New Data Recorder for Gun Launch and Impact Test with Options for Built-in High G Accelerometers and Angular Rate Sensors

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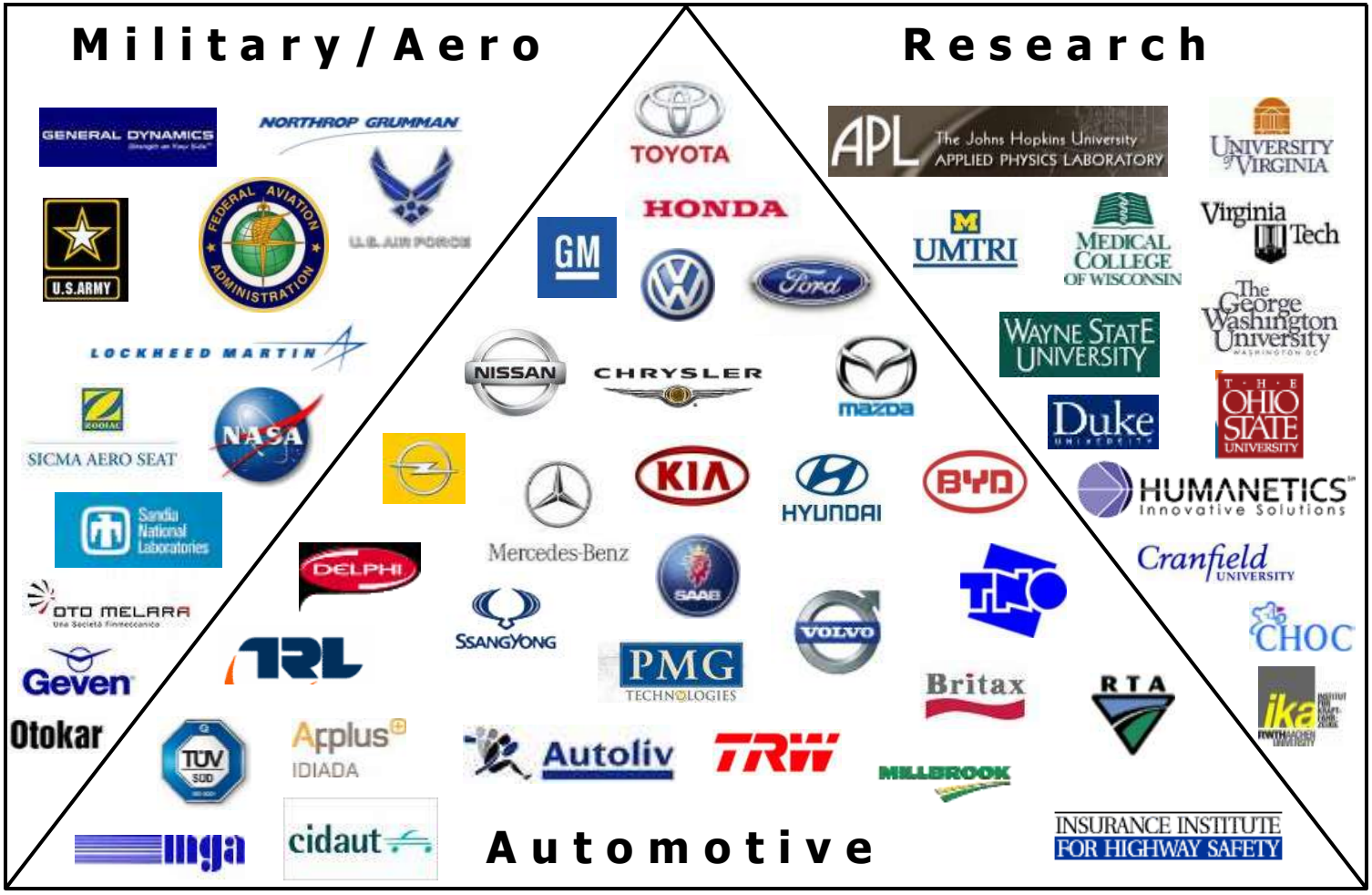
May, 2011

