

# ROLLEASE ACMEDA

## RS485 Network Cabling Standard

August 2017

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## DISCLAIMER

### INTRODUCTION

This product specifications manual has been produced by Rollease Acmeda to supply the necessary information for safe and correct assembly and installation of this system.

### DISCLAIMER

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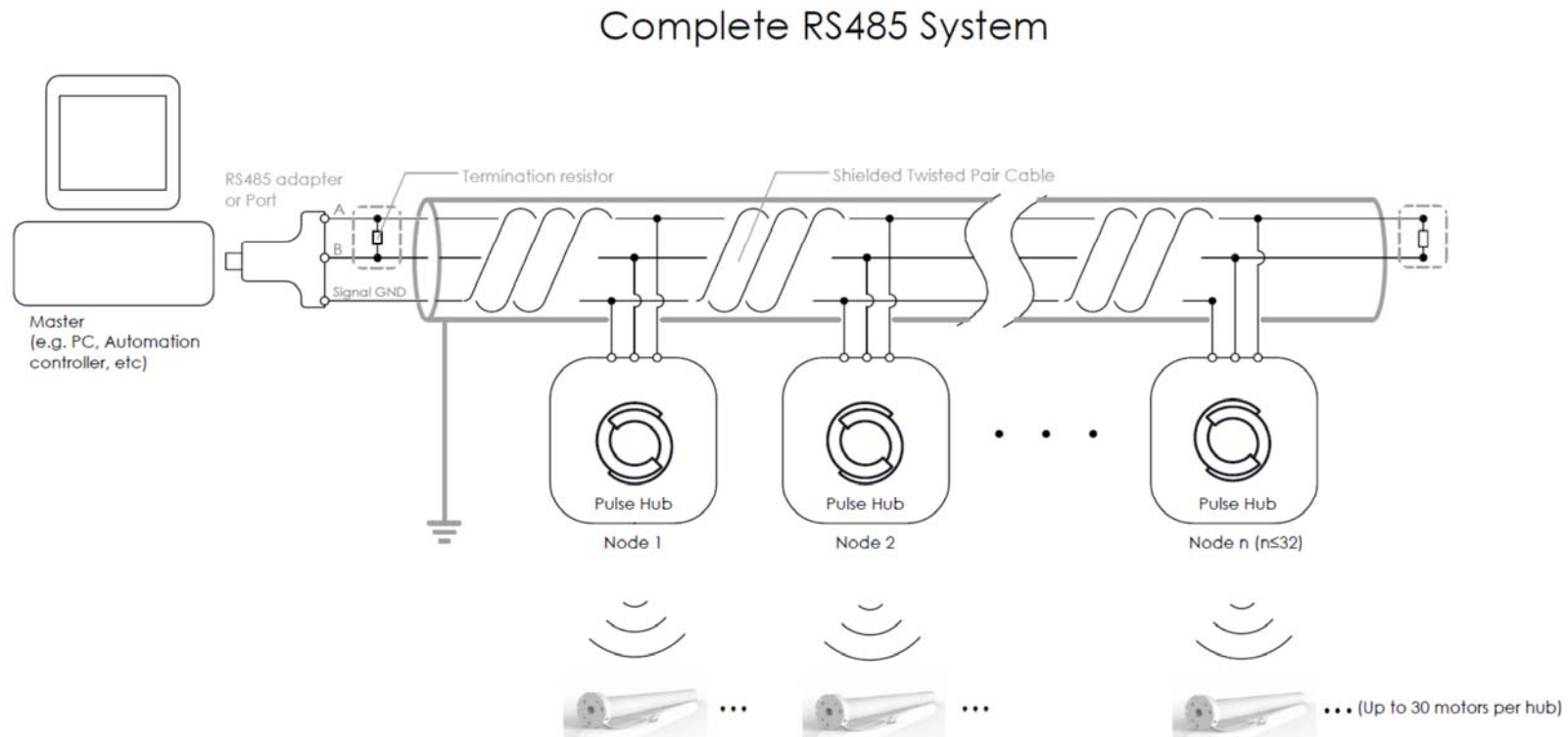
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## SECTION 1 – RS485 BUS OVERVIEW

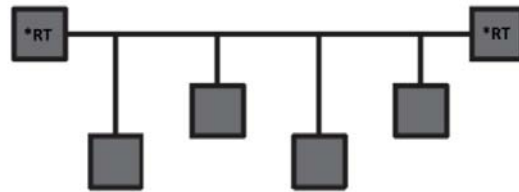
In order to provide reliable/robust communications with Rollease Acmeda RS485-enabled products, several recommendations must be carefully followed. Each of these are listed below and are covered in detail within the following chapters.

1. **Network Topologies** – how to connect hubs to the RS485 bus.
2. **Dimensional Limitations** – the distances that the RS485 bus can reliably communicate over. S
3. **Cable Types** –types of cables that can be used.
4. **Ground Connection Strategy** – how/why grounding is required.
5. **Installation Options** – simple plug & play or customized options.



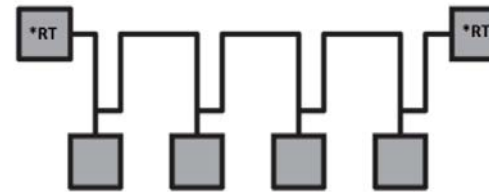
**Diagram 1. Complete RS485 network**

Before an installation can begin, it is important to understand how to connect Rollease Acmeda hubs to the RS485 bus. The following diagram depicts several common network layouts, but note that only two are usable for a RS485 bus.

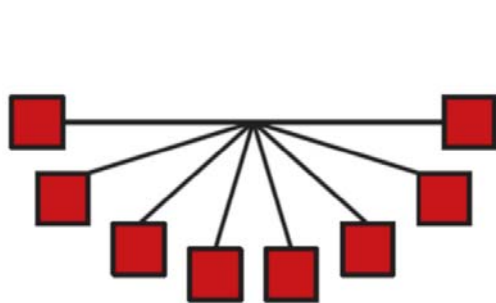


\*Note: Termination resistors are required for bus length >100m.

