



Thermalloy

HEAT SINKS

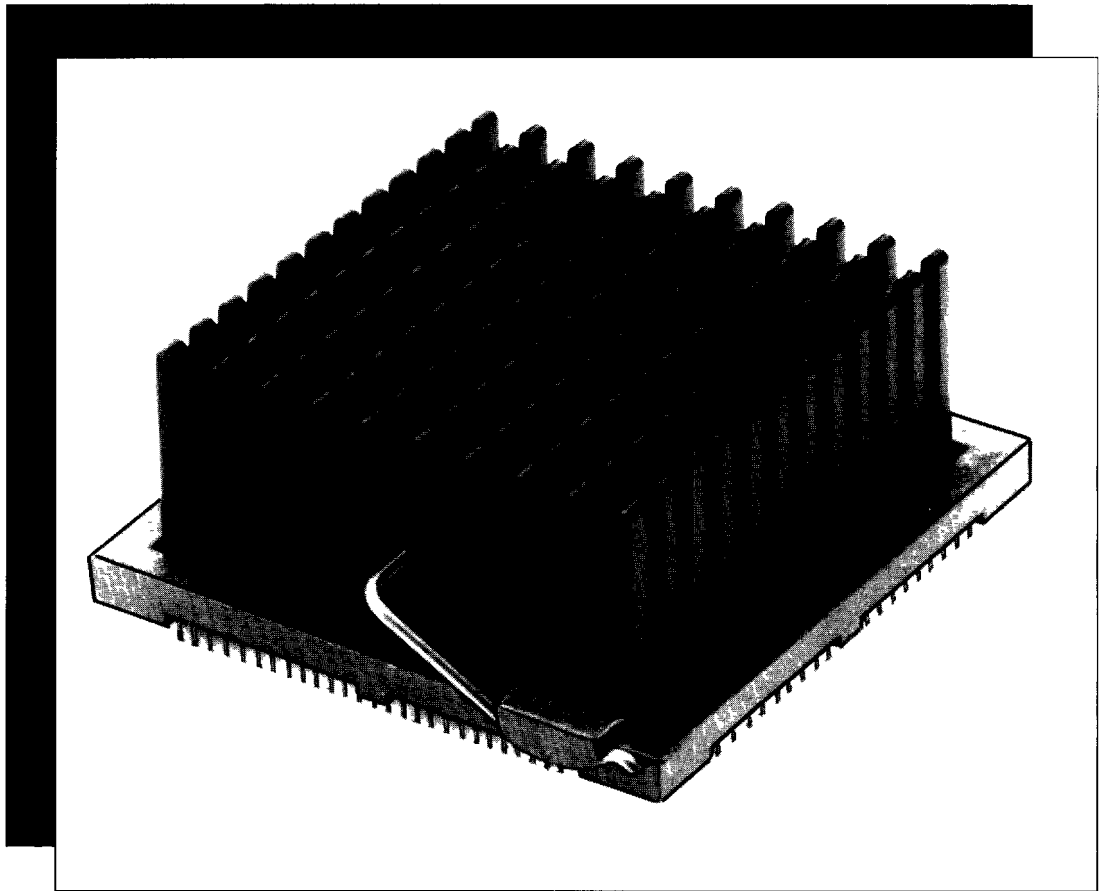
FOR ECL AND CMOS

ASICs

GATE ARRAYS

**MICROPROCESSORS
IN PGA PACKAGES**

**AND THE PGA E-Z MOUNT™
ASSEMBLY METHOD**



Represented By

THERMALLOY

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PGA E-Z MOUNT™

PGA E-Z Mount™

The PGA E-Z Mount™ eliminates many problems associated with bonding the heat sink to the pin grid array. The PGA E-Z Mount provides an easy, positive mechanical means of attachment. The PGA E-Z Mount consists of a plastic "frame" or two plastic "shoes" and a spring clip.

The attachment procedure is easy. The pin grid array is first placed into the frame, then the spring is placed in the heat sink and the spring is snapped over ridges on the frame. The shoes may be used in place of the frame if board space is tight. The two shoes are placed under the outer pins of the pin grid array to allow for spring clip attachment.

The heat sink and spring clip may alternatively be placed on the pin grid array after wave solder if desired. The PGA E-Z Mount also allows you to remove the heat sink from the device after wave solder if necessary.

