Cable Sizing Guide — 48V Systems

Emerging 48V DC systems — leisure vehicles, light commercial and off-highway applications

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Before you start

Picking the right cable comes down to two things: how much current it needs to carry, and where it's going to run. Get those right and the rest follows. This guide covers 48V DC systems. 48V is an emerging architecture in leisure vehicles, light commercial vehicles and some off-highway applications. It is not yet a mainstream installation voltage and this guide should be treated with appropriate caution — component availability, installer familiarity and the standards landscape are all less mature than for 12V or 24V systems. If you are designing a 48V system, you should already have a clear reason for doing so. The physics are compelling: the same power at four times the voltage means one quarter of the current, which means significantly smaller cable, less volt drop, lower losses and lighter wiring. But the infrastructure, tooling and knowledge base around 48V DC in these applications is still developing. Important: the nominal voltage of a 48V system is not 48V in practice. A fully charged 48V LiFePO4 system sits at approximately 58V, with a charging voltage of around 57.6V. For the purposes of cable sizing, protection and component selection, design to 60V as the working ceiling. This also places 48V systems at the boundary of the Safety Extra Low Voltage (SELV) threshold — the regulatory and safety implications of this are outside the scope of this document and will be covered in a dedicated guide. Do not design a 48V system without understanding this boundary. For 12V systems see our 12V guide; for 24V plant and commercial applications see our 24V guide — both available at voltforge.co.uk.

Current carrying capacity — ampacity — is a thermal limit. Too much current through too small a cable generates heat. Enough heat and the insulation fails, and that's how fires start. Cables are cheap. Vans are not.

> **When in doubt, go up a size. A cable running slightly under its rating runs cooler, lasts longer, and costs almost nothing extra.**

The figures in this guide are for a single cable run in open air at normal temperature. If your cable runs through conduit, behind panels, or is bundled with other cables, it cannot shed heat as easily — go up a size as a minimum in those situations. In plant and agricultural applications, ambient temperatures are often higher than in a leisure vehicle — engine bays, machinery cabs and enclosed compartments can easily exceed 40°C. Use the appropriate derating figures from our Ampacity Reference Document.

A word on stranding

Cable cross-sectional area determines current capacity — but how the conductor is constructed determines how pleasant it is to work with and how long it lasts. Automotive cable uses fine-stranded flex: many thin strands rather than a few thick ones. It routes more easily, terminates more cleanly, and holds up better to the vibration and flexing that every vehicle installation lives with every day.

It costs a little more than generic cable. It is worth it.

📖 For a full explanation of cable construction, conductor classes and why it matters in practice, see our Know How guide to cable specifications at voltforge.co.uk

A word on insulation

All cable has an insulation rating — the maximum temperature it can handle. This affects how much current it can safely carry, and where it can be installed.

For most leisure vehicle and campervan work, there are really only two types you need to think about:

- **Standard PVC (80°C rated)** — Fine for interior runs, lighting, and body electrical. Avoid using it near heat sources or in engine bays. This is the cheaper cable you'll find at most motor factors.
- **Quality automotive PVC (105°C rated)** — Better in every way. More flexible, handles heat better, lasts longer. Worth spending the extra for anything permanent. This is what OEM harnesses use. If you're not sure which to buy, buy this.

There are higher-spec insulation types — crosslinked compounds, PTFE, silicone — for demanding applications. The current figures in this guide are based on quality 105°C cable as the practical recommendation for leisure vehicle work.

> 📖 *For a full breakdown of insulation types, temperature ratings, OEM cable standards, and detailed ampacity data across all insulation grades and ambient temperatures, see our Ampacity Reference Document at voltforge.co.uk*

About Voltforge

Voltforge is the retail brand of Zeromachine Ltd, an engineering business based in Blyth, Northumberland. Zeromachine's longer-term programme is the development of a hydrogen fuel cell hybrid electric powertrain for off-highway machinery — serious engineering work that needs a serious commercial foundation underneath it. Voltforge is that foundation, and also the live sandbox for it: a place where low-voltage DC system design principles, documentation standards and product development thinking get tested in the real world before they scale.

