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PAC ACCESS CONTROL

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Installation Best Practice

PAC Hardware

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Aims

This document will provide a best practice guide for installers of PAC hardware.

Please refer to earlier versions of this document (TB228) for information about our legacy products.
E.g., PAC 500 server, PAC 500 controller, etc.

Hardware Scope

- PAC 500 series controllers
- Legacy readers (PAC and KeyPAC)
- PAC RFID readers
- RS-485 Cabling

1.0 Glossary

Term	Definition
CAT 5	Category 5 cable is a twisted pair cable type designed for high signal integrity for high-speed data transmission (MB). May be shielded or unshielded.
CAT 6	Category 6 cable is a twisted pair cable type designed for high signal integrity for high-speed data transmission (GB). May be shielded or unshielded.
DIN Rail	Standardized 35 mm wide rail used for mounting circuit breakers and industrial control equipment inside equipment racks.
EIA	Electronic Industries Alliance.
EMC	Electromagnetic compatibility.
EMI	Electromagnetic interference.
Full-duplex	Able to transmit data in both directions at the same time.
Half-duplex	Able to transmit data in either direction, but only one way at a time.
IEE	Institution of Electrical Engineers.
RFI	Radio frequency interference.
RS-232	A standard for serial binary data signals connecting between a DTE (Data Terminal Equipment) and a DCE (Data Circuit-terminating Equipment), commonly used in computer serial ports.
RS-485	Now officially known as EIA-485. A two-wire, half-duplex, multipoint serial connection. It includes the use of twisted-pair cables and operational amplifiers (op-amps) to reduce signal degradation.
STP	Shielded twisted pair cable.
UTP	Unshielded twisted pair cable.

2.0 RS-485 Cabling and Controller Connection

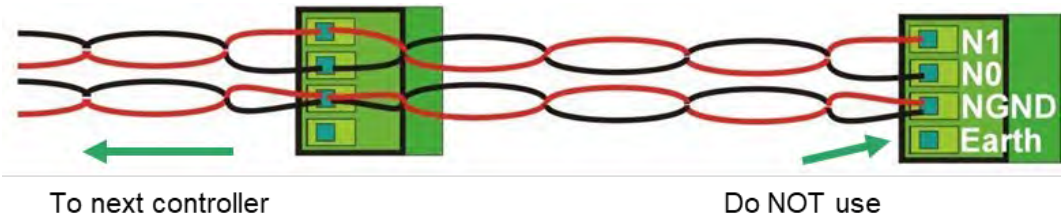
This section describes how to install and connect the RS-485 data bus on PAC 500 series controllers.

If RS-485 cabling is poorly or incorrectly installed, faults can occur that may be difficult (and expensive) to diagnose. The following best practices are intended to minimise problems.

2.1 Connection Using Unscreened Twisted Pair Cable

The RS-485 connection employed in the PAC 500 series is a two-wire data communication bus, with a third wire used to create a common connection (0V) between each controller.

The figure below shows the connection method when using unshielded twisted pair (UTP) data cable.



Note that only **three** cores are required. However the action of parallel connecting two cores for the 0V (NGND) conductor reduces the resistance of this line, resulting in improved system performance.

