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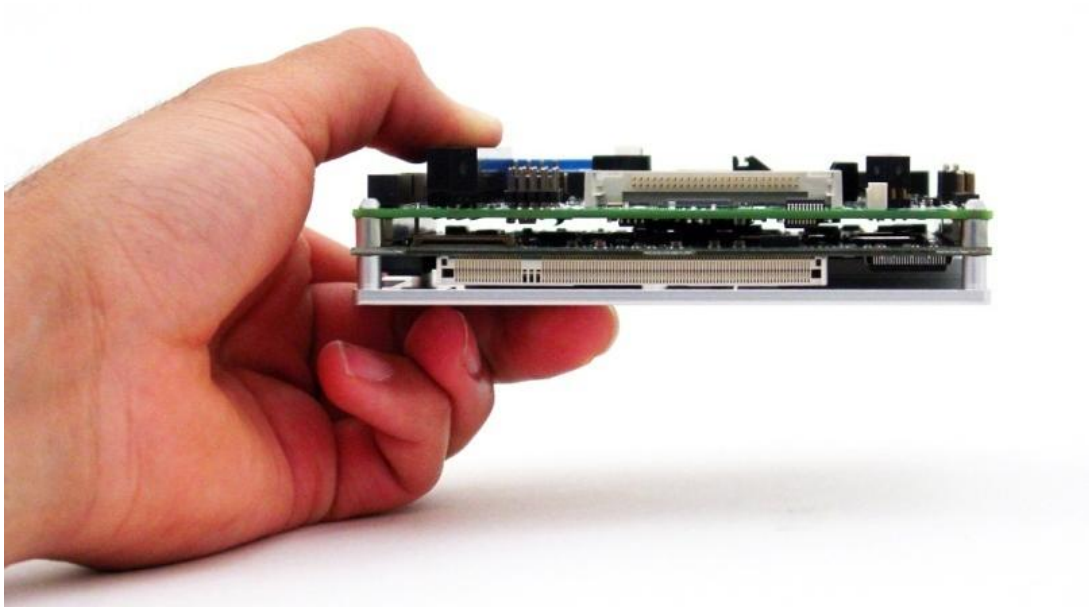
Introducing the Next-Generation Embedded Computing Paradigm:

"Embedded-Ready Subsystems"



December 2009

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About Diamond Systems

- Provider of **Embedded Computing Solutions** ranging from boards to systems to custom solutions
- Leading worldwide supplier of **rugged**, industry standard, and **highly-integrated** single board computers (SBCs) with **built-in data acquisition** and a wide variety of I/O modules
- Broad range of embedded vertical markets including military, industrial automation, medical, and transportation

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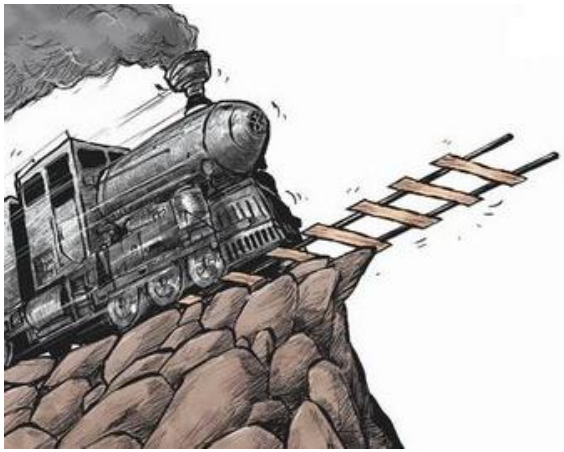
The Stackable-SBC crisis

Question: ***Are PC/104, EPIC, EBX, and other Gen 1 small form-factor stackable-SBC approaches nearing the end of the line?***



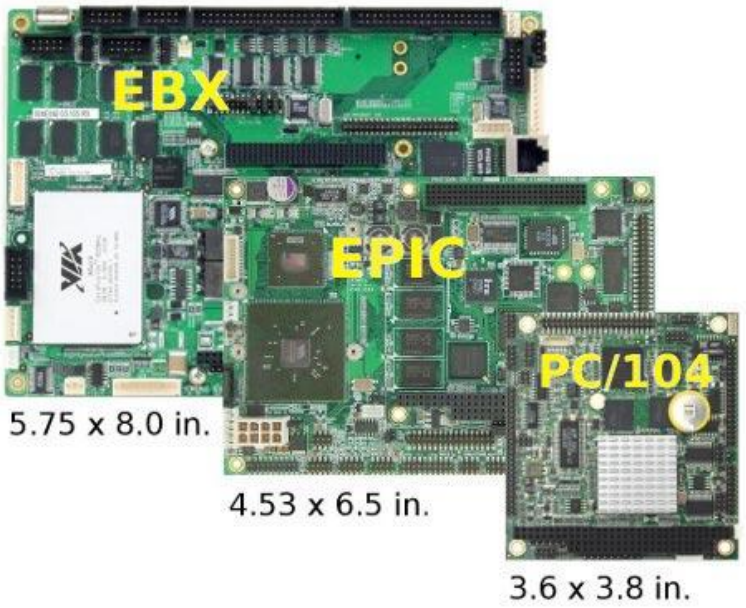
(Source: GraniteGrok.com)

Today's reality...

