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## **EXTENSOMETER DATA LOGGER**

### **Communication Software and Operating Manual**

**Version X1.02**

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# Operating Manual

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## EXTENSOMETER DATA LOGGER COMMUNICATION SOFTWARE

### Version X1.02

The Extensometer Data Logger Communication software is a graphical user interface that enables remote access to functions of the Extensometer Data Logger system. In addition, it recovers stored data to text files that can be readily imported into a spreadsheet software application for further analysis.

The software can be configured to operate with several optional communication links to the logger to recover data or service the logger via local or remote access.

The application is a stand-alone executable created with the National Instruments Corporation LabVIEW® program development system. The installation of this software on any computer will confirm your acceptance of the Software Licence Agreement contained in the **ReadMe.pdf** file accompanying this release kit.

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# System Requirements

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The Extensometer Data Logger Communication software utilises the Windows® operating system. The interface screen has been designed for a 1024 x 768 resolution screen using 256 colours and different settings may result in loss of screen detail.

## MINIMUM SYSTEM

80486-based PC  
 1024 x 768 Monitor using 256 colours  
 Minimum 8MB of RAM (16MB or more recommended)  
 A USB port for installation of the software  
 A mouse or other pointing device  
 A GSM modem capable of operating at 9600 baud (optional)

## Installing the Software

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### INSTALLATION

1. The Extensometer Data Logger Communication software is distributed on a USB memory device or via electronic download. Insert the device and double-click on the <setup.exe> file to begin the installation.
2. Change the path, if necessary, to point to the directory where you require the software to be installed. Click **Finish** to start the installation.
3. The software installer will automatically recognize if an earlier version of the application is installed. Run the <setup.exe> file to upgrade or re-install the application and support files.

### INSTALLED FILES

The installer will create the following files in the directory specified by the user:-

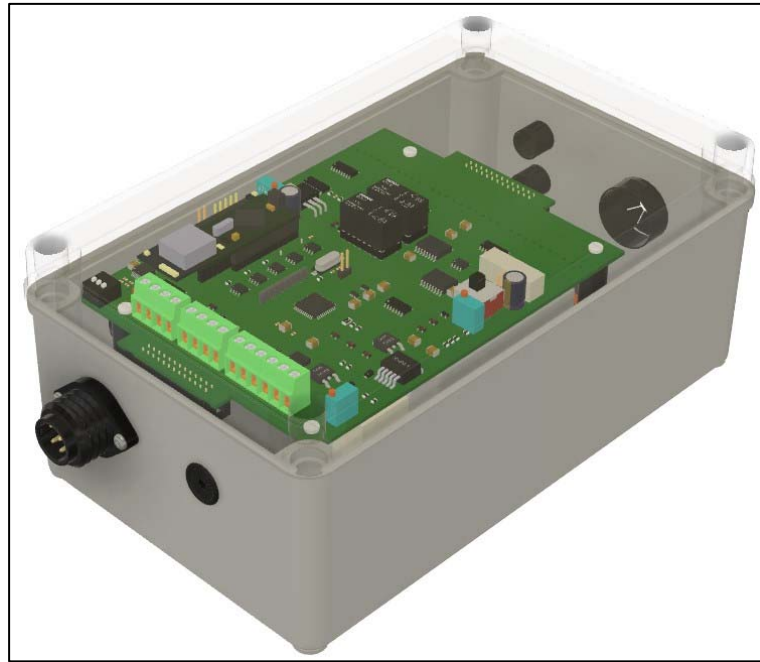
|                                  |                                                       |
|----------------------------------|-------------------------------------------------------|
| <b>EXLX100.exe</b>               | The software application                              |
| <b>EXLX100.ini</b>               | LabVIEW initialisation file                           |
| <b>USBX100.ini</b>               | USB Utility initialisation file                       |
| <b>Configuration Manager.exe</b> | Utility to configure the EXL24 logger operating modes |
| <b>Modem Manager.exe</b>         | Utility to manage site tags for remote connections    |
| <b>Operating Manual.pdf</b>      | A copy of this document                               |
| <b>ReadMe.pdf</b>                | Warranty, disclaimer and installation information     |

# Getting Started

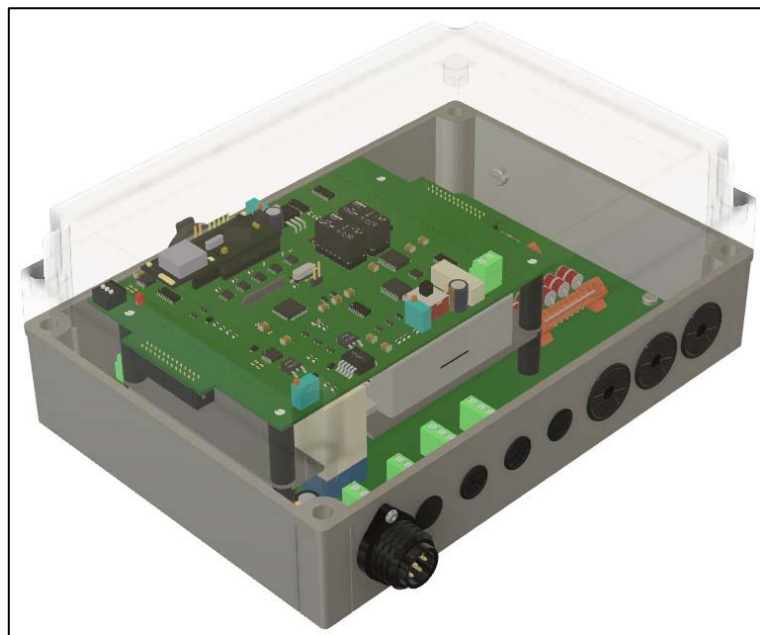
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## LOGGER CONFIGURATIONS

Extensometer Loggers are supplied in two models – an 8-channel logger (EXL8) and a 24-channel logger (EXL24). Both loggers utilize the same measurement system and share the same connection options for configuration and data recovery. The communication software can differentiate between logger models and some drop-down menu options will be disabled if inappropriate for the connected logger.



**EXL8 Logger**



**EXL24 Logger**

## OPERATING THE SOFTWARE

The Extensometer Data Logger Communication software is a graphical user interface designed an operator to send and receive data from the microprocessor-based control system of the Extensometer Data Logger. The operator selects functions from a menu list and transmits them to the system via a [SEND] or [UPDATE] command button. The system will then respond to the selected function request appropriately. Some functions require the operator to enter data to be sent to the system and each command has accompanying on-screen instructions to assist the operator to communicate with the system. In-built transmission error features ensure that data integrity is maintained, and the software has a dialogue response to all commands, so the operator is assured that commands are received correctly.

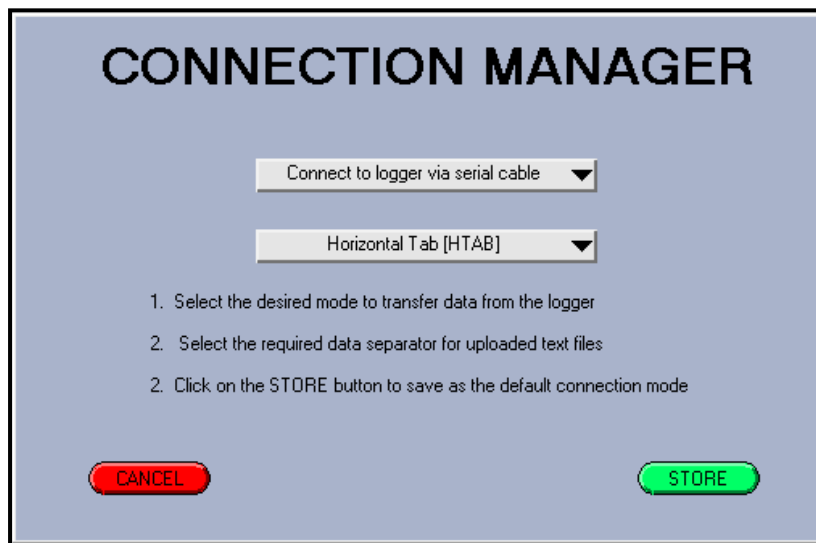
Moving the screen pointer over the required screen function and activating the selection by clicking with the left mouse button carries out software operation. On-line HELP is always available by pressing [CTRL-H] and moving the pointer over the screen components. A brief description of the component function will appear in the HELP window.

## STRUCTURE

The software is configured to run automatically when loaded. Alternatively, it can be started manually by clicking with the left mouse button on the [RUN] Arrow [⇒] in the toolbar. Once the application is running, it can only be shut down through the [CLOSE] button to ensure that the application completes saving all default values prior to shutting down.

# Communication Link Options

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## LOGGER CONNECTION OPTIONS

When installing the software for the first time, a dialogue box will appear to select the mode of connection to the logger. This will normally only be necessary once and the user has the option to save the current selection for future use. The screen can be forced to appear again by editing the **EXLX100.ini** file entry to read [Installed=0].

## DIRECT SERIAL LINK

The Extensometer Data Logger may be connected to the computer serial port by the custom RS232 cable supplied with the software package. This cable must be connected to a 9-pin serial communication port usually located at the rear of the computer. The plug retaining screws should be fastened.

The connection to the logger is via the 7-pin male connector located on the logger module. The solar panel connector must be removed, and the RS232 cable socket correctly aligned before pushing the cable plug onto the connector pins and securing with the screw-lock collar. The plug can be removed by unscrewing the collar and withdrawing the cable socket from the chassis plug. It is vital to replace the solar panel connector or the connector cap to ensure the system remains waterproof.

**NB To conserve battery power, the communication cable must be removed from the system module to allow the system to return to sleep mode.**

When the operator runs the communication interface, an option box appears on the front panel to allow the operator to re-assign the serial port to be used to connect to the Extensometer Data Logger system. Connection is confirmed by a message line and the uploading of the current system configuration parameters to the host computer.

## USB-SERIAL ADAPTER

The Extensometer Data Logger is supplied with USB-Serial adapter to allow it to connect to laptop computers without a conventional 9-pin serial port.

The adapter is supplied with its own installation CD however the adapter should install itself automatically on computers running Windows<sup>®</sup>7, Windows<sup>®</sup>8 or Windows<sup>®</sup>10 operating systems.

## FTP and GSM MODEM SERIAL LINKS

The Extensometer Data Logger may be supplied with a modem connection option utilising available multiband data network(s). All software features are available through the remote link although allowable times for responses from the logger have been increased to account for network delays. The software uses the **EXLX100.ini** configuration file to determine if access via a modem is required.

The modem is located within the logger case and is powered from the logger battery. The power demand of the modem requires recharging via a solar panel and a communication access window wakes the modem for remote access. The Extensometer Data Logger software has the necessary functions to allow the operator to establish this window for a period of 15-minutes from the access start time. The modem window access is set to a default time of 12:00 prior to delivery.

The **Modem Manager** application has been included in the installation directory to customise the list of site ID tags and access telephone numbers. These details are stored in the **EXLX100.ini** file and this file may be edited directly if required. Note that the configuration file format must be rigidly adhered to for the default details to be correctly read.

Direct serial communication is still available through the logger RS232 connection port by cancelling the modem splash screen, however the modem link will be disabled while the logger port is in use. Unplugging the custom serial cable will re-establish modem access to the logger system.

Additional user options for the data separator format are available when this access link is selected.

## GSM DATA TRANSFERS

The Extensometer Data Logger may be supplied with a modem connection option utilising GSM data transfers to a host computer. The user may log on remotely via a second GSM modem attached to the host computer to change logger functions or download stored data manually. The access window will remain open while there is active communication between the host computer and the logger and will close 5-min after the last command is sent. A single composite file containing incremental scan and alarm data will be transferred each time.

GSM transfers are limited to 9600 baud and in this mode, only incremental data uploads are possible to avoid excessively long GSM and expensive connections.

## FTP DATA TRANSFERS

The Extensometer Data Logger may be supplied with a modem connection option utilising FTP transfers to a proprietary server. In FTP mode, the logger will wake with its modem in GSM serial mode at the beginning of the selected window access time. The user may log on remotely via a second GSM modem attached to a host PC to change logger functions or download stored data manually. The access window will remain open while there is active communication between the host PC and the logger. The window will close 5-min after the last command is sent and the FTP data transfer will occur. A single composite file containing uncorrected incremental scan and alarm data will be transferred each time.

Data sent via an FTP link will always default to the CSV format. FTP transfers will only push incremental data to avoid unwanted duplication of scanned information in recovered data files.

## USB DATA TRANSFERS

The Extensometer Data Logger may be supplied with a USB connection socket. Stored sensor and alarm data can be recovered by inserting a pre-configured USB memory device into the external socket. The logger may be re-programmed by creating a unique configuration file using a custom software application utility provided with the logger. Multiple configuration files can be created on a single USB device as an individual logger will only read a file with a matching serial number. Instructions for creating and managing Extensometer Data Loggers via a USB Memory Device start on Page 27 of this manual.

Additional user options for the data separator format are available when this access link is selected. A single composite file containing all stored scan and alarm data will be transferred each time. The logger memory may be optionally cleared after each upload to avoid unwanted duplication of scanned information in recovered data files.

## LoRaWAN DATA TRANSFERS

The Extensometer Data Logger may be supplied with a LoRaWAN module to push data to a proprietary server via a long-range Wi-Fi link. In this mode, the logger will push data after each scan. A single string of data including a logger ID tag will be transferred each time. If alarms are enabled, an additional string of alarm data including a logger ID tag is appended to the data string.

Bi-directional communication is not possible via a LoRaWAN link. The Extensometer Data Logger must be reset locally via a serial connection to change any operating parameters or to recover stored data.

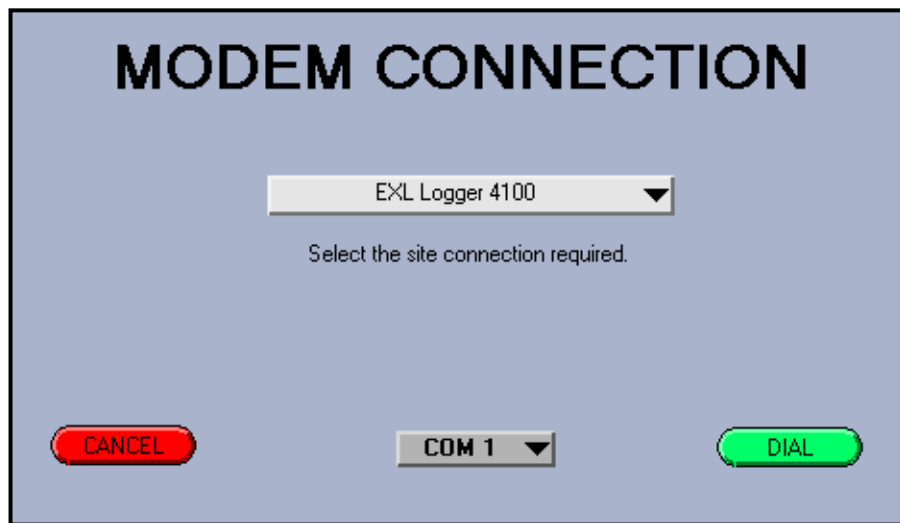
## [Data Separator] MENU

Stored data is recovered as ASCII data and individual channels may be separated by either horizontal tab (best for text file readability) or comma-separated formats. Either format may be imported directly into all popular spreadsheet applications. Data sent via an FTP or LoRaWAN link will always default to the CSV format.

The selected separator will remain in force for all subsequent data transfers. If it is necessary to change the separator parameter, the selection screen can be forced to appear again by editing the **EXLX100.ini** file entry to read [Installed=0]. The separator can be altered as required.

# Communication Interface Functions

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The format of the connection screen will vary depending on the communication link to the logger. The display shown above will appear for loggers utilizing GSM and FTP modem links. This screen will not appear if the logger is configured for a serial cable link.

## [Site Connection] MENU

Click on the arrow with the left mouse button and select from the list of available logger sites. This list of Site ID tags may be customised with the **Modem Manager** application installed with the Extensometer Data Logger software.

## [COM PORT] MENU

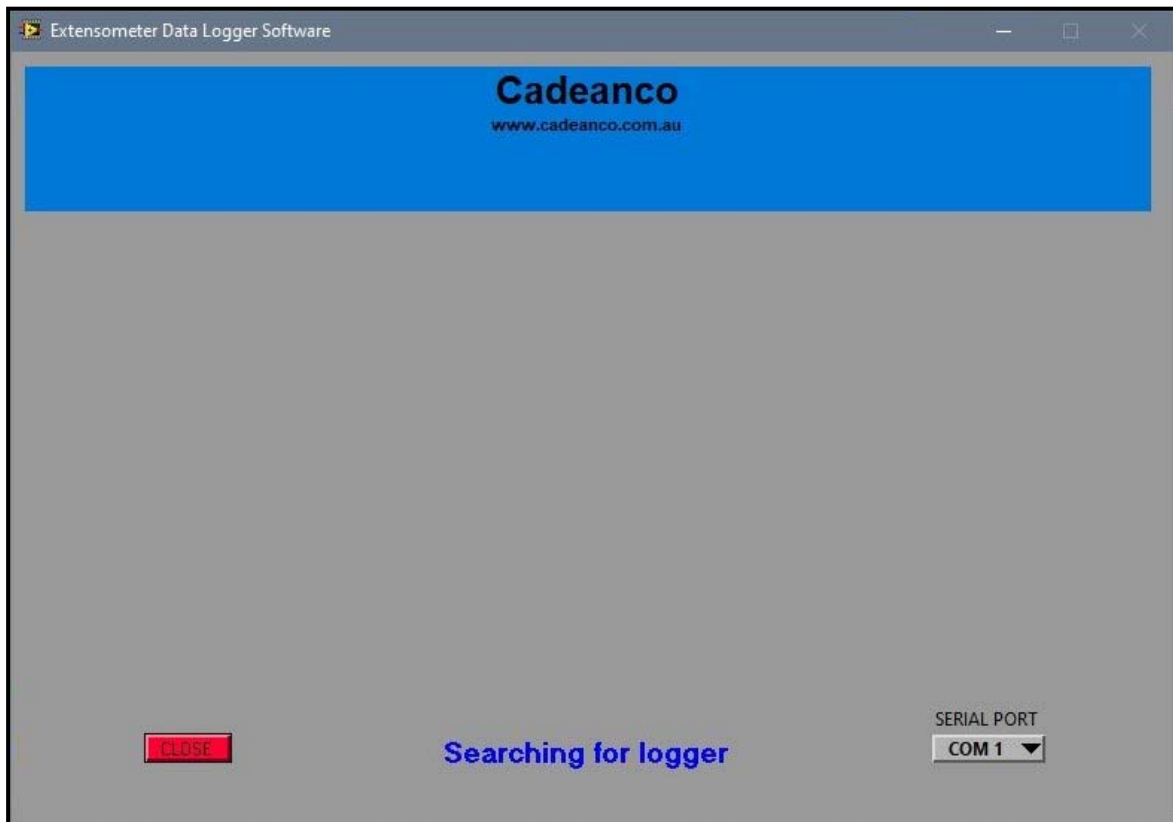
The range of this menu is 1-20 in line with conventional serial protocol. An alternative port may be selected by clicking on the arrow with the left mouse button.

## [DIAL] BUTTON

The modem will dial the selected site when the operator clicks on this control with the left mouse button. The software will carry out all the procedures to establish a dialogue between the computer modem and the remote logger module. Once this link is established the connection display disappears and the modem link becomes transparent to the software operation.

## [CANCEL] BUTTON

Select this option by clicking with the left mouse button to cancel the modem connection process and return to the serial cable connection display.



