

SPHERE SYSTEMS

Facility

DDC

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1. System Introduction

1.0.1 DDC System overview

The Sphere Systems Pty Ltd Direct Digital Control 'DDC' system consists of three main items. The lowest level is the *Minicom controller*. This is responsible for the actual control of plant. Minicoms are either located near the plant they control or are mounted in cubicles. They are mounted by clicking into "snap track". No screws are required for mounting. One Minicom can control up to eighty points. Minicoms are autonomous units containing their own software, real-time clock and battery backup of the configuration.

A Minicom can either be used as a standalone controller or a number of Minicoms can be connected in a network. The control of the network is managed by a network processor 'DP11'. The user can write control programs for the network controller.

The network controller is connected to a PC. A software package called *Facility* running under Microsoft Windows® NT4 – Win95-98 allows the system user to configure the network and to monitor any point on the network. Data logging is also implemented through this package.

1.0.2 Minicom controllers

The MC311 controller is the basic unit in the DDC system. This board has eight universal (analogue or digital) inputs, four universal (analogue or digital) outputs and four digital only outputs. An expansion port on the MC311 allows the addition of additional inputs and outputs. Expansion boards are available for digital inputs and outputs and for analogue inputs and outputs. Each of these expansion boards has eight inputs or outputs. Up to two of each type of expansion board can be attached to a Minicom. Thus the initial capacity of the Minicom can be increased by an extra 64 points. There is also a dedicated digital relay board for the MC311. This board connects directly to the Minicom and converts the 0 to 10 volt outputs of the MC311 to relay outputs. (The digital output expansion board has its own onboard relays.) All analogue inputs to the DDC system are 0-10 volts. Sphere Systems manufactures a range of active temperature sensors to work with the DDC system.

Firmware in the Minicom controller implements a complex set of control algorithms. Before use, a Minicom has to be configured. This configuration specifies how the inputs to the Minicom are to be processed to drive the Minicom outputs. The Minicom contains a battery backed memory which stores this configuration. Each Minicom has its own unique serial number. This allows the configuration for that Minicom to be downloaded from the PC while the Minicom is connected to a network. The Minicom control algorithms include standard P/PI or reset type control loops, heating/cooling control loops, switching/windowing on-off functions, maximum and minimum functions, logic functions, delay functions and numerous configurable delays and overrides. In addition, a real-time clock and calendar in the Minicom allow the setting up of time-clocks to control plant operation. The Minicom firmware also implements a comprehensive alarm system. A multilevel priority system within the Minicom allows the overriding of the DDC control system. The Minicom also has the capacity to log all inputs and outputs internally at rates up to one sample per second on all inputs and outputs.

The power supply for the Minicom is generated from a 240-16 Volt transformer using a MC311PS module.

A Minicom can be used in a standalone configuration, where it communicates with a PC using a RS232 interface without the need for a network controller. The Minicom can also be

operated remotely without being connected to a PC. In this case, firmware inside the Minicom can be set up to automatically dial a Telstra, Link or Hutchinson pager – GSM Phone in the event of an alarm condition.

A number of Minicoms can also be connected in a network using the RS485 standard. This allows up to 125 Minicoms plus 499 VAVcoms to be networked together. In this case a network DP11 controller is required (a total of 10,000 + points per DP11).

1.0.3 DP11 network controller

This unit connects a network of Minicoms to a PC. The controller operating system is multi-tasking. This unit has built in network diagnostics and up to 8 DP11N processors can be linked together each capable of 125 Minicoms, 499 VAVcoms and 250 Doorcoms.

A modified version of the DP311SP is available. This device is snap track mounted and can be used as an enhanced Minicom. It is used where it is necessary to control plant such as chillers which require an RS232 interface for their control. Software can be written for the DP311SP which can be used to interface into various types of plant.

1.0.4 PC Front-end system

The user interface to the DDC system is via a full 32 bit Microsoft Windows® program called *Facility*. This program is graphically orientated and operates in two modes, standalone and network. The network mode of the control program uses a password logon procedure and can be setup in such a way as to give different users different access privileges. For example one can limit a user to only being able to monitor points but not change them. An inbuilt mail system allows users to send messages to each other. In addition, network mode allows the configuration of a network of Minicoms while the standalone mode only a single Minicom to be controlled. The network mode also requires the use of a DP11 network controller. In all other respects the two modes are identical.

A great deal of attention has been given to making the operation of the DDC system as simple as possible for the end user. The front-end software is used to specify a points database and to generate the configuration for each Minicom.

The software allows the user complete control over the DDC system. The user can develop his/her own plant drawings and can overlay text, point data and animations on these drawings. When running online, the point data will display the actual Minicom point status and this can be modified by the user. Point names can be changed and additional points can be incorporated into the system by the end user. The user can also change the Minicom configuration and download this information to the Minicom by clicking a single button.

The front-end software can provide both realtime and background trending. Both types of trending log data automatically to disk files in a Microsoft Excel® compatible format. Realtime trending is displayed graphically as well. This graphical display can be manipulated in several ways. Realtime trending uses the Frontend to obtain the data from the field at regular intervals while background trending uses the internal logging capability of the Minicoms to continue logging even if the Frontend program is stopped.

Alarms generated by the Minicom(s) are logged automatically to a disk file and are also displayed to the user.

1.0.5 DDC hardware

MC311	8 universal inputs, 4 universal outputs, 4 digital outputs
MC311RLY	converts MC311 outputs to relay outputs
MC311AI	8 (0-10 volt, 12 bit resolution) analogue input expansion module
MC311AO	8 analogue output (0-10 volts) expansion module
MC311DI	8 digital input expansion module
MC311DO	8 relay output digital output expansion module
MC311PS	power supply for a Minicom system
DP11	network processor
DP311SP	modified network controller suitable for use on the network
TSRS	room temperature active sensor
TSSPD	room temperature - display - setpoint active sensor
THRS	room temperature - humidity active sensor
TSDS	duct temperature active sensor
TSPS	pipe temperature active sensor
THDS	duct temperature - humidity active sensor

1.0.6 PC requirements

The Frontend software requires the Windows Win95 NT4 operating system. The **minimum** PC requirements for operation are a Pentium 200 processor with 32 Mb of RAM , TCP/IP network card, sound card and about 1.2 Gbytes of hard disk space. The minimum system server requirements for satisfactory operation are a 450 Mhz processor with 64 Mbytes of RAM 6 Gb Hard disk, PCI network card with TCP/IP, sound card, PS2 mouse (on mother board) and a graphics accelerator card.

1.1 Facility control program System Description

1.1.1 General

Programming a Minicom© is unlike programming other DDC systems. The programming task does not require any knowledge of a computer programming language. The Minicom has many control functions built-in. When a Minicom is programmed the information supplied is used to enable various internal functions in the Minicom. The user cannot write "bad code" which will cause the Minicom to crash. The Minicom does not do any checking whether an output is being driven from more than one source. If this is done the Minicom will still function properly but that output might appear to behave in a bizarre and unintended manner.

1.2. Logging on

The network mode uses a logon security system where each user has to logon with a logon name and a password. If the incorrect password is entered then the logon is not allowed and the program will not run. To logon to the program enter your user ID (logon name) and password in the appropriate boxes and click *OK*. You can use the Enter key to move from one field to the next. If you have mail then a mail panel will appear after logging on. For more details refer to section 1.3.2.

1.3. Logon screen

The logon screen for the network control program is arranged in a different manner to the standalone screen. A new panel labelled *Network* has been added to the form and there are several new buttons in other panels. This panel is used to maintain a directory of people who are currently authorised to use the control program. Clicking the *Show* button will bring up a table of users, clicking the button again will hide this table. The users table lists each user giving the user ID code, user name, access level authorisation and permission level, the time of the last logon and last logoff and an auto off time.

The access level for a user determines what features of the control program are available to that user. The access levels vary from 0 (allowing the user to merely observe what is going on but not allowing the user to change anything) to 5 (allowing all features of the program). Later in this manual there is a table describing what features are available at each access level.

The auto off time specifies the maximum time a user can be logged on for. After the user has been logged on for the specified time the program will close down and the user will have to logon again. Note that the program does not stop running, it merely requires the user to logon again.

1.3.1 Modifying the user log

You can edit the user table by clicking the *Update* button in the *User* panel. This will bring up an abbreviated version of the *Users* table and a *User maintenance* panel.

Clicking the *Add user* button will open a panel where the details for the user can be entered. Click *Enter data* after all fields have been filled out or click *Cancel* to cancel the operation. Note that when entering the password the data entry field is filled with asterisks.

To edit or delete a user it is necessary to click on an entry in the users table to highlight it and then either click the *Delete user* button to delete the entry or click the *Edit user* button to edit the table entry. Editing a user entry is identical to adding a user. Change whatever fields you desire then click *Enter data* to accept the changes or click *Cancel* to discard the changes.

Note that each user ID must be unique. You cannot change the user ID when editing an entry! To change the user ID you must delete the entry and then add a new entry.

Click the *Finish* button to close the user maintenance facility.

1.3.2 The user mail system

Clicking the *Post memo* button gives access to the Facility mail system. Users can send mail to each other or can send mail to all other users.

When a user logs onto the system a check is made to see if there is any mail for that user. If so a message is displayed. Clicking the *OK* button will bring up a panel labelled *Memo system*. This lists the mail received. The sender's name is displayed together with the time the message was sent. The message is displayed in a window. The *Next* button is used to step through all messages. Messages can be printed by clicking the *Print* button. To exit from the memo mail form click the *Exit* button.

To send mail to another user, type the message you wish to send in the white panel and then click the users name (or ID) in the users list below. To send the message click the *Send* button. To send a message to all users click the *All users* checkbox and then click the *Send* button.

To exit the mail system click the *Exit* button.

1.4. Network configuration

The network mode has to be able to configure both individual Minicomms and the network. The *Configure* panel is used to gain access to the various configurations.

To configure the network click the *Network* button in the *Configure* panel. This will bring up a new form labelled *Network configuration*. At the top of this form is a table listing the address of each Minicom in the network, the Minicom type, the location of that Minicom, the serial number of the Minicom and the number of inputs, outputs and variables for that Minicom.

The Facility control system makes use of the unique serial number of each Minicom to allow the Minicom network to be configured while all Minicomms are on line. The address of a Minicom is determined by the DP processor it is connected to, the link number on the DP processor and the user assigned logical number for the Minicom. Each Minicom must have a unique address (ie. the DP Link and Mc fields for each Minicom must be different). The location of a Minicom is not used by the control program but is there to provide assistance in locating a Minicom.

The table of Minicomms can be sorted by address, location and type. To sort the table click on the arrow in the *Sort by* panel and then click on the sort order desired. To perform the sort click the *Sort* button.

You can add to, edit or delete table entries. The procedure in all three cases is very similar.

To add a new Minicom to the table click the *Add* button. This will hide the network table and bring up three new panels. Enter the Minicom address into the *Minicom address* panel. **For the current release the DP and Link fields must be 1.** The Minicom number must be less than 126 and VAV controllers between 500 and 999. In the *Minicom details* panel click on the arrow for the Minicom type field to bring up a choice of Minicom types and then click on the desired Minicom type. If the serial number for the Minicom is known at this time enter the 14 digit serial number in the serial number field otherwise leave this field blank and enter the data at a later stage. You can type any text that you like into the location field. This is purely for your own reference. When finished entering data click the *OK* button to save the data. Remember that the Minicom address must be unique. If it is not unique then an error message will be shown.

To edit a data entry, click the desired entry to edit. This will highlight that line in the table. Then click the *Edit* button to bring up the details for that Minicom. You can edit the data as desired and then click the *OK* button to save the changed data.

To delete an entry, click the desired entry to delete then click the *Delete* button.

You can print the network configuration by clicking the *Print configuration* button.

If you are running online, then the *Configure network* button is enabled. Clicking this button will download the logical address of each Minicom to the Minicom network. The logical address is the number you assigned to each Minicom. Minicomms use this logical address rather than the 14 digit serial number as the logical address is a single 8 bit character and thus saves time in transmission over the network.

When you have finished configuring the network click the *Finish* button to close down the network configuration form.

1.5. System configuration

To configure one or more MinicomS click the System button in the *Configure* panel of the control screen.

System configuration is almost identical to the configuration of a standalone Minicom. The only difference is that the points table now has a field for the Minicom number (the logical address of a Minicom) and an asset field. The asset field is a user definable field used typically to record the asset number of the device connected to a point. This field is not used by the control program.

You can add or edit points in the points table by clicking the Edit or Add buttons (In the edit case a point must be selected in the table). The *Define points* form is identical to the standalone form except that there is a new field for the Minicom number and a field for the asset number. Fill in this form in an identical manner to that for the standalone version of the program.

To delete a point, you must first select a point for editing and then click the Edit button. You can then delete one or more points by using the Delete button.

Note that for the current release there are no fields for the DP number and Link number. These are fixed internally to 1. Minicom numbers must be in the range of 1 through 125.

VAVcoms in the range 500 through 999

When finished adding, editing or deleting points click the Finish button.

To configure a Minicom you have to select the Minicom number to configure. You can do this either by using the arrows in the *Minicom to configure* panel or just click on a point entry in the table which has the desired Minicom number. Then click the Configure Minicom button to configure the Minicom as per the standalone program.

1.6. Monitoring the network

To monitor the network click on the Network button in the *Monitor* panel. This will bring up the *Network status* form. Note that you must be online for this button to be enabled. The control program will then try to talk to each Minicom in turn and if the Minicom is offline then it will be listed in the *MinicomS off-line* table. The Minicom currently being talked to is listed in the panel above the table.

You can retest the network by clicking the Retest button. You can close this form by clicking the Exit button.

1.7. Monitoring a Minicom

To monitor a Minicom, click the Minicom button in the *Monitor* panel. This will bring up the *Minicom status* form. This form is virtually identical to that for the standalone version. The main difference is that the points table contains a field for the Minicom number. There is also a field in the *Minicom number* panel for selecting the Minicom number to monitor. Use the up and down arrows to select the Minicom number to view and then click the OK button to select that Minicom. The current Minicom priority level for that Minicom will be displayed.

You can display the current data for the selected Minicom by clicking the *Update current* button and you can monitor the Minicom inputs, outputs, variables, loops etc by using the menu bar.

2. Functions associated with inputs and outputs

2.1 Analogue input functions

Associated with each analogue input are two comparison registers, a lower and an upper threshold. These registers are used as part of the Minicom alarm system. The input signal level is compared with each of these registers and an alarm can be generated if the input is below the lower threshold, above the upper threshold or between the two thresholds. For further details refer to Section 5.

2.2 Digital input functions

Each digital input in the Minicom is debounced.

In the normal configuration a digital input can be *true* or *false*. The logical value *true* can represent either a contact being open or being closed. In normal switching terms the *true* value represents a contact being closed. Each digital input on the Minicom has the provision to invert the input thus making a *true* value represent the input contact being open. This logic reversal takes place before any other operation is performed on the input.

Associated with each digital input is a 32 bit switch counter. This counter is incremented each time the digital input changes from *false* to *true*. If a switch changes state twice per second this counter will not overflow for 68 years.

Alarms can be generated whenever a digital input becomes set (ie becomes *true*), becomes clear (*false*) or changes state.

2.3 Input channels 1 through 8

On the MC11 processor, digital and analogue inputs 1 through 8 share the same input pin. The internal firmware treats each input as if it had sole use of the pin. Thus it is up to the user to determine how a pin should be used. It is quite acceptable to use an input pin for both analogue and digital levels if so desired. The voltage input trip points for converting the pin from an analogue to a digital pin are 3.33 and 6.67 volts. If the input level was below 3.33 volts (equivalent to the switch being closed or *true*) and rises above 6.67 volts the digital input becomes open (*false*). While the input voltage remains above 3.33 volts the digital input remains *false*. If the input falls below 3.33 volts the digital input becomes *true*.

2.4 Analogue output functions

Associated with each analogue output are a lower and an upper limit register. These registers are used to limit the voltage swing of the analogue output. Any attempt to output a value lower than the lower limit will result in the output being set to the lower limit and any attempt to write an output higher than the upper limit will result in the output being set to the upper limit. During Minicom initialisation both these limits are set to zero, thus forcing the analogue output value to zero. Any change to the limits will not affect the current analogue output value.

Each analogue output can be set to operate in reverse polarity. This means that instead of driving from 0 to 10 volts as the analogue output should increase the output will swing from 10 to 0 volts. For example, if in normal mode the output voltage is 3.2 volts then if the analogue output is switched to reverse action the output voltage will be 6.8 volts (10 - 3.2). This function is useful for valves which operate in the reverse action.

Each analogue output can be forced to a specific state (*inhibited*) by any digital input, digital variable or digital output becoming *true*. The value output when an analogue output is inhibited is specified by the inhibit register for that analogue output.

Each analogue output can be driven either directly by a command from the outside or from loops and other functions producing an analogue output within the Minicom. This local control of an analogue output can be turned on or off under program control.

2.5 Digital output functions

As for digital inputs, each digital output can be inverted so that a logical value of *true* can represent either a relay contact being closed (normal mode) or being open (inverted mode). This logic inversion takes place after all other processing has been done on the relay output.

There are a number of timers associated with each digital output. Any of these timers is enabled if its time is set to a value other than 0, otherwise it is disabled.