DTS Introduction

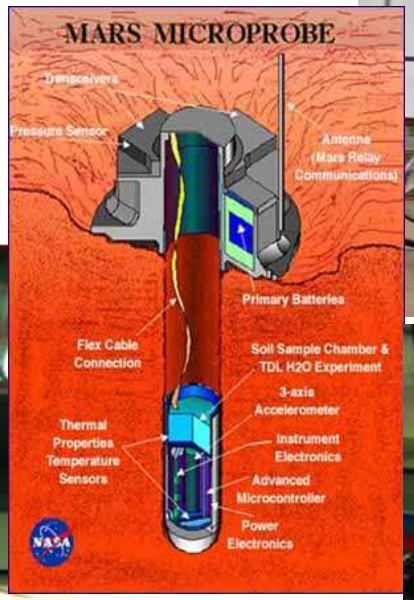
- Data recorders and sensors for high shock testing
- Founded in 1990 by three test Engineers
- Small US private corporation with 55 staff members in 6 offices worldwide
- 90+% of customers do “must collect data” testing
- Key DTS staff have over 100 years of combined high shock test experience

DTS Introduction – Customers



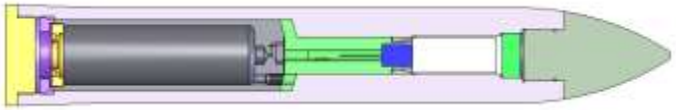
Applications for DTS Products

- Data recorders for Manikin and cadaver test
- Vehicle and soldier blast event
- Ejection seat drop tower and rocket sled
- Aircraft/spacecraft flight and crash test
- Hard target recorders



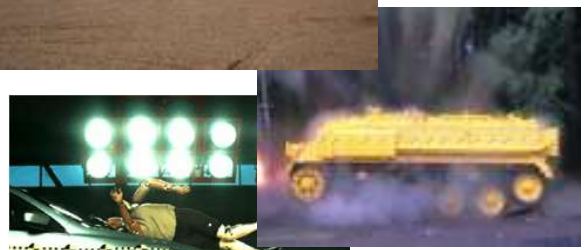
Applications and Shock

- Hard Target Recorder



- Gun Launch

- Military Blast



- Vehicle Crash Safety

- Motorsports

Shock	Sample Rate
100,000 g	1 Msps
20,000 g	100 Ksps
5,000 g	
500 g	20 Ksps
100 g	5 Ksps

Data Acquisition History

1980s

Amplifiers

Tape Recorders and Oscillographs

1990s to Present

Self-contained Data Recorders

Technical Terms

- **DAS**: Data Acquisition System, includes analog electronics for sensor inputs, digital conversion and non-volatile memory
- **Sensor or Transducer:** converts physical world to analog or digital voltages
- **ADC**: converts analog signals to digital data, usually 12 or 16 bit resolution
- **Sampling Rate**: how fast ADC samples each channel (sps)
- **Bandwidth**: analog frequency content of data (Hz, usually expressed as -3dB point filter roll-off)
- **AA Filter**: anti-alias filter, determines bandwidth

SLICE HG

- Based on DTS SLICE data recorder technology
- Eglin Air Force Research Lab ASPIRE Program
  - Phase I and Phase II SBIR, ~Jan 2009 to March 2011
  - Develop 50+ Kg recorder
- DTRA Hard Target Recorder
  - Phase I SBIR, ~Mar 2010 to Dec 2010
  - Develop 100+ Kg recorder
- Also have worked with Sandia Labs and China Lake
- Current contract with Army to up sample rate to 1 Msps/chan, production in 2012

