

Streaming with digital multimeter 3458A

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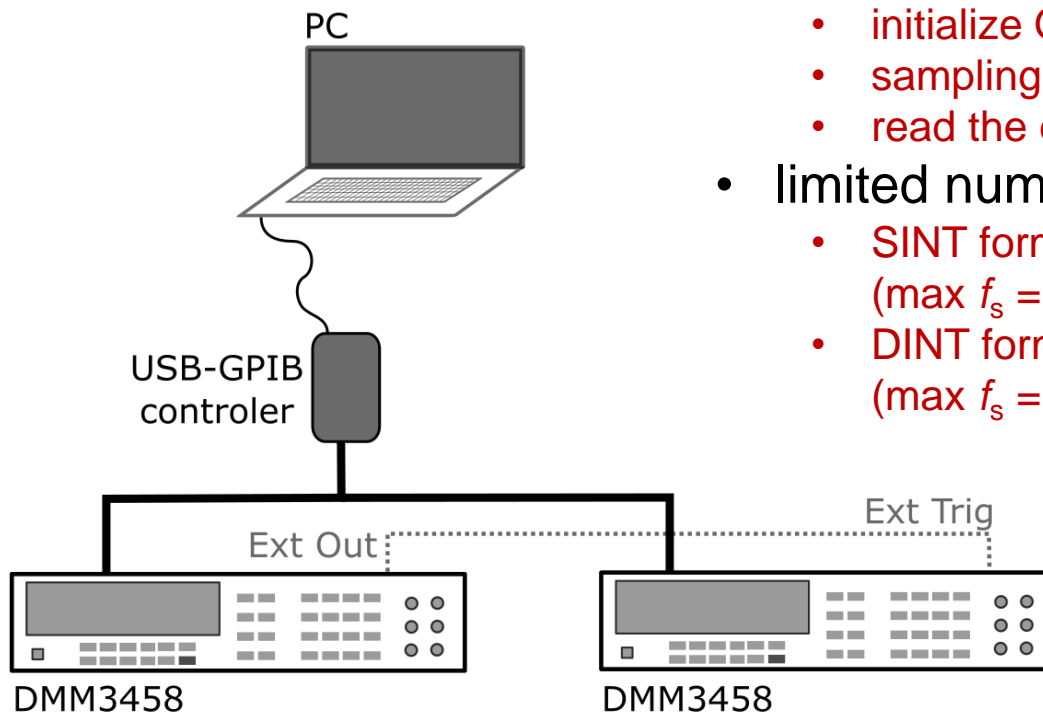
TracePQM final meeting, Brno, 27th – 28th May 2019



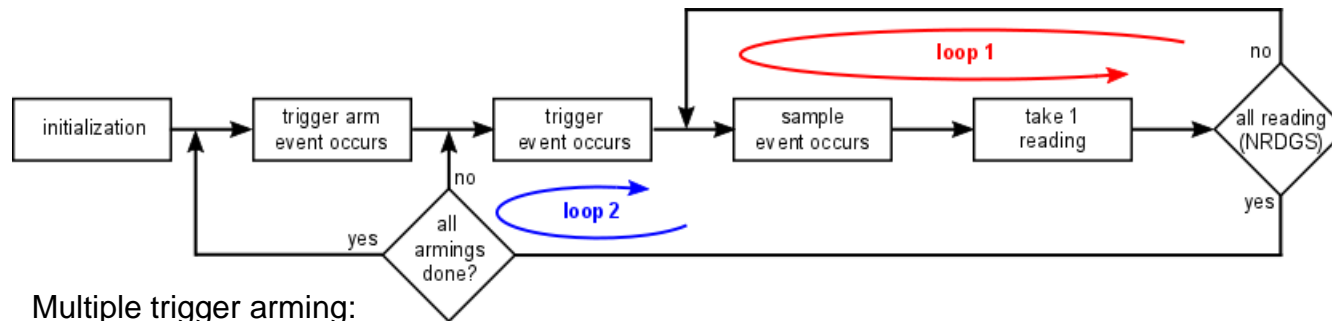
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With you for over
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years
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Sampling with 3458A using memory