- **Performance roadmap challenges/opportunities abound**
- **New serial buses and interfaces have arrived**
- **Legacy interfaces and buses are disappearing**
- **Integration density is skyrocketing**
- **Standards fragmentation pervades**
- **Gen 1 Stackable-SBC approaches are stale!**

Moore's Law meets PC/104

- **Much has changed since PC/104 spawned the "Stackable Single-Board Computer" (SBC) Market back in 1991...**



“Embedded PC” evolution

- **Much has changed since PC/104 spawned the “Stackable Single-Board Computer” (SBC) Market back in 1991...**

	Circa 1991	Circa 2009	Factor
CPU	32-bit 100MHz 80486/486SX	64-bit multi-GHz multicore Core 2 Duo	50-100
RAM	multi-megabyte	multi-gigabyte	1,000
Hard drive	50-100MB IDE	500GB-1TB SATA	10,000
SSD	multi-MB	multi-GB	1,000
LAN	10Mbps	1Gbps	100
System bus	16-bit ISA bus @ 9MB/sec	PCI Express x16 @ 4TB/sec	50,000
Serial I/O interface	PS2 @40Kbps	USB 2.0 @ 480Mbps	10,000

Stackable-SBC evolution has lagged

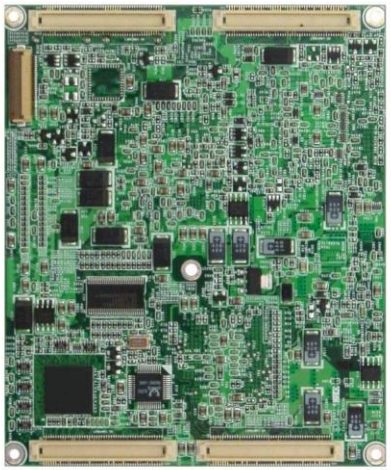
- PC/104 (ISA) is still quite common
- PC/104-*Plus* (ISA + PCI) and PCI-104 (PCI only) are fairly popular
- Duelling stackable-PCIe bus alternatives are competing for market acceptance
- New interfaces (USB 2.0, SATA) are replacing older ones (PS/2, USB 1.x, IDE)
- SBC vendors are struggling to squeeze the latest x86 CPUs into small form-factors

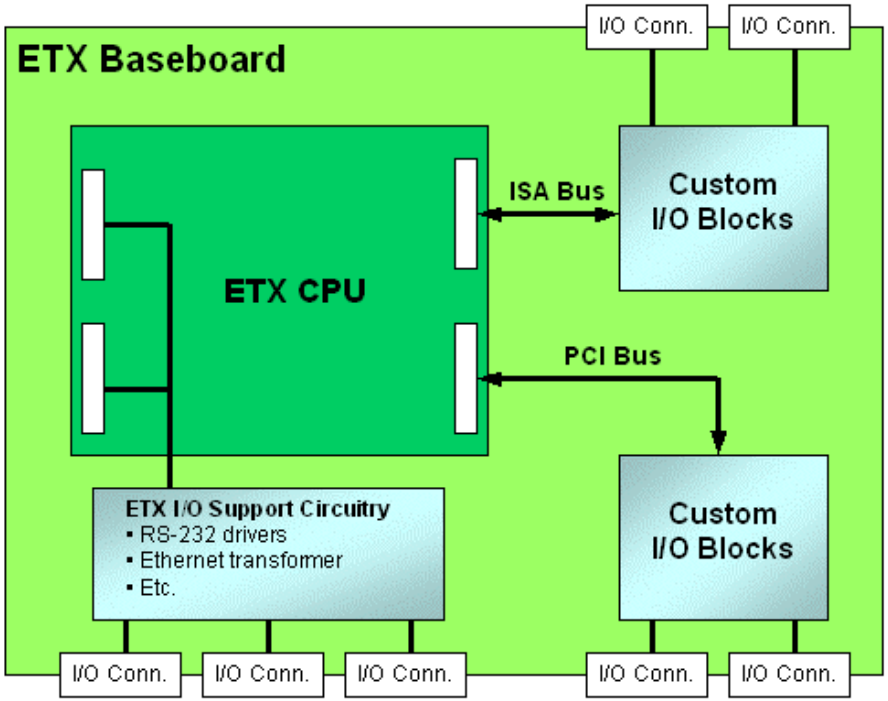
Stacking up solutions

- The stackable-SBC approach makes it easy to construct application-oriented embedded systems using off-the-shelf modules
- However, this approach can't always meet the target application's size, weight, power, thermal, or complexity constraints

The COM alternative

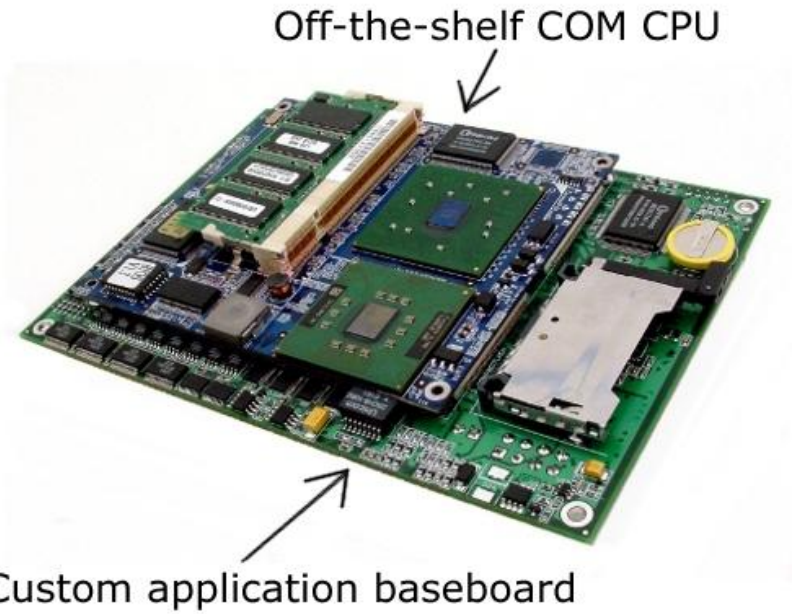
- **Over the past decade, Computer-on-Modules (COMs) have become viable alternatives to Stackable-SBCs for many applications**





The COM compromise

- **In the COM approach to embedded design, a two-board sandwich -- consisting of an off-the-shelf COM CPU plus a "custom application baseboard" -- replaces a complete stack of PC/104-style boards**



SBC pros & cons

- **Advantages:**
  - Fast time-to-market
  - Reduced R&D investments and risks
  - Flexible, upgradeable, maintainable
  - Choice of SBC & I/O module vendors
  - Long product lifecycles
- **Disadvantages:**
  - Lags behind latest CPU, bus, & system I/O technologies
  - Form-factors not strictly standardized
  - Inconsistent thermal solutions
  - Lack of commoditization increases system BOM cost