The power-up delay time provides a programmable delay from when the Minicom is turned on until an output can become *true*. This power-up delay time can be from 0 to 255 seconds. During the power-on delay the Minicom will not allow the digital output to become *true*.

The guard time provides a delay from when the digital output changes state until another point in the Minicom is tested. If, after the guard time has expired the selected point is not in the selected state an alarm will be generated. The guard time can be measured either from the time a digital output becomes *true* or becomes *false*. The selected point to be tested can be a digital input, digital output or a digital variable. The required state (after the guard time expires) for the selected point can be chosen to be either *true* or *false*. The guard time can range from 0 to 255 seconds.

If enabled, the short-cycle timer is started after a digital output changes from *true* to *false* (or vice versa). While the timer is active it is not possible to switch the digital output to *true*. The short-cycle timer can be started either when a digital output goes from *true* to *false* or from the output changing from *false* to *true*. The short cycle time can range from 0 to 65535 minutes.

Associated with each digital output is a runtime counter. This counter increments every second while the digital output is *true*. It is a 32 bit counter.

Each digital output can be forced to a specific state (*inhibited*) by any digital input, digital output or digital variable. When the specified inhibit source becomes *true* the digital output will change to that specified by its inhibit value.

2.6 Analogue variable functions

Analogue variables are internal to the Minicom. They are used to store analogue data.

Associated with each analogue variable is a timer and a default value. Each time the analogue value is written to, either from a command received from the communication system, or by the output of another Minicom function, the timer is restarted. When the timer finally times out the analogue variable output reverts to its default value. The timer delay can be from 0 to 65535 seconds.

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2.8 Pulse accumulator

The MC11 Minicom has a single high speed pulse accumulator. This has 2 inputs (P+ and P-). For the Minicom to register a count each input must be pulled in turn to ground. It is not allowed to pull both inputs to ground at the same time. Doing this will not damage the Minicom but it can result in erroneous counts being recorded. The maximum counting speed is approximately 500,000 counts per second. The accumulator will overflow after about 2 hours when counting at this rate.

3. Minicom built-in functions

3.1 Maximum function

Maximum functions compare the values of up to any 16 analogue sources and store the value of the maximum value in either an analogue variable or an analogue output. The analogue sources can be any analogue input, output, variable or the difference between the input and setpoints for a continuous function loop (used for zoning).

3.2 Logic functions

There are two types of logic functions implemented in the Minicom, the AND and the OR function. Each function output can be inverted thus giving a complete set of logic capabilities. Functions can be cascaded by feeding the output of one function into a digital variable and then using this variable as an input to another function. In this way a function of any complexity can be built up. It is recommended that when functions are cascaded lower function outputs are connected to higher functions. For example, to create the function:

$$(X \text{ AND } Y) \text{ OR } Z$$

where X is digital input 2, Y is digital output 5 and Z is digital input 4

Create logic function 1 as a logical AND function with inputs digital input 2 and digital output 5. The output of this function can be digital variable 1. Then create logic function 2 as a logical OR function with inputs of digital variable 1 and digital input 4. The output of this function is the desired result.

3.2.1 Use of logic functions

The logic functions in the DDC management series (Minicomms, Digicomms, Powercomms etc) and the access control system are implemented in firmware. The functions are processed in numerical order starting with function 1, then 2, 3... etc. This can have unforeseen consequences unless care is taken with the design of logic expressions. (Note that this is no different to designing logic functions where the function is derived using hardware.) The only time there can be a problem is when the output of one function is used as the input to another function.

For example, if the output of logic function 4 drives an input of logic function 6, then when the output of logic function 4 changes the output of logic function 6 will not change at the same time but only when this function is processed. If, on the otherhand, the output of logic function 6 drives the input of logic function 4 there will still be a delay but this delay will be considerably longer than the delay for the previous example as the system has to process virtually all of the logic functions before reaching logic function 4. In itself this might not be a problem but when several logic functions are interconnected the system might not behave as desired. In particular, there could be short, invalid outputs generated. To overcome this potential problem all ROM's dated prior to 10 Nov 1999 did not change the output of the function until all functions had been evaluated. Then the outputs of all functions were updated. This synchronises the outputs of the logic functions but results in a slower response time.

ROM's dated 10 Nov 1999 or later allow the user to select whether each logic function should be run in a *synchronous* mode as previously or whether the output of a logic function should change immediately after it has been evaluated. This is known as the *asynchronous* mode of operation. In general, where logic functions are not interconnected or where the output of a logic function is only connected to the input of a later one (eg the output of 4 drives an input on 9) the use of the asynchronous mode is unlikely to cause any problems. The benefit of using the asynchronous mode is that the response time is decreased. If synchronous mode is used there is a complete processing time delay between the inputs of a function changing and the output changing. If two functions are cascaded then there are two processing cycle time delays etc. Using asynchronous mode the delay between an input change and the output change when cascading functions will usually never exceed one processing cycle.

The access control system ROM's do not implement the use of asynchronous operation as yet.

3.2.2 AND/NAND function

The logic AND function performs a logical AND operation on up to any 16 digital inputs, outputs or variables and stores the result in either a digital variable or as an inhibit on an analogue output. The output of the function can be inverted before being stored. (This results in the NAND function).

3.2.3 OR/NOR function

The logic OR function performs a logical OR operation on up to any 8 digital inputs, outputs or variables and stores the result in either a digital variable or as an inhibit on an analogue output. The output of the function can be inverted before being stored. (This results in the NOR function).

3.3 Delay function

Delay functions behave as retriggerable monostable multi-vibrators. The input to the function is a digital input, output or variable. When this input becomes *true* (or *false* if the inverted input state is selected), a counter is started and the output of the function becomes *true*. The output of the function remains *true* irrespective if the input goes *false* and it will remain *true* until the specified timeout has elapsed. If the input changes from *true* to *false* and then back to *true* while the counter is running, then the counter will be restarted and the timeout will be measured from the last transition from *false* to *true* on the input. The output of the function can be sent to a digital variable or it can be used to control an analogue output..

3.4 Continuous control loop

A control loop operates by measuring the process output (eg. a room temperature) and comparing it to a setpoint to generate an error value. This error value is multiplied by the gain to give an output to drive the process (for example, a valve position for a heating coil). The parameters which can be set are as follows:

The *loop input* specifies where the input signal is coming from. The loop input can be any analogue input, output or variable or it can be a fixed programmable value.

The *setpoint* specifies the required process output (eg. a room temperature). The loop input value is subtracted from the setpoint to generate an error value. If the process output is less than the setpoint then this error will be positive. If the process output is greater than the loop input then this error will be negative. The setpoint can be any analogue input, output or variable or it can be a fixed programmable value (the usual case).

The *proportional gain* specifies how much the controlled output will change for a given change in error. The proportional gain is a fixed programmable value.

The *offset* (or *reset*) gain is the estimated control output required to maintain the process output. It is not essential that it be specified, but it will allow smaller errors to be achieved. The offset gain is added to the product of the error and the proportional gain. The offset gain is a fixed programmable value.

The *loop output* specifies where the output of the loop function is to be sent. It can be any analogue output or any analogue variable.

The continuous loop can be enabled or disabled. This control function has no effect on the operation of the loop. What it does, if enabled, is to allow the output value of the loop to be sent to the specified destination. If the loop output attempts to write to a destination which is already being used by some other function then the results are indeterminate. The Minicom will not be damaged or fail if this occurs.

The *polarity* of the loop can be inverted. This parameter specifies whether the control output goes up with increasing process output (eg. cooling) or down (eg. heating). If the output is to increase when the process output is becoming greater than the setpoint, then the polarity is

positive. If the output is to increase when the process output is becoming less than the setpoint, then the polarity is negative.

3.5 Discrete control loop

This form of control is similar to that of a thermostat. In simple terms, the output switch is off if the input is less than a given value and on otherwise. Another case, called *window* operation, causes the output to be on while the input is between two given values. These simple cases are not workable because of erratic behaviour when the input is almost exactly equal to the switching values. This problem is solved by allowing hysteresis to be specified for the switching points.

The parameters which can be set in the Minicom are as follows:

The *loop input* specifies where the input to the function comes from. It can be any analogue input, output or variable.

The *window bottom* parameter specifies the lower trigger point of the discrete transfer function. The output of the function is false when the analogue input is below this value and true when it is above it. The bottom window parameter can be any analogue input, output or variable or a fixed programmable value.

The *lower hysteresis* parameter allows the trigger value of the discrete transfer function to be perturbed in a manner which prevents random triggering when the analogue input is almost exactly the same as the trigger value. The operation is modified so that while the input value is below the trigger value minus the hysteresis value, the output is false. While the input value is greater than the trigger value plus the hysteresis value, the output is true. Whenever the input value is within the range of the trigger value plus and minus the hysteresis value, no change is made to the output state. The lower hysteresis value is a fixed programmable value from 0 to 255.

The *window top* parameter is only of significance if the window function is selected. If the input value is greater than the window top value then the output is false. If the input is less than the top value and greater than the window bottom level then the output is true. Thus the output is true if the input level is between the bottom and top window values. The top window can be any analogue input, output or variable or a fixed programmable value.

The *upper hysteresis* operates in a similar manner to the lower hysteresis to prevent random switching at the window top level. It is a fixed programmable value from 0 to 255.

The *loop output* determines where the output from the loop goes. It can be any digital variable or as an inhibit on an analogue output.

The discrete loop can be enabled or disabled. This control function has no effect on the operation of the loop. What it does, if enabled, is to allow the output value of the loop to be sent to the specified destination. If the loop output attempts to write to a destination which is already being used by some other function then the results are indeterminate. The Minicom will not be damaged or fail if this occurs.

The *polarity* of the loop can be inverted. When reverse polarity is selected the output of the loop becomes true when the input is below the window bottom value or outside the window range.

The loop can be operated as a single comparator type loop or as a window function loop.

4. Time control of Minicom functions

Time clocks allow the control of analogue outputs, digital variables and digital outputs depending on the current day and the time of day. Associated with each time clock is a *start time*, a *stop time* and a *day of the week activity*. Provided the time clock is active on the current day, and the current time is equal to or greater than the start time (and less than or equal to the stop time) the output of the time clock will be true. If the current time is greater than the stop time the output of the time clock will be false. A time clock runs from a time of 0:00 (hours:minutes) representing midnight until 23:59.

The day of the week activity enables the time clock to be made active on any day or days of the week. For example, one time clock can be used to turn an output on from, say 09:00 to 17:00 from Monday through Friday but not on the weekend.

It is not permissible to have several time clocks driving the same output on the same day as the time clock with a higher number will override all those of lower numbers. Several time clocks can control the same output provided no more than one time clock is active on a single day. If more complex time sequences are required then use a separate digital variable for each time clock and use these digital variables as inputs to a logic function to generate the required output. Note that it is allowed for a single digital variable to control more than one analogue or digital output.

It is possible to have an output active over midnight but this will require using two timeclocks driving the same output. The first clock is made active on the current day but not on the following day. Its start time controls when the output becomes true during the current day. The stop time for this time clock is set to 23:59 meaning that the clock will not turn off. (Remember that the clock turns off **after** the set time, and the next minute after 23:59 is 0:00 **on the next day**). The second time clock is made active for the following day with a start time of 0:00 (ie. its output becomes true at midnight) and its stop time controls when the output goes false.

Up to 16 public holidays can be programmed up to several years ahead. Public holidays override normal time clock active days. If a time clock is set to be active on one or more days during a week but not on public holidays then if a public holiday falls on one of the days the timeclock is active it will not be active on that day. Otherwise a public holiday is treated just as if it were another day of the week.

It is possible to declare the current day a public holiday even if it does not appear in the list of public holidays. This is a temporary declaration and will expire at the end of the day.

5. Minicom alarm (events) generation

As mentioned in Section 2, digital inputs, digital outputs and analogue inputs can all generate alarms. Each possible type of alarm can be enabled or disabled under program control. A digital input can generate an alarm on becoming set (*true*), becoming clear (*false*) or changing state (from *true* to *false* and from *false* to *true*). An analogue input can generate an alarm if the input is below the set lower threshold, above the upper threshold or between the upper and lower thresholds. A digital output can generate an alarm if there is a guard time failure.

The internal Minicom alarm system is double buffered so that any alarms which occur while the outside controller is reading the Minicom alarm status are not lost.

6. Minicom data logging

The Minicom stores past history (logging of data) for all analogue and digital inputs, and all analogue and digital outputs.

Each time a digital input or output changes state this is stored within the Minicom. This change of state log is stored for the last 16 changes of state for each channel. The Minicom stores these changes of state in a circular buffer. The internal log can be selected to either fill the buffer once or to keep storing events with the newest event overwriting the 17th oldest event.

Each analogue input or output can be logged every second or multiples thereof. This sampling rate can be different for every channel if desired. The Minicom stores the value of each input and each output in a 96 entry circular buffer. As for digital samples the buffer can be filled once and then logging stopped or the Minicom can log continuously with each new sample overwriting the 96th oldest sample. The time of the latest sample is also stored so that the time information of each sample can be reconstructed.

7. Methods of programming a Minicom

There are 2 separate ways in which a Minicom can be programmed.

7.1 Via the Minicom command set

The Minicom command set gives the user full access to every feature of the Minicom. The programmer has complete control over how the Minicom can operate, especially using the Minicom alarm system. The disadvantage of using this method is the sheer number of commands that can be sent to the Minicom. To fully configure the Minicom using every input, output, variable, time clock etc requires the transmission of around 1000 commands. With the internal complexity of the Minicom it is not practical to program the Minicom in this way except for testing purposes or for very special purposes.

7.2 Using the Sphere Systems control program

The Sphere Systems control program gives almost total access to all of the internal features of the Minicom plus it automates the logging of data, provides the capability to overlay field data on graphic displays and incorporates a sophisticated alarm system. In addition, it greatly simplifies the programming of the Minicom as the user no longer has to write commands to access the Minicom. It is the only recommended way of accessing and controlling the Minicom. The control program runs on an IBM style computer under the Microsoft Windows operating system. The program is designed to be largely intuitive and uses a mouse almost exclusively for data entry. The plant system is stored in a modern database and logged data is stored on the PC in plain ASCII text files which can be imported into spreadsheets such as Microsoft Excel or Lotus 123.

8. Operation of the Sphere Systems Standalone Control Program

8.1 Installing the program

The Sphere Systems standalone control program is designed to run under the Microsoft Windows 95 / NT4. It makes a significant demand on the system resources as it is graphically orientated and a large number of windows can be open at any one time. The program is supplied on CD Rom and these should be installed using the **setup** command in Fac32

directory (32 bit program).). The program will attempt to install the software in a directory called *c:\program files\facility ddc*. The software ideally should be installed in this directory. The setup program will also install files in other directories.

8.2 Starting the program

To load the control program after installing it, double click on the *facility* icon in the windows program manager group. This will open up the facility program group. Now double click on the *facility* icon to start the program. A startup screen will display immediately followed by the copyright notice. Press *Enter* to continue. The main control panel screen will now appear. There is a control panel on the left side of the screen but all the buttons are disabled other than the *Exit* button. The only choice you have at this stage is to select between *New* or *Open* in the Minicom selection box. If this is the first time the program has been run with a Minicom or you wish to configure a new Minicom then click on *New* otherwise click on *Open*. The initial login and password is ;- login new passwd 1111

8.2.1 New configuration

Clicking on *New* will open up another box showing a choice of Minicom types. The grey selections are not available. To select a Minicom type click in the circle next to the desired name. The circle should now have a black dot in its centre. Next click on the *OK* button. This will result in the Minicom type selection box disappearing and two new boxes opening. The upper box displays a directory tree. Use the mouse to select the directory where the configuration data for this Minicom should be located. Click on the desired directory to select it.

Note that if you are configuring a new Minicom and have switched to a new directory then the Minicom database files **MUST** exist in this directory otherwise an error will occur. See section 8.3.

Click on the desired comm port option button to select it. If the Minicom is to be accessed by a modem then check the *Connect via modem* checkbox. This will enable the modem configuration panel. The initialisation string configures most modems for the correct communication protocol. You can change the configuration as much as you like by typing in the window. The original default configuration can be restored by clicking the *Restore default settings* button. The modem should be configured to a fixed rate of 9600 baud with no error correcting and no compression. Communications should be in the direct mode with no buffering. The *DTR* line is used to hang up the modem when switching to offline. Enter the desired telephone number in the *Telephone number* box. Click *OK* when the configuration is complete. Note that you can recall the communication configuration display at any time while the Minicom is offline by clicking the *Configure comms* button in the *Function* panel located in the main control screen.

Once the communications has been configured the operating mode (online or offline) panel will appear. The operating mode will default to online. Also, most of buttons in the left hand panel are now enabled.

8.2.2 Existing configuration

This mode of operation is used when you want to modify an existing Minicom configuration. After clicking *Open* a file selection window will open. You can select any directory you wish by clicking in the Directory window. The file selection window will contain a list of any configuration files in the selected directory. To select a configuration file either double click

on the file name or click once on the file name and then click the *OK* button. This will load the selected configuration file. Note that the selected configuration file must match the data which is stored in the database.

8.3 Important information if using the program for the first time

All data concerning the physical description of the Minicom and the field wiring connected to it are stored in a database. This database is used by the rest of the program. Every point which is used **MUST** have an entry in the database. Points which are not specified in the database cannot be configured in any way. When exiting the control program a backup copy of the database is created. It is desirable to make a copy of the database on a floppy disk after making changes. This floppy disk should be stored remotely from the main computer to safeguard the data in the case of fire etc. This is standard backup procedure. The database files are *facility.mdb* and *facility.ldb*.) The communications configuration data is stored in a file called *facility.ini*. There will be one such file in each working directory.

