Fuzing & Ordnance Systems

L-3 FOS
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Development of a General Purpose Data Recorder for Very High Mechanical Shock Load Applications
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Presented By

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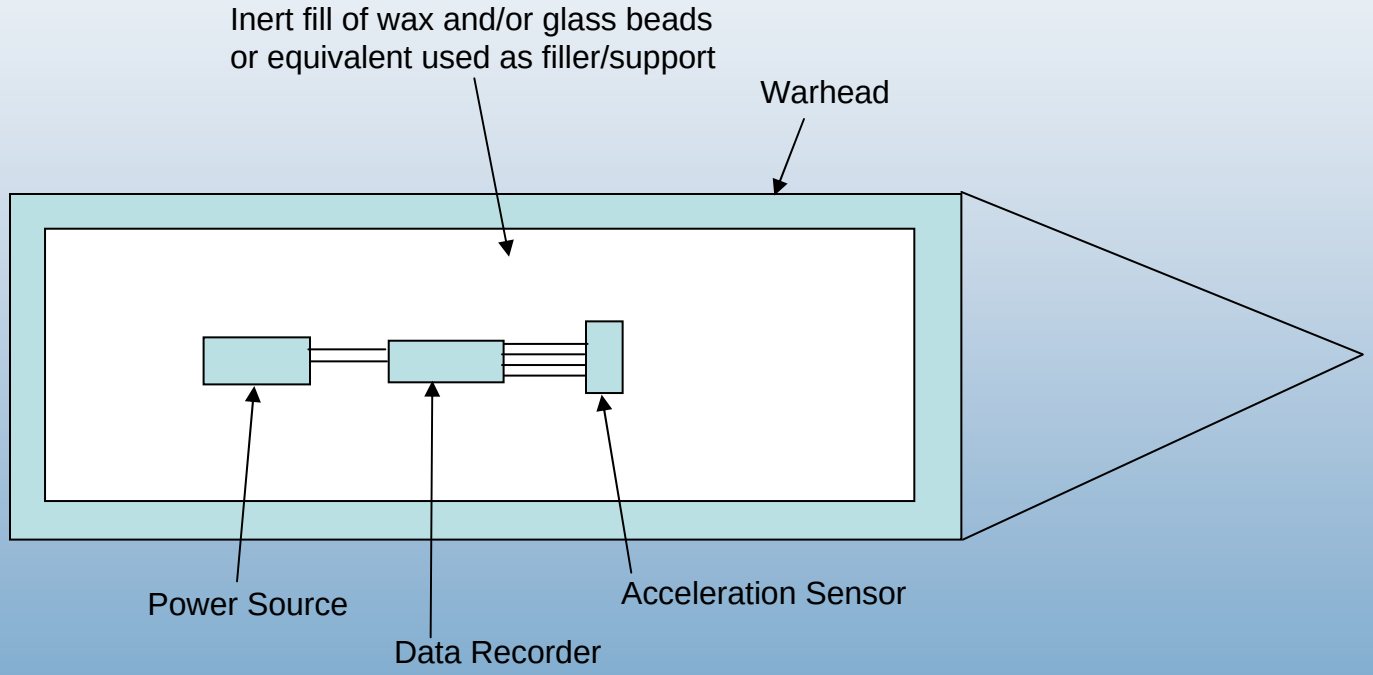
"This presentation consists of L-3 Corporation general capabilities information that does not contain controlled technical data as defined within the International Traffic in Arms (ITAR) Part 120.10 or Export Administration Regulations (EAR) Part 734.7-11."

Agenda

- Background
- Traditional Data Recorder Limitations
- Design
- Interface
- Event Capture & Triggering
- Test History
- Alternate Configuration
- Summary

Background

- Typical method used to obtain data from a high g test event



Problems with Typical Data Recording Method

- Data recorder and supporting hardware are placed in a munition as an "after thought"
  - Causes improperly supported assemblies
  - Increased risk of broken wires
  - Component damage
- Difficulty installing and controlling the supporting fill
  - Leads to possible movement of components
  - Causes broken components/wires.
- Failure of the external power source
  - Broken battery leads
  - Partial or total loss of data.
- Disassembly can cause component damage
  - Requires clean up due to potting
- Momentary/permanent loss of power
  - Volatile memory – Total data loss
  - EEPROM/Flash memory – Partial to total data loss
- Premature trigger events lead to incorrect data being recorded

