

# Automotive Facility Tour

2020

**BOURNS**<sup>®</sup> Automotive Division

# Bourns Automotive Locations



Logan/UT  
M



Auburn Hills/MI  
S, R&D



Taufkirchen/D  
S, R&D



Ajka/HU  
M



Veszprem/HU  
S, R&D



Riverside/CA  
S, R&D, M

Shanghai/CN  
S



Xiamen/CN  
M



Taipei/TW  
S



Tijuana/MEX  
M



Chihuahua/MEX  
M



★ Corporate Headquarters

S = Sales Headquarters

R&D = Research and Development Centers

M = Manufacturing Centers

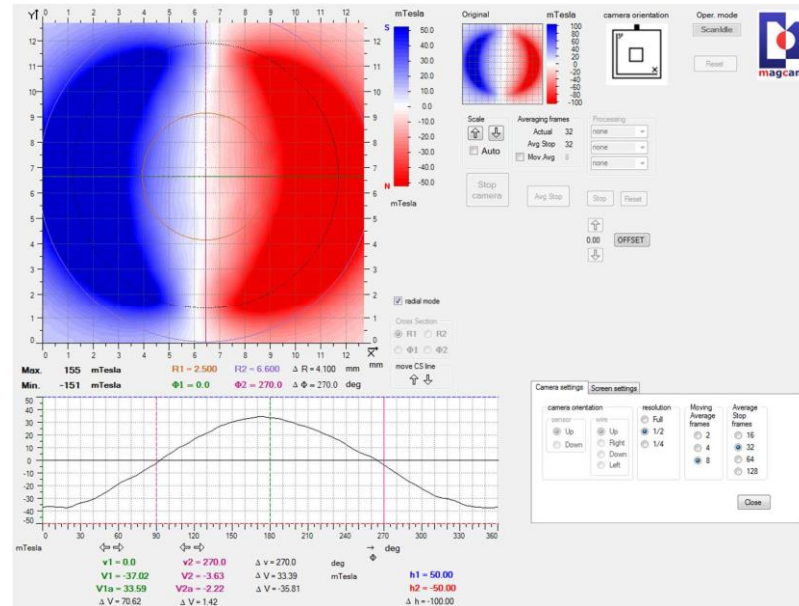
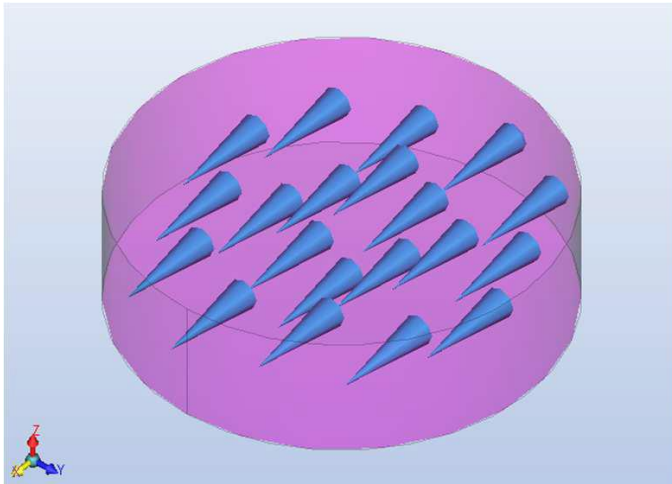
# Bourns R&D Centers

Auburn Hills/US – Taufkirchen-Munich/D – Veszprem/HU



# Bourns R&D Centers

## Sensing Concept Development



- Magnet simulations and measurements
- Close collaboration with magnet and ASIC suppliers for optimal performance

# Bourns R&D Centers

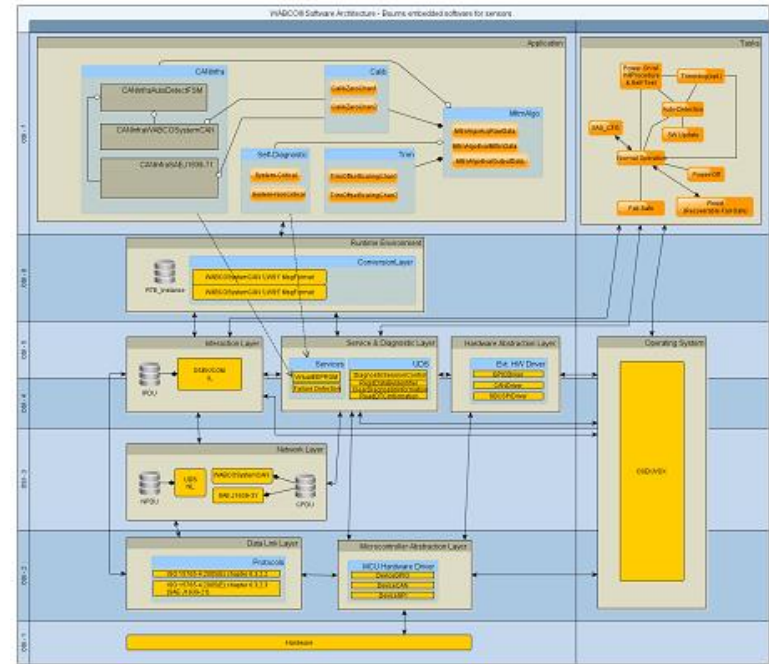
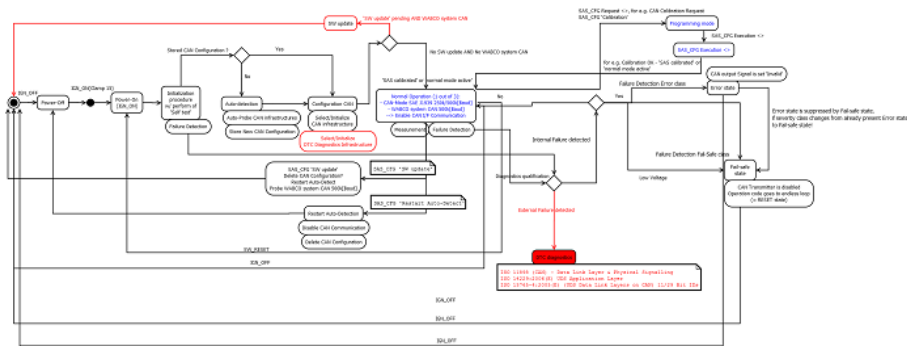
## Electrical Engineering



