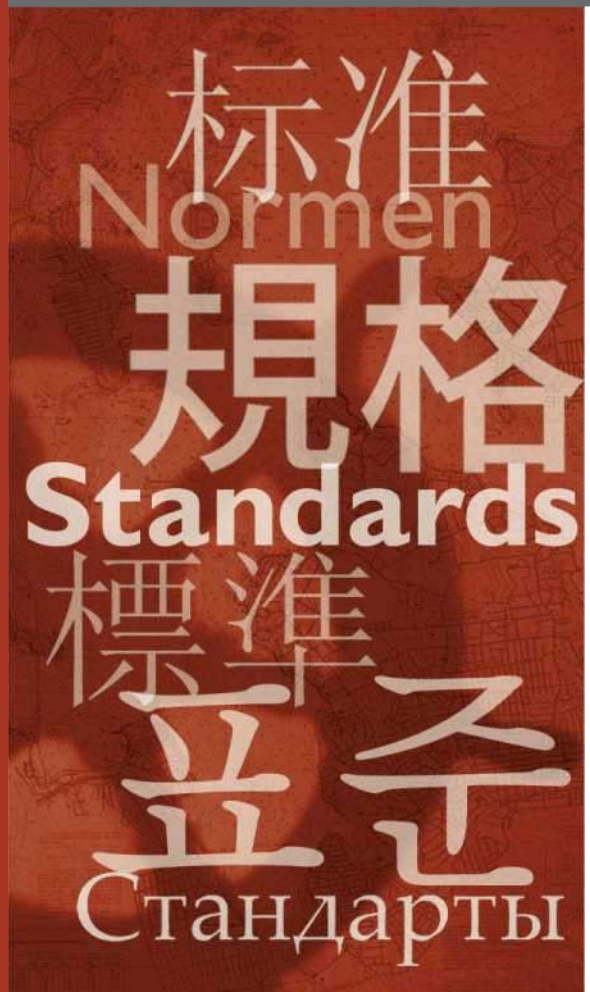
How Semiconductor Tools respond to AC Mains Disturbances



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semi

Problem with old approach to Power Quality:

1. Disturbances happen. They cannot be avoided.
2. Power company is responsible for power quality.
3. Success is technically impossible.

What if cars were engineered like this?

“Make loads tougher, not power better”

Note: requires road that is +/-10% smooth. Otherwise, wheels may fall off.

Aftermarket road-smoothers are readily available.

