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INTEGRATED SYSTEMS

C-Bus Training Course

Introduction to C-Bus

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Scope

This manual provides an installer with basic skills needed to program and use C-Bus. A fundamental technical background is required.

The manual includes:

- an overview of C-Bus
- C-Bus wiring methods
- C-Bus terminations
- C-Bus power supplies
- network burdens
- operating parameters
- multiple networks
- C-Bus addressing concepts.

It is an ideal preparation before attending the C-Bus Basic Training Course.

Learning Outcomes

By the end of this module, you should have an understanding of:

- how C-Bus works
- C-Bus wiring
- characteristics of a C-Bus power supply
- using a Network Burden
- connecting multiple network C-Bus projects
- various C-Bus addresses
- various operating parameters.

Introduction – What is C-Bus?

C-Bus is a microprocessor-based control and management system for buildings and homes. It is used to control lighting and other electrical services such as pumps, audiovisual devices, motors, etc. Whether simple ON/OFF control of a lighting circuit, or variable (analogue) type control, such as electronic dimmable fluorescent ballasts, C-Bus can be used to easily control virtually any type of electrical load.

To ensure fast and reliable operation, each C-Bus device has its own in-built microprocessor and "intelligence", allowing units to be individually programmed.

C-Bus uses a patented method for updating the status of units. This method does not require a central computer or central controller to handle databases or lookup tables to operate. The status of each C-Bus unit is initiated at specific time intervals, without the need of a central controller. Each device is allocated a specific time frame to broadcast its status, synchronised by a self-generated system clock pulse. This allows large amounts of data to be transmitted in a very small time frame, effectively and reliably on the network, leading to low processing overheads and low bandwidth requirements.

1.0 Why Use C-Bus?

There are many reasons to use C-Bus:

- It is a highly robust and reliable control system, with a low cost per node.
- A wide range of tools is available, allowing third party companies to interface with both PC based and embedded systems.
- A single C-Bus cable connection can control many devices.
- C-Bus offers the ultimate flexibility in switching and control. Functions can be changed, added, removed, moved, reprogrammed, at any position on the network, at any time – without any cumbersome hard-wiring.
- C-Bus is simple to install and commission.
- C-Bus can control any type of load, digital and analogue.

Electrical wiring practices have not changed much since the introduction of insulated multicore cabling. However, wiring requirements in commercial buildings have changed rapidly since that innovation. The additions of fire and smoke detection, security and energy management systems have placed high demands on electrical installations.

The need for central monitoring and control of these extra systems may result in massive networks of wires emanating from the control area.

Conventional wiring practice requires current to flow through both a switch and its load. This requires heavy conductors to run from the switchboard to the load and, from the load to the controlling switches. These aspects add to wiring complexity, increasing installation time, documentation control and overall system cost. Maintenance and system flexibility can be problematic.

The C-Bus network overcomes these problems. It uses a twisted pair of wires such as Unshielded Twisted Pair (UTP) Category 5 (Cat-5) Local Area Network (LAN) cable, to

communicate between a building's light switches and load controlling devices. This same cable pair also provides the DC supply voltage to the C-Bus devices.

This greatly reduces the number of heavy wires in an installation, while enabling easy central monitoring and system control.

C-Bus can be expanded to control and monitor a building's electrical appliances from a personal computer. Security, air conditioning and other systems can be programmed to turn on or off at specific times or events. Lighting and temperature can be varied according to ambient conditions. Inputs, switches and loads can be reconfigured without reconnecting a single wire.

1.1 Ease Of Wiring

No point to point wiring is required. All input and output units are looped together with Cat-5 UTP cable. Units do not need to be wired in any particular order.

The positive and negative C-Bus terminals on each unit are connected to the appropriate conductors on the C-Bus cable. These two conductors carry a low voltage power supply for the electronics in each C-Bus unit, and also allow digital control signals to be sent between units.

1.2 Flexibility

A C-Bus input unit can be programmed to perform various functions such as timing, dimming on/off and other functions. This programming can be changed as often as needed.

An input can control many outputs, providing simple load bank control. An output can be controlled by many inputs, providing multipoint control (including dimming) without complex wiring.

The program that specifies which inputs control which outputs can be changed as often as needed, to match an installation's changing needs.

2.0 How C-Bus Works

2.1 C-Bus Network Wiring

The C-Bus network bus is the communications wiring for the system, consisting of an unshielded twisted pair (UTP) Cat-5 cable. The bus not only provides the means of communication between units, but also the small amount of power needed to operate the circuitry within each C-Bus unit.

The C-Bus network is electrically isolated from the mains power, and operates at safe extra low voltage levels (36 V DC). Legal restrictions of mains wiring do not apply, so C-Bus wiring may be run into places that would be dangerous (or illegal) with normal mains wiring.

All input and output devices are wired to any point in the C-Bus network by a twisted pair cable, which carries all communications between the units.

The C-Bus connections may be looped from unit to unit or a branch can be made at any point. This 'free topology' structure provides a flexible system layout. New units can be added anywhere, at any time, without reconfiguration.

During commissioning, the system is programmed so that specific commands trigger specific responses in one (or more) devices on the network. At any time the commands can be re-programmed, and C-Bus units can also be added, removed or moved.

The size of a C-Bus network is practically unlimited. A large network is usually divided into sub-networks of 100 C-Bus units, with a total cable length of 1 km per sub-network. This allows a C-Bus system to be divided into manageable sections, simplifying design, limiting potential fault propagation and aiding in any troubleshooting.

2.2 C-Bus Units

All units on the C-Bus network have their own built-in microprocessor, allowing them to operate independently with "distributed intelligence". This provides extremely reliable and efficient communications.

Every C-Bus unit has a unique number, so that all devices on the network can communicate directly. Also, as C-Bus uses point to multi-point communication, every device on a C-Bus network issues and responds to commands directly from the network, rather than requiring a central computer or controller.

2.3 Simple Control

Each C-Bus device is programmed to issue and respond to the certain commands. A virtually unlimited number of commands can be programmed into the C-Bus system. Generally, input devices are programmed to issue commands, and output devices are programmed to execute those commands.

When a C-Bus Group Address command is issued by a C-Bus device, any other devices that have been programmed with that Group Address will be activated, wherever they are on the C-Bus network. There is no need for any direct 240 V connection between any C-Bus units.

2.4 Multiple Events

Single devices can also produce multiple events. For example, you may program an input switch so that the length of time the key is pressed determines what Command is issued – a short press issues an on/off command and a long press controls a dimming command.

Multiple commands do not have to control the same output device(s), so complex scenarios can be easily created, for example a single push button switch controlling a whole floor of a building.

Multiple input devices can conditionally control a single output device, dependant on specific circumstances. This allows multiple levels of over-ride switching and other complex control systems to be created easily.

2.5 Control Flexibility

The C-Bus system can carry out control in virtually unlimited ways:

- Any input device can be programmed as a master control point. Master overrides can be positioned anywhere in the network, and control any other unit or units on any connected network.
- The system can allow unlimited switching configurations. Two, three (or more) switches can be set to toggle or control any other switch or device.
- Overrides can be easily re-programmed via Windows software at any time.
- A computer or central controller is not required for normal C-Bus operation, but can be used to add additional features if desired.

2.6 Types of Units

There are 3 main categories of C-BUS devices.

System Support Devices

Power Supply

Network Bridge

PC Interface

Computer Network Interface (CNI) Unit

Input Units

Switch Plates (1, 2, 4, 6, 8, 12, 16, 20 or 24 button)

Light Level Sensors

PIR Occupancy Sensors

Temperature Sensors

Real Time Clocks

Auxiliary Input Units

Infrared Receivers

Scene Controllers

Bus Coupler

Output Units

Voltage Free Relays

Voltage Free Changeover relays

Dimmers

DSI Gateway

Analogue Output (0 – 10V DC)

Infrared Transmitters

3.0 C-Bus Communications

When a button is pressed on an input unit, a measurement is made of its press duration. This measurement influences the message that the unit issues in response to the button press (depending on its programming). This is illustrated in Figure 1.

