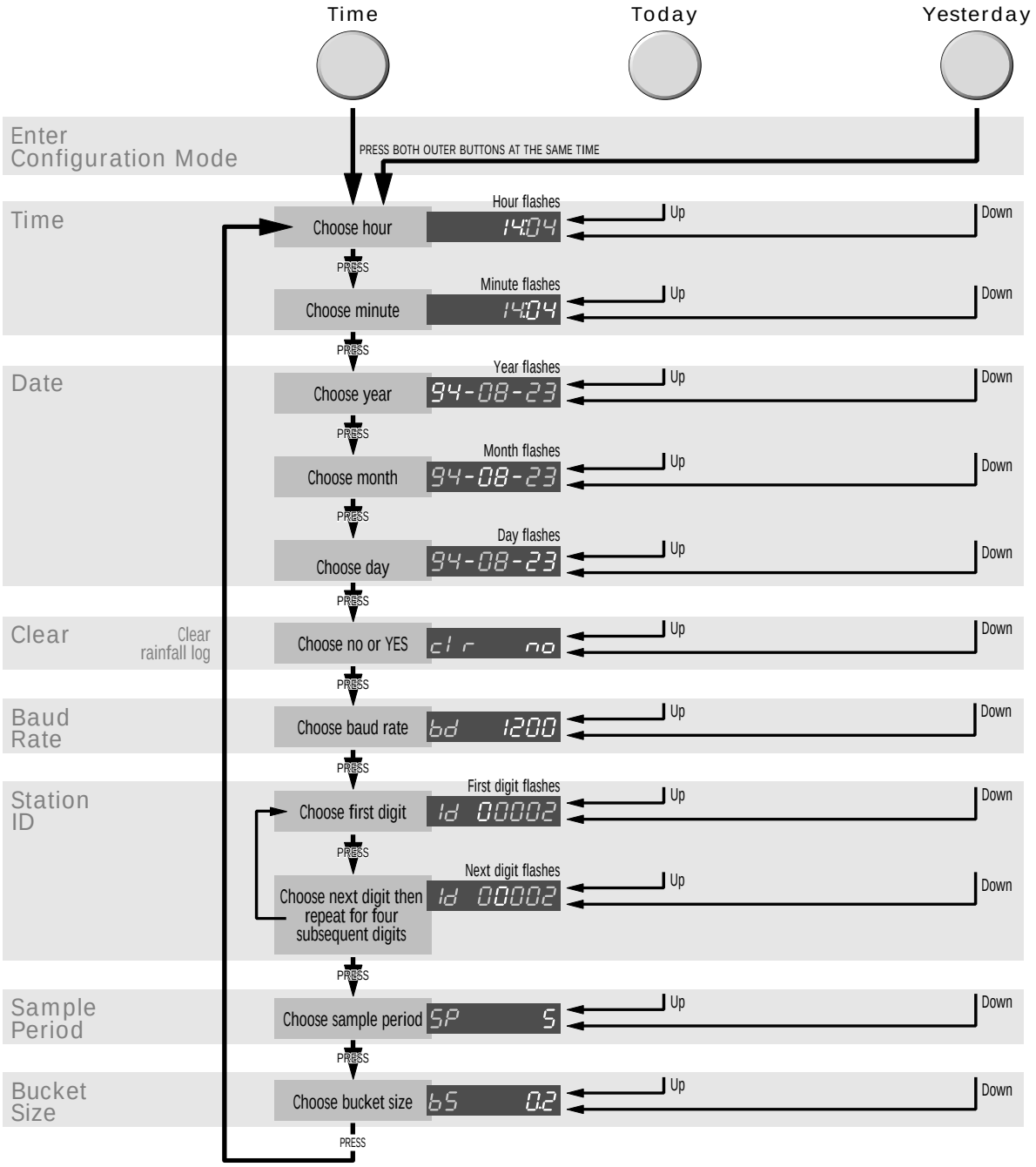
b) Press the left button to move to the next screen.

If clr YES was displayed, this clears the logger's memory of all rainfall data and selects the next DT300 parameter, baud rate.

Now go to topic 4-2.9, "Set Baud Rate", for the next DT300 instruction.

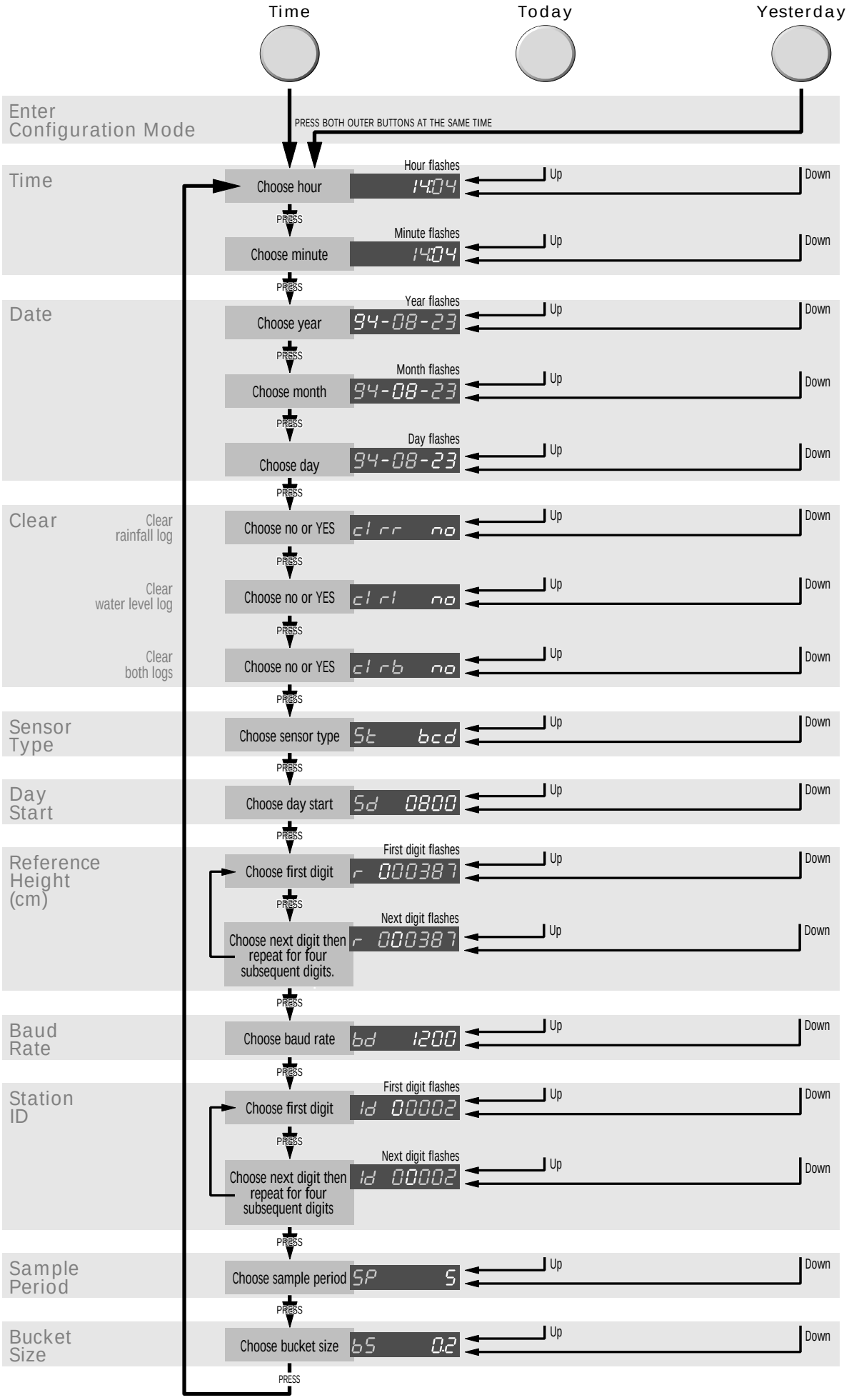
Operation from the Front Panel:

DT300 Configuration Mode



Operation from the Front Panel:

DT350 Configuration Mode



4-2.5 Clear the DT350 Rainfall Log, Water Level Log or Both Logs

DT350 Only

The clear rainfall parameter (clrr) is selected (no is flashing).

a) Use the Today or Yesterday button(s) to select either no or YES.

WARNING When clrr YES is displayed, moving to the next screen or manually leaving the configuration mode (pressing the two outer buttons at the same time) causes the DT350's rainfall memory to be erased. Make sure this is what you really want to do before going to the next step.

b) Press the left button to move to the next screen.

If clrr YES was displayed, this clears the logger's memory of all rainfall data and selects the next parameter, clear water level (clrl).

c) Use the Today or Yesterday button(s) to select either no or YES.

WARNING When clrl YES is displayed, moving to the next screen or manually leaving the configuration mode (pressing the two outer buttons at the same time) causes the DT350's water level memory to be erased. Make sure this is what you really want to do before going to the next step.

d) Press the left button to move to the next screen.

If clrl YES was displayed, this clears the logger's memory of all water level data and selects the next parameter, clear both (clrb).

e) Use the Today or Yesterday button(s) to select either no or YES.

WARNING When clrb YES is displayed, moving to the next screen or manually leaving the configuration mode (pressing the two outer buttons at the same time) causes the DT350's rainfall and water level memories to be erased. Make sure this is what you really want to do before going to the next step.

f) Press the left button to move to the next screen.

If clrb YES was displayed, this clears the logger's memory of all rainfall and water level data and selects the next parameter, water level sensor type.

4-2.6 Set Water Level Sensor Type

DT350 Only

The sensor type parameter (St) is selected (flashing).

a) Use the Today or Yesterday button(s) to choose the sensor type: Gray, BCD or Binary.

b) Press the left button to move to the next screen.

This selects the next parameter, day start for water level logging.

4-2.7 Set Day Start for Water Level Logging

DT350 Only

The day start parameter (Sd) is selected (flashing).

a) Use the Today or Yesterday button(s) to choose day start: 00:00 or 08:00.

b) Press the left button to move to the next screen.

This selects the next parameter, water level reference height.

4-2.8 Set Reference Height (Centimetres)

DT350 Only

The first digit of the water level reference height (r) is selected (flashing).

a) Use the Today or Yesterday button(s) to modify the first digit of the reference height (in centimetres).

b) Press the left button to select the next digit. Use the Today or Yesterday button(s) to modify the value.

c) Repeat step b) immediately above for the remaining digits of the reference height.

d) Press the left button to move to the next screen.

This selects the next parameter, baud rate.

4-2.9 Set Baud Rate

DT300 and DT350

The baud rate parameter (bd)is selected (flashing).

a) Use the Today or Yesterday button(s) to choose a new baud rate: 1200, 2400, 4800 or 9600.

b) Press the left button to move to the next screen.

This selects the next parameter, the first digit of the station ID.

4-2.10 Set Station ID

DT300 and DT350

The first digit of the station ID number (Id) is selected (flashing).

a) Use the Today or Yesterday button(s) to modify the first digit of the station ID number (0↔5).

b) Press the left button to select the next digit. Use the Today or Yesterday button(s) to modify the value (0↔9).

c) Repeat step b) immediately above for the remaining digits of the station ID.

d) Press the left button to move to the next screen.

This selects the next parameter, sample period.

4-2.11 Set Sample Period

DT300 and DT350

The sample period parameter (SP) is selected (flashing).

a) Use the Today or Yesterday button(s) to choose the sample period: one minute or five minutes.

b) Press the left button to move to the next screen.

This action stores the new sample period in the logger's memory and selects the final parameter, bucket size.

4-2.12 Set Bucket Size

DT300 and DT350

The bucket size parameter (bS) is selected (flashing).

a) Use the Today or Yesterday button(s) to choose the bucket size in 0.1 millimetre units.

