Master Controller
for
ACE Station Network

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L.MAN-ACEMASTER

CONTENTS

SECTION 1 INTRODUCTION

1.1 Equipment List

The ACE Master Controller (Central Control Box) is supplied complete with the following items:

ACM-050	Installation kit	(See Appendix 8 – Spares and Accessories)
ACM-086	mains supply lead 2m	
SKF-128	Spares kit	(See Appendix 8 – Spares and Accessories)

1.2 Description

The ACE Master Controller consists of a waterproof box which can be fitted with 'U' brackets or flanges to either a pole in the ground or a tripod, or a vertical surface or just rested on the ground. (See Diagram on Page 4). The box is a painted steel electrical enclosure 40x40x20cm with a hinged door incorporating a rubber seal. The hinged door may be opened by a removable knob which is supplied loose (This is a useful security function making it difficult to open the door without the knob).

The inner surface is sealed against splashes but care should be exercised to prevent water entering if the door is opened during rainy conditions as this could an electrical hazard.

Use it only as specified by the operating instructions or the equipment's intrinsic protection may be impaired.

To clean the internal front panel/display use only a dampened cloth. Do not use aggressive cleaning agents. Do not allow the internal assembly to become wet, which might affect safety insulation.

There are no user serviceable parts inside.

In a typical network system, the Master is used as a central point to download data, configure the stations, monitor their status, and supply them with power from an internal mains power supply with an optional battery backup with 1 or 2 batteries. The two batteries are linked with resetable semiconductor fuses so that a battery can be swapped without excessive current flow.

Ordinary PCs and other computing devices are not designed for use in the same environment as the Master; if they are used to configure the Master or download data from it, they must be protected to prevent any possible safety issues.

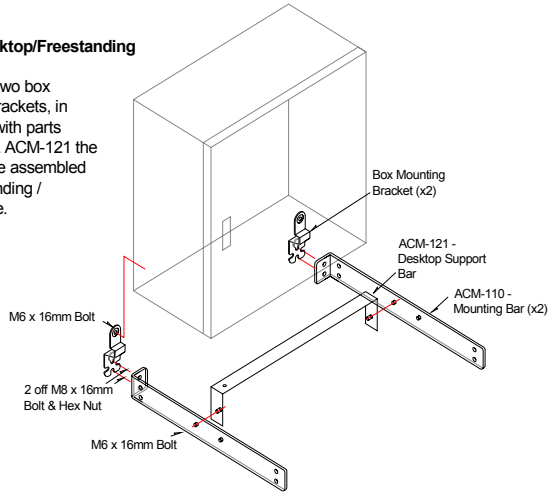
With the door open, the keyboard, a 240x64 dot LCD graphics display and two Compact Flash (CF) card sockets are accessible.
The lower surface of the box carries a panel holding the following connections and sockets:-

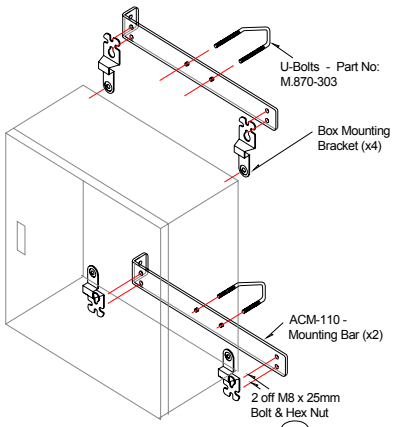
AC IN	Consists of a short flying lead with 3-pin plug for mains power.
DC IN	4-way plug for connection to two batteries.
12V OUT	12Volt 0.5Amp automotive accessory outlet socket.
RS232	9-pin "D" type socket for Serial communications to a PC

Analogue 15-way “D” type socket (auxiliary socket for future use)
USB USB socket (for future alternative to RS232)
Numbered 3-pin sockets for connecting to the ACE Stations. (The Station sockets are supplied in groups of 10 up to a maximum of 30). (See also Section 2.3 – Retrofitting additional Interface boards).
The Master (central control box) can control the assays of a network of up to 30 ACE Stations (chambers) and log the results. Communication with the stations is via a serial FSK modem, a sinusoidal signal being superimposed on the power lines.

Setup A - Bench/Desktop/Freestanding

Using only two box mounting brackets, in conjuction with parts ACM-110 & ACM-121 the AMC can be assembled for free standing / desktop use.



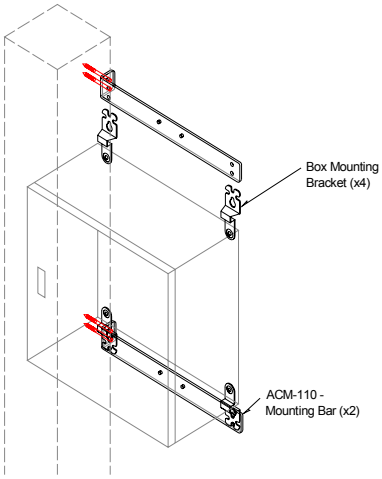


Setup B - Pole / Tripod mount

Using all four box mounting brackets, in conjuction with parts ACM-110 & M.870-303 (U-Bolts) as shown the master controller assembly can be mounted on a secure post or tripod. Ideal post diameter 50mm.

Setup C - Wooden Fence Post / Wall setup

Using the same bracket assembly as setup B but without the U-Bolts the AMC can be fixed to a wooden post or wall using suitable woodscrews (not provided).



SECTION 2 INSTALLATION

2.1 Placing the ACE Master Controller box

The ACE Master Controller can be mounted to a vertical pole or square section post, a horizontal pole or can be freestanding.
The four pressed steel brackets are attached with their full hole to the rear corners, with the top ones pointing up and the bottom ones pointing down. The brackets should be arranged so that their mounting face, with the two slotted holes, is behind the back face of the box. Attach them to the box using the four M6 x 16mm stainless steel bolts provided. The screws fit into the four captive nuts in the back corners of the Master Controller box. Note that these nuts are blind (ie. they do not have a through hole), so that the box is weatherproof. Users must therefore ensure that the correct length bolts are used. If the bolt is too long it will "bottom out", causing the bracket to be loose. If the bolt is too short it may compromise the strength of the mounting.

