IPC Electronics Midwest 2010

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Look out SIR!
SIR Test Results and Misleading Data

Biography:
Managing Director

Over 30 years in the electronics industry, a specialist in conformal coating, cleaning, SIR & CAF, electro-chemical issues, solderability and process control matters. Vice or Co-Chairman of several standards committees with IPC, IEC and BSi, also offering consultancy services.

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Look out SIR!

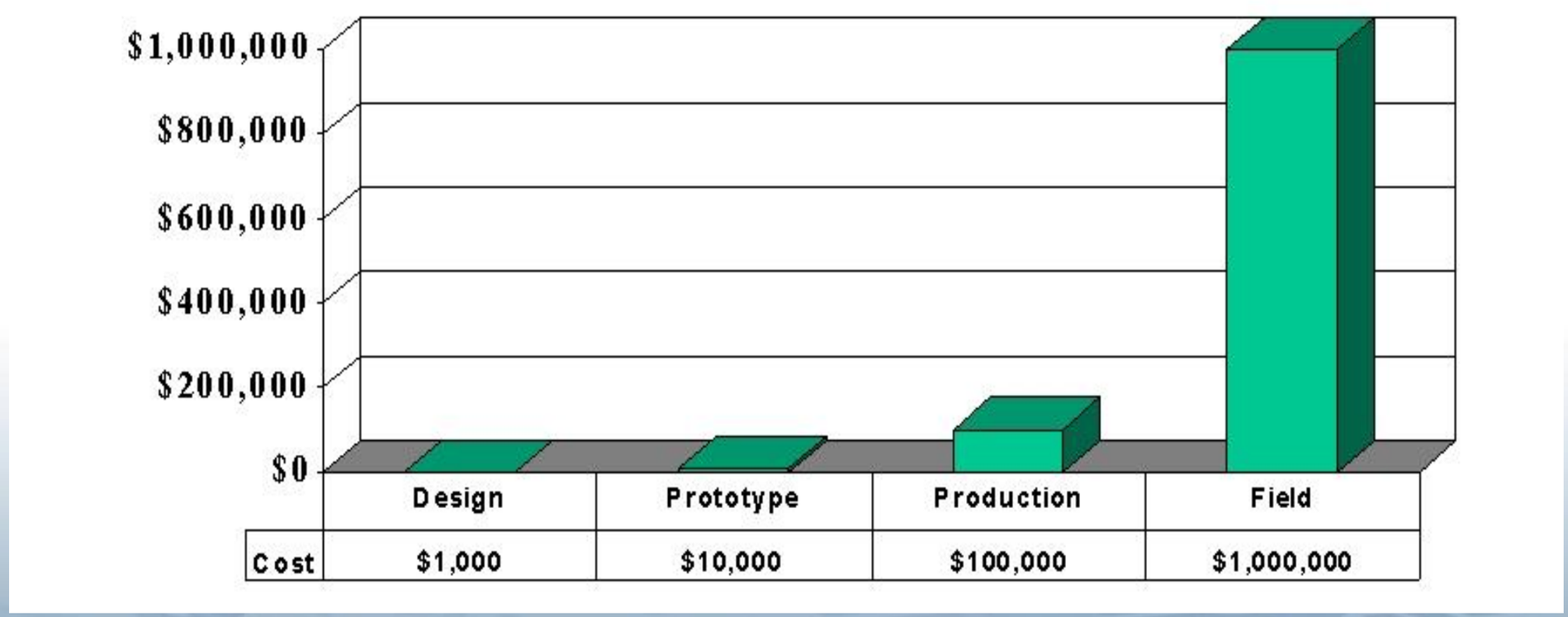
SIR Test Results and Misleading Data

IPC Midwest
Chicago
September 2010

GEN3 SYSTEMS

Look-out SIR!

- Mistakes are costly!



Courtesy of Harvard Business School ("Business Week" Magazine)

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- The most commonly asked question: If I am going to apply a conformal coating do I have to clean?
- Short answer - probably
- Long answer - it depends*....

*Appears courtesy of Doug Pauls

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Ask yourself:

- ...Are you sure you have your process under control?
- ...Are you sure that your process chemistries are electro-chemically compatible?
- ...Do you know the answer to “How Clean is Clean?”

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This question has been around since Adam was a boy!

- In the 1970's the US Military and our (British) DOD decided to put a stake in the ground:
  - That stake remains to this day, but at a level of <1.5µg/cm^2 NaCl equivalence...
  - This measurement involves a quick and easy process control called ROSE or SEC testing

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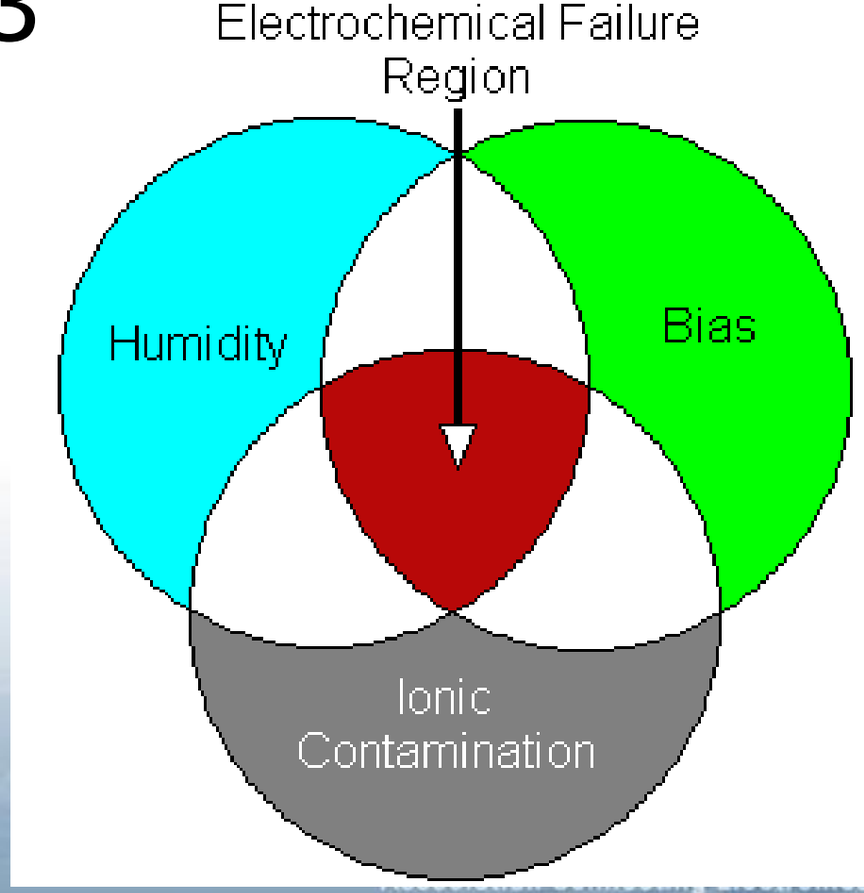
- ROSE / SEC is a measure of ionic contamination that would cause electro-chemical reactions provided that 3 elements are present:
- Humidity
- Ionics
- Electrical bias



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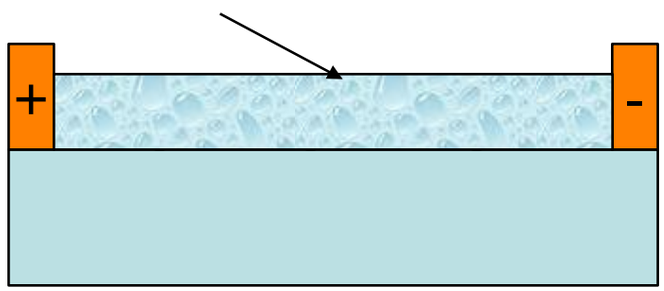
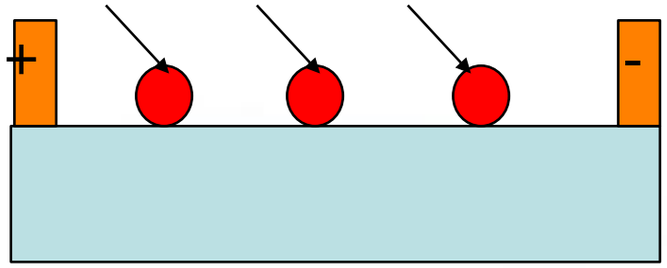
Monolayer of water (liquid)



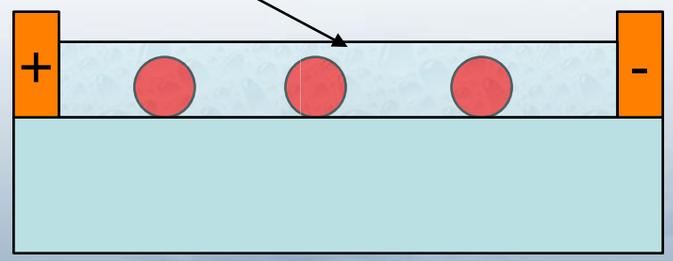
Elevated Humidity/Condensation = Generally OK

Ionic Contamination



Normal Conditions = OK

Electrolyte



Elevated Humidity = Electrolytic Cell

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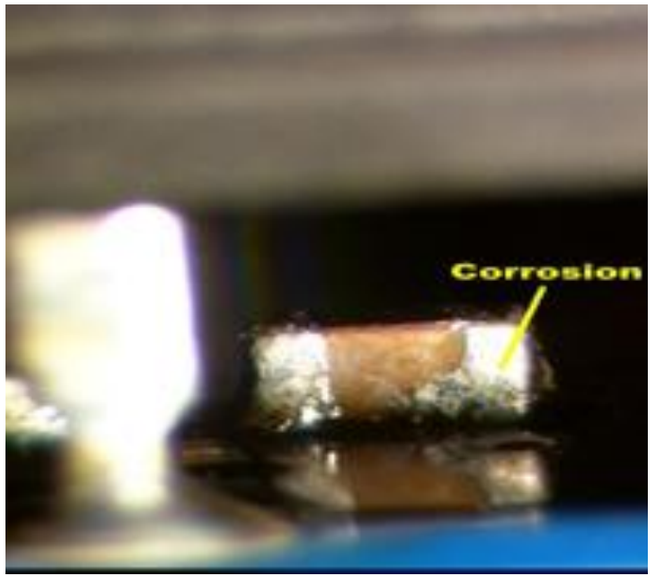
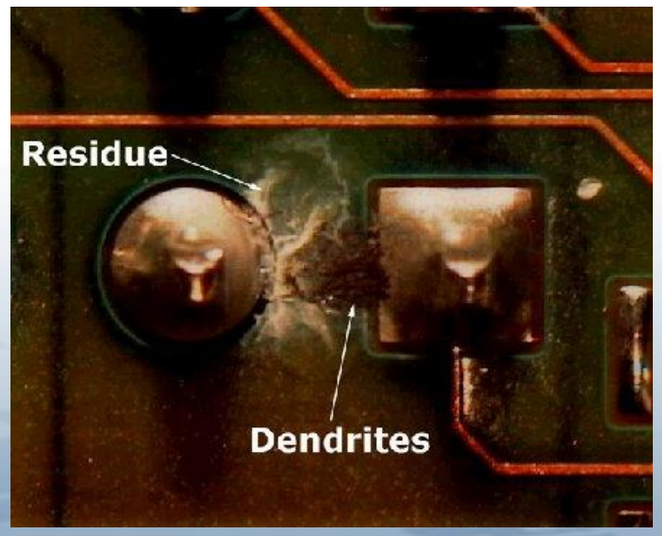
- The major limitations of this test are:
- <1.5µg/cm^2 means its OK to leave UP TO that amount of NaCl on every square cm of your assembly! Are you sure?
- Averaged over the area but the problem might be localised
- It can only detect ionics - what about non-ionics?





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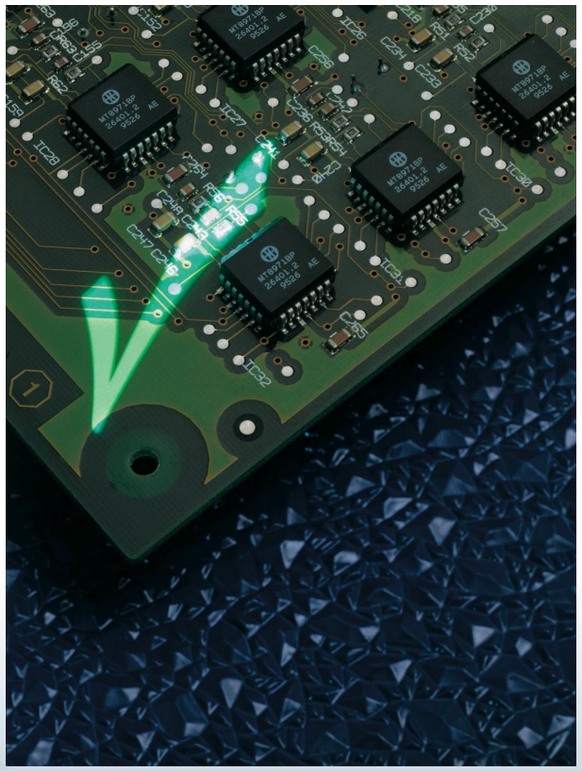
ROSE Testing – Advantages:

- A fast test - 5 to 15 minutes
- Can be run by unskilled operators
- A superb process control tool
- Cheap as chips



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Is there another way?

