

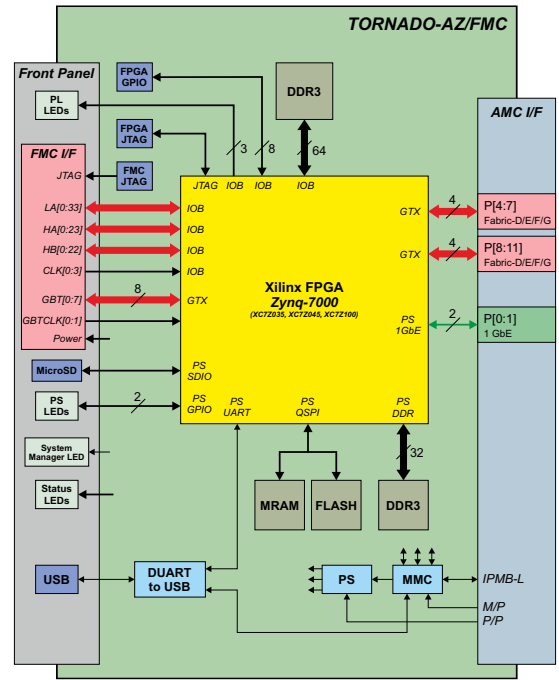
## Key Features

- AMC-module with Zynq-7000 SoC and FMC site for modular MicroTCA® and AdvancedTCA® DSP systems and embedded applications
- Installs into MicroTCA® chassis and AdvancedTCA® mainboards
- FMC site for user adopted I/O using FMC sub-module (AD/DA, RF, etc.)
- In-chassis AMC-to-AMC high-speed real-time data transfer via AMC ports
- Remote control from host PC and Android® devices
- In-chassis AMC-to-AMC control communication
- Unified **TASDK**® tools for applications development and system control
- Complies PICMG® 3.0 Rev.3.0, MicroTCA.0 R1.0, AMC.0 R2.0, IPMI 1.5, VITA® 57.1-2010 specifications
- Stand-alone operation from +12V power for embedded applications



## Details

- Xilinx Zynq-7000 (XC7Z035, XC7Z045, XC7Z100) Kintex AP SoC FPGA with two ARM® cores (PS), high-density logic (PL) and transceivers pool
- VITA® 57.1 FMC HPC site for FMC submodule (160 I/O, 8 GBTs) with a variety of activation modes
- AMC Fabric-DEFG ports 4-7/8-11 for real-time data transfer using 10GbE, 10GBASE-BX4 (XAUI), 40GBASE-KX4, 4x Serial RapidIO (50Gbps), 4x/8x PCIe (32Gbps/64Gbps) protocols
- AMC Fabric-A 1GbE ports 0-1 from PS for remote device control and in-chassis AMC-to-AMC control communication
- DDR3 memory for PS and PL
- PS NOR FLASH memory for applications, data arrays and PL bitstreams
- Nonvolatile MRAM memory for critical PS application data
- Front panel MicroSD card slot for applications and data
- Front-panel PS and PL controlled LEDs
- MMC controller with propriety **TAMMC**® MMC-kernel from MicroLAB Systems, power-temperature monitoring, status indication and more for reliable device operation and protection
- PS and MMC UART ports for remote control and management
- JTAG ports for FPGA and FMC site



TORNADO-AZ/FMC Block Diagram

## Development Tools

- Unified **TASDK**® tools for TORNADO AMC modules with high-level API for quick development of PS applications, PL bitstreams and host Windows, Linux and Android® remote control applications
- Linux, FreeRTOS and "bare-metal" PS software environments
- PS and PL demos for device tests and user projects startup
- Xilinx **Vivado** tools, IP and JTAG emulator to compile and debug PS applications and PL bitstreams

## Applications

- Telecommunication and cell telephony
- RF and SDR
- Image processing
- DSP systems
- Radars and astrophysics
- Industrial, instrumentation and medical



