TRENTON SYSTEMS

THERMAL MARGINING METHODOLOGY

in Embedded Computing

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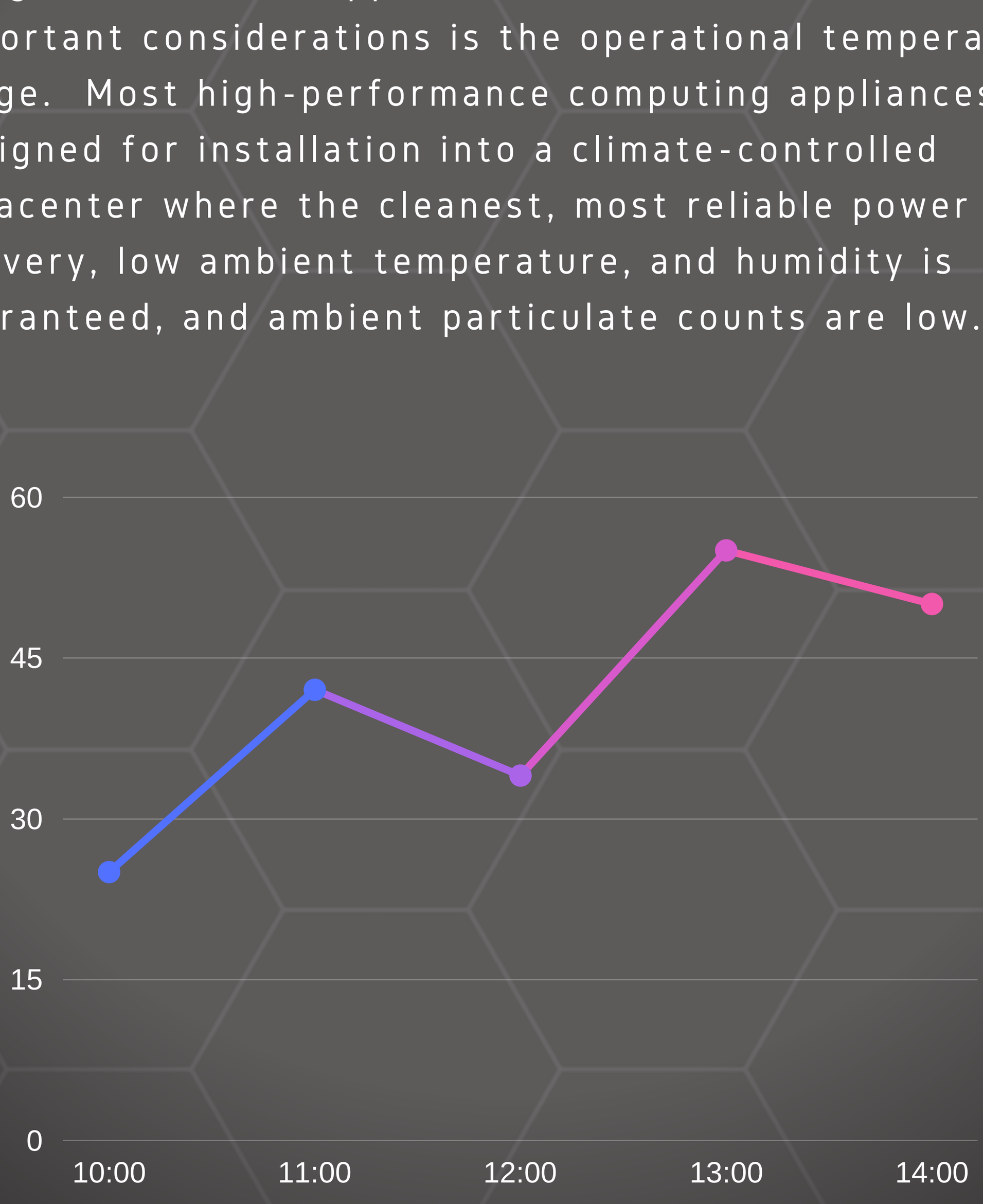
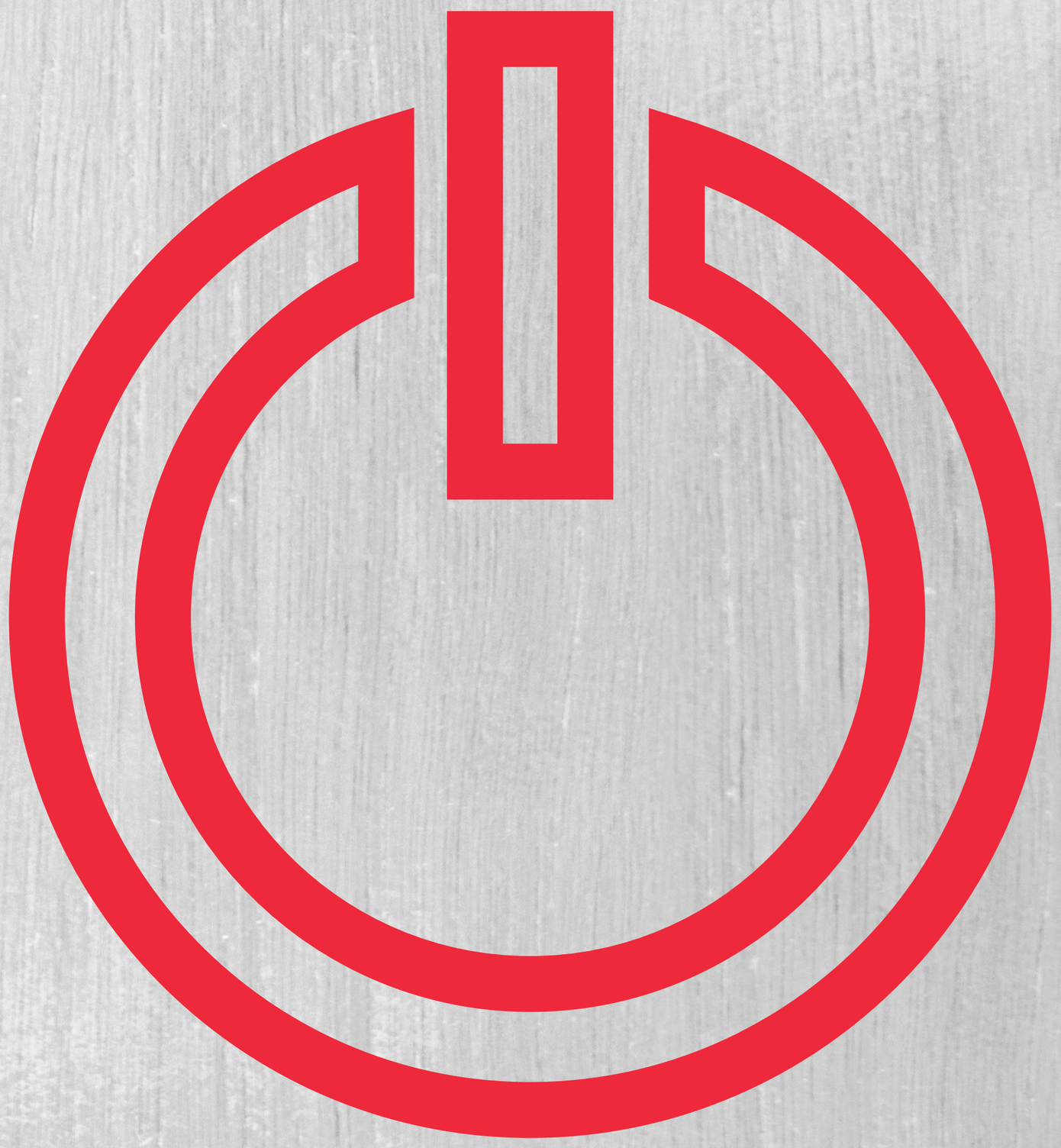
OCTOBER 2, 2017

OPERATIONAL TEMPERATURE RANGE

When reviewing a computing component's suitability for integration into an application, one of the most important considerations is the operational temperature range. Most high-performance computing appliances are designed for installation into a climate-controlled datacenter where the cleanest, most reliable power delivery, low ambient temperature, and humidity is guaranteed, and ambient particulate counts are low.