These problems are addressed with the L-3 FOS design

Design Summary

- Design based on initial intelligent fuze recorder design
- Next generation modular data recorder
  - 3 axis acceleration measurement
  - Non-volatile memory
  - Real-time data storage
- New mechanical envelope
  - Includes 4 removable accelerometer modules
  - 2 inch diameter
  - Configured for tube launched systems

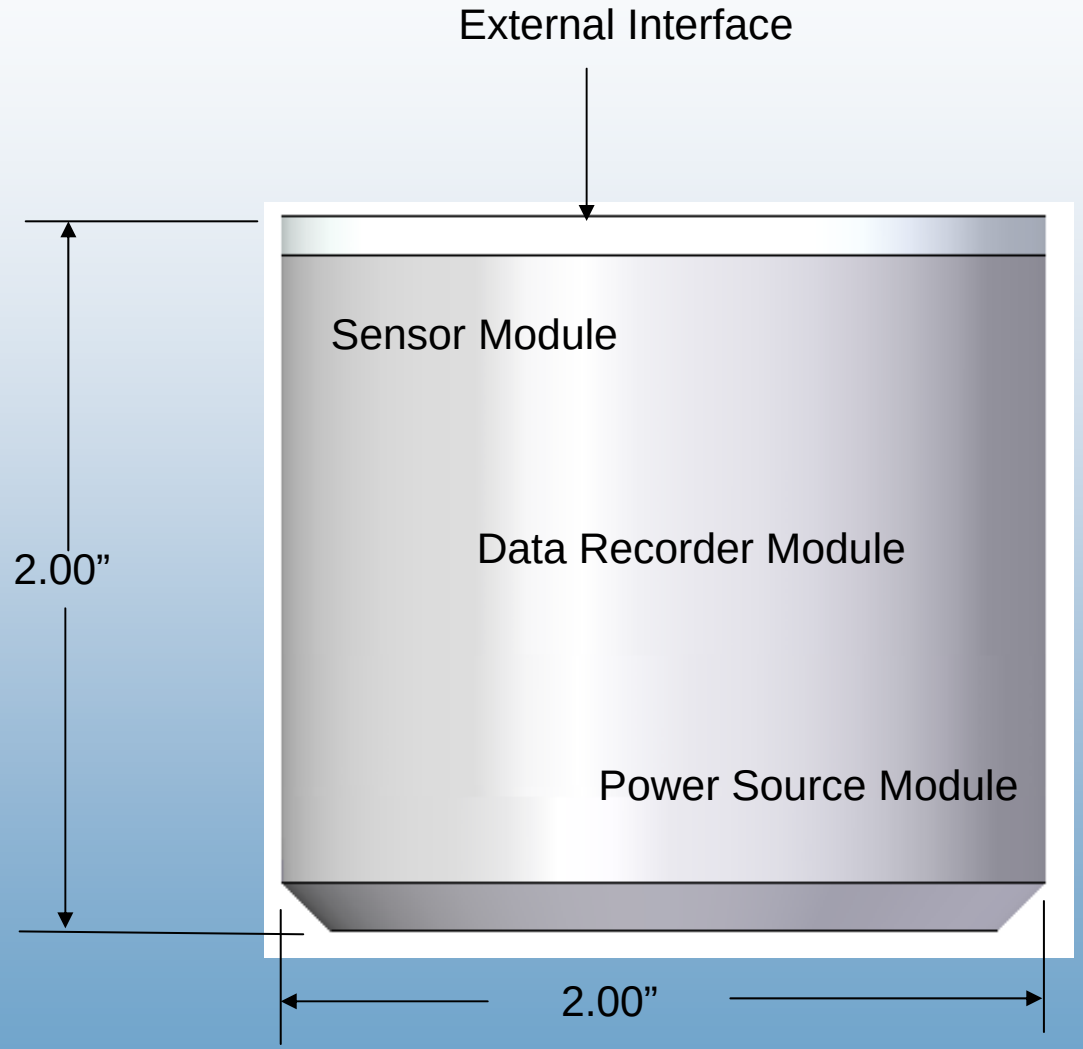
Patent Pending

The information in this presentation is of general capabilities and open for public release

Design Features

- Analog Data Recording
  - 4 simultaneously sampled 10 bit analog channels
- Digital Data Recording
  - 4 simultaneously sampled digital channels
  - Sampled together with analog channels
- Multiple Triggering Options
- Fast Sampling Rate
  - User selectable rate
- Versatile
  - Adjustable pre-trigger position
  - PC Interface via RS422

