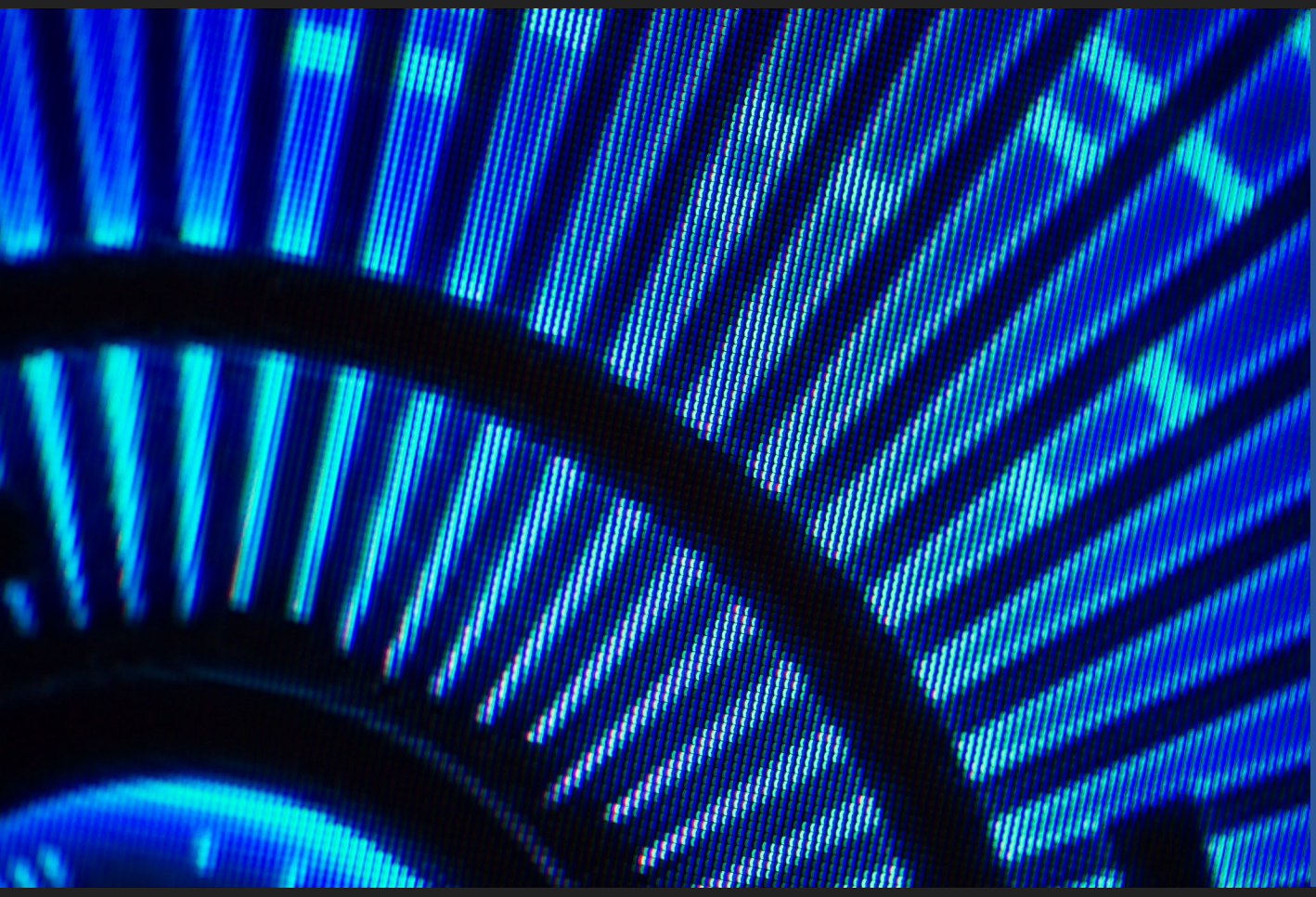
TECHNIQUIP

THE COMPETITIVE EDGE **OF CALIBRATION**

Exacting Control in LED Illumination

TechniQuip Corporation



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Why Calibration Matters in Precision Illumination

In today's advanced imaging and inspection environments, the quality and consistency of illumination can make or break results. From inspecting semiconductor wafers, capturing live cell dynamics, to pushing the boundaries of super-resolution microscopy, precise and repeatable light output is essential. Even small variations in illumination can lead to inconsistent measurements, unreliable images, or failed compliance with regulatory standards.