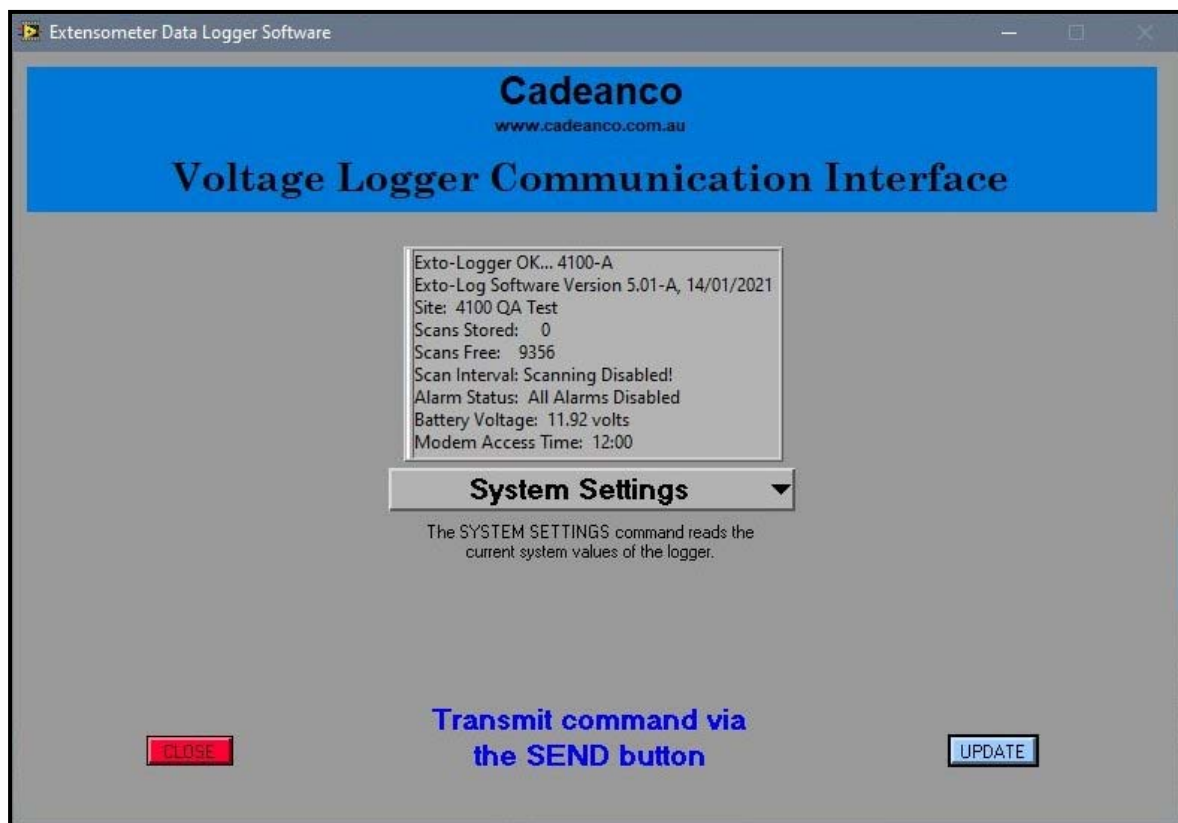
## [SERIAL PORT] CONTROL

This data box will appear while the application is searching for the serial connection to an Extensometer Data Logger system and disappear once a connection is established. During this time, the operator may change the serial communication port used by the software to reflect the connection used by a particular computer. The range of this port is 1-20 in line with conventional serial protocol and alternatives may be viewed for selection by clicking on the arrow with the left mouse button.

The serial port selection box will not be shown when using a USB, GSM or FTP modem link. If the logger search phase continues past three repetitions the connection between the logger and its modem should be checked.

## [CLOSE] BUTTON

Select this option by clicking with the left mouse button to cancel the search for an Extensometer Data Logger system and return to the Communication Interface.



## [System Settings] MENU OPTION

This menu selection displays the status of the Extensometer Data Logger. Alterations to these settings must be made from other appropriate menu commands and the display will automatically update and return to the above screen.

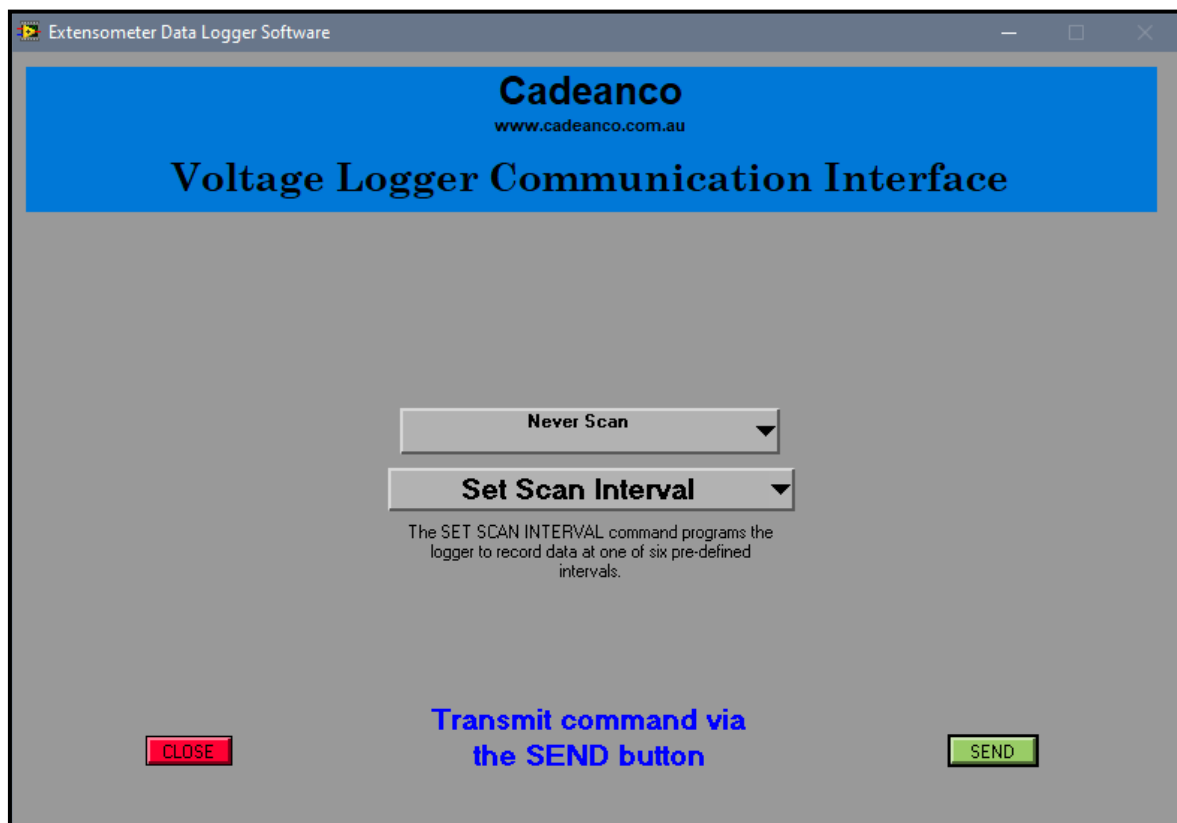
If the connection to the logger is lost at any time, the available menu options will be inhibited until the connection is re-established. This feature ensures the application data remains current and prevents the operator from making decisions based on incorrect data displays.

## [UPDATE] BUTTON

The System Settings display can be manually updated at any time by clicking on this button. The [UPDATE] button can also be activated by pressing [ENTER] on the computer keyboard.

## [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.



## [Set Scan Interval] MENU OPTION

This option displays a second menu to allow the operator to select one of seven available scan intervals for the Extensometer Data Logger system. The selected Scan Interval should be chosen after consideration of the amount of data required and the memory capacity of the system. The [Never Scan] option should be selected prior to carrying out any alterations to the system and care must be taken to reset the required interval at the completion of the task.

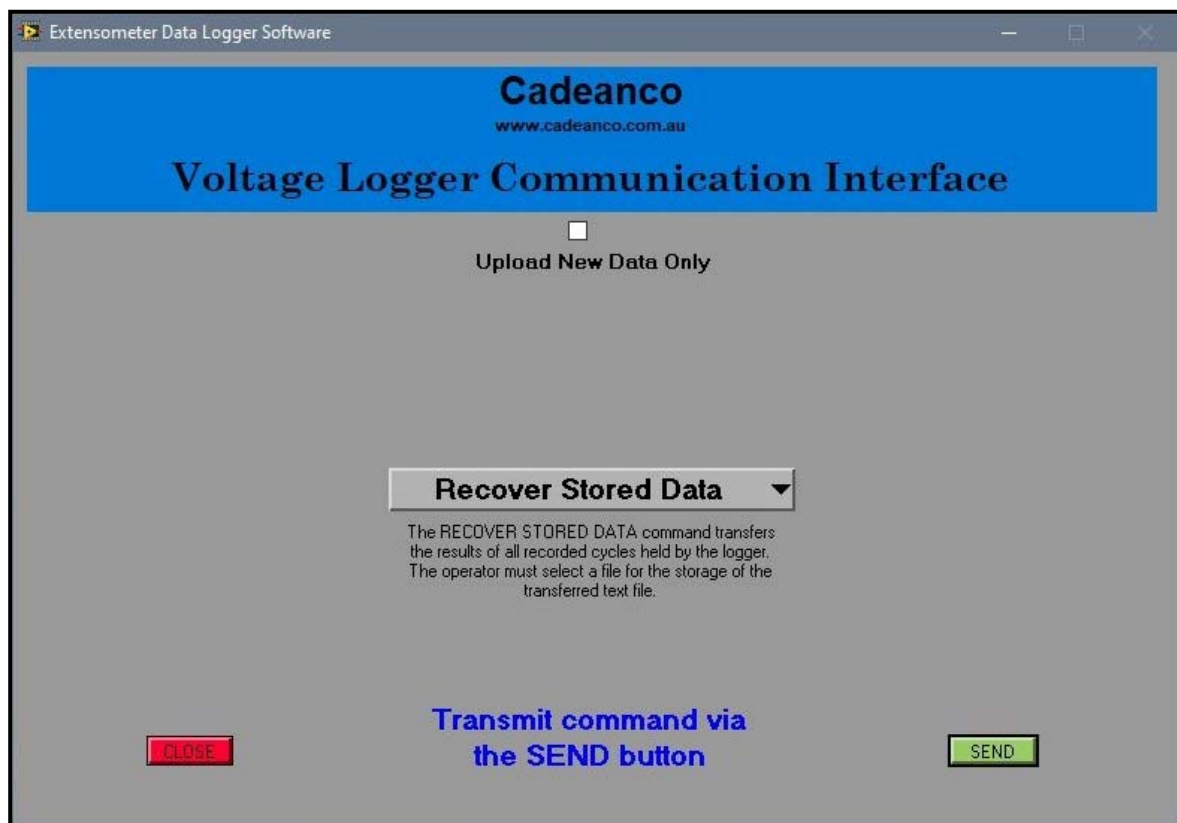
**APPLICATION NOTE:** All scanning is disabled while the logger is on-line to a host PC to reduce transmission errors and minimise data corruption.

## [SEND] BUTTON

Click on this button to transmit the selected scan interval to the logger system. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

## [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.



## [Recover Stored Data] MENU OPTION

Select this option to transfer stored measurement scans from the Extensometer Data Logger system to the host computer. The operator will be prompted to provide a filename and folder for the recovered data. A text file will be created on the computer for the data with an extension denoting that the data was recovered from the system. A full explanation of this data file is given in the relevant section of this manual.

The transmission will be checked for errors and the operator notified via a warning message if the upload is corrupted. Errors usually only affect a single data scan, and most data will still be valid.

Check the <Upload New Data Only> option to recover data recorded since the last upload.

**NB** Due to the relatively slow speed of GSM transfers, only incremental data will be available in this mode.

**[Upload Raw Data] OPTION**

In this mode, two reference channels are included with the data from Extensometer and Crackmeter instruments to allow user correction for instrument lead wire losses.

**[Upload Corrected Data] OPTION**

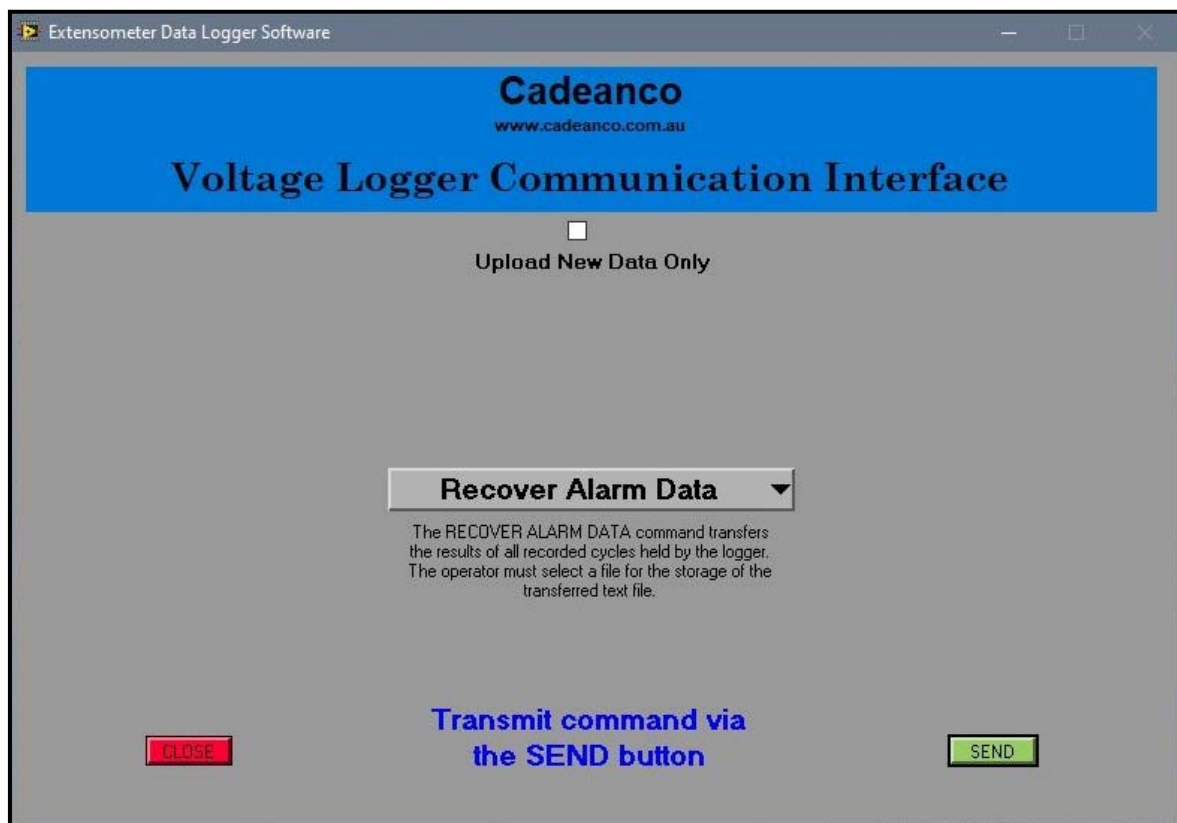
In this mode, the data from Extensometer and Crackmeter instruments is automatically compensated for instrument lead wire losses prior to saving to file.

**[SEND] BUTTON**

Click on this button to recover data from the logger system. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

**[CLOSE] BUTTON**

Select this option to exit from the Extensometer Data Logger Communication Interface.



## [Recover Alarm Data] MENU OPTION

Select this option to transfer stored measurement scans from the Extensometer Data Logger system to the host computer. The operator will be prompted to provide a filename and folder for the recovered data. A text file will be created on the computer for the data with header denoting that the data was recovered from the system. A full explanation of this data file is given in the relevant section of this manual.

The transmission will be checked for errors and the operator notified via a warning message if the upload is corrupted. Errors usually only affect a single data scan, and most data will still be valid.

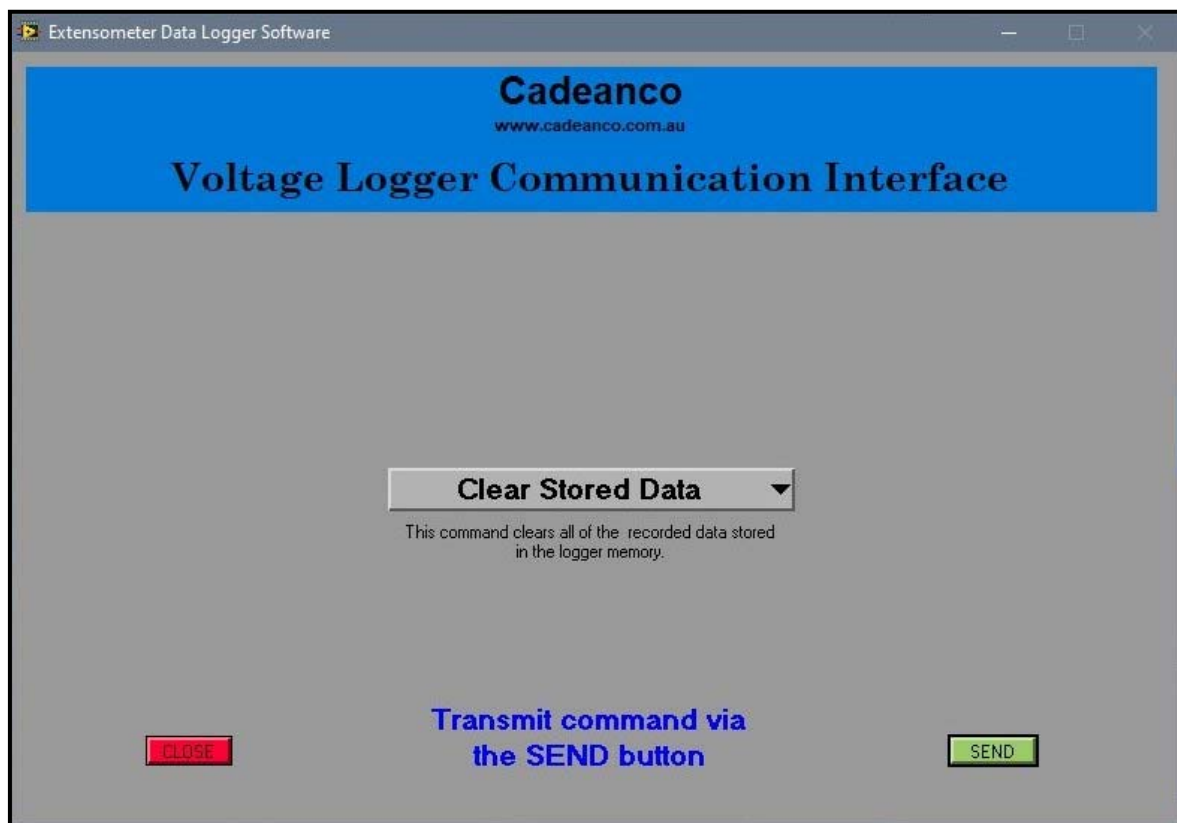
Select the <Upload New Data Only> to recover alarm data recorded since the last upload

## [SEND] BUTTON

Click on this button to recover data from the logger system. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

## [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.



## [Clear Stored Data] MENU OPTION

Select this option to clear stored scans from the Extensometer Data Logger system. The operator will be prompted to confirm the menu selection. Clearing extensometer data will also clear stored alarm data and a warning will be shown to the operator if alarm data is not recovered prior to using this command.

