

A Multi Chip Module (MCM) for the S-ALTRO electronics

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Original plan: Mount all the electronics directly onto the pad module using bump bonded chips to minimize the size.

Some facts to keep in mind :

The 16 channel S-Altro chip (S-Altro16) will be produced in an engineering run and be available in a fairly large number (about 3000 chips) in 2011.

The budget is limited which calls for a solution for the electronics which reduces the costs.

The electronics development needs many prototype steps. An 'all on one board' approach will be very expensive in prototyping.

It will take several years before the 64 channel S-Altro (S-Altro64) is available.

The S-Altro16 chip is consistent with the PCA16-Altro combination in terms of signals and control.

Goals for the S-Altro16 electronics prototype:

The prototype pad modules has to fit into the present endplate

The chip size should be compatible with a realistic pad size. The final goal is to get down to $1 \times 4 \text{ mm}^2$ pad size. The present pad size is about $1 \times 5 \text{ mm}^2$ and the prototype should be compatible with similar size.

Power pulsing should be prototyped.

A solution for efficient cooling has to be found.

A realistic noise level should be achieved.

Experience with the S-Altro16 chip should guarantee a safe final step to the S-Altro64 chip.

Disadvantages with mounting all the electronics directly onto the pad module

Replacement of a malfunctioning bump bonded chip is a difficult operation and requires advanced equipment if at all possible.

A wire bonded chip is easier to replace. However, the die of the S-Altro16 chip is about 50 mm^2 and adding 2mm around it for wire bonding together with the area required for passive components we end up with almost 200 mm^2 . This would correspond to a pad size of $1 \times 10 \text{ mm}^2$.

The pad module has to be dismounted

It will be expensive if a whole module has to be replaced.

Advantages in placing the electronics on separate boards (Multi Chip Modules)

With few or no electronics components on the pad board, it will be easier to design and manufacture. The trace routing is simpler and the pad board needs fewer layers.

Changes during the prototyping phase will be easier to implement and will not be so costly

The S-Altro part and the controller/readout part can be separated.

The trace routing on the plug in board(s) will be easier compared to the case where all the electronics is placed on the pad module.

Analogue and digital functions can be well separated which makes it easier to optimize noise performance.

