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PASCAL AUTOMATION CONTROLLER™



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The Pascal Automation Controller™ (PAC) is a DIN rail mounted C-Bus device which provides sophisticated yet affordable control of a Clipsal C-Bus system. The PAC can perform operations in response to monitored events by executing custom written embedded programs. These programs are written by installers to suit individual application needs using the Windows based Programming Interface for C-Bus Embedded Devices or 'PICED' software.

The PAC provides control based on conditional logic, time scheduling, scene control, RS-232 strings or combinations of these. The unit is programmed using a combination of software GUIs, wizards and an extended version of the standard 'Pascal' computer language which includes customised commands specifically for C-Bus control.

One of the primary uses of the PAC is for installers to develop custom programs which utilise conditional logic. Conditional logic is based on conditions such as time values and C-Bus Group Address levels.

For example, programs can be developed based on whether C-Bus relay outputs are on or off, or on the level of C-Bus dimmer outputs. The PAC is then programmed to perform required C-Bus actions based on these conditions.

The PAC is a native C-Bus device and is able to interact with the complete range of C-Bus and C-Bus Wireless products.

The unit includes a built-in real time clock and 192Kb of user memory which allows installers to include up to 2000 lines of code in their programs. The built-in EEPROM memory retains program information; there is no need for a backup battery or a separate memory unit to back up this information in the event of a power loss. An additional backup battery is only required for backing up the real time clock following a power loss of more than 24 hours.

The on-board processor enables fast data processing, and the execution time for a typical 200 line program is approximately 50 milli-seconds.



Key Features

- Conditional and Real Time events
- Dedicated Scheduling, Logic and Scene Programming Modules
- Downloading programs from a PC to the unit
- Connects directly to C-Bus
- Powered from C-Bus
- Compact size, 4M DIN wide

INPUTS

C-Bus

Date
& Time

Variables

Timers

RS-232

OUTPUTS

C-Bus

Variables

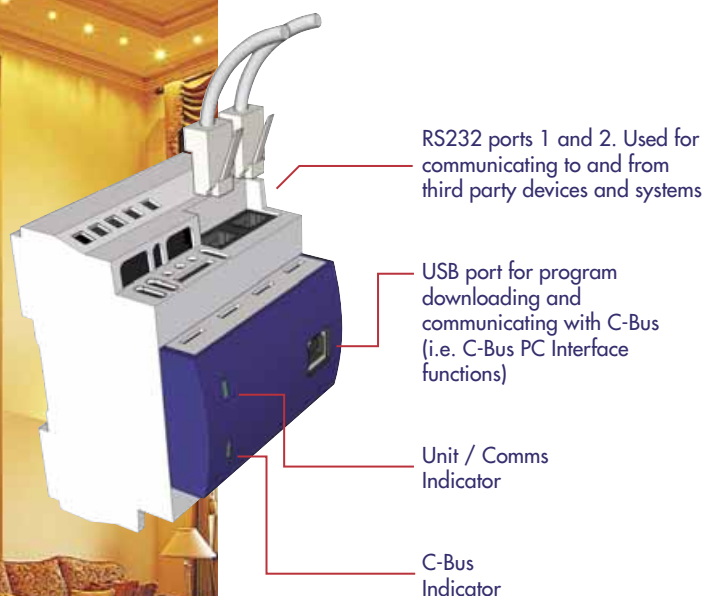
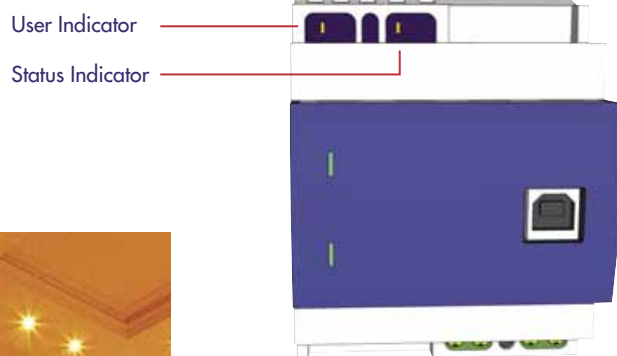
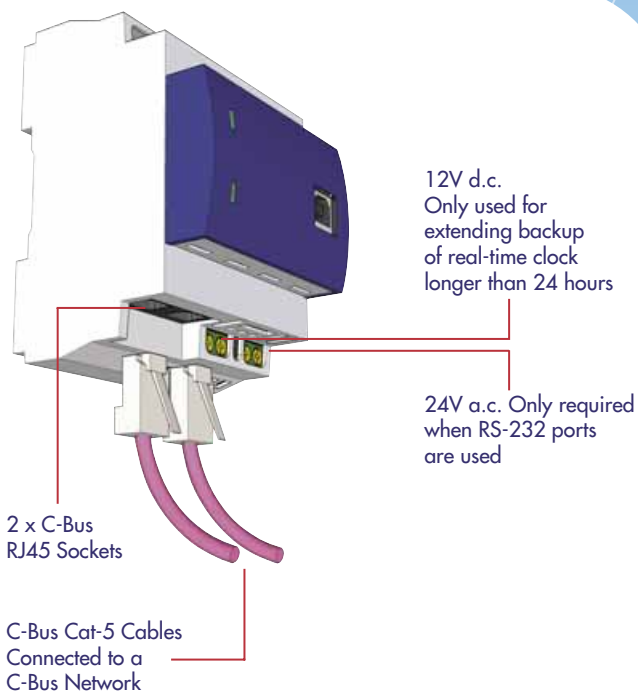
Timers