- up to 148 Kbytes reading memory is available for prolonged data logging (Option 001)
- concept:
 - define sampling parameters
 - initialize GPIB bus and DMM 3458A
 - sampling and storing the data to memory
 - read the data from memory
- limited number of samples:
 - SINT format, 2 bytes per reading, 74 kSa (max $f_s = 100$ kSa/s, **0.74 s**)
 - DINT format, 4 bytes per reading, 37 kSa (max $f_s = 50$ kSa/s, **0.74 s**)

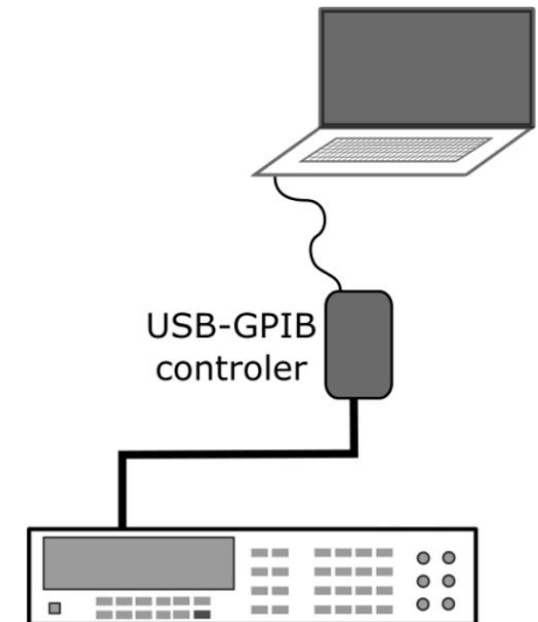


Continuous sampling with one 3458A



Multiple trigger arming:

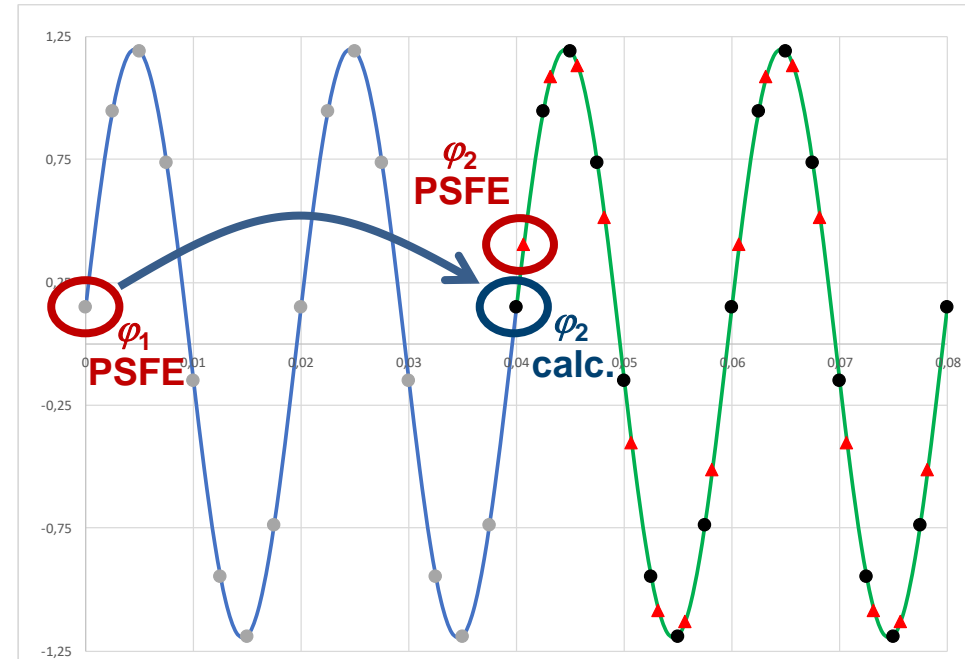
Keysight 3458A Multimeter, User's guide, Ed. 7, 2014



- define sampling parameters
 - f_s , NRDGS, number of loops M , output memory format, T_a
- initialize GPIB bus and DMM 3458A
 - GPIB address, DMMs' range
- sampling
 - SYN arming, AUTO triggering
 - maximal NRDGS is limited to **16.777.215**
 - after predefined NRDGS samples are received the loop is repeated M times
 - each additional loop is stored when the USB-GPIB controller becomes ready to receive the data again
- scaling of the results and closing of the measurement