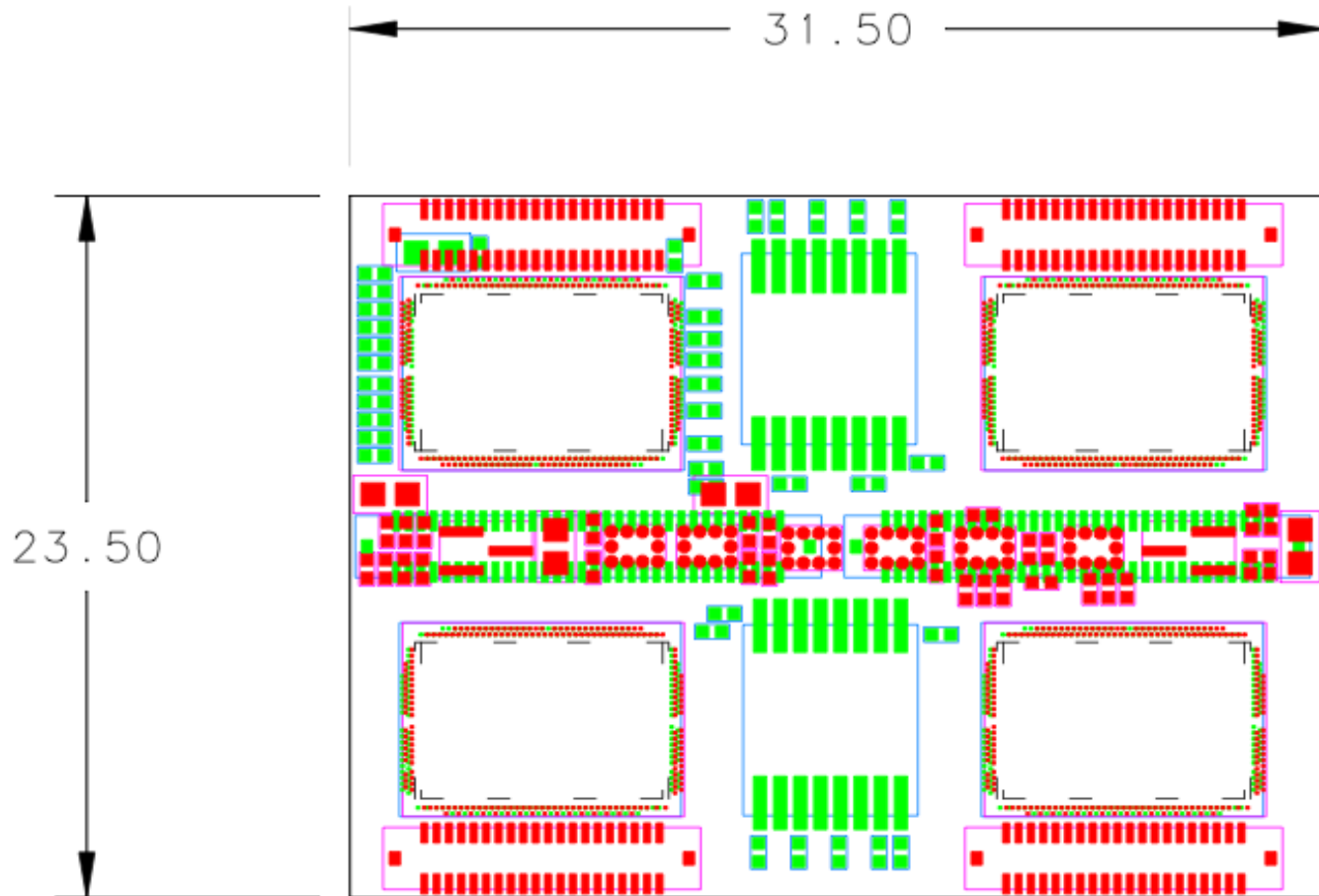
It moves heat away from the TPC endplate

It makes service easier. A malfunction in the readout chain can be fixed by simply replacing a small electronics board instead of dismounting the pad module

The S-Altro16 MCM

Components in red are facing the pad module whereas components in green are on the opposite side.
(note that the chip frame is the occupied bond-area and not the die size)

The dimensions of the board is compatible with a pad size of 1x6 mm².



The readout

In order to keep the size of the MCM to a minimum the following should be placed on a separate board:

The board controller FPGA

The GTL bus-driver chips and/or other interfaces

The voltage regulators for the LV supply

In order to go for a solution similar to the present architecture an MCM should have equally many channels as the FEC has today and a common readout board for 6-8 MCM:s seems practical.

