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Brian Crowley
Quality Assurance Manager

October 17, 2005

Rich Perry
Quality Manager
International Rectifier Hi-Rel
2270 Martin Ave.
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Re: GIDEP FV5-P-06-01

Hello Rich,

We have completed our investigations regarding the problem as described in the GIDEP Advisory through records and data review. The findings and actions implemented since the manufacturing time period in question are referenced along with recommended joint activities to prevent future recurrence.

Background

International Rectifier ordered part number 1210X332K501NMH in June and December 2001 against their Source Control Drawing 608X-0100, Revision C. Product was supplied from the same manufacturing lot for both purchases. Their drawing specifies a Novacap catalog part number with an "N" termination suffix. Per the Novacap 11/00 catalog the "N" suffix indicated a nickel barrier termination with a 90%Sn/10%Pb solder overcoat.

The majority of capacitor users were transitioning to 100%Sn requirement for environmental compliance in the same time frame. Novacap assembled new lines for ramp up to 100%Sn and began transition of older lines to 100%Sn while maintaining a single line of the lower volume Sn/Pb requirements.

A cursory review of MIL-PRF-38534 revisions indicate the prohibition of pure tin in internal element finishes and definition of pure tin as containing less than three percent alloy (Pb) material were not called out until the January 2003 revision E. The previous revision required device finishes to contain a minimum of 2% Pb by weight. (Para. E.4.2.7) The review of the MIL-PRF-123 revision history showed the requirement for a minimum of 4% Pb in the Sn/Pb alloy of the solder overcoat of a barrier layer was implemented 5/30/01. Novacap received a copy of this revision in October 2002. (Novacap implemented internal CA to assure latest revisions of external specifications are maintained)

GIDEP Problem Advisory FV5-P-05-01 goes into greater detail regarding the various measurement techniques and their correlation in regards to electroplated Sn/Pb compositions and process controls.

Investigation

Novacap implemented new plating tanks for 100%Sn in 2000 and transitioned others to 100%Sn while maintaining one line for Sn/Pb. Customers with known requirements for Sn/Pb (90/10 or minimum 2% Pb were controlled based on specification comments and processed through the Sn/Pb line. All others were processed through the 100%Sn lines with low levels of Pb present in the two converted lines. The "N" suffix was changed to mean nickel barrier during the transition with the required overcoat composition controlled by specification.

Novacap catalogs are updated periodically with a greater emphasis on updating the website which contains the catalog as well as other pertinent information. Page 5 of the catalog provides the website address and informs of the intent to maintain updates on the website as Novacap reserves the right to make changes to the catalog offerings. There was no printed catalog revision until 6/04. The "Y" termination was created for 90%Sn/10%Pb in February 2002.

The lot in question was processed in a converted line with low residual levels of Pb remaining. There was no indication on the traveler of the Pb requirement. Samples of the suspect parts were measured in various locations with XRF after removal from the customer's boards. The results ranged from 1.1% to 3.3% Pb which was consistent with the low level Pb in the tanks based on bath chemistry records. However, it is not known what effect the installation and subsequent removal may have had on the consistency of this measurement.

There have been no reported failures of Novacap products due to tin whisker growth.

Summary

The increased level for required percentages of Pb was evolving in the same time frame as the worldwide transition to 100%Sn. The specifications for the suspect part number relied on the Novacap catalog part number, which did change, and did not call out the required solder composition. There was no formal notification to all customers and any website communications of the "N" suffix change were ineffective in this instance. The product in question was manufactured in 2001 prior to the MIL specification standards that it was measured against in 2005.

As an Application Specific supplier Novacap maintains a specification control system that is keyed by the customer and customer part number. The specific requirements as detailed by the customer are loaded into computer files that control the design and processing steps of each part number. These files are intended to allow for specified requirements above and beyond the catalog to assure conformance of the manufactured and supplied products. This system is dependent on the customer's detailing their specific requirements in their communications and controlled documents as well as Novacap review and entry.

Containment Actions

The suspect time period identified during this investigation is January 2000, when 100%Sn plating lines were implemented and February 2002 when the 90%Sn/10%Pb suffix was created. It is possible that other products are affected from this time frame. We continue to supply many customers with the "Y" terminated products with improved controls over the solder composition to assure conforming measurement while taking into account the correlation of the various measurement techniques used in the industry.

