HydroMet



User Manual

MiniLog-ML1A

KISTERS
Empowering decisions of tomorrow

06-2026 – 01-02-004

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I Disclaimer

The information provided in this manual was deemed accurate as of the publication date. However, updates to this information may have occurred.

This manual does not include all of the details of design, production, or variation of the equipment nor does it cover every possible situation which may arise during installation, operation or maintenance. KISTERS shall not be liable for any incidental, indirect, special or consequential damages whatsoever arising out of or related to this documentation and the information contained in it, even if KISTERS has been advised of the possibility of such damages.

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This document is public.

II Safety Instructions

- Read the user manual including all operating instructions prior to installing, connecting and powering up the KISTERS MiniLog-ML1A. The manual provides information on how to operate the product. The manual is intended to be used by qualified personnel, i.e. personnel that have been adequately trained, are sufficiently familiar with installation, mounting, wiring, powering up and operation of the product.
- Keep the user manual on hand for later reference!
- If you encounter problems understanding the information in the manual (or part thereof), please consult the manufacturer or its appointed reseller for further support.
- KISTERS MiniLog-ML1A is intended to be used in hydrometeorological or environmental monitoring applications.
- Before starting to work, you have to check the functioning and integrity of the system.
  - Check for visible defects on the MiniLog-ML1A, this may or may not include any or all of the following: mounting facilities, connectors and connections, mechanical parts, internal or external communication devices, power supplies or power supply lines, etc.
  - If defects are identified that could compromise operational safety, work must be stopped immediately. This applies to defects detected both before work begins and during operation.
- Do not use the KISTERS MiniLog-ML1A in areas where there is a danger of explosion.
- The present user manual specifies environmental/climatic operating conditions as well as mechanical and electrical conditions. Installation, wiring, powering up and operating the KISTERS MiniLog-ML1A must strictly comply with these specifications.
- Perform maintenance only when tools or machinery are not in operation.
- If guards are removed to perform maintenance, replace them immediately after servicing.
- Never make any electrical or mechanical diagnostics, inspections or repairs under any circumstances. Return the product to the manufacturer's named repair centre. You can find information on how to return items for repair in the relevant section of the KISTERS website.



Disposal instructions: After taking the KISTERS MiniLog-ML1A out of service, it must be disposed of in compliance with local waste and environmental regulations. The KISTERS MiniLog-ML1A is never to be disposed of in household waste!



Inputs and outputs of the device are protected against electric discharges and surges (so-called ESD). Do not touch any part of the electronic components! If you need to touch any part, please discharge yourself, i.e. by touching grounded metal parts.

1 Introduction

Thank you for choosing our product. We hope you will enjoy using the device.

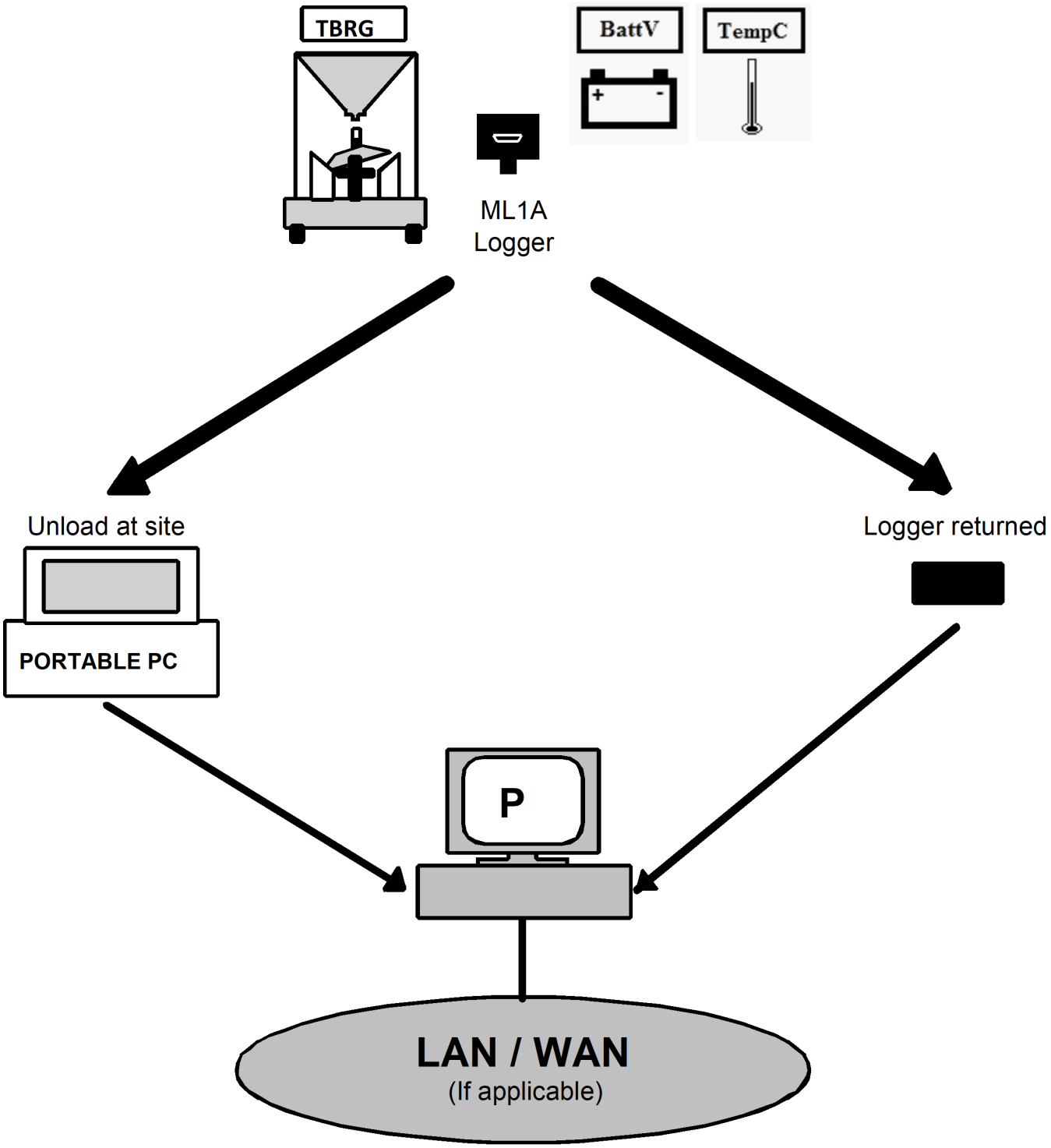
KISTERS manufactures, sells, installs and operates quality instrumentation, data loggers and communication technology. Products are designed with passion for environmental monitoring and with a deep understanding of the quality, accuracy and robustness needed to fulfil the requirements of measurement practitioners in the field.

