# Elastomeric Interconnects-

## Reliable enough for production?

**2007 Burn-in and Test Socket Workshop**
**March 11 - 14, 2007**

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## Current technologies on fumes?

- Some think so. Even today.
- Lead lengths vs. performance requires
  - 10Gb/s + data rates
  - 30 ps – edge rates
  - Interconnect signal paths of 1mm to 0.5mm
- (This paper will focus only on the needs of *high performance* Final test)

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## Incumbent technology

- Spring Probes
  -As they get smaller:
  - challenge both makers and users
  - pitch reduction difficult
  - Increasingly fragile
  - Carry less current
  - Reach Bandwidth limits
  - Ultimately, can't meet lower inductances and ***the need for speed***

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## Elastomers: …to the rescue?

Elastomerics offer:

- Very low profile compliant paths
  - Low resistance
  - Low inductance
  - Low capacitance
  - low force possible
- Highest possible performance metrics
  - High bandwidth

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## "Metal Filled Polymers" (MFP)

- "Elastomers"
  - Most formed as sheets
  - Most vertical path
  - No Individual conductor assembly
  - Individual conductors not serviceable
  - Cost can be lower if volumes higher

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## Focus by structure

- Elastomeric Interconnects with conductive metal paths: Metal Filled Polymers (MFP)
  - **Generic**
    - Wires arrayed & embedded in Elastomer (E)
    - Cohesively stacked particles co-molded in E
  - **Dedicated Circuits**
    - Dispersed particles in E (MFP)
    - Dispersed particles in E (MFP) & on carrier

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## Focus on function

- Elastomeric Interconnects with conductive metal paths
  - We will consider:
    - How they are made
    - How they work
    - mechanical differences
    - Electrical similarities
    - Behavioral issues over time
    - Generic Life span data

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## How they are made

- Metals
  - Powders
  - Particles
  - Wires

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- Elastomer
  - Flexible adhesive binder (matrix)
  - Silicone
  - Epoxy
  - Synthetic Rubber

Metal Filled Polymers (MFP)