RS-232



- Two RS232 Ports for third party device control
- Easy to understand and learn programming language
- Windows based programming GUIs and Wizards
- Command line programming for advanced programmers.





The PAC can be DIN rail mounted with other C-Bus units (eg, in an electrical distribution board) or, as long as the normal C-Bus installation rules are adhered to, it can be field mounted anywhere on a C-Bus network.

The PAC only requires a C-Bus connection to operate¹, it is powered from a C-Bus network and is connected to the C-Bus Cat-5 UTP data bus in the same way as other C-Bus units.

The PAC provides a USB interface through which programs are downloaded. The USB connection can also be used by a PC to communicate directly with a C-Bus installation. This allows the PAC to function as a USB connected PC Interface and can be used by the C-Bus Toolkit software when configuring a C-Bus installation.

The PAC supports multiple C-Bus networks and multiple C-Bus Applications.

It is possible to read from and write to RS-232 serial ports from the PAC. This enables interfaces to many automation and audio/visual products to be created. The two serial ports included can be used simultaneously.

¹Additional power connection may be required if an external RS-232 device is connected to the unit

Typical Applications

- Complex Lighting Scenes, eg. Museums and Multi-Storey Building shutdown sequences
- Corridor Linking in Commercial Buildings
- Partition Dependent Room Linking/Joining in Conference Room, Exhibition Areas, etc
- Extensive Real-Time Scheduling, e.g. Shopping Centres
- Control of third party devices via RS-232 ports*, e.g. Video Projectors
- Interfacing to third party systems via RS-232 ports*, e.g. PLCs, Modbus systems
- Other complex Logic functions, for example multiple blind operations, Exclusive time based switching, i.e. C-Bus wall switch lockouts.

* Advanced Users Functions. These applications may require additional hardware.

PICED Programming Software

The Pascal Automation Controller™ is programmed by an installer using the Programming Interface for C-Bus Embedded Devices, or 'PICED' software. The PICED software provides a programming solution for installers at many levels of expertise and has been designed to be intuitive and easy to use. The PICED software is flexible and includes inbuilt wizards and GUIs for scenes, schedules and logic-based programming.

The inbuilt Text Editor allows freeform text based program entry for more complex logic programs and advanced programmers. The PICED software is available for download from the CIS web site (at no cost) and is continuously being improved by CIS with new features.



PICED Programming Tools

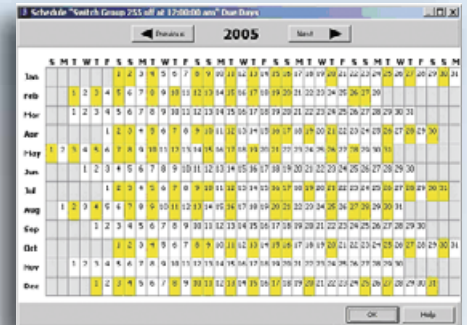
Scheduling Tool

The PICED scheduling tool allows time based events to be programmed into the Pascal Automation Controller™. The PAC checks every second whether a particular event is due to occur, and actions the event (or events) accordingly.



