
SIXTEENTH ANNUAL
BiTS
Burn-in & Test Strategies Workshop
March 15 - 18, 2015
Hilton Phoenix / Mesa Hotel
Mesa, Arizona
Archive – Session 5
© 2015 BiTS Workshop – Image: BCEC/iStock

Session 5
Ashok Kabadi
Session Chair

BiTS Workshop 2015 Schedule

Performance Day

Tuesday March 17 10:30 am

Handle With Care

"Semi Automated DIB/PIB Loader"

Alexander Wieler - esmo AG

"Mechanical Flip Burn In (FBI) for Tire Pressure Monitoring System"

Raimondo Sessego, James Stanley, & Joe Milazzo - Freescale Semiconductor

"Final Test Solution of WLCSP devices"

Mike Frazier- Xcerra Corporation

Copyright Notice

Mechanical Flip Burn In (FBI) for Tire Pressure Monitoring System

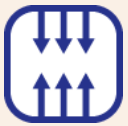
Raimondo Sessego
James Stanley
Joe Milazzo
Freescale Semiconductor

2015 BiTS Workshop
March 15 - 18, 2015

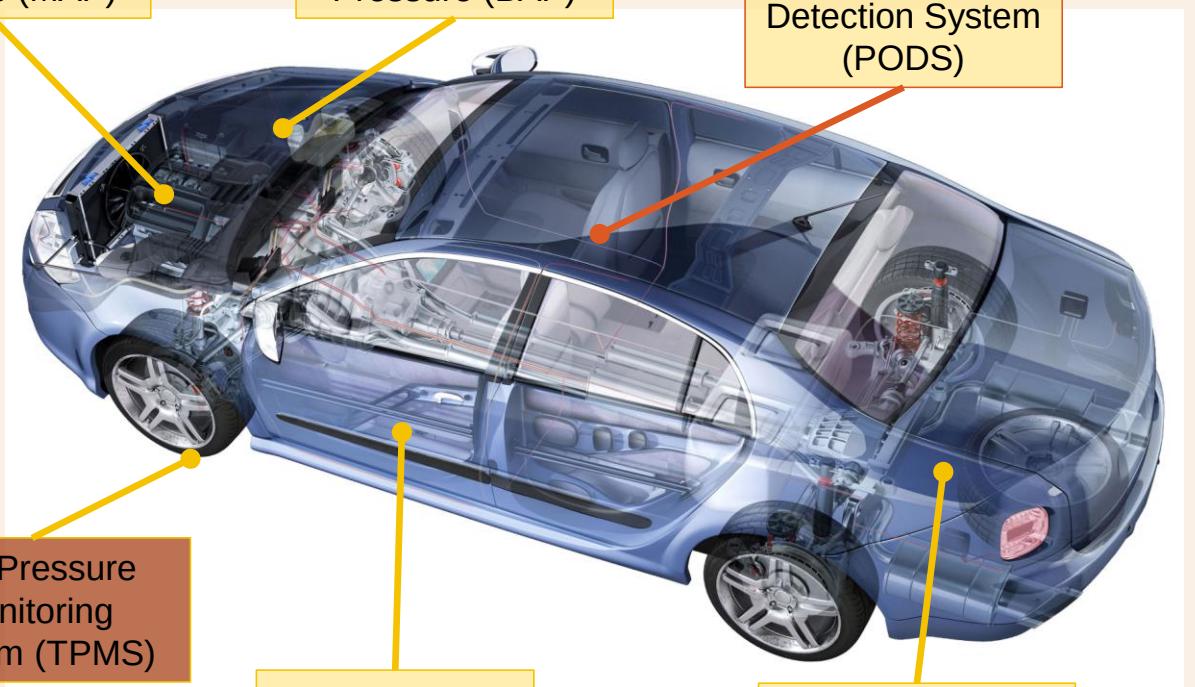
Overview

- Custom flip system to calibrate G sensor for TPMS application .
- Used to verify the 2G calibration for TPMS devices
- Built internally by Freescale Semiconductor.
- Burn IN Board
- Used the TPMs build in microcontroller algorithm to calibrate the G cell sensor
- x168 Parallelism for production
- Old Production system was X32

