

D602

Vital Embedded Single Board Computer with 3 PowerPC 750 6U CompactPCI

- » **3x PowerPC 750 (lockstep mode), 3x 512 MB DDR RAM**
- » **Fail-operational, fault-tolerant behavior**
- » **Fail-safe and fail-silent board architecture**
- » **Clustering of two D602 to raise availability**
- » **Board management, BITE**
- » **SEU (radiation) tolerant**
- » **Certifiable up to SIL 4 (with report from TÜV SÜD) and DAL-A**
- » **Developed according to RTCA DO-254, EN 50129 and IEC 61508**
- » **EN 50155 compliance**
- » **Up to -40°C to +70°C**
- » **Convection or conduction cooling**

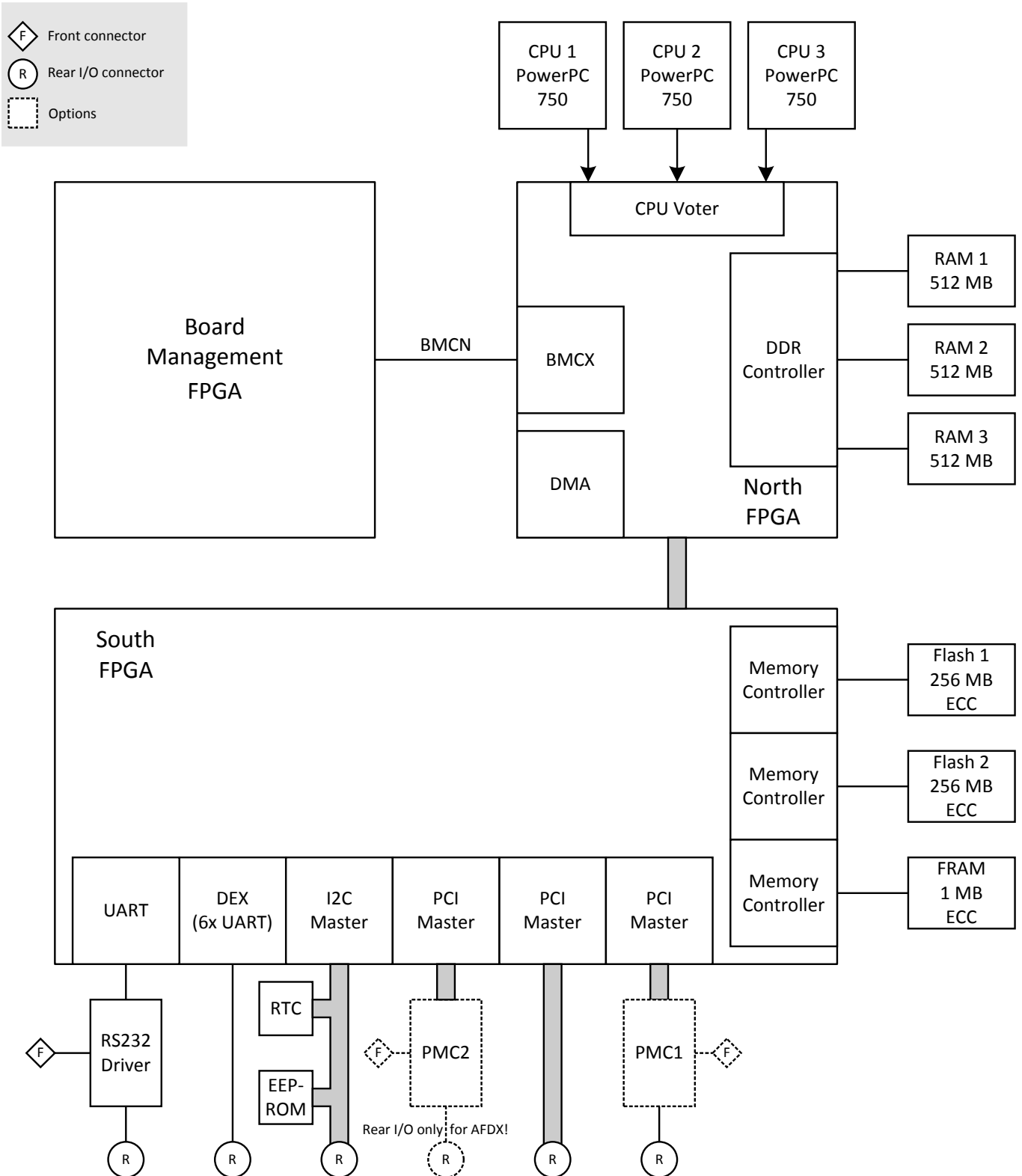


The D602 is a 6U CompactPCI COTS computer with onboard functional safety that realizes triple redundancy on a single board to achieve fail-operational, fault-tolerant behavior. The board can also act as a fail-silent subsystem, i.e. it can shut down in case of a fatal fault. Its complex FPGA-based design helps dramatically lower software development costs as it automatically manages the system's triple-redundant processors and memory. The result: The system's redundant architecture is fully taken advantage of by software designed for a standard single-CPU card.

