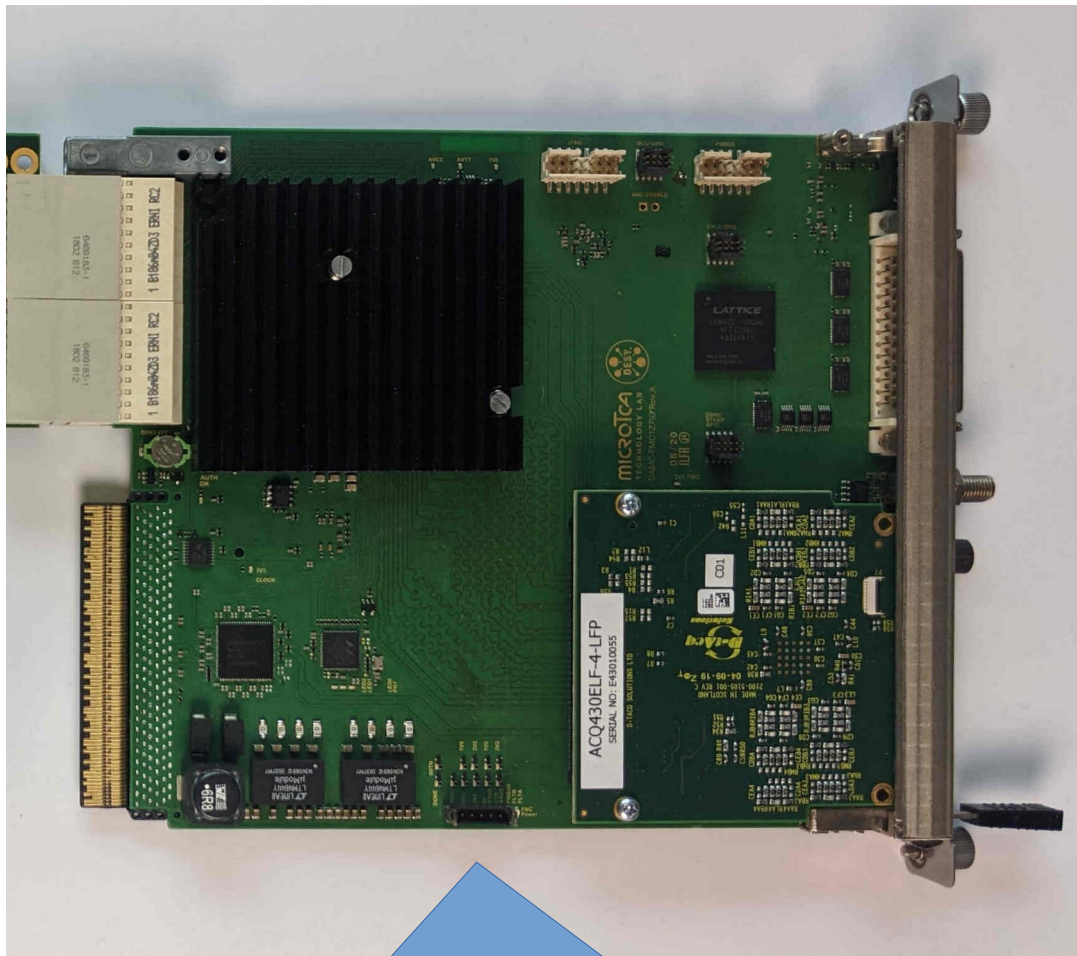


Add High Channel Count Analog IO to MTCA.4

Peter Milne,
D-TACQ Solutions

www.d-tacq.com

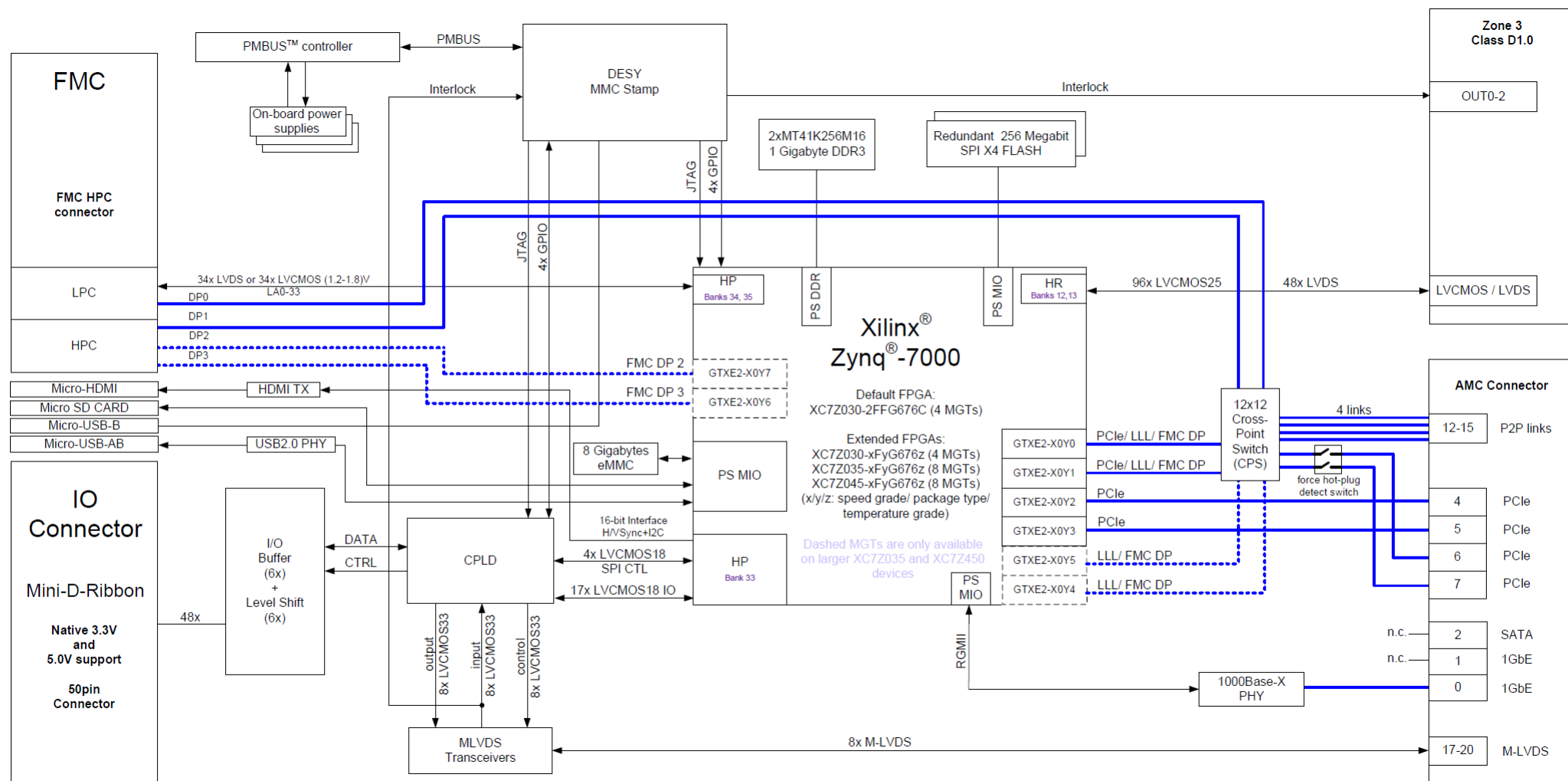
DAMC-FMC1-Z7IO



AMC Module, ZYNQ 7000
Designed by DESY, Built under
license by D-TACQ.



DAMC-FMC1-Z710



Applications with DESY Firmware

- Universität Hamburg
 - LISA: Laser Interferometer Space Antenna.
 - Custom RTM.
 - LIGO and Einstein Telescope.
 - D-TACQ RTM and Modules.
- DESY
 - LISA
 - DAQ with DRTM-AD84 ?
- .. develop with DESY published Yocto Linux and FWK. Device control using Python, status monitor on HDMI graphics.
- .. sample project provided by D-TACQ for RTM.

High Channel Count Analog IO

- FMC Modules:
 - D-TACQ supports a family of 5: AI, AO, DIO
- ELF Modules:
 - D-TACQ supports a family of 13: AI, AO, DIO.
 - ELF is a cost-optimised SUBSET of FMC
 - Defined minimal I/O pin set : max sites / FPGA.
 - FMC LPC:68 I/O, ELF:24 IO 2*ELF: 48 I/O.
 - Provision for external power (ideally, from carrier)
 - Size extended 2x : more real estate, more channels
 - Typical : 32 simultaneous channels, 1MSPS
 - Sample rates 10k .. 80MHz, 14bit, 16bit, 24bit.

