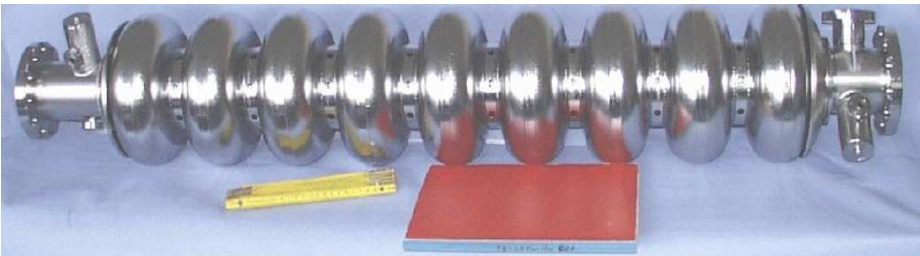
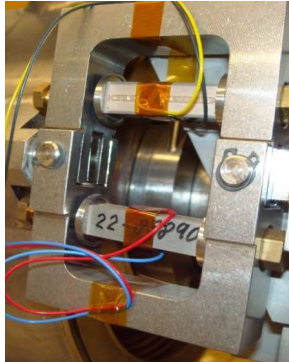


MicroTCA.4 based Single Cavity Regulation

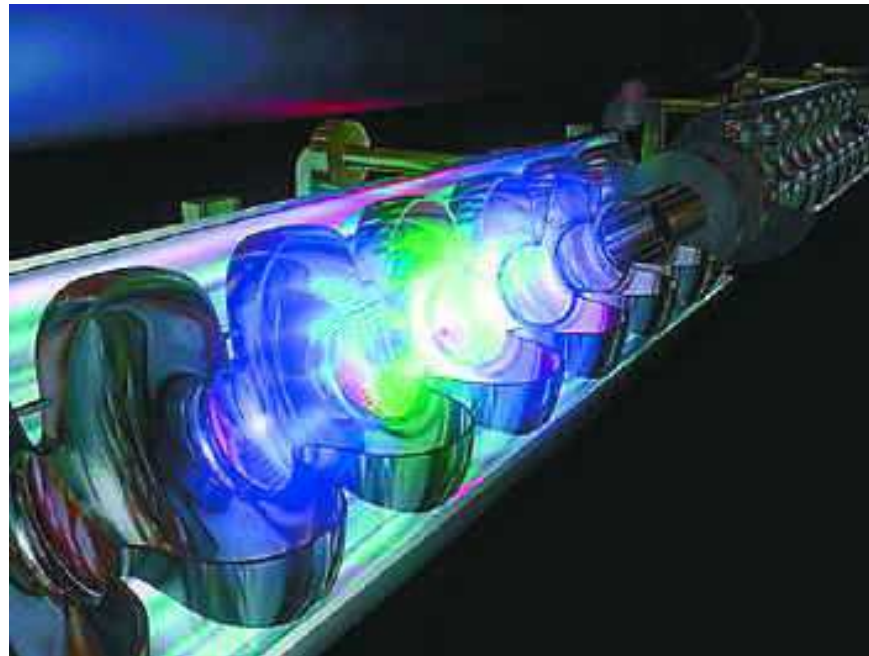
including Piezo Controls



Konrad Przygoda
on behalf of MSK Group

Outline

- > Introduction
- > Hardware
- > Firmware
- > Software
- > Results



Introduction

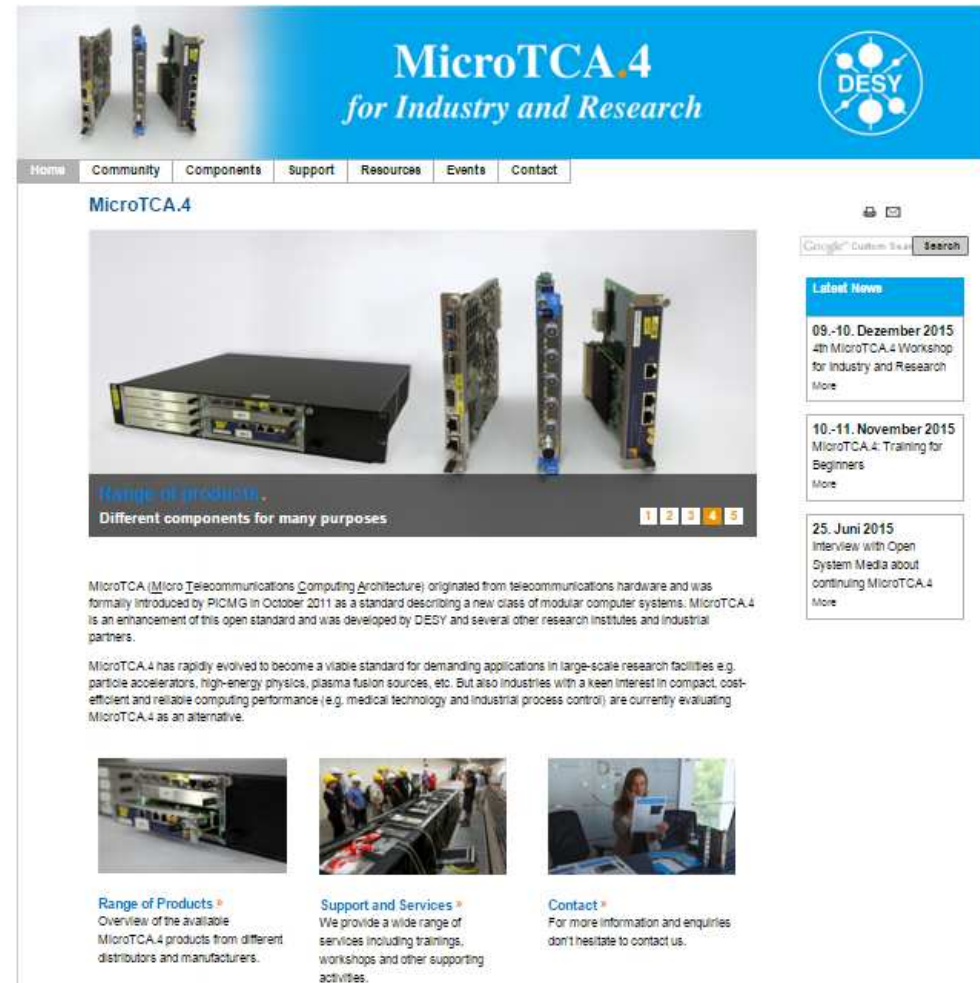
- > DESY employ since Feb. 2015
- > Member of MTCA.4 hardware R&D team leaded by **M. Fenner**