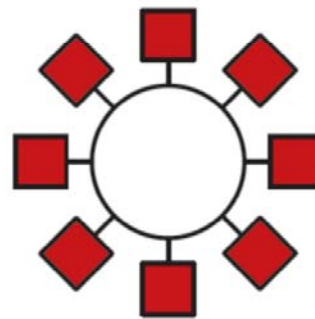
**Backbone with stubs (works)**



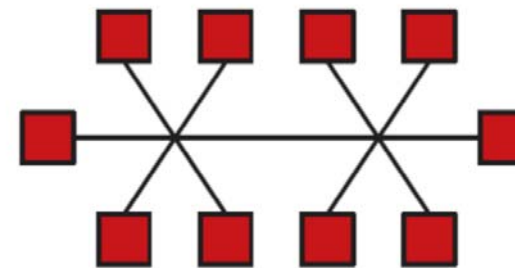
**Daisy chain (best)**



**Star network (do not use)**



**Ring network (do not use)**



**Backbone with stars or clusters (do not use)**

Diagram 2. RS485 network topologies

## SECTION 3 – DIMENSIONAL LIMITATIONS

The maximum length of the RS485 bus (including stubs length) should not exceed 1000m (3281ft). Distances greater than that will result in unreliable/error-prone communications and therefore should be avoided. Conversely, the distance between nodes should be greater than 30cm ( $\approx 12$ in).

### (a) Typical Residential/Light commercial Installations (<100m)

For most residential environments where the total bus length (including stubs) is less than 100m (328ft) the termination resistors are not required.

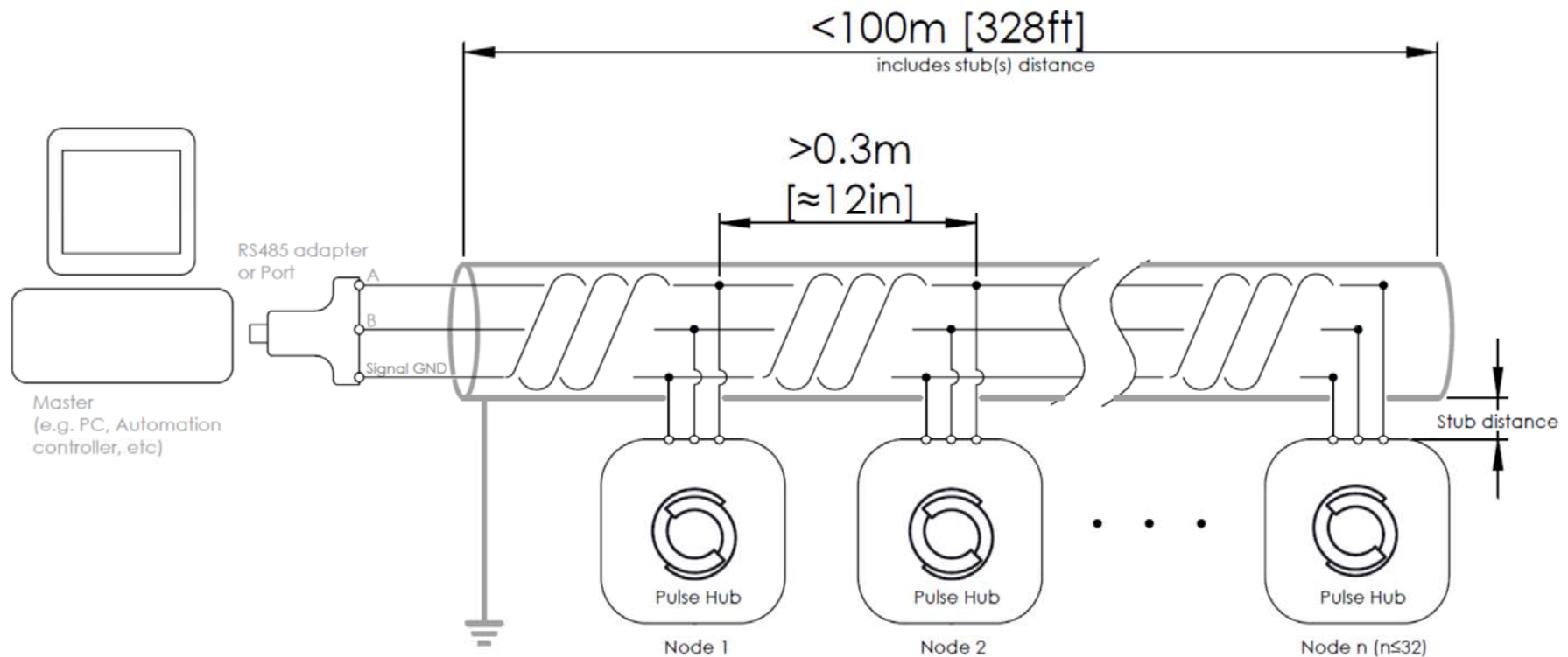


Diagram 3. Dimensional limitations - typical residential/light commercial installations

(b) Long distance/Commercial Installations (<1000m)

For longer distance communications, the termination resistors  $RT=120\Omega$  (RA part no. MT02-0401-000005) must be fitted to the extreme ends of the bus.

