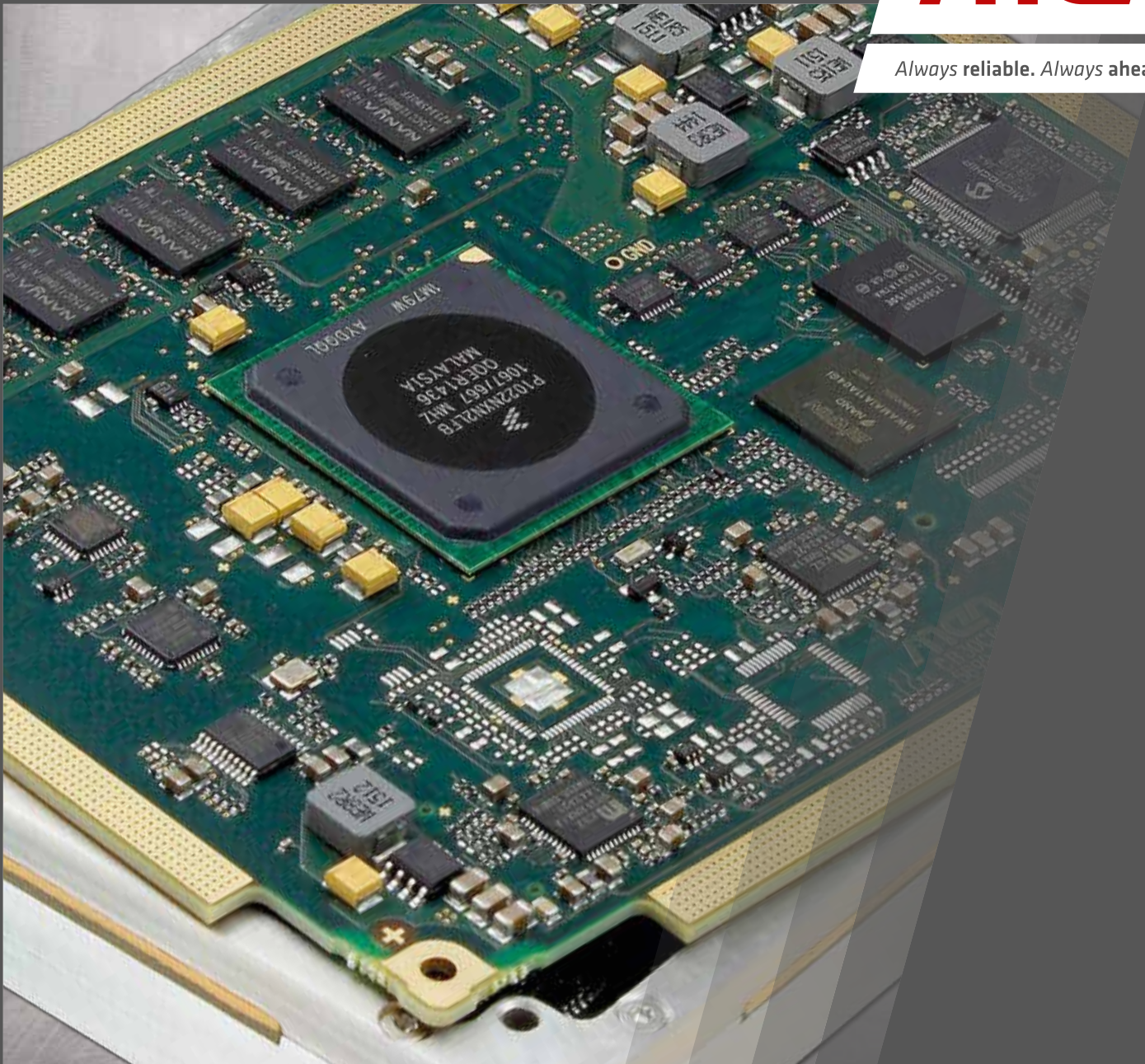


Safe and Rugged Computer-On-Modules

Powerful Small Form Factors