CALIBRATION IS THE PROCESS THAT BRIDGES THE GAP BETWEEN "GOOD ENOUGH" AND "INDUSTRY-LEADING"—ENSURING EVERY SYSTEM DELIVERS THE RIGHT LIGHT, EVERY TIME.

RELIABILITY & REPEATABILITY MATTER

- **Microscopy:** Predictable performance = repeatable data
- **Semiconductor Inspection:** Precise control for predictable system performance
- **OEMs:** Lifetime system performance, predictive maintenance, lower TC

Benefits & Challenges

Calibration is essential for achieving precise, reliable illumination in advanced imaging and inspection systems.

- Correction for non-linear LED response
- Removing per-unit variations
- Ensuring a safe operating range
- Creating a (smaller) desired operating range
- For larger OEMs, calibrating on each tool with the specific hardware installed, will dramatically improve tool-to-tool imaging consistency

While most LED light engine companies do not allow for customer-end calibration, TechniQuip illumination platforms like TALON, HelioLUX and SPARROW allow for application-specific configuration and calibration.

While calibration addresses many sources of variability, there are some limitations:

AMBIENT TEMPERATURE CHANGES

Standard calibration does not correct for shifts in ambient temperature. Illumination output can vary if the environment changes, so recalibration may be needed when operating conditions differ significantly.

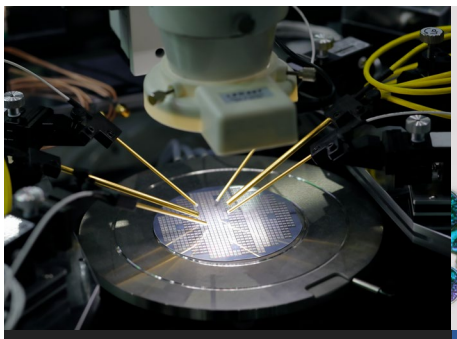
RAPID CHANGES IN INTENSITY (HYSTERESIS)

LEDs require time to reach thermal equilibrium after sudden intensity changes. During this period, light output may temporarily deviate from calibrated values.

NORMAL LED AGING

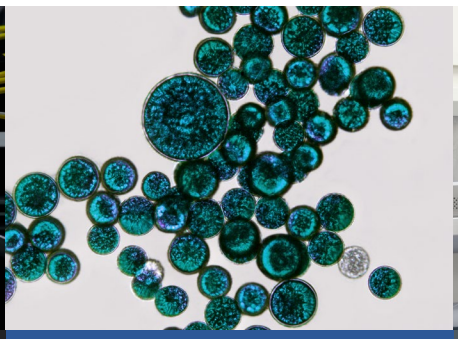
Over tens of thousands of hours, LED output naturally declines. Regular recalibration is necessary to maintain accuracy as components age.

Application Focus: Calibration in Key Markets



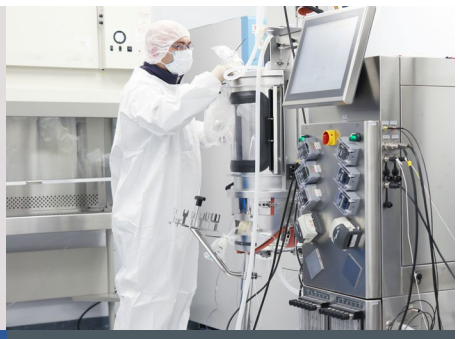
SEMICONDUCTOR INSPECTION

In wafer and device inspection, even minor illumination inconsistencies can lead to false positives or missed defects. Calibration ensures every device is inspected under identical conditions, maximizing yield and quality.



MICROSCOPY

Quantitative imaging demands repeatable, accurate light output. Techniques like PALM and STORM rely on precise illumination for super-resolution results. Calibration guarantees that every experiment is reproducible and every image is trustworthy.



REGULATED ENVIRONMENTS

For applications subject to FDA or CE regulations, traceable and consistent performance is non-negotiable. Calibration supports compliance by providing documented, repeatable control over illumination—critical for drug development, diagnostics, and more.

Introducing Talon

Talon is TechniQuip's advanced, configurable illumination platform designed for the most demanding imaging and inspection applications. Built with flexibility and precision in mind, Talon supports 20 configurable parameters and is delivered with firmware tailored to each customer's needs.

What truly sets Talon apart is its field-calibratable architecture—users can adjust and recalibrate their systems on-site, ensuring optimal performance as requirements evolve. Whether for semiconductor inspection, live cell imaging, or super-resolution microscopy, Talon delivers consistent, reliable illumination that adapts to your workflow.