Time delay between loops

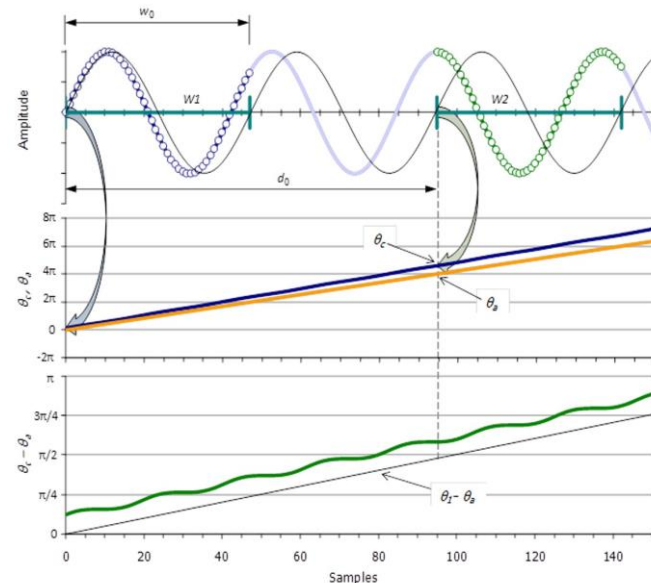
- a certain time delay is expected to occur between the loops
 - additional arming and triggering is needed
- φ_1 and φ_2 estimation with Phase-Sensitive frequency estimation (PSFE) algorithm
 - estimates A , f , φ_1 and DC of non-coherently sampled harmonically distorted sinewave signal



$$\varphi_{2,calc} = 2 \cdot \pi \cdot f \cdot \frac{N}{f_s}$$

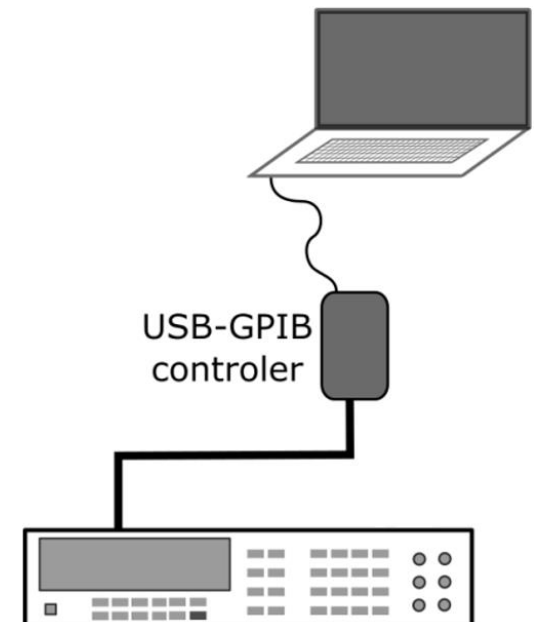
DMMs 3458	s.n.	delay between loops
HP	2823A-20702	38.5 ms
Agilent	US28032184	39.0 ms
Agilent	US28028518	37.2 ms
Keysight	MZ45052833	43.3 ms

