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PowerMX Specifications and Example Applications

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NRC-Herzberg Astronomy Technology Program

Outline

- Motivation for PowerMX.
- PowerMX Specifications.
- Example applications.
- On-line order forms/configurators.
- Future work/vision.

Motivation for PowerMX

- We (engineers in the CSP consortium) are tasked with developing and costing designs now, for production and deployment in the 2018-2022 timeframe.
  - Anything we do now may be obsolete requiring expensive re-design…but we have limited funds and resources.
  - Is there a way to minimize the cost of the next design cycle?

Motivation for PowerMX

- Rather than develop “just another board”, or develop to an existing industry standard that is looking old or doesn’t have the performance/scalability we need…

- Develop a specification that has features that meet our needs, with lots of I/O and performance to “future proof” it.

Motivation for PowerMX

- Factor out, as much as possible, those bits that can survive technology generations…leaving the minimum to develop on the next generation.

- Enough specification for compatibility, enough room for innovation.

Motivation for PowerMX

- Of course, every such technology specification eventually maxes out and needs updating.
  - Make it a “living” set of specifications, adding specifications as needed to keep up with technology evolution.

- Provide a platform to facilitate access/connectivity of FPGAs.
  - But of course not restricted to FPGAs…any devices can be used allowing for development of heterogeneous computing architectures.

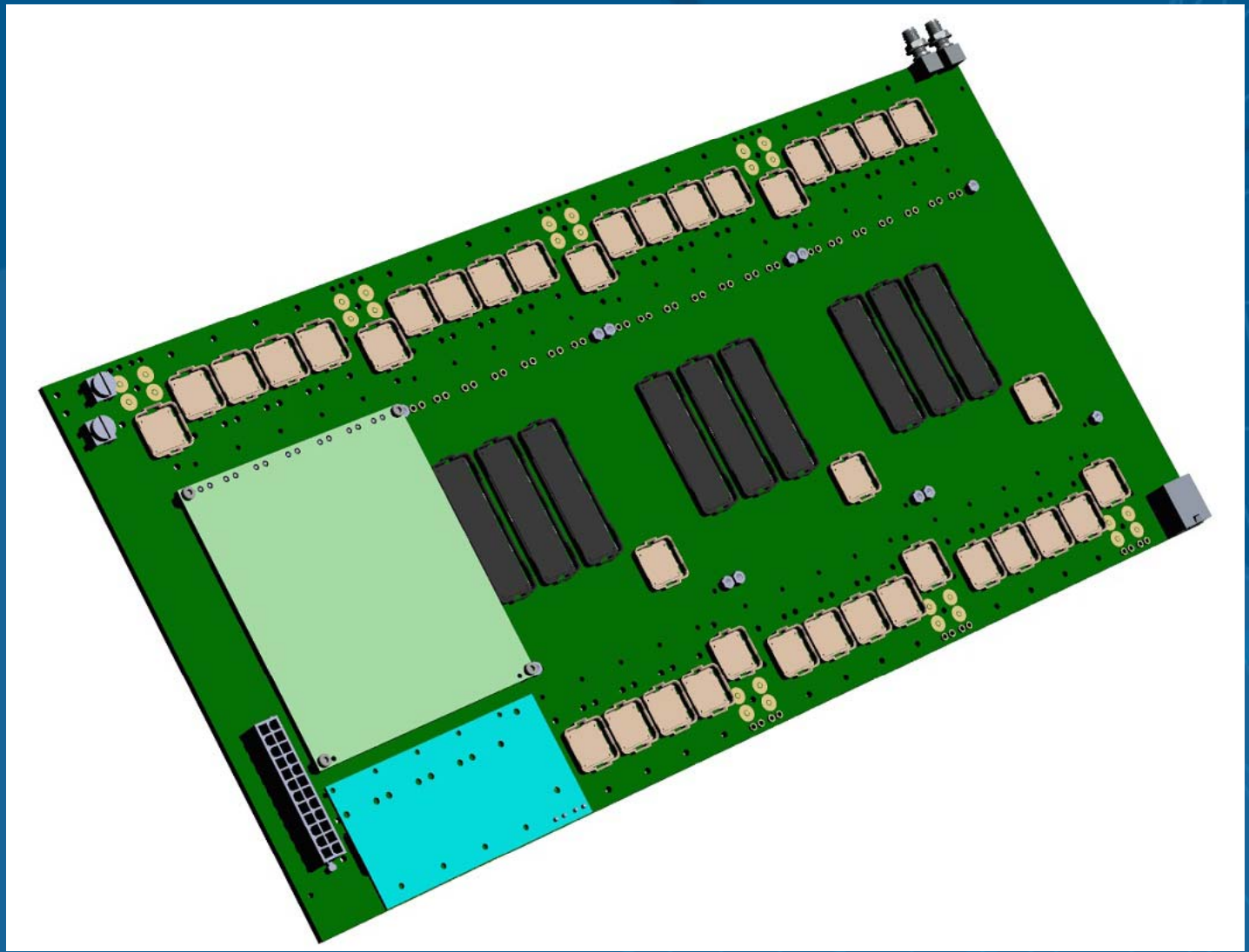
PowerMX PMX.1 Base Specification

- See www.powermx.org for the full PMX.1 Base Specification, open, public, freely available for use.

- Basic concept:
  - Motherboard contains M&C and power infrastructure…1-4 sites.
  - Processing (PMXM) and I/O (PMX_IOC) mezzanine boards.
  - All SERDES connectivity.
  - Use 4 mm stack FCI Meg-Array connector for reliability and 28G/pair performance.
  - Full 4-site motherboard: 384 serial I/Os (@28G ea ~= 10.75 Tbps)
  - A la carte: be fully or partially compliant, as desired. E.g. “hardened” m.b.

- Precipitated from Aug 28-30, 2013 mtg—16 participants, 9 organizations.
  - Not everyone is convinced this is the way to go…
  - Currently “Preliminary”…undergoing H/W design/test.