The engineering background behind Voltforge spans over 30 years of low-voltage DC and high-voltage DC electrical experience across automotive, OEM leisure vehicle, EV, and off-highway and construction machinery applications — including time spent working in OEM leisure vehicle electrical design in the North East. We build connector assemblies, pigtail kits and cable harnesses with the same thinking we apply to much larger and more complex work: correct materials, correct process, and a clear understanding of how a product will actually be used once it leaves the bench. Every assembly we make comes with a full bill of materials citing OEM part numbers, because you should always know exactly what you've got. All Voltforge-built assemblies carry a 2-year warranty.

For larger and more complex work, Zeromachine Works Studio offers bespoke harness design and production, low-voltage DC system design, B2B engineering services, and consultancy for trade and commercial customers. We also offer specialist repair, diagnosis and electrical design services for leisure vehicles, campervans, overlanders and 4x4s across the North East of England. If your system has a fault you can't trace, an install that's grown past what you originally planned, or a build that needs properly thinking through from the start, that's exactly the kind of job we're set up for.

If you know what you need, you can go straight to the shop. If the job is bigger or less straightforward, talk to us. **Tell us what you're building and where you're stuck.**

Disclaimer

This document is provided for general reference and educational purposes only. The figures and guidance contained in it are derived from published industry standards and are intended to support informed decision-making — they are not a substitute for a full engineering assessment of a specific installation. Electrical system design involves variables that no general reference document can account for: installation method, routing, ambient conditions, load characteristics, circuit protection, and the specific products used all affect safe and correct cable sizing. It is the responsibility of the installer to carry out an appropriate assessment for their specific application and to ensure that any installation complies with applicable standards, regulations, and any vehicle or equipment manufacturer requirements. Note that 48V DC systems in leisure vehicles and vehicles are subject to evolving standards. BS EN 1648 (leisure vehicles) has a 15V bus voltage limit that excludes many 48V architectures. The SELV boundary at 60V is relevant to 48V system design and has significant regulatory implications. Always verify the applicable standards and regulatory framework for your specific application before proceeding with a 48V installation. Voltforge and Zeromachine Ltd accept no liability for loss, damage, injury or consequential loss arising from the use of or reliance on the information in this document. If you are in any doubt about the suitability of a cable size or installation method for your application, stop and get proper advice before proceeding.

Common applications — what size do I need?

Use this table as a starting point. Always check the current draw of your specific device on its datasheet or label — these figures cover typical equipment but yours may differ.

Application	Typical Current (12V basis)	48V Cable	Notes
SLI battery to auxiliary battery (VSR or B2B/DC-DC charger)	B2B/DC-DC charger: per charger rated output (typically 20–30A at 48V)	**B2B/DC-DC: per charger spec (VSR not recommended at 48V — use a dedicated DC-DC charger)**	At 48V, always use a dedicated DC-DC charger — a VSR is not suitable. Size cable to the charger's rated output current. Check volt drop on longer runs.
Battery to fuse box / distribution (48V)	Size to total load	**6–16 mm²**	Size to total expected load plus 20% headroom. Err on the larger side — this is your main feed.
Cab refrigerator / cool box	4–10 A	**2.5 mm²**	Running current is low but startup surge can be 3×. Keep runs short or go up a size on longer runs.
Cab / auxiliary LED lighting circuit	1–5 A per circuit	**1.0–1.5 mm²**	LED draws are low. 1.0 mm² is fine for most circuits. Run individual circuits — don't daisy-chain.
Cab power outlets and USB chargers	10–15 A	**2.5 mm²**	Allow for multiple devices running simultaneously. A 2-socket outlet can pull 20A+ if both sockets are loaded.
Inverter feed	See note →	**See note**	Divide inverter wattage by system voltage to get current. A 1000W / 48V inverter draws ~21A — that needs 4–6 mm². Always size to inverter's rated input current, not output.
Solar panel to MPPT charge controller (where fitted)	Varies by panel	**4–6 mm²**	Size to panel short-circuit current (Isc) × 1.25 safety factor. Check your MPPT datasheet for max input current.
MPPT to battery	Varies by controller	**6–10 mm²**	Size to the MPPT's maximum output current rating. This is often higher than the panel input current.
Water pump / low-current auxiliary pump	5–15 A	**2.5 mm²**	Check pump datasheet for stall current. Pumps are motor loads — startup current can be significantly higher than running current.
Diesel cab heater (e.g. Webasto, Espar, Eberspacher)	10–25 A (startup)	**4 mm²**	Glow plug startup draws high current briefly. Running current is much lower. Size for the startup peak — 4 mm² as a minimum on 12V.
Cab resistive loads (kettle, blanket, heating element)	Up to 20 A (12V)	**4–6 mm²**	High resistive loads. Check the device's rated wattage and divide by system voltage. Keep runs short — volt drop matters here.
Winch	100–400 A (operating)	**35–70 mm²**	Always check the winch or machinery manufacturer's cable sizing recommendation. Winch and actuator cables carry enormous current for short periods. Do not undersize.