If You have Your MTCA.4 hardware questions, problems please contact:

mtca-support@desy.de or

michael.fenner@desy.de

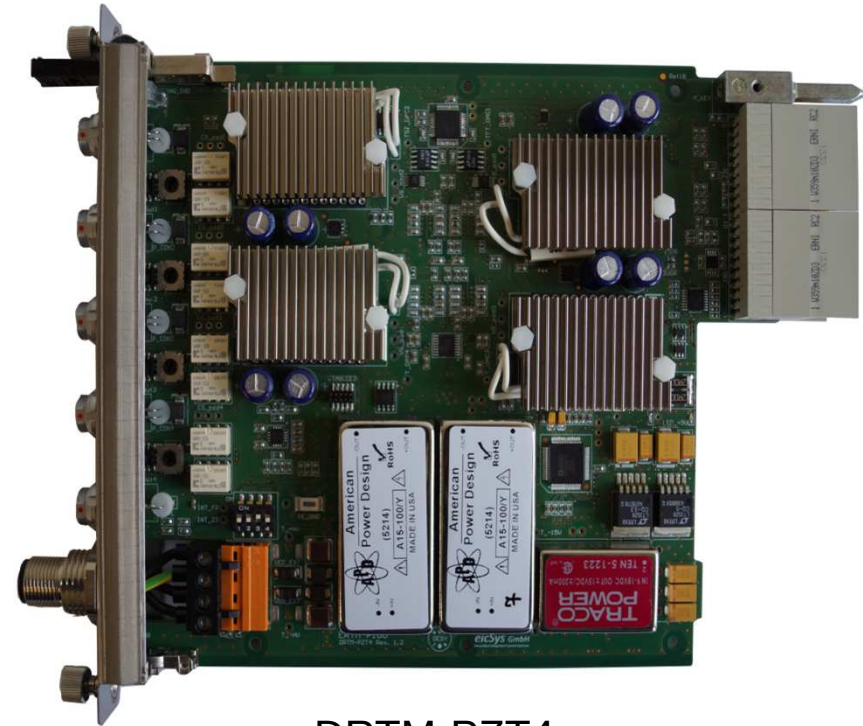
konrad.przygoda@desy.de



MTCA.4 Electronics: RTM

4 Channel Piezo Driver

- Double width MTCA.4, Mid-Size Rear-Transition Module (RTM), Class D1.0, D1.1, D1.2 compatible
- Features:
 - Supports 4-channel Piezo Drivers and Piezo Sensors
 - Remotely switchable actuator and sensor functionality
 - Remotely switchable driving input source (ext./int.)
 - 4x DAC 18-bit up to 0.5 MSPS
 - 16x ADC 18-bit up to 100 kSPS
 - Unipolar: 0..+100 V and bipolar: ± 100 V piezo power supplies (ext./int.)
 - Interlock signal support



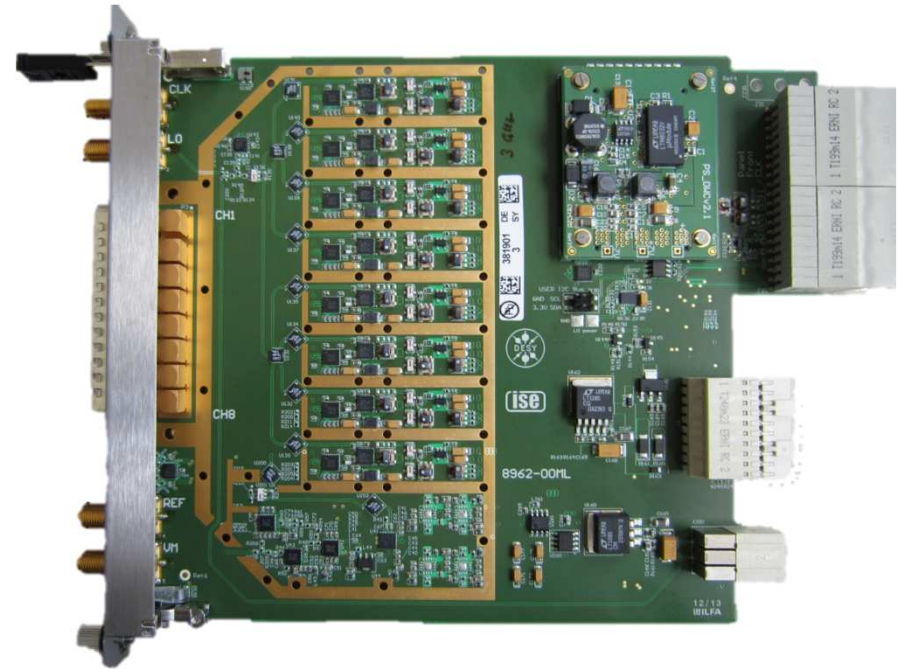
DRTM-PZT4

licensed by Eicsys

MTCA.4 Electronics: RTM

8 Channel Down-Converter 1 channel Vector-Modulator

- Double width MTCA.4, Mid-Size Rear-Transition Module (RTM), Class A1.0, A1.1, A1.2 compatible
- Features:
 - 8 down-conversion input channels (AC) with programmable attn.
 - LO input for analog down-conversion 1.3 GHz
 - 2 analog general purpose inputs (DC)
 - 1 up-conversion output channel (AC) with programmable attn.
 - REF input for analog up-conversion 1.3 GHz
 - ADC clock input (AC) up to 125 MHz
 - Interlock signal support