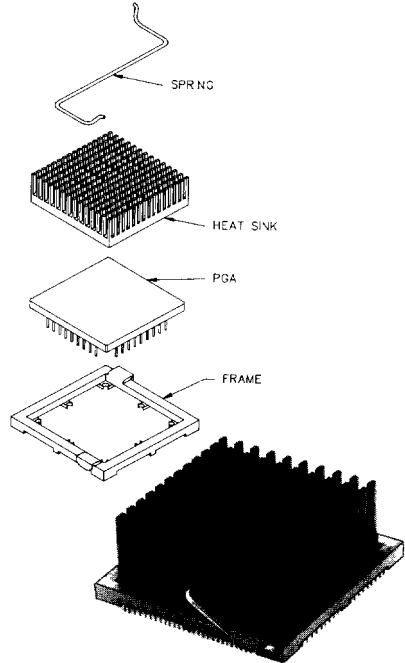
The PGA E-Z Mount prevents chip breakage caused by the thermal expansion mismatch associated with epoxy bonding. The hassles and mess of these secondary operations are also eliminated.

Pin fin and radial fin heat sinks both may be used with the PGA E-Z Mount assembly using either the frame or the shoes. Heat sinks and PGA E-Z Mounts are ordered separately.

To order:

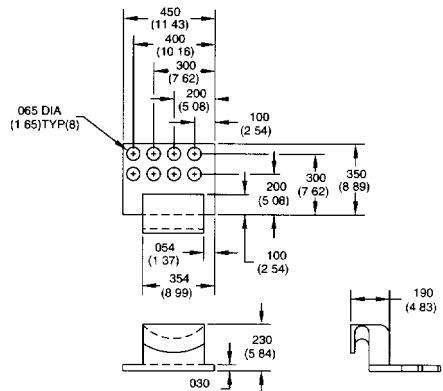
To order the PGA E-Z Mount with the frame attachment method, simply specify the Assembly number corresponding to the heat sink you have selected. For example, 8315-PF15 for a 2330B heat sink.

To order the PGA E-Z Mount with the shoe attachment method, simply replace the frame number with the shoe number that corresponds to the heat sink you have selected. For example, 8301-PF15 for a 2330B heat sink.



8315-PF15
with 2330B Heat Sink

8304 Shoe



NOTE: TOLERANCES ± 0.11 (28) UNLESS OTHERWISE SPECIFIED

Pin Grid Array Attachment Frames

Frame	Dimension A	Dimension B	Dimension C	Weight (lbs./grams)	Spring	Assembly No.
8311	1 350 (34 29)	1 150 (29 21)	150 (3 81)	0 004 (1 81)	PF11	8311-PF11
8313	1 600 (40 64)	1 400 (35 56)	185 (4 70)	0 006 (2 72)	PF13	8313-PF13
8314	1 700 (43 18)	1 480 (37 59)	0 185 (4 70)	0 007 (3 18)	PF14	8314-PF14
8315	1 800 (45 72)	1 542 (39 17)	185 (4 70)	0 008 (3 63)	PF15 or SP15	8315-PF15 or 8315-SP15
8316	1 900 (48 26)	1 700 (43 18)	185 (4 70)	0 008 (3 63)	PF16	8316-PF16
8317	2 000 (50 80)	1 820 (46 23)	210 (5 33)	0 008 (3 63)	PF17	8317-PF17
8318	2 100 (53 34)	1 900 (48 26)	210 (5 33)	0 009 (4 08)	PF18	8318-PF18
8320	2 300 (58 42)	2 050 (52 07)	230 (5 84)	0 009 (4 08)	PF20	8320-PF20
8321	2 400 (60 96)	2 150 (54 61)	0 210 (5 33)	0 013 (5 90)	PF21	8321-PF21

U.S. Patent No 4,745,466 U.K. Patent No 2195051

Pin Grid Array Attachment Shoes

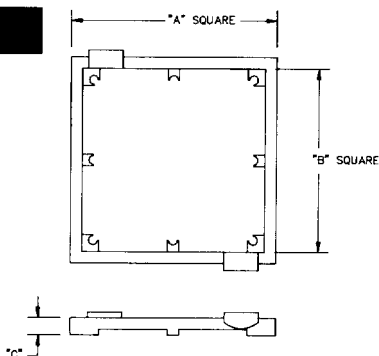
Shoes	Dimensions	Weight
8301	See dimensions in the profiles below	0 001 (0 45)
8302	See dimensions in the profiles below	0 001 (0 45)
8304	See dimensions in the profiles below	0 001 (0 45)

Patent Pending

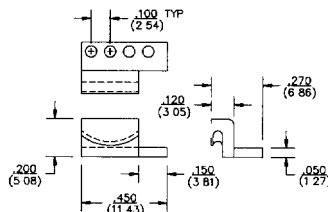
Materials and Finishes: Shoe and Frame: Polyphenylene Sulfide (PPS) per ASTM D4067-84-PPS 000G40A43443, annealed after molding. Flammability UL 94 V-0 and 5V, no finish. U.L. "E" Card number E54700(N).