All cable sizes are minimum recommendations for free air runs at normal ambient temperature using quality 105°C cable. Go up a size for runs in conduit, behind panels, bundles, or in high ambient temperature environments typical of plant and agricultural machinery.

Quick current rating reference

The figures below are for a 48V system. Current carrying capacity is the same regardless of voltage — it is determined by the conductor and insulation, not the voltage. At 48V the current for a given power load is one quarter of the 12V equivalent, which is why cable sizes can be significantly smaller. For 12V or 24V systems see our dedicated guides at voltforge.co.uk.

Cable Size	AWG Equiv.	Max Current (free air)	Typical applications
Quality 105°C cable, free air		Max Current (free air)	
1.0 mm²	17 AWG	**13 A**	Sensors, instruments, low-power LED
1.5 mm²	15 AWG	**17 A**	Lighting circuits, small accessories
2.5 mm²	13 AWG	**24 A**	Sockets, fridge, water pump, lighting feeds
4.0 mm²	11 AWG	**32 A**	Diesel heater, heavy accessories, small motor feeds
6.0 mm²	10 AWG	**41 A**	Alternator sense, heavy accessories, solar feeds
10.0 mm²	8 AWG	**57 A**	Main distribution feeds, medium inverters
16.0 mm²	6 AWG	**76 A**	Large inverters, main battery feeds (smaller systems)
25.0 mm²	4 AWG	**101 A**	Battery to main distribution feed. At 48V the current is significantly lower than 12V for the same load — check volt drop on long runs but cable sizes will be considerably smaller than equivalent 12V systems.
35.0 mm²	2 AWG	**125 A**	Battery cables, high-current main feeds
50.0 mm²	1/0 AWG	**151 A**	Heavy battery/starter cables, large inverters
70.0 mm²	2/0 AWG	**192 A**	Very heavy duty battery cables
95.0 mm²	3/0 AWG	**232 A**	Starter motors, large system main feeds

Figures for quality 105°C PVC insulated stranded copper flex, single conductor, free air, 25°C ambient. Real-world capacity will be lower in hot environments or bundled runs. For under-bonnet or high-ambient plant applications consider 125°C rated XLPE/XLPO cable — see our Ampacity Reference Document.

Volt drop — why cable length matters

Every cable has resistance. Current flowing through resistance causes a voltage drop along the run. On a 48V system volt drop has far less impact than on 12V for the same power delivery. This is one of the key engineering advantages of the higher voltage architecture.

A rough rule of thumb: keep volt drop to 5% or less of your supply voltage on any circuit. On a 48V system that's 2.4V maximum. The volt drop advantage of 48V over 12V is substantial — the same cable carries four times the power for the same volt drop percentage. This is one of the strongest practical arguments for 48V in larger builds.

Longer runs need bigger cable — not just to carry the current safely, but to keep the voltage drop within acceptable limits. If your run is more than 3–4 metres, check the volt drop, don't just check the current rating.

> **Volt drop = (cable resistance in mΩ/m) × current (A) × run length (m) ÷ 1000. Your cable datasheet will give you the resistance figure.**

📖 *For full resistance data (mV/A/m) for all cable sizes, see our Ampacity Reference Document at voltforge.co.uk*