Module Range

DAQ Modules

Model	Description	Resolution	Sample Rate / per channel
ADC: Analog Input			
	ACQ42x Medium Speed Precision SAR ADC		
ACQ420FMC	4 channel simultaneous sampling digitizer	16/18 bit	2 <i>MSPS</i>
ACQ423ELF	32 channel simultaneous sampling digitizer, minimum cost	16 bit	200 <i>kSPS</i>
ACQ424ELF	32 channel simultaneous sampling digitizer	16 bit	1 <i>MSPS</i>
ACQ425ELF	16 channel simultaneous sampling digitizer	16/18 bit	2 <i>MSPS</i>
ACQ425BLF	16 channel simultaneous sampling digitizer RJ45 connectors	16/18 bit	2 <i>MSPS</i>
	ACQ43x Low Noise Delta-Sigma ADC		
ACQ430FMC	8 channel simultaneous sampling digitizer	24 bit	125 <i>kSPS</i>
ACQ435ELF	32 channel simultaneous sampling digitizer voltage or current input	24 bit	125 <i>kSPS</i>
ACQ437ELF	16 channel simultaneous sampling digitizer variable gain voltage input	24 bit	125 <i>kSPS</i>
	ACQ465 High Speed, High SNR Delta-Sigma ADC		
ACQ465ELF	32 channel simultaneous sampling digitizer	24/16 bit	370/1000 <i>kSPS</i>
	ACQ48x High Speed Pipeline ADC		
ACQ480FMC	8 channel simultaneous sampling digitizer	14 bit	80 <i>MSPS</i>
ACQ480ELF	8 channel simultaneous sampling digitizer, LEMO inputs	14 bit	80 <i>MSPS</i>
ACQ482ELF	16 channel simultaneous sampling digitizer differential input, 8x oversampling	14 bit	10 <i>MSPS</i>

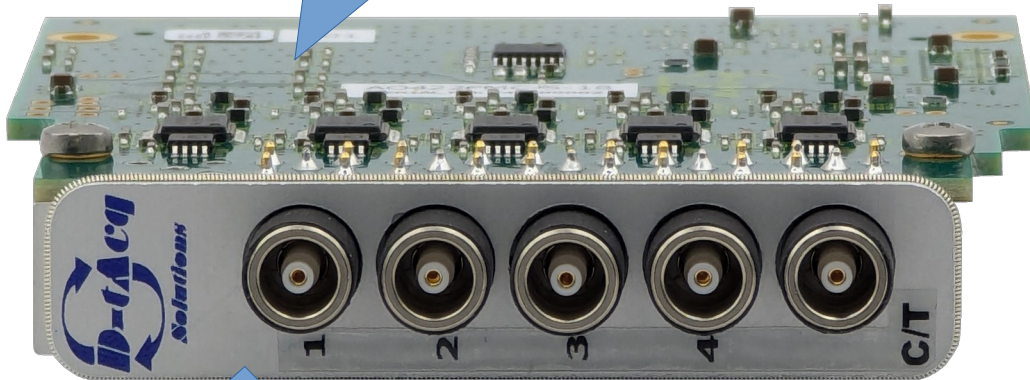
DAQ Modules

Model	Description	Resolution	Sample Rate / per channel
DAC: Analog Output			
AO420FMC	4 channel simultaneous analog output	16/18 bit	1 <i>MSPS</i>
AO422FMC	5 channel simultaneous analog output	18/20 bit	1 <i>MSPS</i>
AO424ELF	32 channel simultaneous analog output	16 bit	500 <i>kSPS</i>
Multifunction ADC+DAC			
ACQ427ELF	8 channel simultaneous sampling digitizer 4 channel simultaneous analog output	16/18 bit 16 bit	2 <i>MSPS</i> 1 <i>MSPS</i>
ACQ436ELF	24 channel simultaneous sampling digitizer current input, dual DAC, 12x MUX output	24 bit	125 <i>kSPS</i>
BOLO8BLF	8 channels bolometer with full ac bridge and calibration feature	16 bit	2 <i>MSPS</i>
Special			
DIO432FMC	32 channels clocked DIO		1 <i>MSPS</i>
DIO482FMC	32 channels clocked DIO		32 <i>MSPS</i>
DIO482ELF-TD	5 channels Pulse Generator Ouput		32 <i>MSPS</i>
DIO422FMC	AquadB RS422		25 <i>MSPS</i>
DI460ELF	12 channels AquadB LVDS		50 <i>MSPS</i>
ACQ494FMC	4 Channels Time to Digital TDC		

https://www.d-tacq.com/modproducts_modules.shtml

What's New in FMC Modules?