Springs: Music wire, pre-tinned finish.

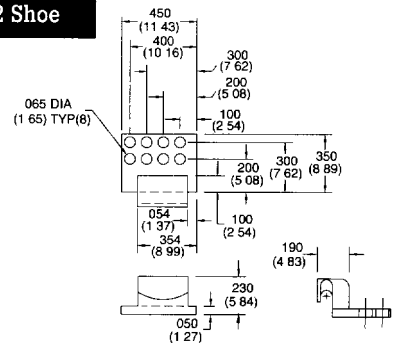
Frame



8301 Shoe



8302 Shoe



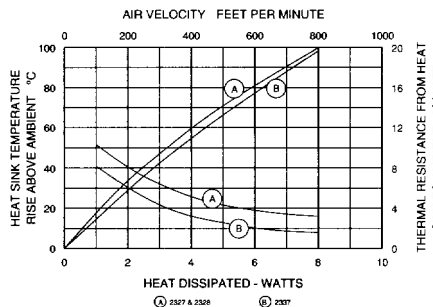
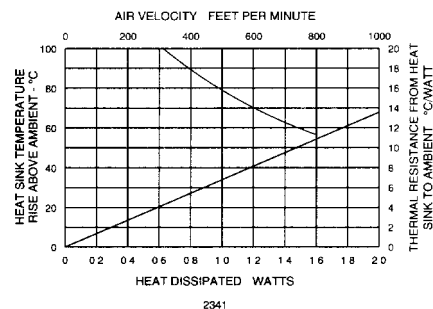
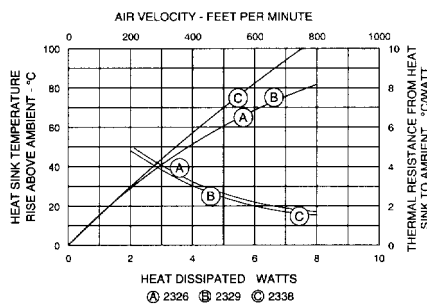
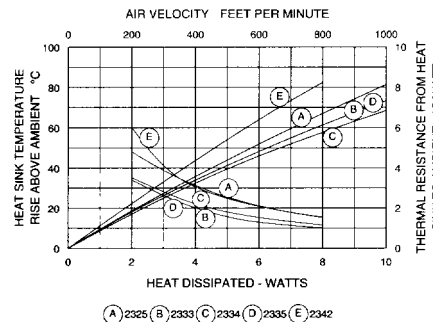
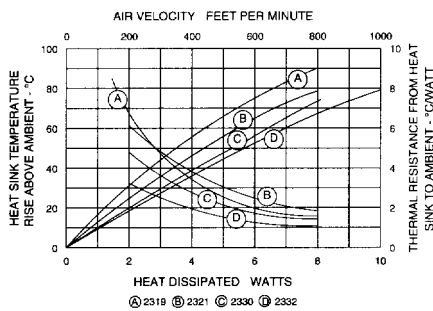
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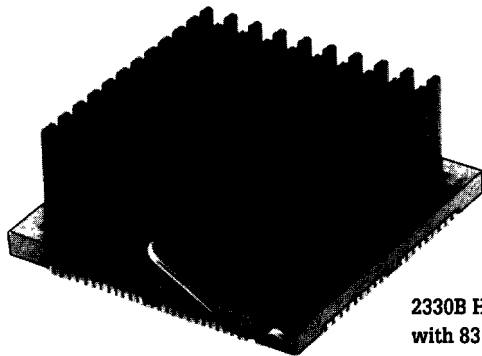
**PIN FIN
HEAT SINKS**