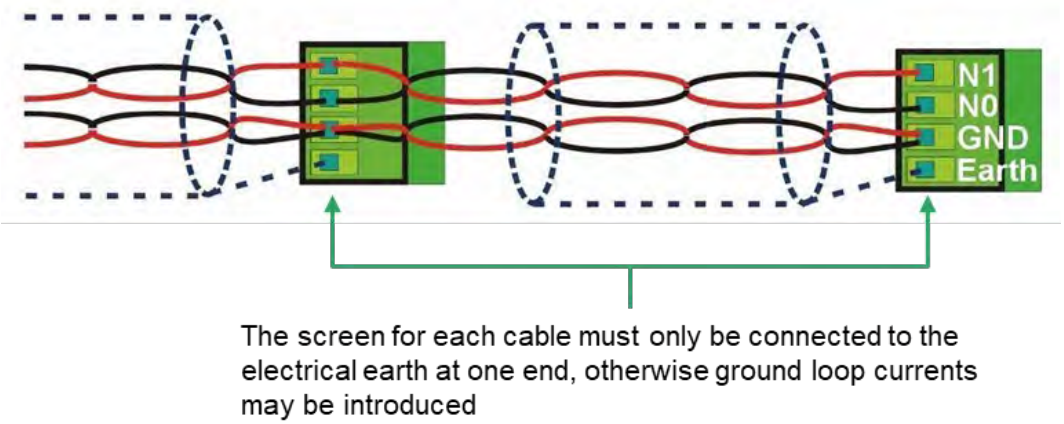
To ensure reliable performance of the RS-485 Bus, for most applications an unshielded twisted pair (UTP) cable may be employed, although in certain harsh environments (in terms of RFI/EMI) shielded twisted pair (STP) cable should be used.

PAC **only** recommend the use of UTP / STP data cable for RS-485 communications connection.

The **Earth** connection is only intended for terminating a cable shield and is not normally used (see the following pages). **<u>This connection must be left disconnected at all times where UTP cable is used</u>**.

2.2 Screen Connection

Under normal circumstances CAT5 / CAT6 or other suitable unshielded twisted pair (UTP) data cable is adequate to ensure protection against the effects of RFI and EMI.



To prevent the creation of ground loops, the shield in each cable segment should only be connected to earth at one end.

Also note, unlike co-axial cable such as that used in analogue CCTV installations, the shield in STP does not form part of the reactive element in the cable—it does not contribute to the dynamic impedance of the cable. It is only used to protect against RFI / EMI ingression; thus a single earth connection is adequate.

2.3 Data Bus Length

For PAC controllers, the maximum recommended cable length of the RS-485 data bus, when using UTP data cable is 1000 m / 3000 ft.

There is no maximum distance between controllers. For example, if two controllers are to be connected to a bus using UTP cable, the maximum length is 1000 m / 3000 ft.

2.4 Termination

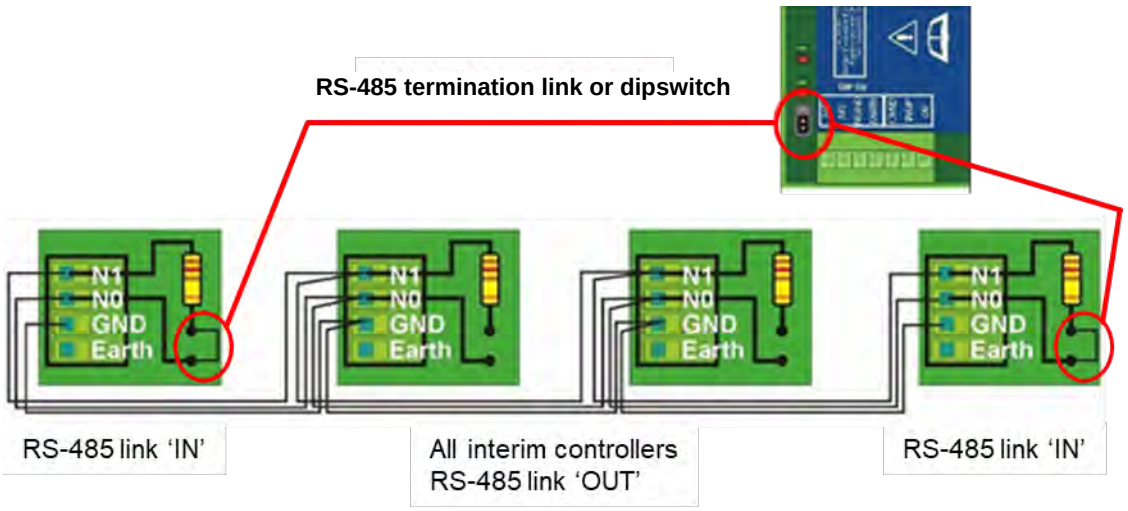
The RS-485 Bus employed in PAC 500 series controllers must be:

- In a **daisy chain** arrangement
- Have **both ends terminated** with a 120Ω resistance to prevent signal reflections

All PAC 500 series controllers come with a termination link, located next to the RS-485 connector.