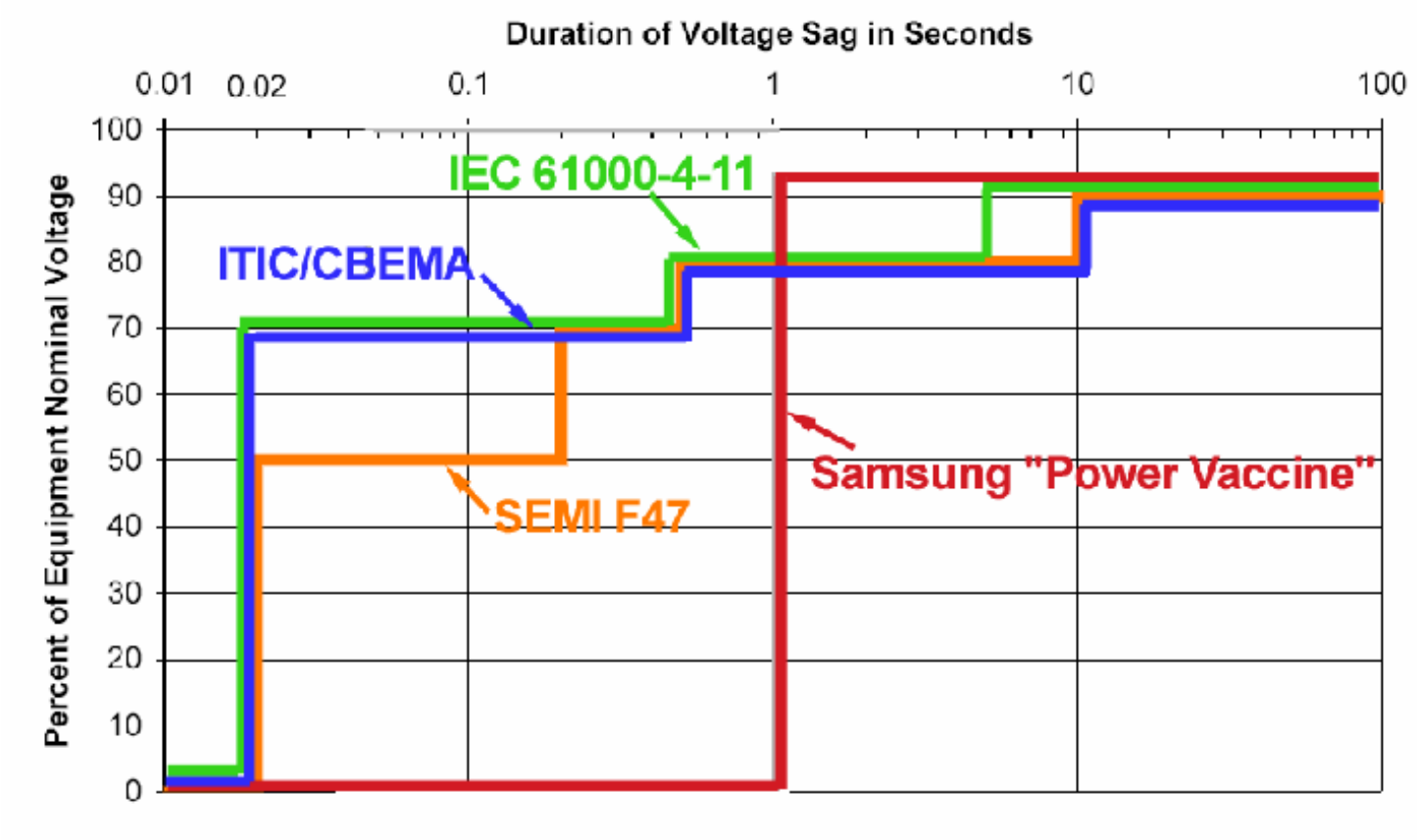
Basic idea behind new approach to Power Quality

- Power quality is compatibility between source and load, not perfection of source
- There are always two solutions to compatibility
- Either improve the power, or make the loads tougher.
- How to choose?

Consequences of new approach to Power Quality

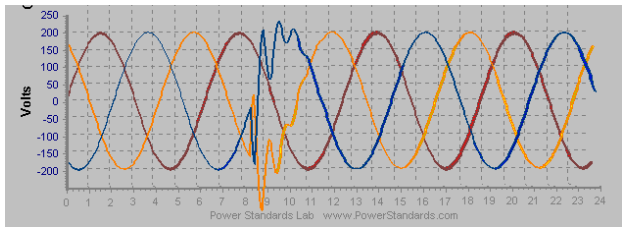
- Power quality is a shared responsibility:
  - electric company or FAB must deliver some level of quality, but not perfection
  - Customer must buy equipment that tolerates normal disturbances.

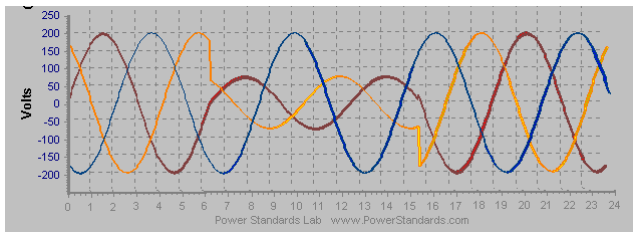
New approach:
What should be tolerated?



What is “typical” disturbance?

What ACMains disturbances?