THERMAL DESIGN POWER

Some of the most powerful, modern server-class Xeon CPUs can even reach 125w of TDP (Thermal Design Power). When designing a multi-processor system, that amount of temperature adds up fast. A well-designed and properly validated computing product acceptable for use in long-life and mission-critical systems will have been extensively tested, with all variables accounted for, and at stress levels beyond what can be applied to a component by the end consumer at the widest range of temperatures possible.

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How should a product be evaluated by designers to confirm safe operating margin for use in mission-critical and long-life applications?

let's find out...

EXCEED

REAL WORLD

OPERATIONAL NORMS

Trenton Systems, an Intel® IoT Solutions Alliance member, utilizes the Power Thermal Utility provided by Intel to fully stress our board designs, beyond what conceivable real-world power draw will be by the components on the board and determine the widest safe operating temperature range for our products possible while still maintaining our legendary reliability and long product life.

TRENTON SYSTEMS'

In-House Thermal Facilities

Trenton Systems also has in-house thermal facilities which allows a thorough, controlled manipulation of the environment in which our boards are tested, in both temperature and humidity. This ultimately means that the temperature and humidity ratings that we certify our boards to is not an estimation, the result of a simulation or simply the least common denominator in a Bill of Materials—it represents what decades of Engineering best practice on top of empirical data about the thermal performance of a design indicate is the "sweet spot" to maximize:

PERFORMANCE
LONGEVITY
OPERATING TEMPERATURE RANGE
EMISSIONS COMPLIANCE
SAFE OPERATION

Whereas other vendors may simply have a "designed to meet" temperature, Trenton Systems products offer the confidence of a validated and margined temperature and humidity rating that we stand behind with our standard 5 year warranty.

THERMAL VALIDATION METHODOLOGY

Trenton's Thermal Validation methodology starts before a board design ever begins. We know that our boards are deployed to some of the most mission-critical applications, in some of the harshest environments possible, so we always choose ruggedized and extended temperature range components where possible when designing a product. Once we have release candidate product, the testing and validation phase involves a comprehensive review of heat-sensitive components in a design, a collaboration between Test and Design Engineering, to determine what components of a design need to be monitored during testing.

At that point, thermal probes are painstakingly affixed onto each vulnerable component.

Often, this can involve more than 50 independent component temperature readings. Then, the board is fully stressed at a range of temperatures until component failure occurs.

MAJOR COMPONENTS WHICH ARE ROUTINELY TESTED INCLUDE:

PROCESSOR(S)

PLATFORM CONTROLLER HUB (PCH)

ETHERNET CONTROLLER(S) (PHY)

