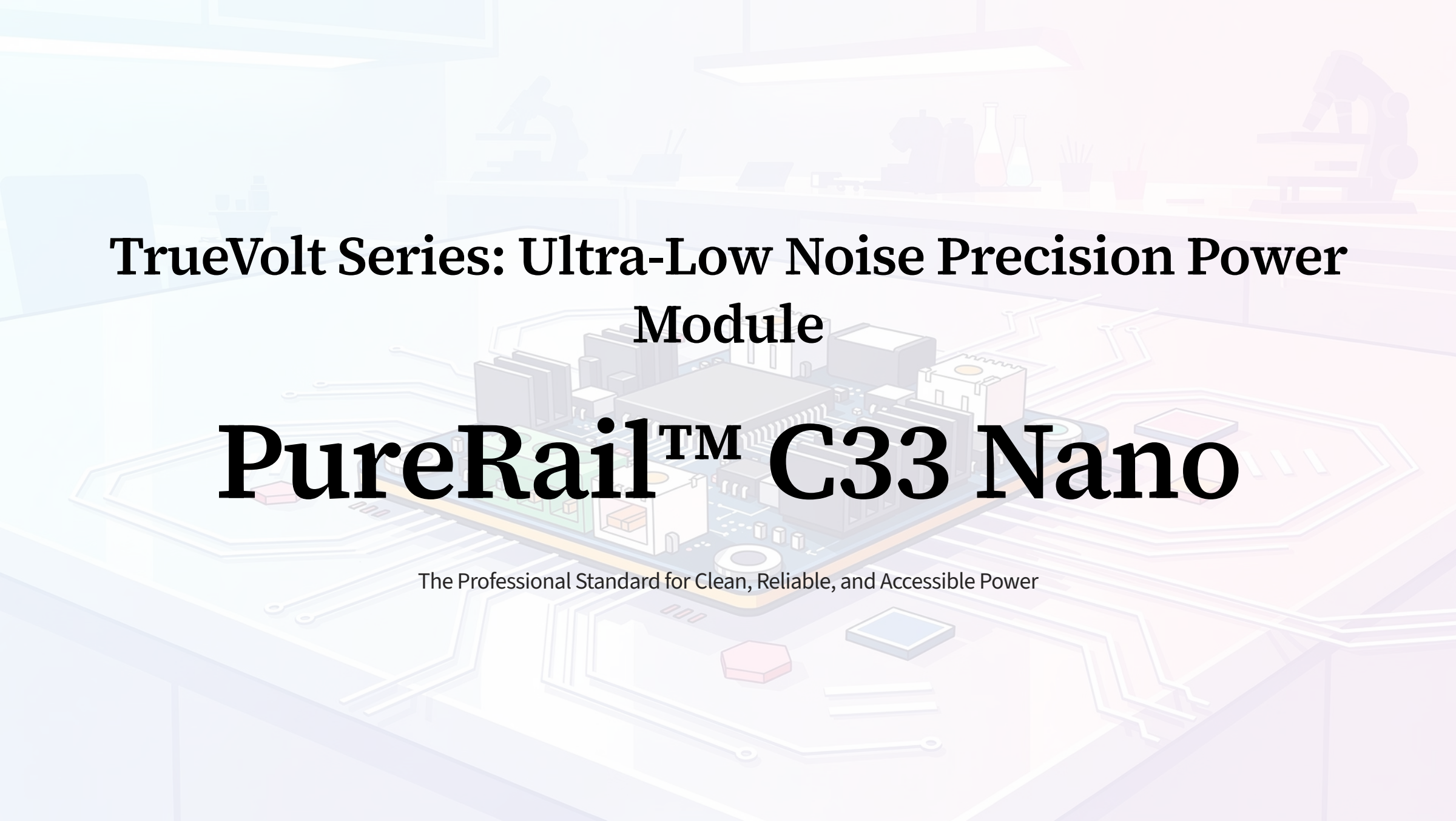


TrueVolt Series: Ultra-Low Noise Precision Power Module

PureRail™ C33 Nano

The Professional Standard for Clean, Reliable, and Accessible Power

Product Overview

The PureRail™ C33 Nano is a high-fidelity power management solution designed for engineers who refuse to compromise on signal integrity. Whether you are developing sensitive analog instrumentation, high-speed RF systems, or precision medical wearables, this module transforms "dirty" power from common USB sources into a laboratory-grade reference rail.