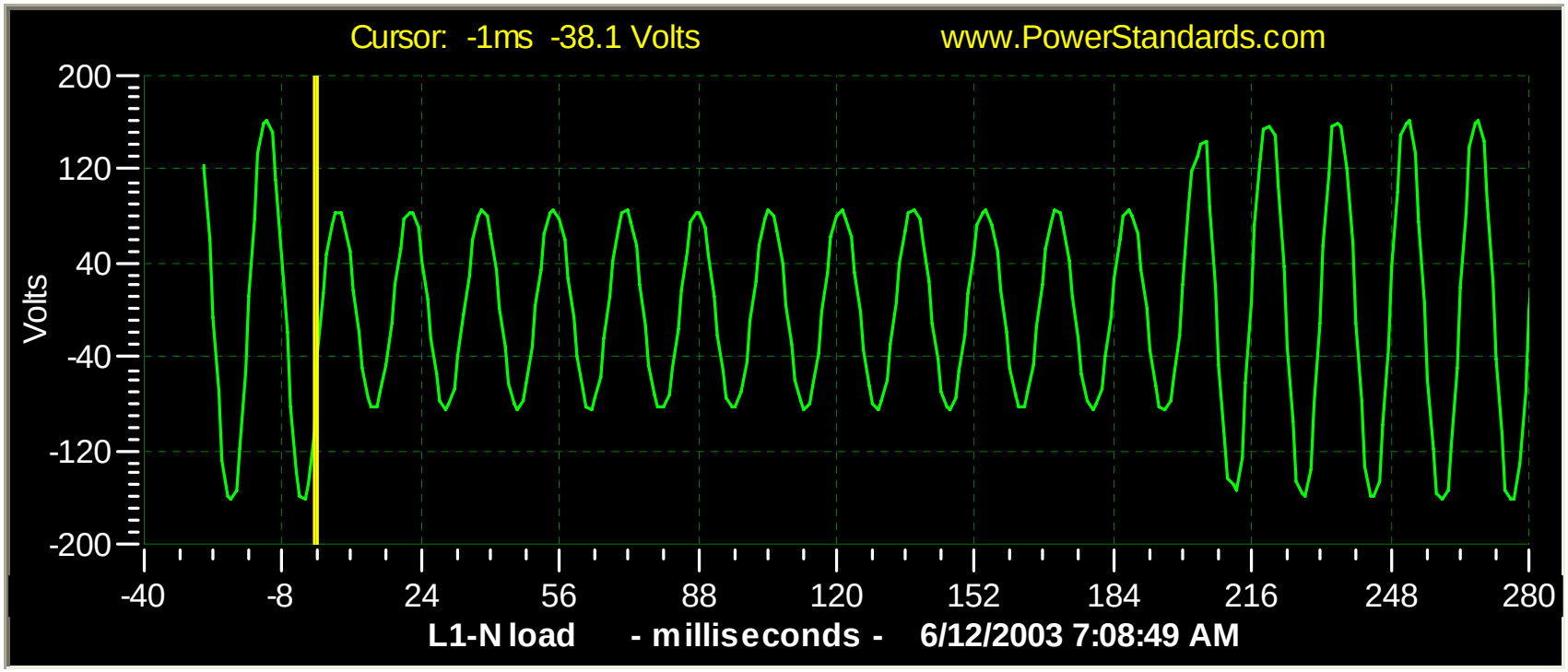




- High frequency impulses
- Voltage swells
- Flicker
- Harmonics (Voltage and Current)
- Capacitor switching transients
- Voltage dips

