Thermal Management

Innovative air & liquid cooled heatsinks and cooling systems

Your problem: You need to protect critical semiconductor and power electronic systems from heat generated during high power applications.

Our solution: Mersen offers innovative thermal management solutions. We deliver patented cooling technology that absorbs and dissipates heat from critical components. Our innovative Fabfin® product was the first “glueless technology” for high performance, high ratio heatsink solutions. Our pioneering products can be found in a wide range of applications and industries including, industrial controls, motor drives, power controls, transportation, communication, medical, solar power and wind power.

Want more information fast? Take advantage of R-Tools® - our free 3D Thermal Modeling software on our website, click Resources & select R-tools. For quotes or questions on heatsinks and cooling systems, email us at sales.mis@mersen.com or contact applications support at 905-795-0077 x258 or x340. You may also visit our website at **ep-us.mersen.com** and click “Products > Product Data >Thermal Management.”

M Thermal Management

Air Cooled

Liquid Cooled

Cooling

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FERRAZ SHAWMUT IS NOW MERSEN

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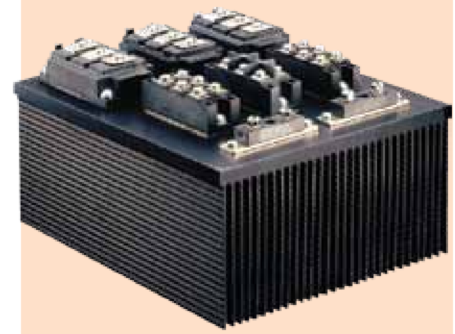
Air Cooled Fabfin® Heatsink

The first patented "glueless technology" air cooled

Fabfin is a fabricated air cooled heatsink with a height-to-fin spacing ratio greater than an extruded section. Fabfin can be supplied essentially of any size where a multitude of aluminum fins of varying heights and thickness are attached by a swaging process to an aluminum base plate of variable thickness, length and width, on four standard fin spacings. These standard spacings are designated as an FF (8.51 mm), DF (6.86 mm), AF (5.49 mm), or MF (3.43 mm) series. Typical alloy is 6063 for both fins and base plate. Finishes are numerous. No glue is used in the process.

Performance can be modeled within R-Tools.



Features/Benefits:

- Fabricated
- Multiple fins joined to baseplate by swaging process
- Metal to metal construction. Al/Al Cu/Al Cu/Cu
- Immensely rugged
- No epoxy/glue used in fabrication process
- No thermal barrier at fin to baseplate join
- Fin height to spacing ratio much greater than extruded section
- -40^{0}C to + 350^{0}C storage and operating range
- Capable of withstanding extensive vibration
- Tongue and groove construction
- Baseplates can be welded together with fins attached

Performance:

- Typically 15% lower thermal impedance than a glued solution
- Can be modeled on R-Tools

Highlights:

- Essentially any width, length or height
- Any fin height to spacing ratio up to 46:1
- Anodize finish
- Chromate finish: Hexavalent + Trivalent
- Electroless nickel finish
- Selective use of copper fins

Applications:

- Communications
- Industrial controls
- Medical, Military
- Motor drives
- Power controls
- Solar energy
- Transportation
- Wind energy

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Air Cooled Fabfin® Heatsink

What you need to know about Fabfin Heatsinks

Welcome to the amazing potential of Fabfin. The design engineer can now leap beyond the limitations of low ratio one piece aluminum extrusions and the thermal barriers of epoxy assemblies by using Fabfin — the high ratio, high performance, immensely rugged, thermal barrier-free aluminum heatsink assembly. Within a broad mechanical envelope lies unlimited possibilities to address your most challenging thermal applications.

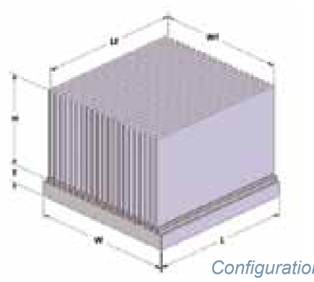
All configurations

- L = Length of baseplate
- L*f* = Length of fin
- W = Width of baseplate
- W*f* = Width over fins
- T = Thickness of baseplate
- T*f* = Thickness of flange

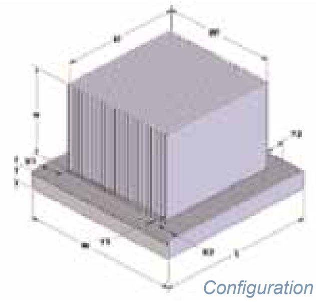
- Baseplate thickness:
  9 mm Min
  64 mm Max

- Non-tooled fin height within each family will be provided by shearing the next taller fin. If quantities dictate we will tool a new fin.

