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# Innovative Test Contactor Cleaning Devices Developed for Floating Base Sockets

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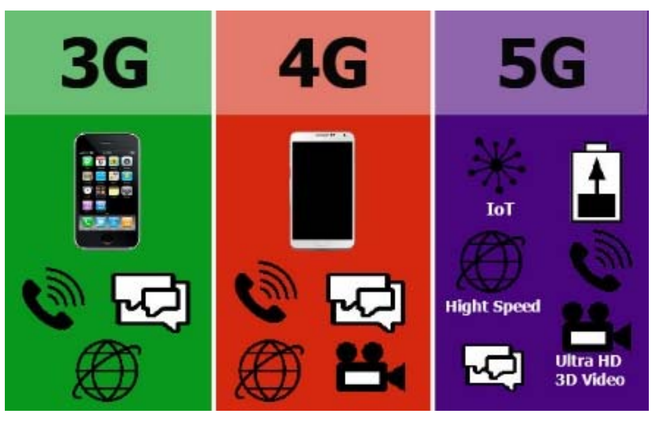
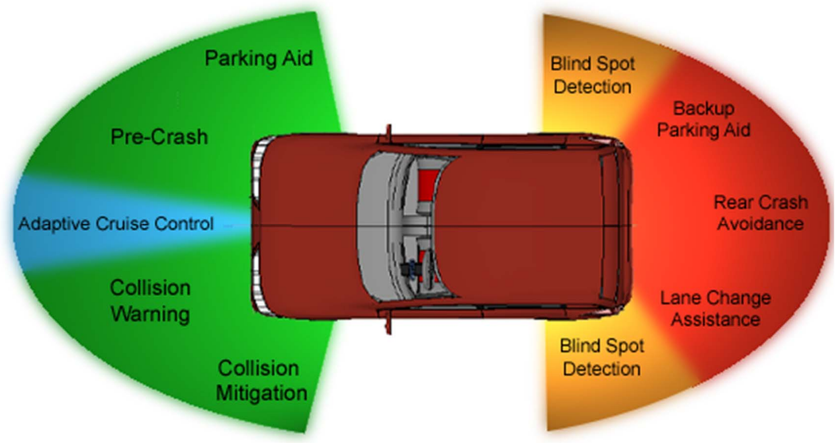
## Introduction

Stable and accurate testing of advanced devices is critical for assuring first pass yields and final product performance. With device insertions, contamination and various particles affecting electrical contact accumulate within the socket and adhere onto the contactors.