PowerMX PMX.1 Base Specification



PowerMX PMX.1 Base Specification

PowerMX
PMX.1
Base Specification

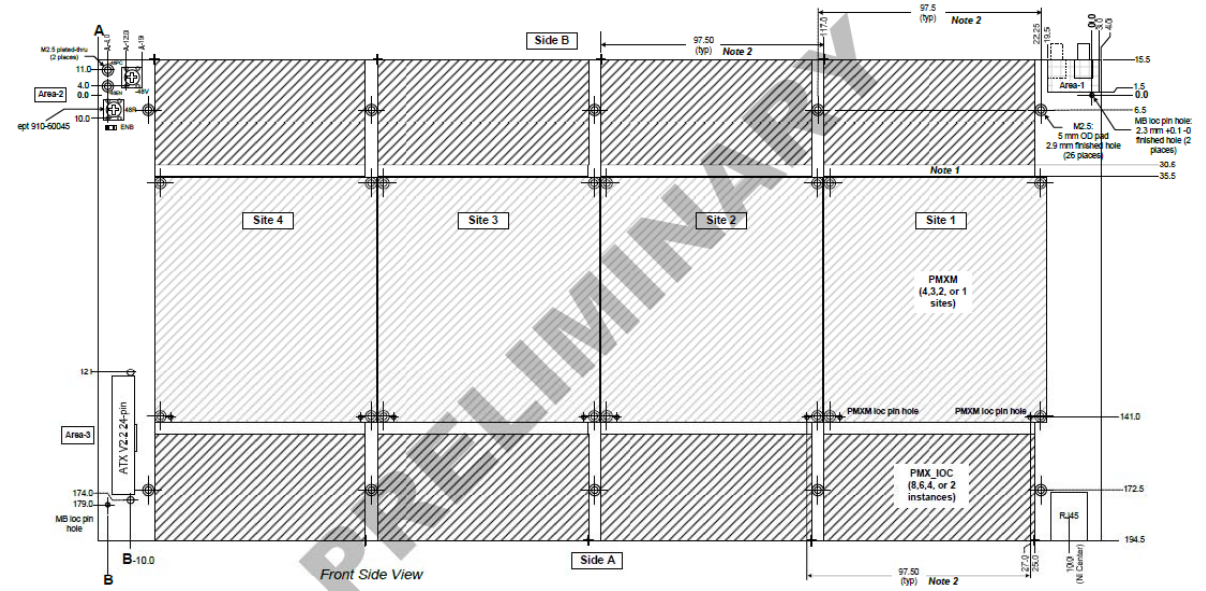


Figure 5-1 PowerMX motherboard dimensions. Coordinates A and B depend on the number of sites provided and are defined in Table 5-1.

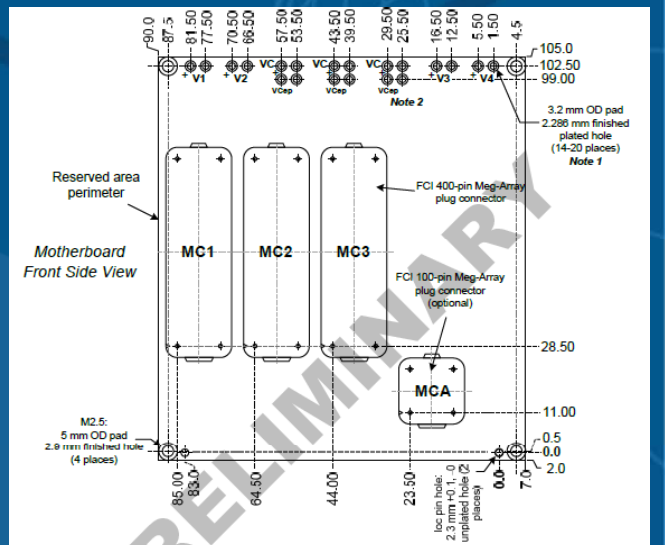


Figure 5-6 PMXM footprint on the motherboard. The "reserved area perimeter" indicates the perimeter within which only those components shown in this drawing may be located on the Front Side of the motherboard.

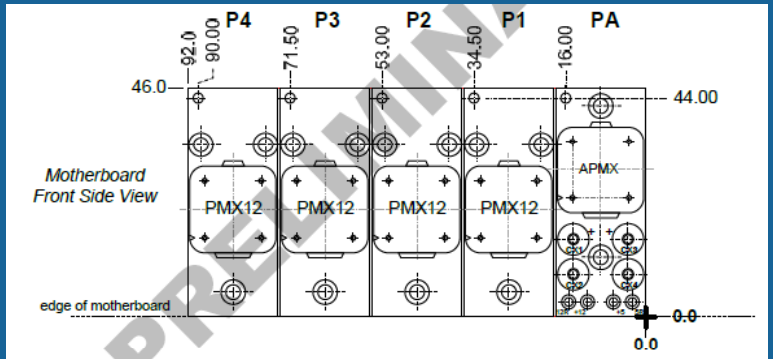


Figure 5-3 PMX_IOC footprint on motherboard showing key coordinates and nomenclature. Note that APMX and PMX12 footprint dimensions are 18.0 mm x 46.0 mm with an 18.50 mm intra PMX_IOC module-to-module pitch.