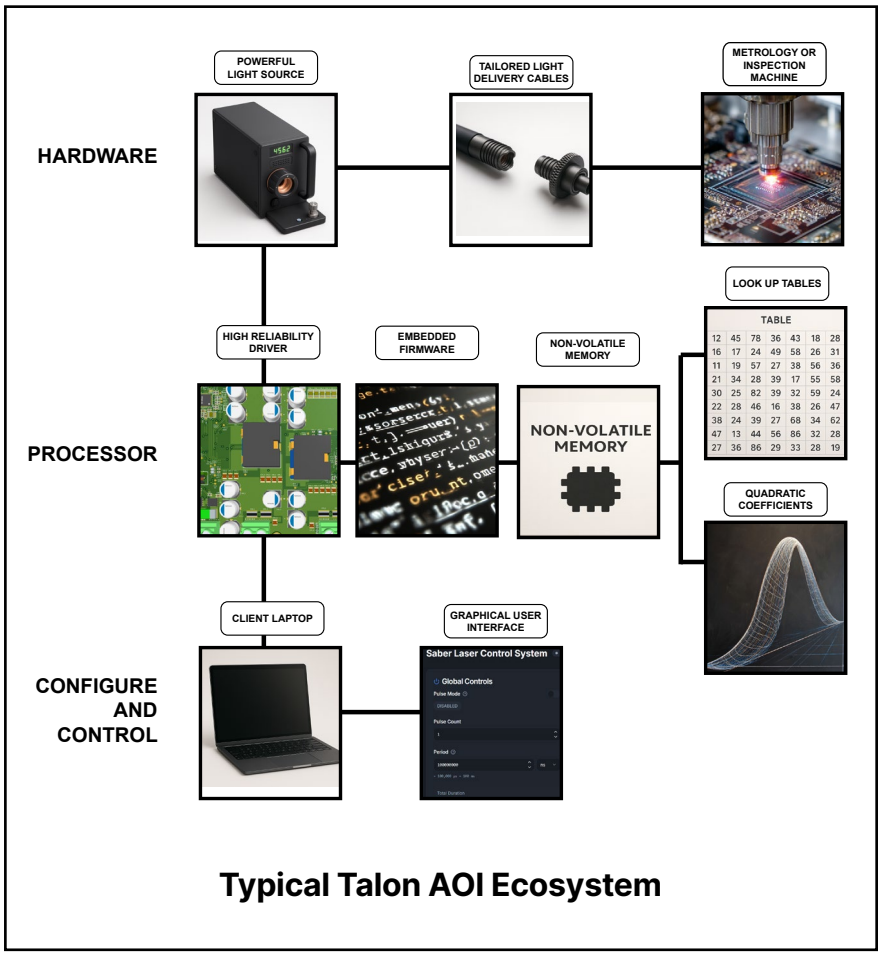
Talon, like many of TechniQuip's LED solid-state illumination systems, is powered by FlightDeck operating system, microcontroller and code. FlightDeck allows for customer configuration and calibration. Autocalibration and autofeedback for preventative maintenance is available.

Talon's Unique Approach: Field-Configurable and Calibratable

Talon stands apart by giving users the power to calibrate and configure their illumination systems in the field. Unlike competitors who restrict client-side calibration, Talon is designed for flexibility and user empowerment. Each Talon unit is delivered with hardware and firmware tailored to the customer's application, but the real advantage is the ability to recalibrate on-site.

This means you can adapt to hardware changes, environmental shifts, or evolving application requirements—without costly factory returns or downtime.

The result: consistent, high-performance illumination that's always under your control.



Typical Talon AOI Ecosystem

Tailored Performance: Hardware, Firmware, and Calibration for Specific Needs

Configured for a Specific Application	Loaded with Firmware Configured for a Specific Application	Stores in Memory Information Tailored to Specific Hardware, Application or OEM Client	Talon Stores in Memory CC And CV Calibration Data which Tailors it to a Specific Application and/ or a Specific Tool
• LEDs and filters set spectral range • LEDs and optics set optical properties (beam angle, uniformity, optical power, etc.) • Driver hardware sets current range, power range, forward voltage range	• Fault detection • Modes (CC, CV) • Support for GPIO accessories (motors, buttons, etc.) • Some temperature range • Fan speed control	• Radiometric range • Temperature range • Sensor hardware values (sense resistance) • Protocol for handling detectable faults • Fan speed control • Options for managing ferrule detection sensors • Options for using on-board or external DAC • IP addressing	• CC calibration data (LINCOEFF) • CV calibration data (LUT)