for Harsh Environments

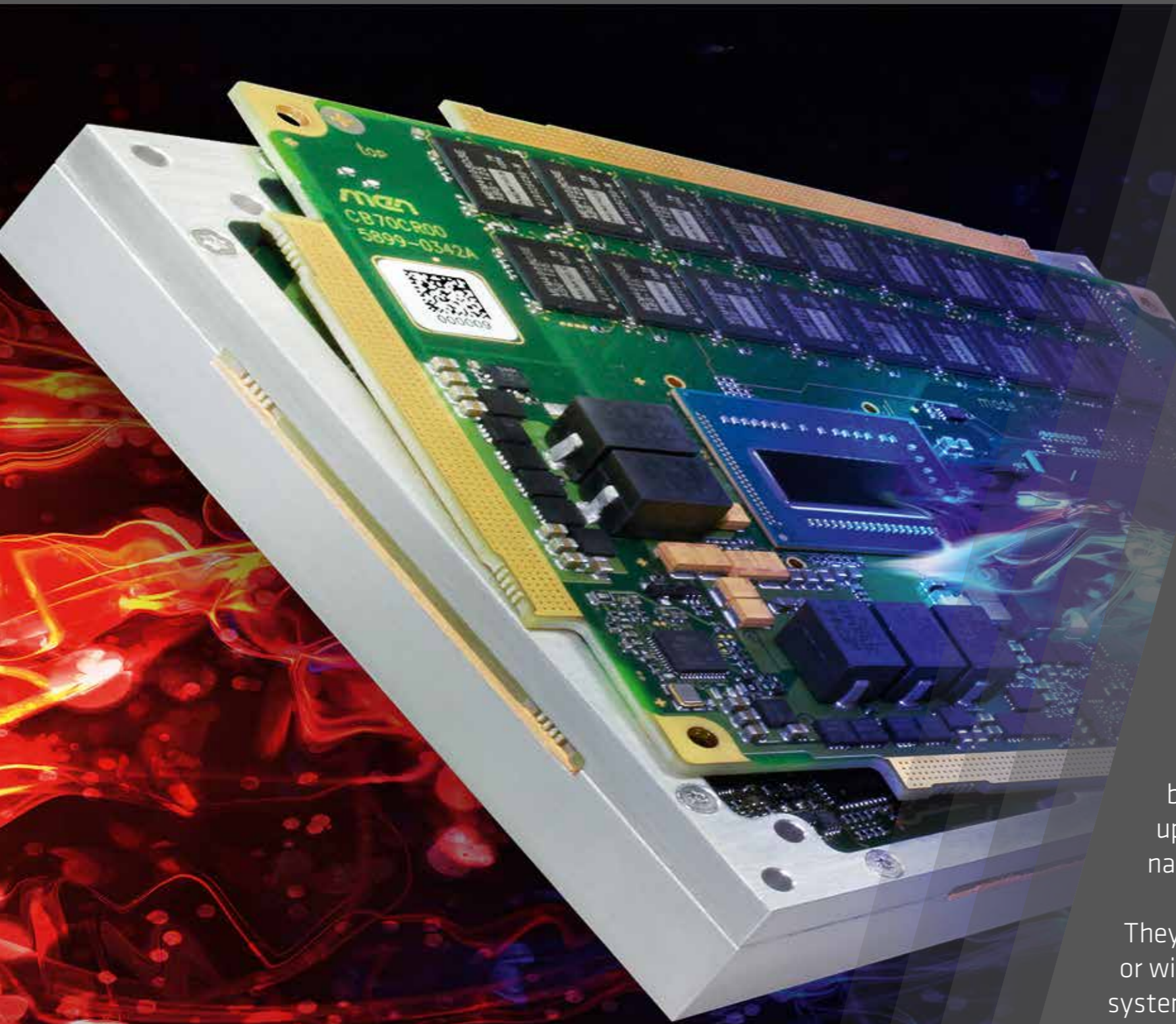


Always reliable. Always ahead.