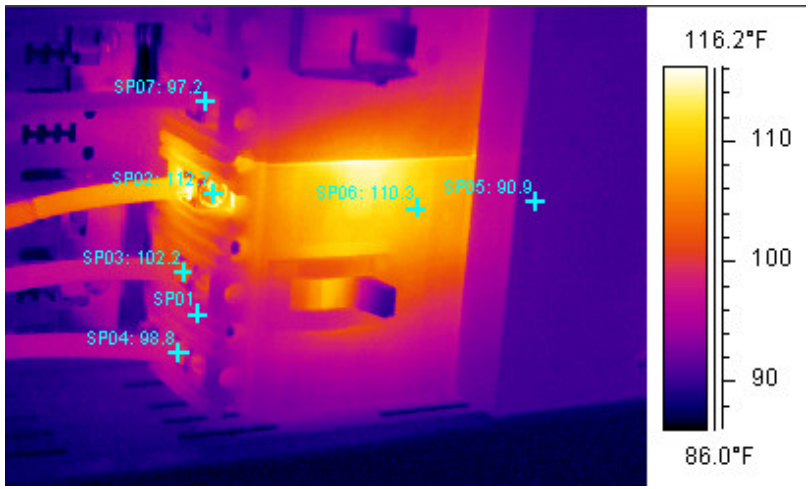
Introduction to AC Mains disturbances

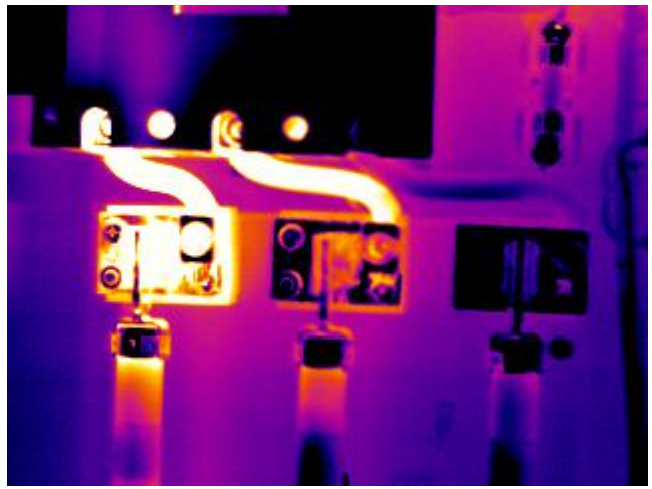
Voltage sags (or dips – BE) are the most common >90% of all AC mains Disturbances