Built with a "Zero-Bottleneck" philosophy, every component from the connector to the silicon has been selected from Tier-1 manufacturers to ensure your project performs at its theoretical limit. This professional-grade module delivers the clean, stable power your precision applications demand, eliminating noise and interference that can compromise measurement accuracy and system performance.

Laboratory-Grade Performance

Transforms USB power into precision reference rails suitable for the most demanding applications

Tier-1 Components

Every part selected from premium manufacturers to ensure zero bottlenecks in your design

Universal Applications

Perfect for analog instrumentation, RF systems, and medical wearables requiring clean power

Key Features

The PureRail™ C33 Nano combines advanced power management with industrial-grade connectivity and comprehensive protection features. This module offers unparalleled flexibility and performance for professional engineering applications.

Dual Power Input

USB Type-C or 2.54mm Pin Headers for maximum flexibility in any environment

Dual Regulated Output

5V output cleaned via high-performance ferrite bead and capacitor filter; 3.3V output driven by TPS7A2033 with ultra-low noise and high PSRR

Industrial Connectivity

Authentic Amphenol Type-C connector with M3 screw mounting for mechanical stability

Power Analysis

On-board 0.255Ω current sense resistor for real-time power monitoring and profiling

Advanced Filtering

AFBC-Q0805 Series Ferrite Bead for superior high-frequency noise suppression

Full Protection

Integrated TVS diode for reverse current and ESD protection safeguarding your investment

Customizable Signal Path: Solder jumpers allow users to bypass the ferrite bead, current sense resistor, or LED for specialized low-burden applications, giving you complete control over your power architecture.

Why Choose the PureRail™ C33 Nano?

The "Pro" Advantage

Unlike low-grade modules using generic, non-branded USB-C ports that often fail or lose connection after a few dozen uses, the PureRail™ C33 Nano utilizes authentic Amphenol interconnect technology and ultra-clean power architecture that sets a new standard for reliability and performance.

The Amphenol™ Interconnect Advantage

- **10,000+ Mating Cycles:** Built for a lifetime of use. This connector will outlast the device it powers
- **Mechanical Integrity:** High-retention stainless steel housing and through-hole mounting prevents connector damage during frequent plugging
- **Precision Contacts:** Gold-plated pins ensure minimal contact resistance and zero signal-drop even at maximum current

Ultra-Clean Power Architecture

- **7 µVrms Silent Rail:** Texas Instruments TPS7A2033 provides 3.3V output with noise levels virtually undetectable by standard oscilloscopes
- **95 dB PSRR:** Multi-stage filtering effectively "erases" switching ripples from cheap wall adapters and notoriously "noisy" USB supply
- **Industrial-Grade Protection:** High-speed TVS Diode prevents back-flow damage and safeguards expensive microcontrollers from voltage spikes

10K+

Mating Cycles

Connector durability that outlasts your project

7µV

Noise Floor

Virtually silent power rail for precision applications

95dB

PSRR Rating

Superior noise rejection performance

Advanced Protection Architecture

The PureRail™ C33 Nano incorporates multiple layers of professional-grade protection to ensure your project remains safe under all operating conditions. From ESD events to reverse polarity mistakes, this module has you covered.

Transient Voltage Suppression

SMAJ15A Bidirectional TVS on VBUS line provides ESD protection and hot-plug protection. Acts as high-speed clamping device, absorbing microsecond spikes before reaching the regulator silicon.

Bidirectional Protection

Protects against both positive and negative-going voltage transients, ensuring the power rail stays clean even in electrically noisy environments.

Reverse Polarity Clamping

High-speed Schottky Diode prevents circuit failure from accidentally swapped 5V and Ground wires. Clamps negative voltage to safe levels instantly.

Zero Voltage Drop

Clamping configuration ensures zero voltage drop during normal operation, maintaining perfect 5V output from USB source.

> "The fail-safe mechanism instantly conducts if power is connected in reverse, clamping the negative voltage to a safe level and preventing destruction of the LDO ."

The USB Type-C "Zero-Cost" Power Solution

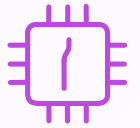
The PureRail™ C33 Nano is designed to save you money while promoting sustainability. Stop investing in bulky, expensive bench power supplies or proprietary AC adapters. Instead, leverage the universal USB-C infrastructure already available in your lab, office, or field deployment.