Computer-On-Modules

for Transportation and Industrial Markets



Embedded technology has found its way into a wider variety of mobile and small form factor applications enabling a new set of technological innovations in fields as diverse as mobile medical equipment, industrial agricultural machinery and mass transit vehicles. Ruggedization of the systems and components has laid much of the groundwork for this growth.

Facing space-conscious requirements, embedded systems are constantly developed to smaller form factors, and they are continually being pressured to pack more performance into less space. Beside the general smaller footprint and ruggedization requirements of today's embedded systems, most also require specific functions to be implemented for various application needs.

Ideally, designers look to develop a system with enough flexibility to accommodate future technological upgrades with minimal reengineering costs. Component compatibility becomes a very attractive feature.

Computer-On-Modules from MEN help you focus on fast and comfortable system integration in harsh environments. All MEN COMs withstand up to -40 to +85 °C operating temperature, shock, vibration, drop, resonance, humidity, chemicals, etc.

They are designed to comply with standards like EN 50155 for railways or with ISO 7637-2 (E-mark) for automotive when integrated in the final system.

MEN products are available up to 10 years and more, thanks to MEN's superior obsolescence management.

Rugged COM Express

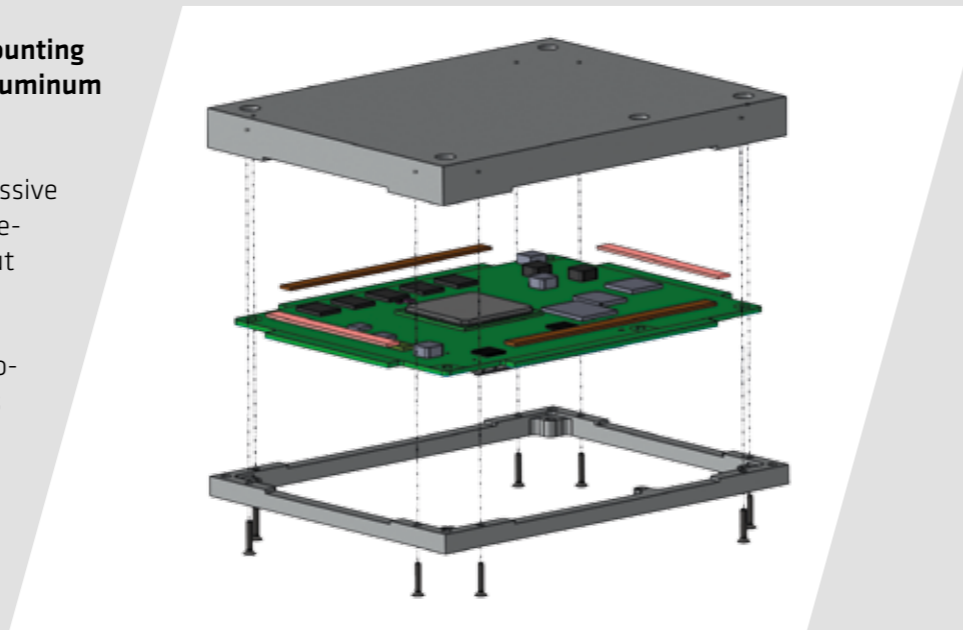
MEN has driven the standardization of Rugged COM Express – a new standard which is based on the PICMG COM.0 (COM Express) specification.

Defined with VITA 59 (currently in process), a mechanical specification has been added, providing the well-accepted COM Express standard with more mechanical stability, rugged physical performance and aggressive fanless cooling for demanding applications in harsh environments.

Rugged COM Express adds PCB wings for mounting the electronics inside a conduction cooled aluminum frame.

