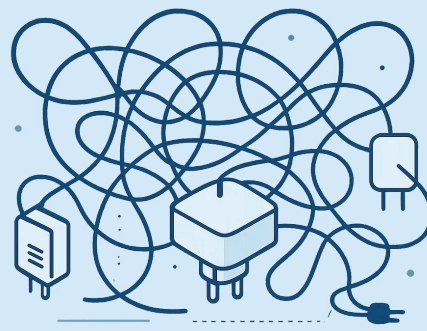




USB-C: The New Language of Universal Power

POWER DELIVERY

ENGINEERING BRIEF

For decades, electronics have been tethered to a fragmented mess of proprietary DC jacks and AC adapters. Today, we are witnessing a paradigm shift. **USB-C is no longer just a data port; it is the new universal language of power.** With a well-defined, market-proven technology stack, it offers a level of interoperability the electronics industry has never seen before.

The Core Problem

DC barrel jacks are "dumb" connectors — no protocol, no protection, no intelligence. A 24V adapter looks identical to a 5V adapter. Your circuit cannot tell the difference until it's already destroyed.

The Engineer's Nightmare

A precision current-sense amplifier — built around high-performance instrumentation amplifiers and LDOs rated to **$V_{in} = 5V$** — was obliterated in a fraction of a second by a misidentified 24V supply. Hours of assembly time lost. Project timeline pushed back. **The DC jack simply delivered.**

Voltage Chaos

Adapters outputting 9V, 12V, 19V, or 24V are physically interchangeable with no warning mechanism.

Polarity Risk

Centre Positive vs. Centre Negative — one wrong plug means instant catastrophic failure.

Physical Fragmentation

Mini, micro, Type-A, Type-B, and dozens of barrel sizes — a world of incompatibility and electronic waste.

The USB-C PD Solution: Digital Intelligence

USB-C Power Delivery replaces "dumb" contact with a **digital handshake**. A PD controller acts as a gatekeeper: by default it only provides 5V. Higher voltages — 9V, 12V, 15V, 20V — are only delivered *after* the device and source successfully negotiate. If communication fails, your circuit remains safe at 5V. The days of accidentally injecting 24V into a 5V input stage are over.



Voltage Negotiation

Higher voltages are gated behind a successful PD handshake. No agreement, no voltage. Your circuit is protected by default.



No Polarity Errors

The reversible 24-pin design makes polarity mistakes physically impossible — a fundamental safety improvement over every legacy standard.



Active Fault Protection

The source side manages current limits and short-circuit protection. A detected fault cuts power before the magic smoke can escape.



The "Anywhere" Ecosystem

Any mobile charger, laptop dock, or quality power bank can serve as the source — including as a **low-noise, isolated supply** for field work and high-fidelity audio.

The democratisation of the power source. USB-C transforms every pocket charger into a precision-capable supply — removing infrastructure dependency and reducing electronic waste simultaneously.

Hardware Integrity: Why Connector Quality is Non-Negotiable

SAFETY CRITICAL

As USB-C scales toward 5A and 240W, the physical quality of the connector becomes a **safety-critical parameter**, not a cost-cutting opportunity. Many low-cost, unbranded connectors sourced from low-tier manufacturers introduce failure modes that can compromise the entire power system — long after the PCB has been assembled and shipped.

High Contact Resistance

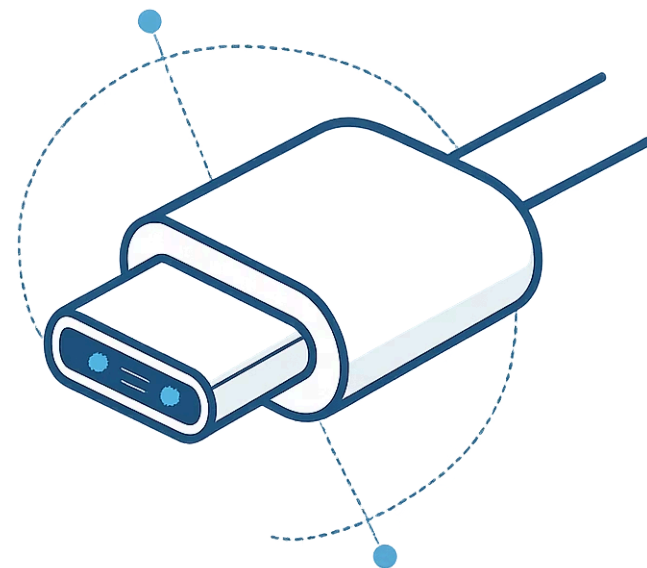
Poor metallurgy raises resistance at contact points. At 3–5A, **I²R heating** melts housings and damages PCB pads.