Time delays for 3458A belonging to different generations



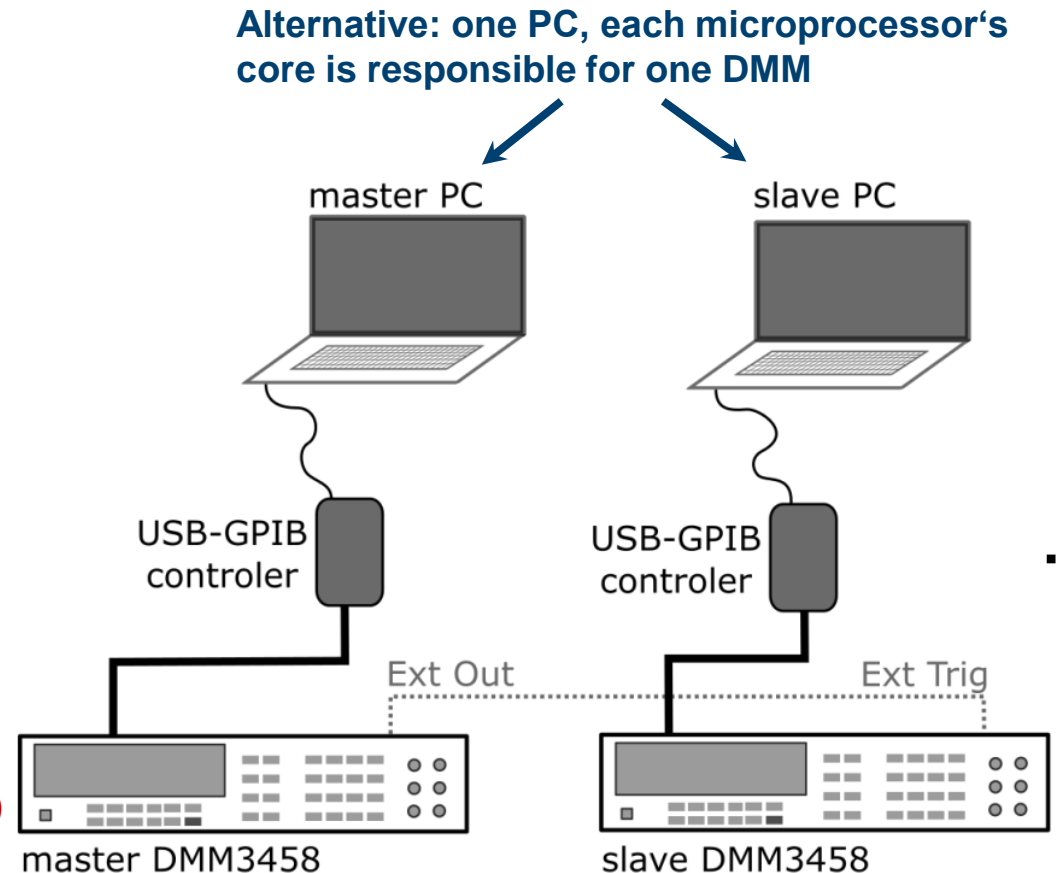
Continuous sampling with one 3458A

- concept is used for long duration measurements (minutes to hours) without internal memory
 - duration of sampling is virtually limited only by computer memory
 - no hardware (DMM) modifications is needed
 - compatibility with different DMM's generations
- the concept works at the highest supported f_s
 - 100 kSa/s SINT, 50 kSa/s DINT
- time delay between the loops equals 37 ms – 47 ms
 - the concept supporting several loops has not been used within the TWM software