Vertical pole mounting (See set-up B in diagram opposite)
The vertical pole needs to be nominally 50mm (2") in diameter.
Once the brackets have been attached to the box fit the straps to the brackets using the M8 nuts, bolts and washers provided, horizontally across the back, with the top strap above the top of the box, and the bottom strap lower than the bottom of the box.
The straps can then be attached to the pole using the "U" bolts & nuts provided.

Vertical square section post mounting (See set-up C in diagram opposite)
This is an alternative arrangement whereby either the left or right rear edge of the box can be attached to a vertical square section post. This is be done by attaching the steel straps so that they both have their angled ends on the same side (left or right). The brackets and straps are attached to the box in the same manner as vertical pole mounting above but attachment to the post is by using bolts or screws passed through the ends of the brackets rather than by using the "U" bolts.

Horizontal pole mounting
Since the corner fixing holes at the back of the box are on a square, the whole mounting arrangement may be rotated by 90 degrees with respect to the box to accommodate a horizontal pole (or indeed a horizontal post).

Freestanding mounting (See set-up A in diagram opposite)
Another mounting arrangement, mainly intended for laboratory use, is to attach the ends of the straps to the bottom brackets only so that the straps protrude forwards on their edges. The straps are then tied together, and the bottom of the box supported, by the tie strip provided. The box and straps will then stand on a bench top with enough clearance underneath for cables to the connection panel and for mains power. However, there is insufficient clearance for the 12V battery connector whose housing is longer than the other connectors. If this needs to be connected we suggest that spacer blocks should be placed under the straps to avoid possible damage to the connector.

2.2 Connecting the ACE Master Controller to the mains

The ACE Master Controller should be powered up before making any connections to the ACE Stations. Power can be supplied either from the mains or from battery(s) or both.
Switch off the double pole mains switch at the left side of the enclosure with the door open, when changing positions or connecting /disconnecting power to the AMC.
The Master Controller has a short flying lead provided for mains connection with a waterproof connector on the end. A mains lead of about 2m is provided in the spares kit (See Appendix 8 – Spares and Accessories) with a suitable mating connector on one end and unterminated at the other end. Before completing the installation it is necessary to fit a connector matching the country (weatherproofed if required).
If a longer mains lead is required the waterproof connector has screw terminals and may be removed and attached to a longer cable which the user must supply.
Use 0.5mm^2 cable for lengths up to 2m. Otherwise the cable should have a CSA of 0.75mm^2 minimum.

The AMC mains supply is designed for overvoltage CATll, which means deriving a supply from a building installation. It is not a good idea to take a 240V supply from an overhead power supply line which may have much larger transients present than typical at a socket in a building. These may damage the safety insulation in the power supply. Also there must be a disconnector and overcurrent protection in the installation. The AMC must only be connected to an earted (grounded) mains supply.

The choice and positioning of the cable should take into account operating temperature range (standard PVC has reduced performance as an insulator in the cold and wet); the effects of UV on some insulation materials; mechanical damage due to traffic or impact.

If the master is repositioned, a safety related inspection of the system should be made. This would take the form of visually inspecting the unit for water/dust ingress and damage and inspecting with special care, the mains lead and ensuring the continued compliance of the protective earth system. This should be followed by a "PAT" test. These activities should only be undertaken in a service area (not outdoors) by a competent person.

If parts affecting safety are removed, then such maintenance must be followed by an earth continuity and dielectric strength test to EN61010-1 annex F.

The maximum mains power requirement is 250W, which will be needed if the master is connected to external batteries which are discharged. The corresponding current will depend on the local supply voltage. For 230V supplies, the maximum current will be 1.1A, for 110V supplies it will be 2.3A.

A DC supply lead (Part No ACM-085) suitable for connecting up to two batteries is available (See Appendix 8 – Spares and Accessories). It connects to the "DC IN" socket and allows for a change of battery without losing supply as well as increased capacity.

Lead acid batteries produce explosive gases when charging and on over-discharge. If you site your batteries in an enclosure ensure it is correctly ventilated

2.3 Connecting the ACE Master Controller to the ACE stations

Each Interconnection lead (Part No M.ACE-079, M.ACE-080 or M.ACE-081) from the ACE Stations should be fitted with the label supplied and the label numbered to match the respective power output (Port) on the bottom of the ACE Master. Ports correspond to sockets (connections to Stations), and are numbered 1 through 30. The master is configured with 10, 20, or 30 ports at the time of ordering.

Each station, after it is connected to the Master, should have its battery switch put to the ON position, but left switched off from its front panel. This is suggested because potentially each ACE Station's small internal battery could be flat which will take a high, although limited, current for a short time.

If all the ACE Stations were connected prior to the ACE Master Controller being powered up the Master Controller may go into current limit itself whilst trying to satisfy this burst of current. Although this would not do any harm it may be disconcerting for the user.

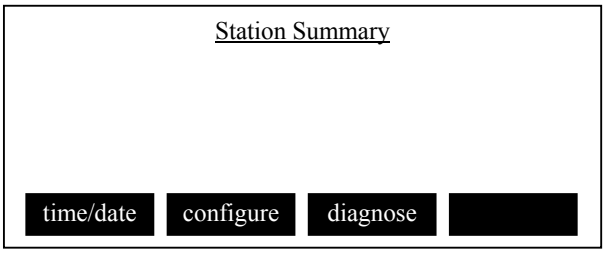
The master has internal circuitry to protect against over-voltage transients on the power lines. If this trips, the result will be a blank screen, and may occasionally occur on power-up or a major power transient. To reset the circuit, disconnect any batteries, switch off the mains, wait 10 seconds, and reapply power.

Once all the Station connections have been made and the Master Controller powered up a configuration is required to detect the Stations. This can be done by pressing the configure key.

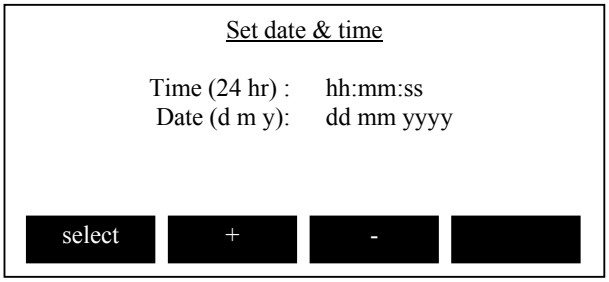
It is recommended that the front door knob is removed and stored safely or secured with string through the small hole at one end of the bar. If left on, it can become loose by, for example, high winds.