Throughout this manual reference is made to *channels*. The term *channel* is used as a generic term referring to an analogue or digital input or output. Thus there are a total of 80 physical input and output channels on a MC11 Minicom. (There are 24 analogue input channels, 24 digital input channels, 20 analogue output channels and 24 digital channels). All channels are independent of each other. For example, you can assign any analogue input to any analogue input channel. Note that for a MC11 8 inputs can be either analogue or digital channels and 4 outputs can be either analogue or digital channels.

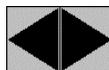
8.4 Methods of inputting data to the program

The Sphere Systems control program uses a mouse for most interactions with the program. In only very limited ways is it necessary (or even possible) to type data into the program. In most other cases data input is via scroll bars such as that shown below:



To change the value associated with this scroll bar adopt any one of the following methods:

- Click on either of the arrows to decrease or increase a value by a small amount (usually about 0.5%)
- Click on the space between the central slider button and the arrow button to either decrease or increase a value by a large change (usually about 10%).
- Place the cursor over the central slider button and depress the left mouse button. While holding the mouse button down drag the slider from left to right or right to left. As you drag the slider the value in the associated data field will change. When the desired value is reached release the left mouse button.



Spin buttons such as the one shown above are used to allow the increase or decrease of a numeric value. To use a spin button position the mouse cursor over the appropriate arrow (left arrow decreases the value, right arrow increases the value) and either click the left mouse button to change the value by 1 or hold the left mouse button down and the value will scroll through all allowed values.

8.5 Configuring a Minicom

The main steps to go through when configuring a system are:

- Generate a list of points describing the field wiring. These point names and their descriptions can be entered directly into the database (see next section).
- For each point the type of point has to be specified together with its channel number on the Minicom. This can be done after the points schedule has been entered. Until this information is entered the point cannot be configured.
- The type of sensor or actuator connected to the point should be specified. Again, this information can be entered later if desired. If no entry is made in this field then it will not be possible to set many of the Minicom configuration parameters.
- After the points schedule is complete it is possible to start configuring individual points on the Minicom.
- Control functions can also be configured at this time.
- If the configuration is being done online (not recommended for a new installation) then after each individual point has been configured the control program will send this configuration data to the Minicom. Otherwise after finishing the Minicom configuration it is necessary to send the whole configuration data to the Minicom.
- When exiting the configuration part of the program all the configuration data is saved in the configuration file specified earlier.
- The physical hardware configuration also has to be described and sent to the Minicom.
- Configuration of alarms and logging is done after the Minicom has been configured. These procedures will be discussed later.

8.6 Manipulating the points database

To access the points database click on the *Minicom configuration* button in the functions box. This will bring up a new form labelled *Points schedule*.

This window is divided into several sections. The top part of the window is a listing of the points database. This has columns showing the code assigned to the point (must be no more than 8 characters and must not include spaces), a description of the point (which can be any arbitrary text up to 40 characters), a two character code describing the type of input or output that the point corresponds to and the physical channel number on the minicom. The type of input or output points are as follows:

Code	Point type
AI	analogue input
AO	analogue output
AV	analogue variable
DI	digital input
DO	digital output
DV	digital variable
LS	loop setpoint

Below the points table are two boxes. The left hand box allows the sorting of the points table by alphabetical order. The sorting can be done on any of the four columns. Click on the down pointing arrow to show the list of choices then click on the desired column name in this list. Clicking the *Sort* button will then sort the database.

It is also possible to find a specific entry in the database. To do this select the column to search as above and then type the text to look for in the window below the *Find* button. Click on the *Find* button to locate the text. The text to search for need not be a full entry in the table. Any part of a word will do (including spaces). If the text string is found that entry in the table will be highlighted. Repeated clicking of the *Find* button will step to the next occurrence of the text string.

The right hand box is the control panel for this window. The database manipulation functions associated with this control panel are described in the next two sections.

8.6.1 Adding points to the database

To add a new point to the data base click on the *Add points* button. This will open up a new form headed *Define points*. This form has a number of fields.

The first step is to assign a point code to the new point. This code must be less than 8 characters and should not include any spaces. It also must be unique. The cursor will be in the correct place to allow the code to be entered. When the code has been entered either use the *TAB* key to step to the next field (the *point type* field) and use the up and down arrows to step through the choices, or use the mouse to click on the down arrow in the *point type* field and then click on the desired point type. When the correct type of point has been selected position the cursor in the *point description* field and type in a descriptive name for this point. This name will be used whenever the point is referred to in the rest of the program so it is desirable to use a name which reflects what is connected to the point or what the point is controlling. For example a name such as *Analogue input 4* is not particularly useful. A better name would be *room 39 temperature*.

After selecting the description the next step is to assign a type of sensor or actuator to the point. Do this by clicking on the down arrow in the *Sensor/actuator* field to display the current list of devices available. If the correct type of sensor is shown then click on the desired sensor otherwise this data will have to be filled in later.

Loop setpoints are internal to the Minicom and are only relevant when the loop setpoint in a continuous function is set to a fixed value. There is no need to assign a sensor or actuator to this type of point.

Finally, it is necessary to set the channel number field. Position the cursor to the field and type in the desired channel number. For loop setpoints the number to enter is the continuous function loop number.

It is not necessary to enter data for all the fields at this time. The only essential item of data is the point code. The rest of the data can be entered or amended at a later time.

When all the data has been entered press the *Update* button to save the new point data. If there are any errors in the entered data then an error message will occur. The data must be corrected before the system will accept it.

After successfully adding a new point more new points can be added by pressing the *Addnext* button.

The *Previous* and *Next* buttons allow the previous and next records in the database to be displayed. These need not be the next records appearing in the points listing in the previous form.

8.6.2 Editing a point in the database

To edit a point in the database, first click on the point in the points table. This will change the background colour of the line describing the point to yellow. Then click on the *Edit* button. The *Define points* form will be displayed. If you attempt to edit a point without selecting it first an error message will be displayed.

Editing a point is almost identical to adding a new point. Just position the cursor over the field to amend or enter and type the required information, or in the case of dropdown lists just click on the selected entry. All entries (including the point code) can be changed. When finished editing a record click the *Update* button to update the record. If you edit the point code without changing it then the update will fail as the system will find a point of this name in the database (ie. the point is not unique). In this case rename the point code to some other name and then re-edit it to change it back to what it originally was.

8.6.3 Deleting a point in the database

To delete a point in the database, first select the point as if you were going to edit it. When the *Define points* form appears click on the *Delete* button to delete the point. You can delete several points one after the other by using the *Next* and *Previous* buttons to step through the points. The point order might not be the same as that displayed in the points table in the *Point schedule* form.

8.7 Adding a new type of sensor or actuator

To add a new sensor or actuator to the list of possible devices, click on the *Add new sensor/actuator* button in the *Points schedule* form. This will result in a new form with a heading *Add a new sensor/actuator* becoming visible.

A name describing the type of sensor or actuator can be typed in. This name can be any arbitrary name including spaces or any other keyboard character. It is limited to 40 characters.

The characteristics of the sensor or activator have to be entered. The *Units* field refers to the physical units of the sensor (for example: kPa for pressure sensors, % RH for relative humidity). If the units are °C then there is no need to type the units just click on the circle labelled °C, otherwise type the physical units. Each sensor has its own scaling factors. The two parameters needed are the value of the sensor output (or actuator input) at a value of 0 Volts and the value at 10 Volts. The program will fit a straight line between these two readings.

For example, if you have a pressure sensor which for an output voltage of 0 Volts reads 230 kPa and for an output of 10 Volts reads 320 kPa enter the following values in the 3 fields:

Units: kPa
Value at zero scale: 230.00
Value at full scale: 320.00

If you wish to add a temperature sensor to the table of available devices and the sensor has a range of 15°C at 0 Volts to 30°C at 10 Volts enter the following values:

Units: click the °C dot
Value at zero scale: 15.00
Value at full scale: 30.00

Click the Save button when finished. This will add the device to the table of available devices. You can only add one device at a time. Click the End button to close the form.

You can make changes to previously defined types of sensor or actuator. Use the Next and Prev buttons to move from sensor to sensor. When you have reached the desired sensor just make the changes desired and click the Update button to save the changes.

Clicking the Cancel button will close the form without making any changes to the database.

8.8 Configuring a Minicom

After you have defined a number of points in the database you may wish to start configuring them before defining more points. To configure a Minicom click the button labelled Configure Minicom. This will result in a form headed *Setup minicom file: MC11* being displayed. The Minicom type is displayed for reference. In the line above it is specified as a MC11 but it could be any other type of Minicom depending on your selection in the opening login screen.

This new form has two sorts of controls on it. There are a number of boxes displayed with buttons to allow various functions and there is also a menu of different choices. To select a function you can either click on the button or on the menu. Clicking on the menu will display a dropdown list of choices and you can then click on the function you wish to perform. In several cases the dropdown list will have a small arrow on its right hand side. This indicates that there are sub-menus associated with this function. Clicking on the function will then display the submenu.

When the Minicom configuration form is displayed there is also a *Resource* form displayed. This lists the available resources available in the Minicom and how many of these are currently

used. A resource is an input, output, variable, function or loop. You cannot make any changes to this form but it will automatically update each time a resource is used or freed.

8.8.1 Common characteristics of configuration forms

Each form has in its top left corner a coloured field stating the channel number for this input. This corresponds to the physical input or output on the Minicom. Only points that have been described in the points database can be configured. Beneath this channel number field is the name given to this point in the database. This field cannot be changed and is for reference purposes only. There is also a checkbox labelled *Used* next to the channel number. This box is automatically checked if the input, output etc is used. In the case of maximum and logic functions you have to manually check this box to enable the function.

In the case of analogue parameters there will be three green boxes indicating the units for the sensor or actuator connected to this point and the sensor/actuator values for 0 Volts (zero) and 10 Volts (full scale).

Most forms contain a button marked *Print*. Pressing this button will result in a screen dump of the form being sent to the currently selected Windows printer.

8.8.2 Configuring an analogue input

To configure an analogue input either click on the button labelled *Inputs* in the *Define* box in the *Setup minicom* form, or click on the *Define* menu item and then click on the *Analog inputs* item in the dropdown list. This will result in the *Analogue input setup* form being displayed. The only channels that can be viewed are those that have been described in the points database.

The analogue input setup form has a variety of fields. Some of these fields have been described in Section 8.8.1. On the right hand side of the form is a panel labelled *Generated events*. There are four checkboxes in this panel. Each checkbox represents one possible event that can be generated. Any number of the bottom three checkboxes can be checked (turned on) but selecting the top option (none) will turn all the other checkboxes to their unchecked (off) state. Clicking on a checkbox to turn it on will result in the display of the relevant threshold for that event. The display of the threshold will be in the units described in the green units box.

To adjust the threshold for the event you must use the scroll bar which appears next to the numerical display of the threshold value, You cannot type numbers into the numerical display. You can use one or more of the methods detailed in Section 8.4 to change the value. Note that what you are doing here is setting the threshold levels for events (alarms) you are not enabling the alarm. The event can only be enabled using the *Monitor minicom* control button in the *Login* form.

When the configuration is complete press the *OK* button to save the configuration. Pressing the *Cancel* button will not save the configuration.

After pressing either of these buttons they will disappear and a new panel labelled *Select channel* will appear. This contains three buttons marked *Next*, *Prev* and *Finish*. The first two of these buttons allow you to step through channels one at a time (remember only those channels described in the database can be accessed). The *Finish* button will close the form and revert to the Minicom configuration form.

If you are running in the online mode each time you press the *OK* button the configuration data for that input will be downloaded to the minicom.

8.8.3 Configuring an analogue output

To configure an analogue output either click on the button labelled *Outputs* in the *Define* box in the *Setup minicom* form, or click on the *Define* menu item and then click on the *Analog outputs* item in the dropdown list. This will result in the *Analogue output setup* form being displayed. The only channels that can be viewed are those that have been described in the points database.

There are 4 fields associated with the various parameters which can be set for an analogue output. These are the Maximum, Minimum, Value and Inhibit values. The units for these fields are those specified next to the green descriptions.

The Maximum field displays the maximum level that the analogue output can be set to.

The Minimum field displays the minimum value that the analogue output can be set to.

The Value field displays the value that the analogue output should be set to. This value will be forced to be between the maximum and minimum value specified. If the analogue output is being driven by a loop then this field has no meaning and can be ignored.

The Inhibit value field displays the value the analogue output should take if it is inhibited. This field only has a meaning if the analogue output can be inhibited (ie controlled by a digital source).

The values in these 4 fields can be changed by means of the scroll bars next to the fields. It is not possible to type numbers into the fields.

To the right of these 4 fields is a panel labelled *Action*. This allows the reversal of the output as described in Section 2.4. Direct action results in an increase in the analogue output resulting in an increase in voltage at the output terminal while reverse action means that an increase in the analogue output results in a decrease in voltage at the output terminal.

The *No local* checkbox stops any loop or function within the minicom from changing the analogue output.

As mentioned in Section 2.4 each analogue output can be inhibited (set to a predefined state) by a digital output. To enable this inhibit system click on the down arrow in the box below the *Inhibit source* label. This will open up a set of possible inhibit sources. Click on the desired type of source. A new set of controls will appear. The left hand box shows the channel number of the chosen inhibit source. This channel number can be changed by positioning the mouse cursor over one of the 2 spin buttons next to the box. Holding the left mouse button down will then let the channel number scroll. Release the mouse button when the desired channel has been selected.

Beneath the channel number selection will appear the name assigned to the channel. This name is taken from the points database. You can choose whether the inhibit should be applied when the selected inhibit source is *true* or *false*. Just click on the circle for whichever choice you make.

When the configuration is complete press the *OK* button to save the configuration. Pressing the *Cancel* button will not save the configuration.

After pressing either of these buttons they will disappear and a new panel labelled *Select channel* will appear. This contains three buttons marked *Next*, *Prev* and *Finish*. The first two of these buttons allow you to step through channels one at a time (remember only those channels described in the database can be accessed). The *Finish* button will close the form and revert to the Minicom configuration form.

If you are running in the online mode each time you press the OK button the configuration data for that input will be downloaded to the minicom.

8.8.4 Configuring an analogue variable

To configure an analogue variable either click on the button labelled *Variables* in the *Define* box in the *Setup minicom* form, or click on the *Define* menu item and then click on the *Analog variables* item in the dropdown list. This will result in the *Analogue variable setup* form being displayed. The only variables that can be viewed are those that have been described in the points database.

This form has 3 values that can be set. The *Value* is the value to set the analogue variable to. This field need not be set if the analogue variable is going to be used as the output of another function.

The other two parameters that can be set are the *Default value* and the *Timeout*. As explained in Section 2.6, each time an analogue variable is written to, the counter for that variable is reset to 0. This counter is incremented once per second. When the counter reaches the Timeout value the Analogue variable Default value becomes the Value of the variable. (If the Timeout is set to 0 then the default value is never used).

When the configuration is complete press the *Next* or *Prev* buttons to save this setup and move to the next or previous variable (remember only those variables described in the database can be accessed). The *Finish* button will close the form and revert to the Minicom configuration form.

If you are running in the online mode each time you press any button the configuration data for that variable will be downloaded to the minicom.

8.8.5 Configuring a digital input

To configure a digital input either click on the button labelled *Inputs* in the *Define* box in the *Setup minicom* form, or click on the *Define* menu item and then click on the *Digital inputs* item in the dropdown list. This will result in the *Digital input setup* form being displayed. The only channels that can be viewed are those that have been described in the points database.

The panel labelled *Generated events* allows the setting of the possible alarms that this input can generate. Click on the relevant checkboxes to enable or disable those alarms. The alarms will not be activated at this stage and must be activated when in the monitoring minicom mode.

A digital input can be a normally open or a normally closed type. These two possible states have to be translated into the internal values of *true* and *false*. The value *true* corresponds to an input which is activated, for example a normally open input would be *true* if in the closed state while a normally closed contact is *true* when in the open state. The value *false* corresponds to an input which is in its inactivated state. (You can consider the word *activated* to be the same as *true*, and the word *unactivated* to be the same as *false*). To cope with the 2 possibilities of normally open and normally closed contacts the minicom can invert the input value before using it in processing. This effectively can make all inputs appear as normally open types. It is necessary to check or uncheck the box below the *Generated events* panel to describe to the minicom the type of switch connected to this input.

When the configuration is complete press the OK button to save the configuration. Pressing the Cancel button will not save the configuration.

After pressing either of these buttons they will disappear and a new panel labelled *Select channel* will appear. This contains three buttons marked *Next*, *Prev* and *Finish*. The first two of these buttons allow you to step through inputs one at a time (remember only those channels described in the database can be accessed). The *Finish* button will close the form and revert to the Minicom configuration form.

If you are running in the online mode each time you press the *OK* button the configuration data for that channel will be downloaded to the minicom.

8.8.6 Configuring a digital output

To configure a digital output either click on the button labelled *Outputs* in the *Define* box in the *Setup minicom* form, or click on the *Define* menu item and then click on the *Digital outputs* item in the dropdown list. This will result in the *Digital output setup* form being displayed. The only channels that can be viewed are those that have been described in the points database.