Precision Illumination Isn't One-Size-Fits-All

Talon includes more than 20 configurable parameters because every application demands fine-tuned control. These parameters allow OEMs and end-users to achieve predictable, repeatable performance under diverse conditions. Here's what that flexibility enables:

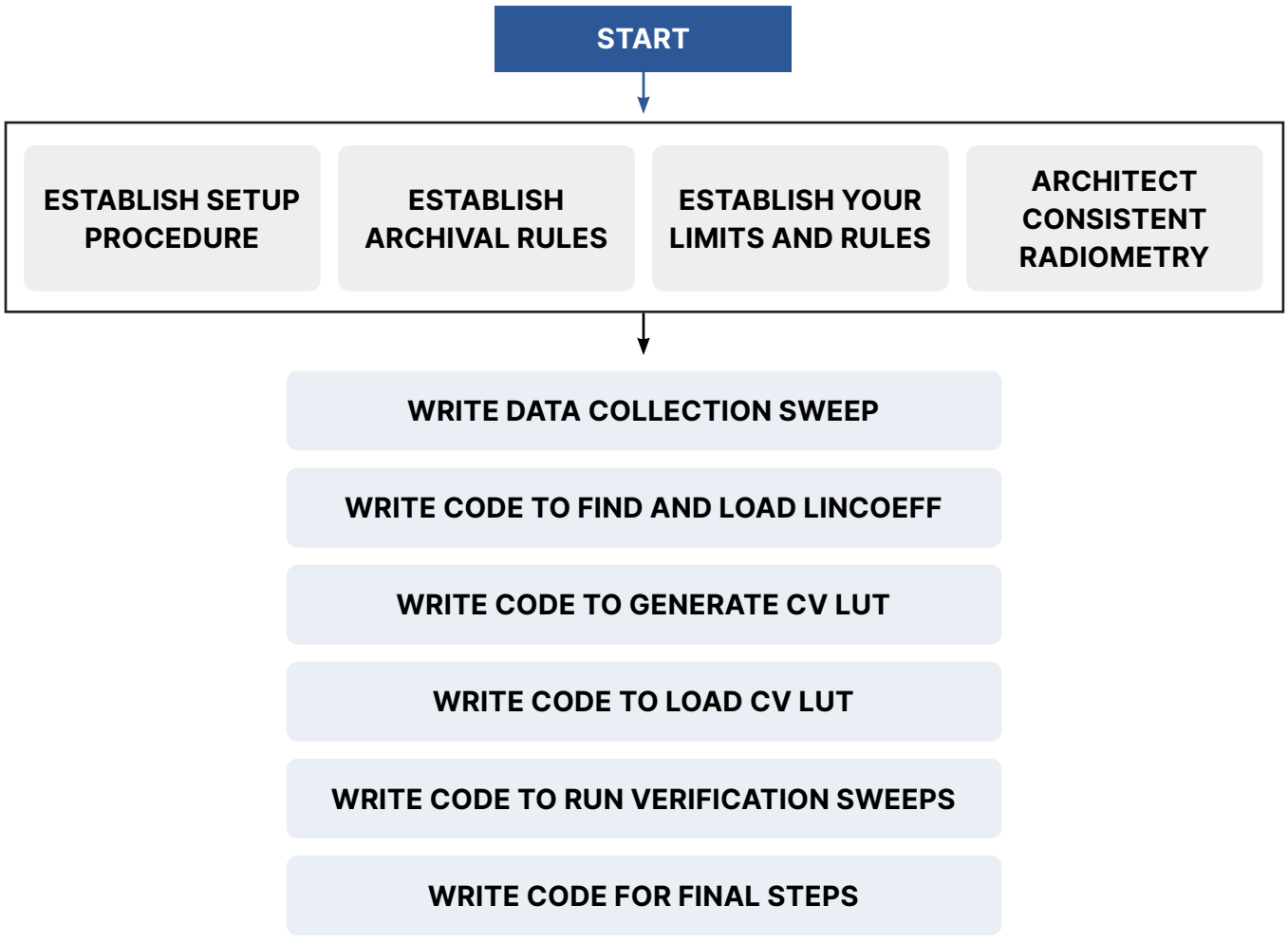
EXACT INTENSITY CONTROL	Users can set dimmer ranges from 1–100%, with predictable steps and defined upper and lower limits. This ensures a precise starting point for every experiment or inspection.
LINEARIZATION FOR ACCURACY	Talon balances two measurement approaches—radiometric (camera-based) and photopic (human eye perception). While 50% intensity may not look like 50% to the eye, calibration ensures the camera sees it correctly, delivering scientifically accurate results.
THERMAL AND SAFETY MANAGEMENT	Parameters govern when the system shuts down due to overheating, when fans activate, and whether cooling prioritizes speed or low noise. These safeguards protect hardware and maintain stability.
CONNECTIVITY AND INTEGRATION	Talon supports multiple interfaces—USB, Ethernet, RS232—plus IP addressing options, making it easy to integrate into complex OEM systems.
USER INTERACTION AND RESPONSIVENESS	Even button behavior is configurable: Should intensity increase in 1% increments, 10%, or accelerate as you hold the button? These details matter for usability and workflow efficiency.

