EXCELITAS TECHNOLOGIES

The Informant™ Nano Recorder

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Why Design an Excelitas Data Recorder?

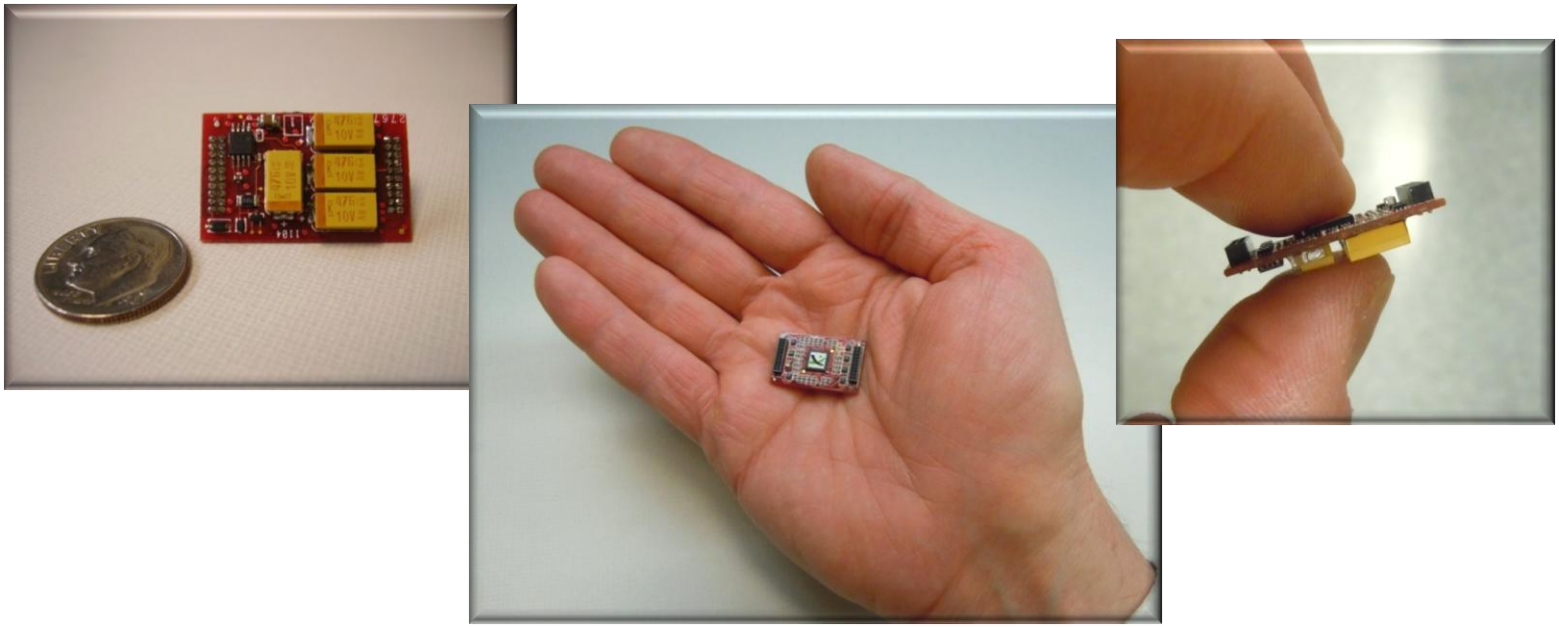
- **We needed a tool to help us find out "What happened?" when a test does not go according to plan or for remote monitoring applications.**
  - Want to reduce the duration and cost of failure investigations.
  - Need to be able to collect data remotely.

- **Existing data recorders are <u>TOO BIG</u> to fit inside today's miniaturized electronic packages, can be expensive, and can have a long lead-time.**
- **We need to be able to verify that the event timing in our products meets requirements and agrees with our analysis.**
- **Most shock-hardened data recorders only capture a few channels of data and some use volatile memory that is lost if power is interrupted.**
- **The Informant™ Nano Recorder addresses these needs.**

What is The Informant™ Nano Recorder?