COM pros & cons

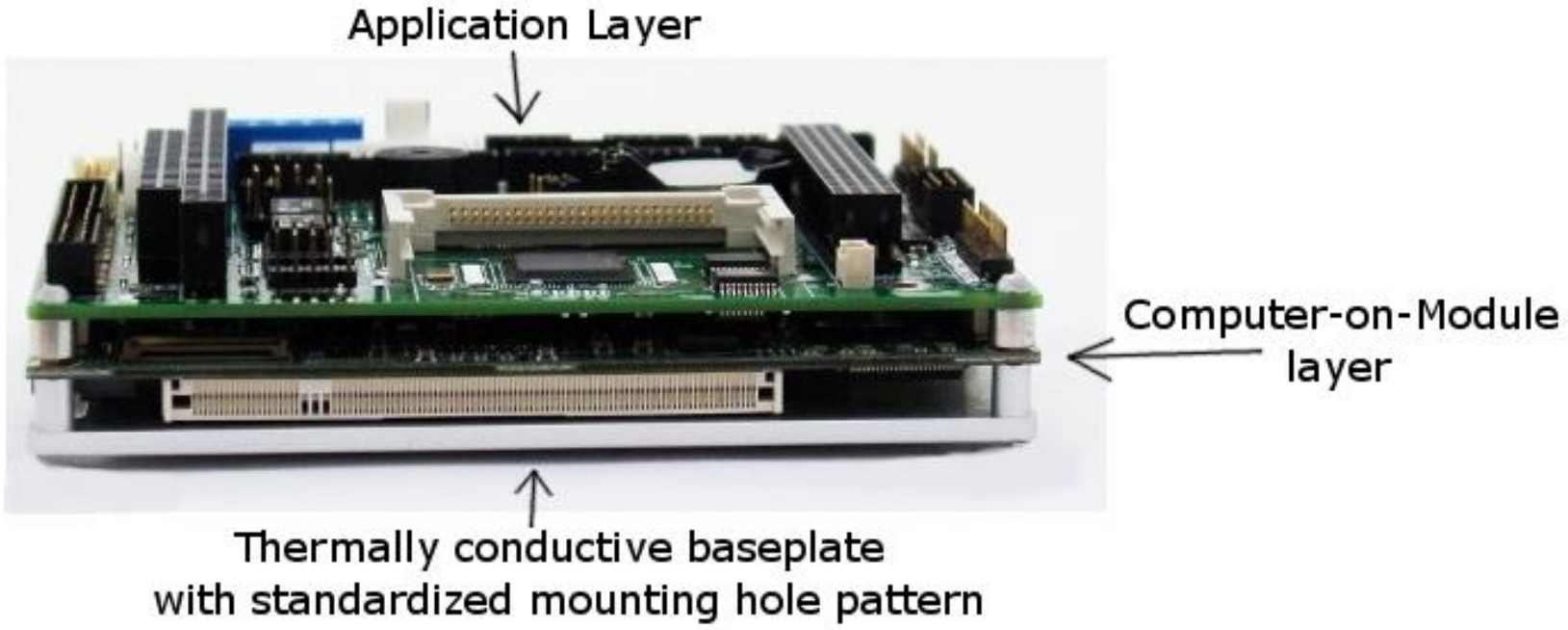
- **Advantages:**
  - Eliminates core computer development costs/risks
  - Tracks latest CPU & system I/O technologies
  - Choice of COM vendors
  - COM commoditization reduces system BOM cost
  - Medium to long product lifecycles
  - Protection from core computer component EOL
- **Disadvantages:**
  - Need for custom application baseboard results in high development costs/risks
  - COM plug-compatibility not as solid as promoted
  - Inconsistent thermal solutions

The COTS dilemma

- SBCs can't keep up with the latest CPU & system I/O technologies
- COMs require custom baseboard designs
- OEMs want off-the-shelf options with fast time-to-market and low risk
- Component obsolescence continually threatens product lifecycles
- How can SBC stacks leverage the latest CPUs, and how can they efficiently cool them?
- How can COM designs be freed from the costs/risks of custom application baseboards?

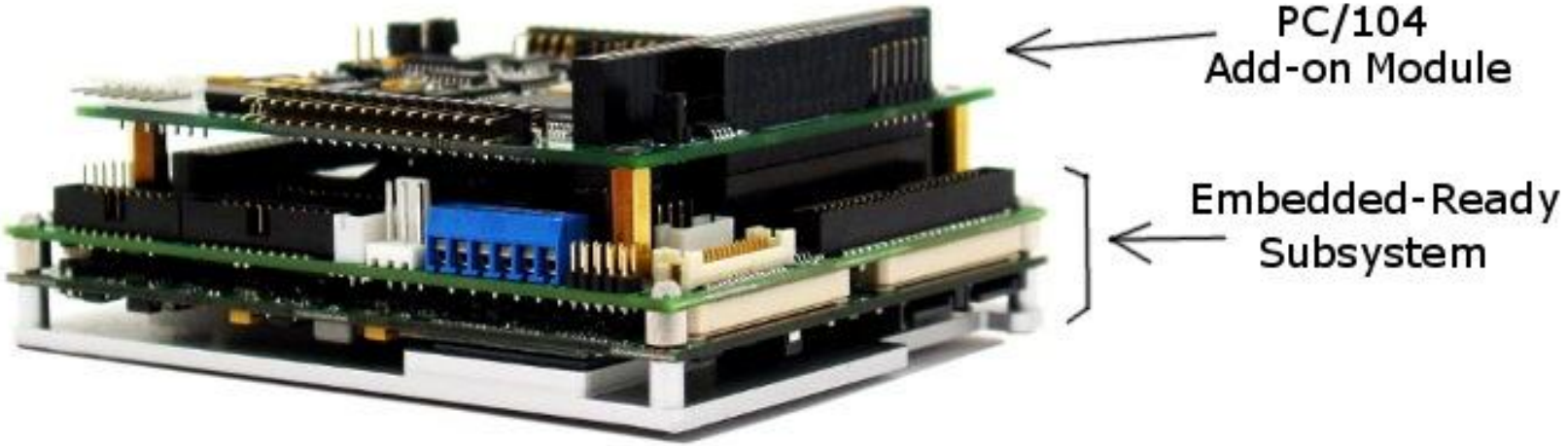
Introducing the new alternative...