This level of configurability isn't overkill. It makes Talon adaptable to a wide range of environments. By giving users control over every critical parameter, Talon ensures performance that's not just precise but perfectly aligned with your application.

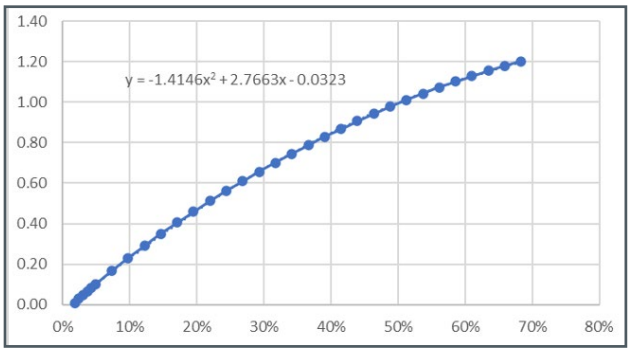
The Technical Foundation: How Talon Calibration Works

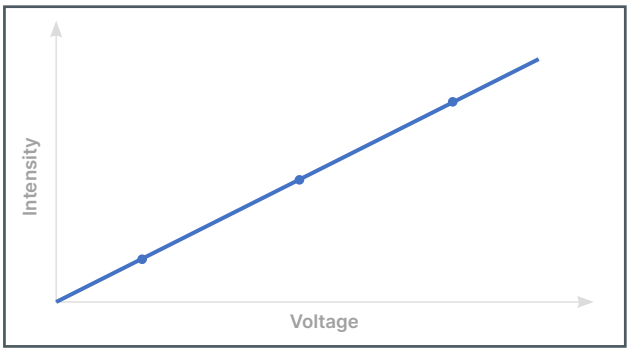
Talon's calibration system is built for both precision and ease of use. The platform supports two main operating modes—Constant Current (CC) and Constant Value (CV)—each with its own calibration data. Calibration begins with a "sweep," where the system methodically steps through intensity settings while measuring radiometric output and other key parameters.

In CC mode, Talon uses a set of quadratic coefficients to create a linear, predictable relationship between commanded intensity and actual light output. In CV mode, a Look-Up Table (LUT) enables ultra-fast pulsing by mapping voltage settings to desired intensities.



