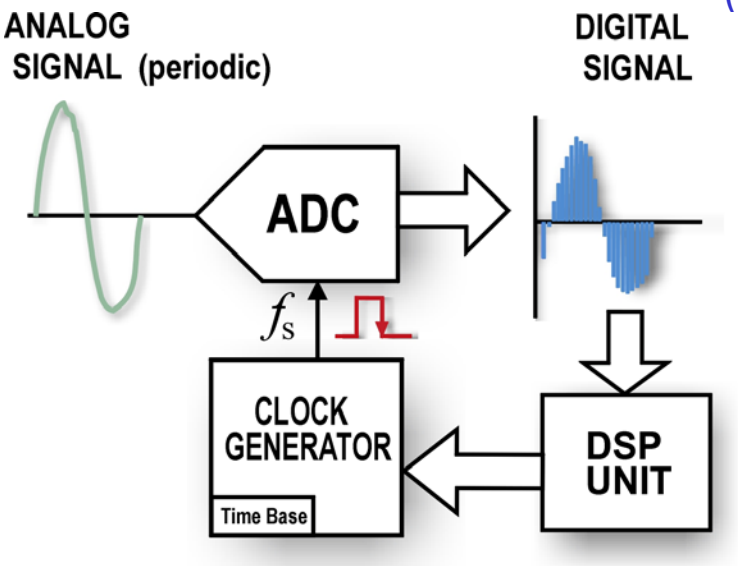
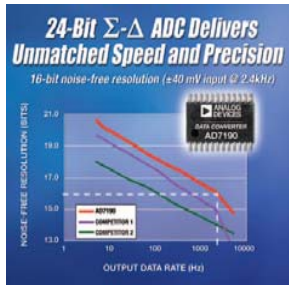
PRECISION DIGITIZERS FOR POWER & ENERGY MEASUREMENTS

(W. G. Kürten Ihlenfeld – PTB)

After Transducers



*



*

*

•Precision ADCs 2010 Catalog AD, available at: http ://www.analog.com/en/analog-to-digital-converters/ad-converters/products/index.html

with consent of Analog Devices Inc.

Metrology Grade Digitising Technology for Power Quality Measurements (PTB, NPL, MIKES, TRESCAL, VSL, METAS, LNE, INRIM)

1. **Compact three phase voltage digitiser up to the 50th harmonic of the mains (PTB).**
   a) ADC interface with USB to PC, b) self-cal., c) Self-Locking (pat. pending) & asynch, c) DSP is a PC, d) Ultra-Linear & unc. < 10 ppm, e) for lab. applic. (RMS, Phase, Ratio, & self-checking), f) Allow other ADCs to be used, e.g., A3458A, AD7763 (Sigma-Delta) & SAR AD7767.

2. **Portable three phase digitiser for on-site measurement of the high voltage grid (NPL, MIKES).**
   a) ADC 7767 interfaced to AD DSP (pre-processing data) & Wireless data transfer, b) async. Sampling, c) further DSP is a PC, d) Ultra-Linear & unc. < 50 ppm (close to above), e) for live lines.

3. & 4. **Wide band digitisers for transient and impulse measurements (TRESCAL, VSL).**

5. **Metrological characterisation of digitisers (METAS, LNE, INRIM, VSL).**

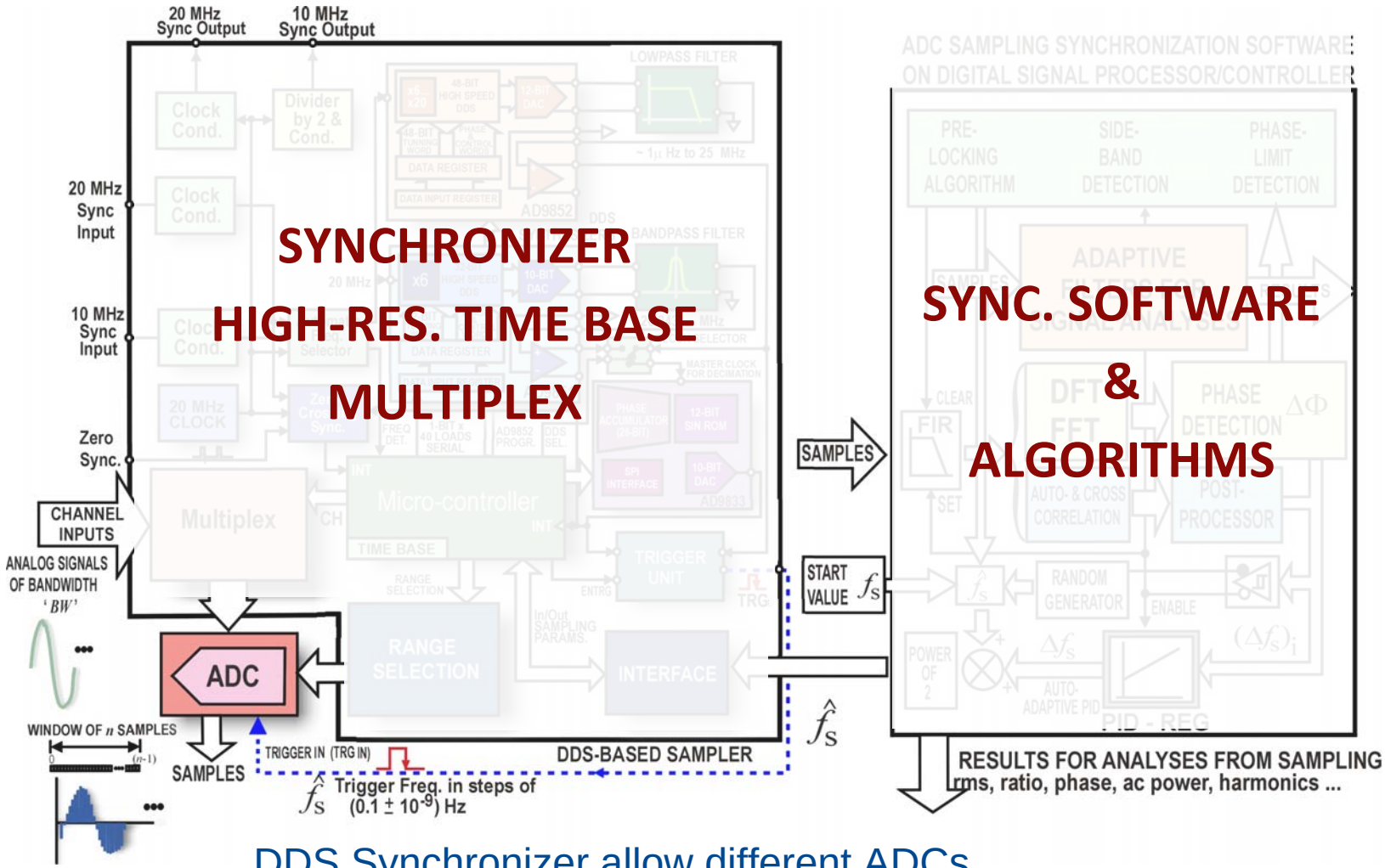
Compact three phase voltage digitiser with a frequency range up to the 50th harmonic of the mains (PTB)

Design constraints:

- uncertainties < 10E-6 V/V
- compact
- self-locking[1] (digitally)
- easy calibration (chopped DC & AC)
- ac metrology: phase, ratio, ac power…
- any ADC (IADC, SAR, S-D)
- intelligent (?, algorithms)

