

Embedded Tech Trends 2013: “Embedded Technologies in Action”

VITA 74 Small Form Factor Systems

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VITA 74 Small Form Factor Systems

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Who is CES?

CES is a designer and manufacturer of complex high-performance electronic boards, subsystems and systems for a specialized segment of the embedded computing market...

- Over 30 years of experience
 - Founded in 1981 in Geneva, Switzerland
 - Initial contract for CERN (European Organization for Nuclear Research)
- Markets
 - Aerospace and defense (core business)
 - Telecommunications
 - Physics
- COTS product lines
 - Single board computers, signal processing, video, small form factor
- Standard and custom systems
- World-wide locations
 - CES Headquarters: Geneva, Switzerland
 - CES-D: Ulm, Germany
 - CES-GB: London, England
 - CES-Spain: Madrid, Spain
 - CES-West: Salt Lake City, Utah, USA
 - CES-CAL: Morgan Hill, California, USA



VITA 74 Standard (SFF)



VITA 74 Standard (SFF)

The story behind VITA 74

- The user community need
 - Standards-based approach for small conduction-cooled systems
 - SWaP critical applications:
 - Aerospace*
 - Unmanned vehicles*
 - Man-wearable systems*
 - Robotics*
 - Oil and gas, mining*
 - Law enforcement*
 - Transport systems*

- The inspiration
 - COM standards including nanoETXexpress miniature CPU modules
 - VITA standards for VPX, OpenVPX, XMC and FMC
 - The need for a smaller size but similar price-point compared to PC/104

- The goal
 - Boards the size of a credit card
 - Stand-alone computers the size of a deck of cards
 - Systems the size of a Rubik's Cube



VITA 74 Standard (SFF)

The story behind VITA 74 - results

- A standards-based small form factor ecosystem and infrastructure
 - VITA 74 Committee established by VITA Standards Organization (VSO) in early 2010
 - The VITA 74 Committee has significant involvement from several merchant board manufacturers, system integrators and defense primes
- A standard that draws upon existing standards reduces risk and schedule
 - Signaling similar to VITA 46 (VPX) and VITA 65 (OpenVPX)
 - Adopts the VITA 57 (FMC) connector
 - Uses VITA 42 (XMC) FRU inventory records for discovery over IPMI
 - Can accommodate the PICMG COM Express nanoETXexpress card (the original NanoPAK)
- Specification scope
 - 12.5mm and 19mm modules
 - Backplane-based (NanoATR) and stand-alone (NanoPAK) module versions

VITA 74 Standard (SFF)

Industry drive to reduce Size, Weight and Power - and Cost (SWaP-C)

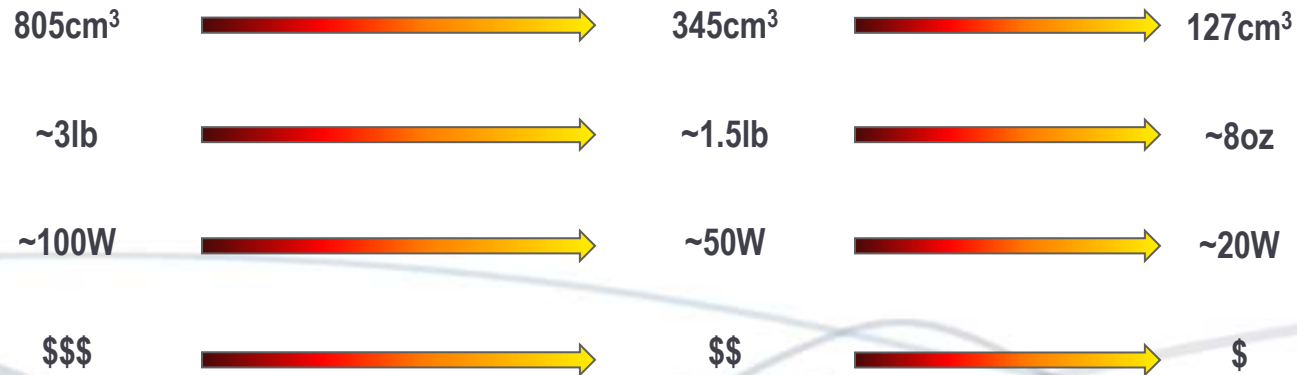
6U
(VPX, VME)
233mm x 170mm x 20mm



3U
(VPX, VME)
100mm x 170mm x 20mm



VITA 74
(NanoATR)
87mm x 77mm x 19mm



VITA 74 Standard (SFF)