The digital output configuration form is complex due to variety of different functions associated with a digital output. Beneath the cyan label giving the output number the program displays the name given to this point in the database. To the right of this name is a panel labelled *State*. Click *On* or *Off* depending on whether you want the digital output to be in the on (*true*) or off (*false*) state. The check box next to the *State* panel can be checked to invert the digital output. Check this box if you need to use a relay which is Normally Closed. (The purpose of this box is to isolate the actual physical characteristics of an output from the logical state that the program uses. For example, if the program drives a digital output to the *true* state then if the output is configured to be normal action the physical output will be high but if the check box is checked, reverse action, the actual physical output will be low.)

Associated with each digital output is a power up delay. After the power to the minicom is turned on each digital output will be held in the *false* state until the power up delay has expired. (Note that this *false* state can correspond to the physical output being on or off depending on the setting of the Normal/Reverse action check box). The power up delay is measured in seconds and can be adjusted by means of the scroll bar.

As detailed in Section 2.5, each digital output has a guard time facility. The controls for this facility are located in the panel labelled *Guard time*. Clicking the down arrow beneath the label for *Checked input* will bring up a list of possible minicom points that can be checked. Click on whichever type of point you wish to check and then use the scroll bar below to select the channel number. The check box below allows you to select the state that the selected point should be in after the guard time expires. You can select the guard time in seconds. The guard time is changed by means of its scroll bar. A guard time of 0 disables the guard time checking. The guard timer can be started after the output goes on (*true*) or off (*false*). Click the check box to select when the guard timer should start. If you wish to enable an event (alarm) if there is a guard time failure check the *Enable event on error* check box. An example of how to use the guard time is as follows:

Suppose the digital output is driving a fan and the fan is on when the output is *true*. There is a airflow switch located some distance away from the fan so that it can take, say, 3 seconds after the fan starts for the airflow switch to close. The airflow switch is normally open and closes on detecting airflow. The airflow switch is connected to digital input 3. You wish to generate an alarm if the airflow switch does not detect airflow within 5 seconds of the fan starting.

The settings to accomplish this are:

- guard time set to 5 seconds
- Timer starts after output goes *On*
- checked input set to *Digital input*
- input channel set to 3
- Input after guard time should be *On (true)*
- Enable event on error *checked*
- Digital input 3 should be configured as a *Normally open* input

Each digital output has a short cycle timer associated with it. The short cycle timer can be started either when the output goes on (Positive polarity) or when the output goes off (Negative polarity) by clearing or checking the polarity checkbox. If while the short cycle timer is active the output becomes *false* then it will not be able to become *true* again until the short cycle time has elapsed. The short cycle timer has no effect on the output provided the output does not change state. You can adjust the short cycle time by means of the scroll bar. Some examples of how to use the short cycle time is as follows:

A pump is on when the digital output is *On (true)*. The pump should only be turned on 3 times in an hour. The settings to accomplish this are:

- Set the short cycle time to 20 minutes
- Set the polarity to *Positive polarity*

A chiller should not be turned on for 15 minutes after it has been turned off. The settings to accomplish this are:

- Set the short cycle time to 15 minutes
- Set the polarity to *Negative polarity*

Each digital output can be inhibited by any other digital input, output or variable. When the selected inhibit source becomes true it forces the digital output to the inhibit value. To set an inhibit source click on the down arrow in the *Inhibit* panel to display the various choices available and then click on the desired source. A channel selection scroll bar and text box will appear below the selected source. Use the scroll bar to select the desired channel. Any channel can be selected even if it is not in the database. If the selected channel is in the database then the point name will be shown beneath the source data. To select the desired state of the output when the inhibit source becomes *true* click on one of the 2 option buttons in the panel.

When the configuration is complete press the OK button to save the configuration. Pressing the Cancel button will not save the configuration.

After pressing either of these buttons they will disappear and a new panel labelled *Select channel* will appear. This contains three buttons marked Next, Prev and Finish. The first two of these buttons allow you to step through outputs one at a time (remember only those channels described in the database can be accessed). The Finish button will close the form and revert to the Minicom configuration form.

If you are running in the online mode each time you press the OK button the configuration data for that channel will be downloaded to the minicom.

8.8.7 Configuring a digital variable

To configure a digital variable either click on the button labelled *Variables* in the *Define* box in the *Setup minicom* form, or click on the D*efine* menu item and then click on the *Digital variables* item in the dropdown list. This will result in the *Digital variable setup* form being displayed. The only variables that can be viewed are those that have been described in the points database.

This form has 3 values that can be set. The *State* is the value to set the digital variable to. This field need not be set if the digital variable is going to be used as the output of another function.

The other two parameters that can be set are the *Default value* and the *Timeout*. As explained in Section 2.6, each time a digital variable is written to, the counter for that variable is reset to 0. This counter is incremented once per second. When the counter reaches the Timeout value the Digital variable Default value becomes the Value of the variable. (If the Timeout is set to 0 then the default value is never used).

When the configuration is complete press the N*ext* or P*rev* buttons to save this setup and move to the next or previous variable (remember only those variables described in the database can be accessed). The F*inish* button will close the form and revert to the Minicom configuration form.

If you are running in the online mode each time you press any button the configuration data for that variable will be downloaded to the minicom.

8.8.8 Configuring a maximum function

To configure a maximum function, either click on the M*aximum* button in the *Set functions* panel or click on the S*et* menu item followed by clicking on the F*unction* and M*aximum* items in the menu. This will open a form headed *Maximum function*.

The source box lists the four possible sources for a maximum function. To add a source to the function, click on the type of source and then use the scroll bar to select the channel number required. You can add any channel to the list even if it is not specified in the database. If the channel is listed in the database, then the name assigned to it will appear below the source box. Finally to add it to the list of sources click on the A*dd >>* button. This will result in an entry appearing in the list on the right side of the form. This list is sorted into alphabetical order. (The Loop error source is used to allow the minicom to do zoning. See Section 8.8.17).

Keep repeating the above procedure for each input to the function. You can have up to 16 possible inputs to a Maximum function.

To delete an entry click the entry in the list. This will make the entry background colour change. Then click the D*elete* button to delete the selected entry.

The next step in creating a maximum function is to describe where the output of the function goes. Click on the down pointing arrow to display the available choice of outputs and then click on the desired output to select it. The channel number for the output can be selected by using the scroll bar underneath the output label.

Clicking the S*ave config* button will save the configuration in the configuration data file while clicking C*ancel* will not. Clicking the S*ave config* button will also cause the *Used* checkbox to become checked thus enabling the function. To disable the function click on the *Used* checkbox to clear it.

After pressing either of these buttons they will disappear and a new panel labelled *Select function number* will appear. This contains three buttons marked *Next*, *Prev* and *Finish*. The first two of these buttons allow you to step through maximum functions one at a time. They will step through all maximum functions, used or not used. The *Finish* button will close the form and revert to the Minicom configuration form.

If running in the online mode the logic function data will be downloaded to the minicom provided that the *Used* checkbox is checked.

8.8.9 Configuring a logic function

To configure a logic function, either click on the *Logic* button in the *Set functions* panel or click on the *Set* menu item followed by clicking on the *Function* and *Logic* items in the menu. This will open a form headed *Logic function*.

The source box lists the three possible sources for a logic function. To add a source to the function, click on the type of source and then use the scroll bar to select the channel number required. You can add any channel to the list even if it is not specified in the database. If the channel is listed in the database, then the name assigned to it will appear below the source box. Finally to add it to the list of sources click on the *Add >>* button. This will result in an entry appearing in the list on the right side of the form. This list is sorted into alphabetical order.

Keep repeating the above procedure for each input to the function. You can have up to 16 possible inputs to a Logic function.

To delete an entry click the entry in the list. This will make the entry background colour change. Then click the *Delete* button to delete the selected entry.

The type of logic function is selected by clicking one of the top two choices in the *Function type* box (the *AND* and *OR* option buttons). The output of the function can be inverted (ie. a *true* output becomes a *false* output). This is done by clicking the *Invert* checkbox in the same box. When this checkbox is checked the output of the function is inverted otherwise it is not.

The next step in creating a logic function is to describe where the output of the function goes. Click on the down pointing arrow to display the available choice of outputs and then click on the desired output to select it. The channel number for the output can be selected by using the scroll bar underneath the output label. (The output of a logic function can go to a digital variable or can be used to control an analogue output).

Clicking the *Save config* button will save the configuration in the configuration data file while clicking *Cancel* will not. Clicking the *Save config* button will also cause the *Used* checkbox to become checked thus enabling the function. To disable the function click on the *Used* checkbox to clear it.

After pressing either of these buttons they will disappear and a new panel labelled *Select function number* will appear. This contains three buttons marked *Next*, *Prev* and *Finish*. The first two of these buttons allow you to step through logic functions one at a time. They will step through all logic functions, used or not used. The *Finish* button will close the form and revert to the Minicom configuration form.

If running in the online mode the logic function data will be downloaded to the minicom provided that the *Used* checkbox is checked.

8.8.10 Configuring a delay function

To configure a delay function, either click on the *Delay time* button in the *Set functions* panel or click on the Set menu item followed by clicking on the Function and Delay time items in the menu. This will open a form headed *Delay function*.

The first step in creating a delay function is to describe where the input of the function comes from. Click on the down pointing arrow to display the available choice of inputs and then click on the desired input to select it. The channel number for the input can be selected by using the scroll bar underneath the input label. (The input of a delay function can be from a digital input, output or variable). If there is a name assigned to the channel then that name will appear below the scroll bar and channel number.

Normally the function would be activated when the selected input becomes *true*, however, you can make the function become activated when the input becomes *false* by checking the checkbox below the input channel scroll bar. The next step in creating a delay function is to describe where the output of the function goes. Click on the down pointing arrow to display the available choice of outputs and then click on the desired output to select it. The channel number for the output can be selected by using the scroll bar underneath the output label. (The output of a delay function can go to a digital variable or can be used to control an analogue output).

The final step in creating a delay function is to set the desired delay time. Use the scroll bar to set the time. The delay time is displayed in hours, minutes and seconds next to the scroll bar. A click on the arrow box at either end of the scroll bar will change the time by 1 second while a click to either side of the scroll button will change the time by 1 minute.

Clicking the Save config button will save the configuration in the configuration data file while clicking Cancel will not. The *Used* checkbox will become checked if the time delay is set to a non-zero value. You can also mark the function as used by clicking the *Used* checkbox, but this should not be necessary.

After pressing either of these buttons they will disappear and a new panel labelled *Select function number* will appear. This contains three buttons marked Next, Prev and Finish. The first two of these buttons allow you to step through delay functions one at a time. They will step through all delay functions, used or not used. The Finish button will close the form and revert to the Minicom configuration form.

If running in the online mode the delay function data will be downloaded to the minicom provided that the *Used* checkbox is checked.

8.8.11 Configuring a continuous loop

To configure a continuous loop, either click on the *C*ontinuous button in the *S*et loops panel or click on the *S*et menu item followed by clicking on the *L*oops and *C*ontinuous items in the menu. This will open a form headed *A*nalogue loop configuration. Forms for analogue inputs and analogue outputs will also appear.

The method of setting the source, setpoint and output for the loop are all identical. Click on the down arrow for the desired parameter to display a list of choices and then click on the selected choice. Use the spin buttons below to select the channel desired. Any channel can be selected even if it is not entered into the database. If the channel is entered into the database then the name assigned to that channel will be displayed. If the source you select is a *F*ixed value then the scroll bar below allows you to set the value in terms of percentages of full scale.

Each time you select a type of input etc or a channel number the configuration form for that combination of input and channel will be displayed. You can use these forms to configure the point as mentioned in previous sections however you cannot step channels. Clicking the *O*K button will hide the form until a change is made on the *A*nalogue loop configuration form.

The *l*oop gain can be selected as a number between 0 and 255 by means of the scroll bar. High loop gains can make the loop unstable. The correct value for any given situation has to be found by experimentation. As a guide start with a loop gain of about 10.

The continuous functions can use *i*ntegral gain. Errors in setting the integral gain can make the continuous loop very unstable. The method used more often in the minicom is to use an *O*ffset. This works very well in typical building situations. To set the offset value start with an offset of 0 and adjust the loop gain until the output of the loop settles at the desired value. (ie. until say the room temperature settles to the desired value). Then look at the value of the output in terms of full scale and set this value to the *O*ffset value. Do not adjust the loop gain.

The *P*olarity of the loop can be changed by clicking the appropriate value in the *P*olarity panel. The polarity is typically different for heating and cooling.

The loop can be enabled or disabled by clicking on the appropriate option button in the *L*oop *E*nable panel.

Clicking the *S*ave config button will save the configuration in the configuration data file while clicking *C*ancel will not. Clicking the *S*ave config button will also cause the *U*sed checkbox to become checked.

After pressing either of these buttons they will disappear and a new panel labelled *S*elect loop will appear. This contains three buttons marked *N*ext, *P*rev and *F*inish. The first two of these buttons allow you to step through continuous loops one at a time. They will step through all loops, used or not used. The *F*inish button will close the continuous loop configuration form and all associated forms and revert to the Minicom configuration form.

If running in the online mode the continuous loop data will be downloaded to the minicom provided that the *U*sed checkbox is checked.

8.8.12 Configuring a discrete loop

To configure a discrete loop, either click on the *Discrete* button in the *Set loops* panel or click on the *Set* menu item followed by clicking on the *Loops* and *Discrete* items in the menu. This will open a form headed *Discrete loop configuration*. Forms for analogue inputs and analogue outputs will also appear.

The loop input, lower window, upper window and loop output are all set the same way. Click on the appropriate down arrow to bring up the choices available, then click on the desired choice. Use the appropriate spin buttons to select the desired channel. Any channel can be selected even if it does not appear in the database. If the selected channel is listed in the database, the name assigned to the channel will be displayed.

The lower and upper hysteresis values can be adjusted by means of the scroll bars. The range of values available is from 0 to 255. It is strongly suggested that only low values (below 5) are used.

The type of loop (*window* or *switch*) can be selected by clicking the appropriate button in the *Type* panel. The polarity of the output can be changed by clicking the appropriate option button in the *Polarity* panel. The message next to the *Type* panel will change as both the polarity and loop type change.

The loop can be enabled or disabled by clicking the appropriate button in the *Enable* panel.

Clicking the *Save config* button will save the configuration in the configuration data file while clicking *Cancel* will not. Clicking the *Save config* button will also cause the *Used* checkbox to become checked.

After pressing either of these buttons they will disappear and a new panel labelled *Select loop* will appear. This contains three buttons marked *Next*, *Prev* and *Finish*. The first two of these buttons allow you to step through discrete loops one at a time. They will step through all loops, used or not used. The *Finish* button will close the discrete loop configuration form and all associated forms and revert to the Minicom configuration form.

If running in the online mode the discrete loop data will be downloaded to the minicom provided that the *Used* checkbox is checked.

8.8.13 Setting public holidays

To set public holidays either click on the *Public holidays* button in the *Set time clocks* panel or click on *Set* followed by clicking on *Time clocks* and *Public holidays* in the menu. This will open up a form called *Public holidays*.

To add a public holiday to the list of holidays click on the date. This will change the date colour and cause a new line to be added to the list of public holidays displayed on the right side of the form.

To change the month or the year click on the appropriate down pointing arrow to display a list of choices. If a scroll bar appears you can use this to show more choices. Click on the chosen item to select it. The calendar will change as well. You can add up to 16 public holidays.

To delete a public holiday either click on the coloured date in the calendar, or click on the entry in the holiday list to select it and then click on the *Delete* button to delete the selected item.

Clicking the *Finish* button will close the form. If running in the online mode then the holiday list will be downloaded to the minicom.

8.8.14 Setting time clocks

To set a timeclock either click on the *Set clock* button in the *Set time clocks* panel or click on *Set* followed by clicking on *Time clocks* and *Clocks* in the menu. This will open up a form called *Set time clock*

The *start* and *stop* times for the clock can be set by means of the scroll bars beneath the *hours* and *minutes* labels. Hours and minutes are set separately. An error message is generated if the stop time is earlier than the start time.

The days of the week when this clock should be active can be set by checking the appropriate boxes in the *When active* panel. If the clock should be active on a public holiday then check the *Public Holiday* checkbox.

To select what the time clock should control click the down arrow beneath the *Output* label. This will display a list of choices. Click on the desired choice and use the spin buttons to select the desired channel. Any channel can be selected even if it does not appear in the database. If the selected channel is listed in the database, the name assigned to the channel will be displayed.

Clicking the *Save config* button will save the configuration in the configuration data file while clicking *Cancel* will not. Clicking the *Save config* button will also cause the *Used* checkbox to become checked.

After pressing either of these buttons they will disappear and a new panel labelled *Select loop* will appear. This contains three buttons marked *Next*, *Prev* and *Finish*. The first two of these buttons allow you to step through timeclocks one at a time. They will step through all timeclocks, used or not used. The *Finish* button will close the set time clock form and revert to the Minicom configuration form.

If running in the online mode the timeclock data will be downloaded to the minicom provided that the *Used* checkbox is checked.

8.8.15 Setting the board configuration

Some types of minicom allow the addition of expansion modules. These types of minicom perform routine checks to see if the current board configuration matches a preset configuration. If the configuration is not correct then an alarm is raised. For the system to function correctly it is necessary to set the minicom configuration.