The D602 is designed for deterministic operation and offers extensive BITE features (e.g., ECC error counters for all types of memory, monitoring of all internal voltages), internal buses with error correction and fault-tolerant (fail-operational) implementation. Its three processors run in lockstep mode with 2-out-of-3 (2oo3) voting implemented in FPGA and software-assisted resynchronization, while its triple redundant dynamic memory automatically corrects upsets caused by cosmic radiation (SEU) and hardware faults.

The system is powered by redundant local power supplies with separate power supplies for the three CPUs and the three main memory ranks.

The D602 has been developed according to DO-254, compliant to DO-160 and certifiable up to DAL-A in avionics applications. Additionally, the product meets the requirements of EN50128/EN50129 and can be deployed in signalling and rolling stock applications up to SIL 4. All I/O is realized in SEU-resistant FPGAs and available on the system's rear connectors. Additionally, the D602 offers two PMC slots (product revisions -02 and later with rear I/O for PMC1). As an option, the second PMC slot can be customized for an AFDX PMC (rear I/O only). A second D602 can be connected to build a high reliability/availability cluster. The two D602s exchange data via a sextuple UART connection and a BMCX link.



CPU

- 3x PowerPC 750 CL
 - Scalable performance
 - 1 GHz processor core frequency
 - Superscalar
 - Classic PowerPC FPU, MMU
 - CPU bus to FPGA: 100-MHz/64-bit
- Lock-step operation
 - All CPUs do the same thing at the same time
 - 2-out-of-3 voting in FPGA with CPU bus clock speed (100MHz)
 - Software-assisted resynchronization
 - No functional interruption in case of an SEU inside the CPU
- Chipset
 - North- and Southbridge realized in FPGA

Memory

- 2x 32 kB L1 cache, 1MB L2 cache integrated in each CPU
- 3 independent ranks of 512MB DDR SDRAM system memory, FPGA-controlled
 - 100MHz memory bus frequency (32 bit)
 - Up to 800 MB/s
 - 2-out-of-3 voting in FPGA
 - Scrubbing to prevent accumulation of SEU
 - No functional interruption in case of an SEU inside the memory
- 2 independent ranks of 256MB Flash, FPGA-controlled
 - Primary and backup Flash ranks contain the same data, auto-selection by boot loader
 - ECC protection
- 1MB FRAM
 - ECC protection
- 4KB serial EEPROM for production data (serial number etc.)

I/O

- All I/O realized in FPGA and available at rear I/O
- Sextuple UART
 - E.g., for communication with other D602
 - Data rates up to 460,800 Baud for each channel
 - Handshake lines: none
- RS232 UART
 - Data rates up to 460,800 Baud
 - 2x 256 Byte transmit/receive buffer
 - Handshake lines: none
- PCI bus
- I²C bus

Mezzanine Slots

- Two PMC slots
 - 32 bit/33 MHz, 3.3V V(I/O)
 - PMC slot 1 with rear I/O (revisions -02 and later)

Miscellaneous

- Voltage monitoring
- Temperature monitoring
- Watchdog
- Reset signal control
- Control of redundant power supplies
- Sleep mode
 - Lowers power consumption in case of primary power supply interruption
 - Power failure indicated through signals from backplane
 - Supports power interruptions specified in Airbus directive ABD0100.1.9
 - CPUs and memory can be put into sleep mode
- Redundant clock generation
- Connection with second D602 possible (with special backplane)
 - Control of shared outputs
 - Exchange of state information
 - BMC and 6x UART link

CompactPCI Bus

- Compliance with CompactPCI Core Specification PICMG 2.0 R3.0
- System slot
- 32-bit/33-MHz PCI-to-PCI bridge
- V(I/O): +3.3V

Electrical Specifications

- Dual power input from CompactPCI bus, uninterrupted (EN 50155, Class S1)
 - 3.3V (-5%/+5%)
 - 5V (-3%/+5%)
 - Standard backplane supplies both input rails with power
 - Continued operation if one power input fails (or is not present)
 - Separate power supplies for the three CPUs and the three main memory ranks
- Supply voltage/power consumption:
 - 30W
 - 15W in sleep mode