AO422FMC:
5 x DAC 1MSPS/18bit



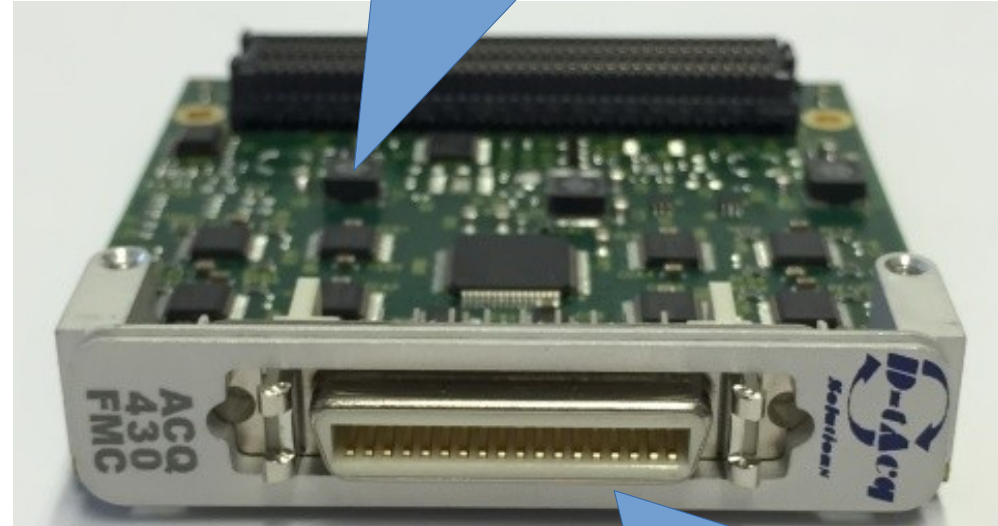
LEMO-00 (max 6) :-

POLL: What's the BEST
connector for an 8
channel FMC,
differential inputs?

MMCX :

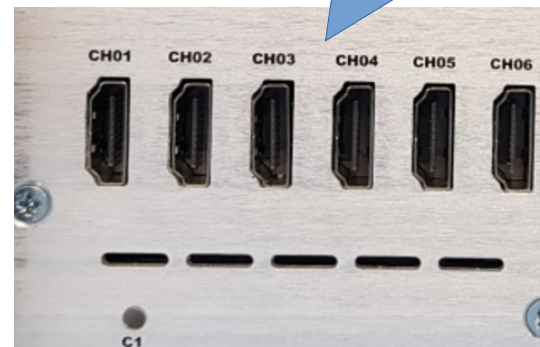


ACQ426FMC:
8 x ADC 1MSPS/18bit
(picture shows ACQ430FMC)



MDR-36 : nice connector, cable difficult to find..
Cost effective to make?

HDMI. Maybe two
Lying on their
sides?



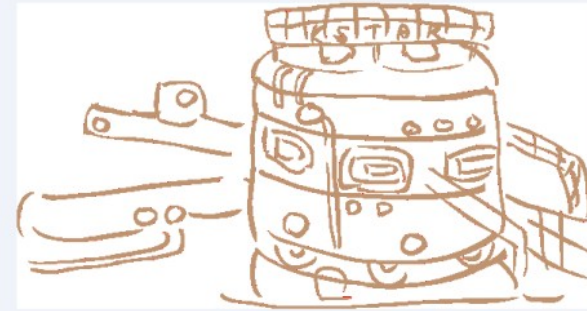
HD15.
NOT FMC
compliant :-



4th MicroTCA Workshop for Industry and Research

9th – 10th December 2015

DESY, Hamburg



Status of MTCA at Korea Superconducting Tokamak Advanced Research (KSTAR) facility

Fusion Woong-ryol Lee (wrlee@nfri.re.kr)