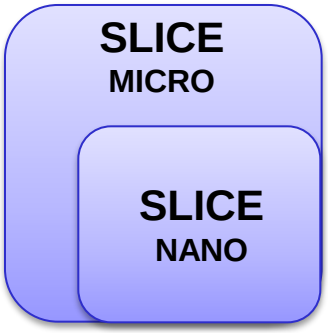
SLICE Overview

- Two package options, same electronics:
- **SLICE NANO**
  - 26 x 31 mm footprint
  - Circular connector inputs
  - For tight space or embedded applications

SLICE MICRO

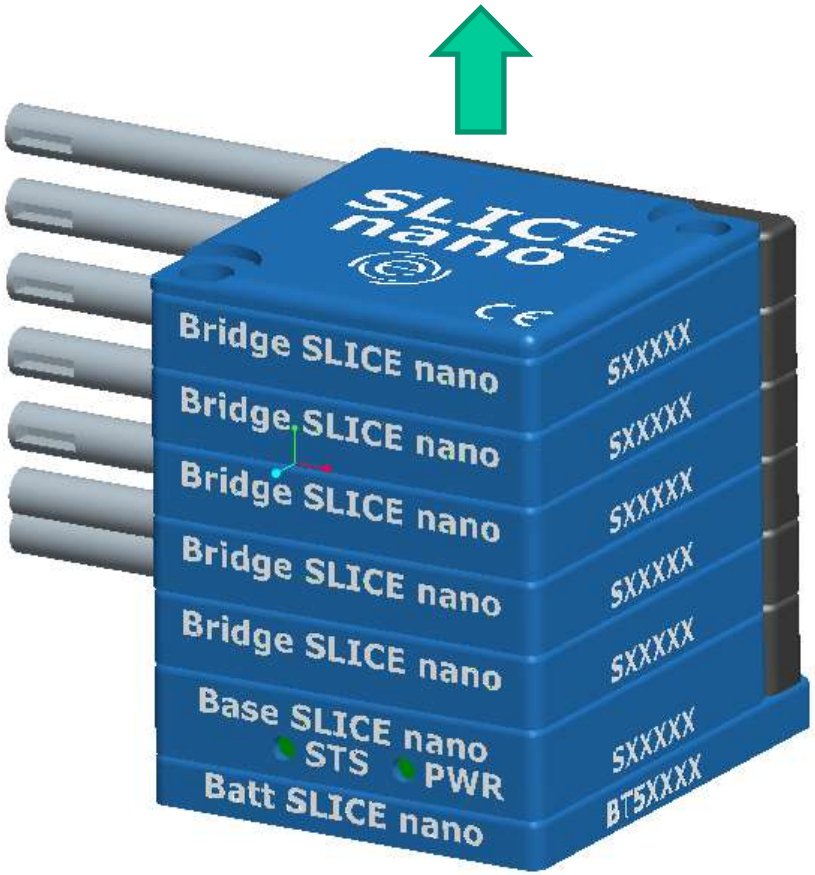
- 42 x 42 mm footprint
- Circular connector inputs

Relative Size



SLICE Modularity

Up to 8 sensor SLICEs per STACK
(24 channels)



