

Basic-AMC – the low-cost MicroTCA.4 Compliant Carrier Module

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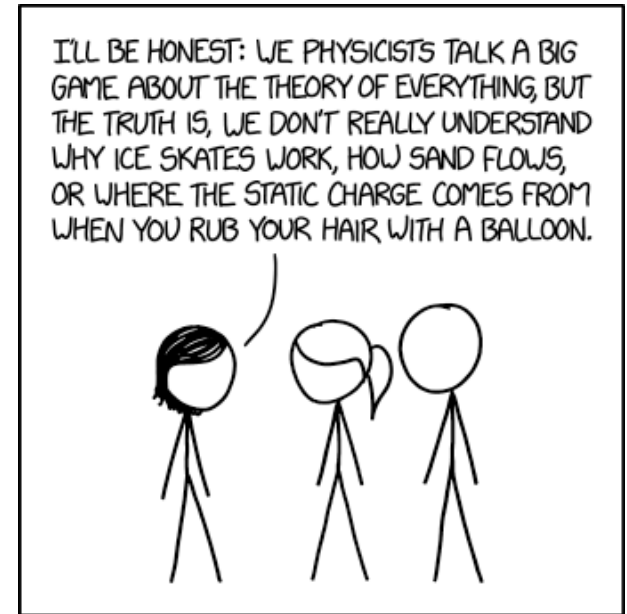
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Agenda

- ▶ Introduction
- ▶ Bolometer System for W7X
- ▶ Features of the Basic AMC Module
- ▶ Bolometer Readout Module
- ▶ Laboratory Tests of the System
- ▶ Status and Summary

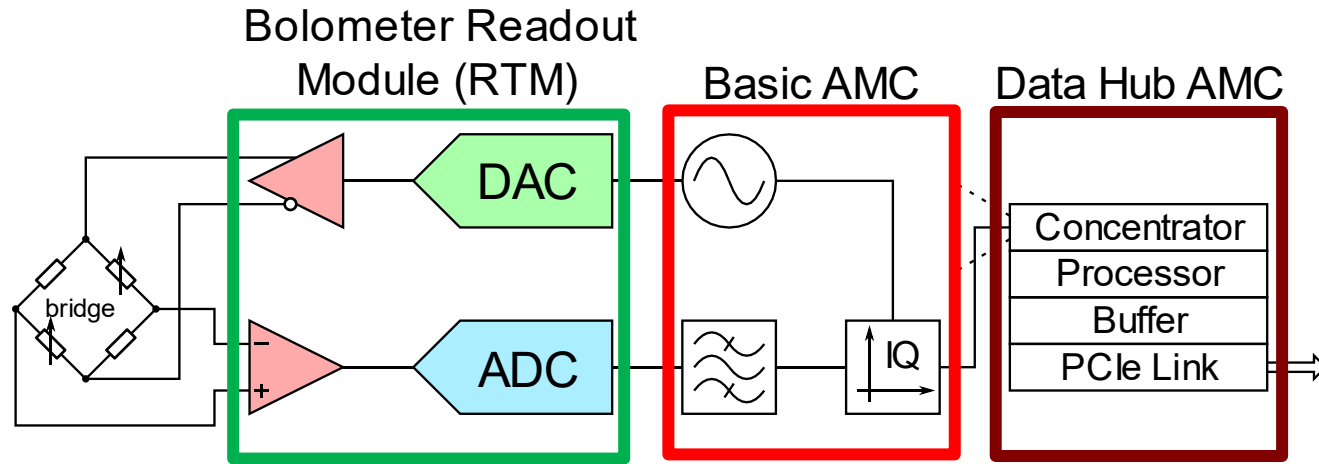
Introduction

- ▶ In W7-X bolometers are used to measure energy losses
- ▶ These are highly-reliable devices with a very low temperature drift
- ▶ Tolerance of high temperatures, high neutron flux, compatibility with high vacuum and insensitivity to radiation damage encourage use of metal foil bolometers



<https://xkcd.com/1867/>

Bolometer System for W7X



- ▶ Bolometer system requires in total 96 channels
- ▶ The system will span three custom modules and an external sensor
- ▶ Application of AC excitation and in-phase detection minimizes the drift
- ▶ Not much memory or processing power needed per channel
- ▶ Low-latency link to data hub is required

Basic-AMC Features

- ▶ Cost-effective solution, fast development
- ▶ Based on cost-effective TE0714 FPGA module (Xilinx Artix)
- ▶ Offers multi-gigabit connectivity:
 - ▶ PCIe x2 gen.2 link
 - ▶ two additional custom links, up to 6.25 Gb/s
- ▶ 90 FPGA I/O signals on Zone 3 and three LVDS clocks (the clocks are also connected to the FPGA)
- ▶ The PCB has only 6 metal layers, including two full ground planes