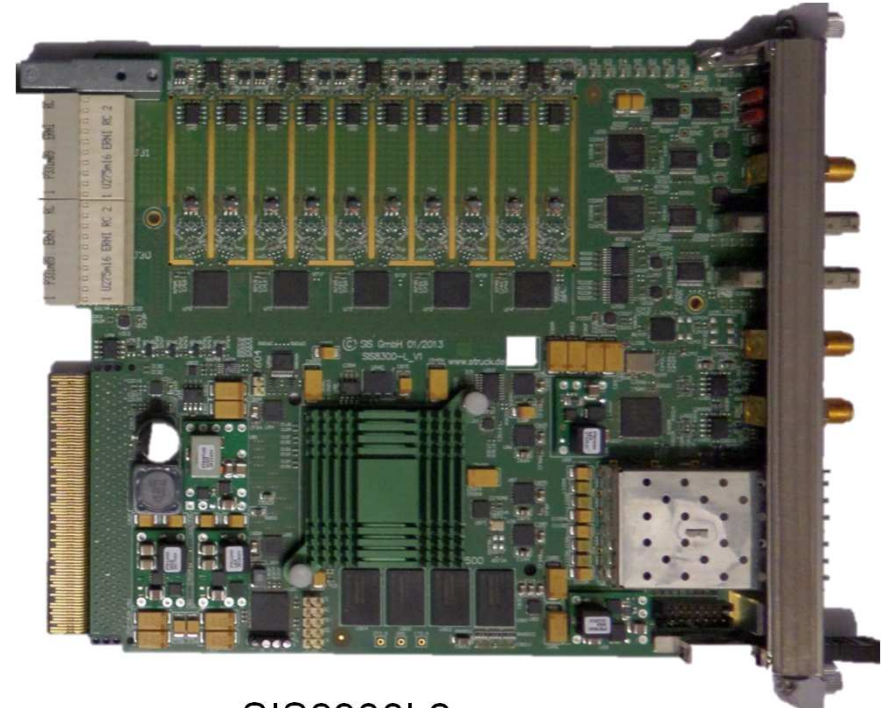


DRTM-DWC8VM1

licensed by Struck Innovative Systems

MTCA.4 Electronics: AMC Fast Digitizer

- Double width MTCA.4, Mid-Size Advanced Mezzanine Card (AMC), Class A1.0, A1.1 compatible
- Features:
 - 10x Analog Inputs: ADC 125 MSPS
 - 2x Analog Outputs: DAC 125 MSPS
 - RTM linked to Virtex 6 FPGA
 - RTM hotplug support
 - PCIe 4x served by Virtex 6 FPGA
 - 6 MGTs (4xLLL + 2x SFP) => up to 10 Gbps

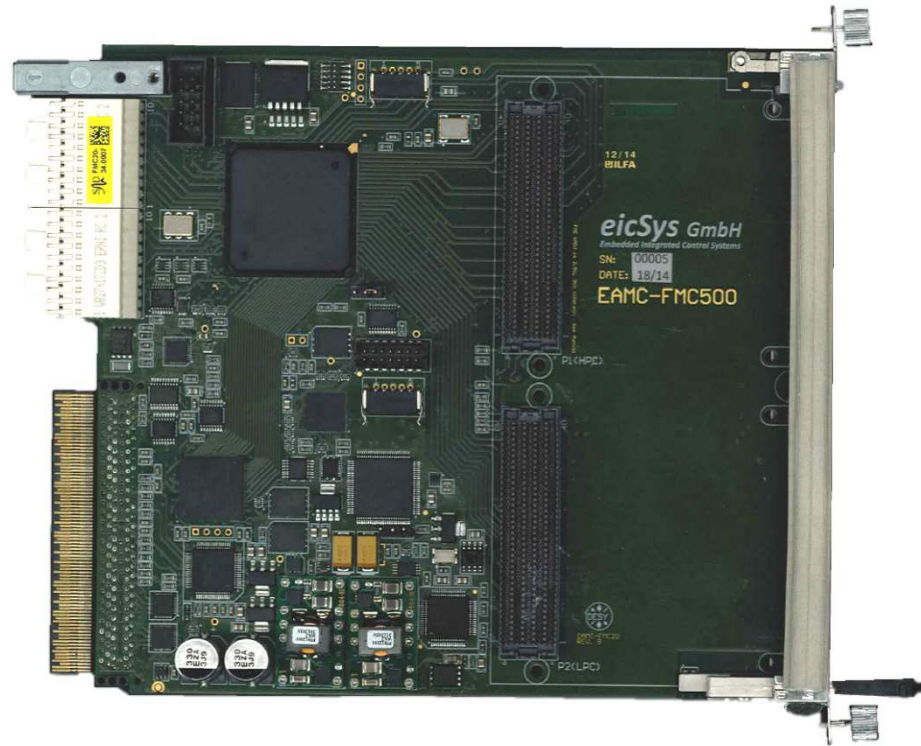


SIS8300L2

Struck Innovative Systems
with DESY collaboration

MTCA.4 Electronics: AMC Dual FMC Carrier Board

- Double width MTCA.4, Mid-Size Advanced Mezzanine Card (AMC), Class D1.0 compatible
- Features:
 - 1x HPC and LPC FMC linked to Spartan 6 150 FPGA
 - RTM linked to Spartan 6 150 FPGA
 - RTM hotplug support
 - PCIe 1x => Spartan 6 45 FPGA
 - 1x MGT => up to 3 Gbps
AMC backplane connection on ports 12-15
 - Interlock signal support

