Guides

/ 120 V outlets in a camper van: inverter, shore power, GFCI and the AC panel

120 V OUTLETS IN A CAMPER VAN: INVERTER, SHORE POWER, GFCI AND THE AC PANEL

THE SHORT ANSWER

You add 120 V outlets to a van by feeding them from an inverter or inverter charger and, on hookup, from shore power through a transfer switch, via a small breaker panel with a GFCI on every circuit. It is 120 V work, so a licensed electrician should design, wire and test it; you decide the loads, which outlets run on battery, where they go, and check the result.

Last updated 25 November 2026

KEY TAKEAWAYS

120 V outlets in a van are fed by an inverter or inverter charger and, on hookup, by shore power, through a breaker panel with GFCI protection; only one source may feed them at a time, Samlex says.

Every output needs a GFCI: Victron requires a UL 943 residual current breaker on each MultiPlus-II output, and Samlex requires UL 943 GFCIs on a vehicle's branch circuits when its inverter is hard-wired.

Exactly one neutral to ground link per mode: two make the GFCI trip, none leaves it blind, and its test button cannot tell you, Victron warns.

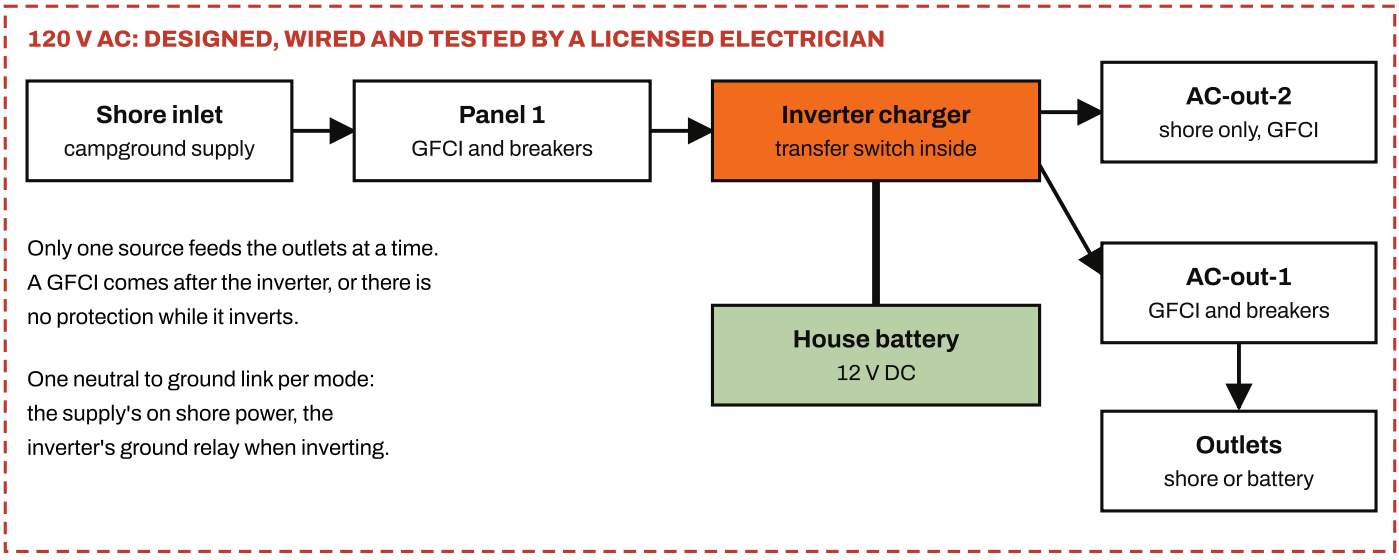
Victron and Samlex both put the 120 V installation in a qualified or certified electrician's hands; your job is the load list, the layout, the brief and the checks.

Keep heating, air conditioning and water heaters off the inverter, as Samlex advises; Victron's AC-out-2 exists for shore-only loads like these.

This guide sits between inverters, inverter chargers and shore power in the electrical system: it covers the outlets they feed.

HOW DOES 120 V REACH THE OUTLETS IN A VAN?

From one of two sources at a time: the inverter, which makes 120 V from the battery, or shore power on hookup. An inverter charger switches between them inside one box, and a breaker panel with GFCIs sits between it and the outlets. [2] [11] [8]



Without an inverter charger: a separate inverter and the shore feed meet in a transfer switch (Samlex STS-30) before the panel, or the inverter feeds its own outlets only (Renogy).

Orientation only, not a wiring diagram. Based on Victron's MultiPlus-II manual and Wiring Unlimited, Samlex and Renogy.

Our diagram of the layout in Victron's MultiPlus-II manual and shore power guide, with Samlex's transfer switch and Renogy's options. Not a wiring diagram. [1] [8] [11] [13]

Victron describes the MultiPlus-II as a sine inverter, battery charger and transfer switch in one casing; when the supply fails it switches to inverting quickly enough that computers are not disturbed.[2] Its shore power guide uses two consumer units with an inverter charger: one after the inlet, feeding the inverter charger and any shore-only loads, and one after the inverter charger's output, feeding the loads you want off-grid.[8] Victron's book explains why the second one matters: if the inverter comes after the RCD, there is no earth protection while it is inverting.[5] Samlex states the rule that makes a transfer switch necessary: only one AC source may be connected to the loads at a time, and the sources must never run in parallel, which can back-feed the grid, endanger line workers and damage the inverter.[11]

INVERTER OUTLETS, A TRANSFER SWITCH OR AN INVERTER CHARGER?