TORNADO-MTCA® DSP modular system including **TORNADO-AZ/FMC** and **TORNADO-A6678/FMC** AMC modules with FMC A/D submodules, **TORNADO-ARX1** RF AMC module and **T/AX-DSPX** AMC module with 10GbE SFP+ ports all installed into MicroTCA® 1U chassis with 10GbE switching fabric



Mini TORNADO-mMTCA® DSP modular system including **TORNADO-AZ/FMC** AMC-module with FMC A/D submodule and **T/AX-DSPX** AMC-module with 10GbE SFP+ ports all installed into dual-slot MicroTCA® mini chassis with passive backplane

## Technical Specifications (TORNADO-AZ/FMC rev.1B)

### FPGA

- Xilinx Zynq-7000: XC7Z035-[1/2/3]FFG900[C/E/I], XC7Z045-[1/2/3]FFG900[C/E/I], XC7Z100-2FFG900I.  
Options to specify during ordering: FPGA type, speed grade ('-1'/'-2'/'-3'), temperature index ('C'/'E'/'I').  
Default FPGA: XC7Z035-1FFG900C (for commercial temperature range), XC7Z100-2FFG900I (for industrial temperature range).
- Two on-board FPGA DDR3 memory banks (specified during ordering):
  - Zynq/PS DDR3: 128M/256Mx32 (512MB/1GB) (mandatory)
  - Zynq/PL DDR3: 128M/256M/512M/1Gx64 (1GB/2GB/4GB/8GB, 1600MTPS) (optional)
- Zynq/PS QSPI NOR FLASH memory 256Mx8 (2Gb).
- Zynq/PS QSPI MRAM memory 128Kx8 (1Mb) (optional, specified during ordering).
- MicroSD card interface (32GB max capacity) (optional, specified during ordering).
- Zynq/PS UART (available via front panel USB port).
- 8-bit external Zynq/PL XGPIO[0:7] (LVTTTL 3V) with individual direction control (optional, specified during ordering).
- Zynq/PL bitstream loading modes: from Zynq/PS applications, via JTAG.
- Zynq/PL bitstream decryption key battery (optional, specified during ordering). User replaceable every 4 years.
- Debug port: Xilinx JTAG (14-pin, LVTTTL 3V) via adapter cable.

### FMC site interface

- Complies VITA 57.1-2008 (R2010) specification.
- FMC mezzanine submodule width: single.
- FMC mezzanine submodule stacking: 10mm (default), 8.5mm (optional).
- FMC interface type: HPC, LPC.
- Number of I/O: 160 (LA[0:33], HA[0:23], HB[0:21]).
- Number of I/O clocks: 4 (CLK\_M2C[0:1]\_p/n, CLK[2:3]\_BIDIR\_p/n with CLK\_DIR direction indicator).
- I/O logic levels (Vadj) for LA/HA/HB I/O pins and CLK\_M2C/CLK\_BIDIR clocks: 1.2V, 1.5V, 1.8V, 2.5V, 3.3V (is set upon activation mode for FMC submodule).
- Compatible FMC VIO\_B\_M2C voltage range: 0V-Vadj.
- Compatible FMC VREF\_A\_M2C voltage range: 0V-Vadj (not monitored, OV protection provided, shall be guaranteed by design of FMC submodule).
- Compatible FMC VREF\_B\_M2C voltage range: 0V-VIO\_B\_M2C (not monitored, OV protection provided, shall be guaranteed by design of FMC submodule).
- Number of GBT transceivers: 8 (GBT[0:7]).
- Number of GBT reference clocks: 2 (GBTCLK\_M2C[0:1]\_p/n).
- GBT bitrate: 8Gbps (for FPGA with '-1' speed grade), 10.3Gbps (for FPGA with '-2' speed grade), 12.5Gbps (for FPGA with '-3' speed grade).
- FMC power consumption: 1Amax@+12V, 3Amax@+3.3V, 4Amax@Vadj, 0.05Amax@+3.3V\_AUX.
- FPGA PL FMC I/F IOB power consumption: 0.3Amax@VIO\_B\_M2C, 0.5mA@VREF\_A\_M2C, 0.5mA@VREF\_B\_M2C.
- Debug port: JTAG (10-pin, LVTTTL 3V) via adapter cable.