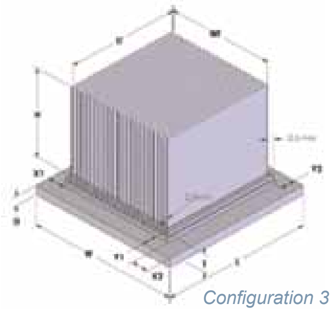
- Max fin height 118 mm except MF which is 49 mm tall. MF equivalent fins can be achieved by selecting the Hollowfin® on 6.86 mm centers.



Configuration 1



Configuration 2



Configuration 3

Note: Configurable aluminum air cooled assemblies. Four series organized on baseplate slot spacing. Highly flexible width, length and fin arrangement.

Copper options available.

Configuration 1

(without mounting flanges: all slots filled)

- L = L*f* =1250
- W = [W*f* + (2 x shoulder)] = Wmax (see Fig. 1 Table 2)
- Number of fins = Width indicator (N) corresponding to W (see formulas in Table 3)
- Shoulder Width ≥ 2.5 mm for MF, 3.5 mm ≥ AF, DF and FF

Configuration 2

(with mounting flanges; exposed fin slots)

- L = (L*f* + Y1 + Y2) =1250
- If flanges Y1 and Y2 = 0, then L*f* = L
- X1 may equal X2 but both must be specified
- W = (W*f* + X1 + X2) = Wmax (see Fig. 1 Table 2)
- Flanges X1 and X2 must be ≥ 2.5 mm for MF, ≥ 3.5 mm for AF, DF and FF
- Y1 may equal Y2 but both must be specified
- Number of fins = Width indicator (N) corresponding to W*f* (see formulas in Table 3)

Configuration 3

(with mounting flanges; machined surfaces)

- L = [L*f* + Y1 + Y2 + (2 x 2.5)] =1250
- If flanges Y1 and Y2 = 0, then L*f* = L
- X1 may equal X2 but both must be specified
- W = [W*f* + X1 + X2 + (2 x shoulder)] = Wmax (see Fig. 1 Table 2)
- Flanges X1 and X2 must be specified beyond 2.5 shoulder for MF and 3.5 mm for AF, DF and FF
- Y1 may equal Y2 but both must be specified
- Number of fins = Width indicator (N) corresponding to W*f* (see formulas in Table 3)
- T*f* must be = T – 3.3 in order to remove the fin slots

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Air Cooled Fabfin® Heatsink Configurator

9-easy steps to configure a Fabfin

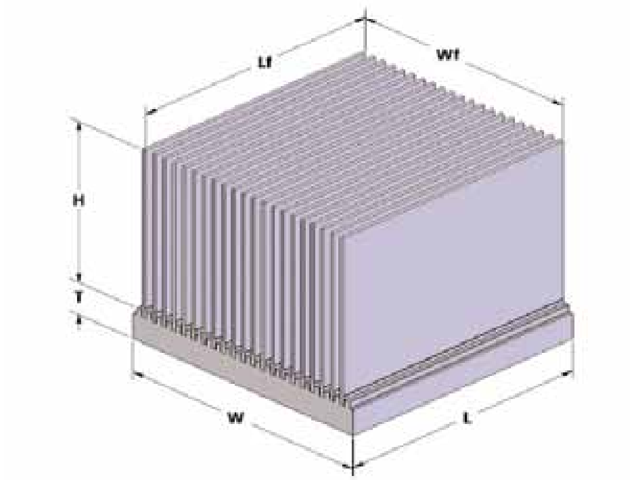
The following represents a sample configuration of Figure 3, page 6

STEP 1: Select a series

Select a series for a fin pitch.

Table 1: Fin Pitch

Series	Fin Pitch (CC) (Center to Center)
MF	3.43 mm
AF	5.49 mm
DF	6.86 mm
FF	8.51 mm



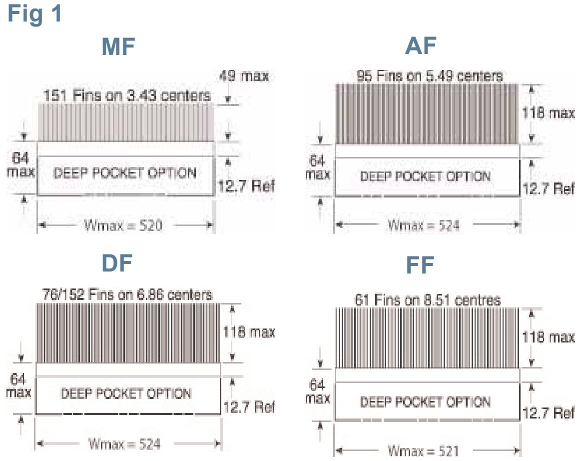
Configuration 1

Fig. 2

Table 1 (above) and Fig. 1 (below) show the four standard Fabfin series based on Fin Pitch (CC). Variables within each series include length, width and thickness of baseplate as well as height and thickness of fins.

