LXI Class-B Enabled Instrumentation

Application Examples

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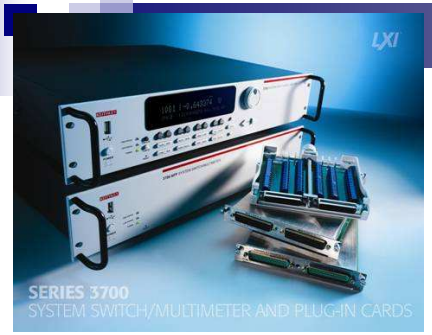
May 23rd, 2008

LXI tm
LAN eXtensions for Instrumentation

Key Benefits of LXI Class-B Technology

- Precise control of time critical events & triggers
- Elimination of unwanted delays & latencies
- Synchronization of physically separate devices
- Time stamping with reference time bases (GPS)
- Works automatically through background signaling
- Recognized standard in power, energy, telecom
- Growing numbers of compatible devices
- Caveats
  - Version 1 vs. Version 2 device incompatibility
  - Specialized networking gear required for maximum accy.
  - Specific instrument implementations vary in performance



Keithley's 1st Implementation of LXI Class-B Technology

Also an industry first!

- 600 Channel Switch/7 ½ Digit DMM System (Model 3706)
  - Example Target applications
    - Production ATE multiplex/matrix channel sequencing
    - Mixed signal data logging, temperature scan and sensor monitoring
    - Multi-Channel I/V sweep and point measure with SourceMeter®'s
    - Long term electrical/physical/environmental experiment monitoring
  - Benefits of Class-B integration → Performance Synergies
    - Reduction of test program, PC OS and communications latencies
    - Improved connect-source-measure timing synchronization
    - Better control of settling timing between signals and channels
    - Tighter synchronization with separate Sourcing Instruments
    - Integrated into Keithley control scripting language (TSP)
    - Scripts able to trigger processes and control events in real time

Example Application #1

Satellite Environmental Exposure Simulation/Testing

- 10+ Meter Diameter Satellite Chamber Monitor/Control
  - Multiple Switch/DMM mainframes placed around perimeter of vacuum chamber and facility to measure temperatures, strains, displacement and DUT electrical signals
  - Each Switch/DMM mainframe running unique scan/measure sequences at pre-scheduled times in synchronized fashion
    - Up to 10 mainframes and 1000's of channels of data run 24/7!
    - 100% of collected data time stamped, correlated and archived
    - Data collection process takes weeks due to chamber dynamics
    - Post processing effort requires precise timing – control and logging

- Key Class-B leverage points
  - Global start of test triggers pre-set following chamber controller
  - Time stamping of all measurements within 100uSec across 10 mainframes and >5000 channels
  - Mission critical time control and stamping due to limited availability of such unique chamber facilities – No "Mulligan's" in satellite testing!

Space Simulation Chamber

(Example)

Example Application #2

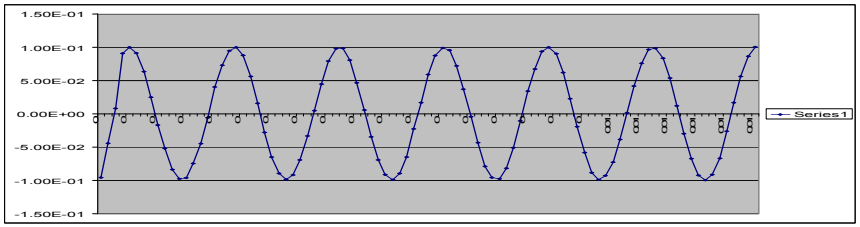
Doubling Effective Sampling Rates Through Multi-ADC Interleaving

- Large ATE system application required a few channels to sample at 2X the maximum rate
  - To re-create a time varying signal effective sampling had to be increased from 10K/sec to 20k/sec rates
  - Two Class-B Switch/DMM mainframes were present and used to capture a common signal channel with sampling triggers programmed with 50 usecs of offset btw DMM's
  - Data was reconstructed in the PC application and a composite waveform created with effective 20k rate
  - Depending on Class-B and ADC timing implementations this technique could be used on high channel count DAQ systems to selectively increase effective sample rates