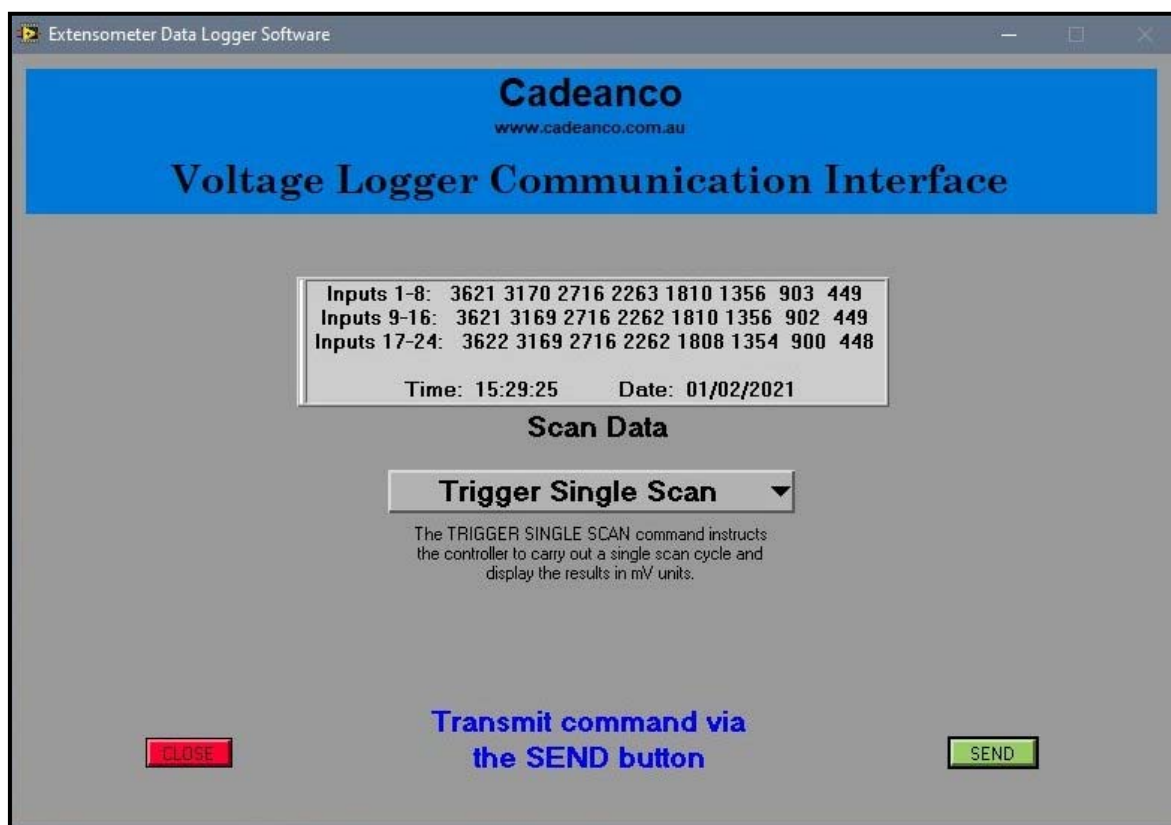
**NB** This command will not function if there is unrecovered data in the system. The system will respond with a visual warning to the operator and return to the System Settings display.

## [SEND] BUTTON

Click on this button to clear stored data from the logger system. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

## [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.



## [Trigger Single Scan] MENU OPTION

This option will instruct the Extensometer Data Logger system to carry out a single scan according to its configuration. The display of the returned data will vary with different configurations however the data will always be displayed in raw millivolt format. This command should be used to confirm that the system is operating correctly prior to leaving it for unattended operation.

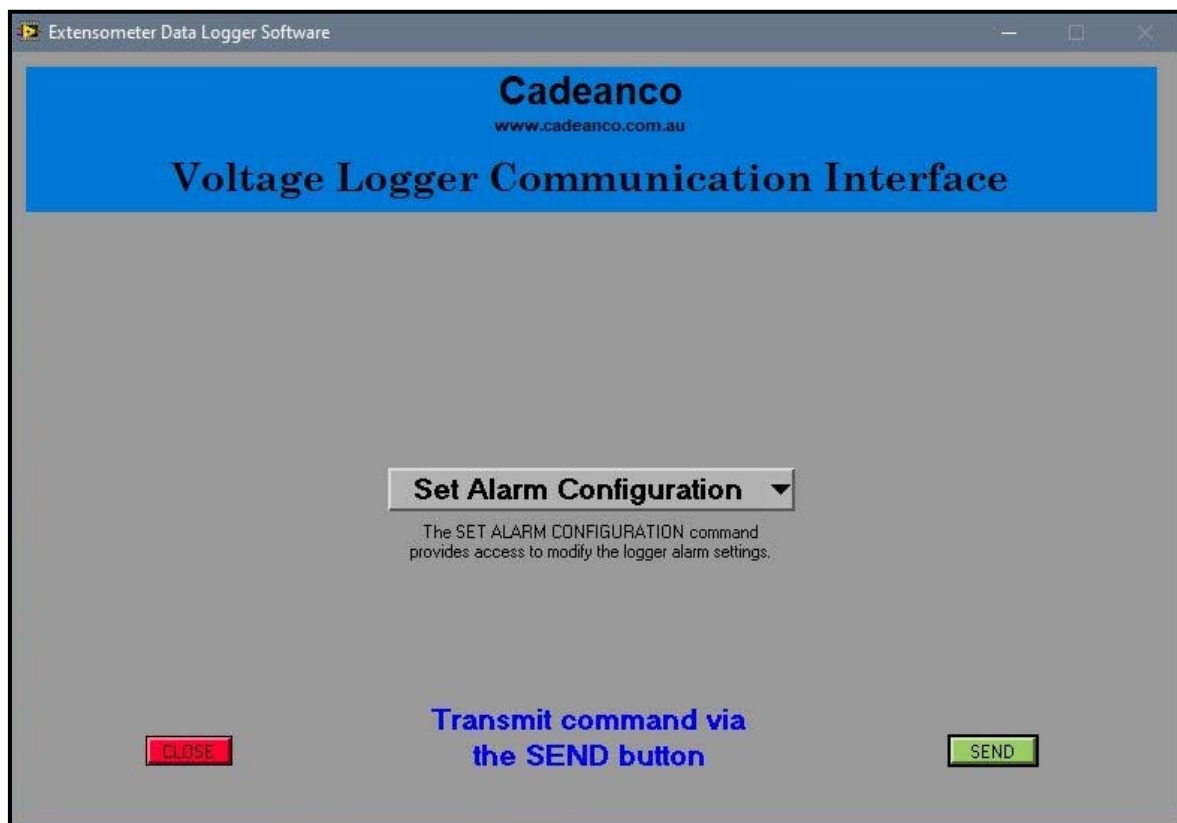
The display data format will vary depending on the configuration of the logger.

## [SEND] BUTTON

Click on this button to carry out a single data scan. The data from this scan will be recorded in logger memory and returned in the Scan Data indicator box. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

## [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.



### [Set Alarm Configuration] MENU OPTION

This option will load the Alarm Configuration Interface to allow access to the set-up options for the logger alarm features.

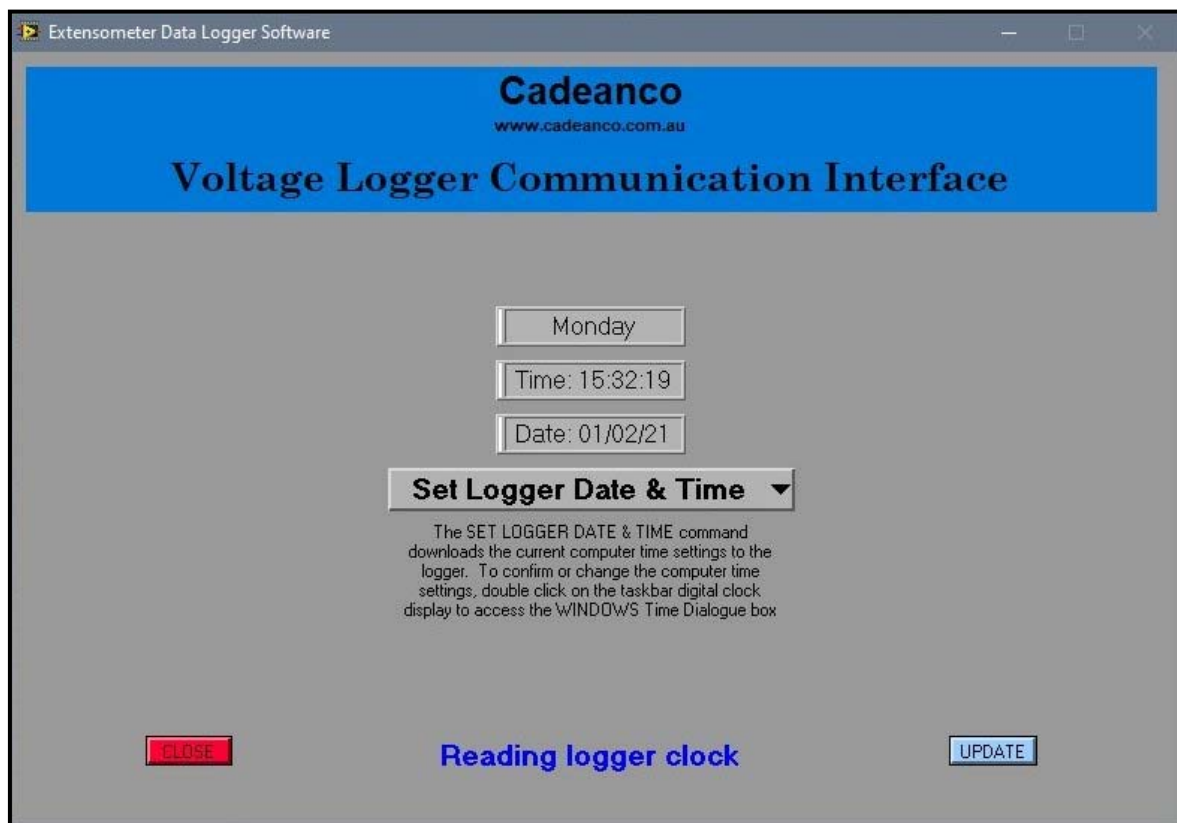
**NB** This option will not be available if the logger is configured for a LoRaWAN interface. Bi-directional alarm functions are incompatible with the 'data push' mode of the LoRaWAN interface.

### [SEND] BUTTON

Click on this button to load the interface. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

### [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.



### [Set Logger Date & Time] MENU OPTION

Select this option to view the current DAY, TIME and DATE settings of the Extensometer Data Logger system. The displayed values are recovered from the system on-line as an indication that a communication link has been established. If a GSM modem connection has been established, the operation will be slow due to transmission delays in the mobile phone network.

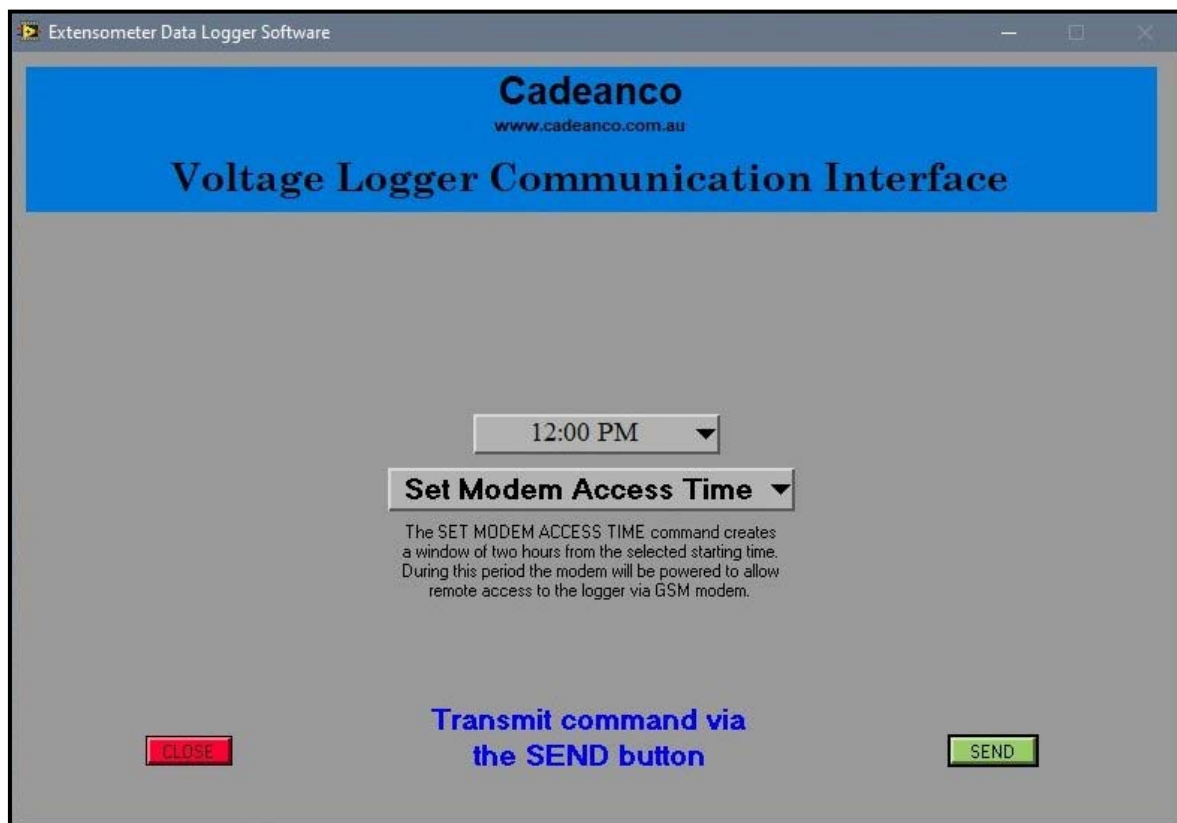
### [UPDATE] BUTTON

Select this option to load the current DAY, TIME and DATE settings of the host computer to the logger system. The [UPDATE] button can also be activated by pressing [ENTER] on the computer keyboard.

The Real Time Clock used in the logger will continue to operate even when the logger is switched off.

### [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.



### **[Set Modem Access Time] MENU OPTION**

Select this option to view a list of start times for remote modem access to the logger. The logger modem will be powered for a 15-minute from the selected start time to enable it to answer incoming calls. Once on-line, all available features of the logger are accessible to the remote user. The current start time value is displayed in both the time selection menu and the System Settings data box. While on-line, timeout will occur if no operator activity is detected by the logger for 5 minutes.

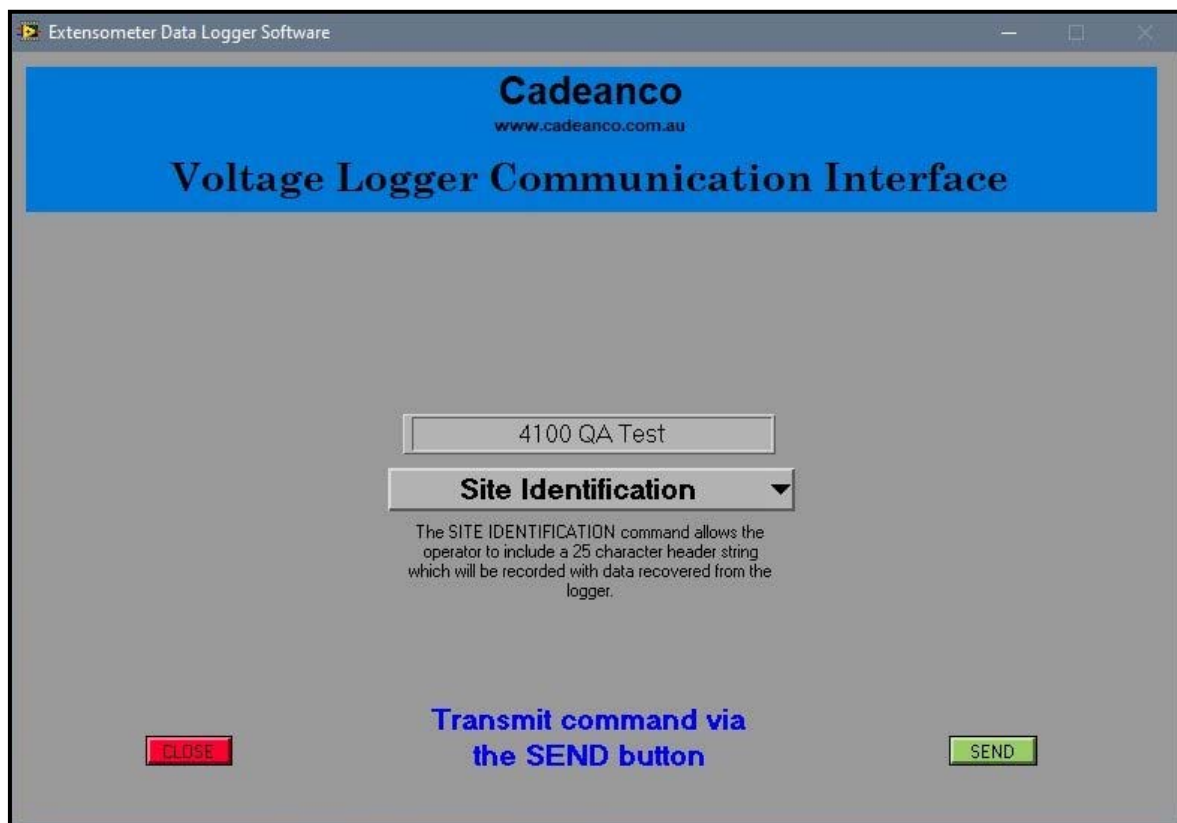
If FTP mode is enabled in the logger, the modem will upload stored incremental data to its defined server following timeout of the 15-minute GSM access window.

### **[SEND] BUTTON**

Click on this button to transmit the modem access start time to the logger system. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

### **[CLOSE] BUTTON**

Select this option to exit from the Extensometer Data Logger Communication Interface.



## **[Site Identification] MENU OPTION**

Select this option to load a Site Identification header to the Extensometer Data Logger system. This identification header will be included with data recovered from the system. New header information can be entered into the data box and sent to the system via the [SEND] button.

When typing data into the Site Identification data entry box, do not terminate the entry with the [ENTER] key, as this will be interpreted as starting a second line of information. Simply finish typing and transmit the line to the logger via the [SEND] button.

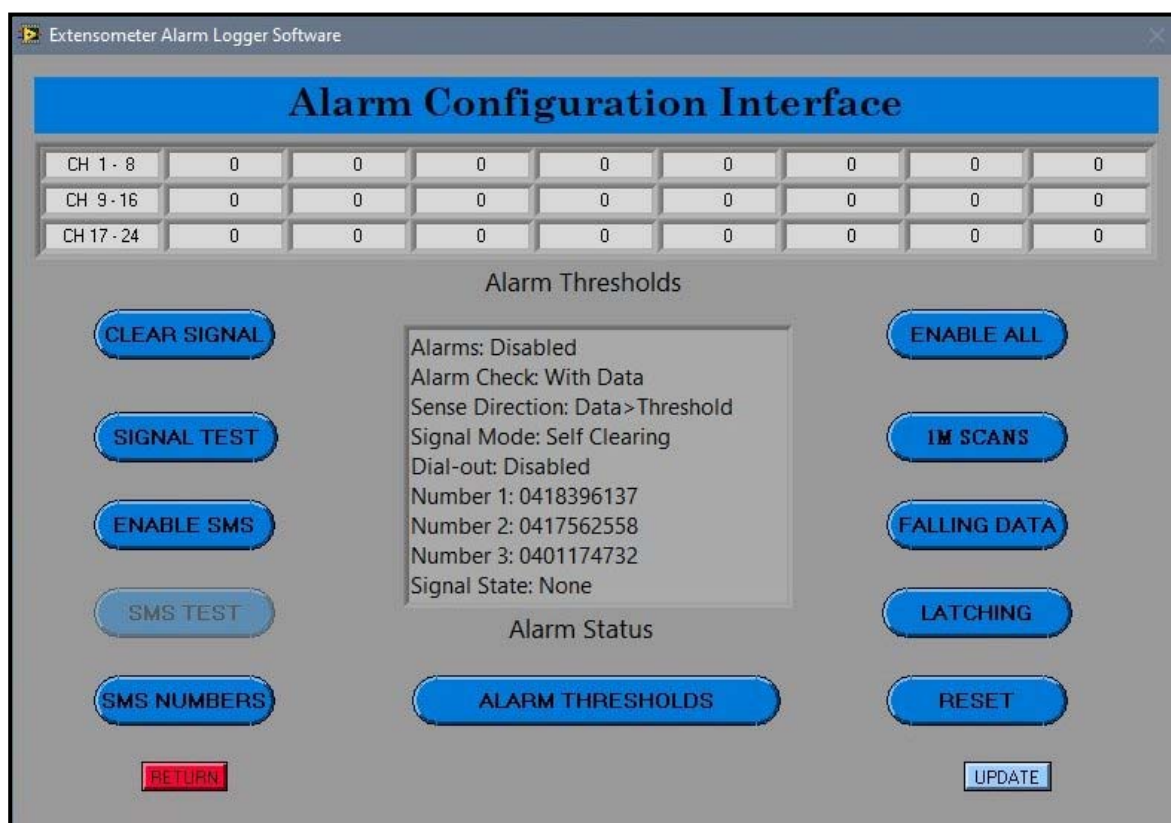
## **[SEND] BUTTON**

Click on this button to download the Site Identification header shown to the logger system.

