FPGA Mezzanine Card (FMC) Power Module

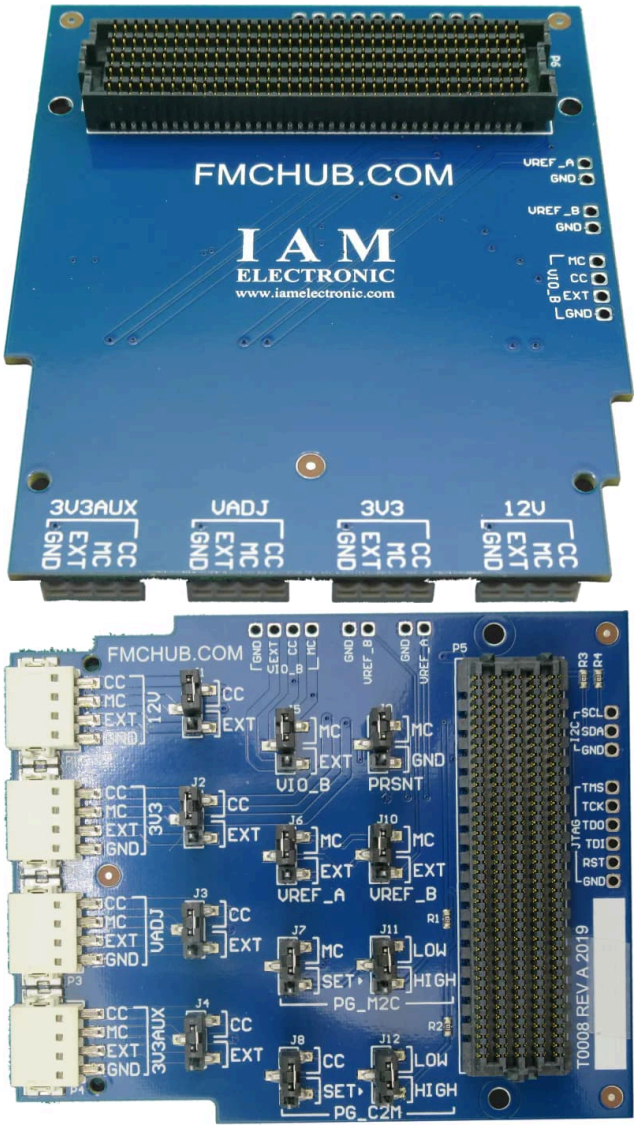
Features

- HPC pass-through between carrier and mezzanine: all FMC HPC signals are forwarded
- All four voltage rails (12P0V, 3P3V, VADJ, 3P3VAUX) opened and brought to a push-in wire connector each
- Voltage and current measurement on every rail
- Jumper per rail: mezzanine fed from the carrier or from an external supply
- Stand-alone supply of a mezzanine without a carrier
- Control flags PRSNT, PG_C2M and PG_M2C passed through or set by jumper
- VIO_B, VREF_A and VREF_B from the mezzanine or from an external source
- I2C and JTAG on pads
- Open-source hardware

Applications

- Voltage and current measurements on the power rails of a carrier or a mezzanine
- Current consumption per rail for the FRU EEPROM of a mezzanine
- Overvoltage and undervoltage tests
- Stand-alone supply of a mezzanine from bench supplies
- Compliance and production tests
- Prototyping and debugging

FMC Power Module



1. Description

An FPGA mezzanine card (FMC) draws its power from four rails: 12P0V, 3P3V, VADJ and 3P3VAUX. On a carrier board these rails run straight from the regulators to the FMC connector, so the voltage and the current of a single rail cannot be measured, and a rail cannot be fed from outside. Every mezzanine has to store its power requirements in the EEPROM of its Field Replaceable Unit (FRU), and those figures come from a measurement.

The **FMC Power Module** is plugged in between carrier and mezzanine and opens each of the four rails. It was built for three jobs:

- **Measuring:** voltage and current of every rail, on the carrier side and on the mezzanine side.
- **Feeding from outside:** a rail can be supplied from a bench supply, for overvoltage and undervoltage tests or to power a mezzanine stand-alone, with no carrier underneath.
- **Setting the control flags:** PRSNT_M2C_L, PG_C2M and PG_M2C are passed through or set by jumper, so a mezzanine can be held in a defined state whatever the carrier does.