- Electrical design with Altium Designer
- PSpice circuit simulation
- EMC and ESD compliant design for passenger car and truck applications
- Design for safety critical systems

# Bourns R&D Centers

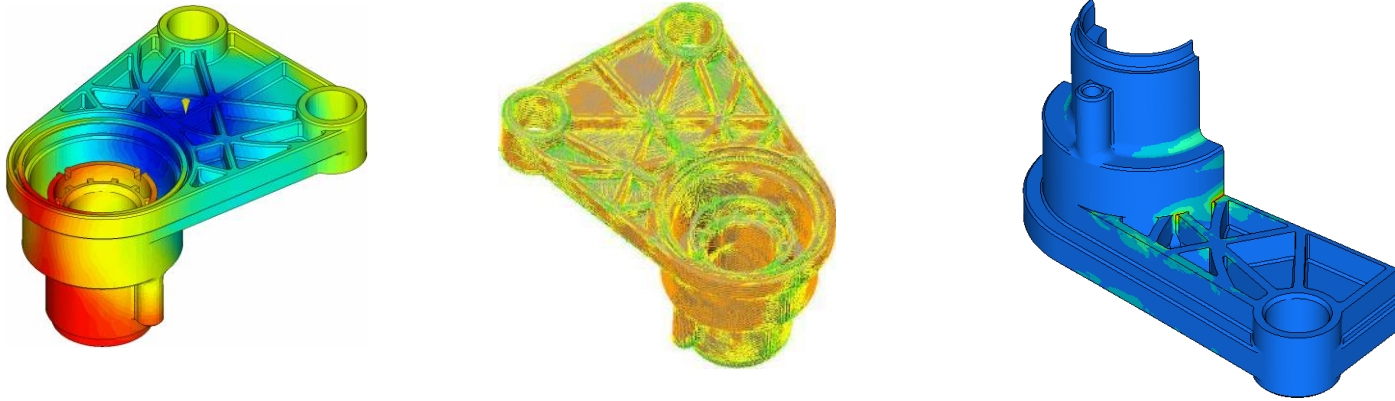
## Software Engineering



- MISRA 2012 compliant C-development
- Sensing algorithm for steering angle sensors
- Self-diagnosis and flow control for safety critical systems
- UDS or KWP compliant diagnostic interfaces over CAN
- White and black box testing including fault injection
- Enterprise Architect for design and modeling

# Bourns R&D Centers

## Mechanical Engineering



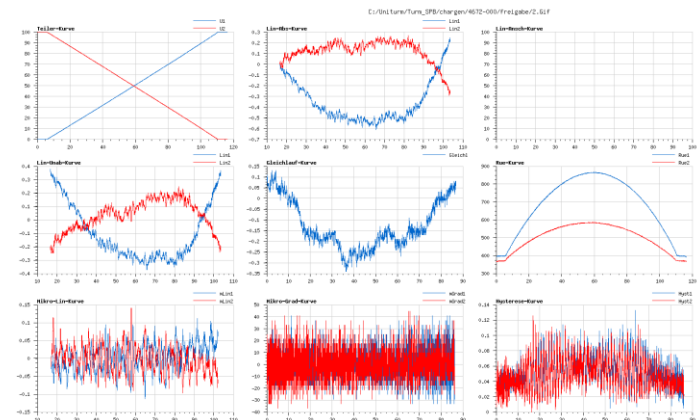
- Development of high precision plastic components for highly accurate sensor applications
- Simulation of mold flow and fiber orientation (CADMOLD)
- FEM simulation and optimization of mechanical properties (ANSYS)
- CAD design with NX

# Bourns R&D Centers

## Functional Test Engineering



- High precision sensor reference system for performance measurements
- Calibration concept for prototypes and production
- Warranty and claim analysis



