onsemi

Guidelines for EFAR
(External Failure Analysis Request)

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onsemi

Table of Contents

1. Customer Returns

2. Failure analysis request

3. Failure analysis units
   - 3-1 Targeted units
   - 3-2 Shipment, handling the targeted units

4. Verification by Customer
   - 4-1 ABA swap
   - 4-2 Waveform
   - 4-3 Schematic/circuit information
   - 4-4 <Imaging Products> Comparison with ODS (Outgoing Defect Specification)

5. Feedback from past failure analysis results
   - 5-1 Massive, Visible EOS failure
   - 5-2 Repeated EOS failure
   - 5-3 Repeated NTF (Not Trouble Found) failure
   - 5-4 Same issue which was confirmed in the past failure analysis
   - 5-5 Visual / Cosmetic failure
   - 5-6 Logistic issues
   - 5-7 Soldering / board mount related failure

6. Data Analytics
   - 6-1 Data analytics

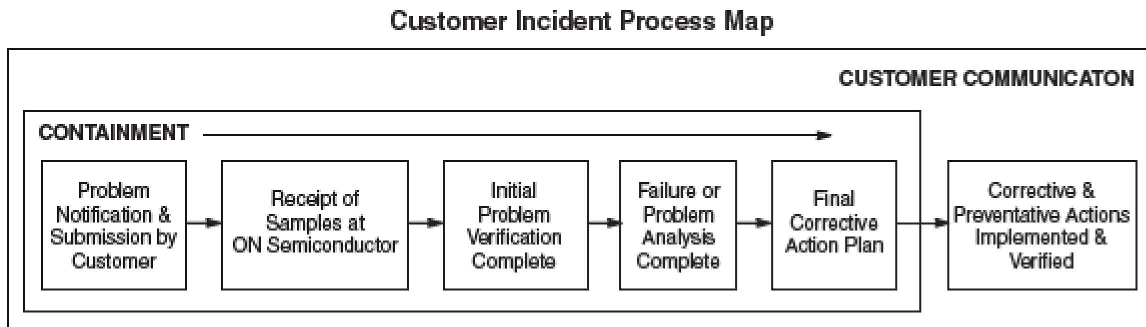
7. onsemi failure analysis support
   - 7-1 EOL (End of Life) parts failure analysis.
   - 7-2 The parts from unauthorized sales channels.7-3 Prototype devices, ES samples
   - 7-4 Customer evaluation samples for failure analysis
   - 7-5 Failure analysis request through authorized sales channels.
   - 7-6 misusing of non-automotive grade device for automotive application

8. ESD Control

1. Customer Returns

The purpose of this document is to provide guidelines to be used by customers when requesting onsemi for failure analysis. Use of these guidelines will help in providing customers with useful and timely information related to a reported product failure.

onsemi's Global Customer Return or Incident process is focused on formal Problem Solving and Responsiveness. We use 8D Problem Solving Methodology to determine Containment, Root Cause, and Corrective/Preventive Actions.



Our Customer Incident Information system tracks Customer Incidents. Monthly customer incident metrics are compiled and distributed corporate-wide. Responsiveness metrics drive continuous improvement in the Cycle Time arena. Failure Mechanism Pareto Charts are used to drive continuous improvement in the Product and Administrative Quality arenas. We review these metrics in our monthly Business Unit & Manufacturing Operations Reviews.

These guidelines can be used for electrical, mechanical as for logistic issues.

Failure analysis is a process that entails vast analytical methods and techniques to help identify the reliability and quality issues that may occur in either the manufacturing or application of our products. The process can be a complicated endeavor due to the many aspects of the ever-advancing semiconductor and packaging technologies and the numerous engineering disciplines involved.

2. Failure analysis request

onsemi will make every effort to provide you the best service to solve the problem you are experiencing as soon as possible. To achieve that, we kindly ask you to DESCRIBE, CHARACTERIZE, and provide as much data as possible (FA report, Data logs…) for the problem you are experiencing. That will allow us to expedite the investigation process. onsemi is asking you to provide following information with any returns.