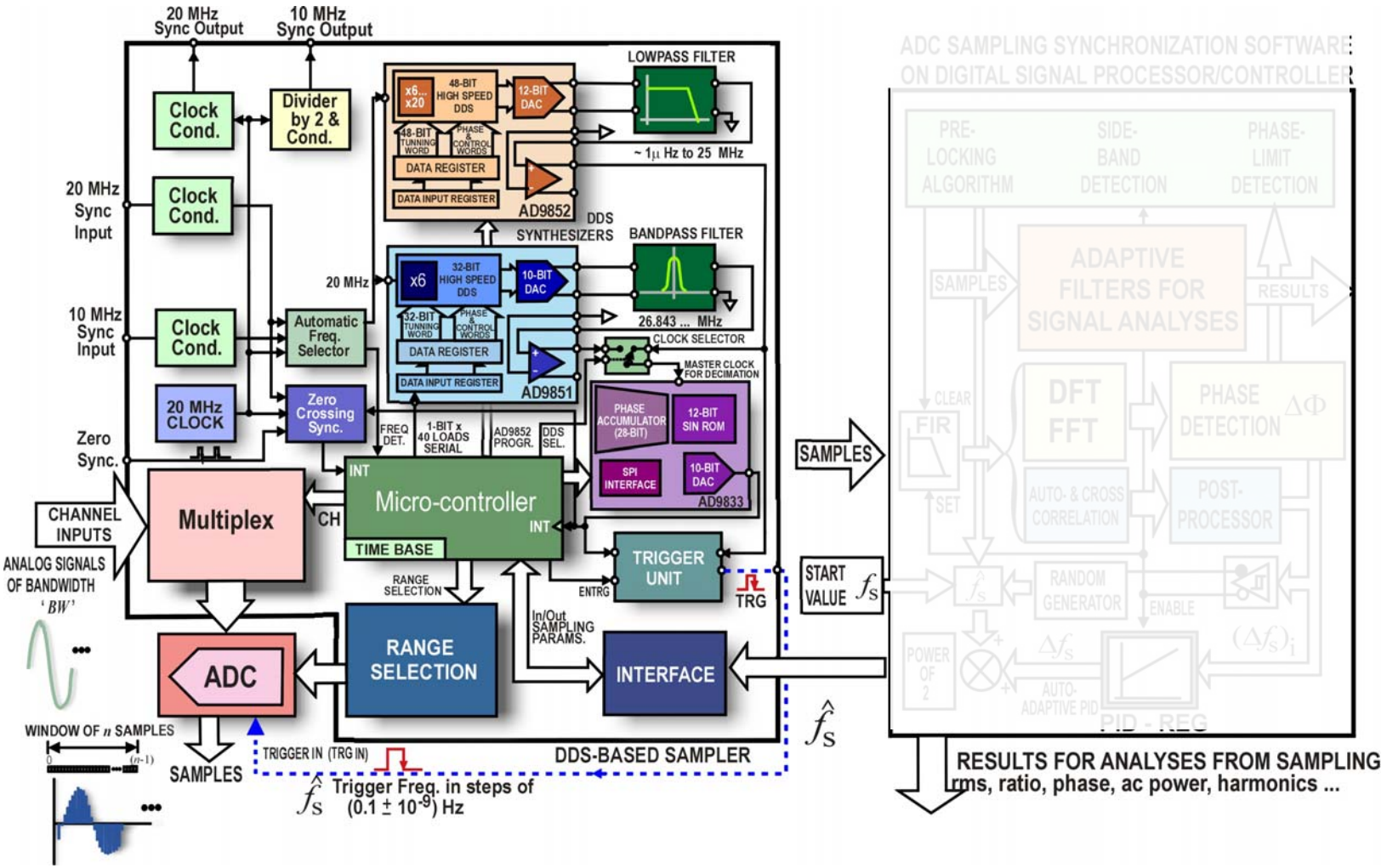
[1] German Patent Application DE 10 **2007** 043 927 A1

Compact three phase voltage digitiser

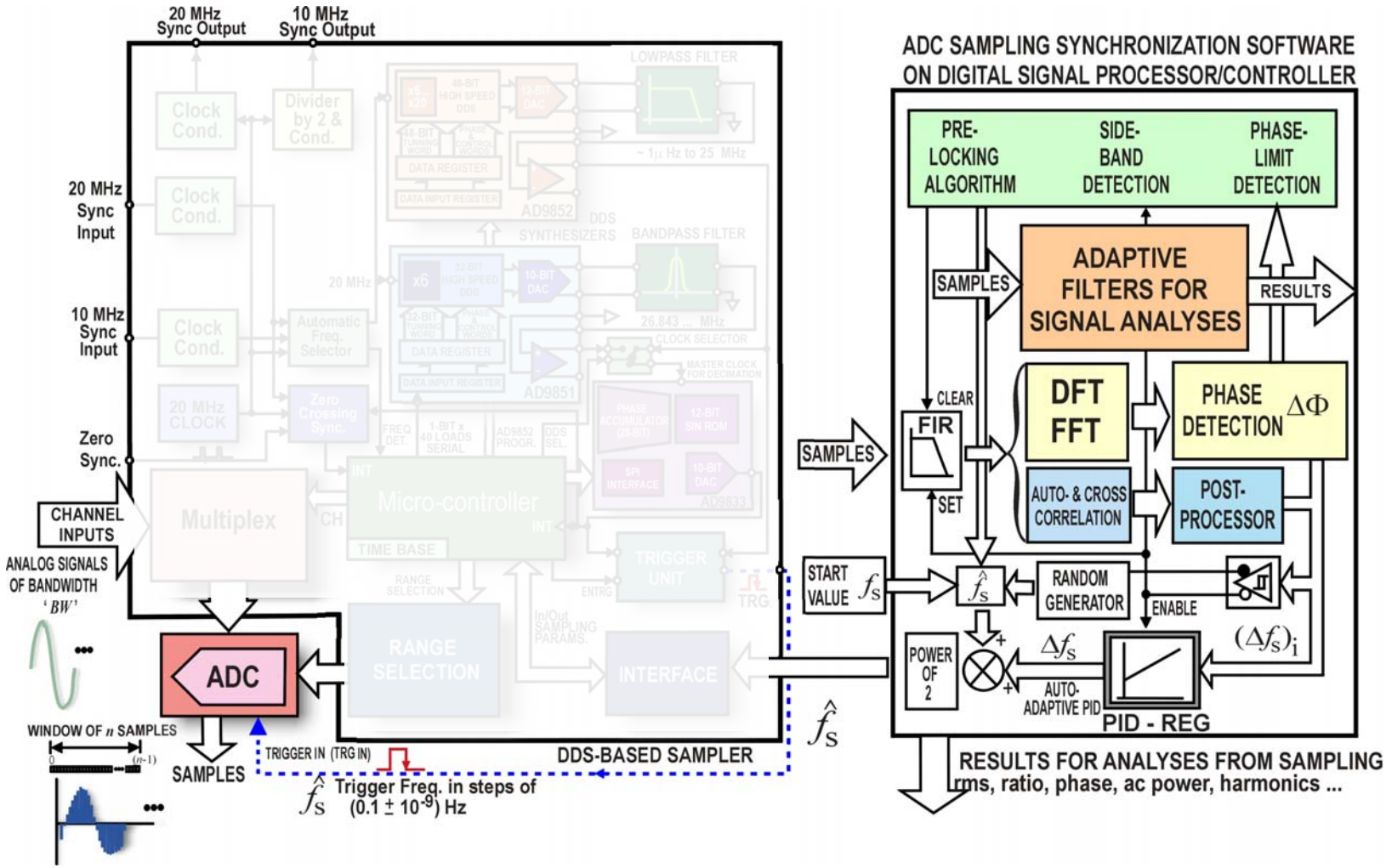


DDS Synchronizer allow different ADCs
to be synchronized: Sigma-Delta, SAR, Dual-Slope