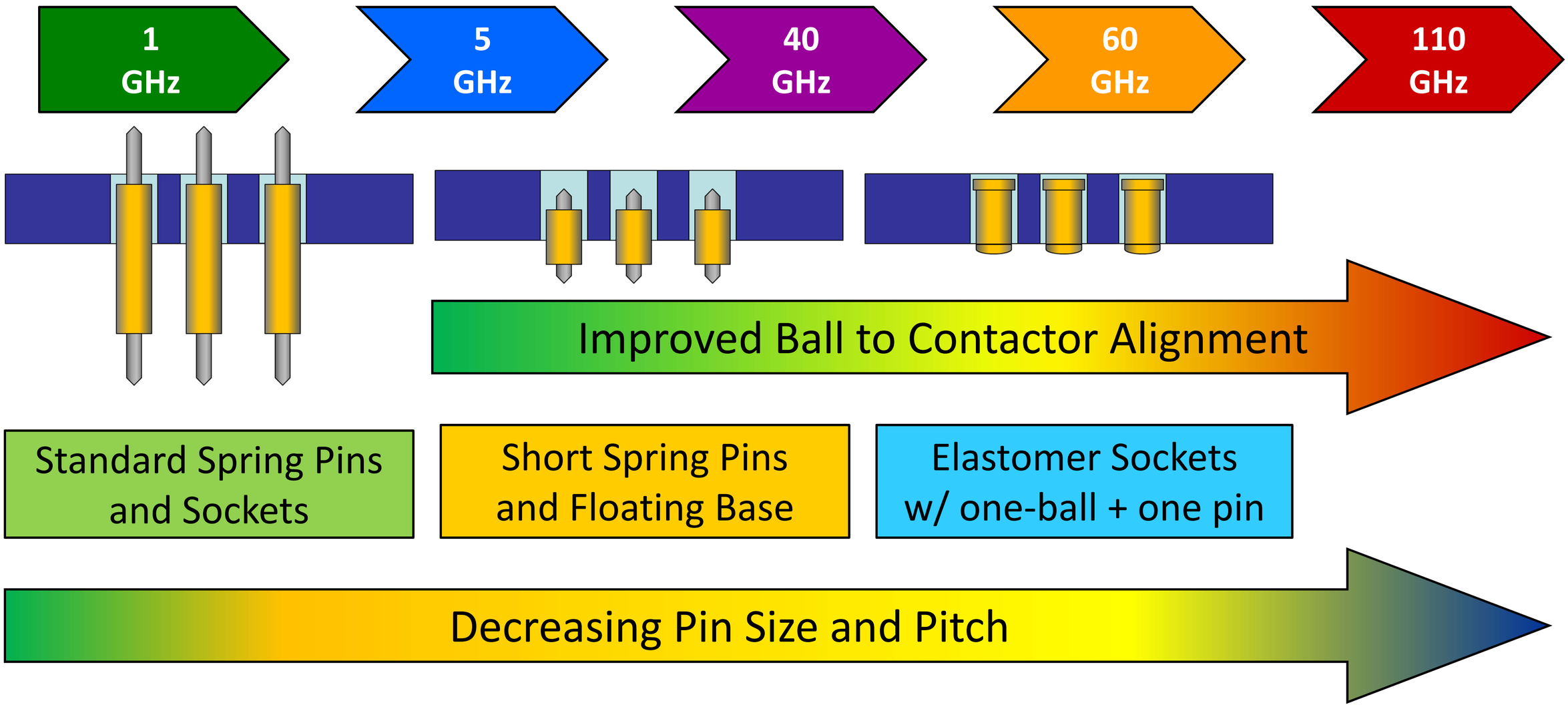
## The "Dirty" Challenge

Advanced devices for 5G, mobile, IoT, and IoV devices have high performance requirements for frequency, power, and pitch that require shorter pins and precise ball-to-pin alignment.




Clemson Vehicular Electronics Laboratory




Using a socket base that "floats" on springs above the probe tips, or a one-ball/one-pin alignment floor, allows the device and balls to well align to the contactors above the probe tips.

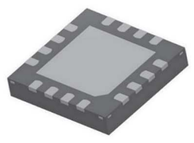
Eventually, sockets and contactors need to be cleaned and the debris removed to maintain high first pass yield (FPY) and stable contact; however, disassembly of the floating base sockets requires manual intervention, cleaning, and long down-time that reduces overall equipment effectiveness (OEE).

# In-line Auto-Contactor Cleaning (ACC) for Reduced Downtime

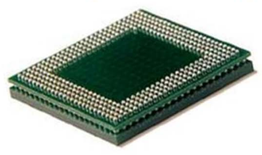
Cleaning units are custom engineered to emulate many different high volume packages.