Basic information	
	onsemi Part Number
	Customer Part Number
	Purchase source (onsemi or Distributor name)
	Device marking, Date code
	LOT number on label, Purchase Order number
	Number of units being returned for analysis
Detection	
	Point of failure (incoming inspection, module assembly, outgoing test, field, etc.
	used conditions in which failure was observed (voltage, temperature, frequency, etc.)
	How failed, detailed description of failure, including all available symptoms, how the symptoms are related to the returned unit. Length of time in the application including the conditions upon failure.
	Failure rate: ppm how many units failed, out of how many based numbers of units.
	Customer Application, Is this a new product, or have any changes occurred in this time frame?
	Did any other components fail at the same time, and if so, how did they fail?
	Are there any devices of this same date code/same lot still available?
Problem Description	
	Include the related failing parameter from the product specification, datasheet or any shared application diagram. For

	image sensor products, please include ODS failing parameter if applicable.
	Describe the part of the circuit where the problem exists
	What is the application’s failure mode, and how can it be related to this device?
	How do you perceive that the device is failing (short, open stuck logic levels)?
	How was the device handled before receipt at onsemi? Were precautions taken in removing and handling (ESD/thermal) the devices to ensure that electrical or physical damage does not occur, and the package’s testability is maintained?
What investigation has already been done by the customer?	
	Photos of target units and evaluation environment
	Waveform of evaluation (Failure case vs normal case)
	Schematic drawing of application and evaluation environment
	Setting conditions. Register setting. <Imaging Products> Lens condition (w/wo, F#), Image streaming mode, Brightness condition
	Measurement equipment, conditions.
	Evaluation result report

A minimum set of background information significantly impacts the overall quality and cycle time of the problem-solving process – the more information, the better.

The cost of failure analysis is high due to the extensive instrumentation, highly technical staff, continual training and development, and associated analysis expenses (chemicals, fixtures). The background documentation must be completed upon receipt to enable those resources’ most efficient utilization. An open communication channel between onsemi and our customers exists to ensure a timely resolution of the problem on either end.

3. Failure analysis units

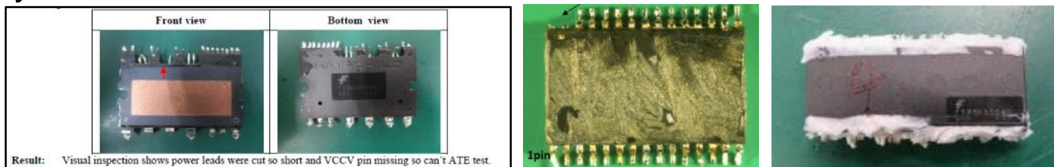
onsemi may choose not to support a Failure Analysis request if the targeted units do not meet the requirements below.

3-1 Targeted units remove from customer PCB.

EFAR targeted units must be removed from customer PCB (Printed Circuit Board). Be carefully removing from PCB to ensure that electrical or physical damage does not occur, and that the package's testability is maintained. onsemi requests customer to return the units in testable condition, it's good to have original onsemi as shipped condition

3-2 Targeted units, damage, and testability

The following examples of targeted units (are not acceptable for failure analysis.



Do not cut-off leads/pins.
Do not mechanical damage the leads/pins or package.
Remove solder residues (specially between pins)
Remove coating material

Damage to leads/pins makes it much more difficult to perform ATE testing for confirmation of electrical conditions.

3-3 Shipping and handling the targeted units

During handling of semiconductor, it is recommended to use antistatic material and conductive packing for storage as well as moisture control. Basically, it is recommended to use onsemi tray and tubes friction during transportation will generate static electrical charge. It is recommended to minimizing movement of parts inside of the box. ESD control shall be compliant to ANSI/ESD S20.20 standard. ESD protective packaging requirements, both inside and outside the EPA per ANSI/ESD S541.

