



## SCREENING FOR COUNTERFEITS

The World Leader in Supplier and Counterfeit Part Risk Mitigation Solutions and Training

### ERAI Recommendations for Screening for Nonconforming and Suspect/Fraudulent/Counterfeit Parts

Counterfeit electronic parts have become a significant cause of worry in the electronics part supply chain. Most of the counterfeit parts detected in the electronics industry are either new or surplus parts or salvaged scrap parts. The packaging of these parts is altered to modify their identity or to disguise the effects of salvaging. The modification can be as simple as the removal of old marking and then adding new marking, or as complicated as recovery of a die and repackaging. (Source: Screening for Counterfeit Electronic Parts - Bhanu Sood and Diganta Das – Center for Advanced Life Cycle Engineering)

The presence of the below noted nonconforming conditions may indicate the part being inspected has been subjected to relabeling, refurbishing, and/or repackaging, processes synonymous with counterfeiting.

#### Documentation, Packaging & Shipping Inspection Revealed:

- ☐ Documentation
  - ☐ Submit Fraudulent, falsified or altered documentation or supply chain traceability (e.g. certificate of conformance (CoC), Purchase Order (PO), or other)
- ☐ Product was not shipped in the original manufacturer's packaging
  - ☐ Parts were packaged in third party/generic reel
  - ☐ Parts were packaged in third party/generic tray
  - ☐ Parts were packaged in third party/generic tube
- ☐ Product was improperly packaged
  - ☐ Not in ESD (ANSI/ESDS20.20) packaging
  - ☐ Not moisture protected (J-STD-020)
  - ☐ Moisture indicator missing
  - ☐ Desiccant missing or damaged
  - ☐ HIC indicates humidity
- ☐ Mishandled/damaged, and/or nonconforming packaging materials
  - ☐ Factory seal tape has been cut or is damaged
  - ☐ Trays are warped, cracked, bent or damaged
  - ☐ Trays are not properly banded
  - ☐ Tubes are warped, cracked, bent or damaged
  - ☐ Reels are warped, cracked, bent or damaged
  - ☐ Cut and/or damaged carrier tape or empty pockets
  - ☐ Tears and/or puncture holes in bag
  - ☐ Erroneous OCM Logo (e.g. manufacturer's logo on label or packaging is absent or does not match that shown on their website or previous shipments)
  - ☐ Generic packaging
  - ☐ Poor syntax, misspelled words, alterations or changes to the packaging
  - ☐ Packaging is imprinted with the incorrect manufacturer name or logo

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- ☐ Label
  - ☐ Lot and/or date codes do not align with product discontinuation notices/last time buy and/or ship dates (e.g. parts were discontinued in 2000 but suspect shipment is marked with 2013 date codes)
  - ☐ Part number, lot and/or date codes and/or COO on label do not match the part number, lot and/or date codes and/or COO on the parts
  - ☐ Lot and/or date codes, serial numbers, etc. on label are invalid
  - ☐ Bar code mismatch (e.g. bar code symbols do not match the human-readable printed part data)
  - ☐ Generic third party label(s)
  - ☐ Poor syntax, misspelled words, alterations or changes to the documentation (e.g. hand written notes, modifications, etc.)
  - ☐ Label is not consistent with a known genuine factory label
  - ☐ Label is torn, damaged and/or barcode is unreadable
  - ☐ The quantity of parts packaged in the tube, reel or tray is different than the quantity noted on the label
- ☐ Inconsistent part orientation
  - ☐ Product inconsistently or incorrectly aligned within a single reel
  - ☐ Product inconsistently or incorrectly aligned within a single tray
  - ☐ Product inconsistently or incorrectly aligned within a single tube
  - ☐ Multiple lot and/or date codes within a single lot
  - ☐ More than one part number or part type within a single lot