**Device Package Type**

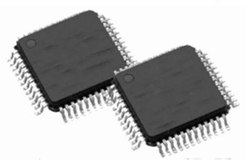
*Quad-Flat-No-Lead*



*Package-on-Package*



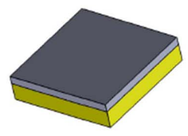
*Quad-Flat-Package*



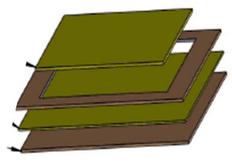
*Bumped Array Package*

**Cleaning Unit Design**

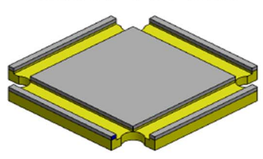
*Leadless TCC Unit*



*POP TCC Unit*



*Leaded TCC Unit*

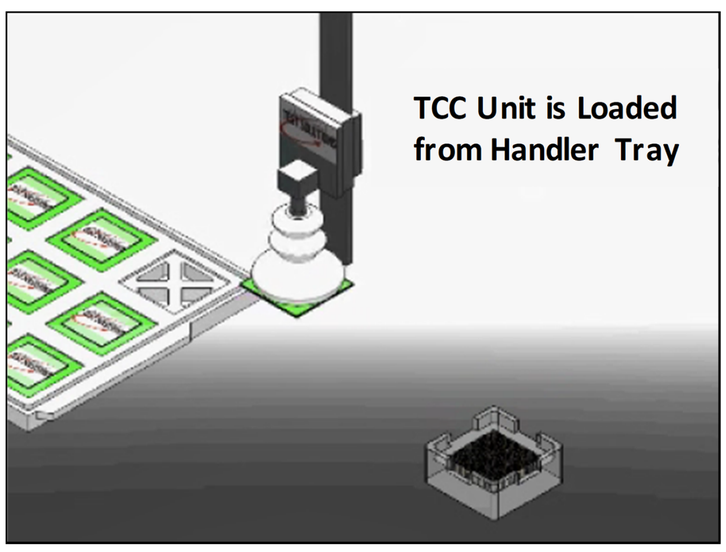


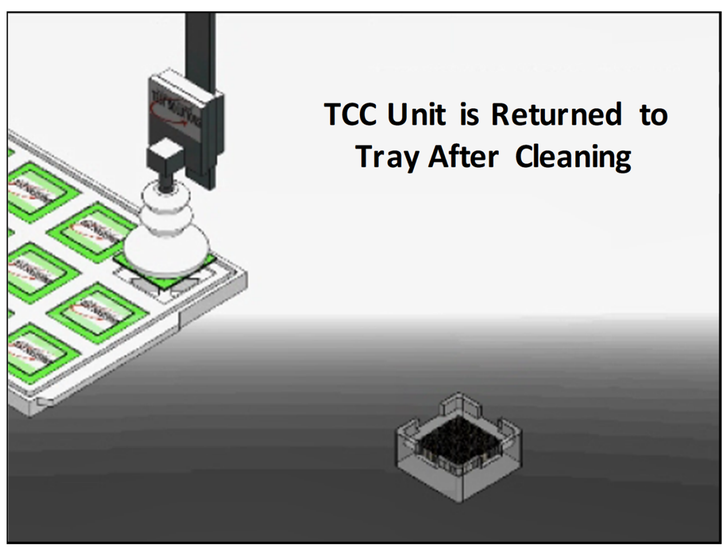
*BGA TCC Unit*

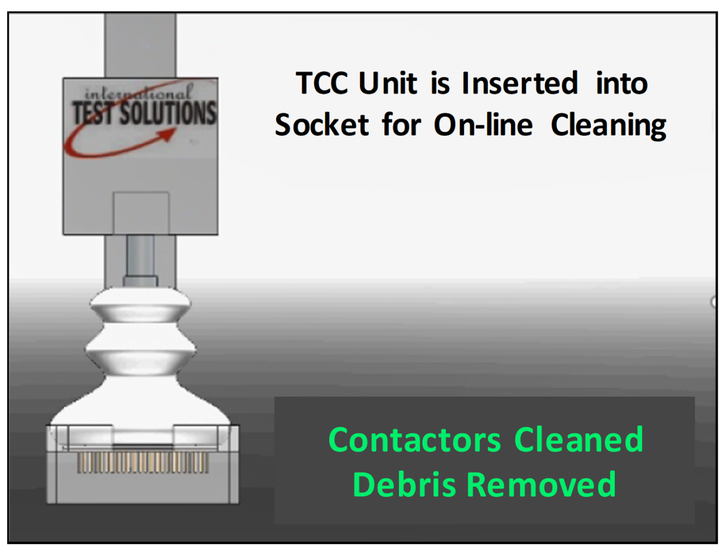
## Test Contactor Clean (TCC) Units

| | | M type | L Type HL Type |
|---|---|---|---|
| **Performance** | Debris Collection | Y | Y |
| | Abrasion | Low | Medium |
| | Polishing | Low | Medium |
| **Thermal Performance** | -45C to 155C | Y | Y |
| **Contactor Type** | Spring Pin (spear, crown) | Y | Y |
| | Sliding / Wiping | N | Y |
| **Package Type** | Non-Leaded (QFN, etc.) | Y | Y |
| | Ball Grid Array (BGA, etc.) | Y | Y |
| | POP Package | Y | Y |
| | Leaded (QFP, SOIC, etc.) | Y | Y |
| **Handler Type** | Low Volume Manual | Y | Y |
| | High Volume Manufacturing | Y | Y |