To set the minicom configuration click on the *Boards* menu item. A new form will be displayed with separate fields for each type of expansion module that can be added. Click on the arrows in each field to describe the minicom hardware configuration. Clicking on the up pointing arrow will increase the number of expansion boards and clicking on the down arrow will decrease the number of expansion boards.

When the configuration is correct click on the *OK* button.

8.8.16 Printing the minicom configuration

To print the complete minicom configuration either click on the *Print* button or click on the *Control* menu item and then click on *Print*.

8.8.17 Programming a minicom

To program a minicom you must have set the program to be in the online state. This is done in the *Login* form by clicking on the *On line* option button in the *Configuration* box. If the minicom is online then it can be fully programmed by clicking the *Program* button or by clicking the *Control* menu item and then clicking *Program* in the dropdown menu list. A status form will show how the programming is proceeding. Programming can take up to a minute.

8.8.18 Examples of control functions which can be implemented

8.8.18.1 Using a minicom to control zones in a building

In many buildings a group of rooms are clustered together and considered a single zone for heating and cooling. This sort of system works by determining which room requires the most cooling and supplying sufficient cooling for this room. Each room also has its own re-heat valve which allows it to be kept at the set temperature. Thus for each room there is a temperature sensor and there is also a temperature setpoint for each room.

For example consider a zoned system comprising 5 rooms. To control such a zoned system the minicom is set up as follows:

- Each temperature sensor is connected to an analogue input. Thus connect temperature sensors 1 to 5 to analogue inputs, say, 1 to 5.
- A continuous function loop is assigned to each temperature sensor with the loop input set to an analogue input (temperature sensor). The loop setpoint is set to the desired temperature in the room and the loop output drives the re-heat valve for that room. Thus for loop 3 (room 3) the input would be analogue input 3 and the output would be analogue output 3. The loop setpoint is set at a fixed value corresponding to the desired room temperature. The loop gain and offset have to be determined later. Start by assigning the loop gain to 10.
- A maximum function is assigned to determine the maximum cooling required. The inputs for this maximum function are the loop errors for each of the continuous function loops configured above. The output of this maximum function is set to an analogue variable. In our example, the inputs to the maximum function would be Loop errors 1 through 5 and the output of the maximum function would be, say, analogue variable 6. If no cooling is required the output of this function will be zero.
- Use another continuous function loop to drive the common cooling valve for this zone. This loop is configured with its input as the analogue variable where the maximum function stores its result, in this case analogue variable 6. The loop setpoint is set to a fixed value of 0 as the input to the function is already an error. The output of the function drives the analogue output to which the cooling valve is connected. Depending on the type of cooling valve used it might be necessary to reverse the loop polarity.

8.8.18.2 Using the delay function to generate a time clock override

Normally a time clock is used to control the operation of plant. It is sometimes desirable to provide a manual override to the timeclock so that plant can be operated for a specified time outside normal timeclock periods. The usual method of triggering such an override is to use the momentary closure of a switch to start the override. The delay function can be used to perform this manual override function. To set up the minicom to do this control follow the following steps:

- Program a timeclock to control the plant as desired and direct the output of this timeclock to a digital variable, say digital variable 3.
- Configure a delay function with the input to the function taken from the digital input to which the pushbutton is connected. The function should be set to start when the input becomes *true*.
- Set the delay time to the desired time the plant should be turned on for when in manual override mode.
- Set the output of the delay function to be sent to a digital variable, say digital variable 4.
- Configure a logic function with two inputs, one coming from the output of the timeclock and the other coming from the delay function. (In this case the inputs to the logic function are digital variables 3 and 4). The logic function should be set to the OR function.
- The output of the logic function can be set to either another digital variable or it can be set to control an analog output.
- To control a digital output, set the digital output inhibit to be controlled by the digital variable to where the logic function output is directed. Set the inhibit state of the digital output to the desired state when the output should be active. Set the normal state of the digital output to the opposite value. (Ie. If the output should be *On* when the timeclock or manual override is active then set the digital output state to *Off* and set the inhibit value to *On*).
- You can use the timeclock and override function to control more than one digital output by repeating the previous step for each output.
- You can also control analog outputs in a similar manner.

8.9 Monitoring a minicom

A minicom can only be monitored when it is online. To set a minicom online click the *online* option button in the *Operating mode* panel in the main control form. When a minicom is set online the *Monitor minicom* button will be enabled. Clicking this button will bring up a new form labelled *Minicom status*. This form has a menu bar and a single button labelled *Exit*. Clicking this button closes the minicom status form and reverts back to the main control panel. The menu bar in the *Minicom status* form allows you to monitor all points on the minicom.

The data displays for the various points on a minicom are all displayed in a similar manner. Data from up to 8 channels are displayed in rows across the form. The channel number is in the left column. Next to the channel number is the name assigned to this point. If the channel does not exist in the database then the message *Unused input* will be displayed as a name. If the channel is unavailable on the minicom (usually because it does not exist) the message *Unavailable* will be displayed as the channel name. Next to this field will be displayed data pertinent to the point being monitored. This data will be discussed further in the following sections.

At the bottom left hand side of each form is a panel with several buttons. Clicking the Next or Prev buttons will display the data from the next or previous group of 8 channels. The buttons will become disabled if there are no further channels in the appropriate direction. Clicking the Uppdate button will cause the program to re-read the data for the group of channels displayed on the screen. This can be used to update the display when required. The End button will close the form and revert back to *Minicom status* form.

The *Change* panel on the bottom right of the form contains controls to allow the user to modify various points in the minicom. These vary for each type of point and are discussed in the following sections. To change a value first click the Change button. This will enable the various controls in this panel. It will also change the button caption to OK. To select the channel to change use the Channel scrollbar. The channel number in the box next to the scroll bar will change as you move the scrollbar. To change a value use the various option buttons to select the item to change and use the scrollbar to change the value. The changes will be shown in the appropriate box but will not be sent to the minicom as yet. You can change as many items as you wish. When finished click the OK button to send the changed values to the minicom.

8.9.1 Monitoring analogue inputs

To monitor an analogue input click on the *Show Analog* menu item and then click on Inputs. There will be a delay as the program reads the data from the first set of up to 8 analogue inputs. The program will then display this data while it is reading data from remaining analogue inputs.

The data which is displayed for an analogue input is the actual value of the input and the lower and upper limits. The data is displayed in the units assigned to the sensor connected to this input. (Refer to section 8.6). The units are displayed to the right of the analogue input value. If no units have been assigned to this channel then the units default to percentage of full scale. To the right of the Upper limit is a text message detailing whether the channel is within the limits or outside either limit.

The only items you can change are the upper and lower windows. To change these values refer to Section 8.9 above.

8.9.2 Monitoring analogue outputs

To monitor an analogue output click on the *Show Analog* menu item and then click on Outputs. There will be a delay as the program reads the data from the first set of up to 8 analogue inputs. The program will then display this data while it is reading data from remaining analogue inputs.

The data which is displayed for an analogue output is the actual value of the output, the minimum and maximum values that the output can take and the output value when the output is inhibited. The data is displayed in the units assigned to the actuator connected to this output. (Refer to section 8.6). The units are displayed to the right of the analogue output value. If no units have been assigned to this channel then the units default to percentage of full scale. To the right of the Inhibit value is a text message area. If the analogue output is inhibited a message will be displayed here to indicate this. If the analogue output is part of a continuous function loop and the loop is enabled then it is not possible to change the analogue output. To indicate that an analogue output is being driven by a loop the message *Loop n* will be displayed, where *n* is the loop number which is driving this analogue output.

The items you can change are the output value, the minimum and maximum allowable output values and the inhibit value. (The analogue output cannot be driven below the minimum value or above the maximum value). To change these values refer to Section 8.9 above.

8.9.3 Monitoring analogue variables

To monitor an analogue variable click on the *Show Analog* menu item and then click on *Variables*. There will be a delay as the program reads the data from the first set of up to 8 analogue variables. The program will then display this data while it is reading data from remaining analogue variables.

The data which is displayed for an analogue variable is the value of the variable, the default value and the timeout associated with that variable.

You can change all three of these parameters for each analogue variable. To change these values refer to Section 8.9 above.

8.9.4 Monitoring digital inputs

To monitor a digital input click on the *Show Digital* menu item and then click on *Inputs*. There will be a delay as the program reads the data from the first set of up to 8 digital inputs. The program will then display this data while it is reading data from remaining digital inputs.

For each digital input there is a coloured circle which is green when the input is on and red when it is off. This state is the state of the input **after** any input inversion is done. Thus an input which is described as on will be the closed state for a normally open contact or the open state for a normally closed contact. The word *On* or *Off* will be displayed next to the coloured circle. To the right of this state indication is a box displaying the number of counts (ie. The number of transitions from the Off to the On state) for this input.

The only parameter which can be changed for a digital input is the number of counts. To change this value refer to Section 8.9 above.

8.9.5 Monitoring digital outputs

To monitor a digital output click on the *Show Digital* menu item and then click on *Outputs*. There will be a delay as the program reads the data from the first set of up to 8 digital outputs. The program will then display this data while it is reading data from remaining digital outputs.

For each digital output there is a coloured circle which is green when the output is on and red when it is off. This indicates the digital output before any logic inversion. There are also fields for the *short cycle* time, *guard* time and an additional field showing the *Runtime* of the output. The *Runtime* is the total time the output has been in the On state.

A digital output can be inhibited, in which case you will be unable to change it. If the output is inhibited then the word *Inhibited* will be displayed next to the guard time box. A digital output can also be driven by a discrete loop and again you will not be able to change it. If this output is being driven by a loop then the words *Loop n* (where n is the loop number) will be displayed next to the guard time box.

You can change the short cycle time and guard times for each digital output. You cannot change the Runtime value. You can also change the digital output state by clicking the word *On* or *Off*. Clicking the coloured circle will have no effect. Refer to Section 8.9 for more details on how to change parameters.

8.9.6 Monitoring digital variables

To monitor a digital variable click on the *Show Digital* menu item and then click on *Variables*. There will be a delay as the program reads the data from the first set of up to 8 digital variables. The program will then display this data while it is reading data from remaining digital variables.

For each digital variable there is a coloured circle which is green when the variable is on and red when it is off. The timeout value for the variable is also shown as its default state.

After clicking the *Change* button, you can change the state of the variable or its default state by clicking the word next to the coloured circle. You can also change the timeout associated with each digital variable. See Section 8.9 for further details.

8.9.8 Monitoring the pulse accumulator

To monitor the state of the pulse accumulator, click the *Counter* item in the *Minicom status* menu. This will result in a new form titled *Pulse counter* becoming visible.

The *Count edge* panel allows you to select whether the counter should increment when either the *P+* or *P-* inputs are grounded. Click on the desired option button.

The *Enable Counter* panel allows you to enable the counter (ie. Allow it accumulate events) or disable (ie. Stop it from accumulating events).

The *Counts* panel shows the total number of counts recorded by the counter. Clicking the *Reset* button will set the counter to zero.

The *Update* button will re-read the counter from the minicom and the *Exit* button will close this form and return to the *Minicom status* form.

8.9.8 Monitoring continuous function loops

To monitor the state of a continuous function loop, click on the *Loops* item in the menu and then click on the *Continuous loops* item. This will open a new form labelled *Continuous loop status*. The form will display 2 loops with a question mark after the loop number. You can display 2 loops at once.

To select a loop to display use the scroll bar for that loop to step through the various loops. If a loop is used the word *Used* will be displayed next to the box displaying the loop number. (There are no restrictions on which loops you can monitor but unused loops could give meaningless data and could result in error messages being displayed.) When you have set one or both scroll bars clicking the *Update* button will change the loop identification labels and the program will read the loop data from the minicom. The blue coloured labels will show the type of input and the channel number connected to the various points on the loop.

To disable a loop click the *Loop off* button. This will disable the loop and change the button caption to *Loop on*. Clicking this button again will turn the loop back on.

To change a loop parameter, click on the *Change* button. (You might have to click this button twice for the first time you want to use it). This will result in the display of several more controls. Click on the down arrow to display a list of the items you can change on this loop. Note that the only items you will be allowed to change are inputs and setpoints assigned to **Fixed** values and the loop gain and offset. If an input is assigned to a variable and you wish to change it, you will have to use the method of monitoring analogue variable to change it.

After selecting the item to change, the text box next to the scroll bar will show the current value of that item. Use the scroll bar to change the value. As you move the scroll button, the value in the box next to it will change. When you have set it to the desired value click the *OK* button to transfer the data to the minicom. You can only change one parameter at a time.

Clicking the *End* button will close this form and revert to the *Minicom status* form.

8.9.9 Monitoring discrete function loops

To monitor the state of a discrete function loop, click on the *Loops* item in the menu and then click on the *Discrete loops* item. This will open a new form labelled *Discrete loop status*. The form will display 2 loops with a question mark after the loop number. You can display 2 loops at once.

To select a loop to display use the scroll bar for that loop to step through the various loops. If a loop is used the word *Used* will be displayed next to the box displaying the loop number. (There are no restrictions on which loops you can monitor but unused loops could give meaningless data and could result in error messages being displayed.) When you have set one or both scroll bars clicking the *Update* button will change the loop identification labels and the program will read the loop data from the minicom. The blue coloured labels will show the type of input and the channel number connected to the various points on the loop. The output of the loop is indicated by the coloured circle (and the word next to it) near the output label. The circle is red if the loop output is off and green if it is on.

To disable a loop click the *Loop off* button. This will disable the loop and change the button caption to *Loop on*. Clicking this button again will turn the loop back on.

To change a loop parameter, click on the *Change* button. (You might have to click this button twice for the first time you want to use it). This will result in the display of several more controls. Click on the down arrow to display a list of the items you can change on this loop. Note that the only items you will be allowed to change are inputs and upper and lower limits assigned to **Fixed** values and the upper and lower hysteresis values. If a point is assigned to a variable and you wish to change it, you will have to use the method of monitoring analogue variable to change it.

After selecting the item to change, the text box next to the scroll bar will show the current value of that item. Use the scroll bar to change the value. As you move the scroll button, the value in the box next to it will change. When you have set it to the desired value click the *OK* button to transfer the data to the minicom. You can only change one parameter at a time.

Clicking the *End* button will close this form and revert to the *Minicom status* form.

8.9.10 Changing time clocks

To change a time clock click on the *Time* menu item and then click on *Time clocks*. This will result in the display of a form labelled *Timeclock status*.

This form displays data for groups of 8 timeclocks. For each timeclock the start and stop times are displayed together with the days of the week that the timeclock is active. If the time clock is used the point the output is controlling will be displayed together with the name assigned to that point. If the timeclock is not used the message *Not used* will be displayed.

To change a value associated with a time clock you **must** click the *Change* button. (You can click on any of the checkboxes at any time but this will have no effect to the minicom). Clicking the *Change* button enables the other controls. You can now click on any of the 8

checkboxes per timeclock to change the day of the week that each timeclock is active. If you wish to change the start or stop time of a timeclock, use the *Channel* scroll bar to select the desired timeclock and use the option buttons to select either the *Start* or *Stop* time for that timeclock. You can then use the *Hours* and *Minutes* scroll bars to change the time. You can change as many timeclocks on a screen as you wish.

To send the changes to the minicom you **must** click on the *OK* button. The *Next* and *Prev* buttons allow you to page through the various timeclocks on the minicom.

The *MC time* panel shows the current time and date in the minicom. This time is read from the minicom every 5 seconds. To update the internal minicom time click the *Set time* button.

Clicking the *Pub Hols* button will bring up the form for displaying and changing public holidays. See next Section for more details.

Clicking the *End* button will close this form and revert to the *Minicom status* form.

8.9.11 Changing public holidays

To change the list of public holidays click on the *Time* menu item and then click on *Public holidays*. This will result in the display of a form labelled *Public holidays*. (As mentioned in Section 8.9.10 you can also display this form from the *Timeclock status* form).

The current public holiday list is read from the minicom and displayed in the *Public holidays* panel. To delete a date from this list click on the date to delete (this will cause the background to change colour) and then click the *Delete date* button.

To add a date to the list use the calendar to select the day, month and year. The month and year can be changed by clicking on the appropriate horizontal arrows. Holding the left mouse button down while over an arrow will step through the various allowable months and years. Click on the selected day of the month. This will change its background colour. Then click on the *Add date* button to add the date to the current list.

The *For today only* panel allows you to declare the current day a normal day or a public holiday. Click on the appropriate choice and then click the *OK* button to send this change to the minicom. This setting overrides any settings made by the public holiday list. The setting will be cancelled by the minicom at midnight.

Clicking the *End* button will transfer the updated public holiday list to the minicom and close the form. **It will not transfer the *For today only* setting!** Control will return to wherever the form was called from (ie. The *minicom status* form or the *Timeclock status* form).

8.9.12 Monitoring events (alarms)

The minicom has a sophisticated built-in event system as described in Section 5. There is no real difference between an event and an alarm. To monitor the current event status of the minicom click the Events item in the menu and then click on either Input or Output to view the desired events. Clicking on the Input item will bring up a form labelled *Digital input event status* while clicking the Output item will bring up the *Digital output events status form*. To display the analogue input events data click on the *Analogue input events* button in the *Digital input event status* form.