Future Vision of Green Energy

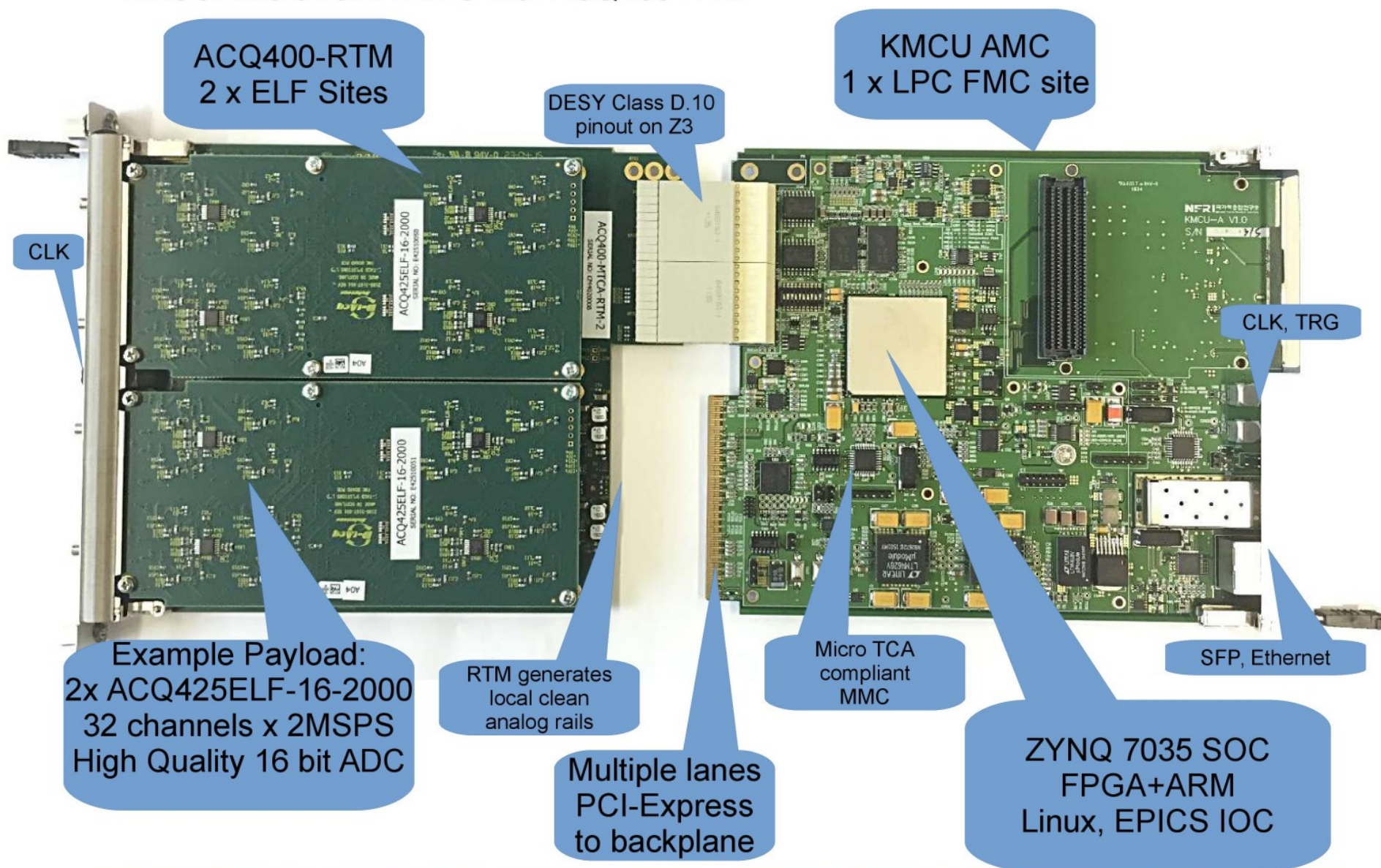
on behalf of the KSTAR control team

9th Dec. 2015

NFRI 국가핵융합연구소
National Fusion Research Institute



KMCU: MicroTCA.4 AMC with ACQ400 RTM



Z7IO with ACQ400RTM



RTM with 2 ELF sites
Payload: Simultaneous
AI64 x 1 MSPS
AI32x 2 MSPS
AO64 * 500Ksps
DIO