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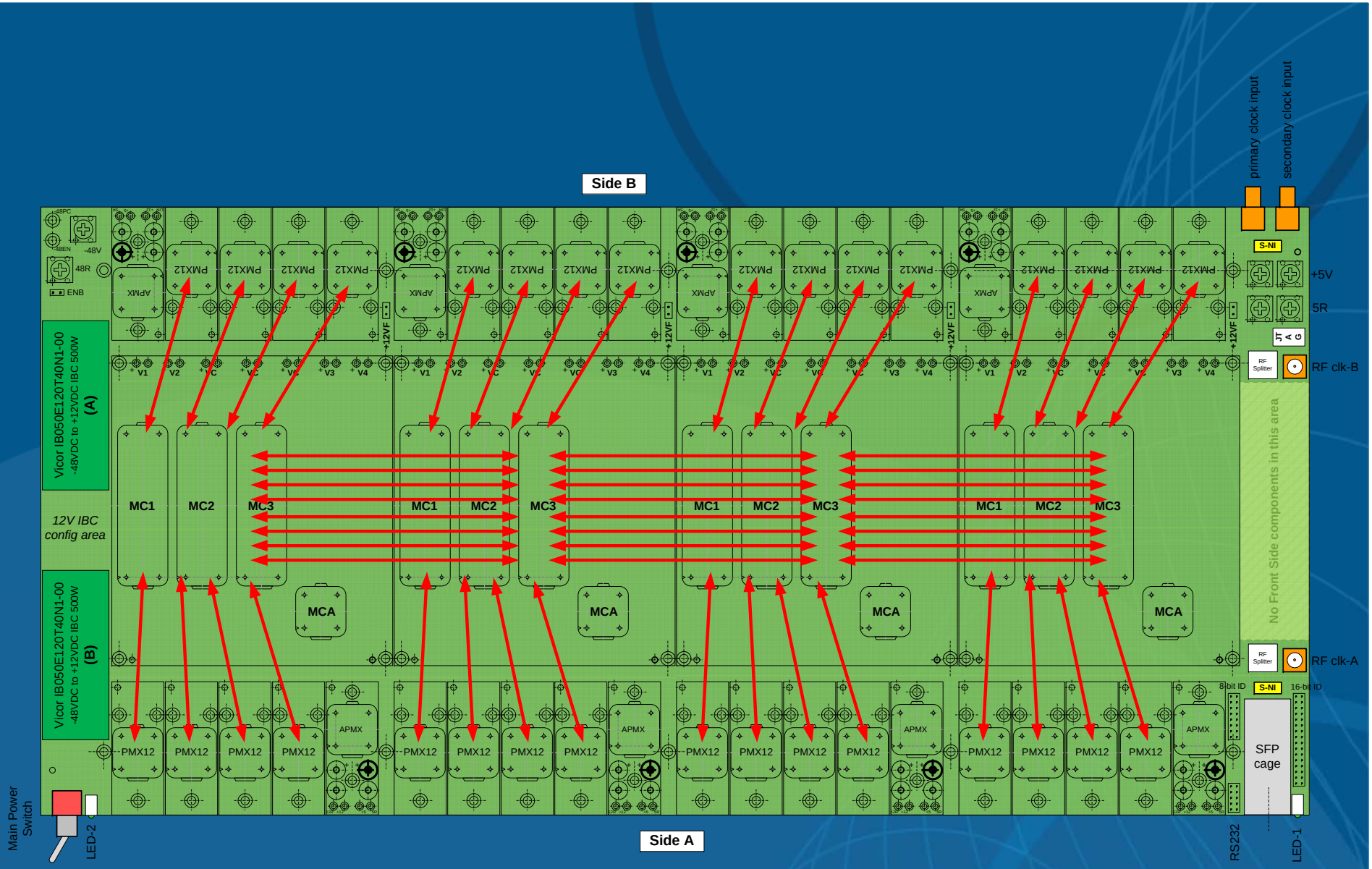
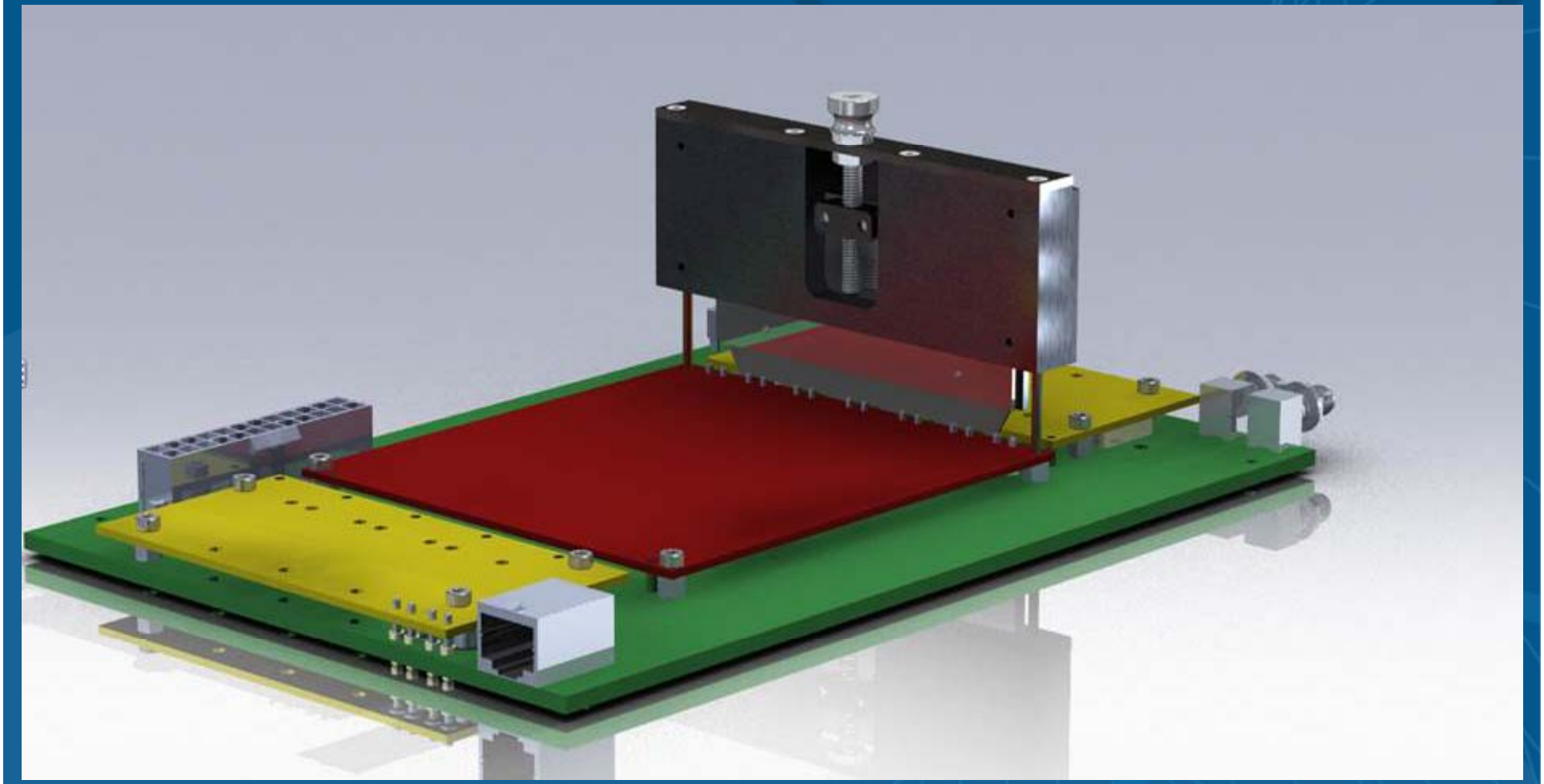

Side B
primary clock input
secondary clock input
S-NI
+5V
5R
JTAG
RF Splitter
RF clk-B
RF clk-A
Vicor IB050E120T40N1-00
-48VDC to +12VDC IBC 500W
(A)
Vicor IB050E120T40N1-00
-48VDC to +12VDC IBC 500W
(B)
12V IBC
config area
MC1
MC2
MC3
MCA
PMX12
APMX
+12VF
V1
V2
VC
V3
V4
No Front Side components in this area
8-bit ID
16-bit ID
SFP
cage
RS232
LED-1
LED-2
Main Power
Switch
-48PC
-48EN
-48V
48R
ENB
Side A