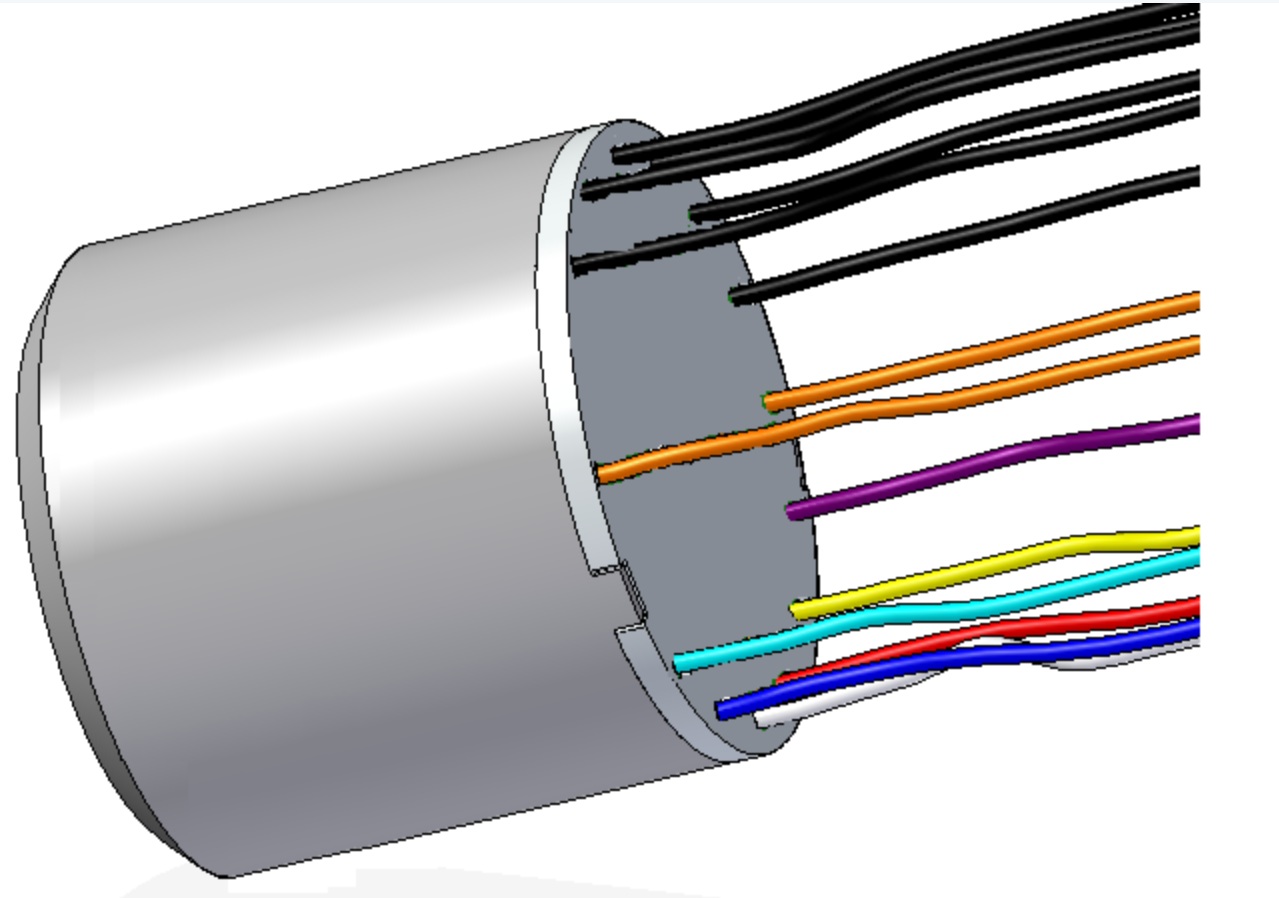
Mechanical Design, Envelope



Electrical Design

- Data recorder hardware contained in 3 separate modules:
  - Sensor Module:
    - Accelerometer(s)
    - Signal Conditioning
    - Power Conditioning
    - Analog and Digital signals passed through to data recorder
  - Data Recorder Module:
    - Microprocessor Based
    - Non-volatile Memory – memory stored in real-time
    - Input Buffers for analog and digital channels
  - Power Module:
    - Additional Energy Storage (capacitors, batteries…)