- Yes. Ion Chromatography (IC)
- BUT: At this point someone with an IQ >120 is required!

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Ion Chromatography (IC)

– IC is based on the use of specialised column packing for separation of ions

– An analytical technique used to separate, identify, and quantitate ions in a sample matrix

– Separating ions due to their different size, polarity, ionic strength, and affinity to stationery phase

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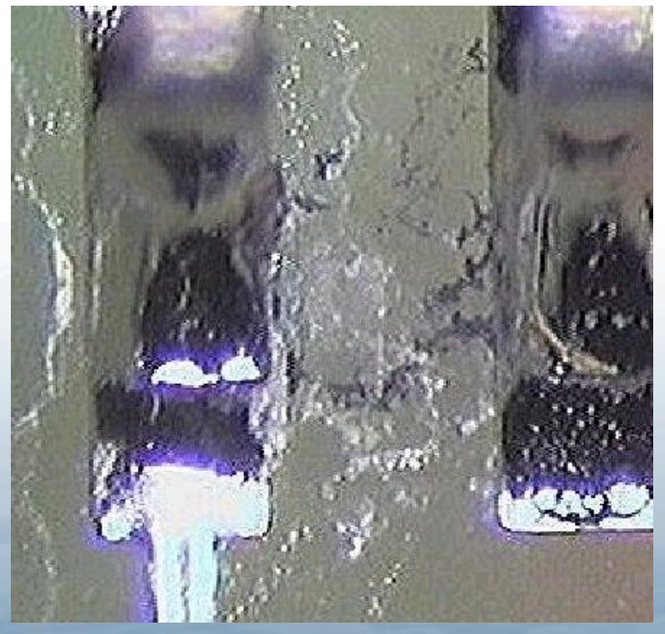
Ion Chromatography - Limitations:

- Requires highly skilled operators
- Expensive to run
- Time to run test is a lot more than 15 minutes!



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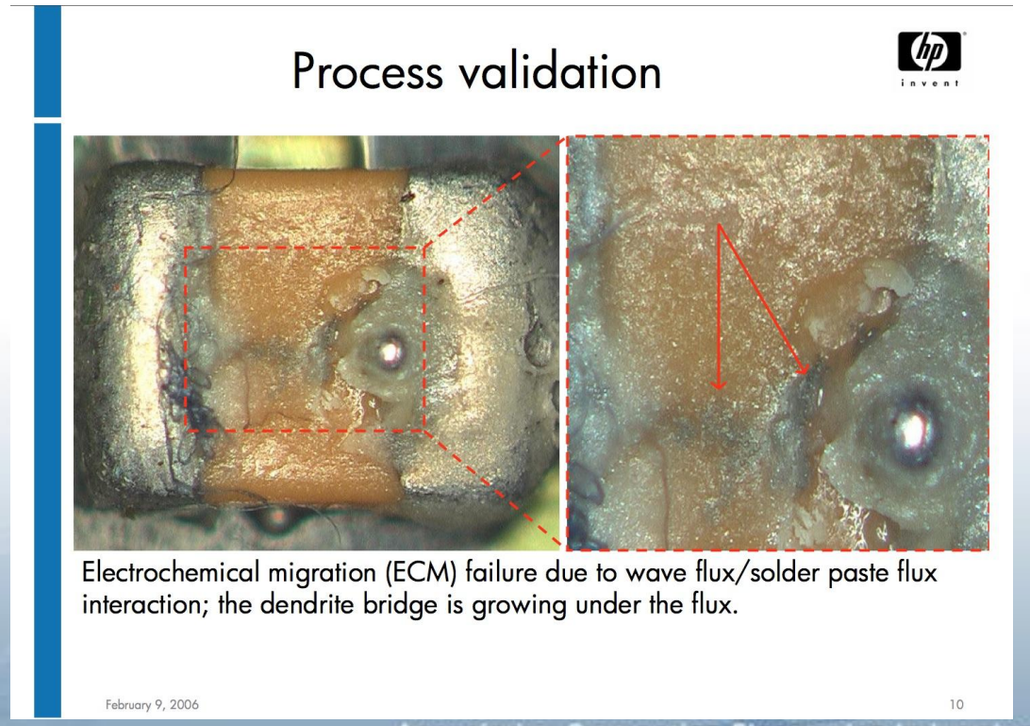
Ion Chromatography - Limitations:

Ion Chromatography will tell you exactly what is on the surface under test -

- it will NOT tell you whether the end product will be reliable.



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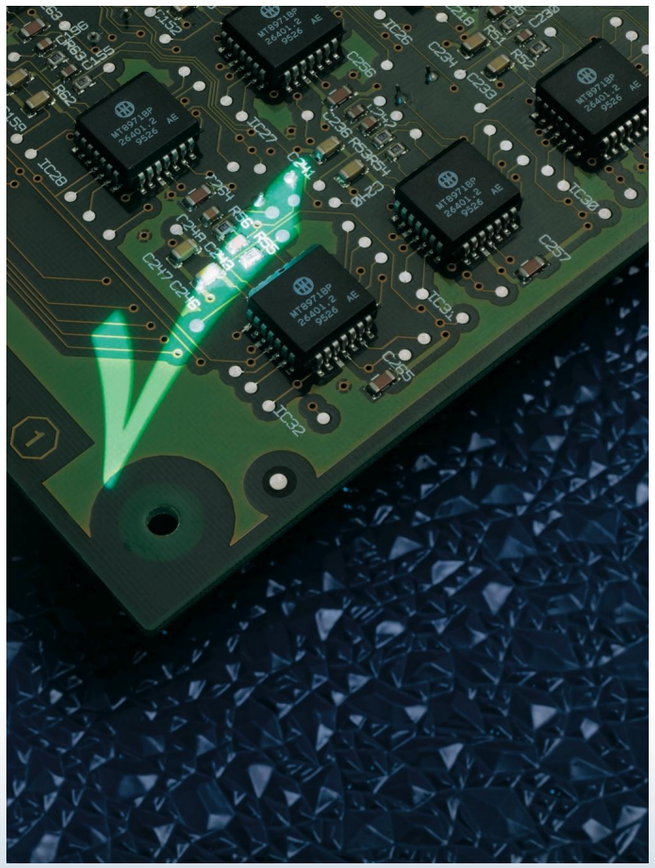
Ion Chromatography - Advantages

- Highly accurate
- Excellent species differentiation
- Can be employed for locallised contamination
- Looks impressive to the visiting customer!



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...Is there another way?

- Yes. FTIR - Fourier Transform Infrared Spectroscopy
- AKA - Frustrated Total Internal Reflection!
- At this point someone with an IQ >140 is required!

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FTIR - Fourier Transform Infrared Spectroscopy -

- …is a measurement technique whereby spectra are collected based on measurements of the temporal coherence of a radiative source, using time-domain measurements of the electromagnetic radiation or other type of radiation.
- Thank-you Wikipedia!

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…and the other way?

SIR = Surface Insulation Resistance

The principal:

– An inter-digitated test pattern
– Electrical bias
– Measuring the degradation or changes of surface insulation resistance

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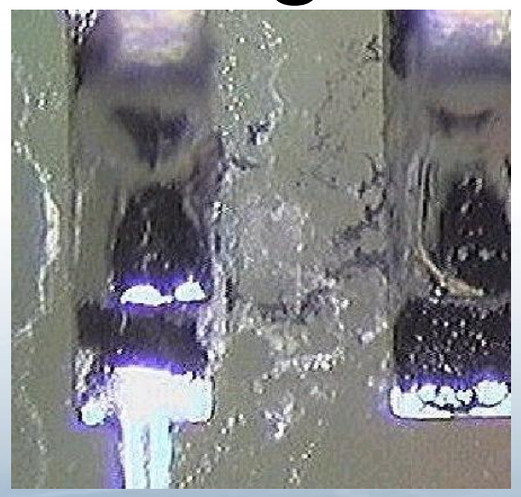
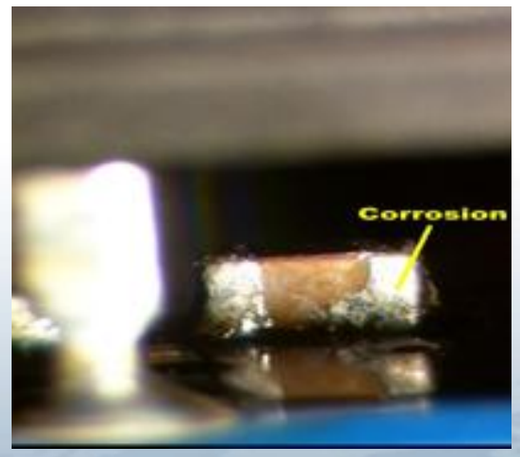
- SIR Testing will tell you if the end product will be electro-chemically reliable, but it won't tell you what it is that is causing a failure.





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New SIR test standards have been published that facilitate Process Characterisation Testing:

- IEC 61189-5 Method 5E02
- IPC-TM-650 2.6.3.7

And under consideration:

- IPC-9202
- IPC-9203

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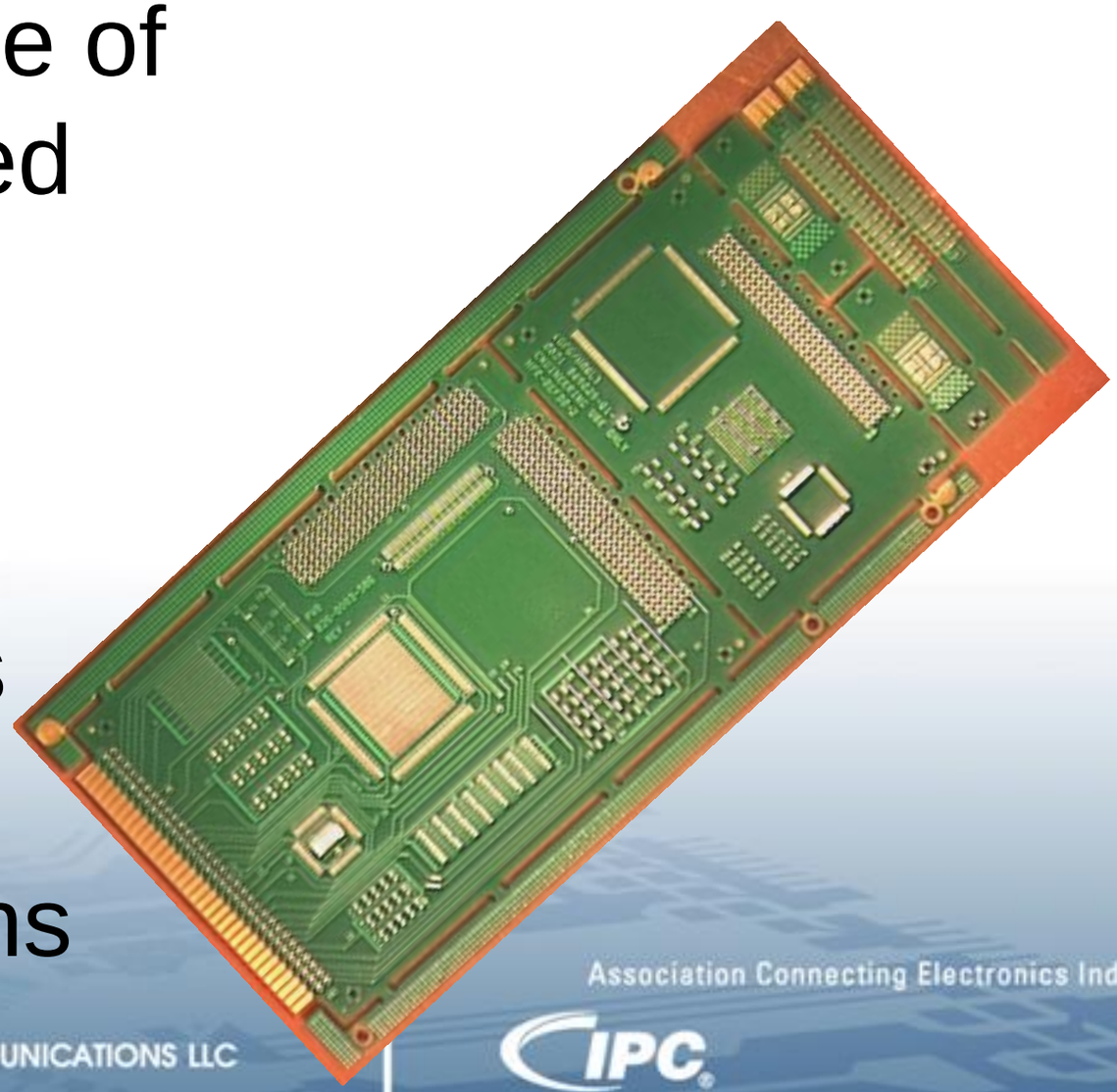
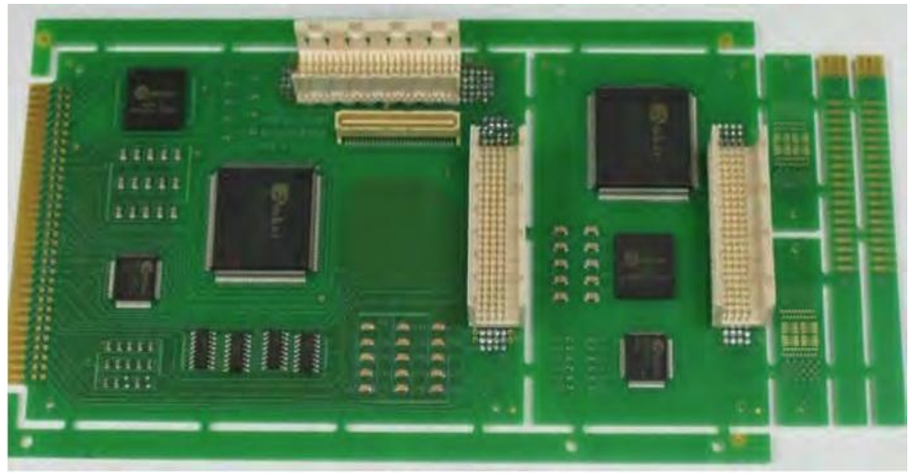
- What is involved?
  - A test coupon (IPC-B52 as shown or IEC-TB57)
  - A test chamber capable of providing well controlled heat and humidity
  - A precision measuring system
  - Interconnecting cables
  - Data collection and graphical interpretations