The present User Manual will help you understand, install and deploy the device. If, however, you feel that a particular information is missing, incomplete or confusing, please do not hesitate to contact us for further support!

The MiniLog Model ML1A -FL is a Digital Data Logger, suitable for short term or long term remote data logging applications. It can measure rainfall events from Tipping Bucket Rain Gauges or pulses from water meters.

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 – it also monitors an external 12V battery, the internal battery and the ambient temperature inside the MiniLog enclosure. 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 syntax. The ultra-low power allows the logger to be powered from an internal 3.6V AA lithium battery for about 1 year or a 1.5V AA alkaline battery for about 6 months. The indicator LED flashing once a second as a heartbeat, gives the user confidence that the MiniLog is alive and well.

The only difference between the ML1A and the ML1A-FL is the supplied ”Fly Lead” wired to the digital input!



Product Overview

The 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.

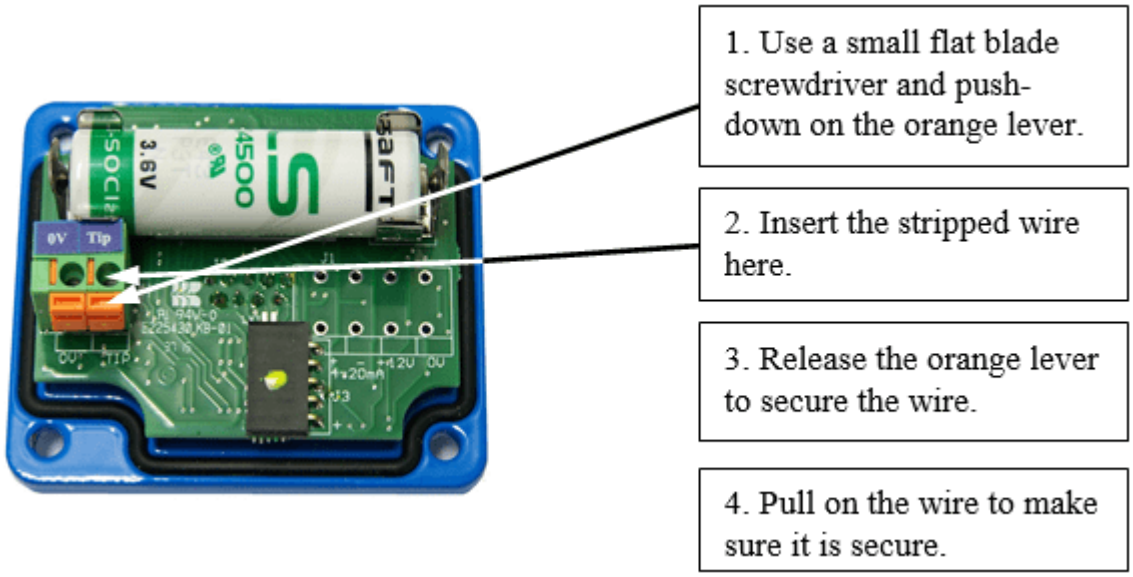
The data extraction process is accomplished via a PC or similar. A simple one-to-one DB9 cable connection is made between the PC and logger to allow data retrieval upon operator command. The data format of the logger file is specified within this document.

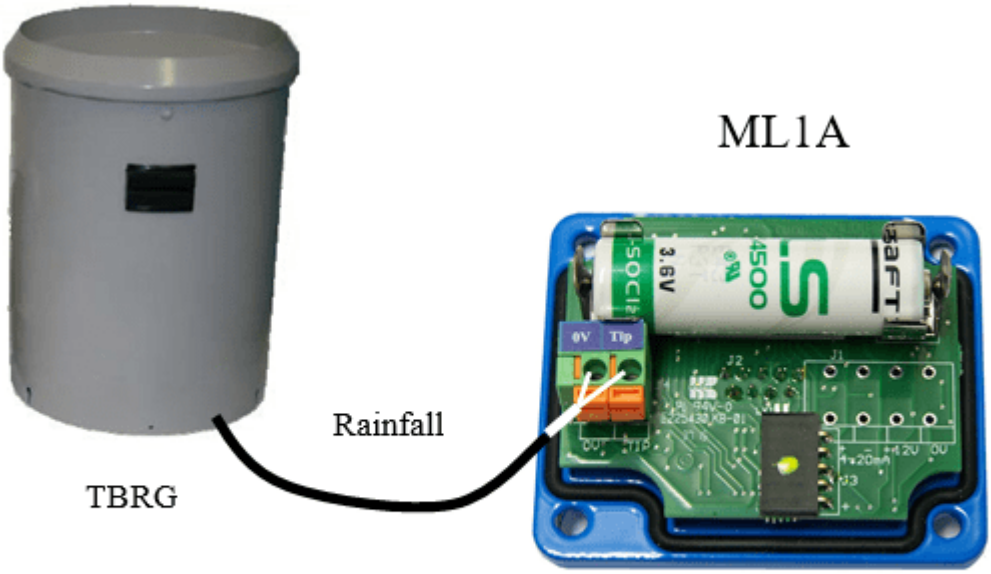

Mini Log
DATA LOGGER
HYDROLOGICAL SERVICES P/L
AUSTRALIA, Ph: (61) 29601 2022
Email: sales@hydrologicalservices.com

2 Installation

The MiniLog has a single DB9 female connector, which is mainly used for communications – (the digital input and external power may be taken through this connector, making it pin compatible with the ML1). The pinout is designed to be compatible with direct connection to a PC Comm port. Note that when external power is supplied, whether though an external 12V battery or RS232 handshake lines, the power drawn from the internal battery is reduced to zero.