Mechanical Design, Application



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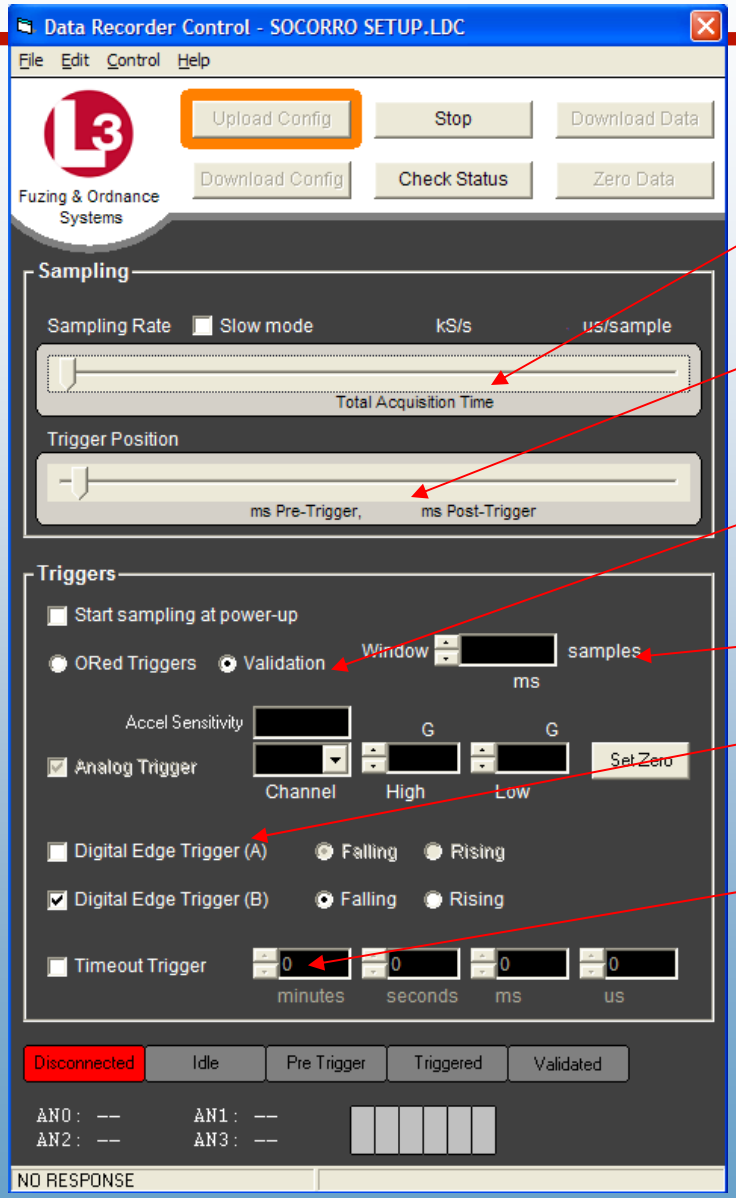
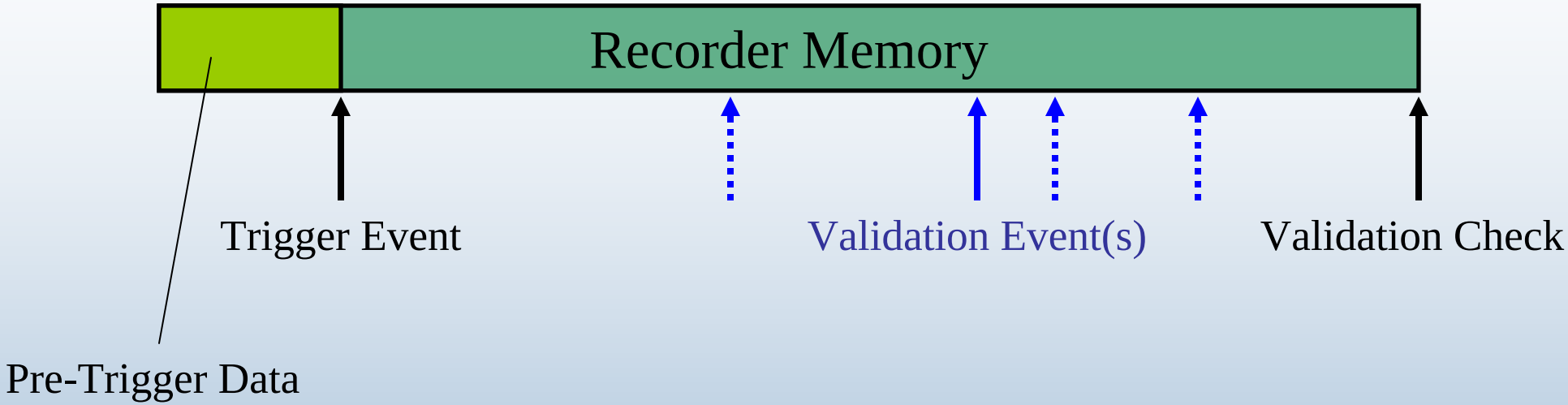
Graphical User Interface (GUI)/Firmware