#### **BGA Lead External Visual Inspection Revealed:**

- ☐ Evidence of refurbishing present
  - ☐ Inconsistent ball formation (non-uniform size and shape of solder spheres and/or columns)
  - ☐ Parts failed co-planarity testing
  - ☐ Scratches on substrate beneath lead spheres (i.e. balls)
  - ☐ Excessive, uneven or non-uniform plating or thickness
  - ☐ Discoloration and/or poor or excessive solder coverage (e.g. plating flaking off leads)
  - ☐ Excess flux and/or solder paste present on substrate
  - ☐ Objective evidence and/or acknowledgement the parts have been refurbished/retinned
- ☐ Evidence of improper handling and/or storage present
  - ☐ Missing and/or damaged lead spheres (i.e. balls)
  - ☐ Flattened spheres or misaligned columns
  - ☐ Oxidation and/or corrosion visible
  - ☐ Dirt, residue and/or foreign contamination on substrate and/or solder spheres

#### **Lead External Visual Inspection Revealed:**

- ☐ Incorrect construction
  - ☐ Lead/pin count, formation, finish or type of lead (DIP, SMB, Gull Wing, etc.) is not consistent with the datasheet

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- ☐ Pin or terminal layout and/or count is not consistent with the datasheet
- ☐ Evidence of refurbishing/replating present
  - ☐ Evidence of lead reattachment, rework, etc.
  - ☐ Solder splash, excess solder, solder tails, solder paste, and/or solder bridges
  - ☐ Lack of exposed base metal at the lead tip
  - ☐ Lack of tooling marks
  - ☐ Discoloration and/or poor or excessive solder coverage (e.g. voids, pitting, plating flaking off leads, orange peel texture)
  - ☐ Prior solder reflow and/or excessive, uneven or non-uniform plating or thickness (e.g. evidence of refurbishing)
  - ☐ Objective evidence and/or acknowledgement the parts have been refurbished/replated
- ☐ Evidence of prior use present
  - ☐ Insertion marks, brush marks and/or scratches on inside and/or outside of leads
  - ☐ Missing, bent, trimmed, cracked and/or non-planar leads
  - ☐ Inconsistent lead shape, length, style, etc.
  - ☐ Leads failed co-planarity testing
  - ☐ Damaged leads, threads, etc.
- ☐ Evidence of improper handling/storage present
  - ☐ Discoloration, dirt or residues
  - ☐ Oxidation and/or corrosion visible
  - ☐ Exposed copper visible
  - ☐ Leads failed co-planarity testing
  - ☐ Tin whiskers visible

#### Part Markings External Visual Inspection Revealed:

- ☐ Part markings are suspect
  - ☐ Inconsistent part marking styles (e.g. fonts) within a homogeneous lot
  - ☐ Inconsistent part markings (e.g. COO present or not present) and/or styles (e.g. fonts) when suspect part is compared to a known good part
  - ☐ Incorrect or inconsistent part number and/or part markings (e.g. serialization, color)
  - ☐ Parts are marked with an invalid date and/or lot code
  - ☐ Inconsistent part marking location (e.g. orientation) within a homogeneous lot
  - ☐ Inconsistent backside markings within a homogeneous lot
  - ☐ Inconsistent COO markings within a homogeneous lot (e.g. different COOs)
  - ☐ COO markings display inconsistent alphanumeric orientation within a homogeneous lot (e.g. inconsistent font size, spacing and/or placement)
  - ☐ Logo missing, distorted or inconsistent with Intellectual Property Holder's logo
  - ☐ Previous marking partially visible on the surface (e.g. ghost markings)
  - ☐ Poor quality markings (e.g. blurred, lack of clarity or sharpness etc.)
  - ☐ Polarity indicator is suspect (e.g. inconsistently aligned, running through the indents, is inconsistent in color, width or length, etc.)
  - ☐ Poor quality marking (e.g. burn holes present indicative of aftermarket laser mark equipment)

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### Device Package External Visual Inspection Revealed:

- ☐ Evidence of tampering present
  - ☐ Package dimensions (e.g. thickness, width, height, etc.) and/or weight are inconsistent with the manufacturer's specifications (Method 2016 of MIL-STD-883 or equivalent)
  - ☐ Inconsistent or incorrect package construction
  - ☐ Die marking size, shape and/or placement inconsistent within a homogenous lot
  - ☐ Inconsistent surface texture (e.g. color discrepancy between the top, bottom and/or side of the part)
  - ☐ Pin 1, orientation marks, etc. not present when presence is called for on manufacturer's datasheet
  - ☐ Inconsistent package indents, texture, shape, size, depth and/or placement (e.g. mold pin, pin 1 indicator, ejector pin or COO stamp)
  - ☐ Unidirectional abrasions (e.g. directional sanding)
  - ☐ Differences in the corner radius between the top and bottom surfaces (e.g. evidence of sanding)
  - ☐ Evidence of part surface alteration (e.g. microblasting, sand blasting, acid etching, lapping, etc.)
  - ☐ Exposed bond wires due to excessive surface alteration (e.g. directional sanding, micro-blasting, acid etching, etc.)
  - ☐ Secondary coating/blacktopping visible on the leads, substrate, etc.
  - ☐ Visible secondary coating/blacktopping cascading over the side of the part (e.g. overspray, overflow)
  - ☐ Secondary coating/blacktopping in and around the surface indent (e.g. pin 1 indicator, mold indent, etc.)
  - ☐ Scratches in and around the surface indent (e.g. pin 1 indicator, mold indent, etc.)
- ☐ Evidence of prior use and/or improper handling and storage present
  - ☐ Test marks and/or glue, adhesives or other residues on the surface of the package or substrate
  - ☐ Evidence of color fade, stains, blotches, scratches, cracks or visible damage such as burn marks, pit marks or chipouts on the part surface of substrate
  - ☐ Foreign debris, contamination, and/or corrosion visible on the part surface or substrate

### Remarking & Resurfacing Testing Revealed:

- ☐ Solvent Test for Remarking (Marking Permanency Testing - MPT) Revealed
  - ☐ Part markings were removed using three (3) parts mineral spirits (CAS Registry Number 9072-35-9) with one (1) part isopropyl alcohol (CAS Registry Number: 67-63-0), or Method 2015 of MIL-STD-883 or equivalent.
  - ☐ Original part markings visible after test
  - ☐ Directional sanding marks visible after test
  - ☐ Previous part markings (e.g. ghost markings) visible after test
  - ☐ Difference in surface texture visible after test

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- ☐ Resistance To Solvents (RTS) - Acetone Revealed
  - ☐ Surface material was removed using acetone (e.g. CAS Registry Number 67-64-1)
  - ☐ Original part markings visible after test
  - ☐ Directional sanding marks visible after test
  - ☐ Previous part markings (e.g. ghost markings) visible after test
  - ☐ Difference in surface texture visible after test
- ☐ Resistance To Solvents (RTS) - Uresolve Revealed
  - ☐ Surface material was removed using Uresolve
  - ☐ Original part markings visible after test
  - ☐ Directional sanding marks visible after test
  - ☐ Previous part markings (e.g. ghost markings) visible after test
  - ☐ Difference in surface texture visible after test
- ☐ Heated Chemical Test (HCT) aka Heated Solvents Test Revealed
  - ☐ Surface material was removed using 1-Methyl 2-Pyrrolidinone (CAS Registry Number: 872-50-4)
  - ☐ Original part markings visible after test
  - ☐ Directional sanding marks visible after test
  - ☐ Previous part markings (e.g. ghost markings) visible after test
  - ☐ Difference in surface texture visible after test
- ☐ Dynasolve 750 or equivalent test Revealed
  - ☐ Surface material removed using Dynasolve 750 or equivalent
  - ☐ Original part markings visible after test
  - ☐ Directional sanding marks visible after test
  - ☐ Previous part markings (e.g. ghost markings) visible after test
  - ☐ Difference in surface texture visible after test

#### **Mechanical Scraping (e.g. Scrape Test, Scratch Test) Revealed:**

- ☐ Evidence of tampering present
  - ☐ Secondary coating/blacktopping lifted during test
  - ☐ Directional sanding marks visible after test
  - ☐ Previous part markings (e.g. ghost markings) visible after test
  - ☐ Difference in surface texture visible after test