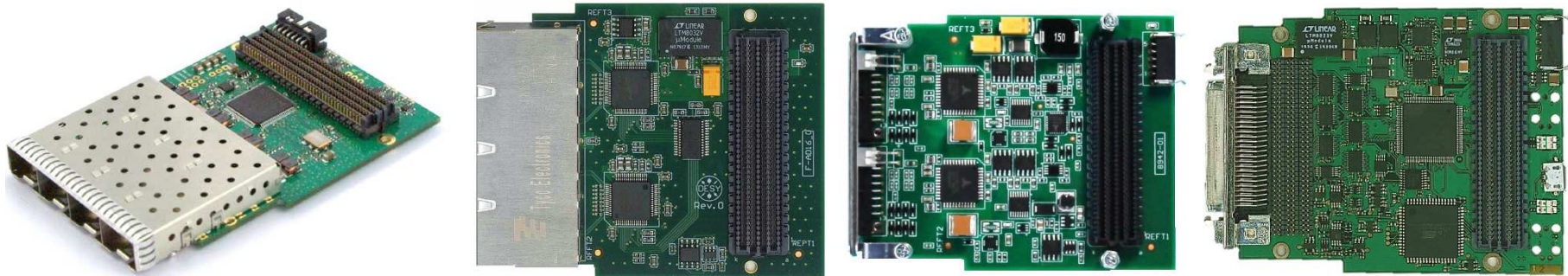


DAMC-FMC20

licensed by Eicsys

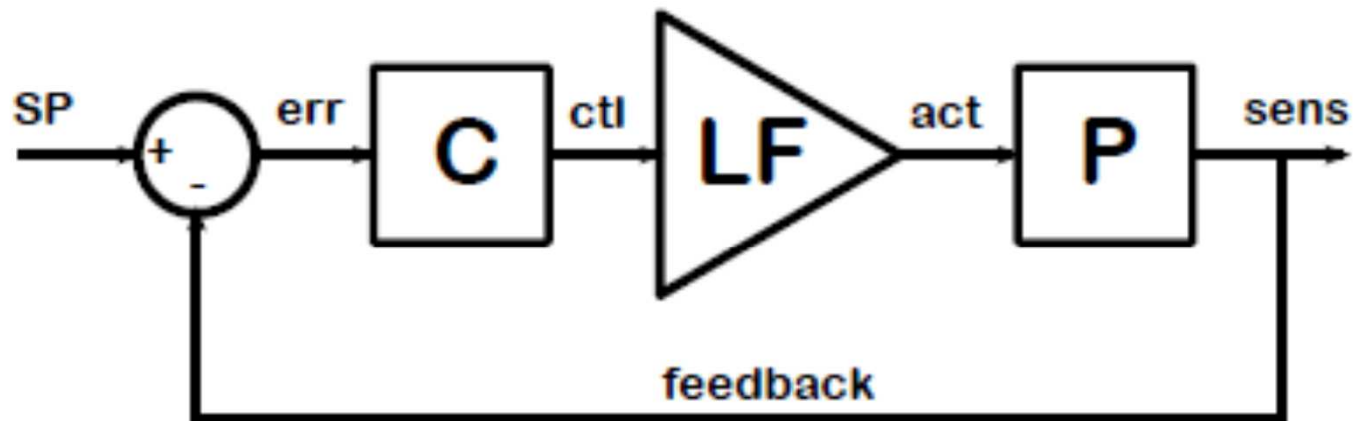
FMC Extensions

- DFMC-SFP4: 4x SFP up to 10 Gbps
- DFMC-AD16: 16x analog inputs up to 100 kSPS
- DFMC-MD22: 2x step motor drivers
- DFMC-UNIO: 48x general purpose I/Os, external clock input



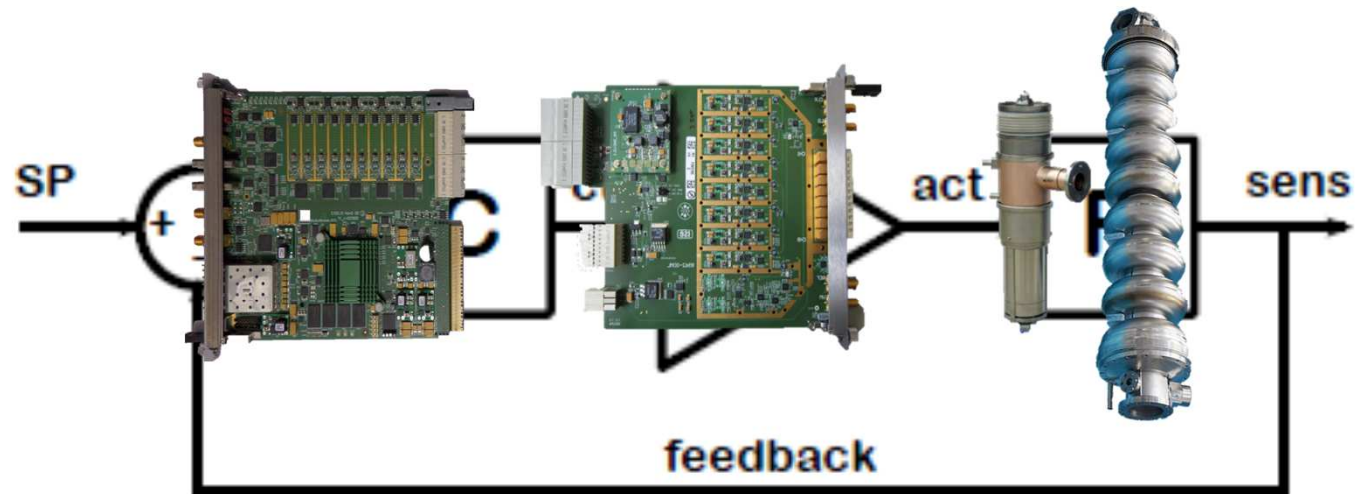
Single Cavity RF and Detuning Controller