The digital input from the TBRG is connected to the internal screw less terminal blocks – these specific terminals are used because they keep a constant tension on the wires that are inserted.





"ML1A Typical Application"

- Hardware Connections 9

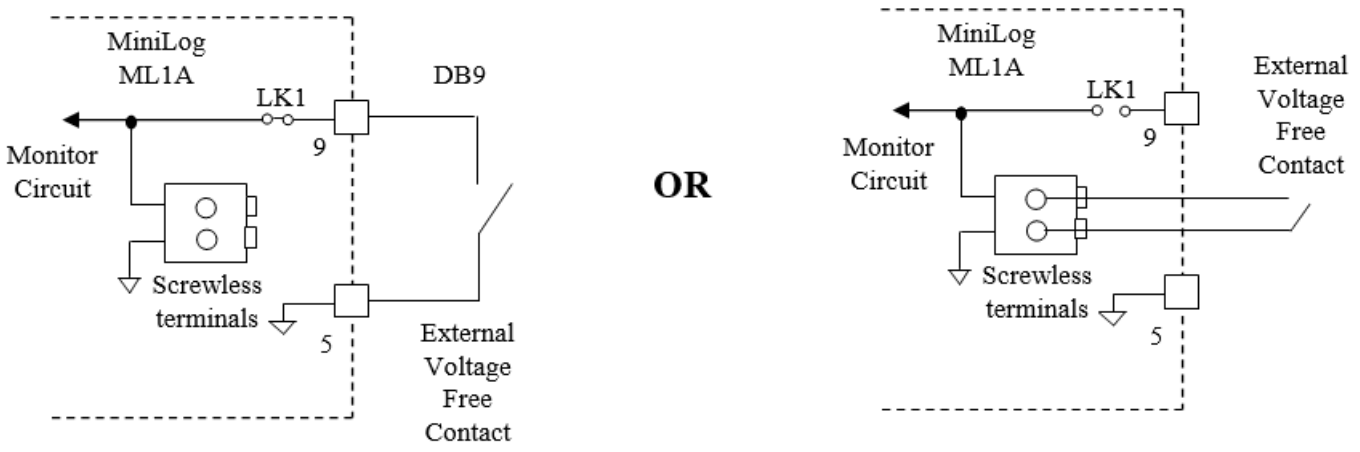
2.1 Hardware Connections

This chapter contains the following subsections:

- Contact Closure Input 10
- External Power Supply 10
- Communications 11

2.1.1 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 an option that is left open circuit when the ML1A 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

2.1.2 External Power Supply

The ML1A draws power from the RS232 signals for communications – which relieves the internal battery from this power drain.

The ML1A may be powered externally through the DB9 connector if required – see section Communications 11 for the connections required. The internal and external voltage is measured and logged periodically by the logger. The logging interval is set with the "BVINT" command, which can be set from 1 to 999 minutes. The logged data can be retrieved with the DUBVI (internal battV) command, DUBVE (external battV) command, DUBVT (battV and tempC) command or the DUALL (dump All) command.

While the MiniLog ML1A is in the field monitoring the contact closure, an external power supply is **not** required. The logger enters a "sleep" mode, waking only to update the time, and log a contact closure event. In this mode the logger will operate continuously for about 1 year on the internal 3.6V lithium battery (or 6 months on a 1.5V alkaline battery). In either case we recommend the battery be replaced annually to ensure the continuity of your data.

2.1.3 Communications

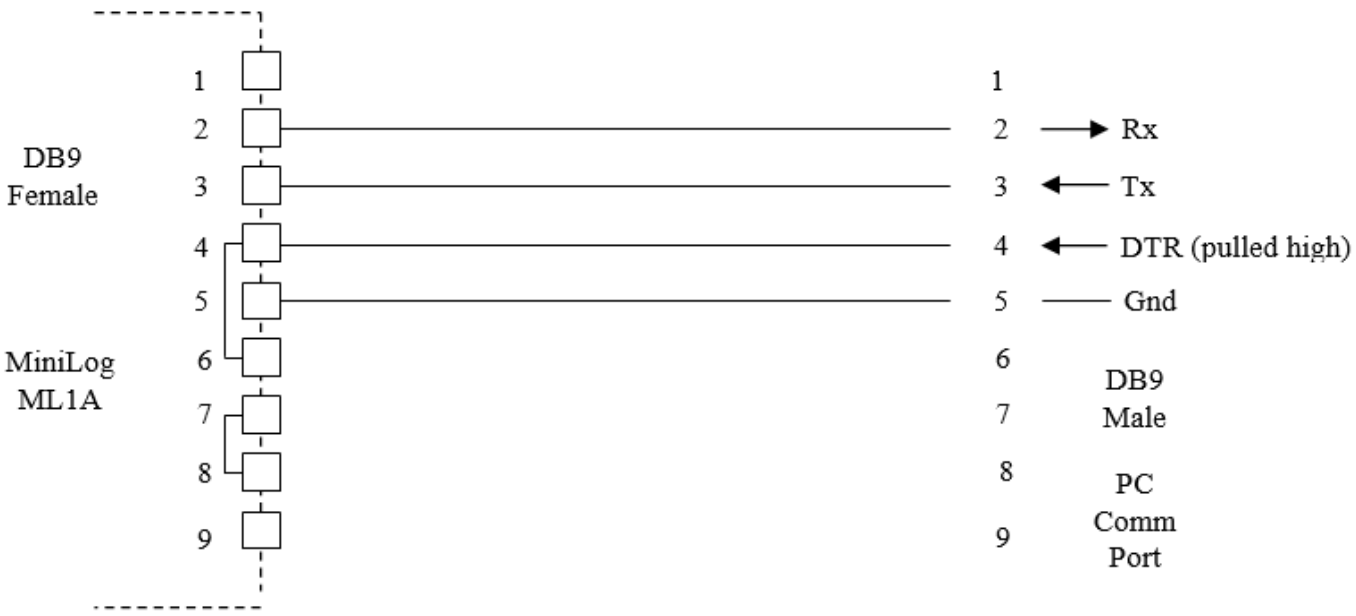
The pinout of the DB9 female connector on the front of the ML1A logger is as follows:-