Emergency Backup Power,
up to 3 minutes

Bridge SLICE

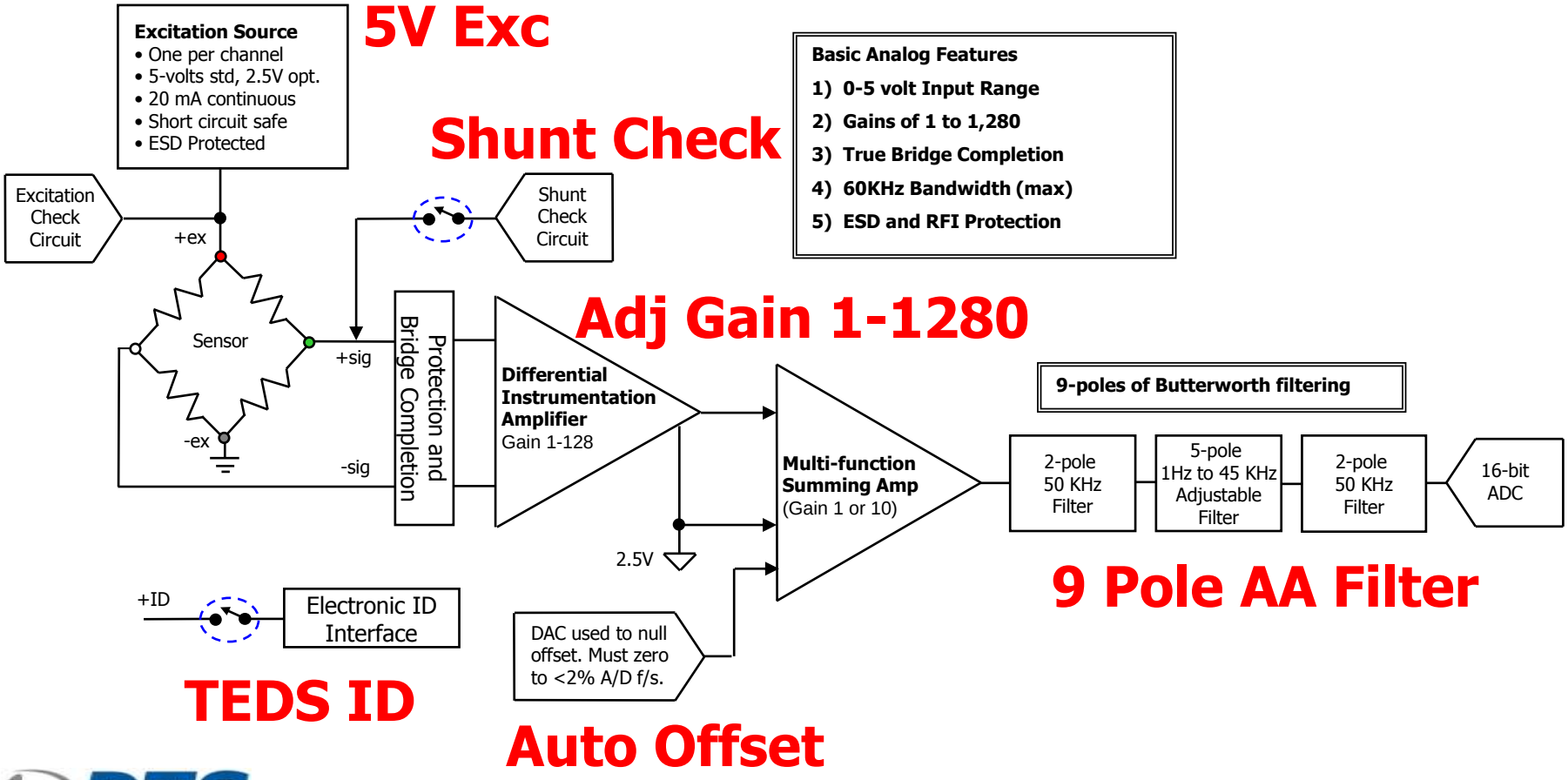
- 26 x 31 x 5.5 mm
- 3 channels, 16 bit/chan
- 9-poles of Butterworth filter, adjustable 1 to 40 KHz
- 5V sensor excitation
- Auto offset and shunt

Base SLICE

- 26 x 31 x 6.5 mm
- USB 2.0 plus USB hub
- 7 GB Flash memory
- Up to 120 Ksps/chan
- 1 Msps coming in 2012
- Standard 5 Kg shock
- HG packaging to ~50 Kg