The CCA technology can be combined with passive cooling making electronics work in high temperature ranges from -40 to +125°C even without high-maintenance fans.

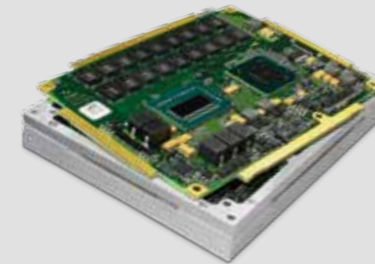
Through the solid metal block with the electronics inside firmly screwed, the design delivers high resistance against shock and vibration. In addition, the concept allows 100% EMC protection and keeps the electronics free of humidity, chemicals or dust that could compromise the electronics.



The pending standard utilizes the existing COMs form factors along with all the associated mechanics and pin-out requirements for easy design implementation. Within those form factors, a VITA 59 module has provisions for a 5 mm wing extension for cooling and mounting.

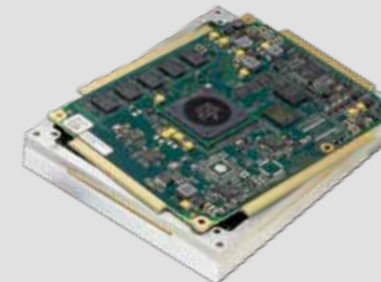
Form Factor	COM Express Module Dimensions	Rugged COM Express (VITA 59) Module Dimensions
Mini	55 mm x 84 mm	65 mm x 94 mm
Compact	95 mm x 95 mm	95 mm x 95 mm
Basic	95 mm x 125 mm	105 mm x 135 mm

CB70C – Rugged COM Express with Intel Core i7



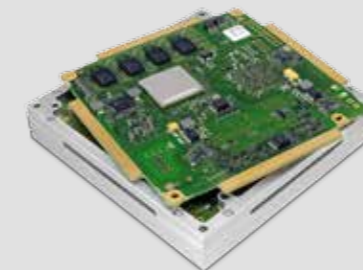
- » Compliant with COM Express Basic, type 6
- » Intel Core i7, 3rd generation
- » Quad-core 64-bit processor
- » Up to 16 GB DDR3 DRAM, ECC, soldered
- » Board Management Control
- » Active Management Technology
- » Open CL 1.1 support
- » 9 V to 16 V extended input range
- » -40 °C to +85 °C Tcase screened, depending on processor
- » Conduction cooling
- » PICMG COM.0 COM Express version also available

CB30C – Rugged COM Express Safe Computer with QorIQ



- » Compliant with COM Express Basic, type 6
- » Freescale QorIQ P1022 CPU
- » Up to 2 GB DDR3 SDRAM with ECC, soldered
- » Safe supervisor
- » Fail-safe and fail-silent board architecture
- » Event logging
- » SIL 2 with report from TÜV SÜD (EN 50128, EN 50129)
- » EN 50155, class TX compliance
- » -40 °C to +85 °C Tcase qualified
- » Conduction cooling
- » Conformal coating
- » PICMG COM.0 COM Express version also available

CC10C – Rugged COM Express with ARM i.MX 6



- » Compliant with COM Express Compact, type 6
- » Freescale ARM i.MX 6 Series
- » Quad-core processor
- » Comprehensive usage of i.MX 6 I/O
- » Configurable FPGA I/O with 140 pins
- » Maximum flexibility in interface configuration
- » Up to 4 GB DDR3 SDRAM
- » eMMC multimedia card
- » U-Boot Universal Boot Loader
- » -40 °C to +85 °C Tcase qualified
- » Conduction cooling
- » PICMG COM.0 COM Express version also available

Ultra-Rugged ESMexpress & ESMini

The ESMexpress and ESMini boards from MEN have been developed to offer rugged COM solutions, which couldn't be realized with the existing COM standards available at that time.