WARNING When you change the logger's bucket size setting, be sure to change the actual physical bucket in the rain gauge at the same time (before the next bucket tip occurs), otherwise inaccuracies will result.

The next press of the left button will store the new bucket size in the logger's memory and return you to the first screen.

4-2.13 Check the Settings

DT300 and DT350

a) Press the left button repeatedly.

This returns you to the first screen and then continues through the others so you can check the settings and make any changes.

b) When you're sure all the parameters are as you want them, leave the configuration mode correctly as described next.

4-2.14 Leave Configuration Mode

DT300 and DT350

a) Finally, leave the configuration mode by pressing the two outer buttons at the same time, or by allowing the logger to go back to sleep.

NOTE You can leave the configuration mode at any point in the procedure above.

4-3
Battery Replacement Mode

Battery replacement mode is the logger's third operating mode. You use it to safeguard data stored in the logger when disconnecting the main power supply.

It is described fully in section 6-1 of this manual.

4-4
Battery Failure Mode

Battery failure mode is the logger's fourth operating mode. The logger puts itself into this mode when it detects that a failure of the main power supply is imminent (does a controlled shutdown to preserve battery power).

It is described fully in section 6-5 of this manual.

5 Operation from a Computer

You can link a computer running communications software to the logger's RS-232 port by cable, modems or even satellite. Then, using commands from the computer, you can

- obtain today's rainfall figure and yesterday's total rainfall figure;
- obtain current rainfall and water level addresses;
- obtain the current water level; yesterday's average, maximum and minimum water levels; and today's water level at day start;
- copy the rainfall log to a computer via the logger's RS-232 port (DT300);
- copy the rainfall log, the water level log, or both logs to a computer via the logger's RS-232 port (DT350);
- clear the rainfall log (DT300);
- clear the rainfall log, the water level log, or both (DT350);
- view and configure all of the logger's internal settings except baud rate;
- view and set the logger's battery records;
- view general and diagnostic information about the logger.

Section 5-2 describes the commands you use to perform these functions, grouped into data reporting commands, configuration commands and maintenance commands.

Section 5-1 provides important details for connecting the computer to the logger, section 5-3 is a quick reference to the error codes incorporated into the logger, and section 5-4 provides advice for creating command files to be sent to the logger.

Communications Cables

Communication with the logger, either via modem or directly to a computer, requires the appropriate RS-232 communications cable(s). See section 1.5 "RS-232 Communications" earlier in this manual for more details, and appendix 3 for the cable specifications.

Automatic Baud Rate Detection

The logger supports Data Electronics' proprietary method of automatic baud rate detection, so communications software that also has this feature (DeTerminal, for example) is able to automatically detect the logger's baud rate and adjust to suit.

5-1 Connect the Computer

Before you use a computer to configure a logger or to transfer data from it, either directly or via a pair of modems, make the communications link now.

Make the Comms Link

a) Make the logger-to-computer communications link (direct or via modems).

See appendix 3 for details of the cable(s) you require.

NOTE Be sure to use the right cable. Among other faults, a cable that is incorrectly wired may cause the logger to remain awake unnecessarily and therefore waste the main battery.

Match Baud Rates

b1) Direct Link (No Modems) Ensure that the computer and the logger are set to the same baud rate.

A simple way to do this is to leave the logger set to its default rate of 1200 baud and set the computer to the same value.

If you are using Data Electronics' DeTerminal software, the computer's baud rate is automatically set to that of the logger. You do nothing.

b2) Modem Link Each modem's baud rate must be the same as that of the device to which it is directly connected. That is, the baud rate of the computer and its modem must be the same, and the baud rate of the logger and the logger's modem must be the same. Do this as follows:

- **At the Computer End**
  The baud rate of the modem is automatically matched to that of the computer when the modem receives an AT command from the computer (ATDT…, for example). You do nothing.
- **At the Logger End**
  The logger does not send AT commands, therefore *you* must match the baud rates of the logger and its modem. A simple way to do this is to leave the logger set to its default rate of 1200 baud and configure the modem to the same value.

5-2 Commands

Using suitable RS-232 communications software — Data Electronics' DeTerminal, for example — the DT300 and DT350 recognise the commands described in this section and respond accordingly.

NOTE The commands are intentionally long to reduce the possibility of accidental activation over noisy RS-232 links.

Rules

- To give the logger adequate time to process each command, be sure to incorporate a time delay of at least 0.3 seconds between each command you send to the logger (also applies to single carriage returns — the "null command"). This delay is inherent when sending commands one-at-a-time from the computer keyboard. But when sending command files, you must include a pause between each line in the file — see section 5-4.
- Uppercase characters only.
- No space characters are allowed before, within or after a command (except the diagnostics commands; see 5-2.34 and 5-2.35).
- Leading 0s (zeros) are always required in date, time and other numeric commands.
- Commands must be terminated with a carriage return character as the delimiter (symbolised by ↵ throughout this manual).

Echo

The logger does not echo characters as they are typed.

Return and Line Feed Characters

The logger's response to any command ends with a carriage return character(↵) and a line feed character (←). These are included to place the computer's "invisible cursor" at the beginning of the next line ready for the next response. They are not visible on screen.

Waking the Logger

The terminal software you use for communication with the logger must be capable of waking the logger. Section 1-5, "Requirements for Waking the DT300 and DT350", covers this topic.

Wake Mode Off When Using DeTerminal

Data Electronics' DeTerminal software (V2.00 or later) incorporates a "wake mode", accessed by pressing the key combination Alt F2 when DeTerminal is running. When wake mode is on, DeTerminal automatically prefixes each transmission with a special character that makes sure the logger is awake.

WARNING *To maximise the life of the logger's main battery, do NOT use this wake mode when communicating with the DT300 or DT350 — make sure DeTerminal's wake mode is OFF.*

The commands are presented here in the same order as Table 1 at the start of this manual.

Data Reporting

5-2.1 Get Today's Rainfall (from 08:00 today)

DT300 and DT350

This command gets today's running total of rainfall (in millimetres) beginning from 08:00 today.

The command is

RAINTODAY↵

The logger responds with, for example,
0.6 mm↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **RAINTODAY↵**

5-2.2 Get Yesterday's Rainfall (24 hours from 08:00 yesterday)

DT300 and DT350

This command gets yesterday's total rainfall (in millimetres) — that is, the total rain that fell beginning from 08:00 yesterday until 08:00 today.

The command is

RAINYESTERDAY↵

The logger responds with, for example,
6.4 mm↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **RAINYESTERDAY↵**

The symbol ↵ represents <CR> (carriage return, ASCII 013, Hex D).
The symbol ← represents <LF> (line feed, ASCII 010, Hex A).

5-2.3 Get Current Rainfall Record Address

DT300 Only

This command gets a 5-digit number that is related to the number of rainfall records stored. The number increases each time a new rainfall record is stored in the DT300's memory.

The command is

ADDRESS↵

The DT300 responds with, for example,
AD 00345↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **ADDRESS↵**

The address can not be set by the user, only read. It automatically resets to 00000 after reaching its maximum of 65535.

5-2.4 Get Current Rainfall Record Address

DT350 Only

This command gets a 5-digit number that is related to the number of rainfall records stored. The number increases each time a new rainfall record is stored in the DT350's memory.

The command is

RAINADDRESS↵

The DT350 responds with, for example,
AD 00345↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **RAINADDRESS↵**

The address can not be set by the user, only read. It automatically resets to 00000 after reaching its maximum of 65535.

5-2.5 Dump Raw Rainfall Log

DT300 Only

This command causes the raw (does *not* include records of zero rainfall) rainfall log to be copied to the DT300's RS-232 port. Dumping can be stopped at any time by sending any character.

This command does not delete the rainfall log from memory.

The command is

DUMP↵

The DT300 responds with the raw data in rows of 16 bytes, each row prefixed by an address. For example:

```
0000:010100001100E00000000…
0010:0001011320B311CE8C00A…
0020:1400C9C9C9B6000B00CE1…
```

All data and addresses are in hexadecimal format (base 16).

In the case of an error, the logger responds with
DE nn↵← where nn=01 ⇒unknown command

Example: **DUMP↵**

5-2.6 Dump Raw Rainfall Log

DT350 Only

This command causes the raw (does *not* include records of zero rainfall) rainfall log to be copied to the DT350's RS-232 port. Dumping can be stopped at any time by sending any character.

This command does not delete the rainfall log from memory.

The command is

DUMPRAIN↵

The DT350 responds with the raw data in rows of 16 bytes, each row prefixed by an address. For example:

```
0000:010100001100E00000000…
0010:0001011320B311CE8C00A…
0020:1400C9C9C9B6000B00CE1…
```

All data and addresses are in hexadecimal format (base 16).

In the case of an error, the logger responds with
DE nn↵← where nn=01 ⇒unknown command

Example: **DUMPRAIN↵**

5-2.7 Unload Tabular Rainfall Log

DT300 and DT350

This command causes the logged rainfall to be copied to the logger's RS-232 port in tabular format (which includes records of zero rainfall). Unloading can be stopped at any time by sending any character.

This command does not delete the rainfall log from memory.

The command is

UNLOAD↵

The logger responds with, for example,

```
Station ID nnnnn↵←
DT350 Ver 1.00↵←
12:13   96/05/21↵←
↵←
   Date→   Time→  Rain(mm) Info.  ↵←
 ========→=====→ =======→===   ↵←
 96/05/20→12:15→   0.3         ↵←
 96/05/20→17:25→   1.1    TB   ↵←
    ⇓       ⇓       ⇓      ⇓   ⇓

 96/05/20→21:40→   0.1   B=0.1 ↵←
 ========→=====→ =======→===   ↵←
↵←
DE  OK↵←   if the command was recognised
```

or

```
DE  nn↵←   in the case of an error,
           where nn=01⇒unknown command
```

Tabs (indicated by →) are used to separate columns of data. Letters appearing in the Info. column are explained in "Rainfall Log" in section 1-2 of this manual.

Example: **UNLOAD↵**

5-2.8 Get Water Level at Start of Day

DT350 Only

This command returns the water level at day start (00:00 or 08:00, a configuration setting). The DT350 adds the reference height setting to the reading.

The command is

LEVELATSTARTOFDAY↵

The DT350 responds with, for example,

```
LEVEL SOD 0123.45 m↵←
DE  OK↵←   if the command was recognised
```

or

```
DE  nn↵←   in the case of an error,
           where nn=01⇒unknown command
```

Example: **LEVELATSTARTOFDAY↵**

5-2.9 Get Yesterday's Water Level — Average

DT350 Only

This command returns yesterday's average water level. The DT350 adds the reference height setting to the reading.

The command is

LEVELAVE↵

The DT350 responds with, for example,

```
LEVEL AVE 0123.45 m↵←
DE  OK↵←   if the command was recognised
```

or

```
DE  nn↵←   in the case of an error,
           where nn=01⇒unknown command
```

Example: **LEVELAVE↵**

The symbol ↵ represents <CR> (carriage return, ASCII 013, Hex D).
The symbol ← represents <LF> (line feed, ASCII 010, Hex A).

5-2.10 Get Yesterday's Water Level — Maximum

DT350 Only

This command returns yesterday's maximum water level reading. The DT350 adds the reference height setting to the reading.

The command is

LEVELMAX↵

The DT350 responds with, for example,
LEVEL MAX 0123.45 m↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **LEVELMAX↵**

5-2.11 Get Yesterday's Water Level — Minimum

DT350 Only

This command returns yesterday's minimum water level reading. The DT350 adds the reference height setting to the reading.