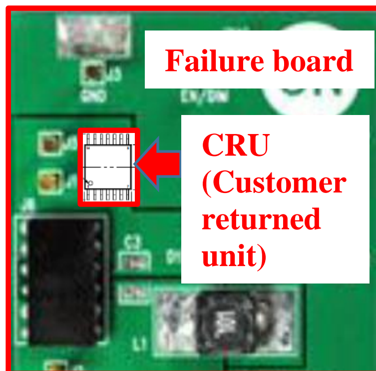
The customer can add also reference good parts, if this can be a help in finding the issue. However, if the customer returns also reference good parts it is important that these should be logged separately “for reference only, no EFAR devices…” and not count them under the "defect parts".

4. Verification by Customer

4-1 ABA swap

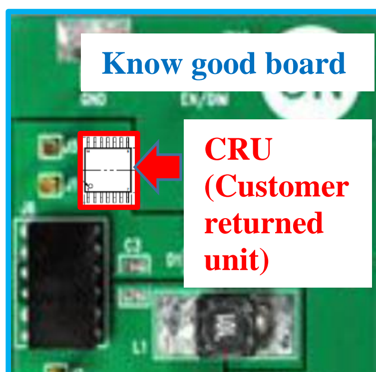
ABA swap (Cross check) is recommended to confirm the failure of the suspected unit/units.

Original failure status

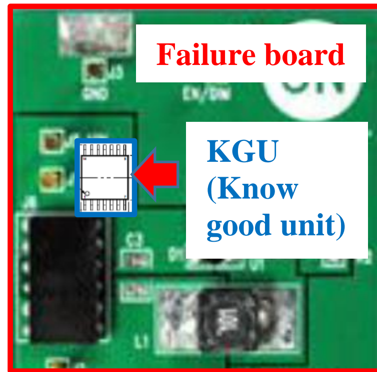


Swap “Suspected unit” onto Known good board
Confirm same failure under same conditions

<Imaging Products> This ABA swap step to be swapped suspected unit onto Known good board must be checked by a customer.



Swap “KGU (Know good unit)” onto original failure board
Confirm normal operation under same conditions

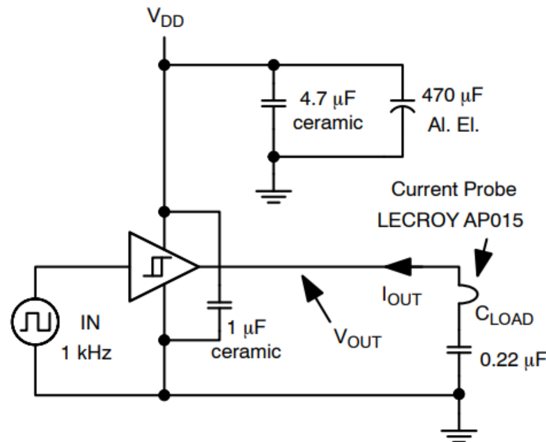


4-2 Waveform

Confirm failure with waveform of Passing and Failing cases using the same conditions, (supply voltage, temperature, setup condition, sequence until failure and so on).

4-3 Schematic/circuit information

It is recommended to provide schematic/circuit illustration which is related to the CRU (Customer returned unit),like in the following example.



4-4 <Imaging Products> Comparison with ODS(Outgoing Defect Specification)

Regarding imaging products, ODS(Outgoing Defect Specification) is defined as showing image quality spec and image shooting condition definition to check the image quality following keywords in reported issues:

