LXI Overview
Wired Trigger Bus

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LXI tm
LAN eXtensions for Instrumentation

Wired Trigger Bus Objective

- To provide a uniform physical trigger mechanism between Class A LXI Devices
  - Class A requires the presence of Class B triggers and timing
  - Class C devices may become available with the Wired Trigger Bus
- Functional equivalent to ad hoc trigger exchange between instruments over coaxial cables
- Part of the overall suite of LXI Triggers

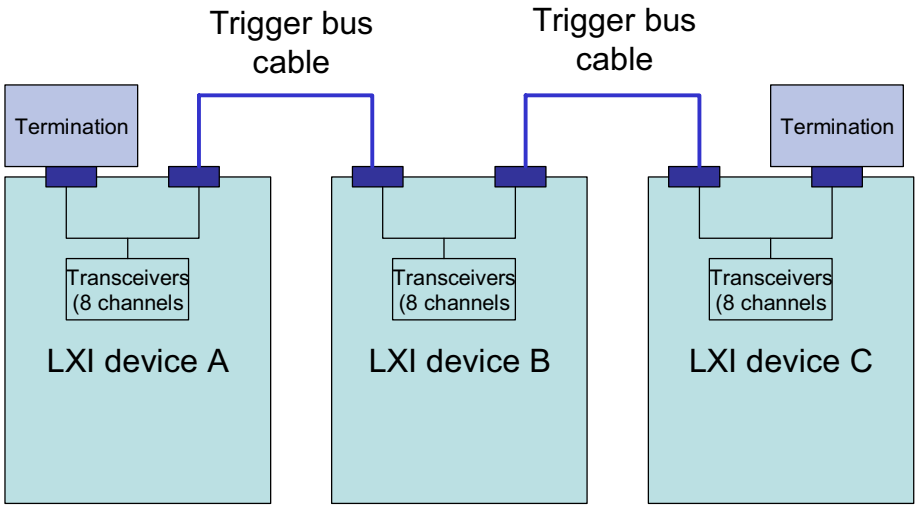
Why a physical wired trigger bus?

- Low latency
  - Connection time is primarily defined by hardware
- Low jitter
  - Delays do not vary significantly
- Can be used to exchange data over the trigger lines
- Enables the exchange of clock signals over trigger bus

WTB Capability

- Provides 8 independent channels of connectivity between LXI Class A Devices
  - Matches the channel count in other LXI trigger methods
    - Permits easy exchange of trigger operation between different trigger methods
  - Matches trigger bus count of VXI and PXI
    - But uses cable interconnect instead of a backplane
- Each LXI Device has two WTB connectors physically wired together

How the system looks



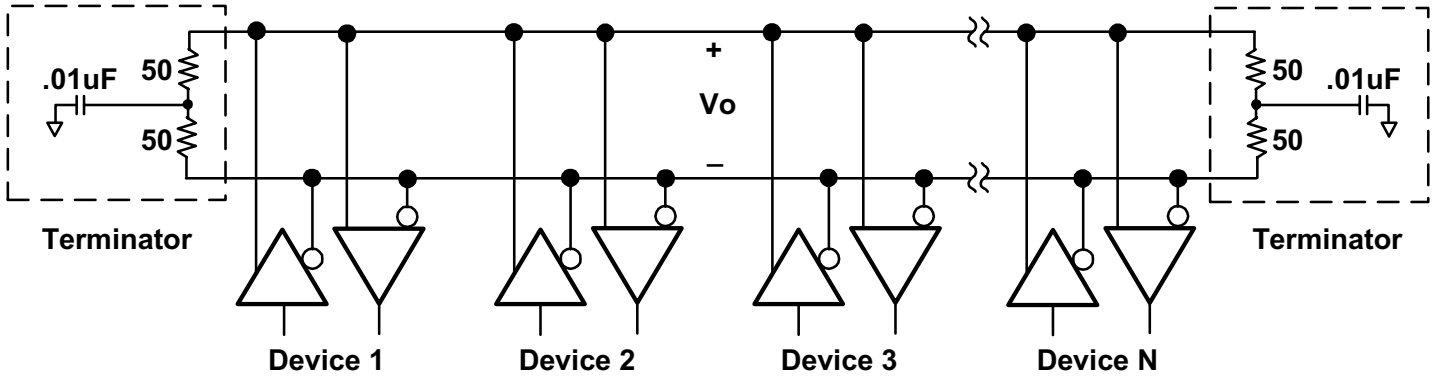
- LXI Devices are connected by LXI Trigger Bus cables
- Trigger bus cable carries 8 channels
- Cable forms a transmission line that is terminated at both ends by the terminator
  - Use of a terminated transmission line ensures triggering is on forward wave and not reflected wave
  - The need to avoid stubs precludes the use of connectors that can stack on top of each other (as GPIB)