If outlets only need battery power, an inverter with its own outlets is simplest. If the same outlets must also run on shore power, use an inverter charger, or a plain inverter plus a transfer switch. Renogy describes all three.[13]

Three ways to power 120 V outlets in a van (copy it)

SET-UP	HOW IT WORKS	WHAT THE MAKERS SAY
Inverter with its own outlets	Outlets on the inverter, or wired only to it; live only when it is on[13]	Samlex's PST has NEMA 5-20R GFCI outlets built in; never connect its output to a wall outlet or to a panel also fed from shore power[12]
Inverter plus transfer switch	Shore power and the inverter both go to a transfer switch, which feeds the breaker panel[13]	Samlex recommends its STS-30, 30 A and 3,600 VA, which switches line and neutral; installed by a qualified electrician[12][11]
Inverter charger	Transfer switch, charger and inverter in one; passes shore power through and charges, inverts when it goes[2][13]	Victron: installed only by a qualified electrical engineer, UL 943 residual current breaker on each output[1]

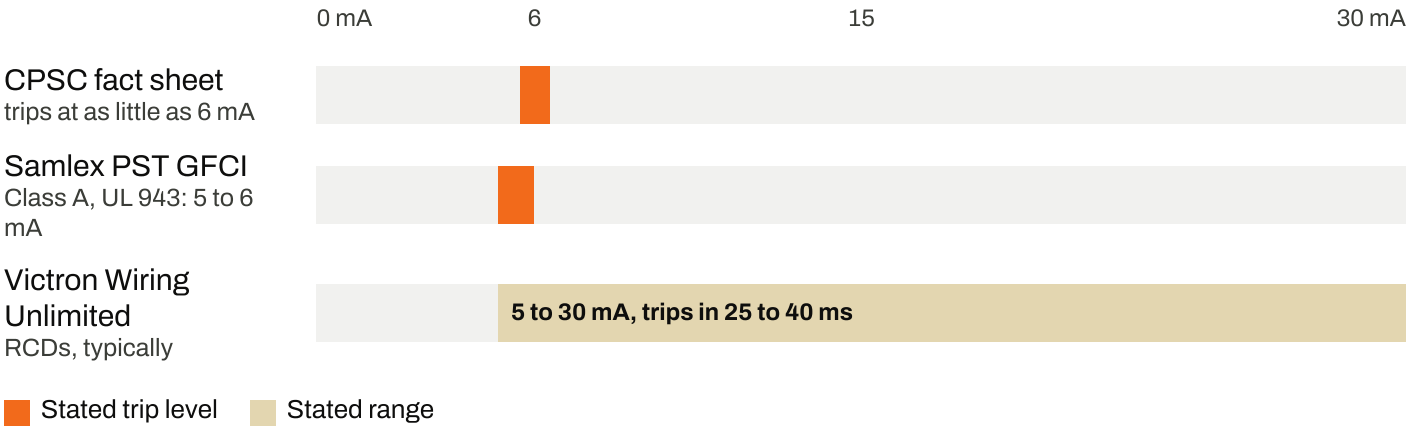
The Samlex STS-30 shows what a separate switch does. It uses one double pole relay to switch both line and neutral, is rated 30 A or 3,600 VA at 120 V, and has an optional 20 to 25 second delay meant for generators, which should never be started under load.[11] Samlex's inverter manual explains why it matters for outlets: a switch that moves the neutral as well keeps the neutral to ground bond at a single point, either the inverter or the supply panel, and the sub-panel it feeds must not bond neutral to ground.[12] With an inverter charger this switching happens inside the unit; compare models in inverter chargers.

WHY DOES EVERY 120 V OUTLET NEED GFCI PROTECTION?

Because a GFCI cuts power when a few milliamps leak to ground, long before a breaker would. Victron calls an RCD (GFCI) compulsory in all AC installations, and both Victron and Samlex require UL 943 devices on a van's outputs or branch circuits.[5][1][12]

TRIP THRESHOLD

Leakage that trips a GFCI or RCD, as each source states it



Sources: CPSC GFCI fact sheet; Samlex PST manual section 8.5.2; Victron Wiring Unlimited chapter 7. Read 25 November 2026; chart ours. Breakers trip at several amps, Victron notes.[14][12][5]

Victron's book puts the difference in plain terms: an RCD looks for leakage typically of 5 to 30 mA, far below the several amps a fuse or breaker needs, and is designed to act within 25 to 40 milliseconds.[5] The CPSC says a GFCI trips on a difference as small as 0.006 A and can also prevent some electrical fires.[14] For vans, the makers are explicit. Victron requires a UL 943 residual current breaker in series with each MultiPlus-II output and recommends Blue Sea

Systems GFCI breakers for it.[1] Samlex says that when its inverter is hard-wired to the panel in an RV or camper, GFCIs listed to UL 943 must protect the branch circuits.[12] In houses, the CPSC notes, the NEC requires GFCI receptacles in places such as kitchens, bathrooms and outdoors; we could not open the RV rules in NFPA 1192 or NEC Article 551, so treat every van circuit as needing one and let the electrician apply the code.[14]

WHERE DOES THE NEUTRAL TO GROUND BOND GO?

In exactly one place per mode. On shore power it is the supply's; when inverting the inverter must make its own. Victron says a GFCI needs that link to work, and a second link makes it trip.[5]

Inverters handle this differently, which is the main reason this is an electrician's design call. Ask which of these your unit is:

How three inverters handle the neutral to ground link (copy it)

UNIT	NEUTRAL TO GROUND	WHAT IT MEANS FOR THE OUTLETS
Victron MultiPlus-II 120V (inverter charger)	Ground relay links output neutral to chassis when there is no AC input, opens before the input relay closes[1]	The output GFCI works on shore and on battery; casing bonded to the chassis in a vehicle[1]
Victron Inverter VE.Direct 120V	Output floating except the GFCI model; a neutral to ground link must be made for a GFCI to work[9][10]	Local rules may require a true neutral; never connect the output to another AC source[10][9]
Samlex PST-1500 and PST-2000	Neutral bonded internally to the chassis; GFCI outlets built in[12]	Feeding it into a panel where neutral is bonded to ground trips the GFCI[12]

Victron's chapter on mobile installations explains the stakes. A van has no earth stake, so all touchable metal is bonded together as a local earth; when the van unplugs from the grid it also loses the grid's neutral to earth link, and unless the inverter makes one, the RCD can no longer