Pin Connection	ML1A Logger Signal Name DB9 Female		PC Signal Direction	PC Signal DB9 Male
1	No Connection		⇨	CD
2	Tx (RS232 Serial data output)		⇨	Rx
3	Rx (RS232 Serial data input)		⇦	Tx
4	External Power (+ DTR / DSR loop)		⇦	DTR
5	Gnd			Gnd
6	External Power (+ DSR / DTR loop)		⇨	DSR
7	External Power (+ RTS / CTS loop)		⇦	RTS
8	External Power (+CTS / RTS loop)		⇨	CTS
9	Contact closure input (See note 3)		⇨	RI

Notes:

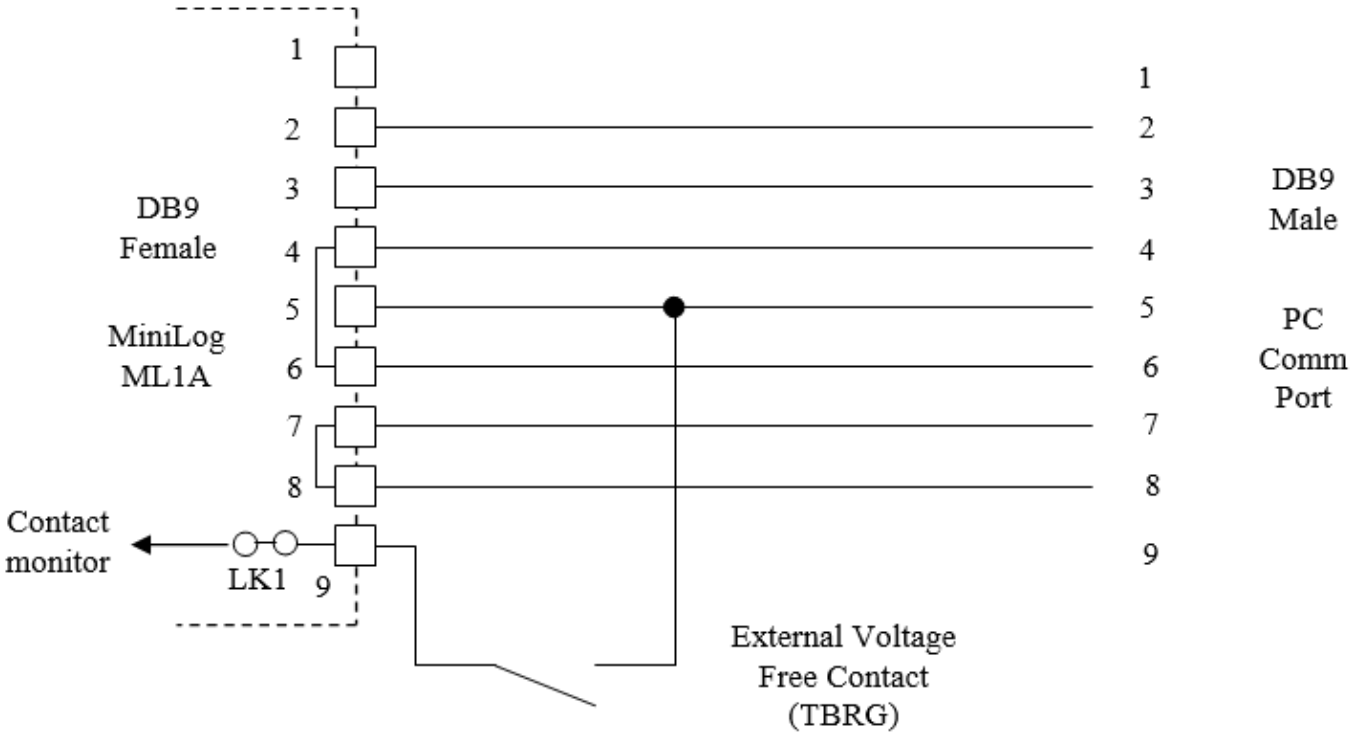
1. When the ML1A is directly connected to a PC the following handshake signals are linked
   - Pins 4 and 6 are linked together inside the ML1A.
   - Pins 7 and 8 are linked together inside the ML1A.
2. When the ML1A is directly connected to a PC, sufficient power is extracted from the handshake signals to power the ML1A – which prevents power drain from the internal battery while communications is in progress.
3. A solder link LK1 on the ML1A PCB allows the digital input from the TBRG to be connected through pin 9 of the DB9F connector. See section Contact Closure input 10 for more details.

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. (The minimum connection is pins 2, 3, 4 and 5.)



Minimum Connection of PC on DB9F

Communications can also be active while the contact closure input on pin 9 is used when jumper LK1 is soldered, and a special cable is prepared.



Connection of PC together with Contact Closure Input through the DB9F

3 Configuration

Once the ML1A 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.

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- System Time/Date 13
- Sensor + Parameters 13
- Communications 13
- First Time Installation Summary 13

3.1 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 Dump Log Records (DUR, ….DUALL, CLR, MW, LOG) 21 for more information on this command.

3.2 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.

3.3 Sensor + Parameters

The Minilog ML1A 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 digital (rainfall) channel. The "Increment" (INC) parameter defines the capacity of the specific digital sensor used as well as the number of external events that constitute one logged event - this determines the digital input resolution.

See section Temperature (TEMPC) 19 for more information on these commands.

3.4 Communications

The MiniLog ML1A 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.

If initially you can't establish communications with the ML1A, try each of the 7 baud rates, in case it has been changed from the default rate of 9600.