- **The Informant™ Nano Recorder is a complete 22-channel data acquisition system in a tiny package.**

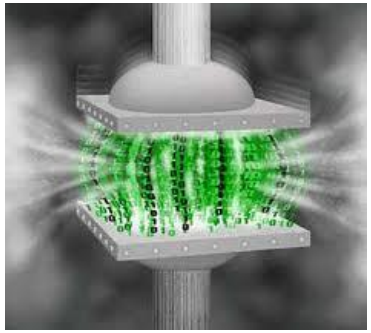
- **All that is required to collect data is a power source (2.1 – 5.5 VDC) and signal inputs to at least one of the 22 input channels.**
  - There are 16 digital channels and 6 analog channels



A New Approach to Memory Usage

- **The Informant™ Nano Recorder employs data compression and provides much more efficient memory usage than older approaches.**
  - **This requires rethinking what memory capacity means.**

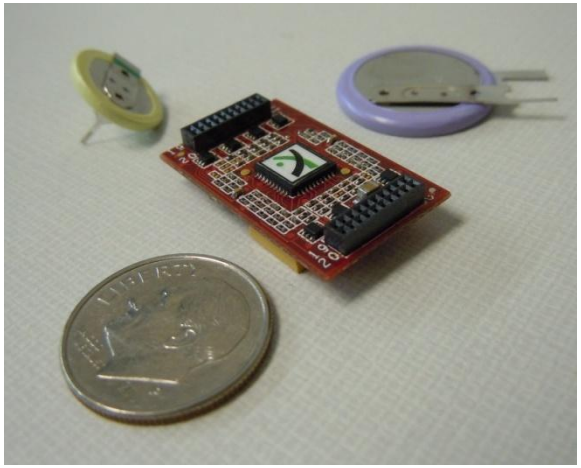
- **The Informant™ only records events when it detects a significant change in state, so memory is not wasted storing noise or periods of inactivity.**
  - There is nothing new about an event recorder, but Excelitas applies this same event-driven approach to analog signals (patent pending).



- **This data compression scheme minimizes the memory capacity required to store data.**

- **This allows the use of a smaller memory module, which promotes miniaturization, enhances shock survivability, and reduces current draw.**

I/O, Power, and Protection



- **22 input channels.**
  - 6 analog and 16 digital channels.
  - All inputs have three-stages of ESD protection.
  - RC noise filtering on all inputs.
- **Powered from 2.1 – 5.5 VDC.**
  - Draws <1 mA continuous.
  - Powered from a regulator or a battery (alkaline, Lithium, button cell, AAA, etc.).
  - Three power inputs provided: one main input and two additional diode-ORed inputs. Allows triple redundant power sources and/or battery backup.
- **Serial interface for programming µC and downloading data.**
  - UART or I^2C modes: selectable by populating resistors on the circuit board.
- **All I/O and power lines are designed to be short-circuited without damaging recorder.**

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Multiple layers of protection and redundancy are built in

Data Storage and Dimensions

- **Sampling frequency is user determined (currently 6.7 to 593 Hz).**
  - Default is 500 Hz (sample once every 2 ms).
- **ADC resolution = 8 bits (12.9 mV / bit with 3.3 V signal levels).**
- **Data storage = 29.5 kB.**
  - Old concepts of memory capacity no longer apply.
  - Stores up to 2516 12-byte records.
- **Physical size = 26.5 mm L X 16.5 mm W X 6.0 mm T**
  - Smaller than a postage stamp!
  - Designed to fit inside the packaging of the device being monitored.