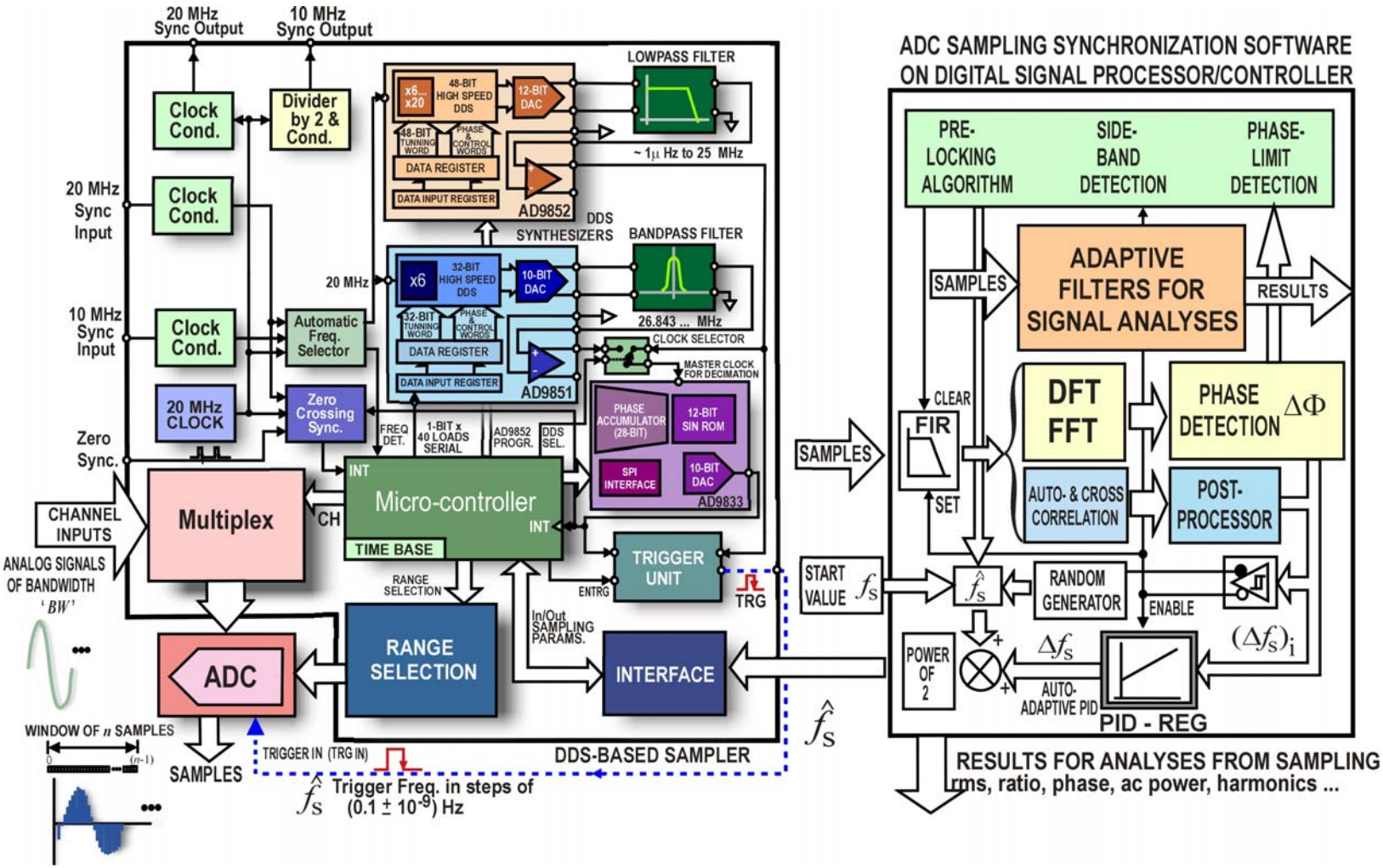
Synchronizer, high res. Time base, Multiplex.