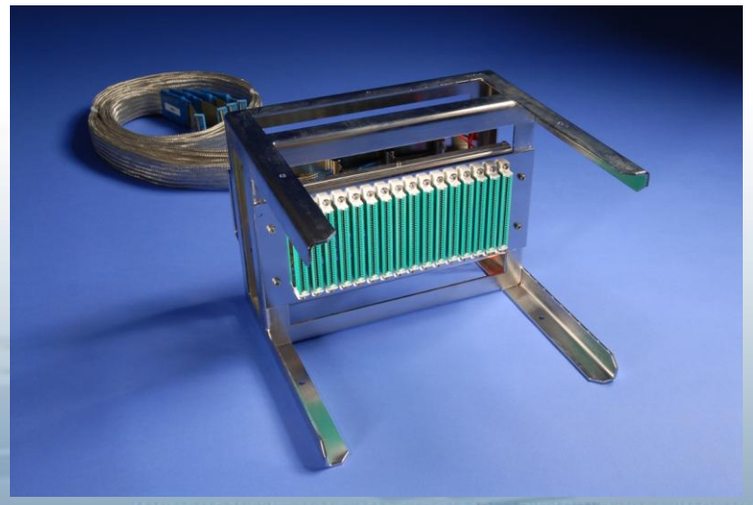


Look-out SIR!

- It’s not as hard as you might think and easier than it used to be

1. Select your process suppliers - board and finishes
2. Purchase the kits of dummy components
3. “Process” the coupons as per the end product
4. Place into the test rack
5. Turn on the chamber
6. Sit back and relax for at least 72 hours!





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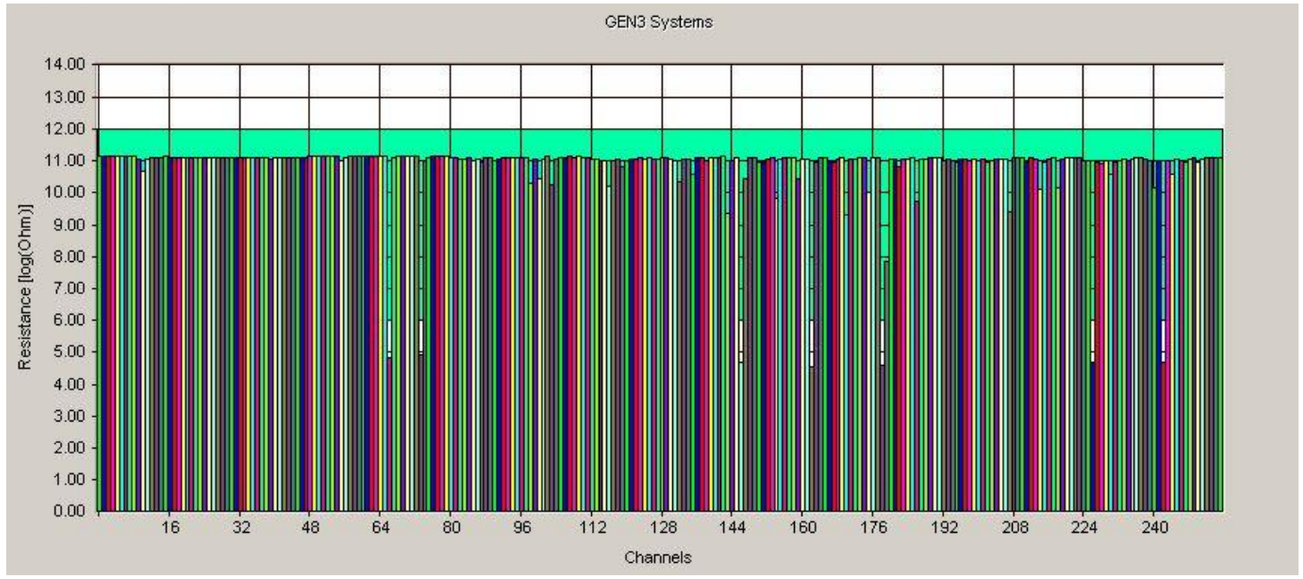
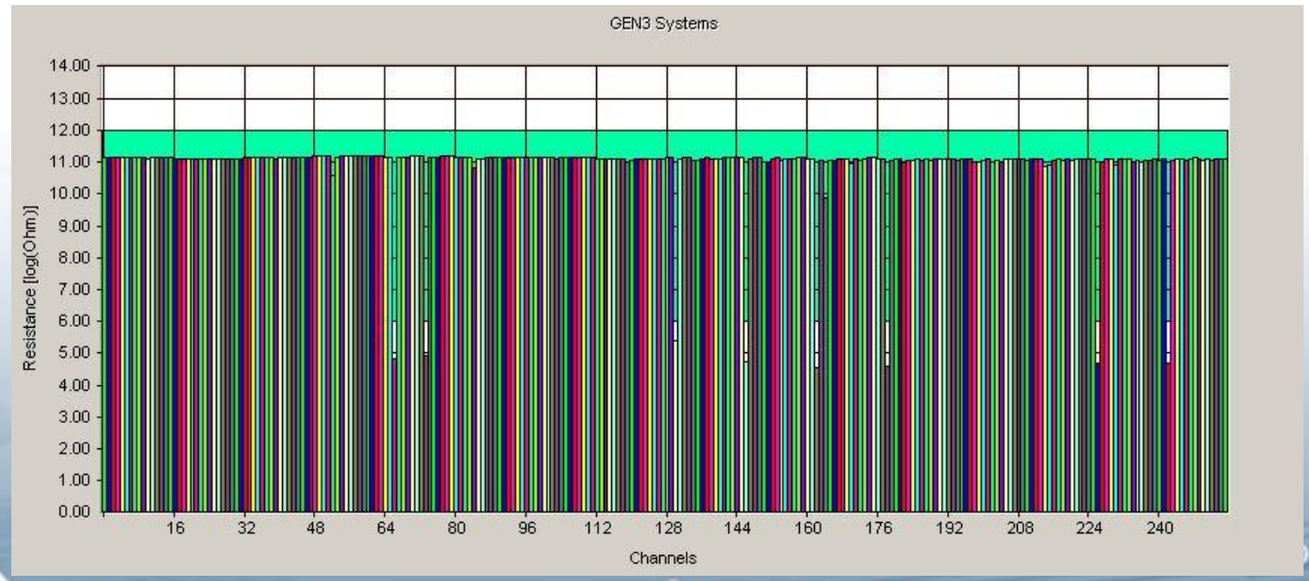
- Results?
  - These are good results:
  - At start of test





- At end of test

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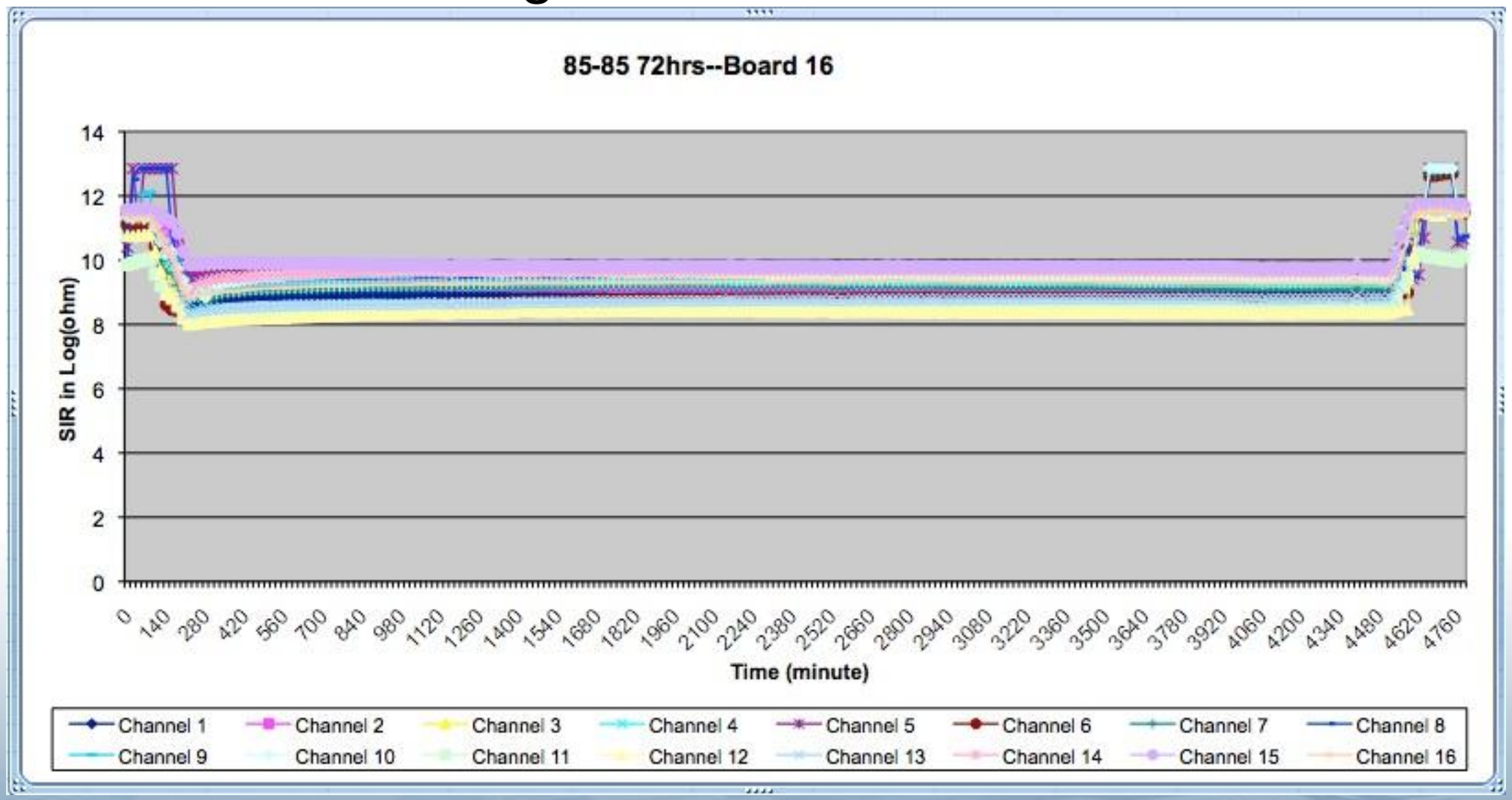
- Results?
  - These are good results:



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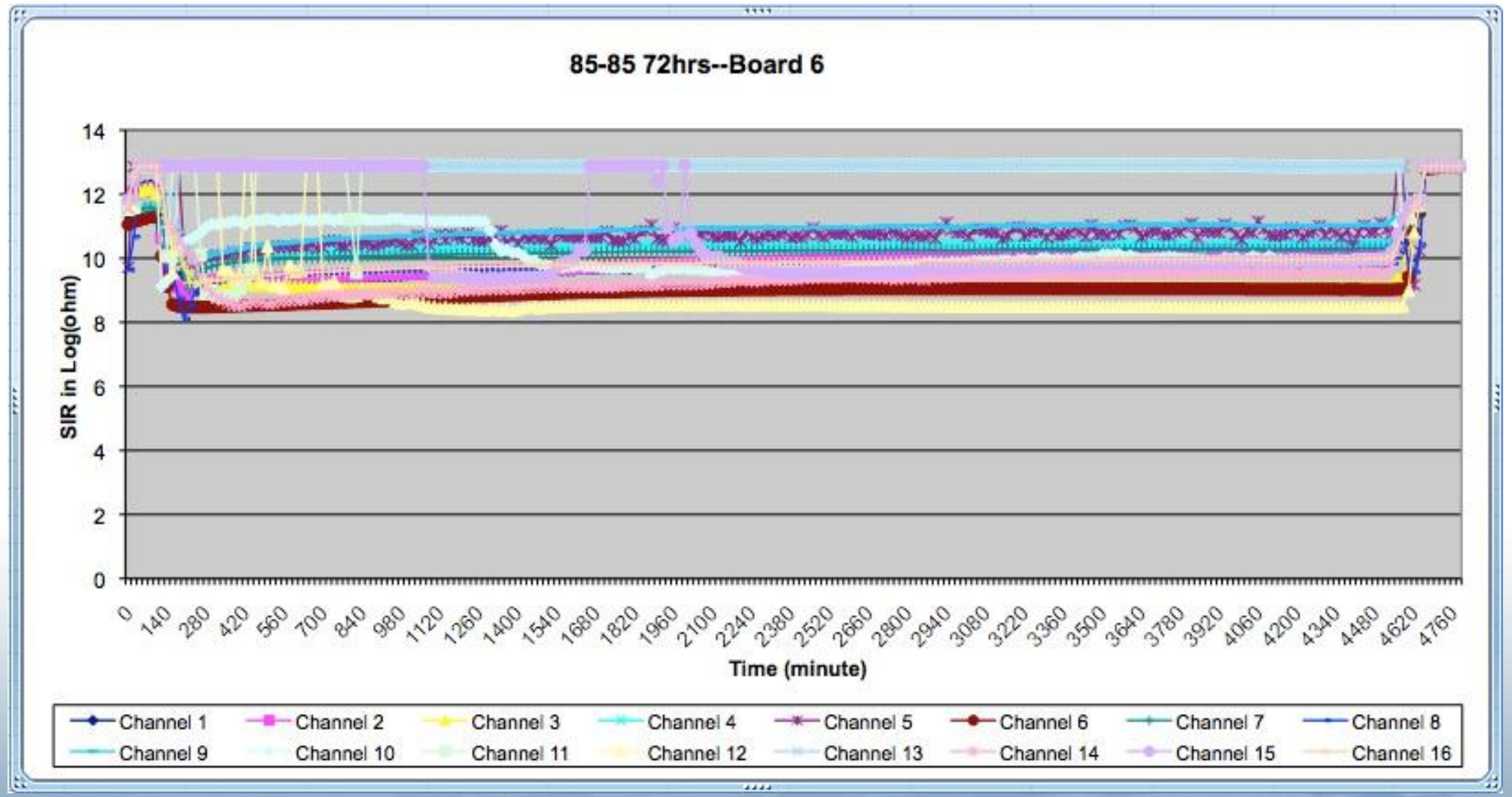
- Results?
  - Pass or Fail? You decide:



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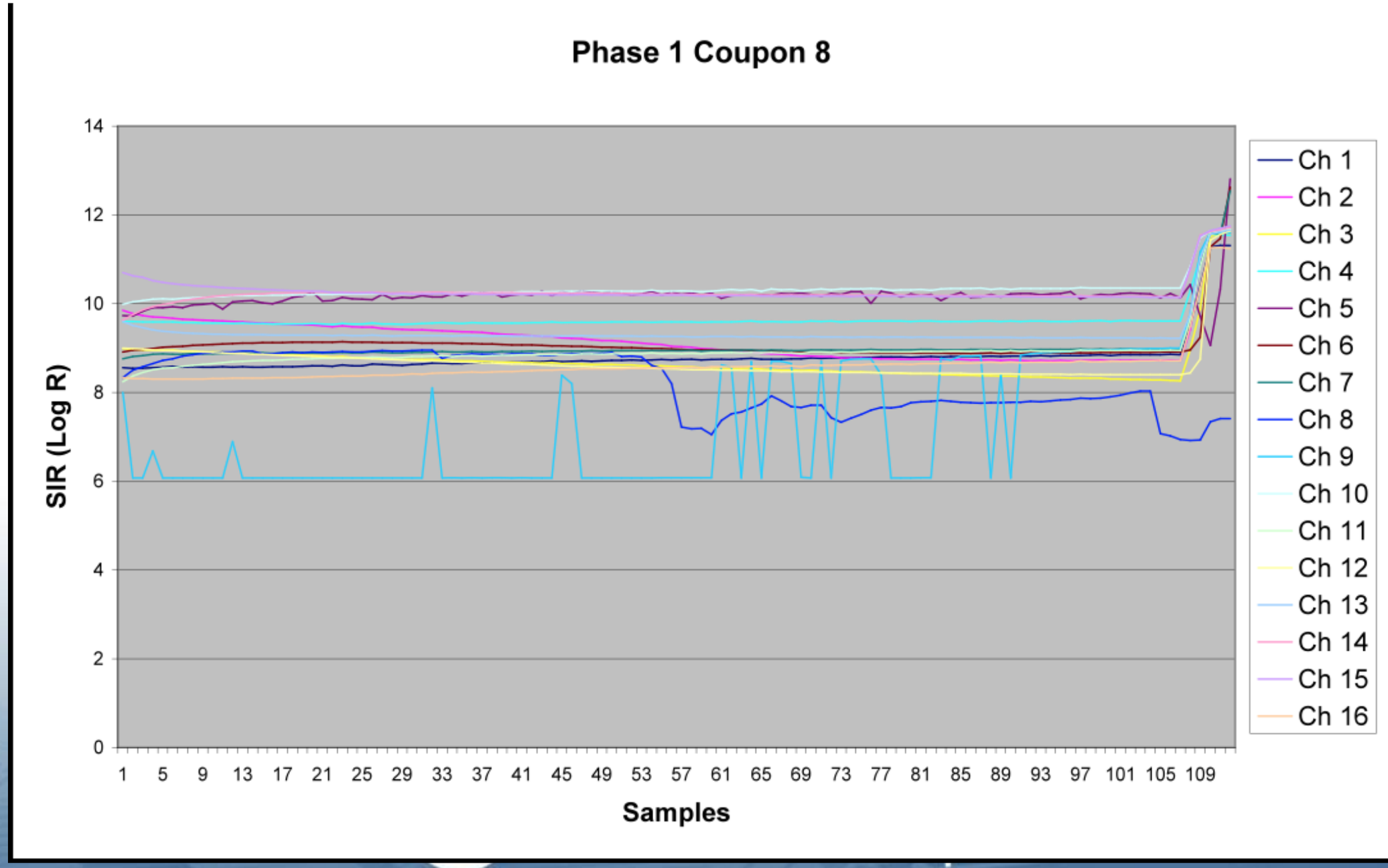
- Results?
  - Failures look like this:



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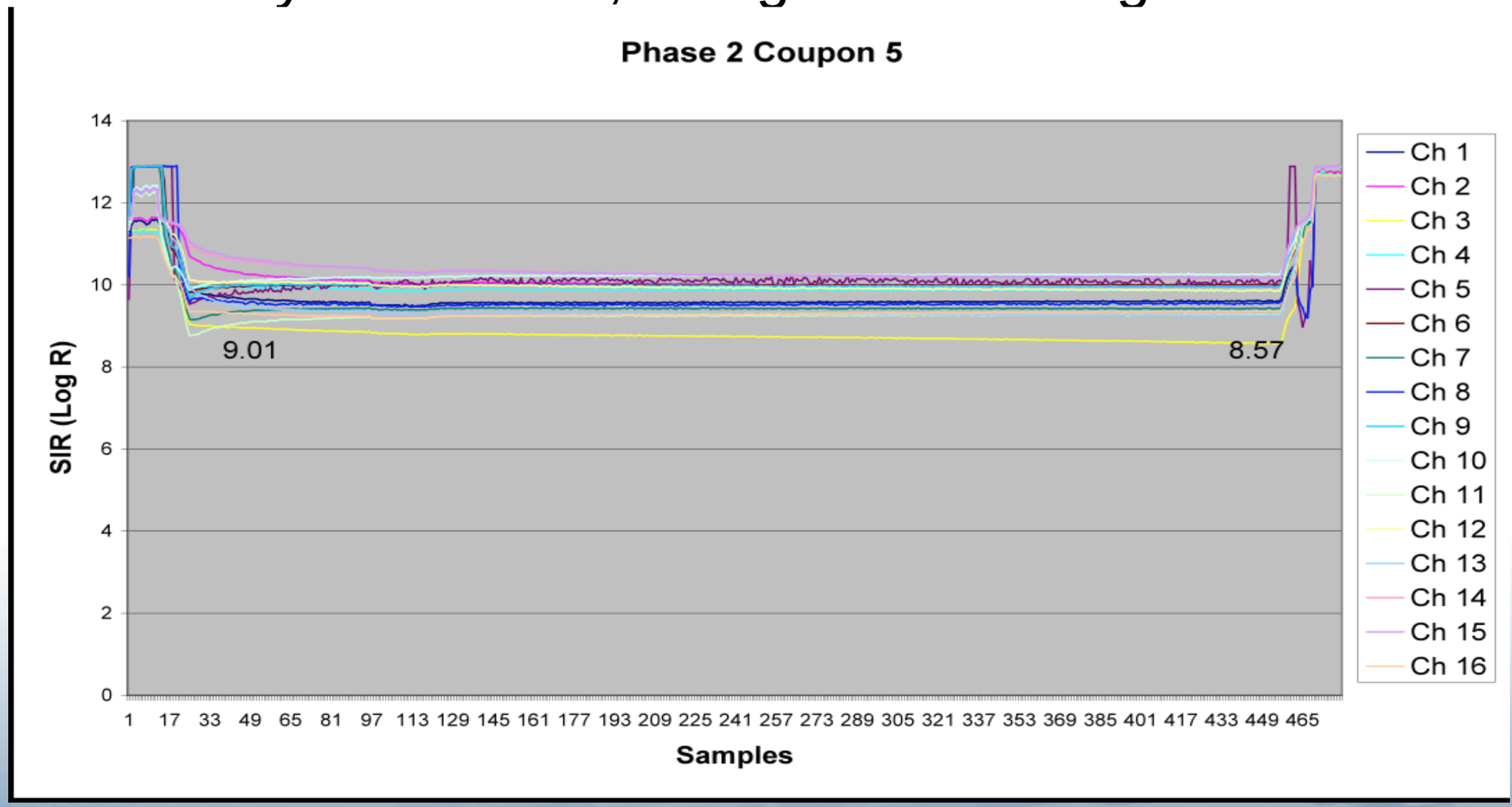
- Results?
  - If you see this, it might mean longer term