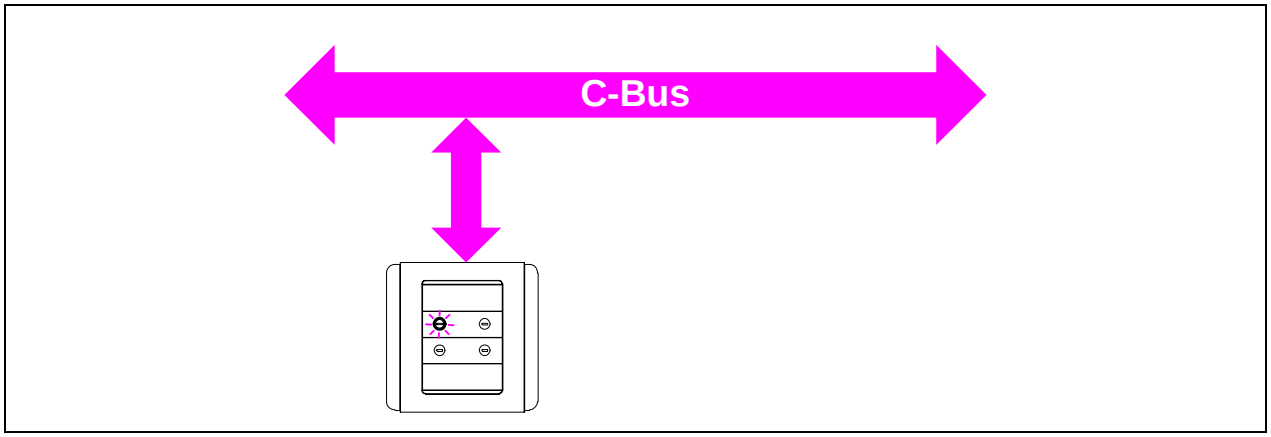

Figure 1 – An input unit measures the duration of a button press before responding

The relevant C-Bus message is then transmitted over the C-Bus network as indicated by the dashed line in Figure 2.

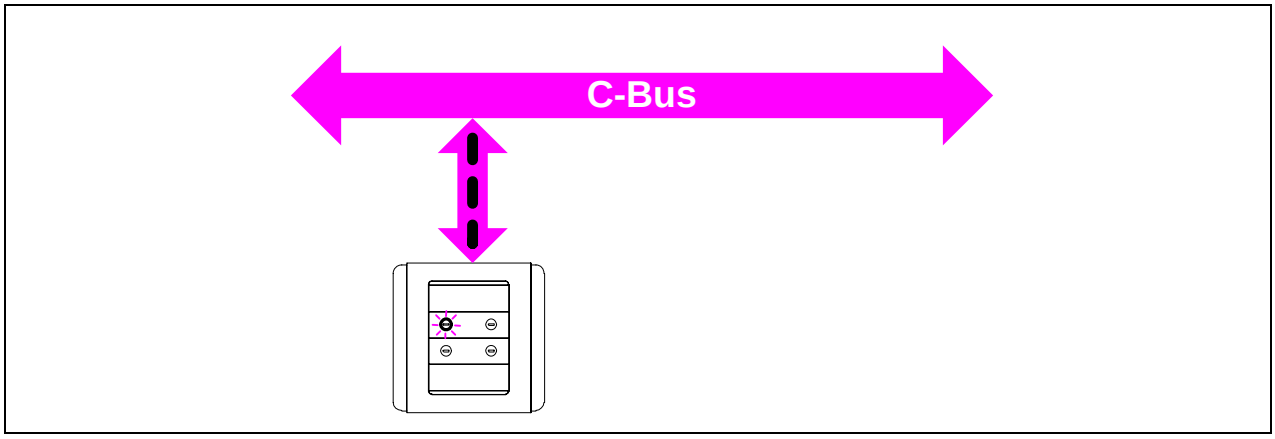

Figure 2 – An input unit transmits a message over the C-Bus network

The C-Bus message is broadcast over the bus for all C-Bus units to read, as illustrated in Figure 3. It contains information about the Group Address and the operation to be performed, such as switch on or off. Only the C-Bus units with the same address will respond.

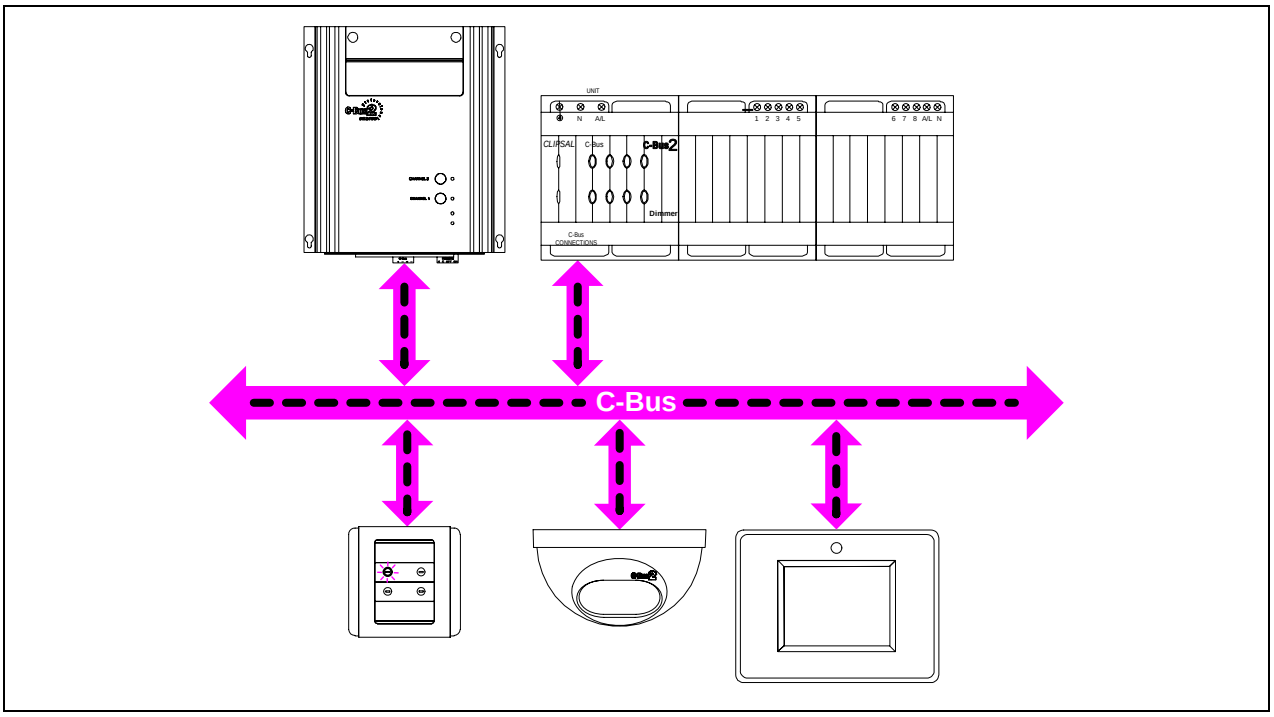

Figure 3 – A C-Bus message is read by all C-Bus units connected to the same network

Once the C-Bus units have received and interpreted the message, they respond according to their programming, switching the appropriate load (Figure 4).