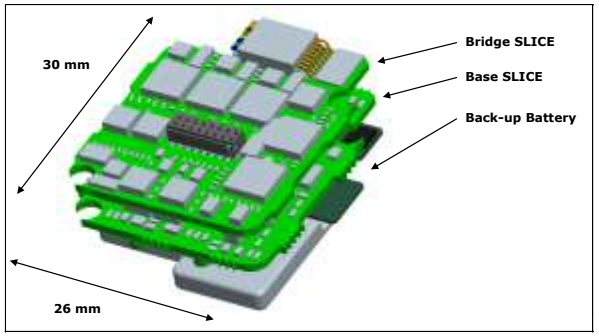
SLICE Bridge – Sensor Interface

Piezo-resistive, strain gauge or voltage inputs



SLICE HG – General Specs

- Uses standard SLICE PCBAs (1 Base SLICE, 1 Bridge SLICE, 1 Battery SLICE), packaged in two stage potting process



- 3 channels, 120 Ksps/chan
- 40 KHz bandwidth, 9 pole hardware AA filters
- 7 Gbyte non-volatile flash memory = > 2 hours
- Backup power source for ≥ 3 minutes
- Every unit tested at DTS to > 20 Kg, 0.1 msec

SLICE HG – Arming and Triggering

Arming Options

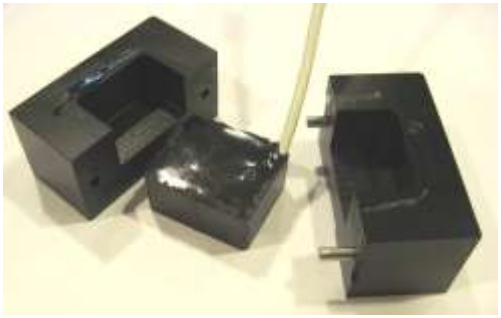
- Arm on Power up – wait for Start signal
- Start Recording on Power up

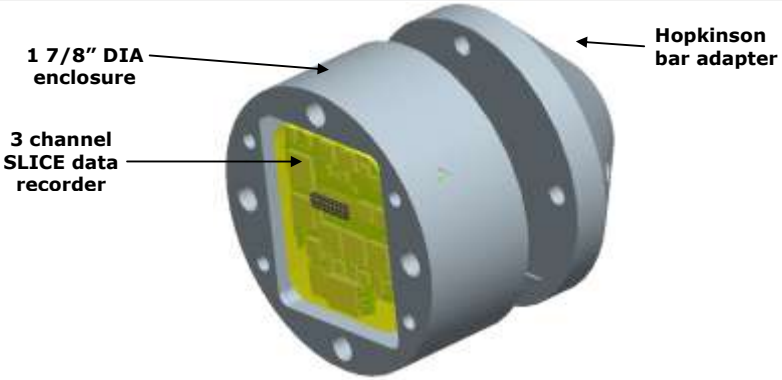
Triggering Options

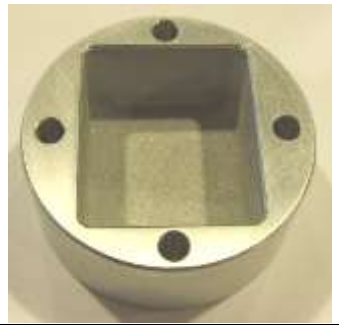
- Start signal on separate 0-5V input
- Event (T=0) on Contact Closure or Level Trigger
- Over 2 hours of data collection
- Non-volatile flash memory

