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INFN Milano Bicocca, INFN Trieste

PMT/SIPM READOUT SYSTEM FOR THE MAROC ASIC

Alessandro Berra, Davide Bolognini, Michela Prest (Università dell'insubria, INFN Milano Bicocca, Italy)
Erik Vallazza (INFN Trieste, Italy)

ABSTRACT

We present a VME system used to read out MA-PMT and SiPM. A scintillator bar tracker instrumented with 1 mm diameter SiPM from FBK-IRST is shown. The MAROC-3 ASIC is used with an external trigger based on scintillator tiles.

The Multi Anode ReadOut Chip [1](MAROC) has been developed by the Omega group [2](LAL, Orsay) for the ATLAS luminometer to read out 64 multi-anode PMT. The ASIC is produced in 0.35 µm SiGe technology and its main features are a 100% trigger efficiency for signals larger than 1/3 photoelectron, a dynamic range extending to ~5pC with a linearity of 2% or better and a crosstalk less than 1%. Three different versions have been produced; each MAROC channel consists of a low impedance pre-amplifier with a variable gain, a tunable slow shaper and a sample & hold circuit for the analog readout, a tunable fast shaper and a discriminator (the threshold is provided by a 10 bit DAC) for the digital one; the number of the components (e.g. fast shapers) varies depending on the version. The ASIC provides one multiplexed analog output which can be digitized by an external ADC or by an internal 8, 10 or 12 bit Wilkinson ADC, and 64 parallel HSTL digital outputs. The MAROC ASIC has been used in high energy physics both with MAPMTs and SiPMs.

TECHNOLOGY STAGE

- The MAROC ASIC is available contacting the LAL group (contact person: Pierre Barrillon)
- The INFN readout board and VME control board could be made available within a frame of scientific collaboration

POSSIBLE APPLICATIONS

High energy physics

The ASIC will be used:

- to read out the MAPMTs (Hamamatsu H7546B) of the Electron Muon Ranger (EMR) detector in the framework of the MICE experiment; tests on bench and with particles have already been made
- to read out the SiPMs of a shashlik calorimeter (a 19 X_0 lead scintillator calorimeter) used on the CERN T9 line in the framework of the INFN FACTOR/TWICE experiment.
- to read out the scintillator bar tracker of the ASCUSA-CUSP TRAP antihydrogen experiment at CERN (in collaboration with INFN Pavia/University of Brescia).

Medical physics

Dosimeter for gammas with scintillator fibers and for neutrons with boron doped scintillator fibers. The fibers can be read out by either SiPMs or MAPMTs.

MAIN SPECIFICATIONS (MAROC-3 ASIC)

- Area: 16mm^2 (4mm x 3.9mm)
- Technology: AMS 0.35µm SiGe
- Power rail: 3.5V
- Power consumption: 220mW (~ 3.5mW/channel)
- Package: CQFP240

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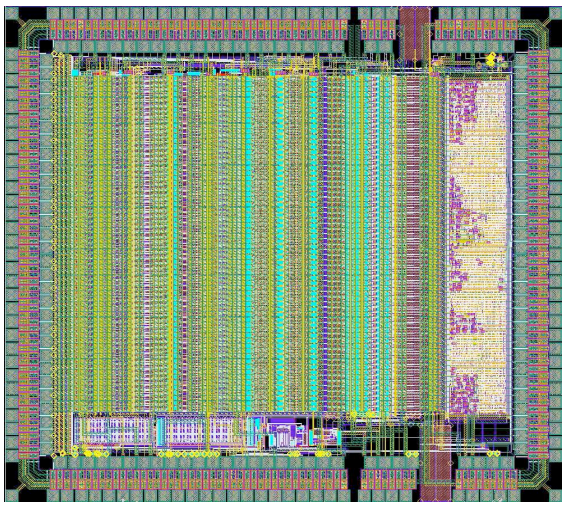
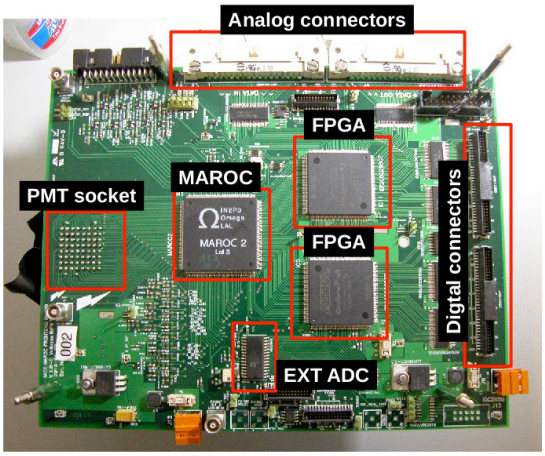


Layout of the MAROC (4x3.9 mm^2)



MAROC prototype board hosting the socket for the MAPMT, the MAROC ASIC, two FPGAs to configure the ASIC and to perform the readout sequence.

ADVANTAGES

- Low impedance, large bandwidth input stage
- Analog and digital readout
- Self-triggering
- All the MAROC components are tunable with a string of bits
- Channel-by-channel configuration capabilities
- Internal ADC

LIMITATIONS

- No possibility to act on the SiPM bias values

SPECIFICATIONS OF THE INFN READOUT BOARD:

- One MAROC-2 or MAROC-3 ASIC (64 channels)
- Differential LVDS connections for analog readout, configuration and control (two 34-pin cables)
- External ADC for analog readout (AD9220) with the possibility to use the

internal ADC of the MAROC-3

- Analog readout with up to 4 board on the same output cable
- Controlled by a dedicated VME board (MAROC CONTROL), based on the ALTERA Cyclone-II FPGA.
- USB and PC Parallel Port interface under test
- 64 parallel trigger outputs available as LVDS signals
- Self-triggering capability of the board under test

CONTACT

Name: Erik Vallazza/INFN Trieste

Tel.: +39 040 3756253

Fax: +39 040 3756258

Email: erik.vallazza@ts.infn.it

REFERENCES

[1] S. Franz and P. Barrillon, Nucl. Instr. and Meth. in Phys. Res. A 610 (2009) 35-40

[2] LAL group: http://omega.in2p3.fr/