Universal Compatibility

Use the mobile phone charger already in your pocket. No need for specialized power supplies or proprietary adapters. Any modern USB-C PD charger provides stable, reliable power instantly.

Eco-Friendly & Sustainable

By leveraging existing USB-C infrastructure, you reduce e-waste and eliminate the need for extra cables in your lab. One charger powers multiple devices across your entire workflow.



Smart Detection

Integrated 5.1kΩ CC logic tells any modern USB-C PD charger to provide a stable 5V rail safely and instantly. No configuration required—just plug and power.

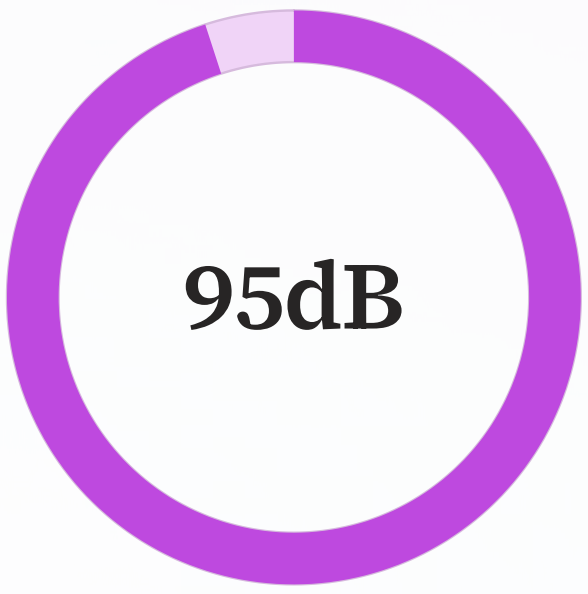
Key Features & Specifications

The PureRail™ C33 Nano delivers professional-grade performance across every specification. From ultra-low noise floors to industrial-grade components, every parameter has been optimized for precision engineering applications.

Parameter	Specification	Advantage
Input Options	USB Type-C / 2.54mm Header	Total flexibility for lab or field use
Output Rails	5.0V (Filtered) & 3.3V (Regulated)	Power digital and analog rails simultaneously
Noise Floor	7 µVrms (10Hz–100kHz) for 3.3V rail	Ideal for 24-bit ADCs and Audio DACs
PSRR	95 dB @ 1kHz	Eliminates "Hiss" and switching artifacts
EMI Filter	150Ω @ 100MHz (ABRACON FB)	Blocks high-frequency interference for both rails
Shunt Resistor	0.25Ω Precision Sense (Panasonic)	Effortless current monitoring and profiling
Capacitors	Samsung 1206 X5R 10µF (25V rated)	High stability, high voltage margin
Mounting	M3 Screw Hole (Grounded)	Secure mechanical and electrical chassis bonding
Protection	SMAJ5.0CA and SD103 Schottky diode	Hot-Plugging, ESD Shielding and reverse current flow

Ultra-Low Noise

RMS noise floor for pristine signal integrity



PSRR Performance

Industry-leading power supply rejection

EMI Filtering

High-frequency interference blocking at 100MHz

Customization via Solder Jumpers

The PureRail™ C33 Nano puts complete control in the user's hands with four strategic "Hardware Config" points. These solder jumpers allow you to optimize the module for your specific application requirements, whether you need zero series impedance, minimal voltage drop at high currents, or ultra-low power consumption.

01

SJ1 (5V FB Bypass)

Short to bypass the Ferrite Bead for applications requiring zero series impedance for 5V rail. Ideal when you need maximum current delivery without any filtering impedance.

02

TP1-TP2 (Sense Bypass)

Short TP1 and TP2 to bypass the 0.255Ω resistor to eliminate the minor voltage drop at high currents. Perfect for applications where every millivolt counts.