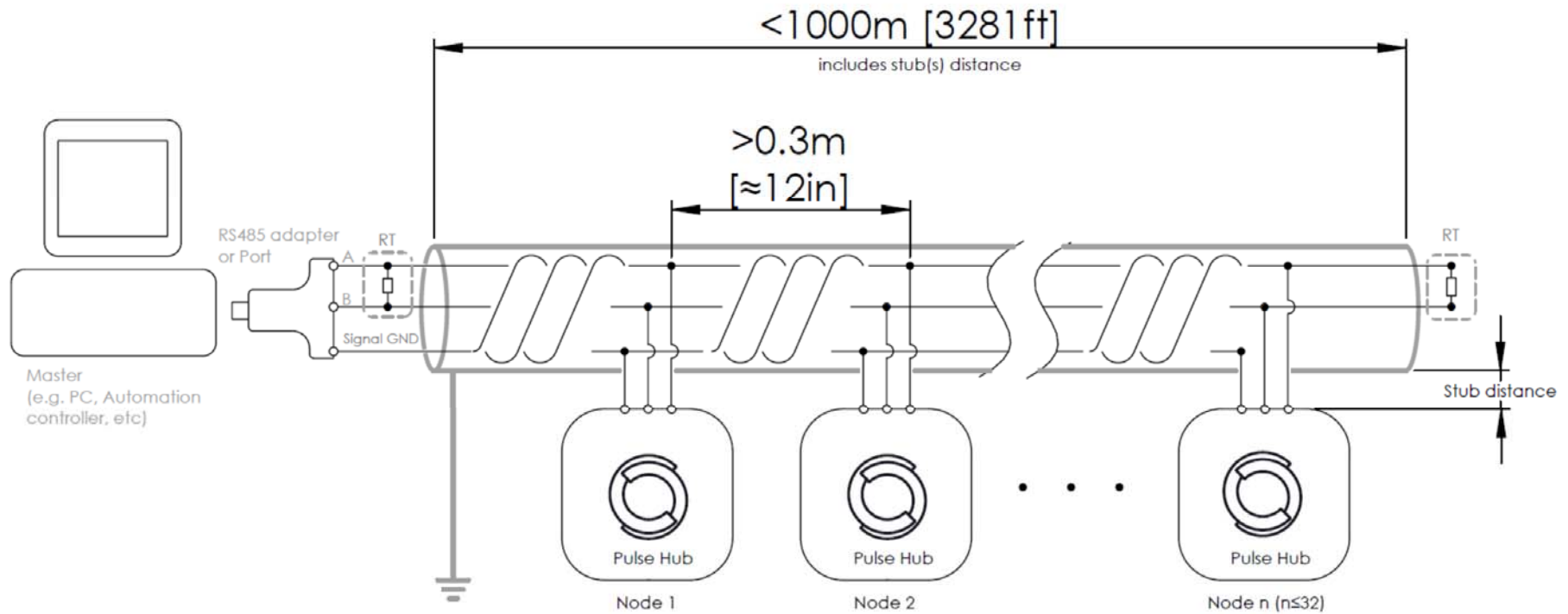
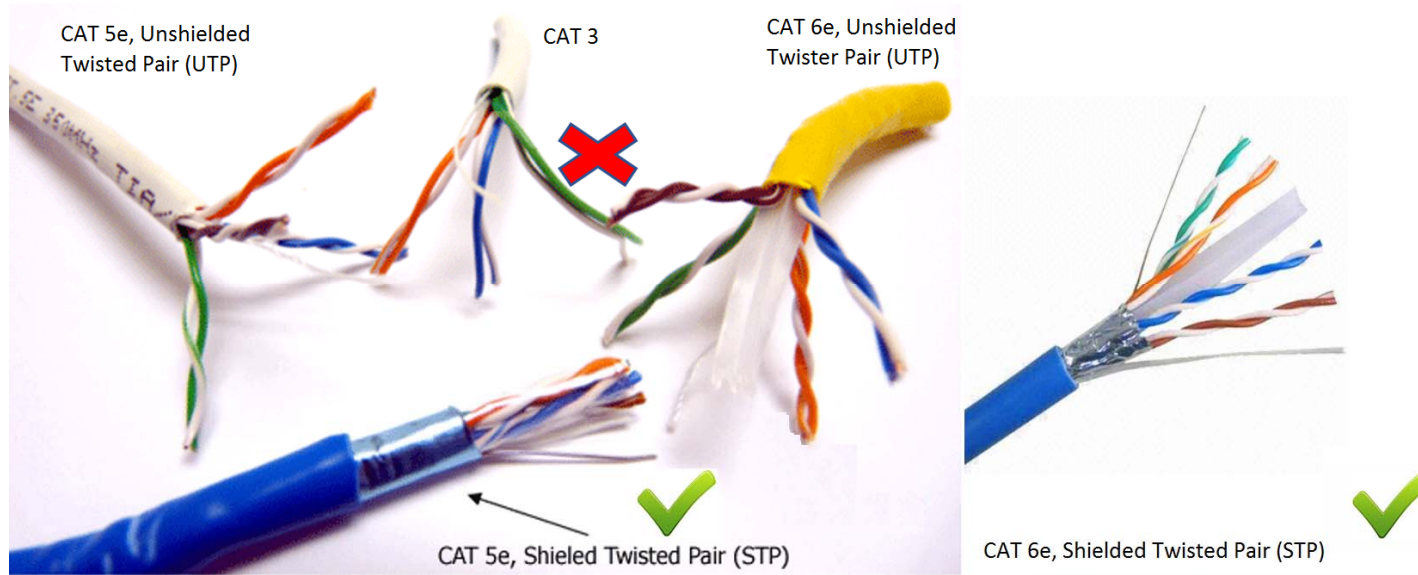


Diagram 4. Dimensional limitations - long distance/commercial installations



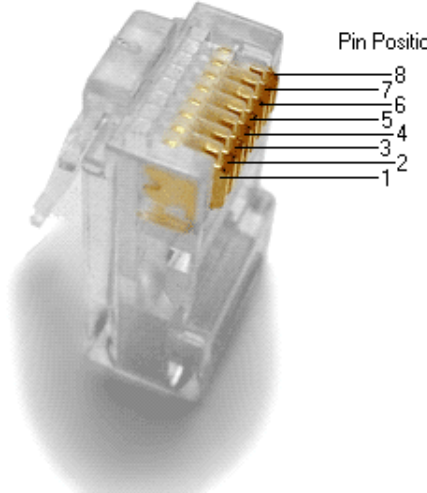














Rollease Acmeda only recommend the use of Twisted Pair ethernet cables, these can be either CAT5 or CAT6. For most residential environments, the cable can be of either UTP or STP type. However, for long distance or commercial environments we only recommend the use of STP type cables.