Part Number Example: FF

Fig 1



STEP 2: Select a configuration

All Fabfin baseplates can be configured with or without a mounting flange. To define the configuration see detailed diagrams on page 3. If configuration 2 or 3 are selected please specify the x and y coordinates for the mounting flange area.

Configuration 1

* fully populated, full length fins and without mounting flanges- all slots filled

Configuration 2

* unmachined exposed flange(s)

Configuration 3

* machined exposed flange(s)

Part Number:

Configuration 1 = no digit required

Configuration 2 = 2

Configuration 3 = 3

**(if configurator 2 or 3 is selected the digit/code appears at the very end of the product number)*

Part Number Example: FF

Air Cooled Fabfin® Heatsink Configurator

STEP 3: Select a total length

Select the total length in mm *(this is user defined)

eg. L = L*f* = 300 mm

Part Number Example: FF300

STEP 4: Select a baseplate thickness

(refer to Table 2)

All Fabfin heatsinks are available with standard 12.7 mm baseplate thickness but many other thicknesses are tooled. The baseplate thickness is typically governed by the mechanical, thermal and cost requirements of the application. Custom baseplate thicknesses can be provided within the range of 9 mm to 64 mm by cutting new extrusion dies or gang slotting of the baseplate. New tooling is coming on-line continuously and we may be able to supply your special needs at no additional cost.

Part Number Example: FF300T13

Table 2 (a-d) Baseplate Thickness

Table 2a - MF Baseplate Options

Thickness Reference	Thickness T (mm)	Maximum Width Wmax(mm)
T13	12.7	Up to 305 mm
T00	to be specified	

Table 2b - AF Baseplate Options

Thickness Reference	Thickness T (mm)	Maximum Width Wmax(mm)
T10	9.9	Up to 222 mm
T13	12.7	Up to 524 mm
T15	14.9	Up to 524 mm
T19	19.0	Up to 343 mm
T00	to be specified	

Table 2c - DF Baseplate Options

Thickness Reference	Thickness T (mm)	Maximum Width Wmax(mm)
T10	9.5	Up to 310 mm
T13	12.7	Up to 524 mm
T14	14.2	Up to 337 mm
T15	15.3	Up to 524 mm
T17	17.3	Up to 324 mm
T18	18.3	Up to 400 mm
T00	to be specified	

Table 2d - FF Baseplate Options

Thickness Reference	Thickness T (mm)	Maximum Width Wmax(mm)
T13	12.7	Up to 520 mm
T00	to be specified	

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Air Cooled Fabfin® Heatsink Configurator

STEP 5: Select a baseplate material

Choose one of the following materials: A = Aluminum
C = Copper

Part Number Example: FF300T13A

STEP 6: Determine width indicator (N)

To convert baseplate width to width indicator, select desired baseplate total width (W). To determine Width Indicator (N) use the formula at the bottom of each series table. (refer to Table 3)

i.e. If W = 260 mm

$$N = \frac{260 - 9.4}{8.51}$$

= 29.4 *(round up to the nearest integer)

N = 30

Refer to Table 3 for standard tooled baseplate widths (W).

Alternatively go to the Fabfin configurator section on the website for a complete listing of all widths and fin counts.

Mersen will manufacture this heatsink by machining the next wider standard baseplate. (refer to Table 3d)

Fin count

Configuration 1: Number of fins = Width indicator (N)
Configuration 2,3: Substitute W_f into the formula at the bottom of each series in Table 3 to obtain fin count.

Wider widths are frequently supplied by welding Fabfin assemblies together. The swaged fin to baseplate joint is unaffected by the elevated welding temperatures.

Part Number Example: FF300T13A30

Fig. 3 Sample Heatsink

Table 3 (a-d) Width Indicator

Table 3a - Standard Tooled Baseplates

Width (mm) W	Width Indicator N	Width Fin to Fin (mm) Wf
127	36	121.4
202	58	196.8
237	68	231.1
264	76	258.6
302	87	296.3

Table 3b - AF Standard Tooled Baseplates

Width (mm) W	Width Indicator N	Width Fin to Fin (mm) Wf
223	40	215.4
234	42	226.4
300	54	292.3
343	62	336.2
349	63	341.7
404	73	396.6
525	95	517.4

Table 3c - DF Standard Tooled Baseplates

Width (mm) W	Width Indicator N	Width Fin to Fin (mm) Wf
257	37	249.4
298	43	290.5
310	45	304.2
325	47	318.0
339	49	331.7
401	58	393.4
524	76	516.9

Table 3d - FF Standard Tooled Baseplates

Width (mm) W	Width Indicator N	Width Fin to Fin (mm) Wf
121	14	113.0
190	22	181.1
274	32	266.2
308	36	300.3
393	46	385.4
521	61	513.0

Air Cooled Fabfin® Heatsink Configurator

STEP 7: Select fin

To select fin material, style and height, please refer to Fig. 4 and Table 4 for standard heights and fin height ratios for each series.