- **The Embedded-Ready Subsystem merges the best of both the SBC and COM worlds by combining an off-the-shelf Application Layer, an off-the-shelf Computer-on-Module, and a thermally conductive baseplate**



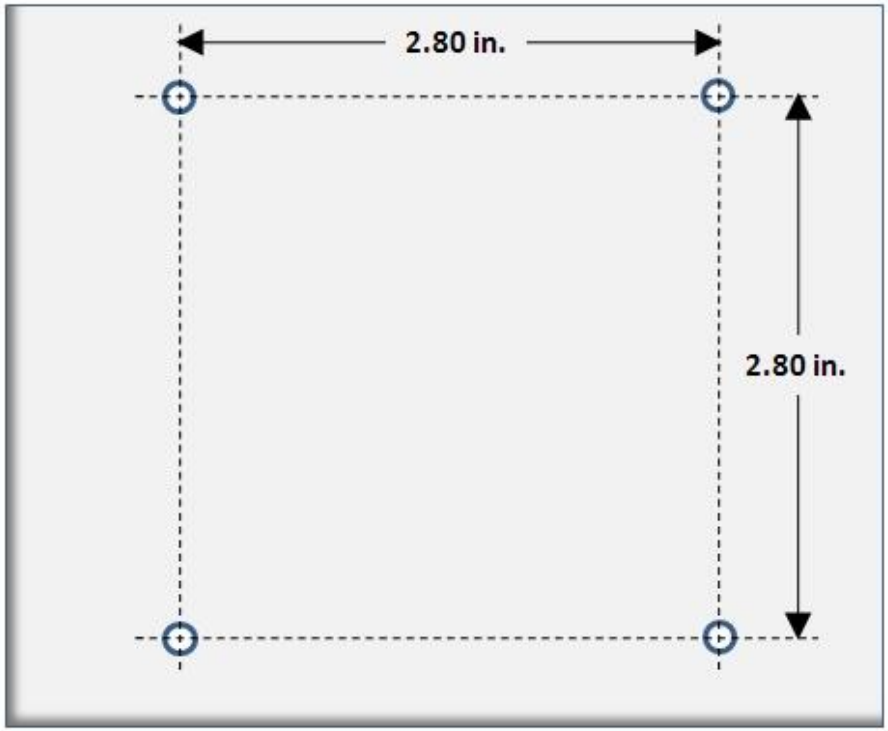
Modularly expandable

- **The Application Layer's stackable expansion bus facilitates flexible expansion using off-the-shelf standards-based modules**



Comprehensive thermal solution

- **The Embedded-Ready Subsystem's heat-conducting baseplate features a standardized mounting hole pattern facilitating fanless designs**



The ERS advantage

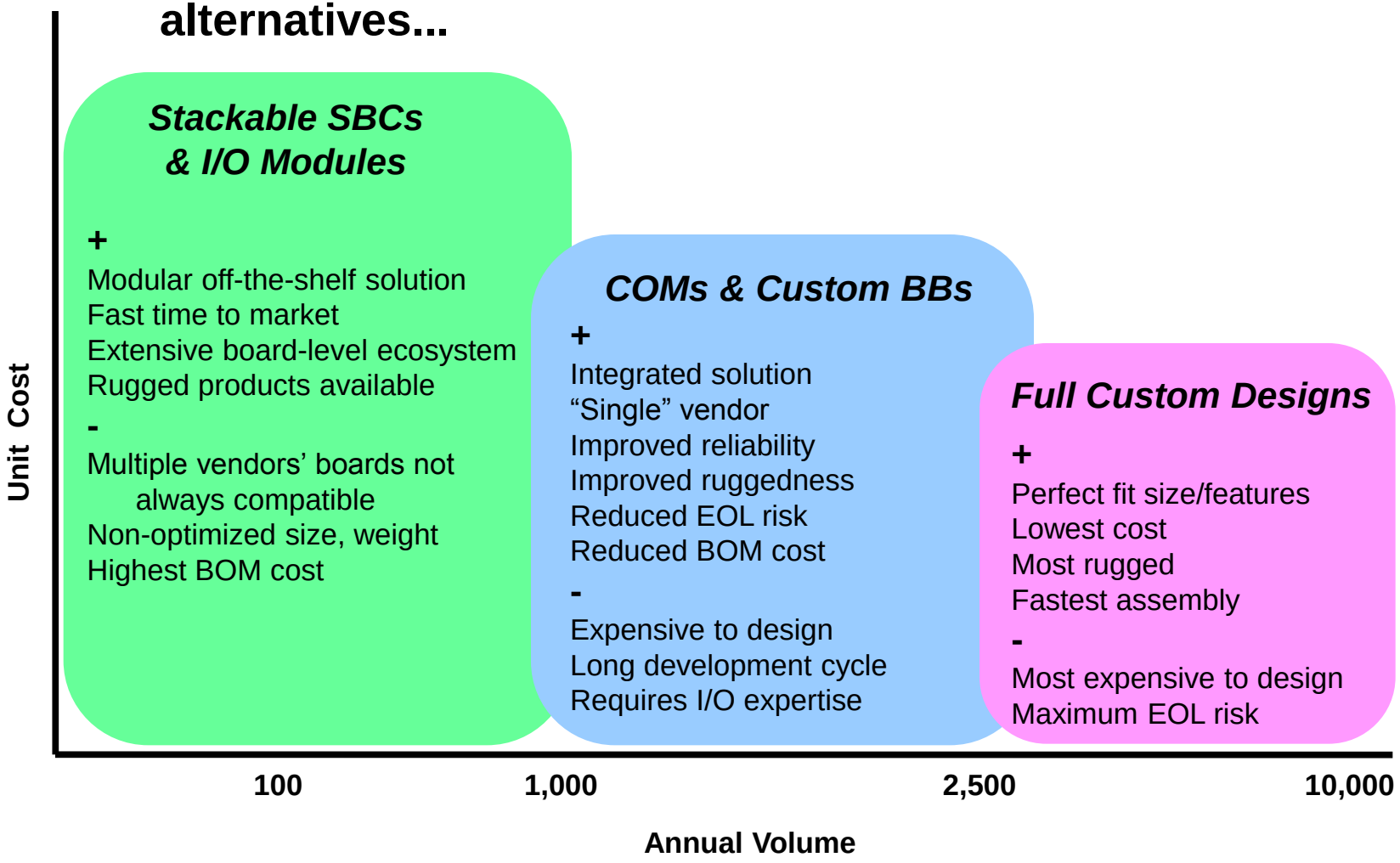
- Fully off-the-shelf solution; fast time-to-market
- Keeps up with core computing & I/O technology
- Low-cost, commoditized computing cores
- Protection from component obsolescence
- Comprehensive thermal management solution
- Supports latest buses/interfaces within one footprint
- Expansion module bus/form-factor agnostic
- Standardized mounting across multiple formats
- Migration path for both stackable-SBC and COM-based designs