Managing Schedules

Schedules are created and managed in PICED software using the Scheduling Manager. The Scheduling Manager allows the installer to view a summary of all the schedules in a PAC project and see which are currently active. Schedules can be added, duplicated, edited and deleted in the Schedule Manager.



Editing Schedules

Schedules are edited using the PICED software schedule editor.

The schedule editor allows the following to be edited.

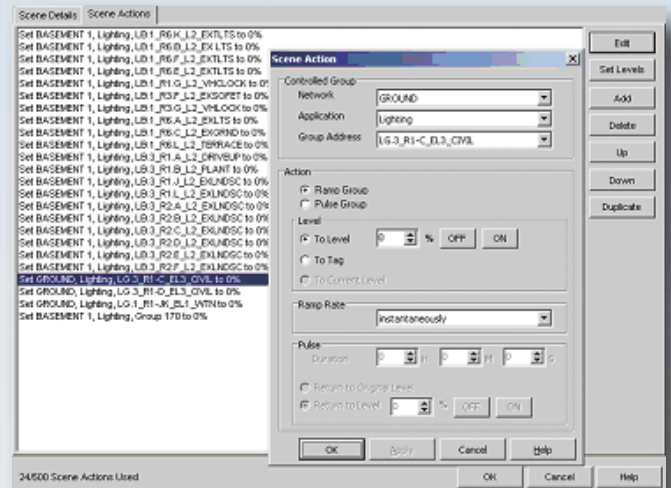
- The schedule name or description
- Enabling and disabling schedules. Schedules can be enabled and disabled via a specified C-Bus Group Address level
- Schedule time(s). This can be a fixed time, a time based on sunrise/sunset (plus or minus an offset) or a schedule repeated at regular intervals.
- Schedule day(s). This can be once only, every day, every week day, every weekend, every week, every month, every year, repeat days, odd days, even days, combinations of these and many other options.
- Schedule event(s). This can be setting a C-Bus Group Address to a level (including the setting the ramp rate), pulsing a C-Bus Group Address to a level or setting a C-Bus scene to occur.

Scene Programming Tool

The PICED scene programming tool allows installers to quickly and easily program scenes into a PAC. Common examples of uses of scenes which can be set using the Pascal Automation

Controller™ are:

- Setting all of the lighting in a building on or off, either manually or at scheduled times
- Setting the lighting in a room for a particular use (for a presentation or for a meeting)
- Controlling a series of loads for a particular use. For example, to set up for a video presentation, a scene could dim the lighting, close the blinds, lower the projector screen, start the DVD player and start the projector).



Triggering Scenes

Scenes can be 'set' in two ways:

- By automatically setting the required scene at a particular time (or times) via a schedule, or
- By setting the C-Bus scene Trigger Group to its trigger level.

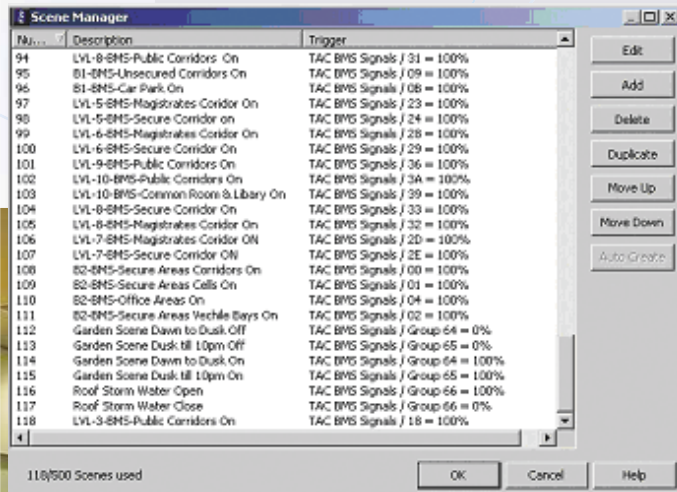
Managing Scenes

The Scene Manager allows the installer to view, add, copy, edit and delete scenes in a PAC project.

