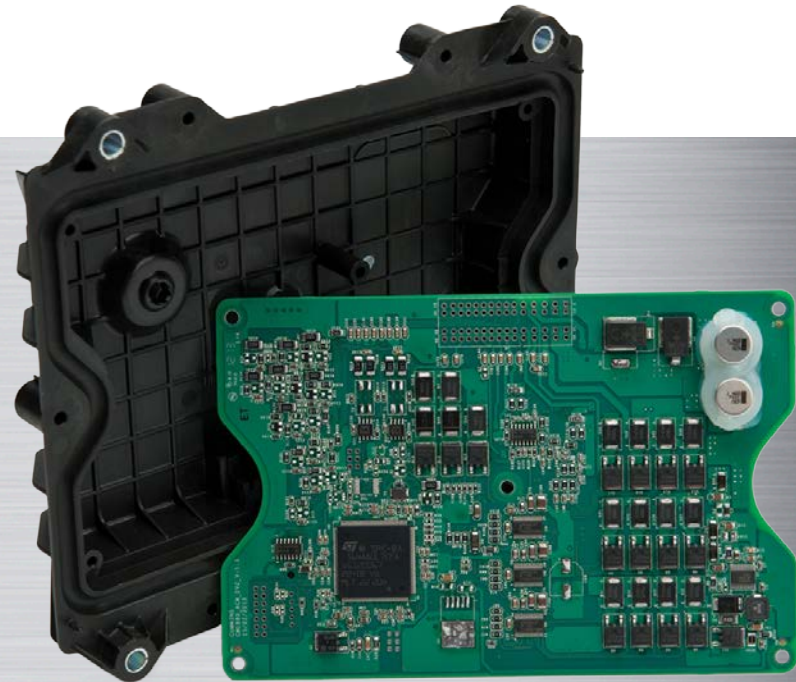


Summary of CM2350 Loose Bracket Issue

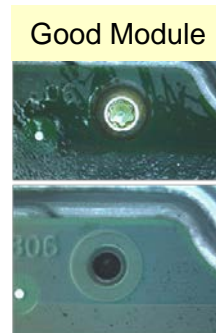
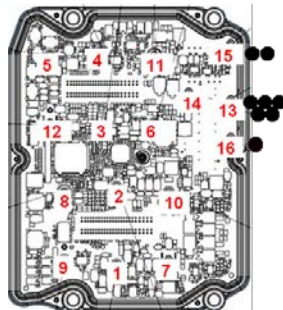
August 28th, 2015

Confidential



Problem Description

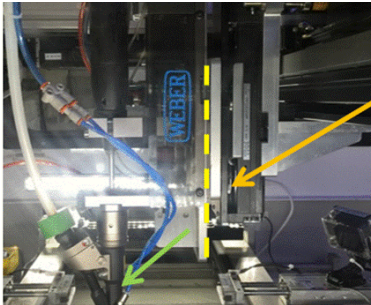
- 8 CM2350A modules with Vboost short to ground.:
 - 3 Plant returns at programming station with communication error.
 - 3 Plant returns due Engine Test Station fault codes related to ECM.
 - 2 OEM returns, failure mode is ECM blowing 30A fuse.
- These 8 ECM's are showing a short to ground damage around the area of any of 3 specific screw locations, the concentration diagram is shown below.
- The ECM's are manufactured in two final assembly lines (A and B), all 8 confirmed failures were manufactured through Screw Cell of line A.
- A screw feed error from line A caused a screw contact to the PCB during the screw insertion, which result in ECM with the Vboost short to ground failure.