Sensors Solutions Division

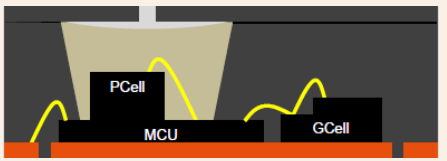
	Pressure	**Automotive, industrial, medical** and **consumer** absolute and differential sensors *Flow, comfort management, HVAC, medical, engine control*
	Accelerometer	**Consumer and industrial** low-g sensors and tilt sensors **Automotive** medium- and high-g crash sensors *Vehicle stability, airbag, vibration monitor, tilt alignment*
	Magnetometer	**Consumer and industrial** magnetic field sensor and 3D compass *Orientation alignment, proximity detection, magnetic switch*
	Gyroscope	**Consumer and industrial** angular rate sensors and 6/9-DOF IMU **Automotive** roll sensor and IMU *Stabilization, motion and gesture HMI, inertial navigation, gaming*
	Sensing systems	**Consumer and industrial** MCU and sensor integrated platforms **Automotive** tire pressure monitoring system *Smart sensors, pedometer, anti-tamper, fault prognostication*

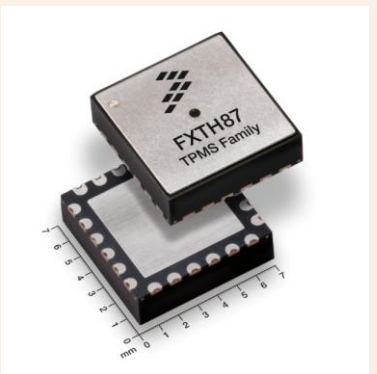
Automotive Pressure Sensors



TPMS Device

- 7X7 QFN Package
- Pressure, Acceleration, Radio TX/RX, Microcontroller





Sensor Mounted on top of the tire Valve

Sensor Mounted on the Rim of the Tire

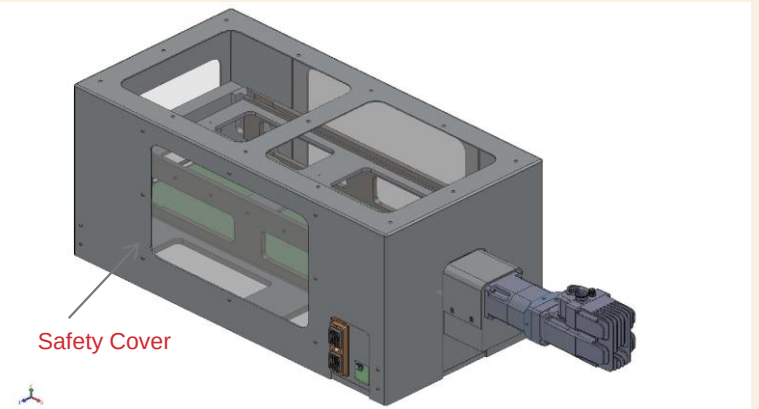
Problem Statement

- What is “Flip”?
- Historical ATE “Flip” test
- TPMS Gen 3 ATE “Flip” test vs. TPMS Gen 4 FBI (Flip Burn-In) test process
- FBI Implementation / Test partitioning and equivalency
- Performance comparison
- Gen 3 Flip handler stimulus plus ATE capital cost was 1.5 Million
- Flip burn In (FBI) integrates the flip during the Burn in phase
- Used imbedded software on the TPMS microcontroller to perform the G cell trim and measure function
- Cost of the Flip burn In (FBI) $50K
- Design and Patented by FSL manufactured in Asia

High Level – what is "Flip"

- The term "Flip" implies providing +/- 1 g-level physical stimulus to the DUT typically using a handler.
- During the physical stimulus the DUT is trimmed & tested
- (**Trim**) Subject the device to +1g and -1g and perform offset & gain measurements to derive the gain and offset SMI (Sensor Measurement Interface) trim codes.
- (**Test**) Measure the sensor output at +1g and -1g using the SMI codes established during (Trim) then calculate and record the device Offset and Sensitivity.
- Sweep the offset codes to support Dynamic Offset Coefficients

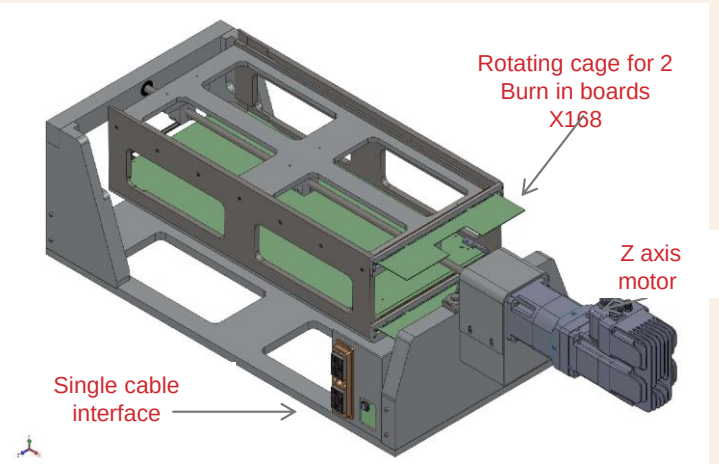
Gen 4 Proposed Solutions



Objective

Develop a system that can flip trim TPMS devices while parts are loaded in a burn-in board. Flip to be done before parts are to be loaded into burn-in oven. Limits are applied to trim coefficients at the test insertion following burn-in.