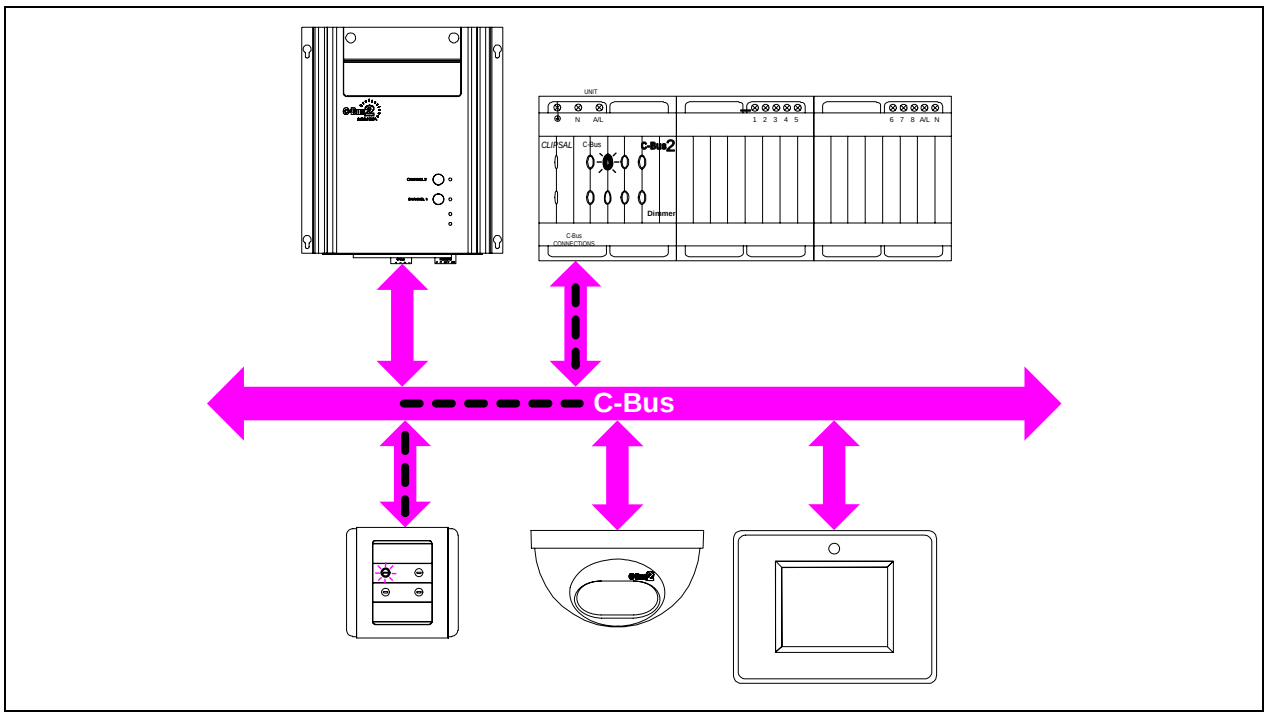

Figure 4 – A C-Bus output unit switches its loads in response to a message sent by an input unit

4.0 Wiring Methods

The following sections demonstrate the difference between conventional wiring and C-Bus wiring, when installing a two-way control for four light circuits.

4.1 Conventional Wiring

Figure 5 indicates how many wires are needed to perform two-way control between two four-gang plates. As many as 13 mains conductors need to be run between the two plates and the loads.

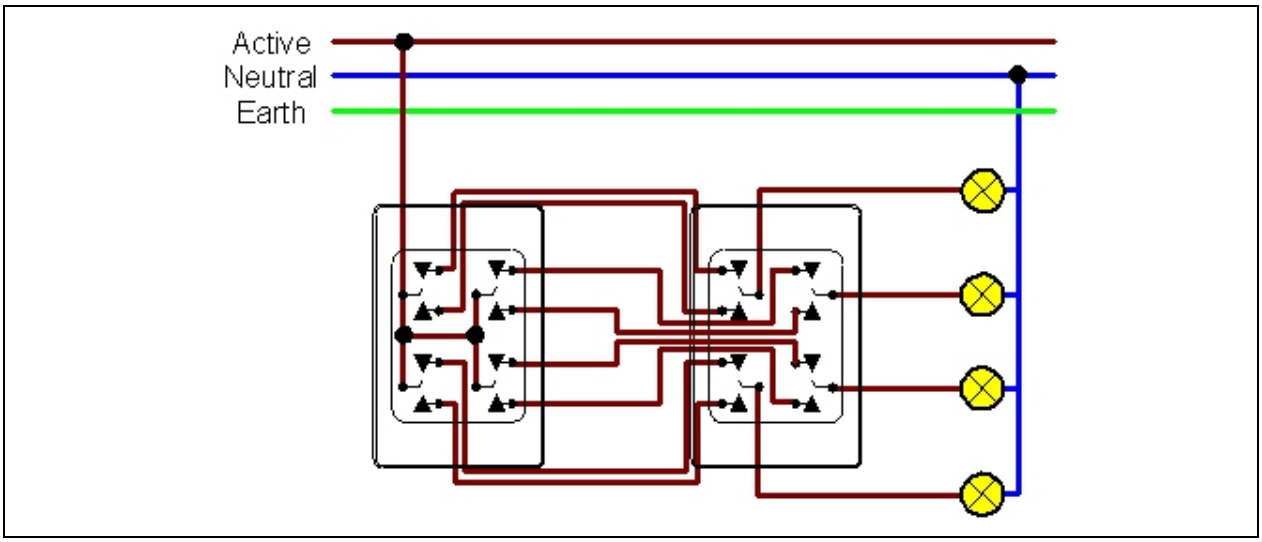

Figure 5 – Conventional wiring of a two-way control for four light circuits

4.2 C-Bus Wiring

Figure 6 shows how the same two-way control is wired using C-Bus (pink wiring). The control circuitry is simpler than the conventional method. If a four or eight button switch is used instead of the two button, the wiring remains the same. Just two conductors are required to link the C-Bus control.

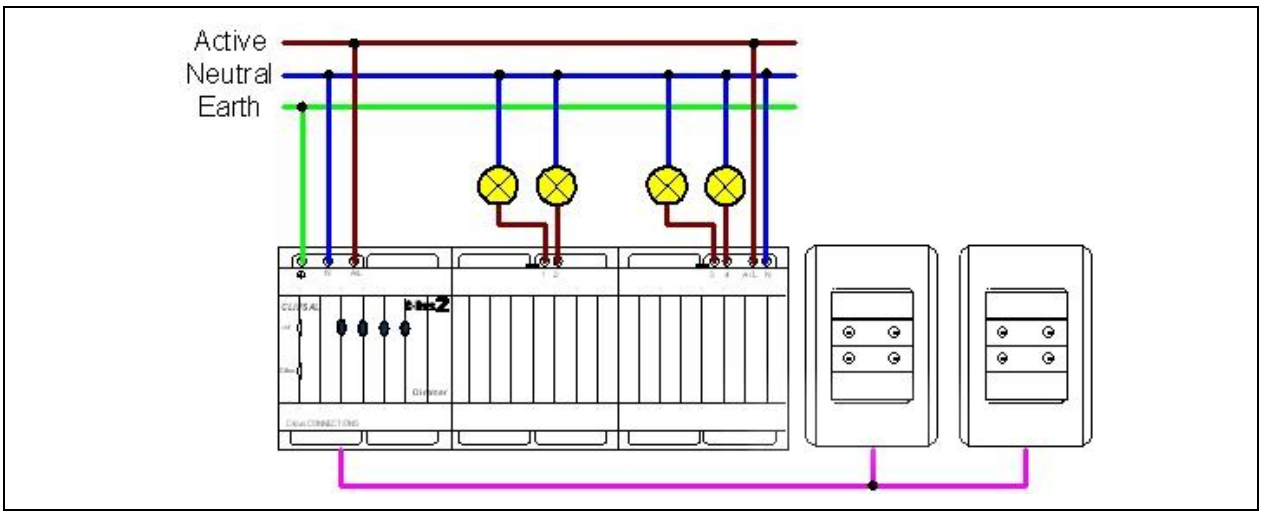

Figure 6 – C-Bus wiring of a two-way control for four light circuits

4.3 Wiring a C-Bus Network

The C-Bus system is wired using Cat-5 UTP cable.