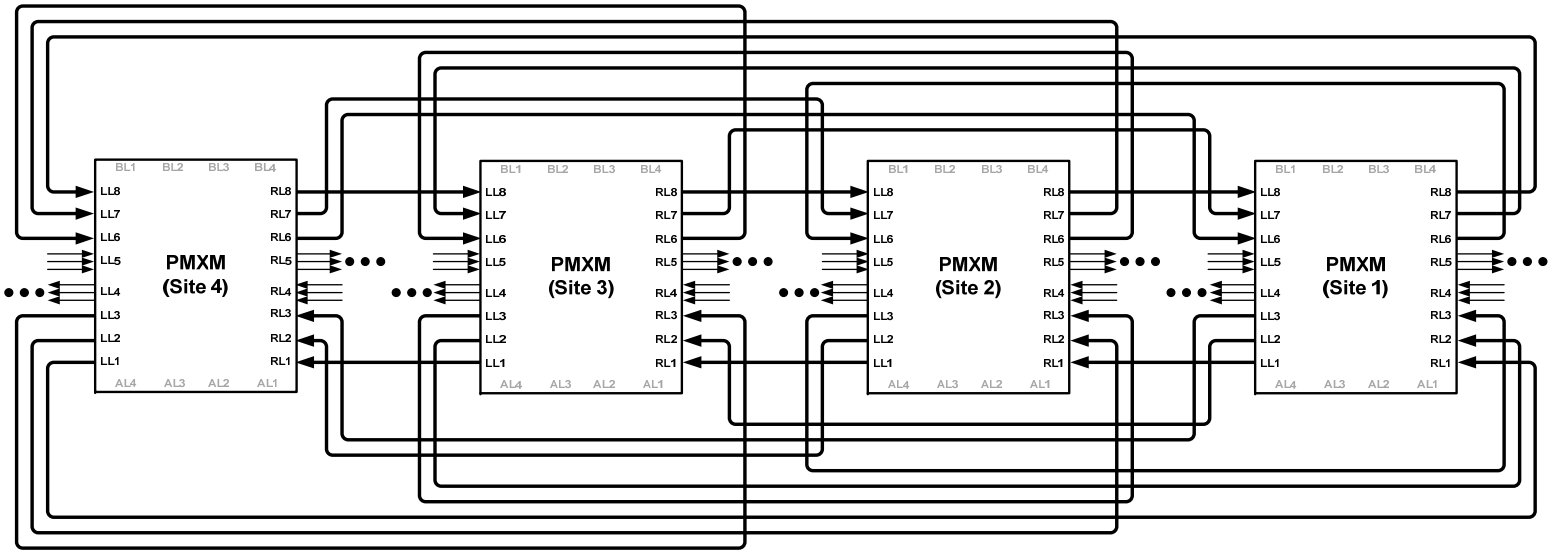
PowerMX PMX.1 Base Specification

- Includes PA/QA requirements, reliability reporting…and auditing.
  - Establishes base level of quality and reliability reporting.

- Also includes description of plan/vision for more layers, defined in other specification documents:
  - Other H/W layers (PMX.1.x)
  - SMC: Supervisory M&C (PMX.2.x)
  - AMC : Application M&C (PMX.3.x)
  - PMX.4.x: Application F/W
  - PMX.5.x: Applications…

PowerMX PMX.1.1 Mesh Specification

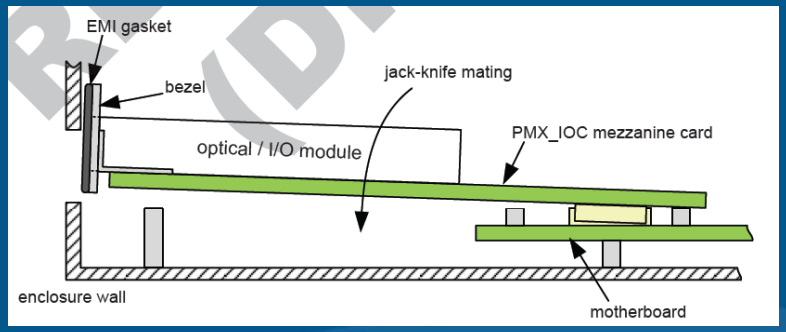
- Defines motherboard PMXM-to-PMXM mesh connectivity.
  - Prioritized lanes with possibility for hybrid mesh and nearest neighbour connectivity.
  - If there can be different flavours of mezzanines, why not motherboards?

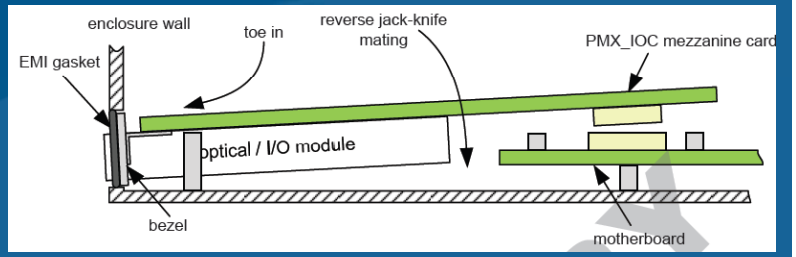


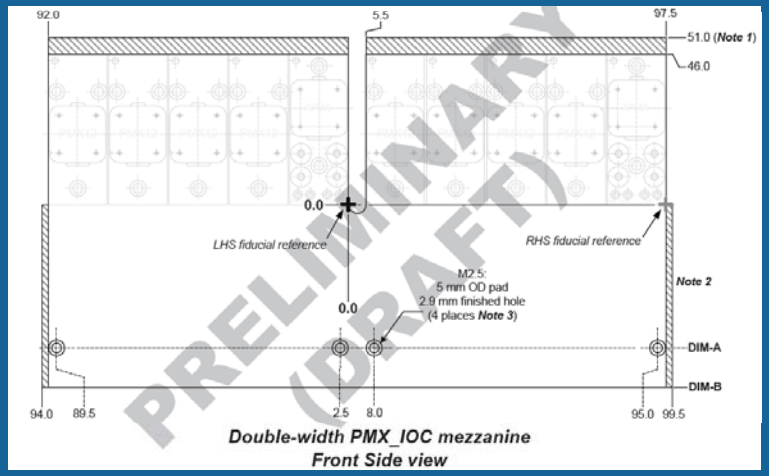
PowerMX PMX.1.2 Standard I/O Module Specification

