

Pin Fin Aluminum Blue Anodized Heatsink for the IBM 5x86C Microprocessor



Application Note

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Revision Summary: This is the initial release of this Application Note.

Introduction

The objective of this application note is to provide users with the mechanical and thermal specifications of Pin Fin Aluminum Blue Anodized Heatsink. In a heatsink of this design a group of pins is formed by cutting through the parallel fins of the extruded heatsink perpendicular to the fins and thus it is called Pin Fin type heatsink.

Thermal Specifications

A heatsink is usually characterized by thermal resistance. Sink-to-ambient thermal resistance of the heatsink is obtained by first subtracting the ambient temperature from the temperature at the bottom of the heatsink where it makes contact with the CPU and dividing the resultant difference by the generated power in the CPU. Table 1 lists the thermal resistance of Pin Fin Aluminum Blue Anodized Heatsink for various air flows.

Air Flow over Heatsink in Feet per Minute (FPM)	Thermal Resistance of Heatsink in Degrees C per Watt
0	10.52
50	9.5
100	7.87
200	5.57
400	3.95

Table 1. Sink-to-Ambient Thermal Resistance of Pin Fin Aluminum Blue Anodized Heatsink.

Note that the thermal resistances in Table 1 are estimated values. The actual measured thermal resistance of the heatsink in a natural convection environment was 10.20 ° C per watt; which is close to the estimated value. As you can see from Table 1, the thermal resistance of the heatsink decreases when the air flow over the heatsink increases and vice versa. Note also that the lower the thermal resistance of the heatsink, the better the thermal performance of the heatsink.

IBM uses THERMATTACH™ T405 thermally conductive tape to attach the heatsink to the CPU. The thermal resistance of the tape is 0.16 degrees C per watt.

CPU Internal Clock Frequency in MHz	Air Flow over Heatsink in Feet per Minute (FPM)	Maximum Allowable System Ambient Temperature in Degree C
100	0	38.9
100	50	43.3
100	100	50.3
100	200	60.2
100	400	67.2
120	0	31.2
120	50	36.3
120	100	44.5
120	200	56.1
120	400	64.3

Table 2. Maximum Allowable System Ambient Temperature for 168 I/O PGA Ceramic Package 5x86C Microprocessor with Pin Fin Aluminum Blue Anodized Heatsink

For a given 168 I/O PGA Ceramic package 5x86C microprocessor with a known internal clock frequency and air flow over the Pin Fin Aluminum Blue Anodized Heatsink, the maximum allowable system ambient temperature can be obtained from Table 2. If the maximum allowable system ambient temperature is lower than the operating temperature specification, air flow over the heatsink can be increased to meet the operating temperature requirement. Note that the temperature inside the system is usually 5 - 10 degrees C higher than the room temperature.

Mechanical Specification

As the name implies, the heatsink is fabricated with extrusion grade aluminum material, usually 6061 alloy, followed by a coating of blue anodize to protect against corrosion and to enhance the esthetics. Below is the detail on mechanical specification of the heatsink. Note that a couple of fins are thicker than the rest of the fins but are not mentioned below. Also note that all the dimensions specified below are actual measured values.

Overall Size	44.55 mm (1.75 inches) X 44.55 mm (1.75 inches) X 9.04 mm (.356 inches)
Base Thickness	2.54 mm (.1 inches)
Fin Thickness in X-Direction	1.75 mm (.069 inches)
Fin Thickness in Y-Direction	2.2 mm (.087 inches)
Fin Spacing in X-Direction	1.8 mm (.071 inches)
Fin Spacing in Y-Direction	1.65 mm (.065 inches)
Pin Fin Matrix	13 X 12
Approximate Weight of the Heatsink	24 grams (.05 lb.)
Thermal Conductivity	154 Watt per meter - degrees K (89.01 BTU per hour-feet-degrees K)
Fin Surface Area	8010 sq. mm (12.42 sq. inches)
Heatsink Surface Area	12430 sq. mm (19.27 sq. inches)

If the overall size values of the heatsink exceed the available physical envelope in the system, this heatsink can not be employed.

Summary

This application note discussed the detail mechanical and thermal specifications of a Pin Fin Aluminum Blue Anodized Heatsink. It also provided the reader with the maximum allowable system ambient temperature for 168 I/O PGA Ceramic packaged 5x86C microprocessors at internal clock frequency of 100 and 120 MHz with Pin Fin Aluminum Blue Anodized Heatsink.

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