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

3.5 First Time Installation Summary

*** Make sure a fresh battery is installed ***

	// Connect the TBRG Raingauge to the logger input

	// Connect your PC and start WinComLog
passwd=BOMM	// Enter the password
si=MySiteName	// Enter your site name
d=23/10/17	// Set the date
t=10:35:30	// Set the time
inc=0.5/01	// Make sure the bucket increment matches your TBRG (0.5 mm)
	// Tip the bucket a few times
dur	// make sure the data is logging
clr	// Clear any previous data
	// Unplug your PC
	// Congratulations, your done – the logger will now record all TBRG tips.

4 Operation

This chapter contains the following subsections:

- LED Indicator 15
- External Contact Interface 15
- Communications Interface 15
- Watchdog 15
- Power Supply 15
- System Memory 15
- System Clock 16
- Logger Identification 16
- Commands / Syntax 16
- Data Output Format 24

4.1 LED Indicator

The LED indicator on the MiniLog ML1A 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 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.

4.2 External Contact Interface

The MiniLog ML1A 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.

4.3 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.

4.4 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.

4.5 Power Supply

The MiniLog is powered by an internal AA battery, for normal event logging. This can be anything from an alkaline (1.5V) to a lithium (3.0V or 3.6V) – with each type of battery giving a different life. 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 connected through the DB9 connetor - use 6V DC to 19V DC.

4.6 System Memory

A fundamental requirement of the logger unit is for sufficient memory capacity to store 400,000 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 returned package will conform 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 **Parameter Memory** to store unique station parameters.

4.7 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 °C. The Time Adjust command allows for automatic software adjustment of the real time clock crystal.

4.8 Logger Identification

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

4.9 Commands / Syntax

The following sections give detailed information on each of the MiniLog ML1A 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.

- Online Help (?) 16
- Communications (BAUD, EV, RE, CLEAR) 17
- Battery Voltage (BV, BVINT) 18
- Temperature (TEMPC) 19
- Digital Channel Parameters (CHID, INC, TDAY, TOT, TYPED, UD) 19
- Date/Time Parameters (D, FMT, T, TA) 20
- Dump Log Records (DUR, ….DUALL, CLR, MW, LOG) 21
- Miscellaneous (ID, SI, PASSWD, BYE, SLEEP, RESET, VER) 23
- Status Window (ST) 24

4.9.1 Online Help (?)

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

On-line Help

?			
ML1A Data Logger Command Syntax		[...] = optional to set parameter	
(Command may be upper and/or lower case)		<CR> = press carriage return	
General Commands			
BAUD[=xxxx]<CR>	(comms BAUD rate)	BYE<CR>	(exit passwd access)
CLEARx[=30char]<CR>	(Clear Seq.x=1,2,3,4)	D[=d/m/y OR m/d/y]<CR>	(Date)
EV[=On/Off]<CR>	(EVent output)	FMT[=dmy/mdy]<CR>	(date ForMaT)
ID<CR>	(logger ID)	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)	VER<CR>	(s/w VERsion)
Battery Voltage and Temperature Commands			
BV<CR>	(Batt. Voltages now)	BVINT[=mmm]	(BV/TempC log INTerval)
TEMPC<CR>	(TEMPerature oC now)		
Digital Input Commands			
CHID[=7 dig]<CR>	(CHannel ID - Digital)	INC[=x.x/mm]<CR>	(INCrement+mult.)
TDAY<CR>	(Total toDAY)	TOT<CR>	(TOTal)
TYPED[=16chars]<CR>	(TYPE of Dig i/p)	UD[=8char]<CR>	(Units Digital)
Dump/Clear Commands			
DUR/N/h:m/d/m/y<CR>	(DUmp Rain log)	CLR<CR>	(Clear all Records)
DUBVI[....]<CR>	(DUmp BattV.Internal)	DUBVE[....]<CR>	(DUmp BattV.External)
DUTMP[....]<CR>	(DUmp TempC)	DUBVT[....]<CR>	(DUmp BattV+TempC)
DUALL[....]<CR>	(DUmp ALL Data)	(All dump commands have the same syntax)	
eg.	DUR	=> Dump all Rainfall data	
	DUR/3	=> Dump last 3 days of Rainfall data	
	DUR/10/12:00/15/2/16	=> Dump 10 days of Rainfall data from 12:00 15-Feb-16	

4.9.2 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.

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. (Due to the worldwide removal of wireless dialup PSTN modem access, these sequences should 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.

4.9.3 Battery Voltage (BV, BVINT)

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 and external battery voltages

The battery voltage log interval can be set with the (**BVINT**) command from 1 to 999 mins. The internal battery, external battery and temperature are logged at this interval. The logged data can be retrieved using the DUBVI, DUBVE, DUBVT and DUALL commands.

BVINT<CR>	Displays the log interval in mins.
BVINT=015<CR>	Set the battery and temperature log interval to 15 mins.

4.9.4 Temperature (TEMPC)

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

TEMPC<CR>	Displays the internal temperature in degrees C

The temperature log interval is set with the (**BVINT**) command above, from 1 to 999 mins. The internal battery, external battery and temperature are logged at this interval. The logged temperature can be retrieved using the DUTMP, DUBVT and DUALL commands.

4.9.5 Digital Channel Parameters (CHID, INC, TDAY, TOT, TYPED, UD)

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 Digital Channel ID
CHID=0012345<CR>	Sets the Digital Channel ID to 0012345

The "Increment" (**INC**) is a parameter that specifies the quantity that each contact closure represents. This might be 0.2 mm 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 Digital" (**TYPED**) 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.

TYPED<CR>	Display the digital channel Type
TYPED=Rainfall<CR>	Set the digital type to Rainfall
TYPED=Flow<CR>	Set the digital type to Flow.

The "Units Digital" (**UD**) 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.

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

4.9.6 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.

4.9.7 Dump Log Records (DUR, ….DUALL, CLR, MW, LOG)

(DUR, DUBVI, DUBVE, DUBVT, DUTMP, DUALL, CLR, MW, LOG)

The MiniLog ML1A logged data is stored in the on-board flash memory.

The "Dump Rain log" (**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**) – please note that the CLR command clears all logged data, rain, battery and temperature!! 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 Dump Log Record 24.