Picture 1. Recommended cables

## SECTION 5 – PINOUT DEFINITION

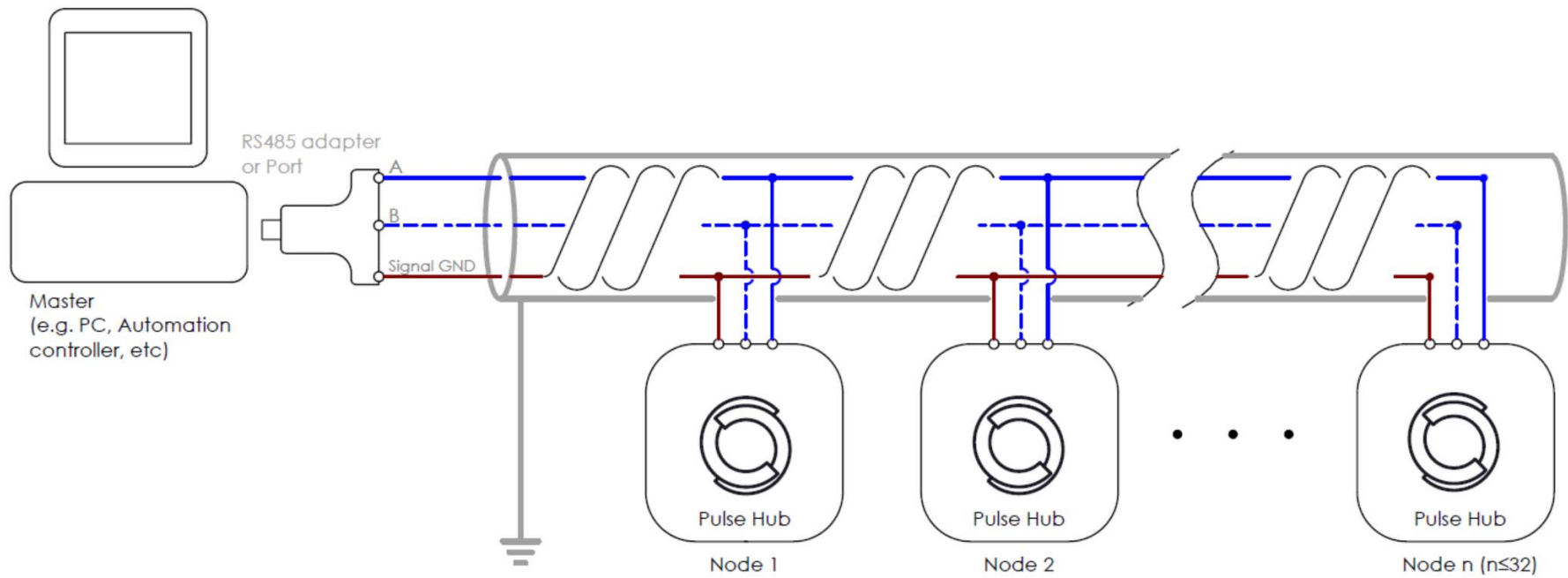
Either TIA/EIA 568A or 568B configuration cable (or a combination of both) can be connected in a RA RS485 network. This is because only the cores that share the same pinout & color-code across both standards are used (see in Table 1. Pinout definition and Diagram 5. Color cores of cable connected in RS485 network).

Pin No.	Pinout Definition	T568A Color	T568B Color	Pins on plug face
1	Not used	 white/green stripe	 white/orange stripe	
2	Not used	 green solid	 orange solid	
3	Not used	 white/orange stripe	 white/green stripe	
4	+RS485	 blue solid	 blue solid	
5	-RS485	 white/blue stripe	 white/blue stripe	
6	Not used	 orange solid	 green solid	
7	Not used	 white/brown stripe	 white/brown stripe	
8	Signal ground	 brown solid	 brown solid	

\* Note: unused cores should be tied to ground if the RS485 bus is greater than 100m. Refer to page 15 for details.

**Table 1. Pinout definition**





**Diagram 5. Color cores of cable connected in RS485 network**

## SECTION 6 – GROUND CONNECTION STRATEGY

While a differential signal does not require a signal ground to communicate, the ground wire serves an important purpose. Over a distance of hundreds or thousands of feet there can be very significant differences in the voltage level of "ground." RS-485 networks can typically maintain correct data with a difference of -7 to +12 Volts. If the grounds differ more than that amount, data will be lost and often the port itself will be damaged. The function of the signal ground wire is to tie the signal ground of each of the nodes to one common ground.

### Strategy (a): Shielding Against Low Frequency Noise

For most residential or light commercial environments, one end of the shield should be connected to ground in order to improve shielding against low frequency electrical noise such as 50/60Hz mains noise. (refer to Diagram 5)