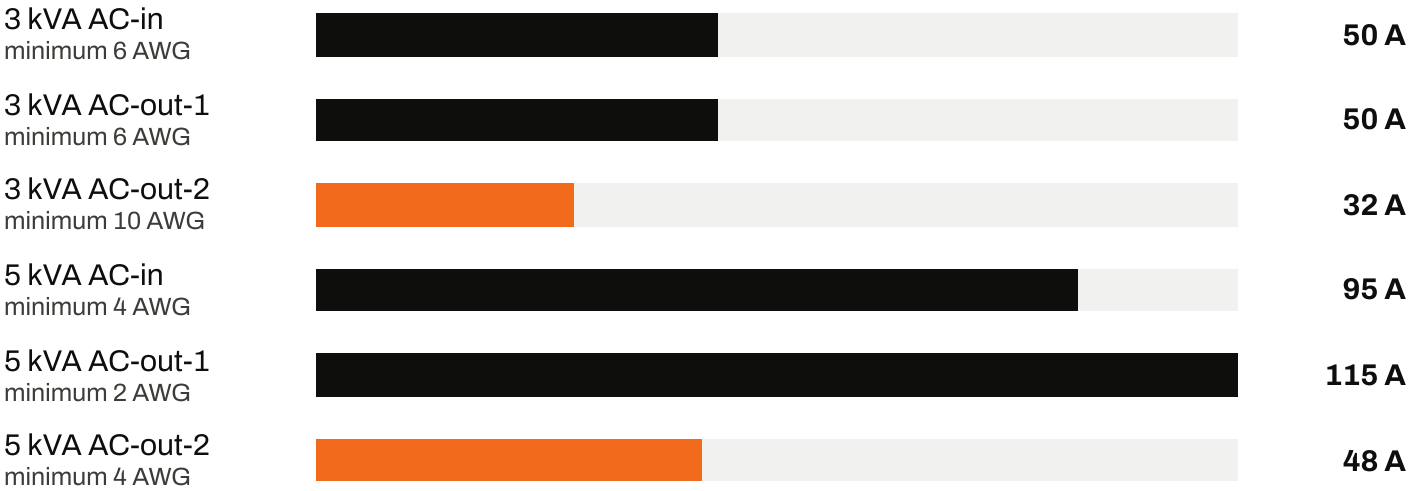
see a leak, while its test button still clicks.[5] The same chapter lists a double neutral to earth link as a cause of nuisance tripping.[5] The bonding rules are the same ones in shore power and inverter chargers; this guide applies them to the outlets.

HOW BIG IS THE AC PANEL, AND WHICH LOADS GO WHERE?

The inverter charger's terminals set the limits. On Victron's MultiPlus-II 3 kVA, AC-in and AC-out-1 are rated 50 A with 6 AWG minimum, and the shore-only AC-out-2 32 A with 10 AWG minimum.[1]

TERMINAL RATINGS

MultiPlus-II 120V AC terminals: rated current and minimum wire



Victron MultiPlus-II 120V manual, installation, section 4.4, read 25 November 2026; chart ours. Three-wire 90 °C copper; stripping length 0.7 in (18 mm).[1]

BY MODE

Which outputs are live on shore power and on battery



Victron MultiPlus-II description and installation chapters, read 25 November 2026; chart ours. [2] [1]

Each circuit in the panel gets its own breaker matched to its load and cable, Victron's book says, and it describes the B, C and D breaker curves: type B, the usual household breaker, trips magnetically at five times its rating.[6] It also asks for fine, flexible stranded wire rather than rigid strands at inverter charger terminals, and suggests a manual bypass switch rated for the full load so the outlets can be fed directly if the inverter charger fails.[6] How many outlets per circuit and which breaker is for the electrician to decide from the code; we found no maker figure to quote for a van.

WHERE SHOULD THE OUTLETS AND PANEL GO?

Outlets where you use power, with GFCI protection everywhere and especially near water; the panel and inverter in a dry, reachable cabinet; AC cable kept apart from DC cable. Mark it all before the walls close. [14] [15] [11]

Few makers give placement rules for a van, so here is what the sources do say. The CPSC stresses GFCI protection where electrical equipment is near water.[14] Ancor quotes ABYC: conductors exposed to damage need loom, conduit or similar protection, and AC conductors run with DC ones must be sheathed, bundled or otherwise kept separate.[15] Samlex's transfer switch is not weatherproof and must not go in an engine compartment, under sink drains or water pipes, in the battery compartment or where flammable liquids are stored; it can sit near the power cord entry and must be fixed firmly enough to hold during driving.[11] Victron wants its inverters as close as possible to the batteries but never directly above them.[9] Plan the

layout with the van layout guide and the wiring diagram, and run the cables in the walls before they close.

HOW TO PLAN AND CHECK 120 V OUTLETS IN A CAMPER VAN, STEP BY STEP

Plan the loads, the set-up and the layout, brief a licensed electrician, then check what they built: settings, GFCIs in both modes, the switchover and monthly tests. There are no live wiring steps here by design. [1] [12] [14]

SKILL

Professional recommended

STEPS

9

TOOLS

- Load list and van floor plan
- Inverter charger settings app, such as VictronConnect
- A lamp to test GFCIs
- Portable surge protector for hookups

MATERIALS

- Inverter or inverter charger
- AC breaker panels with UL 943 GFCI protection
- Transfer switch, if the inverter has none built in
- Outlets and boxes chosen by the electrician

> **Everything at 120 V, from the panels to each outlet, is for a licensed electrician to design, wire and test. Victron says the MultiPlus-II may only be installed by a qualified electrical engineer and wired to the National Electrical Code; Samlex says installation**

and wiring must be done by a certified electrician.[1][3][12] You can do the planning, the settings and the checks.