2300 Series Pin Fin Heat Sinks

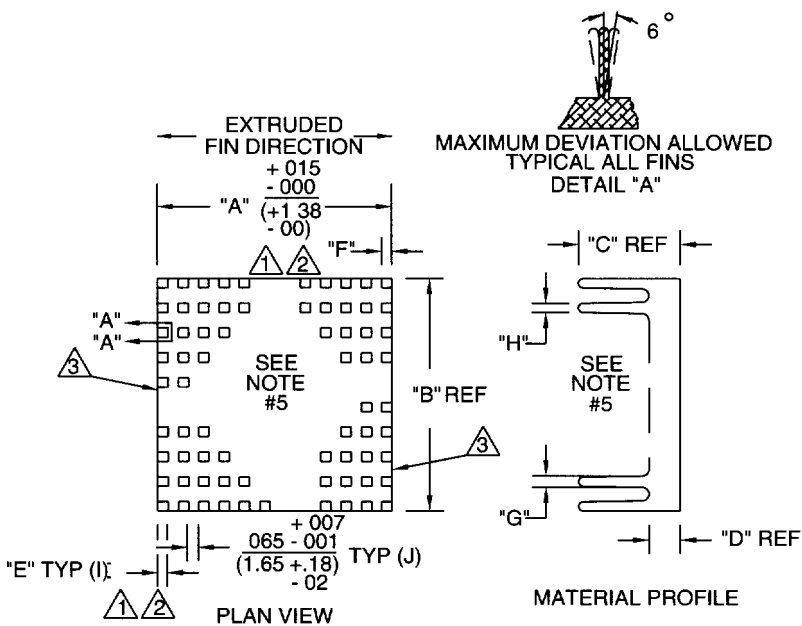
- Omnidirectional heat sinks for pin and arrays.
- Ideally suited to impingement cooling
- 20% greater performance than extruded equivalents.
- Heat Sinks may be bonded to the PGA with epoxy or with the PGA E-Z Mount™*



2341B



**2330B Heat Sink
with 8315-PF15 PGA E-Z Mount**



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**PIN FIN AND
HIGH FIN RATIO
HEAT SINKS**

Pin Fin Heat Sinks

Model	PGA Size	R _θ Natural Convection °C/W*	R _θ Forced Convection (400 FPM) °C/W	Pin Fin Matrix	Weight (lbs./grams)	PGA E-Z Mount		Dimensions								Typical	
						Frame	Spring	A	B	C	D	E	F	G	H	I	J
2341B	N/A	34.1	18.0	4 x 6	004 (1.81)	N/A	N/A	685 (17.40)	400 (10.16)	400 (10.16)	052 (1.32)	060 (1.52)	060 (1.52)	064 (1.62)	052 (1.32)	5	5
2327B	11 x 11	13.6	5.2	7 x 9	027 (12.25)	N/A	N/A	1 105 (28.07)	1 100 (27.94)	600 (15.24)	150 (3.81)	065 (1.65)	065 (1.65)	062 (1.57)	062 (1.57)	8	8
2328B	11 x 11	14.4	6.2	7 x 8	028 (12.70)	8311	PF11	975 (24.76)	1 100 (27.94)	600 (15.24)	150 (3.81)	065 (1.65)	065 (1.65)	062 (1.57)	062 (1.57)	7	7
2337B	12 x 12	12.9	3.1	8 x 9	036 (16.33)	▲	PF11	1 105 (28.07)	1 200 (30.48)	650 (16.51)	200 (5.08)	065 (1.65)	065 (1.65)	059 (1.50)	059 (1.50)	8	8
2326B	13 x 13	10.0	3.0	8 x 10	041 (18.60)	8313	PF13	1 235 (31.37)	1 300 (33.02)	650 (16.51)	200 (5.08)	065 (1.65)	065 (1.65)	061 (1.55)	061 (1.55)	9	9
2338B	13 x 13	13.0	3.0	9 x 10	034 (15.42)	8313	PF13	1 235 (31.37)	1 300 (33.02)	490 (12.45)	130 (3.30)	065 (1.65)	065 (1.65)	082 (2.08)	060 (1.52)	9	9
2329B	14 x 14	10.0	3.0	9 x 10	045 (20.41)	8314	PF14	1 235 (31.37)	1 358 (34.49)	650 (16.51)	200 (5.08)	065 (1.65)	065 (1.65)	076 (1.93)	062 (1.57)	9	9
2319B	15 x 15	12.5	3.5	10 x 12	033 (14.97)	8315	PF15	1 495 (37.97)	1 500 (38.10)	400 (10.16)	120 (3.05)	065 (1.65)	065 (1.65)	060 (1.52)	060 (1.52)	11	11
2330B	15 x 15	9.2	2.8	10 x 12	062 (28.12)	8315	PF15	1 495 (37.97)	1 500 (38.10)	650 (16.51)	200 (5.08)	065 (1.65)	065 (1.65)	076 (1.93)	060 (1.52)	11	11
2321B	17 x 17 18 x 18	10.0	3.9	12 x 13	043 (19.50)	8317 8318	PF17 PF18	1 625 (41.28)	1 700 (43.18)	350 (8.89)	120 (3.05)	065 (1.65)	065 (1.65)	061 (1.55)	061 (1.55)	12	12
2332B	17 x 17 18 x 18	8.2	2.0	12 x 13	078 (35.38)	8317 8318	PF17 PF18	1 625 (41.28)	1 700 (43.18)	650 (16.51)	200 (5.08)	065 (1.65)	065 (1.65)	072 (1.83)	050 (1.27)	12	12
2333B	17 x 17 18 x 18	7.2	2.0	12 x 14	087 (39.46)	8317 8318	PF17 PF18	1 755 (44.58)	1 800 (45.72)	650 (16.51)	200 (5.08)	065 (1.65)	065 (1.65)	073 (1.85)	051 (1.30)	13	13
2342B	17 x 17 18 x 18	10.3	3.0	14 x 14	046 (20.86)	8317 8318	PF17 PF18	1 755 (44.58)	1 800 (45.72)	275 (6.98)	120 (3.05)	065 (1.65)	065 (1.65)	070 (1.78)	058 (1.47)	13	13
2335B	19 x 19	7.2	2.0	12 x 15	095 (43.09)	▲	PF19	1 885 (47.88)	1 900 (48.26)	650 (16.51)	200 (5.08)	065 (1.65)	065 (1.65)	085 (2.16)	063 (1.60)	14	14
2325B	21 x 21	8.3	2.1	16 x 16	070 (31.75)	8321	PF21	2 015 (51.18)	2 100 (53.34)	400 (10.16)	120 (3.05)	065 (1.65)	065 (1.65)	060 (1.52)	060 (1.52)	15	15
2334B	21 x 21	6.5	2.1	14 x 16	112 (50.80)	8321	PF21	2 015 (51.18)	2 100 (53.34)	650 (16.51)	200 (5.08)	065 (1.65)	065 (1.65)	064 (1.62)	050 (1.27)	15	15