> Control Theory Point of View



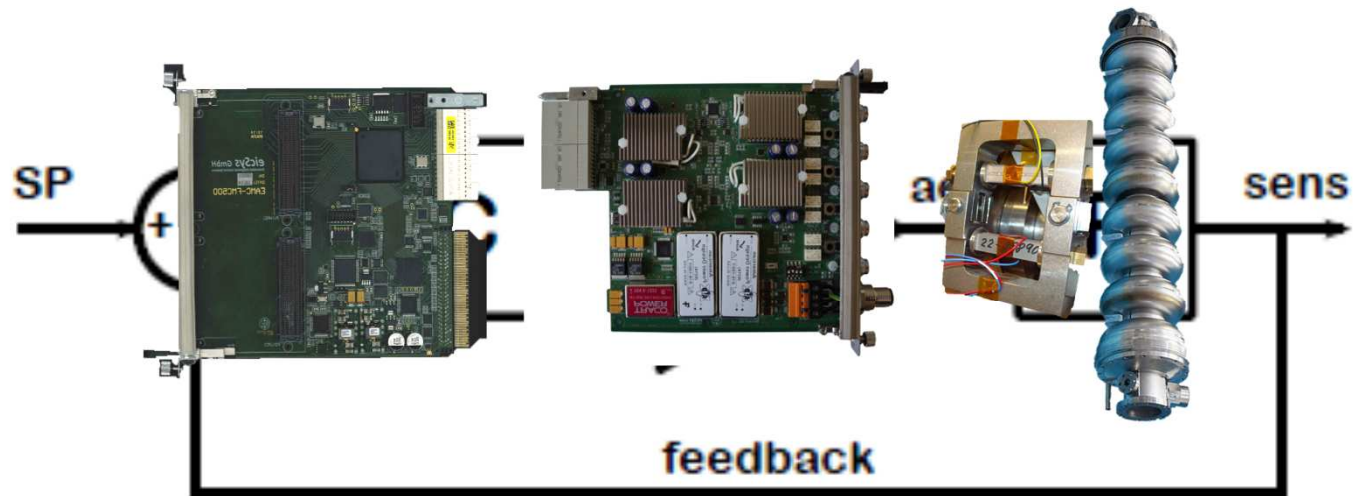
Single Cavity RF Controller

> MTCA.4 Point of View



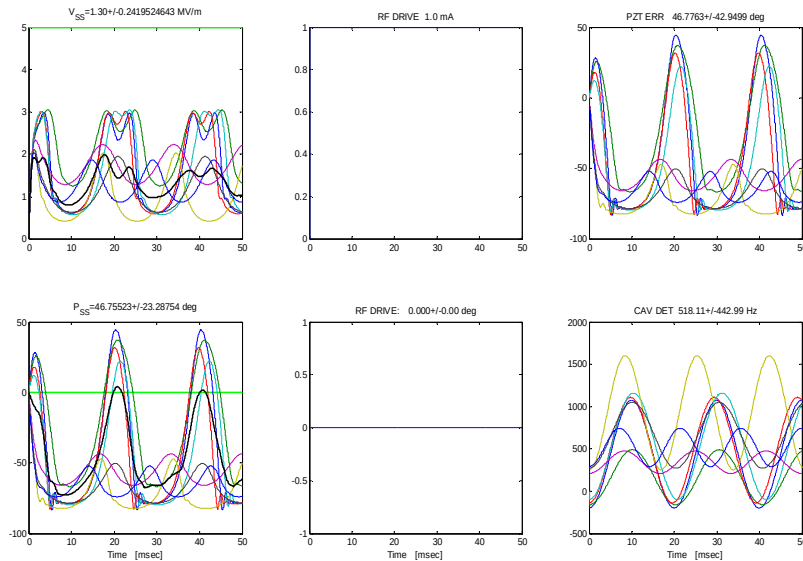
Single Cavity Detuning Controller

> MTCA.4 Point of View



Cavity RF and Detuning Controller (Simulation)

> RF/Piezo Feedbacks off



for ii=1:Ncav

$$V_{cav}(n, ii) = (V_{cav}(n-1, ii) + DT * w_0 * \rho_0 * I_{fwd} * \exp(1i * \phi_{ig})) \dots$$

$$/ (1 + DT * (w_{12} + 1i * \det(ii)));$$

end

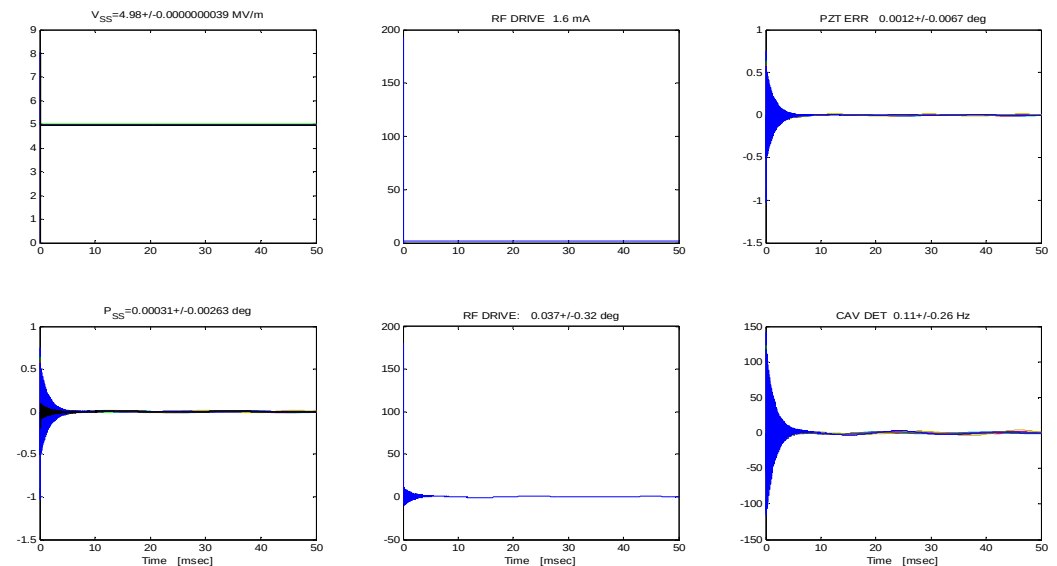
for ii=1:Ncav

if NOISE && dw_m(ii).ena

$$\det(ii) = \det(ii) + 2 * \pi * dw_m(ii).ampl * \sin(2 * \pi * dw_m(ii).freq * n * DT);$$