01 List the 120 V loads and mark which must run on battery

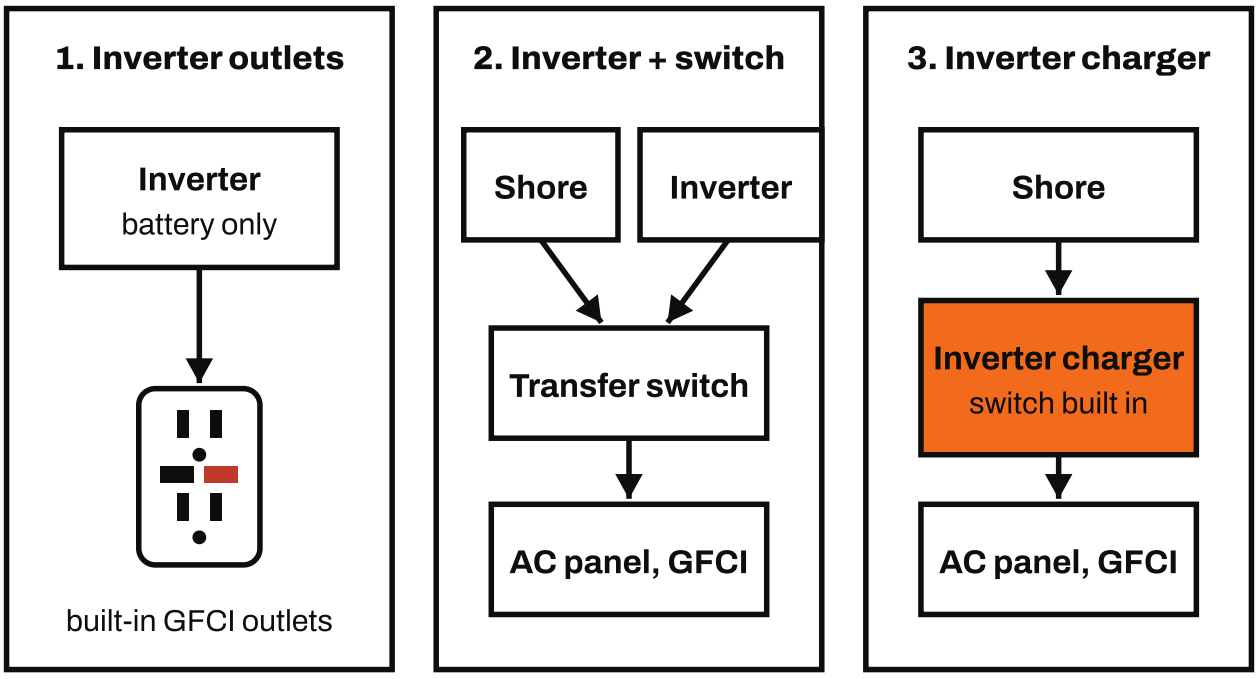
Write down every 120 V appliance and decide which must work off-grid. Samlex notes that in an RV the inverter typically supplies only the highest priority loads, and that running heating, air conditioning and water heaters from batteries is not practical.[11] Size the inverter and battery from that list in the power budget and inverter size.

Load	W	On battery?
Laptop charger		yes / no
Induction hob		yes / no
Kettle		yes / no
Air conditioner		yes / no
Water heater		yes / no

Samlex: inverters typically supply the highest priority loads; heating, air conditioning and water heaters are not practical from batteries.

02 Choose inverter outlets, a transfer switch or an inverter charger

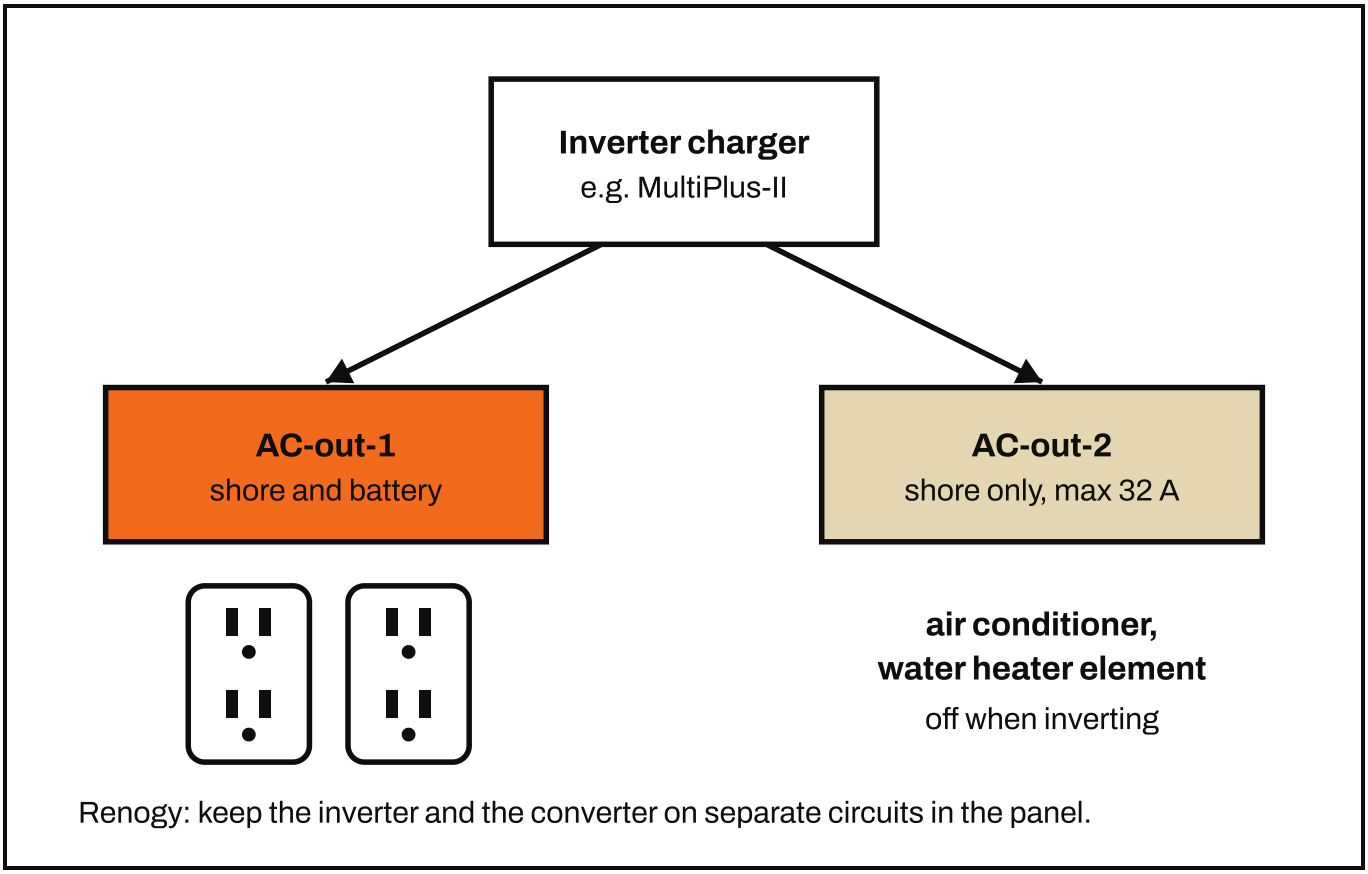
Renogy describes three set-ups: outlets fed only by the inverter; an inverter and shore power joined by a transfer switch into the RV breaker panel; or an inverter charger with the transfer switch built in.[13] Whichever you choose, Samlex's rule holds: only one AC source may feed the loads at a time.[11]



Only one source may feed the outlets at a time (Samlex); options from Renogy.

