**MINILOG
DIGITAL DATA LOGGER**

MODEL ML1-FL

INSTRUCTION MANUAL

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1. Introduction

The Hydrological Services MiniLog Data Logger ML1-FL has been designed using surface mount technology to provide a very small, ultra low power and reliable data logger that can be used in harsh environments for extended periods. Flash memory technology has not only been used for data storage but also for program storage - which provides secure non-volatile data storage as well as the unique capability of software download as new software features and revisions become available. The logger can be connected to a standard Tipping Bucket Rain Gauge OR any device that requires a contact closure to be monitored. The communication features allow for very flexible operation directly connected to a computer. The unique on-board help feature allows the user to obtain a list of commands with their syntax. The ultra low power allows the logger to be powered from an internal 3.6V lithium battery for up to 5 years *(Warning: this estimate is dependant on logging interval, battery brand, condition and remaining shelf life when installed)*. The indicator LED flashing once a second as a heartbeat, give the user confidence that the MiniLog is alive and well.
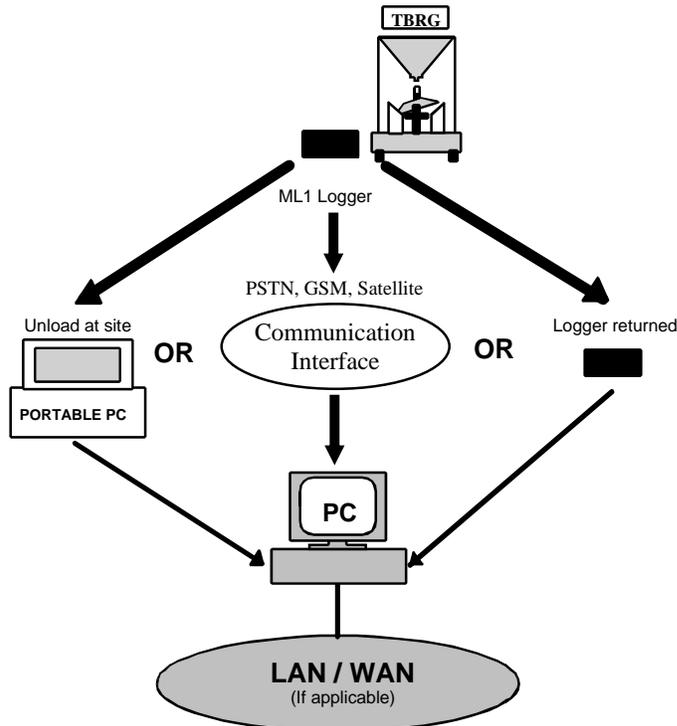
Please Note : This manual applies specifically to software Rev 1.13 and above. Use the Help command ? to obtain a list of commands and syntax that are specific to your version.

2. Product Overview

2.1 Overview

The Hydrological Services MiniLog Data Logger is easily installed within many products due to its small size. Its primary purpose is to count contact closures.

One such application would be inside a Tipping Bucket Rain Gauge, (TBRG). Rain falling on the collecting funnel is directed through a syphon control unit and discharges as a steady stream into a 2 compartment bucket mounted in unstable equilibrium. As each compartment fills, the bucket tilts alternately about its axis. Each tip forces a contact closure of a magnetic reed switch corresponding to a height of rainfall depending on bucket capacity, (Bucket Capacity can be 0.2 mm, 0.5 mm, 1.0 mm, 0.01 inch). The logger unit accepts the contact closure and records the event as a time stamp to one second resolution. Each event is stored in secure, non-volatile flash memory in preparation for data extraction. The logger unit can be removed from the TBRG for data retrieval while a fresh replacement logger is fitted to continue the rainfall record.

The data extraction process is accomplished via a PC or similar. A simple one-to-one DB9 cable connection is made between the PC and logger to allow data retrieval upon operator command. The data format of the logger file is specified within this document.

3. Installation

The MiniLog has a single DB9 female connector, which is used for inputs and communications and external power. The pinout is designed to be compatible with direct connection to a PC Comm port. Note that when external power is supplied, whether though a power supply or RS232 handshake lines, the power drawn from the internal lithium battery is reduced to zero.

3.1 Hardware Connections

The DB9 female connector on the ML1-FL logger is as follows :-

Pin Connection	ML1-FL Logger Signal Name DB9 Female		PC Signal Direction	PC Signal DB9 Male
1	External Battery Voltage input		⟹	CD
2	Tx (RS232 Serial data output)		⟹	Rx
3	Rx (RS232 Serial data input)		⟸	Tx
4	External Power		⟸	DTR
5	Gnd			Gnd
6	External Power		⟹	DSR
7	External Power		⟸	RTS
8	External Power		⟹	CTS
9	Contact closure input (See note 3)		⟹	RI

Notes:

1. When the ML1-FL is directly connected to a PC the following handshake signals are linked
   - Pins 4 and 6 are linked together inside the ML1-FL.
   - Pins 7 and 8 are linked together inside the ML1-FL.

2. When the ML1-FL is directly connected to a PC, sufficient power is extracted from the handshake signals to power the ML1-FL – which prevents power drain from the internal lithium battery while communications is in progress.

3. When the ML1-FL is directly connected to a PC, it is best to make sure that Pin 9 of the connector is not connected through. The high impedance "Contact closure input" to the ML1-FL is pulled low by the low impedance "RI" input to the PC, causing an event to be logged. (No electrical damage will occur) (On the latest version of the ML1-FL PCB, a solder link LK1 isolates the contact closure from pin 9.)