- **The best feature of the Informant™ is that we can copy and paste it into the schematics of new products and have on-board data recording.**

Setting the Trigger Threshold for Analog Channels

- For triggering data capture on analog inputs, a trigger threshold is selected by the user during data recorder setup.
- The user determines what change in an analog voltage level is considered signal and what change is considered noise.
- In order for the change in the analog channel to be deemed significant, the difference between the previously stored, digitized sample and the current sample must be greater than or equal to the user-set threshold.
- Once the trigger threshold is exceeded in any analog channel all 22 data channels, along with a timestamp, are recorded to memory.

This new data compression scheme is “patent pending”.

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A sliding analog “noise gate” is employed in decision making

Triggering and Recording Sequence

1. **At power up the Informant™ executes routines to setup peripherals.**

2. **Following setup it enters a micro-power mode (≈270 µW) waiting for a rising edge on the trigger input line.**

3. **Once triggered, the Informant™ begins polling the analog and digital channels at the user-selected sample rate.**

4. **The data recorder then stores all 22 channels into non-volatile memory only when there is a change in a digital channel or a significant change in an analog channel.**
   - This configuration classifies the Informant™ as an event recorder, not a continuous data recorder, which wastes valuable memory storage space.
   - By setting the analog trigger threshold to zero, the Informant™ operates as a continuous data recorder.

5. **Recording continues until the memory is full or power is lost.**

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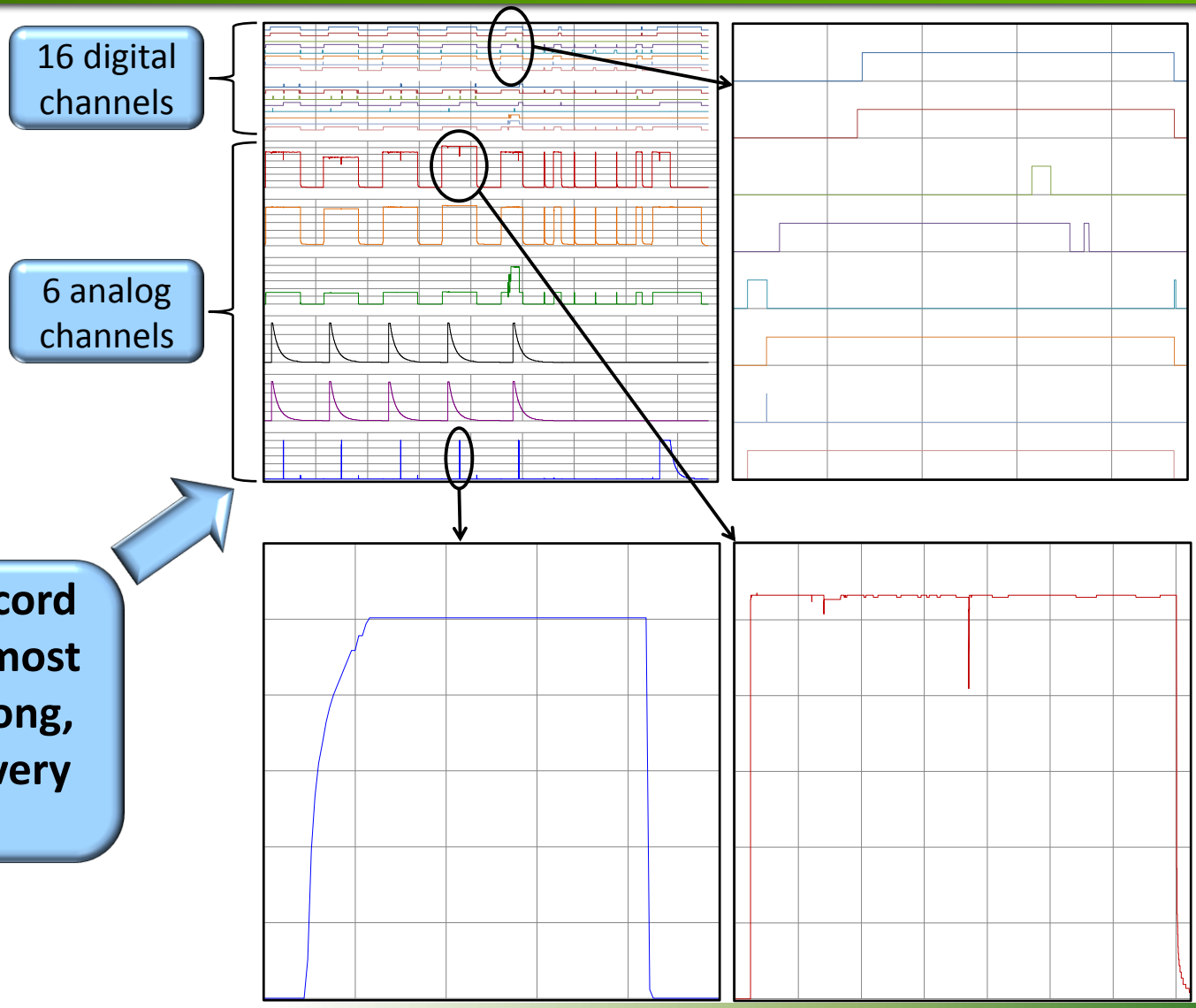
Informant™ Power Loss and Recovery