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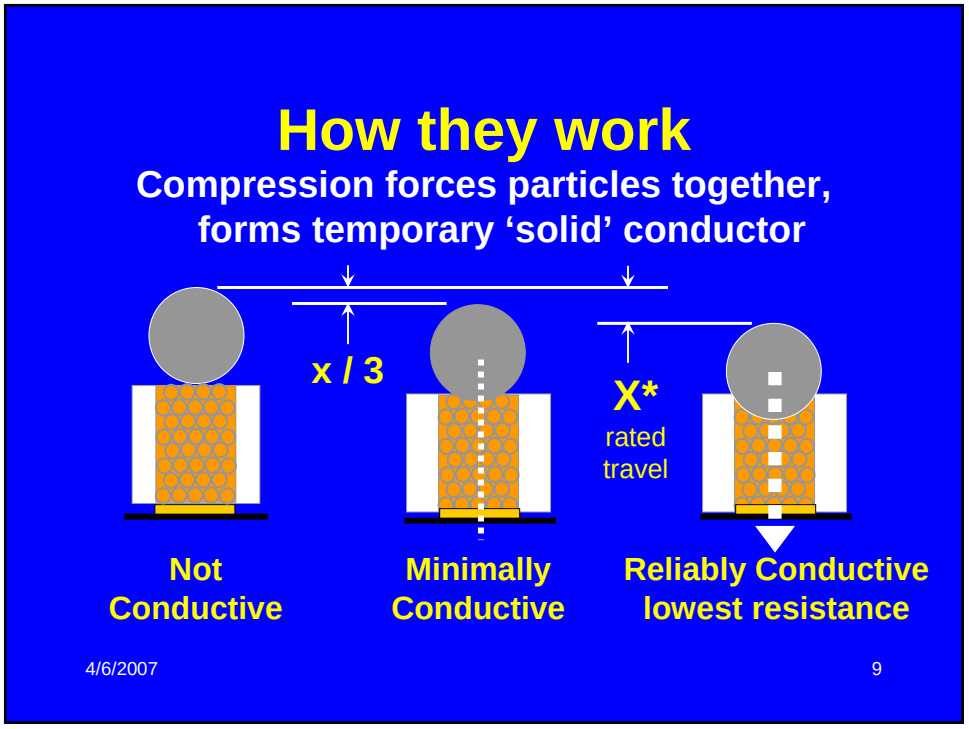
How they work
Compression forces particles together, forms temporary 'solid' conductor
x / 3
X*
rated travel
Not Conductive
Minimally Conductive
Reliably Conductive lowest resistance
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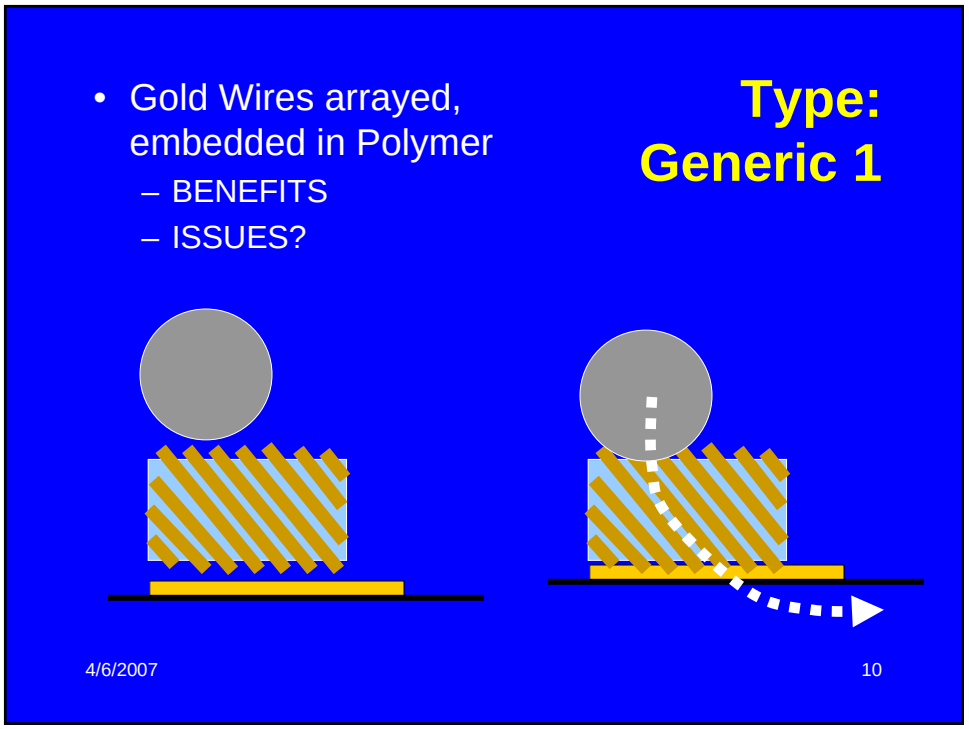
• Gold Wires arrayed, embedded in Polymer
– BENEFITS
– ISSUES?
Type: Generic 1
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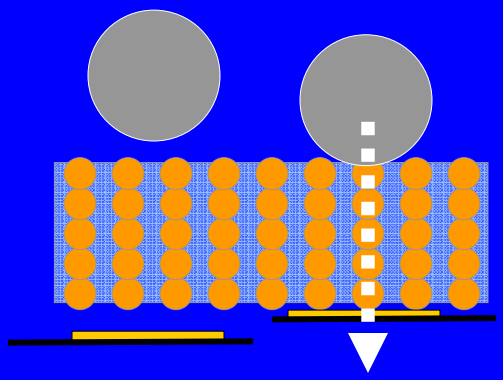
## Type: Generic 2

- Metal spheres arrayed, embedded in Polymer
  - BENEFITS
  - ISSUES?