03

SJ2 (3.3V FB Bypass)

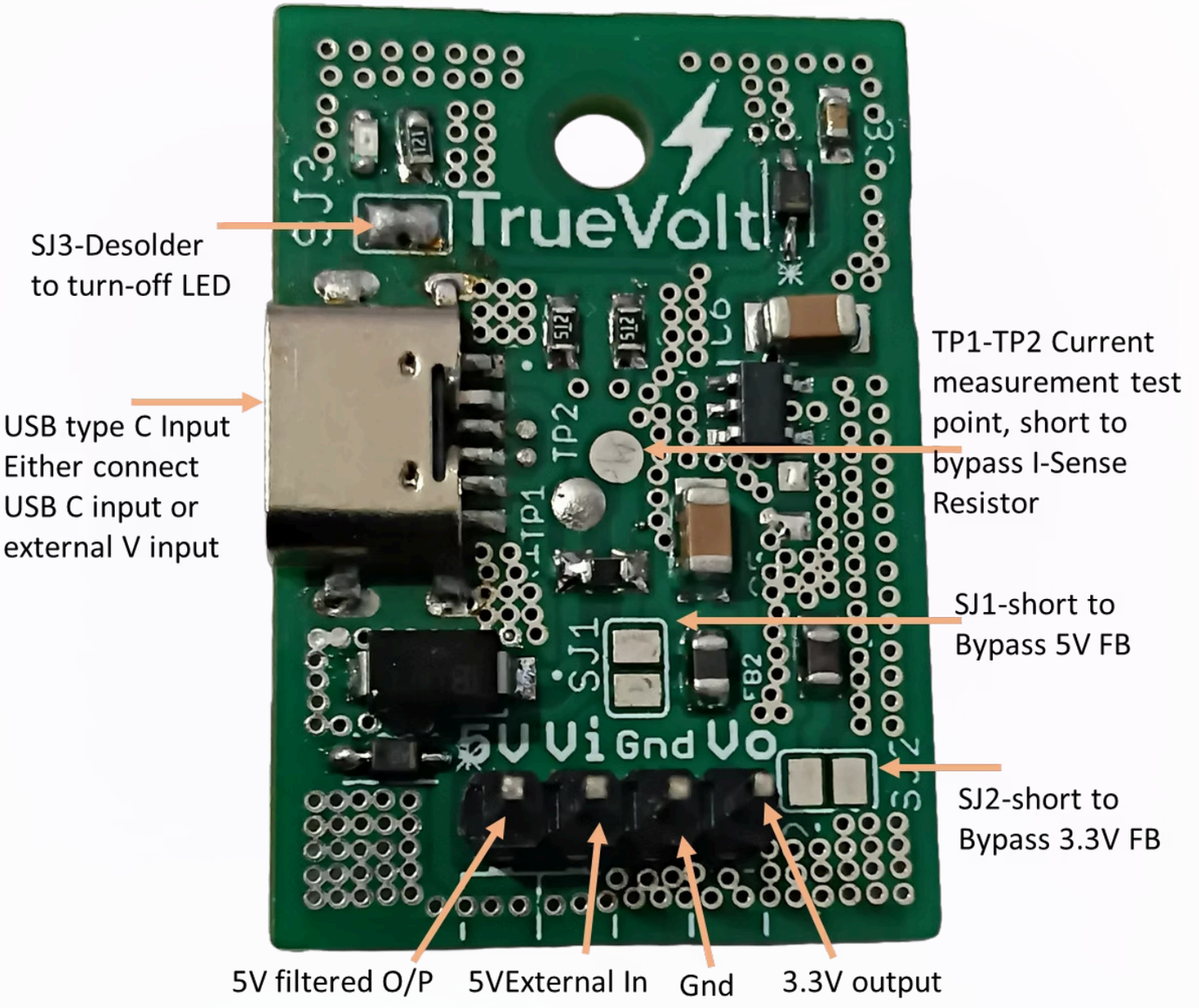
Short to bypass the Ferrite Bead for applications requiring zero series impedance for 3.3V rail. Provides direct path from regulator to load when filtering isn't needed.

04

SJ3 (LED Disable)

Desolder to disable the "Power-On" LED for ultra-low power or stealth deployments. Eliminates LED current consumption for battery-powered applications.

Professional Tip: These hardware configuration options allow you to fine-tune the module's performance characteristics without requiring firmware changes or external components. Experiment with different configurations to find the optimal setup for your specific application.



Pinout of PureRail™ C33 Nano

How to Use

The PureRail™ C33 Nano offers multiple operating modes to suit different application requirements. Whether you need a standard voltage regulator, an inline current meter, or integration with external power sources, this module adapts to your workflow.