# How Does the Basic ACC Function Work for a PnP Handler ?



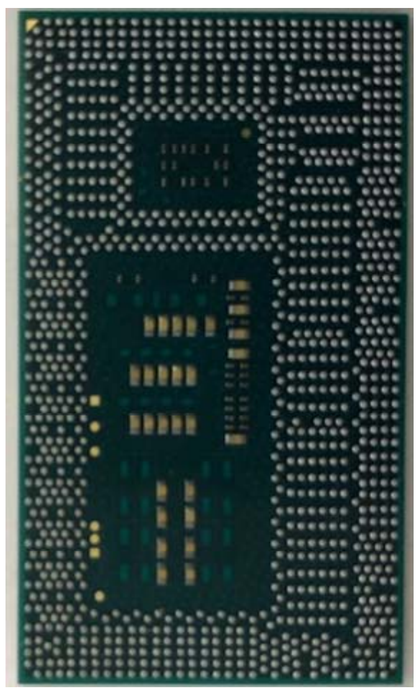




# Bumped Cleaning Units for Floating Base Socket

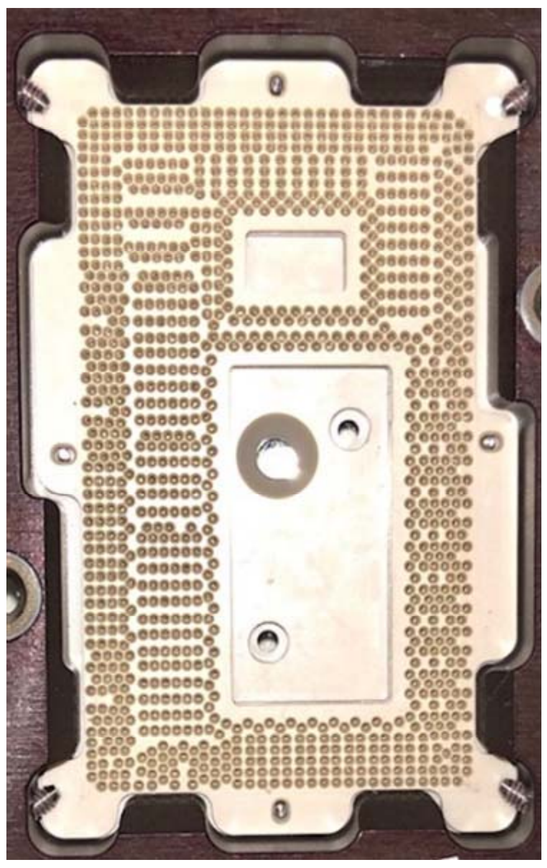
Rather than a simple flat “unfeatured” surface, featured TCC units are built with abrasive polymer “cleaning balls” that emulate the size of the balls and BGA layout on the DUT.

The “cleaning balls” nest into the floating base guides of the socket and provide precise ball to pin alignment in the guide hole when the pins do not protrude through the socket floor.