SBC vs. COM vs. ERS scorecard

	SBC	COM	ERS
Multi-sourced components	Yes	Partial	Yes
Fast time-to-market	Yes	No	Yes
Fully off-the-shelf solution	Yes	No	Yes
Bus and form-factor agnostic	No	No	Yes
Standardized mounting across multiple formats	No	No	Yes
Supports latest buses/interfaces within one footprint	No	No	Yes
Protection from component obsolescence	No	Partial	Yes
Comprehensive thermal management solution	No	Partial	Yes
Cost savings due to commoditization	No	Yes	Yes
Access to latest CPU & system I/O technology	No	Yes	Yes

A volume perspective

- **Today's alternatives...**



A volume perspective

- **Adding a new alternative...**

Stackable SBCs & I/O Modules

Embedded-Ready Subsystems

+

Off-the-shelf, pre-integrated
"Single" vendor
Improved reliability
Improved ruggedness
Least EOL risk
Reduced BOM cost
Reduced size, cabling

-

Not optimized for the exact I/O of every application

COMs & Custom BBs

+

Integrated solution
"Single" vendor
Improved reliability
Improved ruggedness
Reduced EOL risk
Reduced BOM cost

-

Expensive to design
Long development cycle
Requires I/O expertise

Full Custom Designs

+

Perfect fit size/features
Lowest cost
Most rugged
Fastest assembly

-

Most expensive to design
Maximum EOL risk

Unit Cost

100 **1,000** **2,500** **10,000**

Annual Volume

Beating custom at its own game

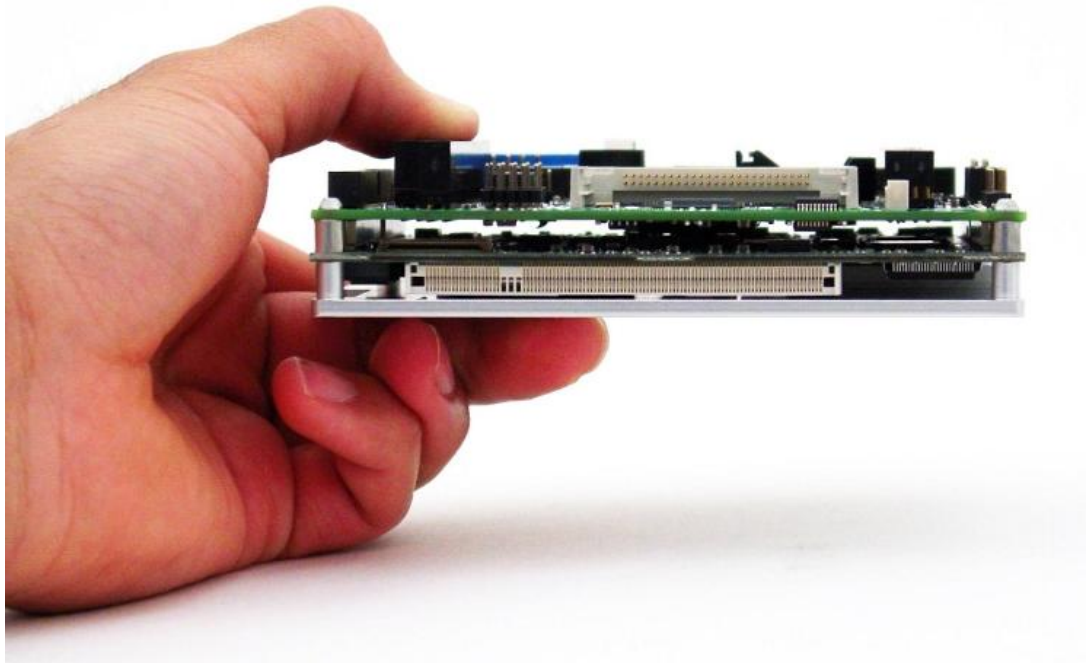
- **When dictated by cost, space, or power consumption constraints, a Customized Embedded-Ready Subsystem can be created by integrating application-specific functions into a Custom Application Layer**

Standard Embedded-Ready Subsystem
+ PC/104 expansion module

Embedded-Ready Subsystem
with Custom Application Layer

An example...