As a Standard Regulator

1. Plug in your USB-C phone charger
2. The "Power-On" LED will illuminate
3. Tap 3.3V from the header for your sensors and 5V (Filtered) for your controllers

As an Inline Current Meter

Connect a multimeter in mV mode across the sense resistor pads TP1 and TP2.

Calculation:

$$Current(A) = \frac{Voltage_{Read}(V)}{0.255}$$

For External Power Integration

If building the module with external power source, use the 2.54mm Vi Input header Pin.

The Ferrite filtering will treat the external source with the same rigor as the USB input.

Plug & Play

Instant power with any USB-C charger

Real-Time Monitoring

Built-in current sensing capability

Flexible Input

USB-C or external power options

Best choice for battery Operated system

The PureRail™ C33 Nano is an ideal solution for battery-powered applications, thanks to its ultra-low quiescent current, which significantly extends battery life. Its low dropout voltage ensures that a standard 3.7V Li-Po battery can be utilized efficiently, providing continuous operation even as the battery discharges.

Ultra-low Quiescent Current

Only 6.5µA for extended battery life.

Low Dropout Voltage

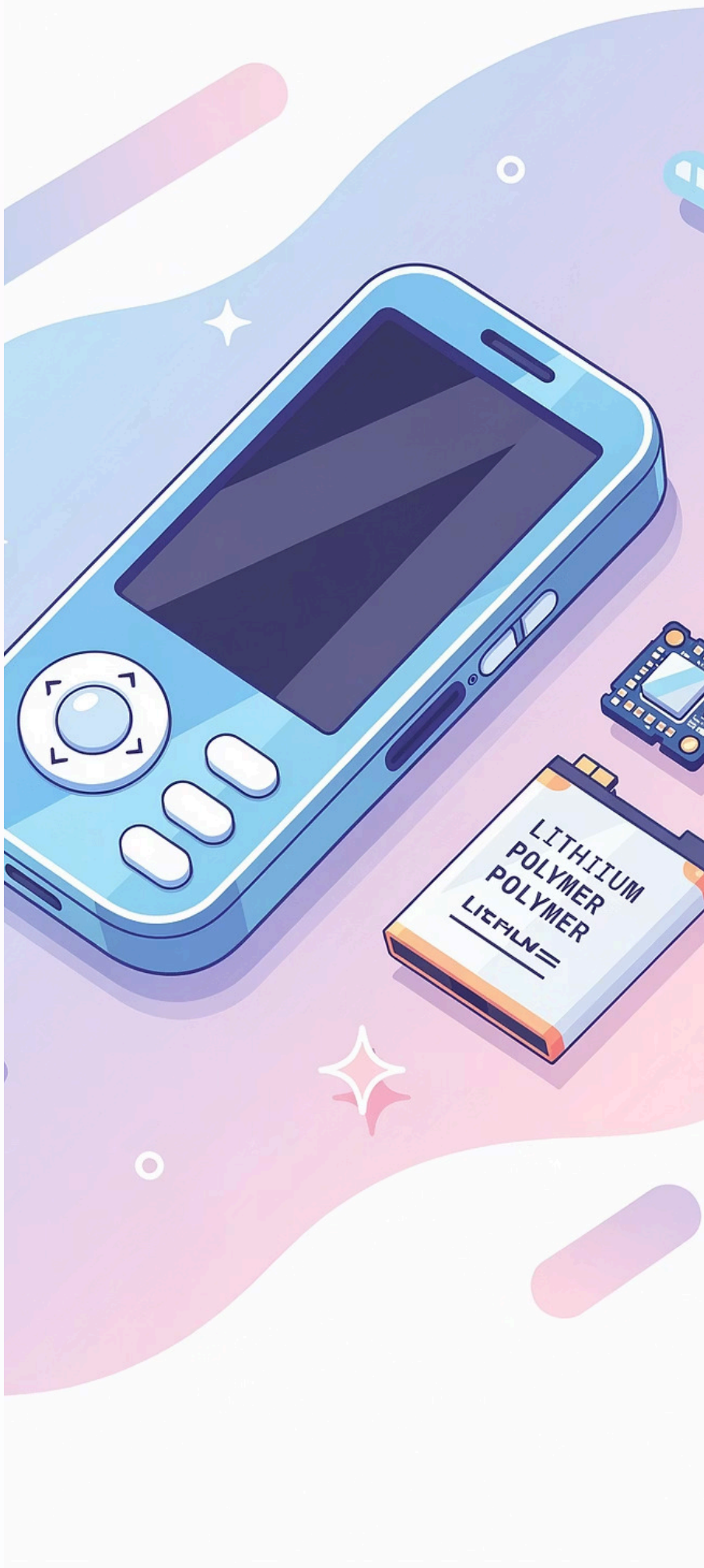
145mV at 300mA maximizes usable battery capacity.