The general appearance of these three forms is similar and the control of the event system is identical. As in common with other monitoring forms there is a panel consisting of Next, Prev and End buttons. These allow you to step through all possible channels in groups of 8 or close the form. (See Section 8.9 for more details). For each channel the name associated with that channel is also displayed. Each form also displays one or more groups of columns consisting of checkboxes and text fields. Each column is divided into two groups. The *Enabled* group consists of checkboxes. If a checkbox is checked then the event is enabled, otherwise it is not enabled. The *Set* column displays the word *Yes* if this event has become set otherwise the word *No* is displayed.

Clicking the Uppdate status button will read the current event status from the minicom. This will display any events which have occurred since the last time the events were read and it will also clear all current events.

To enable or disable events from occurring click on the appropriate checkboxes. The label next to the checkbox will indicate whether the event is allowed to occur or not. You can change as many of these checkboxes in a screen as you wish. When you have finished setting (or clearing) event enables click on the Uppdate enables button to transfer the data to the minicom.

Clicking the End button will close the event form and return to the *Minicom status* form.

The *Digital output events status* form behave in an identical manner to the input forms except that there is only one column of data displayed as the only event associated with a digital output is a guard time failure. To assist fault diagnosis this form also shows the tested point.

8.9.13 Simple data logging on the minicom

Simple data logging can only be done when there is no background logging specified. (See Section 8.10). Simple logging allows you to monitor any 2 digital input or output channels and any 2 analogue input and output channels in the minicom. The results of the logging are displayed in tabular form and in the case of analogue logging they can also be plotted in a graph. This function of the minicom is largely superseded by the realtime and background logging facilities. The only advantage of these simple logging facilities is that they allow you to set up a log on two points and acquire just a single frame of data. (In the case of digital points this is 16 changes of state and for analogue points it corresponds to 64 samples).

The configuration of digital and analogue logging is identical. Click either the *Input* or *Output* option button to enable channel selection. Use the scroll bar to select the channel. The channel number is displayed beneath the scroll bar and the name assigned to the channel is displayed in the panel above. Click the *Single frame* checkbox if you wish to stop acquiring data after the internal minicom buffer is full or leave this unchecked if you wish to overwrite old data with new data after the buffer fills. To read the minicom buffer click the Read button.

Click the *End* button to close the form.

8.9.13.1 Digital logging

Refer to Section 8.9.13 for information as to how to configure logging.

Each time the digital point changes state the state will be shown together with the time of change of state.

8.9.13.2 Analogue logging

Refer to Section 8.9.13 for information as to how to configure logging.

The analogue logging form has an additional scroll bar labelled *Log interval*. Use this scroll bar to tell the minicom how often to log the data. When you change the position of the scroll button the *Read* label will change to *Set log*. Click this button to transfer the data to the minicom. Click the *Read* button to read data from the minicom.

The *Plot* button can be used to display the logged data in a graphical form. For further details on how to use the graphical features refer to Section 8.10.1.2

8.10 Data logging on the minicom

Section 8.9.13 discussed a simple method of data logging on the minicom. As mentioned there, this form of data logging is largely superseded by the methods discussed in this section.

The minicom provides an internal logging capability on every input and output. In the case of the digital points the minicom keeps a history of the last 16 changes of state on the point together with the time that each change of state occurs. For analogue points the minicom keeps a history of the last 64 values of an analogue point. The minicom buffers are arranged in such a way that, when full, the newest data point overwrites the oldest point in the buffer. This internal history of the minicom is used to provide a *background logging* capability. The control program can also perform datalogging. This is termed *realtime logging*. This operates by the control program reading points in the minicom at regular intervals and storing this data in the program and also writing the data to a disk file. Both types of logging can be run simultaneously if so desired.

8.10.1 Realtime logging and display

As explained above, realtime logging uses the control program to do the logging, so, if the control program is not active, logging of data will not occur. Data logged in realtime is written to a disk file. The last 512 points of logged data can also be displayed in graphical form as they are being logged but data older than this cannot be displayed with the control program. The log data file is in standard ASCII text and is compatible with Microsoft Excel (r) and other spreadsheet programs. A maximum of 16 points can be logged in realtime. Realtime logging can record digital inputs, variables and outputs.

8.10.1.1 Configuring the logging

Realtime logging can be configured by clicking the *Logging* button located in the *Functions* panel in the main control form. This will bring up a new form called *Configure logging of points*. There are a number of panels displayed on this form.

The *Points table* lists the database of points for this minicom. You can use the option buttons in the *Sort order of Points table* to reorder the entries in the points table, just click on the appropriate option button.

The *Log table* panel displays a list of the current points selected for logging. It lists the points in alphabetical order and also displays the type of point being logged.

The *Log interval* panel allows you to select the interval that logging should take place. This must be the same for every point. To select a logging time use the scroll bars to set the desired time. Logging can only be done in multiples of 10 second intervals.

To add a point to the log table, click on the point in the points table, the background colour of the entry will change. Then click the *Add* button to add the point. (You must have set a logging time or an error will occur).

To delete a point from the log table, click on the point in the log table, thus changing its background colour and then click on the *Delete* button to delete the point. Clicking on the *Clear all* button will delete all points from the log table.

Provided that you have changed the log table list, clicking either the *End* button or the *Background to disk* option button will result in a file selection dialogue box opening. Use this box to set the name of the logfile.

Clicking the *End* button will close the form and revert to the main control form. Clicking the *Background to disk* option button will allow you to configure background logging. Any changes to the minicom internal logging system are transmitted when the *End* button is clicked.

To start logging the minicom must be online. If the minicom is online then the *Realtime log* panel will be displayed. Use the *Start log/Stop log* button to control logging. Depending on the online/offline state when logging was configured, you might have to toggle this button to start logging. When the realtime log is active the name of the file will be displayed in the logging status bar at the bottom of the screen. When the control program starts up the minicom is initially set to the online mode and thus any realtime logging already specified will automatically start. You can stop this log by clicking the *Stop log* button in the *Realtime log* panel.

8.10.1.2 Display of the realtime logged data

Clicking on the *Plot* button in the *Realtime log* panel in the main control panel allows you to display the realtime acquired data. The form which is shown has four separate areas. At the top of the screen is a menu bar which gives access to various options. Beneath this menu bar is the main graphic display panel. The background of this panel is black as this provides the best contrast for display of traces. You can change the background colour of this panel by clicking on the *Options* menu item and then clicking on the *Background colour* item. This will bring up a colour dialog box, click on the desired background colour and then click the *OK* button.

To the right of the graphic display is another panel with a black background. The point names for each trace are displayed in this panel. The colour of the point name is the same as the

colour of the data for this point. Next to each point name is a checkbox. This checkbox controls whether the data for that point is displayed or not. If the checkbox is checked the data is displayed. To hide the data uncheck the checkbox by clicking it and then click the *Redraw* menu item to redraw the screen omitting the trace for this point. Checking an unchecked checkbox will immediately redraw the data for that point. When hiding point data, you can clear as many checkboxes as you wish before clicking the *Redraw* menu item.

Beneath the black graphic areas of the screen is a status bar. This is used mainly when the graphic cursors are enabled. The left box shows the minimum value of the graph and the box next to it shows the maximum value. You can change either of these values by clicking on the data box and typing a new value in. The graph will automatically rescale and be replotted. You can also change these values by clicking on the *Limits* menu item. This will open a dialog box and you can change the minimum and maximum values in this box and then click the *OK* button to rescale the graph.

Clicking the *Cursors on* menu item will result in two yellow vertical lines appearing in the graph area of the screen. The left line is dashed while the right line is made up of long and short dashes. You can move these cursors by positioning the mouse cursor over the cursor and holding down the left mouse button. The cursor will change to white and then, while holding the mouse button down, move the mouse to drag the cursor to wherever you want. You cannot make the cursors cross over and you cannot make the cursors move outside the graph area. Releasing the mouse button drops the cursor and it will revert back to yellow. When the left cursor is over valid data the time and date corresponding to the point at the cursor will be displayed in the status bar. Similarly, when the right cursor is over valid data, the time corresponding to the point under the cursor will be displayed. The righthand box in the status bar shows the time difference between the two cursors. This will have a value in irrespective whether either cursor is over valid data. The menu item will also have changed to *Cursors off*, and clicking this item will turn the cursors off.

When you turn the cursors on coloured boxes will appear next to each point. The numbers in each of these boxes is the value of that point at the position of the left cursor.

While the cursors are displayed the *Expand* menu item is enabled. Clicking this item will expand the horizontal scale so that the data between the two cursors fills the display area. (It also changes the *Expand* item to a *Normal* item). There are no restrictions on how much you can expand the data but you can only expand the display once. If you want to change the display again you must first click the *Normal* menu item and then reposition the cursors. When the display has been expanded the cursors remain where they were on the screen. You can still drag the cursors around and the status bar will still reflect the data associated with the point under each cursor.

The *Drag* menu item allows you to drag digital traces up and down the screen. This is necessary as digital traces are displayed initially at the top of the screen and if you expand the vertical scale they will disappear at the top of the display. To drag a digital trace click on the coloured box next to the point name. A dashed horizontal line will appear at the trace corresponding to this point. Position the cursor at this line and hold the left mouse button down. Now drag the trace to where you want it and let the mouse button go. The digital trace will move to this location. You can drag each trace as often as you want.

The *Options* menu item has three entries. The bottom two entries are mutually exclusive. In normal operation the displayed data is frozen at the time the *Plot* button in the main control form is clicked. This means that new data will not be displayed as it is acquired. The other option is *Update on new data*. Selecting this option will allow the graphic system to display

new data as it is acquired. If you are using the expand mode, then new data will not be displayed until the display is returned to its normal mode.

You can dump the entire graphic screen to a printer by clicking the *Control* menu item and then clicking *Print*. This will cause the background colour of the display to change to white while the display is being printed. The display will be printed on the default Windows printer.

To terminate the display click on the *Control* menu item and then click on *Exit*.

8.10.2 Background logging

Configure background logging in the same way that realtime logging is configured. Refer to Section 8.10.1.1 for more details. For background logging you can specify a different log time for every point. Ensure that the log interval is properly set. You can set log intervals as short as 1 second if you wish. (Digital points don't use the log time as they only record changes of state but this log time is still required as it determines how often the control program has to gather data from the minicom). To change the log time for a point, click on the point in the log table and then change the log interval time. Click the *Change time* button to set the new time. Click the *End* button when finished.

The minicom has to be online for background logging to take place. To enable background logging, after configuring logging, you might have to toggle the minicom from online to offline and back to online.

Background logged data is gathered from the minicom at a period of 30 times the shortest log interval specified. Data is written to a number of files, one for each point specified to be logged. The file name for each logged point is of the form *ptname.bgl* where *ptname* is the point code. Thus if you want to log all 80 input/output points in the minicom you will have 80 files! Data is stored in a background log file as plain ASCII, each point records its state or value together with the time and date of the sample. Digital points record changes of state only. Data files are fully compatible with standard spreadsheets such as Microsoft Excel (r).

If the control program stops running, then no data will be lost provided it is back in operation before the internal minicom buffers fill up. When the control program starts the minicom will be set to the online mode and any background logging specified will start. The only ways in which this logging can be stopped are by switching the minicom offline (the minicom will still log the data internally but the control program will not read it) or by using the logging command to delete all points from the background log. You cannot stop the minicom logging digital points. The logging status bar at the bottom of the main control form shows the current status of background logging.

8.11 Developing system diagrams and data displays

You can only develop system diagrams and data displays while the minicom is offline. To generate a plant drawing click on the *Drawing generation* button in the *Functions* panel in the control form. This will result in the display of a new panel in this form. This panel contains a list of existing drawings and several buttons. You can add a new drawing by clicking the *Add drawing* button or you can edit an existing drawing by clicking on the drawing in the drawing list (thus highlighting it) and then clicking the *Edit drawing* button. When you attempt to add a new drawing another panel will appear. The drawing name should be entered into the textbox in this panel and then click *OK*. Drawings can also be deleted by clicking the selected drawing in the list of drawings and then clicking the *Delete drawing* button.

When you either add a new drawing or edit an existing drawing a new form will appear. This form is labelled *Plant drawing*. It contains a toolbar at the top and several buttons at the bottom. The toolbar icons allow you to develop the drawing. Online help is available by clicking the *Help on* button. When the cursor is positioned over a toolbar icon a brief description of how to use the icon appears. The toolbar icons are as follows:



This icon is used to move the toolbar. Position the cursor over the icon and hold the left mouse button down. While holding the button down drag the toolbar to where you want it and then release the button.



This icon is used to insert text into the drawing. Position the cursor over the icon and hold the left mouse button down. While holding the button down drag the mouse to where you want the text to be located. A small rectangle will be attached to the cursor. When you have positioned the cursor where you want the centre of the text to be release the mouse button. A dialog box will open. Type your text in the text box in the *Text* panel. You can change the size of the font and also bold and underline it by checking the various checkboxes in the *Font style* panel. When you are happy with your selection click the *OK* button and the text will appear on the drawing.



This icon is used to insert a point into the drawing. The point will display the current data from the minicom every few seconds when the drawing is loaded in the online mode. To insert a point proceed as for text insertion as above. When the dialog box opens either type the point code into the textbox in the *Point name panel* or to display the points table click on the *Show points* button. To select a point either double click on the point in the table or click once on the point to highlight it then click the *Select* button. The point code will appear in the textbox in the *Point name* panel. The name of the point will also be displayed on the drawing. You can choose to hide this name by unchecking the *Show name* checkbox. As for the text insertion above, you can modify the text style for the point name. When you click the *OK* button the point name will appear in the drawing in a box. The point name will be replaced by the actual point data when the minicom is running online.



This icon is used to insert a picture in the drawing. Click on the icon to open a file selection dialog box. You can select any **Windows metafile (*.wmf)**, **JPG**, **GIF**, or a **Windows bitmap (*.bmp)** file. Windows metafiles will be automatically scaled to fit the drawing area. This could result in distortion of the drawing if the aspect ratio is not the same as the display aspect ratio. Windows Bitmap files are cropped to fit the display area. Thus a bitmap which is, say, wider than the display area but the same height will have its right hand side cropped to fit the display area. You can replace the current drawing with another drawing by clicking again on this button.



This button is used to delete labels and points in a drawing. To use this button click on it. A help message displays on the bottom of the screen. To delete a point or label just double click on it. The label or point will not be deleted immediately but will change colour and will be deleted when the drawing is saved.



This button is used to place a heading on the drawing. Clicking this button to open a dialog box. Proceed as for the text icon above. You can change font characteristics if desired.

When the OK button is pressed the name you have chosen will have replaced the heading of the form. You can replace this heading as often as you wish.



This button can only be used with digital points. It inserts a point into the drawing in exactly the same way as the icon above, however, when inserting the point the *Colour controls* panel will be enabled. This control differs from the standard point insertion tool in that the colour of an object on the screen is changed when the point changes from off to on. To select the off and on colours click on the coloured rectangles in the *Colour controls* panel. This will open a colour dialog box. Click on the desired colour and then click *OK* to select the colour. The chosen colour will fill the rectangle. You can choose whether the state of the point is displayed on the drawing. Check the *Show data* box to display the state else uncheck this box. When you click the OK button a new item will appear on the drawing. This will have the point name sandwiched between the two colour bars. (The left bar is the off colour, the right bar is the on colour. If you position the cursor over either of these coloured bars and double click the left mouse button you will reopen the colour dialog box). The cursor is replaced by a cross. Position this cross in the region you want to change colour and click the left mouse button. The area will briefly flash with a white crosshatch indicating the area which will change colour. (A message reminding you to do this will appear at the bottom of the screen). When you have finished the mouse cursor will revert to its original form. Note that if you select an open object when the item changes colour large areas of the screen can be affected. The colour fill is restricted to an area of a solid colour.

You can move text and points after you have dropped them. Simply position the cursor over the item to move and hold the left mouse button down. Then drag the item to where it should go and release the mouse button. If you attempt to move the item over an illegal area then the mouse cursor will change to a white circle with a diagonal white line. You can still drop the item if you wish but it might not move.

The Print button will draw the form on the current Windows printer.

The Exit button will close the form and save the drawing to disk.

8.12 Showing plant diagrams while running

To view a plant drawing when the minicom is online, click the *Plant status* button in the *Functions* panel in the main control screen. This will open a panel listing the available drawings. Double click on the desired drawing and it will appear on the screen. The data associated with this drawing will update every few seconds.

To view another drawing you can either close this drawing or you can click on the Drawings button to display the list of drawings.

You can make changes to the minicom by clicking on any minicom point in the drawing. Only outputs and setpoints can be changed, any attempt to change an input will result in an error message being displayed. When you click on a point a dialog box labelled *Modify value* will appear. You can change the point either by clicking the option button in the *Value* panel (digital output) or by means of the scroll bar in the case of an analogue point. The modified data will be immediately transmitted to the minicom. The *Priority level* panel is not yet implemented in the minicom. It will allow you to select the priority level to write to in the minicom. A setting in a higher level priority overwrites any lower values.

8.13 Alarms

The control panel monitors events in the minicom. Any event which occurs will generate an alarm. The minimized alarm icon changes to a telephone and rings when an alarm has occurred. There are two type of alarms that are recognised. The first is any event in the minicom (The event has to be enabled for an alarm to be generated). The second alarm is given when the board configuration in the minicom is detected as not matching the configuration downloaded to the minicom.

When the alarm rings you can double click on the icon to bring it up to normal size, and stop the ring. The alarm status form displays a list of alarms that have occurred together with the time information as to when each alarm occurred. This information is also written to disk in a file called *alarm.txt*. You can choose to delete any entry by highlighting it (click on it) and then clicking the *Delete* button, or you can delete all entries by clicking the *Delete all* button.