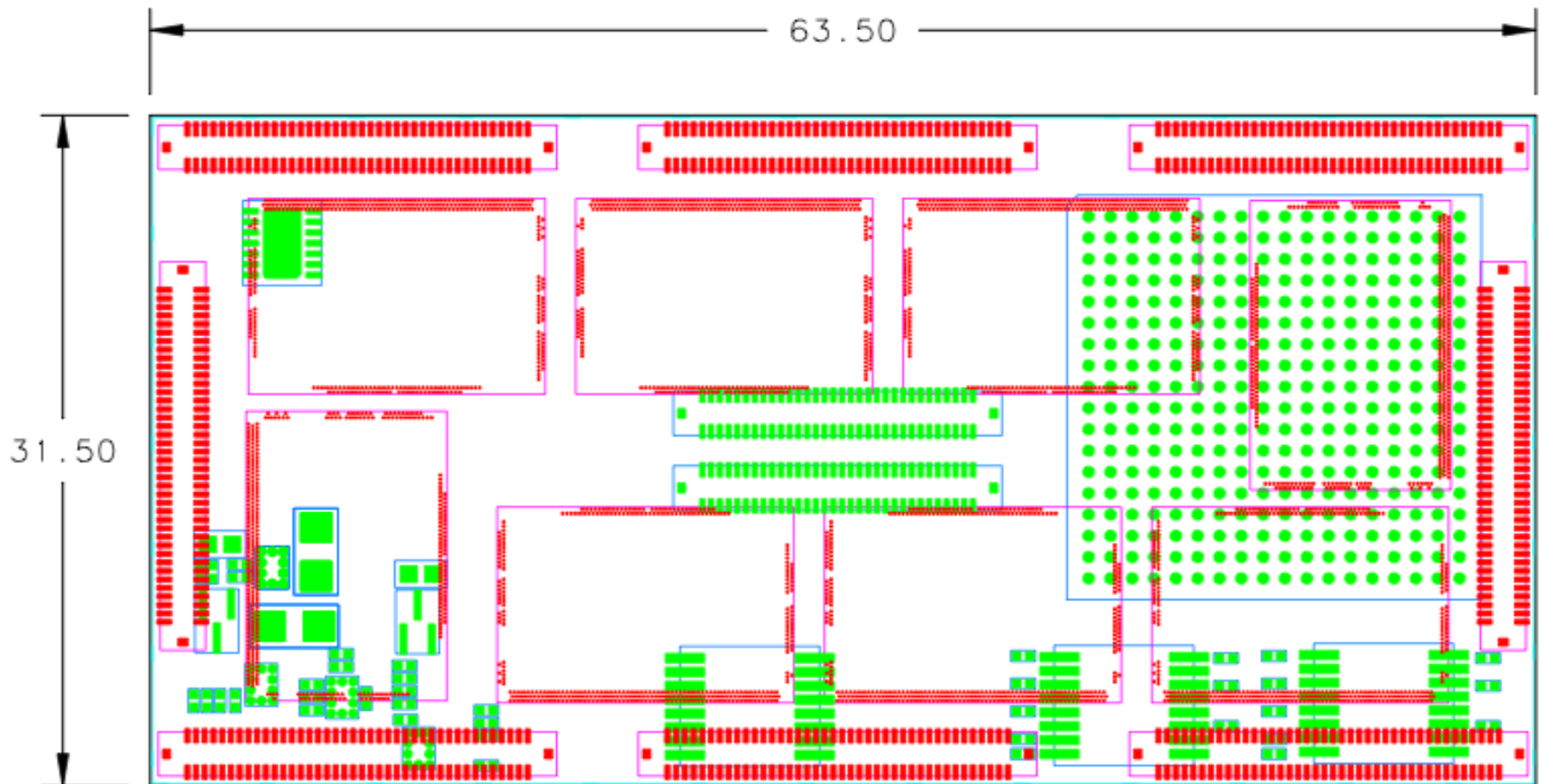
The connection to the Readout Control Unit (RCU) can be done via short flat cables.

For the long term future a redesign of the readout architecture can be prepared like e.g. fast serial optical readout.

The S-Altro64 MCM

The actual dimensions of the chip are not known but the size has been estimated to 100 mm². The dimensions 12.5x8 mm² has been assumed.

The size of the board is compatible with 1x4 mm² pads.



Summary

There are obvious disadvantages in mounting all the electronics directly onto the pad module.

Instead a system with Multi Chip Modules is proposed.

It is a fairly conservative approach, reducing the risks.

Cheaper to produce

It has several advantages in the prototyping phase.

It provides realistic prototyping for safely taking the final step to the S-Altro64 chip.

It offers better separation between analogue and digital circuitry and it offers great flexibility in terms of how the electronics components are organized.

The size of the MCM for the S-Altro64 chip is compatible with $1 \times 4 \text{ mm}^2$ pads

It can be easily moved from a system with GEM readout to a system with MicroMegas readout.

Its modular structure allows re-design of the readout chain without affecting the pad board

It offers simple and fast servicing compared to if the electronics is mounted directly on the pad board

and last but not least

It offers excellent opportunities for several institutes to contribute in various areas which means that the available resources and competence can be used in the most efficient way