The command is

LEVELMIN↵

The DT350 responds with, for example,
LEVEL MIN 0123.45 m↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **LEVELMIN↵**

5-2.12 Get Current Water Level

DT350 Only

This command causes the DT350 to make an instantaneous water level reading. The logger adds the reference height setting to the reading.

The command is

LEVELNOW↵

The DT350 responds with, for example,
LEVEL NOW 12324.56 m↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **LEVELNOW↵**

5-2.13 Get Current Water Level Address

DT350 Only

This command gets a 5-digit number that is related to the number of water level records stored. The number increases each time a new water level record is stored in the DT350's memory.

The command is

LEVELADDRESS↵

The DT350 responds with, for example,
AD 00345↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **LEVELADDRESS↵**

The address can not be set by the user, only read. It automatically resets to 00000 after reaching its maximum of 65535.

5-2.14 Dump Raw Water Level Log

DT350 Only

This command causes the entire water level log to be copied to the DT350's RS-232 port in raw format.

The current date, time and reference height precede the data, which is not adjusted for reference height. Dumping can be stopped at any time by sending any character.

This command does not delete the rainfall log from memory.

The command is

DUMPLEVELS↵

The DT350 responds with the raw data in rows of 16 bytes. For example:

```
000324223FFFDFFF80808040
000324223FFFDFFF8080
000324223FFFDFFF80808040
```

All data and addresses are in hexadecimal format (base 16). Appendix 1 contains additional details of these variable-length records.

In the case of an error, the logger responds with
DE nn↵← where nn=01 ⇒unknown command

Example: **DUMPLEVELS**

5-2.15 Dump Raw Rainfall Log & Raw Water Level Log

DT350 Only

This command causes the contents of the DT350's rainfall memory and water level memory to be copied to the logger's RS-232 port in raw format.

The current date and time precede each set of data. The water level data is not adjusted for reference height. Dumping can be stopped at any time by sending any character.

This command does not delete the rainfall log or the water level log from memory.

The command is

DUMPALL↵

The DT350 responds with the raw rainfall log as described in 5-2.5, automatically followed by the raw water level log as described in 5-2.13.

Example: **DUMPALL↵**

Configuration

5-2.16 Report Logger Configuration

DT300 Only

This command returns the DT300's current settings.

The command is

CONFIG↵

The DT300 responds with, for example,

```
Station ID 00000↵←
DT300 1.00↵←      (model & version)
96/05/20   12:13↵←
↵←
PERIOD       5 minutes↵←
BUCKET       0.1 mm↵←
BATTERYFAIL 96/10/20   12:00↵←
BATTERYDATE 96/10/20   12:00↵←
BATTERYNEW  95/05/01   12:00↵←
↵←
DE  OK↵←  if the command was recognised
```

or

DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **CONFIG↵**

5-2.17 Report Logger Configuration

DT350 Only

This command returns the DT350's current settings.

The command is

CONFIG↵

The logger responds with, for example,

```
Station ID 00000↵←
DT350 1.00↵←      (model & version)
96/05/20   12:13↵←
↵←
PERIOD       5 minutes↵←
BUCKET       0.1 mm↵←
BATTERYFAIL 96/10/20   12:00↵←
BATTERYDATE 96/10/20   12:00↵←
BATTERYNEW  95/05/01   12:00↵←
RF  ADDRESS    345↵←
WL  ADDRESS    121↵←
WL  SENSOR   GRAY↵←
REF  HEIGHT  0176.00  m↵←
↵←
DE  OK↵←  if the command was recognised
```

or

DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **CONFIG↵**

5-2.18 Set Time

DT300 and DT350

Use this command to set the logger's time. Accurate time and date setting is crucial for useful, meaningful rainfall and water level records.

The command is

TIME=hh:mm↵

You must type all digits and colons: two hour digits, a colon, then two minute digits (use leading zeros as in the example below).

The logger responds with
DE OK↵← if the time was successfully set

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command
05⇒ hour not in range (00⇔23)
06⇒ minute not in range (00⇔59)

Examples: **TIME=14:03↵**
TIME=02:58↵

The symbol ↵ represents <CR> (carriage return, ASCII 013, Hex D).
The symbol ← represents <LF> (line feed, ASCII 010, Hex A).

5-2.19 Set Date

DT300 and DT350

Use this command to set the logger's date. Accurate date and time setting is crucial for useful, meaningful rainfall and water level records.

The logger is aware of leap years.

The command is

DATE=yyyy/mm/dd↵

or

DATE=yy/mm/dd↵

You must type the following digits and slashes: two or four year digits (see examples below), slash, two month digits, slash, then two day digits. Remember also to use leading zeros as in the examples below.

The logger responds with
DE OK↵← if the date was successfully set

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command
02⇒ day not in range
03⇒ month not in range (01⇔12)
04⇒ year not in range (1994⇔2024)

Examples: **DATE=1996/03/22↵**
DATE=96/11/08↵

5-2.20 Set Water Level Sensor Type

DT350 Only

Use this command to configure the DT350 for the type of water level sensor: Gray, BCD or Binary.

The command is

SETLEVELTYPE=GRAY↵

or

SETLEVELTYPE=BCD↵

or

SETLEVELTYPE=BINARY↵

The DT350 responds with
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command
13⇒ invalid sensor type

Example: **SETLEVELTYPE=BINARY↵**

5-2.21 Set Day Start for Water Level Logging

DT350 Only

Use this command to set the start of day for water level logging to either 00:00 or 08:00.

The command is

SETDAYSTART=00:00↵

or

SETDAYSTART=08:00↵

Be sure to type the colon (**:**) and use leading zeros.

The DT350 responds with
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command
14⇒ invalid day start

Example: **SETDAYSTART=08:00↵**

5-2.22 Set Water Level Reference Height (Units: Centimetres)

DT350 Only

Use this command to set the DT350's reference height (explained in section 1-2 "Terminology") in centimetres.

Type six digits (height in centimetres), and use leading zeros as in the example below.

The command is

SETREFERENCE=123456↵

The DT350 responds with
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command
12⇒ invalid reference height
(use six digits, centimetres)

Example: **SETREFERENCE=000434↵**

5-2.23 Set Station ID

DT300 and DT350

If you have more than one DT300 or DT350, use the station ID to uniquely identify each one.

Be sure to enter five digits — use leading zeros.

The command is

STATION=00005↵

The logger responds with
DE OK↵← if the station ID was successfully updated

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command
08⇒ ID not in range
(00000⇔59999)

Example: **STATION=12345↵**

5-2.24 Set Sample Period (Units: Minutes)

DT300 and DT350

Use this command to choose the logger's sample period — 1 minute or 5 minutes.

The command is

PERIOD=1↵

or

PERIOD=5↵

The logger responds with
DE OK↵← if the sample period was successfully set

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command
09⇒ sample period invalid

Example: **PERIOD=5↵**

The symbol ↵ represents <CR> (carriage return, ASCII 013, Hex D).
The symbol ← represents <LF> (line feed, ASCII 010, Hex A).

5-2.25 Set Bucket Size (Units: 0.1 mm)

DT300 and DT350

Use this command to tell the logger the size of the actual bucket used in the rain gauge. Be sure to enter two digits — use a leading zero if required.

> **IMPORTANT**
> When you change the logger's bucket size setting, be sure to change the actual physical bucket in the rain gauge at the same time (before the next bucket tip occurs), otherwise inaccuracies will result.

The command is

BUCKET=05↵

Every time the rain gauge's bucket tips, the rainfall is incremented by BUCKET x 0.1mm (5 x 0.1 = 0.5 for the command above, 2 x 0.1 = 0.2 for the example below).

The logger responds with
DE OK↵← if the bucket size was successfully set

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command
10⇒ bucket size invalid or not in range (01⇔10)

Example: **BUCKET=02↵**

Maintenance

5-2.26 Clear Rainfall Log

DT300 Only

This command erases all logged rainfall data from the DT300's internal memory.

It does *not* erase the logger's configuration settings.

> Use this command with great care.
>
> It can not be undone.

The command is

CLEARLOGGER↵

The DT300 responds with
Type YES to Clear Rainfall Log

Then, if you definitely want to clear the logger's rainfall memory, respond by typing **YES↵**

Typing anything else cancels the command and generates an error message.

The DT300 responds with
DE OK↵← if the memory was successfully cleared
or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command

Example: **CLEARLOGGER↵**
YES↵

5-2.27 Clear Rainfall Log

DT350 Only

This command erases all logged rainfall data from the DT350's internal memory.

It does *not* erase the logger's configuration settings.

> Use this command with great care.
>
> It can not be undone.

The command is

CLEARRAIN↵

The DT350 responds with
Type YES to Clear Rainfall Log

Then, if you definitely want to clear the logger's rainfall memory, respond by typing **YES↵**

Typing anything else cancels the command and generates an error message.

The DT350 responds with
DE OK↵← if the memory was successfully cleared
or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **CLEARRAIN↵**
YES↵

5-2.28 Clear Water Level Log

DT350 Only

This command erases all logged water level data from the DT350's internal memory.

It does *not* erase the logger's configuration settings.

> Use this command with great care.
>
> It can not be undone.

The command is

CLEARLEVELS↵

The DT350 responds with
Type YES to Clear Water Level Log

Then, if you definitely want to clear the logger's water level memory, respond by typing **YES↵**

Typing anything else cancels the command and generates an error message.

The logger responds with
DE OK↵← if the memory was successfully cleared
or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **CLEARLEVELS↵**
YES↵

The symbol ↵ represents <CR> (carriage return, ASCII 013, Hex D).
The symbol ← represents <LF> (line feed, ASCII 010, Hex A).

5-2.29 Clear Rainfall and Water Level Logs

DT350 Only

This command erases all logged rainfall and water level data from the DT350's internal memory.

It does *not* erase the logger's configuration settings.

> Use this command with great care.
>
> It can not be undone.

The command is

CLEARALL↵

The logger responds with
Type YES to Clear Both Logs

Then, if you definitely want to clear the logger's rainfall and water level memories, respond by typing
YES↵

Typing anything else cancels the command and generates an error message.

The logger responds with
DE OK↵← if the memory was successfully cleared
or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **CLEARALL↵**

YES↵

5-2.30 Set Battery Failure (Time & Date)

DT300 and DT350

This command initialises (sets to the logger's current time and date) two of the battery-related records kept by the logger, BatFail and BatDate, and causes a re-calculation of BatNew. (These terms are summarised in Table 3 and explained in detail in section 6-4 of this manual.)

Use this command when you re-power the logger after the main battery has been removed.

Sending this command causes BatFail and BatDate to be set to the logger's current time and date, which you should have already set to the local real time and date.

The command is

SETBATTERYFAIL↵

The logger responds with
DE OK↵←

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **SETBATTERYFAIL↵**

5-2.31 Get Last Battery Fail (Time & Date)

DT300 and DT350

This command reports BatFail, the end time and date of the sample period *immediately before* the last time the logger ceased receiving power from its main battery, either by becoming discharged or being disconnected.

The command is

BATTERYFAIL↵

The logger responds with, for example,
96/09/20 17:43↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error, where nn= 01⇒ unknown command

Example: **BATTERYFAIL↵**

5-2.32 Get Last Battery Replacement (Time & Date)

DT300 and DT350

This command reports BatDate, the time and date of the logger's last power-up.

The command is

BATTERYDATE↵

The logger responds with, for example,
96/05/20 13:54↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command

Example: **BATTERYDATE↵**

NOTE By comparing BatFail with BatDate you can calculate the time lost during change-over or failure of the main battery or power supply.

5-2.33 Get New Battery Replacement (Time & Date)

DT300 and DT350

This command reports BatNew, the time and date when the logger's main battery is due for replacement.

The logger calculates BatNew by adding the expected life of a new main battery (BatLife) to the Last Battery Replacement date (BatDate).