U S Patent Nos 4,879, 891 and 4,884,331 U K Patent No 2204181

Note: Tolerances are ± 0.11 (28) unless otherwise specified

* The thermal resistance is based on mounting surface temperature rise of 75°C above the ambient

Notes:

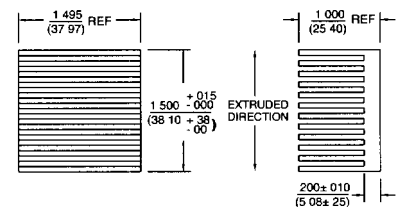
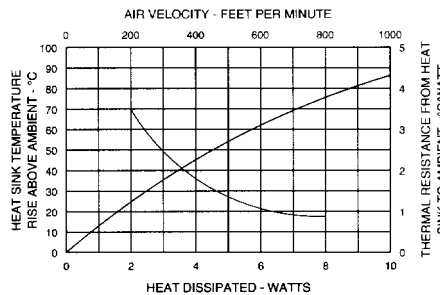
- ▲ In order to achieve fin uniformity, variation from minimum fin dimension to maximum fin dimension must be 0.16 (41) or less
- ▲ Tolerances do not apply to last row of fins due to manufacturing variances This row, however, meets requirements as specified in note ▲ above
- ▲ Cut off either end to be ±1/2° angularity in relation to extruded length
- ▲ Dimensions and tolerances are to be considered at the extruded base unless otherwise specified
- ▲ Fin layout as shown is intended to be representative only The actual fin count and layout is specified in the table
- ▲ The 8301, 8302, or 8304 "shoes" may be used in place of the frame if desired
- ▲ The PF13 and PF19 springs are available on special order – contact the factory
- ▲ The PGA E-Z Mount is compatible with heat sinks listed under smaller PGA sizes

2380

- For pin grid arrays of 15 x 15 pins
- High fin ratio, 12.1 (fin height fin spacing), provides 100% more surface area than conventional extrusion of same size