03 Split battery-backed and shore-only loads

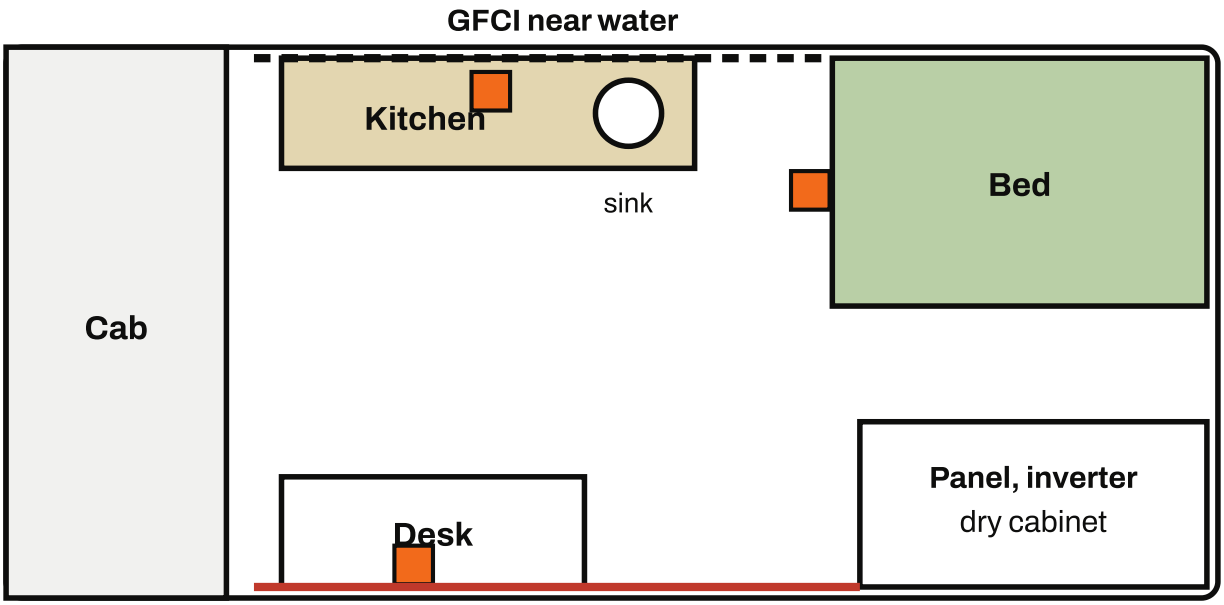
Put the outlets you want on battery on the inverter's output and keep big shore-only loads off it. Victron's MultiPlus-II has a second output, AC-out-2, that drops its load when inverting, for loads such as an electric boiler or air conditioner; on the 3 kVA it is rated 32 A. [2] [1] Renogy asks for the inverter and converter to be on separate circuits in the panel. [13]



Renogy: keep the inverter and the converter on separate circuits in the panel.

04 Mark outlet, panel and cable positions before the walls

Draw where each outlet, the panel and the inverter go before insulation and walls close. Keep AC cable separate from DC: Ancor quotes ABYC that AC conductors run with DC ones shall be sheathed, bundled or otherwise kept separate.[15] Samlex says not to mount its transfer switch in an engine compartment, under sink drains or water pipes, or in the battery compartment.[11]



Red: AC cable run. Dashed: DC cable run, kept separate (ABYC as quoted by Ancor). Not under sink drains, in the engine bay or the battery box (Samlex).