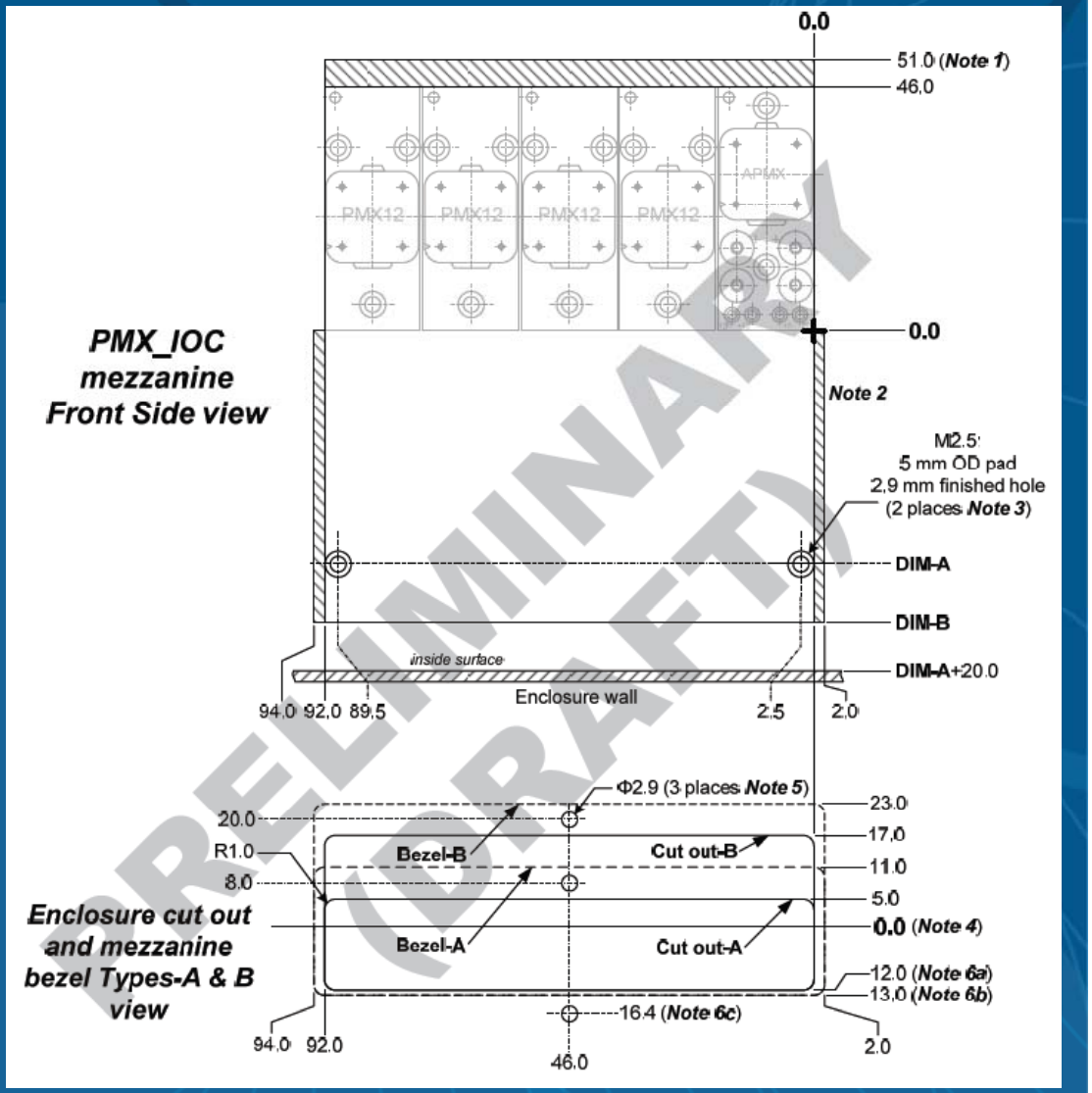
- Defines standard PMX_IOC (I/O) module dimensions.
  - 4 different module sizes for different needs.
  - 3 different bezel sizes for different needs.
- Establishes certainty for compatibility between PCBAs and enclosures.

PowerMX PMX.1.2 Specification









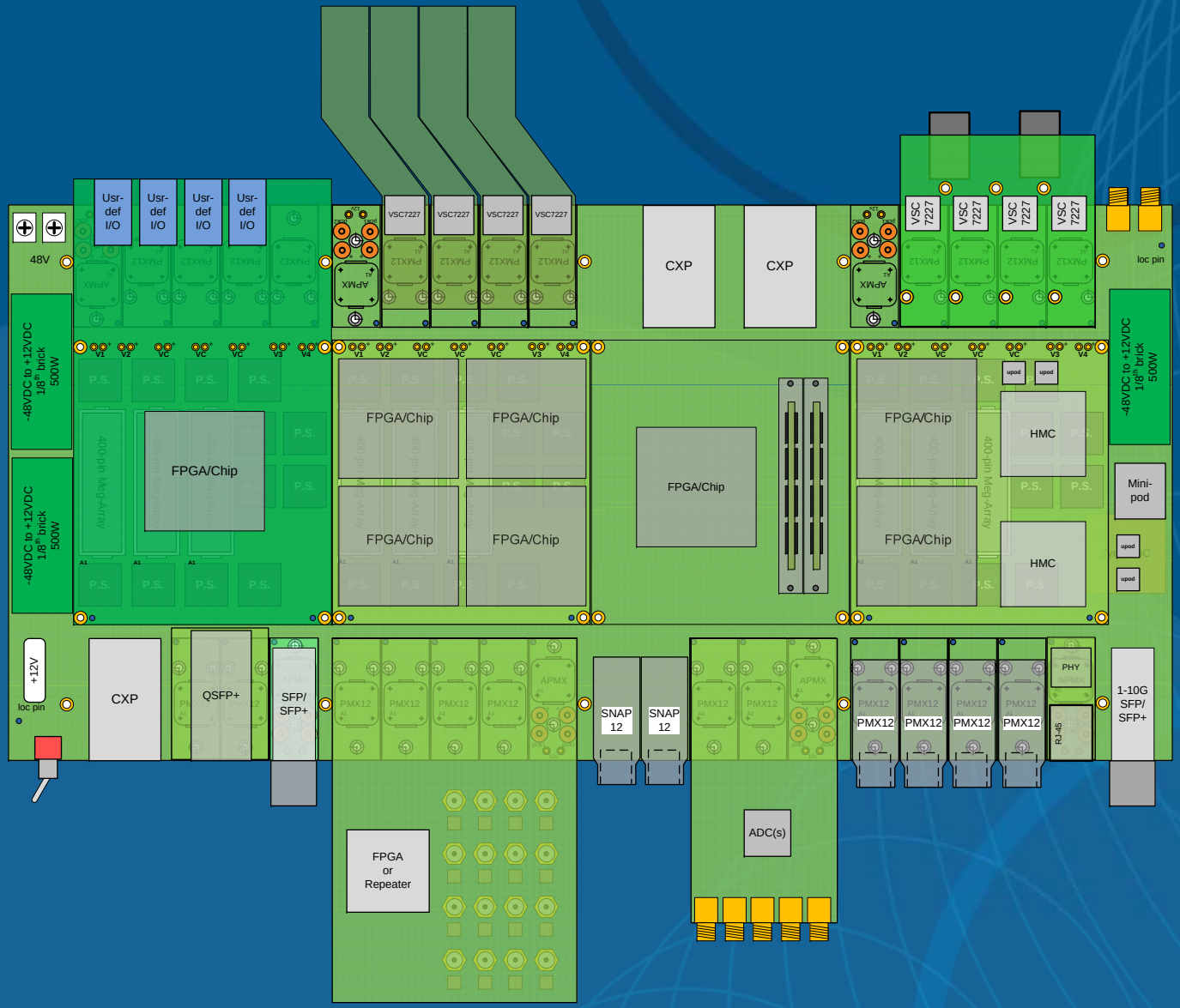
PowerMX PMX.1.3 Specification

- Defines 64-pair PMX_IOC…for more intensive I/O and less PMXM-to-PMXM. Still a work in progress.