3.1.1 Contact Closure input

The voltage free contact to be monitored should be connected either between Pin 9 (contact closure input) and Pin 5 (Gnd) with PCB solder link LK1 bridged   OR   it can be connected to the internal screwless terminal block, through a cable gland on the enclosure. (**Note** that the PCB solder link LK1 is a new option available only on the latest PCB revision and is left open circuit when the ML1-FL is supplied from the factory.) (**Also Note:** In the first option (shown on the left), an extra tip will be generated when the DB9 connector is plugged into a PC, unless pin 9 is clipped on the DB9 lead.)
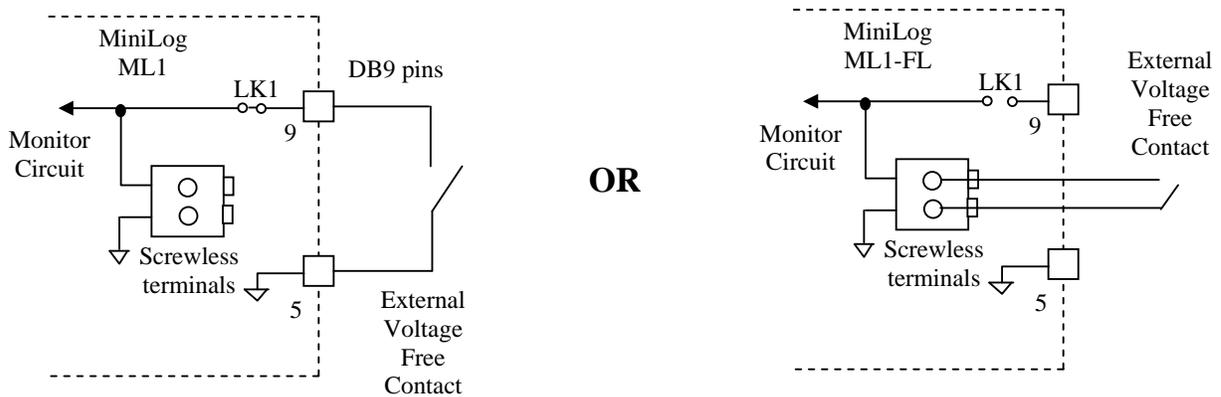
Connection of Contact Closure Input

3.1.2 External Power Supply

While the MiniLog ML is in the field monitoring the contact closure, an external power supply is **not** required. The logger enters a "sleep" mode and consumes only 40uA, waking only to update the time, and log a contact closure event. In this mode the logger will operate continuously for 2 years on the internal lithium battery.

During a communication session however, external power is required so the logger can stay awake. When external power is supplied, either through an external power supply, an external battery, or through the RS232 handshake lines DTR and RTS, the MiniLog ML1-FL senses the power connection and immediately wakes up and is ready for communications.
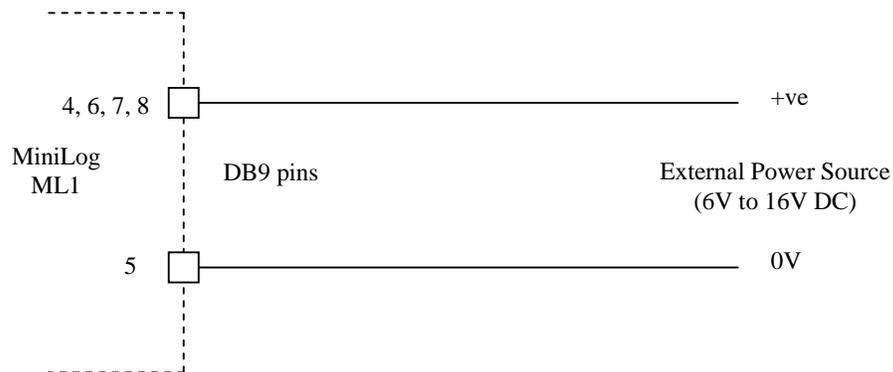
Connection of External Power Source during communications

A new feature of the latest hardware and software (Rev 1.11 or higher) is the monitoring of an external battery voltage. This is most useful on a system such as RainTrak where there is an external 12V battery charged by a solar panel. The battery is wired between pins 1 and 5 of the DB9 connector as shown.
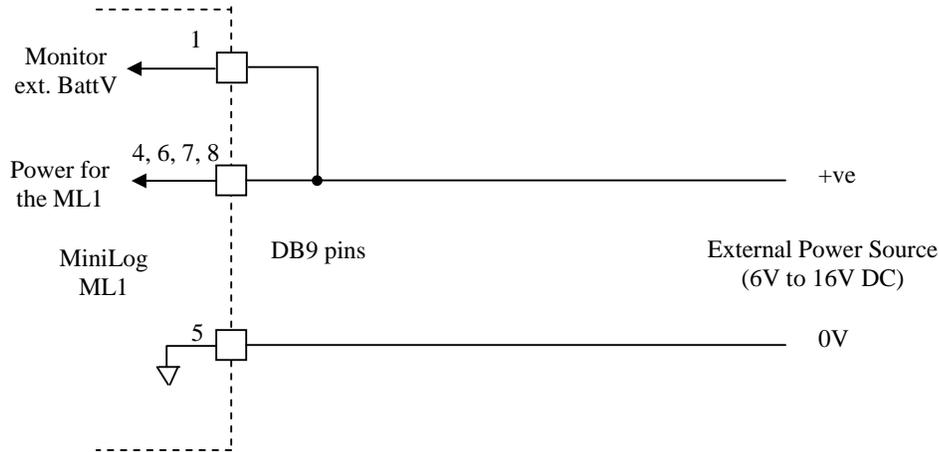
Connection of External Power Source during communications

The monitoring is turned on with the command "BVEXT = on". If the response "Feature not available" is returned, then your hardware does not support the external voltage measurement. When the "BVEXT" flag is enabled, the BV command will return both the internal 3.6V lithium battery voltage as well as the external 12V battery voltage. The external battery will have a continuous 25K ohm load – a current draw of about 0.5mA.

At 00:00 midnight every night, the external battery voltage is measured and logged. When a DUR is performed, the battery voltage is displayed at the end of the midnight report each day. Measurement at midnight means the battery has been running for several hours without additional solar energy, and gives a rough indication of the battery condition, and the solar energy put into the battery each day.

Passwd=****
bvext=on
bv
3.6V / 12.7V

dur
09:30:08 15/9/07 0 Record Clear
15:37:05
22:19:28
00:00:00 16/9/07 2 12.4V
00:00:00 17/9/07 0 12.6V
02:15:47
02:17:29
03:42:06
03:44:47
00:00:00 18/9/07 4 12.9V
Record End
Data Logger Model ML1

3.1.3 Communications

The DB9 female connector on the logger is the communications port and is setup as a DCE. This allows direct connection to a PC comm port using a DB9 male to DB9 female 1-to-1 cable.

*** **Note** that it is best to remove pin 9 from this communication cable, as the low impedance RI input on the PC RS232, will pull down the contact closure input on the MiniLog ML1-FL and cause an event to be logged. (Pin 9 can be easily removed with a pair of long nose pliers and is rarely used in any communications equipment.)