2.4 Setting the Date & Time

On receipt of your ACE Master Controller the date and time will have been set to either GMT (Greenwich Mean Time – now known as Universal Time) or BST (British Summer Time); the latter being GMT + 1 hour.



The Master will probably need to have its date and time set to suit its locality.
To do this, press the PAGE key to reach the settings page. Press the time/date key then press the select key to select each component of the date & time in turn, using the + and - keys to change each value in turn. Note that the seconds go to zero when changed.



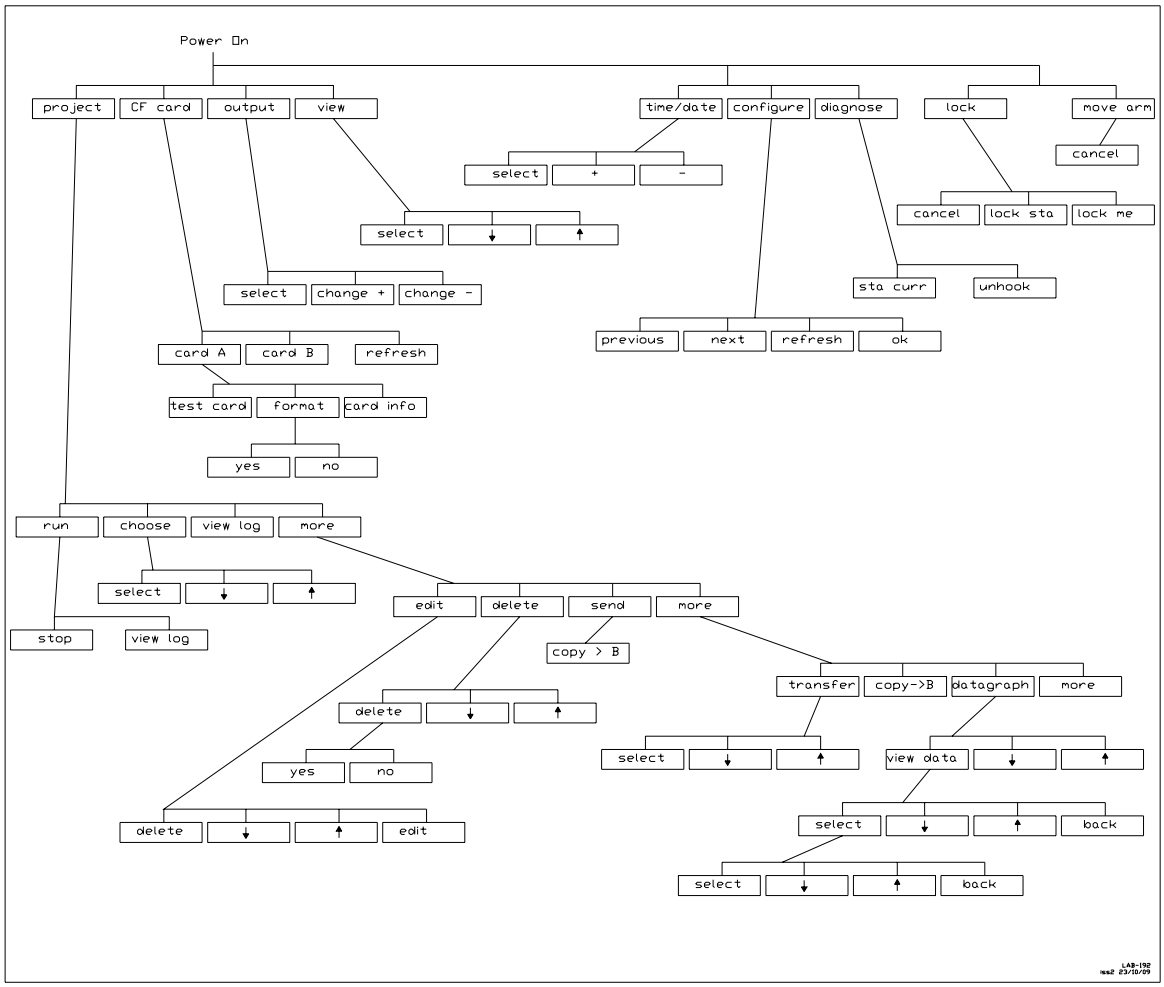
2.5 Security

In order to protect the ACE Master Controller's project programming and Station configuration(s) from unauthorised alteration the front panel may be locked with the key sequence lock lock me. If the front panel is locked, a 'pin' needs to entered before the Master's program can be accessed.

The pin is fixed to be adcb.

Note however that if **ALL** power is temporarily disconnected, the Master keyboard will return to an unlocked state.
The Stations can also be locked from the Master Controller by pressing lock lock sta