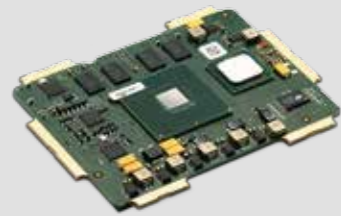
As an evolution of the concept of having a solid metal housing around the modules, they paved the way for the adoption to Rugged COM Express.

Based on the same concept as RCE but equipped with a more rugged connector type, these boards can be operated in even harsher environments as the RCE modules.

Dimensions for ESMexpress are 95 mm x 125 mm, for ESMini 95 mm x 55 mm.

ESMexpress Modules

XM1L – ESMexpress COM with Intel Atom XL



- » Intel Atom Z510P, Z530P, Z510PT, Z520PT
- » Up to 2 GB DDR2 SDRAM
- » Up to 2 PCI Express
- » Up to 1 Gb Ethernet
- » 1 SATA port
- » 8 USB 2.0
- » SDVO, LVDS
- » Intel HD Audio
- » -50 °C to +85 °C Tcase screened or qualified

XM51 – ESMexpress COM with QorIQ P4080



- » Freescale QorIQ P4080, P4040 or P3041
- » Power Architecture e500mc CPU
- » Up to 8 cores, up to 1.5 GHz
- » Up to 16 GB ECC DDR3 SDRAM, 1 or 2 controllers
- » Up to 128 KB FRAM, up to 256 MB Flash
- » 2 Gb Ethernet, 4 USB 2.0, 1 USB client
- » 2 SATA (3 Gbit/s), 2 PCIe x1 (5 Gbit/s)
- » U-Boot Universal Boot Loader
- » -50 °C to +85 °C Tcase qualified

ESMini Modules

MM2 – ESMini COM with Intel Atom E600 Series



- » Intel Atom E600 series, up to 1.6 GHz
- » Up to 2 GB DDR2 SDRAM
- » 2 PCI Express
- » 2 Gb Ethernet interfaces
- » 6 USB 2.0 hosts and 1 USB 2.0 client
- » 4 UARTs
- » 1 CAN bus interface
- » SDVO, LVDS
- » Intel HD audio
- » 2 SATA ports
- » -40 °C to +85 °C Tcase screened or qualified

COM Carriers and Evaluation

XC4 – ESMini COM Evaluation Carrier Board



- » microATX form factor
- » 1 ESMini computer-on-module slot
- » 2 PCI Express x1 connectors
- » 2 GB USB Flash
- » 1 SATA
- » LVDS, DVI
- » HD audio in and out
- » 5 USB 2.0 Master, 1 USB 2.0 Client
- » 2 Fast Ethernet
- » 2 × CAN bus, 2 × RS232 via SA-Adapters
- » 120 FPGA signals from ESMini

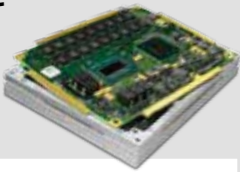

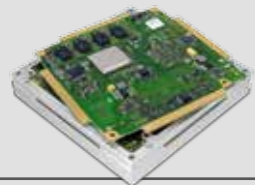
XC15 – Rugged COM Express Evaluation Carrier Board



- » microATX form factor
- » 1 Rugged COM Express slot
- » 8 PCI Express connectors
- » 4 SATA connectors
- » 3 Display ports
- » LVDS, VGA
- » HD audio
- » 1 Gb Ethernet
- » 4 USB 3.0
- » 2 USB 2.0
- » 2 CAN connectors

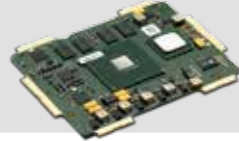

Computer-On-Modules (COMs)