Voltage sag causes in Fabs

1. Either increase in source impedance (rare)
2. Or increase in current (common).

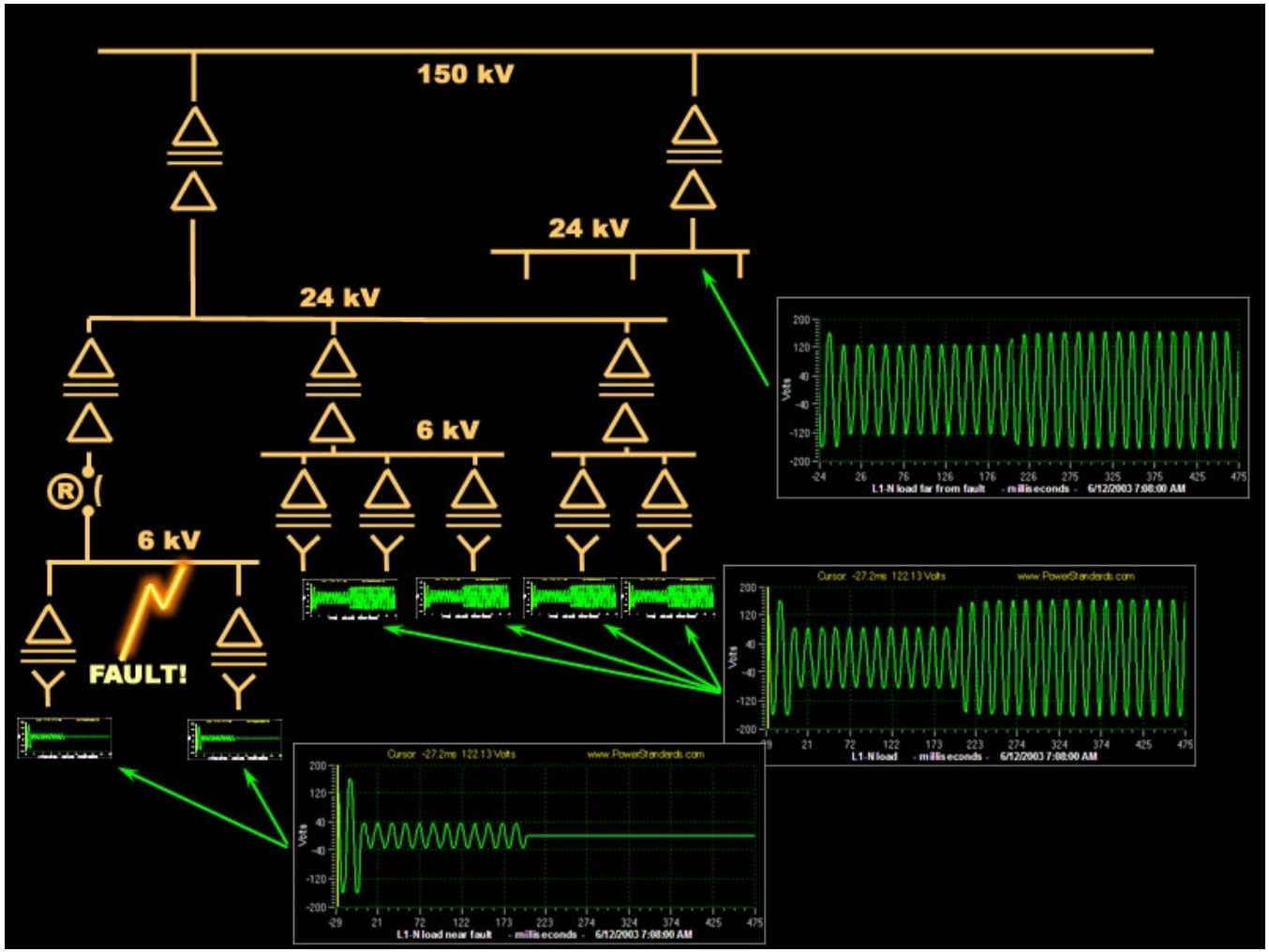




California mudslide - January 2004 - Alex McEachern

AP / Damian Dovarganes

Voltage Sags on Fab level



How do semiconductor tools respond to voltage dips?

Remember:

The Tool must continue to run the Process

Without Operator invention

How do semiconductor tools respond to voltage dips?

- Extreme #1 – no problem at all

  (rare)

- Extreme #2 – explosion, fire,

  bearing failure

  (extremely rare)

How do semiconductor tools respond to voltage dips? (Continued)

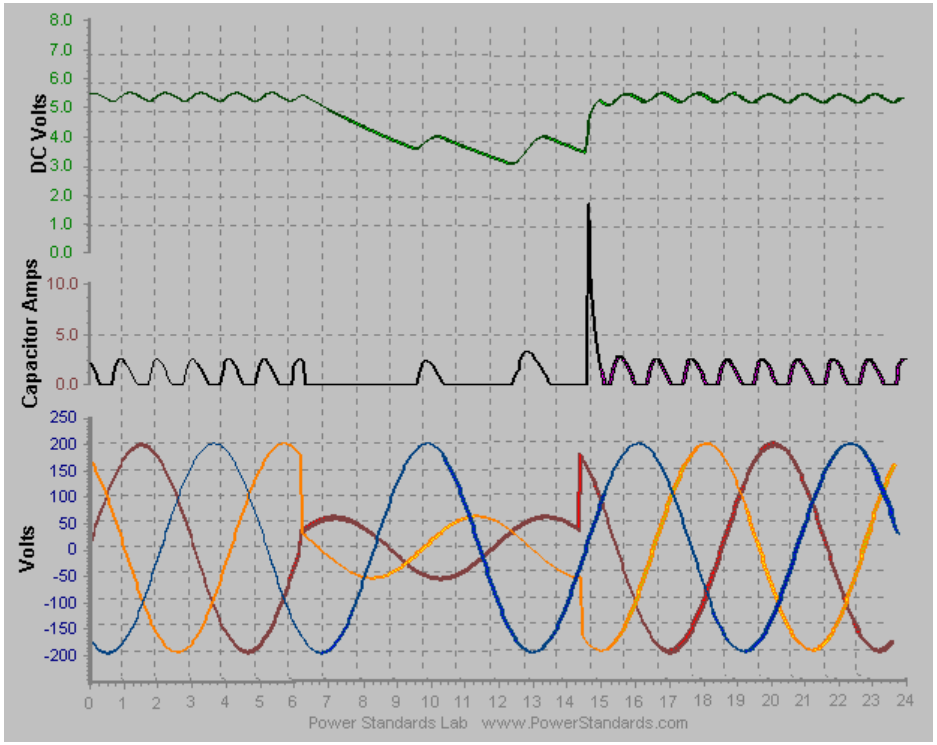
- Extreme #3 – graceful restoration

using power quality sensor, for example (becoming more common)

How do semiconductor tools respond to voltage dips? (Continued)