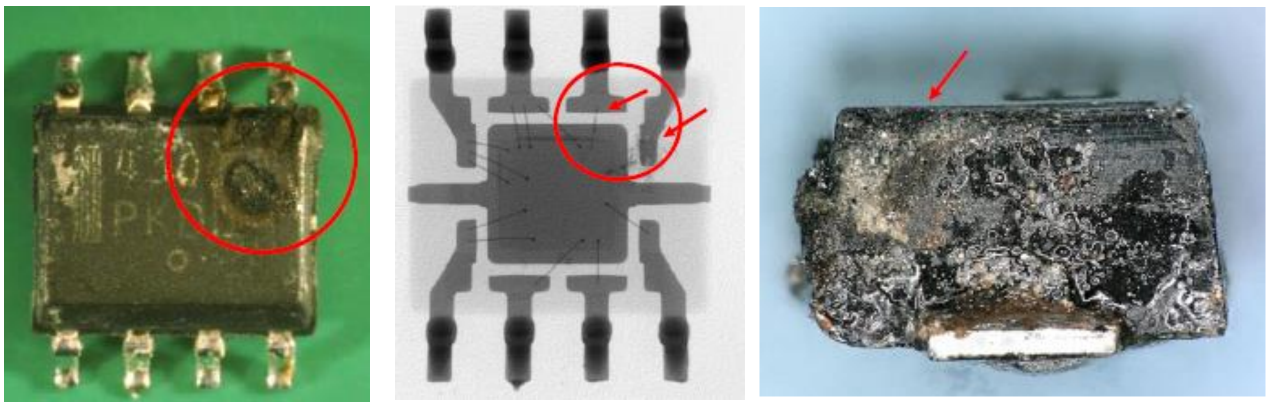
- White Dots, Black Dots, Color Dots, Bright Dot, Dark Dot
- Dead Pixel, Dark pixel, Bright Pixel, Pixel Defect
- Cluster Defect
- Horizontal Line
- Row/Column FPN

Please note there is a certain number of these defects that is allowed as noted in the product ODS. Please verify before declaring a product defect and requiring analysis. A customer must compare failed images and image shooting condition with ODS with not processed RAW images to check that images are actually outside spec when failure mode relates to such phenomena shown above.
And RAW images should be provided when FA request is submitted.

5. Feedback from past failure analysis results

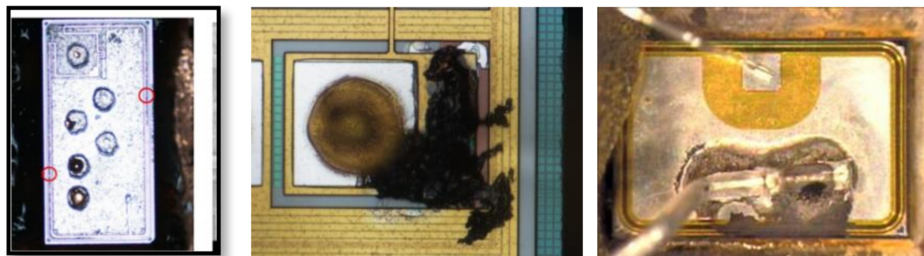
5-1 Massive, Visible EOS failure

Visible EOS (Electrical Overstress) damage may mask the root cause of the incident of failure. It will be difficult to understand the root cause without an investigation of the application conditions. onsemi will review the customer request with the past data of failure analysis to potentially determine next course of actions.

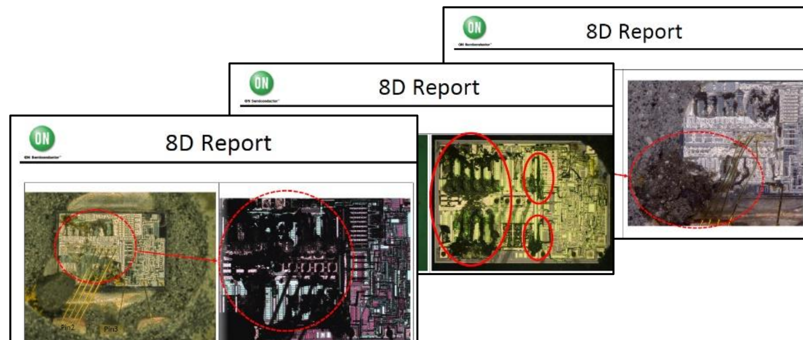


5-2 Repeated EOS failure

In case of repeated EOS failures on the same devices and same application, the application-level approach will be most effective for the investigation. The customer design team and application engineers may be needed to support the investigate into the root cause of EOS rather than to perform the device level failure analysis.



Especially when there are the same repeated EOS failures, suspected application issue. The higher priority analysis here is the investigation of application-level EOS incidents.



In case onsemi receive a 2nd failure analysis request whose previous result was EOS with the same application, onsemi may request to share your application-level investigation result against our 1st failure analysis report prior to the 2nd failure analysis.