Editing Scenes

The Scene Editor allows the installer to edit the scenes in a PICED project. The values edited are:

- The name or description of each scene.
- The C-Bus Trigger Group Address for each scene. A scene can be triggered based on the level of a C-Bus Trigger Group Address.
- A series of 'actions' for each scene. Actions are C-Bus events that the scene will execute when triggered. Actions allow the user to ramp C-Bus Group Addresses to specified levels or pulse C-Bus Groups Addresses to specified levels for a defined duration.



Logic Programming

The programming language used in the PICED software is based on the standard Pascal computer language, enhanced by CIS with specific commands related to C-Bus control. Logic programs are developed by the installer using freeform text entry or, for simple logic programs and for installers new to the PICED software, a programming wizard is provided.

The Pascal language supports commands such as:

- Conditional logic (IF, THEN, AND, OR, NOT etc)
- Flow Control (FOR, REPEAT, WHILE)
- Variables (integer, real, Boolean, character, string)
- Procedures and Functions
- Arithmetic.

The Language has been extended to support functions such as:

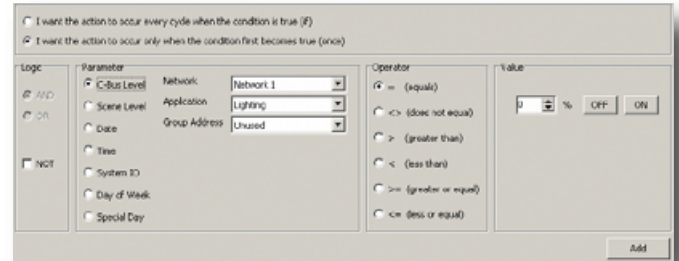
- Control and monitor C-Bus Group Addresses
- Control and monitor C-Bus scenes
- C-Bus tag names
- Serial (RS232)
- Edge triggered conditional statements.

Programming Wizard

Logic based programs can be created with the programming wizard. The wizard provides a GUI based point and click method for creating basic logic programs. These basic logic programs are suitable for a number of applications. More complex programs are produced by advanced users utilising the freeform text programming method (see next page).

The following details can be entered into the wizard:

- Name
- Description
- Task. This selects whether the code is to be a conditional action or just a series of actions
- Run. This selects whether the code should run continuously or only when triggered.



Wizard Conditions

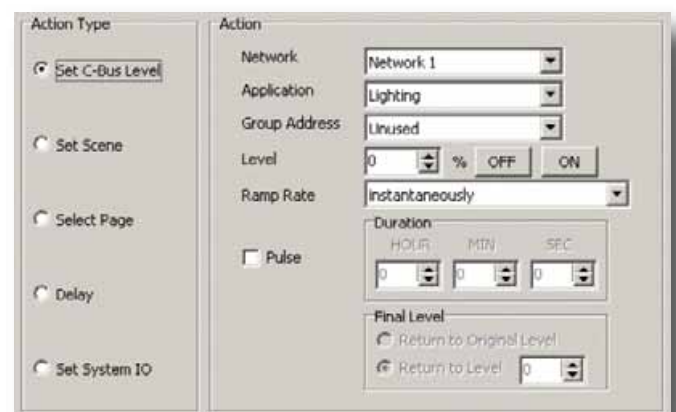
Conditions are the circumstances under which actions are to be executed. The types of conditions which can be used in the logic wizard are:

- C-Bus level
- C-Bus scene level
- Date (day/month/year)
- Time of Day
- Day of the Week.

Wizard Actions

An action is something that the PAC is able to do under specified conditions. The types of actions which can be performed include:-

- Set a C-Bus level
- Set C-Bus scene
- Delay
- Enable / Disable a program module.



Freeform Text Programming

PICED logic programs can be input by typing text directly into the editing window. To assist the readability of typed programs, the logic commands are highlighted automatically in a different colour.

The PICED software utilises C-Bus project database tag files, so C-Bus Group Address tags previously created in the C-Bus Toolkit software can be utilised by installers when C-Bus Group Addresses are used in PAC programs. There is no need to use hex or decimal C-Bus Group Address values. This ensures programs are easy to read.