2380B
with 8315-PF15



Note: Radii allowable on tips of fins and between fins at the base

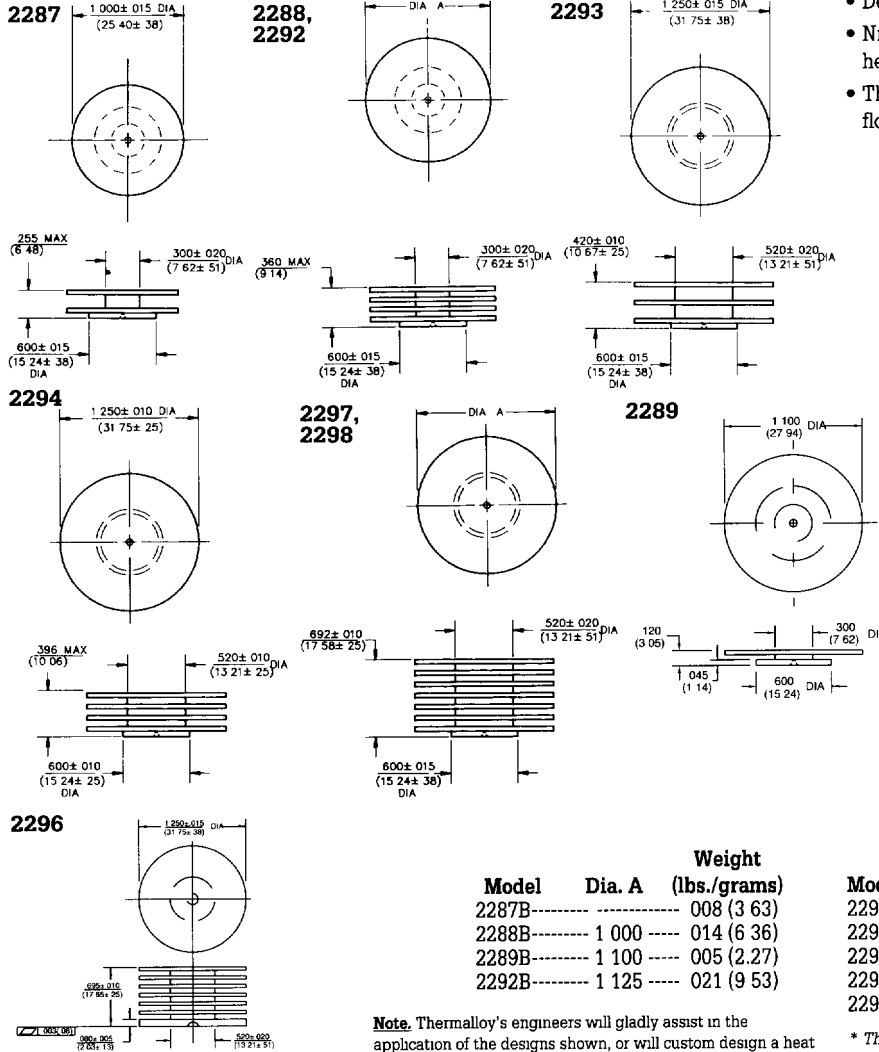
Model	Weight (lbs./grams)	PGA E-Z Mount™ Frame	Spring
2380B-----	138 (62.60) -----	8315-----	PF15

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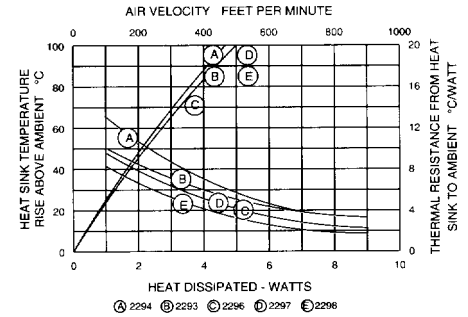
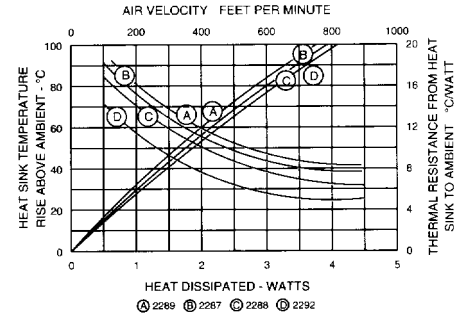
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**RADIAL FIN
HEAT SINKS**

2280 and 2290 Series



- Designed for gate arrays packaged in pin grid arrays
- Nine alternatives for differing pin grid array sizes and heat sink heights
- The 2287 and 2293 offer wide fin spacing, allowing air flow to several in-line heat sinks