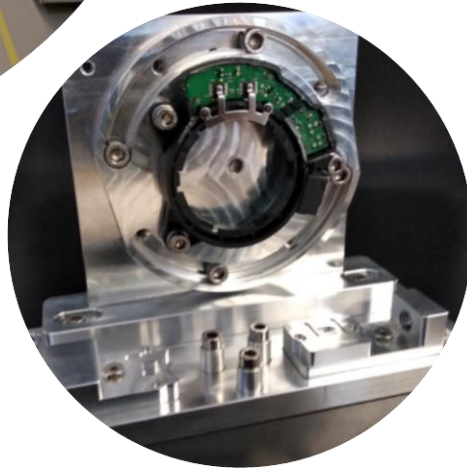
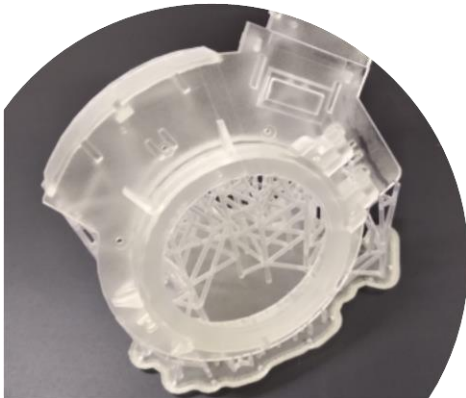


# Bourns R&D Centers

## Sample / Tool Shop



- Design and production of test fixtures
- Preparing mockups and A, B, C sample building



# Bourns R&D Centers

## Central Laboratory



- DV and PV tests for all product families
- Warranty and failure analysis
- Electrical function test, EMC Bulk Current Injection (BCI) and ESD tests
- Vibration and mechanical shock testing at ambient temperature
- Salt spray testing from ambient temperature up to 60 °C
- Rotational torque measurement at ambient temperature and with profile
- Linear and rotational sensor excitation profiles @ temperature cycles

# Bourns R&D Centers

## Central Laboratory

Temperature life cycle test with mechanical drive and data



Temperature shock chamber



# Bourns R&D Centers

## Central Laboratory

EMC BSI box



Salt spray chamber



# Bourns R&D Centers

## Central Laboratory



Vibration room



Decapsulation room

# Bourns R&D Centers

## Central Laboratory



Machine shop

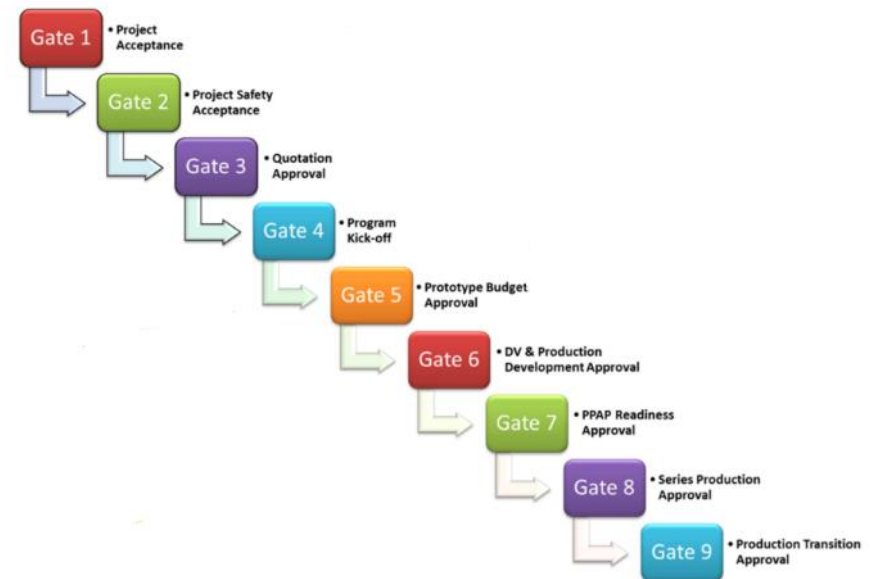


Production development room

# Bourns R&D Centers

## Program Management

- Management of complete process from first technical concept until running a stable series production of a new product by using the Bourns C2C process
- C2C system consists of 9 gates in which the project is reviewed in detail until the team/management decide about the start of the next project phase
- C2C assures project management according to APQP standards
- C2C includes development according to ISO 26262



# Bourns, Inc. – Logan/US

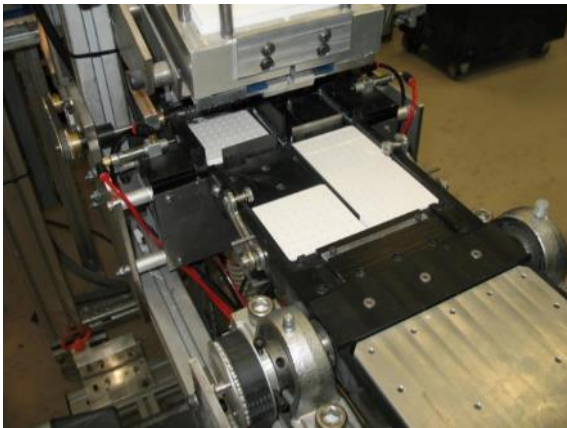




# Bourns, Inc. – Logan/US

## Ceramic Manufacturing

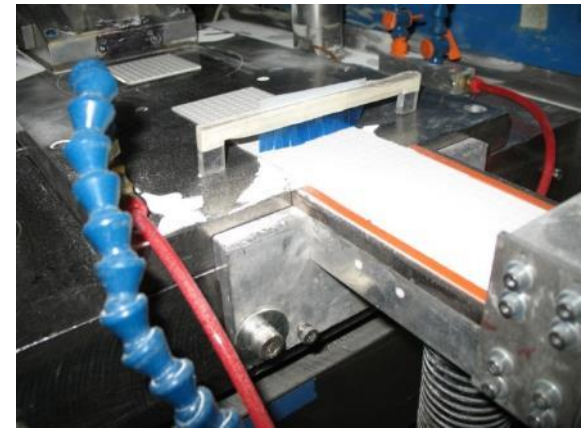
Ceramic components are formed in one of three main processes:



Green scoring



Roll compaction

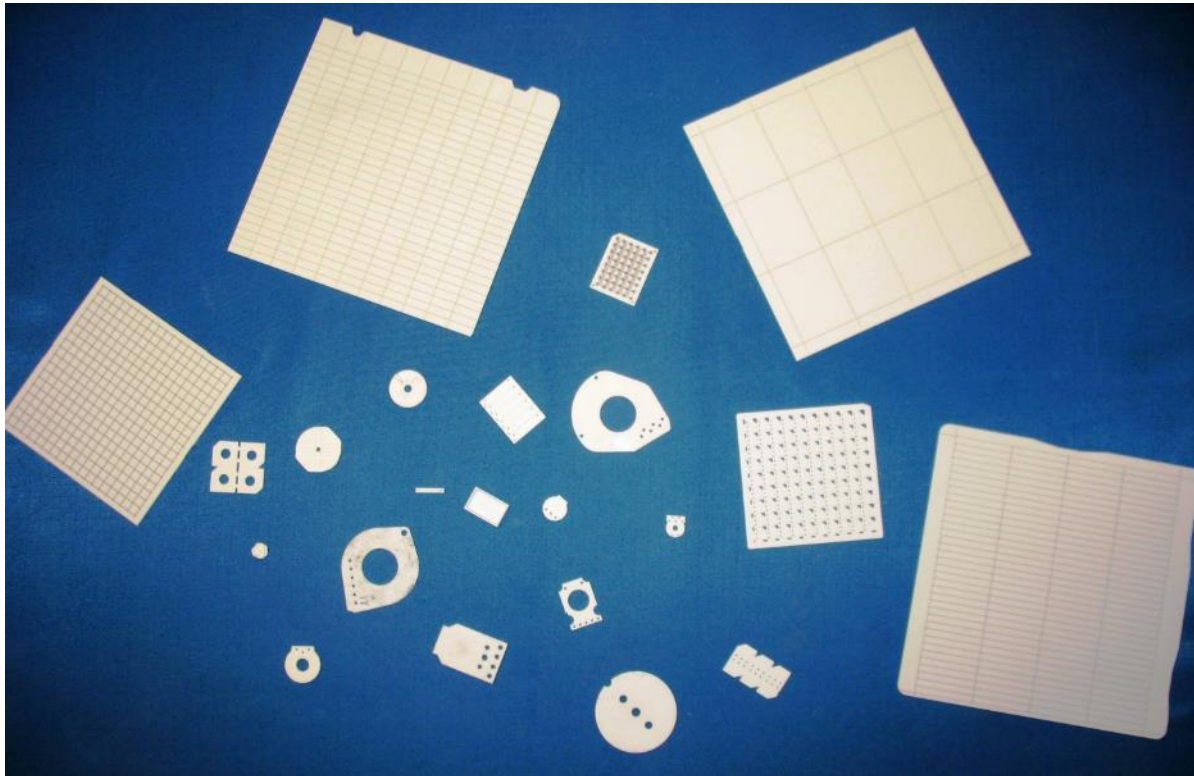


Dry pressing

# Bourns, Inc. – Logan/US

## Ceramic Manufacturing

Applying the three available processes of ceramic fabrication Bourns Ceramic is able to produce a variety of ceramic shapes and sizes to meet the specific demands of customers and the finished application.



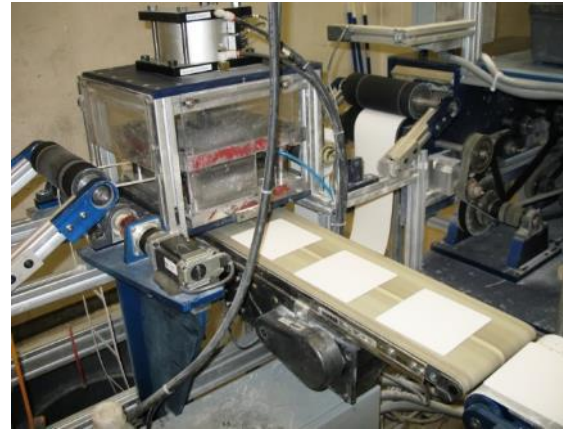
# Bourns, Inc. – Logan/US

## Ceramic Manufacturing

Green ceramic parts are prepared to be sintered in high temperature kilns.