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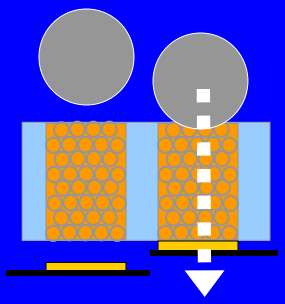
## Metal Filled 1 Defined leads

- Randomly arranged particles in Polymer
  - BENEFITS
  - ISSUES?



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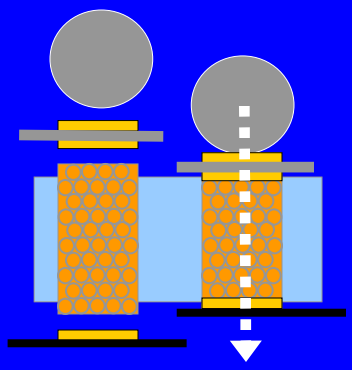
## Metal Filled 2 Defined leads



- Randomly arranged particles in Polymer
- Includes topside protective layer
  - BENEFITS
  - ISSUES?

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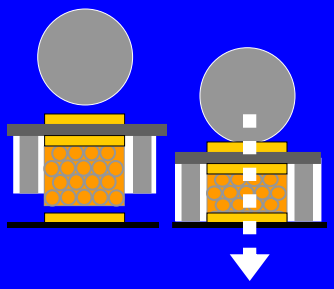
## Metal Filled 3 Defined leads

- Randomly arranged particles in Polymer - on a Carrier
- includes Integrated topside protective layer
  - BENEFITS?
  - ISSUES?



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## Data Capture

- **History:** 600+ test sequences
  - 110 Million+ hits
  - Over 4 years
  - ~ test length: 150K – 250K hits (some up to 700K)

- Conditions
  - Room Temp
  - Pneumatic Drive
  - Set to 35 PSI
  - 5500 hits/ hr 24/7
  - Hardstops required
  - Automated data capture

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PC &
HP DVM

## DATA CAPTURE Hardware


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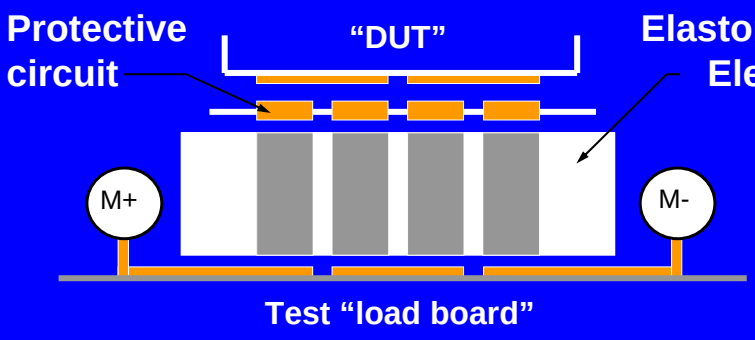
## Test Setup 1

**Schematic of test setup -shown exploded-**
**Tests are conducted under 30-35% compression**

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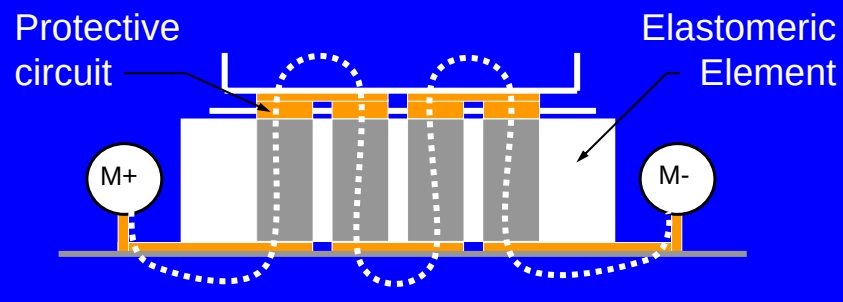
## Test Setup 2