Electrical interface (1)

- Electrical specification is based on a variation of TIA/EIA-889 Multipoint LVDS
- Each channel set to operate in one of two modes
  - Driven mode. Point to multipoint connection
  - Wired OR Mode. Multipoint to multipoint connection
- WTB operates as normal with un-powered devices attached to the trigger bus

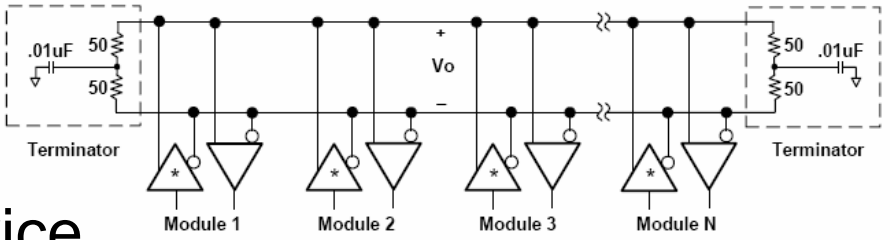
Electrical Interface (2)

- LVDS signalling allows a long transmission range, high signal immunity and low signal emissions
- M-LVDS is a variation of LVDS
  - Greater current capacity from the drivers
  - Driver sends current in both directions down a transmission line
  - Has two terminations for the transmission line instead of one
  - The LXI implementation uses two drivers on each line