- When operating in harsh environments complete power loss or temporary power interruptions may occur.

- The Informant™ uses non-volatile memory and does not lose previously stored data upon power loss.
- If power falls below a threshold, the Informant™ enters low power mode and pauses recording. If power returns to a good state before energy storage is depleted (brown out) the Informant™ automatically resumes recording in <1 ms.
- If power is lost completely and the energy reserve is depleted (blackout) the Informant™ automatically resumes recording data 2-3 ms after power is restored.
- The Informant™ can record up to 500 samples (1 s) after input power has been disconnected.

The power loss and recovery features are “patent pending”.

Sample Data From an Excelitas Product

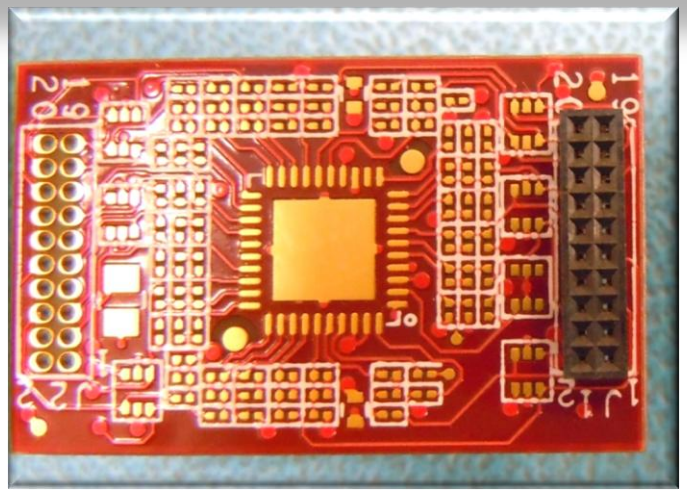


The data record shown is almost 7 minutes long, sampling every 2 ms.

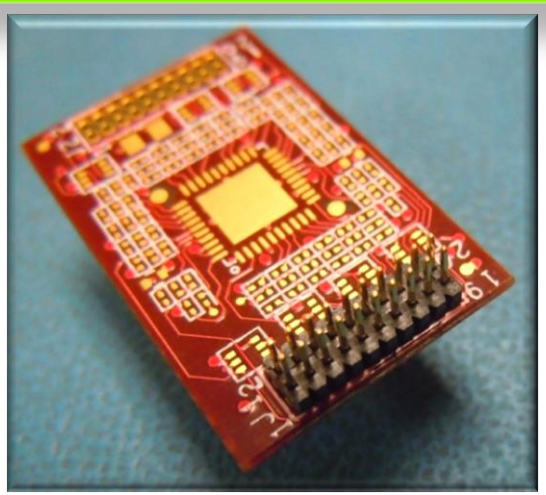
In practice, 22-channels turns out to be plenty