## **[CLOSE] BUTTON**

Select this option to exit from the Extensometer Data Logger Communication Interface.

# Alarm Configuration Interface



## [Alarm Thresholds] DISPLAY

Shows the current trigger level settings of the logger alarm channels in (mV) units. Access to non-configured channels will be inhibited and these channels will be ignored by the logger when testing input channels.

## [CLEAR SIGNAL] BUTTON

Click to cancel any active external signal connected to the logger.

This function also cancels any active alarm channels. These channels will not generate any further alarms until the RESET button is used to re-arm all the configured logger channels.

## [SIGNAL TEST] BUTTON

Click to test the operation of an external signal connected to the logger.

## [DISABLE SMS] BUTTON

Click to enable or disable automatic generation of an SMS message by the logger in response to an alarm condition. The logger will remain awake between 1 and 2 hours after successful transmission of the SMS test message to allow the operator to access the logger to check recorded data or alter alarm settings. The total access time will depend at what point in the hour the SMS alarm is triggered.

SMS Alerts will be automatically disabled until at least one contact number is programmed.

## [SMS TEST] BUTTON

Click to test the SMS message sent by the logger in response to an alarm condition. The logger will report an alarm condition on Channel 99 to confirm the SMS set-up parameters. Access to the logger will be inhibited for 30 seconds while the SMS test message is transmitted.

The SMS Test command request is stored in the logger until the current connection is terminated however the request will be cancelled if either the RESET or CLEAR SIGNAL buttons is operated.

**APPLICATION NOTE:** The logger cannot respond with a test message while either the serial communication cable is connected or access to the logger is via a GSM modem link.

**Serial Cable Link:** The test message will not be sent until the software breaks the current connection however the serial cable MUST BE REMOVED FROM THE LOGGER WITHIN 20 SECONDS to allow it access to the GSM modem.

**GSM Modem Link:** The logger automatically recognizes that it is on a call and the test message will not be sent until the software breaks the current connection.

## [SMS NUMBER] BUTTON

Click to edit up to three contact numbers to be used for SMS Alerts

## [ALARM ENABLE] BUTTON

Click to enable or disable alarm scanning. This function affects all configured alarms.

## [ALARM CHECK] BUTTON

Click to select alarm status testing at either 1-minute intervals or in conjunction with data scanning. This function affects all configured alarms.

**APPLICATION NOTE:** 1-minute alarm scanning is disabled while the logger is on-line to a host PC to reduce transmission errors and minimise data corruption. Alarm operations can be checked by using the < WITH DATA > option and manually triggering a data scan.

## **[ALARM SENSE] BUTTON**

Click to select the direction in which data must cross the pre-set threshold to trigger an alarm condition. This function affects all configured alarms.

**RISING DATA:** The channel value must be greater than the pre-set threshold level to trigger an alarm.

**FALLING DATA:** The channel value must be less than the pre-set threshold level to trigger an alarm.

## **[ALARM MODE] BUTTON**

Click to select the mode of operation for triggered alarms.

**SELF-CLEARING:** In this mode, the data controls the operation of the external signal. Any configured alarm may generate a signal condition however all configured alarm channels must be clear for the logger to de-activate the signal.

When an input crosses back across its threshold value, only the external signal will be cleared. The logger will still note the initial alarm and register the channel as 'tripped'.

**LATCHED:** In this mode, a signal will be activated by any threshold crossing and remain active regardless of future data activity. The signal can only be cleared by the CLEAR SIGNAL or RESET buttons.

## **[RESET] BUTTON**

Click to clear any alarms currently registered and re-arm all configured alarm channels. This function will also cancel any active external signals and SMS Test requests.

## **[ALARM THRESHOLDS] BUTTON**

Click to access and adjust the alarm trigger point of individual configured data channels.

## **[UPDATE] BUTTON**

The current Alarm Status display can be manually updated at any time by clicking on this button. The [UPDATE] button can also be activated by pressing [ENTER] on the keyboard.

## **[CANCEL] BUTTON**

Select this option to exit from the Alarm Interface and return to the Extensometer Logger Communication interface

Extensometer Alarm Logger Software

### Alarm Configuration Interface

| CH 1 - 8 | 100     | 200     | 300     | 400     | 500     | 600     | 700     | 800   |
|----------|---------|---------|---------|---------|---------|---------|---------|-------|
| STATUS   | Tripped | Tripped | Tripped | Tripped | Tripped | Tripped | Tripped | Armed |
| DATA     | 3622    | 3170    | 2716    | 2263    | 1810    | 1356    | 903     | 449   |

| CH 9 - 16 | 900     | 1000    | 1100    | 1200    | 1300    | 1400  | 1500  | 1600  |
|-----------|---------|---------|---------|---------|---------|-------|-------|-------|
| STATUS    | Tripped | Tripped | Tripped | Tripped | Tripped | Armed | Armed | Armed |
| DATA      | 3621    | 3169    | 2716    | 2262    | 1809    | 1356  | 902   | 449   |

| CH 17 - 24 | 1700    | 1800    | 1900    | 2000    | 2100  | 2200  | 2300  | 2400  |
|------------|---------|---------|---------|---------|-------|-------|-------|-------|
| STATUS     | Tripped | Tripped | Tripped | Tripped | Armed | Armed | Armed | Armed |
| DATA       | 3622    | 3169    | 2716    | 2262    | 1808  | 1354  | 901   | 448   |

**Channel 01** ▼

Channels

**100**

Threshold Level

**Tripped**

Channel Status

RETURN
UPDATE CHANNEL DATA VALUES
PRINT

## [Alarm States] DISPLAY

This display shows the status of individual channels. This display assists the operator to set threshold level offsets with respect to the current value of each individual channel.

## [Threshold Level] DATA ENTRY

Enter channel threshold value in (mV) units. New data may be directly entered into the dialogue box. The data may also be incremented and decremented by one (mV) unit at a time by clicking on the direction arrows with the left mouse button. Changes to individual channel thresholds are updated in the displayed array of all logger channels.

Engineering value thresholds are determined by reference to the individual instrument calibration data sheets.

## [Channels] MENU

Click on the arrow to view and select each available channel configured for alarm scanning.

## [Channel Status] DISPLAY

Configured logger channels have four possible states:

Armed: The channel data has not crossed its threshold at any time.

Tripped: The channel data has crossed its threshold and has triggered an alarm. The channel is marked to prevent it causing multiple SMS alerts.

Cancelled: The channel data has crossed its threshold and triggered an alarm. This alarm has been cancelled by the CANCEL SIGNAL button. The channel is marked and will not generate any further alarms until it is re-armed with the RESET button.

Inhibited: The channel threshold value is set to zero and the alarm system will not scan this channel.

The status of all logger channels is shown in the displayed array of all logger channels.

## [PRINT] BUTTON

Click to print a summary of the current alarm set-up to the default printer.

```

                                ALARM SUMMARY REPORT

SITE ID:  4100 QA Test

Alarms: Enabled
Alarm Check: With Data
Sense Direction: Data>Threshold
Signal Mode: Self Clearing
Dial-out: Disabled
Number 1: 0418396137
Number 2: 0417562558
Number 3: 0401174732
Signal State: None

Channel 01, Threshold (mV) = 100, Status: Tripped
Channel 02, Threshold (mV) = 200, Status: Tripped
Channel 03, Threshold (mV) = 300, Status: Tripped
Channel 04, Threshold (mV) = 400, Status: Tripped
Channel 05, Threshold (mV) = 500, Status: Tripped
Channel 06, Threshold (mV) = 600, Status: Tripped
Channel 07, Threshold (mV) = 700, Status: Tripped
Channel 08, Threshold (mV) = 800, Status: Armed
Channel 09, Threshold (mV) = 900, Status: Tripped
Channel 10, Threshold (mV) = 1000, Status: Tripped
Channel 11, Threshold (mV) = 1100, Status: Tripped
Channel 12, Threshold (mV) = 1200, Status: Tripped
Channel 13, Threshold (mV) = 1300, Status: Tripped
Channel 14, Threshold (mV) = 1400, Status: Armed
Channel 15, Threshold (mV) = 1500, Status: Armed
Channel 16, Threshold (mV) = 1600, Status: Armed
Channel 17, Threshold (mV) = 1700, Status: Tripped
Channel 18, Threshold (mV) = 1800, Status: Tripped
Channel 19, Threshold (mV) = 1900, Status: Tripped
Channel 20, Threshold (mV) = 2000, Status: Tripped
Channel 21, Threshold (mV) = 2100, Status: Armed
Channel 22, Threshold (mV) = 2200, Status: Armed
Channel 23, Threshold (mV) = 2300, Status: Armed
Channel 24, Threshold (mV) = 2400, Status: Armed

```

## **[UPDATE CHANNEL DATA VALUES] BUTTON**

Click to trigger a full scan of configured inputs. The current value of individual channels is updated in the displayed array of all logger channels.

If alarms are enabled, the alarm and channel status will respond according to the current alarm parameter settings to assist the user to evaluate the alarm mode operation.

## **[RETURN] BUTTON**

Click to return to the alarm interface display.

# USB Memory Device Utility

---

The USB Memory Device Utility is a graphical user application designed to create and save a set of instruction files on a USB Memory device. When the memory device is inserted into the USB socket of a Extensometer Data Logger, these instruction files are read and executed by the control system of the logger. The operator can select from a list of basic instructions to recover stored data or customize the operating mode of the logger.

## USB MEMORY DEVICE

The Extensometer Data Logger has no external switches to enhance its field reliability and waterproof integrity. When the logger is configured with the USB option, communication with the logger takes place via a USB memory device. Serial communication is still available via the standard RS232 port as an alternative to set logger and alarm functions. Any USB memory device is suitable for use with Extensometer Data Logger providing the insertion shaft is metal however devices with a large indicator light are preferred. The USB memory device indicator light displays data transfer activity, and the device must not be removed while this indicator is active. Removing the USB Memory device will return the logger to its low power mode.

## USB DEVICE FILES

Configuration instructions and data for/from multiple loggers may be recorded onto a single USB device as a specific logger will only respond to its own coded file corresponding to the serial number of the Extensometer Data Logger.

Configuration files are always created in the root directory of the memory device and use the **EXLGnnnn.set** format where **nnnn** is the logger serial number. **EXLGnnnn.set** files are automatically deleted after the instructions are activated to ensure that Time and Date data can never be reused. Configuration files must not be moved from the root directory as all loggers will search this directory by default.

Data recovered from individual loggers is contained in unique files in dedicated folders, based on the logger serial number. Information uploaded will vary depending on the configuration of the logger itself. however, sensor data will always be in mV and °C format.

- Files are stored in directories named **EXLGnnnn** where **nnnn** is the logger serial number.
- The filename extension is preset by the operator when the logger is initially connected to the software interface. Changing the format of the uploaded data can only be done through the interface.
- Recovered data filenames will be either **Ennnnxxx.txt** or **Ennnnxxx.csv** where **nnnn** is the logger serial number and **Axx** is an auto-indexed value between **A00** and **Z99**.
- The unique filename will be automatically indexed to avoid duplication.
- Temperature data will be appended automatically if the logger is programmed to record sensor temperature.
- Alarm data will be appended automatically if the logger is configured for alarms and the global alarm functions are enabled.

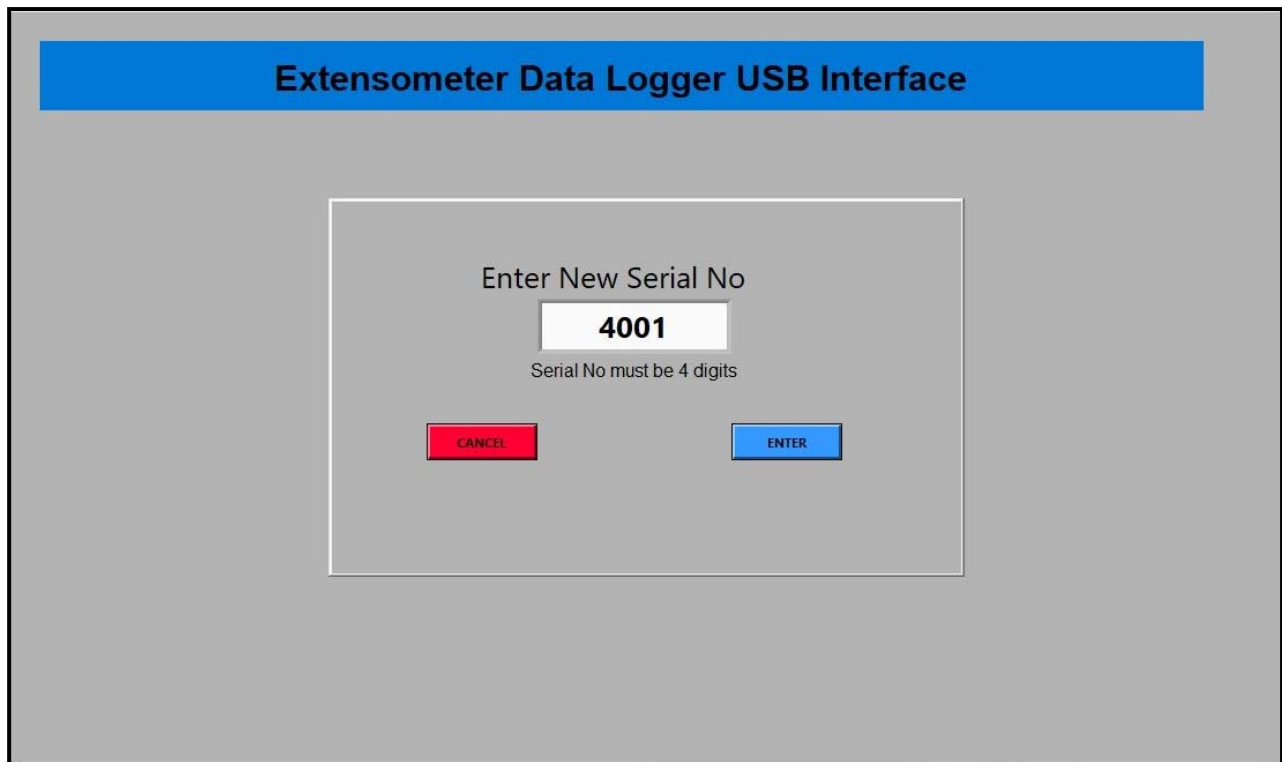
## MEMORY DEVICE MAINTENANCE

Badly fragmented USB memory sticks will cause significant delays (30 seconds or more!) opening files or making directories. This is because the USB module must search through the file system to establish useable clusters.

It is recommended that devices used for data recovery be periodically re-formatted. The memory device should be reformatted completely for best results. Using the 'quick format' option or simply deleting files from the device will not produce a significant improvement.

# USB Interface Functions

---



## [Enter New Serial No] DIALOGUE SCREEN

This screen will only appear when the interface does not have any stored logger information in its default list. Type in a new 4-digit serial number found on the logger case or with accompanying documentation. The data box will not normally appear during routine interface operations unless all stored serial numbers are deleted from the default list.

**APPLICATION NOTE 1:** This 4-digit number is used to create unique instruction files that will only be read and implemented by a logger with the same serial number. Multiple instruction files may be stored on the same USB memory device for convenience. Ensure that the serial number is entered correctly for proper operation with your specific logger(s).

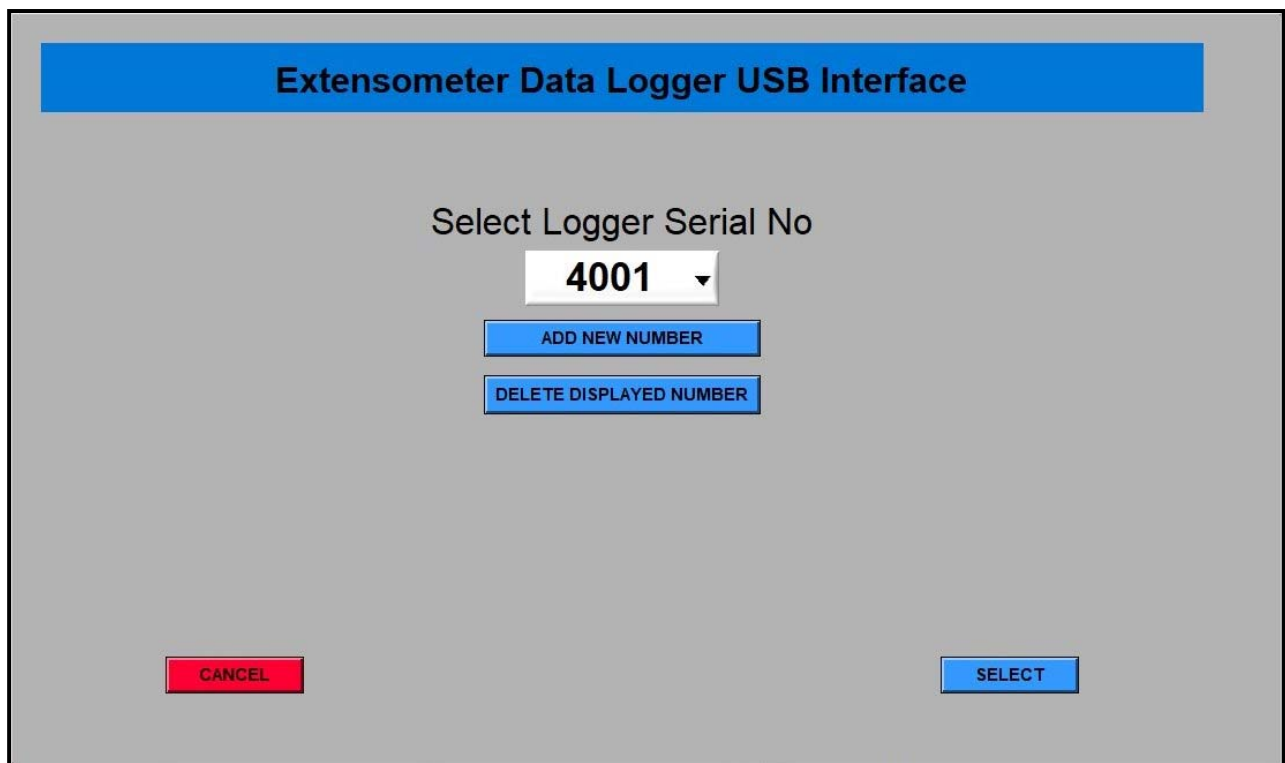
**APPLICATION NOTE 2:** Entering [0000] will generate a global file that can be read by all Extensometer Data Loggers. Access to the configuration command options is inhibited as they cannot be used as global functions.

## [ENTER] BUTTON

Select this option by clicking with the left mouse button to save the new serial number to the default file. This button will not appear until exactly 4 digits are entered/

## [CANCEL] BUTTON

Select this option by clicking with the left mouse button to exit without saving any data to the default file.



### **[Select Logger Serial No] MENU OPTION**

This menu selection displays the current stored list of logger serial numbers. Expand the list by clicking on the ▼ arrow with the left mouse button.

### **[SELECT] BUTTON**

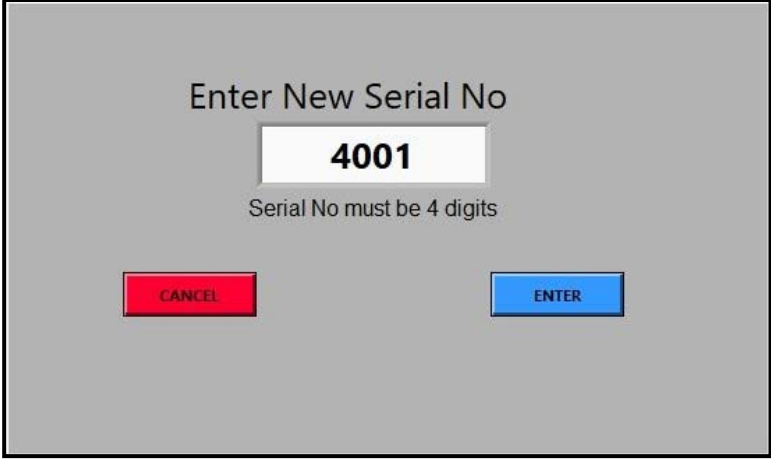
Select this option by clicking with the left mouse button to view available logger instructions and default data for the selected logger.

