

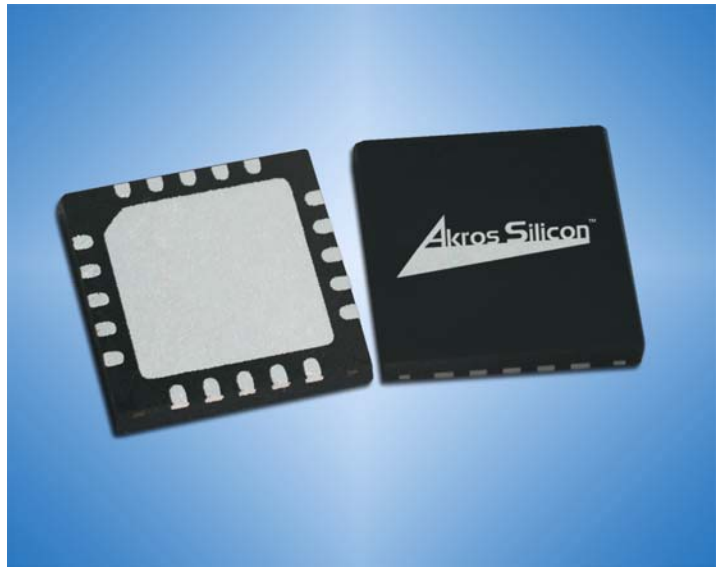


Application Note AN022

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# AS1135 Thermal Characterization Report

Revision 0.6, February, 2008



AS1135 silicon has been characterized in Akros Engineering Lab for thermal performance and estimation of junction temperature.

### **AS1135 Design Targets and Constants:**

Package thermal constants are:

$$\Theta_{ja} \text{ (Junction to Ambient)} = 31^{\circ}\text{C/W}$$

$$\Theta_{jc} \text{ (Junction to Case)} = 3.4^{\circ}\text{C/W}$$

AS1135 Max power consumption = 1.2W

AS1135 measured nominal power consumption = 0.9W

Following equations can be used to estimate the die-temperature based on these thermal constants:

$$T_{\text{junction}} = T_{\text{ambient}} + \Theta_{ja} * P_{\text{diss}}$$

or 
$$T_{\text{junction}} = T_{\text{case}} + \Theta_{jc} * P_{\text{diss}}$$

Based on above max power consumption – following **WORST case temperatures** can be derived

T <sub>ambient</sub> (°C)	T <sub>case</sub> (°C)	T <sub>Junction</sub> (°C)
25	58.1	62.2
40	73.1	77.2
70	103.1	107.2
85	118.1	122.2

Above calculations show that the junction temperature of the device is just about 4°C above the case temperature as measured at the copper paddle of the device.

### **Customer X Board Characterization:**

Customer X board is a 4-layer

#### **Configuration:**

- DUT: Customer X PoE Board #5
- Part: AS1135A2 part # 3

#### **Setup:**

- Lab Bench: 03
- DUT Power: DC Power Supply (Agilent 6634B) connected to DUT RJ45 power input
- DUT Load: Eload (HP 6063B) connected to DUT output header – J1, pins 49/50-1/2 (12V DC-DC output)
- Thermal Probes: Type K thermocouple attached to AS1135 case, Type K thermocouple placed near DUT to monitor air temperature
- Thermometer: Fluke 52 II
- Oven: Despatch LBB1-23A-1
- Thermal Environment: DUT placed in oven

Below picture shows the characterization setup.

**Procedure:**

1. Power up DUT (48V nom.) and adjust Eload for 30W nom. input to RJ45.
2. Ramp air temperature to 40 degC nom. and monitor AS1135 case temperature.
  - Stable measurement condition: < 1degC temperature excursion over 15 minute observation period

**Results:**

- Input: 48.01V, 0.6217A (29.85W)
- Output: 12.0V, 2.0A
- Ambient Temp.: 44.8 degC
- Case Temp.: 72.8 degC
- Soak Time: 1 hr.
- AS1135 Power dissipation: 0.9W

Based on above measurements, we can back calculate thermal constants.

$$\Theta_{ca} = (72.8 - 44.8)/0.9W = 31.1^{\circ}C/W$$

$$\text{Using } \Theta_{jc} \text{ of } 3.4^{\circ}C/W \Rightarrow \text{Operation } T_{junction} = 72.8 + 0.9W * 3.4 = 75.8^{\circ}C$$

**Correlation:**

Above measurement correlates well with the package design targets.

The AS1135 is designed in an automotive silicon process that is qualified at 160°C. Reliability data for the silicon process indicates that operation under 145°C limit will result in an overall failure rate of less than 21 FIT (1 failure / billion devices).

Good thermal performance does require adherence to appropriate board layout guidelines so that PCB can act as a good heat sink. Please refer to Akros Silicon Application Note AN018 for QFN Layout Guidelines.

**CONTACT INFORMATION**

Akros Silicon Inc.  
6399 San Ignacio Ave, Suite 250,  
San Jose, CA 95119  
USA

Tel: (408) 746 9000 ext. 100  
Fax: (916) 351-8102  
Email inquiries: [marcom@akrossilicon.com](mailto:marcom@akrossilicon.com)

Website: [www.akrossilicon.com](http://www.akrossilicon.com)

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