The command is

BATTERYNEW↵

The logger responds with, for example,
97/05/01↵←
DE OK↵← if the command was recognised

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command

Example: **BATTERYNEW↵**

When the main battery is due to be replaced (that is, when today's date is equal to or greater than BatNew), the hyphens on the logger's display flash for five seconds every time the logger wakes. Therefore, the flashing hyphens will be evident every day on and after the BatNew date whenever a front-panel button is pressed or the logger is awakened via its RS-232 port — and at the end of every sample period — until the battery is replaced. (See "Power Supply Alerts" in section 1-4.)

5-2.34 Set Battery Life (Units: Months)

DT300 and DT350

Use this command to set BatLife, the expected life of the main battery you are using.

NOTE If the logger is powered from a mains adaptor instead of a battery, we recommend that you set BatLife to its maximum value of 99 so that the BatNew warning does not appear on the logger's display. (Actually, it will appear 99 months after BatDate.)

The logger's default value is 12 (months).

The command is

SETBATTERYLIFE=↵

The logger responds with
DE OK↵← if the battery life was set

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command
11⇒ battery life invalid or not in range (1⇔99)

Example: **SETBATTERYLIFE=36↵**

The command updates BatLife and forces a recalculation of BatNew.

5-2.35 About This Data Logger

DT300 and DT350

This command reports the logger's station ID, model, firmware version, and current date and time.

The command is

VER↵

The logger responds with, for example,
Station ID 00000↵←
DT350 1.00↵←
96/04/22 14:38↵←

or
DE nn↵← in the case of an error,
where nn= 01⇒ unknown command

Example: **VER↵**

5-2.36 Get Diagnostics

DT300 and DT350

This command reports the most recent internal diagnostic information saved by the logger (for use by Data Electronics when servicing the unit). It is cleared when the logger's backup battery is removed.

The command is

DIAGNOSTICS↵

5-2.37 Get Previous Diagnostics 1, 2, 3, 4 or 5

DT300 and DT350

These commands report the five previous sets of diagnostic information saved by the logger.

The commands are

DIAGNOSTICS 1↵

DIAGNOSTICS 2↵

DIAGNSTOICS 3↵

DIAGNOSTICS 4↵

DIAGNOSTICS 5↵

Note the single space between **DIAGNOSTICS** and the numeral.

When the logger generates a new set of diagnostic information it is stored in **DIAGNOSTICS**, displacing the previous contents down to **DIAGNOSTICS 1**, which displaces the previous contents of **DIAGNOSTICS 1** down to **DIAGNOSTICS 2**, and so on. Information displaced from **DIAGNOSTICS 5** is lost.

They are cleared when the logger's backup battery is removed.

5-2.38 Get Diagnostics 6 (Minimum & Maximum Internal Logger Temperatures)

DT300 and DT350

This command reports the minimum and maximum internal logger temperature since the previous startup. It is cleared when the logger's backup battery is removed.

The command is

DIAGNOSTICS 6↵

Note the single space between **DIAGNOSTICS** and **6**.

5-2.39 Get Device Characteristics

For use by Data Electronics' service department.

The command is

TESTØ↵

5-3
Command Error Codes

The table below summarises the command error codes built in to the DT300 and DT350.

Table 4:
DT300 & DT350 Error Codes

DE 01	Unknown command
DE 02	Day not in range
DE 03	Month not in range
DE 04	Year not in range
DE 05	Hour not in range
DE 06	Minute not in range
DE 07	— (not used)
DE 08	ID not in range
DE 09	Sample period invalid or not in range
DE 10	Bucket size invalid or not in range
DE 11	Battery life invalid or not in range
DE 12	Invalid reference height (DT350 only)
DE 13	Invalid water level sensor type (DT350 only)
DE 14	Invalid day start (DT350 only)
DE OK	Command executed successfully

5-4
Command Files

A “command file” is a group or list of commands and comments that you send to the logger as a block.

Pause Between Commands

To make command files reliable and robust so that they function no matter what state the logger is in, no matter what it’s doing, be sure to incorporate a time delay between each command line in the file, as discussed in “Rules” at the beginning of section 5-2. The minimum delay is 0.3 seconds, and the recommended safe value is 4 seconds.

DeTerminal has a backslash command (`\Wn`) that forces the program to wait for n seconds before sending the next command. For example, the command `\W4` causes the program to pause for four seconds.

6 Power

All the topics in this section are vital to the reliable operation of the DT300 and DT350 loggers.

As introduced in part A of this manual, if you disconnect the logger's main power supply at certain times during its operating cycle (in particular, at the moment the logger writes data to its internal memory), it's possible for the rainfall and water level logs to become corrupted. To safeguard against this, the DT300 and DT350 have a "battery replacement mode". Once you put the logger in this mode, you can safely remove and replace the main battery without endangering the stored data.

To guard against loss of data caused by a failing main power supply, the loggers also have a "battery failure mode", which they automatically enter if a low supply voltage is detected.

These two modes are described here.

NOTE If both the main supply and the backup battery are ever removed together (that is, if the logger has been totally un-powered for any length of time), be sure to initialise the logger's main battery records. The procedure is described in section 3-3, "Initialise Battery Records".

6-1 Replacing the Main Power Supply Safely: Battery Replacement Mode

RECOMMENDATION We recommend that you always put the logger in battery replacement mode before disconnecting the main battery.

When the logger is in battery replacement mode it no longer functions as a rain logger or water level logger — it does not accept bucket tips, water level measurements, or RS-232 communication. In this mode the logger is "frozen", but all data and settings are guaranteed to be maintained while the main power supply is removed and replaced.

Battery replacement mode is only available when the logger has a functional backup battery installed.

You can only start and stop battery replacement mode using the buttons on the logger's front panel. It's not possible to start or stop the mode from a computer connected to the logger.

Battery replacement mode does not time out. The logger stays in the mode until you press one of the front-panel buttons.

Entering and leaving battery replacement mode is indicated in the tabular rainfall log by the characters R and F (respectively) in the Info. column.

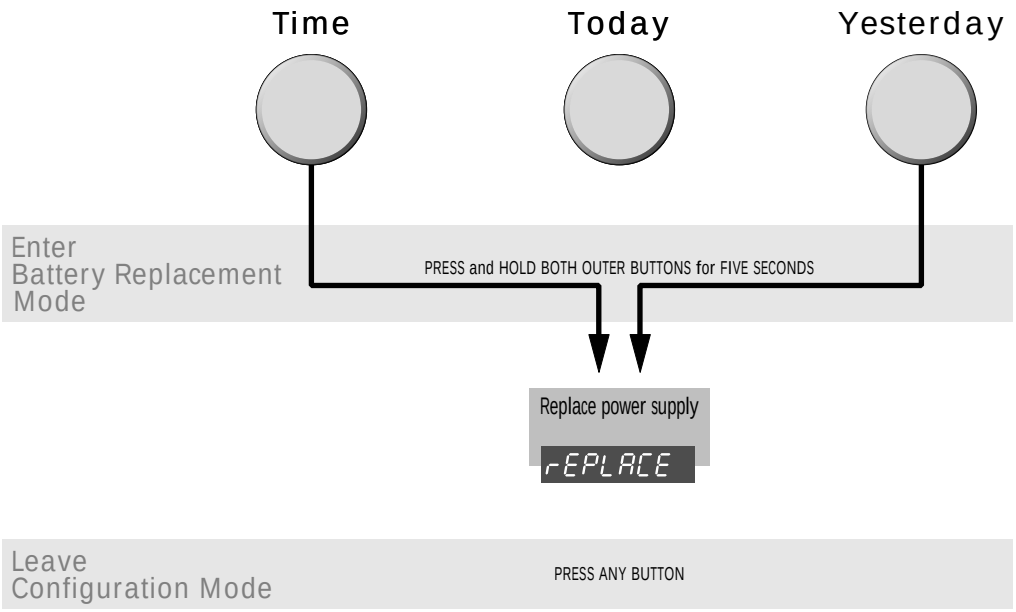
Here is the procedure for connecting or replacing the main battery:

Enter Battery Replacement Mode

a) Press *and hold* the two outer buttons (Time and Yesterday) simultaneously for a period of 5

Operation from the Front Panel:

Battery Replacement Mode



seconds — until the display flashes the rEPLACE message.

b) Release the buttons.

The logger is now in battery replacement mode.

Connect/Replace the Supply

c) Remove the existing power supply by loosening the two screw terminals on the rear of the logger's circuit board and withdrawing the flying leads.

The display ceases to operate.

d) Connect the new main supply's leads to the correct terminals.

e) If applicable, turn the power supply on.

The logger resumes flashing the rEPLACE message, verifying that main power has been restored and the logger is still in battery replacement mode.

Leave Battery Replacement Mode

f) Press any one of the front-panel buttons to take the logger out of battery replacement mode.

The logger displays a steady row of hyphens for 10 seconds, the main battery failure alert, to indicate that the logs may be incomplete.

6-2 Battery Failure Mode

When the logger senses an imminent failure of its main power supply (supply voltage drops below 9.4V), it flashes the bAt FAIL message for 10 seconds and then enters a low power mode called "battery failure mode":

- If awake, the logger flashes a "battery failure" alert for 10 seconds and then carries out a controlled shutdown.
- If asleep, the logger simply carries out a controlled shutdown.

It does this to carry out a controlled shutdown while adequate power is still present and thereby not lose or corrupt data (possible in the case of an abrupt power failure).

In battery failure mode, the logger can be awake or asleep:

- If a comms cable is plugged into the logger's RS-232 port, the logger goes into low power operation but flashes the bAt FAIL message constantly, to alert you to its state.
- Without a comms cable plugged into the RS-232 port, the logger enters sleep mode and the bAt FAIL message only flashes for 10 seconds whenever one of the front panel buttons is pressed.

Restoring the Logger from Battery Failure Mode

Once the logger has entered battery failure mode, you must connect a new main power supply of at least 10.25VDC (and not greater than 14.4V) to make the logger operational again. The logger automatically detects the higher supply voltage and returns to normal operation.

To restore the DT300 or DT350 from battery failure mode:

a) Confirm that the logger is in battery failure mode by checking that the bAt FAIL message is present.

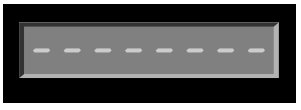
If the message is not constantly flashing, press one of the front panel buttons. The message should then appear for 10 seconds.

b) Remove the existing main power supply by loosening the two screw terminals on the rear of the logger's circuit board and withdrawing the flying leads.

c) Connect the new main supply's leads to the correct terminals.

d) If applicable, turn the main power supply on.

The logger displays a steady (not flashing) row of hyphens for 10 seconds, then resumes normal operation.



Steady Hyphens

This is to warn you that the logs are incomplete (because logging ended with the last valid sample period before the logger entered battery failure mode).

6-3
Connecting/Replacing the Backup battery

The lithium backup battery should be replaced every five years.

WARNING Keep the logger's main battery connected while replacing the backup battery to ensure that the logger's configuration settings, data and clock are maintained during the changeover.

a) Check that the logger is being powered from its main battery by pressing any button to light the display.

b) Remove the old backup battery by de-soldering the screw terminals marked + and – either side of the rectangular battery cut-out on the logger's circuit board.

c) Install the new backup battery by soldering its leads to the same terminals: battery + to the logger's + terminal, battery – to the logger's – terminal.

d) Check the battery's orientation thoroughly because the logger gives no warning if you connect the battery with reverse polarity — the logger's memory will not be backed-up, and all data will be lost next time you change the main battery.

6-4
Power Supply Alerts

The loggers use their front-panel displays to warn you of the following four main power supply situations. They are summarised in Table 2.

