DEFENSE LOGISTICS AGENCY
DEFENSE SUPPLY CENTER, COLUMBUS
POST OFFICE BOX 3990
COLUMBUS, OH 43216-5000

IN REPLY
REFER TO DSCC-VAC (Mr. Barone/DSN 850-0510 / (614)692-0510)

MEMORANDUM FOR VSS (Mr. Art Hudson)

SUBJECT: Dated Engineering Practices (EP) Study on small die bipolar - Project Number: 5961- 2379

Findings and recommendations Engineering Practices (EP) Study, dated 30 July 2001, and attachments are enclosed.

It is requested that your office take the necessary electronic action to reflect completion of these projects.

Enclosure

TOM HESS
Chief
Active Devices Team

ENGINEERING PRACTICES STUDY

TITLE: Problems in the Standardization of small die bipolar transistors

30 July 2001

STUDY PROJECT (SEE ATTACHMENT 1)

FINAL REPORT

Study Conducted by Alan Barone

Prepared by

Alan Barone

I. OBJECTIVE: The objective of this project is to determine the most optimal requirements for burn-in and life tests for signal bipolar transistors.

II. BACKGROUND: The content of this proposal was derived from user complaints regarding T_J during burn-in and life tests.

The key criteria are the T_J and P_T requirements. In most cases P_T was upgraded to a realistic value which correlates with thermal resistance junction to ambient, however, some specifications appear to be over rated (example /398). (Compared with other specification of the same package and die size the P_T varies by 20%.) Lowering this specification as proposed from 1 watt to a .8 watt device is a class one change. DSSC will not allow a class one change without the proper government and user concurrence. Data from at least 1 supplier proves that at 1 watt this part is running exceptional hot.

Another serious problem DSCC is trying to resolve involves small die signal transistors (399, 301, 343, 426, and 511). One supplier claims "small die geometry's will not tolerate T_J of 135°C burn-in at room ambient." A lower (than expected) power rating is proposed so that with 75% P_T min. applied, to the devices will see T_J of about 110°C min. and additional ambient temperature is used to reach the (T_J) 135°C and 150°C min requirements. DSCC's initial objection is why are these devices (rated at 200°C max) not able to tolerate a T_J greater than 110°C. The 135°C was chosen as a standard to accommodated burn-in equipment not to reflect part capability. Most other small signal devices can tolerate T_J (without ambient assist) as high as 175°C min. For these devices, all suppliers are in agreement to raise the present power rating significantly but they are not all in agreement to raise the T_J to 135°C min. due to unknown failure mechanism(s) which cause this parts to fail (leakage and gain shifts).

About 8 years ago power burn-in for signal transistors was reduced from 160 hours to 80 hours. This was justified by adding thermal response, and adding a PDA requirement to HRTB, as well as reviewing power burn-in data. Although there has been no known negative effects, the data provide was burned-in at T_J much lower than expectations. It has been proposed to continue to allow 80 hrs for devices burned-in at T_J=150°C min. and to increase the time to 160 hrs for all signal transistors burned-in less than T_J=150°C. This proposal could have a significant impact on industry. All options and consequences should be carefully reviewed before any action is taken.

III. RESULTS: The applicable bipolar specifcations are being revised. Burn-in time will not be increased to 160 hours on specifications which are stressed to TJ = 135°C, however, the small emitter specifications which process parts at low Tj are candidates for increased burn-in time.

IV. CONCLUSION DSCC has agreed not to invoke any Tj requirements to burn-in on devices with small emitters. However, a Tj = 150°C for life test would be required. External heating will be allowed. Power ratings will not be lowered

V. RECOMMENDATIONS: After numerous meetings, data collection, and measurements; government and industry recommended the following for the majority of small signal transistors:

Burn-in would require T_J = 135°C min. and life test would require T_J = 150°C min. Burn-in and life test would specify that the power applied shall be $P_D \geq 75$ % of rated P_T. The power ratings, derate schedule and thermal resistance junction to ambient were corrected and standardized. Voltage was allowed to vary from 10-30 volts and device current is adjusted to achieve the minimum T_J requirements. Ambient temperature is allowed provided $P_D \geq 75\%$ of rated P_T.