DUR<CR>	Dump the complete rain 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/30/12:00/1/1/11	Dump 30 days of data starting at 12:00pm on 1-Jan-2011
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 Day/Month/Year)
DUR/L	Dump all the data since the last dump

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 "Dump Internal Battery Voltage log" (**DUBVI**) command, unloads the internal battery voltage log 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 log command (**CLR**) – please note that the CLR command clears all logged data, rain, battery and temperature!! The log is dumped in ascii format, as shown in section Dump Log Record 24.

DUBVI<CR>	Dump the complete internal battery voltage log record.

(The DUBVI command has all the same search syntax as the DUR command.)

The "Dump External Battery Voltage log" (**DUBVE**) command, unloads the external battery voltage log 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 log command (**CLR**) – please note that the CLR command clears all logged data, rain, battery and temperature!! The log is dumped in ascii format, as shown in section Dump Log Record 24.

DUBVE<CR>	Dump the complete external battery voltage log record.

(The DUBVE command has all the same search syntax as the DUR command.)

The "Dump Battery Voltages and Temperature log" (**DUBVT**) command, unloads the internal and external battery voltage and temperature log 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 log command (**CLR**) – please note that the CLR command clears all logged data, rain, battery and temperature!! The log is dumped in ascii format, as shown in section Dump Log Record 24.

DUBVT<CR>	Dump the complete internal+external BV + tempC log record.

(The DUBVT command has all the same search syntax as the DUR command.)

The "Dump Temperature log" (**DUTMP**) command, unloads the temperature log 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 log command (**CLR**) – please note that the CLR command clears all logged data, rain, battery and temperature!! The log is dumped in ascii format, as shown in section Dump Log Record 24.

DUTMP<CR>	Dump the complete temperature log record.

The DUTMP command has all the same search syntax as the DUR command.

The "Dump All log" (**DUALL**) command, unloads all data 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 log command (**CLR**) – please note that the CLR command clears all logged data, rain, battery and temperature!! The log is dumped in ascii format, as shown in section Dump Log Record 24.

DUALL<CR>	Dump the complete log of all parameters.

The DUALL command has all the same search syntax as the DUR command.

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 400 events, and there are 1023 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 – note that this command erases the Rain, Battery Voltage and Temperature logs. A question will appear to remind the user that all data will be erased – answer y or Y to delete the log and any other key to abort.

CLR<CR>	Erase complete log record.

*** This will clear the Rain, Battery and TempC Logs ***: Are you sure ? (Y/N) Y

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!

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)

4.9.8 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. (The first 2 numbers are the year of manufacture)

ID<CR>	View the logger ID. Eg. MJ110001

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.

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.

4.9.9 Status Window (ST)

The Status Window (ST) returns a summary of station set-up details together with a report of the present conditions. 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          Rainfall Channel ID (CHID):     0012345
LoggerID(ID):                MJ110001        Rainfall Log Start:             22/01/16
Date(D):                     28/03/16        Rainfall Inc. (INC):            0.2/01
Time(T):                     10:06:46        Rainfall Today (TDAY):          5.2
Baud Rate (BAUD):            9600            Rainfall Total (TOT):           1260.8
Response On/Off(RE):         On              Rainfall Units (UD):            mm
Event Output (EV):           On
Events Left:                 321763          Temperature (TEMPC):            24.3C
Memory Wrap (MW):            Off             BV+T Log Interval(BVInt)mmm:    720
Go to sleep after (SLEEP):   5 min           Battery Volt (BV):              3.60/12.6V
Logging On/Off (LOG):        On
S/W Revision (VER):          5.01