TE0714 Module

- ▶ XC7A35T FPGA (there is also XC7A50T option)
- ▶ 16 MB SPI flash memory
- ▶ DC/DC converters running from 3.3 V generating all necessary power supplies
- ▶ 4 Multi-Gigabit Transceivers (GTP)
- ▶ MEMS oscillator for serial links
- ▶ Only 3 × 4 cm, quite easy routing



<https://trenz-electronic.de>

Order number: TE0714-03-35-21

In Stock: 179

Quantity	Unit price
To 9	€84.00
From 10	€75.60
From 25	€71.40
From 50	€67.20
From 100	€63.00
From 250	€58.80
From 500	€54.60
From 1000	€50.40

Basic-AMC Features (continued)

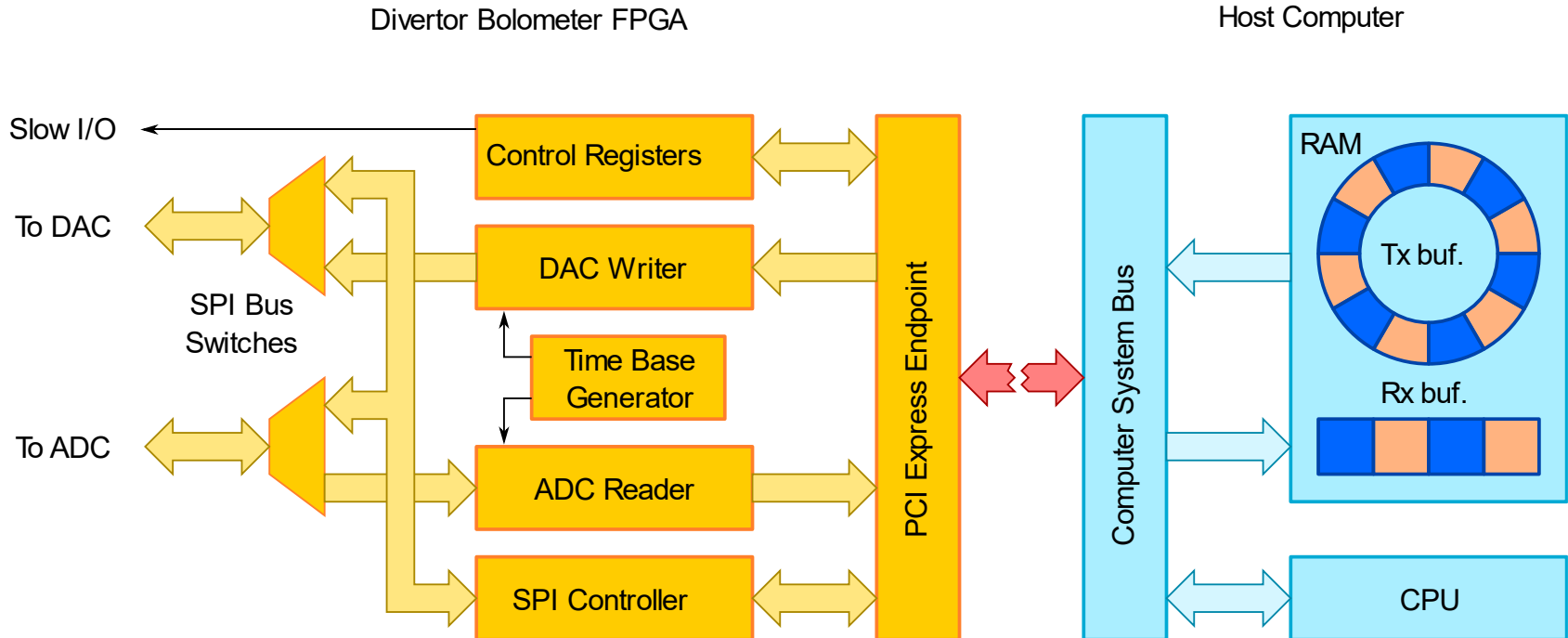
- ◆ Provides 24 W of ± 15 V for RTM
- ◆ Contains fully functional IPMI controller based on ARM SoC
- ◆ FPGA UART handled by MMC
- ◆ Supports MTCA.4 M-LVDS bus
- ◆ Contains 4 bidirectional front panel Lemo interfaces
- ◆ Can be used without FPGA for clock and trigger distribution (can route signals between M-LVDS and Lemo I/O)