All other FMC HPC signals are passed straight through from the mezzanine card connector P5 (MC-HPC-10, bottom side, faces the carrier) to the carrier card connector P6 (CC-HPC-10, top side, takes the mezzanine).

2. Application information

2.1 Rail connectors

Each rail is brought to its own 4-pole push-in connector on the board edge, P1 to P4 (tab. 1). The four contacts carry the carrier side of the rail (CC), the mezzanine side (MC), the external input (EXT) and ground (GND). The contacts are named on the silkscreen. Use solid wire or stranded wire with a ferrule, 26 to 20 AWG.

Tab. 1: Rail connectors and their contacts.

Connector	Rail	Contact 1	Contact 2	Contact 3	Contact 4
P1	12P0V	12P0V_CC	12P0V_MC	12P0V_EXT	GND
P2	3P3V	3P3V_CC	3P3V_MC	3P3V_EXT	GND
P3	VADJ	VADJ_CC	VADJ_MC	VADJ_EXT	GND
P4	3P3VAUX	3P3VAUX_CC	3P3VAUX_MC	3P3VAUX_EXT	GND

2.2 Jumpers

Twelve 3-pin jumpers set the source of every rail, the reference voltages and the control flags (tab. 2). The middle pin always carries the signal that is being switched; the two outer positions are named on the silkscreen. A HIGH level set with J11 or J12 comes from a 10 kΩ pull-up (R1, R2) to 3P3V on the mezzanine side, so it needs 3P3V there, from the carrier or from the external input.

Tab. 2: Jumpers and their positions. Silkscreen names in capitals.

Jumper	Signal	First position	Second position
J1	12P0V	CC: mezzanine fed from the carrier	EXT: mezzanine fed from the external input of P1
J2	3P3V	CC: mezzanine fed from the carrier	EXT: mezzanine fed from the external input of P2
J3	VADJ	CC: mezzanine fed from the carrier	EXT: mezzanine fed from the external input of P3

J4	3P3VAUX	CC: mezzanine fed from the carrier	EXT: mezzanine fed from the external input of P4
J5	VIO_B_M2C	MC: carrier receives VIO_B from the mezzanine	EXT: carrier receives VIO_B from the external pad
J6	VREF_A_M2C	MC: carrier receives VREF_A from the mezzanine	EXT: carrier receives VREF_A from the external pad
J10	VREF_B_M2C	MC: carrier receives VREF_B from the mezzanine	EXT: carrier receives VREF_B from the external pad
J9	PRSNT_M2C_L	MC: passed through from the mezzanine	GND: carrier sees a mezzanine as present
J7	PG_M2C	MC: passed through from the mezzanine	SET: carrier receives the level set with J11
J11	PG_M2C level	LOW: ground	HIGH: 10 kΩ pull-up to 3P3V
J8	PG_C2M	CC: passed through from the carrier	SET: mezzanine receives the level set with J12
J12	PG_C2M level	LOW: ground	HIGH: 10 kΩ pull-up to 3P3V

The external inputs of VIO_B, VREF_A and VREF_B are pads next to the jumpers, each with a GND pad beside it. The VIO_B group also has pads for its carrier side (CC) and its mezzanine side (MC).

2.3 Measuring voltage and current

The voltage of a rail at the mezzanine is measured between the MC and GND contacts of its connector, the voltage delivered by the carrier between the CC and GND contacts. The current a mezzanine draws from the carrier is measured in one of two ways:

- **At the connector:** remove the jumper of the rail and connect the ammeter between the CC and MC contacts of its connector.
- **At the jumper:** remove the jumper of the rail and connect the ammeter between its CC pin and its middle pin.

With the jumper on EXT, the current is the current of the external supply. A rail whose jumper is removed and that has no ammeter in its place is open: the mezzanine gets no supply on it.