C-Bus Cat-5 UTP has a mains rated sheath (pink) and consists of four colour-coded twisted pairs. The standard colours are:

- blue twisted with blue & white
- orange twisted with orange & white
- green twisted with green & white
- brown twisted with brown & white

The conductors within a C-Bus cable are displayed in Figure 7.

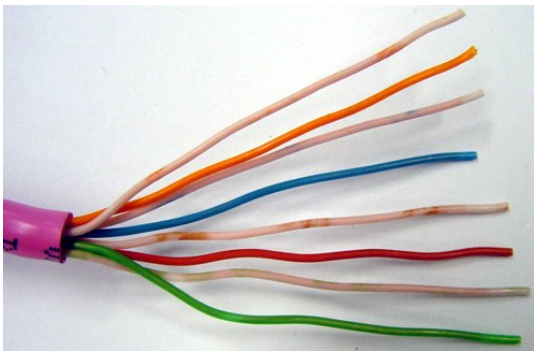

Figure 7 – Conductors within a C-Bus cable

The electrical characteristics of Cat-5 UTP cable include low resistance and capacitance. The cable also has high noise immunity (provided by the twist between the pairs), making it ideal for C-Bus wiring.

Two conductors are used for each positive connection to a C-Bus unit and two for each negative connection:

- A termination is more secure when made with two conductors.
- The extra copper provided by the second conductor reduces the voltage drop on long cable runs.

4.4 Which Wires to Use

In order to maintain noise immunity, the natural twist between pairs must be retained when connecting to the positive and negative C-Bus terminals.

It is important that the following Cat-5 conductors are used when making C-Bus connections:

- orange + blue for positive C-Bus Wires
- orange & white + blue & white for negative C-Bus Wires

Figure 8 shows correct wiring that maintains the natural twist of the C-Bus cable conductor pairs.

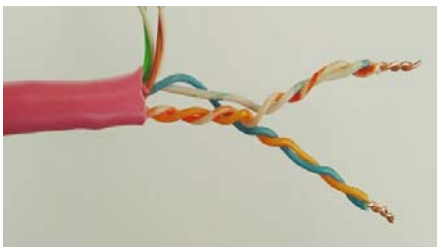

Figure 8 – Correct pairing of C-Bus conductors

Figure 9 shows incorrect pairing of conductors. This increases the C-Bus network's susceptibility to electrical interference.

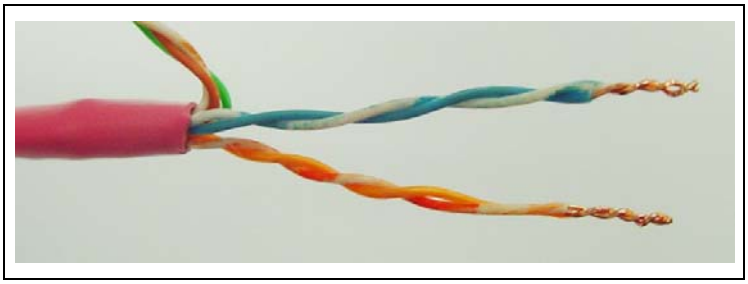

Figure 9 – Incorrect pairing of C-Bus conductors

Important

Using the correct pairing while maintaining the cable twist (Figure 8) provides increased immunity to electromagnetic interference.

CIS have standardised on using the orange conductor and blue conductor for the positive connection, and the orange & white conductor and the blue & white conductor for the negative connection. This colour code matches that used in Cat-5 patch cords supplied with the C-Bus DIN range of products.

4.5 C-Bus Terminations

The C-Bus network uses an Unshielded Twisted Pair (UTP), Category 5 LAN cable as the communications medium. The Clipsal catalogue number for this product is 5005C305B.

It is recommended that the C-Bus cable be terminated by twisting the pair together or by using a bootlace crimp as shown in Figure 10.

When terminating the C-Bus cable, do not solder as in Figure 11. This may cause "cold flow".

When twisting the pair together, avoid frayed terminations as shown in Figure 12.

Cat-5 cable normally consists of single strand 0.2 mm^2 copper in each conductor. Care must be taken when twisting the conductors together to ensure the wire does not break. Care must also be taken to ensure all wires are secure.

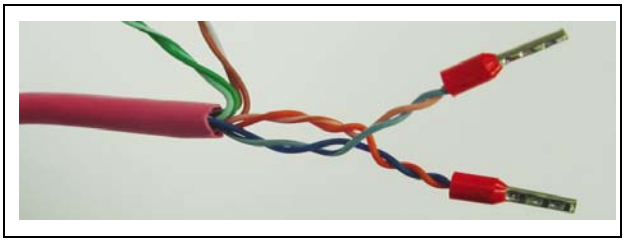

Figure 10 – Terminating with a bootlace crimp

Figure 11 – Soldering may cause cold flow

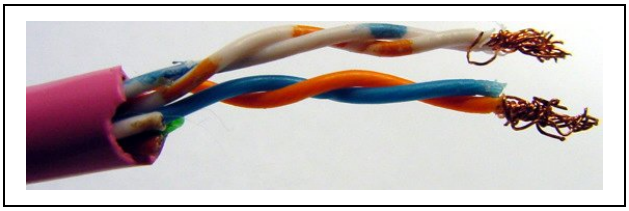

Figure 12 – Avoid frayed terminations

Up to four Cat-5 conductors can be securely held using a small bootlace or ferrule crimp. Depending on the size of crimp, several crimps may be held in a terminal.

Soldering conductors together shrinks back the insulation, increasing the likelihood of short circuits between conductors. Over time the solder will cold flow away from the point of pressure (under the terminal screw), causing an intermittent or high resistance joint.

The Clipsal C-Bus data cable is strongly recommended due to its distinctive pink outer sheathing. This reduces confusion between a C-Bus network and information systems (such as data, fire and telephone), at the same installation. The Cat-5 UTP also has a 240 V mains rated outer sheath. This is a requirement where the cable enters a switchboard, and is present in the same enclosure as single insulated mains wire.

The RJ45 end is an 8-position modular connector that looks like a large phone plug. There are a couple variations available. The primary variation you need to pay attention to, is whether the connector is intended for braided or solid wire. For braided/stranded wires, the connector has contacts that actually pierce the wire. For solid wires, the connector has fingers, which pierce the insulation and make contact with the wire by grasping it from both sides. The connector is the weak point in an ethernet cable, choosing the wrong one will often cause grief later. If you just walk into a computer store, it's pretty impossible to tell what type of connector it is, if it isn't specifically labelled. Strain relief boots are somewhat helpful sometimes.

The C-Bus connectors are wired as a standard patch lead, as shown in Table 1.

Pin	Connection	Colour
1	Remote Override ON	Green & white
2	Remote Override ON	Green
3	C-Bus Negative (-)	Orange & white
4	C-Bus Positive (+)	Blue
5	C-Bus Negative (-)	Blue & white
6	C-Bus Positive (+)	Orange
7	Remote Override OFF	Brown & white
8	Remote Override OFF **Note**: RJ45 pictured with clip facing down.	Brown

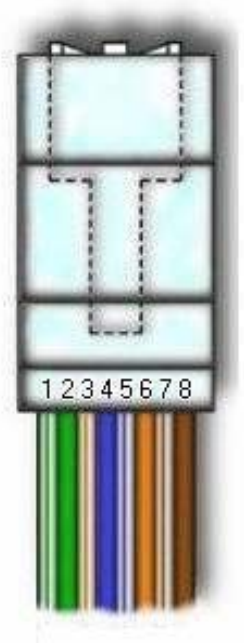

Table 1 – C-Bus connector identification

4.6 Standard Network Topology

C-Bus units can be wired together in a number of different ways. They can be "daisy chained" together. This uses the least amount of cable but may cause excessive voltage drop over long runs. (Spreading C-Bus power supplies or output units with in-built power supplies around the network, will address this).