Both Batteries Failed

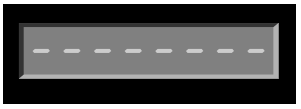
If *both* supplies — main and backup — ever become disconnected or discharged at the same time, for a period longer than 10 seconds, the logger flashes the StArtUPI alert for 10 seconds the first time main battery power is re-applied.

Flashing Message

This is to warn you that any logged data has become corrupt and unrecoverable, and that the logger's internal settings have been returned to their default values. Reconfigure the logger if the default settings are not what you require (see section 3-2).

Main Battery Failed

If you disconnect the main power supply (or if the supply is a battery that becomes discharged), the logger displays a steady (not flashing) row of hyphens for 10 seconds the first time main battery power is re-applied.



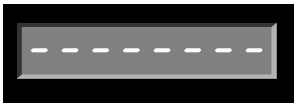
Steady Hyphens

This is to warn you that the logs are incomplete (because logging ended with the last valid sample period before main power ceased).

The backup battery maintains the logger's memory and settings when power is not available via the main battery.

Main Battery Due for Replacement

The logger displays a flashing row of hyphens to warn you that the main battery is due for replacement.



Flashing Hyphens

On the day you last connected the main supply and executed the SETBATTERYFAIL command, the logger calculated a New Battery Replacement date (BatNew) by adding the expected life of a new main battery (default is 12 months — see NOTE in section 3-3) to the current date.

When this New Battery Replacement date falls due (that is, when BatNew ≥ today's date), the logger flashes its hyphens for 5 seconds *every time it wakes* — when a button is pressed on the front panel, when the logger is wakened via its RS-232 port, and at the end of every sample period — until the battery is replaced.

Main Battery Failure is Imminent

If the main power supply drops below 9.4V, the logger flashes the bAtFAIL alert for 10 seconds, then enters a low power mode.

Flashing Message

This is to alert you to the fact that the main battery probably needs replacing and that the logger has shut down to conserve power.

If you see this message, replace the main battery as described in section 6-2.

6-5 Power Supply Records

The loggers maintain four useful records concerning their main power supply. They are summarised in Table 3.

Last Battery Failure

Last battery failure (BatFail) is the time and date of the end of the last valid sample period before failure or disconnection of the main supply occurred.

You can read BatFail by sending the BATTERYFAIL command from a computer connected to the logger (see section 5), and you can initialise BatFail to the logger's current time and date with the SETBATTERYFAIL command.

Last Battery Replacement

Last battery replacement (BatDate) is the time and date of the logger's last power-up (that is, when the main power supply was last re-connected/replaced).

You can read BatDate by sending the BATTERYDATE command from a computer connected to the logger (see section 5).

NOTE By comparing BatFail with BatDate you can calculate the time lost during change-over or failure of the main battery or power supply.

Battery Life

Battery life (BatLife)is the expected life of the main battery.

The logger's default is 12 months, which is a conservative figure for the alkaline main battery most likely to be used with the logger.

The logger uses this value to calculate the new battery replacement date (see next item).

You can set BatLife to any number of months between 1 and 99 using the SETBATTERYLIFE command.

RECOMMENDATION If you are using a constant power supply (a mains adaptor, for example) instead of a main battery, set BatLife to its maximum (99 months) so that the BatNew alert (see next topic) is unlikely to occur. The BatNew alert is not relevant when using a constant power supply.

New Battery Replacement

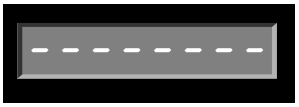
New battery replacement (BatNew) is the recommended date for replacing the main battery.

The logger calculates this date by adding BatLife to BatDate:

BatDate + BatLife = BatNew

You can read BatNew by sending the BATTERYNEW command from a computer connected to the logger (see section 5).

When BatNew is equal to or greater than the logger's current date, the hyphens flash on the logger's display to alert you that the expected battery life has expired and you should replace the main battery.



Flashing Hyphens

DT300

DT350

Appendix 1

Memory Usage

Design Philosophy

We have optimised the memory usage of the DT300 and DT350 loggers for maximum data storage. For example, if no rain falls during a sample period, no memory is used to indicate this fact.

However, because of this optimisation, the organisation of memory and the subsequent reconstruction of rainfall data becomes considerably more complex. For example:

- **Rainfall Only**
  Time stamps and significant events — like battery failure and replacement, bucket size and sample period changes, and memory clearing — are written to memory as well as the rainfall data. All of these records have different lengths and formats, making it difficult to look at at the raw rainfall log and interpret its contents.
- **Rainfall and Water Level**
  The DT350's rainfall and water level memories are arranged as large circular buffers. This means that memory gradually fills until an upper limit is encountered and then, instead of stopping the storage of further data, *new data overwrites the oldest data (*memory wrap). And data that is overwritten can never be recovered. In addition, the oldest data stored can occur anywhere within the physical memory (not necessarily at the start).

Data Areas (DT350 Only)

Specific data areas are set aside in the DT350 for the storage and reconstruction of rainfall and water level data.

1. Rainfall Data Storage Area (Rainfall Memory)

   30 kilobytes are set aside for the storage of rainfall data.

2. Water Level Data Storage Area (Water Level Memory)

   80 kilobytes are set aside for the storage of water level data.

3. Base Information Areas

   Each of the rainfall and water level areas has its own base information area that contains
   - a buffer start pointer and a buffer end pointer (to maintain the circular buffer)
   - a time stamp (time and date) of the earliest record in each store, and its type ("normal" or "start of new record")
   - a time stamp of the most recent record in each store
   - various records relating specifically to rainfall logging (rainfall area only)
   - various records relating to water level logging (water level area only)
   - initial event flags (rainfall area only).

Data Compression

Rainfall Data Storage Area

Information stored in the Rainfall Data Storage Area is minimised/compressed by storing no rain records when there has been no rainfall.

But, so that a complete rainfall log can be reconstructed whenever the data is unloaded from the logger, the start and end times of these "dry" (no rainfall) periods must be available, and this is done as follows:

- The start of a dry sample period is equal to the end of the preceding "wet" (non-zero rainfall) sample period. Therefore, because sample period time stamps record the *end* of each sample period, the logger calculates the time stamp (time and date) of the dry sample period by adding one sample period to the time stamp of the preceding wet sample period.
- The end of a period of no rainfall (one or more dry sample periods) is determined by the next record: it is calculated by subtracting one sample period from the time stamp of the successive wet sample period.
- From this information, the logger can determine the time stamps and number of the dry sample periods between any two wet sample periods and thereby reconstruct the entire rainfall log.

The topic overleaf, "Record Formats — Rainfall", explains the five storage formats used.

Water Level Data Storage Area

Each hourly water level record (which contains 12 differential values calculated from the DT350's five-minute water level measurements) is compressed and stored in the Water Level Data Storage Area. The compression is achieved by a coding procedure that is dependent on the magnitude of the change between the consecutive level readings.

The topic “Record Formats — Water Level” later in this section explains the four storage formats used.

Changing Settings

Altering any or all of the logger’s time, date, bucket size or sample period settings during a logging session does not invalidate the data for the sample period during which the changes were made.

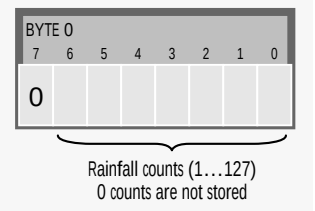
When you change any of these four settings, the logger immediately records the time and the number of counts so far in the sample period (resulting in a shorter-than-normal sample period) *and then* makes the internal change as requested by the user. Finally, the logger follows this short sample period with another of suitable length to re-synchronises itself with the current “normal” sample period timing.

In the case of a change to bucket size or sample period, the logger also writes a configuration record to indicate the new bucket size and/or sample period to be used for all following records.

Record Formats — Rainfall

The logger uses five record formats for rainfall:

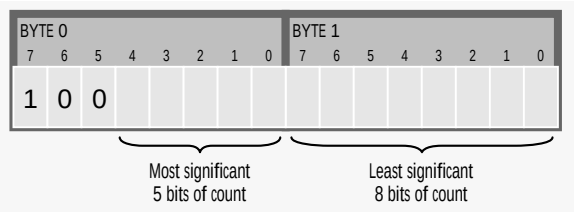
Rainfall Record Format 1: Short Rainfall Record (< 128 tips)



A Short Rainfall Record is written to memory when more than 0 and less than 128 tipping bucket counts have occurred between the beginning and the end of the most recent sample period.

- If preceded by a time stamp then the rainfall value can be zero (whenever a time stamp is written, a rainfall record record must also be written no matter how many counts have been accumulated.
- When a rainfall record follows a time stamp in the store, the time stamp is the time stamp for that record. If the preceding record is another rainfall record, the time stamp for the rainfall record is equal to the time stamp for the preceding rainfall record plus the current sample period.

Rainfall Record Format 2: Long Rainfall Record (≥ 128 tips)



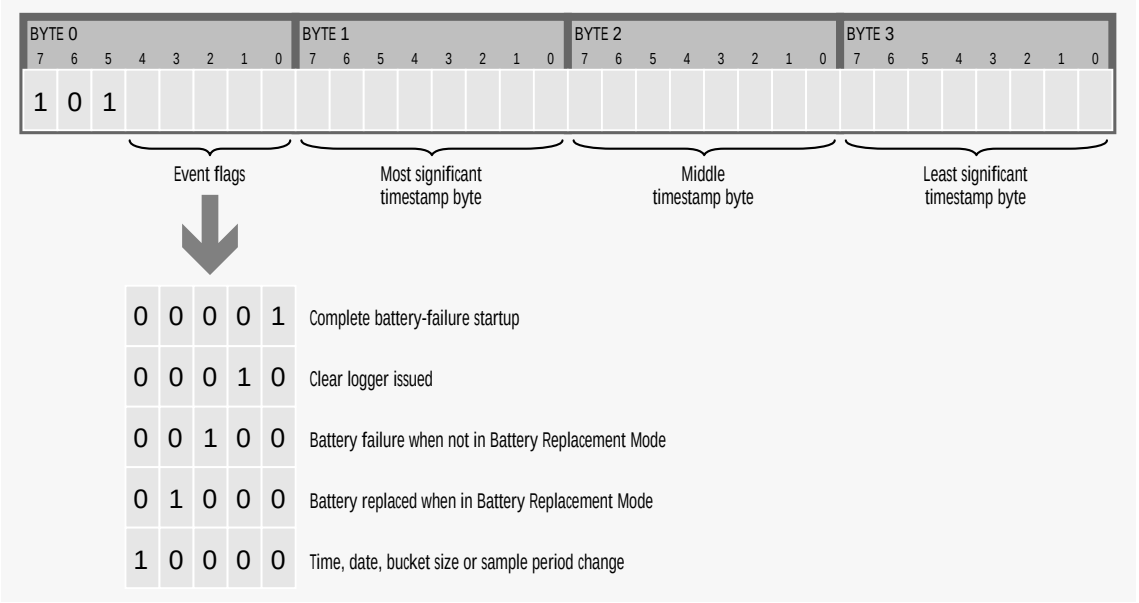
A Long Rainfall Record is written to memory when 128 or more tipping bucket counts have occurred between the beginning and the end of the most recent sample period.

- When a rainfall record follows a time stamp in the store, the time stamp it follows is the time stamp for that rainfall record. If the preceding record is another rainfall record, the time stamp for the rainfall record is equal to the time stamp for the preceding rainfall record plus the current sample period.

Rainfall Record Format 3:
Normal Time Stamp (in minutes from 00:00 on 1 Jan 1994)

A Normal Time Stamp record is written to memory when a new period of rainfall has started after a period of no rainfall, or when there has been an event that affects the integrity of the logger's data storage which needs to be recorded.