Stamping green plates



Dry press parts loaded to be fired

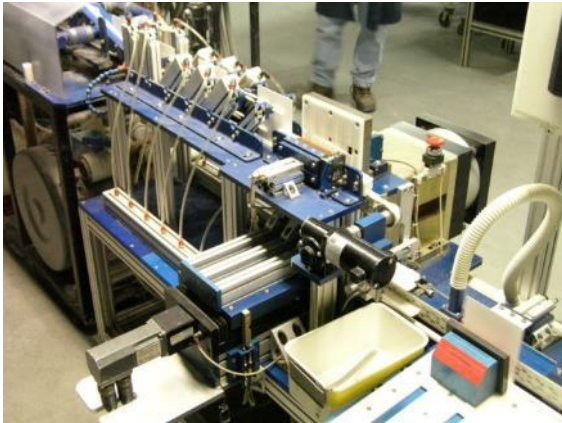


Loading green ceramic on to kiln cars

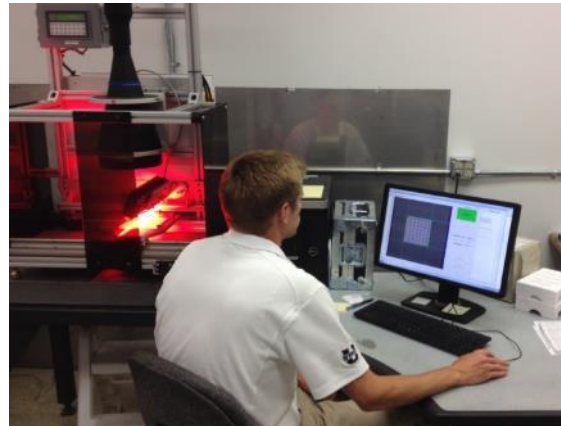
# Bourns, Inc. – Logan/US

## Ceramic Manufacturing

Inspection operations verify the density, camber flatness and dimensions of the sintered ceramic parts



Fired plates are first cleaned and then checked for camber flatness



Vision inspection verifies dimensional compliance fired

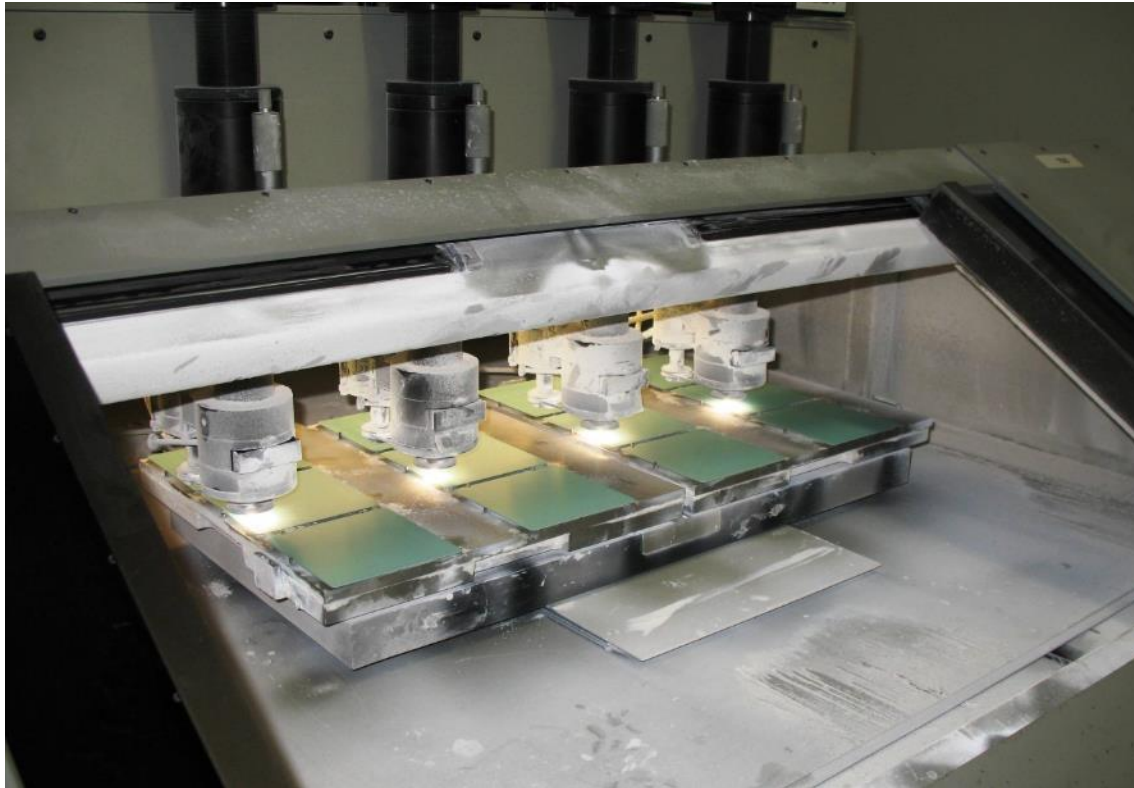


Precision balance and laser measurements define the green density of the ceramic

# Bourns, Inc. – Logan/US

## Ceramic Manufacturing

Laser operations after sintering is capable of accurate scribing, cutting, and drilling of the ceramic plates to meet the close tolerance requirements of final ceramic substrates.