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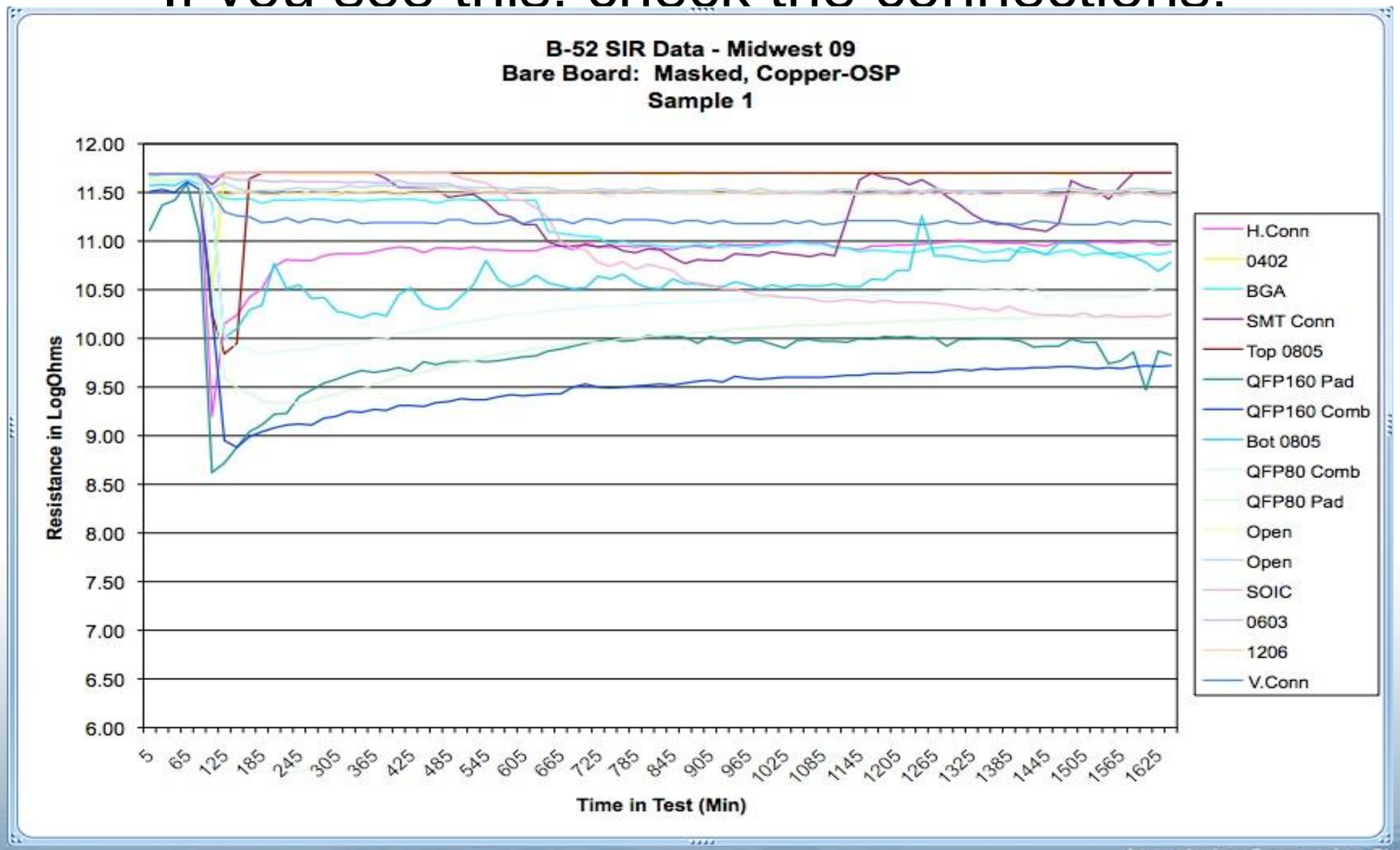
- Results?
  - If you see this, check the connections!



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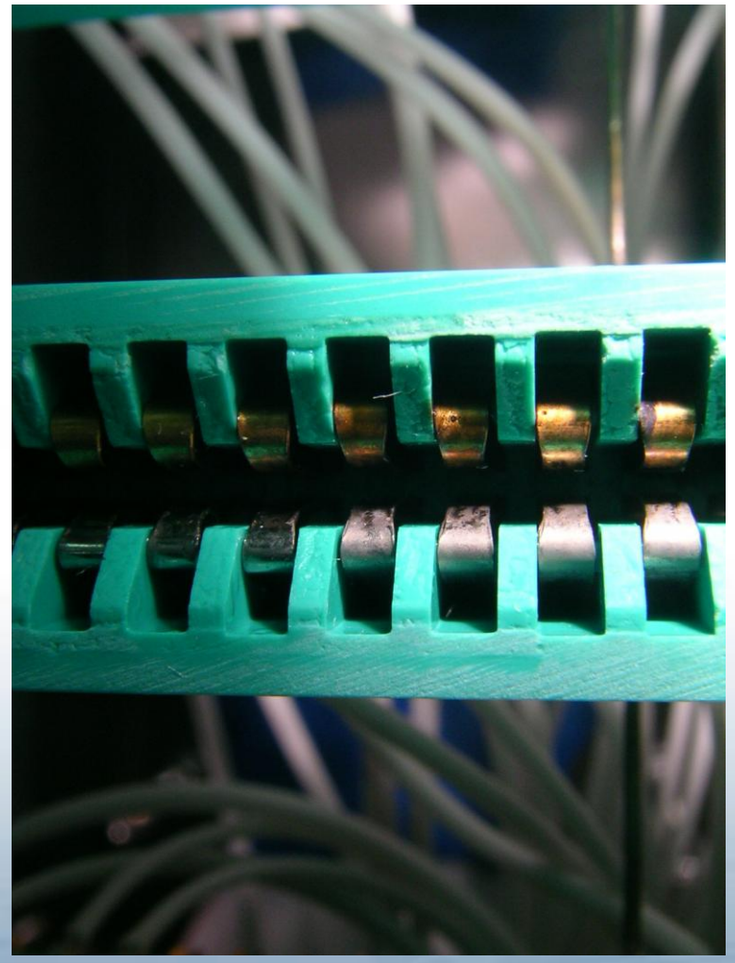
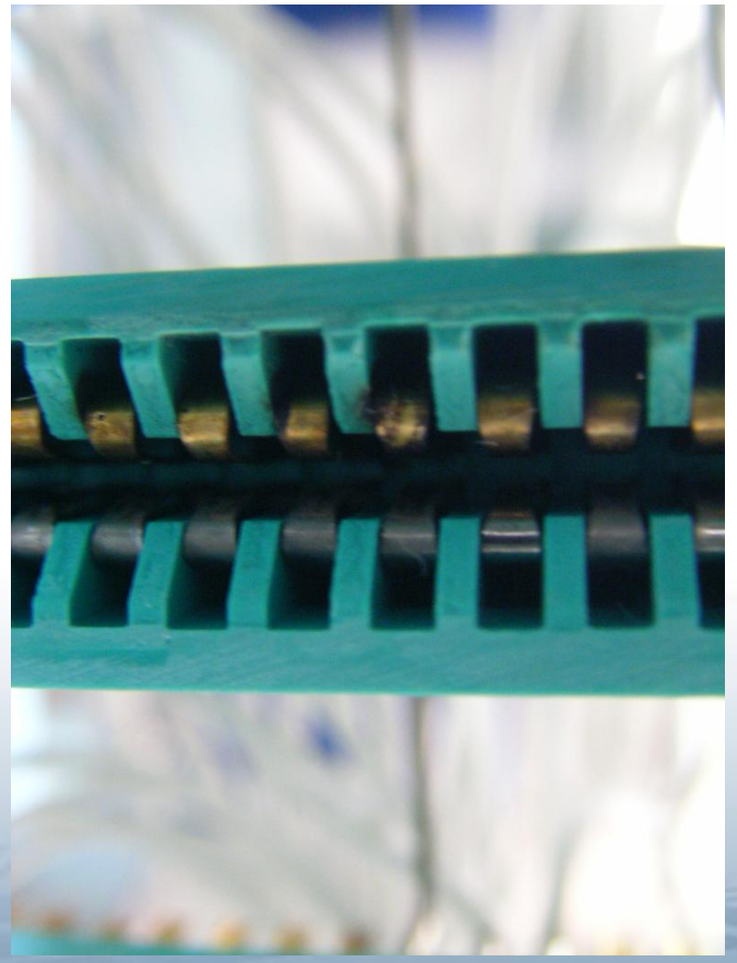
- Results?
  - If you see this before you test, you have a “poisoned” chamber





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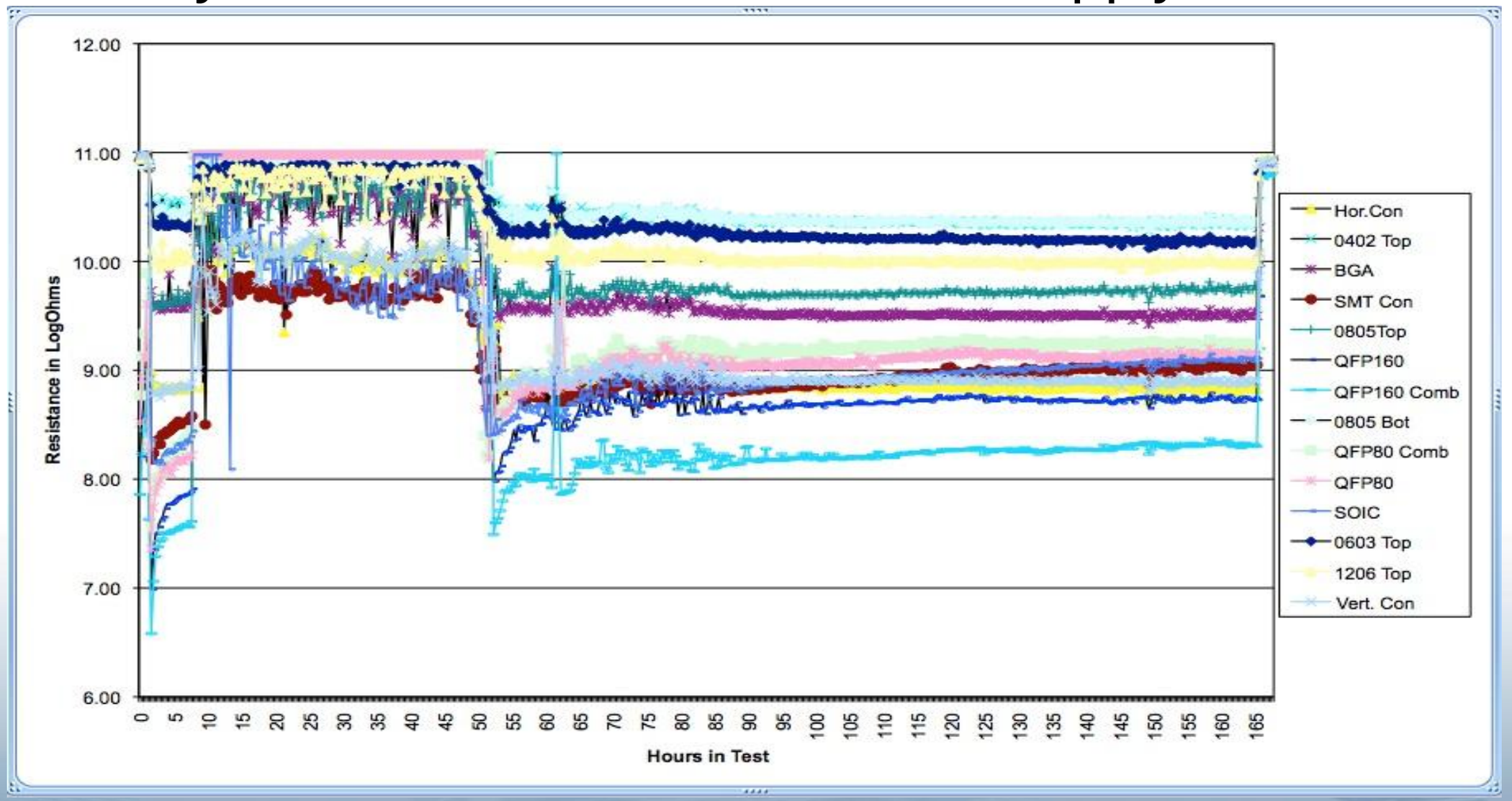
- Results?
  - If you see this, check the water supply to the chamber