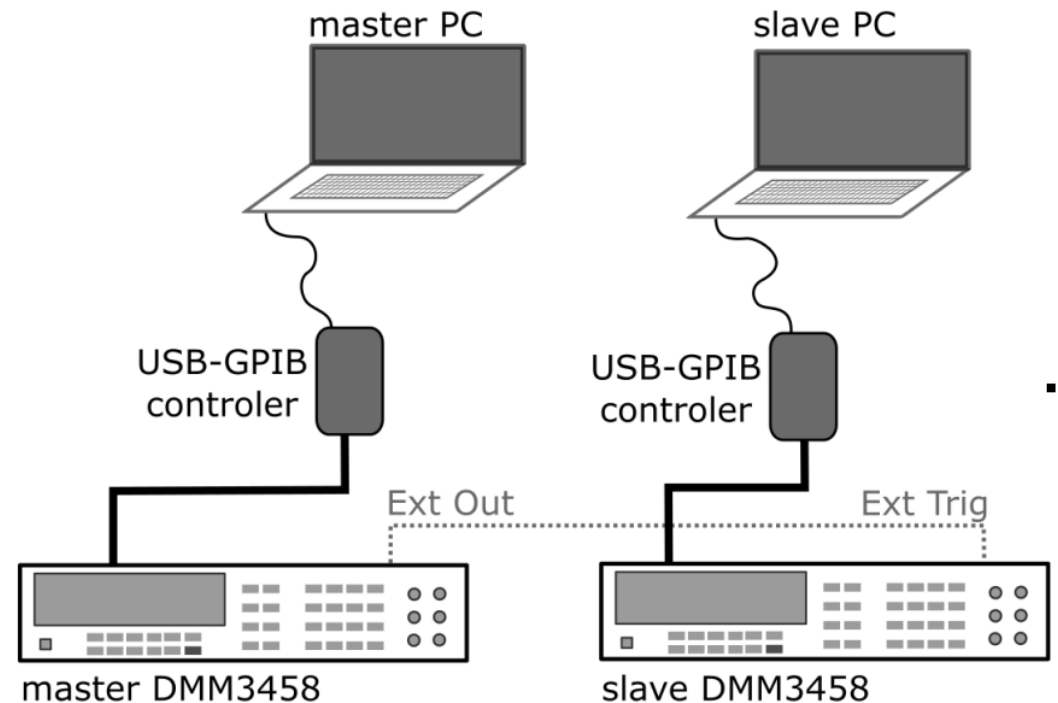
Continuous sampling with several 3458A

- PQ measurements sometimes need sampling of more waveforms
 - *e.g. voltage and current (power, energy)*
 - *phase difference*
 - *voltage in all three phases*
 - *etc.*
- concept should allow synchronous sampling with several DMMs without significant modifications:
 - *two DMMs are connected to master and slave PC using two NI GPIB-USB controllers*
 - *“external output” of the master is connected to “trigger input” of the slave(s)*



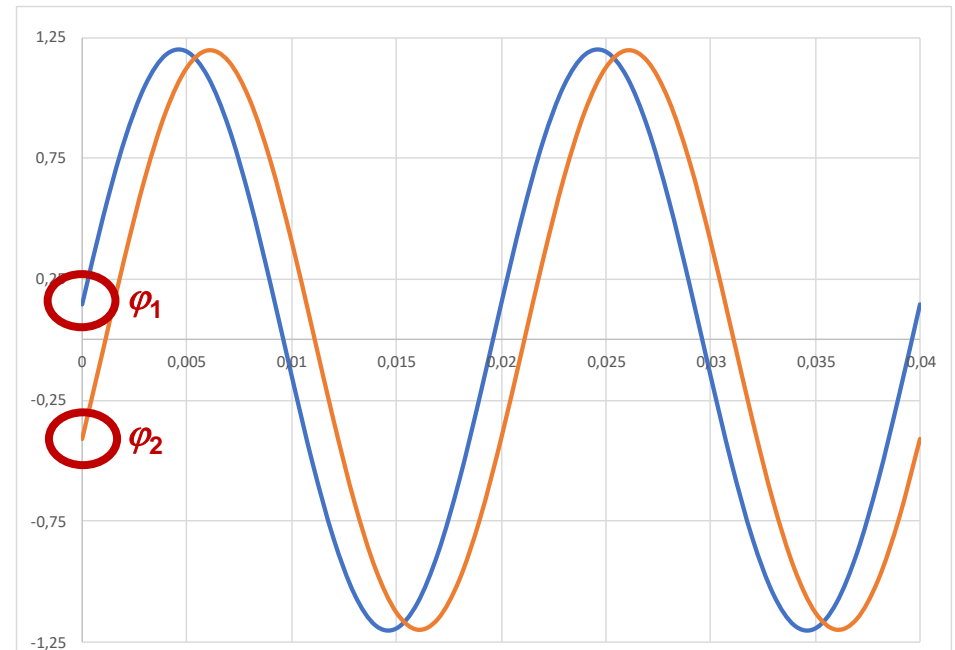
Continuous sampling with several 3458A

- software modification:
 - master: external output should be enabled
 - slave: triggering should be set to external
 - aperture time, f_s , output format, NRDGS, M should be the same for both DMMs
- running measurements:
 - run master (initialization)
 - master paused
 - run slave(s) (initialization)
 - slave(s) paused
 - master triggers synchronously sampling of all DMMs



Time delay between channels

- a certain time delay between the master and slaves is expected
 - triggering delay
 - non-synchronized internal clock
 - slight difference between internal clock
- both inputs were connected to the same source
 - cables had equal length
- waveforms were analysed by PSFE algorithm
 - φ_1 and φ_2 estimation
- measured delay between master and slave is around **1 μ s**



Thank you for your attention