Alternatively C-Bus units can be "star wired" back to a central point, such as a switchboard where the output units are mounted. This limits voltage drop but may use more cable.

In most cases the most suitable topology is a combination of daisy chain runs, which are star wired out from output unit locations.

Ring topologies are not recommended. While they offer some redundancy in case of broken or damaged wires, ring topologies can provide parallel communication runs that may result in distorted waveforms and "race" conditions.

A calculator tool and information regarding voltage drop across networks is available at http://www2.clipsal.com/cis/technical/downloads/software/

4.7 Location of C-Bus Units

It is important to choose a suitable location to mount a C-Bus unit. Input units are typically located in a position convenient for the people who will operate them. DIN Rail output units are typically installed inside a power distribution board or cabinet.

Some important factors to consider:

- Ensure the mounted unit will not be subject to high temperatures. Most C-Bus units are rated to operate at an ambient temperature of up to 45 °C. When mounted in a confined space (such as a cabinet), the units contribute to the ambient temperature. This is particularly true of dimmer units, which dissipate more heat than other unit types. Avoid mounting in places that may become hot such as ceiling cavities or in direct sunlight.
- Choose a location that will not become wet or subjected to extreme humidity.
- Ensure units are mounted at a suitable height for the end user.
- Consult the unit's Installation Instructions as there may be specific mounting considerations for a particular unit type.

5.0 Mains and C-Bus Segregation

With all C-Bus units that have mains as well as 36 V DC bus connections, care must be taken to adequately separate the 240 V AC wiring from the bus wiring. Pink C-Bus Cat-5 UTP, with its mains rated outer sheath, must be used within the confines of a switchboard.

Wiring practices vary from installer to installer. Sometimes the mains cable entering the switchboard is double insulated, while other times it is single insulated. When it is double insulated, the outer insulation must be stripped back to allow the connection of mains wires to the DIN unit power supply and output terminals.

No isolation issues can be expected between C-Bus and a single insulated mains cable, when the pink C-Bus Cat-5 cable enters a switchboard and plugs straight into a DIN module.

The 300 mm pink Cat-5 patch leads supplied with all DIN units are used to loop in and out of any other DIN units within the enclosure.

Where more than one pink Cat-5 cable enters the switchboard, care must be taken to ensure that any join made between multiple Cat-5 cables is effectively insulated with no exposed terminal screws etc. Consider terminating multiple C-Bus Cat-5 cables outside the switchboard, and bringing just one into the RJ socket on a DIN unit.

The mains rated pink sheath allows the C-Bus Cat-5 cable to run closer to mains wiring than would otherwise be allowed. To give the greatest margin of noise immunity within the switchboard and overall installation:

- Always maintain 150 mm of separation between C-Bus and mains cable, when running C-Bus cable in parallel with mains.
- Ensure that C-Bus always crosses mains cable at a 90 degree angle, with at least 60 mm of separation.

Most importantly, securely anchor both Cat-5 and mains cable in switchboards. This provides an additional safety margin against contact between loose mains conductors, and the C-Bus 36 V DC wiring.

Wiring regulations covers these issues. An installer must ensure that wiring is carried out in a safe manner. The safety and protection of users of equipment is of the highest importance. The product warranty will be affected if a failure is found to be caused by poor wiring practice. In addition, the isolation between mains and C-Bus wiring is one of the key checks made during a CIS Approved Installer* visit.

* An Approved Installer is a person or company that has had the standard of their installation, servicing abilities and quality of service to customers recognised by Clipsal Integrated Systems. This recognition is secured through continuing training, on site assessments and customer feedback.

6.0 C-Bus Power Supplies

The two-wire connection between C-Bus units serves two purposes. It is the communication medium through which on and off signals are sent between inputs and outputs. It also carries a 36 V DC supply to power the electronics in C-Bus units.

6.1 Voltage and Electrical Characteristics

The C-Bus power supply is isolated from the mains supply by at least 3 kV. It achieves this isolation using a double wound transformer. The output voltage is capped at 36 V. C-Bus units that connect to both mains and C-Bus supplies use transformers or opto-isolators to achieve isolation.

To achieve successful communication across the bus, power supplies must have the correct electrical characteristics. For this reason only C-Bus power supplies are suitable for use in a C-Bus installation.

6.2 Short Circuit and Overload Protection

The internal circuitry of the power supply will react if:

- the bus conductors are shorted together
- too many C-Bus units are connected to a supply
- a C-Bus unit is incorrectly connected.

In all cases the power supply will limit the amount of current that flows to a safe level, ensuring that neither it nor any other C-Bus unit is damaged.

6.3 Over Voltage Protection

It is recommended that sufficient over voltage and lightning protection be fitted, particularly in areas where there is a high incidence of lightning strikes. The Clipsal 970 Series may be useful for this purpose.

6.4 Multiple Power Supplies

Where the number of C-Bus units used on a system exceeds the capability of a C-Bus power supply, additional power supplies are connected to increase capacity. In larger installations the power supplies are best distributed around the system, to minimise voltage drop across the C-Bus conductors. On any one C-Bus network, the combined power from the power supplies should not exceed 2 A, as this would exceed the current handling capability of the Cat-5 cable.

6.5 Types of Power Supplies

C-Bus power supplies are available in a number of configurations. These include stand-alone units, and supplies incorporated into relay or dimmer output units. Table 2 lists the output currents of various power supply types.

Type of Power Supply	Output Current
DIN rail stand-alone	350 mA
DIN rail on-board	200 mA
Pro Series Dimmer on-board*	60 mA

Table 2 – Power supply output currents

* The Twelve Channel Pro Series Dimmer does not come with an on board C-Bus Power Supply.

The output current specified in an on-board power supply is independent of any power that the unit uses itself. When calculating the number of units to be powered by an on-board supply, you do not need to include the unit with the on-board supply in the calculation.

7.0 Network Burdens

A network burden is a 1 kΩ resistor in series with a 10 μF to 22 μF, 50 V capacitor. A network burden acts as an AC filter, and must be connected across each network to ensure reliable communication. Only one burden should be present on a C-Bus network.

A network burden has been built-in to particular C-Bus units. Depending on the Unit Address, the network burden is enabled or disabled using the C-Bus Toolkit software. For a network burden to be enabled via software, the unit must be at Unit Address 001.

An external hardware network burden can also be used. It is enclosed in an RJ45 package, which can be plugged into any C-Bus RJ45 socket on the network.

Software burdens can be found on:

- all C-Bus DIN Rail Output Units
- the C-Bus Network Interface
- the PC Interface
- Touch Screens
- the HomeMinder
- General Input Units
- Network Bridges
- Telephone Interfaces.

This list will continue to grow as additional C-Bus units are developed. For more information on a C-Bus unit, see the installation instructions included with the unit.

8.0 C-Bus Operating Parameters

The following are important considerations when planning a C-Bus network:

1) The maximum total length of Cat-5 UTP cables on any one C-Bus network is 1 km.
2) The maximum recommended number of C-Bus units on any one network is 100 units. The actual number is dependent on the impedance and amount of flowing current. The current must not exceed 2 A.
3) Multiple C-Bus power supplies can be connected to a C-Bus network to provide sufficient power for C-Bus units. The power supplies will share the load evenly. The maximum combined power supply output for a single network is 2 A. Examples of acceptable configurations for a single network are:
   - 6 × 5100PS rated at 350 mA each
   - 10 × DIN Rail Output Unit on-board power supplies rated at 200 mA each
   - 30 × Pro Series Dimmer power supplies (except the 12 Channel) rated at 60 mA each.
4) Any combination of power supply units is allowed as long as the total power available does not exceed 2 A.
5) Where more than 1 km of cable or 100 standard C-Bus units are required, two or more networks can be linked using a network bridge.