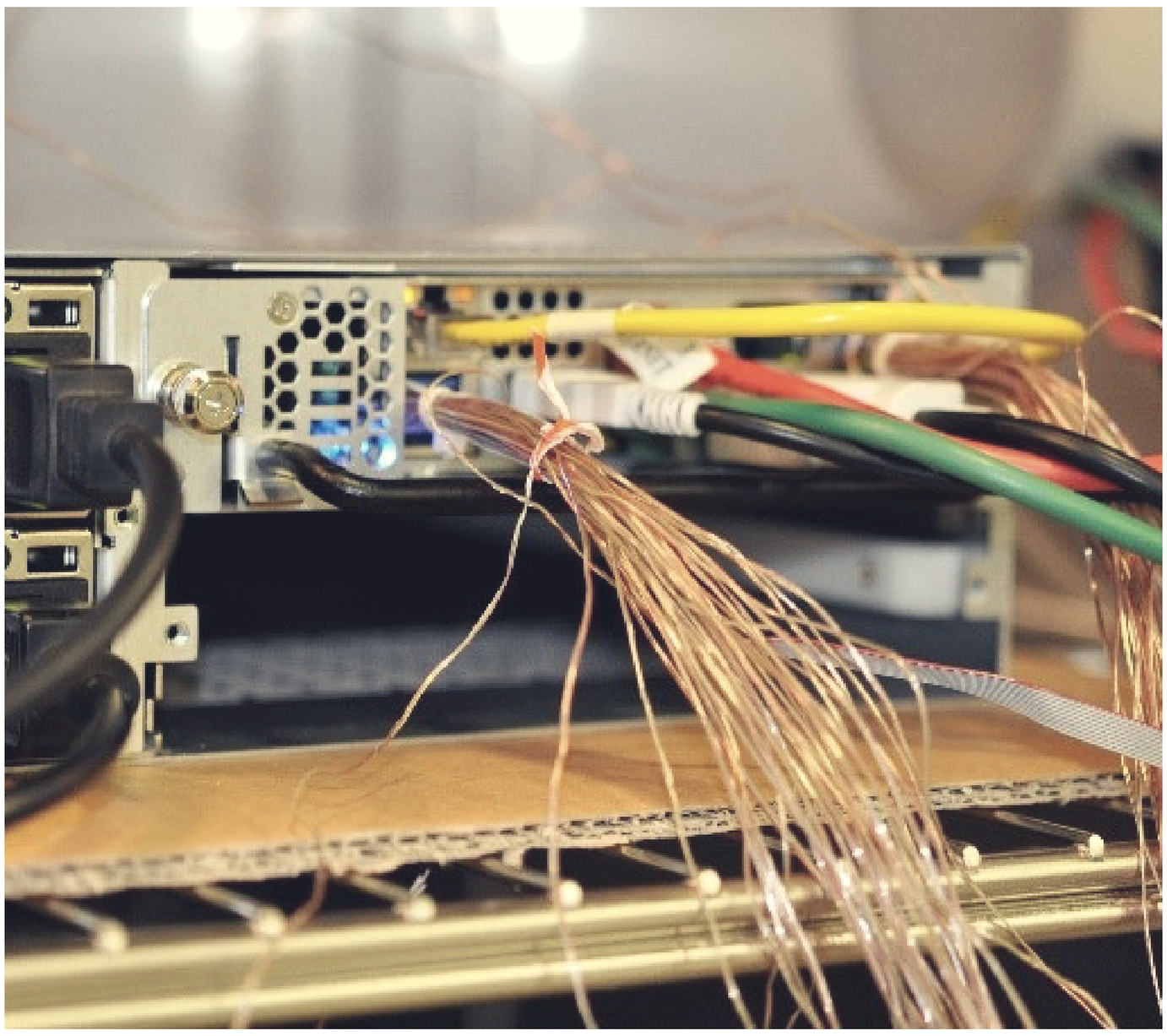
BASEBAND MANAGEMENT CONTROLLER (BMS)