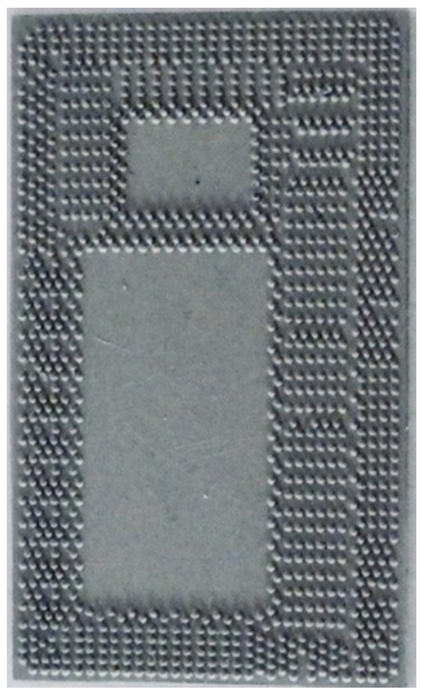
**DUT**



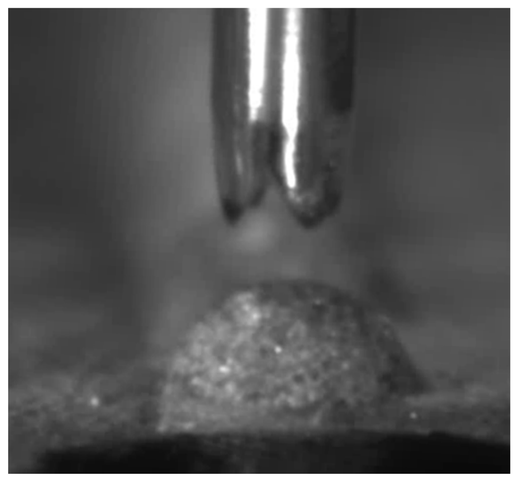
**Socket**

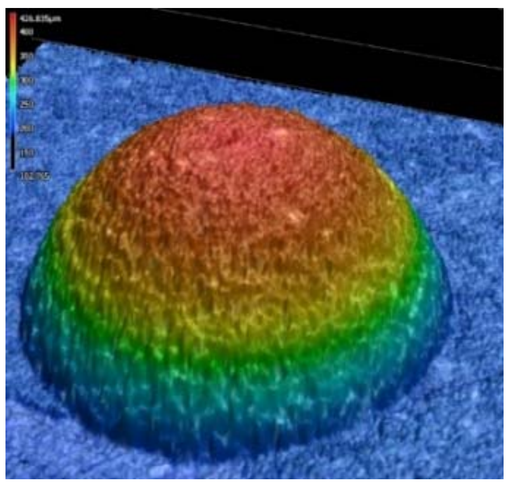


**Cleaning Unit**

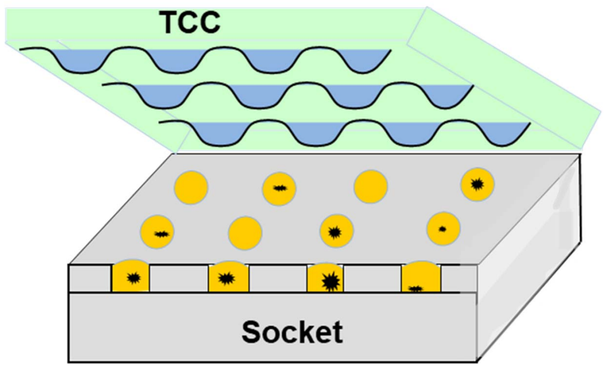


Polymer Cleaning Ball

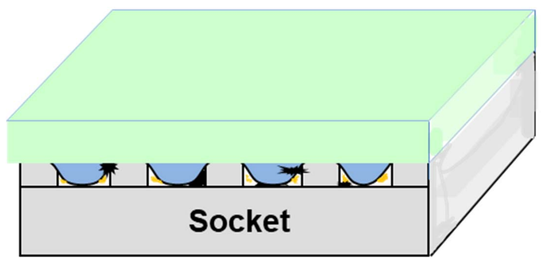




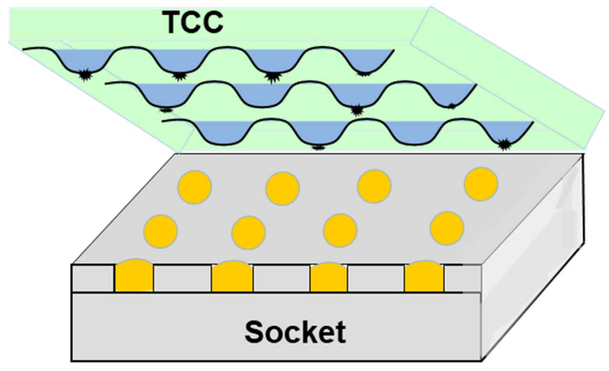
# Customer Implementation




Bumped cleaning device ball array designed to match the DUT BGA layout and test socket geometry