Standard Li-Po Compatibility

Seamlessly integrates with 3.7V Li-Po batteries.

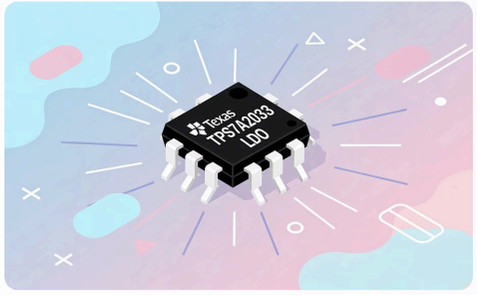
Extended Operation

Maintains function down to 3.45V battery voltage.(assuming the input ferrite bead and current sense are bypassed)



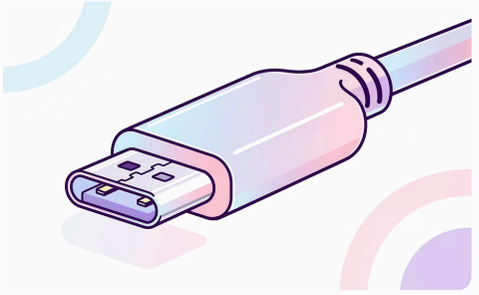
Authenticity Guarantee

We believe you should get more than what you pay for. Every PureRail™ C33 Nano is manufactured using 100% Original Parts sourced through authorized global distributors including Mouser, DigiKey, and element14. We do not use "Market Grade" or "Generic" components that compromise reliability and performance.



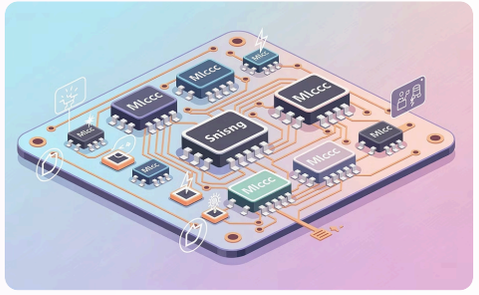
Texas Instruments LDO

Genuine TPS7A2033 ultra-low noise regulator, not counterfeit or remarked chips. Guaranteed performance specifications.



Amphenol Connector

Authentic Amphenol Type-C connector rated for 10,000+ mating cycles. No generic substitutes that fail prematurely.



Samsung Capacitors

Premium Samsung 1206 X5R MLCCs with 25V rating. High stability and reliability for critical applications.

> "Your project will never fail due to component degradation. Every component is sourced through authorized distributors with full traceability and authenticity verification."

⚠️ IMPORTANT: Power Input Conflict Warning

The PureRail™ C33 Nano module provides dual input options via USB Type-C and 2.54mm headers for maximum flexibility. To maintain the module's high-efficiency path and compact design, these power inputs are connected to a common rail.

CAUTION

DO NOT connect an external 5V power supply to the pin headers while a USB Type-C cable is simultaneously plugged in. Because these inputs are not isolated from one another, connecting both at once creates a direct path between the two power sources.

Risk of Damage

This can cause significant back-feeding, which may result in permanent damage to your USB power source, mobile charger, or computer USB port.