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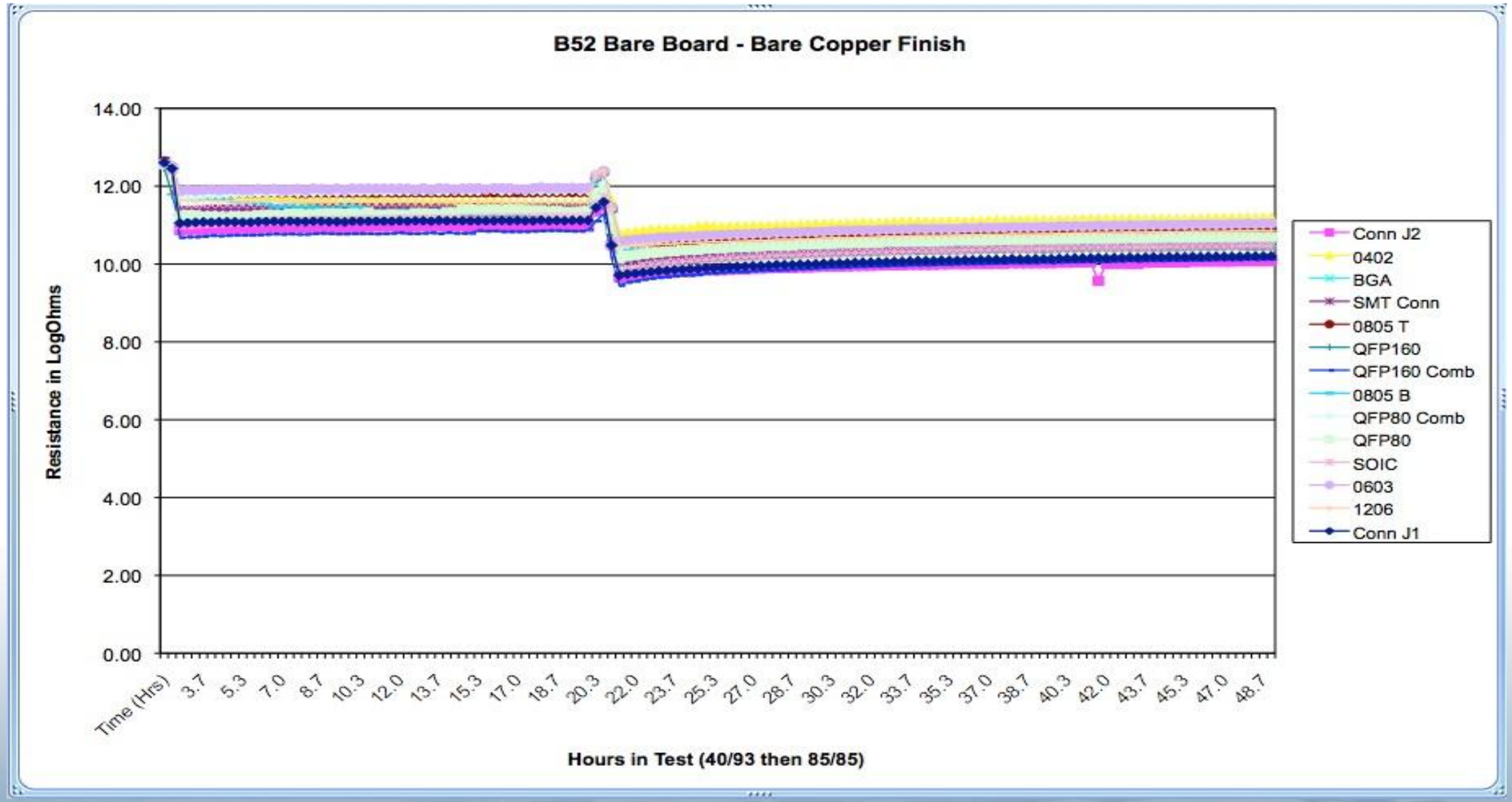
- Results?
  - The difference between 40^{0}C 90%RH and 85^{0}C



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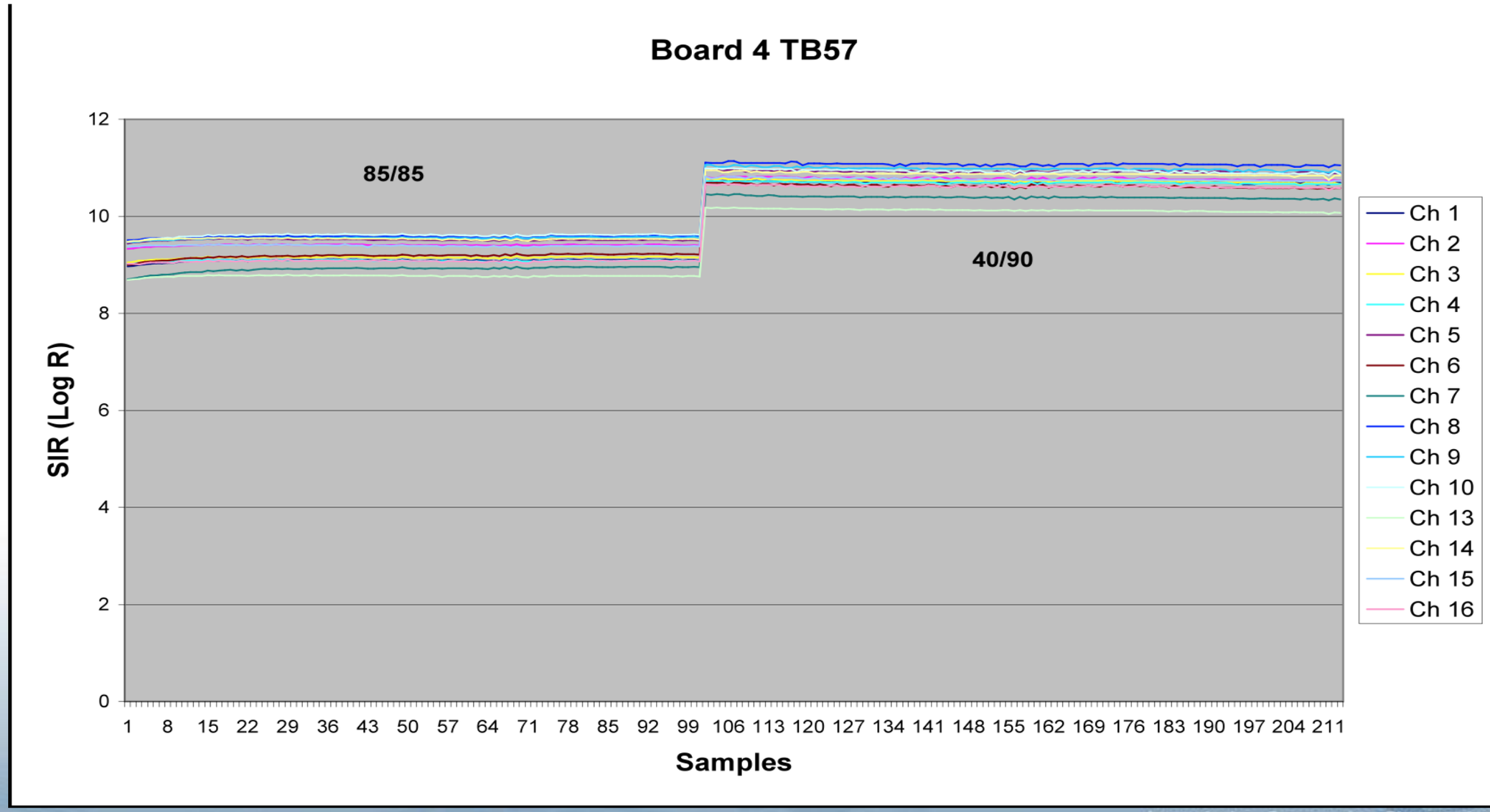
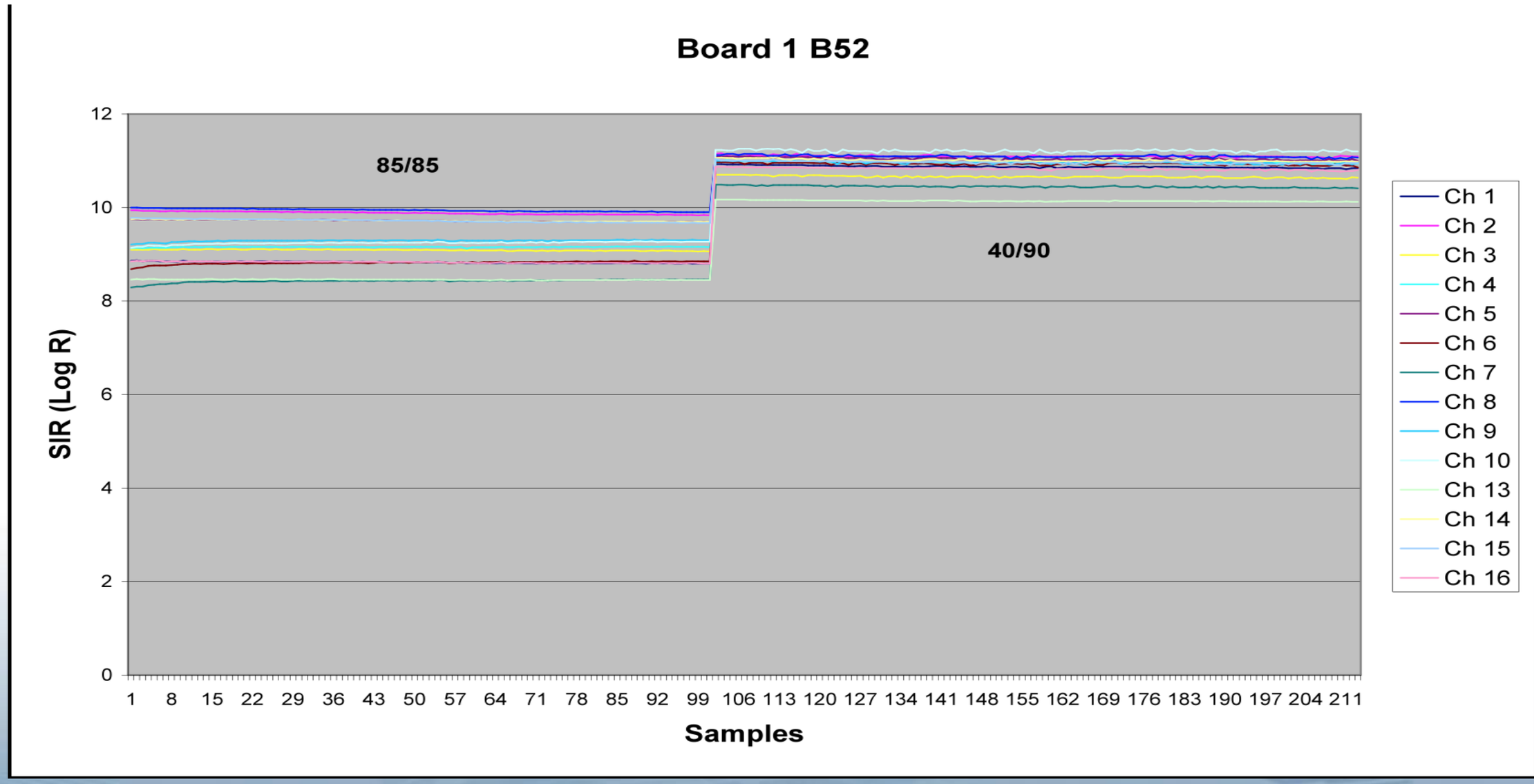
- Results?
  - Compare IPC B52 with IEC TB57 & 85/85 v 40/90



Look-out SIR!