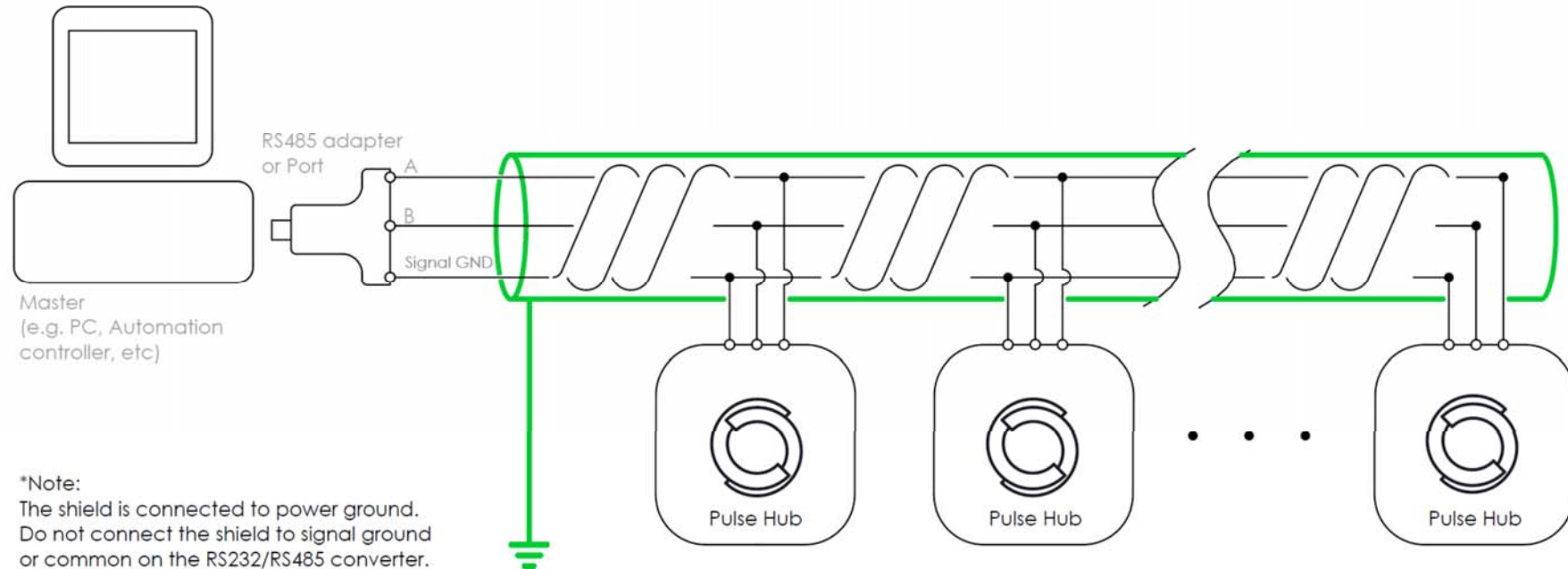
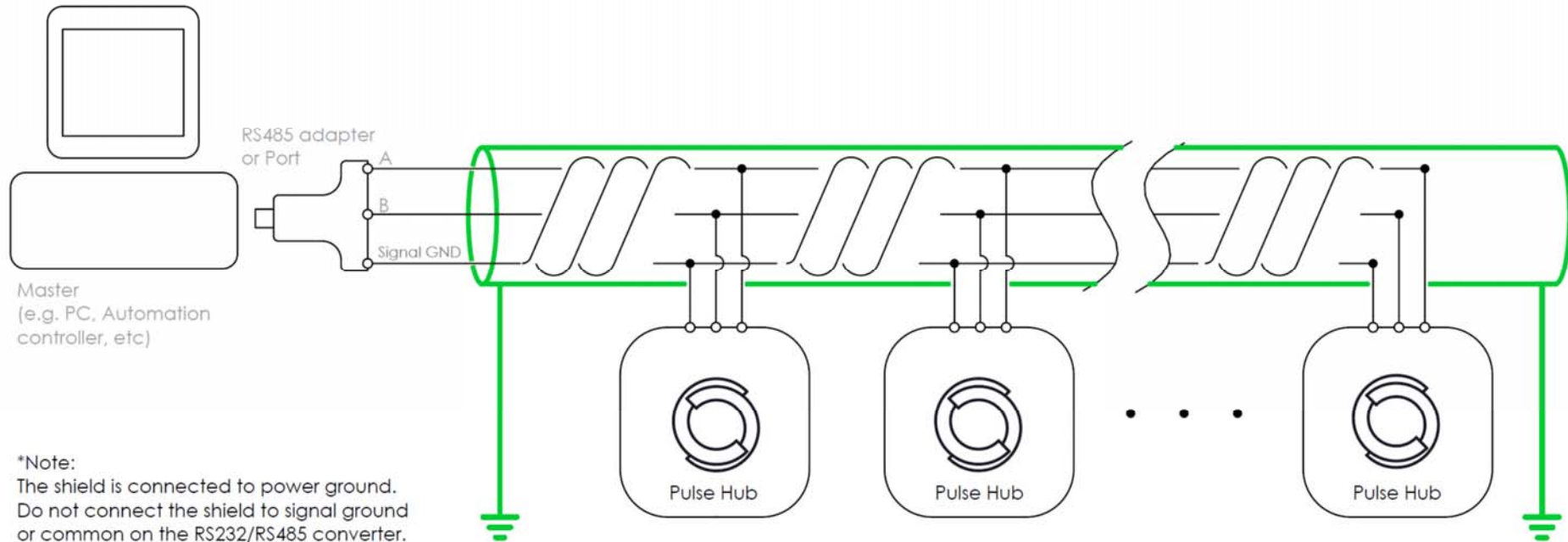


Diagram 6. Ground connection - shielding against low frequency noise

### Strategy (b): Shielding Against High Frequency Noise

For industrial/electrical noisy environments, both ends of the shield should be connected to ground in order to improve shielding against high frequency electrical noise such as switch-mode power supplies etc. (refer to Diagram 6)



**Diagram 7. Ground connection - shielding against high frequency noise**

## SECTION 7 – INSTALLATION OPTIONS

### (a) “Plug & Play” cabling Option

Pre-terminated ethernet cable (commonly available from most electrical stores) can be used to create a robust RS485 network without the need for specialized termination skills & tools. Rollease Acmeda provide RJ45-compatible connectors/splitters (RA part no. MT02-0401-000004) for this type of installation.