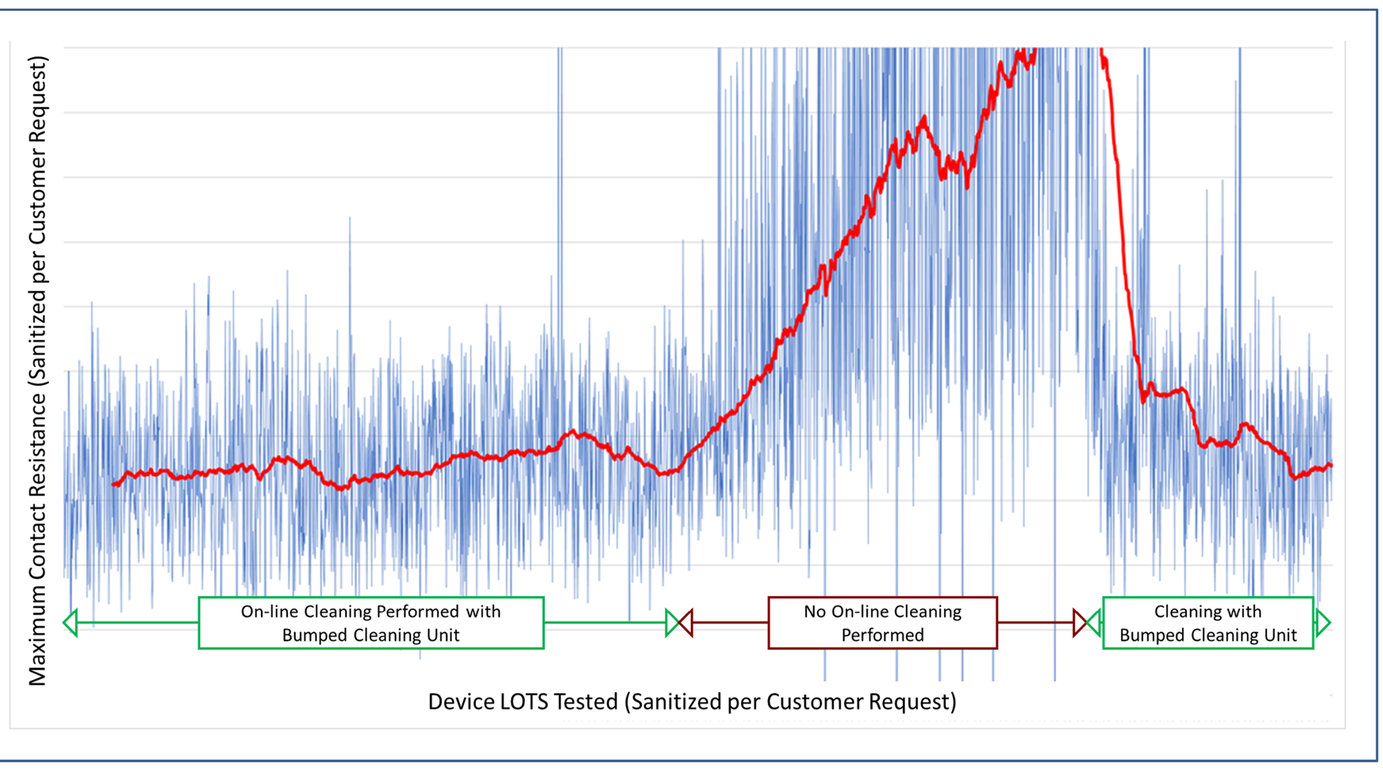



Cleaning device is actuated into the socket and the polymer balls clean the pin contacts below the socket floor.




Pins are polished with debris removed from contactor, guide-holes, and the floor of the socket.

# "Sanitized" Test-floor Results for HVM Customer




Clean Recipe:

- CL-Freq = every 50 device insertions
- CL-Insertions = 2 to 5 insertions/clean
- TCC Replacement = 200 total cleans

- Implementation of Featured TCC with "Cleaning Balls"
  1. Maximum CRES was controlled and remained below the allowable upper limit values
  2. When on-line cleaning was terminated, CRES and CRES variance dramatically increased
  3. Upon reimplementation of on-line cleaning, CRES stability was immediately recovered

- Featured cleaning units were effective for controlling contact integrity and debris removal from floating base socket guide-holes

## Summary / Conclusions

Featured test contactor cleaning (TCC) units built with abrasive polymer "cleaning balls" are ideal for BGA and other bumped package types that require precise alignment.

When the cleaning unit is compressed into the socket, the polymer "cleaning balls" are aligned to guide holes of floating plate and depressed into the spring pins below the floor surface for an effective cleaning action.

Complex cleaning devices that emulate balls and pads can be built using top and bottom optical and physical features for the high accuracy alignment required for PoP devices.