# Bourns Kft. – Ajka/HU



# Bourns Kft. – Ajka/HU

## Assembly Lines – Non-Contacting Sensors



# Bourns Kft. – Ajka/HU

## Assembly Lines – Transmission Sensors





# Bourns Kft. – Ajka/HU

## Assembly Lines – Throttle Position Sensors



# Bourns Kft. – Ajka/HU

## Additional Competencies



Ink production and developing



SMT technologies



Fuel card test lab

# Bourns Kft. – Ajka/HU

## Thick Film Manufacturing Processes

Ink mixing,  
screen printing



Curing, plasma treatment,  
laser trimming

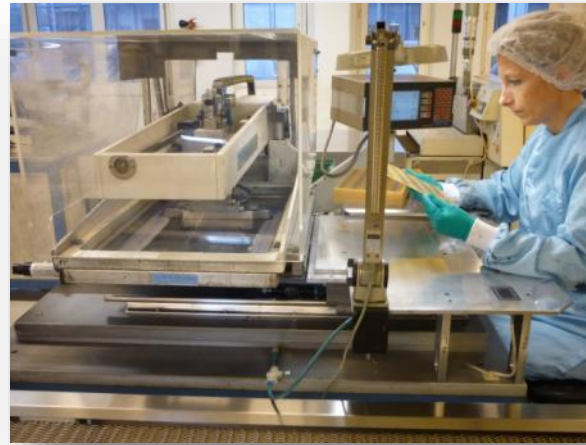


Automated visual  
inspection and EOL testing



# Bourns Kft. – Ajka/HU

Thick Film Processes (Laminates – Thermoset – Ceramics)



# Bourns Kft. – Ajka/HU

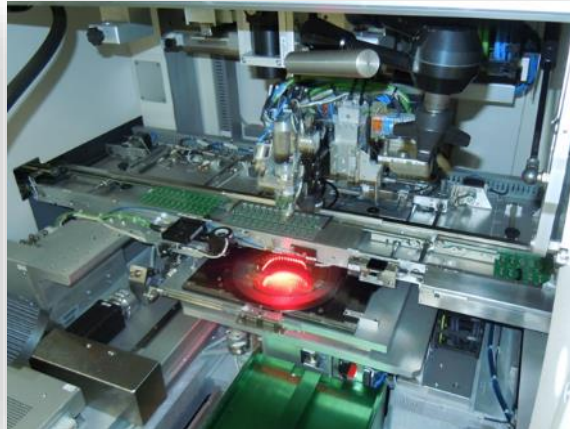
## Thick Film Technology / Printing



- Clean room ISO class 7
- Automatic feeding and positioning  
+/- 12 micron accuracy
- Laser trimming, adjustment
- Different ink systems (resistor and conductor, polymer based and cermet)
- Substrate materials: FR4, thermoset, ceramic
- Different curing, tempering processes (convection, IR, UV)
- Special ink mixing and technology know-how
- Automated optical inspection system

# Bourns Kft. – Ajka/HU

## Microelectronics Bonding / Clean Room



- Silver epoxy dispensing system
- Automated pick and place (ASIC – MR)
- Automated gold wire bond (1.0 & 1.5 mils wire)
- Clean room ISO class 7
  - Temperature controlled:  $21\text{ }^{\circ}\text{C} \pm 3.5\text{ }^{\circ}\text{C}$
  - Humidity: 40-60 % rel.
- Full ESD protected area
- Automated optical inspection system



# Bourns Kft. – Ajka/HU

## Test Lab: Environmental and Warranty Analysis



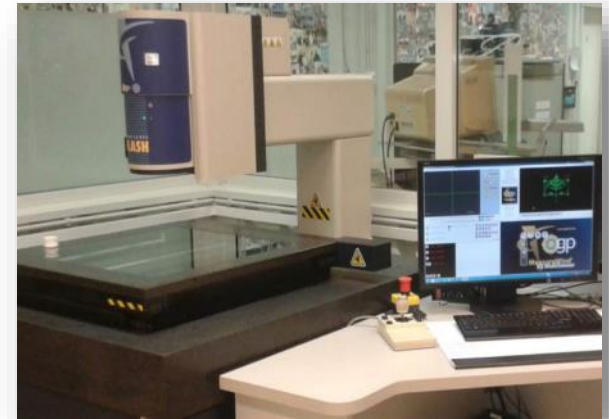
- Requalification test
- Fuel card requalification
- Temperature and humidity cycle, high frequency continuous data monitoring, analog/digital technology, high frequency data recording
- Warranty analysis
- Failure analysis for production support

# Bourns Kft. – Ajka/HU

## Metrology Lab



- High accuracy dimension measurement
- 3D and 2D optical measurement
- Equipment calibration





# Bourns Kft. – Ajka/HU

## Injection Molding Production



- Insert and automatic molding
- Various plastics: PBT, PA, POM, etc.
- 15 various machines: 25 t – 110 t; H and V
- Built-in pressure sensor monitoring
- Average spec. for parts:  $\pm 0.03$  mm
- 2 bridge cranes
- Tool shop



# Bourns Kft. – Ajka/HU

## High Level Storage



- 1,000 sq. meters
- 1,250 pallet place
- Separated hazardous material storage
- Truck docking stations