05 Hand the plan and a written brief to a licensed electrician

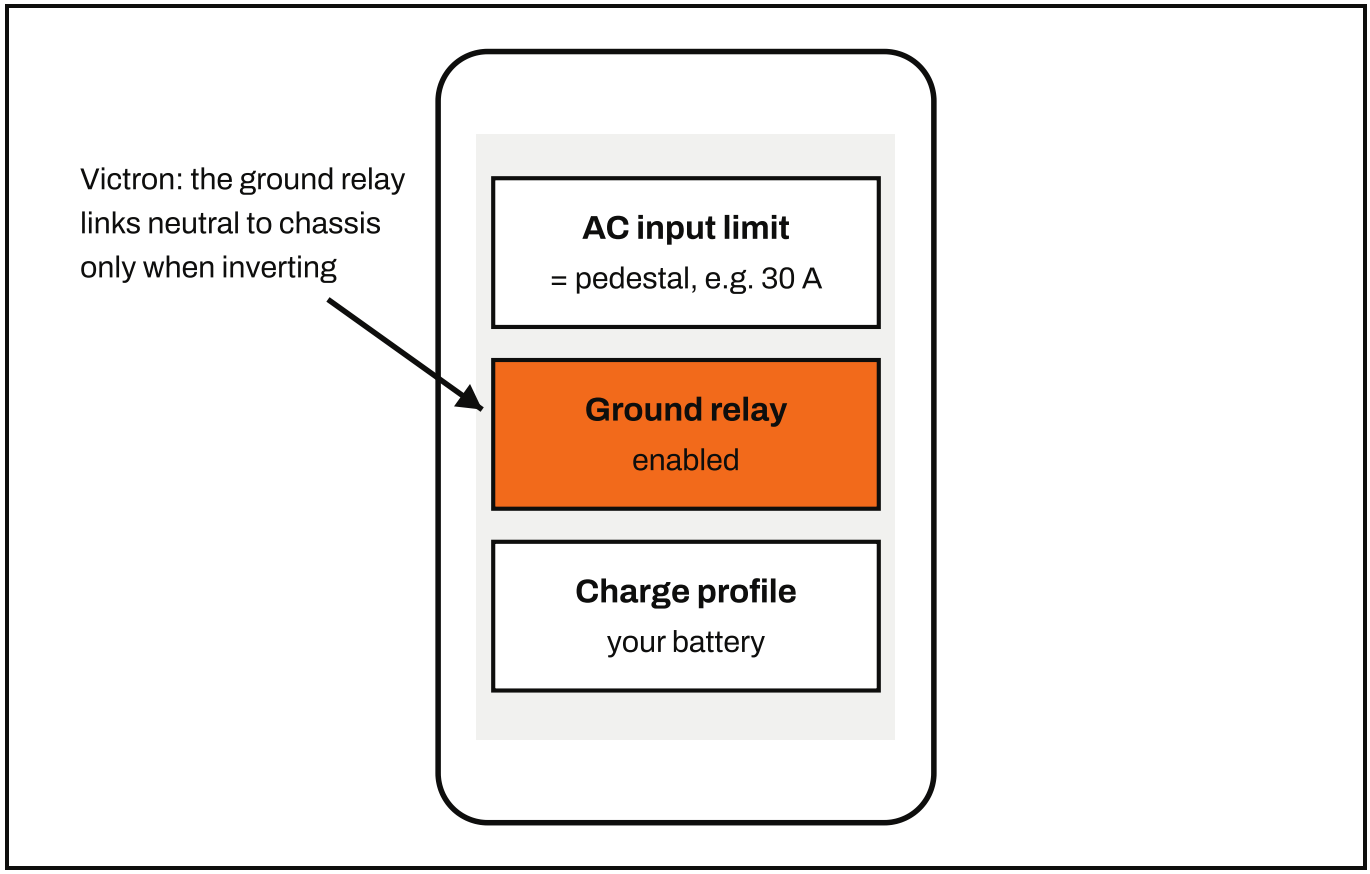
Give the electrician your load list, layout and the manuals. Victron says the MultiPlus-II may only be installed by a qualified electrical engineer and its wiring must follow the National Electrical Code, ANSI/NFPA 70; Samlex says installation and wiring must be done by a certified electrician to the codes.[1][3][12] The brief's questions are in the checklist below.

Brief for the electrician

- [ ] One source at a time
- [ ] UL 943 GFCI on every output
- [ ] One neutral-ground link per mode
- [ ] Casing bonded to chassis
- [ ] AC and DC runs kept apart
- [ ] Wired to the NEC, as the manual asks
- [ ] Outlets and panel marked on the plan
- [ ] Shore-only loads on their own output

06 Set the inverter charger once it is installed

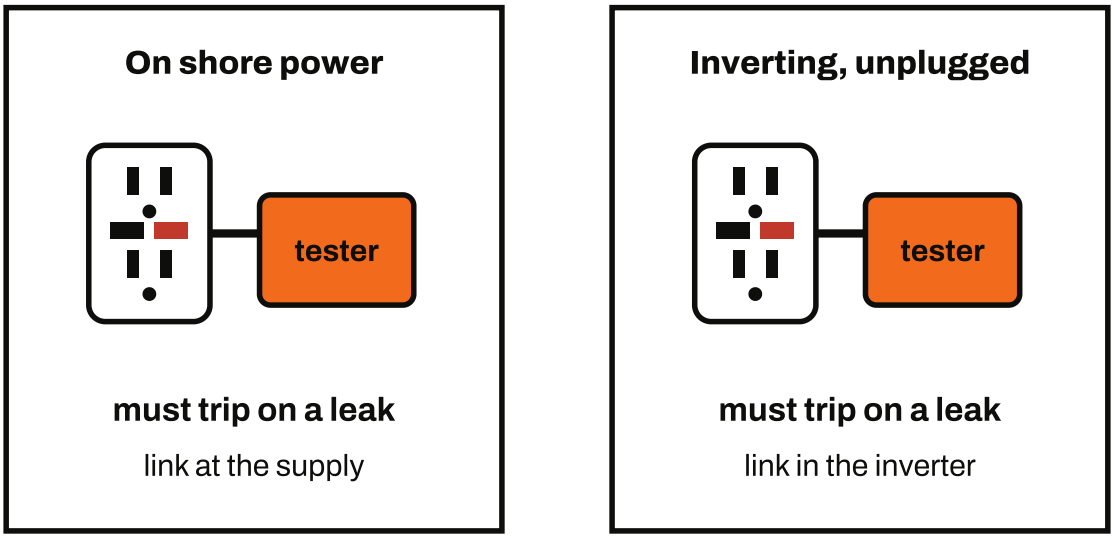
With the electrician, check the settings that affect the outlets. Victron's ground relay connects output neutral to the chassis only when the input relays are open, so a residual current breaker on the output works in both modes; leave it on unless a hard-wired link replaces it. [4] [5] Set the AC input current limit to the supply, as in shore power. [4]



07 Have the electrician prove every GFCI in both modes

Ask for each GFCI to be tripped by a real leak on shore power and again while inverting. Victron warns that if the neutral to earth link is missing, pressing the test button gives a false impression: the button tests the device, but the RCD will not operate on an earth fault. [5]