***Pluto:* Diamond's ETX-sized Embedded-Ready Subsystem with modular PC/104-Plus expansion and a configurable ETX COM CPU**



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Meet Pluto

Pluto's Application Layer adds a full set of I/O interface pin-headers, PC/104-*Plus* expansion, a CF socket, a 2nd Ethernet port, two serial ports, and digital I/O to its ETX COM core

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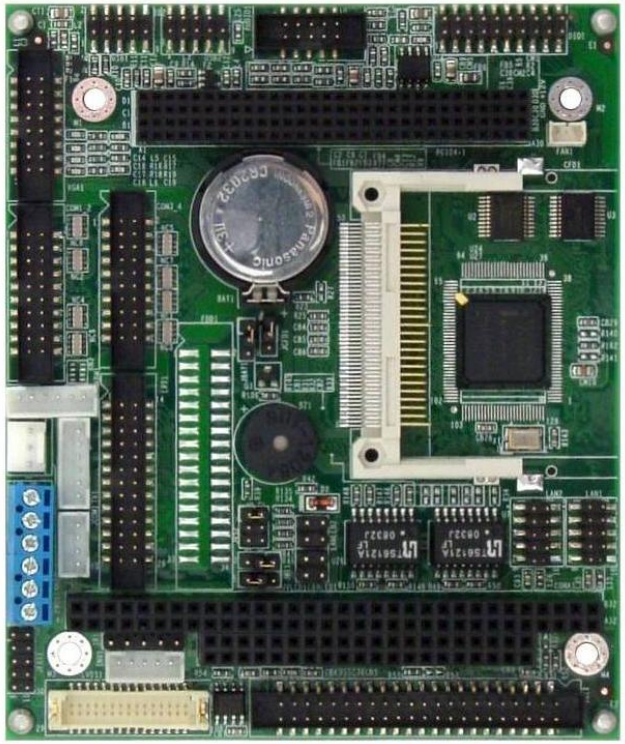
Pluto matches ETX's footprint

The Pluto baseboard precisely matches the footprint and mounting holes of its ETX 3.0 embedded-PC core, which mounts to its underside.

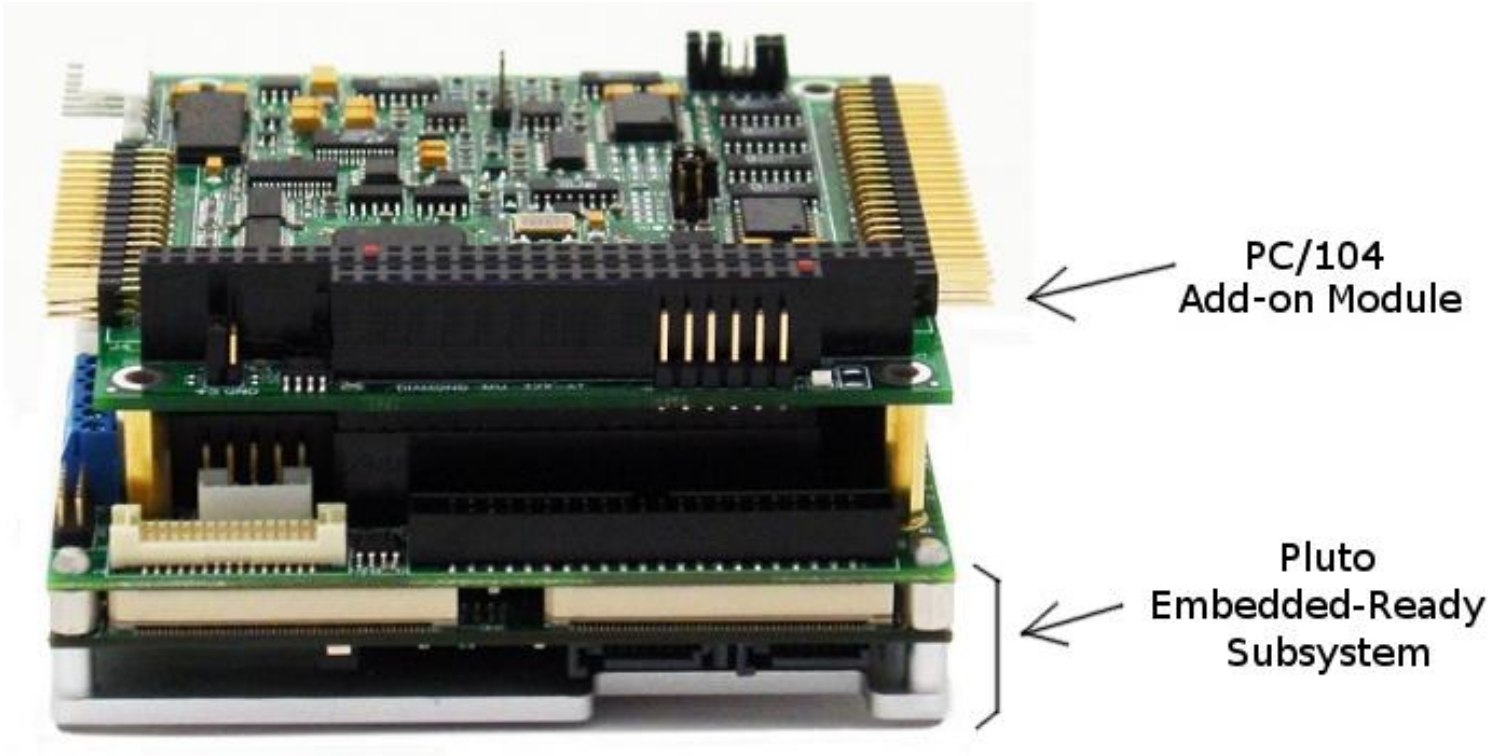


Top View Showing I/O & Bus Headers

Bottom View Showing ETX Socket

Pluto expands via PC/104-*Plus*

The Pluto platform expands flexibly via industry standard PC/104, PCI-104, or PC/104-*Plus* modules...