Gen 4 Proposed Solutions



System

- Two BIB can be flipped simultaneously for x168 parallelism.
- MCU collects data at each angle and calculates trim coefficients.
- Motor are control by an National Instrument System
- The system just start and stop of test
- MCU Signal the NI when measurement are done

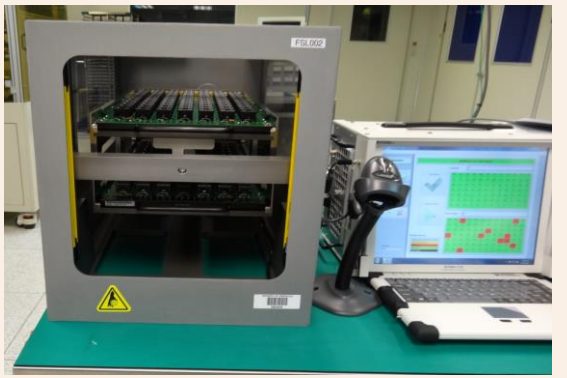
FBI Flip

Test System

- Motorized Flip Unit
- Supports 2 Burn-In boards
- Touch-screen interface
- Supports Q-check and “Flip”
- Pass/Fail Graphical Feedback.

FBI Firmware

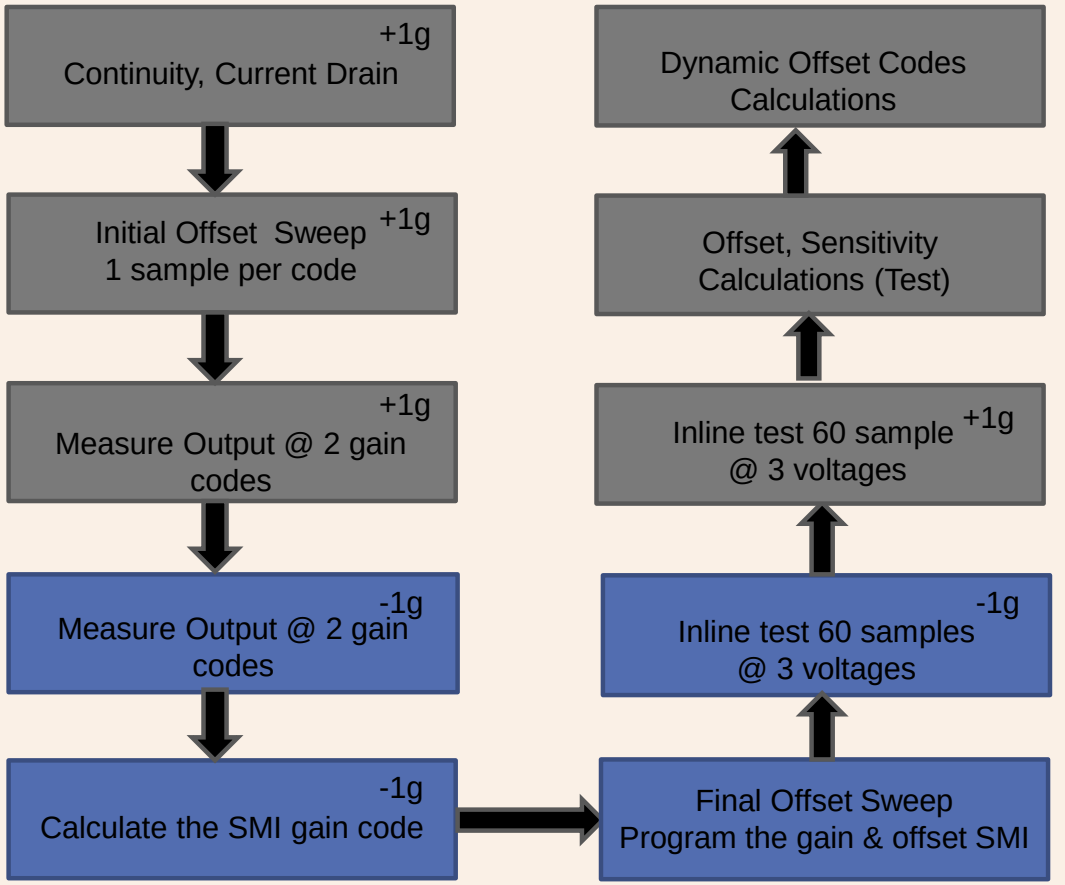
- Firmware loaded at the end of -20C
- Options to sweep gain codes, extrapolate between two pre-defined gain codes
- Performs +/- 1g measurements and trimmed SMI codes