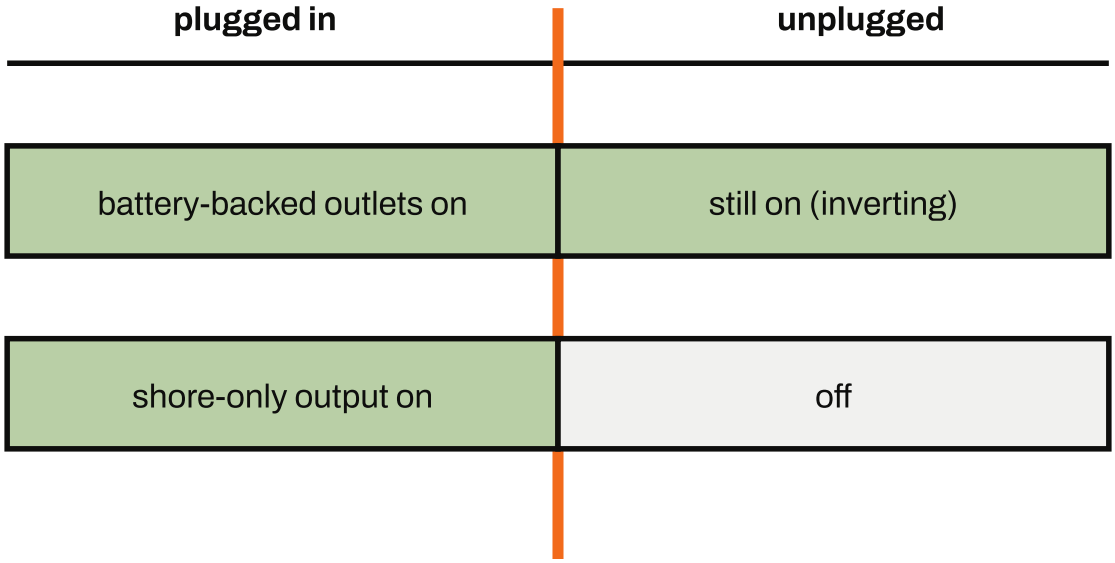
Caution. Do not open a panel or outlet box yourself. Victron says people have died from voltages as low as 42 V and that electrical work should be done by a qualified electrician. [7]



Victron: the test button only tests the device; with no neutral to ground link the GFCI cannot see a leak. Leak tests are the electrician's job.

08 Unplug shore power and check each outlet against the plan

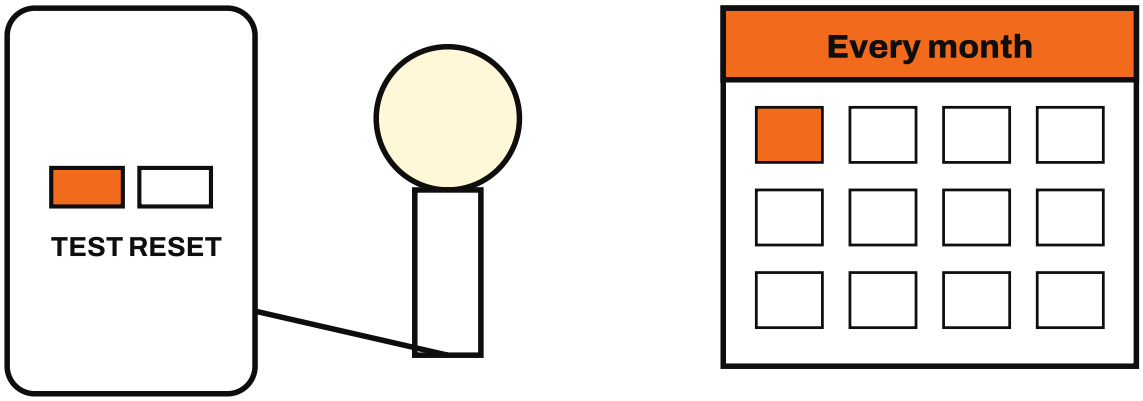
With the van on shore power, unplug it and see what stays on. Outlets on the inverter charger's main output should keep working: Victron says it switches over quickly enough not to disturb computers. Loads on AC-out-2 should switch off.[2] Anything that behaves differently goes back to the electrician.



Unplug the shore cord and check each outlet against your plan (Victron).

09 Test each GFCI monthly and after a power failure

The CPSC says to test every GFCI after installation, at least once a month and after a power failure. Samlex's method: plug in a lamp, press test and the lamp goes off, press reset and it comes back; if the GFCI will not trip or reset, replace it. [14] [12]



Press TEST: the lamp goes out. Press RESET: it comes back.

Test after installation, monthly and after a power failure (CPSC).

If it will not trip or reset, replace it (Samlex).

WHAT SHOULD YOU ASK THE ELECTRICIAN?

Ask how they will keep to one source at a time, protect every output with a UL 943 GFCI, make one neutral to ground link per mode, bond the casing to the chassis, keep AC and DC apart and follow the manuals and code. [11] [1] [5] [15]

Questions for the electrician (copy it)

ASK	WHY
How can shore power and the inverter never feed the outlets at the same time?	Paralleled sources damage the inverter and can back-feed the grid [11] [12]
Which UL 943 GFCI protects each output and branch circuit?	Required by Victron on each MultiPlus-II output and by Samlex on hard-wired vehicle circuits [1] [12]
Where is the neutral to ground link on shore power, and where when inverting?	One link per mode: two trip the GFCI, none leaves it blind [5]
Is the inverter casing bonded to the chassis?	Victron requires it in a mobile installation, since unplugging also disconnects the ground [1]
Which loads are on AC-out-2 or shore-only circuits?	Heating, air conditioning and water heaters are not practical from batteries [11] [2]
Are the inverter and the converter or charger on separate circuits?	Renogy asks for it in the panel [13]
How are AC cables kept apart from DC cables?	ABYC, as quoted by Ancor, wants them sheathed, bundled or kept separate [15]
Which code and manual sections did you follow, and will you test each GFCI on a real leak in both modes?	The MultiPlus-II manual asks for NEC (ANSI/NFPA 70) wiring methods; a test button alone can mislead [3] [5]
Is there a manual bypass if the inverter charger fails?	Victron recommends one, rated for the full AC load [6]

Victron's book adds that wiring rules differ by place, and that you are responsible for seeking advice from local authorities and licensed electricians before any electrical work. [7] At each campground hookup, the surge protector routine in shore power still applies.

WHO MAKES THE INVERTERS AND INVERTER CHARGERS?

These 6 verified businesses in our directory make inverters and inverter chargers or sell van electrical systems built around them; each links to its listing.

Victron Energy B.V., Almere, Netherlands: Maker of off-grid energy equipment such as inverters, chargers, batteries, battery monitors and solar charge controllers, used in vans, boats and buildings.

Samlex America, Burnaby, British Columbia, Canada: Maker of power inverters, inverter chargers, battery chargers, DC-DC converters and Samlex Solar products for RV, marine and off-road use.

Renogy, Ontario, California: Ontario, California maker of solar panels, lithium batteries, inverters and off-grid power kits for RVs, vans, marine and cabins.