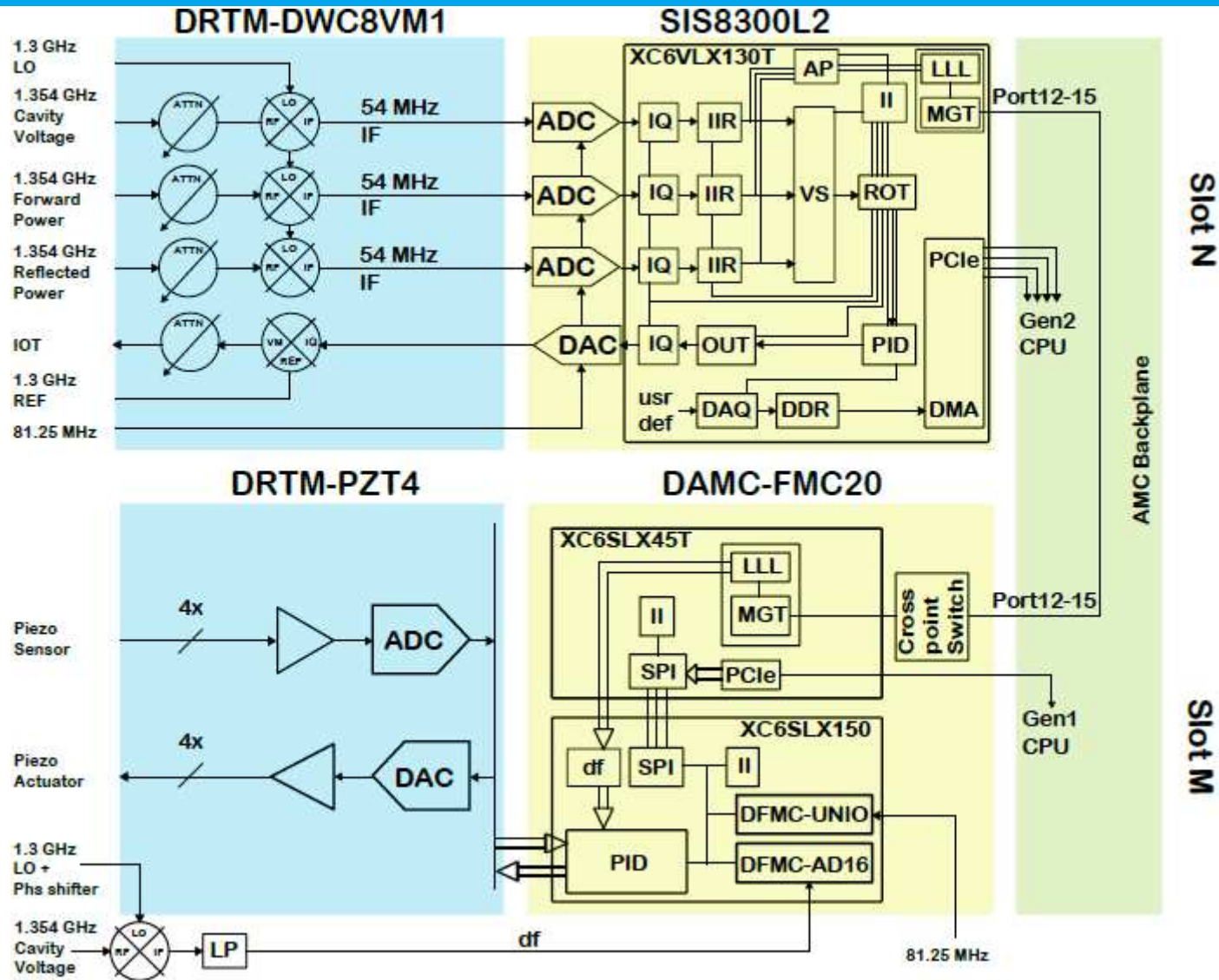
end

end



> RF/Piezo Feedbacks on

Single Cavity RF and Detuning Controller (Firmware)



Single Cavity RF and Detuning Controller (Software)

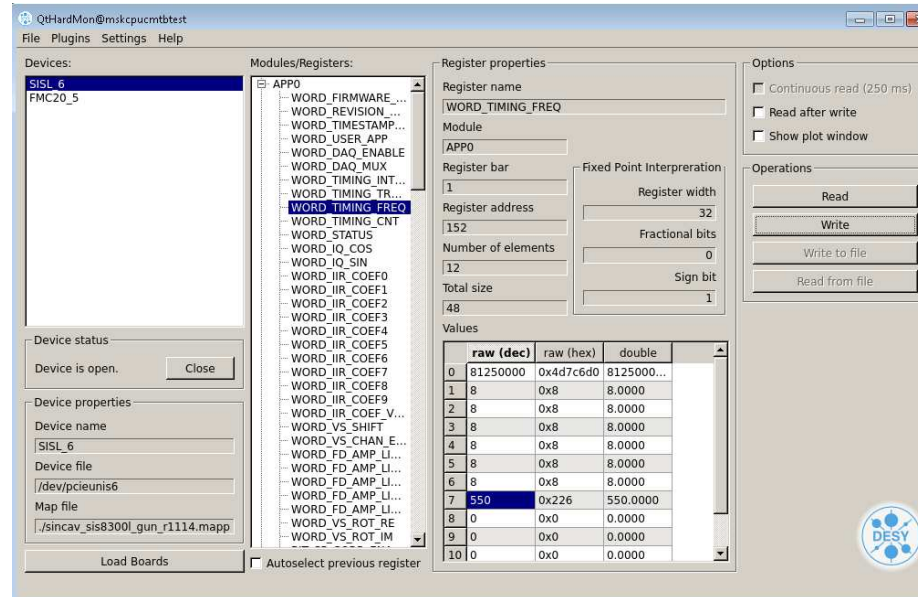
```
rf_c=mtca4u('SISL_6')  
pzt_c = mtca4u('FMC20_5')
```

```
rf_ctl_init(rf_c)
```

```
rf_ctl_ff(rf_c,val)
```

```
rf_ctl_sp(rf_c,val)
```

```
rf_ctl_fb(rc_c,val)
```



```
piezo_ctl_init(pzt_c)
```