6) Each C-Bus network requires only one network burden. A burden is contained within:
   - all C-Bus output units (such as dimmers and relays)
   - most system support devices (such as a PC or network interface)
   - some input units (including C-Touch and the Four Channel General Input Unit)

   A network burden can also be assembled using a 1 kΩ, 0.6 W (or higher) resistor and a 10 μF, 50 V capacitor in series, connected across the C-Bus 36 V rails.
7) Each C-Bus network requires at least one (and a recommended maximum of three) system clock generating units. A system clock generator is contained within:
   - all C-Bus output units (such as dimmers and relays)
   - most system support devices (such as a PC or network interface)
   - some input units (including C-Touch and the Four Channel General Input Unit)
8) The maximum number of networks that may be combined in a single installation is 255.
9) The maximum number of networks that may be connected in series to the local network is seven (using six network bridges).
10) C-Bus power supply units (including DIN and Pro units) may be connected to different phases.
11) Individual relay channels may be connected to different phases. On DIN Rail Dimmers, the 240 V supply connected to the units' power supply and the output channels, must be on the same phase.
12) The isolation between the 240 V AC mains and the 36 V DC C-Bus circuitry is greater than 3.5 kV. This is achieved using double wound transformers and opto-isolators.

9.0 C-Bus Multi Network Installations

A C-Bus system cannot be expanded past a certain point without the inclusion of a C-Bus Network Bridge. A bridge splits the installation into separate networks, which are electrically isolated from each other. It can be programmed to allow communication between networks.

A bridge must be added whenever the current requirement (or the number of units) exceeds the C-Bus limit, or when the total length of Cat-5 cable exceeds 1 km.

Cross-network communication between units (across a bridge) is determined by programming. It can be allowed in both directions, in one direction only, or not at all. Regardless of what this is set to, an operator scanning the network from their PC will be able to see every network connected to a C-Bus system.

Since a bridge provides electrical isolation between networks (using galvanic separation), power supplies cannot be shared across this connection. This also means that a separate network burden is required for each network.

9.1 Maximum Number of Networks

Up to 255 C-Bus networks can be connected using C-Bus Network Bridges. Various topologies can be employed when connecting the C-Bus networks. There are three types of connection topologies:

- star configuration
- daisy chain configuration
- a combination of star and daisy chain configurations.

An example of a multiple network connected using a star configuration is shown in Figure 13.

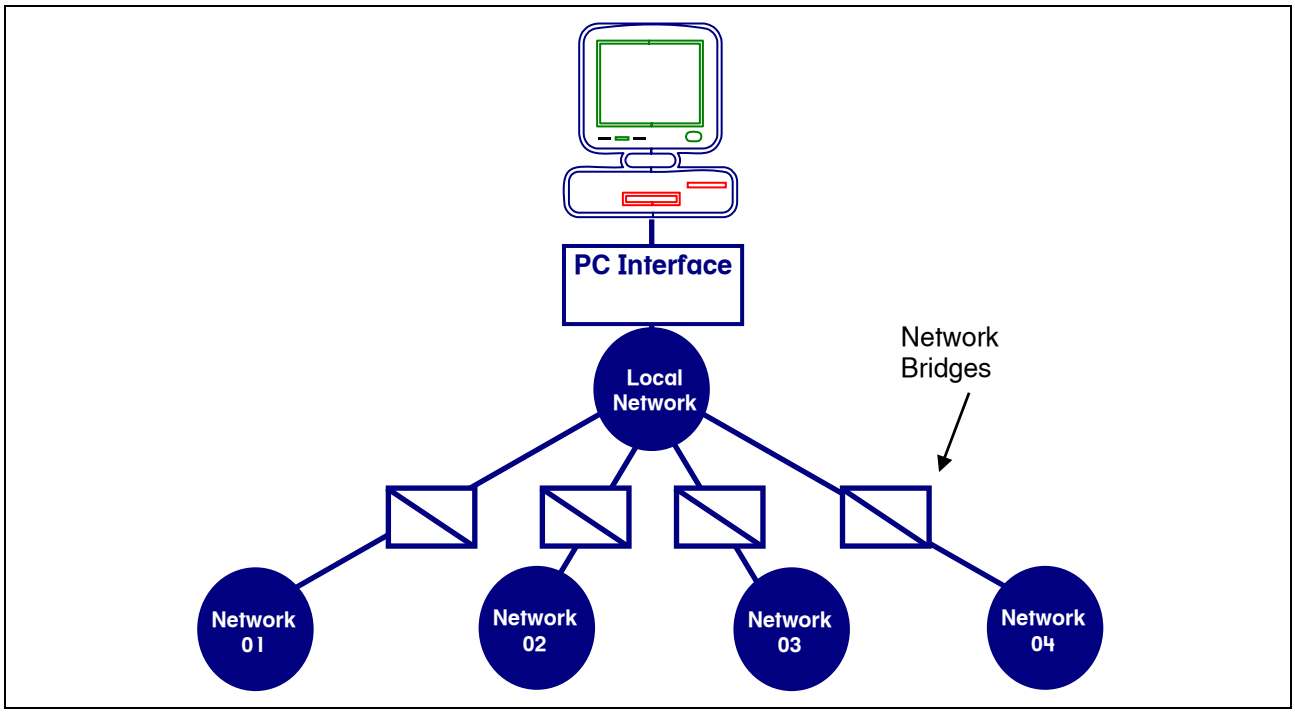

Figure 13 – Example of a multiple network connected using a star configuration

A daisy chain configuration must not exceed six bridges deep. An example of a multiple network connected using this configuration is shown in Figure 14 .

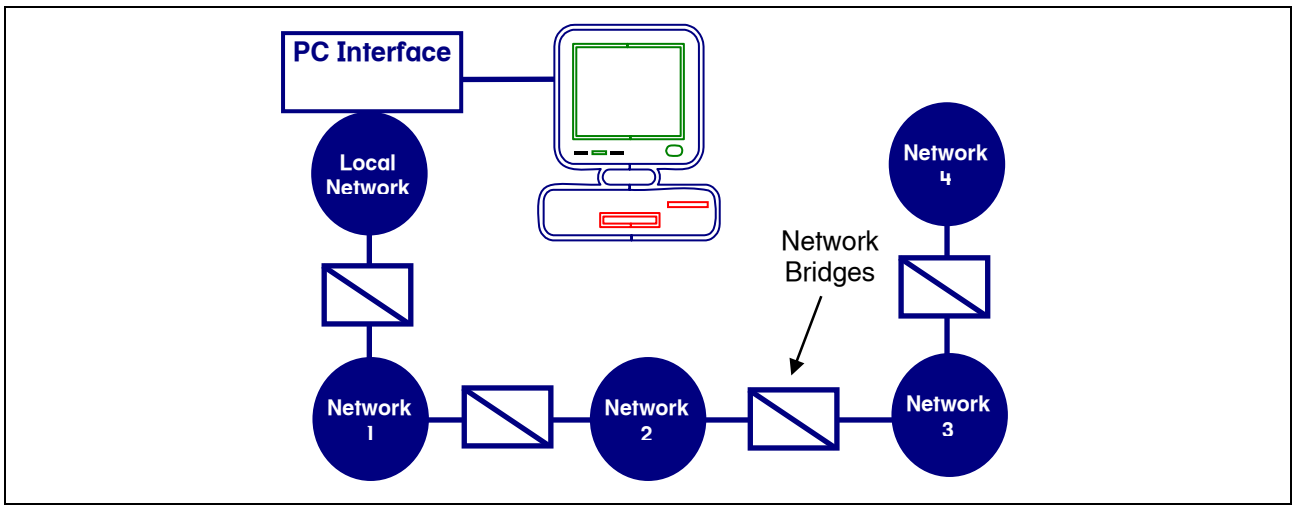

Figure 14 – Example of a multiple network connected using a daisy chain configuration

Figure 15 shows an example of how a combination of star and daisy chain topologies may be used. There are hundreds of possible combinations.