Connection of PC

Communications can also be active while the contact closure is being used, with the preparation of a special cable.
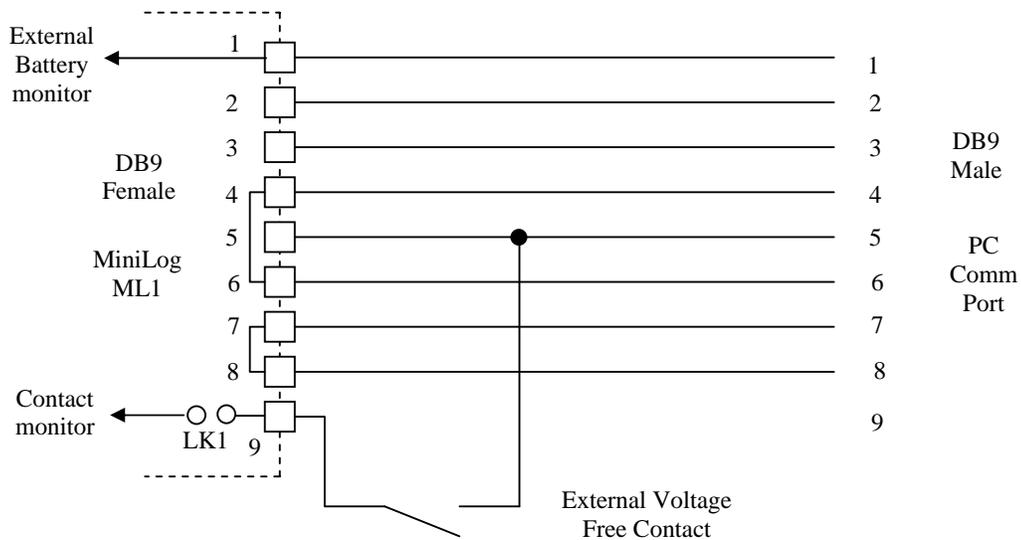
Connection of PC together with Contact Closure Input

3.2   Setup and Configuring the Logger

Once the ML1-FL logger has been connected to a computer, the parameters can be setup using WinComLog or any 'dumb' terminal emulation program. (NOTE: If a third party application is used, the handshake signals DTR and RTS should be forced high to enable the MinLog to have power.) If using a third party program, it should be set for the appropriate baud rate, and 8/N/1 (bits/parity/stop), handshake off, and "local echo on". On receipt of individual commands from the computer, the logger will respond with the present parameter setting. (Note that the command keywords permit both upper and lower case characters, or a combination of both.) A carriage return (< CR > , Enter Key) immediately following an entry will action the command. Invalid entries return a "Command Error" response. A list of all logger commands may be viewed on the computer screen by using the unique on-board help system. Simply type ? and then press the Enter key.

Data and parameter security is provided by means of a user password. Any data or parameters may be viewed without a password, but parameters may only be altered and data may only be cleared after the password has been entered correctly. The default password when the logger is supplied is "BOMM". Parameters may be entered by typing the command, then the equals symbol (=) and then the new parameter, followed by the Enter key.

3.2.1 Site Information

The "Site Information" (SI) is a user definable 16 character string that allows each logger to have a unique location name. Alternatively, loggers in a locality may be given the same name and the rainfall channel ID may be used to uniquely identify the logger data. This allows for easy identification of dumped data or status window information. See section 4.1.8 for more information on this command.

3.2.2 System Time/Date

The "Time" (T) and "Date" (D) should be checked for accuracy during installation.

The "Time Adjust" (TA) command allows the Real Time Clock to be adjusted for crystal frequency inaccuracies.

3.2.3 Sensor + Parameters

The Minilog ML1-FL has several parameters that allow characterisation of the sensor being used. The "Channel ID" (CHID) is a 7 digit user definable number that should be set to uniquely identify the channel. The "Increment" (INC) parameter defines the capacity of the specific sensor used as well as the number of external events that constitute one logged event - this determines the resolution and the rate at which flash memory is used. See section 4.1.4 for more information on these commands.

3.2.4 Communications

The MiniLog ML1-FL has an RS232 serial interface to support asynchronous ASCII communications to accommodate data extraction and user set-up. This port operates at 1200, 2400, 4800, 9600, 19200, 38400 and 57600 baud with 8 data bits, no parity and 1 stop bit.

Each event that is logged is also transmitted on the serial port, unless the event output flag is off (EV=off).

4.   Operation

4.1   Commands / Syntax

The following sections give detailed information on each of the MiniLog ML1-FL commands. Simply type the command and then press enter to view the parameter. To change a parameter, the password must first be entered, and then type the command followed by =, then the new parameter followed by Enter.   Eg. SI=Sydney then press Enter.

4.1.1 On-line Help (?)

Type a **?** then press Enter to get the following help screen. The commands are listed in alphabetical order.

On-line Help

```
?↵
Data Logger Command Syntax              [...] = optional to set paramete
(Command may be upper and/or lower case)  <CR>  = press carriage return
BAUD[=xxxx]<CR>        (comms BAUD rate)   BV<CR>                (Batt. Voltage)
BVEXT[=On/Off]<CR>    (BattV EXTernal)     BYE<CR>               (exit passwd access)
CHID[=7 dig]<CR>      (CHannel ID)         CLEARx[=30char]<CR>  (Clear Seq.x=1,2,3,4)
CLR<CR>               (Clear Log Record)   D[=d/m/y OR m/d/y]<CR> (Date)
DUR/N/h:m:d/m/y<CR>   (DUmp log Record)    EV[=On/Off]<CR>       (EVent output)
FMT[=dmy/mdy]<CR>     (date ForMaT)        ID<CR>                (logger ID)
INC[=x.x/mm]<CR>      (INCrement+mult.)    LOG[=On/Off]          (En/Disable Logging)
MW[=On/Off]<CR>       (Memory Wrap)        PASSWD=****<CR>       (4 char password)
RE[=On/Off]<CR>       (REsponse output)    RESET<CR>             (software RESET)
SI[=16chars]<CR>      (SIte name)          SLEEP[=N]<CR>         (Set Sleep time mins)
ST<CR>                (STatus window)      T[=hh:mm:ss]<CR>      (Time)
TA[=hh:mm:ss]         (Time Adjust)        TOT<CR>               (TOTal  )
TDAY<CR>              (Total toDAY)        TYPE[=16chars]<CR>    (TYPE of logger)
U[=8char]<CR>         (Units)              VER<CR>               (s/w VERsion)
```

(The LOG command is only available in S/W Version 1.13 and above)

4.1.2 Communications (BAUD, EV, RE, CLEAR)

The "Baud" (**BAUD**) command allows the baud rate to be viewed or changed. Acceptable baud rates are 1200, 2400, 4800, 9600, 19200, 38400 and 57600.

BAUD<CR>	Display the present baud rate
BAUD= 9600<CR>	Set the baud rate to 9600 baud

The "Event" (**EV**) flag allows the time stamps that are transmitted on the serial port to be enabled or disabled. When an event occurs, the time is transmitted on the serial when EV is on. When EV is off, nothing is transmitted on the serial port when an event occurs.