Application #2 test results

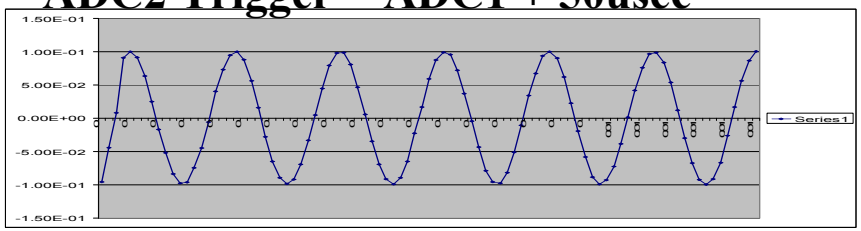
Two sets of time interleaved data

One re-created waveform at twice the effective sample rate



ADC2 Trigger = ADC1 + 50usec

+



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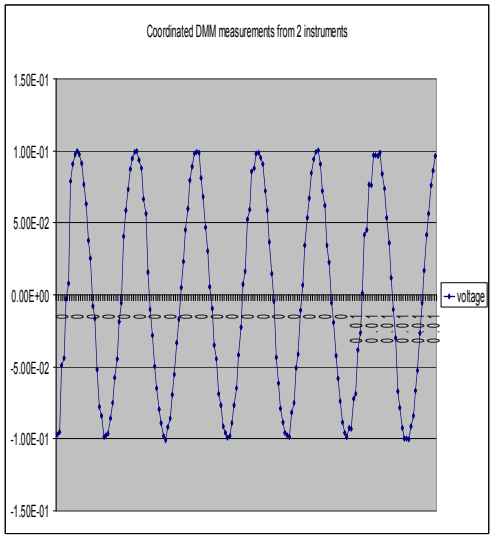

Typical sync accuracy observed ~ 15usec jitter

Benefit of Class-B is tight alignment of independent ADC clock/triggers

Application Example #3

Common Event Synchronization

- Accelerator ring application
  - Users need pre-scheduled event capabilities to capture key information using 1588
  - Researchers expose devices and materials to the beam at pre-scheduled/known intervals
  - Beam time is costly so researchers need instruments to all work for short period of scheduled time and they need some to work remotely
- Importance of 1588
  - Reliable scheduling of events that can trigger complicated tests without hardware triggering is critical to using the shared lab resources

Critical Performance Requirements (CPR's)

- Channel synchronization <1msec between mainframes (10 units)
- Measurement synchronization to start of test signal within 0.5msec (all mainframes)
- Timestamp accuracy within 0.1msec for each of 5000 measure channels
- System synchronization to GPS time

Class-B Enabled Scripting

TSP™ Test Script Programming Language with 1588 sync

- Increases Ease of Operation
  - Contains “intelligence”; i.e., controls scanning, measuring, pass/fail decisions, test sequence flow control, binning, data logging
- Custom Functions for Your Application
  - Create your own, or choose from our library of pre-written functions
- A great environment to manage 1588 signals
  - Schedule events and triggers

```
function scan_with_1588()
reset()
scan.reset()
buffer=dmm.buffer.make(200)
dmm.connect=dmm.CONNECT_ALL
dmm.autodelay=dmm.OFF
dmm.range=10
dmm.autozero=dmm.OFF
dmm.nplc=.0005
dmm.measurecount=1
dmm.configure.set('mydcvolts')
dmm.setconfig('1101', 'mydcvolts')
scan.add('1101','mydcvolts')
scan.measurecount=100

scan.trigger.measure.stimulus=
                schedule.alarm[1].EVENT_ID
sec,ns=ptp.time()
schedule.alarm[1].ptpseconds=sec+5
schedule.alarm[1].fractionalseconds=0
schedule.alarm[1].repetition=1000
schedule.alarm[1].period=0.000010
schedule.alarm[1].enable=1

scan.execute(buffer)

end function
```

Summary

- Many new applications and higher performance levels possible through Class-B defined capabilities
- Specific implementations of Class-B technologies key to ease of use and performance levels
- Exploitation of shared and accurate sense of time in systems requires careful planning and new approaches to event scheduling