5-3 Repeated NTF (Not Trouble Found) failure

In cases of repeated NTF on the same devices and same application, there can be several reasons of NTF (lack of detailed information, setting and condition of failure on the application, other device failure on the application, gaps between customer condition and onsemi condition, required special sequence to create the failure, special environment condition, wrong information, … etc.) all should be considered.
Your design team and application engineers shall support the investigation into the root cause of NTF since without confirmed failure no device level failure analysis can be done.
<Imaging Products> To ensure that there is common hardware platform between customer and onsemi, customer is recommended to reproduce the failure on demokit and provide INI file with their register settings

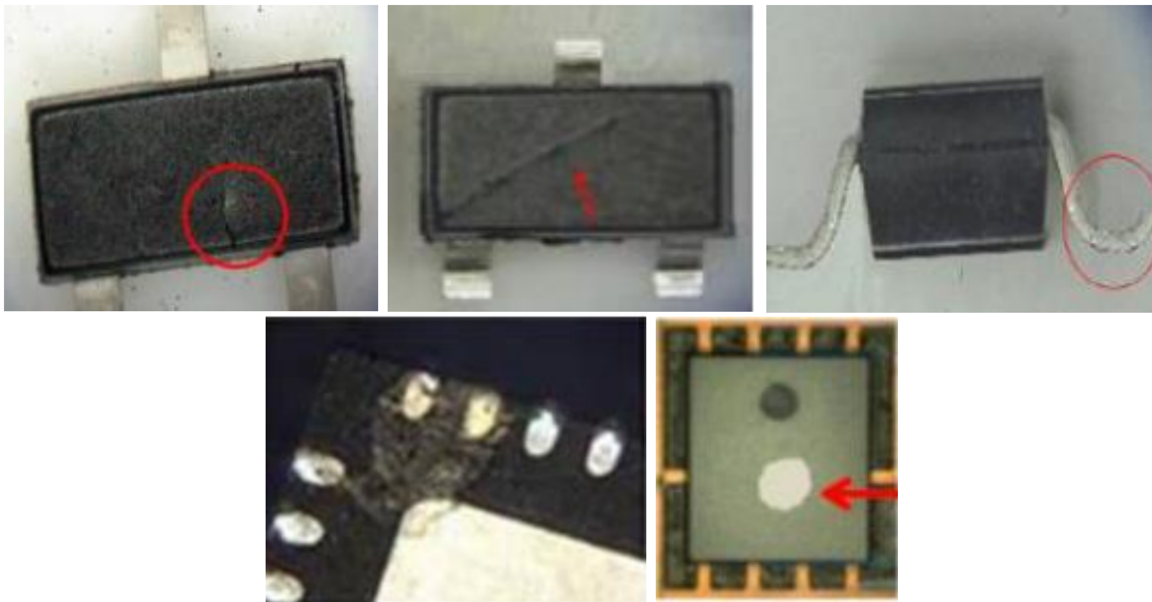
5-4 Same issue which was confirmed in the past failure analysis

If a same failure as observed in the past is detected, the report which was issued in the past will be reported. For cases with the same failure analysis result as a past report, the analysis will be not effective for quality improvement (Especially, if the units were the production which is before corrective action implemented). It will likely be same issue as on the past

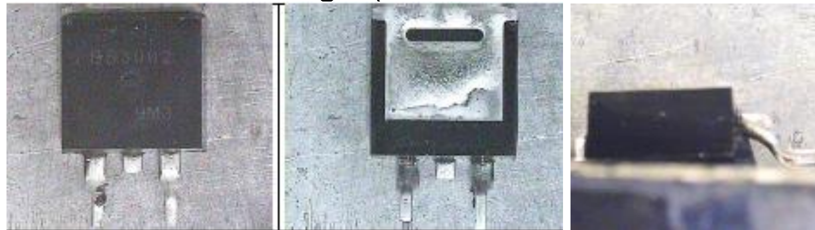
report. We would not perform the failure analysis in these cases. If it is the same issue occurring after the corrective action was implemented, we will investigate the incident.