### **[CANCEL] BUTTON**

Select this option by clicking with the left mouse button to exit without saving any data to the default file.

## [ADD NEW NUMBER] BUTTON

Select this option by clicking with the left mouse button to open a dialogue data entry box to add a new serial number to the default list. All logger instruction commands are initially set to <NO> for new serial numbers. Click on the [CANCEL] or [ENTER] buttons to close the dialogue box and return to the main screen.



The screenshot shows a grey rectangular dialog box titled "Enter New Serial No". In the center, there is a white text input field containing the number "4001". Below the input field, the text "Serial No must be 4 digits" is displayed. At the bottom of the dialog box, there are two buttons: a red button labeled "CANCEL" on the left and a blue button labeled "ENTER" on the right.

The user will be prompted to enter a channel configuration for the new logger



The screenshot shows the same "Enter New Serial No" dialog box as before, but with an additional sub-dialog box open in the center. The sub-dialog is titled "Select logger configuration" and contains two buttons: "8 Channel" (which is highlighted with a blue border) and "24 Channel". The "CANCEL" and "ENTER" buttons from the main dialog are still visible at the bottom.

## [DELETE DISPLAYED NUMBER] BUTTON

Select this option by clicking with the left mouse button to remove the selected serial number from the default list. The delete command must be confirmed before it is carried out. Click on the [CANCEL] or [ENTER] buttons to close the dialogue box and return to the main screen.



The screenshot shows a grey rectangular dialog box titled "Confirm Delete?". At the bottom of the dialog box, there are two buttons: a red button labeled "CANCEL" on the left and a blue button labeled "YES" on the right.

**Extensometer Data Logger Serial No 4001**

Recover stored data? **YES**

Clear memory after data recovery? **YES**

Reset scan interval? **YES**

View configuration options? **NO**

✓ Never Scan  
1 Min Intervals  
10 Min Intervals  
1 Hour Intervals  
6 Hours from 00:00  
12 Hours from 00:00  
Daily at 12:00

**CLOSE** **CREATE FILE**

### [Recover stored data?] OPTION

Click on the [NO/YES] selector to instruct the logger to copy data stored in the logger memory onto the USB Memory device. The data file will be given a unique filename based on the logger serial number.

**APPLICATION NOTE 1:** By default, stored data will remain in the logger memory after this instruction is implemented. The logger memory can only be cleared by implementing the [Clear memory after data recovery?] option.

**APPLICATION NOTE 2:** There is no option to upload corrected sensor data via the USB memory device.

### [Clear memory after data recovery?] OPTION

Click on the [NO/YES] selector to instruct the logger to clear all stored data once it is successfully transferred to the USB memory device. Setting this option to [NO] will leave data in the logger memory.

**APPLICATION NOTE:** The logger memory is large enough to hold many scans of data depending on logger configuration mode. Leaving data in the logger memory means that this old data will be transferred every time the logger memory is read. This will impact on the time taken to transfer data and logger battery life. The user will also have to manage old data included with the data file.

**[Reset scan interval?] OPTION**

Click on the [NO/YES] selector to see available options for recording data. Changes to the scan interval are implemented immediately the new instruction is received by the Extensometer Data Logger.

**[View configuration options?] OPTION**

Click on the [NO/YES] selector to expand the menu to show configuration options for the logger.

**APPLICATION NOTE 1:** In general, these expanded options will be used to initially setup the logger for a particular application. Care should be taken when using these options to ensure the logger is set correctly for the connected instruments and logging requirements.

**APPLICATION NOTE 2:** When any of the configuration options are selected, a second instruction file is generated. Once this second file is read by its designated logger, it is automatically deleted to avoid accidental implementation of the configuration instruction set during subsequent use of the USB memory device.

**[CREATE FILE] BUTTON**

Click on this button to open a Window File Dialogue box to save the instruction file.

**[CLOSE] BUTTON**

Select this option by clicking with the left mouse button to exit without saving any data to the default file.

**Extensometer Data Logger Serial No 4001**

|                                   |                                    |
|-----------------------------------|------------------------------------|
| Recover stored data?              | <input type="button" value="NO"/>  |
| Clear memory after data recovery? | <input type="button" value="NO"/>  |
| Reset scan interval?              | <input type="button" value="NO"/>  |
| Reset logger type & inputs?       | <input type="button" value="YES"/> |
| Change data separator?            | <input type="button" value="NO"/>  |
| Reset Site Identity data?         | <input type="button" value="NO"/>  |
| Reset Date and Time?              | <input type="button" value="NO"/>  |

- ✓ Extensometer Logger (Input 1)
- Extensometer Logger (Input 1 & 2)
- Extensometer Logger (Input 1, 2 & 3)
- Voltage Logger (Input 1)
- Voltage Logger (Input 1 & 2)
- Voltage Logger (Input 1, 2 & 3)
- Crackmeter Logger (Input 1)
- Crackmeter Logger (Input 1 & 2)
- Crackmeter Logger (Input 1, 2 & 3)

## [Reset logger type & inputs?] OPTION

Click on the [NO/YES] selector to see available options for configuring the logger.

The available drop-down menu lists all available options currently implemented in the logger firmware. The option chosen will depend on the instrument configuration to be monitored.

**APPLICATION NOTE:** When the [Reset logger type?] command is implemented, two data files are automatically generated. The first file shows data stored in the logger memory prior to the change of configuration. The second file will contain a header with a single data scan to confirm the revised configuration parameters. All stored data will be lost during the re-configuration of the logger.

**Extensometer Data Logger Serial No 4001**

|                                   |                                    |
|-----------------------------------|------------------------------------|
| Recover stored data?              | <input type="button" value="NO"/>  |
| Clear memory after data recovery? | <input type="button" value="NO"/>  |
| Reset scan interval?              | <input type="button" value="NO"/>  |
| Reset logger type & inputs?       | <input type="button" value="NO"/>  |
| Change data separator?            | <input type="button" value="YES"/> |
| Reset Site Identity data?         | <input type="button" value="NO"/>  |
| Reset Date and Time?              | <input type="button" value="NO"/>  |

Horizontal Tab (HTAB)  
Comma Separator (CSV)

### [Change data separator?] OPTION

Click on the [NO/YES] selector to see available options for configuring the logger.

This option allows data to be recovered using either horizontal tab separators (HTAB) or in Comma Separated Variable format. Both formats can be readily loaded into spreadsheet applications however the HTAB format is preferable to view data in the raw text file.

Extensometer Data Logger Serial No 4001

|                                   |                                               |                                                     |
|-----------------------------------|-----------------------------------------------|-----------------------------------------------------|
| Recover stored data?              | <input type="button" value="NO"/>             |                                                     |
| Clear memory after data recovery? | <input type="button" value="NO"/>             |                                                     |
| Reset scan interval?              | <input type="button" value="NO"/>             |                                                     |
| Reset logger type & inputs?       | <input type="button" value="NO"/>             |                                                     |
| Change data separator?            | <input type="button" value="NO"/>             |                                                     |
| Reset Site Identity data?         | <input checked="" type="button" value="YES"/> | <input type="text" value="Logger #4001 Test Site"/> |
| Reset Date and Time?              | <input type="button" value="NO"/>             |                                                     |

### [Reset Site Identity data?] OPTION

Click on the [NO/YES] selector to open a text data box.

This option allows the logger to be assigned a local site identity that will be included with data recovered from the logger for easier identification. The site identity description must be limited to 25 characters and longer entries will be truncated.

The site identity can be updated at any time by implementing this instruction with new data entered in the text entry box.

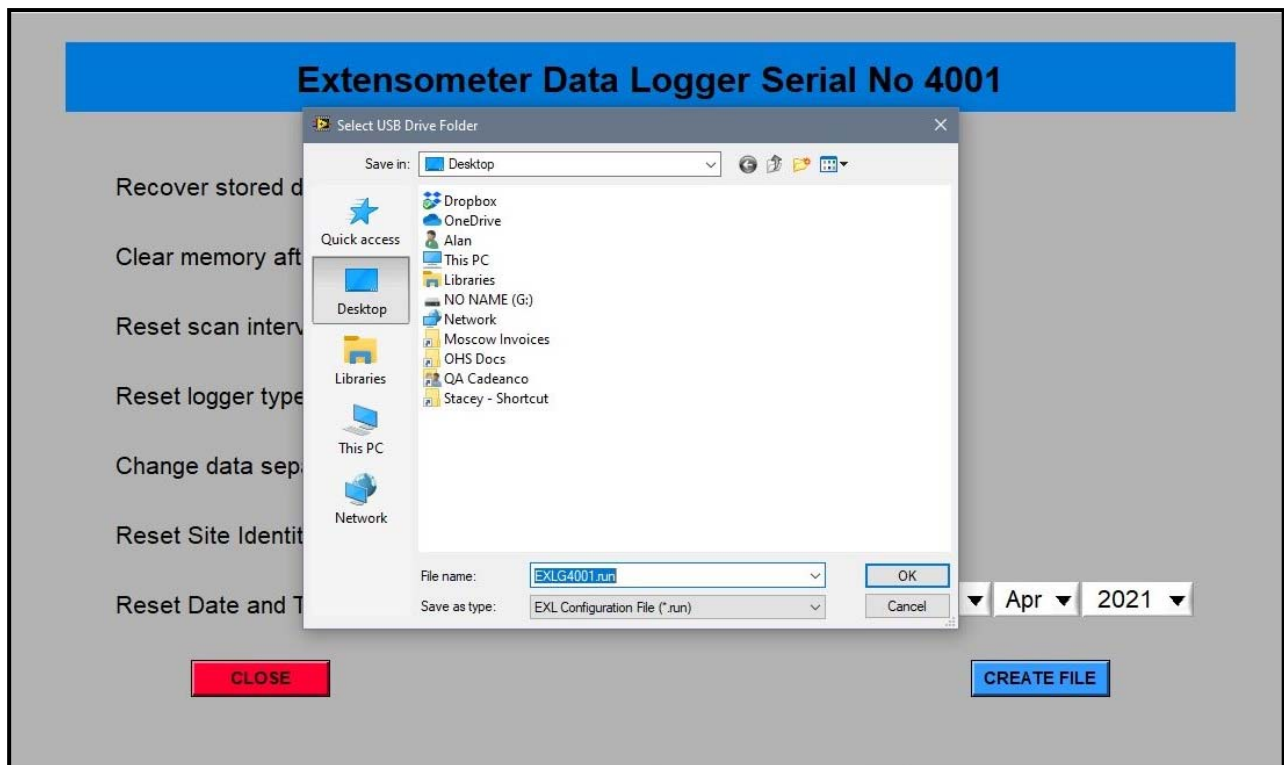
**Extensometer Data Logger Serial No 4001**

|                                   |                                                                           |
|-----------------------------------|---------------------------------------------------------------------------|
| Recover stored data?              | <input type="button" value="NO"/>                                         |
| Clear memory after data recovery? | <input type="button" value="NO"/>                                         |
| Reset scan interval?              | <input type="button" value="NO"/>                                         |
| Reset logger type & inputs?       | <input type="button" value="NO"/>                                         |
| Change data separator?            | <input type="button" value="NO"/>                                         |
| Reset Site Identity data?         | <input type="button" value="NO"/>                                         |
| Reset Date and Time?              | <input checked="" type="button" value="YES"/> 20 ▾ 00 ▾ 06 ▾ Apr ▾ 2021 ▾ |

### [Reset Date and Time?] OPTION

Click on the [NO/YES] selector to show time and date selection boxes.

**APPLICATION NOTE:** The logger internal clock will be reset to match the displayed time and date parameters immediately the USB memory device is inserted into the logger USB port. Set a suitable time and date far enough ahead to allow the logger to be reset to correctly match the local time zone so that recorded events can be accurately evaluated.



### [Select USB Drive Folder] OPTION

Select the destination drive for the logger instruction file(s).

Instruction files for multiple loggers can be created and stored into the same root directory and a single USB memory device may be used for all loggers. An Extensometer Data Logger will only respond to an instruction file name matching its own pre-set format and will ignore instruction files created for loggers with other serial numbers.

**APPLICATION NOTE 1:** The file must be stored in the root drive of the USB memory device as this is the default location for all Extensometer Data Loggers to search for their own instruction file.

**APPLICATION NOTE 2:** When any of the configuration options are selected, a second instruction file is generated. Once this second file is read by its designated Extensometer Data Logger, it is automatically deleted to avoid accidental implementation of the configuration instruction set during subsequent use of the USB memory device.

**APPLICATION NOTE 3:** Do not edit the <EXLG\*\*\*\*.run> or <EXLG\*\*\*\*.set> file name formats that are automatically generated for recognition by the specified logger.

# Configuration Manager Utility

---

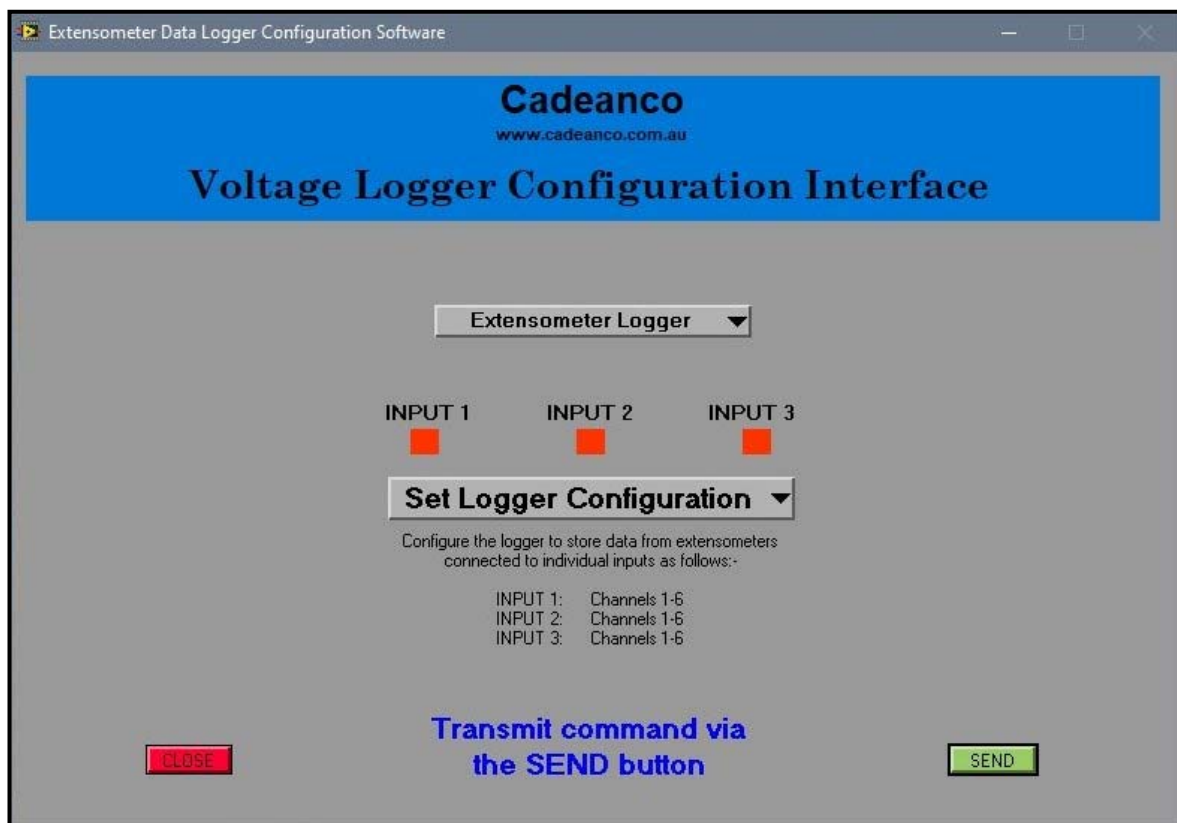
## OVERVIEW

The Configuration Manager is used with the Extensometer logger variation to set the operating mode prior to deployment in the field. In addition to the individual configuration screens shown on the following pages, this utility also allows access to the following logger functions for operator convenience.

- System Settings
- Set Logger Data & Time
- Set Modem Access
- Site Identification

## SERIAL CONNECTION

The Configuration Manager can only connect to the logger via the RS232 serial cable supplied. Loggers fitted with remote access hardware such as radio or telephone modems should be configured prior to deployment into the field. Alternatively, a laptop computer needs to be available on site should a logger need to be re-configured.



## [Set Logger Configuration] MENU OPTION

Select the required input connection(s) for up to three 6-channel extensometers. The logger system will be optimised for data acquisition, memory usage and serial data transfer.

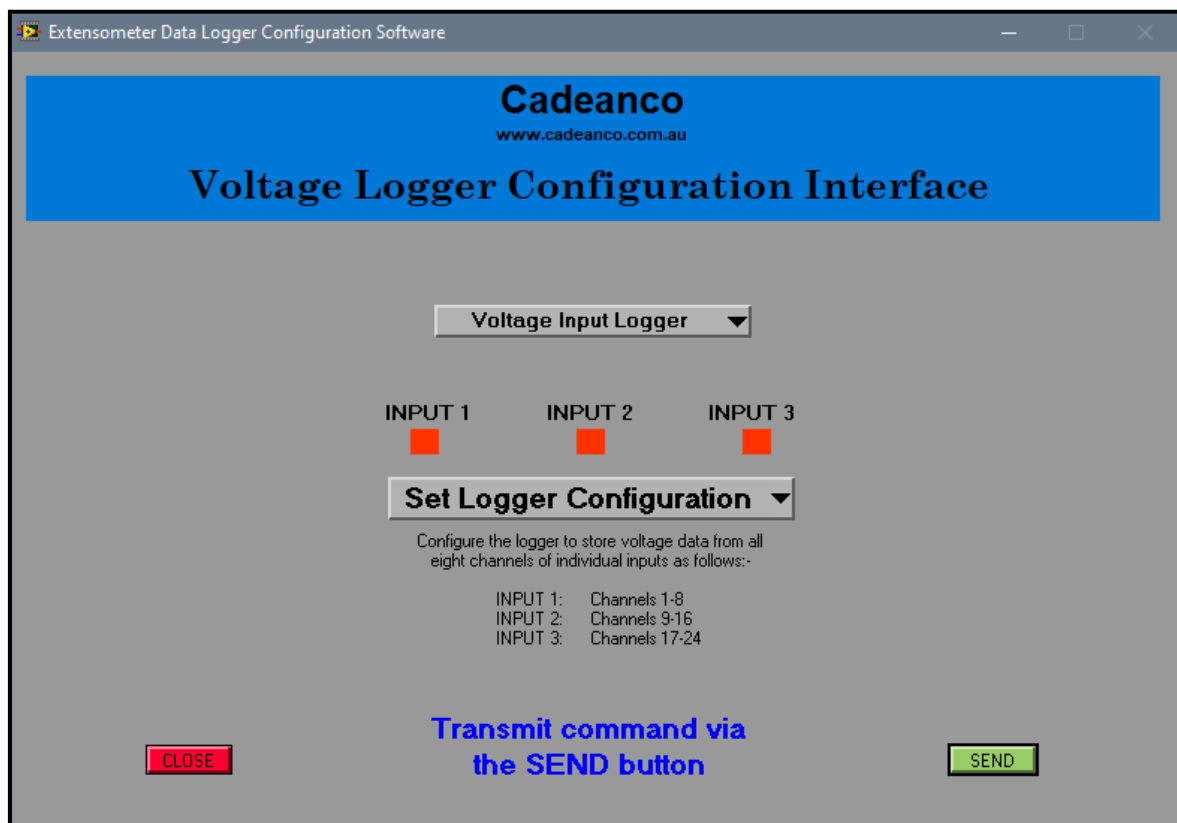
Refer to the Logger Input Connection section for input connector pin configurations.

## [SEND] BUTTON

Click on this button to transmit the selected configuration to the logger system. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

## [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.



## [Set Voltage Logger Configuration] MENU OPTION

Select the required input connection(s) for up to 24 voltage input channels. The inputs will be read in groups of 8 channels and unused input connection channels should be tied to ground as good practice. The logger system will be optimised for data acquisition, memory usage and serial data transfer.