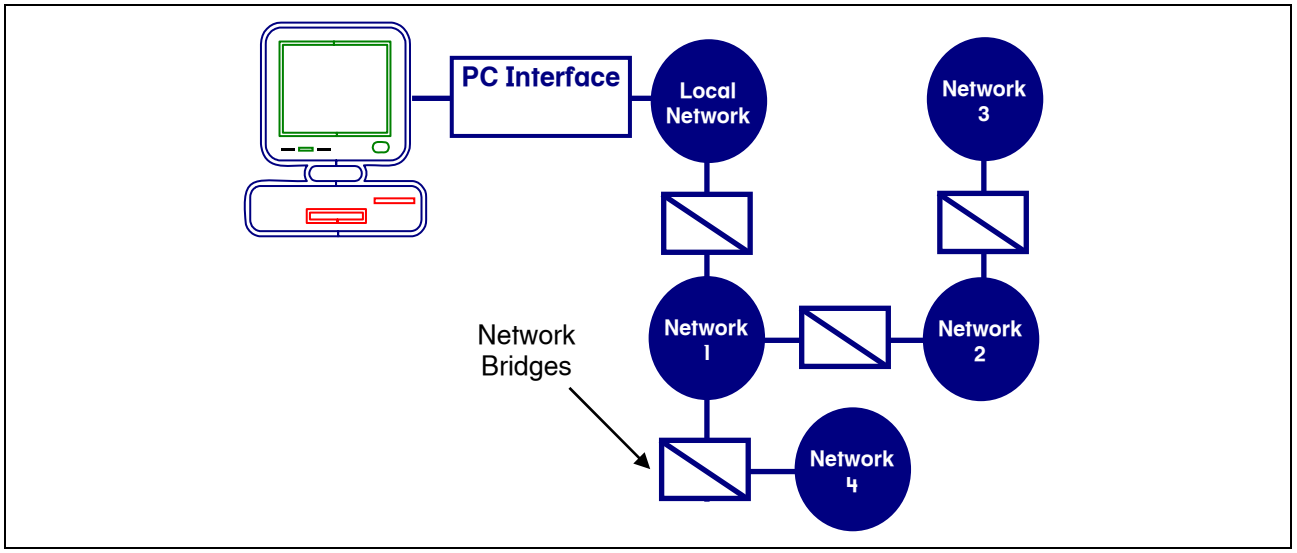

Figure 15 – Example of a multiple network connected using a mixed topology configuration

10.0 Address Structure

Several types of addresses are used when communicating with C-Bus units. These are described in Table 3.

Network Address	Identifies each network. Network Addresses range from 000 to 254 (255 is reserved).
Unit Address	Identifies each individual unit on a C-Bus network. Unit Addresses range from 000 to 254 (255 means undefined).
Application Address	An Application Address is used with a Group Address and Area Address to define which input(s) will control which output(s). The default Application Address is "lighting". The programmer can specify up to 255 different Applications, but some Application Addresses have been reserved for specific command types. Using a combination of Application Address and Group or Area Address gives thousands of unique combinations.
Group Address	This is used together with an Application Address to provide an association between C-Bus inputs and outputs. Up to 255 different Group Addresses may be used on any one Application Address.
Area Address	This is a Group Address entered into a special Area Address field on a C-Bus output. It is similar in action to the Group Address except that it can be entered into one or more C-Bus relays and/or C-Bus dimmers to give master control of all of the channels on those relays or dimmers.
Level or Selector	This is a value of a Group Address. A Level is most often used to set a light to a specific level. A Selector is generally used to trigger a specific scene or select a Schedule. The value of a Level or Selector ranges from 000 to 255.

Table 3 – Types of addresses used when communicating with C-Bus units

10.1 Unit Address

The Unit Address ranges from 000 to 254. It gives each unit on a C-Bus network a unique identity. There are 255 addresses available that can be displayed in decimal or hexadecimal format. Figure 16 illustrates how Unit Addresses are used.

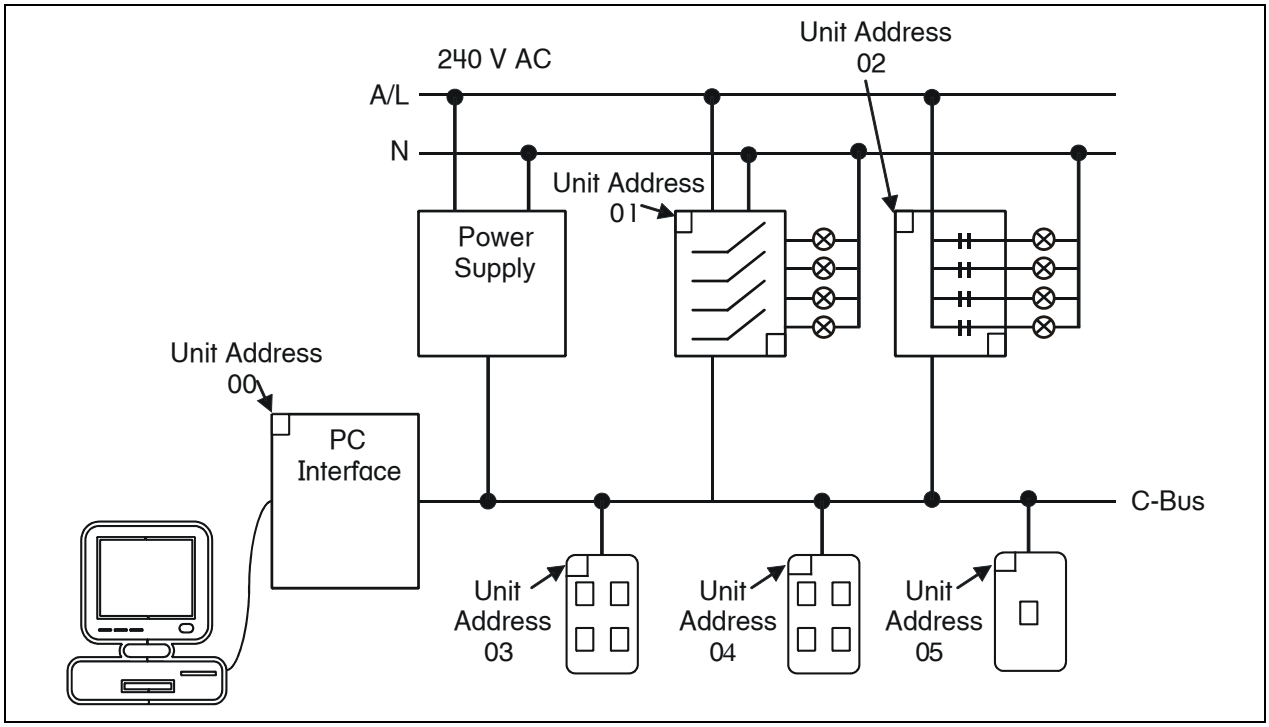

Figure 16 – Unit Addresses

No two C-Bus units on the same network may have the same Unit Address. The C-Bus Toolkit software will recognise any such conflict, and resolve it by assigning a unique Unit Address to one of the units.

10.2 Group Address

The Group Address determines which button inputs control which output channels. There are 255 addresses available (000 to 254) that can be displayed in decimal, hexadecimal* or text format (Tags)†. Figure 17 illustrates how Group Addresses are used.