Pluto features

- **Footprint matches ETX 3.0**
- **Computer-on-Module Layer...**
  - Provides price/performance scalability, reduces cost, protects from premature obsolescence
  - CPU options include Intel's **Atom**, **Core Duo**, and **Core 2 Duo** in LV and ULV technologies
- **Application Layer...**
  - Provides modular PC/104-*Plus* (ISA + PCI) expansion
  - Provides reliable header connectors for nearly all I/O
  - Adds 1 Ethernet + 2 serial ports to ETX COM's I/O
  - Adds a CompactFlash socket
- **Thermally Conductive Baseplate...**
  - Provides efficient heat transfer and standardized mounting holes

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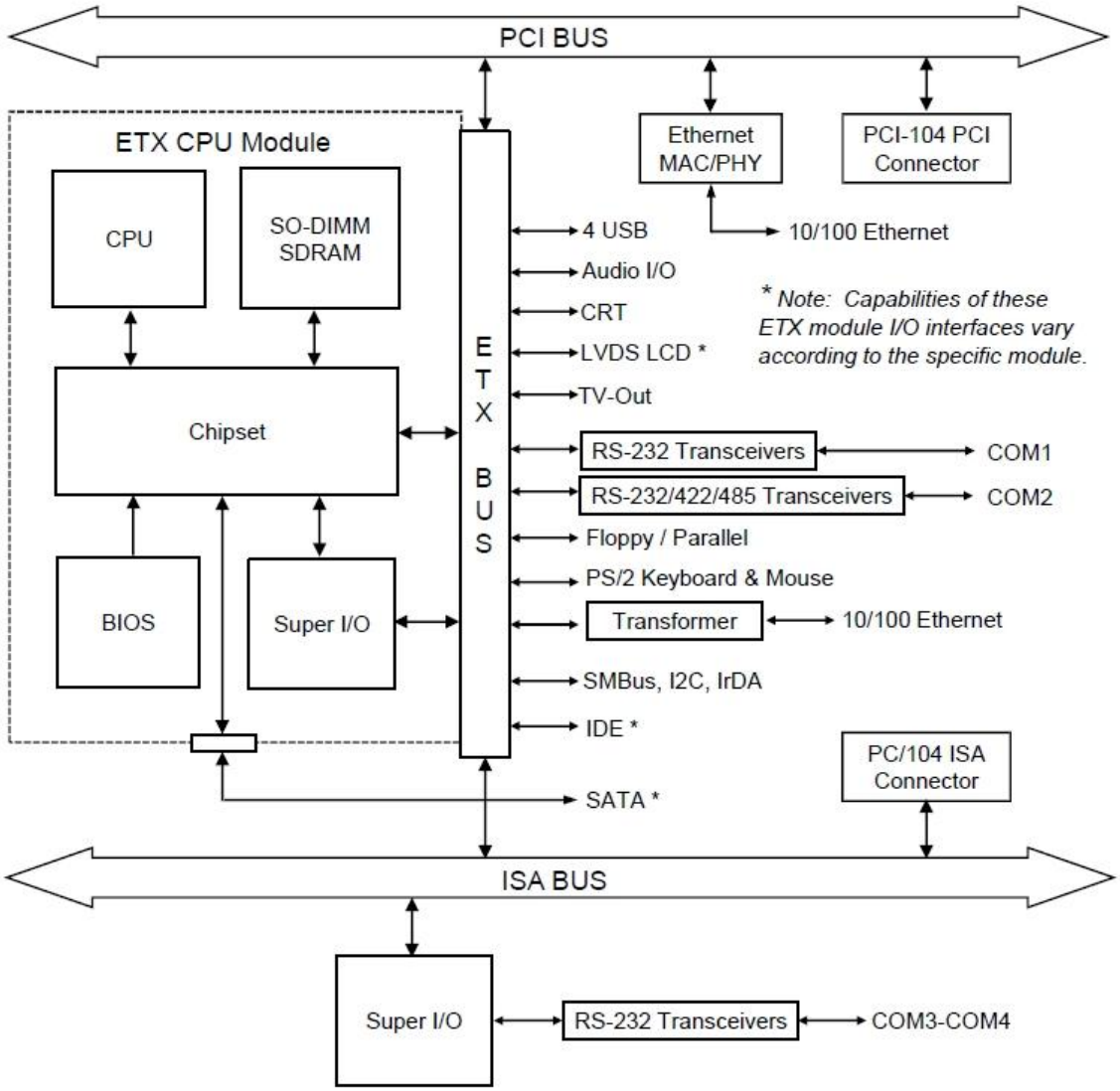
Pluto block diagram