Z3
D1.0

AMC with ZYNQ 7000,
FMC-LPC, DIO
USB, HDMI

D-TACQ MTCA

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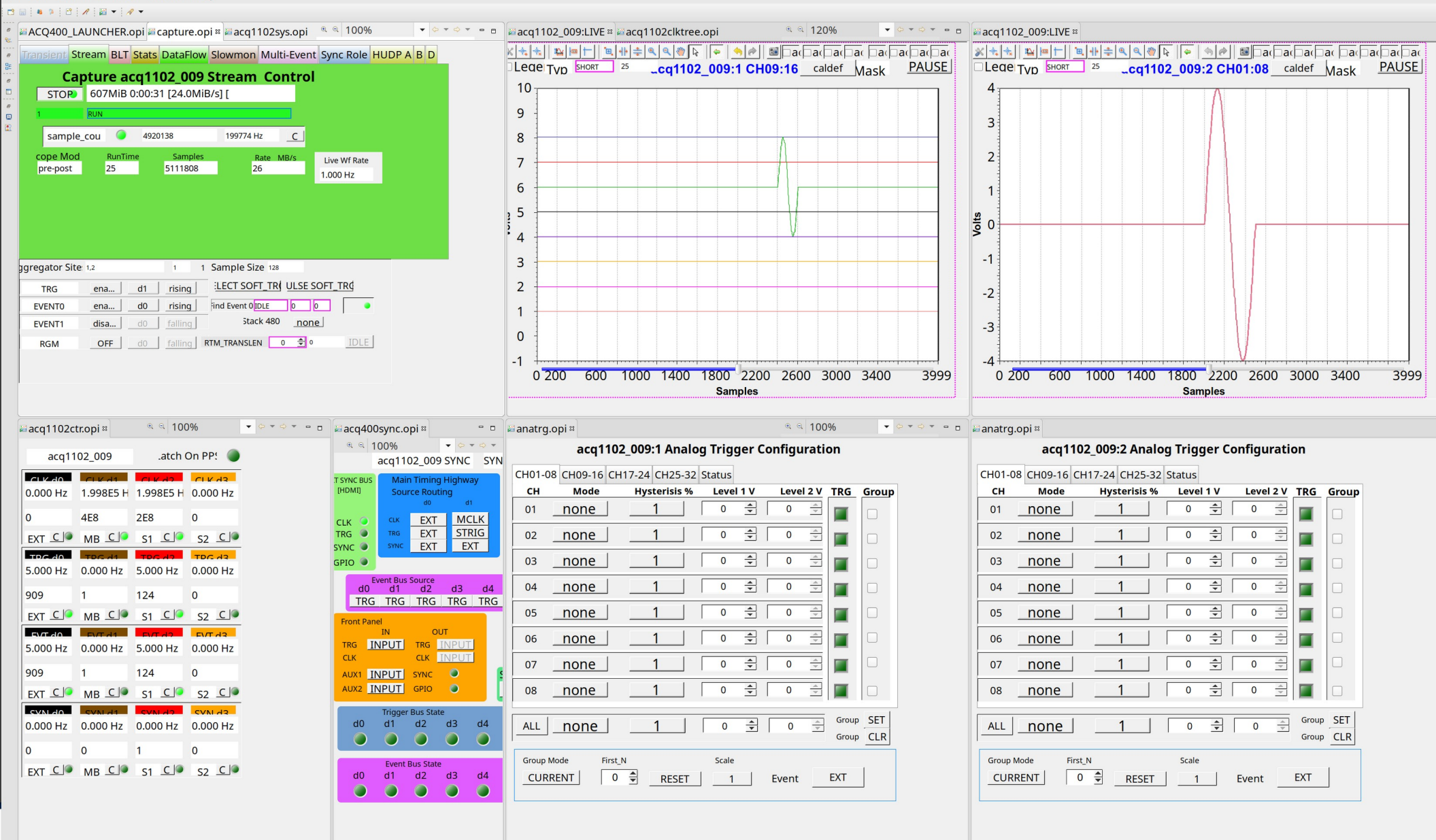
Z7IO Applications with ACQ400RTM-2

- 64 channel Scope.
 - 64x 1MSPS, 50Hz Digital trigger
 - Defined region per channel stats
 - EPICS Display.
 - “Judgement System”
 - (compare to Mask) : idea by JAEA
 - Per-channel stats: idea by KIT.
 - System used by CEA/Saclay.
- 64 Channel Scope, Analog Trigger
 - 64x 1MSPS, 50Hz Analog Trigger
 - DSP Logic: per-channel trigger condition.