- Adjustable Sampling Rate
- Adjustable Trigger Point
- Trigger Validation Option
- Trigger Window
- Analog and digital triggering options
- Timeout Triggering

Trigger Validation Timeline



- Pre-trigger data recorded until a **Trigger Event** is detected
- Recording proceeds normally until memory is full
- If no validation event is detected, memory is cleared and recording starts back in pre-trigger mode
- Validation can be time-windowed with trigger

High Shock Testing History

- Data recorder proven to survive high g impacts
  - Multiple Stubbi/Howitzer tests up to 2 ft concrete and complex targets.
  - Artillery Shell Howitzer 9 inch concrete target
  - Multiple Sled Test/Warhead Test
  - Five Inch Gun Fired Tests
- Survived and data downloaded 2 months after projectile stuck in gun tube

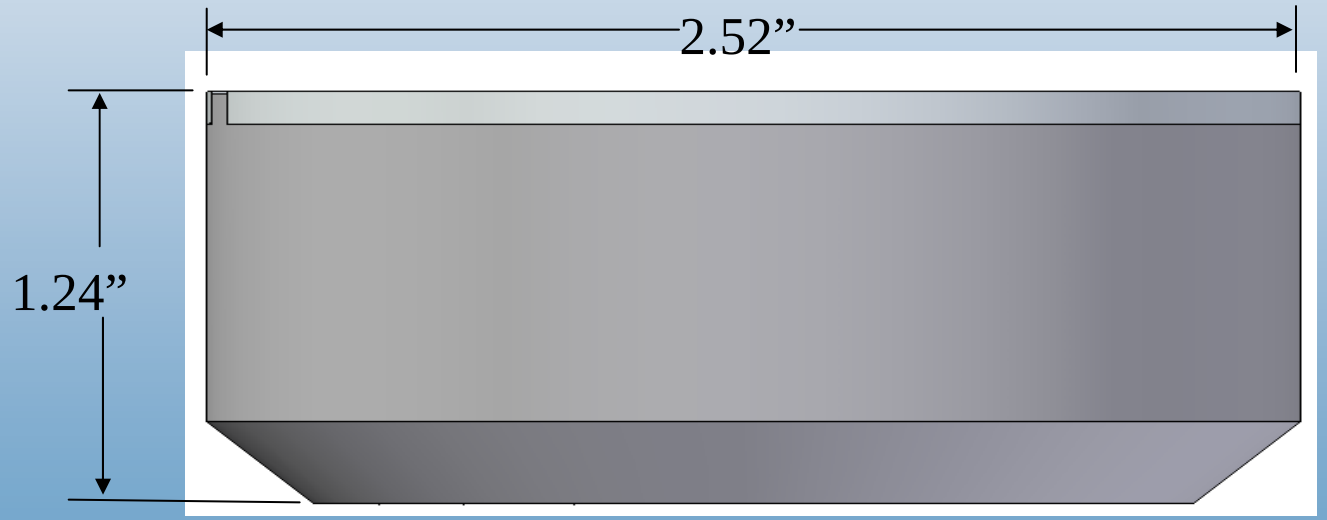
Specifications

- Device is functionally specified and tailorable to applications
- Data recorder data sheet pending public release
- Data sheet available upon request

Parameter	Description	Value		units
W1	Weight			lbs
				kg
Vdd	Supply voltage	**Min**	**Max**	volts
Idd	Supply current	**Typ**	**Max**	mA
Vin (min)	analog/digital input minimum voltage			volts
Vin (max)	analog/digital input maximum voltage			volts
Vth+	Digital input positive going threshold	**Max**		volts
Vth-	Digital input negative going threshold	**Min**		volts
Idin	Digital input max input current			µA

Alternate Configuration

- 2.5 Inch Data Recorder Design
  - Packaged to fit in a 3 Inch Booster Cup
  - Prototype testing in June of 2009



Summary

- L-3 FOS used its expertise in fuzing to develop a general purpose hardened data recorder
- L-3 FOS Data Recorder has been tested in applications >20kGs.
- L-3 FOS Data Recorder provides a:
  - Flexible launch diagnostic tool
  - Ordnance impact performance analysis tool
  - Survivable non-volatile data recorder
- L-3 FOS continues to expand its fuzing and development tool set

Rely on L-3 FOS to solve your ordnance problems