To:

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Subject ; RA (H2S Package) RF Power module series substrate crack.

This document shows the conclusion for RA(H2S Package) series RF Power module substrate crack.

1. Substrate crack mechanism

   We show the substrate crack mechanism by theory , stress measurement results and thermal stress analysis by simulation.

   Tensile to substrate increase at a faster rate after the amount of bent reach to zero between module flange and chassis.

   When the tensility over the limit of substrate tensile, the substrate occur the crack.

   We seems that the substrate crack occur by excess stress by poor flatness of attached surface of module or faster temperature rise of module.

   Page 3 shows the substrate crack mechanism (Theory)

   Page 4 shows the measurement results of stress on the substrate with some conditions.

   Page 5 shows the thermal stress analysis by simulation.

2. Analysis results of crack place.

   We analysed the crack place by electron microscope.

   This results show the typical substrate crack by high temperature or excess stress.

   There are no signs in which have a small crack that is latent in the substrate.

   RA series module inspected 100% of HOT Po test.

   Hot Po test means that measure the output power on the high temperature(100Deg/C).

   Hot Po test can reject the micro crack and another poor assembling by heat stress.

   Page 6,7 shows the the place of crack by electron microscope.

   Page 8,9 shows the Hot po measurement equipment.

3. Calculation results with stress limit VS temperature rise.
   We calculated the stress limit of substrate by FEM. FEM; Finite element method

   We measure the stress on the substrate with some temperature rising conditions.
   In this results we recommended to keep in the safety temperature rise area.

   Page 10 shows the stress limit VS temperature rise.
   Page 11 shows the safety area for temperature rise.

4. Example of poor flatness for attached surface of module.
   Page 12 shows the example of poor flatness of chassis.
   Page 13 shows the example of flatness improvement.

5. The test results of RoHS compliant module.
   We tested the RF on and off with extreme conditions for temperature rising.
   Following are test results.

r/n=8/8	Non RoHS compliant module	(All substrate crack at few cycles)
r/n=0/16	RoHS compliant module	(No substrate crack over 3000cycles)

   The reason is that the solder of RoHS compliant is hard than present solder.
   In this results, module flange difficult to drop away.

   Page 14 shows the RF on /off results with RoHS compliant ver.

Conclusion;

The present module have a enough strength with keep the flatness of chassis, temperature rising time and maximum temperature of module.
Additionally RoHS compliant ver. have a more high strength than non RoHS ver.
We think ,substrate crack problem will be clear by using RoHS compliant ver.
But Please keep the our recommendation for the flatness of chassis, temperature rising time and maximum temperature of module.