Safe Operating Procedure

1 **Disconnect USB First**

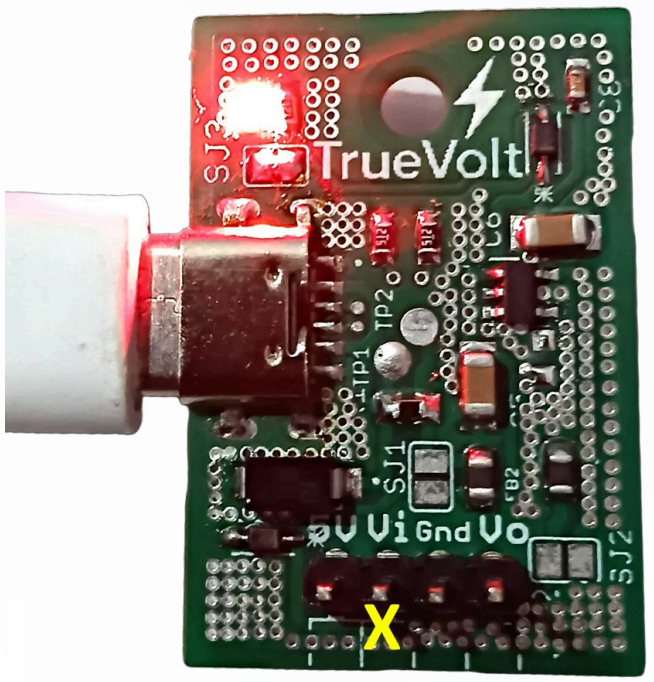
Ensure the USB Type-C cable is disconnected before applying power to the external 5V header.

2 **Verify No External Voltage**

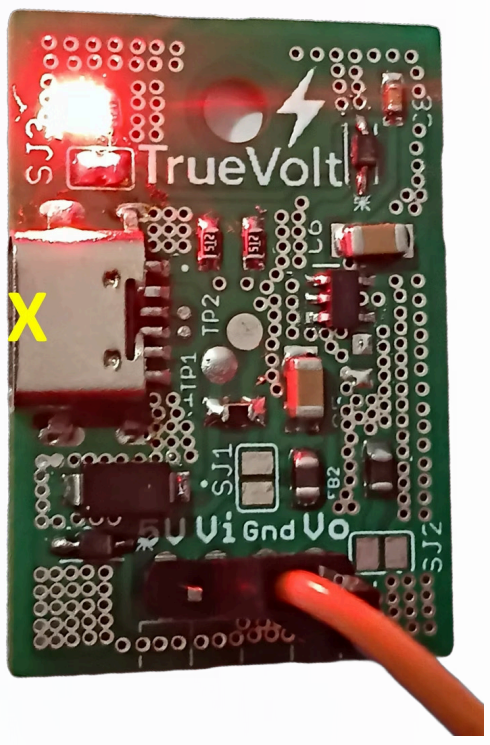
Ensure no external voltage is present on the headers before plugging in a USB Type-C cable.

3 **Use One Source Only**

Use only one power source at any given time to ensure the safety of your equipment and prevent costly damage.



Use either USB-C **OR** External Vin(5V max)—never both at once.



Never connect USB-C while external power is active.(Vi max = 5V)

SINGLE INPUT ONLY ; ONE PWR SRC AT A TIME

TECHNICAL NOTE: Current Output Limitations

Although the USB Type-C interface is capable of supplying up to 3A, the internal power traces and parts used on this module are optimized for precision and low-noise performance rather than high-current distribution. Understanding these limitations is critical for proper system design and longevity.

1.0A	300mA	1.0A
Maximum Continuous Load	**3.3V Output Limit**	**5V Filtered Output**
Recommended safe operating current	TPS7A20 LDO maximum rating	Continuous current capability

Usage Guidelines

3.3V Output: Limited to 300mA by the high-precision TPS7A20 LDO. This ensures ultra-low noise performance and thermal stability. Exceeding this limit will cause the LDO to enter thermal shutdown.

5V Filtered Output: Can handle up to 1.0A continuously. The ferrite bead and trace design are optimized for this current level while maintaining excellent filtering performance.

Caution: Drawing loads exceeding 1.5A may result in excessive heat generation on the PCB tracks and potential voltage instability. For high-power applications such as driving large motor arrays, ensure your total system draw remains within these specified limits.

Proper thermal management and current monitoring will maintain the longevity and precision of the module throughout its operational lifetime.

Design Recommendation: For applications requiring higher current, consider using multiple modules in parallel or upgrading to a higher-power solution. The PureRail™ C33 Nano excels in precision, low-noise applications where clean power is more important than raw current capacity.

Precision Over Power

Optimized for ultra-low noise and signal integrity rather than high-current distribution

Thermal Considerations

Stay within specified limits to prevent heat generation and maintain voltage stability

System Design

Plan your power budget carefully to ensure long-term reliability and performance

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PureRail™ C33 Nano: Professional Power. No Excuses. *(TrueVolt Series Product)*

Contact: contact@ramanusystems.com

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