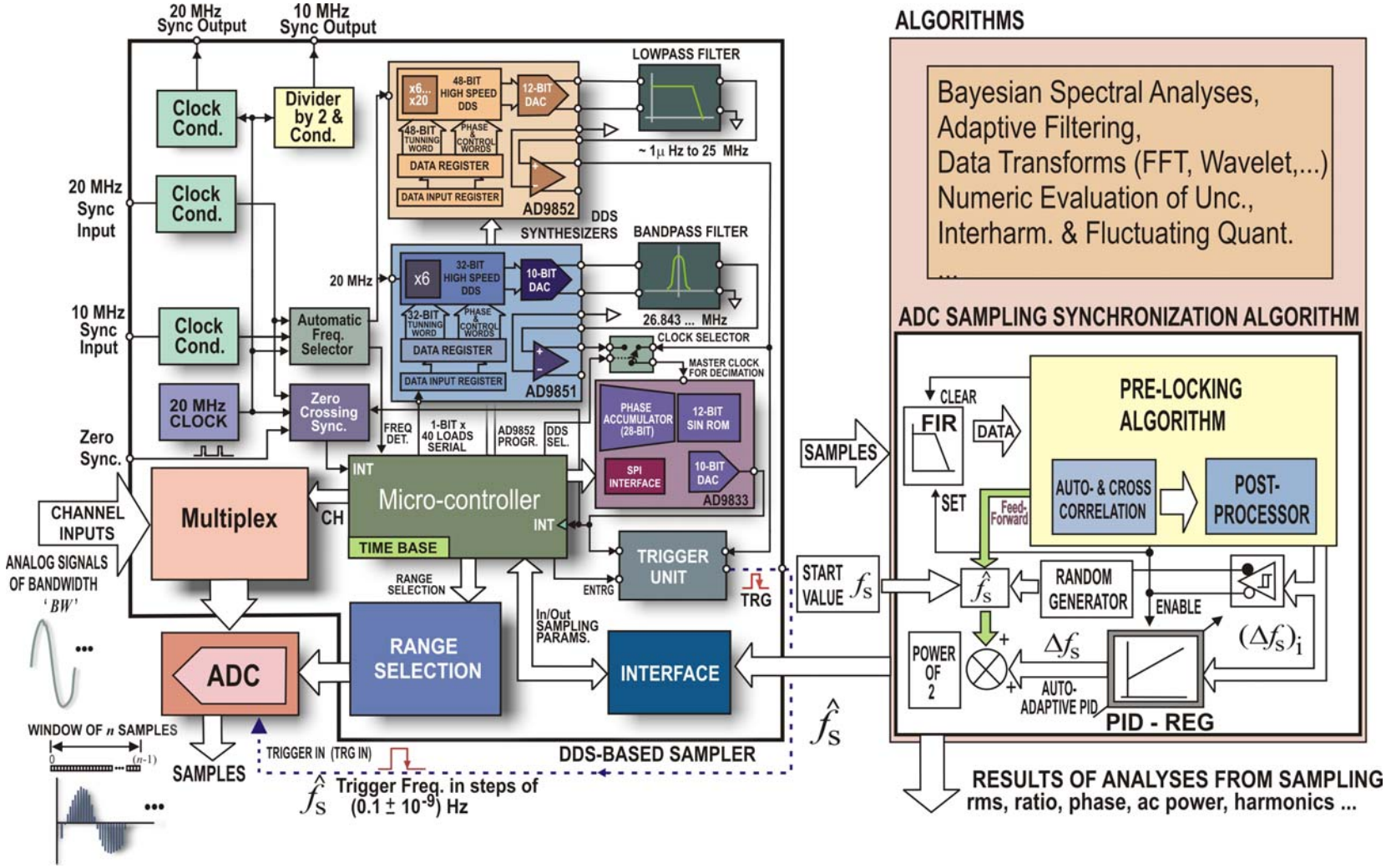
SYNC. SOFTWARE & ALGORITHMS



Compact three phase voltage digitiser Complete

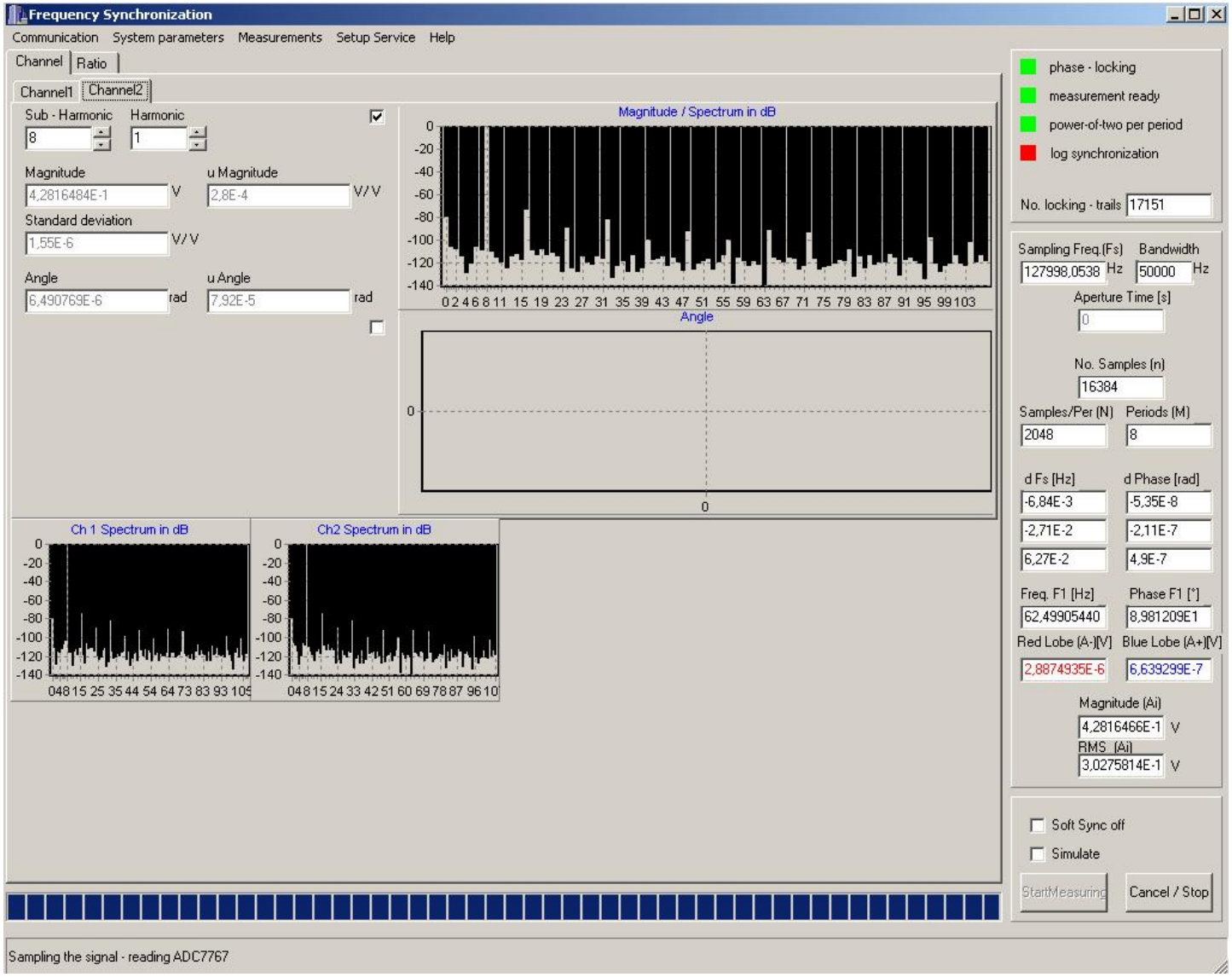


Compact three phase voltage digitiser Updated

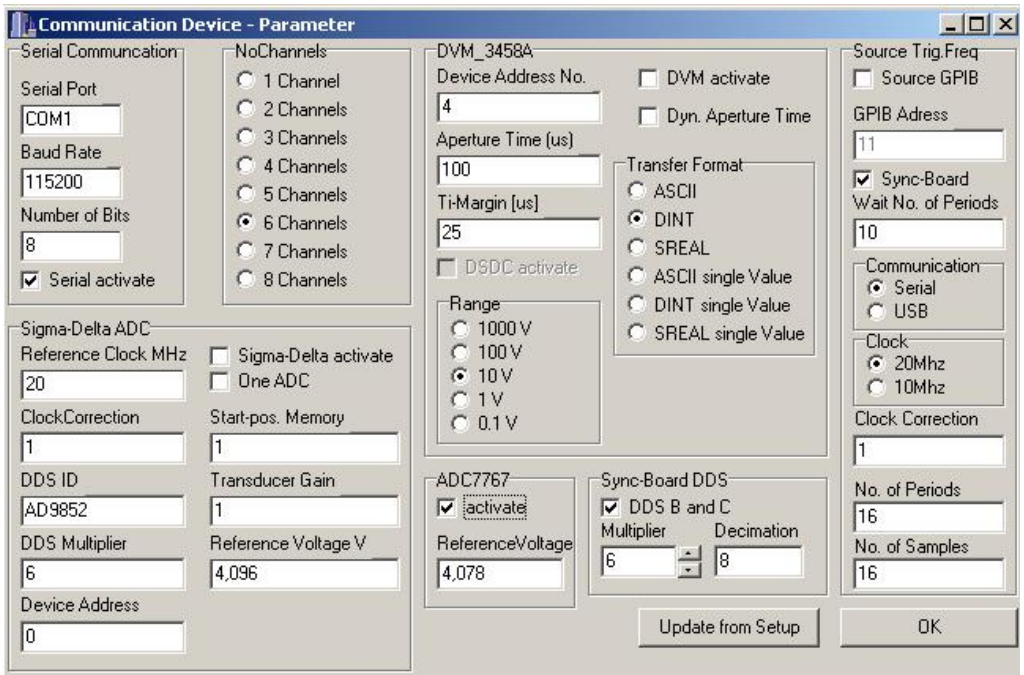


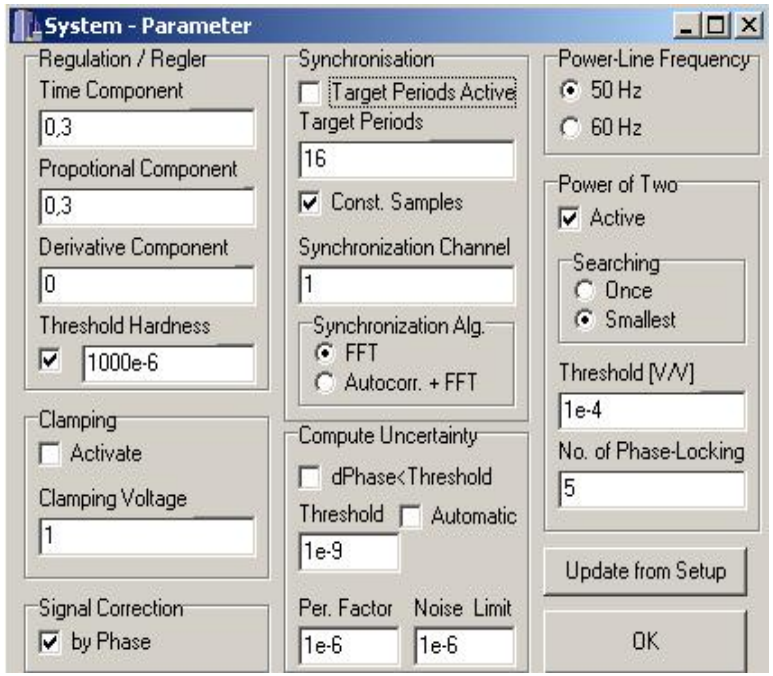
"Lapuh R., PHASE SENSITIVE SINE FITTING ALGORITHM FOR ASYNCHRONOUSLY SAMPLED DATA, Proc. 1st Reg.l Metrology Organisations Symposium – RMO 2008; 20th International Metrology Symposium, November 12-15, 2008, Cavtat-Dubrovnik, Croatia"