Committee members and participating companies

VITA 74 participating committee members:

- Creative Electronic Systems
- Themis Computer
- Samtec
- Elma Bustronics
- Molex
- Acromag
- Curtiss Wright (observer)
- Lockheed Martin
- VITA
- X-Embedded



Other companies active in VITA 74 projects:

- Colorado Engineering Inc.
- VectorNav
- Alphi Technologies
- Pentek
- Techsource
- Rockwell Collins
- MILCOTS
- Neuro Logic Systems



VITA 74 Standard (SFF)

NanoATR and NanoPAK

- NanoATR

- Backplane-based module
- Used in multiple module enclosures
- Or single module rugged enclosures



- NanoPAK

- Stand-alone computer module
- Cable I/O connector included

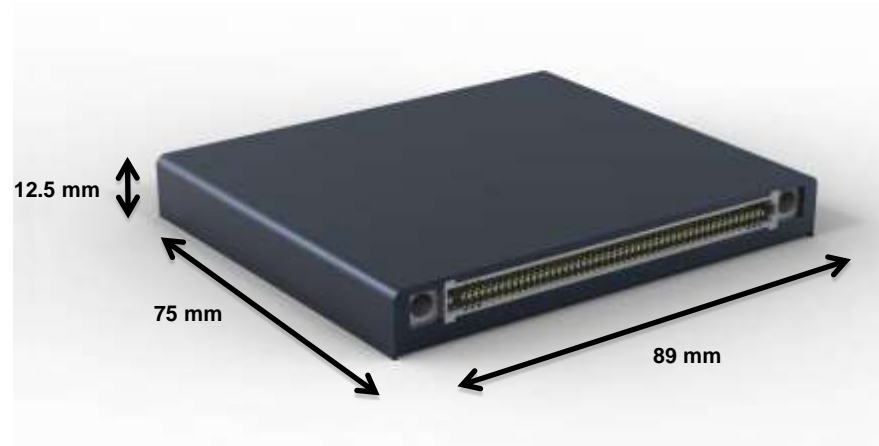


VITA 74 Standard (SFF)

Modules

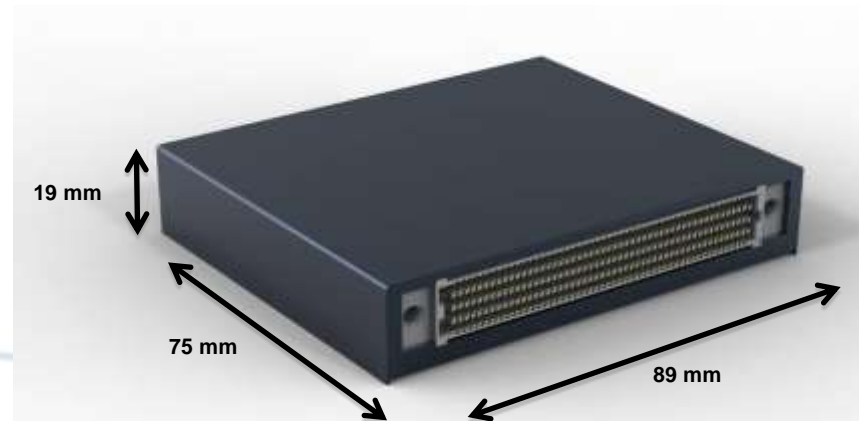
- 12.5mm module

- Single base card only
- 4 row connector (200 pins)
- Backplane pins for locating / ESD
- Applications are mainly peripherals:
 - I/O*
 - GPS / IMU*
 - Storage*