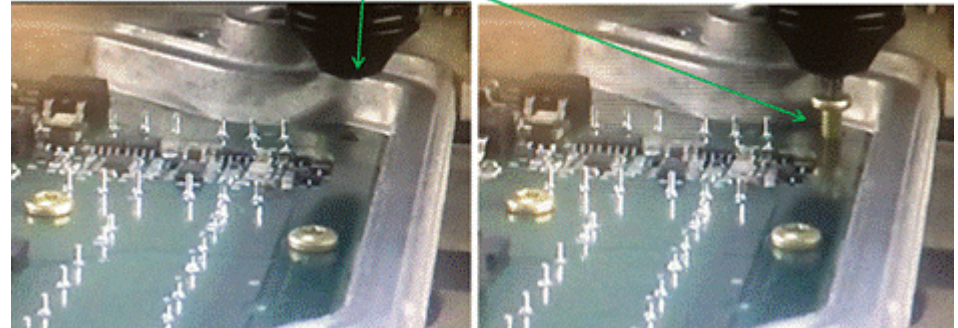
Root Cause

- The EOL test was not capable to detect Vboost short to ground condition and there was no system to detect screw hitting the PCB during the screw feed process.
- At the Screw Cell line A, the bracket that holds the screwdriver in place had loose screws, and therefore, the Screwdriver was found offset from the PCB Screw hole. The screw hit and damage the edge of the PCB Hole creating a Vboost Short to ground Failure.
- The Preventive Maintenance plan did not include the verification of the bracket screws.

Location of loose bracket
At screw cell



Screw could hit PCB hole creating PCB damage



Containment Actions

- Loose bracket of Screw Cell line A was fixed by tightening the screws on the bracket and adding Loctite to the screws (Completed on 7/22/2015).
- The screw/process retry option was removed from the screw cells from operators (Completed on 7/24/2015).
- Route any screw failed units to analyzer for a high magnification inspect. (Completed on 7/24/2015).
- The torque value of the driver in the Screw Cell line A was verified. (Completed on 7/24/2015).
- The bracket was verified and replicated all actions at Screw Cell line B. (Completed between 7/22 and 7/24/15).
- Process Traceability Records of returned ECM's were verified confirming the failures were manufactured in Screw Cell line A. **Suspect population identified built between 7/19 and 7/22/2015** (Completed on 8/10/15).
- A Quality Alert was issued to inspect 5 ECMs of each line every 6 hours to confirm the modules are not being damaged at screw cell. (40 units per day; 12hr shifts) (Completed on 8/10/15). **600+ modules verified and no screw witness marks have been found.**
- Impact marks of the confirmed ECM failures were shown to all related process operators, quality controllers, and analyzers. A quality alert was posted at the Screw Cells to define the reject criteria. (Completed on 8/10/2015).

Short Term Actions



- Change screw feeding process (Completed on 7/28/15):
 - Before condition: 1. Feed screw into driver → 2. Driver moves to position in relative to PCB screw hole → 3. Driver moves down → 4. Drive screw to torque.
 - After condition: 1. Driver moves to position in relative to PCB screw hole → 2. Driver moves down → 3. Feed screw into driver → 4. Driver screw to torque.
- End of line ECM test update to detect the Vboost to ground short (Completed on 8/14/15).
 - Fault insertion (red board) process added to confirm test coverage at the beginning of every shift.
- Add slow motion cameras to screw cells of both lines (Completed on 8/14/15).
 - Initially, once every 2 hours, a Quality Controller verifies the screw insertion process by recording a slow motion video.

Long Term Actions



- Update Preventive Maintenance plan to include the verification of bracket screws. Documented as PM Plan completion (Completed on 8/17/15).
- Develop Preventive Maintenance plan to include the verification of all critical screws of all machines of ECM line. (Due Date: 9/28/15).
- End of line ECM test update to detect the Vboost to ground short (Completed on 8/14/15).
 - Fault insertion (red board) process added to confirm test coverage at the beginning of every shift.
- Add steel plate to bracket of screwdriver cells to increase support points. (Completed on 8/28/15)
- Add this Cause of the failure mode into the PFMEA, update Control Plan. (Completed on 8/28/15).
- Update MQV to include this failure mode and lesson learn will be considered for future models. (Completed on 8/28/15).