Multiple Connection Options

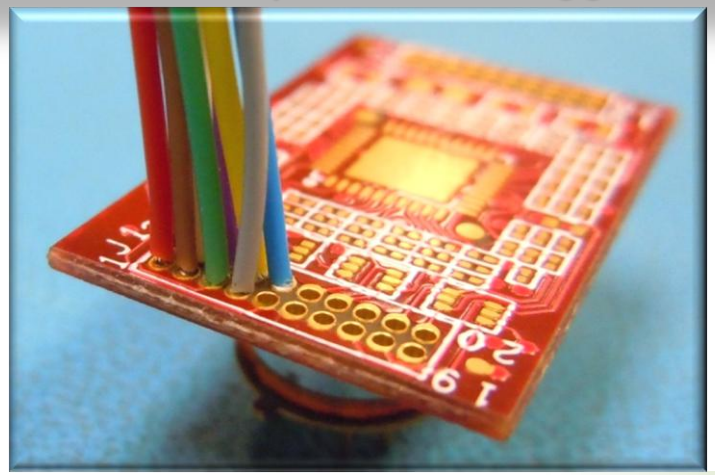
Female Header



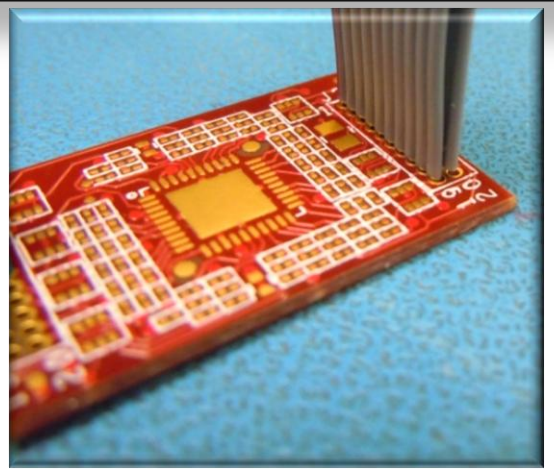
Male Header



Discrete Wires (Maximum Ruggedness)



1 mm Pitch Ribbon Cable



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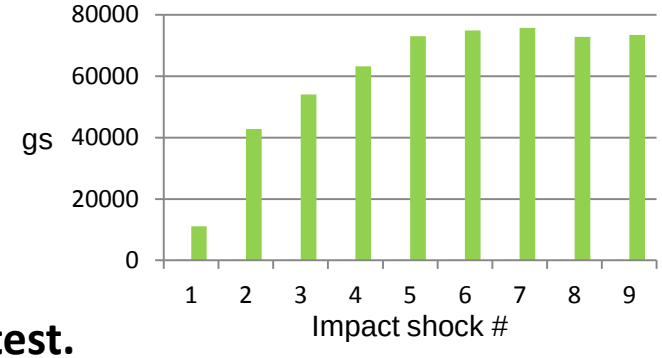
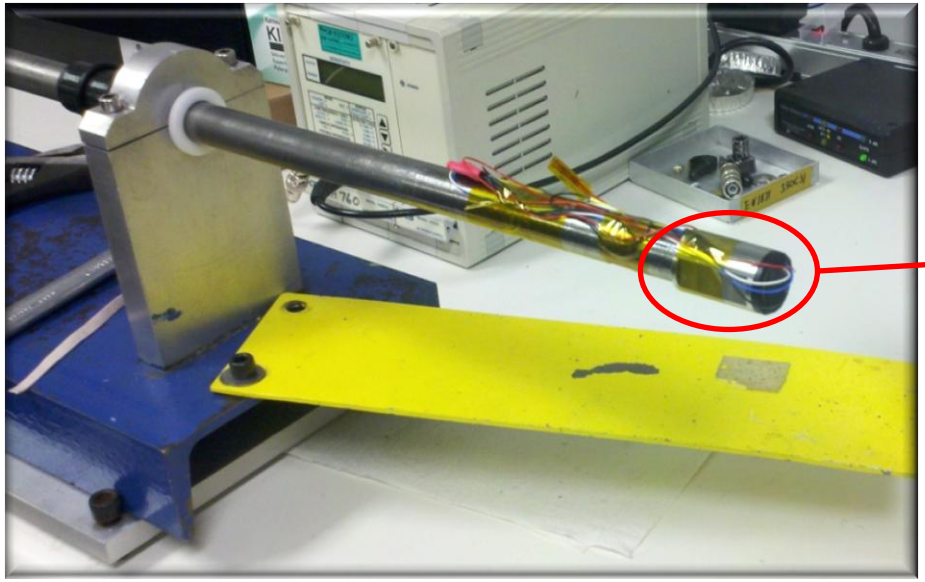
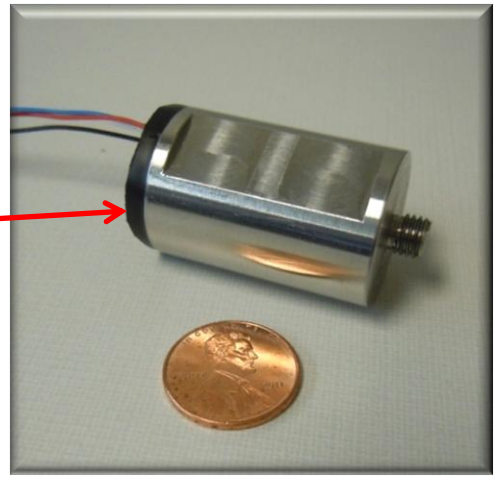
…to meet the needs of the application