Menu Tree



V2.0

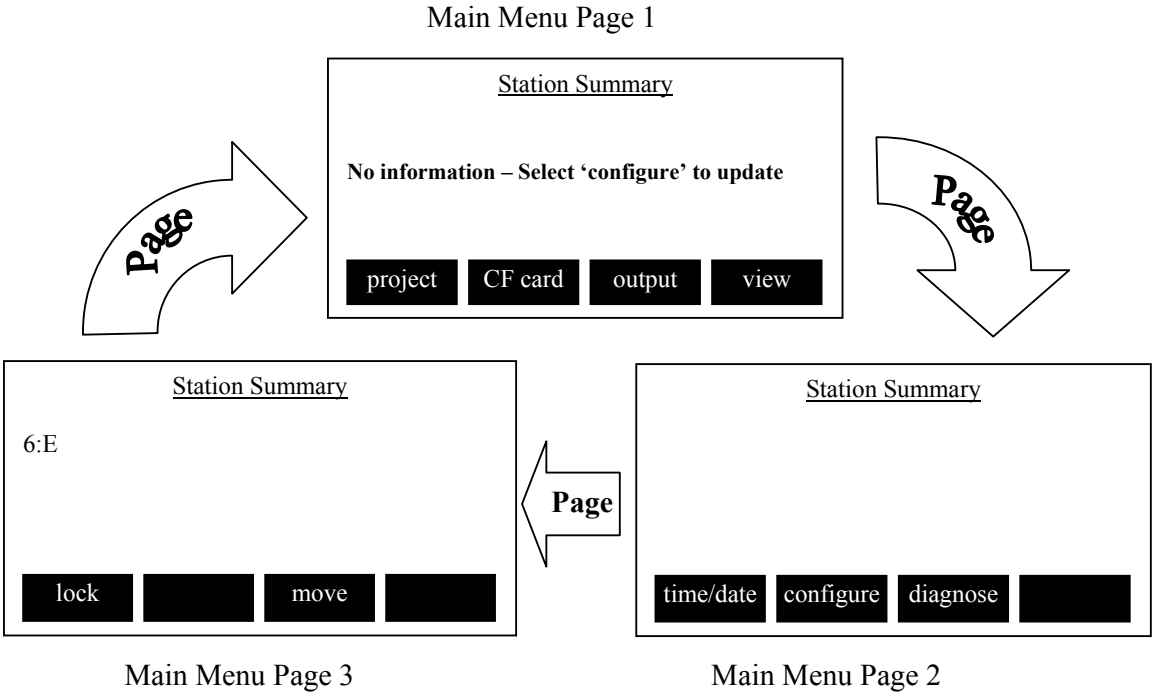
SECTION 3 SOFTWARE OPERATION

The ACE Master Controller's software operation is similar to that of the ACE Stations, consisting of a menu system with a PAGE key and 4 'soft' keys. Note however, that there is no on/off switching via these keys. A separate switch is provided if operated via the mains but if operated from the DC input there is no switch.

The user can cycle between the main pages: main1, main2 and main3 by pressing the PAGE key. The PAGE key also acts as a terminator (i.e. select an item by highlighting it then pressing PAGE to exit the current sub-menu page).
On some menu pages there is also an OK button, this is because it is possible, on these pages, to highlight several different things and action them in turn, before leaving the page. Only the item being highlighted can be changed, e.g. a numerical value, or the units of a value.
The PAGE button is not a 'soft' key and is used only to exit from the current page being displayed.

See the menu tree opposite for how the functions flow together.

If the software locks, pressing the PAGE key and the left hand two keys all together will generate a hardware reset on the processor. The time and date will not be affected.



SECTION 4 OPERATION DESCRIPTION

The ACE Master Controller initiates assays on each ACE Station according to a sequence file (.SEQ) (See Appendix 1 – Scheduled Event (Sequence) File Format). This file contains assay instructions for a 24hr period. The instructions are then repeated indefinitely each day until terminated by the user.

Each command will initiate an assay on between 1 and 30 of the Stations. After each assay is initiated the Station is polled for assay completion and the results uploaded and logged. Each Station is communicated with individually; therefore those Stations due to start an assay at the same time will be communicated with in turn in the order of their port number.

Note that the sequence file only initiates assays, the assay parameters are defined on each Station. These parameters can be modified from the ACE Master Controller or at each Station.

The sequence file is one of 4 files associated with a project, the others being a configuration file (.CFG) which contains the assay parameters, the data file (.TXT) and log file (.LOG) which contains a history of the project. Further details can be found in Appendix 5 Project Files.

Facilities available to the user are:

1. Synchronise time and date of all Stations.

2. Set measurement interval for each Station using sequence file software.
   (Note that each Station may be different, and may not be constant, .)

3. Logging data from the Stations to the Compact Flash card.

4. Load, edit and run sequence files which control the timing of measurements. (Sequence files are used to initiate assays of Stations; they do not define the assay parameters).

SECTION 5 CONFIGURING THE STATIONS

5.1 Interrogation

When the Master Controller is powered up the number of connected stations is unknown. In order to make a search for any connected stations press the configure key upon which a list will be made. This list is displayed on the config screen page and shows all the Stations which are available, identified by their port number. It will take a while for this list to be built due to the time it takes for the serial communications.

Each Station is identified by a port number followed by 1 or more letters the code of which can be seen in Appendix 2 – Port Number Codes.

Ports which have no connection to them are not shown. If a Station is unplugged after the list is built, the Master will be unaware of this until it tries to issue the missing Station with a command. To get the on screen list updated after Stations have been added or removed, it is necessary to use PAGE, to go back one menu level then press configure/refresh which will rescan the stations and detect if a Station has been added or removed.

Configure also updates all connected stations with the Master Controller's current time and date.

The Master Controller recognizes whether Interface boards supporting ports 21 to 30 and 11 to 20 are installed and will count down from the highest port available to it. The Master Controller asks each station for its settings, and saves them to RAM. This may take a few minutes, during which time a pop-up box "Updating Station information, one moment please… calling station" will initially appear with the port number of the Station currently being communicated with. During this time, as stations are detected, they are displayed, so the list will get bigger in real time until number 1 is reached.

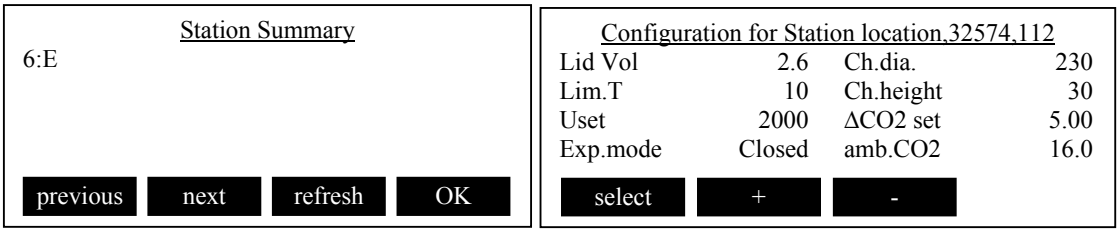
5.2 Configuring a Station

The following parameters can be selected and edited. When the settings have been changed as needed, and configure is pressed, the parameters are transmitted back to all the Stations which were selected.
If a modified value of LimT is transmitted, the Station period is changed to 0.

Experimental mode	Open, OpenZ, Closed, ClosedZ
Lid volume	litres
Chamber diameter	millimetres
Chamber height	millimetres
LimT	minutes
Uset	µmols s^{-1}
DeltaCO2set	
ambient CO2	mmols m^{-3}

To alter a Stations configuration from the Master Controller go to the configuration menu by pressing the configure key on the second top layer menu.