- Results?
  - Compare IPC B52 with IEC TB57 & 85/85 v 40/90



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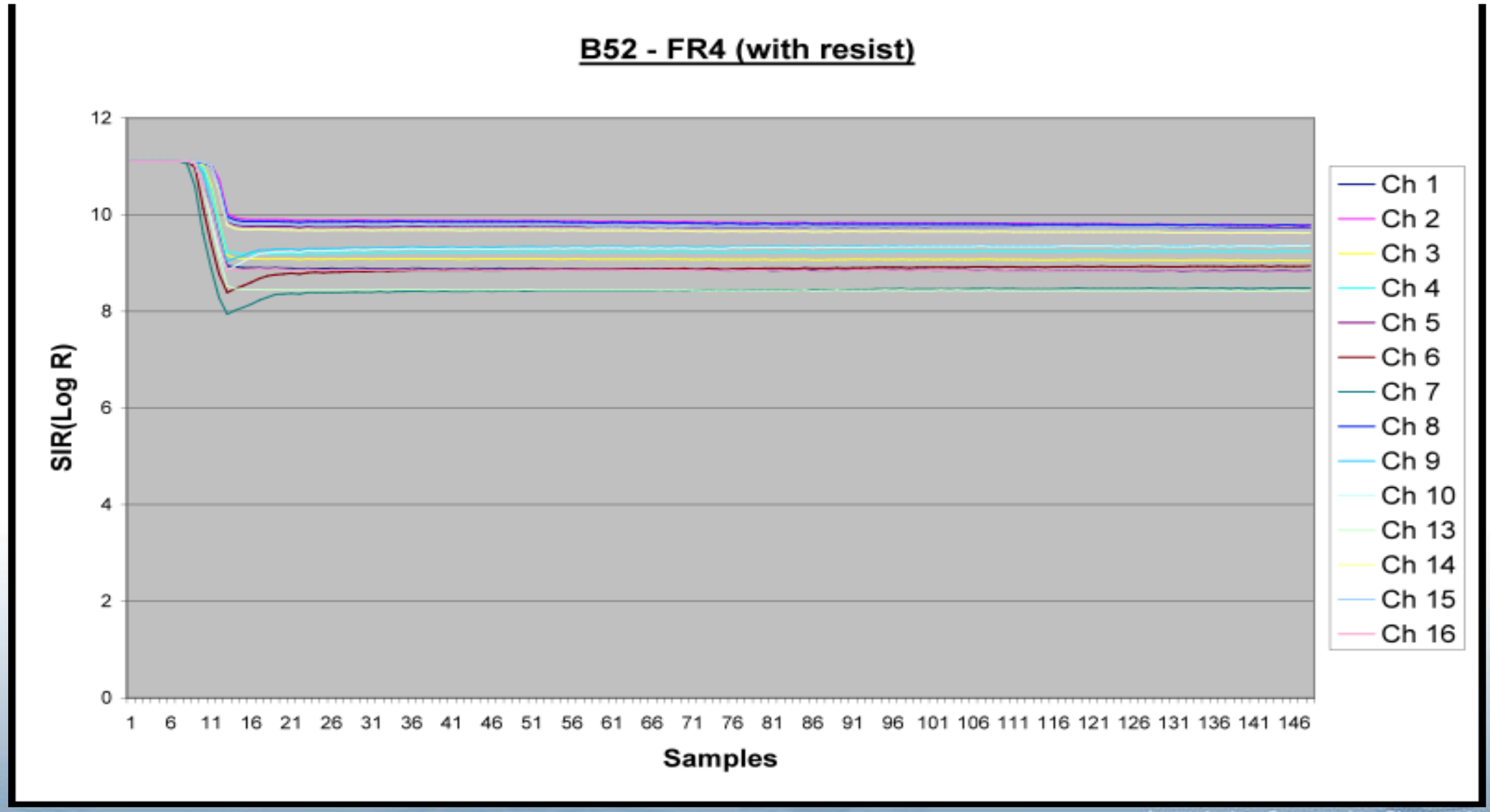
- Results?
  - Effect of solder resist – IPC B52 bare coupon



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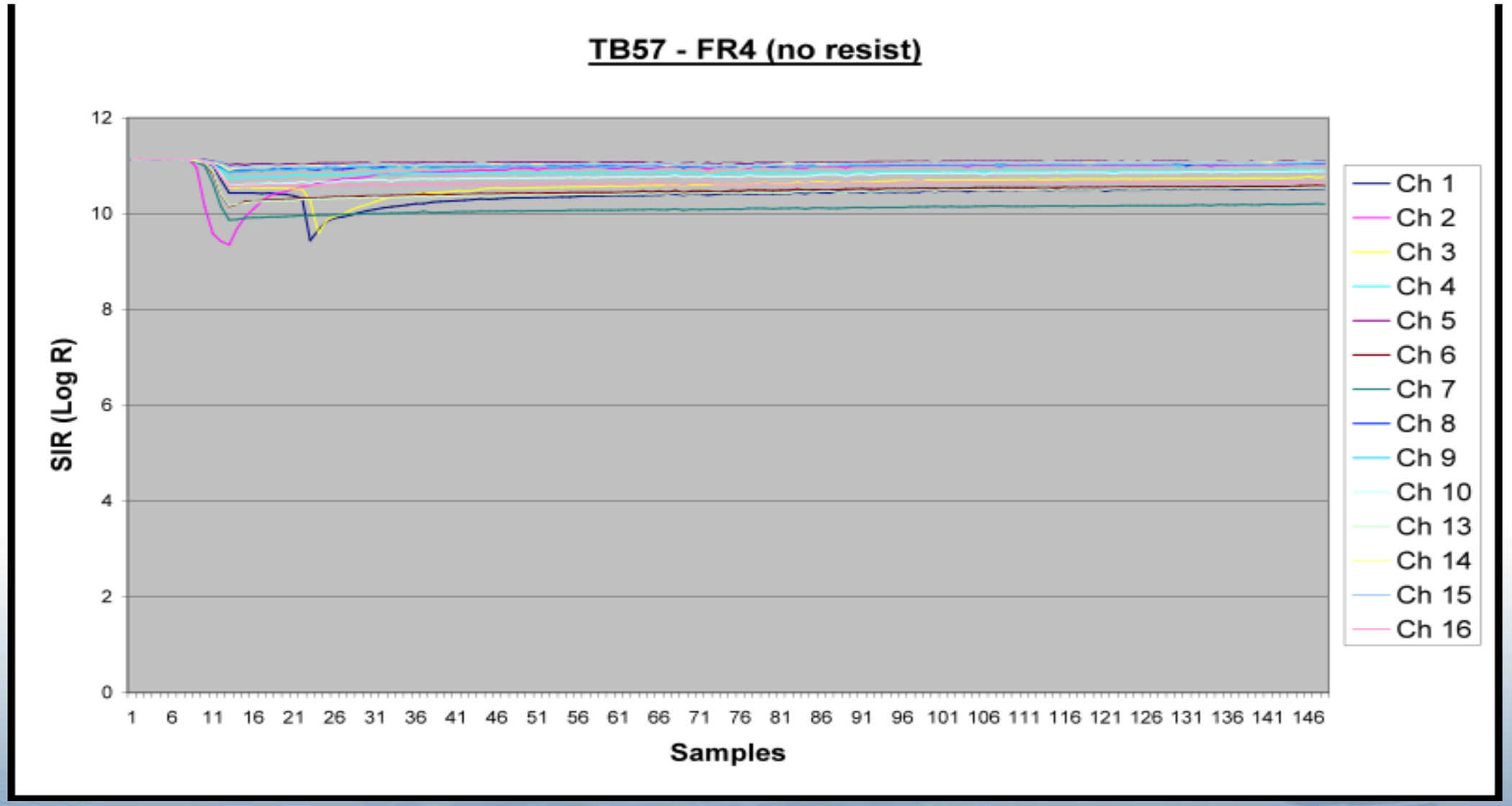
- Results?
  - Effect of solder resist – IEC TB57 bare coupon



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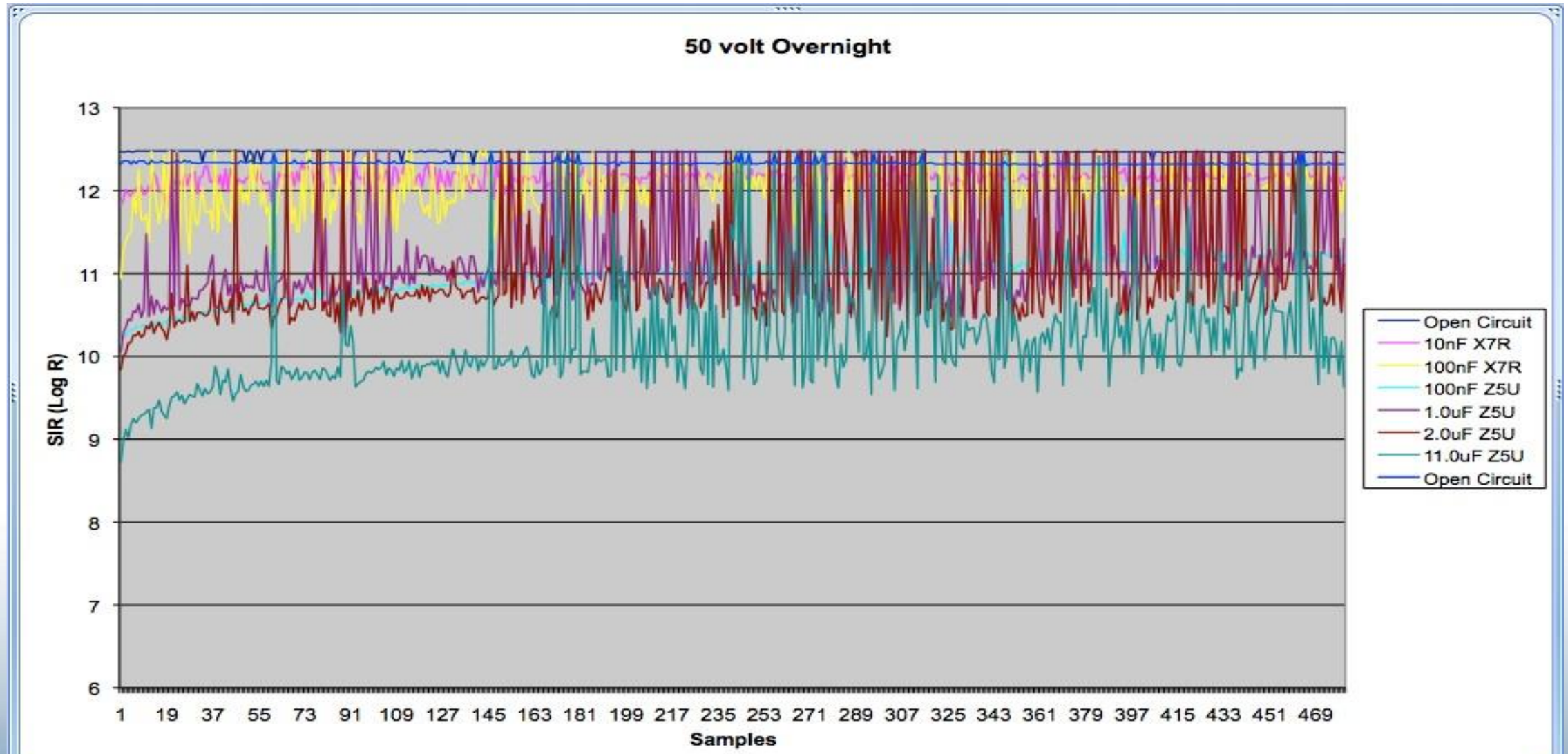
- Results?
  - The effect of capacitance



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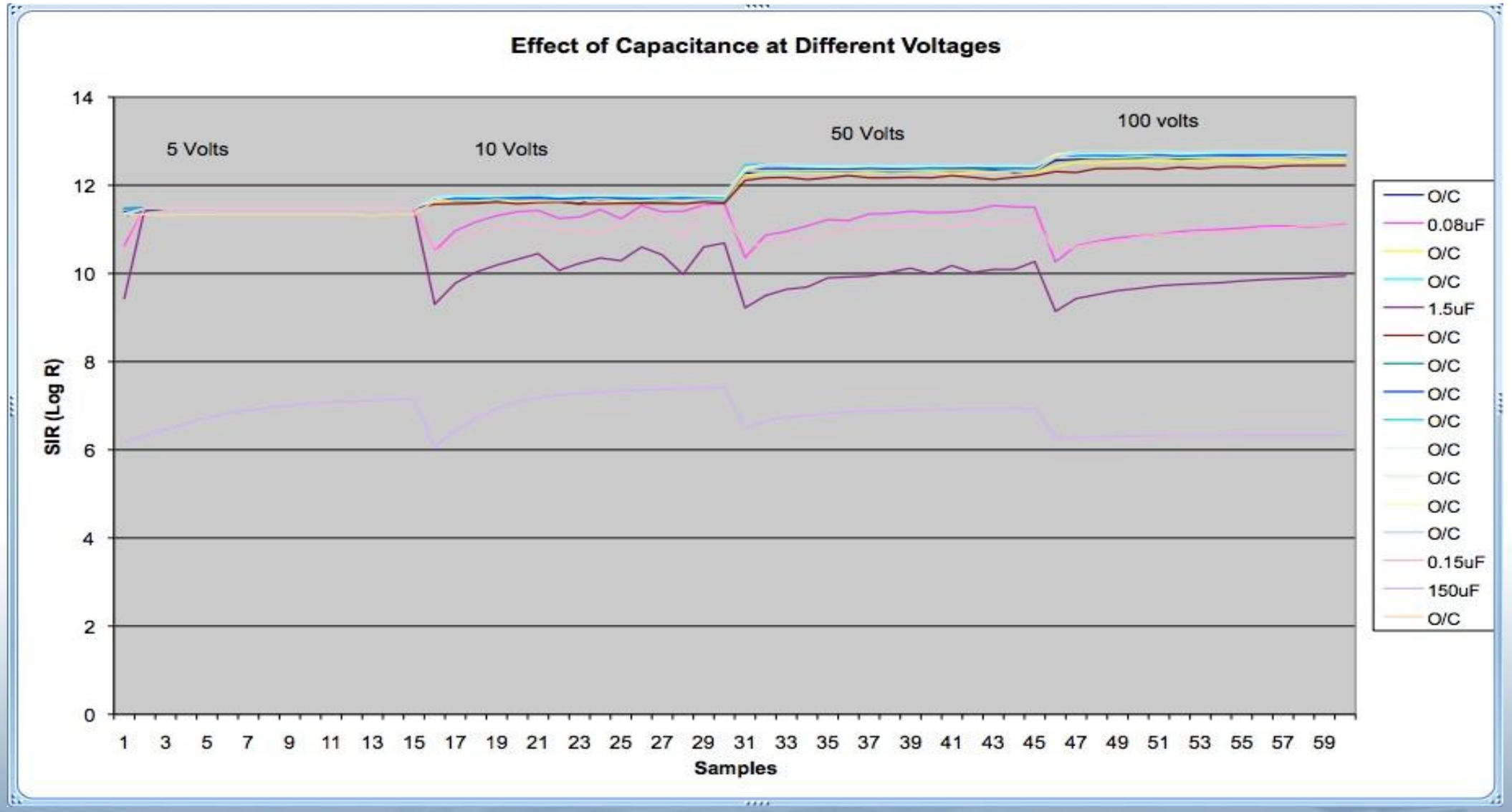
- Results?
  - The effect of capacitance