64 Channel Scope, ATD

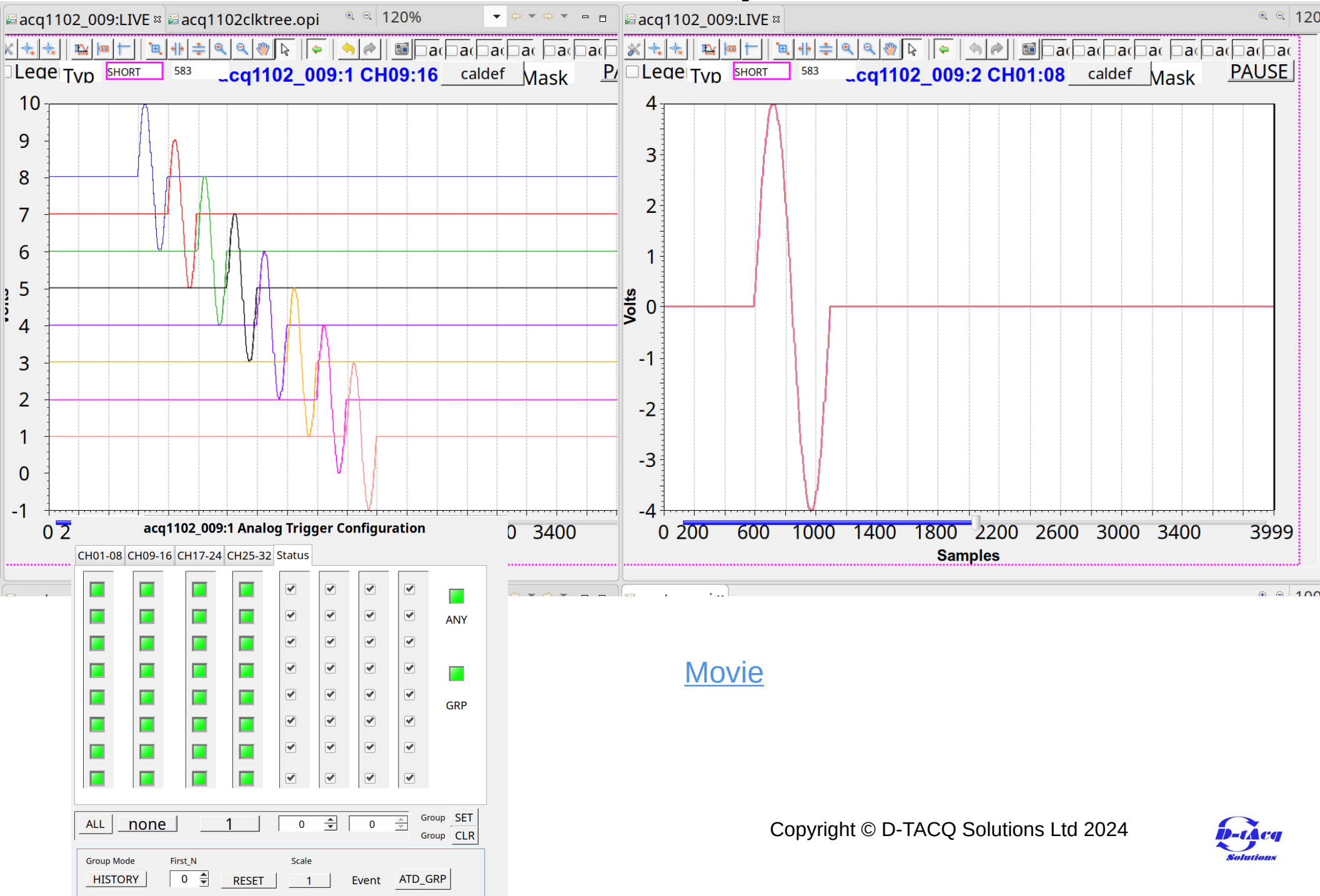
CS-Studio

File Edit Search CS-Studio Window Help



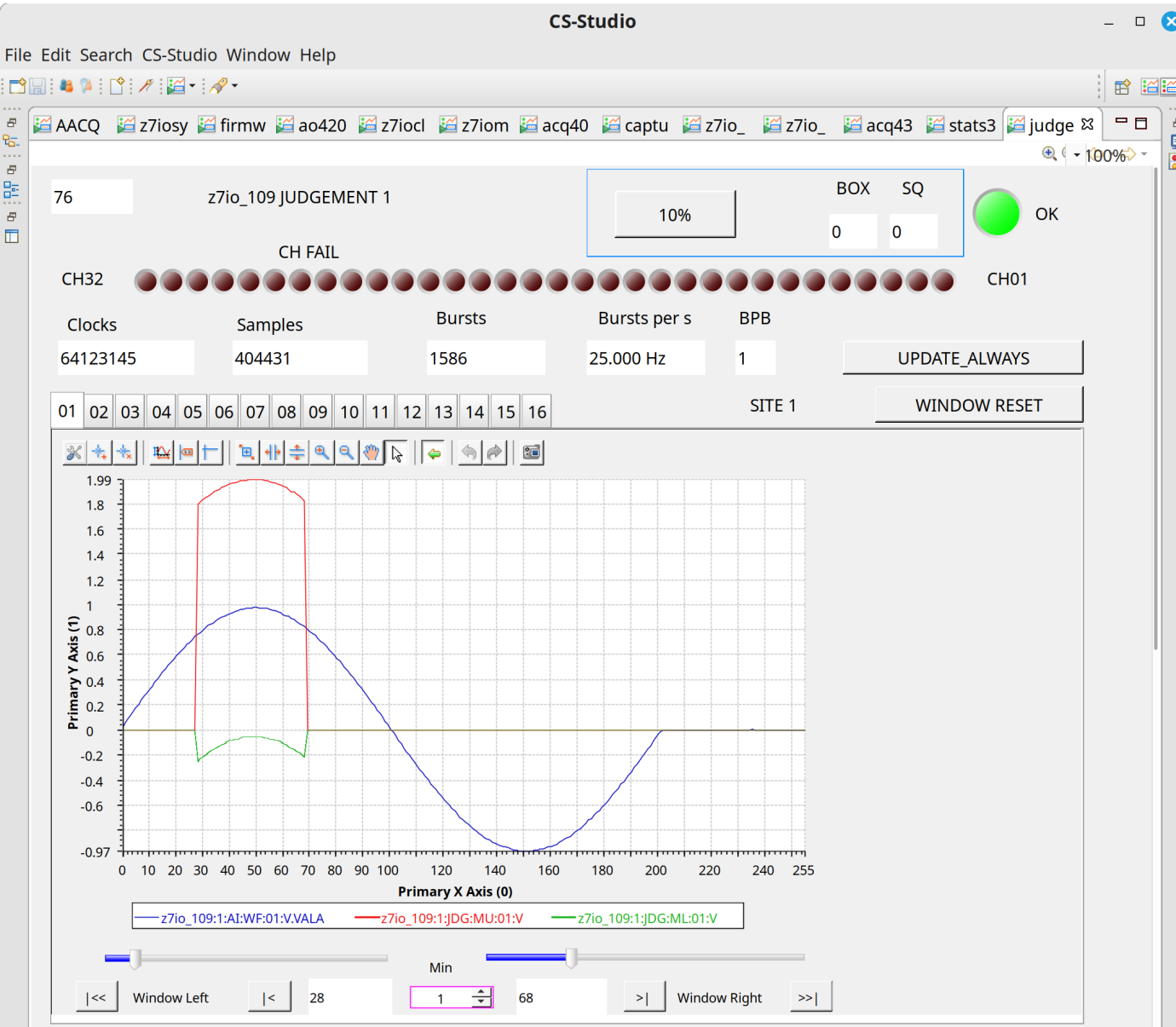
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64 Channel Scope, 64 ATD



[Movie](#)

EPICS Display for “Judgement”



AACQ z7iosy firmw ao420 z7io_109 JUDGEMENT 1

1	01	02
Min	0.756	-0.001
Max	0.969	0.000
Mean	0.904	-0.000
RMS	0.906	0.003

Movie

FPGA DSP Applications

- Fast Control loop:
 - 16AI x 2MSPS, 16AO x 1MSPS
- Fast Control loop, PWM output
 - 4AI, AO, 32DIO
- Support for custom FPGA DSP project.
 - Use D-TACQ Framework provides a sandbox with access to the IO data stream
 - Frame provides a register file and Linux VFS to access the register file

How May We help you?

- ZYNQ AMC runs autonomously.
 - Fit to a spare slot and forget..
- COTS:
 - Wide Range of IO on ACQ400RTM2
 - Standard firmware: ACQ400 or DESY/FWK
- Custom
 - Custom FPGA DSP logic?
 - ELF Modules are (relatively) cheap to design
 - Z3 D1.0 RTM is (relatively) cheap to design

<https://www.d-tacq.com/mtca.shtml>