Mechanical Specifications

- Dimensions: conforming to CompactPCI specification for 6U boards
- Front panel: 4HP with ejector
- Weight: 640g (with heat sink)

Environmental Specifications

- Temperature range (operation):
 - 1-slot models: -40..+55°C, temperature classes T1, T2, and TX inside buildings, or in containers with temperature control for signalling equipment, according to EN 50125-3, table 2
 - 2-slot models: -40..+70°C, temperature classes T1, T2, and T3 for equipment onboard rolling stock, according to EN 50125-1, table 2
 - Airflow: min. 2 m/s
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing
- Altitude: -300m to +2,000m (EN50124, Class AX)
- Compliant to EN50125-1, meeting requirements of EN61373, Cat. 1, Class B and Classes GTX, GL3 for rolling stock
 - Shock: 50 m/s², 30 ms (EN 61373)
 - Vibration (function): 1 m/s², 5 Hz - 150 Hz (EN 61373)
 - Vibration (lifetime): 7.9 m/s², 5 Hz - 150 Hz (EN 61373)
- For signalling equipment, a distance of 3m from the track bed is required
- Protection class IP00 (EN50124, Category PD1)
- All components soldered

MTBF

- 46 000 h @ 40°C according to MIL.HDBK-217FN2 with modifications.
 - Weighted mean figure for 65% operation in AIC (air inhabited cargo) and 35% operation in GF (ground fixed) conditions
 - 312 437 h @ 40°C according to IEC/TR 62380 (RDF 2000)
 - 430 705 h for continuous operation @ 25°C according to IEC/TR 62380 (RDF 2000)
-

Safety

- Erroneous behavior of CPU/memory subsystem < 1E-8 / h
 - Considering hardware failures and worst-case SEU environment
 - PCB manufactured with a flammability rating of 94V-0 by UL recognized manufacturers
-

EMC Conformity

- EN55011 (radiated emission disturbances - rolling stock)
 - EN 61000-6-4 (radiated emission disturbances - signalling equipment)
 - EN 61000-4-3 (electromagnetic field immunity)
 - EN61000-4-2 (electrostatic discharge immunity)
 - EN61000-4-8 (power - frequency magnetic field)
 - EN61000-4-9 (pulsed magnetic field)
-

BIOS

- MENMON
-

Software Support

- VxWorks, VxWorks/Cert
- PikeOS

Options

Mezzanine Slots

- PMC slot 2 customized for AFDX PMC (rear I/O only)

Real-time Clock

- Buffered by GoldCap

Environmental Specifications

- Temperature range (operation):
 - -40..+70°C (8HP front panel with convection cooling or 4HP front panel with conduction cooling)

Cooling Concept

- Also available with conduction cooling in MEN CCA frame

Some of these options may only be available for large volumes.

- Please ask our sales staff for more information.

Germany

MEN Mikro Elektronik GmbH

Neuwieder Straße 3-7
90411 Nuremberg
Phone +49-911-99 33 5-0

sales@men.de
www.men.de

USA

MEN Micro Inc.

860 Penllyn Blue Bell Pike
Blue Bell, PA 19422
Phone 215-542-9575

sales@menmicro.com
www.menmicro.com

France

MEN Mikro Elektronik SAS

18, rue René Cassin
ZA de la Châtelaine
74240 Gaillard
Phone +33-450-955-312

sales@men-france.fr
www.men-france.fr

China

MEN Mikro Elektronik Co., Ltd.

Room 301A, #971 Dongfang Road
200122 Shanghai
Phone +86-21-5058-0963

sales@men-china.cn
www.men-china.cn

Up-to-date information, documentation and ordering information:

www.men.de/products/d602/

MEN is not responsible for the results of any actions taken on the basis of information in the publication, nor for any error in or omission from the publication. MEN expressly disclaims all and any liability and responsibility to any person, whether a reader of the publication or not, in respect of anything, and of the consequences of anything, done or omitted to be done by any such person in reliance, whether wholly or partially, on the whole or any part of the contents of the publication.

The correct function of MEN products in mission-critical and life-critical applications is limited to the environmental specification given for each product in the technical user manual. The correct function of MEN products under extended environmental conditions is limited to the individual requirement specification and subsequent validation documents for each product for the applicable use case and has to be agreed upon in writing by MEN and the customer. Should the customer purchase or use MEN products for any unintended or unauthorized application, the customer shall indemnify and hold MEN and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim or personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that MEN was negligent regarding the design or manufacture of the part.

In no case is MEN liable for the correct function of the technical installation where MEN products are a part of.

© 2018 MEN Mikro Elektronik GmbH