Rugged COM Express

	Type	CPU	Memory max.
CB70C 	Rugged COM Express (VITA 59)	Intel Core i7, up to i7-3612QE, 2.1 GHz (64-bit CPU)	16 GB DDR3 DRAM
CB30C 	Rugged COM Express (VITA 59)	Freescale QorIQ P1022/P1013, up to 1.067 GHz	2 GB DDR3 DRAM
CC10C 	Rugged COM Express (VITA 59)	Freescale ARM Cortex-A9 i.MX 6 series i.MX6S, i.MX6DL, i.MX6D or i.MX6Q 800 MHz or 1.0 GHz	4 GB DDR3 SDRAM, eMMC card

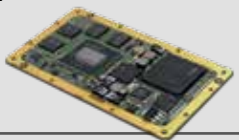
Interfaces	Cooling Concept	Dimensions	Software
1 LVDS, 3 DDI, 1 VGA, HD Audio, 2 SATA 3 Gb/s, 2 SATA 6 Gb/s, 4 USB 3.0, 4 USB 2.0, 1 Gb Ethernet, 7 PCIe x1 (2.x), GPIO, LPC, SPI	Conduction cooled according to VITA 59 Air cooled versions according to PICMG COM.0	135 mm x 105 mm (Basic format)	Windows, Linux
2 SATA 3 Gb/s, SDIO, 4 USB 2.0, 2/3 Gb Ethernet, 2/3 PCIe x1 (1.1), 2/4 UARTs, GPIO, I2C, SPI Optional: DVI, LVDS, processor local bus	Conduction cooled according to VITA 59 Air cooled versions according to PICMG COM.0	135 mm x 105 mm (Basic format)	Windows, Linux, INTEGRITY
1 Gb Ethernet, 1 Fast Ethernet, 6 USB 2.0, LVDS, DVI, AC'97 audio, 1 SATA 3 Gb/s, 1 PCIe x1 (1.1), UARTs, PWM, I2C, SPI, further I/O in FPGA (140 pins available) or driven by i.MX 6	Conduction cooled according to VITA 59 Air cooled versions according to PICMG COM.0	105 mm x 105 mm (Compact format)	Linux, VxWorks

ESMexpress

	Type	CPU	Memory max.
XM1L 	ESMexpress	Intel Atom Z510P / Z530P / Z510PT / Z520PT up to 1.6 GHz	2 GB DDR2 SDRAM
XM51 	ESMexpress	PowerPC eight-core P4080, quad-core P4040 or quad-core P3041 1.2 to 1.5 GHz	Up to 16 GB DDR3 SDRAM (ECC), 128 KB FRAM, 256 MB Flash

Interfaces	Cooling Concept	Dimensions	Software
1 Gb Ethernet, 1 SATA 1.5 Gb/s, 8 USB 2.0, SDVO, LVDS, HD Audio, PCIe x1 link to carrier	Conduction cooled	95 mm x 125 mm	Windows, Linux, VxWorks, QNX
2 Gb Ethernet, 2 SATA 3 Gb/s, 4 USB 2.0 + 1 USB client, 2 PCIe x1 links to carrier	Conduction cooled	95 mm x 125 mm	VxWorks (Linux on request)

ESMini

	Type	CPU	Memory max.
MM2 	ESMini	Intel Atom E600, up to 1.6 GHz	2 GB DDR2 SDRAM

Interfaces	Cooling Concept	Dimensions	Software
Up to 2 Gb Ethernet, 2 SATA, 7 USB 2.0, 4 UARTs, 1 CAN bus, SDVO, LVDS, HD audio, 2 PCIe x1 links to carrier	Conduction cooled	95 mm x 55 mm	Windows, Linux, VxWorks, QNX

Our Custom Design Service

It is MEN's goal to find a tailored solution for the application together with our customers. While using as many standard COTS components as possible, parts of the solution may include customization on system, board or component level (in FPGA).