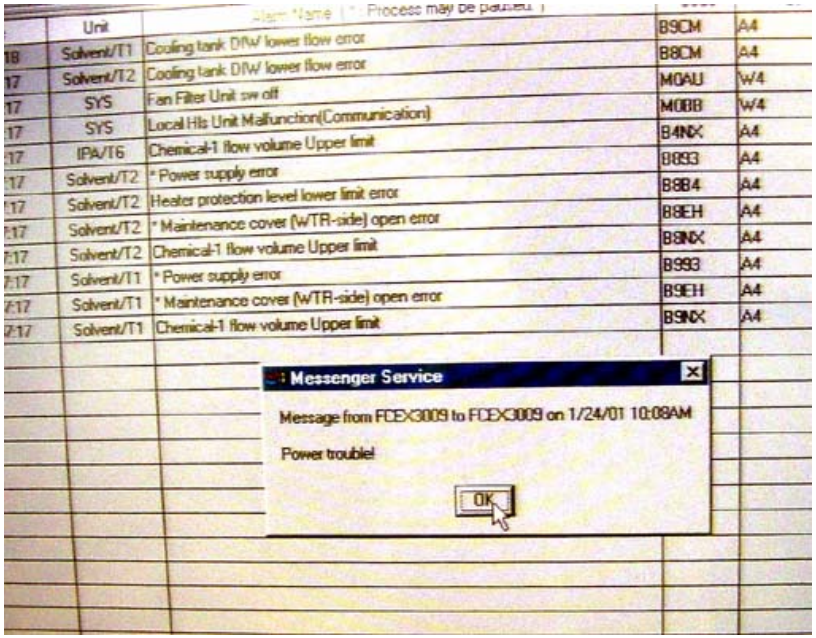
- Ordinary, common responses
- EMO shutdown
  - Small relay failures
  - Safety relay failures
  - GFI (PE Sense) trip at end of dip

How do semiconductor tools respond to voltage dips? (Continued)



- Unbalance sensor trip
- Power supply fuses fail
- Contactor may drop
- Circuit breakers open due to increased current on phases without dips

How do semiconductor tools respond to voltage dips? (Continued)



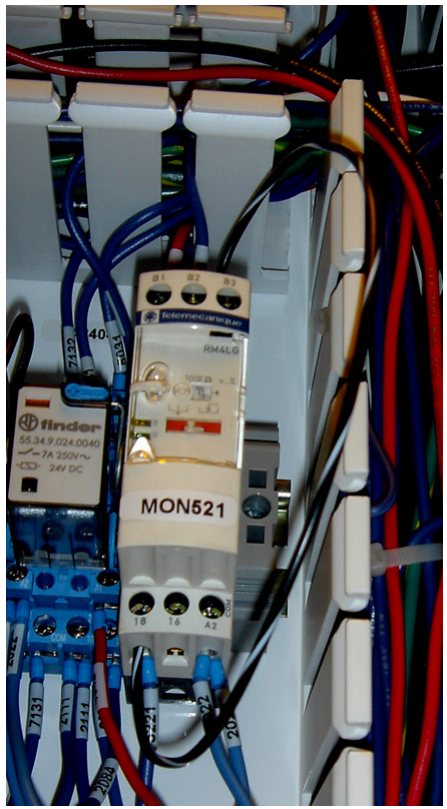
- Sensor faults or errors
- flow, temperature,