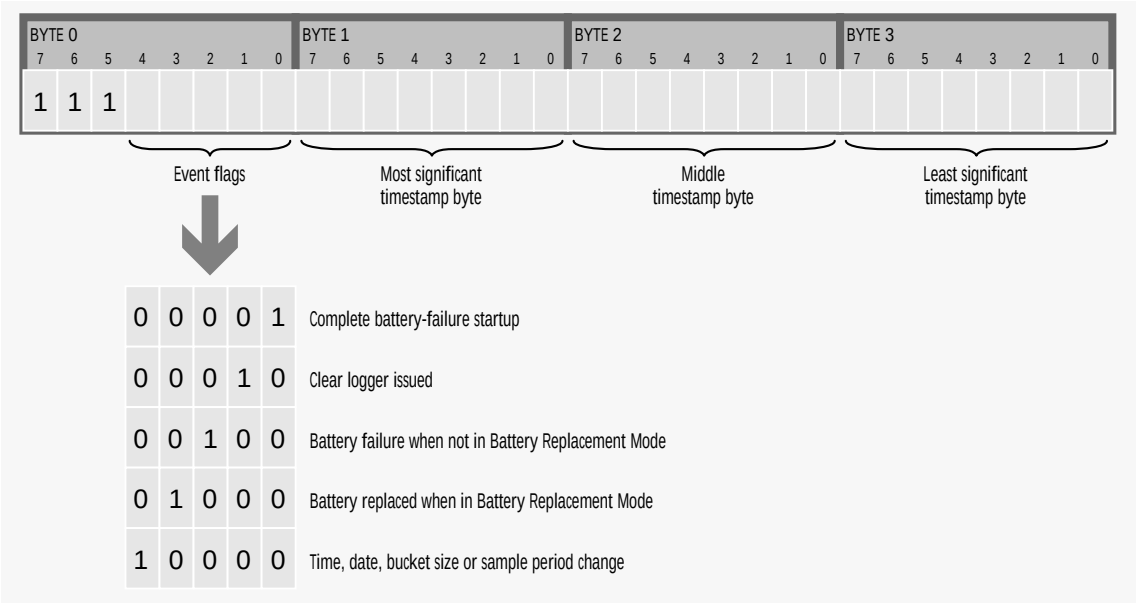
- If the time stamp is placed in the store because a new period of rainfall has begun then no event flags will be set.
- If the time stamp is placed in the store because of one (or more) of these events, then the appropriate bits will be set in the event section of the time stamp (see below for bit mappings). Whenever one of these time stamps is encountered in the store then zero-rainfall records can be generated for intervals between the last output record and the time given by the time stamp.
- Always preceded by a Short Rainfall Record or a Long Rainfall Record.
- Always followed by a Short Rainfall Record or a Long Rainfall Record.



Rainfall Record Format 4:
Start Of New Rainfall Time Stamp (in minutes from 00:00 on 1 Jan 1994)

A Start of New Rainfall Time Stamp record is written to memory as the first time stamp after a short interval has been recorded. It is used to indicate that no zero records need be generated between this time stamp and the last rainfall record's time stamp. Any notable events (Clear data store, replacement of battery etc.) that occur between the last time stamp in the store and this time stamp will be recorded in the first byte in the event mask (the same as for normal time stamps).

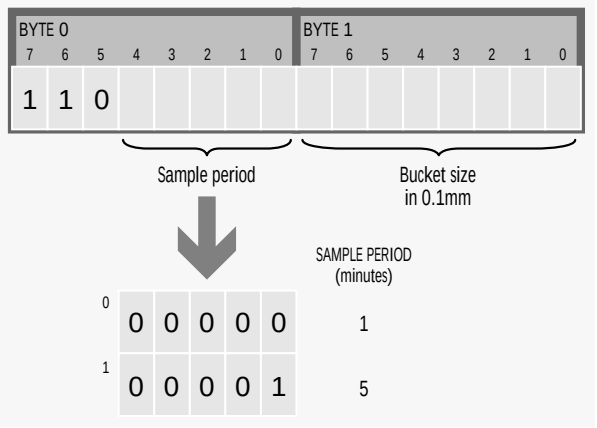
- Always preceded by a Short Rainfall Record or a Long Rainfall Record, or a Configuration Record.
- Always followed by a Short Rainfall Record or a Long Rainfall Record.



Rainfall Record Format 5: Configuration Record

A Configuration Record is written to memory when either the bucket size or the sample period changes. The bucket size and sample period in the configuration record is only applied to rainfall records after the configuration record.

- Always preceded by a Short Rainfall Record or a Long Rainfall Record.
- Always followed by a Start of New Data Time Stamp



Reconstructing Rainfall Records

Rainfall records can only be reconstructed by working through memory sequentially from the first record pointed to by the buffer start pointer (note that this is not necessarily the physical start of the memory area).

Rainfall cannot be reconstructed by working backwards through memory, or by beginning at some point other than the start record.

The base information gives the necessary details on where to start decoding information, and where to end.

Here's an example:

Base Information

Initial time stamp 00:05 on 1/1/94, time stamp type = normal
Initial events = Clear of store
Last time stamp 01:05 on 1/1/94
Sample period = 5 mins, bucket size = 1

Data

00	=>	short rainfall record	0.0mm
A0 00 00 0F	=>	normal time stamp	00:15 on 1/1/94
1C	=>	short rainfall record	2.8mm
11	=>	short rainfall record	1.7mm
0A	=>	short rainfall record	1.0mm
02	=>	short rainfall record	0.2mm
A0 00 00 32	=>	normal time stamp	00:50 on 1/1/94
05	=>	short rainfall record	0.5mm
A0 00 00 33	=>	normal time stamp	00:51 on 1/1/94
00	=>	short rainfall record	0.0mm
C4 05	=>	config record	changes bucket size to 0.2mm
E0 00 00 37	=>	start of new data time stamp	00:55 on 1/1/94
00	=>	short rainfall record	0.0mm

Tabular Format

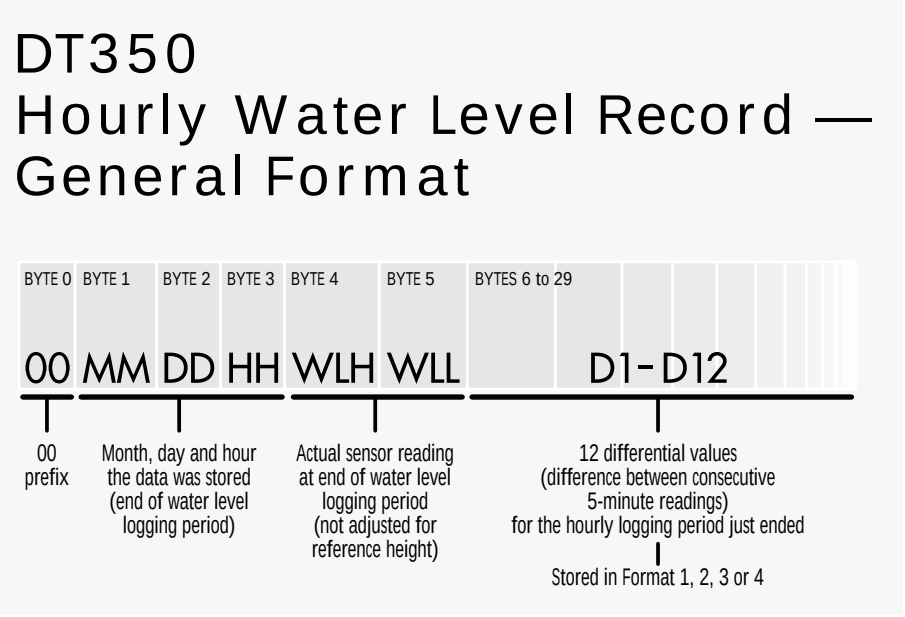
Date	Time	Rainfall(mm)		
1/1/94	00:05	0.0		
1/1/94	00:10	0.0		
1/1/94	00:15	2.8		
1/1/94	00:20	1.7		
1/1/94	00:25	1.0		
1/1/94	00:30	0.2		
1/1/94	00:35	0.0		
1/1/94	00:40	0.0		
1/1/94	00:45	0.0		
1/1/94	00:50	0.5		
1/1/94	00:51	0.0	B= 0.2	(bucket size changed to 0.2mm)
1/1/94	00:55	0.0		
1/1/94	01:00	0.0		
1/1/94	01:05	0.0		

Record Format — Water Level

At the end of each hour the logger stores one complete water level record, which consists of the following information:

- the prefix 00
- the month, day and hour the data was stored (that is, the month, day and hour of the end of the water level logging period)
- the actual sensor reading at the end of the water level logging period
- 12 level change values. (During each hour the DT350 takes 12 water level readings at five-minute intervals and calculates the change between the consecutive readings — the 12 change values are called *differential* values.)

Thus one water level record consists of ten to thirty bytes as shown in the figure "DT350 Hourly Water Level Record — General Format" below.



D1–D12 Formats

To achieve optimum data compression, each of the 12 differential values D1 to D12 is stored in Format 1, 2, 3 or 4 as described in the following sections.

The format used, and hence the number of bytes needed to store each differential, depends on

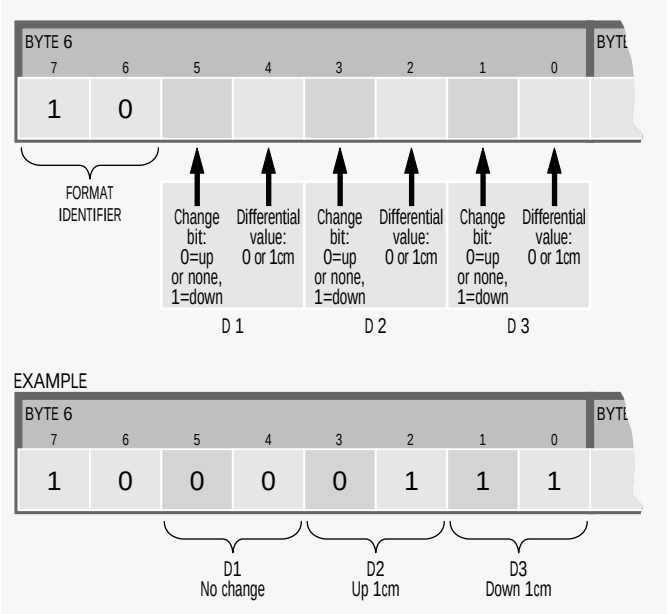
- the magnitude of the change in water level over the five-minute sample period
- the magnitude of the change in water level of adjacent five-minute sample periods.

In general terms, the number of bytes needed to store the differentials is as follows:

- Format 1 Small change Three differential values can be stored in each byte.
- Format 2 Medium change Two differential values can be stored in each byte.
- Format 3 Large change One differential value can be stored in each byte.
- Format 4 Huge change One differential value requires two bytes.

Water Level Record Format 1:
Small Changes (0 or 1cm) Between THREE Consecutive Five-Minute Readings

This situation — the change in river height is small and slow — is the most common. The DT350 uses this format when the level change over three sample periods is zero or one centimetre.