Kisae Technology, Canada: Maker of power inverters, inverter chargers, DC-DC chargers and solar products for RV, marine and recreational van conversion use.

Explorist.life, Redmond, Oregon: Husband-and-wife business selling camper electrical systems, components and wiring kits for DIYers, with professional installation in Redmond, Oregon.

Vanlife Outfitters, Sarasota, Florida: Sarasota, Florida store for camper van electrical systems, batteries, solar, suspension, water tanks, swivels and other road-tested van parts.

More in parts makers and kit makers; every build topic is on the DIY hub. The electrical series: the whole system, inverters, inverter chargers, shore power, power budget, wiring diagram and, for the 12 V side, crimping 12 V wire. Cooking on 120 V? See induction vs propane; air conditioning is in van air conditioners.

The live version of this guide, with every source linked: vanlife.co/guides/van-120v-outlets. Builders, kits and parts makers we checked: vanlife.co/builders.

QUESTIONS PEOPLE ASK

Can I wire the 120 V outlets in my van myself?

Plan them yourself, but have a licensed electrician wire and test them. Victron says its MultiPlus-II may only be installed by a qualified electrical engineer, Samlex says installation and wiring must be done by a certified electrician, and Renogy advises hiring a licensed electrician if unsure.

Do the outlets in a van need GFCI protection?

Yes. Victron calls an RCD (a GFCI in the US) compulsory in all AC installations and requires a UL 943 residual current breaker on each MultiPlus-II output. Samlex says that when its inverter is hard-wired to a panel in a vehicle, UL 943 GFCIs must protect the branch circuits.

Why does my GFCI trip when I switch between shore power and inverter?

Often a second neutral to ground link. Victron says a double link makes the RCD trip, and Samlex says its GFCI trips if it sees a neutral to ground bond on the load side, such as a panel where neutral is bonded to ground. A leaking appliance can also trip it. Have an electrician find the cause.

Can I plug my inverter into the van's shore power inlet with a cord?

No. Victron says never connect an inverter's output to another AC source, and Samlex warns never to use a cord with a male plug on both ends to feed a receptacle. Feeding the same outlets from two sources needs a transfer switch or an inverter charger.

Do I need a separate transfer switch with an inverter charger?

No. An inverter charger has the transfer switch built in: Victron describes the MultiPlus-II as an inverter, charger and transfer switch in one casing, and Renogy says an inverter charger removes the need for separate switching. A plain inverter sharing a panel with shore power does need one.

Which 120 V loads should not run on the inverter?

Samlex says running heating, air conditioning and water heaters from batteries is not practical, so inverters typically supply only the highest priority loads. Victron's MultiPlus-II has a second output, AC-out-2, that disconnects when inverting, for loads such as an air conditioner or electric boiler.

How often should I test the GFCI outlets?

The CPSC says after installation, at least once a month and after a power failure. Samlex's monthly test uses a lamp: press test and the lamp goes out, press reset and it comes back on. If it will not trip or reset, the GFCI must be replaced.

SOURCES

System, GFCI and grounding rules from Victron's MultiPlus-II 120V manual (installation, description, safety, configuration), its Wiring Unlimited book and RV shore power article, and its Inverter VE.Direct 120V manual; transfer switching and inverter GFCI behaviour from Samlex's STS-30 and PST manuals; set-up options from Renogy's RV inverter guide; GFCI testing from the CPSC fact sheet; AC and DC separation from ABYC as quoted in Ancor's catalog. We give no AC wiring instructions: the HowTo covers planning and checks only. NFPA 1192 and NEC Article 551 could not be opened and are not paraphrased; the CPSC's list of NEC GFCI locations is for houses, not RVs. Renogy's own inverter charger manual is hosted on a server that refused our connection, so we cite its guide instead. No maker gives an install time, so none is given. All read 25 November 2026.

Victron Energy, MultiPlus-II 120V manual, Installation (AC cabling, AC-out-1 and AC-out-2, UL 943 residual current breakers, ground relay, mobile installations) (https://www.victronenergy.com/media/pg/MultiPlus-II_120V/en/installation.html). Read 25 November 2026

Victron Energy, MultiPlus-II 120V manual, Description (transfer switch, UPS function, two AC outputs) (https://www.victronenergy.com/media/pg/MultiPlus-II_120V/en/description.html). Read 25 November 2026

Victron Energy, MultiPlus-II 120V manual, Safety instructions (NEC wiring methods, safety class I grounding) (https://www.victronenergy.com/media/pg/MultiPlus-II_120V/en/safety-instructions.html). Read 25 November 2026

Victron Energy, MultiPlus-II 120V manual, Configuration (ground relay, AC input current limit) (https://www.victronenergy.com/media/pg/MultiPlus-II_120V/en/configuration.html). Read 25 November 2026

Victron Energy, Wiring Unlimited, chapter 7: Ground, earth and electrical safety (RCD, neutral to earth link, mobile installations) (https://www.victronenergy.com/media/pg/The_Wiring_Unlimited_book/en/ground,-earth-and-electrical-safety.html). Read 25 November 2026

Victron Energy, Wiring Unlimited, chapter 6: AC wiring (circuit breakers, manual bypass, cable strands) (https://www.victronenergy.com/media/pg/The_Wiring_Unlimited_book/en/ac-wiring.html). Read 25 November 2026

Victron Energy, Wiring Unlimited, chapter 1: safety warnings and disclaimer (https://www.victronenergy.com/media/pg/The_Wiring_Unlimited_book/en/introduction.html). Read 25 November 2026

Victron Energy, RV Shore Power: A beginner's guide (knowledge article, 16 June 2026) (https://www.victronenergy.com/knowledge-articles/2026/6/16/adding-shore-power-to-rv-solar-system). Read 25 November 2026

Victron Energy, Inverter VE.Direct 120V manual, Installation (AC outlet, never connect to another AC source) (https://www.victronenergy.com/media/pg/Inverter_VE.Direct_120V_-_HW15/en/installation.html). Read 25 November 2026

Victron Energy, Inverter VE.Direct 120V manual, Appendix (neutral to ground connection) (https://www.victronenergy.com/media/pg/Inverter_VE.Direct_120V_-_HW15/en/appendix.html). Read 25 November 2026

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