Why Telecom Power Systems Commonly Use −48V DC

Learn why −48V DC remains common in telecom, what the negative sign means, how the real voltage window changes, and what engineers must specify.

PRODUCT KNOWLEDGE

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Understand the historical and engineering reasons for −48V DC, what the negative sign means, why the bus does not stay at exactly 48 volts, and what a project specification must define.

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Contents
 A label reading "−48V DC" does not mean that every terminal remains at exactly −48.0 volts. It identifies a nominal interface class. The operating voltage moves with battery state, charger control, load current and distribution drop, while the minus sign describes polarity relative to the DC return reference.Telecom networks commonly retain this arrangement because a standardized low-voltage DC interface can connect critical equipment and battery reserve on one power path, while 48 volts keeps current more manageable than 12 or 24 volts for many site loads. Decades of compatible equipment, operating practice and spare parts reinforce the original engineering choice. A sound **telecom power supply** specification therefore states the complete interface—not just "48V."

Four separate questions: nominal voltage, permitted operating range, polarity/return arrangement and protective-earth design are related, but they are not interchangeable. Confirm each one at the declared equipment interface.

What does −48V DC mean in a telecom power system?

In a conventional −48V telecom interface, the supply conductor is negative relative to the 0V DC return; under the referenced ETSI arrangement, the positive return conductor is connected to earth according to the applicable bonding design. The number 48 is the nominal designation, not a promise that the measured voltage is fixed at that value.

ETSI EN 300 132-2 V2.8.1 (2024-10) defines interface “A” between a power supply system and power-consuming ICT equipment. It specifies a nominal −48V DC interface with the positive conductor connected to earth and distinguishes isolated and common DC-return arrangements. That interface is a functional reference point; the project must identify where it is physically located.

- **−V supply:** the energized supply conductor at a negative potential relative to the DC return.
- **DC return:** the 0V power-return conductor, sometimes called battery return.
- **Protective earth and bonding network:** the safety and equipotential-bonding structure defined by the installation design.
- **Equipment chassis or signal reference:** connections whose relationship to DC return must come from approved manufacturer and project documentation.

These labels should not be collapsed into one conductor in a drawing or installation instruction. An unauthorized extra return-to-earth connection can change fault-current paths, introduce circulating current or defeat the intended monitoring arrangement.

Why did 48V DC become common in telecommunications?

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48V DC became common because it matched central battery practice, allowed stored energy to support loads directly, reduced current compared with lower-voltage alternatives and eventually became a widely supported equipment interface. Its continuing use is a combination of engineering fit and installed-base compatibility, not one isolated advantage.

A battery-compatible nominal class

The current ETSI interface note traces the nominal value in many systems to a 24-cell lead-acid battery. Cell voltage changes between charging and discharge conditions, so the connected equipment was designed around a range rather than a single number. Modern lithium-ion systems can also be compatible, but only when their cell configuration, BMS limits, charge settings and discharge window fit the declared ICT interface.

This battery relationship gives a **48V DC interface** a practical continuity advantage: after an upstream AC source or rectifier path is lost, a correctly integrated battery can continue feeding the common DC bus without first converting stored DC energy to AC. The actual topology can still include contactors, protection, converters and control logic;

“direct battery support” does not mean an unprotected connection.

Standardization became its own design input

Once switching, transmission and radio equipment, rectifier plants, battery systems, distribution hardware and maintenance procedures converged on the same interface class, compatibility reduced integration effort. Current standards still recognize several alternatives. Recommendation ITU-T L.1210 (12/2025) discusses −48V DC alongside AC, low-voltage DC, power over Ethernet and DC interfaces up to 400V for different network situations.

The recommendation also identifies an important trade-off. Lower-voltage DC can ease some safety-related installation and maintenance requirements, while the higher current of a 48V system limits economical reach and increases conductor demand at high power. That is why −48V remains common without being the correct answer for every load or distance.

Why is the telecom supply negative rather than positive?

The negative designation results from using the positive side as the DC return and bonding reference in the established telecom arrangement. Historical outside-plant practice also associated this polarity with control of electrochemical corrosion, but present-day installations must be designed from the current earthing, bonding and stray-current requirements rather than from the historical explanation alone.

A **positive earth return** does not mean that polarity is optional or that the negative conductor is harmless. Reversed equipment connections can damage input stages or operate protective devices. Test instruments, surge protection, branch devices, battery strings and monitoring circuits must all follow the same approved reference convention.

The sign is not a safety rating. Shock, arc and fault hazards depend on potential difference, available current, source energy, environment, access conditions and the applicable safety rules. A negative sign does not make an energized conductor safer to touch.

48V is a current compromise, not an efficiency guarantee

For a constant power demand, raising the voltage magnitude reduces current. That can reduce conductor cross-section, connector burden and resistive loss compared with 12V or 24V distribution. It does not automatically make the complete site more efficient; conversion losses, cable length, operating voltage, load profile and equipment architecture still decide the result.

Ideal DC current: $I = P \div |V|$
Conductor-loop loss: $P_{loss} = I^2 \times R_{loop}$

Consider a hypothetical 2.4kW load and hold conductor-loop resistance at 0.002Ω only to expose the voltage-current relationship. The table first calculates ideal current at each nominal voltage, then applies that screening current to the loss formula. Real designs require an iterative voltage-drop check and would select different conductors, protective devices and interfaces.

Nominal voltage magnitude	Ideal current at 2.4kW	Illustrative I^2R loss at 0.002Ω
12V	200A	80W
24V	100A	20W
48V	50A	5W

At equal power and resistance, doubling 24V to 48V halves current and reduces I^2R loss to one quarter. Going to a much higher voltage can reduce current further, but it changes equipment interfaces, insulation, protection, installation practice and safety obligations. It is a different architecture decision, not a free extension of the same 48V bus.