- 19mm module

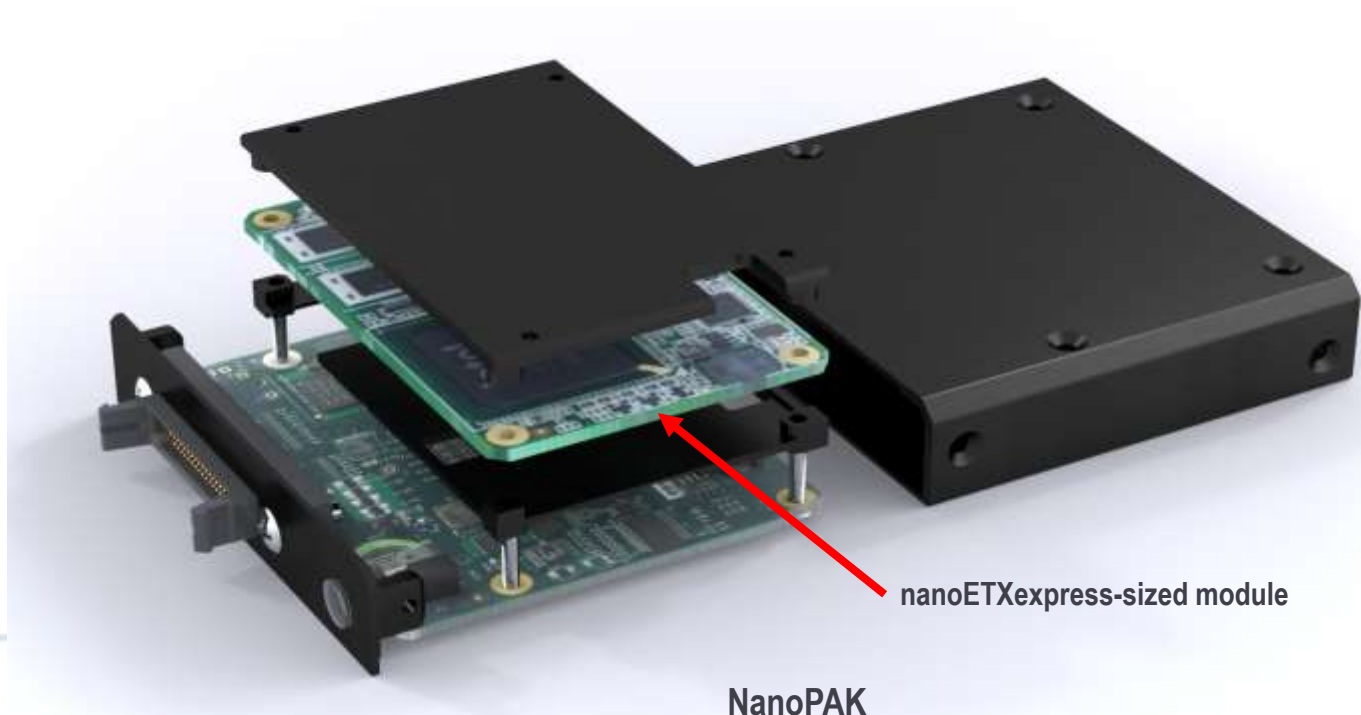
- Base card plus nanoETXexpress-sized mezzanine card
- 8 row connector (400 pins)
- Backplane pins for locating / ESD
- Applications:
 - Single board computer*
 - Software defined radio*
 - Graphics/video*
 - FPGA*



VITA 74 Standard (SFF)

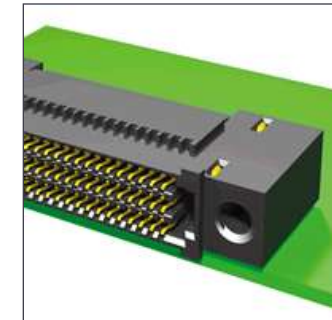
Robust thermal management design

- Conduction cooling path from chip to heatsink
 - Chip to profiled spreader (skyline interface)
 - Spreader to case
- Module provides heat spreading on 3 sides



VITA 74 Standard (SFF)

Backplane connector (NanoATR)



- Samtec SEARAY series
 - As qualified in VITA 57 (FPGA mezzanine card)
 - High density: 4 or 8 rows, 200 or 400 pins, with 1.27mm pitch
 - High speed: up to 11 Gb/s with 3 dB loss
 - Straight or right angle
 - Shock 100G @ 6 msec