Bolometer Readout Module by

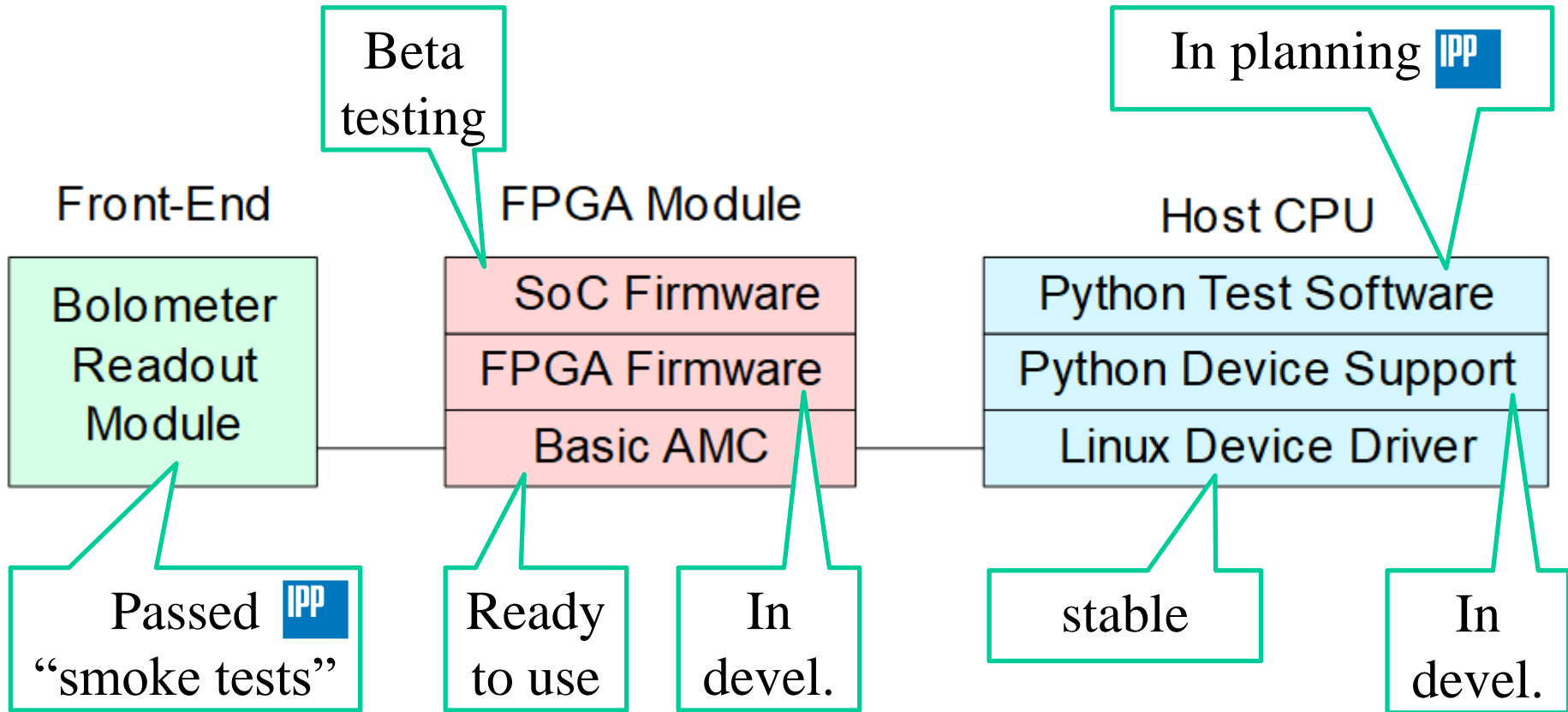
- ◆ Implemented as MicroTCA.4 Rear Transition Module
- ◆ The prototype controls a single bolometer, the final design will have 3 – 4 channels
- ◆ The device enables in-situ calibration of the sensor bridge
- ◆ One channel consists of 4 SPI DACs and a single 4-channel SPI ADC
- ◆ There is a number of slow control signals for:
 - ◆ Adjusting gains
 - ◆ Enabling measurement and calibration data paths
 - ◆ Configuring and synchronizing the converters

Laboratory Tests of the Bolometer



- ◆ No hub module during tests, device controlled directly over PCIe
- ◆ TE0714 has no RAM, therefore, the buffer must be implemented in CPU
- ◆ Looped “playback” buffer and shingle-shot acquisition buffer

Status and Summary



Thank you for your attention