Why is a −48V bus rarely measured at exactly −48.0V?

A −48V bus moves because the battery and charger operate across a voltage range and current creates drop along the distribution path. The equipment must tolerate the agreed conditions at its declared interface; the nominal label alone cannot establish compatibility.

For ETSI interface “A,” the published normal service range for the nominal −48V supply is −40.5V to −57.0V DC. The standard ties the upper side to battery charging and regulation assumptions and the lower side to distribution drop and battery end-of-discharge conditions. Those values belong to that particular standardized interface; a different operator requirement, equipment class or contractual reference can define another boundary.

The real **DC voltage window** must be checked in each operating state:

1. **Normal source available:** rectifiers or DC/DC converters carry the live load and maintain the approved battery condition.
2. **Battery charging or recovery:** bus voltage and charge current follow the allowed battery, load and controller limits.
3. **Battery discharge:** voltage falls with state of charge, temperature, current and

internal resistance.

4. **High load or feeder peak:** cable, terminal and protective-device drop reduces voltage at the remote equipment.
5. **Disconnect and restart:** load-disconnect, BMS and equipment thresholds determine which device opens first and how service returns.

The current consequence is measurable. A hypothetical constant 2.4kW load draws an ideal 50A at 48V magnitude but about 59.3A at 40.5V, an increase of roughly 18.5%. Busbars, feeders, terminals and protection therefore need the applicable low-voltage operating point, not only the nameplate current at 48V.

When should a designer not assume −48V DC?

A designer should not assume −48V whenever the connected equipment, distribution distance, power level or operator architecture specifies another interface. Confirm the input datasheet and project standard before selecting rectifiers, batteries, DC/DC converters, protection or cable sizes.

A **nominal 48V system** may still contain 12V or 24V auxiliaries behind DC/DC converters, AC-powered equipment, PoE branches, vendor-specific remote-power arrangements or a higher-voltage DC subsystem. Even two products marketed as “48V” may have incompatible polarity, charge limits, startup current, isolation or low-voltage shutdown behaviour.

- Do not connect equipment marked +48V to a −48V plant without an approved interface design.
- Do not infer load compatibility from a battery label such as 48V or 51.2V.
- Do not place a long remote feeder on the local cabinet bus without checking delivered voltage, return path and fault protection.
- Do not use a converter’s adjustable setpoint as permission to exceed battery or load limits.
- Do not treat the 0V return, chassis, cable screen and protective-earth terminals as interchangeable.

The telecom rectifier system guide owns rectifier capacity, redundancy and battery-charge coordination. The telecom lithium battery guide owns battery chemistry, usable energy, BMS behaviour and lifecycle duty.

Replace “48V required” with a voltage-interface passport

A procurement note that says only “48V DC” leaves the supplier to guess where voltage is measured and which states the equipment must survive. A useful interface passport records the conditions on both sides of the handoff.

1. **Interface and location:** name the applicable standard or operator class and mark the physical measurement terminals.
2. **Nominal value and polarity:** identify −V, DC return, protective earth, chassis and any permitted connection between them.
3. **Normal and abnormal voltage ranges:** state required operation, ride-through, survival and automatic-recovery behaviour.
4. **Load demand:** provide steady, peak, startup and inrush current at the relevant minimum delivered voltage.
5. **Source states:** define grid/rectifier, PV converter, battery, generator and any alternate-feed combinations that reach the interface.
6. **Battery limits:** provide permitted charge/discharge voltage and current, temperature conditions, BMS actions and reconnect logic.
7. **Distribution allowance:** assign cable length, conductor, terminal, device and return-path voltage-drop budgets.
8. **Protection and isolation:** state protective-device type/rating basis, fault-current path, disconnect method and backfeed prevention.
9. **Monitoring:** identify voltage/current measurement points, accuracy, alarm thresholds, timestamps and communication-loss behaviour.
10. **Acceptance evidence:** connect each requirement to a datasheet, calculation, drawing, FAT step, SAT step or recorded setting.

The telecom energy standards guide helps identify the applicable document families. The project authority must still select the governing editions and reconcile them with local electrical rules and the delivered equipment.

How should −48V compatibility be verified before handover?

Compatibility should be verified at the declared interface under the operating states that create the highest and lowest voltage, the highest current and the required recovery sequence. A no-load reading near −48V proves polarity at one moment; it does not prove the system.

1. Compare nameplates, datasheets, settings, the single-line diagram and terminal schedule before energization.
2. Confirm instrument reference, conductor identity, polarity and the intended DC-return bonding arrangement.
3. Record source and load voltage at the same time so distribution drop can be separated from source regulation.
4. Apply the approved load states and confirm minimum delivered voltage, current, temperature and protective-device stability.
5. Exercise source loss, battery support, source restoration and recharge while recording bus voltage and alarm sequence.

6. Verify low-voltage disconnect, equipment shutdown and restart order without driving the battery beyond approved limits.
7. Retain calibrated measurements, controller logs, deviations, final settings and as-built interface identifiers.

Project boundary. This article explains a common telecom interface; it does not prescribe −48V DC for every site. Final polarity, voltage limits, return/bonding arrangement, conductor sizes, protective devices, battery settings and test levels require approved equipment data and project-specific engineering.

Define the voltage window before selecting the power hardware

Provide the load input ranges, polarity and return requirements, source architecture, battery limits, cable lengths, operating states and applicable standards. Huijue can map those interfaces to the rectifier, storage, distribution, cabinet and monitoring scope for review.

Send the site voltage inputs

Related engineering resources

Telecom Rectifier System Guide
Telecom Energy Standards
Solar Controller vs Telecom Rectifier
Products and Engineering Services

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