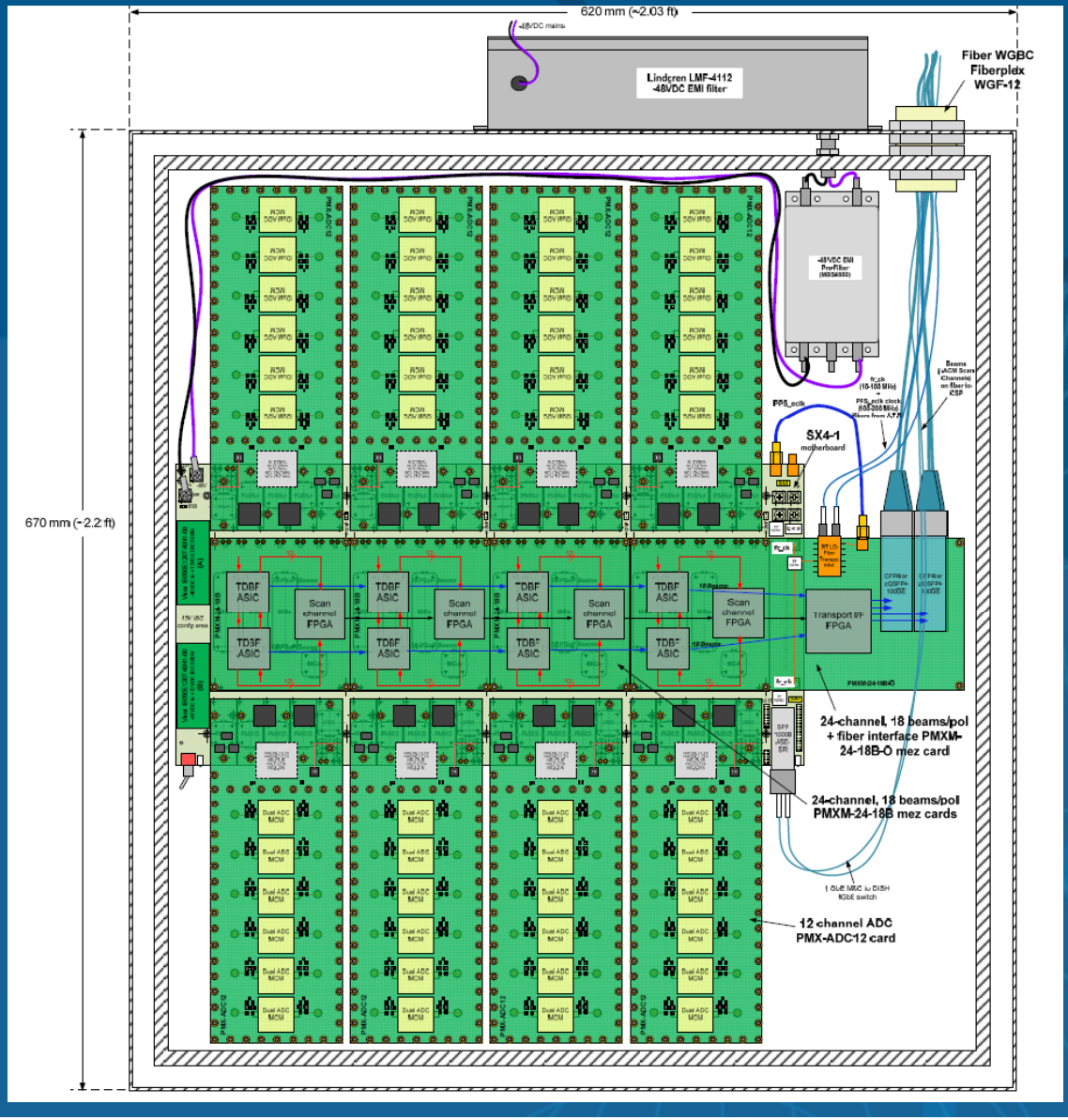
VCC	GND	GND	GND	VCC	VCC	VCC	GND	GND	VCC	1
GND	P0+	P0-	GND	GND	P8+	P8-	GND	GND	GND	2
Tm	GND	GND	P4+	P4-	GND	GND	P12+	P12-	GND	3
GND	P1+	P1-	GND	GND	P9+	P9-	GND	GND	GND	4
VCCm	GND	GND	P5+	P5-	GND	GND	P13+	P13-	+12V	5
GND	P2+	P2-	GND	GND	P10+	P10-	GND	GND	GND	6
SD	GND	GND	P6+	P6-	GND	GND	P14+	P14-	+12V	7
GND	P3+	P3-	GND	GND	P11+	P11-	GND	GND	GND	8
Hn	GND	GND	P7+	P7-	GND	GND	P15+	P15-	Vsen-	9
Fn_E	1W	VCC	VCC	GND	GND	VCC	VCC	VCC	Vsen+	10
A	B	C	D	E	F	G	H	J	K	

PMX16 100-pin Meg-Array Pinouts

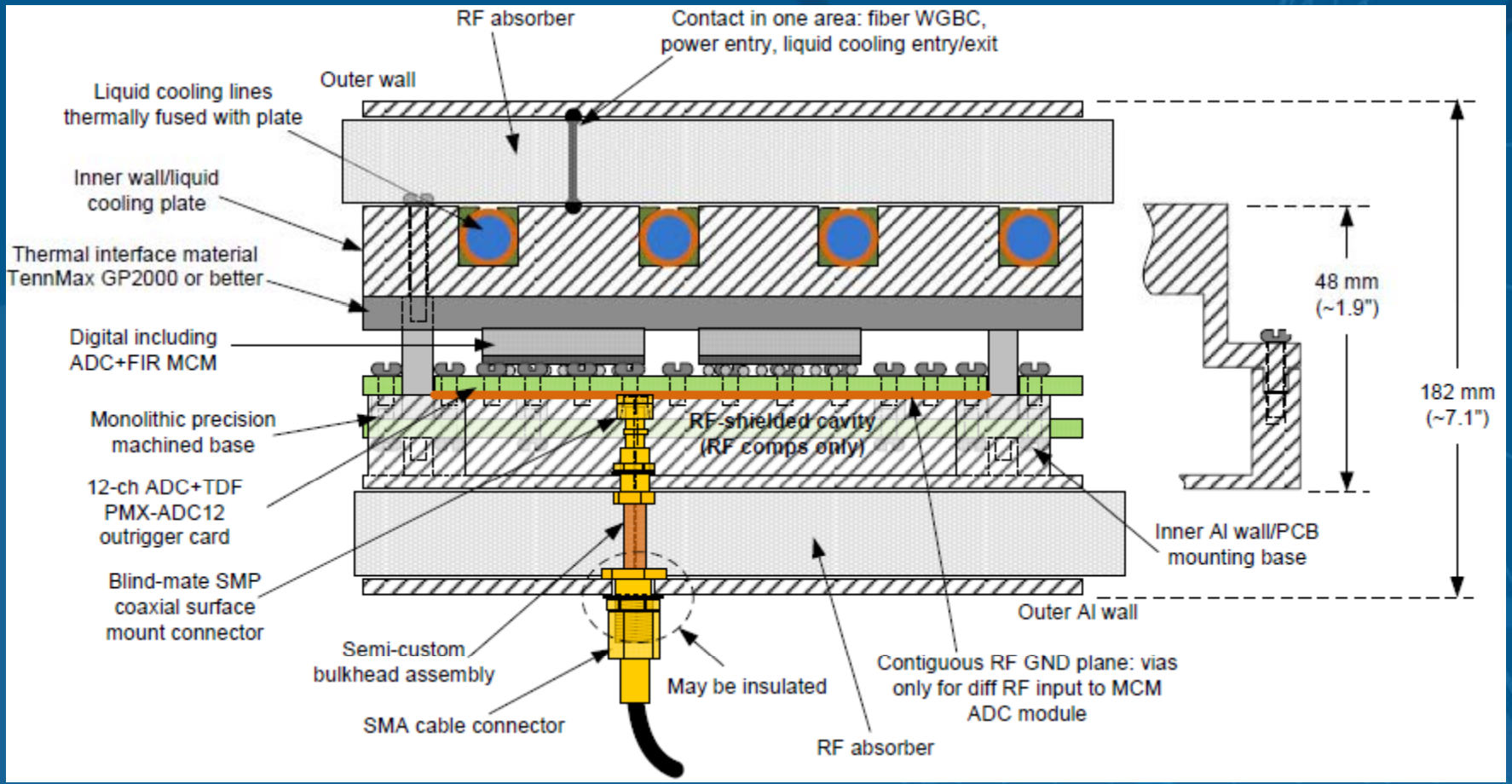
Packaging/Use Examples: Collage of possibilities