While maximised the alarm system will still be active. You can stop any new ringing by clicking the *Stop ring* button. You can minimize the form again by clicking the *>Icon* button. Clicking the *Print* button will print the current alarm list to the default Windows printer.

9. Installation Details

9.1 Mechanical

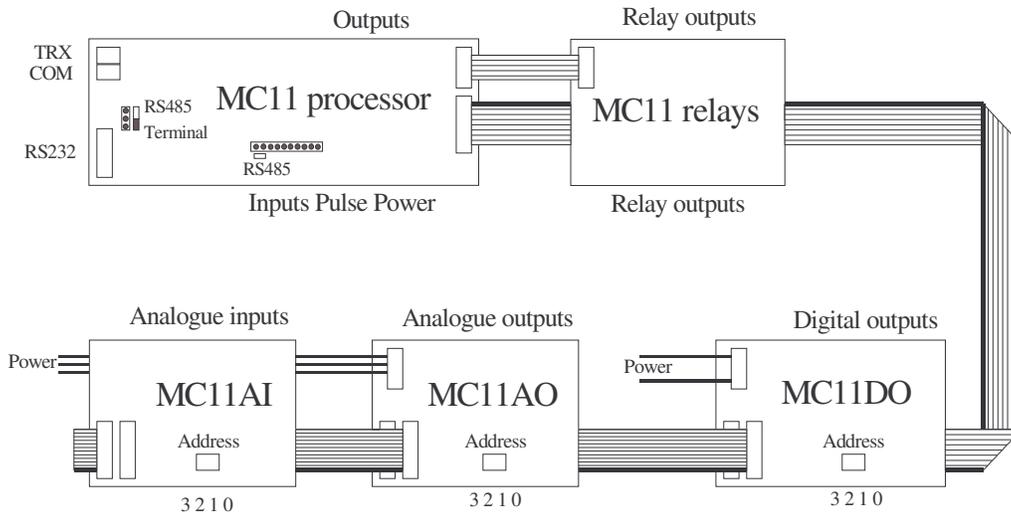
The minicom system is installed in 3.25" wide snap track. Individual modules are snapped into place and can be removed by using the screwdriver cutouts along both edges of each board. The boards can be mounted either vertically or horizontally in a cabinet. Keep all wiring away from the components on each board. It is recommended that all wiring be kept in channels located parallel to each row of snap track.

9.2 Electrical interconnection of boards

The main interconnection cable between the processor board and its addon expansion cards is by means of a 20 way ribbon cable. This cable is plugged into the matching socket on the MC11 processor and then is daisy-chained through all the peripheral cards. To facilitate wiring, each peripheral card is provided with two IOBUS sockets wired in parallel. The incoming 20 way cable is plugged into one of these sockets and the other socket is used to connect the outgoing cable to the next card. The cable should be run in the snap track underneath each card. To make the installation neat the 20 way cable can be folded where necessary. Individual cards can be plugged in as needed even while the system is running.

The analogue and digital output cards each have an additional power connector. This is either a screw terminal connection. The connections to these additional power connectors are made with individual cables which should be colour coded. The power wiring can be daisy-chained from one card to the next. If using screw terminals it is recommended that the main power to the minicom be turned off to avoid the possibility of momentary shorts while making connections. When wiring in the additional output boards, only those terminals which are labelled need be connected to the power supply. (For analogue output boards the terminals which have to be connected are *GND*, *+15*, *-15* and for the digital output board they are *GND* and *+12*).

The relay board which is driven by the MC11 processor board is connected to the MC11 by means of a 10 way ribbon cable. This plugs into the processor board immediately above the 20 way IOBUS connector. The diagram below shows the general connection diagram for a minicom system.



9.3 Input/output configuration on MC11 processor

9.3.1 Outputs

The MC11 processor has 8 output channels, 4 of which are purely digital channels (1 through 4) and 4 of which can be used as either analogue output or digital output channels (channels 5 through 8). There is no need to configure these last 4 channels, if you treat them as analogue channels they will become analogue channels, if you write to them as digital channels then they will behave as digital channels. They will stay in the mode they were last written to.

9.3.2 Inputs

The eight input channels on the MC11 can be used as either analogue or digital channels (or even as both simultaneously). If you use them as digital channels you either have to supply a voltage to a channel or, for voltage free contacts, insert a jumper to short the adjacent pins of the *DIGIN* jumper block located directly above the Pulse input. This will put a voltage on the corresponding input pin.

9.4 Peripheral board configuration

As indicated on the above diagram, each expansion board has a block of 4 switches. These switches set the address for the card. Ignore the numbering on the switch, the numbering to follow is that on the circuit board. The correct settings for each switch is as follows:

Switch number	Position
0	*
1	ON
2	ON
3	ON

* This switch is **ON** for the first board in a pair (ie. For channels 9 through 16) and **OFF** for the second board in a pair (ie. For channels.17 through 24). **Do not have two identical types of board with the same switch settings.**

9.5 Communication cables

The minicom communication interface can be changed from RS232 to RS485 by means of 2 jumpers as shown in the above diagram. When a single jumper is connected as shown by the solid bar, the minicom is configured with a RS232 interface. When two jumpers are inserted as shown by the empty boxes, the minicom is configured to run with a RS485 interface.

9.5.1 RS232

The RS232 mode of communication runs at 9600 baud with 8 data bits, one stop bit and no parity.

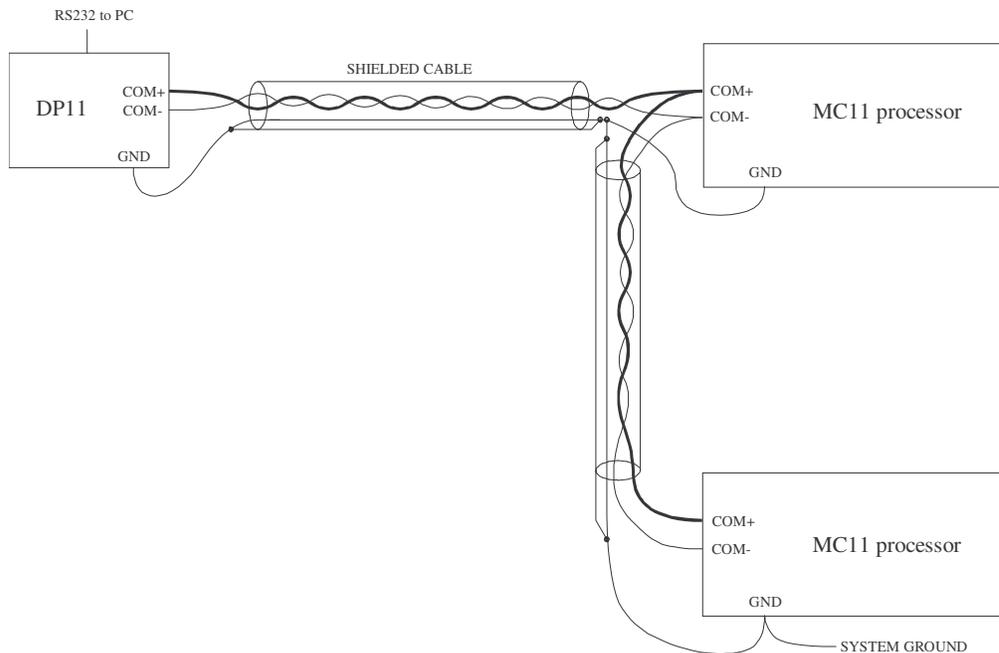
The RS232 connector is a 10 pin ribbon cable. It is designed to be pin compatible to a standard IBM 9 pin COM1 connector. The matching connector is a female type allowing the use of standard extension cables. When extending this cable the RS232 specification should be followed and the cable length should be kept to below 15 metres. Longer lengths *might* work but are not guaranteed to work. IBM 9 pin connections are as follows:

Pin number	Connection
1	DCD*
2	RXD
3	TXD
4	DTR*
5	GND
6 - 9	No connection

The DCD and DTR connections are not required for use with a terminal.

9.5.2 RS485 Communications

The RS485 method of data transmission requires a shielded, twisted pair cable. For connections between the DP11 processor and the minicom a single pair is adequate (connected to the *COM+* and *COM-* terminals) but for connections made after a repeater two twisted pairs are required (the second pair is connected to the *TRX+* and *TRX-* terminals). It is essential that these pairs are not inadvertently crossed. It is absolutely essential that a minicom network is only grounded at one point. Failure to do this will result in errors in data transmission and could result in the destruction of the equipment.



The correct installation is for each minicom, and the equipment it is controlling, to be isolated from ground. The required ground reference is transmitted via the communication cable via the shield, and preferably by using a 2 pair + 1 wire cable. The single wire is tied to the shield at every minicom and screwed into one of the ground connectors on the minicom. This allows the communication connector on the minicom to be removed without removing the ground reference. *At one and only one point in the network is the shield tied to ground.*

9.5.3 RS485 Introduction

The RS485 communications standard has been widely adopted for network communications in industrial and scientific applications. It is a very robust system when installed correctly. There are constraints which must be observed during installation to ensure satisfactory network performance. This document describes how to install an RS485 network.

9.5.4 RS485 Cabling Specifications

RS485 communication cable is a constant impedance, shielded, twisted pair cable. Many cable manufacturers supply cable meeting the RS485 standard. The characteristic impedance is generally close to 120 Ohms although other impedances are sometimes available. The lower impedance limit is set by the drive capability of the RS485 chips. The driver chips used by

Sphere are sourced from Maxim, National Semiconductor and Texas Instruments (SN75176/DS75176) and can drive impedances down to approximately 50ohms

Other cabling media such as telephone cable, coaxial cable and non-constant impedance cables such as shielded wire, multi-core wires, building wire and wet string will prove problematical and not provide satisfactory performance.

A typical cable specification is:

1. Cable Code	DCK4702
2. Cable Description	2 pair 7/0.2tcw (24AWG) polyethylene insulated aluminium polyester tape screened including a 7/0.2 TCW drain. TCW braided PVC sheathed. EIS RS485 Data Cable. Low voltage, not for mains connection.
3. Construction	
3.1 Conductor	7 strands of 0.2mm tinned annealed copper to AS1125, drawn from Class 11A "Electrolytic tough pitch copper" to AS 1574. Max DC conductor resistance at 20C 89.0 Ω/km
3.2 Insulation	Coloured polyethylene to AS1049 Nominal Diameter 1.7mm Nominal Wall 0.5mm
3.3 Lay Up	2 pairs twisted PAIR 1 Black + White PAIR 2 Red + Green
3.4 Screen	Aluminium/Polyester tape over layup plus 7/0.2 TCW Drain
3.4 Braid	Tinned annealed copper wire braid to 80% cover
3.5 Sheath	Coloured 4V75 PVC to AS3191 Nominal diameter 7.0mm Nominal wall 0.76mm
3.6 Typical Electrical Properties	Nominal impedance 120Ω Nominal capacitance 42pF/m cond to cond Velocity of Propagation 66%

This cable is manufactured by Tycab and distributed by AIM.

9.5.5 Topology

RS485 allows multiple network nodes to be connected to a single cable. The cable must be installed to pass close by each node. Stubs (cables joining the node to the cable) or stars (multiple cable segments brought back to a single point) are not permitted.

If stubs or stars are required then a repeater must be installed to drive the stub or star segment.

9.5.6 Cable Length

The maximum length of a single cable run is 1200 metres.

9.5.7 Termination

The cable must be terminated at each end with a terminating resistor equal to the characteristic impedance of the cable. This is to prevent reflections which would disrupt communications. A cable with a 120 Ohm characteristic impedance must have a 120 Ohm resistor at each end. A power rating of ¼ Watt is adequate. The terminating resistors should be carbon composition or carbon or metal film. Wire-wound resistors have substantial inductance and should not be used.

The characteristic impedance of the cable is published by the cable manufacturer as part of the cable specifications.

9.5.8 Repeaters

Sphere supplies repeater types for different applications.

The standard repeater is used to connect to a stub or to extend cable length

An optically-isolated repeater is used to maintain electrical isolation between cable runs in separate buildings. Note: Electrical isolation is required where separate MEN grounds are installed but are desirable for any data link between buildings.

9.5.9 Cable Isolation

The communication cable must not be run in cable trays carrying power wiring nor in close proximity to power wiring. Current surges in power wiring due to high equipment starting currents or to faults can disrupt communications and may cause damage to Sphere equipment.

9.6 Ground and Earth Connections

The grounding and earthing connections in RS485 provide two separate functions. The first is related to safety and the second to establish a reference voltage.

9.6.1 Safety

The RS485 cable screen must be bonded to the protective earth system of a building at one point only.

The cable screen must be electrically continuous throughout the entire cable run.

9.6.2 Voltage Reference

The screen of the RS485 cable establishes a ground reference voltage for the RS485 signal conductors. For this reason the cable shield must be connected to the ground reference for each node on the network.

It is not acceptable practice to tie the node ground reference to the building protective earth as this will introduce electrical noise into the system and may lead to equipment damage in the event of electrical fault currents.

9.7 Installation throughout Multiple Buildings

There are two separate installation procedures depending on the type of electrical earthing system.

9.7.1 MEN System at one building

In this case the installation may be made as though it exists in a single building. The cable shield will be continuous throughout the installation.

9.7.2 MEN System in each building

In this case there must be electrical isolation between buildings with different MEN systems. Each building is wired as a separate and complete installation with the cable shield tied to the building protective earth at one point.

Optically isolated repeaters or optical fibre must be used to connect the communications network between buildings.

9.8 Wiring Details

Figure 1 shows how the RS485 network should be wired between various network nodes. The essential features to note are:

1. All the cable shields are tied together and are tied to a Ground connection (GD or Shield) on EACH node. Without the cable shield connected there will be no ground reference voltage established for the RS485 drivers and receivers. Reliable communications will not be achieved.
2. The cable shield is connected to a building protective earth at ONE POINT. Any point along the shielded cable can be used to attach this protective earth. This earthing is required to ensure that the network cabling cannot float to dangerous voltages.
3. The DP11, or in fact any other node, can be connected at any point along the cable. It does not need to be at one end.
4. Termination resistors must be connected at each end of the cable. The nominal resistance is 120Ω. These resistors make it appear that the cable continues indefinitely and hence eliminate reflections from the end of the cable. These resistors can be ¼ or ½ Watt resistors.
5. The polarity of the cable is important. For ease of installation and maintenance it is recommended that a consistent colour code be adopted throughout the network. An acceptable scheme may be Blue for COM- and White for COM+.

6. Beyond any repeater the cable must be 2-pair with one pair connecting the COM terminals and the second pair connecting the TRX terminals. In figure 2 the 2-pair cable as shown as fatter lines

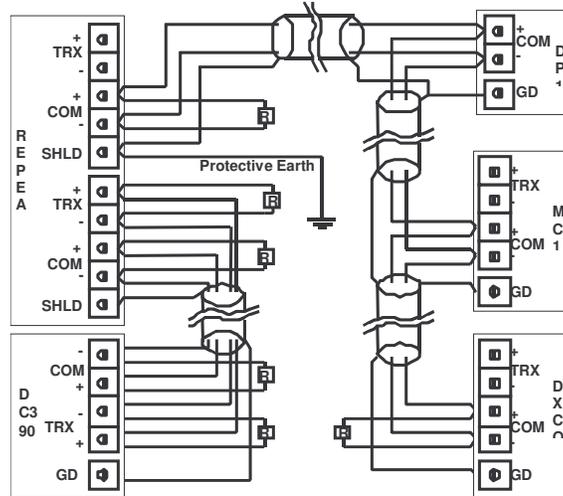


Figure 1 Wiring Details for RS485 Network

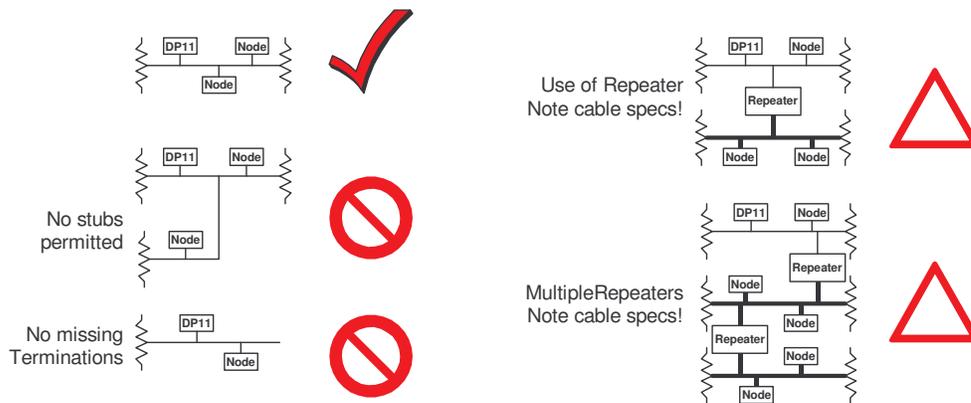


Figure 2 RS 485 Cabling Topologies

9.9 RS485 References

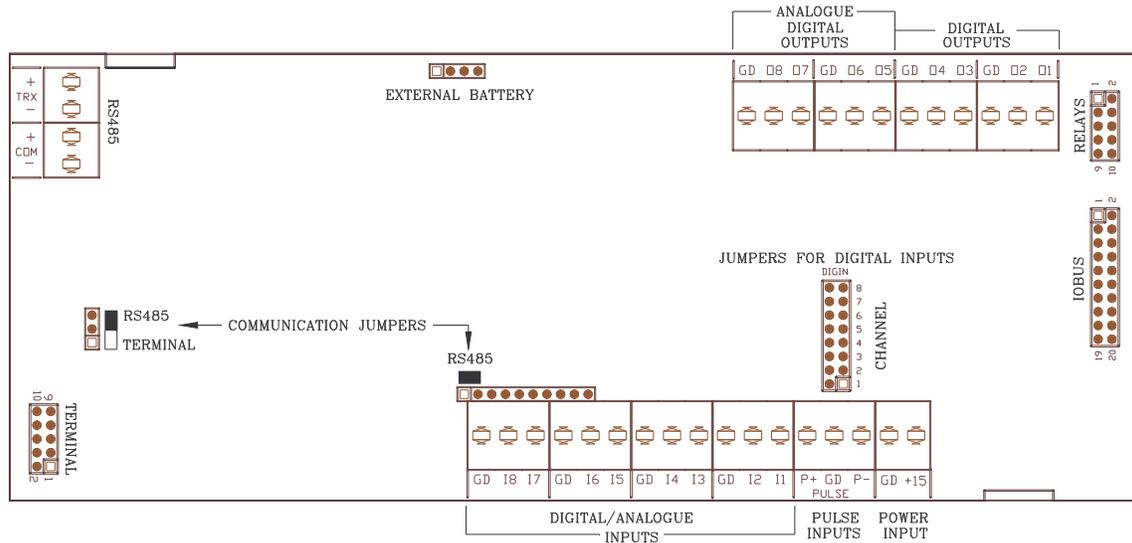
TIA/EIA-485 ELECTRICAL CHARACTERISTICS OF GENERATORS & RECEIVERS FOR USE IN BALANCED DIGITAL MULTIPOINT SYSTEMS (<http://global.ihs.com/>)

AUSTEL Customer Premises Cabling Manual. (<http://www.standards.com.au/>)

10. Minicom Specification

10. MC311 boards connectors and jumpers

10.1 MC311 processor



Inputs:

Maximum of 40 inputs as follows:

MC311 processor

8 universal (analogue or digital) inputs.