For correct and reliable operation, the links or dip switch on the **first** and **last** controllers must be set to the 'IN' position.

The links on all other controllers must be set to the 'OUT' position.



It is possible to connect using a star arrangement provided that RS-485 hubs are employed.

Do NOT attempt to use star configuration without a hub.

In RS-485 networks, branch and T arrangements **must not** be used.

2.5 Checking RS-485 Termination

The termination resistance at each end of the network on a PAC 500 series controller is 120 Ω, therefore the effective DC resistance will be the parallel resistance (i.e., 60 Ω) plus a small amount of cable resistance.

Use a multimeter set to the resistance range across terminals N1 and N0 to check the result is around 60Ω.

- A reading of 120Ω indicates the presence of only one termination resistor.
- A constantly fluctuating reading, or a reading of >100 kΩ indicates that there are no termination resistors.
- A reading of <60Ω indicates the presence of more than two resistors, or a fault on the cable.

- A reading of 60Ω only confirms the presence of two resistors on the bus. It does not confirm that the two resistors are located at the ends. If you are investigating the cause of intermittent or permanent controller communications problems, it will be necessary to visually verify that the terminations are at the ends of the RS-485 data bus.
- You can apply the resistance check to the data bus whilst the bus is live, although the impedance of the multimeter may interrupt the data on the bus, possibly resulting in alarm events being generated.

2.6 Locating Controllers

All readers and controllers provided by PAC meet the EMC standard.

Do **not** mount readers and controllers in close proximity to large electromagnetic fields, such as those associated with incoming mains supply equipment, high current carrying conductors, high voltage switching equipment, etc.

2.7 RS-485 Data Bus Loading

The maximum number of controllers that can be connected onto a single data bus is determined by the RS-485 limits and the PAC controller type.

Direct Connection	PAC 512 DC door controllers are connecting directly to the PAC application server via a USB – Serial converter: **24 controllers maximum.**
IP Connection	PAC 512 DCi door controller is acting as a gateway between the PAC application server and the RS-485 connected controllers: **24 controllers maximum.**
GSM / GPRS Modem Connection	PAC application server connects to the PAC 512 door controllers using wireless telephony technology: **4 PAC 512 DCs controllers maximum.**
I/O connected controllers	Max. 5 controllers: (1 × PAC DCi \ DC & max. 4 × I/O controllers)

It is not necessary for the PAC 512 DC controller that is connecting to the PAC application server to be at the end of the RS-485 ‘daisy chain’. This controller may be positioned anywhere along the length of the bus.

A PAC 512 DCi controller must never be used as a non-IP controller, i.e., simply connecting via the RS-485 bus. Communication issues will occur because the Lantronix Ethernet to serial converter on the controller will still periodically attempt communications.

3.0 Earthing

The function of this earth connection is to provide a return path for any RFI / EMI signals that may otherwise enter the controller via reader, power or RS-485 network cables.