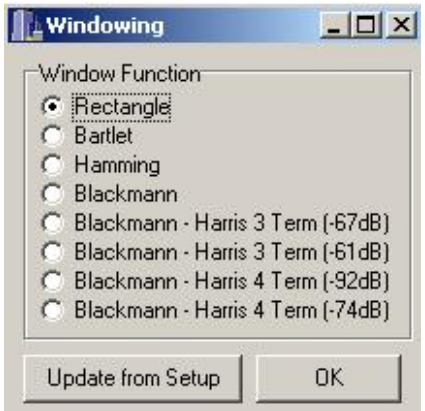
Compact three phase voltage digitiser Software (on PC)

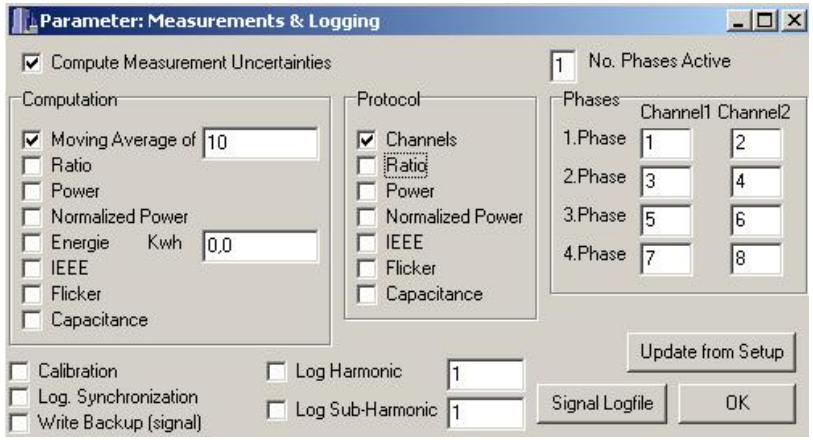


Compact three phase voltage digitiser Software (on PC)