- Connector partitioning similar to VPX
 - S0 utility plane: similar to VPX (power, control, clocks, management)
 - S1 fabric: currently PCI Express Gen 1 or 2, up to 16 lanes
 - S2 user I/O: 18 differential, 36 single-ended in a full ground grid

- Enhanced connector locating and ESD protection
 - Provided with separate locator pin/receptacle similar to VPX

S0

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S1

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S2

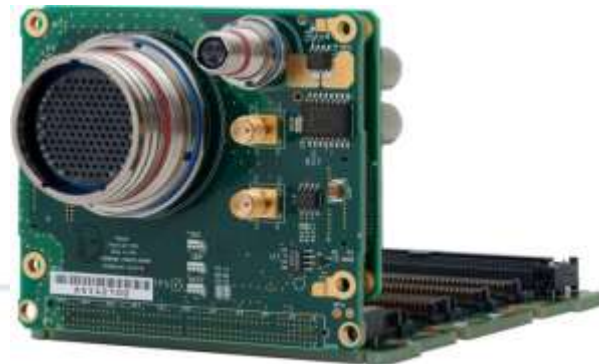
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VITA 74 Standard (SFF)

Reference chassis, backplane and I/O transition panel

- Themis cube

- 2x 19mm VITA 74 modules
- 2x 12.5mm VITA 74 modules
- 1x rear SSD storage module
- Circular MIL (“Mighty Mouse”) and SMA RF connectors
- Slot utilization example:
 - SBC*
 - Video frame grabber*
 - IMU / SAASM / GPS*
 - MIL-STD-1553 or discrete I/O*
- Operating Temp: -40°C to +71°C
- Power consumption: up to 85W
- Weight: 2 kg (typical)



VITA 74 Standard (SFF)

Specification structure

- VITA 74.0 NanoATR base specification
 - NanoATR module
 - Signal definitions
 - Power
 - Module and system requirements
- VITA 74.1 NanoPAK
 - Covers features specific to the NanoPAK module standard
- VITA 74.2 NanoATR rear transition module
 - Development RTM standard
 - Allows module user I/O to be brought out to commercial connectors
 - Promotes standard development platforms and backplanes
- VITA 74.3 NanoATR CPU module
 - An optional standard I/O pinout to allow ease of interchangeability and technology insertion for CPU modules

VITA 74 Applications



VITA 74 Applications

Nano application examples

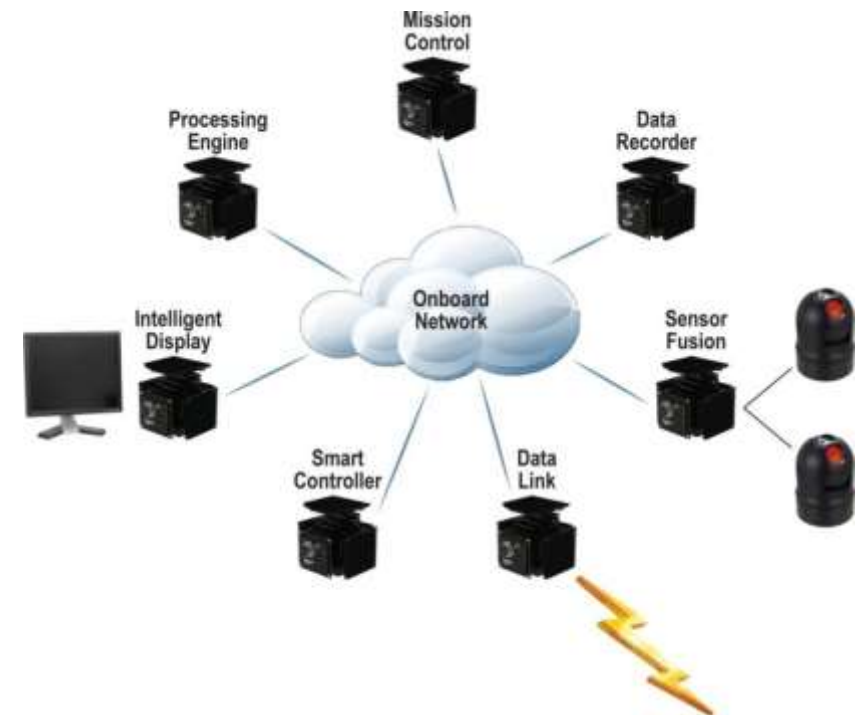
- VITA 74 SBC as CPU for smart displays
 - NanoPAK / NanoATR + dumb display = smart display
 - Easy technology refresh
- NanoPAK as man wearable computer for soldier and industrial use
 - Wrist or kneeboard display and keyboard
 - Monocle display
- NanoPAK or NanoATR as industrial computer
 - Replace shoebox-sized ETX applications
 - Oil and gas, mining, and other rugged applications
 - Trucks and fleet vehicles
- NanoPAK or NanoATR as unmanned vehicle or payload control
- Avionics