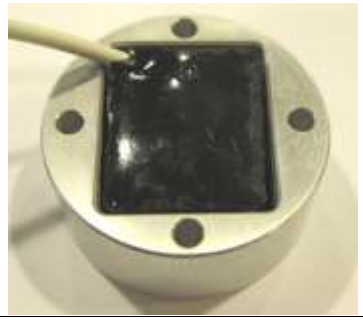
SLICE HG - Packaging

Two stage, hard then software potting



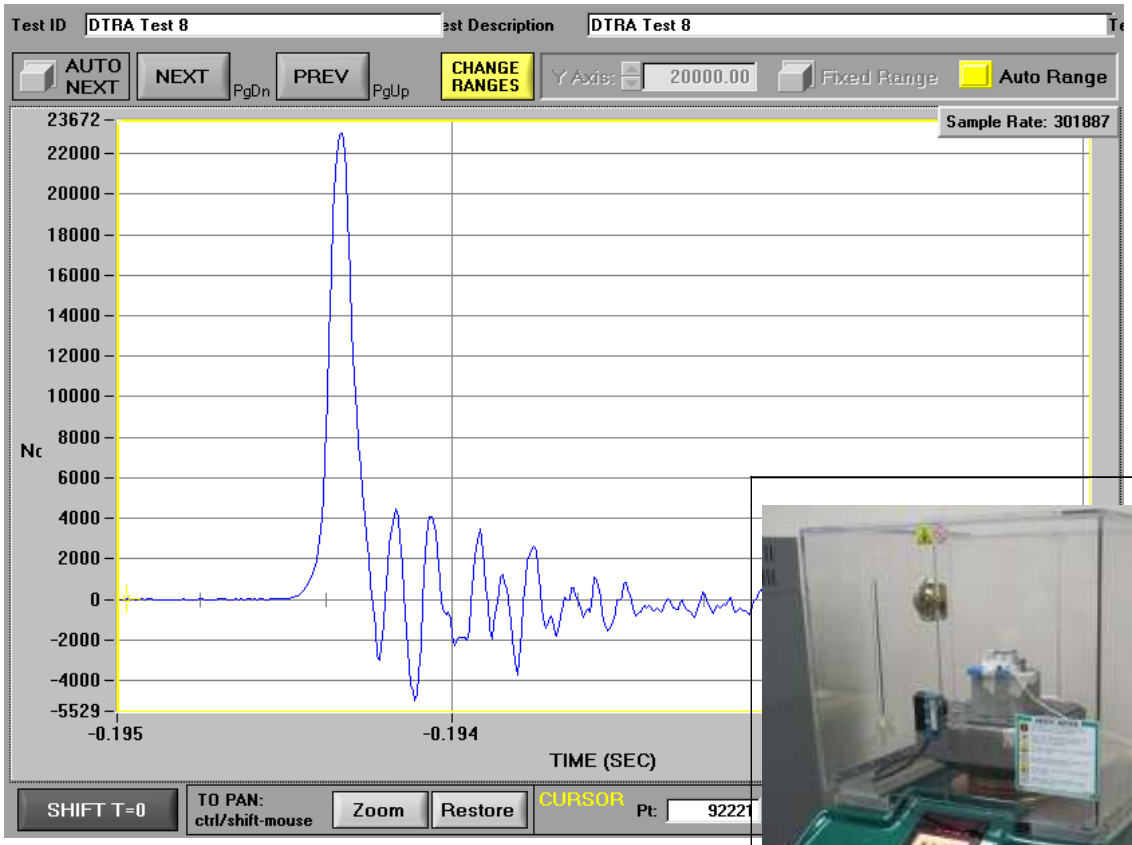


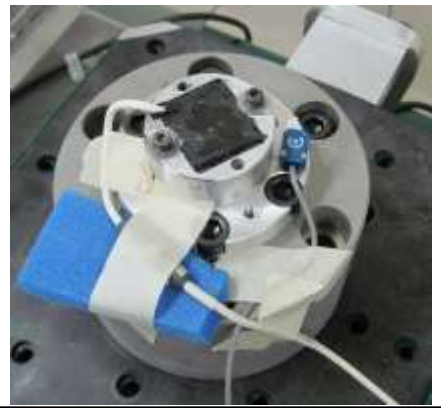




SLICE HG – Shock Testing

Tested at DTS to ~23,000 g's, 0.1 msec





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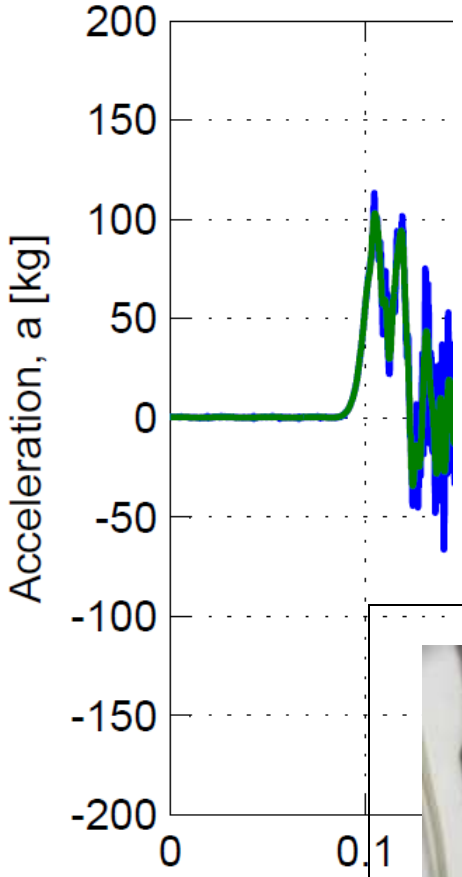
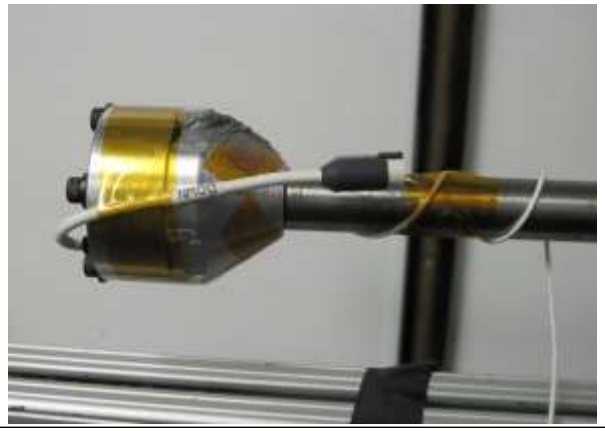


Tested at Endevco on Hopkinson Bar, ~80,000 g's, 0.04 msec



SLICE HG – Shock Testing

- China Lake has run sled tests for missile impact with success
- 6 SLICE HG units delivered to Eglin AFB for test
- SLICE HG at Sandia for test

Shock Hardening Considerations

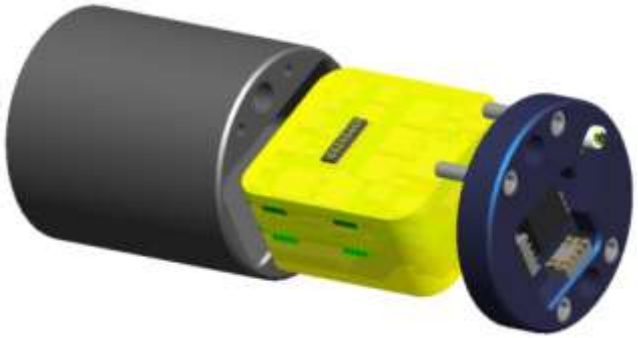
For 20 Kg+ g environments, DTS products incorporate these features:

- Large IC's on PCB epoxied down before soldering
- Other larger components have adhesive applied
- Crystal time base oscillators used, up to 100K g rating
- Other high shock rated components used as required
- Visual and X-Ray inspection used on PCB assemblies and solder joints
- PCB assemblies are potted in a two-stage potting process
- All final products are 100% shock tested to 20+ Kg to verify robust operation before delivery to customer