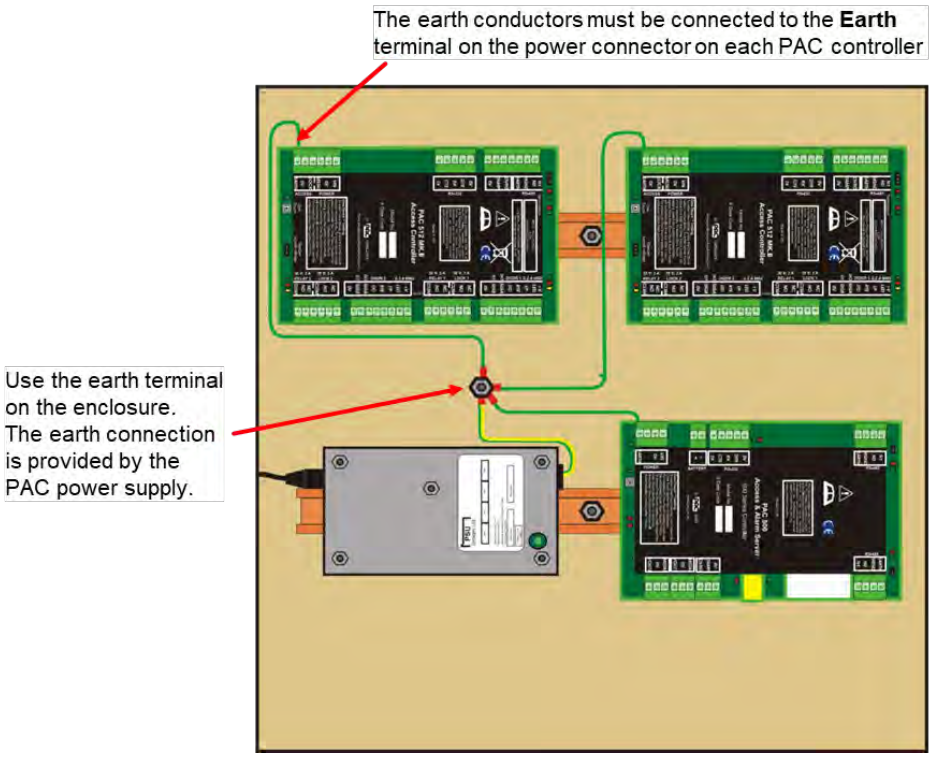
3.1 Controller Earthing—DIN Rail

Where the controllers are mounted in a multi-case on plastic DIN rail, they are electrically isolated from the metal enclosure, meaning that there is no earth connection between the controller and the earthed metal enclosure. For this reason, an earth wire must be connected to the **Earth** terminal on the Power connector on each controller.

The connection to **Earth** should use 0.75 mm² or larger cable.

It is essential that the earth connections are all taken from a single point in star arrangement. Ideally, RF noise must be removed to earth via the shortest possible route and using a daisy chain arrangement between earth terminals does not provide such a route.

Where a PAC 3A or 7.2A power supply is used (recommended), the **Earth** conductor on the power supply would be used to provide the functional earth path, in addition to the electrical safety earth connection.



The safety earth (green and yellow image above) **MUST NOT** be removed.

- The earth terminal on the 4-way and 6-way PAC enclosures also provides a means of forming a **safety** earth for the metal enclosure and must be connected to an electrical earth circuit that has been installed and tested to BS 7671 (when installed in the U.K.), or relevant electrical standards for the country of installation.
- If a controller is installed in a metal enclosure, the enclosure must be earthed.
- The hinged or removable cover must also be earthed.

3.2 Controller Earthing—No DIN Rail

Where a controller is mounted in an enclosure with no DIN rail, i.e., the controller is screwed directly to the metal case, a functional earth connection is provided by the connection between the controller and the case. In this instance there is no need to connect the **Earth** connection on the controller to earth.

4.0 Power Cables and Power Supply

We recommend that installers use a Comelit-PAC power supply for PAC controllers.

4.1 Power Cables and Data Cables

- The 230V AC power arrangement must comply with current IEE wiring regulations (when installed in the U.K.), or relevant electrical standards for the country of installation.
- The 230V AC power arrangement must be installed and tested by a competent electrical engineer.
- Data cables must be segregated from 230V power cables.
- Avoid running power cables and data cables parallel to each other over long distances. If it is necessary to do so, cross the power cable and data cable at 90° at regular intervals, e.g., every 1 metre.

4.2 Recommended Battery Backup

Only use a 7Ah/12V Lead Acid battery.

The Lead Acid battery can be connected to the installed PSU, via the terminals provided, when using a standard PAC enclosure and installation.