EMBEDDED-PC PC/104-Plus MODULES

ETX® 3.0 Long Term Support

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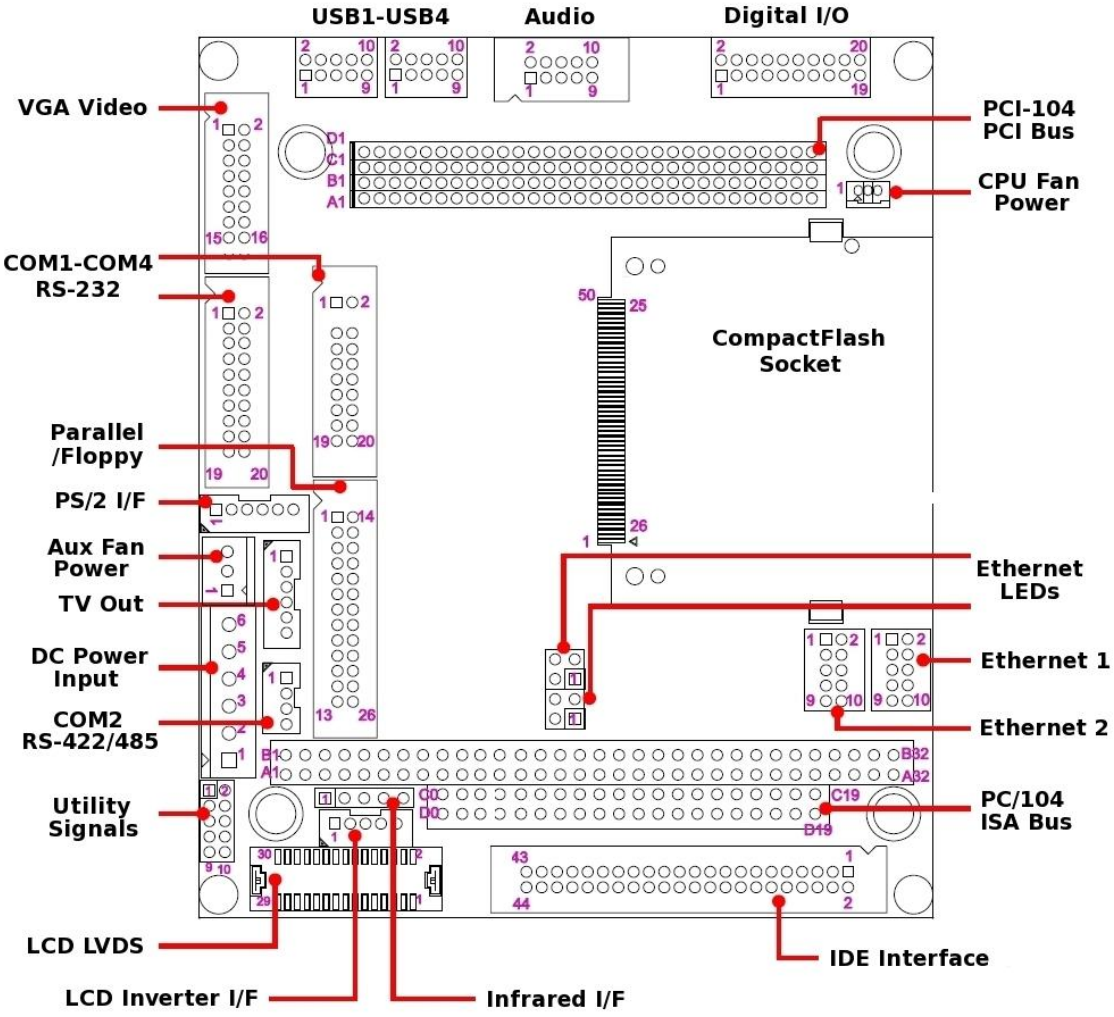
Pluto I/O connectors



EMBEDDED-PC PC/104-Plus MODULES

ETX® 3.0
Long Term Support

Pluto specs

- **Processor:** Intel Atom, Core Duo, or Core 2 Duo LV or ULV
- **RAM:** 1GB or 2GB DDR2 SDRAM via SO-DIMM module
- **Graphics:** high resolution VGA and LVDS; TV Output
- **LAN:** 2 10/100BaseT Ethernet ports
- **USB:** 4 USB 2.0 ports
- **Serial:** 1 RS-232/422/485 and 3 RS-232-only serial ports
- **Keyboard/mouse:** supports PS/2 and USB devices
- **Mass storage:**
  - 1 IDE interface (supports 2 drives, as master/slave)
  - 2 SATA ports (support 1 drive each)
  - On-board CompactFlash socket
  - Floppy port (shared with parallel interface)
- **Parallel port** (shared with floppy interface)
- **Digital I/O:** 8 inputs and 8 outputs
- **Other:** SMbus, I^2C, IrDA; PC speaker; watchdog timer
- **Power:** +5V @ 10W (1.6GHz Atom N270 version)

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Pluto ERS vs. SFF SBCs

Pluto compares favorably with typical small form-factor, high performance (Atom, Core Duo, Core 2 Duo) stackable-SBCs

Feature	PC/104-sized SBC	Pluto	3.5-inch SBCs
Compact footprint	13 in^2 (3.6 x 3.8 in.)	17 in^2 (3.7 x 4.5 in.)	23 in^2 (4 x 5.75 in.)
PC/104-*Plus* (ISA + PCI) expansion	Yes	Yes	Rare
All I/O on pin-headers	Yes	Yes	No
Extended operating temp.	Yes	Yes	No
Scalable CPU	No	Yes	Rare
Comprehensive thermal solution	No	Yes	No
Core Duo, Core 2 Duo CPUs	Rare	Yes	Yes
Dual Ethernet LAN	Rare	Yes	Yes
Serial ATA support	Rare	Yes	Yes
Onboard CompactFlash socket	Rare	Yes	Yes

EMBEDDED-PC PC/104-*Plus* MODULES

ETX® 3.0 Long Term Support

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Pluto markets

Pluto targets DSC's traditional markets and applications:

- **Transportation**
- **Energy Management**
- **Aerospace/Defense**
- **Test Equipment**
- **Industrial Automation**
- **Medical**

EMBEDDED-PC PC/104-Plus MODULES

ETX® 3.0 Long Term Support

Pluto summary

- Complete, ready-to-use **Embedded-Ready Subsystem**
- Compact, rugged, low-power, modularly expandable
- Scalable CPU price/performance – from Atom to Core 2 Duo (in LV and ULV versions)
- COM-based design protects investment, reduces risks
- Higher performance and more I/O, compared to most PC/104 SBCs
- Wider operating temperature and more rugged I/O connectors, compared to most 3.5-inch SBCs

Embedded-Ready Systems summary

- Merges the benefits of COMs with the flexibility of Stackable-SBCs
- Leverages the latest embedded-PC technologies
- Enables scalable performance
- Expands flexibly via off-the-shelf modules
- Supports legacy, current, and future I/O formats
- Shortens time-to-market
- Lengthens time-in-market
- Reduces both development and per-unit costs
- Efficient thermal solution with standardized mounting
- A rugged, wide-temperature, reliable solution

Further information...

- **Download the Embedded-Ready Systems whitepaper:**

  click here to download whitepaper pdf

- **View a recording of this webinar and download a pdf of this presentation:**

  www.DiamondSystems.com/webinar-120109.php

- **Learn more about Diamond's ETX sized, PC/104-*Plus* expandable Pluto ERS:**

  www.DiamondSystems.com/products/pluto

- **Visit Diamond's website:**

  www.DiamondSystems.com

Thank you for joining us!

Embedded-Ready Subsystem Q&A...