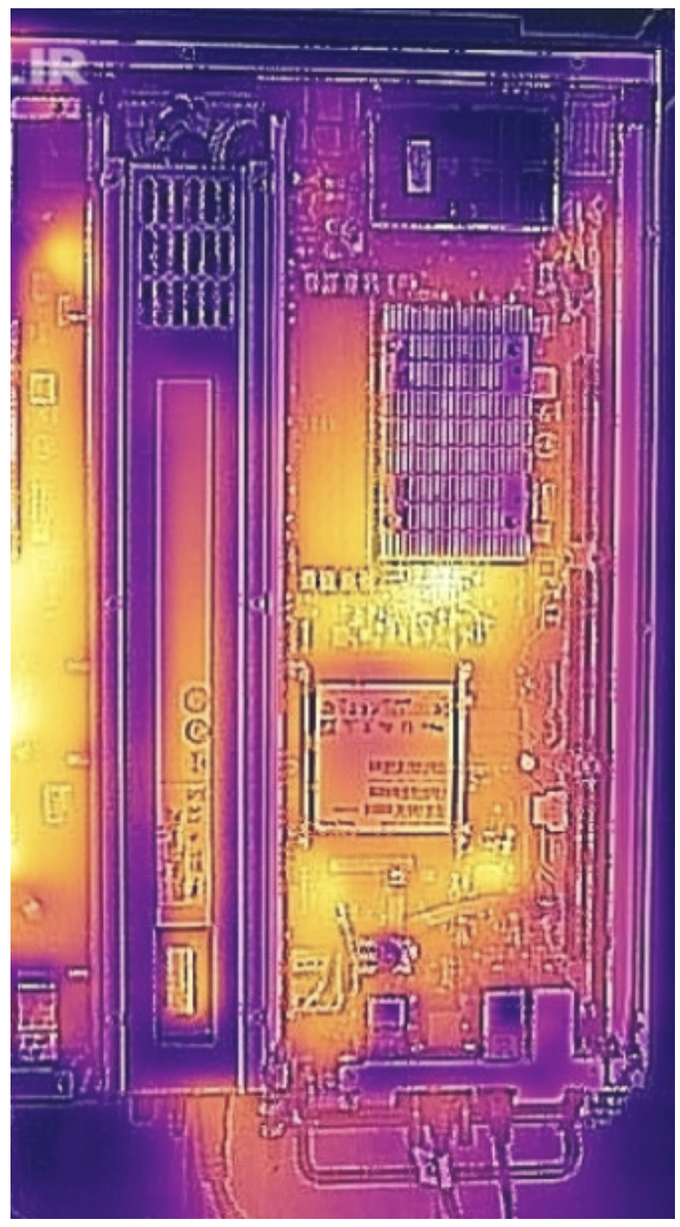
VOLTAGE REGULATOR(S) (VRM)

OTHER TEMPERATURE SENSITIVE COMPONENTS

We then analyze this data to determine to what temperature we can safely rate our products.

Surprisingly, often, it is not the components that have heatsinks which are the limiting factor in an operational temperature rating, but rather, the smaller lower-power components, as they are more susceptible to heat soak.





A CAPITAL COMMITMENT TO QUALITY AND ASSURANCE

Trenton Systems uses numerous Thermal Probes which are affixed to the components of concern.

We then set up a Validation Run in the Thermal Chamber for testing.

LEVERAGE OUR EXPERIENCE AND DEDICATION

Only then will our Engineers determine what a safe operational temperature rating a product is deserving of.

Generally, our goal is to design products that are capable of operation up to 50° Centigrade.

Occasionally, operational realities force us to de-rate in specific conditions, but we always attempt to validate to the widest possible temperature range so that you can confidently deploy a Trenton System to the harshest environments with the knowledge it is up to the challenge.

01 AIRFLOW
350LFM continuous airflow

02 STORAGE TEMPERATURE
-40° to 70° C

03 OPERATING TEMPERATURE
0° to 50° C

04 HUMIDITY
5% to 90% non-condensing

TRENTON SYSTEMS®

Trenton Systems has the electrical design and validation expertise and obsolescence management processes necessary to become your trusted partner in long-lifecycle, mission-critical, revision-controlled computers and components destined for demanding environments.

If you need to deploy computing resources where other manufacturer's parts just can't go, give us a call and speak to one of our Atlanta, Georgia-based Engineers about one of our COTS solutions, or, designing or specifying a solution to meet your exact needs.

TALK TO US

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