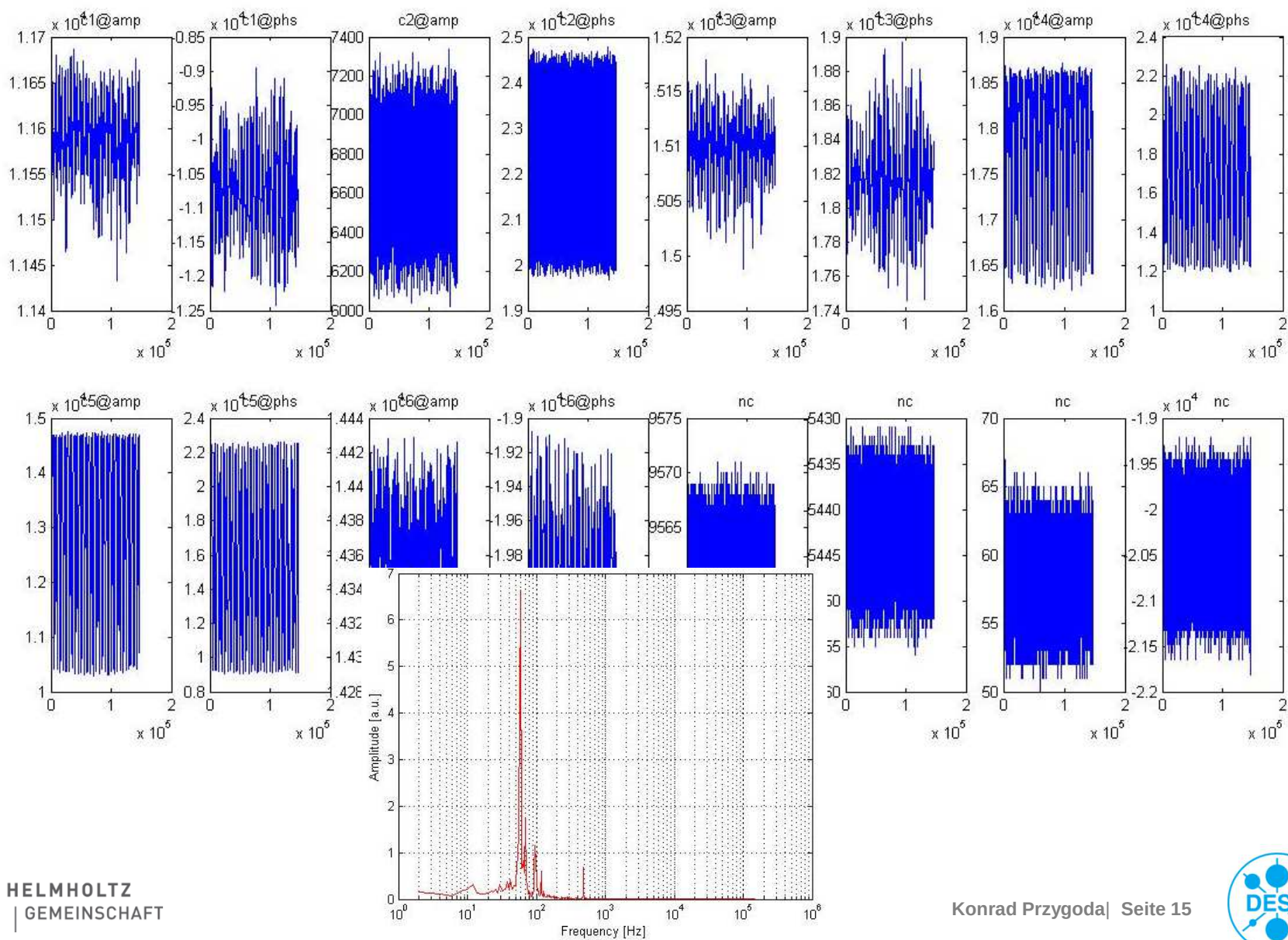
```
piezo_ctl_ff(pzt_c,val)
```

```
piezo_ctl_sp(pzt_c,val)
```

```
piezo_ctl_fb(pzt,val)
```

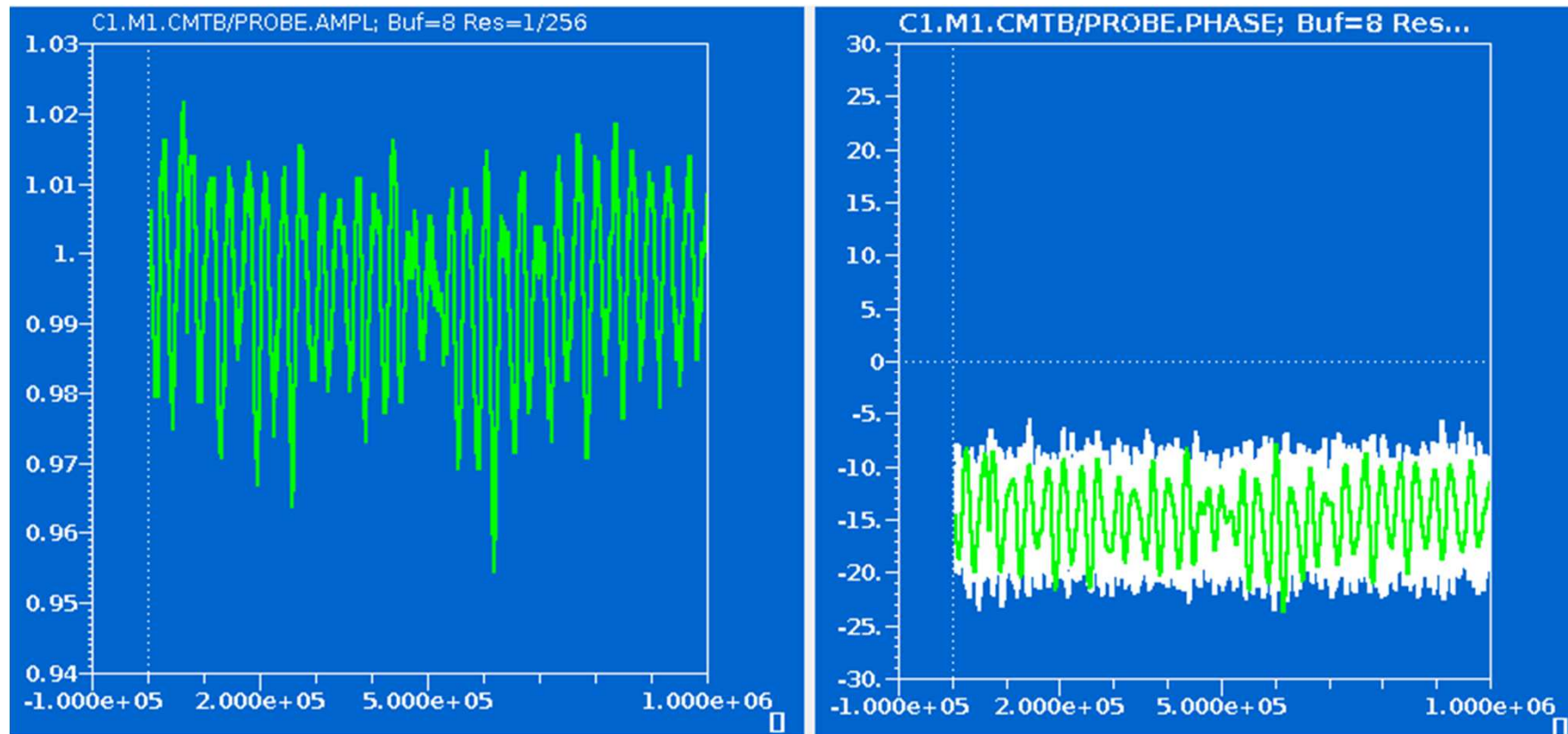
```
[a b] = read_dma_daq({rf_c;pzt_c},no_chan, no_samp, addr)
```