The most common structure used in programs is the 'once' statement. It is used to perform an action if certain conditions are true. For example, if it is required to switch on the Outside Lighting at 7:00 PM every night, the statement would be typed as:

```
once (time = "7:00PM") then  
    SetLightingState("Outside Lighting", ON);
```

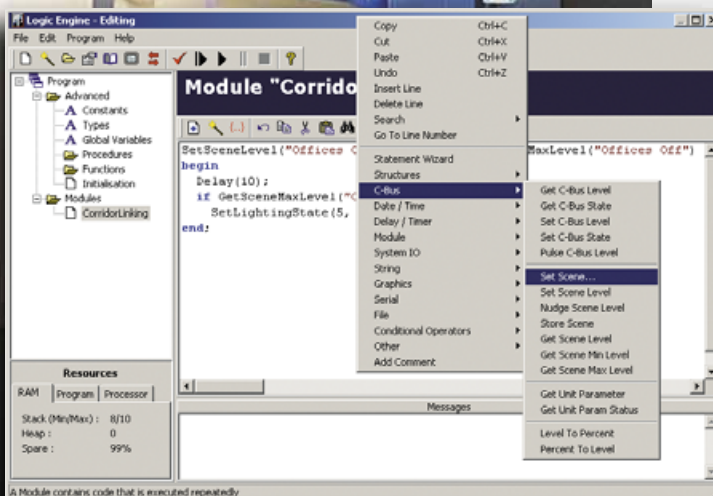
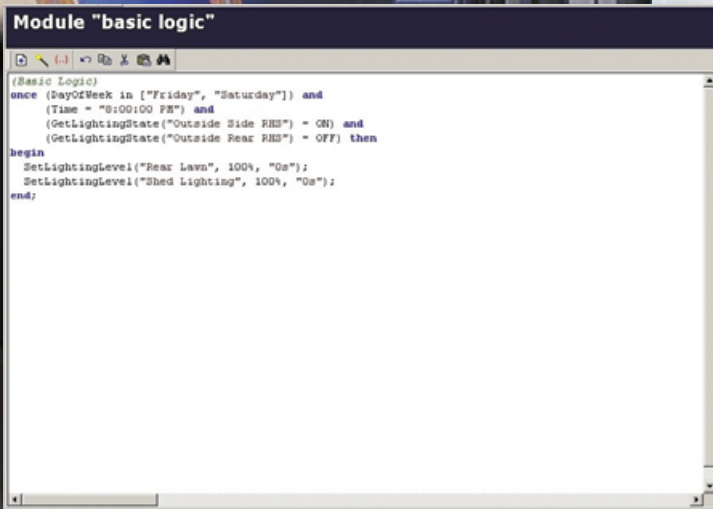
When entering freeform text programs, menus of common programming tools are quickly accessible by clicking the right mouse button in the text entry window. This conveniently provides the installer with all the necessary functionality to accomplish a task within a single menu. This menu includes tools to edit, insert, copy, cut and paste commands, as well as undoing changes. All commands are accessible from this menu. A search facility is included to find words within the code window.