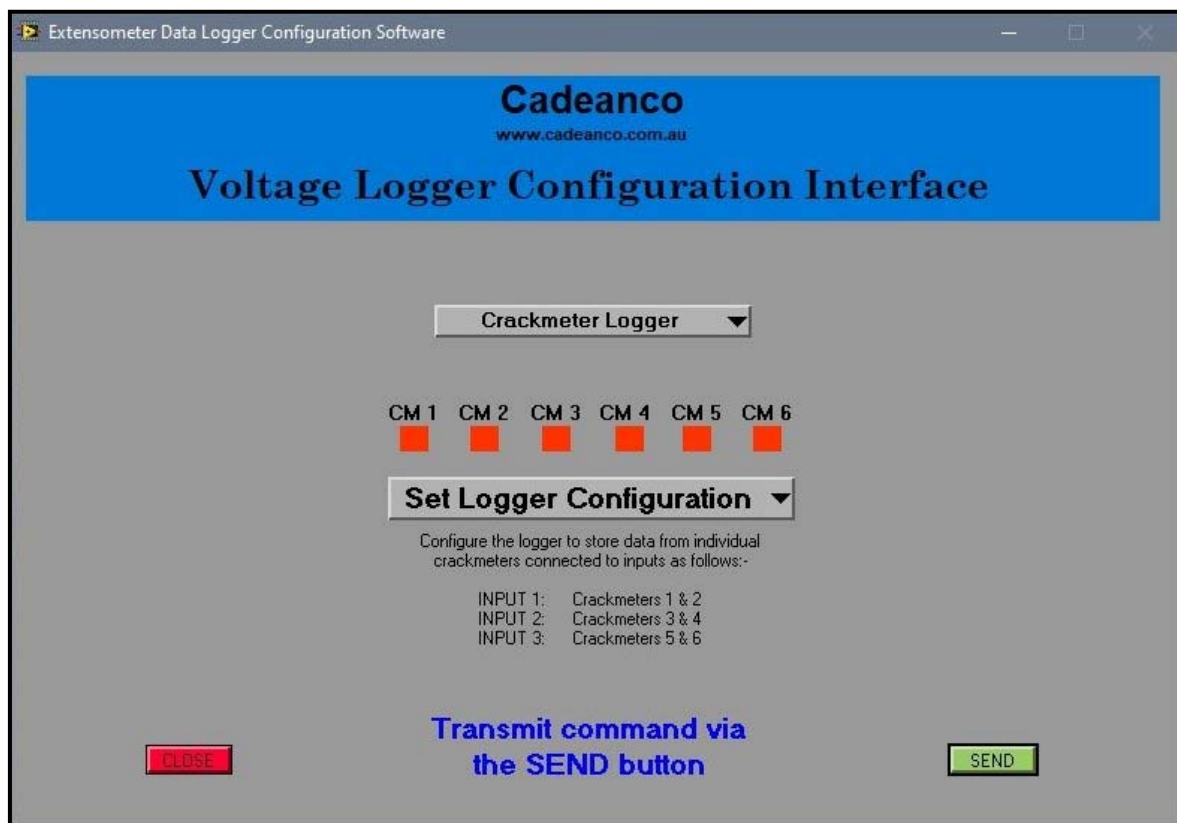
Refer to the Logger Input Connection section for input connector pin configurations.

## [SEND] BUTTON

Click on this button to transmit the selected configuration to the logger system. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

## [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.



### [Set Crackmeter Logger Configuration] MENU OPTION

Select the required input connection(s) for up to 6 single channel crackmeters. The logger system will be optimised for data acquisition, memory usage and serial data transfer. Selections will be automatically allocated to the first available input.

Refer to the Logger Input Connection section for input connector pin configurations.

### [SEND] BUTTON

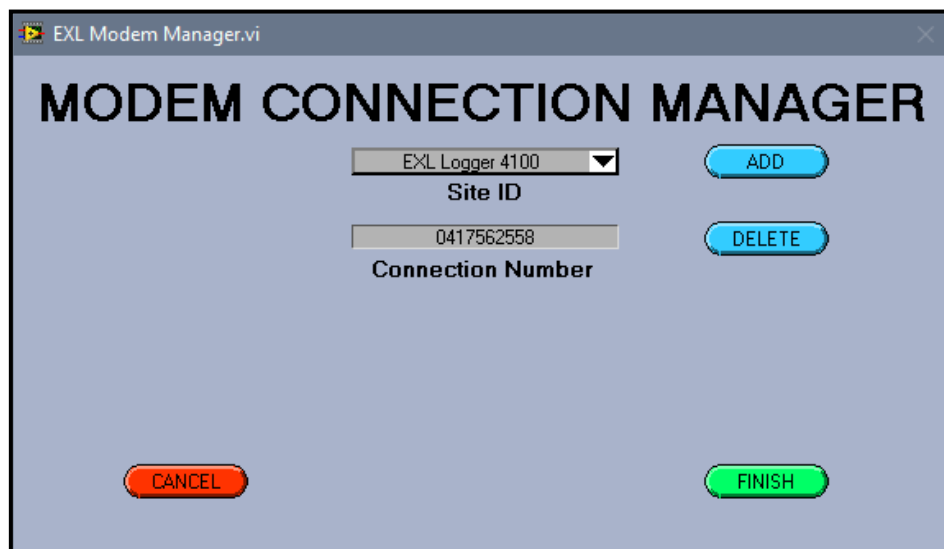
Click on this button to transmit the selected configuration to the logger system. The [SEND] button can also be activated by pressing [ENTER] on the computer keyboard.

### [CLOSE] BUTTON

Select this option to exit from the Extensometer Data Logger Communication Interface.

# Modem Manager Utility

---



## SELECTING THE INITIALIZATION FILE

Modem connection numbers are always written to the **EXLX100.ini** file.

### [Site ID] MENU

Click on the arrow with the left mouse button and select from the list of available logger sites and connection number. This site list may be edited with the **ADD** and **DELETE** buttons.

### [ADD] BUTTON

Clicking this button with the left mouse button will display two empty data entry boxes for the operator to type in a new Site ID and its assigned connection number. The new ID and access number (including any access codes) will be inserted into the existing Site ID list immediately before the site currently displayed.

### [DELETE] BUTTON

Clicking this button with the left mouse button will remove the site currently displayed.

### [FINISH] BUTTON

Select this option by clicking with the left mouse button to end the edit process and close the utility. The revised Site ID list will be used for future modem connection attempts.

### [CANCEL] BUTTON

Select this option by clicking with the left mouse button to cancel the edit process and close the utility without changing the original Site ID list.

# Extensometer Logger Data Files

Extensometer Logger Data File

Site: Exto Logger #4001

Date: 27/01/21

Time: 15:10:37

Battery Voltage: 14.04

Raw Data in mVolts

| X1-1 | X1-2 | X1-3 | X1-4 | X1-5 | X1-6 | X1-V | X1-Z | Time     | Date       |
|------|------|------|------|------|------|------|------|----------|------------|
| 624  | 1194 | 1765 | 2335 | 2906 | 3476 | 4046 | 53   | 14:00:00 | 25/01/2021 |
| 624  | 1194 | 1765 | 2335 | 2906 | 3476 | 4046 | 53   | 15:00:00 | 25/01/2021 |
| 624  | 1194 | 1765 | 2335 | 2906 | 3476 | 4046 | 53   | 16:00:00 | 25/01/2021 |
| .    |      |      |      |      |      |      |      |          |            |
| .    |      |      |      |      |      |      |      |          |            |
| 624  | 1194 | 1765 | 2335 | 2906 | 3476 | 4046 | 53   | 14:00:00 | 26/01/2021 |
| 624  | 1194 | 1765 | 2335 | 2906 | 3476 | 4046 | 53   | 15:00:00 | 26/01/2021 |

Data transfer complete.

The data file header contains the following information: -

- A file-type identification
- The system site identification information
- The data recovery date
- The data recovery time
- The logger battery voltage after the data recovery
- The recovered data format
- A header line to assist with identification of measured data  
(X1-V is the extensometer excitation voltage, X1-Z is the extensometer reference voltage)

When the **UPLOAD RAW DATA** option is used, each scan is saved as follows: -

- Input data from each of the six measurement channels of connected extensometer(s)
- Excitation voltage of each instrument measured at the individual extensometer head
- The time and date that the scan occurred
- All data scans use Tab or CSV separation between columns

Data in mVolts corrected to 4.000 Volts Excitation

| X1-1 | X1-2 | X1-3 | X1-4 | X1-5 | X1-6 | Time     | Date       |
|------|------|------|------|------|------|----------|------------|
| 572  | 1143 | 1715 | 2286 | 2858 | 3429 | 14:00:00 | 25/01/2021 |
| 572  | 1143 | 1715 | 2286 | 2858 | 3429 | 15:00:00 | 25/01/2021 |
| 572  | 1143 | 1715 | 2286 | 2858 | 3429 | 16:00:00 | 25/01/2021 |
| .    |      |      |      |      |      |          |            |
| .    |      |      |      |      |      |          |            |
| 572  | 1143 | 1715 | 2286 | 2858 | 3429 | 14:00:00 | 26/01/2021 |
| 572  | 1143 | 1715 | 2286 | 2858 | 3429 | 15:00:00 | 26/01/2021 |

Data transfer complete.

When the **UPLOAD CORRECTED DATA** option is used, each scan is saved as follows:-

- Input data from each of the six measurement channels of connected extensometer(s)
- The time and date that the scan occurred
- All data scans use Tab or CSV separation between columns

## Voltage Input Logger Data Files

```

Voltage Logger Data File
Site:  Extometer #4001
Date:  27/01/21
Time:  15:10:37
Battery Voltage: 14.04
Raw Data in mVolts
CH 1   CH 2   CH 3   CH 4   CH 5   CH 6   CH 7   CH 8   Time   Date
  452    910   1366   1822   2278   2735   3192   3648   14:00:00  25/01/2021
  452   1010   1366   1822   2278   2735   3192   3648   15:00:00  25/01/2021
  452   1010   1366   1822   2278   2735   3192   3648   16:00:00  25/01/2021
.
.
  452   1010   1366   1822   2278   2735   3192   3648   14:00:00  26/01/2021
  452   1010   1366   1822   2278   2735   3192   3648   15:00:00  26/01/2021
Data transfer complete.

```

The data file header contains the following information: -

- i) A file-type identification
- ii) The system site identification information
- iii) The data recovery date
- iv) The data recovery time
- v) The logger battery voltage after the data recovery
- vi) The recovered data format
- vii) A header line to assist with identification of measured data

Each scan is saved as follows:-

- i) Input data from each of the eight measurement channels of every selected input(s)
- ii) The time and date that the scan occurred
- iii) All data scans use Tab or CSV separation between columns

# Crackmeter Logger Data Files

```
Crackmeter Logger Data File
Site:  Extto Logger #4001
Date: 27/01/21
Time: 15:10:37
Battery Voltage: 14.04
Raw Data in mVolts
Crk1   C1-V   C1-Z   Crk2   C2-V   C2-Z   Time   Date
2050   4045   56    2055   4044   55    14:00:00   25/01/2021
2050   4045   56    2054   4045   56    15:00:00   25/01/2021
2050   4045   56    2054   4044   57    16:00:00   25/01/2021
.
.
2051   4045   56    2054   4045   56    14:00:00   26/01/2021
2051   4045   56    2055   4045   55    15:00:00   26/01/2021
Data transfer complete.
```

The data file header contains the following information: -

- i) A file-type identification
- ii) The system site identification information
- iii) The data recovery date
- iv) The data recovery time
- v) The logger battery voltage after the data recovery
- vi) The recovered data format
- vii) A header line to assist with identification of measured data  
(Cn-V is the crackmeter excitation voltage, Cn-Z is the crackmeter reference voltage)

**APPLICATION NOTE:** Crackmeter data is recorded as 'Input Pairs'. e.g. if a single crackmeter is connected to Input 1, the data file will include readings for Crackmeter #2. These extra 'false' readings should be ignored, or the unused input tied to ground to force the stored readings to zero.

When the **UPLOAD RAW DATA** option is used, each scan is saved as follows: -

- i) Input data from each connected crackmeter(s)
- ii) Excitation voltage of each instrument measured at the individual crackmeter head
- iii) The time and date that the scan occurred
- iv) All data scans use Tab or CSV separation between columns

```
Data in mVolts corrected to 4.000 Volts Excitation
Crk1   Crk2   Time   Date
2000   2006   14:00:00   25/01/2021
2000   2004   15:00:00   25/01/2021
2000   2004   16:00:00   25/01/2021
.
.
2001   2004   14:00:00   26/01/2021
2001   2005   15:00:00   26/01/2021
Data transfer complete.
```

When the **UPLOAD CORRECTED DATA** option is used, each scan is saved as follows: -

- i) The millivolt data from each connected crackmeter(s)
- ii) The time and date that the scan occurred
- iii) All data scans use Tab or CSV separation between columns

## Alarm Data Files

Voltage Logger Alarm File

Site: Exto Logger #4001

Date: 27/01/21

Time: 15:10:37

Battery Voltage: 14.04

| CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 | CH8 | Time     | Date       |
|-----|-----|-----|-----|-----|-----|-----|-----|----------|------------|
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 14:00:00 | 25/01/2021 |
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 15:00:00 | 25/01/2021 |

*(Alarms must be enabled by operator)*

|   |   |   |   |   |   |   |   |          |            |
|---|---|---|---|---|---|---|---|----------|------------|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16:00:00 | 25/01/2021 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17:00:00 | 25/01/2021 |

*(Channel #2 crosses threshold value)*

|   |   |   |   |   |   |   |   |          |            |
|---|---|---|---|---|---|---|---|----------|------------|
| 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 18:00:00 | 25/01/2021 |
| 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 19:00:00 | 25/01/2021 |

*(Channel #2 alarm state cancelled by operator)*

|   |    |   |   |   |   |   |   |          |            |
|---|----|---|---|---|---|---|---|----------|------------|
| 0 | -2 | 0 | 0 | 0 | 0 | 0 | 0 | 20:00:00 | 25/01/2021 |
| 0 | -2 | 0 | 0 | 0 | 0 | 0 | 0 | 21:00:00 | 25/01/2021 |

Data transfer complete.

The alarm data file header contains the following information:-

- i) A file-type identification
- ii) The system site identification information
- ii) The data recovery date
- iv) The data recovery time
- v) The logger battery voltage after the data recovery
- vi) A header line to assist with identification of measured data

The data recorded for each scan is recorded as follows: -

- i) Scans logged with alarms disabled will record a [0] value on all channels
- ii) When alarm scanning is enabled, channels whose threshold value is crossed in the defined sense direction will record a positive data values equal to their Channel No. This allows convenient plotting in a spreadsheet application such as MS Excel or Lotus  
eg. Channel #2 generates an alarm, [2] is recorded.
- iii) When a channel is cancelled, a negative channel data value is recorded.  
eg. Channel #2 is cancelled, data record changes to [-2]
- iv) If a measured channel value crosses back over its threshold value, the recorded value will return to [0]. If the channel alarm was cancelled, then a [-0] value will be recorded
- v) Alarm scanning does not take place for channels measured as zero
- i) The time and date that the scan occurred.
- ii) All data scans use Tab or CSV separation between columns

# LoRaWAN Data

Data streamed over LoRaWAN networks must comply with accepted 'fair use' rules including stream lengths and repetition rates. To retain maximum flexibility and compliance, logger data is compressed into a single line and individual sensor values must be extracted from the received stream.

Pushed data scans use CSV separation between columns for easy integration with spreadsheet applications. The order of information sent in the data string is the same as detailed for serial, GSM and FTP data transfers

## Extensometer Data

```
4001,DATA,01, 624,1194,1765,2335,2906 ,3476,4046, 53,14:00:00,25/01/2024
```

The data recorded for each scan is transmitted as follows: -

- i) An identification prefix based on the logger serial no (e.g. 4001).
- ii) An identification string to define the data type of each line.
- iii) A status byte to define the data string. See **Status Byte Format** notes.
- iv) Input data from each of the six measurement channels of connected extensometer(s).
- v) Excitation voltage of each instrument measured at the individual extensometer head.
- vi) The time and date that the scan occurred.

## Voltage Data

```
4001,DATA,01, 452, 910,1366,1822,2278 ,2735,3192,3648,14:00:00,25/01/2024
```

The data recorded for each scan is transmitted as follows: -

- i) An identification prefix based on the logger serial no (e.g. 4001).
- ii) An identification string to define the data type of each line.
- iii) A status byte to define the data string. See **Status Byte Format** notes.
- iv) Input data from each of the eight measurement channels of every selected input(s).
- v) The time and date that the scan occurred.

## Crackmeter Data

```
4001,DATA,01,2050,4045, 56,2055,4044, 55,14:00:00,25/01/2024
```

The data recorded for each scan is transmitted as follows: -

- i) An identification prefix based on the logger serial no (e.g. 4001).
- ii) An identification string to define the data type of each line.
- iii) A status byte to define the data string. See **Status Byte Format** notes.
- iv) Input data from each connected crackmeter(s).
- v) Excitation voltage of each instrument measured at the individual crackmeter head.
- vi) The time and date that the scan occurred.

## Status Byte Format

The structure of the data stream for each scan can be identified from the status byte sent at the start of each line of data:

Bit 0: If set, Sensor channels 1 to 8 are included as the first data group in the stream.

Bit 1: If set, Sensor Channels 9 to 16 are included as the second data group in the stream.

Bit 2: If set, Sensor channels 17 to 24 are included as the third data group in the stream.

Bit 3: Always zero.

Bit 3: Always zero.

Bit 5: Always zero

Bit 6: Always zero

Bit 7: Always zero

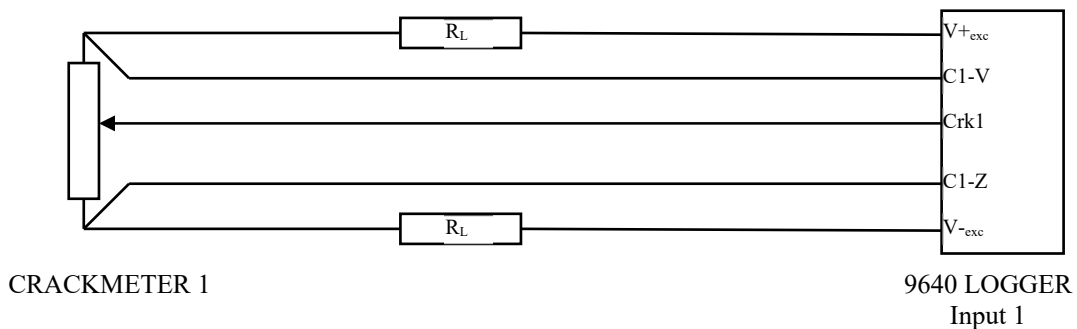
## Alarm Data

When a LoRaWAN interface is fitted, alarm scanning is automatically disabled in the logger. The LoRaWAN interface is used to push data to a connected server system and the user must evaluate the received data to determine if data is exceeding pre-determined thresholds. The LoRaWAN connection is not compatible with the requirements of the logger alarm system.

# Data Compensation Techniques

## LEAD-WIRE COMPENSATION

The logger has two input channels on each connector to measure the excitation voltage at the instrument head via the REFERENCE cables provided by the instrument manufacturer. This allows a correction to be made for voltage losses due to the internal resistance of the instrument cables supplying power to the instrument. When raw data is recovered from a logger configured for either extensometers or crackmeters, these offset voltages are included and may be applied as shown to reflect the true voltage of the active measurement channels.



## EXCITATION VOLTAGE STANDARDIZATION

Both extensometers and crackmeters output a voltage level that varies as a measure of physical movement. Individual instruments are calibrated by the manufacturer using their own reference voltage however this invariably differs from the excitation voltage of individual installations. The Extensometer Data Logger automatically compensates for lead-wire losses and recalculates the resultant value for a 4.000volt excitation level. This allows the data to be easily converted to a physical change when the manufacturers calibration factor is applied.