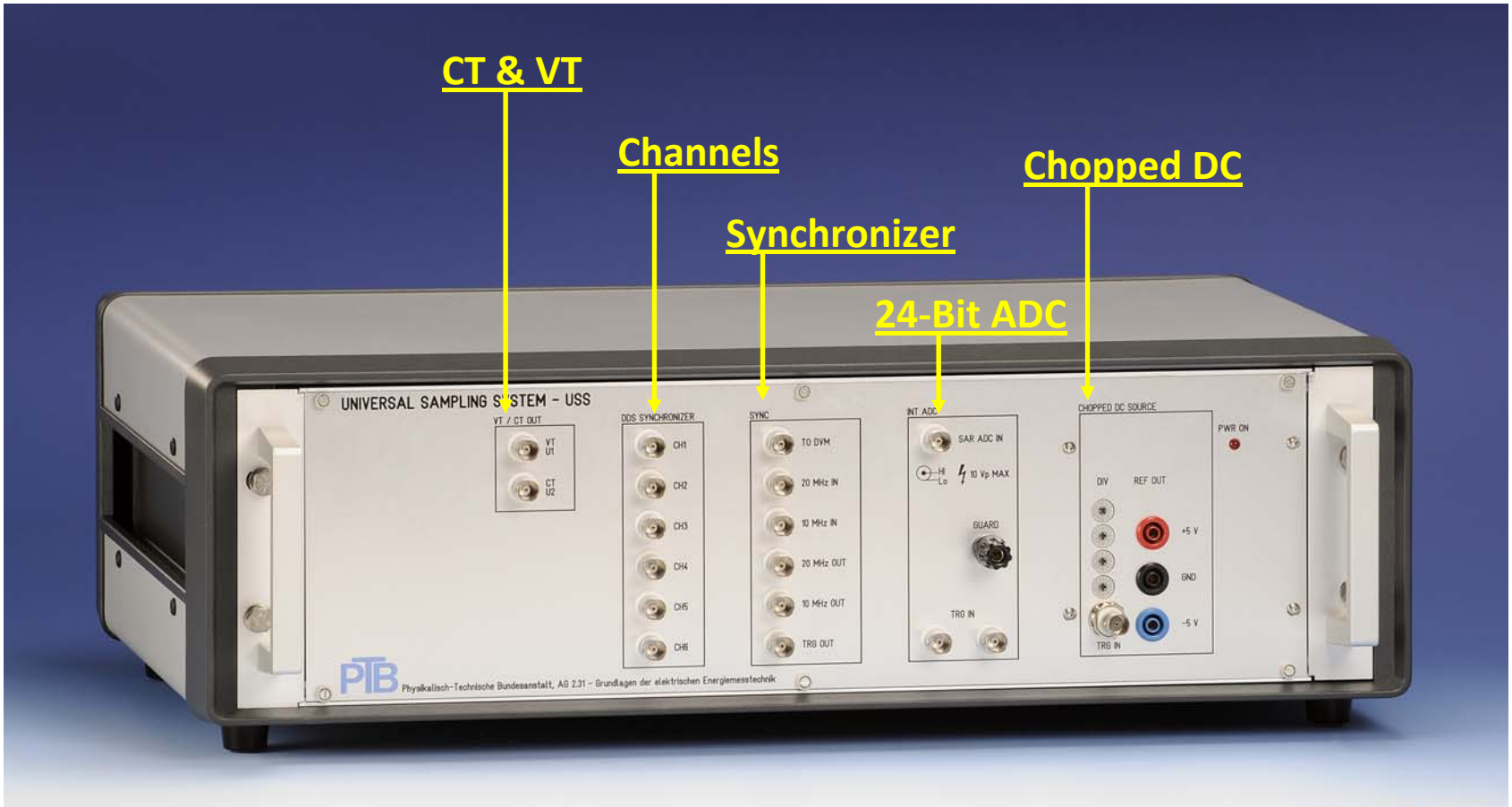








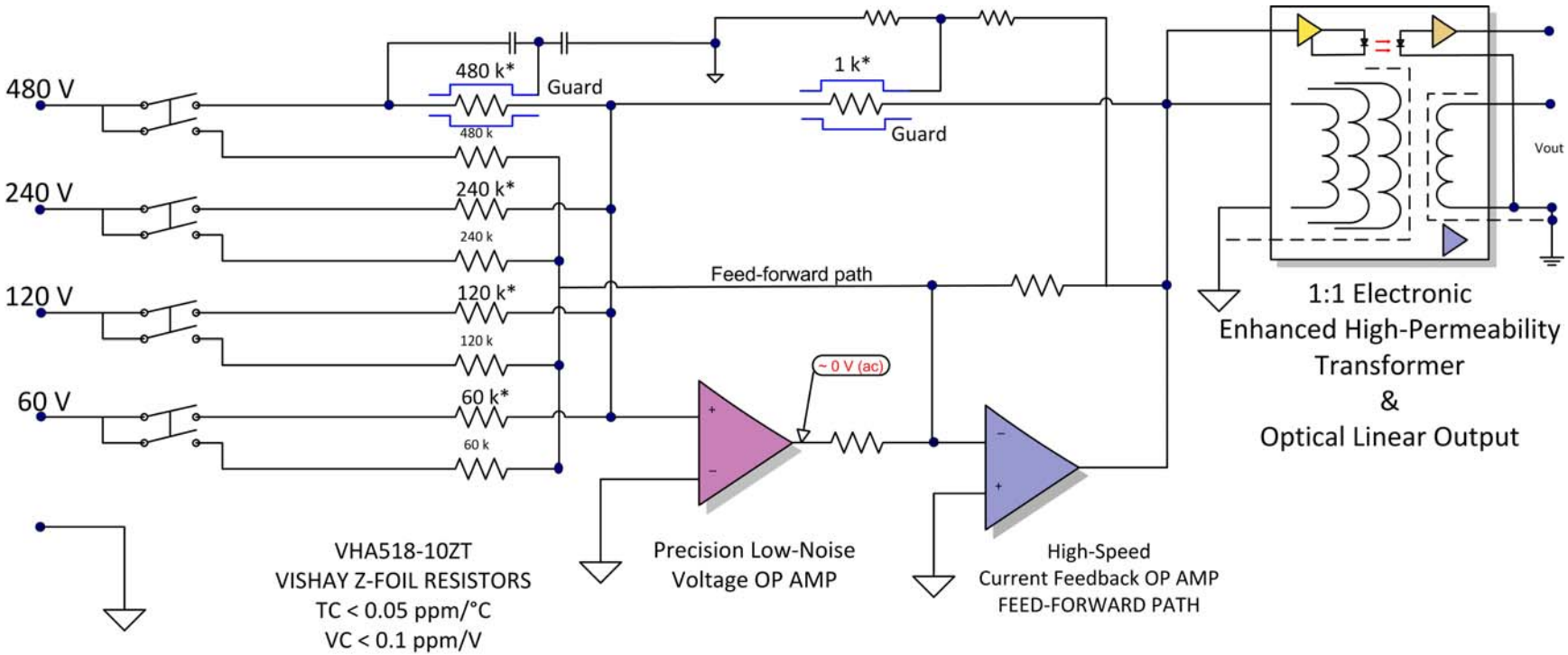
Compact three phase voltage digitiser Updated

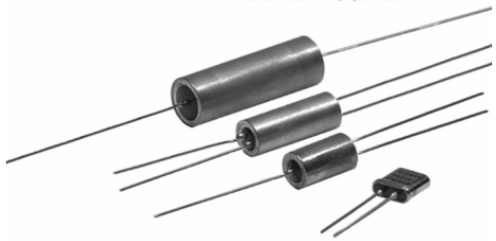


Internal SAR ADC 24 Bit, max. 128 kHz, Nonlinearity < 10 ppm!

Compact three phase voltage digitiser Updated

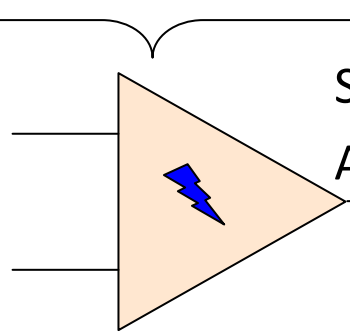
Compact three phase voltage digitiser
Voltage Transformer