74 kg Hopkinson Bar Shock Testing

- **PCB Piezotronics performed impact shock testing on the Nano Recorder using a Hopkinson bar.**
- **Five ≈74 kgs, 10 µs impact shocks were delivered.**
- **The Informant™ was recording data during the shock test.**
  - The Nano Recorder worked perfectly during and after the shock testing.
  - The data was successfully retrieved after the unit was returned to Excelitas.







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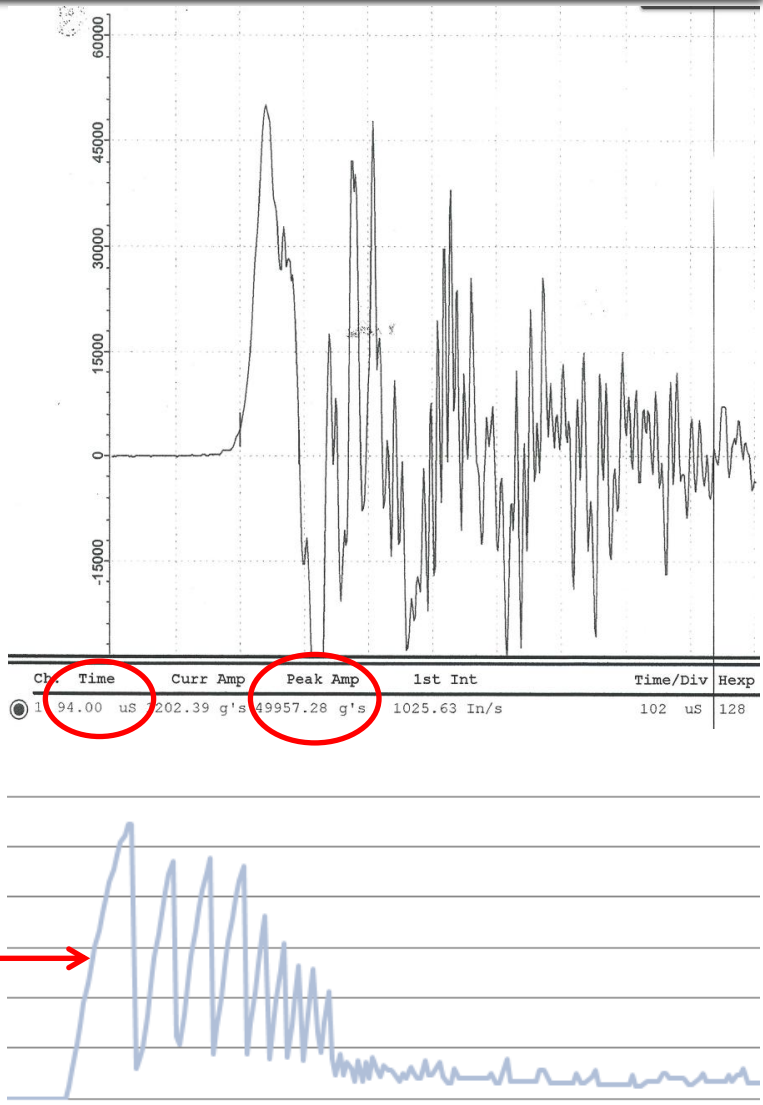
Designed to survive and "live to tell the story" afterwards

