

12 Thermal Management

This section describes the 21164 thermal management and thermal design considerations.

12.1 Operating Temperature

The 21164 is specified to operate when the temperature at the center of the heat sink (T_c) is 72.6°C for 366 MHz, 70.6°C for 433 MHz, or 68.6°C for 500 MHz. Temperature (T_c) should be measured at the center of the heat sink (between the two package studs). The GRAFOIL pad is the interface material between the package and the heat sink.

Table 42 lists the values for the center of heat-sink-to-ambient (Θ_{ca}) for the 499-pin grid array. Table 43 shows the allowable T_a (without exceeding T_c) at various airflows.

Note: Samsung recommends using the heat sink because it greatly improves the ambient temperature requirement.

table 42 Θ_{ca} at Various Airflows

	Airflow (linear ft/min)					
	100	200	400	600	800	1000
Frequency: 366 MHz, 433 MHz, and 500 MHz						
Θ_{ca} with heat sink 1 (°C/W)	2.30	1.30	0.70	0.53	0.45	0.41
Θ_{ca} with heat sink 2 (°C/W)	1.25	0.75	0.48	0.40	0.35	0.32

table 43 Maximum T_a at Various Airflows (Sheet 1 of 2)

	Airflow (linear ft/min)					
	100	200	400	600	800	1000
Frequency: 366 MHz, Power: 31 W @Vdd = 3.3 V and @Vddi = 2.5 V						
T_a with heat sink 1 (°C)	—	32.3	50.9	56.2	58.7	59.9
T_a with heat sink 2 (°C)	33.9	49.4	57.7	60.2	61.8	62.7

Operating Temperature

table 43 Maximum T_a at Various Airflows

(Sheet 2 of 2)

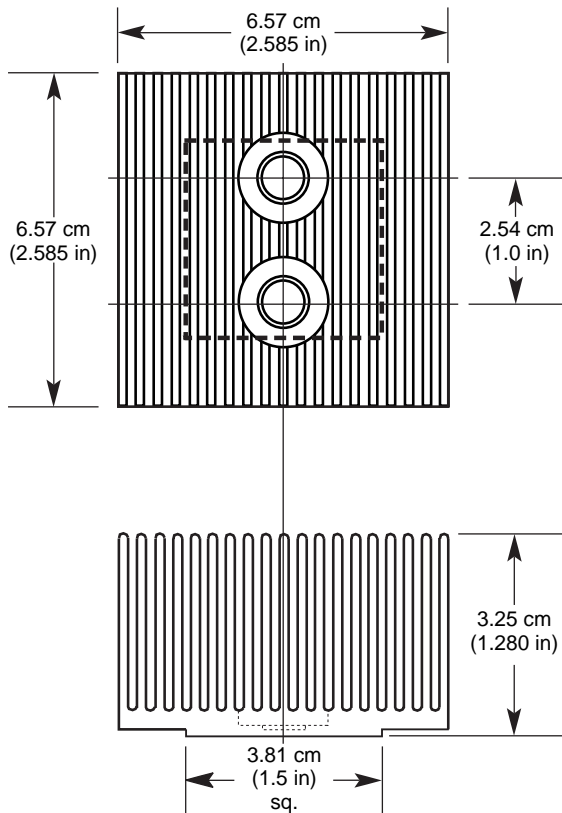
	Airflow (linear ft/min)					
	100	200	400	600	800	1000
Frequency: 433 MHz, Power: 36 W @Vdd = 3.3 V and @Vddi = 2.5 V						
T_a with heat sink 1 (°C)	—	23.8	45.4	51.5	54.4	55.8
T_a with heat sink 2 (°C)	25.6	43.6	53.3	56.2	58.0	59.1
Frequency: 500 MHz, Power: 41 W @Vdd = 3.3 V and @Vddi = 2.5 V						
T_a with heat sink 1 (°C)	—	—	39.9	46.9	50.2	51.2
T_a with heat sink 2 (°C)	—	37.9	48.9	52.2	54.3	55.5

Heat-Sink Specifications

12.2 Heat-Sink Specifications

Two heat sinks are specified. Heat sink type 1 mounting holes are in line with the cooling fins. Heat sink type 2 mounting holes are rotated 90° from the cooling fins. The heat sink composition is aluminum alloy 6063. Type 1 heat sink is shown in Figure 22, and type 2 heat sink is shown in Figure 23, along with their approximate dimensions.

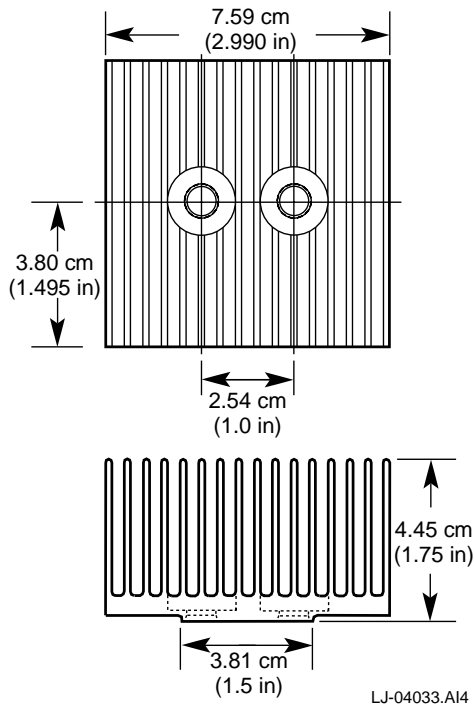
Figure 22 Type 1 Heat Sink



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Thermal Design Considerations

Figure 23 Type 2 Heat Sink



12.3 Thermal Design Considerations

Follow these guidelines for printed circuit board (PCB) component placement:

- Orient the 21164 on the PCB with the heat-sink fins aligned with the airflow direction.
- Avoid preheating ambient air. Place the 21164 on the PCB so that inlet air is not preheated by any other PCB components.
- Do not place other high-power devices in the vicinity of the 21164.
- Do not restrict the airflow across the 21164 heat sink. Placement of other devices must allow for maximum system airflow in order to maximize the performance of the heat sink.