Note. Thermal performance is based on gold chromate finish

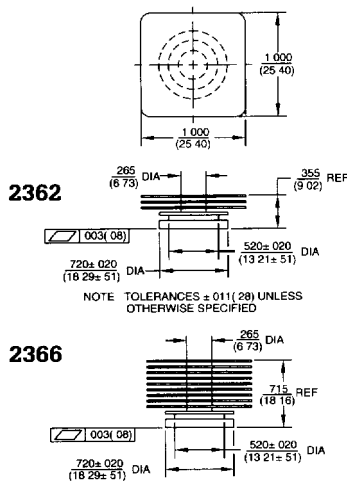
Model	Dia. A	Weight (lbs./grams)
2287B	1.000	008 (3.63)
2288B	1.000	014 (6.36)
2289B	1.100	005 (2.27)
2292B	1.125	021 (9.53)

Model	Dia. A	Weight (lbs./grams)	PGA E-Z Mount Frame*	Spring
2293B	023	(10.44)	8314	SP15
2294B	024	(10.90)	8314	SP15
2296B	047	(21.32)	8314	SP15
2297B	1.250	040 (18.16)	8314	SP15
2298B	1.500	050 (22.70)	8315	SP15

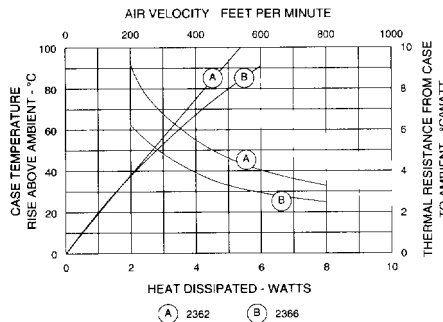
Note. Thermalloy's engineers will gladly assist in the application of the designs shown, or will custom design a heat sink that meets your exact thermal and mechanical specifications

* The 8301, 8302, or 8304 "shoes" may be used in place of the frame if desired

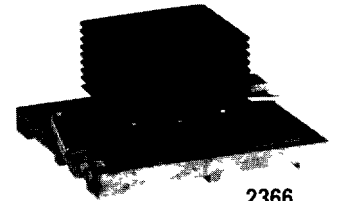
2362B, 2366B



NOTE TOLERANCES ± 0.11 (.28) UNLESS OTHERWISE NOTED



Model	Weight (lbs./grams)
2362B	012 (5.44)
2366B	026 (11.79)



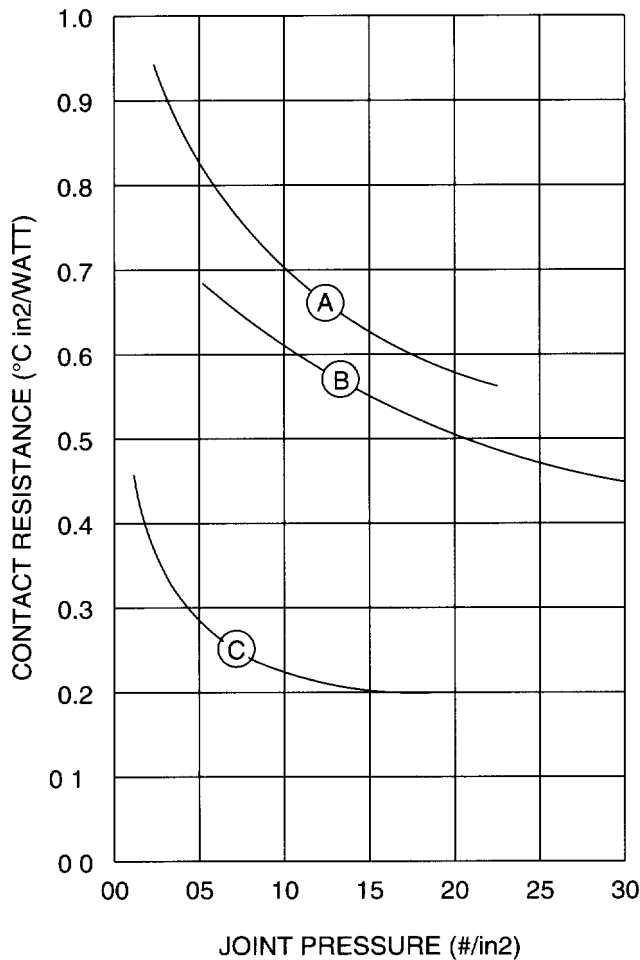
2366
with 8315-SP15

- Optimum heat transfer through extended surface area in small volume
- May bond with epoxy, or use PGA E-Z Mount for 15 x 15 pin PGA's
- The 2362 has 3 fins, the 2366 has 9 fins

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JOINT CONTACT RESISTANCE
VS JOINT PRESSURE



- Ⓐ 1.50 in. x 1.50 in /no grease
- Ⓑ ROHSENOW/HARTNETT
Handbook of Heat Transfer
- Ⓒ 1.50 in x 1.50 in /with grease

Test Data-General

Thermalloy has experimentally examined the interface thermal resistance versus interface pressure for dry and grease filled joints. These data have been normalized to unit areas and the results are shown in the graph. For comparison, the graph also shows the results of other experimenters* and, as can be seen, the test results compare rather favorably considering all the variables involved.