## CALCULATIONS

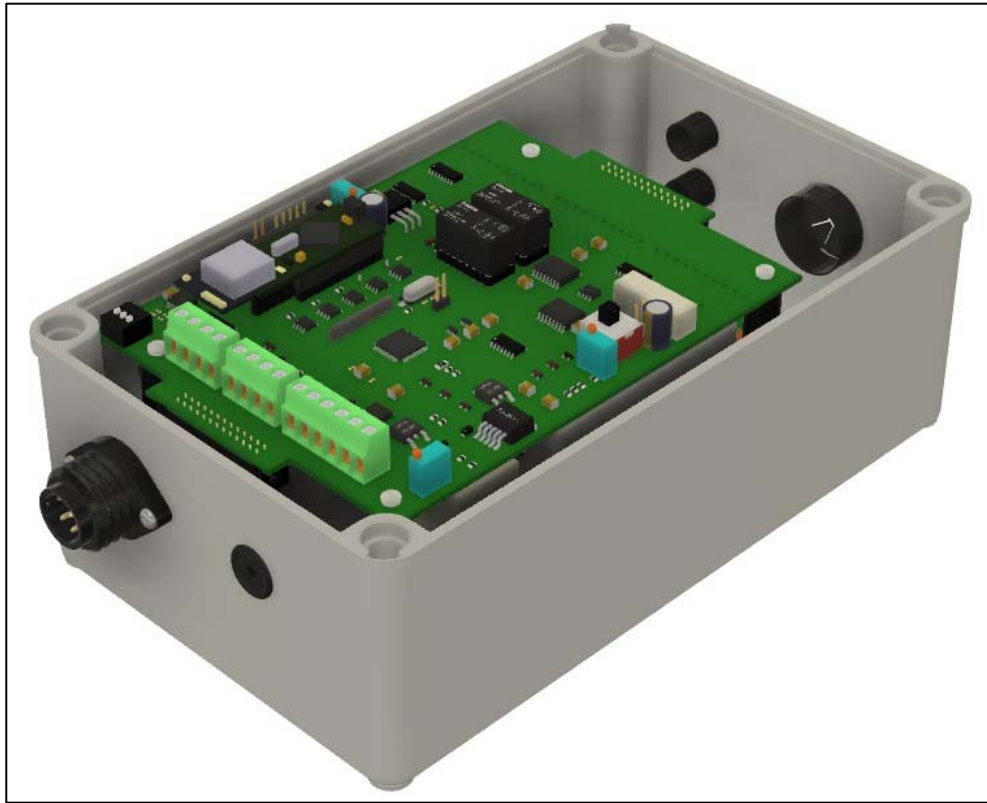
```
Raw Data in mVolts
Crk1      C1-V  C1-Z  Time  Date
2050      4045   56  14:00:00  25/01/2021
Data transfer complete.
```

$$\Rightarrow \text{Corrected Crk1} = \left[ \frac{(Crk1) - (C1-Z)}{(C1-V) - (C1-Z)} \times 4000 \right] = \left[ \frac{(2050 - 56)}{(4045 - 56)} \times 4000 \right] = 2000 \text{ mvolts}$$

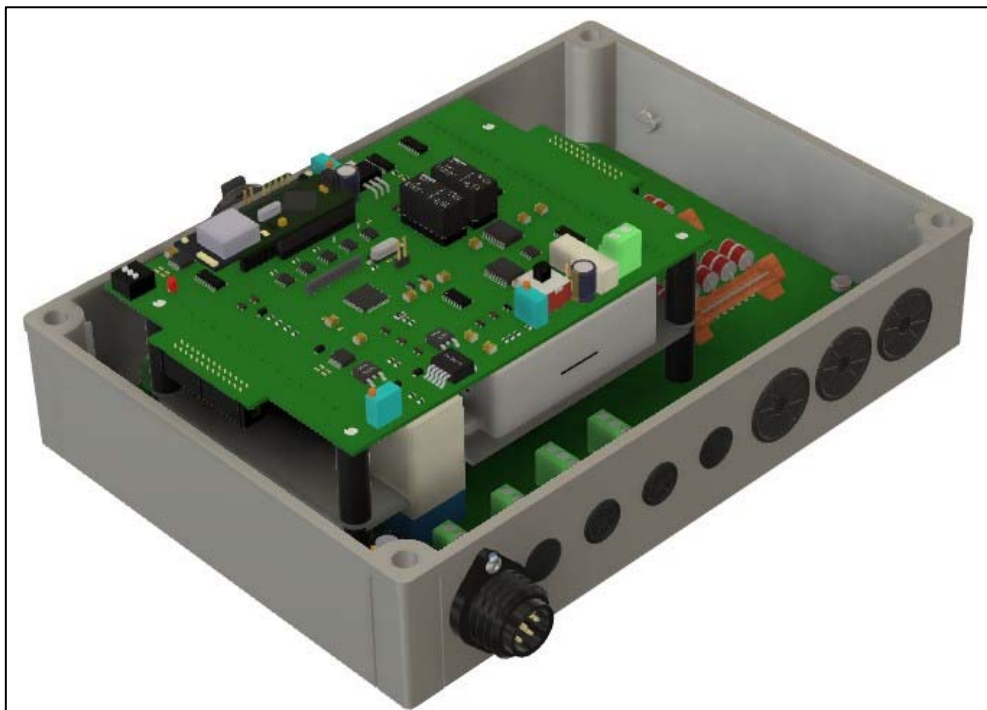
```
Data in mVolts corrected to 4.000 Volts Excitation
Crk1      Crk2  Crk3  Time  Date
2000      2006  2003  14:00:00  25/01/2021
Data transfer complete.
```

## Logger Hardware Options

Extensometer Loggers are supplied in two models – an 8-channel logger (EXL8) and a 24-channel logger (EXL24). Both loggers utilize the same measurement system and share the same connection options for configuration and data recovery. Wiring to each logger will vary slightly due to space restrictions on the smaller EXL8 case however the connection terminals are labelled identically for operator convenience.



**EXL8 Logger**



**EXL24 Logger**

# Logger Operation

---

## CONNECTING POWER TO THE LOGGER

The logger requires an external 12v DC power source, usually a lead-acid battery. The battery must be connected by unscrewing the retaining screws and removing the lid of the logger case. Connect the battery to the B+ and B- terminals on the upper board (EXL8) or the lower board (EXL24) as appropriate.

**NB Care must be taken to connect the battery using the correct polarity to avoid damaging the logger.**

## CONNECTING SENSORS

Individual sensors are connected may be connected to the logger in a variety of ways depending on the logger model supplied end-user requirements.

The logger is usually supplied as part of a larger logger system and housed in an external waterproof case. Connections are made either to an auxiliary terminal strip, pre-wired by the system manufacturer or via the cable access holes in the polycarbonate case, directly to the terminal block plugs located on the lower board of the logger.

Sensors are allocated according to the input connections shown on Pages 52 - 56 of this manual. Connections for the EXL8 variant are restricted to the INPUT 1 terminals

**NB In the Voltage Logger configuration, input signals are read in groups of eight for any selected connector. Unused input channels within a connector group should be connected to the reference voltage input (Pin 10) to remove unwanted input signal drift.**

## INITIALISING THE LOGGER

Remove the case lid, move the on-board slide switch S2 to the ON position and re-seal the logger taking care that the o-ring seal seats correctly to maintain the sealing integrity of the logger.

The Set Date & Time menu should be run at least once to set the logger to the same time zone as the connected PC.

The case need not normally be re-opened however the battery should be disconnected via the power switch if the logger is to be stored for an extended period.

## RE-CHARGING LOGGER BATTERY

The POWER terminals are located on either the upper board (EXL8) or the lower board (EXL24) of the logger. This terminal is used to re-charge the external lead-acid battery connected via the B+ and B- terminals. The battery may be re-charged using either the supplied plug-pack module or an optional solar panel connected to the SP+ and SP- terminals.

**NB Care must be taken to connect the recharging source using the correct polarity to avoid damaging the logger.**

**APPLICATION NOTE:** The internal charging circuit is designed for a maximum charging capacity of 10 Watts. If a battery that requires a charging system larger than 10 Watts is installed to supply logger power, an external regulator must be fitted between the solar panel and the battery. In this case, the solar panel would not be connected to the circuit board terminals but directly to the external regulator. Please contact your supplier if further advice is required.

Connections for this terminal are shown in the input connection table as follows: -

| Input Voltage         | POWER Terminal Block |
|-----------------------|----------------------|
| 14 volt to 18 volt DC | SP+                  |
| 0 volts               | SP-                  |

## SENSOR POWER

Normally instruments will be powered from the 4volt regulated supply available on Pin 9 of Inputs 1, 2 and 3.

A fused 12V, 150mA supply from the logger battery is available on both the main processor board and the lower extension board via the [Vo] terminal for instruments with their own voltage regulation. This supply may be either activated when the logger wakes up or left permanently powered if a link is fitted to the [OVRide] terminal headers. The impact on battery life must be taken into consideration when sensors are left permanently powered.

# Logger Input Connections

---

## Extensometer Configuration Input 1, 2 or 3

### Extensometer Connection Signal

Anchor 1  
Anchor 2  
Anchor 3  
Anchor 4  
Anchor 5  
Anchor 6  
V+ Reference  
V- Reference  
Excitation +ve  
Excitation -ve

### Logger Connection

Input \*, Pin 1  
Input \*, Pin 2  
Input \*, Pin 3  
Input \*, Pin 4  
Input \*, Pin 5  
Input \*, Pin 6  
Input \*, Pin 7  
Input \*, Pin 8  
Input \*, Pin 9  
Input \*, Pin 10

## **Voltage Logger Configuration Inputs 1-8**

### **Voltage Input Signals**

0-4V Single-end, Input 1  
 0-4V Single-end, Input 2  
 0-4V Single-end, Input 3  
 0-4V Single-end, Input 4  
 0-4V Single-end, Input 5  
 0-4V Single-end, Input 6  
 0-4V Single-end, Input 7  
 0-4V Single-end, Input 8  
 Regulated 4V supply  
 0V Reference, Inputs 1-8

### **Logger Connection**

Input 1, Pin 1  
 Input 1, Pin 2  
 Input 1, Pin 3  
 Input 1, Pin 4  
 Input 1, Pin 5  
 Input 1, Pin 6  
 Input 1, Pin 7  
 Input 1, Pin 8  
 Input 1, Pin 9  
 Input 1, Pin 10

## **Voltage Logger Configuration Inputs 9-16**

### **Voltage Input Signals**

0-4V Single-end, Input 9  
 0-4V Single-end, Input 10  
 0-4V Single-end, Input 11  
 0-4V Single-end, Input 12  
 0-4V Single-end, Input 13  
 0-4V Single-end, Input 14  
 0-4V Single-end, Input 15  
 0-4V Single-end, Input 16  
 Regulated 4V supply  
 0V Reference, Inputs 9-16

### **Logger Connection**

Input 2, Pin 1  
 Input 2, Pin 2  
 Input 2, Pin 3  
 Input 2, Pin 4  
 Input 2, Pin 5  
 Input 2, Pin 6  
 Input 2, Pin 7  
 Input 2, Pin 8  
 Input 2, Pin 9  
 Input 2, Pin 10

## **Voltage Logger Configuration Inputs 17-24**

### **Voltage Input Signals**

0-4V Single-end, Input 17  
 0-4V Single-end, Input 18  
 0-4V Single-end, Input 19  
 0-4V Single-end, Input 20  
 0-4V Single-end, Input 21  
 0-4V Single-end, Input 22  
 0-4V Single-end, Input 23  
 0-4V Single-end, Input 24  
 Regulated 4V supply  
 0V Reference, Inputs 17-24

### **Logger Connection**

Input 3, Pin 1  
 Input 3, Pin 2  
 Input 3, Pin 3  
 Input 3, Pin 4  
 Input 3, Pin 5  
 Input 3, Pin 6  
 Input 3, Pin 7  
 Input 3, Pin 8  
 Input 3, Pin 9  
 Input 3, Pin 10

## **Switched power supply from battery**

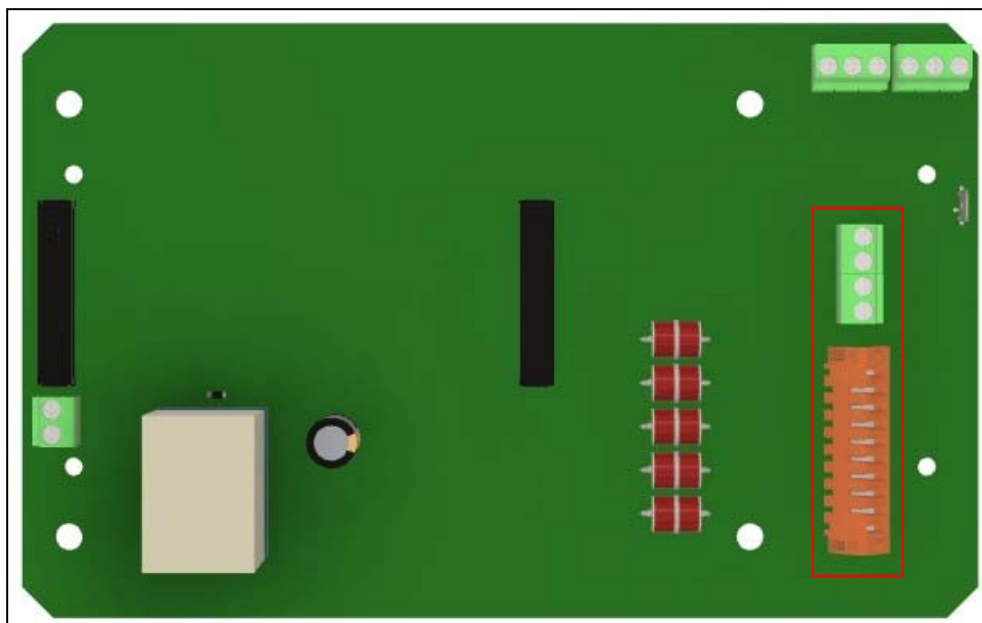
Fused 12V, 150mA supply  
 Battery -ve return line

Vo Terminal, Pin 1 (upper board)  
 Vo Terminal, Pin 1,2 (lower board)  
 Vo Terminal, Pin 2 (upper board)  
 Vo Terminal, Pin 3,4 (lower board)

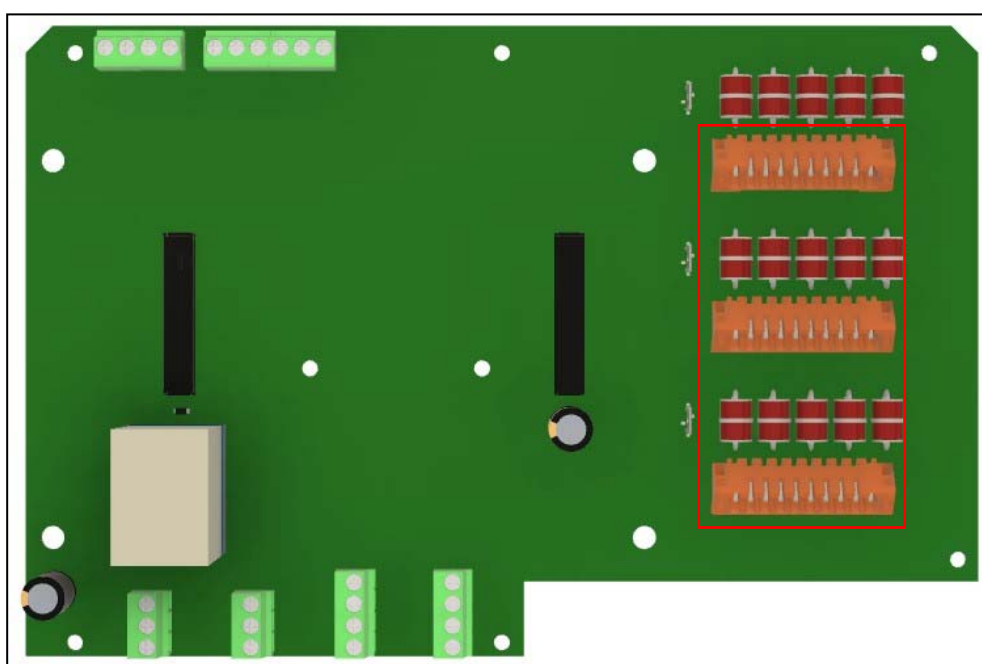
## **Crackmeter Configuration Inputs 1, 2 or 3**

| <b>Crackmeter Connection Signal</b> | <b>Logger Connection</b> |
|-------------------------------------|--------------------------|
| Crackmeter #1, Active Channel       | Input 1, Pin 1           |
| Reference +ve                       | Input 1, Pin 2           |
| Reference -ve                       | Input 1, Pin 3           |
| Excitation +ve                      | Input 1, Pin 9           |
| Excitation -ve                      | Input 1, Pin 10          |
| Crackmeter #2, Active Channel       | Input 1, Pin 4           |
| Reference +ve                       | Input 1, Pin 5           |
| Reference -ve                       | Input 1, Pin 6           |
| Excitation +ve                      | Input 1, Pin 9           |
| Excitation -ve                      | Input 1, Pin 10          |
| Crackmeter #3, Active Channel       | Input 2, Pin 1           |
| Reference +ve                       | Input 2, Pin 2           |
| Reference -ve                       | Input 2, Pin 3           |
| Excitation +ve                      | Input 2, Pin 9           |
| Excitation -ve                      | Input 2, Pin 10          |
| Crackmeter #4, Active Channel       | Input 2, Pin 4           |
| Reference +ve                       | Input 2, Pin 5           |
| Reference -ve                       | Input 2, Pin 6           |
| Excitation +ve                      | Input 2, Pin 9           |
| Excitation -ve                      | Input 2, Pin 10          |
| Crackmeter #5, Active Channel       | Input 3, Pin 1           |
| Reference +ve                       | Input 3, Pin 2           |
| Reference -ve                       | Input 3, Pin 3           |
| Excitation +ve                      | Input 3, Pin 9           |
| Excitation -ve                      | Input 3, Pin 10          |
| Crackmeter #6, Active Channel       | Input 3, Pin 4           |
| Reference +ve                       | Input 3, Pin 5           |
| Reference -ve                       | Input 3, Pin 6           |
| Excitation +ve                      | Input 3, Pin 9           |
| Excitation -ve                      | Input 3, Pin 10          |

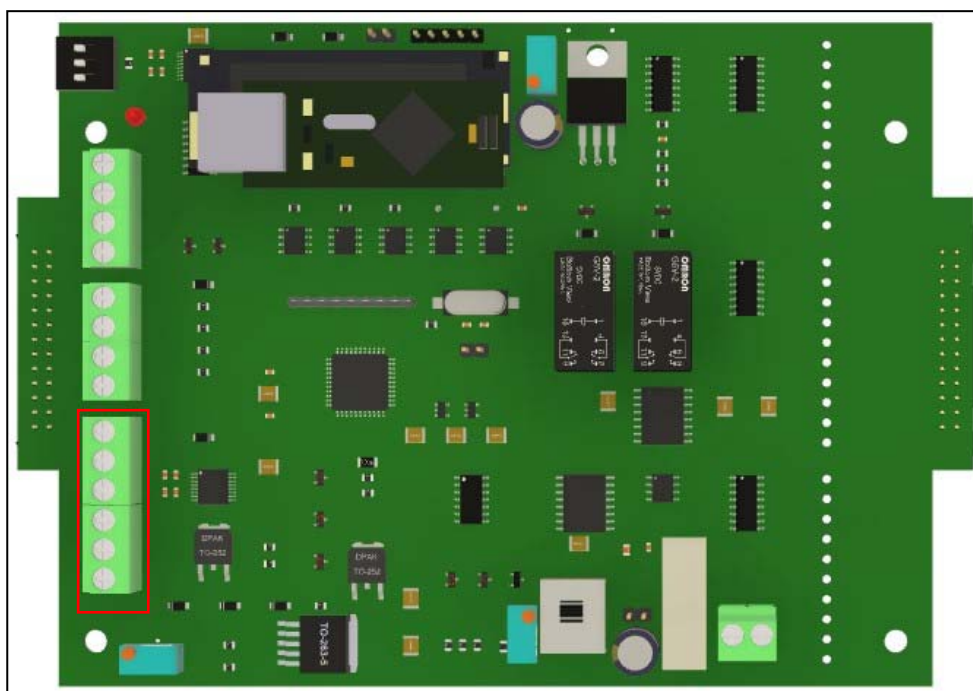
**APPLICATION NOTE:** Crackmeter data is recorded as 'Input Pairs'. e.g. if a single crackmeter is connected to Input 1, the data file will include readings for Crackmeter #2. These extra 'false' readings should be ignored, or the unused input tied to ground to force the stored readings to zero.