EV<CR>	Display the state of the event flag.
EV=ON<CR>	Enable event reporting
EV=OFF<CR>	Disable event reporting

The "Response" (**RE**) flag allows the error response to commands, to be enabled or disabled. When RE is on then you may see "Command Error" or "Syntax Error" messages appear if the MiniLog does not understand what was typed. When RE is off then there will be no response if the MiniLog does not understand what was typed. It is useful to turn this off when connected to a modem, so that the MiniLog and the modem don't engage in endless "Command Error" conversations.

RE<CR>	Display the state of the response flag.
RE=ON<CR>	Enable all error responses.
RE=OFF<CR>	Disable all error responses.

The "Clear" (**CLEAR1/2/3/4**) command sequences are used to control an external modem – that is force it into a known state. (If there is no modem connected to your MiniLog, then these sequences can be left clear. Eg. Set CLEAR1=<CR> then CLEAR2=<CR> then CLEAR3=<CR> and finally CLEAR4=<CR>)

The Clear sequences are performed when a Bye command is received, and/or if no comms is received within the Sleep timer period.

There is a maximum of 30 characters in each of the 4 clear sequences. Special characters include **~** = 0.5 second pause and **^** = CTL character (Eg ^M = carriage return)
The format of each sequence is CLEAR1 = Command Sent / Expected Reply / Timeout

Eg **CLEAR1=+++~~ATH^M/OK/10**   Sends +++, then waits 1 second, then send ATH<CR> then waits up to 10 seconds for an OK response.

The expected reply and the timeout parameters are optional. If no timeout is specified, then a default of 60 seconds is used. The timeout may be a one or two digit number.

CLEAR1<CR>   Display the clear1 sequence
CLEAR1=+++~~<CR>   Set the clear 1 sequence. Send +++ then wait 1 sec
CLEAR1=+++//5<CR>   Send +++, no response and wait 5 seconds

After CLEAR1 sequence is performed, CLEAR2 then CLEAR3 and finally CLEAR4 sequence is performed.

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4.1.3 Battery Voltage (BV, BVEXT)

The MiniLog battery voltage is measured and displayed when the battery voltage command (**BV**) is executed as well as during a status window command (ST)

BV<CR>   Displays the internal lithium battery voltage (BVEXT=off)
                        Displays the internal lithium and external battery voltage when (BVEXT=on)

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External battery voltage monitoring can be turned on or off with the (**BVEXT**) command. When it is turned on, the BV and ST command display both the internal lithium and external battery voltage – as well as log the external battery voltage a midnight. This is displayed on the midnight report of a DUR command.

BVEXT<CR>   Displays the present BVEXT state as on or off
BVEXT=ON<CR>   Enable external battery voltage monitoring
BVEXT=OFF<CR>   Disable external battery voltage monitoring

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4.1.4 Channel Parameters (CHID, INC, TOT, TDAY, TYPE, U)

The "Channel ID" (**CHID**) is a 7 digit user definable number that should be set to uniquely set to identify the channel.

CHID<CR>   Displays the present Channel ID
CHID=0012345<CR>   Sets the Channel ID to 0012345

The "Increment" (**INC**) is a parameter that specifies the quantity that each contact closure represents. This might be 0.2mm of rain for a tipping bucket rain gauge, or 10 litres of water for a flow meter, or 1 widget for a product counter. The parameter is split into 2 parts – the first part is the amount that each contact closure represents, and the second part is the number of contact closures that represent one event. The increment command has 5 different acceptable formats.

INC<CR>   Display the existing increment parameter.
INC=0.01/01<CR>   Defines say a TBRG bucket of 0.01 inches of water, and one tip
                            represents one logged event.
INC=0.2/01<CR>   Defines say a TBRG bucket of 0.2 mm of water, and one tip
                            represents one logged event.
INC=10/10<CR>   Defines say 10 litres of water per contact closure of a flow
                            meter, and 10 such closures logged as one event. This means
                            that each event represents100 litres of water.
INC=100/01<CR>   Defines say 100 litres of water per contact closure of a flow
                            meter, and 1 such closure logged as one event.
INC=1000/05<CR>   Defines say 1000 washers in a box, and 5 such boxes logged as
                            one event. This means that each event represents 5000 washers.

The "Total" (**TOT**) command allows the Total number, of whatever is being counted, to be displayed. This is the total since the last reset – or the total since the last CLR record clear.

TOT<CR>   Displays the total of what is being counted since the last record
                            clear.

The "Total Today" (**TDAY**) command allows the Total number, of whatever is being counted, to be displayed. This is the total today since midnight.

TDAY<CR>   Displays the total of what is being counted since midnight.

The "Type" (**TYPE**) is a 16 character user defined string that allows the Status Window to be customised for your counting application. It simply changes the aesthetics of the Status Window. The MiniLog may be used for accumulating Rainfall, measuring Flow, counting People or Cars etc…. It is best to start this parameter with a capital letter – for aesthetic reasons.

TYPE<CR>   Display the MiniLog Type
TYPE=Rainfall<CR>   Set the logger to Rainfall
TYPE=Flow<CR>   Set the logger to Flow.

The "Units" (**U**) is a user defined 8 character string that assists in defining what is being counted. For example it may be mm or inches or litre/hr or widgets. This parameter is so the retrieved data has meaning.

U<CR>   Display the present units.
U=mm<CR>   Set the units to mm.

4.1.5 Date/Time Parameters (**D, FMT, T, TA**)

The MiniLog date and time is maintained by the microprocessor, and the LED flashing once a second indicates that the logger is alive and operational. (This flash is only 1mS in duration and consequently the power consumption is negligible.)

The "Date" (**D**) is displayed as day/month/year or month/day/year with slash separators. (This depends upon the format (FMT) parameter.)

D<CR>   Displays the date.
D=22/09/05<CR>   Set the date. (Note: leading zeros are optional, BUT
D=9/3/5<CR>   day+month+year must be entered)

The "Format"(**FMT**) parameter is used to change the date format to either day/month/year or month/day/year.

FMT<CR>   Display the present format as "dmy" or "mdy"
FMT=dmy<CR>   Set the date format to day/month/year.
FMT=mdy<CR>   Set the date format to month/day/year

The "Time" (**T**) is displayed in 24 hour format separated by colons. When entering the time and date, all fields must be entered. Note that if the time is entered as T= then it will be reset to midnight 00:00:00.