**Schematic of test setup -shown compressed**

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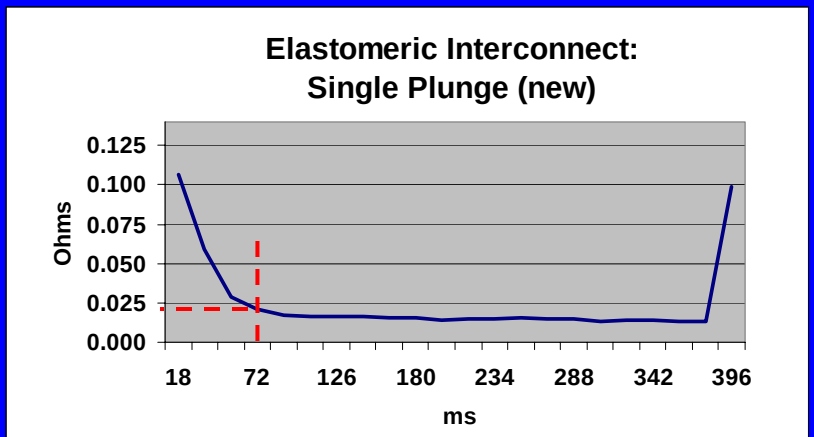
## The First Plunge

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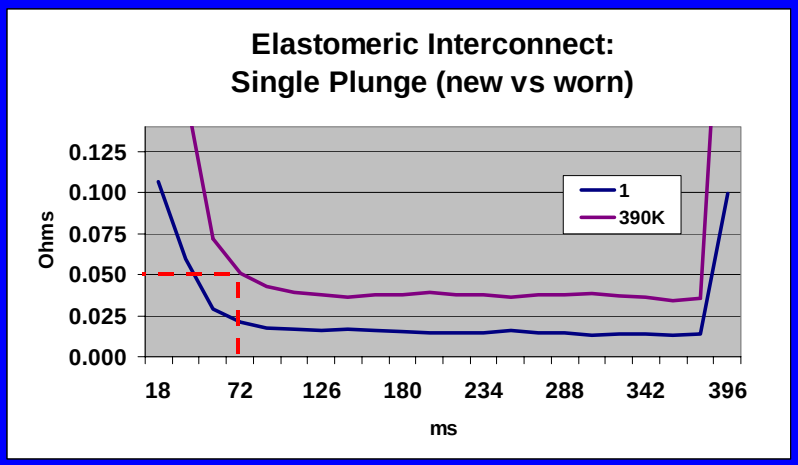
## & the Last Plunge

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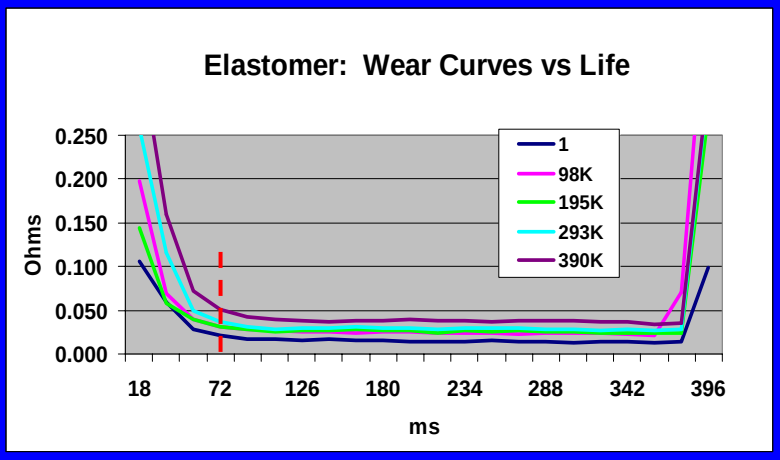
## Test Results: Wear