# Bourns de Mexico – Tijuana/MX



# Bourns de Mexico – Tijuana/MX

## Assembly Lines – Chassis Level



# Bourns de Mexico – Tijuana/MX

## Assembly Lines – SMT

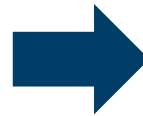


# Bourns de Mexico – Tijuana/MX

## Current Manufacturing Processes Fuel Cards



Surface treatment



Laser trimming



Fuel cards with cable assembly



Automatic selective solder



EOL

# Bourns de Mexico – Tijuana/MX

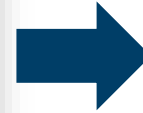
## Thick Film Processes



Heat treatment



Laser trimming



Plasma treatment



Singulated PCB



Final inspection & EOL testing

# Bourns de Mexico – Tijuana/MX

## Torque Sensor Assembly Line





# Bourns de Mexico – Tijuana/MX

## Thick Film Technology / Printing

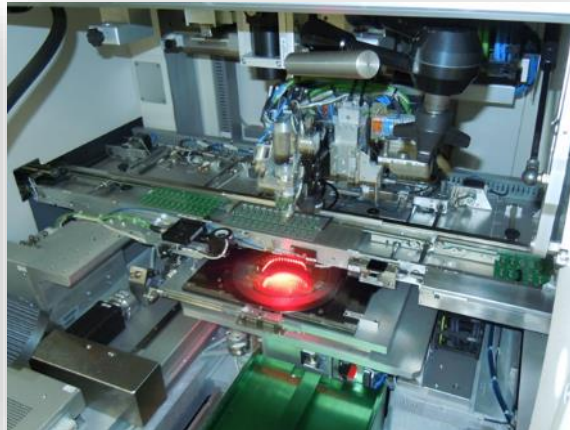


- Clean room environment
- Automatic and manual printing machines
- Automatic feeding and positioning
- Different ink systems (resistor and conductor, polymer based and cermet)
- Substrate materials: FR4, thermosets, ceramic
- Different curing, tempering processes (convection, IR, UV)
- Special ink mixing and technology know-how



# Bourns de Mexico – Tijuana/MX

## Microelectronics Bonding / Clean Room

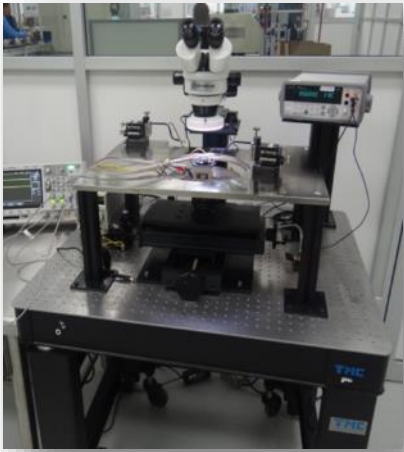


- Silver epoxy dispensing system
- Automated pick and place (ASIC – MR)
- Automated gold wire bond (1.0 & 1.5 mils wire)
- Clean room ISO class 7
  - Temperature controlled:  $21\text{ }^{\circ}\text{C} \pm 3.5\text{ }^{\circ}\text{C}$
  - Humidity: 40-60 % rel.
- Full ESD protected area
- Automated optical inspection system

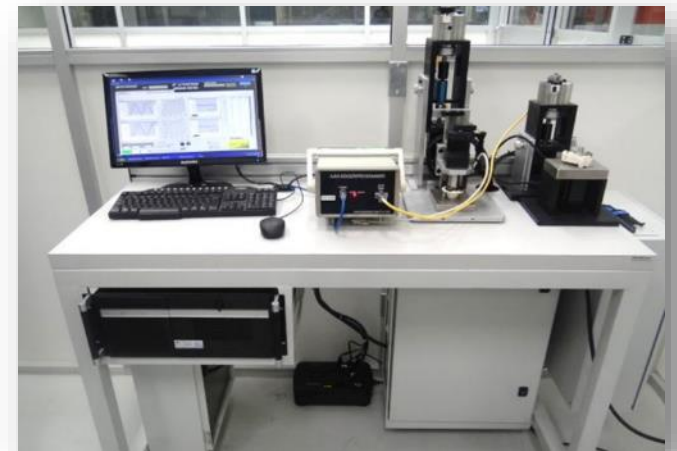


# Bourns de Mexico – Tijuana/MX

## Laboratory, Analysis and PV Testing



- Laboratory tester
- Micro-probing station and optical inspection
- Leakage current measurement
- Silicon gel removal / aluminum etching room
- Full lifetime test according specification
  - Climate chamber, shock temperature chambers, etc.
- Endurance tester with/without movement
- Full product analysis



# Bourns de Mexico – Tijuana/MX

## Injection Molding Production



- Insert and automatic molding
- Various plastics: PBT, PA, POM, etc.
- 15 various machines : 25 t – 110 t; H and V
- Built-in pressure sensor monitoring
- Average spec. for parts:  $\pm 0.03$  mm
- 2 bridge cranes
- Tool shop