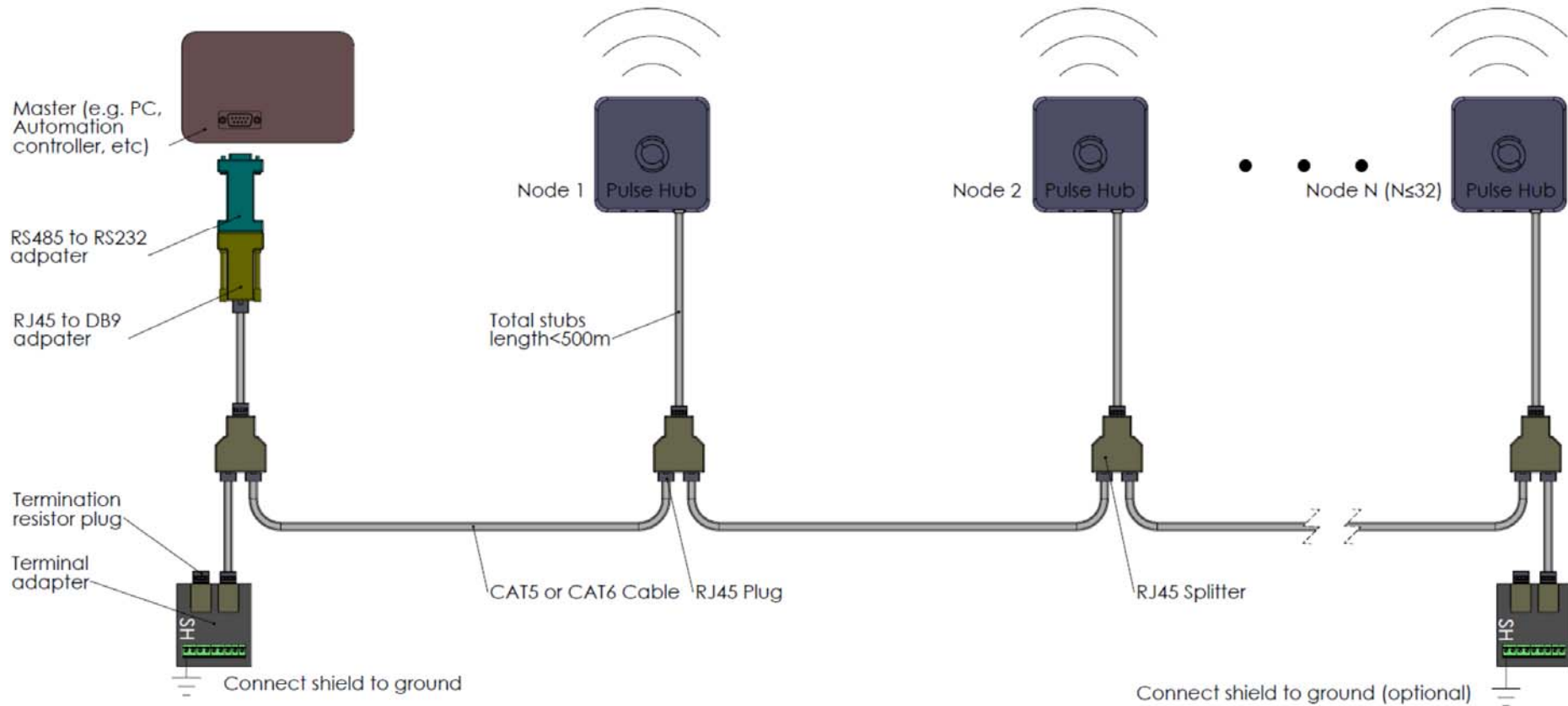


Diagram 8. Option (a) “Plug & Play” cabling

### (b) Hard-wired cabling Option

Unterminated ethernet cable (commonly available from most electrical stores) can be used to create a “customized/cut-to-length” RS485 network without the need for specialized termination skills & tools. Rollease Acmeda provide a terminal-block-type adapter (RA part no. MT02-0401-000006) allowing the cable to be easily joined/split.

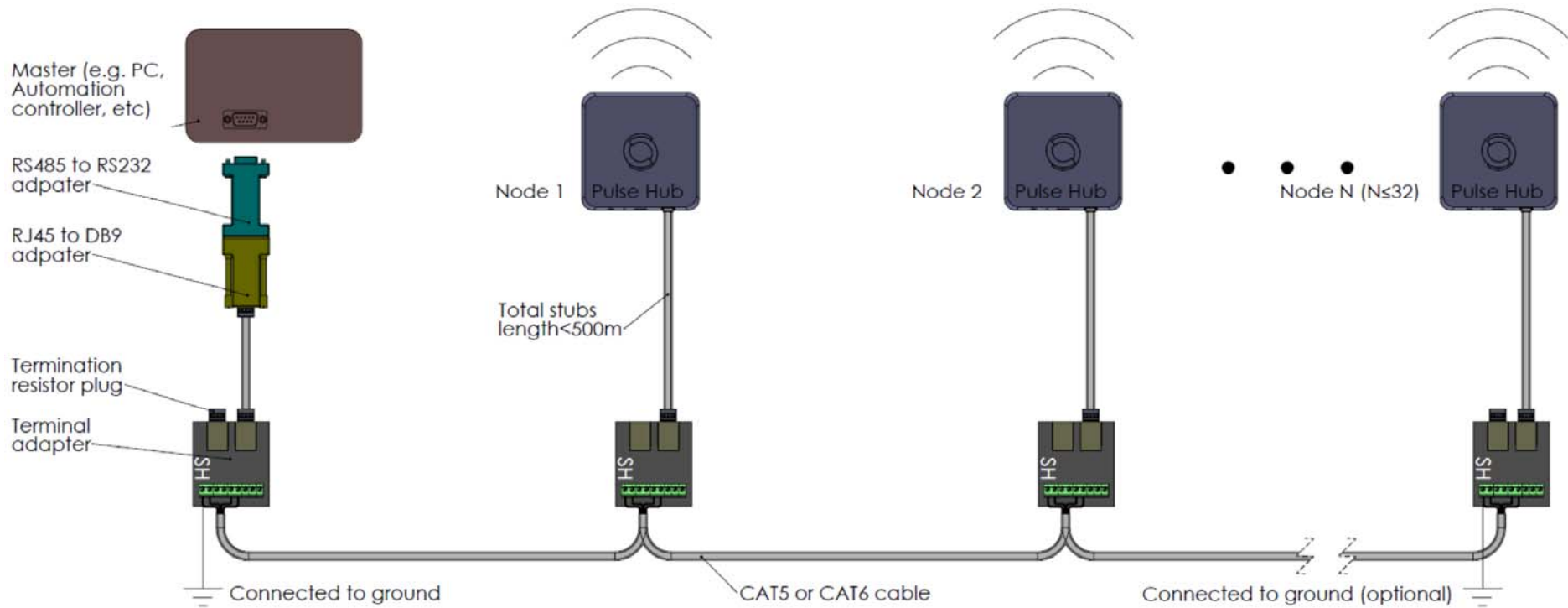


Diagram 9. Option (b) Hard-wired cabling

(c) Unused Cable Pairs

i. Residential

For most residential or light commercial environments where the bus is <100m, the unused wires should be connected to ground.