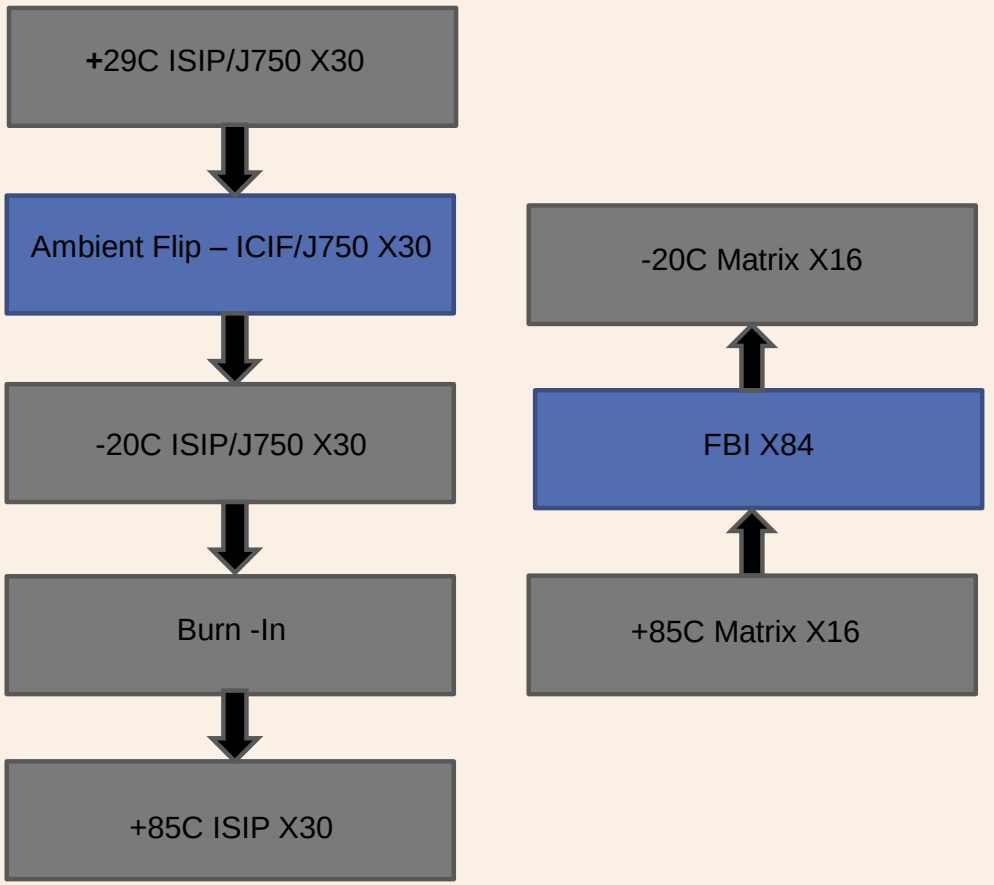
Sensor Measurement Interface (SMI)

- The SMI consist of a capacitance- to-voltage converter (C2V) and analog gain stages.
- The SMI provides a bias to the g-cell, detects capacitance, converted the capacitance in to a voltage and gains the voltage to an appropriate voltage for the A2D.
- The Nogaro/ Lausitz use a 6-channel, 10-bit analog-to-digital converter module.
- The SMI trim codes are flashed into the NVM.
- The data from the ADC10 is then pre-processed by a dynamic range firmware routine that will return the two values necessary to calculate the acceleration
- TPMS is a medium g- sensor ~ 42g yet it needs to work up to 350g, hence the need for Dynamic Offset Code correction.

Classical single axis "Flip" Flow



Historical ATE "Flip" test vs. FBI



Cost comparison

- ATE Flip (J750/V93K and Multitest ICIF) X30
  - Test Time ~ 1.3 sec/device (2 – axis device)
  - Test cell cost $1.1M
  - Test cost $0.04/sec
- FBI X82
  - Test Time ~ 0.8 sec/device (2 – axis device)
  - Test cell cost $50K
  - Test cost $0.01/sec

Conclusion and Remarks

- Current Handler for Mems are becoming more expensive than ATE test.
- There are no commercially available low cost solution for Mems test
- This solution provide sizable capital cost reduction
- Test cost is reduced by 300%