T<CR>	Displays the time in 24 hour format
T=9:45:00<CR>	Set the time (Note: leading zeros are optional BUT
T=16:7:0<CR>	hrs+mins+secs must be entered)

The "Time Adjust" (**TA**) command performs the same function as the time (T) command, except it determines if the clock is running fast or slow, and calculates an adjustment to add or subtract 1 second every xxx hours. In effect, this is a software adjustment to bring the clock into specification. A sample procedure would be :

1. Set the time accurately using the T=12:35:00<CR> command
2. Wait at least 12 hours (the longer the time period the better the accuracy – this could be over many months.)
3. Set the time again using the TA=17:13:30<CR> command

The new time adjustment will be calculated and displayed. (NOTE: If there is already a time adjustment in progress, then the MiniLog will take this into account when calculating the new adjustment.) After this procedure the clock accuracy will be improved considerably.

TA<CR>	Display the present time adjustment
	eg. +1 Sec every 0014 hours
TA=<CR>	Remove the existing time adjustment.
TA=10:13:55<CR>	Set the time to 10:13:55 and calculate the new time adjustment.

4.1.6 Dump Log Record (DUR, MW, CLR, LOG)

The MiniLog ML1-FL logged data is stored in the on-board flash memory.

The "Dump log Record" (**DUR**) command, unloads the historical records from the start of the record to the most recent event stored. On completion of successful data retrieval, the memory remains intact until cleared by the clear rain log user command (CLR). When the memory becomes full, with Memory Wrap off, the logger stops logging and tacks a "Mem Full" message onto the end of an event message. When Memory Wrap is on, and memory becomes full, the oldest records are erased and replaced by the newest records. The log is dumped in ascii format, as shown in section 4.2.1.

DUR<CR>   Dump the complete log record.

The "DUR" command also allows for searching through the log and starting at a specific location instead of always dumping the complete log record.
Syntax : DUR / No of days / Time / Date

Examples :
DUR/2<CR>   Dump 2 full days of data, starting 2 days back from the current date at 00:00
DUR/1/1:40<CR>   Dump 1 day of data starting at 1:40am today
DUR/30/12:00/1/1/06   Dump 30 days of data starting at 12:00pm on 1-Jan-2006
DUR/12/15:30/13   Dump 12 days of data starting at 3:30pm on the 13th day of the current month and year. (Note that the date format in this example is DayMonthYear)

DUR/L   Dump all the data since the last dump
                               (**NOTE :** Only for S/W Ver 1.13 and above)

NOTE : The format of the date in the DUR command depends upon the date format in the MiniLog – that is either Day/Month/Year or Month/Day/Year.

The "Memory Wrap" (**MW**) command, enables or disables the wrapping of memory. When memory wrap is on, and the historical log becomes full, then the first data stored will be erased one block at a time. (A block of Flash memory holds approximately 50 events, and there are 2048 blocks available.) In this mode memory never becomes full, and the most recent data is always available. It is advisable that when changing the state of the Memory Wrap flag, the existing logged data be erased so that logging can start afresh.

MW<CR>   Display the present state of the memory wrap flag
MW=ON<CR>   Turn memory wrap on.
MW=OFF<CR>   Turn memory wrap off.

NOTE: It is best to clear all of memory (using CLR) when changing this flag.

The "Clear Record" (**CLR**) command erases the complete memory log of all history. Be careful using this command – there are no second chances.

CLR<CR>   Erase complete log record.

The "Log" (**LOG**) command allows logging to memory, to be turned on or off. This is used to test a logger without disturbing the existing logged data. The LED will still flash and the event will appear on the comms (if EV is on) so the operator can verify the event has been recognised. When the comms cable is removed (or the sleep timer expires), logging is automatically turned on ! (This command is only available in S/W Rev 1.13 and above)

LOG<CR>   Display the present state of the Log parameter
LOG=OFF<CR>   Turn logging off (Events are not logged to memory)
LOG=ON<CR>   Turn logging on (Events are logged to memory again)

4.1.7 Miscellaneous (ID, SI, PASSWD, BYE, SLEEP, RESET, VER)

The "Logger Identification" (**ID**) is a unique number embedded in the MiniLog at the time of manufacture and can only be read.

ID<CR>   View the logger ID. Eg. ML0001

The "Site Name" (**SI**) variable is used to either identify a specific logger or the location of the logger. This is a variable string up to 16 characters long and can be any alphanumeric character. The user can use this field for whatever they wish.

SI<CR>   Display the present site name.
SI=Sydney<CR>   Set the site name to "Sydney"

The password (**PASSWD**) prevents unauthorised access to altering the parameters or clearing the historical log record. Password access is cleared when the comms is unplugged and the MiniLog returns to its sleep mode, or the BYE command is performed.

The password is a 4 character alphanumeric string that is upper / lower case sensitive. New passwords may be entered by first gaining access by entering the existing password, and then immediately entering the password command again with a new password.

PASSWD=BOMM<CR>   To attempt access, or change password if access already
                                         accepted.

In S/W Rev 1.13 and above, if the password is set to the special value of ****, then the password function is disabled! That is, the user does not have to enter the password before they change parameters or clear memory. For example :

PASSWD=BOMM<CR>   Enable access.
PASSWD=****<CR>   Password function disabled.

This may be reversed by first entering the **** password and then entering a new password. For example :

PASSWD=****<CR>   Enable access.
PASSWD=BOMM<CR>   Save BOMM as the new password.

If the MiniLog is connected to a modem, then it may have the comms cable permanently connected. In this situation, once the password is entered, access is permanently granted. The "Bye" (**BYE**) command forces the MiniLog to cancel the password access, and also performs the CLEAR1/2/3/4 sequence of commands. (When the sleep timer expires, password access is also cancelled.)

The "Sleep" (**SLEEP**) command provides a timer, so that a "Bye" is performed if there is no communications in the preset time. The timer is set in minutes. For example, if "sleep" is set to 5 minutes, and there is no communications for a 5 minute period, then password access will be cancelled, and the CLEAR1/2/3/4 will be performed. When Sleep is set to 0, the function is disabled.

SLEEP = 5<CR>   Sets the sleep timer to 5 minutes (Acceptable values are 0 to 9)

The "Reset" (**RESET**) command performs a hardware reset, but does not affect the time, date, parameters or logged data.

RESET<CR>   Perform a reset of the MiniLog. Note that this command is
                                         equivalent to switching the logger off and then on again.

The "Version"(**VER**) command allows the MiniLog firmware version to be displayed.

VER<CR>   Displays the MiniLog firmware version and date.