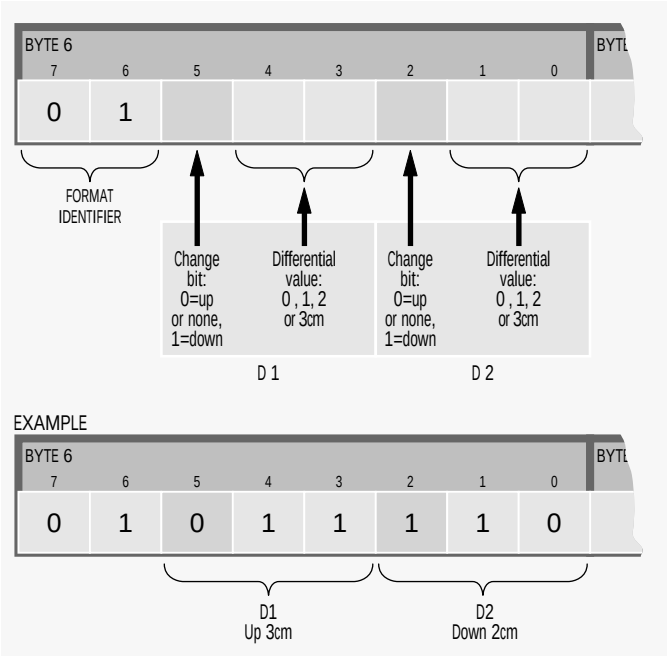


This format provides the most compression because the data for three sample periods can be saved in one byte.

If one byte can not be completely used (that is, there are not three consecutive sample periods where the change is zero or one centimetre), the logger tries Format 2.

Water Level Record Format 2:
Medium Changes (0 to 3cm) Between TWO Consecutive Five-Minute Readings

The DT350 uses this format when the level change over two consecutive sample periods is between zero and three centimetres.

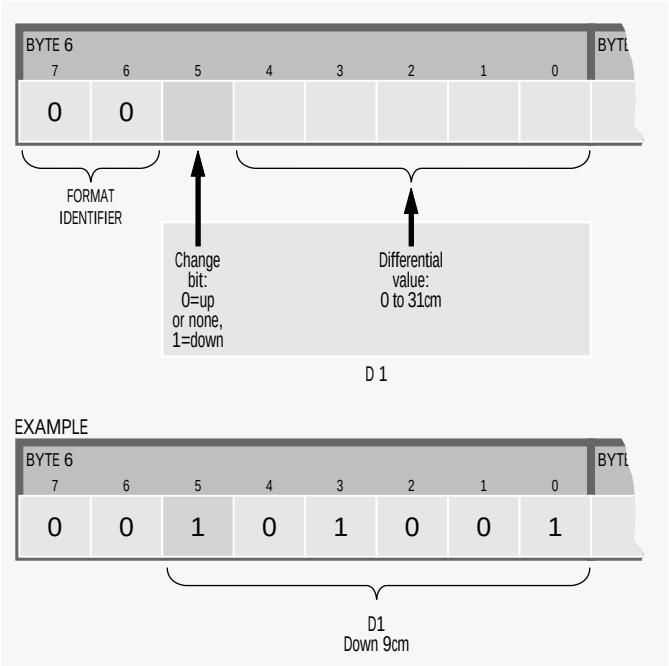


In this format, the data for two sample periods can be saved in one byte.

If one byte can not be completely used (that is, there are not two consecutive sample periods where the change is between zero and three centimetres), the logger tries Format 3.

Water Level Record Format 3:
Large Change (0 to 31cm) Adjacent to a Smaller Change

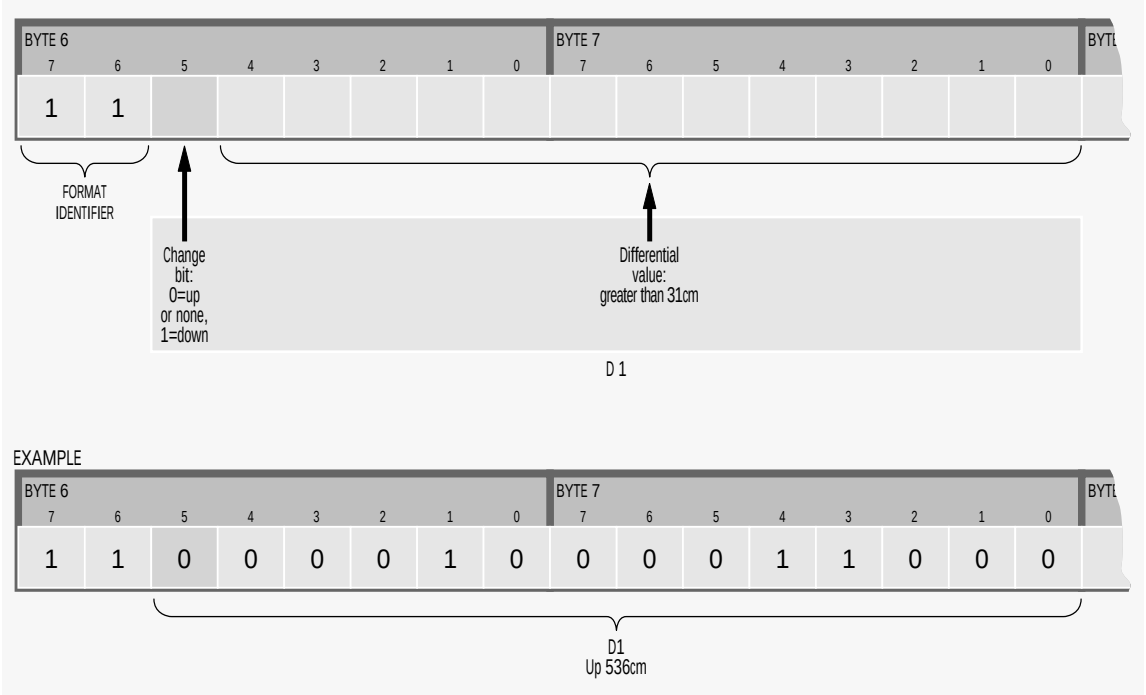
The DT350 uses this format when the level change over one sample period is between zero and 31 centimetres and not covered by Format 1 or Format 2 above.



In this format, the data for only one sample period can be saved in one byte.

Water Level Record Format 4:
Huge Change (Greater than 31cm)

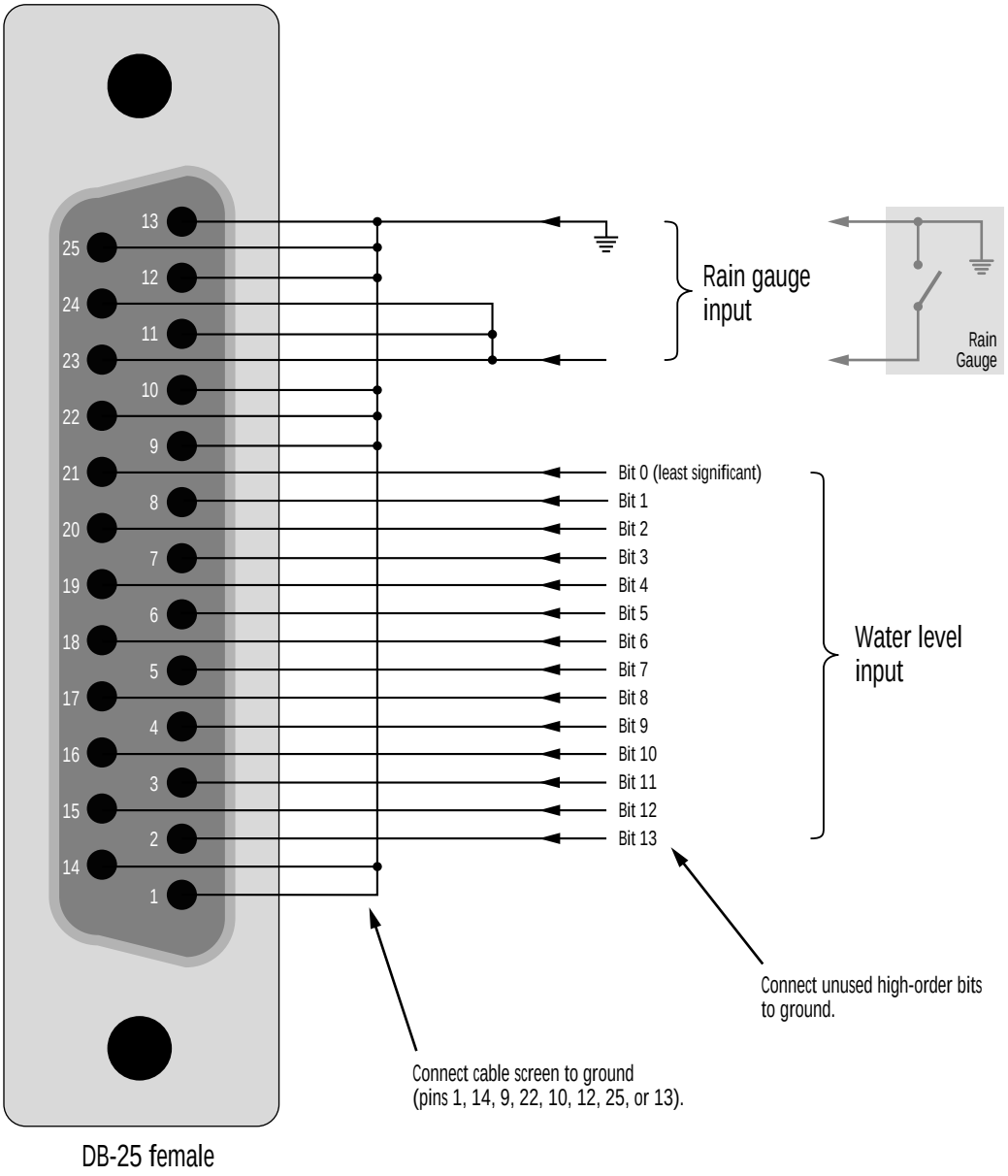
The DT350 uses this format when the level change over one sample period is greater than 31 centimetres.



In this format, the data for one sample period requires two bytes.

Appendix 2

DT350 Sensor Connector Specifications



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Appendix 3

RS-232 Serial Port

Specifications, Cable Guide and Management

DT300 and DT350 Serial Port Specifications

Complete RS-232 Standard		Function	Flow	Logger Serial Port (DE -9 Male)
Data Carrier Detect	DCD	Keeps logger awake	→	1
Received Data	RXD	Data to logger	→	2
Transmitted Data	TXD	Data from logger	←	3
Data Terminal Ready	DTR	Enables modem	←	4
Signal Ground	Ground	Signal ground	↔	5
Data Set Ready	DSR	None	→	6
Request To Send	RTS	Permanently true	←	7
Clear To Send	CTS	None	→	8
Ring Indicator	RI	Initiates call answer, wakes logger	→	9

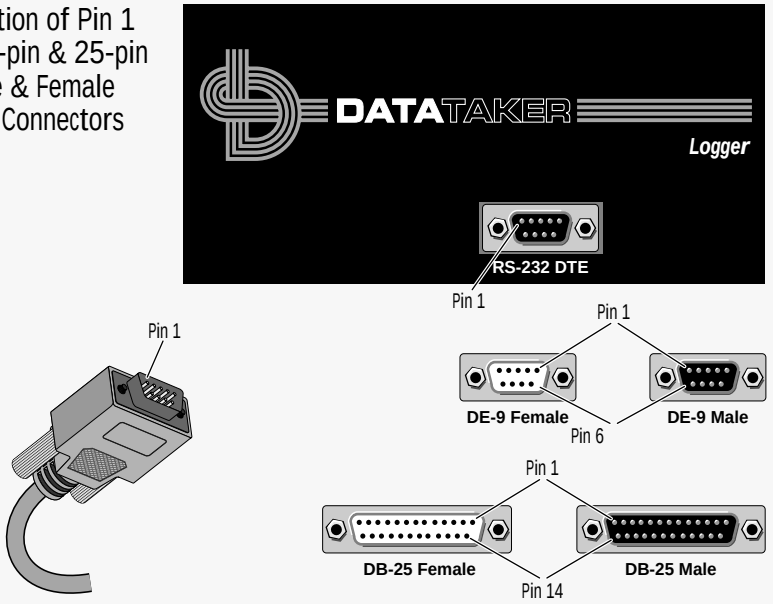
DEFINITIONS

DTE
Data terminal or terminating equipment.
The non-communications-orientated components of a data communications system. Functions as a data source, data sink, or both. Examples: computers, terminals, multiplexers, DT350 loggers.