Press the previous or next keys until the Station of interest is highlighted then press OK to select it. The current settings of the selected Station will then be displayed.



Press the select key to highlight the parameter to change and then the + and - keys to change the value. When satisfied press the OK key. The Master will then update the chosen Station with the new details.
More than one parameter may be selected and changed in this way, and will be uploaded to the selected Station when the PAGE key is pressed. During the update process which may take a noticeable time, the message “sending data please wait” will pop up.

The configuration data that has been changed is added to the CFG file on the CF card and date/time stamped.

5.3 Storing Station Configurations

It is not practically possible to track a Station if it has been transferred to a different socket between projects runs. For this reason the Stations are not routinely programmed with a configuration prior to an assay. Instead, each actual Station configuration is read and stored in the configuration file at the start of each project run.
Thus the Master Controller does not keep a record of the Station configuration (or changes to it) unless a project is actually running.

Provision is made to view and change Station configurations from the controller as shown in Section 5.2 – Configuring a Station. Changes can be made while a project is running, providing the Station is not busy at the time. Any configuration change is logged, and recorded (with date/time stamp) in the configuration file.

Stations are locked during a project run to prevent undetected local changes to the configuration.

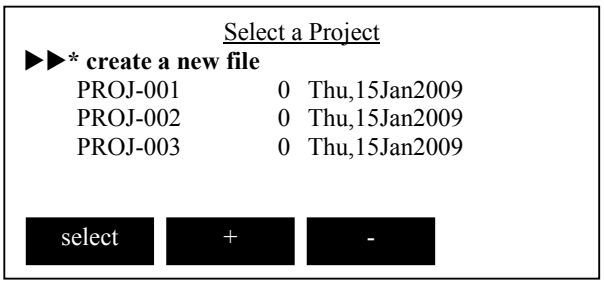
Pressing the move arm key has immediate effect on the Station selected by opening and closing its arm. This enables the operator to visually identify which Station is which.

It may take up to 70 seconds for the arm to move, and after the command has been cancelled, there may be up to 3 further arm movements before it actually terminates.

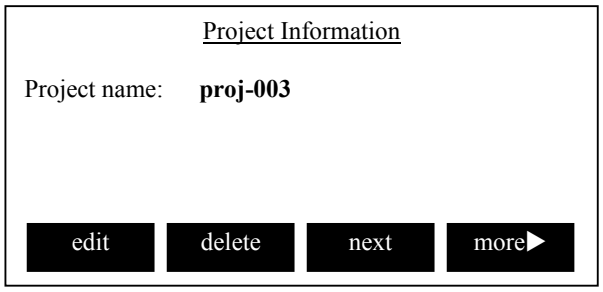
SECTION 6 PROJECT CONTROL

The ACE Master uses projects to run a series of assays on an ACE Network. An explanation of the associated files may be found in Appendix 5 Project Files.

6.1 Creating a Project



To create a new project go to the project menu by pressing the project key on the first top layer menu. Press choose and select "*create a new file*" option. A default file name will then be generated in the form "*proj-nnn*" which can be modified as required. (The nnn part of the file name is automatically incremented by one each time a new project is started and prior to any manual changes made to it by the user).



Pressing the ▶ key moves the cursor to the next character in the file name.
Pressing delete deletes the character under the cursor.
As each character is selected it can be changed by using the ↑ & ↓ keys to scroll through the alpha-numeric set (which includes the dash sign)
Note that this name is limited to 8 characters.
After accepting the file name there is an option to either generate a new sequence file or to copy one from a previous project. Either way you end up in the edit menu. See section 6.2

Upon starting a project run, after the Stations have been polled, a warning is given if nothing is connected to ports referenced in the sequence file (i.e. missing Stations), or if a port is connected, but the sequence does not address it (unused Stations). This gives the user the chance to correct any connection errors. Missing Stations cause an error to be written to the log, but do not otherwise affect the project running.

The master will only collect date for assays that it has initiated. If you manually get a station to do an assay, the data will not get stored in the master, and it also will not get stored in the master if the station does its own timed assay. These locally produced assays can be stored locally if a CF card is fitted.
The master takes no notice of the period that you set at the station. The Master will ask the station to do an assay whenever the sequence file says to. If the station also has a period set, it will also do its own assays, and then things will get busy and confusing. So it is best normally to have the station period set to zero.

6.2 Editing a Sequence file

Sequence files refer to ports, and so the linking of sequence file entries to a given Station relies upon the socket used remaining the same.

To edit a sequence select more edit from the project menu. This brings up the edit menu where the up and down arrows may be used to select either a step to modify or a new one. Press the edit key and navigate the edit screen with the previous and next keys. Adjust the selected parameter with the + and – keys. Once adjustment is made press the PAGE key to return to the upper level and alter any other steps as required. A step may be deleted with the delete key. When this page is exited with the PAGE key a confirmation screen will appear and the changes saved.

Note that sequence files can be edited on a PC with a text editor. See the file format information in Appendix 1 – Scheduled Event (Sequence) File Format.

6.3 Running a Project

To run a project go to the project menu by pressing the project key on the first top layer menu and then press run. The sequence file for the project will then start at the next scheduled event within the 24hr cycle and continue indefinitely until the stop key is pressed. On power up the logging shall default to the previously set project name and it will append to the last data file used. The project must be stopped before data is transferred or any other activity is performed.
Card B is reserved for copying only. Project files are run from card A.

6.4 Station Summary

This screen lists the stations which are connected and their status eg busy (see appendix 2)
The screen is only updated when the user presses the refresh key.

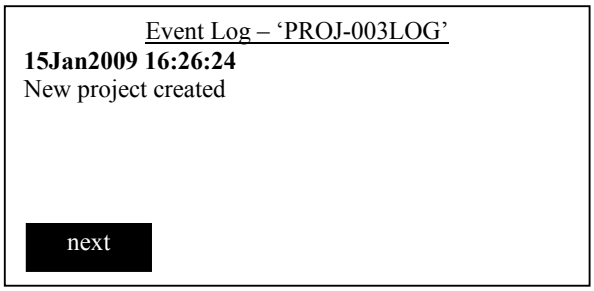
6.5 Data Collection

Data collected after each assay is as shown below.
These are saved in 2 files, the configuration and data files, as the headings below imply.
List of parameters that are logged for each Station.