H-Series (Z-Foil) hermetically sealed

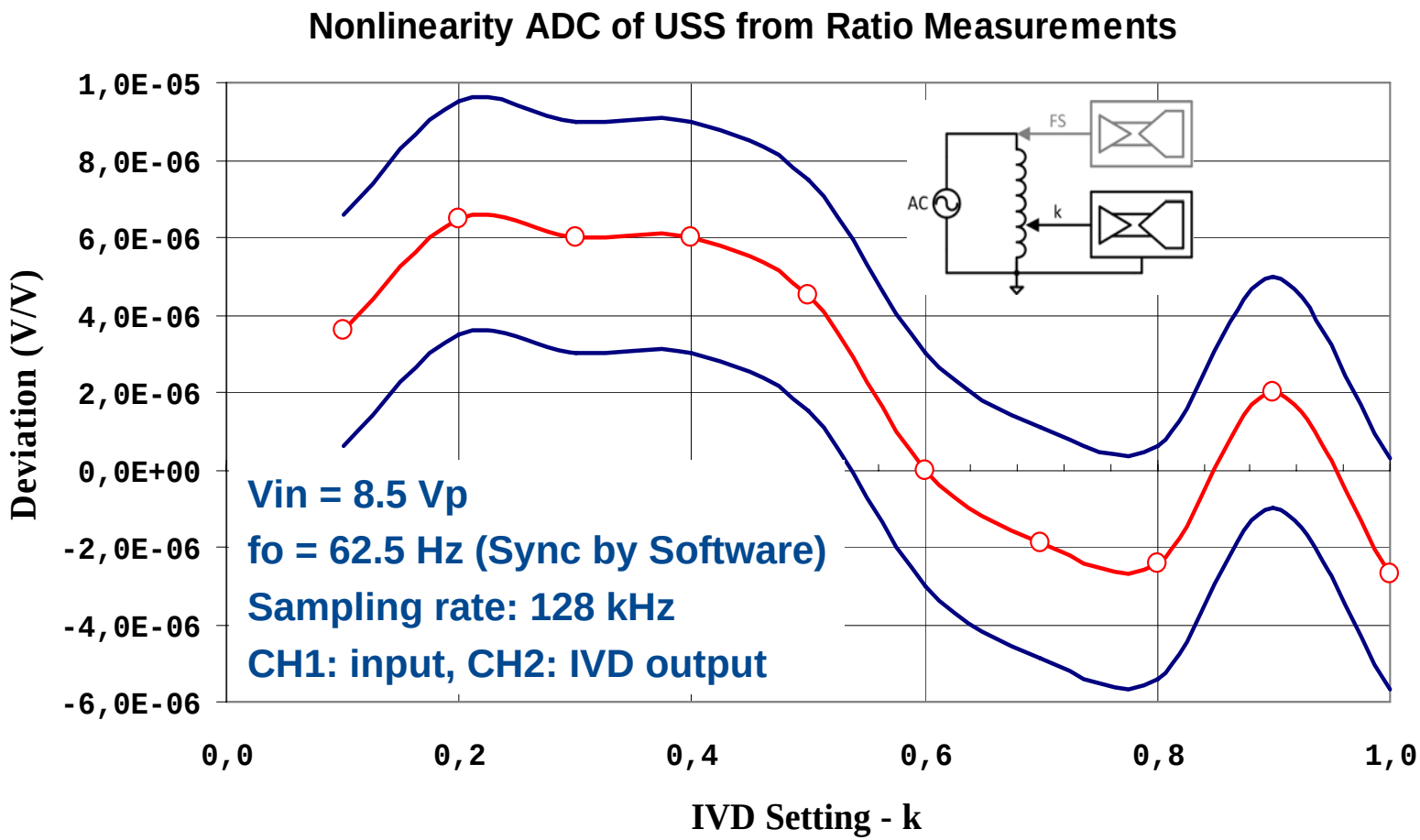
Time-constant < 1ns



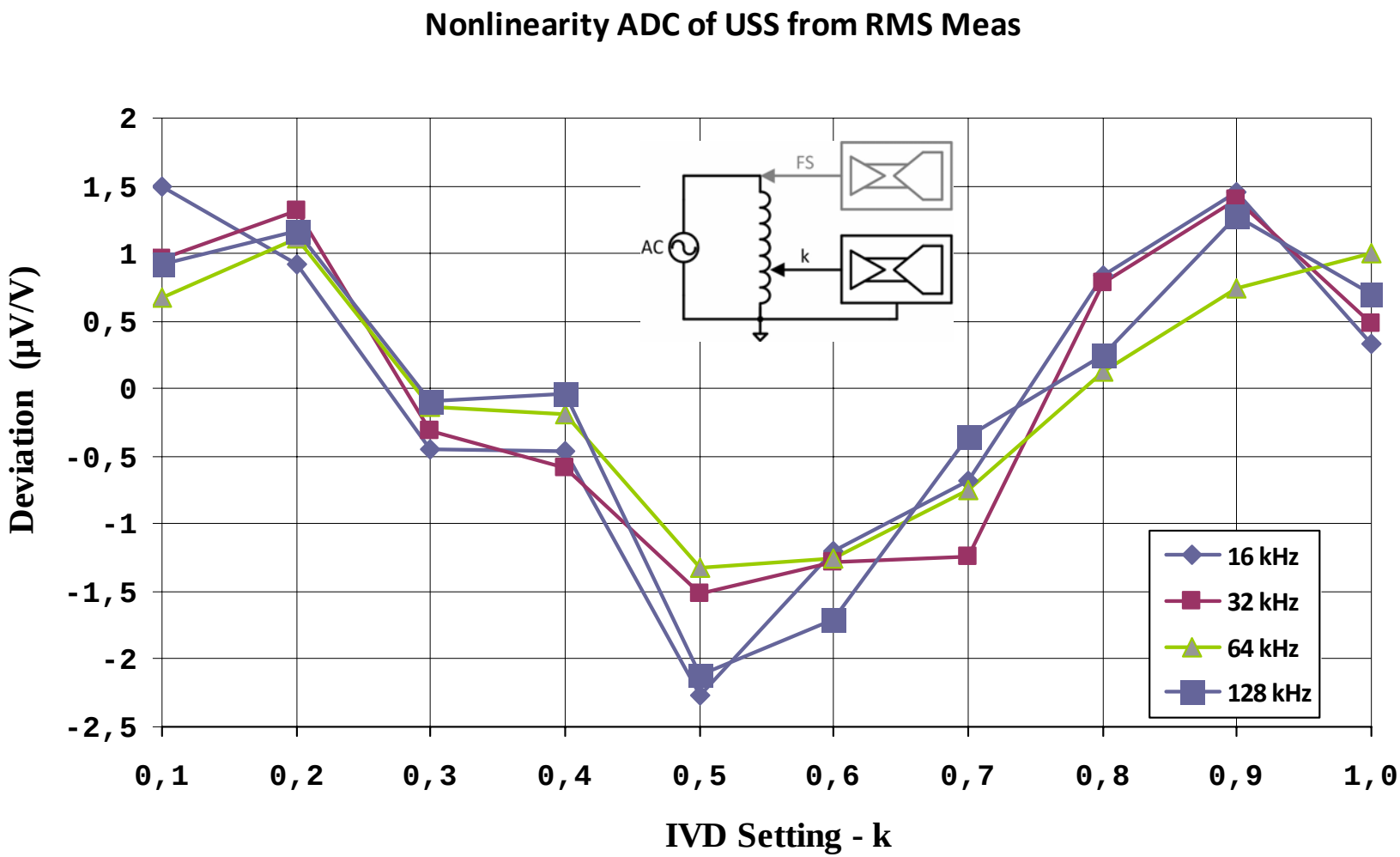
Super Gain

Amplifier: $10^{09} - 10^{12}$ V/V

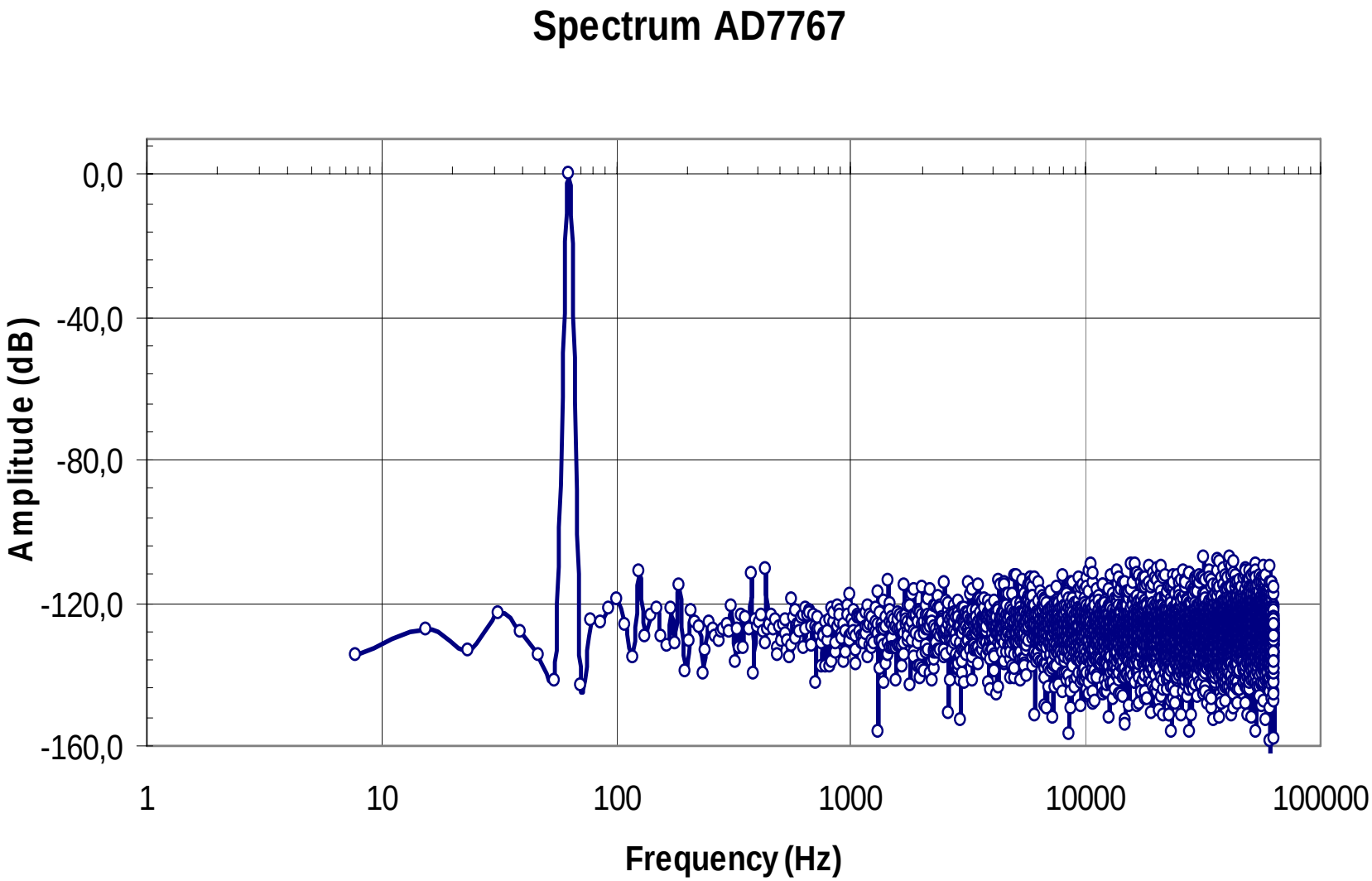
Compact three phase voltage digitiser
Some figures