CC Calibration vs CV Calibration





CONSTANT CURRENT (CC) MODE

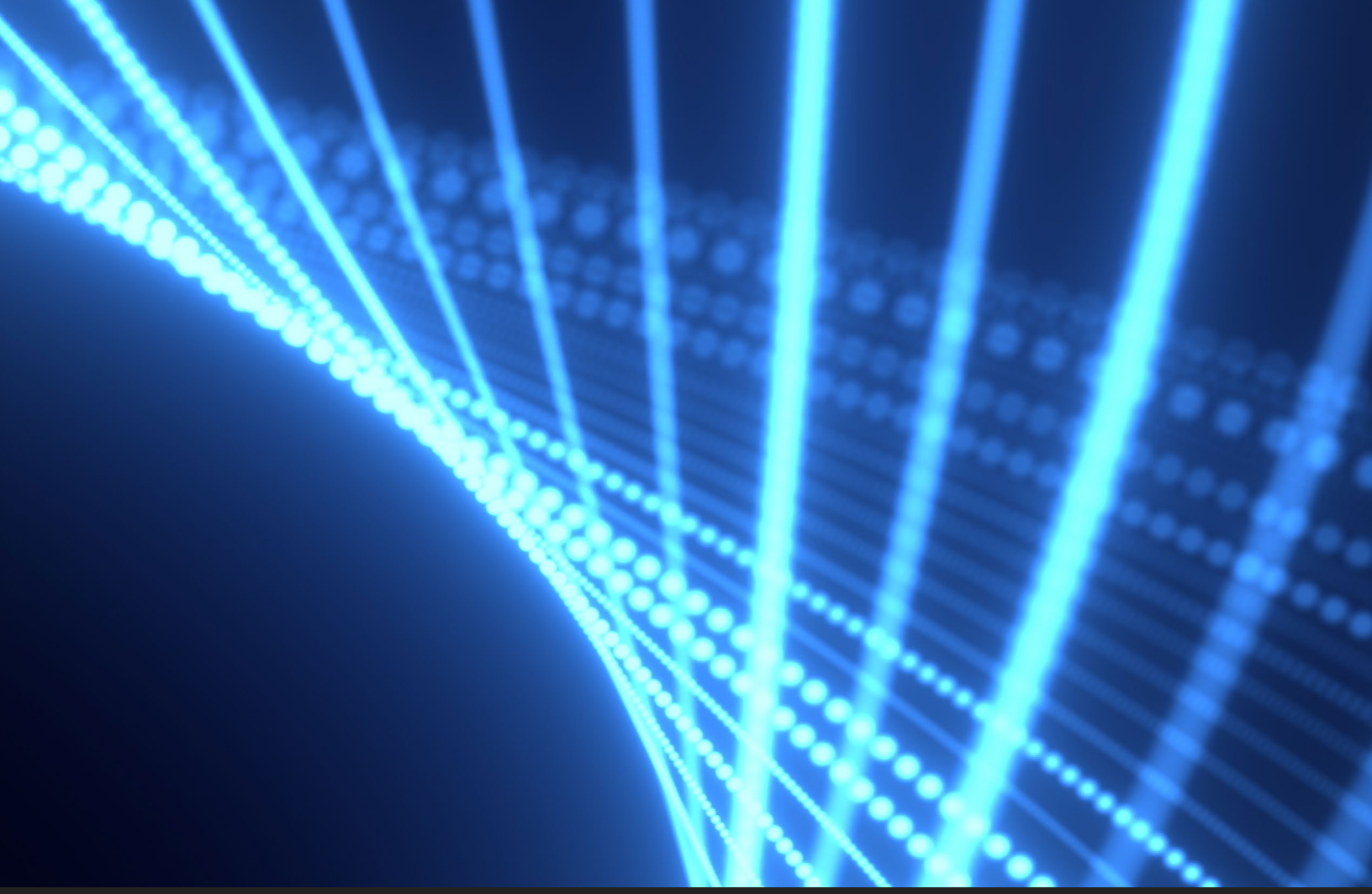
The traditional operating mode for high-precision illumination, used whenever high-speed pulsing is not required. In CC mode, Talon's calibration process establishes a linear relationship between the commanded intensity and the actual radiometric output. By performing a calibration sweep, collecting data across the device's operating range, and fitting a quadratic equation to the results, CC Calibration ensures that every intensity setting delivers predictable, accurate light output.

CONSTANT VALUE (CV) MODE

Designed for applications that require ultra-fast pulsing, where the system must respond more quickly than traditional current control allows. In CV mode, Talon uses a Look-Up Table (LUT) to map each desired intensity to a specific voltage setting. Calibration in CV mode involves generating this LUT by aligning voltage values with the radiometric output measured during the calibration sweeps.

Best Practices and Practical Guidance

TO GET THE MOST FROM TALON'S CALIBRATION FEATURES, FOLLOW THESE BEST PRACTICES:
Recalibrate whenever hardware is changed, after significant use (e.g., every 10,000 hours), or if environmental conditions shift.
Archive calibration data, including device serial numbers, firmware versions, and environmental parameters, for traceability and compliance.
Use verification sweeps to confirm calibration accuracy and monitor for drift over time.
Take advantage of Talon's flexible configuration options—such as adjustable parameters, fault detection, and drift monitoring—to tailor performance to your specific needs.
For regulated applications, periodic recalibration and documentation are essential for maintaining compliance and ensuring consistent results.



Partnering with TechniQuip

Choosing Talon means more than just acquiring advanced hardware—it means gaining a partner committed to your success. TechniQuip works closely with OEMs and end-users to configure each system for its intended application, providing technical support, code examples, and guidance throughout integration.

Need help with calibration, custom firmware, or adapting Talon to a unique workflow? TechniQuip's team is ready to assist.

This collaborative approach ensures you get the most from your investment, with a solution that evolves alongside your needs and delivers lasting value.

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Designed and built in Pleasanton, CA