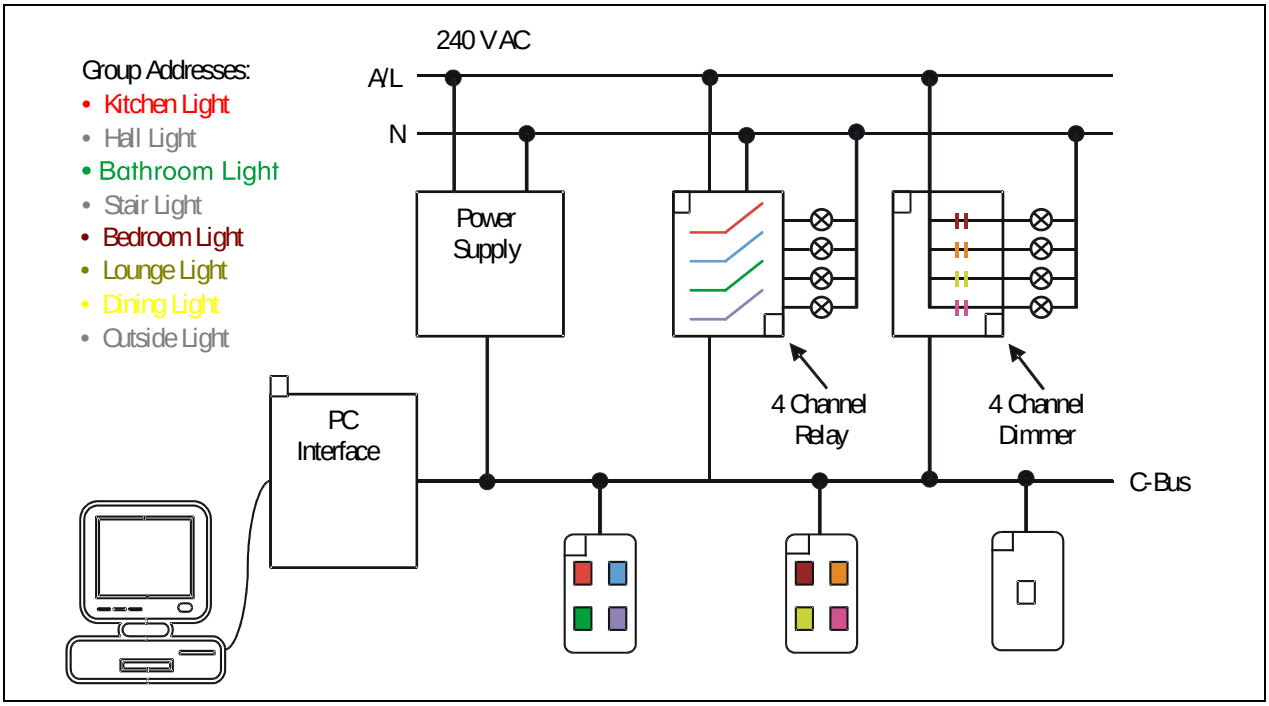

Figure 17 – Group Addresses (Shown as Tags)

* Hexadecimal refers to the base-16 number system, which consists of 16 unique symbols: the numbers 0 to 9 and the letters A to F. For example, the decimal number 15 is represented as F in the hexadecimal numbering system.

† A C-Bus address can be used in raw numeric form, or it may be assigned a meaningful name, known as a Tag.

10.3 Area Address

The Area Address is used to simultaneously control all channels on a C-Bus relay or dimmer unit. Figure 18 illustrates how Area Addresses are used.

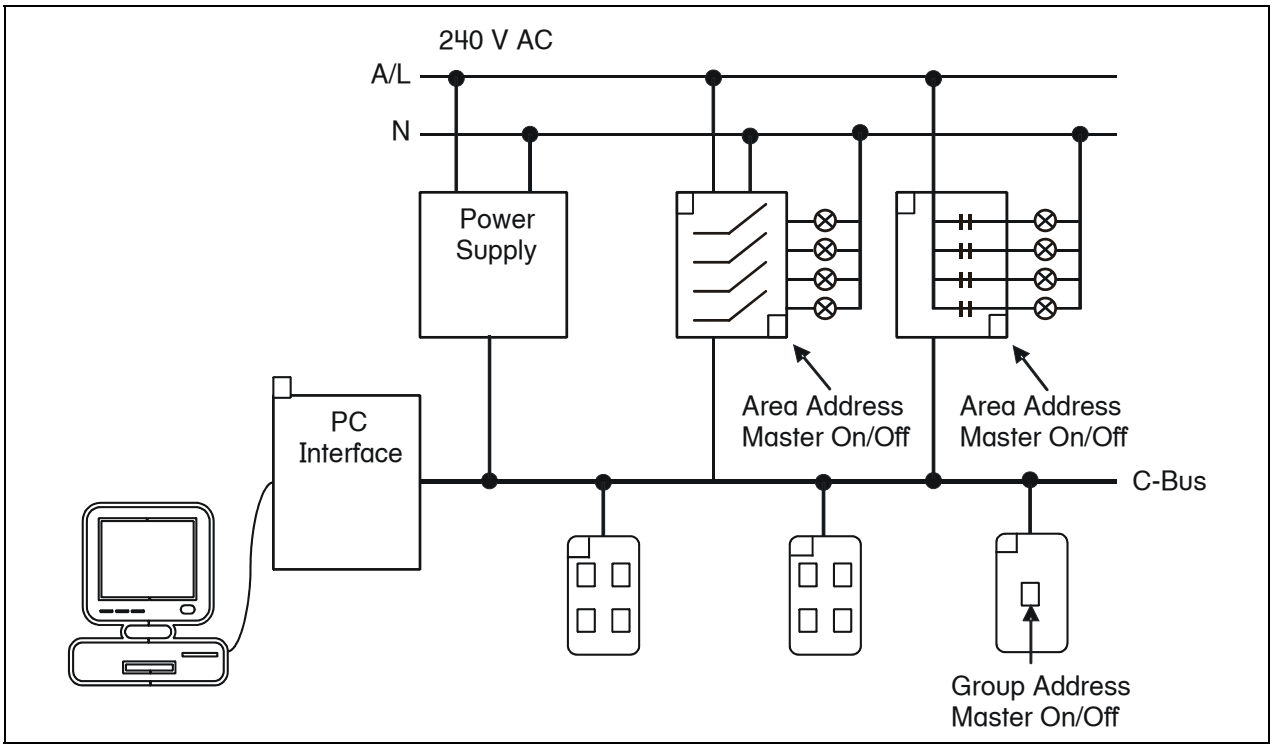

Figure 18 – Area Addresses

Individual relay and dimmer channels can also be controlled from their local toggle buttons (unless disabled by software).

11.0 Programming Technique

All C-Bus units leave the factory with a default undefined Unit Address value of 255. You need to assign a unique Unit Address to each unit before connecting it to a C-Bus system.

You do this by programming each unit prior to delivery, using a computer, a 5500PC interface and a 5500PS power supply:

1) Ensure the 5500PC has a Unit Address of 000 before connecting the new C-Bus unit).
2) Connect the C-Bus unit to be programmed.
3) Assign the Unit Address, as a minimum programming requirement.
4) Disconnect the unit and mark it with its Unit Address.
5) Deliver the unit to site and install it on the network.

12.0 C-Bus Tools and Functions

12.1 Local Toggle Buttons

DIN and Pro series C-Bus outputs are equipped with local toggle control for each output channel. These toggle buttons operate as long as mains is connected to the DIN unit. They do not require the C-Bus connection to be wired in. Pressing a local toggle control button will alternately switch the load wired to the respective channel, on and off. This allows you to check that the mains wiring is correct and that the loads switched by each channel are correct.

12.2 C-Bus Network Analyser 5000NA

This product is temporarily connected to a C-Bus network. It indicates the status of the C-Bus power supply, network burden, system clock and acceptable cable length.

12.3 Learn Mode

Learn Mode is a function of C-Bus that allows anyone to program a C-Bus Network (to a basic level), without needing a PC Interface. When learn mode is activated, associations between input and output units are learnt by pressing buttons on the units.