Whether standard or custom, MEN products benefit from our unique development expertise:

- » Robust designs for harsh environments
- » Safety-critical designs in accordance with IEC 61508, EN 50126, EN 50128, EN 50129, DO-245, DO-178B, DO-254
- » Based on Intel, AMD, PowerPC and ARM architectures
- » Based on more than 50 proprietary cores in FPGA
- » Completed by real-world I/O
- » Supported by real-time software

The Design Process

Custom design at MEN follows a defined development process from specification to design, verification and validation of a product, which is part of our quality management system according to DIN EN ISO 9001, EN/AS 9100 and IRIS.

The design process follows an adapted V-Model, depending on SIL level, and includes requirement tracing.

RAMS (Reliability, Availability, Maintainability and Safety) procedures are applied in the planning phase to avoid costly mistakes down the road.



Computer-On-Module Standards Comparision

Shock / Vibration

Not all types of board-to-board connectors make the connection between the COM and carrier robust enough for high demands. A housing gives the connection more stability. Socketed components like SO-DIMMs are not a good choice for rugged applications as they reduce resistance to shock and vibration.

Cooling

A heat spreader or heat sink is the easiest way of implementing a tailored, mechanical cooling element. This is always individual to the processor and COM and can result in varying total component dimensions and the additional need for active ventilation. A conduction-cooling housing optimizes the thermal contact between the heat source and outer enclosure's wall to lead away the heat passively. Having a uniform size, it can be combined with a standard heat sink installed on top of the housing.

EMC

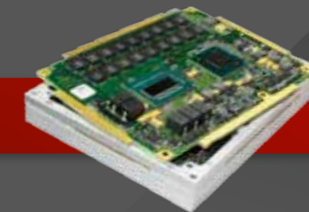
A plain computer-on-module PCB does not address EMC issues. It always depends on its carrier and a surrounding housing, which are mostly individual for every COM. However, if the COM itself is embedded in a metal housing, it is already EMC-proof, giving it a head start for sensitive environments.

ESMexpress / ESMini



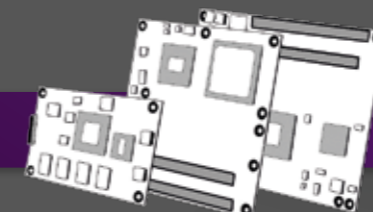
Standard Company standard
Form Factor ESMexpress 95 × 125 mm
 ESMini 95 × 55 mm
Shock / Vibration ... High resistance
Operating Temp..... -55 °C to +125 °C
Cooling Conduction Cooling
EMC 100 % sealed metal housing
 incl. connector

Rugged COM Express



Standard VITA 59 RCE
Form Factor 3 different ones
 65 × 94 mm to 105 × 135 mm
Shock / Vibration ... High resistance
Operating Temp..... -55 °C to +125 °C
Cooling Conduction Cooling
EMC 100 % sealed metal housing
 incl. connector

COM Express



Standard PICMG COM.0
Form Factor 4 different ones
 55 × 84 mm to 110 × 155 mm
Shock / Vibration ... Medium resistance
Operating Temp..... -40 °C to +85 °C
Cooling Heat spreader
EMC Not EMC proof

Application Examples

Mining Machine Control Platform

Using two standard ESMini modules protected by a fire-safe, IP67-protected housing, this control unit for mining machines withstands extreme conditions. Thanks to the sophisticated design of the solid housing the two modules can work side by side without any electromagnetic interference and deliver passive cooling capabilities for a temperature range of -10 °C to +70 °C. In addition to this, the system is immune to extremely high vibrations of up to 5G and shock up to 50G as well as environmental influences like dust, humidity and chemicals.



Vehicle Panel PC for Intelligent Farming

This custom-designed intelligent vehicle display is a core element of "Precision Farming" technology based on standard ESMexpress computer-on-modules. Depending on the performance requirements of the different farming vehicles, the COMs used are either Intel Atom based like the XM1L or Intel Core 2 Duo based like the XM2. All wireless interfaces like WLAN, GPS, GSM and UMTS are installed as PCI Express Mini cards mounted on the carrier board.