Config file	Data (TXT) file
Date	Date
Time	Time
Station port number (1-30)	Station port number
Lid volume	Cref
Limit assay time	PAR
Flow (for open mode)	NCER
Experimental mode	Temperatures 1 to 6
Config (O,OZ,C,CZ)	Moistures 1-to 4
Chamber diameter	Line current (not fully
Chamber height above ground	implemented)
CO^2 delta set	Comment error codes

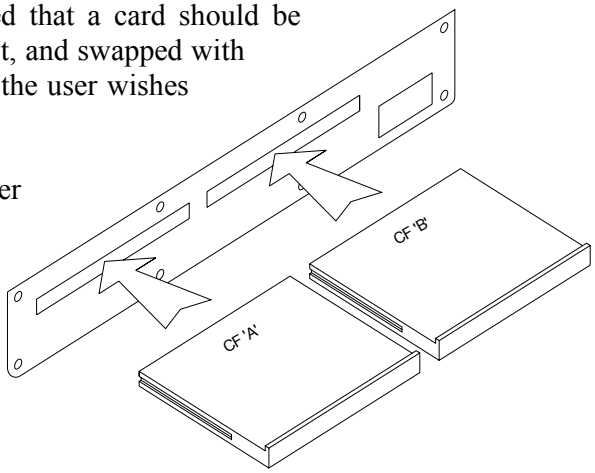
6.6 Viewing a Project Log File

Use view log from the project menu to step through the log file which lists operations of the project.



SECTION 7 COMPACT FLASH FUNCTIONS

Compact Flash cards must be fitted with the lip and plain label upwards as shown. Do not attempt to fit them with the lip down. The A card is for saving data and the B card is for copying to. It is intended that a card should be permanently fitted in at least the A (left) slot, and swapped with an empty one or copied to the B slot when the user wishes to collect data.



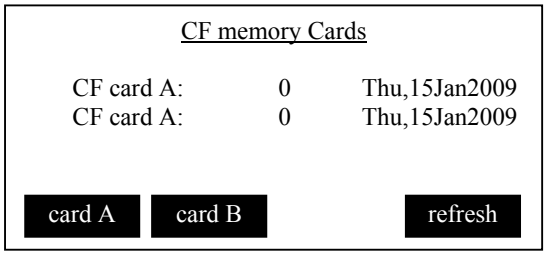
Pressing the CF-card key on the first top layer menu gains access to the compact flash functions menu. From here the cards may be tested, formatted and card information obtained. First the A or B slot must be selected and then the function selected. A red LED will glow through the front panel, above a CF card slot when it is being accessed.

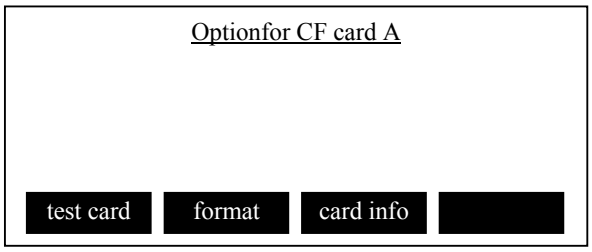
Do not remove a card while the software is accessing it, for example during a format, or when the card's size is being determined just after insertion. If the card has an untimely removal, the software will lock. To restart the processor, press the PAGE key (on the right) and the two left hand keys simultaneously.

The file operations are DOS compatible and so can be read on a PC. Note however that it doesn't allow for directories and a card with directories on may not work. If in doubt format the card under the CF-card menu.

N.B. If a card is formatted all the data on it will be lost. A message to that effect will be displayed when the format key is pressed asking for confirmation prior to formatting proceeding.

Some card types are prone to causing the software to lock.

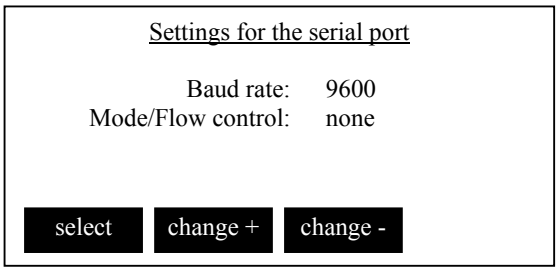




SECTION 8 SAVING PROJECT AND DATA FILES TO A PC

There are two methods to save data to a Personal Computer (PC).
The first method is to copy the data to a second CF card which can be subsequently read in a PC. The second method is to transfer it over a serial link.

In the first method a CF card should be placed in socket B (right hand socket) and then press more send copy>B (available when a project is stopped). This will copy all the project files from the currently selected project. Most modern PCs have CF card readers and if not they may be purchased for modest sums.



In the second method a serial connection must be made between the ACE Master Controller's RS232 socket (located on the bottom of the box), and the PC using a straight-through 9-pin plug to 9-pin socket cable. The RS232 settings on both the Master and the PC must be the same. The settings on the Master can be changed on the output menu.

The serial transfer menu can be found at project more more transfer . After selecting the project to transfer, a menu is shown giving the options of files to transfer and transfer protocol. If all project files is selected then only the Y-modem-batch transfer method is available. Note that the mode/flow control is always forced to none when the X-modem and Y-modem protocols are used.

HYPERTERMINAL[tm] may be used as the serial transfer program on a PC running a WINDOWS[tm] -based operating system. Otherwise a Terminal emulator will be required. Further details on setting up HYPERTERMINAL[tm] may be found in Appendix 6 – Setting up HYPERTERMINAL[tm].

APPENDIX 1 Scheduled Event (sequence) File Format

NOTE: For the benefit of European users, who use comma as a decimal place separator, files are saved in TAB separated format. On loading a schedule file the ACE controller will accept files using either comma or tab delimited formats.

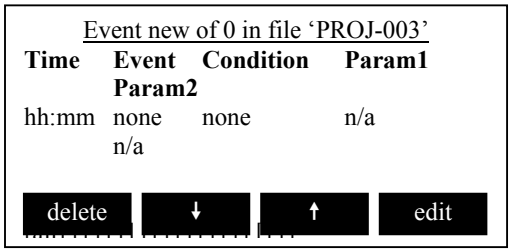
The saved file consists of a tab-delimited text file.
Each line in the file corresponds to a single timed event, except for lines that begin with a '#' character which are considered to be comments and so are ignored.