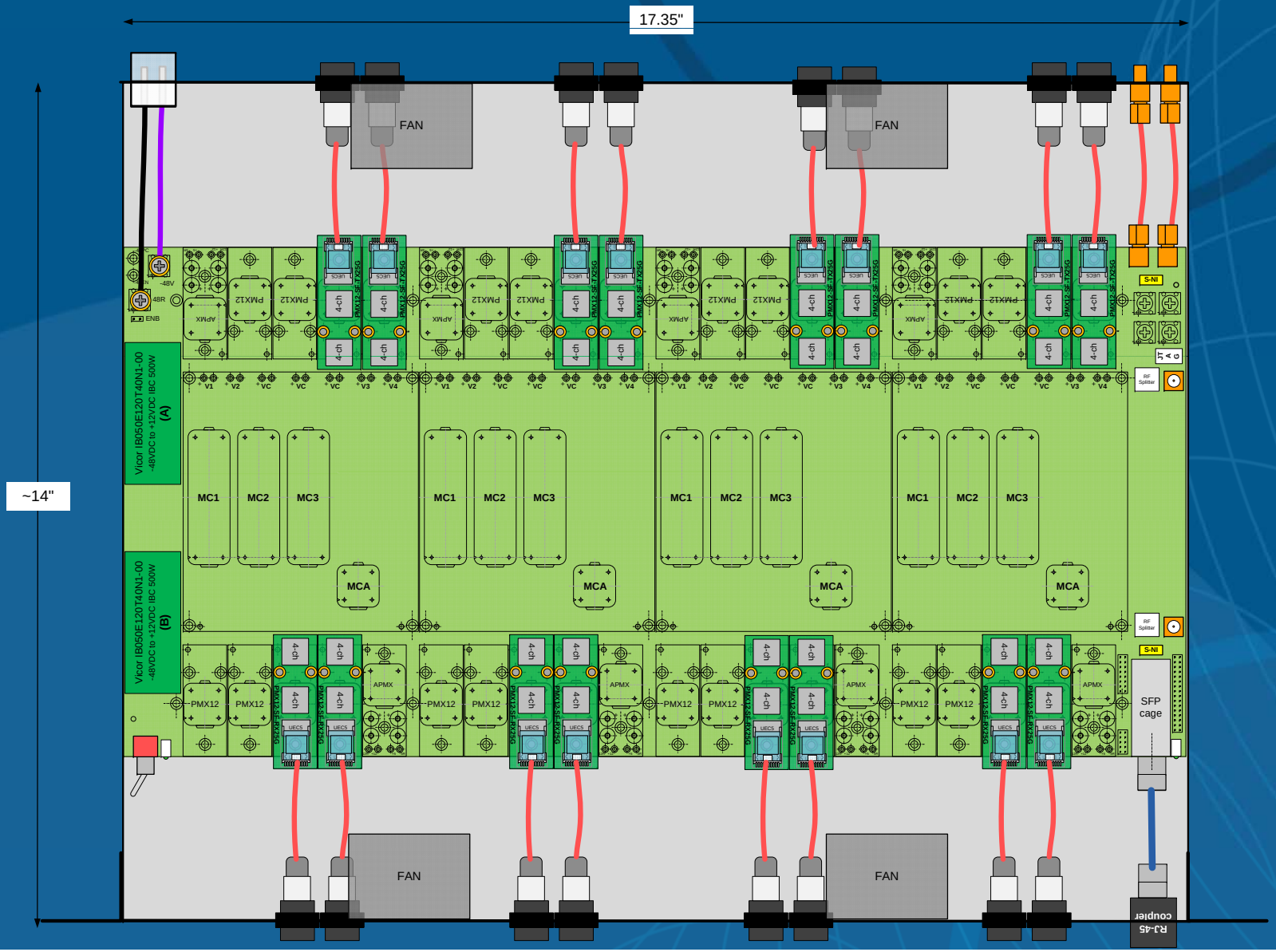
Packaging/Use Examples: PAF DBE/Beamformer