Clear1:                      +++~~
Clear2:                      ATH^M/OK/9
Clear3:
Clear4:
-------------------------------------------------------------------------------------------------------------
```

Note: The word "**Rainfall**" 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.

Note that the data in the Status Window is grouped to describe each area of the MLA, that is "general configuration" on the left, "digital input configuration" on the top right, and "battery / temperature configuration" at the lower right.

4.10 Data Output Format

This chapter contains the following subsection:

- Dump Log Record 24

4.10.1 Dump Log Record

The following data represents the historical log record as output from a MiniLog ML1A data logger. The example below represents a data record as presented to a computer after invoking a Dump Log Record command (DUR). 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.

The contact closure (or bucket tip from a rain gauge) is represented by a time stamp only. Look back through the log to obtain the date of the event. Other dump commands are shown on the following pages.

** Rainfall Record **	DUR
Station Set-up Header	Sydney 0012345 MJ110001 0.2< crlf >
Logger Start Header	09:35:23 24/3/11 0 Record Clear< crlf > 10:25:37< crlf >
Events (time stamp)	10:27:42< crlf > 16:53:05< crlf >
Daily Summary	00:00:00 25/3/11 3< crlf > 15:43:09< crlf > 15:44:23< crlf > 15:45:00< crlf > 22:22:55< crlf > 00:00:00 26/3/11 4< crlf > 22:24:00< crlf > 00:00:00 27/3/11 0< crlf >
End of Record Marker	Record End< crlf >

Field	Par.	Parameter Definition
Station Set-up Header	Sydney 0012345 MJ110001 0.2	Site Name, variable length (16 char), user programmable. Channel ID Number or observational site number, 7 digits, user programmable. Logger ID, 6 digits, hard coded by manufacturer, where first two digits “MJ” represent an alphanumeric manufacturer ID followed by a six digit unit number. Recording Increment, 0.2 millimetres, user programmable.
Logger Start Header	09:35:23 24/3/11 0 Record Clear	Logger Start Time, Hour:Minute:Second. Logger Start Date, Day/Month/Year. Start Count, event accumulator, 0 counts. Indicator to identify start event, normally “Record Clear”.
Event	10:27:42	Time Stamp of contact closure, Hour:Minute:Second.

Field	Par.	Parameter Definition
Daily Summary	00:00:00 25/3/11 3	Time Stamp check at zero hours, Hour:Minute:Second. Date Stamp check at zero hours, Day/Month/Year. Daily event accumulator, (daily total = 3 events).
End of Record Marker	Record End	Indicator to identify the end of the log record.

** Internal Battery Voltage Record **	DUBVI
Station Set-up Header	Sydney MJ110001< crlf >
Logger Start Header	09:35:23 24/3/11 Record Clear< crlf > 10:00:00 3.55< crlf >
Events	11:00:00 3.55< crlf >
(time + internal BattV)	12:00:00 3.55< crlf > 23:00:00 3.54< crlf >
Midnight Marker	00:00:00 25/3/11 < crlf > 00:00:00 3.54 <crlf>
End of Record Marker	Record End< crlf >

** External Battery Voltage Record **	DUBVE
Station Set-up Header	Sydney MJ110001 < crlf >
Logger Start Header	09:35:23 24/3/11 Record Clear< crlf > 10:00:00 12.13< crlf >
Events	11:00:00 12.12< crlf >
(time + external BattV)	12:00:00 12.12< crlf > 23:00:00 12.11< crlf >
Midnight Marker	00:00:00 25/3/11 < crlf > 00:00:00 12.10 <crlf>
End of Record Marker	Record End< crlf >

** Battery Voltage + Temperature Record **	DUBVT
Station Set-up Header	Sydney MJ110001 < crlf >

** Battery Voltage + Temperature Record **	DUBVT
Logger Start Header	09:35:23 24/3/11 Record Clear< crlf > 10:00:00 3.55 12.13 25.1< crlf >
Events	11:00:00 3.55 12.12 24.7< crlf >
(time + internal BattV +	12:00:00 3.55 12.12 24.4< crlf >
external BattV + TempC)	23:00:00 3.54 12.11 24.2< crlf >
Midnight Marker	00:00:00 25/3/11 < crlf > 00:00:00 3.54 12.10 23.1<crlf>
End of Record Marker	Record End< crlf >

** Temperature Record **	DUTMP
Station Set-up Header	Sydney MJ110001 < crlf >
Logger Start Header	09:35:23 24/3/11 Record Clear< crlf > 10:00:00 25.1< crlf >
Event	11:00:00 24.7< crlf >
(time + TempC)	12:00:00 24.4< crlf > 23:00:00 24.2< crlf >
Midnight Marker	00:00:00 25/3/11 < crlf > 00:00:00 23.1 <crlf>
End of Record Marker	Record End< crlf >

** Dump All Records **	DUALL	
Station Set-up Header	Sydney MJ110001 < crlf >	
Events	1, 24/03/11, 09:35:23, 0.2< crlf >	(=0.2 mm rain)
(type, date, time, level)	3, 24/03/11, 10:00:00, 3.55< crlf > 4, 24/03/11, 10:00:00, 12.13< crlf > 5, 24/03/11, 10:00:00, 25.1< crlf > 1, 24/03/11, 10:37:52, 0.2< crlf > 1, 24/03/11, 10:39:43, 0.2< crlf >	(=3.55 V BVint) (=12.13 VBVext) (=25.1 C Temp) (=0.2 mm rain) (=0.2 mm rain)
End of Record Marker	Record End< crlf >	

The event types are:

0 = Housekeeping

1 = Rainfall / Digital input

3 = Internal Battery Voltage

4 = External Battery Voltage

5 = Temperature

5 Maintenance

Hydrological sites are routinely visited to maintain the sensors. During these visits, you will probably also download data and check the condition of the internal ML1A batteries.

Our recommendation when using lithium batteries in the ML1A:

- If the voltage is 3.2V or lower, then change the batteries immediately.
- If the voltage is 3.3V, and you were coming back in 3 months, then you could probably wait until next time.
- If the voltage is 3.3V, and you were coming back in 6 months, then I would replace the batteries now.
- If the voltage is 3.4V, and you were coming back in 6 months, then you could probably wait until next time.
- Replace the batteries annually to be on the safe side. (This all depends on what your data is worth.)

Our recommendation when using alkaline batteries in the ML1A :

- If the voltage is 1.2V or lower, then change the batteries immediately.
- If the voltage is 1.3V, and you were coming back in 3 months, then you could probably wait until next time.
- If the voltage is 1.3V, and you were coming back in 6 months, then I would replace the batteries now.
- If the voltage is 1.4V, and you were coming back in 6 months, then you could probably wait until next time.
- Replace the batteries annually to be on the safe side. (This all depends on what your data is worth.)

When the ML1A is opened to replace the internal battery, check for internal moisture on the PCB and check the state of the seal around the lid and replace if necessary.

After the battery is replaced, check the date and time to make sure it is correct before leaving the site.

6 Troubleshooting

This Troubleshooting guide should be used by the ML1A 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 internal 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. An alkaline battery should be about 1.5V and a lithium battery should be between 3.2V and 3.6V See the previous "Maintenance" section for battery replacement recommendations.
- 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.
  Try all 7 baud rates from 1200 to 57600 on the PC.
- 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. Try the other available comm ports on the PC.
- Check that you have selected the correct comm port in WinComLog:
  - Remove the USB to RS232 adapter from your PC.
  - Click on the Comm Port drop list and check the list of comm ports.