Novacap is prepared to analyze any suspect samples or review process records for any parts of concern from the suspect period or any product produced since.

Any customer requiring 90%Sn/10%Pb products should review their specification to assure their requirements are clear and have been provided to Novacap. If the requirements are spelled out or if they are relying on the catalog part number the specification should be revised and provided to Novacap for entry into our specification system to assure conforming product supply.

Sincerely,

Brian D. Crowley
QA Manager

Statement from IR, Santa Clara 29 September 2005

A DC/DC converter manufactured by International Rectifier was identified to contain a capacitor with a pure tin termination by EDS testing during a DPA. The identified capacitor was manufactured by Novacap.

The capacitor was purchased in August 2001 to Novacap part number 1210X332K501NMH for which the termination designator "N" originally specified nickel barrier, 90Sn/10Pd. Novacap subsequently changed the "N" designator from nickel barrier, 90Sn/10Pb, to specify nickel barrier, 100% tin. The designator for 90Sn/10Pb was changed to "Y'. International Rectifier was not aware of the designator change. Further investigation has identified other parts purchased with the "N" designator that potentially have the same problem.

MIL-PRF-38534, General Specification for Hybrid Microcircuits, paragraph E.4.2.7.1 states that the use of pure tin is prohibited from internal element finishes. Tin is considered to be pure if it contains less than three percent alloy material. In addition, NASA requirements prohibit the use of pure tin in any application due to a phenomenon called "whisker growth" and/or "sublimation" (refer to the following web site for further information. http://nepp.nasa.gov/whisker/). Industry studies have shown that the use of a pure tin finish can promote the growth of tin (Sn) whickers, which might cause potential reliability risks related to electrical shorts, debris, or contamination. MIL-PRF-123, the Performance specification for fixed ceramic capacitors states that tin finish is prohibited as a final finish or as an undercoat. Tin-lead (Sn-Pb) finishes are acceptable provided that the minimum lead content is four percent. For additional information, see ASTM B545 (Standard Specification for Electrodeposited Coatings of Tin).

IR is currently researching hybrids manufactured (capacitors, where used) and plans to notify customers in direct receipt of affected product.

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Section 20 (continued)

Table I – Affected Hybrids with Pure Tin

Part Number	D/C
8486*S 'CH' AFL2805SW/CH	0514
8486*S 'CH' AFL2805SW/CH	0532
8486*S 'CH' AFL2805SW/CH	0441, 0517
8487*S 'CH' AFL2806R5DW/CH	0424
8487*S 'CH' AFL2806R5DW/CH	0424
8487*S 'CH' AFL2806R5DW/CH	0441
8487*S 'CH' AFL2806R5DW/CH	0523
8487*S 'CH' AFL2806R5DW/CH	0526
8488*S 'CH' AFL2820SX/CH	0419, 0423, 0435
8488*S 'CH' AFL2820SX/CH	0521, 0522, 0523
8870*B 'CH' AFL2808SX/CH	0505, 0510
8870*B 'CH' AFL2808SX/CH	0523, 0528
8933*B 'CH' AFL2808SX/CH	0429, 0438, 0444
8958*B (AHF2815TF/CH	0407
AFL27028SX/CH	0123
AFL27028SZ/CH	0121, 0122
AFL2803R3SX/CH	0448
AFL2805SX/CH	0448
AFL2805SX/CH	0448
AFL2805SZ/CH*B	0409
AHF2815T/CH	0243
AHF2815T/CH	0143
AHF2815TF/CH	0238
AHF2815TF/CH	0142
AHF2815TF/CH	0128, 0129
ASA2812D/CH*B	0422, 0433
M3G2803S	0310
M3G2803S	0310
M3G2805D	0229
M3G280505T-HY	0244
M3G2812D	0230
M3G283R415T	0235, 0244
M3G5005S-R01	0206
M3G5015D-R01	0146, 0147,0206
M3G7015D	0330
M3GX280552S	0215, rwk 0225
M3GX2815D	0215
M3H280515T	0249
M3H2805S	0246
M3H2805S	0310
M3L2803S	0319
S2803R3S	0324
S2805S	0333