Cavity Signals Readout (RF feedforward)



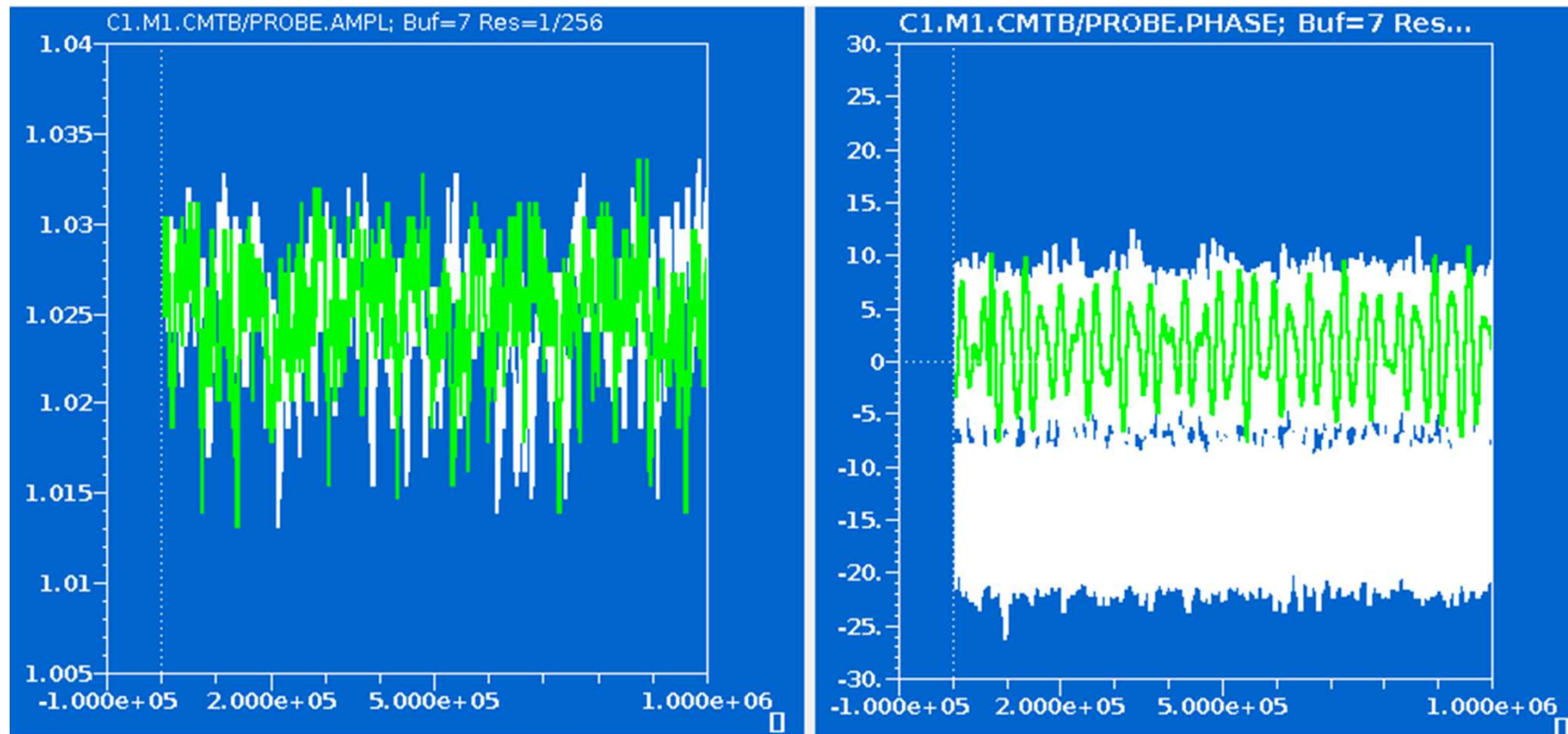
Single Cavity RF and Detuning Controller (First Results)

- RF Feedback off (Feedforward only; SP=1MV)
- Piezo Feedback off (Cavity detuned by 15 degrees)



Single Cavity RF and Detuning Controller (First Results)

- RF Feedback off (Feedforward only; SP=1 MV)
- Piezo Feedback on (Cavity tuned to 1.3 GHz resonance frequency)



Future Plans

- Demonstrate full performance of single cavity RF feedback
- Demonstrate full performance of single cavity detuning feedback
- Demonstrate full performance of single cavity both feedbacks
- Out-of-loop measurements
- DOOCS server and operator panels evaluation
- Share our experience with other labs, i.e. HZB, HZD



Thank You for Attention