2.4 External supply and stand-alone operation

Set the jumper of a rail to EXT and connect a bench supply between the EXT and GND contacts of its connector. The carrier side of that rail then ends at the CC contact and no longer reaches the mezzanine. This is how a mezzanine is run at a voltage the carrier does not deliver, in an overvoltage or undervoltage test for example. Operating a mezzanine outside its specification can damage it.

Without a carrier, the FMC Power Module powers a mezzanine stand-alone: set the jumpers of all rails the mezzanine needs to EXT and feed each of them from a bench supply. A mezzanine that waits for PG_C2M gets it with J8 on SET and J12 on HIGH.

2.5 I2C and JTAG

The I2C bus (SCL, SDA, GND) and JTAG (TMS, TCK, TDO, TDI, RST for TRST_L, GND) come out on pads next to the mezzanine card connector, named on the silkscreen. SCL and SDA each have a 10 kΩ pull-up (R3, R4) to 3P3V on the mezzanine side.

3. Electrical data

The printed circuit board is open-source hardware. The FMC Power Module schematics and the board layout files are on GitHub in their latest revision.

Tab. 3: Parts list of the FMC Power Module.

Designator	Description	Manufacturer and part

P1 to P4	Push-in wire connector, 4 poles, 2.5 mm pitch	Phoenix Contact 1814650 (PTSM 0,5/4-2,5-H SMD)
P5	FMC HPC mezzanine card connector MC-HPC-10	Samtec ASP-134488-01
P6	FMC HPC carrier card connector CC-HPC-10	Samtec ASP-134486-01
J1 to J12	Pin header, 3 pins, 2.54 mm pitch	Samtec TSM-103-04-T-SV
R1 to R4	Resistor 10 kΩ, 1 %, 0603	Walsin WR06X1002FTL

The board has four copper layers and a thickness of 1.6 mm. The rail traces are 1.27 mm wide. The carrier and mezzanine sides of 12P0V, 3P3V and 3P3VAUX run on the inner layers, VADJ runs on the outer layers. Tab. 4 gives the current each rail carries for a temperature rise of 10 °C, calculated from the trace width and the copper thickness (IPC-2221). The values are calculated, not measured.

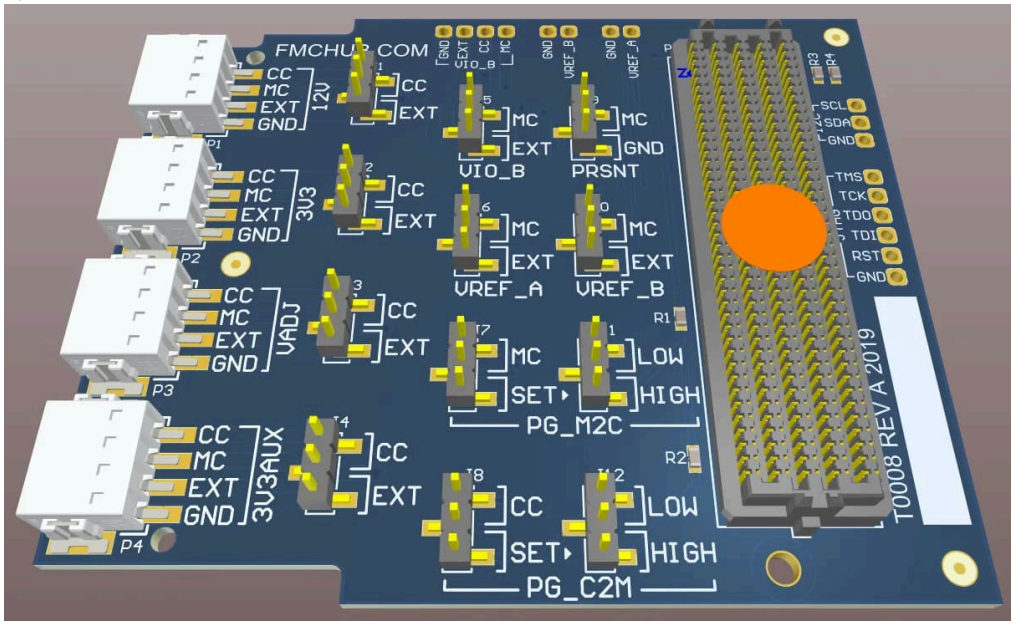
Tab. 4: Current per rail, calculated for a temperature rise of 10 °C.