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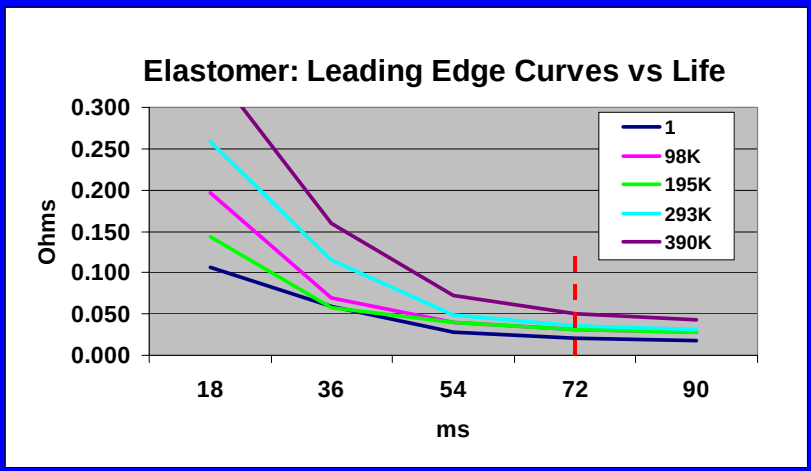
## Test Results: the Front edge

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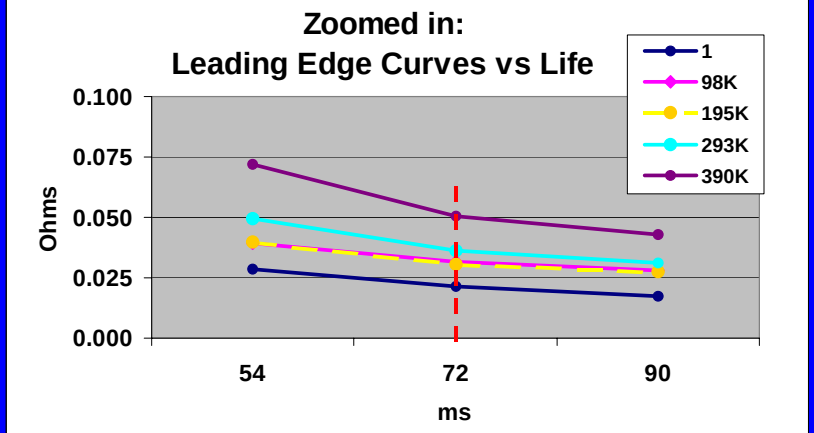
## Again, the Front edge

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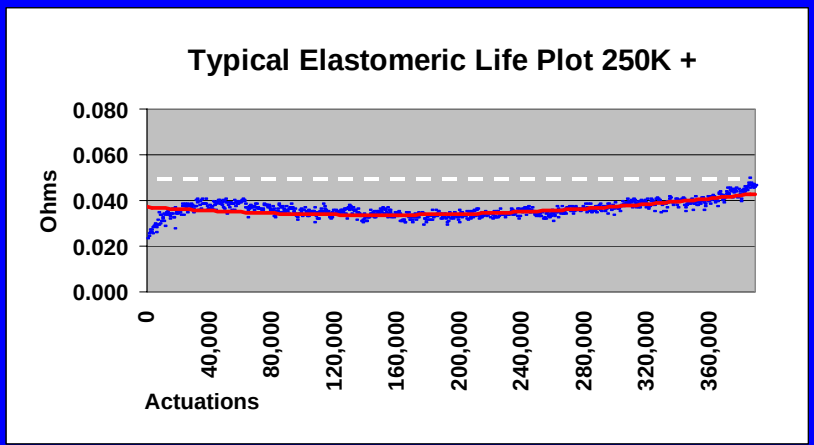
## Test Results 5 (Reliability)