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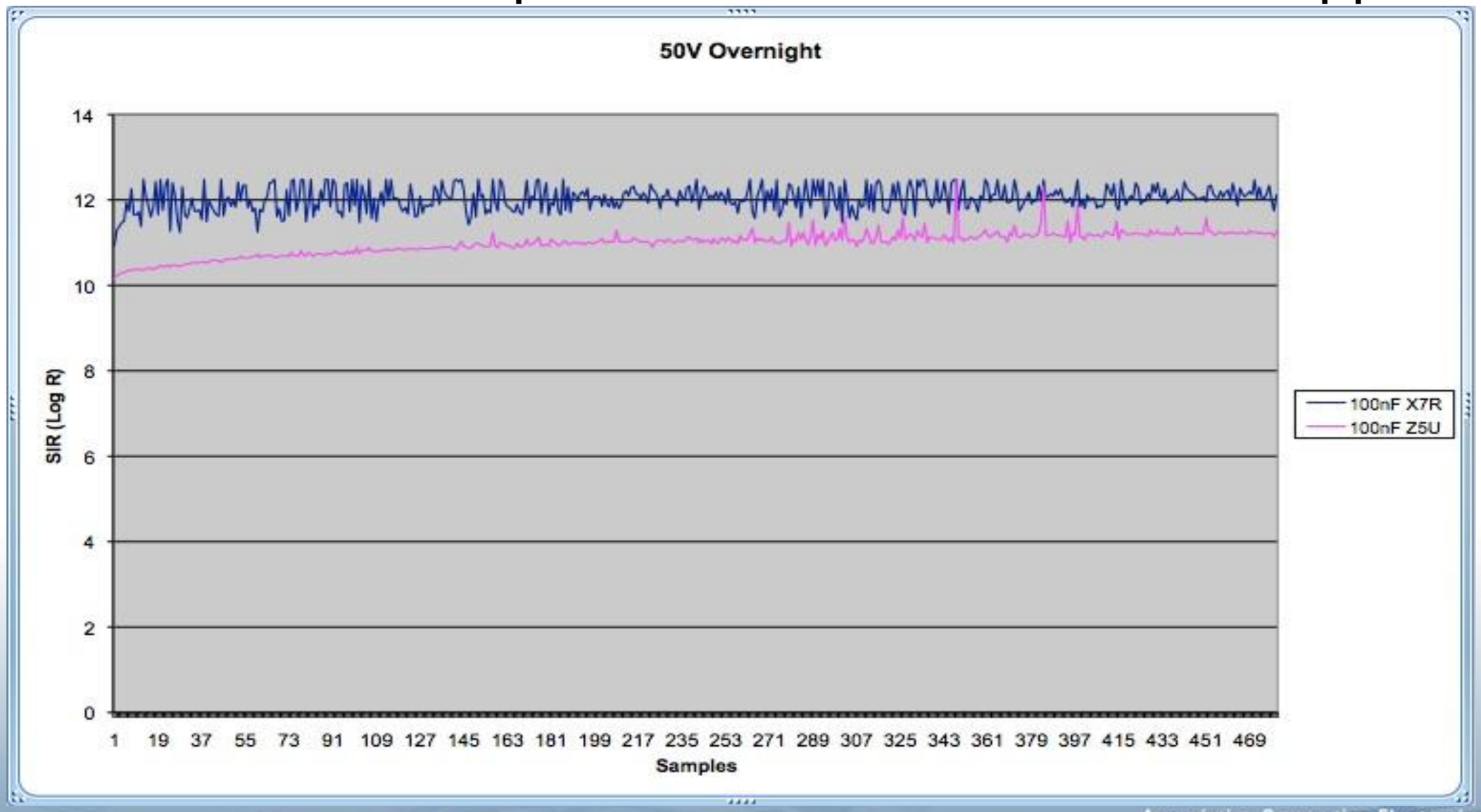
- Results?
  - The effect of capacitance with 2 alternative suppliers



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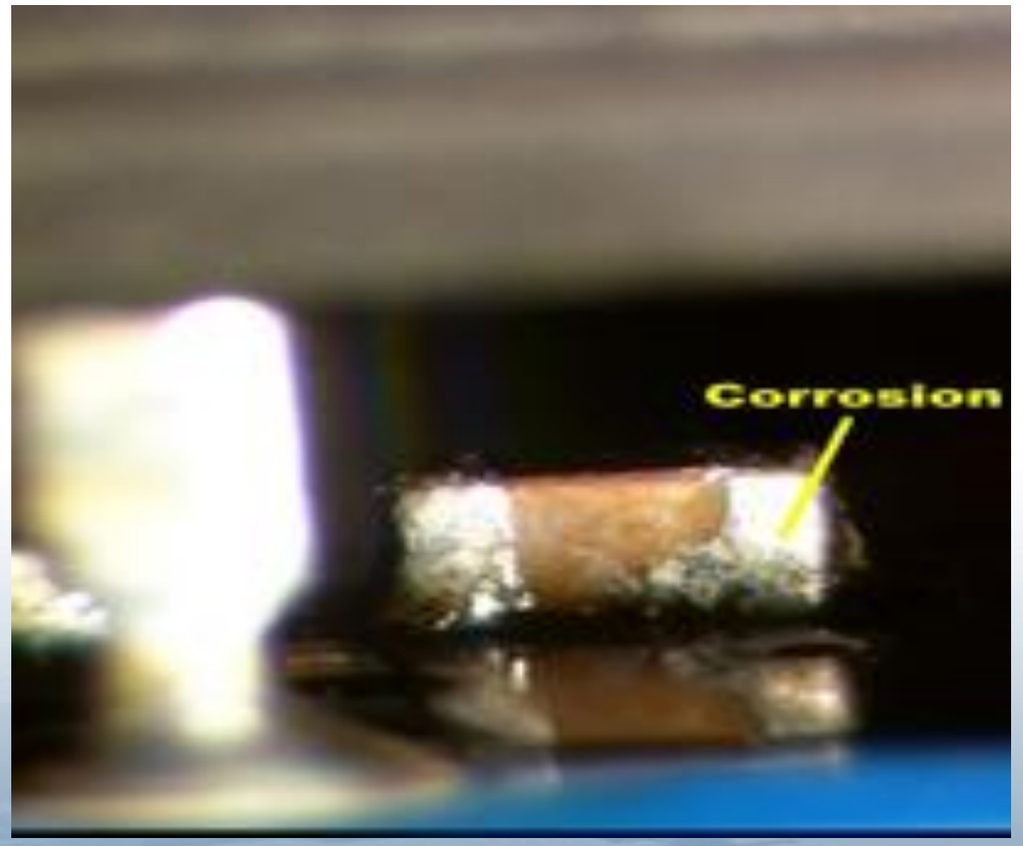
SIR Testing - Limitations:

- It requires skilled operators
- Requires dedicated equipment
- Takes a long time - not less than 72 hours
- Expensive - but what price failure?



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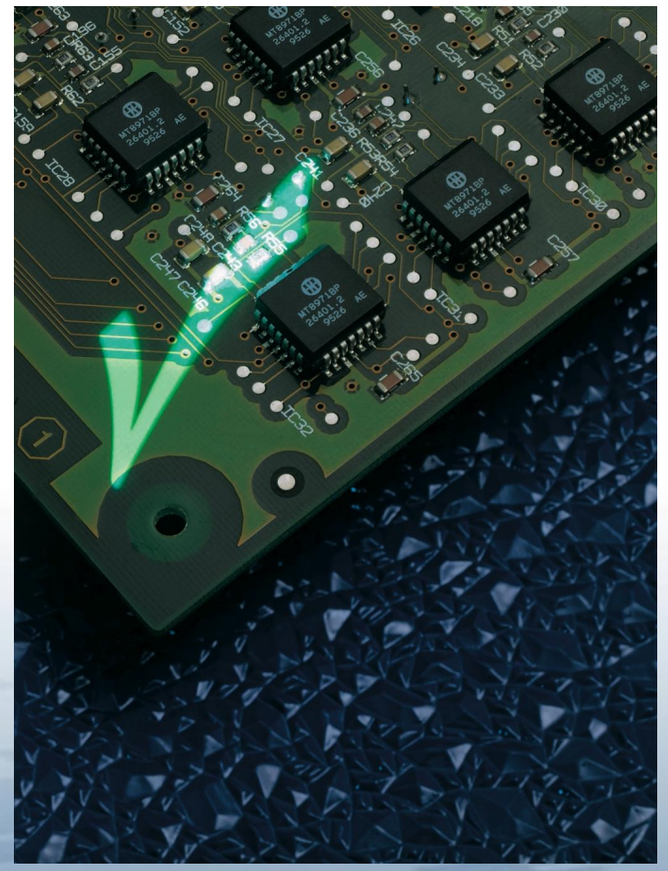
SIR Testing - Advantages:

- Determines the effects of both ionic & non-ionic contamination
- Demonstrates the electro-chemical compatibility between ALL process materials
- Can be used to monitor material trends



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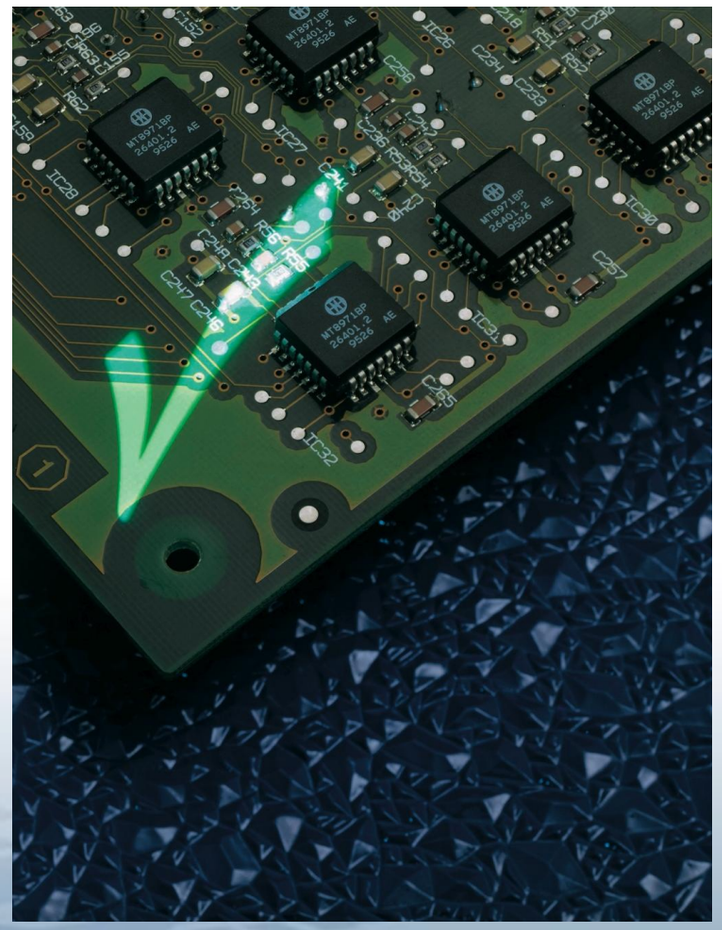
SIR Testing - Advantages:

- A quantitative not a qualitative test method
- Works in conjunction with ROSE / SEC
- Predicts whether your end product will be electro-chemically reliable



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To summarize by recommendation:

- Decide on your preferred process material mix and run SIR qualification tests
- Analyze any failures using IC or FTIR
- Use ROSE / SEC tests to maintain the process
- Use SIR to monitor material quality by trend