SLICE HG – Package Sizes

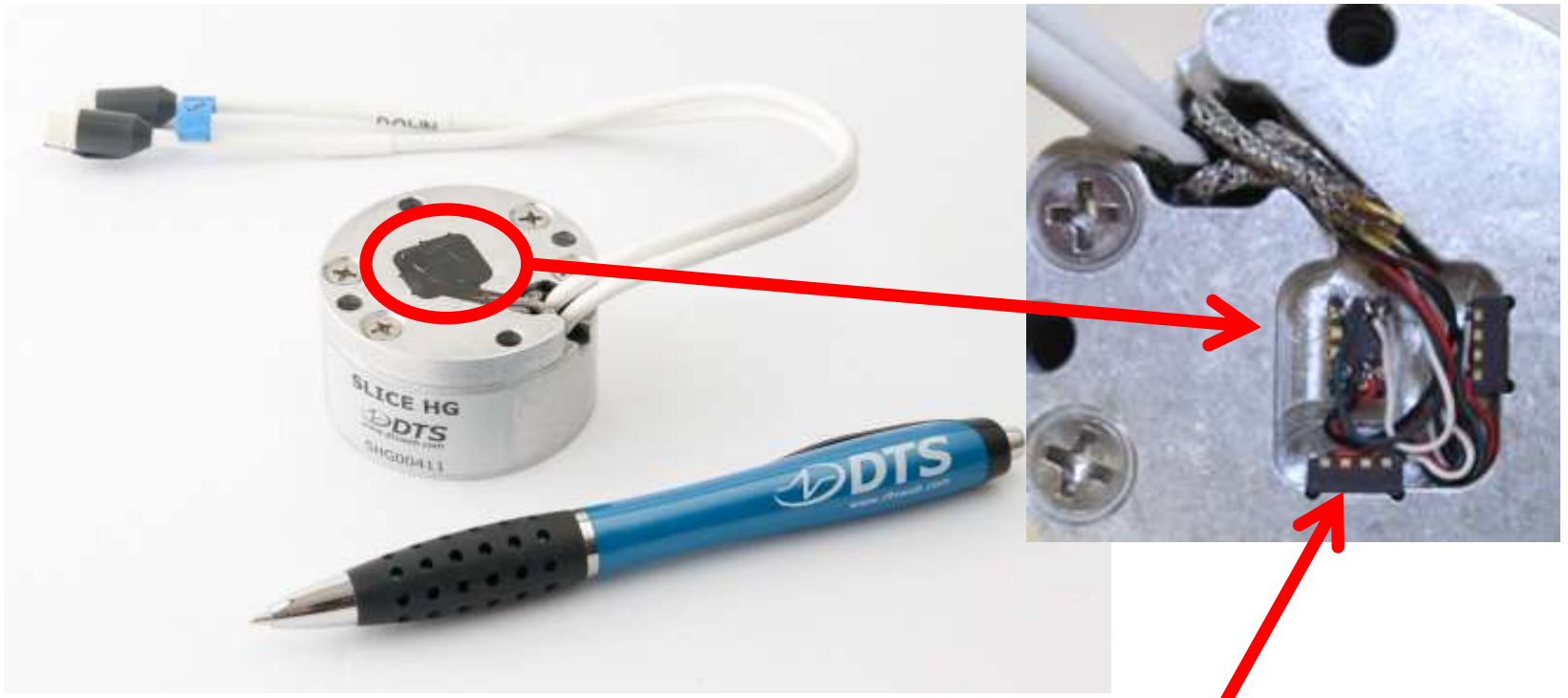
- 1.875″ DIA x 1.05″ (47.6 x 26.5 mm)

- 1.25″ DIA x 1.67″ (31.8 x 42.5 mm)



SLICE HG – Configurations

Option for embedded 3 axis accelerometers from various manufacturers or an angular rate spin sensor



PCB 3501 60 Kg accels

SLICE HG – Configurations

- Up to four 3 chan. units can be chained (12 chan.)
- External power: ~12V at 250 mA per 3 channel unit
- Units are independent, standalone. The failure of one does not cause failure of another
- Various options for triggering and monitoring

SLICE HG – Availability

- In production
- Price is ~$15,000 per 3 channel unit
- Additional cost of built-in accelerometer or ARS options depend on sensor manufacturer/model
- Typical lead time is 8 weeks
- Export status is pending revue
- DTS offers 24/7 technical support and on-site training

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