CAVU AEROSPACE

Hi-Power RT THERMAL CONTROL UNIT

100 krad TID | **86 MeV·cm²/mg SEE** | **110 Sensor Input** | **48- Heater Channel**

50-100V Input | **5,000W** | **1-7A Heater Channels** | **HiPer-D Glenair**

Hi-Power RT TCU combines high-channel-count temperature acquisition, closed-loop heater control, and housekeeping monitoring in a compact two-board assembly built entirely from qualified space-grade components. The TCU-RT supports multiple sensor technologies — thermistors, RTDs, and IC temp. sensors — through a per-section configurable analog front end, allowing a single product to serve a wide range of mission thermal architectures.

Radiation tolerant to 100 krad TID & 86 MeV·cm²/mg SEE.

Variations: Std. TCU, TCU-L, TCU-Max, TCU-Linear.

KEY FEATURES

- Up to ~110 temperature sensor inputs (128 muxed slots provisioned)
- 48 independently controllable PWM heater outputs
- Per-section configurable analog front end: NTC thermistor, RTD, and IC temperature sensor channels
- 14-bit precision temperature acquisition (SAR-only)
- Dual redundant acquisition fault domains with cross-strapped spare inputs
- Arm Cortex-M4 rad-hard controller with latch-up-immune technology
- MRAM-based non-volatile store for RAM, ROM, and boot (embedded ECC)
- CAN-FD and RS-422 command/telemetry interfaces; 10/100 Eth. via a Microchip rad-certified Eth. PHY
- 100 V bus variants

ELECTRICAL SPEC.

Temperature sensor inputs:	110 (128 muxed slots available)
Supported sensor types:	NTC thermistor, RTD, and IC temperature sensor
Precision resolution:	14-bit (SAR)
Reading accuracy:	±0.5 °C
Setpoint range:	2 °C to 100 °C (mission-configurable)
Control deadband:	±0.1 °C
High-temp. sensor: support	Mission-configurable RTD-based implementation; thermocouple support available only through custom front-end
PWM heater outputs:	48 independent 1A channels
Monitoring / OCP:	12-bit housekeeping and current-sense acquisition per board
Command / telemetry:	CAN-FD, RS-422
Network:	10/100 Ethernet via a radiation-certified Ethernet PHY
Bus voltage variants:	100 V

MICROCHIP Authorized Design Partner

ACQUISITION AND CONTROL

- The temperature acquisition chain uses two 14-bit SAR converters split into independent fault domains and expanded through four radiation-hardened analog multiplexers. Bank outputs are cross-strapped into spare converter inputs, so the unit continues operating in degraded mode after a single converter fault.
- RTD channels use ratio-metric excitation with multiplexer resistance held out of the reference path. A separate 12-bit converter handles housekeeping monitoring and over-current protection.
- The PWM expansion and heater-bank safety logic are implemented independently of the main controller software, supporting deterministic heater-off behaviour under reset, watchdog timeout, or invalid command conditions.
- Heater control is provided by the rad-hard controller's native timers augmented by a radiation-tolerant non-volatile FPGA sequencer. The sequencer provides PWM expansion, watchdog-gated enable, protected update logic, heater-bank interlocks, and deterministic heater-off safe-state behaviour, driving 48 rad-hard FET power stages on the heater-driver board with per-channel current sensing.
- The acquisition chain is SAR-only. Thermocouple and µV-level sensor support is not part of the standard product and is provided only as a custom sensor front-end under mission-specific NRE.

BUDGET, Env. & Rad.

- Configuration: Two-board assembly (control/acquisition + heater driver)
- Envelope: 200 × 180 × 45 mm
- Mass: 1,740 g
- Power consumption: 4–6 W (control electronics, excluding heater load)
- Operating temperature: −40 °C to +85 °C
- Radiation: 100 krad
  SEE-immune 86 MeV·cm^2/mg

INTERFACES

- **Sensor**: multi-connector interface supporting ~110 sensor inputs
  NTC / RTD / IC temperature sensor channels
- **Heater**: 48 PWM heater output channels with current sensing
- **Command/telemetry**: CAN-FD and RS-422 (Optional 1553)
- **Network**: 10/100 Ethernet via a radiation-certified Ethernet PHY
- **Power**: 100 V bus input (variant-dependent)

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