Poor Mating Cycle Rating

High-grade connectors are rated for **10,000 cycles**. Generic versions often fail after 500, causing intermittent power and field failures.

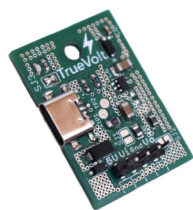
Mechanical Instability

Under high current, cheap connectors lose mechanical pressure — leading to **heat spikes and localised arcing** at the interface.



⚠ At 5A, a contact resistance increase of just 20mΩ results in 500mW of localised heating — enough to degrade the housing, lift pads, and initiate a thermal runaway event in confined enclosures.

"In the world of high-reliability modules, the connector is the first line of defence. We don't just design for performance; we design to prevent the mistakes that stop your work in its tracks."



The Solution: PureRail C33 Nano

TRUEVOLT SERIES RAMANU SYSTEMS

The **PureRail C33 Nano** by Ramanu Systems is engineered to transform "dirty" power from common USB sources into a **laboratory-grade reference rail** — suitable for 24-bit ADCs, high-fidelity audio, and precision RF instrumentation. Every design decision follows the "Zero-Bottleneck" philosophy: eliminate the failure modes before they reach your circuit.



Built-In Intelligence & Protection

Integrated **5.1kΩ CC logic** ensures any modern USB-C PD charger delivers a stable 5V rail instantly. A **SMAJ5.0CA TVS diode** and high-speed Schottky clamp act as ultimate gatekeepers against back-feed and voltage spikes. A dedicated **freewheeling diode** on the output protects microcontrollers from inductive back-EMF — making it relay-ready for industrial control loops.



Tier-1 Hardware Integrity

The module utilises authentic **Amphenol™ interconnect technology** — rated for **10,000+ mating cycles** with gold-plated precision contacts for minimal contact resistance. Unlike generic ports that degrade after a few dozen insertions, this connector is designed to outlast the device it powers.



Laboratory-Grade Signal Integrity

Powered by a genuine **Texas Instruments TPS7A2033**, the module delivers 3.3V with a noise floor of only **7μVrms** (10Hz–100kHz) — virtually undetectable by standard oscilloscopes. With **95dB PSRR** at 1kHz, it effectively erases the switching ripples and hiss of cheap wall adapters. An Abracon **150Ω @ 100MHz** EMI filter blocks high-frequency interference at the input.

Key Specifications at a Glance

Parameter	Specification	Advantage
Input Options	USB Type-C / 2.54mm Header	Total flexibility for lab or field use
Noise Floor	7μVrms (10Hz–100kHz)	Ideal for precision ADCs and DACs
PSRR	95dB @ 1kHz	Eliminates switching artefacts and hiss
EMI Filter	150Ω @ 100MHz (Abracon)	Blocks high-frequency interference
Connector	Amphenol™ (10k+ Cycles)	Industrial-grade mechanical longevity
Protection	TVS + Schottky + Freewheeling	Safeguards against hot-plugging and ESD

✓ The PureRail C33 Nano empowers you to use the charger in your pocket — or a standard 3.7V Li-Po battery — as a seamless, high-precision power source. Universal USB-C infrastructure. Clean, stable output. **No Excuses.**

RAMANU SYSTEMS

Ready to Eliminate Power Failures?

Precision power modules engineered for engineers who can't afford failure.



Website

www.ramanusystems.com



Email

contact@ramanusystems.com



PureRail C33 Nano

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