Cockpit Display Computer

A rugged Computer-On-Module is the heart of all kinds of airborne video and control displays that are necessary for the information of the pilot. The PowerPC-based COM is designed according to DO-254 for safety level DAL-A. It is specified for a permanent operation temperature of -40 °C to +70 °C (and one hour up to +85 °C) as well as shock, vibration and humidity according to DO-160E. The module is based on the ESMexpress standard (ANSI-VITA-59 i.p.), supporting conductive cooling with the electronics completely embedded in an aluminum frame and cover, thus making it also 100% EMC-proof.



Why MEN?

Development and production of rugged and reliable products

Our boards and systems are developed to meet requirements such as temperature ranges between -40 °C and +85 °C through convection or conduction cooling, shock, vibration, chemical influence or the option of coating against humidity right from the start.

Development based on quality management systems of our markets

We are certified according to ISO 9001 and ISO 14001, plus EN/AS 9100 (aerospace) and IRIS (railways) and provide systems according to ISO 7637-2 (road traffic) requirements. We develop according to the GRESS requirements by Airbus and are preparing for EFQM (European Foundation for Quality Management).

Development based on relevant standards know-how for our markets

Preparing products for environmental qualification according to vertical market standards is one of our key services, for example EN 50155 (railways), DO-160G (airborne), German Lloyd (ships) or ISO 7637-2 (automotive E-Mark).

Fully automated, high-quality in-house production

To achieve the highest product quality, our manufacturing and test process is fully automated. Vapor-phase soldering assures smooth processing of the components. Traceability is guaranteed by time stamps throughout the whole process.

All relevant environmental tests in-house

We carry out the preliminary qualifications in our own environmental test lab (temperature, shock, vibration, humidity), high-voltage and EMC chambers. Further calculations and analyses include MTBF, FMEA, Hazard Tree, HASS or HALT.

FPGA technology expertise

FPGAs allow us to customize our hardware without touching the board layout while keeping costs low, even in small quantities. FPGA-based solutions are flexible, offer long-term availability and support extended temperature operation.

Custom design of computer boards and systems

Often the most cost-effective solution results in a custom design – while using as many standard components as possible. Synergy effects emerge through the mutual development of standard and custom boards and systems, completed by the built-to-order approach of MEN's box PCs and 19"-based application-ready and turnkey systems.

Complete system solutions based on in-house mechanical design

Whether a 19" system, wall-mount, standalone or DIN-rail is needed, we guarantee overall operability of each system, minimizing the integration effort and the handling cost on the customer's side. The quality of our systems is assured by applying traceability through the V-model.

Customer assistance in configuration of mission-critical systems

Computer architectures with safety-critical requirements are very complex. Considerations include safety-critical characteristics and levels (SIL, DAL), reliability questions, error behavior modes and the major IEC and EN standards – backed by a professional safety and risk management.

MEN is a member of:

- » **AMD** (Fusion Partner Program)
- » **ARINC** (Aeronautical Radio Incorporated)
- » **BavAIRia** (Cluster for innovative aerospace technology in Bavaria)
- » **CNA** (Center for Transportation & Logistics Neuer Adler e.V.)
- » **Intel**® (IoT Solutions Alliance)
- » **NXP** (Design Alliance)
- » **Open Source Automation Development Lab** (OSADL)
- » **PCI-SIG** (Peripheral Component Interconnect Special Interest Group)
- » **PICMG** (PCI Industrial Computer Manufacturers Group)
- » **RSSI** (Railway Systems Suppliers, Inc. Trade Association)
- » **Unife** (Union des Industries Ferroviaires Européennes)
- » **USB-IF** (Universal Serial Bus Implementers Forum, Inc.)
- » **VITA** (VMEbus International Trade Association)
- » **Wind River** (Partner Eco System)
- » **ZVEI** (German Electrical and Electronic Manufacturers Association)



ISO 9001
ISO 14001
EN 9100

IRIS
Certification