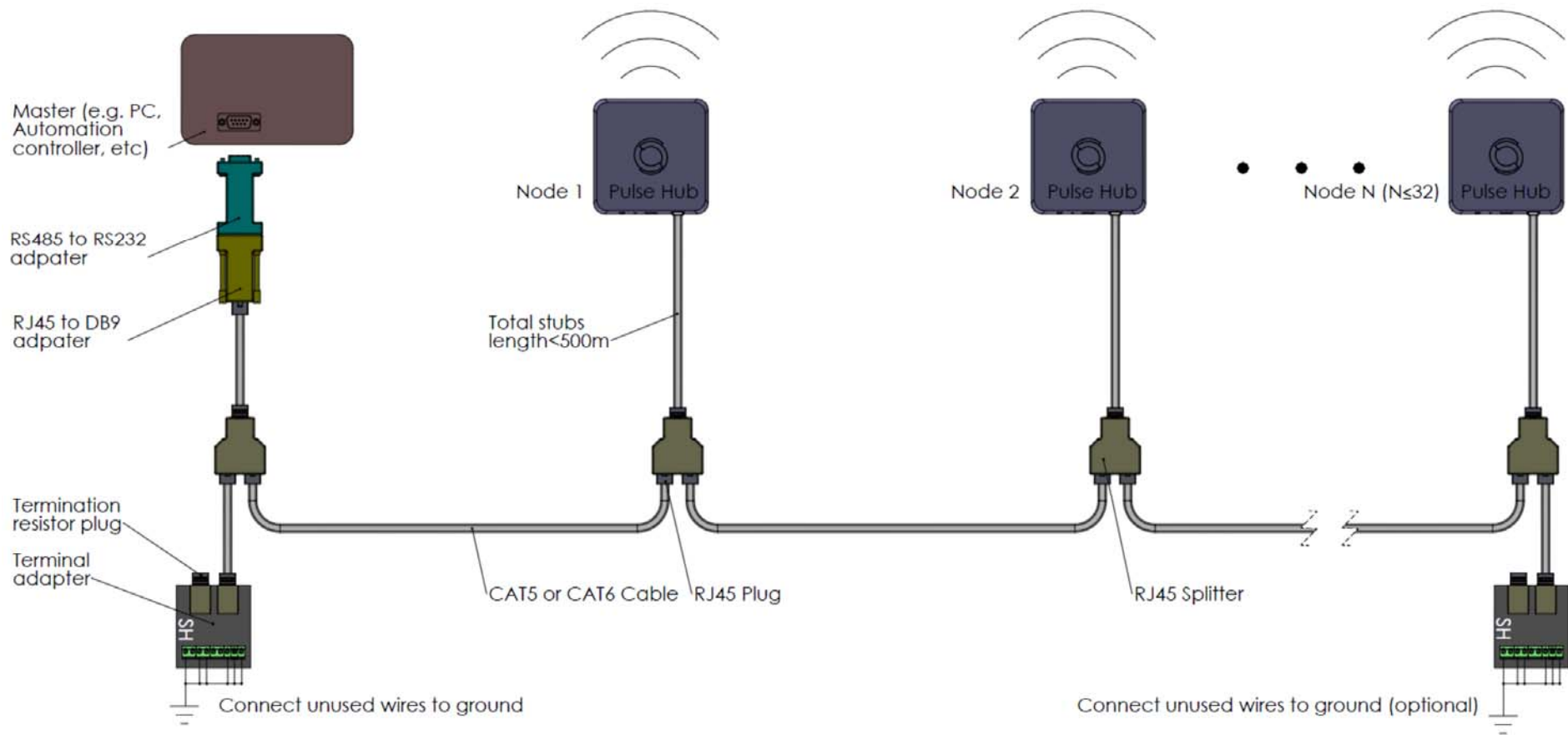


Diagram 10. Unused Cable Pairs connection – Residential

ii. Long distance/commercial

When using ethernet cable for single pair applications, the unused wires should be properly terminated to ground with  $R_G = 100\Omega$  at both cable ends. This prevents noise coupling due to self-resonance at all sorts of frequencies from the unused wires into the data pair.