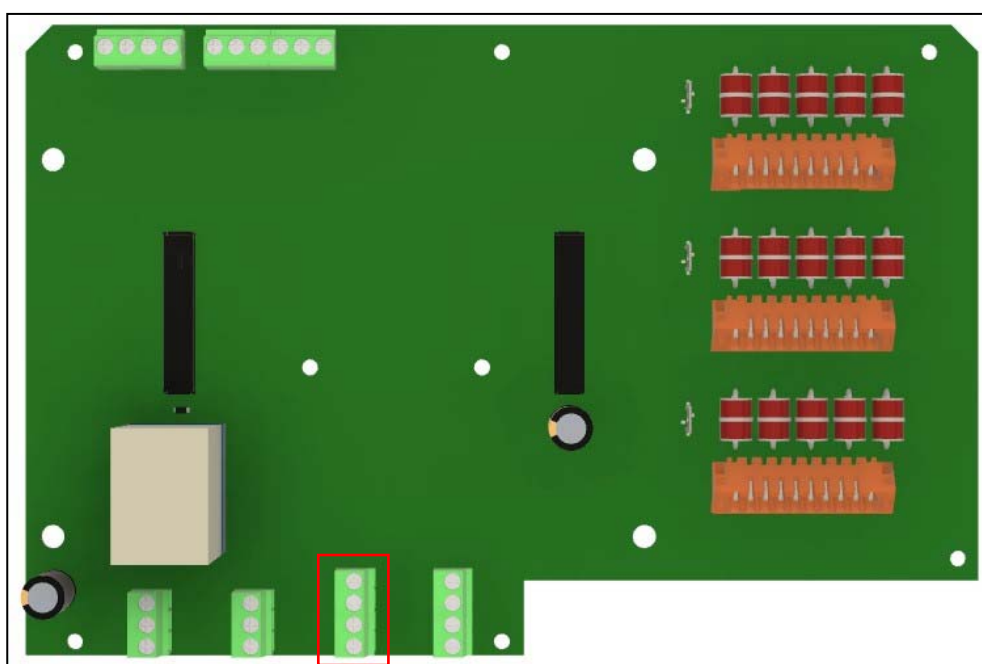
**EXL8 Signal Connections**



**EXL24 Signal Connections**

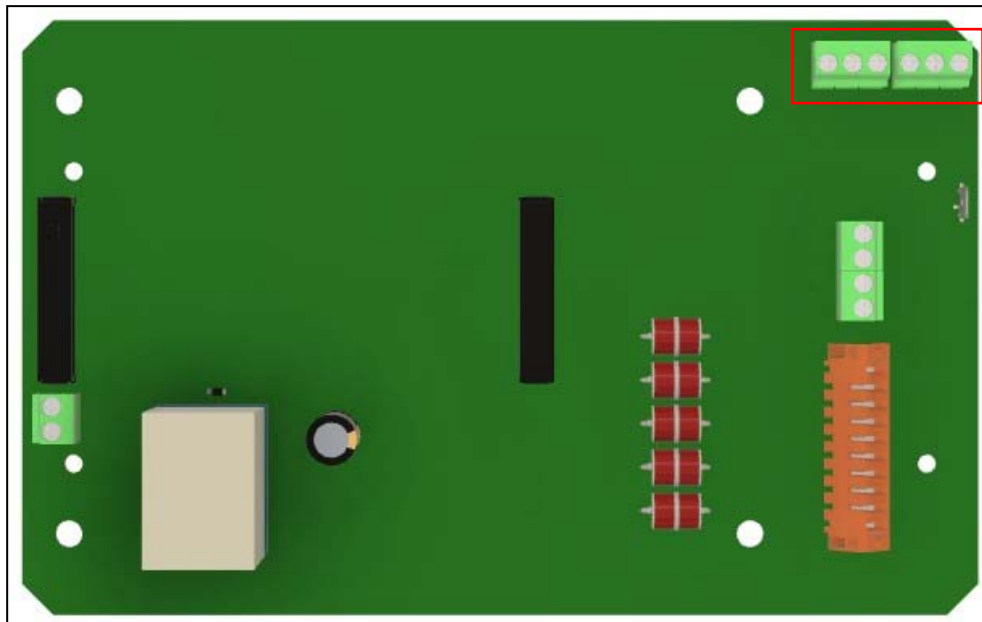


**EXL8 Power Connections**

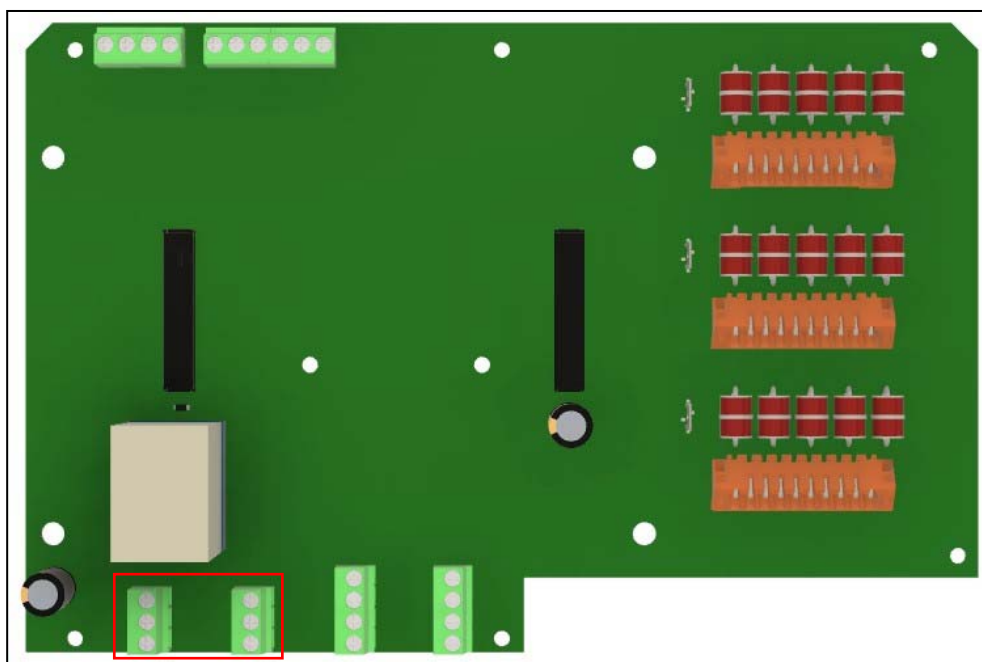


**EXL24 Power Connections**

# Logger Alarm Connections



**EXL8 Alarm Connections**



**EXL24 Alarm Connections**

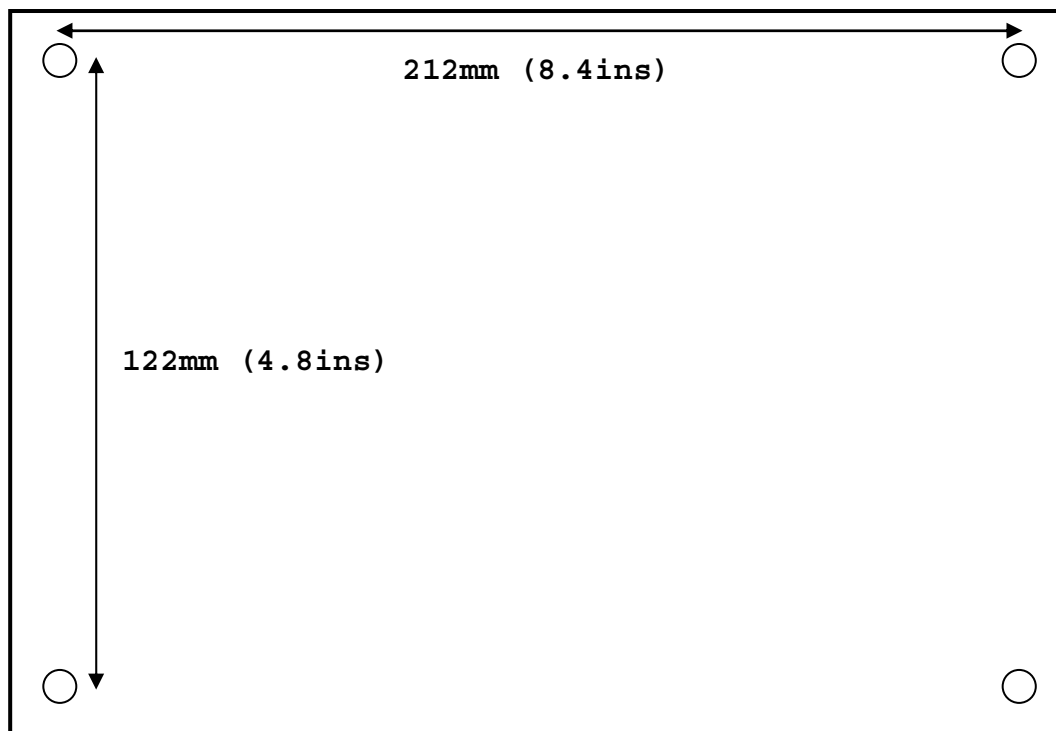
## OVERVIEW

The logger has an integrated alarm system with two terminals for direct connection of both NO and NC alarms. External signal devices requiring drive currents of up to 2A steady state may be driven from the same external battery source as the logger module. The relay is specified for maximum 30v DC switching and the alarm connection terminals are fully isolated from the power supply.

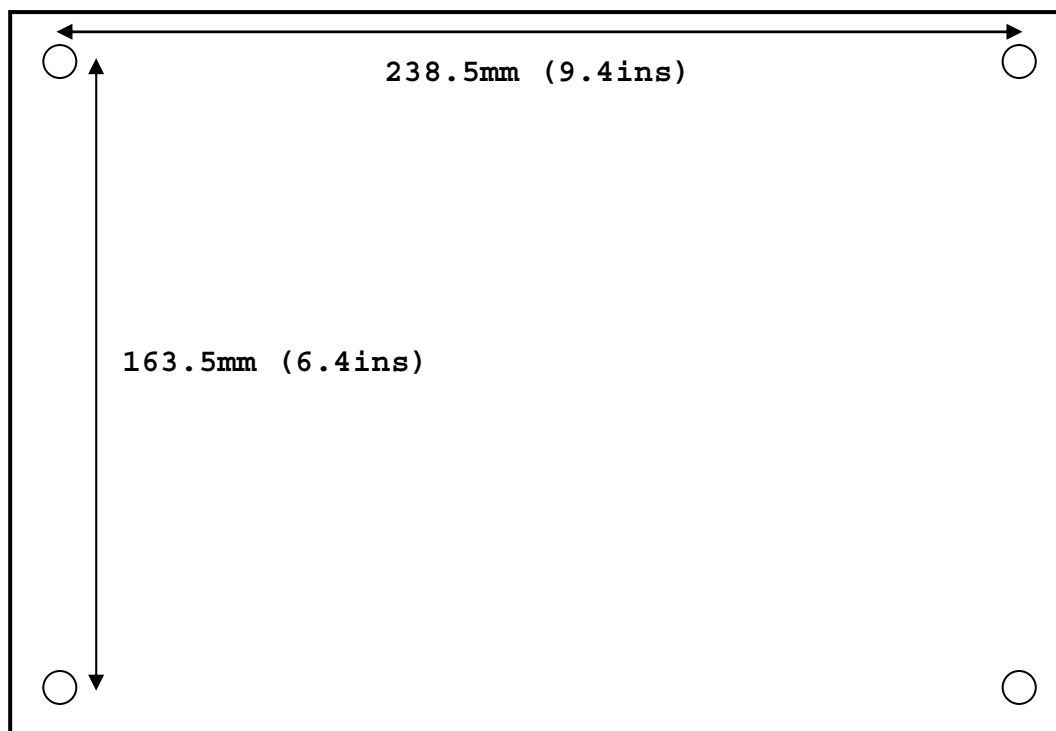
The external relay may be inhibited by a slide switch located on the main control board of the logger if the external alarm connections are not being utilised.

# Logger Case Mounting Layout

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**EXL8 Case Mounting Dimensions**



**EXL24 Case Mounting Dimensions**

# EXL8 Logger Specifications

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## PHYSICAL SPECIFICATIONS:

|                     |                                           |                |
|---------------------|-------------------------------------------|----------------|
| <b>Size:</b>        | 140mm high x 230mm wide x 100mm deep      |                |
| <b>Weight:</b>      | 1.2kg                                     |                |
| <b>Material:</b>    | Glass-filled polycarbonate with clear lid |                |
| <b>Sealing:</b>     | Dependant on supplied external case       |                |
| <b>Temperature:</b> | Operating                                 | -20°C to +55°C |
|                     | Storage                                   | -25°C to +70°C |

## ELECTRICAL SPECIFICATIONS:

|                        |                     |                                                                                               |
|------------------------|---------------------|-----------------------------------------------------------------------------------------------|
| <b>Power:</b>          | External Battery:   | Suggested minimum: Sealed Lead Acid, 12V, 1.3Ah                                               |
|                        | Supplied:           | 240V Plug-pack Charger Module                                                                 |
|                        | Option:             | 10W Solar Charger                                                                             |
| <b>Configurations:</b> | Extensometer:       | 1 instrument, 6 anchors per extensometer<br>Up to 21833 scans                                 |
|                        | Voltage Input:      | Up to 8 single-end inputs, 4V max input level<br>Up to 21833 scans with 8 inputs connected    |
|                        | Crackmeter:         | Up to 2 instruments<br>Up to 21833 scans with two crackmeters                                 |
|                        |                     |                                                                                               |
| <b>Data Logging:</b>   | Input Channels:     | Depends on logger configuration                                                               |
|                        | Excitation:         | 1 x 4v regulated plus 1 x fused 12v, 150mA per input                                          |
|                        | Resolution:         | 1mV                                                                                           |
|                        | Digital Filtering:  | 64 sample integration                                                                         |
|                        | Storage Capacity:   | Up to 21833 scans inc Time and Date data<br>(depends on logger input configuration)           |
|                        | Data Backup:        | 150 years without primary power                                                               |
|                        | Logger Timing:      | Real-time clock, non-volatile operation                                                       |
|                        | Scanning Intervals: | 1-min, 10-min, 1-hour, 6-hour, 12-hour, 24-hour<br>Manual trigger mode via computer interface |
| <b>Alarm Logging:</b>  | Logging Control:    | Global enable/disable of all alarm functions                                                  |
|                        | Alarm Scan Rate:    | Synchronised with data scan or at 1-minute intervals                                          |
|                        | Trigger Level:      | Individual channel threshold value set by operator                                            |
|                        | Trigger Sensing:    | Threshold crossed in either [+ve] or [-ve] direction                                          |
|                        | Signal Mode:        | Set by operator to either Latched or Self-clear mode                                          |
|                        | Signal Outputs:     | Integrated alarm with 2 isolated relay terminals<br>SMS alert option when a modem is fitted   |
| <b>Communications:</b> | Baud Rate:          | 9600 baud, 8 data, 1 start, 1 stop, no parity                                                 |
|                        | Data Format:        | Data (mV units), Time, Date                                                                   |
|                        | Data Separator:     | Tab/CSV separated columns, text format                                                        |
|                        | Data Recovery:      | Custom WINDOWS Interface software                                                             |
|                        |                     | USB Memory Device                                                                             |
|                        |                     | GSM Modem<br>FTP Modem<br>LoRaWAN (data pushed with scan)                                     |

|                       |                 |                                                                                   |
|-----------------------|-----------------|-----------------------------------------------------------------------------------|
| <b>Modem Options:</b> | Type:           | Intellimax+4G (GSM or FTP Modes available)                                        |
|                       | GSM Comms Rate: | 9600 baud, Non-transparent mode                                                   |
|                       | FTP Mode:       | Includes a default time window for remote bidirectional communication with logger |
|                       | SIM Card:       | Micro-SIM                                                                         |

*Cadeanco is continually improving its products and processes and as such information contained in this document is subject to change without notice.*

# EXL24 Logger Specifications

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## PHYSICAL SPECIFICATIONS:

|                     |                                                |                |
|---------------------|------------------------------------------------|----------------|
| <b>Size:</b>        | 180mm high x 255mm wide x 105mm deep           |                |
| <b>Weight:</b>      | 1.3kg                                          |                |
| <b>Material:</b>    | Glass-filled polycarbonate with smoke-tint lid |                |
| <b>Sealing:</b>     | Dependant on supplied external case            |                |
| <b>Temperature:</b> | Operating                                      | -20°C to +55°C |
|                     | Storage                                        | -25°C to +70°C |

## ELECTRICAL SPECIFICATIONS:

|                        |                     |                                                                                                           |
|------------------------|---------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Power:</b>          | External Battery:   | Suggested minimum: Sealed Lead Acid, 12V, 1.3Ah                                                           |
|                        | Supplied:           | 240V Plug-pack Charger Module                                                                             |
|                        | Option:             | 10W Solar Charger                                                                                         |
| <b>Configurations:</b> | Extensometer:       | Up to 3 instruments, 6 anchors per extensometer<br>Up to 21833 scans with a single extensometer connected |
|                        | Voltage Input:      | Up to 24 single-end inputs, 4V max input level<br>Up to 21833 scans with 8 inputs connected               |
|                        | Crackmeter:         | Up to 6 instruments<br>Up to 21833 scans with two crackmeters                                             |
|                        |                     |                                                                                                           |
| <b>Data Logging:</b>   | Input Channels:     | Depends on logger configuration                                                                           |
|                        | Excitation:         | 1 x 4v regulated plus 1 x fused 12v, 150mA per input                                                      |
|                        | Resolution:         | 1mV                                                                                                       |
|                        | Digital Filtering:  | 64 sample integration                                                                                     |
|                        | Storage Capacity:   | Up to 21833 scans inc Time and Date data<br>(depends on logger input configuration)                       |
|                        | Data Backup:        | 150 years without primary power                                                                           |
|                        | Logger Timing:      | Real-time clock, non-volatile operation                                                                   |
|                        | Scanning Intervals: | 1-min, 10-min, 1-hour, 6-hour, 12-hour, 24-hour<br>Manual trigger mode via computer interface             |
| <b>Alarm Logging:</b>  | Logging Control:    | Global enable/disable of all alarm functions                                                              |
|                        | Alarm Scan Rate:    | Synchronised with data scan or at 1-minute intervals                                                      |
|                        | Trigger Level:      | Individual channel threshold value set by operator                                                        |
|                        | Trigger Sensing:    | Threshold crossed in either [+ve] or [-ve] direction                                                      |
|                        | Signal Mode:        | Set by operator to either Latched or Self-clear mode                                                      |
|                        | Signal Outputs:     | Integrated alarm with 2 isolated relay terminals<br>SMS alert option when a modem is fitted               |
| <b>Communications:</b> | Baud Rate:          | 9600 baud, 8 data, 1 start, 1 stop, no parity                                                             |
|                        | Data Format:        | Data (mV units), Time, Date                                                                               |
|                        | Data Separator:     | Tab/CSV separated columns, text format                                                                    |
|                        | Data Recovery:      | Custom WINDOWS Interface software                                                                         |
|                        |                     | USB Memory Device                                                                                         |
|                        |                     | GSM Modem                                                                                                 |
|                        |                     | FTP Modem<br>LoRaWAN (data pushed with scan)                                                              |

|                       |                 |                                                                                   |
|-----------------------|-----------------|-----------------------------------------------------------------------------------|
| <b>Modem Options:</b> | Type:           | Intellimax+4G (GSM or FTP Modes available)                                        |
|                       | GSM Comms Rate: | 9600 baud, Non-transparent mode                                                   |
|                       | FTP Mode:       | Includes a default time window for remote bidirectional communication with logger |
|                       | SIM Card:       | Micro-SIM                                                                         |

*Cadeanco is continually improving its products and processes and as such information contained in this document is subject to change without notice.*