  - Now plug in the USB to RS232 adapter, and click on the Comm Port drop list again – there should be 1 new comm port – this is the one you need to select.
  - If a new comm port does not appear, then Windows is not recognizing the USB device. You need to make sure the USB device driver is loaded correctly. Consult your IT department.

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.
- 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.

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. The factory default password is "BOMM"

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.

The external battery voltage read is lower than I expect at 5.84V.

The external battery is probably disconnected or completely flat – you are probably seeing the voltage supplied from the RS232 port.

I don’t have an external battery, but it is reading 5.84V.

You are seeing the voltage supplied from the RS232 port – this is normal.

7 Repair

KISTERS precision instruments and data loggers are produced in quality-controlled processes. All KISTERS production and assembly sites in Australia, New Zealand and Europe are ISO 9001 certified. All equipment is factory tested and/or factory calibrated before it is shipped to the client. This ensures that KISTERS products perform to their fullest capacity when delivered.

Despite KISTERS most rigorous quality assurance (QA), malfunction may occur within or outside of the warranty period. In rare cases, a product may not be delivered in accordance with your order.

In such cases KISTERS' return and repair policy applies. For you as a customer, this means the following:

- Contact KISTERS using the Repair Request Form and the Declaration of Contamination made available online:

Region (Language)	Download Link
Asia-Pacific (English)	Repair Request Form (APAC) Declaration of Contamination (APAC)
Europe, the Middle East and Africa (English)	Repair Request Form (EMEA) Declaration of Contamination (EMEA)
Germany (German)	Repair Request Form (DE) Declaration of Contamination (DE)

  In response you will receive a reference number that must be referenced on all further correspondence and on the freight documents accompanying your return shipment.
- Please provide as much information and/or clear instructions within the return paperwork. This will assist our test engineers with their diagnosis.
- Please do not ship the goods prior to obtaining the reference number. KISTERS will not reject any equipment that arrives without reference number; however, it may take us longer to process.

Custom requirements for items sent to KISTERS for warranty or non-warranty repairs: Check with your national customs/tax authorities for details, processes and paperwork regarding tax exempt return of products. Typically, special custom tariff codes are available (such as HS Code = 9802.00) that verify the item is being returned for repair and has no commercial value. Please note that the customs invoice / dispatch documents should also clearly state: "Goods being returned to manufacturer for repair – No Commercial value". It is mandatory to have any returned goods accompanied by a commercial invoice on headed paper. KISTERS reserves the right to charge the customer for time spent rectifying incorrect customs documents.

Note: Please ensure that your goods are packed carefully and securely. Damage that occurs during transit is not covered by our warranty and may be chargeable.

8 Technical Data

Inputs	1 × digital, with 0.5 m flylead
Data Memory	4 MB Serial Flash EPROM, 400,000 events (1 second resolution)
Events Logged	Digital input, battery voltage (internal) and temperature (internal)
Power Supply	1 × 3.6 V Lithium battery (12 months operation)

9 Obligations of the Operator and Disposal

This chapter contains the following subsections:

- Obligations of the Operator 34
- Dismantling / Disposal 34

9.1 Obligations of the Operator

European Union

In the Single European Market it is the responsibility of the operator to ensure that the following legal regulations are observed and complied with: national implementation of the framework directive (89/391/EEC) and the associated individual directives, in particular 2009/104/EC, on minimum safety and health requirements for the use of work equipment by employees at work.

Worldwide

Regulations: If and where required, operating licences must be obtained by the operator. In addition, national or regional environmental protection requirements must be complied with, regardless of local legal provisions regarding the following topics:

- Occupational safety
- Product disposal

Connections: Local regulations for electrical installation and connections must be observed.

9.2 Dismantling / Disposal

When disposing of the units and their accessories, the applicable local regulations regarding environment, disposal and occupational safety must be observed.

Before dismantling

- Electrical Devices:
  - Switch off the units.
  - Disconnect electrical appliances from the power supply, regardless of whether the appliances are connected to the mains or to another power source.
- Mechanical devices:
  - Fix all loose components. Prevent the device from moving independently or unintentionally.
  - Loosen mechanical fastenings: Please note that appliances can be heavy and that loosening the fastenings may cause them to become mechanically unstable.

Disposal

Operators of old appliances must recycle them separately from unsorted municipal waste. This applies in particular to electrical waste and old electronic equipment.

Electrical waste and electronic equipment must not be disposed of as household waste!

Instead, these old appliances must be collected separately and disposed of via the local collection and return systems.

Integrated or provided batteries and accumulators must be separated from the appliances and disposed of at the designated

collection point. At the end of its service life, the lithium-ion battery must be disposed of according to legal provisions.

EU WEEE Directive

As players in the environmental market, KISTERS AG is committed to supporting efforts to avoid and recycle waste. Please consider:

- Avoidance before recycling!
- Recycling before disposal!

This symbol  indicates that the scrapping of the unit must be carried out in accordance with Directive 2012/19/EU. Please observe the local implementation of the directive and any accompanying or supplementary laws and regulations.

10 Appendices

The ML1A has a limited amount of surge protection on the inputs and outputs. If the equipment is installed in a lightning prone area we recommend installing additional surge protection on cables entering the cabinet housing the ML1A.

Different suppression is required, depending upon the voltage to be protected.

Figure below on the next page show suggested methods of protecting equipment against transients. The transient suppressors and the metal cabinets should also be connected to a solid earth at the site.

(**Note**: HS warranty does not cover equipment damaged by surges or transients!)

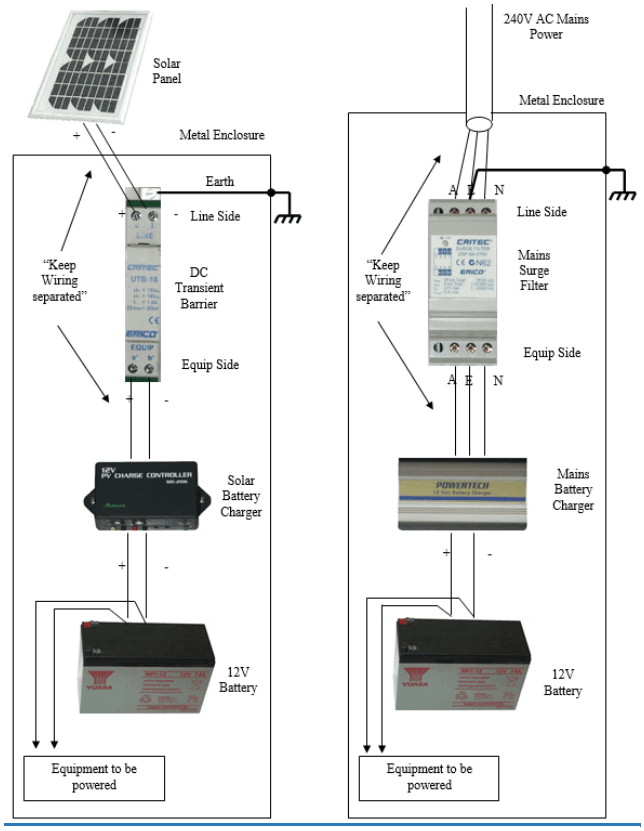


Figure 1 – Typical solar or mains powered site

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