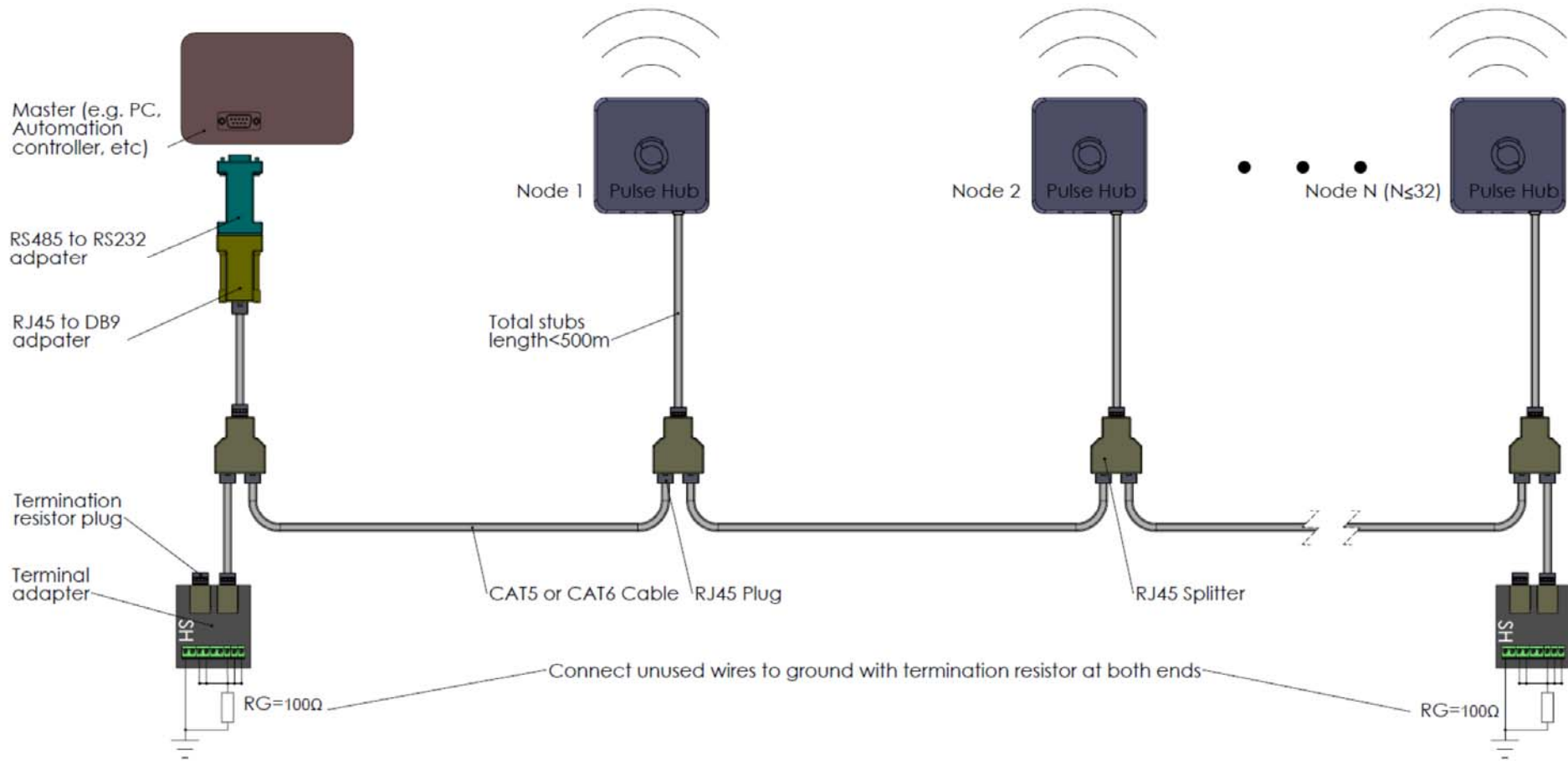


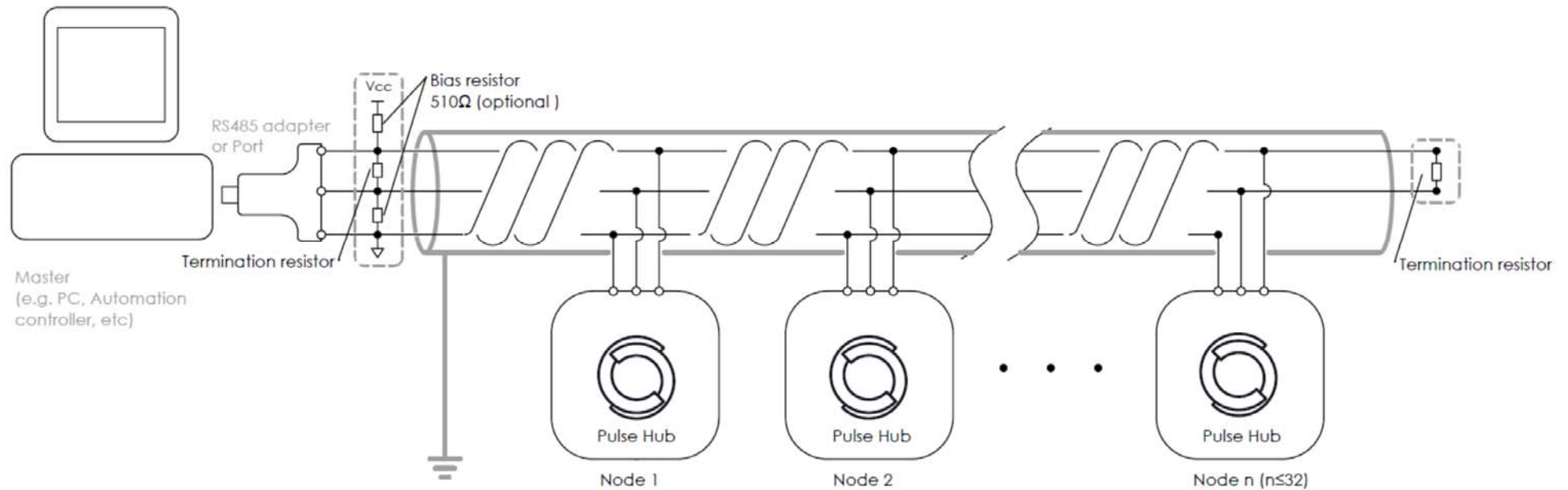
Diagram 11. Unused Cable Pairs connection – Long distance/commercial

#### (d) Bias resistor

In RS485 network when inputs are between  $-200\text{mV}$  and  $+200\text{mV}$ , receiver output is "undefined". There are four common fault conditions that result in the undefined receiver output that can cause erroneous data:

- 1) All transmitters in a system are in shutdown.
- 2) The receiver is not connected to the cable.
- 3) The cable is open circuit.
- 4) The cable is short circuit.

The bias resistors ( $510\ \Omega/1\text{W}$ ) are connected to VCC (DC 5V) and signal ground to solve this issue (refer to Diagram 8). This way the bus will always be at a known level regardless of the fault condition. All RA Pulse hubs have these resistors internally, so the only benefit of adding these externally is if the first hub's connection becomes faulty the bus will still be at "known levels" for the master/controller.



**Diagram 12. Optional bias resistor installation**