11

Thermal Characteristics

The maximum junction temperature must be kept below T_j(max)and this can only be guaranteed by proper analysis of the operating environment and the thermal path between the die and the air surrounding it.

11.1 Device Characteristics

These are fixed characteristics of the device and are independent of the operating environment or the characteristics of any heatsink:-

Maximum Junction Temperature	$T_{j(max)}$	=	125 °C.
Maximum Power Dissipation	Pd(max)	=	6.7 Watts
Nominal memory clock frequency	f_{MClk}	=	125 MHz
Nominal core clock frequency	f_{KClk}	=	125 MHz
Junction to case resistance	θ_{jt}	=	5.5 °C/Watt

(Eq: 11-1)

11.2 Thermal Model

The formula used to calculate the junction temperature (T_j) is

$$T_j = T_a + Pd(\theta_{jt} + \theta_{cs} + \theta_{sa})$$
$$= T_a + Pd\theta_{ja} \quad \text{(Eq: 11-2)}$$

Where:

T_j = Junction temperature (°C)
T_a = Ambient temperature (°C)
Pd = Power dissipation (Watts)
θ_{jt} = Junction to top of case thermal resistance (°C/Watt)
θ_{cs} = Case to Heatsink thermal resistance (°C/Watt)
θ_{sa} = Heatsink to Air thermal resistance (°C/Watt)
θ_{ja} = Total Junction to Air thermal resistance (°C/Watt)

(Eq: 11-3)

11.3 Cooling

PERMEDIA 3 should be operated with an attached heatsink or fan.

11.4 Operation with Heatsink

With a heatsink attached to the device the junction temperature will depend on θ_{cs} and θ_{sa} where θ_{cs} is the thermal resistance of the join between the heatsink and the case and θ_{sa} is the thermal resistance of the heatsink, which will be a function of system airflow. An ambient temperature of 40° C is assumed.

Heatsink to air thermal resistance			θsa
Maximum Junction Temperature	$T_{j(max)}$	=	125°C
Ambient Temperature	Ta	=	40°C
Maximum Power Dissipation	Pd(max)	=	6.7 Watts
Junction to case resistance	θjt	=	5.5°C/Watt
Heatsink to case resistance (EG 7655 epoxy - see below)	θcs	=	1.0°C/Watt

then:

$\theta sa \leq [(125 - 40)/6.7] - 5.5 - 1.0$

$\leq 6.2°C/Watt.$ Eq: 11-4

In this example a heatsink must be chosen which has a thermal resistance figure of no greater than 6.2°C/Watt at an airflow matching the expected airflow in the system..

11.5 1.1 Heatsink Attachment

The following method has been approved for the purpose of attaching a heatsink directly onto the copper surface of the SBGA package:

Thermally conductive epoxy using either Loctite Output 315 with Loctite 7386 or type EG 7655 from A.I. Technology Inc. The thickness of the epoxy layer should be between 0.05mm and 0.15mm with 95% coverage of the contact area.

Typical achievable ?cs using this method is 1.0 ° C/Wat