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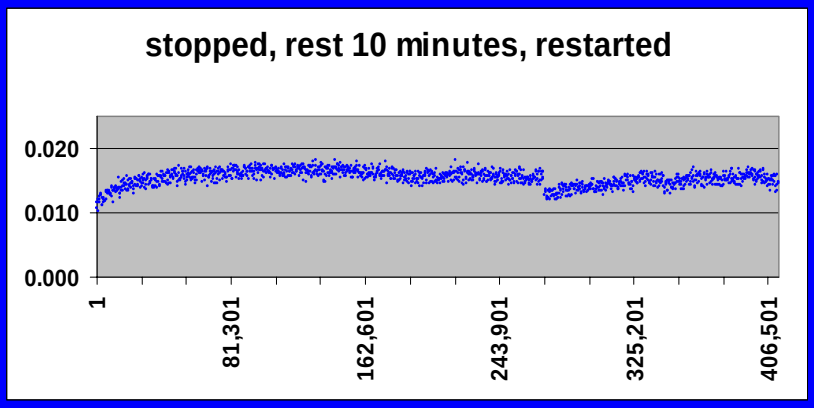
## Test Results 6
### Characteristic Behavior vs. time

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## Failure: what happens

- **Resistance Rise**:
  - Strain through accumulated use (wear): Supporting structures soften with use
  - Excessive Overactuation = strain (tear)
  - Prolonged exposure to heat & compression causes reformation: mechanical compression set, loss of resilience
  - Contamination of Dut side Surfaces:

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## Failure: What doesn't happen

- **Sudden** electrical changes are rare
- **Opens are rare -** Surface contamination is the usual culprit –some are cleanable
- **Shorts almost never -** Redistribution of conductor material

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## Do's and Don'ts of care

- **Do keep them clean**
- **Remove pressure when not in use**
- **...Especially at high temp**
- **Alcohol Free**
- **Store Appropriately**

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## REVIEW Values: Electrical Lows & Highs

- Short path = "low…"
  - Low profile
  - Low resistance
  - Low inductance
  - Low capacitance
  - low force
- Short path = " high…"
  - High bandwidth
  - High Current
  - High "performance"

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## REVIEW Value Offsets:

- In Automation- Coplanarity, Actuation, critical
- Devil's in the Details- design & materials
- Elastomerics: can be damaged- misinsertion, careless handling
- High data rates for automation at a moderate cost
- Easy Replacement and Maintenance
- Coming Pitch Reductions seen as easier
- Service is rare

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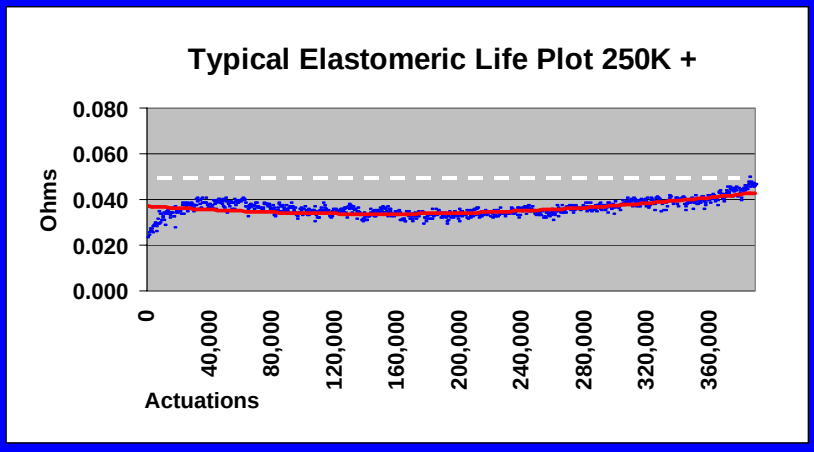
REVIEW

## Review
### (Reliability)

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## Bottom line

**At 10-40 GHz+ -and beyond,**
**The technology is here.**

**Elastomeric Element Lifetimes of 250K to 400K are expectable**

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