45 kg Drop Shock Testing At Temperature Extremes

- Informant™ Nano Recorders were integrated inside of two potted electronic assemblies, each of which contained less than 0.6 in^3 of available space.
- One of the electronic assemblies was subjected to three ≈45 kg, 100 µs drop shocks at -40°C.
- The other assembly was subjected to three ≈45 kg, 100 µs drop shocks at +70°C.
- Both Informants™ successfully recorded 5 analog and 8 digital channels before, during, and after all shock events.
- On one occasion, the Informant™ Nano Recorder successfully recorded a catastrophic failure of the electronic assembly under test.



Designed to survive and "live to tell the story" afterwards

The Next Generation Informant™

- **The microcontroller used in the Informant™ is now available with a much faster sample rate.**
  - The next iteration of the Informant™ will allow ≈10X faster sample rate (≈5 kHz: sample once every 200 µs).

- **The new microcontroller draws much less current, allowing us to reduce current consumption from <1 mA to a few hundred microamps.**

- **The Informant™ can be made much smaller by using smaller components.**

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…will have a faster sample rate and lower current consumption

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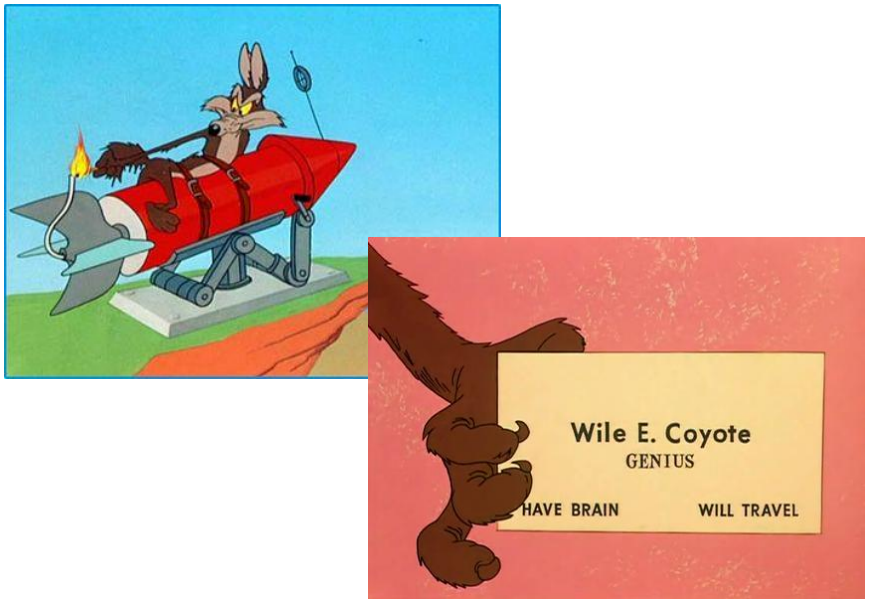

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