Statement Wizard

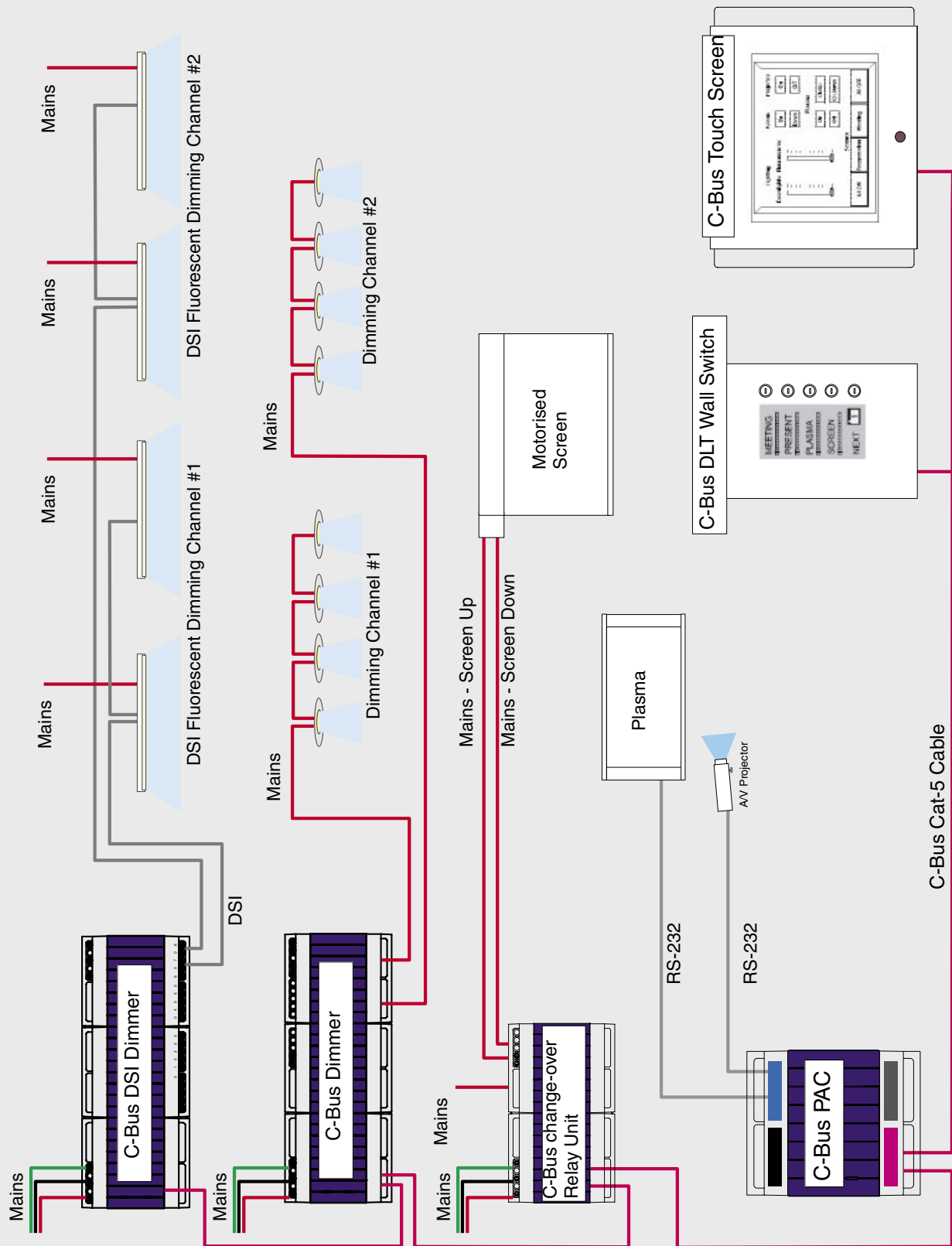
The Statement Wizard creates sections of code. It can be used to create conditional statements (a condition and some actions) or plain statements (actions only). The Statement Wizard is accessed by right-clicking on the code window where the code is to be inserted and selecting the Statement Wizard item from the pop-up menu. Many dialogue boxes are also included to automate the generation of program text for the installer.

Logic Programming Guide

A complete programming guide is available for PICED software. This is supplied with the downloaded software in Windows Help and pdf formats.



Typical C-Bus Applications Schematic





EXAMPLES

LOGIC PROGRAMMING COMMANDS

The PICED software programming language includes over 200 commands to achieve the C-Bus functionality required by clients. Some of these commands are listed below.

EXAMPLES OF C-BUS RELATED COMMANDS

One of the primary purposes of the PAC is to provide control and monitoring of C-Bus. There are a series of functions provided for access to C-Bus Group Address levels and states. Some of these are listed below.

GetCBusLevel Function	Reads the level of a C-Bus Group Address.
GetCBusState Function	Reads the state of a C-Bus Group Address.
GetLightingLevel Function	Reads the level of a C-Bus Group Address.
PulseCBusLevel Procedure	Pulses the level of a C-Bus Group Address.
SetCBusLevel Procedure	Sets the level of a C-Bus Group Address.

EXAMPLES OF C-BUS SCENES RELATED COMMANDS

The programming language also includes functions which enable the control and monitoring of C-Bus scenes.