### Front-panel

- A "window" for front bezel of FMC mezzanine submodule.
- Zynq/PS application controlled LEDs: 2 (Red/Green, Green/Yellow).
- Zynq/PL application controlled LEDs: 3 (Red/Green, Green/Yellow, Yellow/Green/Blue).
- AMC status LEDs: BLUE LED, AMC LED1 ("Power" function, Red/Green), AMC LED2 ("t<sup>o</sup>" function, Yellow/Green).
- Zynq/PS System Manager Status LED (Yellow/Green/Blue).
- Zynq/PL configuration status LED (Red/Green).
- FMC submodule status LED (Red/Green/Blue).
- MicroSD card slot (optional, specified during ordering) and MicroSD card power status LED (Red/Green).
- Micro-USB port with MMC UART (115kbaud) and Zynq/PS UART (115kbaud).

### AMC interface

- Complies PICMG® AMC.0 R2.0, MicroTCA.0 R1.0 specifications.
- AMC Fabric-DEFG ports 4-7 and 8-11 (AMC.2 Ethernet, AMC.4 Serial RapidIO, AMC.1 PCIe).
- AMC-Fabric-A ports 0-1 (AMC.2 1GbE).
- MMC ports: IPMB-L port

### MMC module management controller

- Firmware based on propriety **TAMMC®** high-performance MMC-kernel from MicroLAB Systems.
- Complies IPMI 1.5, IPMB CPS v1.0, PICMG® 3.0 rev.3.0, MicroTCA.0 R1.0, AMC.0 R2.0 and VITA® 57.1-2008 specifications.
- High-speed monitoring of payload power and all backend power supplies.
- Multi-point temperature monitoring for PCB, FPGA and FMC submodule area.
- Activation and status monitoring of FMC submodule.
- LED indicators for power and temperature status of AMC module and for FMC submodule status.
- Remote MMC console via MMC UART 115kbaud port.

### Physical

- Dimensions (is specified on ordering):
  - Single width Mid-size (M/S) AMC-module (181 x 74 x 19 mm) (default).
  - Single width Full-size (F/S) AMC-module (181 x 74 x 29 mm) (optional).
- Weight 0.35 kg.

### Power and temperature

- AMC +12V P/P payload power or external +12V power for stand-alone/embedded applications:
  - without FMC mezzanine submodule installed: +12V @ 0.8A (min) (9W), 1.8A (typ) (22W), 4.5A (max) (55W).
  - with max power FMC mezzanine submodule installed: +12V @ 2.8A (typ) (34W), 6.2A (max) (74W).
- AMC M/P management power: +3.3V @50mA (typ).
- Operating temperature (ambient): 0°C...+55°C (FPGA with 'C'/'E' temperature grades), -40°C...+55°C (FPGA with 'I' temperature grade).
- Storage temperature (ambient): -40°C...+80°C.

## Ordering information

### TAZFMC1B/XC7Z1002I/D1/F2/E512/M128/A01/SD/LD2/LI/FC/FB/SA/MS

TORNADO-AZ/FMC rev.1B AMC-module, Xilinx Zynq-7000 XC7Z100-2FFG900I (**XZ1002I**), 1GB (256Mx32) Zynq/PS DDR3 memory (**D1**), 2Gb (256Mx8) Zynq/PS QSPI FLASH memory (**F2**), 512Kb (64Kx8) Zynq/PS I<sup>2</sup>C SEEPROM memory (**E512**), 128Kx8 Zynq/PS nonvolatile QSPI MRAM memory (**M128**), 1GbE PHY for AMC ports 0 and 1 (**A01**), front panel MicroSD card slot (**SD**), 2GB (256Mx64) Zynq/PL DDR3 memory bank #1 (**LD2**), 8-bit external Zynq/PL XGPIO interface (**LI**), FMC site interface (**FC**), Zynq/PL bitstream decryption key battery (**FB**), stand-alone/embedded operation mode support (**SA**), single-width mid-size (M/S) AMC-module dimension (**MS**), standard 10mm FMC mezzanine module stacking.