4.1.8 Status Window (ST)

The Status Window (ST) returns a summary of station set-up details together with a report of the present conditions on user command. Each set-up parameter is identified by name followed by its unique command keyword, (parameter abbreviation). The Status window provides a 'plain English' response for visual interpretation when the ST command is issued.

Command Example

```
ST ↵
Site(SI):                    Sydney     Flow Channel ID (CHID):               0012345
LoggerID(ID):                ML0001     Flow Log Start:                      22/09/05
Date(D):                   28/03/94     Flow Inc. (INC):                        10/01
Time(T):                   10:06:46     Flow Today (TDAY):                      270.0
Baud Rate (BAUD):              9600     Flow Total (TOT):                      9760.0
Response(RE):                    On     Flow Units (U):                        lt/min
Event Output (EV):               On     Events Left:                            99321
Battery Volt (BV):            3.54V     Memory Wrap (MW):                         Off
Clear1:                       +++~~     Go to sleep after (SLEEP):              5 min
Clear2:                ATH^M/OK/10       Logging On/Off (LOG):                     On
Clear3:                                 S/W Revision (VER):                      1.13
Clear4:

  --------------------------------------------------------------------------------------------------------
```

NOTE : The word "**Flow**" in the above Status Window, is the result of the TYPE parameter. This string can be changed to customise the Status Window to your requirements.

The "Logging" status and "S/W Revsion" are only listed if the S/W Version is 1.13 or greater.

4.2   Data Output Format

4.2.1 Dump Log Record

The following data represents the historical log record as output from a MiniLog ML1-FL data logger. The example below represents a data record as presented to a computer after invoking a Dump Log Record command. Each parameter is separated by a 'space' character with each line terminating with a carriage return line feed marker, (< crlf >). Additional housekeeping events, identified as 'plain English' text fields, are automatically logged to the record on the instance of a variety of events. The text fields Record Clear, Time Change, Date Change and Record End are examples of some of the text event indicators.

Station Set-up Header	➡	**MELB 0012345 ML0001 0.2< crlf >**
Logger Start Header	➡	**09:35:23 24/8/05 0 Record Clear< crlf >**
		10:25:37< crlf >
Event	➡	**10:27:42< crlf >**
		16:53:05< crlf >
Daily Summary	➡	**00:00:00 25/8/05 3< crlf >**
		15:43:09< crlf >
		15:44:23< crlf >
		15:45:00< crlf >
		22:22:55< crlf >
		00:00:00 26/8/05 4< crlf >
		22:24:00< crlf >
		00:00:00 27/8/05 0< crlf >
End of Record Marker	➡	**Record End< crlf >**

Field	Par.	Parameter Definition
Station Set-up Header	MELB	Site Name, variable length, user programmable.
	0012345	Channel ID Number or observational site number, 7 digits, user programmable.
	ML0001	Logger ID, 6 digits, hard coded by manufacturer, where first two digits "ML" represent an alphanumeric manufacturer ID followed by a four digit unit number.
	0.2	Recording Increment, 0.2 millimetres, user programmable.
Logger Start Header	09:35:23	Logger Start Time, Hour:Minute:Second.
	24/4/94	Logger Start Date, Day/Month/Year.
	0	Start Count, event accumulator, 0 counts.
	Record Clear	Indicator to identify start event, normally "Record Clear".
Event	10:27:42	Time Stamp of contact closure, Hour:Minute:Second.
Daily Summary	00:00:00	Time Stamp check at zero hours, Hour:Minute:Second.
	25/4/94	Date Stamp check at zero hours, Day/Month/Year.
	3	Daily event accumulator, (daily total = 3 events).
End of Record Marker	Record End	Indicator to identify the end of the log record.

5.   Specification

5.1   Hardware Specification

Microprocessor   Microchip PIC18F2680 nanowatt processor

Program Memory   Internal to microprocessor (64K bytes)

Program Upgrade   Via RS232 WinComLog Application

Data Memory   45DB041   512KB Serial Flash EPROM

Parameter Memory   EEPROM internal to microprocessor (1024 bytes)

Events Recorded   100,000 events , 1 second resolution

Real Time Clock   Day/Month/Year Hour/Minute/Second
                          32768 Hz crystal
                          Accuracy adjustable under software control

Inputs   1 x Digital input (for rain or flow etc..)
                          (Maximum recording rate = 30 events per second)
                          1 x external Battery Voltage measurement (25k ohm load)

Indicators   LED indicator

Connections   1 x DB9 Female

Communications   RS232 Port (Tx, Rx)

Power Supply   1 x Internal 3.6V Lithium AA cell
                          5 year battery life => average consumption less than 40uA
                          (no consumption if external supply present)
                          *(Warning: this estimate is dependant on logging interval,
                          battery brand, condition and remaining shelf life when
                          installed)*

                          External Supply 6V to 16V DC
                          (All RS232 inputs diode-ored together)

PCB Dimensions   54mm x 49mm

Dimensions   65mm x 60mm x 40mm (L x W x D)

Weight   200 grams

Environmental   -40C to + 70C at 95% RH Non Condensing
                          Aluminium waterproof housing IP67

5.2   LED Indicator

The LED indicator on the MiniLog ML1-FL will flash once a second. This heartbeat indicates that the MiniLog is alive and well. (Note that the flash is only 1 mS in duration and has an insignificant contribution to the 2 year lithium battery life.)

When an external event or communication occurs, the LED flashes much longer. This makes it easy to distinguish an event from the heartbeat.

5.3   External Contact Interface

The MiniLog ML1-FL logger includes an interface for an external voltage free contact. The occurrence of an external event causes the logger to wake momentarily, record the event to the historical record, transmit the event on the serial port (if the EV flag is on), update the Total Events and Events Today before going back to sleep.

5.4   Communications Interface

The communications allows for simple direct connection to a PC. The hardware interface is standard RS232, and the low consumption of the MiniLog means that sufficient power can be extracted from the RS232 handshake lines to power the logger while a communication session is in progress. Seven baud rates can be selected.

5.5   Watchdog

The MiniLog incorporates 'watchdog' circuitry within the microprocessor to automatically recover from unforeseen software or noise induced failures. The action of a watchdog reset does not affect previously recorded data or any set-up parameters including date and time.

5.6   Power Supply

The MiniLog is powered by an internal lithium battery for 2 years, for normal event logging. External power is required during a communication session – but this is normally provided through the RS232 handshake lines when an RS232 cable is connected.

External power may be supplied to relieve the internal lithium battery. If this option is elected, then use 6V DC to 16V DC.

5.7   System Memory

A fundamental requirement of the logger unit is for sufficient memory capacity to store 100,000 events.