#### **Radiological (X-ray) Inspection Revealed:**

- ☐ Evidence of tampering present
  - ☐ Die not present
  - ☐ Die size, shape and/or placement inconsistent within a homogenous lot
  - ☐ Inconsistent internal construction within a homogeneous lot
  - ☐ Inconsistent and/or incorrect internal construction when compared to a known authentic part
  - ☐ Die size and/or shape inconsistent when compared to a known authentic part
  - ☐ Lead frame construction inconsistent within a homogenous lot

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- ☐ Lead frame construction inconsistent when compared to a known authentic part
- ☐ Bond wire construction inconsistent within a homogeneous lot
- ☐ Bond wire construction inconsistent when compared to a known authentic part
- ☐ Evidence of double wire bonding throughout a lot not consistent with repair
- ☐ Nonconforming condition(s) present
  - ☐ Extraneous matter (e.g. die attach, burrs, ball bonds, delamination)
  - ☐ Die attach incorrect (e.g. voids traverse die, misalignment)
  - ☐ Bond wires broken or missing
  - ☐ Evidence of double wire bonding due to possible repair
  - ☐ Bond wires traverse (e.g. bond wires touch)
  - ☐ Delamination visible

#### Lead Finish Evaluation (XRF or EDS/EDX) Revealed:

- ☐ Nonconforming condition(s) present
  - ☐ Incorrect lead finish composition (e.g. presence or absence of lead (Pb) or other constituent elements)

#### Decapsulation Internal Analysis (a.k.a. delidding, decap) Revealed:

- ☐ Evidence of tampering present
  - ☐ Die not present
  - ☐ Inconsistent or incorrect die marking or die construction
  - ☐ Die markings do not correspond with the component part number or the component markings
  - ☐ Die markings do not match those identified in the manufacturer's datasheet
  - ☐ Scribe marks, surface scratches, voiding, corrosion, contamination, chipouts and/or cracks visible
  - ☐ Incorrect die map layout
  - ☐ Bond wires broken or missing
  - ☐ Inconsistencies identified during cross-section analysis in comparison to a known good device
  - ☐ Inconsistencies identified during cross-section analysis within a homogenous lot

#### Scanning Acoustic Microscopy (SAM) Revealed:

- ☐ Nonconforming condition(s) present
  - ☐ Delamination detected

#### Fourier Transform Infrared (FTIR) Spectroscopy Revealed:

- ☐ Nonconforming condition(s) present
  - ☐ Inconsistent surface composition
  - ☐ Inconsistent ink marking composition
  - ☐ Ionic or organic contaminants detected

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- ☐ Surface coating, chemical film, or other materials associated with part surface cleaning or alteration detected

#### **C-Mode Scanning Acoustic Microscopy (CSAM) Revealed:**

- ☐ Nonconforming condition(s) present
  - ☐ Delamination detected

#### **Scanning Electron Microscopy (SEM) Revealed:**

- ☐ Evidence of tampering present
  - ☐ Surface texture is inconsistent within a homogenous lot
  - ☐ Surface texture is inconsistent when compared to a known authentic part
  - ☐ Particle media detected indicative of microblasting

#### **Reflection Electron Microscopy (REM) Revealed:**

- ☐ Nonconforming condition(s) present
  - ☐ Microstructure is inconsistent when compared to a known authentic part

#### **XRF Analysis Revealed:**

- ☐ Nonconforming condition(s) present
  - ☐ Positive bias element error detected

#### **Solderability Testing Revealed:**

- ☐ Parts Failed Solderability Testing
  - ☐ Terminations did not exhibit a minimum continuous solder coating of 95%

#### **Electrical Testing Revealed:**

- ☐ Parts Failed Electrical Testing
  - ☐ Root Cause Specified
- ☐ Nonconforming Condition Present
  - ☐ IDCODE check revealed inconsistent version numbers in a homogenous lot