CrossFadeScene Procedure	Sets the level of a C-Bus scene Group Addresses to their default levels, but using ramp rates selected such that all Group Addresses get to their final level at approximately the selected time.
GetSceneLevel Function	Reads the level of a C-Bus scene.
SetScene Procedure	Sets the level of a C-Bus scene Group Addresses to their default levels.
StoreScene Procedure	Stores the level of a C-Bus scene Group Addresses.
NudgeSceneLevel Procedure	The NudgeSceneLevel procedure adjusts the level of a C-Bus scene Group Addresses by a particular offset.
SetSceneOffset Procedure	The SetSceneOffset procedure sets the level of a C-Bus scene Group Addresses to their default level plus an offset. The scene Group Addresses are set to particular levels with a particular ramp rate. The level for each Group Address is its default value plus the offset value.

EXAMPLES OF TIME RELATED COMMANDS

Sunrise Function	The Sunrise function provides a value which represents the time of sunrise. The sunrise time depends on the longitude and latitude, the date and daylight savings. The software dynamically calculates the sunrise time (based on longitude and latitude) and can be used to trigger events based on this time.
Sunset Function	The Sunset function provides a value which represents the time of sunset.
TimerRunning Function	The TimerRunning function returns whether the specified timer is running or not.

EXAMPLES OF RS-232 RELATED COMMANDS

ReadSerial Procedure	The ReadSerial procedure reads data from a serial port.
WriteSerial Procedure	The WriteSerial procedure sends data to a serial port.

PASCAL AUTOMATION CONTROLLER™ SPECIFICATIONS

Electrical

Connections	2 x C-Bus (RJ45) 2 x RS-232 (RJ45) 1 x USB type B socket 2 x screw terminals for DC battery + / - (for extended real time clock backup) 2 x screw terminals for RS-232 power
C-Bus supply voltage	15 to 36V DC @ 32mA
RS-232	The two RS-232 ports allow the PAC to interface with third party device or system. These ports are opto-isolated and require to be powered if used. They can be powered from the DTR and RTS handshaking lines of the RS-232 ports (if the third party serial device has control over the handshaking lines) or via an external power supply connected to the PAC.
RS-232 supply voltage	24V a.c. @ 20mA (Note, this power connection does not charge the external backup battery).
Backup battery	Super Capacitor included for backing up of time clock for 24 hours after C-Bus loss. External battery connection for extended time clock backup. No battery backup required for program configuration backup.
Battery backup supply voltage	12V d.c. @ 30mA
C-Bus system clock	Software selectable
Network burden	Software selectable
Operating humidity range	10 to 95% RH
Operating temperature range	0° to 45°C

LED Indicators

Status Indicator	The "Status" indicator provides a guide to the internal PAC status.	
	Indicator Status	Meaning
	On	User configuration data is corrupt. A new configuration file must be transferred.
	Off	Logic Error
	Rapid constant flash (approximately 5Hz)	The firmware is corrupt. New firmware and a new configuration file must be transferred.
	Erratic flash (approximately 1 Hz)	Logic is running. The indicator state is toggled when logic is run.
User Indicator	The "User" indicator is controlled by the logic programs. Its state will vary depending on how the project is programmed.	
Unit/Comms Indicator	The "Unit/Comms" indicator shows the status of the PAC unit.	
	Indicator Status	Meaning
	On	Normal operation
	Erratic Flash	Data exchange in progress (USB port)
	Off	No C-Bus power connected
C-Bus Indicator	The "C-Bus" indicator shows the status of the C-Bus network at the unit.	
	Indicator Status	Meaning
	On	Power is on and functional
	Flashing	There is insufficient power to support the C-Bus network
	Off	No C-Bus clock signal is present