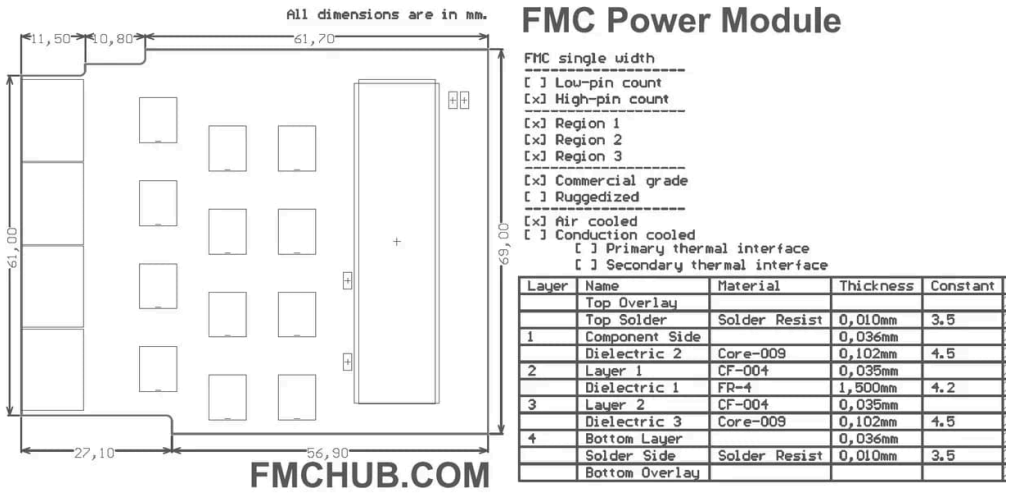
Rail	Traces	Current
12P0V	1.27 mm, inner layer, 35 µm copper	1.4 A
3P3V	1.27 mm, inner layer, 35 µm copper	1.4 A
VADJ	1.27 mm, outer layer, 36 µm copper	2.9 A
3P3VAUX	1.27 mm, inner layer, 35 µm copper	1.4 A

The rail connectors P1 to P4 are rated 5 A per contact by their manufacturer.

4. Mechanical data

The board outline is defined by the ANSI/VITA 57.1 standard for single-width FMC modules and uses the regions 1, 2 and 3. The board measures 84.0 mm × 69.0 mm.





Layer	Name	Material	Thickness	Constant
	Top Overlay			
	Top Solder	Solder Resist	0,010mm	3.5
1	Component Side		0,036mm	
	Dielectric 2	Core-009	0,102mm	4.5
2	Layer 1	CF-004	0,035mm	
	Dielectric 1	FR-4	1,500mm	4.2
3	Layer 2	CF-004	0,035mm	
	Dielectric 3	Core-009	0,102mm	4.5
4	Bottom Layer		0,036mm	
	Solder Side	Solder Resist	0,010mm	3.5
	Bottom Overlay			

Fig. 1: Mechanical drawing of the FMC Power Module.

The mounting holes are plated but have no electrical connection. Their sizes and positions are in accordance with ANSI/VITA 57.1 single-width FMC modules.

5. Ordering information

The FMC Power Module can be ordered at various online market places, or you can request a quotation by sending an e-mail to info@iamelectronic.com. The board is supplied with twelve jumpers.

Tab. 5: Assembly variants of FMC Power Module with product numbers and market places.

Product no.	Description	Market place	Request quote	Standard lead time
T0008	FMC Power Module with MC-HPC-10 and CC-HPC-10 connectors on bottom and top side, with twelve jumpers.	IAM Electronic Shop Ebay #185439259823 Tindie #26892 DigiKey 6068-T0008-ND	info@iamelectronic.com	Normally in stock, otherwise 3 weeks

6. Document history

Document number:
DS#T0008

Version history:
2026/11/25: Description rewritten. Added: application information, parts list, current per rail, board dimensions
2022/05/24: Add ordering information, Tindie and ebay article listings
2022/05/20: Initial release