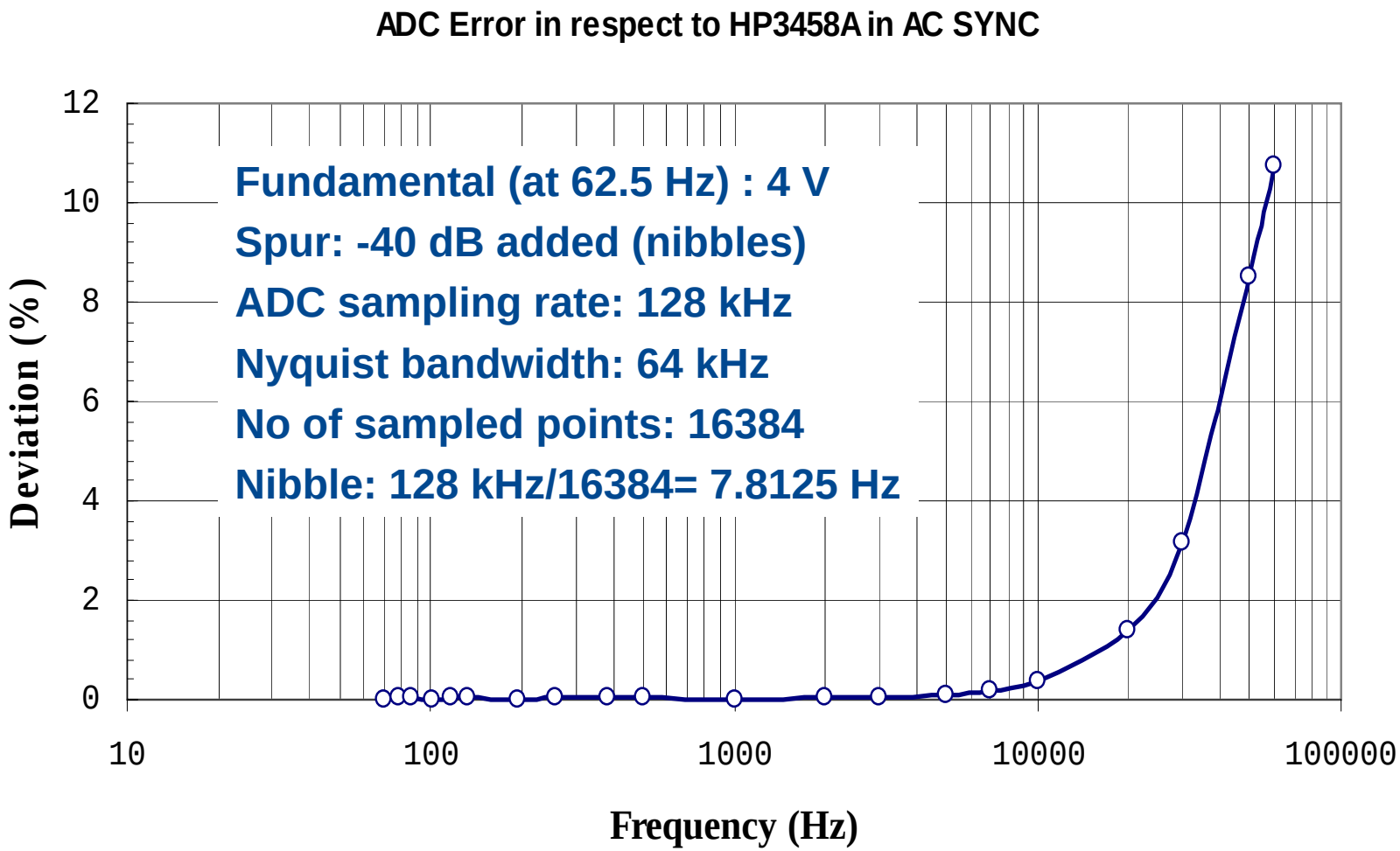
Compact three phase voltage digitiser
Some figures



Compact three phase voltage digitiser
Some figures



Compact three phase voltage digitiser
Some figures



Precision Lab Digitizer (PTB) in short

- 24 bit delta sigma ADC, 24 bit SAR.
- Uses a DDS Synthesizers to generate variable sampling frequencies for digital PLL: Soft-Sync., asynchronous meas. also possible.
- Allow tight sychronous meas., quasi-sync and asynchronous too.
- Allow Agilent 3458A to be used if desired (not a must!)

The same unc. figures as the PTB primary standard.

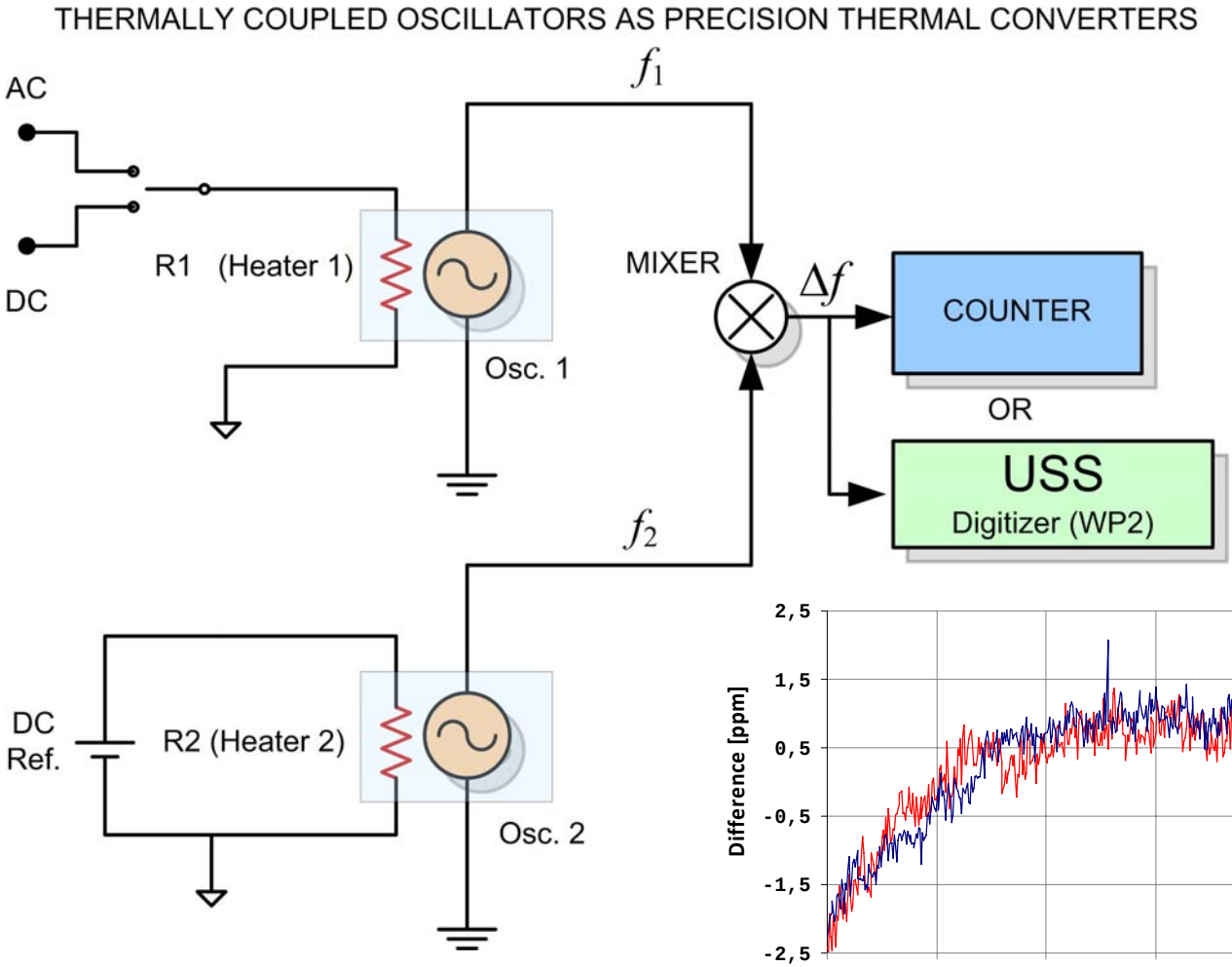
Internal SAR with comparable performance as the Agilent 3458A, allowing but higher sampling rates.

- Ultra-pure sinewave gen. (Spurs <-180 dB) locked to a quartz time base was developed to investigate ADCs.

Future work

- Improvements: Synchronizer with FPGA.
- Multiple ADCs to be read by FPGA & USB 2.0.
- Replacement of Agilent 3458A by USS (PTB).
- Improvements on ultra-pure sinewave generator.

Future work



THANK YOU!