In most cases the MiniLog can be returned to the processing centre via surface mail. The logger's small size and weight means the package returned, conforms with low cost postage tariffs.

The logger application requires three essential memory areas, **Data Memory** for storage of the historical records, **Program Memory** for storage of the application firmware and **Paramter Memory** to store unique station parameters.

5.8   System Clock

The clock performance in terms of reliability and maintainable accuracy is of prime importance as the historical record is unusable should time and date errors occur. The clock should maintain an accuracy of better than 20 seconds per month with resolution to one second across an operating temperature range from -10°C to $+70^{o}$C. The Time Adjust command allows for automatic software adjustment of the real time clock crystal.

5.9   Logger Identification

Each logger has a six digit unique identification number hard coded and accessible as a **read** only system parameter via software.

6. Fault Finding

This fault finding guide should be used by the ML1-FL user before they consult the manufacturer to assist with specific problems.

LED does not flash once a second.
- If you have attempted to load new software / firmware, then attempt the procedure again.
- The lithium battery may be flat. Remove the 4 screws on the top of the MiniLog and remove the top cover exposing the PCB and battery. Use a DVM to measure the battery voltage. It should be between 3.2V and 3.6V.
- If LED still does not flash after the above has been checked, return the logger to the supplier for service.

No communications from logger.
- Check if LED flashes when sending a character to the logger. If not, see if the LED flashes in response to an external event. The RS232 handshake lines provide power to the MiniLog – so make sure the RTS and DTR signal are in their hi state – especially if you are using a third party terminal emulation package.
- Check the logger baud rate, number of bits and parity (8/N/1) matches that of the terminal emulation program being used on the computer. If you receive strange characters in response to a carriage return, then the baud rates probably don't match - change the baud rate on the terminal emulation program, and try again.
- Check the Tx, Rx, RTS, DTR and Gnd wiring to the logger from the computer.
- Check that the terminal emulation program is working, by disconnecting the logger and shorting the Tx and Rx wires together, and type on the computer. You should get each character twice on the screen.

What I type on the computer the characters do not appear, but the logger seems to respond OK.
- Set the third party terminal emulation program "Local echo" to on.

An external event flashes the LED but nothing gets transmitted.
- Set the event flag (EV) to on to allow events to be transmitted. However the flag should be off if the logger is connected to an intelligent modem.
- Check that the multiplier (**mm**) in the increment parameter (INC=x.x/**mm**) is set to a reasonable number. Remember that **mm** contact closures represent one event.

When I type <CR> (Enter) on the computer the LED flashes but I get no reply.
- Set the response flag (RE) to on. This flag is used to stop the logger responding to data from an intelligent modem. If you are talking through a modem then this is correct, you will not get a response to a <CR> (Enter) because the response flag must be left off.

The logger will not accept my password.
- Check that you have the correct password, and you are entering it in the correct upper and lower case.
- If still no success, the logger must be returned to the manufacturer, to set a default password. Keep your password written down in a secure place.

When I enter a parameter I just get a "Syntax Error" reply.

- Check the exact command syntax by using the on-line help. Type ?<CR> . Now re-enter the parameter with all leading and trailing zeros.

When I enter a command I just get a "Command Error" reply.
- Check that the command you are entering is a valid command by using the on-line help. Type ?<CR> and check the exact spelling of the command.

When I connect an external battery between the DB9 pin1 and pin 5, I can't read the voltage.
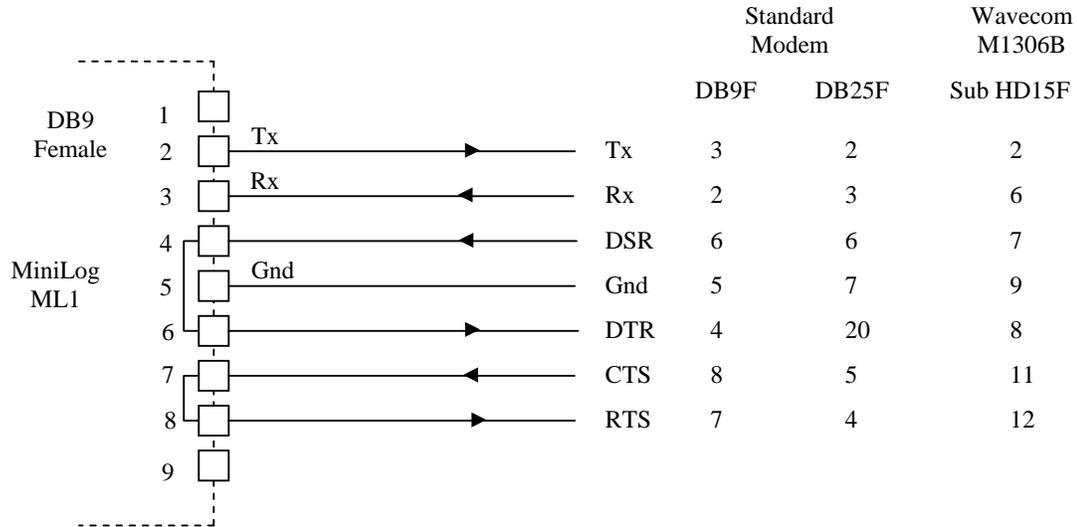- Enable the external battery voltage monitoring with BVEXT=ON<CR> then type BV.

When I try to enable the external battery voltage I get the message "Feature not available"
- This feature is only available on Rev F or greater hardware. You may need to purchase a new ML1-FL to obtain this feature.

Appendix A. Interfacing to a Modem

The MiniLog may be connected to a modem to allow remote communications.

The MiniLog only uses Tx and Rx for communications, however, the modem handshake lines **must** also be connected to provide power for the MiniLog during the communication session. These handshake lines are looped together inside the MiniLog as shown.

		Standard Modem		Wavecom M1306B
		DB9F	DB25F	Sub HD15F
Tx	Tx	3	2	2
Rx	Rx	2	3	6
	DSR	6	6	7
Gnd	Gnd	5	7	9
	DTR	4	20	8
	CTS	8	5	11
	RTS	7	4	12

Hardware Connections - Basic Modem Interface

Standard Modem Settings

Before a modem is put into service, the following settings should be programmed into the modem. Simply connect the modem to your PC using the cable supplied with the modem, and run a program such as WinComLog or Hyperterm. Type AT<CR> and you should get an "OK" response. Then set the following commands in the modem :

ATE0	Turn off character echo
AT&C0	DCD is always on
AT&D0	DTR is ignored
AT&S0	DSR is always on
ATS0=2	Auto-answer after 2 rings
AT&W	Save these settings (they will be restored on the next power up)

It is best to turn the MiniLog "RE" parameter OFF when connected to a modem, so that the MiniLog and the modem don't engage in endless "Command Error" conversations.