  RF forward or reverse power,

  fan speed, pressure
- Can be sensor error, or

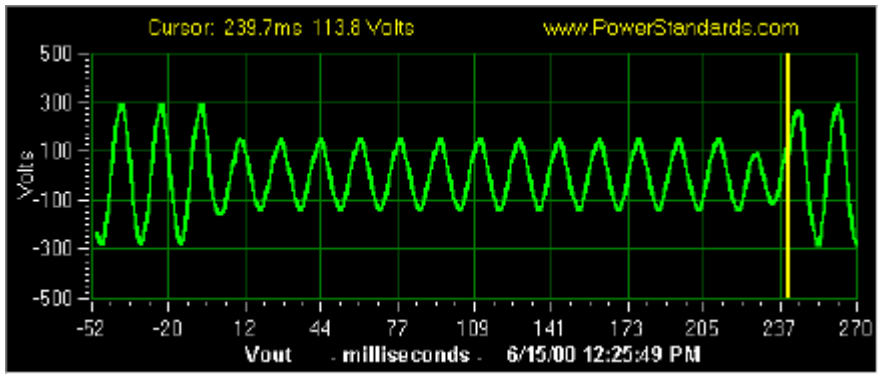
  <u>software design</u> error

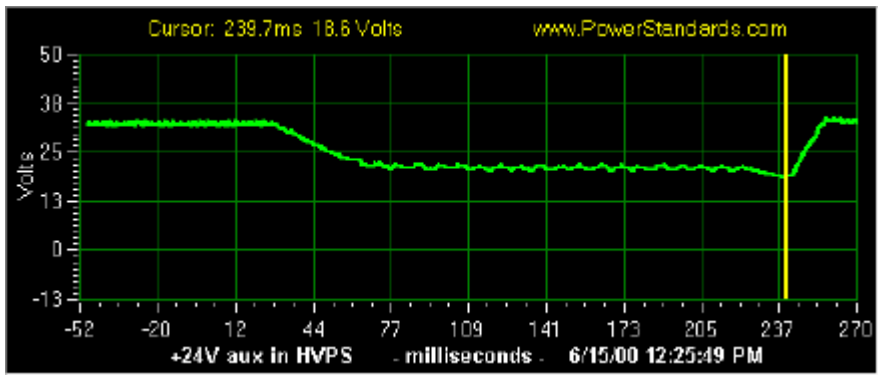
How do semiconductor tools respond to voltage dips? (Continued)



- Interaction between sub-systems during sag
- Communication problems can result tool to misbehave or stop
- Under-voltage sensor at drives, and controllers etc. kicks in

How do semiconductor tools respond to voltage dips? (Continued)



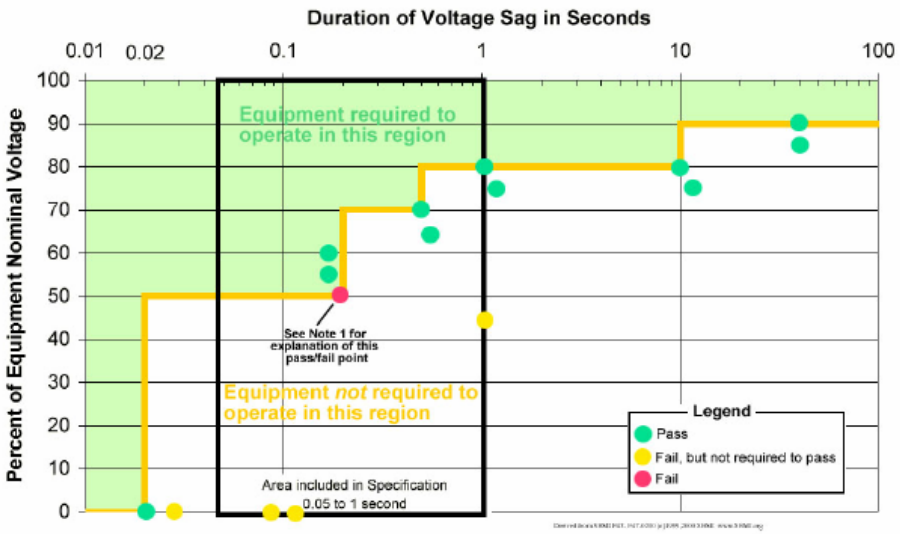


- DC Power Supply faults (surprisingly uncommon)
- Lack-of-energy faults
- Shut-down faults
- Effect of universal input supplies

How do semiconductor tools respond to voltage dips? (Continued)

- Robot faults
  - Can destroy wafers
  - Emergency braking
  - Gate closing
  - Transport strategy (software error)

How do semiconductor tools respond to voltage dips? (Continued)



- ASD shutdown
- Loss of plasma requiring manual re-strike
- Main computer re-boots
- Loss of tool's internal communication network
- Subsystems in tool get out of synchronization

New approach to power quality – How to make AC mains disturbances

Using a Voltage Sag Generator in Semiconductor Industry.

Conclusion: How do semiconductor tools respond to voltage dips?

- **No simple answer –** not just a power supply problem
- Requires testing real tools with real voltage dips
- Requires testing team: power, hardware, software experts
- Solutions rarely require mains power conditioning
  - Minor component value changes
  - Minor software changes
  - More on this topic later!