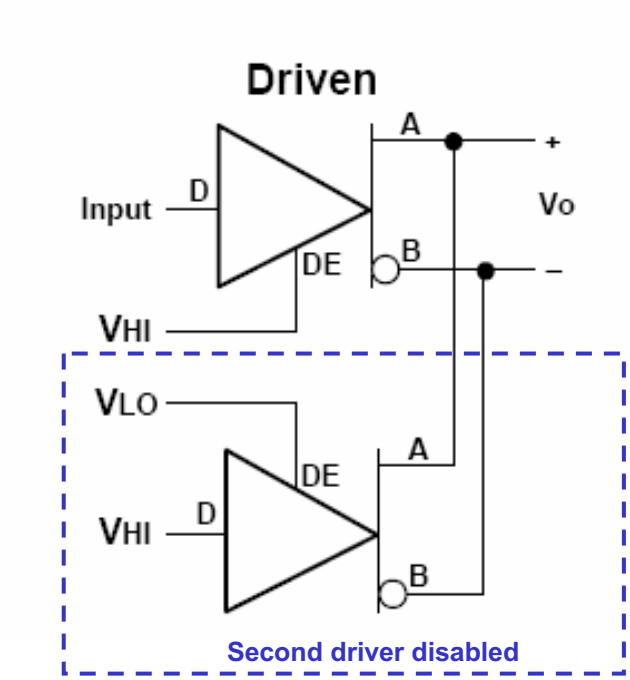


★ Driver uses two devices connected in parallel

Driven Mode

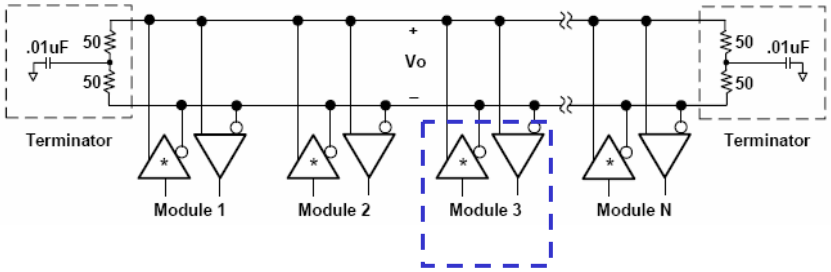


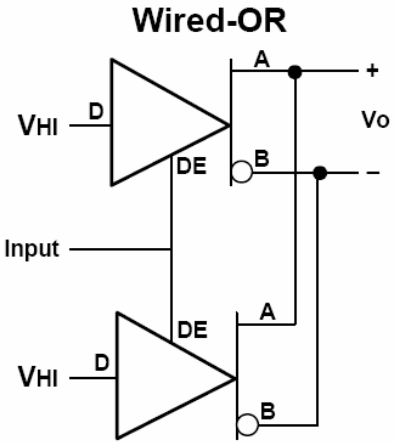
- For driven mode one LXI Device controls the transmission line condition and many receive
  - One driver only is used to drive the transmission line
  - Similar principal to PXI backplane triggers but with differential signalling over a cable and PCB interconnect and has a terminated transmission line



Wired OR Mode

- Designed to allow the first device ready to set the interface high
- A Bias device forces the interface low with one unit of current, others are tri-state
- The first device to trigger forces the interface high with two units of current
- Reverse operation (last device ready) is the same but all devices are set to be on with two units of current
  - Last to go tri-state allows the bias device to force the transmission line low
- Very similar characteristics to VXI Trigger Bus
  - But much faster





Connectors

- Specified as 25 pin Micro D Type, commercial grade used
  - Small and robust connector with 1 Amp current rating
- Connector carries 8 M-LVDS pairs, shields, 3.3 V power and power return
- The 3.3 V power is limited to 100 mA and cannot be extended into the cable
  - Ensures no voltage conflict between LXI Devices

Pin	Signal
1	+3.3V
2	GND
3	CH1 (+)
4	CH1(-)
5	GND
6	CH3 (+)
7	CH3 (-)
8	GND
9	CH5 (+)
10	CH5 (-)
11	Reserved
12	CH7 (+)
13	CH7 (-)
14	CH0 (+)
15	CH0 (-)
16	Reserved
17	CH2 (+)
18	CH2 (-)
19	GND
20	CH4 (+)
21	CH4 (-)
22	GND
23	CH6 (+)
24	CH6 (-)
25	Reserved
Connector Shell	CHASSIS

Connectors on the LXI Device

- Each LXI Device has two connectors
  - Can be side by side or stacked on top of each other (dual connector)
- Two connectors ensures daisy chaining of trigger bus
- Connectors electrically are wired together with PCB transmission lines
  - minimized stubs preserve the transmission line parameters
    - Defects will compromise the whole trigger bus

Cable Assembly

- Mating connectors at each end with locking screws
- Cable carries 8 twisted pairs with a screen for each
  - Screen reduces crosstalk between cable pairs
- Wire is specified to have a high conductivity finish to avoid signal degradation at high frequency on longer cable runs
  - Classic problem of skin effect losses
- Cable is relatively thin and flexible
  - Easy to interconnect and bend