# Bourns de Mexico – Chihuahua/MX



# Bourns de Mexico – Chihuahua/MX

## Production Area



# Bourns de Mexico – Chihuahua/MX

## Production Area



# Bourns de Mexico – Chihuahua/MX

## Production Area



- Wire cutting
- Wire stripping

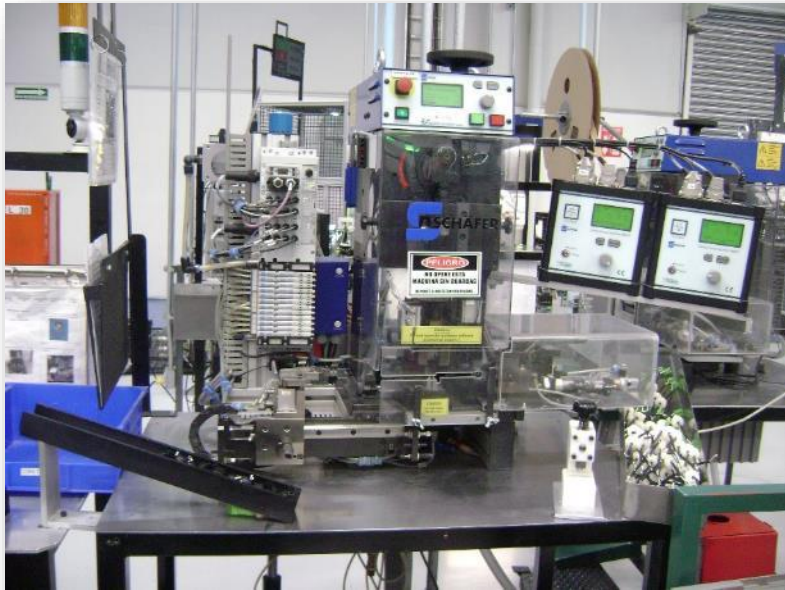


KOMAX equipment



# Bourns de Mexico – Chihuahua/MX

## Production Area



Crimping station



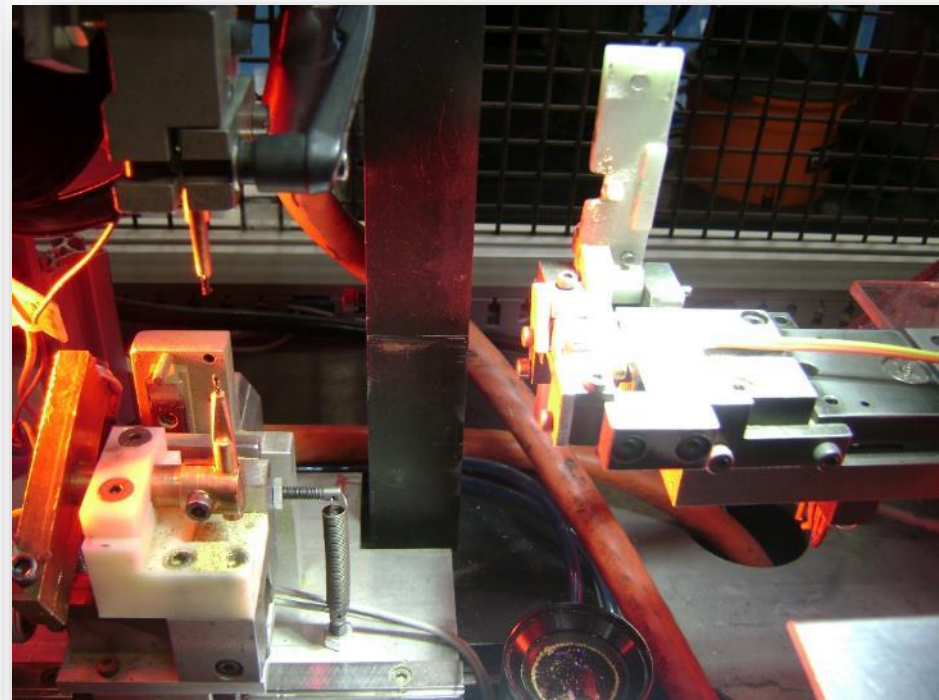
Molding area

# Bourns de Mexico – Chihuahua/MX

## Production Area



Welding equipment



Zoom into the process

# Bourns de Mexico – Chihuahua/MX

## Production Area



Electrical test

- Functional test
- Components presence
- Print date code (laser stamping)

# Bourns de Mexico – Chihuahua/MX

## Production Area



Line 32 (new launch)

# Bourns de Mexico – Chihuahua/MX

Production Area, Line 32



Magnet insert



Magnetized station



IC welding



Electrical test



Bold insert station &  
screw installation



Cure oven

# Bourns Xiamen, Ltd. – Xiamen/China



# Bourns Xiamen, Ltd. – Xiamen/China

## PCB Assembly Line



SMT lines/ICT/AOI



Conformal coating

# Bourns Xiamen, Ltd. – Xiamen/China



SMT

Connect assembly & coating



Test



# Bourns Xiamen, Ltd. – Xiamen/China

## Steering Angle Sensor – Assembly Line



# Bourns Xiamen, Ltd. – Xiamen/China

Torque Sensor – Molding, Cleanroom and Final Assembly Line



Molding



Clean Room



Final Assembly

# Bourns Asia Pacific, Inc. – Taipei/Taiwan

Engineering Center for Circuit Protection Devices



# Bourns Asia Pacific, Inc. – Taipei/Taiwan

## Engineering Center for Circuit Protection Devices

Trimmer SMD Auto Line



Trimmer Through-hole Auto Line



# Your Contacts



## Europe

Bourns Sensors GmbH  
Eschenstrasse 5  
82024 Taufkirchen, Germany

Phone +49 89 80 90 90 0



## The Americas

Bourns, Inc.  
1660 N. Opdyke Road, Ste. 200  
Auburn Hills, MI 48326-2655, USA

Phone +1 248 926 4088



## Asia

Bourns Trading (Shanghai) Co., Ltd.  
Room 1111-1112, Tower A  
SCG Huihao Business Plaza, No. 88  
South Gujin Road  
Xuhui District, Shanghai, CN  
Phone +86 21 6482-1250

[www.bournsautomotive.com](http://www.bournsautomotive.com)  
[automotive@bourns.com](mailto:automotive@bourns.com)