5-5 Visual / Cosmetic failure, contamination issue

When a visual or cosmetic failure on a device is detected, photos of the affected part will be effective to investigate the fact of incident. The photos should have, not only failure area, but also entire image of the returned units and related parts.



photos for entire image (all area has been confirmed)

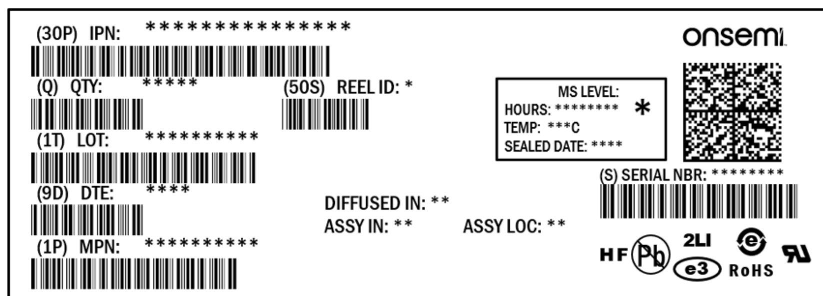


<Imaging Products> Regarding all of visual / cosmetic failure, contamination issue affecting image quality except moving particle on active pixels (e.g. scratch, contamination on a glass lid or active pixels), its effect to image quality should be referred to ODS to establish if it is a valid EFAR.

And it’s not valid EFAR in the cases,

- Cannot be visible with 20x magnification microscope
- Visible only by tilting or by inspecting at an angle
- Can be cleaned by onsemi recommended cleaning method
- Outside of active pixelsDefect is <50um (on top of active array), and does not impact image quality under ODS conditions
- Defect is <100um on top of periphery (not on top of active array)

A visual or cosmetic related incident may have a risk which could impact multiple units. Information of affected lots and reference lots will help onsemi investigate the root cause quickly. onsemi packing label as below is effective when investigating the lot. (photos of label is good for understanding)



5-6 logistic issues (labeling, wrong deliveries, damage...etc...)

When a packing problem or damage on the shipment is detected, the photos of affected part will be helpful to investigate the root cause, similar to the visual and cosmetic failures. Packing label information is effective in finding the cause.

5-7 Soldering / board mount related failure

Soldering and board mount related failure might have multiple factors on application side, board layout, chemical material, temperature condition and device conditions.

See the document “Soldering and Mounting Techniques Reference Manual”. This can be downloaded from the onsemi web site, www.onsemi.com.

6. Data Analytics

6-1 Data Driven Signature Analysis (DDSA)

As a technology company, onsemi uses advanced data driven analytics to improve the effectiveness and efficiency of our customer returns process. Our vast storage, decades of device data, advanced analytic techniques, and experienced analysts allow for accurate data mining and the quick assessment of many issues. By employing data analytics early in the process, we can significantly reduce our overall response time and increase the accuracy of product analysis. Data analysis is conducted utilizing an analytics engine which includes attributes such as date code, package type, wafer fabrication facility, wafer process technology, assembly site, and test site information. The customer returned product is retained intact in case further analysis becomes critical in the future.

The three possible outcomes of a “DDSA” investigation are 1) Electrically Passing Unit, 2) Electrical Overstress with a high degree of confidence, or 3) Random defect not related to a systemic manufacturing issue. In all cases, the returned unit is retained intact in case further analysis is deemed business-critical.

7. onsemi failure analysis support

7-1 EOL (End of Life) parts failure analysis

Because EOL devices are not being loading into production, onsemi will not have a chance to perform corrective actions from the feedback of the failure analysis result. In those cases, only the failure analysis can be performed with limited resource. No corrective actions can be implemented. If FA is required, provide the reasoning to perform the failure analysis.

7-2 The parts from unauthorized sales channels

onsemi provides no warranty for onsemi product(s) purchased through unauthorized sales channels. In the event that any one or more of the foregoing conditions is not satisfied, onsemi shall have no liability under this warranty whatsoever. No failure analysis for the devices through unauthorized sales channels.

7-3 Prototype devices, Engineering samples (ES)

The prototype devices and ES samples are for the purpose of the evaluation of function only. The devices may not have completed all of production related requirements or reliability testing. There will be no or limited failure analysis for the devices of those samples. All the samples free of charge are also the same as ES samples. Failure analysis for those samples will be at onsemi's discretion.