The battery backup serves two main functions:

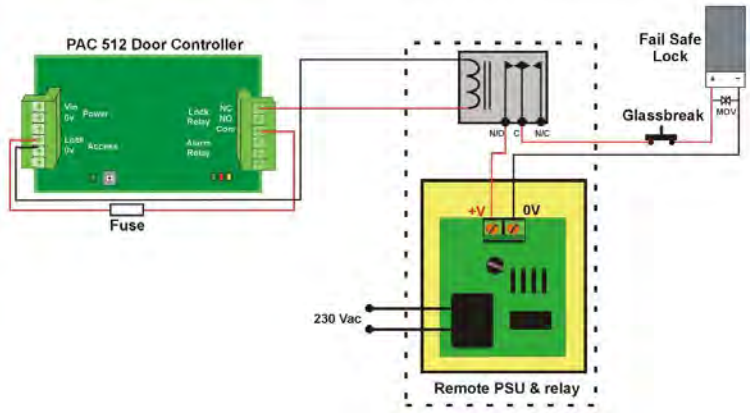
- In the event of mains power failure, the battery backup will enable the server with PAC software to keep running and maintain the access control system functionality to prevent immediate shutdown of the server. **Note**: the mains power should be **resumed as soon as possible**; the duration of the battery life is entirely dependent on the load placed on it by the continuing use of the system.
- The battery will help to smooth out any power fluctuations and noise, protecting the controller from the effects of data corruption often associated with such power anomalies.

4.3 Lock Power Connection when using a Remote Power Supply

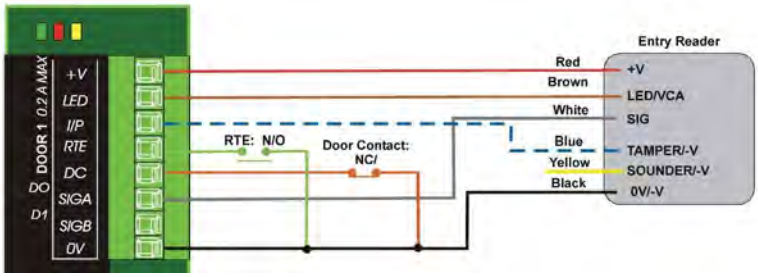
The use of a separate lock power supply would normally be required when:

- Long cable distances between door controller and lock would result in voltage drop.
- High power locks are being used which would exceed the 1A availability from the controller power supply.

The diagram below shows the connection method for a fail safe lock.



For fail secure lock types, connect the power supply as shown in the figure below, use the N/O and Com terminals on the PAC controller lock output.

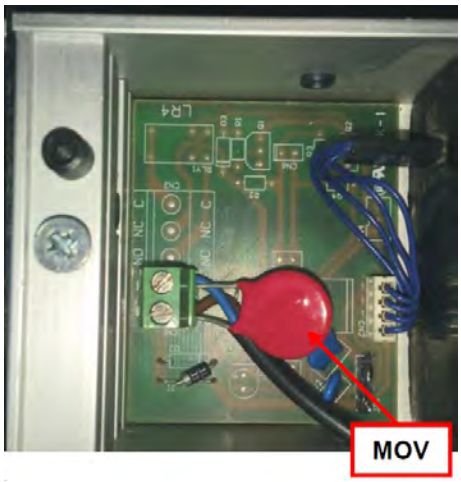


4.4 Lock Suppression using a MOV

A suppression device must be fitted across the +/- lock power terminals at the lock.

MOVs are supplied with all PAC door controllers and readers.

- 1W MOVs are provided with the door controllers, and a 0.5W MOV with each reader.
- Where possible, always try to fit the larger 1W device.
- Where the lock current exceeds 1A, the large 1W MOV must be used.



5.0 Reader Installation

This section includes important information about the installation of PAC controllers.

5.1 Reader Cable

- Each reader must be individually wired with a separate cable.
- Where a door has 2 readers i.e., read-in and read-out, the readers **MUST NOT** be wired with the same cable.

- For normal operation in areas where excessive levels of RFI/EMI is not a problem, we recommend the use of standard 0.22 mm^2 8 core alarm cable.
- For normal installations, we do not recommend the use of shielded / screened cable for their readers because of the capacitive effects on the data.