PROGRAMMING SPECIFICATION

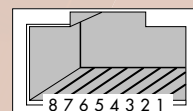
Available User Memory for programming	192Kb
Maximum program length	~2000 lines
Maximum number of C-Bus Applications supported	10
Maximum number of C-Bus Group Addresses supported	255 Group Addresses on each C-Bus Application, 2550 total
Number of programming commands available	>200
Maximum number of If-Then conditions	No specific limit, >1000
Maximum levels of If-Then "nesting"	No specific limit, >1000
Maximum number of individual modules in a program	50
Number of flags	No specific limit, >1000
Number of variables	No specific limit, >1000
Number of timers	20 in-built, >1000 user definable
Maximum number of event schedules	250
Variable mathematical functions	Yes
Schedule events by time	Yes
Sunrise/Sunset events (dynamic, based on longitude & latitude)	Yes
Daylight savings time adjustment	Yes
Adjust clock within schedule	Yes
Random event times	Yes
Power failure recovery process	User defined
Time resolution	1 second
Clock Accuracy	0.5 second per day

ADDITIONAL PAC INPUTS / OUTPUTS

Wall switch input	C-Bus Wall Switches
Telephone control	C-Bus Telephone Interface Unit
Light level control	C-Bus Light Level Units
Touch Screen control	C-Bus Touch Screens
Analogue output (0-10V d.c.)	C-Bus Analogue Output Units
Digital outputs	C-Bus Relay Units
Digital inputs	C-Bus General Input Units, Auxiliary Input Units & Bus Couplers
Analogue inputs	C-Bus General Input Units
Infra-red outputs (a/v control)	C-Bus Infra-red Transmitter Units

RS232 INTERFACE

User-controllable	Yes		
Number	2		
Baud rate	600 to 38400 Baud		
Transmit (output) capability	ASCII, binary, variable values, etc.		
Receive (input) capability	ASCII, binary, variable values, etc.		
Maximum receive data length	255 bytes		
Pinouts	Pin	Name	Description
	1	DCD	Data Carrier Detect
	2	DSR	Data Set Ready
	3	DTR	Data Terminal Ready
	4	GND	Ground
	5	RD	Receive Data
	6	TD	Transmit Data
	7	CTS	Clear To Send
	8	RTS	Request To Send



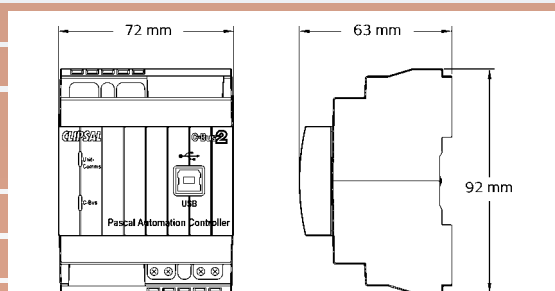
When the RS-232 port is connected to an external device(s), a suitable shielded data cable should be used. The RS-232 cable length should be limited to 15 metres for communication speeds up to 19,200 bps, or 7.5 metres at 38,400 bps.

Example of PICED logic program
to send text from RS-232 Port #1 of the PAC.

```
{arm the security system when triggered}
once GetTriggerLevel("Arm System") = 255 then
begin
WriteSerial(1, 'Arm System');
end;
```

MECHANICAL SPECIFICATION

Enclosure	DIN rail mounted, 4M Modules Wide
Dimensions (W x H x D)	72 x 92 x 63 mm
Programming connector	USB for PAC program downloading and C-Bus Communication (PC Interface functionality)
C-Bus connectors	2 x RJ45 sockets (in parallel)
RS232 port connectors	Port #1 1xRJ45, Port #2 1xRJ45
Weight	150g



STANDARDS COMPLIED

Australian/New Zealand EMC & Electrical Safety Frameworks and Standards
The 5500PACA product complies with the following:



Regulations
EMC (C-Tick)

Standard
AS/NZS CISPR 22
AS/NZS CISPR 24

Title
IT Equipment Emissions Standard
IT Equipment Immunity Standard

European Directives and Standards
The 5500PACA product complies with the following:



European
Council Directive
EMC Directive
89/336/EEC

Standard
EN 55022
EN 55024

Title
IT Equipment Emissions Standard
IT Equipment Immunity Standard

Other International Directives and Standards
The 5500PACA product complies with the following:

Regulations
EMC

Standard
CISPR 22
CISPR 24

Title
IT Equipment Emissions Standard
IT Equipment Immunity Standard

Part Number
5500PACA

Description
C-Bus Pascal Automation Controller™ (PAC)



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