Description of Test Set-up

Test data were obtained by attaching a heater block to one side of the interface joint and a liquid cooled loop on the opposing surface. The test set-up was thermally isolated from the environment to minimize an energy leak from the exposed edges or surfaces (guarded plate) of the set-up. The energy input was measured by the current/voltage input and the temperature drop across the joint measured using 36 gauge thermocouples embedded in the joint plates. The joint load was imposed at the area centroid and measured using the Chantlin gauge/loading instrument.

* Warren M. Rohsenow and James P. Hartnett, *Handbook of Heat Transfer*, McGraw-Hill, 1973

Engineering Information Releases (EIR's)

Many tests and evaluations have been conducted on PGA heat sinks by Thermalloy's Engineering Department. They are available to you upon request by calling your local Thermalloy representative or the factory directly.

INTRODUCTION

EIR 87-1012 Heat Sinks for Gate Arrays

ADHESIVE ATTACHMENT AND INTERFACE DATA

EIR 87-1021 Adhesives for Heat Sink Attachment

EIR 87-1035 An Abbreviated Analysis of the Thermal Expansion Mismatch Substrate-to-Heat Sink ASIC Applications

EIR 87-1022 Interface Thermal Resistance ($R_{\theta CS}$) Data for Gate Array Heat Sink Applications

EIR 90-1003 Interface Resistance vs Transistor Loading - General

PIN FIN AND HIGH FIN RATIO HEAT SINKS

EIR 87-1026 Thermal Performance of Pin Fin and High Fin Ratio (HFR) Heat Sinks 2328B, 2330B, 2334B, and 2384B

EIR 87-1027 Thermal Comparison of the 2330B vs a 4/10 Inch Tall 2330B

EIR 87-1040 Simulated PGA Performance Using the 8315-SP15 Frame and Spring with Various Heat Sinks.

Thermalloy Heat Sinks and PGA E-Z Mount™ for Specific Microprocessor Manufacturers

Manufacturer	Device	PGA Size	Heat Sink	Height		Rθ		PGA E-Z Mount	
				Inches (mm)	(° C/W)	Natural Convection (° C/W)	Forced Convection (° C/W, 400FPM)		
Intel	i386	14 x 14	2329B	.650 (16.51)	10.0	3.0		8314-PF14	
	i486	17 x 17	2342B	.275 (6.98)	10.8	4.0		8317-PF17	
			2321B	.350 (8.89)	10.0	3.9		8317-PF17	
			2332B	.650 (16.51)	8.2	2.0		8317-PF17	
i860	17 x 17	2342B	.275 (6.98)	10.8	4.0		8317-PF17		
		2321B	.350 (8.89)	10.0	3.9		8317-PF17		
		2332B	.650 (16.51)	8.2	2.0		8317-PF17		
i960	17 x 17	2342B	.275 (6.98)	10.8	4.0		8317-PF17		
		2321B	.350 (8.89)	10.0	3.9		8317-PF17		
		2332B	.650 (16.51)	8.2	2.0		8317-PF17		
Advanced Micro Devices (AMD)	Am386	14 x 14	2329B	.650 (16.51)	10.0	3.0		8314-PF14	
			Am29000	2342B	.275 (6.98)	10.8	4.0		8317-PF17
				2321B	.350 (8.89)	10.0	3.9		8317-PF17
				2332B	.650 (16.51)	8.2	2.0		8317-PF17
Motorola	68040	18 x 18	2342B	.275 (6.98)	10.8	4.0		8318-PF18	
			2321B	.350 (8.89)	10.0	3.9		8318-PF18	
			2333B	.650 (16.51)	7.2	2.0		8318-PF18	
			2338B*	.490 (12.45)	13.0	3.0		8318-PF18	

* Smaller heat sink is recommended when chip capacitors are present on the top surface of the PGA.

Weittek	386 (coprocessor)	13 x 13	2338B	.490 (12.45)	13.0	3.0		8313-PF13
			2326B	.650 (16.51)	10.0	3.0		8313-PF13

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