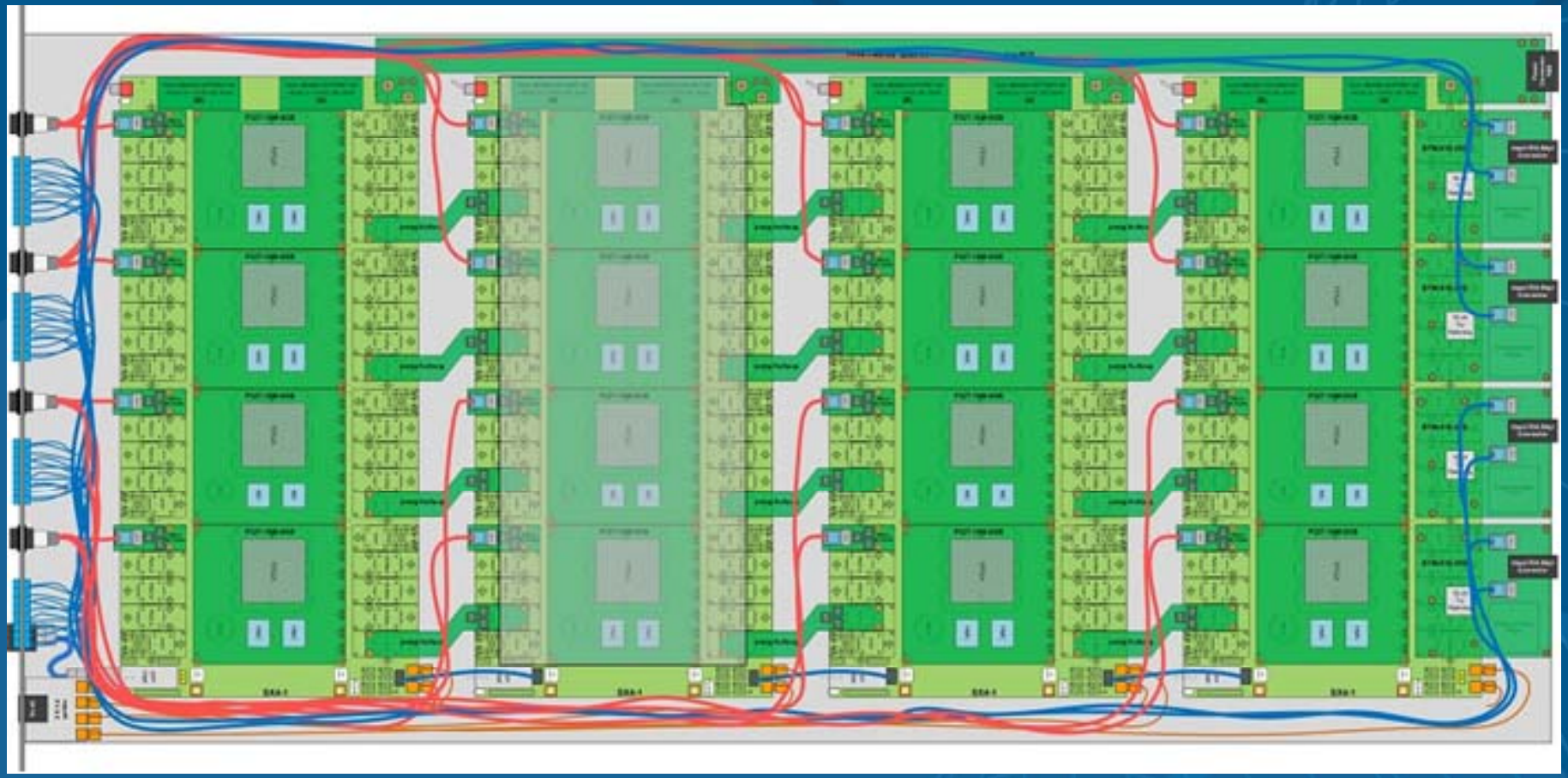
Packaging/Use Examples: PAF DBE/Beamformer



Packaging/Use Examples: Pizza box



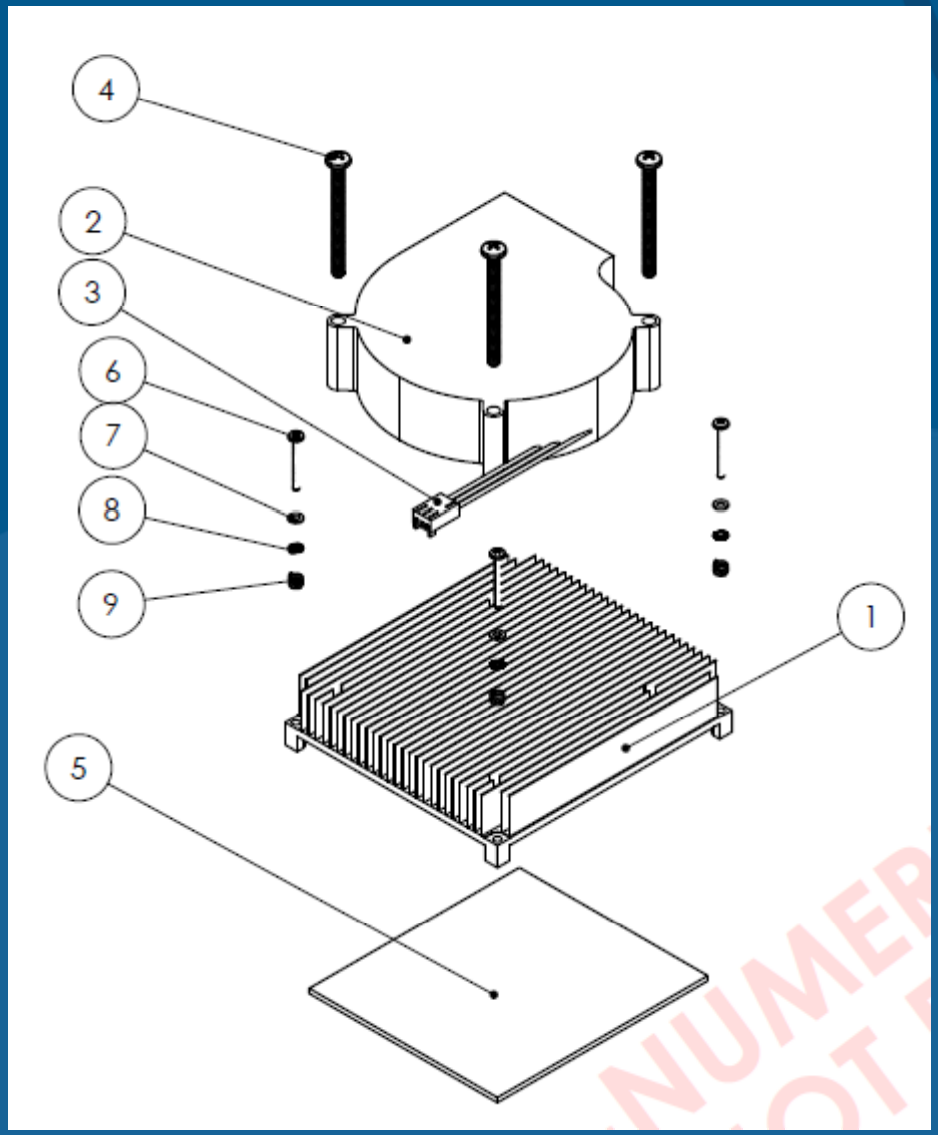
Packaging/Use Examples: Multi-board blade



On-line order forms/configurators

- In addition to being an open-public set of specifications, use the www.powermx.org web site as a goto site for anyone to order parts from mfgs:
  - PCBAs.
  - Mechanical bits and pieces.
  - Applications(?)

- Currently two such mechanical items are in the works:
  - Parameterized PMXM active-fan/passive heatsink—Radian Heatsinks CA, U.S. Available imminently. Done “on spec”.
  - Parameterized pizza box “configurator” compliant to PMX.1 and PMX.1.2 specifications—Imagination Machine Works, Kelowna Canada. Also done “on spec”.



Parameters:

-Fan type (axial, squirrel cage, none).

-Fin height.

-Post height.

-Mounting style (hard or spring).

-Thermal interface material type and thickness.

On-line order forms/configurators

- Want to also add:
  - Thermal modeling configurator...using free on-line thermal modeling software (if possible).
  - Parameterized PMXM liquid cooled plate.

Future work/vision

- Flesh out vision of module plug-n-play compatibility.
  - Further specification layers define module requirements for such compatibility.
  - F/W, host S/W device drivers, “out of the box” GUIs.
  - Definition and set up of repository for applications.

1. Buy modules/motherboards/mechanics for your application.
2. Open box, plug them in.
3. Power up…”self-aware”…download S/W/drivers.
4. Ready for further application development, or ready to start processing.

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Thank you

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