

Intelligent Thermal Management System (iTMS™)

Aavid, Thermal Division of Boyd Corporation offers engineering design, development, validation/qualification testing, and manufacturing of custom, self-contained Intelligent Thermal Management Systems (iTMS). An example iTMS is shown in Figure 1. Using our Ruggedized Liquid Cooling Systems (rLCS) as a foundation, additional sensors, electronics, and logic controllers are added to create a plug and play, intelligent “life support system” that provides precise thermal control of thermally sensitive electronic hardware.

Key features may include, but are not limited to:

- ▶ Sub Ambient Cooling
- ▶ PID temperature control
- ▶ Conditioning heaters to facilitate rapid “cold start”
- ▶ Liquid level sensors
- ▶ Fault Tolerance/Safety flow switch provides visual and electrical confirmation of coolant flow
- ▶ PLC control of pumps, heaters, valves, etc.
- ▶ LED status indicators
- ▶ Data logging
- ▶ Color touchscreen display/interface panel
- ▶ Shock Mounted for Vibration Isolation

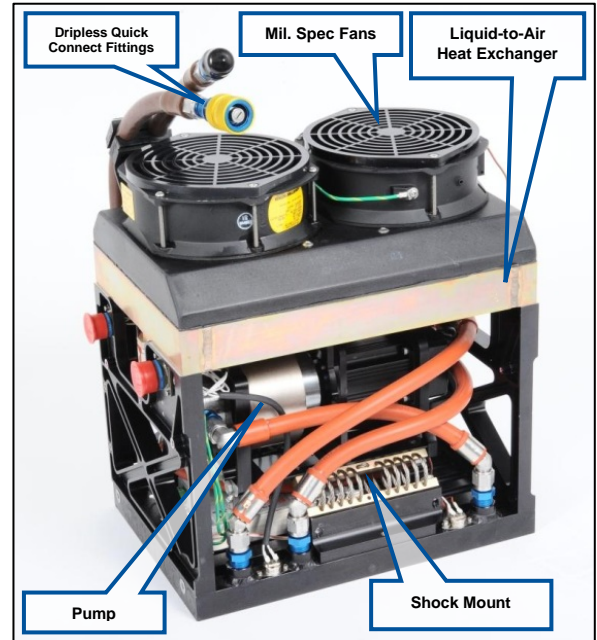


Figure 1 – iTMS for Rugged UAV Computer

Key Benefits

- ▶ Precise Temperature Control for Optimum Electronics Cooling for Reliability and Long Life
- ▶ Integrated control system allows reduction or elimination of electronics in next level assembly
- ▶ Energy consumption is reduced by actively adjusting pump speed, fan speed, and other operating components only when needed
- ▶ Reliability is increased
 - Pumps can't run dry
 - Components won't operate outside of their operating temperature range
 - Live switching between redundant pumps provides automatic recovery from single pump malfunction
- ▶ Vital system information can be communicated to higher level electronics via industry standard interfaces
- ▶ Flexibility
 - Pick and choose what features are needed
 - Specify what parameters need to be monitored
 - Chassis can be COTS, modified COTS, or completely custom
- ▶ Designs can be ruggedized for MIL-STD-810, MIL-STD-461E, VITA 58 requirements or customized for applications such as military aircraft, ground vehicles, and commercial aircraft.
- ▶ FEA Analysis to assure structural performance (reference Figure 2.)

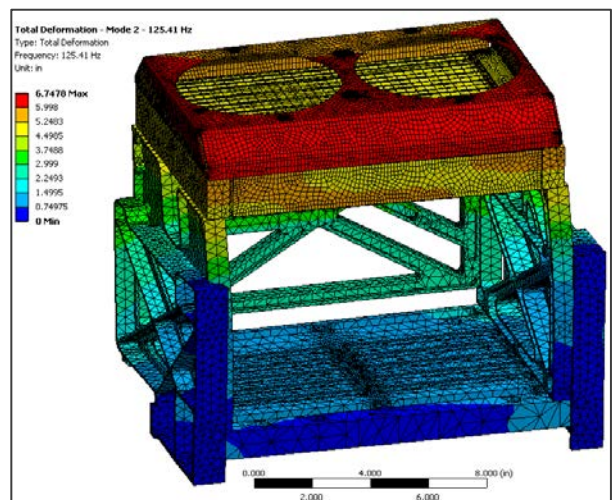


Figure 2 – FEA Analysis of iTMS for Structural Integrity



Figure 3 – Example 14U Airborne iTMS



Figure 4 – iTMS Heat Pipe Cold Plate Subsystem

Critical Application Needs

- ▶ Embedded Computing Applications
 - Unmanned Vehicles (UAVs, UGVs, USVs)
 - Military /National Security (Airborne and Ground),
 - Oil & Gas/Seismic Processing,
 - Medical Diagnostic and Imaging Equipment
 - Test Equipment
 - Scientific & Academic Research
- ▶ Harsh, Rugged Environment Computer Cooling
- ▶ Signal, Image, Mapping, and Radar Processing Applications
- ▶ Microwave/RF, Power Electronics, Military Radars, Power Converters, Laser Diodes Cooling
- ▶ VITA Standards Include: OpenVPX, VME, VXS

Options – Intelligent Thermal Management System (iTMS)	
Power / Heat Load (kilowatts)	0.1kW to 20kW+ typical
Heat Pumping Technology (sub ambient systems only)	Vapor Compression or Thermoelectric Chillers (COP 1.0 typical)
Cold Plate Technology	Vacuum Brazed, Dip Brazed, or Tube-in-Plate
Heat Exchanger	Aluminum or Stainless Custom or COTS, as needed
Pump	Centrifugal or Positive Displacement Up to 50,000 MTBF Redundancy if needed
Fluid Interconnects	Aerospace grade AN hoses Aluminum/Stainless lines with compression fittings
Reservoir	COTS or custom, as needed
Coolant Level Sensing	<ul style="list-style-type: none"> • Electro-optic point level sensor (typical) • Continuous level capacitive • Ultrasonic
Thermostatic Control Valve	Passive wax cartridge style or servo operated
Communication Interfaces	RS282, RS485, RS422, Ethernet (TCP/IP Supported)
Control	-PID Temperature Control -PLC control of system function
Coolant	Ethylene Glycol/Water, PAO, De-ionized water, Fluorinert™ or per specification
Temperature Control Precision	+/- 0.5°C or better
Typical System Operating Voltage	12-28 VDC
Typical Input Voltage	28VDC, 120/240VAC, or as specified. If needed, voltage spikes IAW MIL-SPEC-1399
Maximum Operating Temperature	65°C
Minimum Operating temperature	Governed by Coolant/Fluid
Storage Temperature Range	-55°C to +71°C (fluid dependent)
Maximum Operating Altitude	75,000 feet
Maximum Shock (operating/non-operating)	40G / 75G

Other Related Technologies

- ▶ Liquid Cooled Cold Plates
- ▶ Ruggedized Liquid Cooling System (rLCS)