Terminator

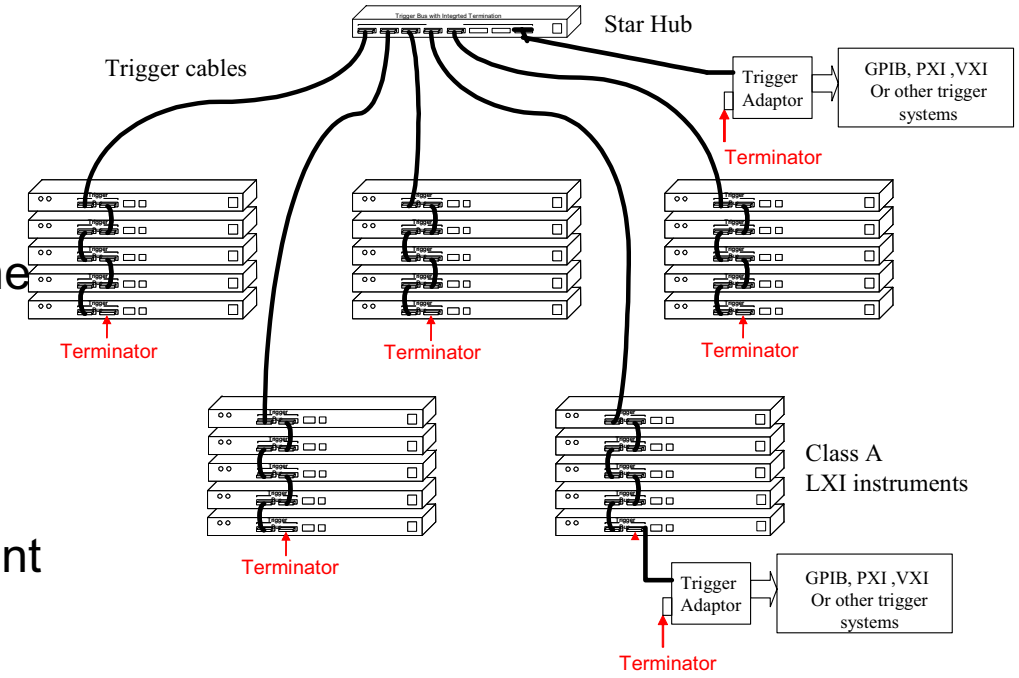
- Simply a block including differential terminations for each differential pair
  - Two 50 ohm resistors in series across the pair with 0.01 uF to ground at centre tap for each channel
- Terminates differential line in 100 ohms at each end
- Centre tap provides common mode termination of any AC current imbalance
  - Some imbalance is always present
    - Driver mismatch
    - Difference in operating times coming out of tri-state mode for drivers

Overall performance

- Can have 16 LXI devices daisy chained together
- Can propagate a 10 ns pulse over 10 m of cable in Driven Mode
- Can propagate a 20 ns pulse over 10 m in Wired OR mode
  - Performance difference resulting from use of tri-state mode for drivers
- Connection length can be extended but at the expense of need for wider pulses
  - Doubling distance doubles the pulse width supported
- Flexibility of both driven and Wired OR mode
- Remember that it can also be timed by Class B devices

Expanding with a Star Hub

- Star Hub can be used to connect segments together
  - Extends the number of LXI Devices
  - Electrically separates the segments
  - Can use two connectors or one connector with internal termination on each port
- Star Hub can provide a logical mapping between the segments
  - How much is vendor dependent
- Star Hub acts a directional barrier
  - Has an impact on both Driven and Wired OR mode



Adapting to other trigger interfaces

- Triggers from other devices can be adapted to LXI Trigger Bus with Class A Digital I/O interface
  - Fully compliant with the LXI standard
  - Relatively complicated and expensive device
- Maybe simpler non compliant interfaces
  - Simple converters with controls not complying to the LXI specification

Cable, Terminator and Adaptor Availability

- Working with suppliers to ensure commercial availability terminator and cable assemblies
  - No barriers to other parties to achieve compliance
  - Publish enough information about requirements and construction with no IPR
- Defining a compliance procedure
  - Permit compliance tested product to carry the logo
  - Encourage suppliers to submit for testing
- Adaptors more ad hoc
  - No specific compliance procedure

Compliance Procedure

- Requires access to high speed scope
  - Preferably with a differential probe
- Requires some supporting hardware to allow access to the WTB
- There is a procedure for testing the LXI Device
  - Part by vendor declaration
  - Part by physical testing
- Separate procedure will be generated for cable assemblies and terminators
  - Entirely based on the rules already in the standard
  - Will provide user assurance about the performance of the cables and terminators

Comparing LXI WTB to VXI/PXI trigger

- Uses a cable connection instead of a backplane
  - Gives more accessibility over greater distance and freedom from the chassis
  - Costs more to implement
- Has the same channel count
- Much faster than VXI
  - Similar or slightly slower than PXI trigger bus
- Includes Wired OR capability
  - Much faster than VXI
  - Not supported on PXI
- Can support more devices on one bus segment
  - All can be extended with buffers

When might you use WTB rather than LAN?

- Need lowest latency and jitter
- Distance between LXI Devices is not very large
  - Needs to be within cabling range
- You need to exchange data or clocks in real time
- Triggers are initiated by device hardware events rather by time