Configured as analogue inputs:

Full scale range 0 - 10 volts

Resolution 8 bit (40mV per step)

Configured as digital inputs:

Dry switch closure to ground. Sinks about 2mA when switch closed.

Analogue expansion module

8 additional inputs per module. Up to 2 expansion modules allowed.

Full scale range 0 - 10 volts

Resolution 12 bits (2.5mV per step)

Digital expansion module

8 additional inputs per module. Up to 2 expansion modules allowed.

Dry switch closure to ground.

Each input has a LED (light emitting diode) to indicate input status.

Outputs:

Maximum of 40 outputs as follows:

MC311 processor

4 digital outputs and 4 universal analogue or digital outputs.

Individual LEDs on each output. LED intensity indicates output level.

Digital outputs switch between 0 and 12 volts. Current source capability is up to 100mA per output, limited by power supply capacity. Current sink current is up to 300mA per output. Positive DC voltage only. An optional relay output board can be used with the processor.

Analogue outputs are pulsewidth modulated 0 to 10 volts. Current source and sink specifications as per digital outputs.

Relay output module

Interfaces to the MC311 processor via 10 way ribbon cable. Provides 8 relays each with Form C contacts. Each relay is individually selectable to be driven by the ddc system or can be switched manually on or off.

Analogue expansion module

8 analogue outputs per module. Up to 2 expansion modules allowed.

0 - 10 volt outputs capable of driving 20mA loads.

8 bit resolution.

Digital expansion module

8 relay outputs per module. Up to 2 expansion modules allowed.

Relays have individual jumpers for selecting as ddc control, off or on.

LED indications on each relay.

Form C contacts. (Both NO and NC).

Relays rated at 10A AC, 5A DC.

Other hardware features:

- On-board battery backed real time clock keeps track of current date and time.
- Battery life is greater than 10 years. Clock accuracy is better than ± 1 minute per month.
- Battery backed memory saves system setups and logged data.
- High quality detachable input/output terminals for ease of connection.

Onboard firmware:

- The MC311 minicom contains a rich set of algorithms which can be used to implement complex control systems without the need for writing any programs. This allows the MC311 to keep plant running even if the network it is connected to fails.
- Communication to the MC311 is either via a standard RS232 link at 9600 baud or via Sphere Systems RS485 network.
- The MC311 implements time clocks for the time control of outputs.
- The MC311 has extensive data logging capabilities and all analog input and output channels can be logged at user selectable data rates. Digital inputs and outputs can also be logged.
- The MC311 implements after-hours fallback, economy plant on/off cycling, load shedding and lead/lag algorithms.
- 8 level priority system for both analogue and digital outputs.
- The MC311 implements a comprehensive alarm system.

Digital inputs (max 24)

Programmable input polarity.

Debounced inputs.

Counting of input transitions.

Digital inputs can be put into manual mode.

Analogue inputs (max 24)

Facility to trim inaccurate sensors.

Optional square root or user defined input conversion functions.

Analogue inputs can be put into manual mode.

Digital outputs (max 24)

Programmable output polarity.

Programmable power-up delay.

Programmable short cycle time. Can be timed from either edge of the digital output.

The output can be inhibited by another input or output.

Logging of runtime hours.

Digital outputs can also be used as pulse-width modulated analogue outputs.

Load shedding control of all outputs.

Analogue outputs (max 20)

Programmable output polarity.

User defined limits on output swing.

Output can be forced to a specified state (inhibited) by a variety of sources.

Digital variables (max 32)

These are internal to the minicom and can be used to store digital data.

Retriggerable timeout to a specific state.

Analogue variables (max 32)

These are internal to the minicom and can be used to store analogue data.

Retriggerable timeout to a specific value. Switchable settings.

Arithmetic functions (8 total)

Takes the maximum, mean, median or minimum value of a set of user defined analogue inputs, outputs, variables or continuous function loop errors.

Logic functions (16 total)

Logic functions generate the logical OR of up to 8 product (AND) terms generated from 8 digital inputs, outputs or variables. Each input can be selected to be either True or False for each product term. The output of the function can be negated and can drive any digital output, digital variable, control an analogue output or generate an alarm.

Delay functions (32 total)

These can generate either a single pulse output or a retriggerable delay. They are triggered by a change of state on a digital input, output or variable and produce an output pulse of a user defined length. The delay functions can also provide a delay proportional to an analogue value thus allowing their use in generating economy cycles.

Continuous function loops (32 max)

These loops use the difference between a setpoint and an input value to control an output. Both the inputs and setpoints can come from a variety of sources. The loop can function as either a PI loop or a reset gain type loop. The loop output can be directed either to an output or a variable. The output can also be inhibited by a digital source. Heating/cooling loops can utilise afterhours fallback.

Discrete function loops (32 max)

These loops test an input against a threshold value. Both a simple above a single limit or a window type comparison can be made. The sources for the lower and upper limits can be derived from any analogue input, output or variable. A hysteresis function with user defined levels can be applied to both thresholds. The output of each loop can be used in other minicom functions.

Time clocks (32 max)

Timeclocks can be used to control loops or digital variables. Each time clock can be programmed with its own on and off time and can be programmed to take effect for any days in the week. In addition, the minicom stores up to 16 public holidays internally (user programmable up to 2 years in advance) and the time clocks can be programmed to be active on these days as well. There is also a facility to override the normal operation of a timeclock by declaring today a public holiday.

Alarm functions (32 max)

Alarm functions take any analogue or digital point as a source. Analogue points are compared to another analogue point or a fixed value (with programmable hysteresis) while digital points are tested for true or false. If the alarm condition is present for more than a selectable time an alarm is generated. The output of the alarm function can go to any digital point. Alarms can be inhibited by a digital point. Each alarm can be programmed to send an individual message to an individual pager connected to the Telstra paging system.

Lead/lag function (1 only)

Takes up to eight inputs and controls an equal number of outputs. When the first input changes state from true to false, the output assigned to a given input changes. Thus a given input will successively drive each output. Each output has an associated status source which can inhibit the use of that output. Inputs, status and outputs can be any choice of digital inputs, variables and outputs.

Load shedding functions (24 max)

These functions are associated with digital outputs. Each digital output can be set for load shedding, load shedding only in the case of emergency (standby) power or not capable of being load shed. If enabled for load shedding, there is a programmable minimum offtime and a programmable maximum offtime for each output.

Data logging

For digital inputs and outputs the minicom stores the time when there is a change of state on the point. The last 16 of these events are stored within the minicom. Each analogue input and output can be logged at any user desired rate up to one sample every second. The minicom stores the last 64 of these samples. On all channels logging can be specified to log either until the buffer is full or continuously.

When run with the Sphere Systems standalone control program, data can be logged from all inputs and outputs with user selectable sample rates on the analogue channels. Data is written to disk files which can be read back through programs such as Microsoft Excel. In addition, data can be logged from up to 16 channels (inputs, outputs or variables) and displayed in graphical form on the screen. Up to 8 hours data can be displayed at once with a time resolution of 1 minute. A zoom facility allows the expansion of any section of this data. This data is also recorded in an Excel compatible disk file. Both types of logging can take place at the same time.

Programming:

RS232

Using the Sphere Systems standalone control program running under Microsoft Windows. This control program also provides comprehensive data logging and display facilities, the generation of plant drawings and automatic alarm notification and logging.

RS485

Up to 126 MC311's can be networked together from a single IBM PC running the network version of the Sphere Systems control program. Individual MC311 processors can be programmed while connected to the network without disrupting any other device connected to the network. The maximum network size for a single PC allows 10,080 points.

Physical data:

Board mounting: Snap track - no screws required.
Environmental: 5 - 50°C 10% - 90% noncondensing
Interconnect cables: Data - 20 way Flat ribbon. 3 metres maximum.
Power - screw plug in terminals.

MC311 processor

Dimensions: 62mm wide x 208mm long
Power requirements: Nominal 15V DC @ 250mA. unregulated

MC311 relay output module

Dimensions: 62mm wide x 102mm long

Analogue input expansion

Dimensions: 62mm wide x 92mm long

Analogue output expansion

Dimensions: 62mm wide x 104mm long
Power requirements: ± 12 - 15V DC. (16V maximum)
Current depends on output load.

Digital input expansion

Dimensions: 62mm wide x 92 mm long

Digital output expansion

Dimensions: 62 mm wide x 153mm long

Power requirements: 12 - 15V DC @ 250mA.

Power supply module

Dimensions: 62mm wide x 104mm long

Power input: 15V AC 50 - 500Hz

RS232 communications extender

Extends RS232 port communications to a maximum distance of 1200 metres

Dimensions: 62 mm wide x 41mm long

Power input: 9 - 15V DC

11.0 DP11 specifications

11.1 General

The DP11 is a network processor for controlling a network of Minicomms, Doors and VAVcoms. The DP11 is designed to be attached to the serial port of a PC or a modem and has its network port connected to a RS485 network of field processors. The DP11 handles all the messaging between field processors. It also is responsible for alarm pre-processing and will do automatic dial-outs to pagers and other devices accepting the PET protocol. Telstra, Optus and Hutchinson communications have certified the PET protocol as compliant. Alarm conditions can be printed on a local printer and are also sent to the attached PC for display to the operator. The DP11 will not acknowledge alarms, this is the responsibility of the operator.

The DP11 also has 4 digital inputs that can be configured to send global messages to all devices on the field network. These inputs are typically designed for use for fire alarm warnings.

11.2 Physical

Both cards are design to fit Augat 3TK Series SnapTrack. SnapTrack for easy installation.

The DP11 card is 173mm long by 82.5mm wide by 30mm high. The relay output board is 110mm long by 82.5mm wide by 20mm high.

11.3 Power supply

The DP11 is designed to run of a 9V to 12V AC supply or a 12V DC supply. Total current drain is about 250mA DC.

11.4 External Connection

The field wiring is connected to the card through screw terminated connectors.

The interconnection of the processor board and output board is via a 10-way ribbon cable.

11.5 Enclosures

All electronics and power supplies can be mounted in plastic or metal sealed enclosures to meet environmental requirements. No fans, heat sinks or other heat dissipation methods are required. Field wiring connections can be provided through plugs, sockets or penetrations in the enclosure meeting expected environmental requirements.

Enclosures will be sized to accommodate the equipment to be housed.

12.0 DXcom specifications

12.1 General

The DXcom is a small general purpose field processor with no expansion capability. A DXcom has a total of 12 inputs and 8 outputs. A range of in-built functions provides flexibility, allowing the DXcom to meet various specifications. These functions are discussed below.

Custom applications can be configured through firmware changes to provide additional and more flexible combinations.

12.2 Inputs

- A total of 8 universal analogue or digital inputs. Each input can be individually configured as a digital or analogue input.
- Up to 4 Dallas 1wire temperature sensors can also be used.

Digital inputs

- A total of 8 digital inputs.
- A 32 bit counter on every input which counts the changes of state of the input.
- Each input has a timer (in seconds) which accumulates the total ON time for that input.
- Each input can be debounced with degraded maximum sampling rate. Debouncing is not needed for clean, electronic pulse generation.

- Maximum sampling rate is 16 pulses/sec.
- Input polarity reversal for each input.
- Times of last 64 changes-of-state are stored.
- Inputs can be locked in a manual state.
- 64 days of switch counts at midnight stored for each input.

Analogue inputs

- 8 8-bit analogue inputs on the processor, can also be used as digital inputs.
- Each input can be scaled using a user-defined conversion graph or a square root function.
- Individual software trim for each input.
- History of last 250 samples are stored. Sampling time adjustable from 1 sec upwards.
- Inputs can be locked in a manual state.

Temperature inputs

- Up to 4 Dallas 1wire temperature sensors can be attached as Analogue inputs 9 through 12.
- History of last 250 temperature values is stored. Sampling time adjustable from 1 sec upwards.
- Temperature range selectable from -50 to +50, -25 to +75 or 0 to 100 deg Celcius
- Temperature conversion accuracy is 12 bit

Digital outputs

- 8 on the processor board. 4 of these outputs can be used as PWM analogue outputs.
- All digital outputs drive relays capable of switching 10A resistive loads.
- Each output has an on-timer associated with it giving a total of the runtime for that output.
- Short cycle timer, with a selectable polarity, for each output. Timed in minutes.
- Adjustable startup timer for each output. (0-255 seconds).
- Pulse width modulation available for each output.
- Each output can be inhibited by a digital point (selectable inhibit polarity).
- Times of last 64 changes of state are stored.
- Priority level structure on the outputs.

Analogue outputs

- 4 analogue outputs shared with digital outputs.
- PWM analogue output.
- User selectable upper and lower limits.
- Output can be inhibited by a digital point.
- Selectable output inhibit value.
- Selectable inhibit polarity.
- Output slew-rate control.
- Direct or reverse action.
- History of last 150 outputs is stored. Sampling time adjustable from 1 sec upwards.
- Priority level structure on the outputs.

Digital variables

- 32 digital variables.
- Selectable polarity.
- Network timeout and timeout value.

Analogue variables

- 32 analogue variables.
- Switchable between 2 values by a digital point.
- User defined values.
- Network timeout and default value.

Pulse accumulator input

A single pulse accumulator provides high-speed pulse counting.

- The maximum continuous count rate is 1kHz with a burst rate (<250 pulses) up to 20kHz.

Functions

The DXcom has many in-built functions which are configured under software control to meet specific requirements. The in-built functions are designed to meet the majority of needs for plant monitoring and control. These functions are enabled and configured using a Graphical User Interface on a connected PC using Windows 95, 98 or NT. The standard configuration includes:

- 16 continuous loop functions
- 16 discrete loop functions
- 8 arithmetic functions
- 24 logic functions
- 16 delay functions
- 32 time clocks
- 16 public holidays
- 16 alarm functions
- 8 lead-lag inputs to the lead-lag function

Programming Limitations

The design of the DXcom provides a large range of inputs and functions. The number of inputs and outputs points, the configuration of those points and the functions that can be accommodated is limited by memory, expansion bus addressing capacity and processing speed of the CPU. In practice these limitations are not likely to be reached. Where specific requirements exist, changes to firmware can be made which optimise the DXcom for a particular task. Sphere Systems will be happy to discuss specific needs with customers.

Physical

Both cards are design to fit Augat 3TK Series SnapTrack. SnapTrack for easy installation.

The DXcom card is 173mm long by 82.5mm wide by 30mm high. The relay output board is 110mm long by 82.5mm wide by 20mm high.

Power supply

The DXcom is designed to run of a 24V AC supply. Total current drain with all relays activated is less than 500mA DC.

External Connection

The field wiring is connected to the card through screw terminated connectors.

The interconnection of the processor board and output board is via a 10way ribbon cable.

System Specifications

Enclosures

All electronics and power supplies can be mounted in plastic or metal sealed enclosures to meet environmental requirements. No fans, heat sinks or other heat dissipation methods are required. Field wiring connections can be provided through plugs, sockets or penetrations in the enclosure meeting expected environmental requirements.

Enclosures will be sized to accommodate the equipment to be housed.

Sphere Systems Pty Ltd will be upgrading this product line from time to time and specifications are subject to change.