When a file is saved, comments times, names and conditions will be output in a standard form, and unnecessary spaces removed.

There is no requirement for the events to be in any particular time order. When the controller saves a file it is sorted by time, so that the event with the latest time is the last in the file.

Where there are two or more events specified with the same time, the controller will use only the first line, discarding subsequent time duplicates.
Time duplicate entries may be lost if the file is copied or edited.

The controller has a maximum capacity of 99 events. Surplus events are discarded when the file is loaded.



The format of an event in the file is as follows:

hh:mm<t>**name**<t>**station_map**<t>**conditions**<t>**param1**<t>**param2**<t>**note**

Where the fields, each separated by a single tab character (<t>), are:

hh:mm Is the time of day in hours and minutes that the event should occur, using the 24 hour clock. There may be (event specific) restrictions on the minimum time between successive events.
The time can also be specified in minutes since midnight, by omitting the colon (this is the form used internally).
Spaces are not allowed, but zeroes are optional.
e.g. these times are equivalent (to 7 AM) and valid:
'07:00'
'7:0'
'7:'
'420'
As are these, which all specify midnight:
'00:00'
'0'
':'

name Specifies the name of the event to perform. The name can be in upper, lower or mixed case, but it cannot be abbreviated. A name may contain up to 7 characters, excluding any leading & trailing spaces and the tab separator. Leading and trailing spaces will be discarded. If the name is not recognised, no action is taken and the line is ignored.

Valid type names are:

Mlog Logs the Master Controller's local readings.
The station number is shown as 0 (master).
The data columns are: not used, aux inputs 1-7 (volts), and are not labelled.

ASSAY Initialise an assay according to the parameters that follow.

station_map Specifies the Station(s) that the event is applied to.
The station_map is a 30 bit binary value with a bit being '1' to include a port and '0' to exclude it.
Bit 0 corresponds to port 0, through to bit 30 corresponding to port 30.
The numbers correspond to the sockets on the Master controller and so stations are mapped to ports by physical connection.

Port 0 is the Master Controller itself, ports 1 through 30 are the remote head units (Stations), though of course not all ports may be connected to a Station).

The station_map can be specified in several formats:

Hexadecimal (up to 8 digits) is signalled by a leading '0x'
Binary (up to 30 digits) is signalled with a leading '0b'
Decimal (up to 10 digits) is assumed if there is no prefix.

The binary format is easiest to read.

If the station_map value is blank, it is assumed to be zero - no Stations will be affected by the event.

The word 'ALL' or just the letter 'A' can be used in place of the number to specify that all connected Stations will be used. Upper/Lower case is ignored.

Where an event type is not Station-specific, the station map value is ignored. However it must be present as a placeholder if any of the following fields are required.

Conditions The conditions field is a number containing bit flags corresponding to various pre-conditions.
A '1' bit in the conditional value makes the event execution conditional on that pre-condition being 'true', a '0' means otherwise.

A conditions value of zero means that no conditions are applied; the event will always be actioned.

If the conditions field is blank or missing, it is assumed to be zero.

At present, only bit 0 is defined. When set, bit zero means that the event only happens on ONE DAY A WEEK, on Sunday.

The conditions number can be specified in decimal, hex or binary (with prefixes as per the station_map).

param1 These values may be number or alphabetic data.
They are event-specific values and should be set with reference to the documentation for the required event.
Parameters can be omitted if not required.
Where parameter values are expected, but are blank or missing they will be interpreted in an event-specific way.
Each parameter field can contain a maximum of 8 characters. Excessive characters are discarded.

param2 As param1

note Any text following the sixth tab and up to the end of the line is treated as comment and ignored by the controller.
Typically, the note is used to indicate the event number.
A minimum of time, name and station_map must be specified.
If a note is present, the preceding fields must be present - use tabs as necessary - e.g. to prevent a note being interpreted as another field.
The file is read once on starting a run, and the contents loaded into memory in a compact form.

APPENDIX 2 Port Number Codes

Stations that are connected have a group of letters defining their status displayed next to their port number. Multiple codes may be shown. The status codes are as follows:

Channel status codes:

Δ	Communications lost.
B	Station is busy (in assay)
E	Error during last assay, or no assay yet done (when first configured)
M	An assay result is expected
W	Station has open mode capability
Z	Station has zero capability
?	No information available

APPENDIX 3 Station Error Codes

The log file may record a numeric error code for a station. These are:

10	EQU #NO_CARRIER	no modem signal on the line.
11	EQU #COM_FAIL	no (recognisable) response from the station.
12	EQU #COMPLETED	good reply was received.
13	EQU #BUSY	a busy reply was received; station cannot execute command
14	EQU #BAD_CMD	command character was not received.
15	EQU #BAD-STAT-NO	Station was selected for an external command

Appendix 4 Analogue Port pin connections

1 Power ground
2 Signal ground
3 12V DC out
4 Analogue channel 1
5 Analogue channel 2
6 Analogue channel 3
7 Analogue channel 4
8 Analogue channel 5
9 Analogue channel 6
10 Analogue channel 7
11 SCL (if internal link fitted)
12 SDA (if internal link fitted)
13 not used
14 not used
15 not used

APPENDIX 5 PROJECT FILES

The project is a collection of four files sharing the same name part, but with different extensions: .CFG, .SEQ, .TXT, .LOG. The software attempts to maintain the integrity of the project file set by limiting the ability to delete or rename individual files from the set.

Configuration (<name>.CFG)

This file holds the configuration of each connected Station. The file is updated once each time a project is run, by polling all connected Stations reading the configuration and storing them in this file. Each line in the file holds the time & date, serial number, port number and configuration settings from one Station.

If the same project is run multiple times, the configuration file will have multiple entries with different time/date stamps. This allows any changes to Station configuration (and so effect on results) to be tracked and logged.

A Station can be configured locally or by the Master. (See Section 5 – Configuring Stations)

When a new project is created, a blank configuration file is automatically created (replacing any existing file) and will be populated at the start of the first run.

Sequence (<name>.SEQ)

This file contains a list of timed events (typically assays). When a project is 'run', in effect, the sequence file is executed. The sequence is a set of timed events over a 24 hour period. At midnight, the sequence is reset, and so the events it holds are repeated on each day.