DCE
Data communications equipment.
The communications-oriented components of a data communications system.
Examples: modems, telephone switching equipment, microwave relay stations.

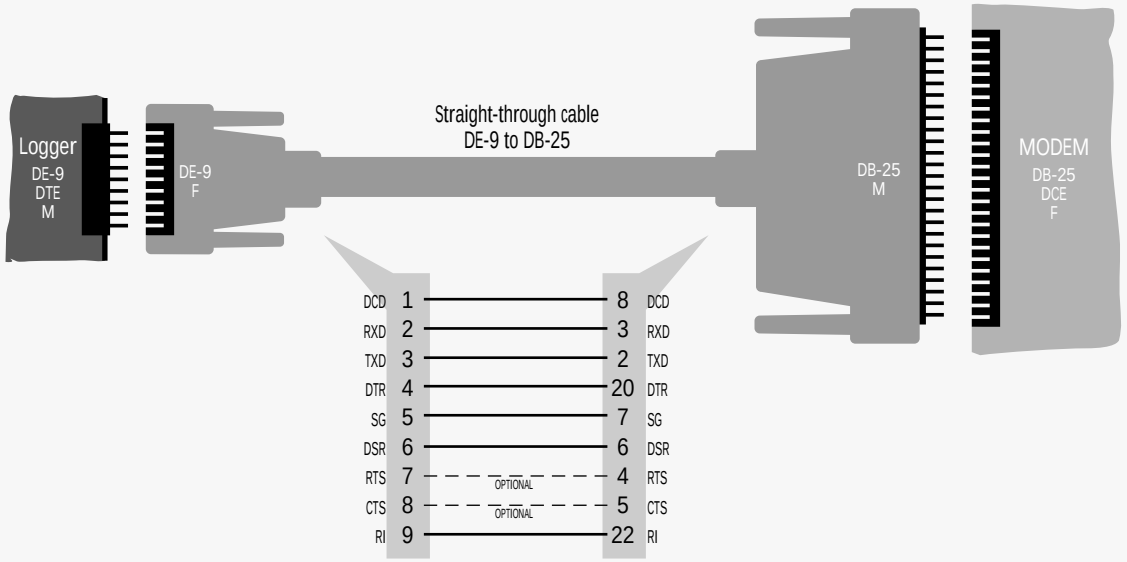
A DCE is the interface between a DTE and the communications network.

Location of Pin 1 on 9-pin & 25-pin Male & Female "D" Connectors

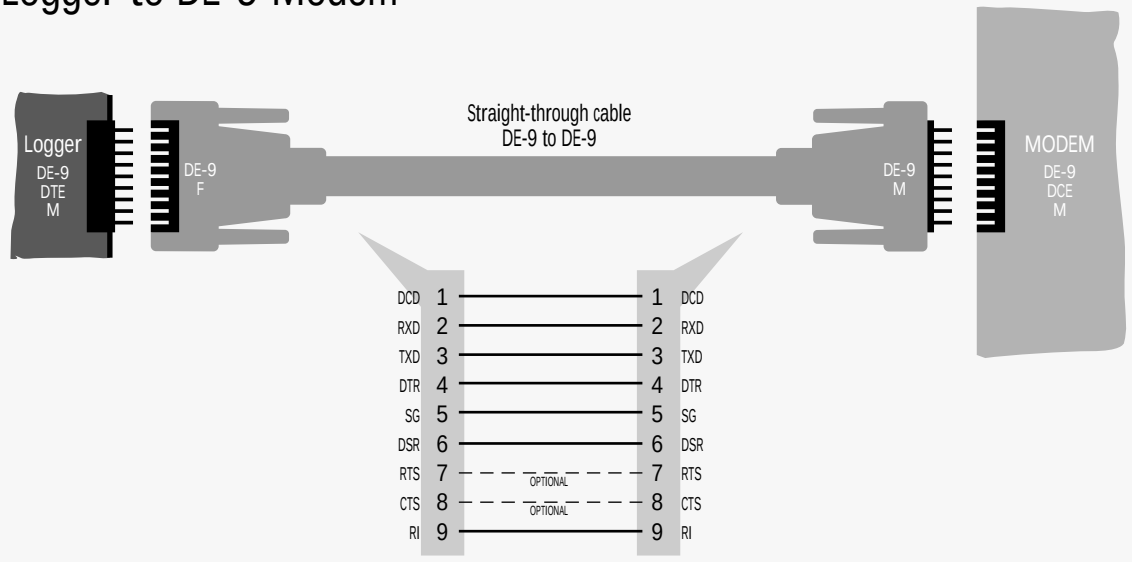


DT300 and DT350
RS-232 Cable Specifications — Logger to Modem

Logger to DB-25 Modem

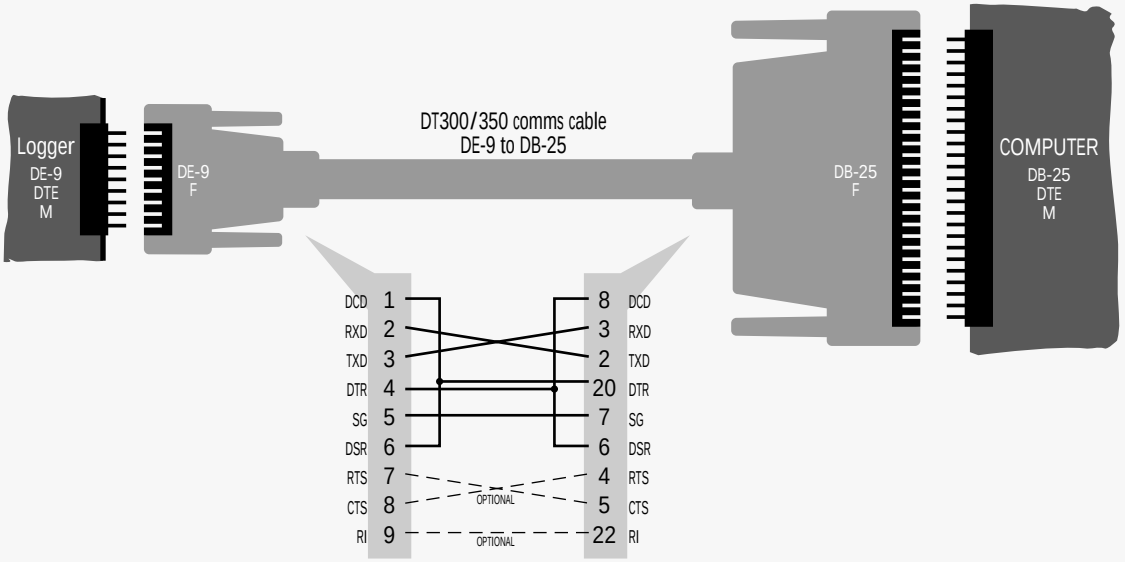


Logger to DE-9 Modem

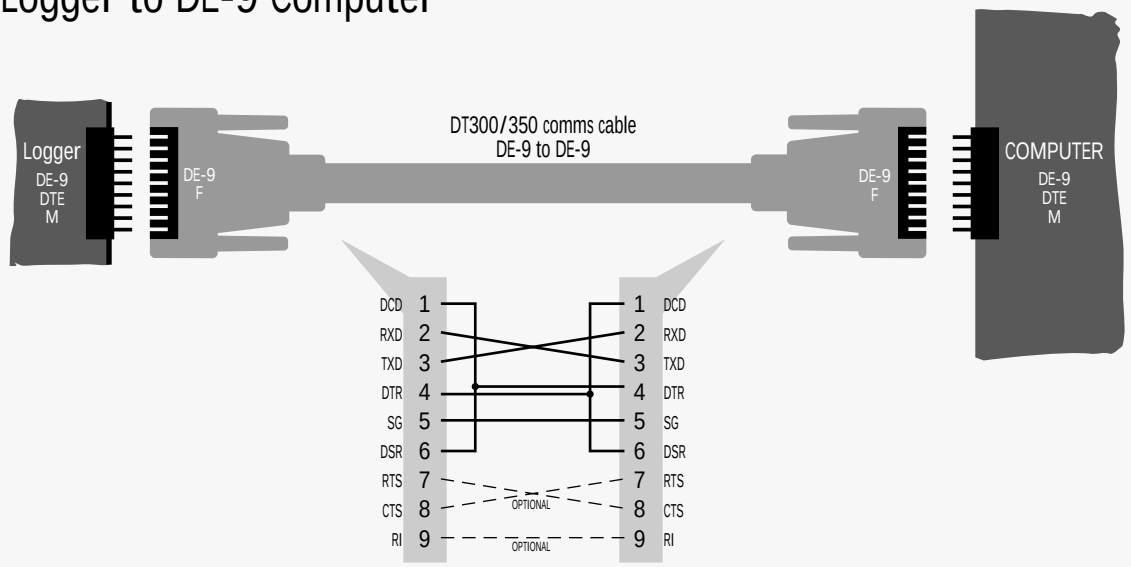


DT300 and DT350
RS-232 Cable Specifications — Logger to Computer

Logger to DB-25 Computer



Logger to DE-9 Computer



RS-232 Management

Logger to Modem

The modem must be configured to respond to DTR transitions generated by the logger (AT&D2 on Hayes-compatible modems).

1. The modem sends a Ring Indicator (RI) signal to wake the DT350.
2. The logger responds by raising the Data Terminal Ready (DTR) line to logical 1.
3. The modem responds to DTR going high and communication is established between the two devices.
4. The modem raises the Data Carrier Detect (DCD) line to logical 1, which holds the logger awake.

If the modem does not raise DCD within two minutes of DTR being raised, the logger drops DTR to logical 0.

The logger monitors the state of the DCD line. If DCD drops to logical 0, the logger stops responding to characters and drops the DTR line to logical 0.

Logger to Computer

The cable used between the logger and a computer must be wired so that the computer's DTR output is connected to the logger's DCD input.

The computer's DTR output is normally low (logical 0). To wake the logger (and keep it awake) and enable RS-232 communication, the computer raises its DTR output to logical 1 (high), which raises the logger's DCD input.

The logger monitors the state of its DCD input. If the logger's DCD input drops to logical 0, the logger stops responding to characters.

Received characters do not wake the logger. They are ignored by the logger unless its DCD input is high. The logger does not transmit characters unless its DCD input is high.

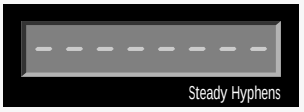
The computer must lower its DTR output at the end of the session. This then lowers the logger's DCD input and allows the logger to go to sleep. *Failure to do this will cause the logger to remain awake indefinitely, and will reduce battery life.*

Appendix 4

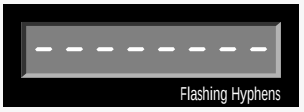
Display Alerts

The figure below summarises the loggers' display alerts.

BOTH BATTERIES FAILED
Both batteries were disconnected or discharged — clear memory and carry out initial configuration procedure.



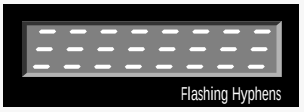
MAIN BATTERY FAILED
Main battery was disconnected or discharged — rainfall log may be incomplete.



MAIN BATTERY DUE FOR REPLACEMENT
Main battery is due for replacement.

BATTERY FAILURE MODE
Main battery failure is imminent.
Main supply voltage <9.4V.

BATTERY REPLACEMENT MODE



CLOCK/CALENDAR LIMIT EXCEEDED
Clock/calendar is no longer valid
(after 8:00 a.m. on 31 December 2024).

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