7-4 Customer evaluation samples for failure analysis

onsemi cannot support the failure analysis for special condition evaluation like reliability test which does NOT follow public standards such as JEDEC/AEC conditions.

7-5 Failure analysis request through authorized sales channels.

For indirect purchases:
If customer has a failure analysis request to onsemi, the product (Customer Returned Samples) should be returned through the authorized channel from

whom the product was sold. The authorized channel should handle the product return to Q-Center based on the shipped to country. The distributor contacts the customer and will manage the formal failure analysis request to onsemi Q-Center through the sales channel CQE (Customer Quality Engineer) regionally (EU, US, Asia, Japan). The CQE for the sales channel region has the responsibility for the failure analysis. The distributor will manage the customer returned unit to transport to onsemi failure analysis locations.

For direct Business with onsemi:

1. When you need to return onsemi product for failure analysis and/or credit, you must first contact your onsemi customer quality representative (preferably using the Q-Center group email address process outlined below).
2. Complete the form provided to you by your customer quality rep / Q-Center contact including detailed information regarding your complaint.
3. Email the completed Customer Returns Form back to the Q-Center / Customer Quality Rep.
4. Once your completed form is received by onsemi, the Q-Center will then provide you with the proper shipping address with routing instructions.

Q-Centers:

For all product returns, please send an email to the Q-Center group address below for direction on the returns process and shipping address. The appropriate Customer Quality Engineer / Manager and other onsemi employees, who will assist you in your product returns process, are part of the Q-Centers listed below by region.

USA: QCenter_AMERICAS@onsemi.com
EUROPE: QCenter_EMEA@onsemi.com
ASIA: QCenter_ASIA@onsemi.com
Japan: QCenter_Japan@onsemi.com

7-6 misusing of non-automotive grade device for automotive application

onsemi doesn’t support failure analysis and 8D report if customer uses non-automotive grade device for automotive application unless there is a valid reason and agreed by onsemi.

8. ESD Control

Semiconductors are sensitive to ESD and therefore need to have special care during handling. Basic ESD control is to eliminate the source of static electrical charge. The following are generic actions for static electrical charge. These actions should be implemented for assembly, test, packing, shipping and transportation, delivery, incoming and storage. After mounting parts on PCB, the same controls will be required.

1) Environment, Equipment, Facility

Static electrical charge can be generated under low relative humidity condition. So, it is recommended to handling semiconductor under 45 to 55%RH. Do not put the material that generates static electricity around the device or PCB. Regular monitor of ESD control is important action to assure compliance. For preventing static electrical charge, measurement system, test system, working table and tool must be connected to ground. A conductive mat (105 to 109Ω) is required on the working table and floor. If you cannot achieve sufficiently low ESD conditions, an ionizer is helpful in removing electric charge. Please Research the amount of charge, polarity of charging and verify by repeatable monitoring.

2) Human

Operator will wear wrist strap or foot strap. For protecting human and products, resistor (1M to 10MΩ) for prevention of electric shock and voltage drop of discharge will be connected in series to ground. When handling products, antistatic gloves or finger cots are required for preventing direct contact with products. Work clothes and work shoes will charge by friction, so it is recommended to use conductive smock and shoes. Generally, 1M to 100MΩ is recommended but it can vary by humidity, friction and pollution. When wearing conductive clothing, one needs to pay attention to electric shock by not touching to DC current.

3) Working method

In working area, don’t use electrified insulator, especially plastic and manmade fiber, use of conductive parts is preferred.

When use soldering iron, low voltage spec likes of 12V to 24V for semiconductor is recommended. Tip of solder iron must be grounding thru resistor of 1M to 10MΩ. Handing time and duration of the part should be minimized.

During handling of semiconductors use antistatic material and conductive packing for storage. Basically, it is recommended to use tray and tube.

However, condition of tray and tube will change by humidity, friction and pollution, so that needs attention. Friction during transportation will generate static electrical charge. So, it is recommended to minimize movement of parts inside of box.