When a new project is created, a valid sequence file must also be created. The software allows a sequence to be edited from scratch, or copied from an existing file/project.

Attempting to run a project will prompt the sequence file if none exists. Attempting to run a project with an empty sequence file (i.e. no events) will fail. Sequence files are associated with a particular project and can be no more than 99 steps long.

If more than 1 Station is set to perform an assay at the same nominal time, they will actually be separated by 30 seconds to avoid simultaneous power loading and allow time for data transfer.

Data (<name>.CSV or <name.TXT>)
This file holds the results for each assay, one line for each channel. The results are read and stored after each assay has finished. By default the ACE master uses 'TXT' mode where the values are separated by tabs. It can also operate in 'CSV' mode, where commas are used as an option. The file extension is set to facilitate automatic import in to MS Excel.
When a new project is created, an empty data file is created automatically (replacing, after warning, any existing file). Records are saved to this file during the project run.

At the end of each line, there are codes to indicate how the station on that line behaved:

1st character indicates type of assay
- [O] open mode
- [C] closed mode

2nd character indicates status if zero estimation
- [E] error estimating the zero
- [O] no error
- [_] zero estimation not attempted (due to cancel or error)

3rd character relates to curve fitting in closed mode
- [?] uncontrolled character in OPEN mode
- [E] in CLOSED, error during NCER calculations
- [G] in CLOSED, NCER etc calculated OK
- [_] in CLOSED, NCER calculations not attempted (cancel or error)

4th character shows the status of any zero adjust at the end of the assay.
- [F] zero adjust failed
- [Z] zero adjust succeeded
- [N] zero adjust not required
- [_] zero not attempted

5th, 6th and 7th characters show the number of readings taken.
- [123] 3 digit count of readings
- [ ] space if the assay failed at an early stage
- [J23] arm jammed
- [S23] source failure

8th character shows the status at the end of the assay
- [T] ended due to time out
- [D] gas end condition was satisfied
- [C] general error, cancelled or otherwise failed to complete
- [R] ended with error; reading over or under range.

e.g. [COGN123D] = Closed mode; No error; NCER OK; Zero OK;
123 records stored; satisfactory assay.

Log (<name>.LOG)

This is a simple text file holding details of the project run. It holds a record of operations performed and any errors encountered. Each log entry occupies a single line, and is prefixed by the date & time. Entries are plain text descriptions of events.

Although not important for interpreting results, the log file is useful for diagnosing problems and confirming operations are as expected. In particular it indicates that assays were conducted successfully. If the message all results are collected does not appear before the next step starts, then not enough time has elapsed before requesting a new set of assays, and the data from at least one Station has been lost.

When a project is created, a log file is created automatically (replacing any existing file). It contains a single entry detailing creation time and date.

APPENDIX 6 SETTING UP HYPERTERMINAL™

This applies to Windows 95, 98, NT and XP. For non-Windows systems, you will need to use a terminal emulator.

1. Select HYPERTERMINAL[tm] from the start menu: "START", "PROGRAMS", "ACCESSORIES". In WIN95 select "HYPERTERMINAL", in later versions select "COMMUNICATIONS"

2. Select (double click on) the Hypertm.exe icon.

3. Name your new connection e.g. ACE Assays, and choose a different icon if desired. Click on "OK".
   This will save all your settings so that it is easy to repeat the transfer.

4. The next window will ask you to type in a phone number as it assumes you will be connecting via a modem. Ignore this and click on the *connect using* option window.
   Select the COM port number that you intend using on your PC. (*The other options on this window will then be automatically deselected*).

   Click on *OK*.
   A new window will then appear asking you to set the COM port settings.
   Set them as follows:-

bits per second	9600 (*or match the Station's setting*)
data bits	8
parity	none
stop bits	1
flow control	none (*or match the Station's setting*)

5. Click on *OK*
   Ensure the settings match those on your ACE Station before transmitting data (See section 4.2)

6. Click on the *transfer* button and if Raw text has been selected as the protocol on the ACE master select *capture text*. If not jump to step 10.

7. Enter a filename and click on *start*
   Tip: if you give your file a '.CSV' extension you will be able to import it directly into most spreadsheet programs.

8. The PC should now be ready to receive data from the ACE Master, which can be sent by pressing transfer on the ACE Master.

9. To stop data capture click on *transfer, capture text, stop*
10. Select either Y-modem or X-modem as selected on the ACE Master.
11. Press the transfer key on the ACE Master followed by clicking receive in HYPERTERMINAL[tm].

APPENDIX 7 Specifications

Mains input voltage:	Universal 100 to 240 Volts 50/60 Hz.
Mains power:	maximum 250 Watts
Mains current	Mains voltage dependant 1.4A @240V, 3.4A @100V
DC power:	External lead acid 12V batteries, up to 2 supported.
12V DC out.	12 Volts DC @ 0.5 Amperes accessory supply
Battery charging voltage:	13.8 Volts.DC
Battery charging current:	10A max each battery.
Number of station ports:	10 to 30 in groups of 10.
Display:	LCD matrix 240 x 64 pixels
Programming:	Menu system with 5 keys
Recording media:	Two CF card drive slots
Serial communications:	RS232 selectable baud rates of 300 to 57600
Enclosure:	Steel with weather-strip to IP66. 40 x 40 x 20 cm
Weight:	12kg.
Case rating	IP66

APPENDIX 8 Spares and Accessories

Part No.	Description
M.022-801	Fuse car 10A blade
M.197-200	Compact flash card
M.866-167	EEprom removal tool
M.886-880	Cable identification label
M.870-303	"U" clamps for 50mm diameter tubing.
M.ACE-072	CF Card extractor tool
M.ACE-079	50m master-station interconnect cable.
M.ACE-080	9.9m master-station interconnect cable.
M.ACE-081	100m master-station interconnect cable.
M.ACM-085	Dual battery supply lead
M.ACM-086	Mains supply lead 2m
M.ACM-110	Mounting bar
M.ACM-121	Desktop support bar
Z.S-MC6MOPAP-165	M6 x 16mm screw Pan-Pozi stainless steel
Z.S-MC8MOHEX-165	M8 x 16mm screw Hex-head stainless steel
Z.N-MC8MOFUO-005	M8 Full nut stainless steel
Z.W-MC8MOPLO-005	M8 Plain washer stainless steel