Some modems require a specific sequence to hangup correctly. Enter these sequences into the CLEAR1/2/3/4 parameters and use the BYE command and then the "Hangup" button to close the communication session.

Using the Wavecom Fastrack M1306B GSM Modem and the Intercel SAM Modem.

A GSM modem is just like any PSTN modem you may be familiar with, except it communicates via the GSM mobile phone network, rather than the Public Switched Telephone Network (PSTN).

SIM Card

The GSM modem must have a SIM card installed, the same way your mobile phone has a SIM card. However you can't just use a standard mobile phone SIM card, you must have the card "Data Enabled" – that is you must contact your mobile phone network provider and specifically ask them to "Data Enable" the card. (In Australia the Telstra contact phone number is 1300 131 816.)
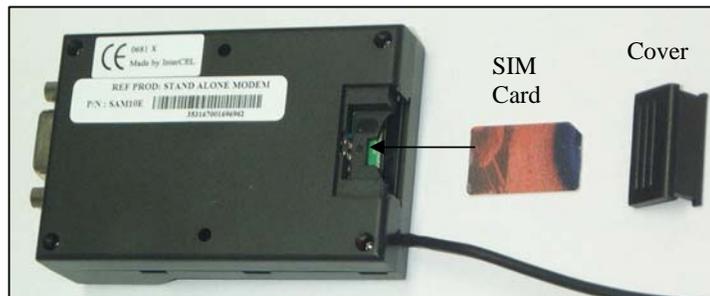
Wavecom Fastrack :

Push the eject button shown, to make the SIM card holder pop out.

Put the SIM card into the SIM card holder as shown, and insert the SIM card holder back into the modem.

Intercel SAM :

The SIM card fits into the rear of the SAM modem – so the modem must be unscrewed from its mounting, the cover removed from the modem, the SIM card inserted and the cover replaced.

Connect the antenna and apply 12V DC to the modem.

LED Indicator

Both the Wavecom M1306B and Intercel SAM modems have a LED indicator that flashes as follows :

LED Steady   => Not registered with network   (No SIM card, no signal, no PIN)
LED Slow Flash   => Registered OK but not connected
LED Fast Flash   => Connected and communicating

Modem Settings

Before the modem is put into service, the following settings should be programmed into the modem (in the same way as a PSTN modem). Simply connect the modem to your PC using the cable supplied with the modem, and run a program such as WinComLog or Hyperterm. Type AT<CR> and you should get an "OK" response. Then set the following commands in the modem :

ATE0	Turn off character echo
AT&C0	DCD is always on
AT&D0	DTR is ignored
AT&S0	DSR is always on
ATS0=2	Auto-answer after 2 rings
AT&W	Save these settings (they will be restored on the next power up)

Further advanced settings are required for the GSM modem.

AT+IPR=9600	Force 9600 baud communications to Minilog
AT+CSQ	Determine the signal strength. Typical Reply :
	+CSQ: 26,0
	(0-10 insuffucient : 11-31 sufficient : 99 no measure available)
AT+CREG?	Determine the registration status. Typical reply :
	+CREG: 0,0 Not Registered (no signal or SIM card not installed)
	+CREG: 0,1 Registered (home network)
	+CREG: 0,5 Registered (roaming)

Some SIM cards have PIN access. So enter the PIN code as follows, and then turn off the PIN requirement. (The PIN must be disabled, as there is no way for the MiniLog to enter a PIN)

AT+CPIN=xxxx	Enter the pin code
AT+CLCK="SC",0,xxxx	Turn off the PIN requirement

The Wavecom Fastrack and Intercel SAM modems both recommend that for continued network coverage, they be setup to reset every 24 hours by using the following command :

AT+WRST=1,"024:00"	Reset every 24 hours

The GSM modem should now be ready to connect to the MiniLog with the appropriate cable (see the connection diagram earlier in this appendix).

Use WinComLog (Rev2.20 or greater) and enter the phone number of the GSM modem SIM card, then press the "Dial" button. (+++ will be sent to the PC modem to get its attention, and then the ATDTxxxxxxxx command will be sent to perform the dialling to the GSM modem.) You will hear the usual dialling, ringing and connection tones through the modem. When a connection has been made, send a simple command like ?<CR> to check that communications has been established. When the communications session is complete, press the "Hangup" button. (Again +++ will be sent to the modem to get its attention, and then ATH to perform the hangup)

Appendix B. Installing a RainTrak System

The Hydrological Services "RainTrak" consists of a MiniLog, a Intercel SAM GSM modem, a solar panel, and mounting hardware for a Tipping bucket raingauge. (The user must provide their own 12V, 7Ah battery)

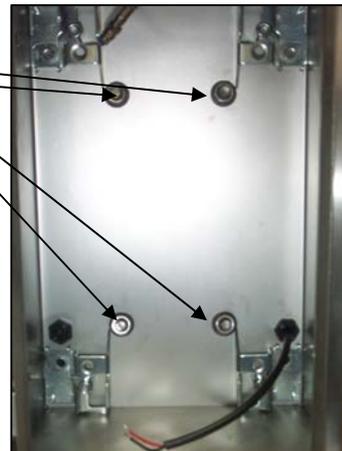Bolts securing electronics mounting plate. (Two more below)

Nuts securing U-bolts

GSM modem to aerial connector

Terminal Block

Removing electronics mounting plate

When installing the RainTrak on to a post, the following procedure must be followed:

- Remove the 2 x wires from the solar panel to the terminal block.
- Remove the 2 wires from the tipping bucket to the terminal block.
- Undo the connector from the GSM modem to the aerial.
- Remove the 4 x bolts that secure the electronics mounting plate to the enclosure.
- Remove the electronics mounting plate from the enclosure.
- Position the enclosure on the post, making sure that the solar panel faces roughly north, and do up the 4 nuts, inside the enclosure, that secure the two U-bolts.
- Reinstall the electronics mounting plate.
- Re-connect the aerial to the GSM modem.
- Re-connect the 2 tipping bucket wires.
- Re-connect the 2 solar panel wires.
- Re-install the 12V 7Ah battery.
- Check operation.

The Intercel SAM GSM modem must be unbolted from the mounting plate, as the SIM card fits to the rear of the modem.

Unbolt the modem.

Remove SIM card cover.

Insert the SIM card as shown.

Replace the SIM card cover, and bolt the modem back onto the mounting plate.