VITA 74 Applications - Case Study: Avionics

Benefits of VITA 74 for the avionics market - decentralization

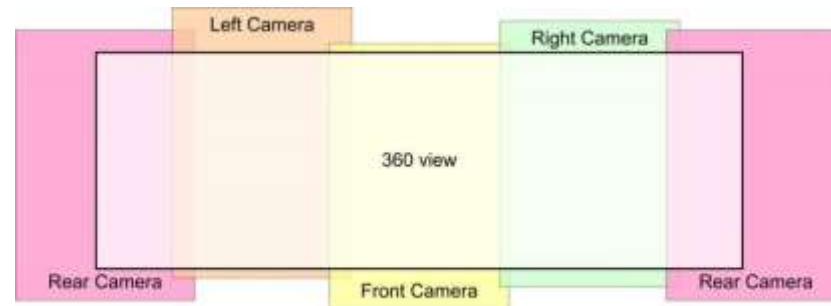
- Decentralization drivers
 - Reduce cost, especially in certification
 - Increase reliability
- Decentralization enablers
 - Reduced SWaP of VITA 74 systems
 - High-speed interconnects to enable the physical separation of functions
 - Standard interfaces to simplify integration
- Decentralization benefits
 - Multiple smaller boxes provide functional redundancy and segregation
 - Control electronics can be placed close to actuators and sensors
 - Critical analog signal lengths are reduced
 - Leads to more generic processing
 - Localized sensor fusion and decentralized control reduces cabling
 - Reduced criticality of individual units
 - Reduction in certification costs



VITA 74 Applications - Case Study: Avionics

Typical avionics applications

- Video processing functions
 - 360° video acquisition
 - Sensor fusion
 - Digital maps
 - Target recognition, tracking
 - Digital video recorder
 - Intelligent displays, video over Ethernet
 - Video compression / decompression
 - Video selector / tiling video
- Mission control and processing
- Distributed I/O and control electronics
- Data link and network processing



VITA 74 Applications - Case Study: Avionics

Typical avionics VITA 74 module requirements

- **PowerPC® processor modules**
 - Ideal: Freescale QorIQ P1 or P2 multicore system on chip
- **Video processor modules**
 - HD H.264 Compression: CES VIP-7412
- **Intelligent avionic I/O module(s)**
 - MIL-1553B, ARINC-429, RS-422
 - +28V isolated discrete I/Os
 - Analog I/Os
 - AFDX® for critical control, GETH for video and maintenance
- **Real-time operating system**
 - VxWorks® (653), Integrity®, etc.
 - Linux® if not critical
- **Safety-critical option**
 - DO-254 and DO-178B/C up to DAL-A
- **Other requirements**
 - Open standard, COTS solution to reduce cost
 - Weight of the system is critical
 - Conduction-cooled, sealed box, vibration-resistant
 - +28 VDC power supply, EMI/EMC protection



Conclusion



Conclusion

VITA 74 and Nano systems summary

- Standards-based path to SFF systems
- Includes a stand-alone module (NanoPAK) and a scalable multi-module system (NanoATR)
- Leverages the 3U VPX signaling
- Existing qualified small connector
- Straight-forward migration path from 3U VPX
- Environmentally robust
- Good SWaP properties
- Ideal candidate for decentralized avionics systems
- CES provides a straight-forward path for VITA 74 to attain DO-178 and other safety certifications
- Multiple suppliers and customers are embracing the emerging VITA 74 standard