Non-standard fin height within each family will be provided by shearing the next taller fin.

The exact fin height in millimeters should substitute the 000 in the Fin Reference in Table 4. If quantities dictate we will tool a new fin.

AC = Aluminum Corrugated
AS = Aluminum Serrated
AH = Aluminum Hollow
CF = Copper Flat
AF = Aluminum Flat

Part Number Example:
FF300T13A30AC118

STEP 8: Select a finish

Choose from the following finishes:
C = RoHS compliant tri-valent clear chrome
B = Black Anodize
A = Clear Anodize
D = Degrease only

Part Number Example:
FF300T13A30AC118B

STEP 9: (Optional)

Choose legs if desired:
Yes = L
No = no digit required

Part Number Example:
FF300T13A30AC118B

Fig.4a

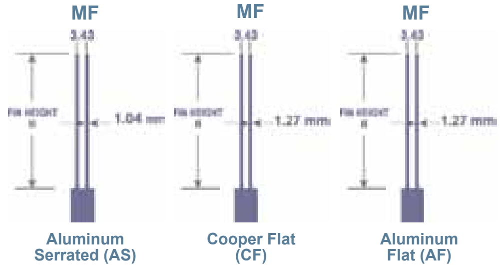


Fig.4b

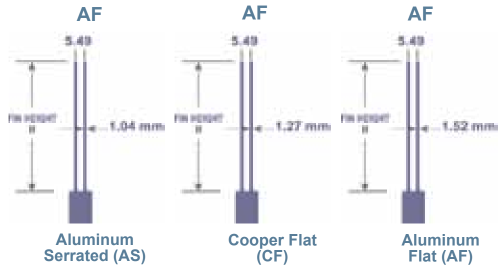


Fig.4c

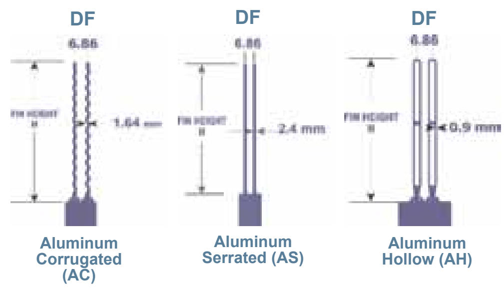
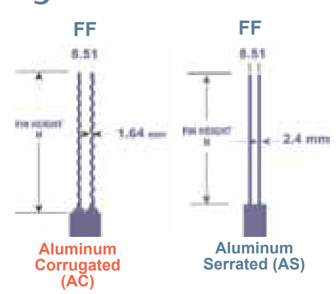


Fig.4d



*Note: Take this part number and enter into R-Tools to simulate thermal performance using your selected interface materials and semi-conductors. * (refer to Fig. 3 on page 6 for picture of this configured part FF300T13A30AC118B)*

Table 4 (a-d) Fin Styles

Table 4a - MKMF Fin Options

Fin Reference	Fin Style	Fin Height H (mm)	Ratio H to Space
AS035	Serrated	35	15:1
AS049	Serrated	49	20:1
AS000	Serrated	to be specified	
AF000	Flat	to be specified	
CF000	Flat	to be specified	

Table 4b - AF Fin Options

Fin Reference	Fin Style	Fin Height H (mm)	Ratio H to Space
AS037	Serrated	36.5	8:1
AS051	Serrated	50.5	11:1
AS091	Serrated	90.5	20:1
AS120	Serrated	119.5	27:1
AS000	Serrated	to be specified	
AF000	Flat	to be specified	
CF000	Flat	to be specified	

Table 4c - DF Fin Options

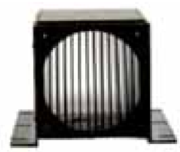
Fin Reference	Fin Style	Fin Height H (mm)	Ratio H to Space
AC071	Corrugated	71.4	13:1
AS071	Serrated	71.4	16:1
AC119	Corrugated	119.4	22:1
AS119	Serrated	119.4	26:1
AH060	Hollow	59.5	24:1
AH063	Hollow	63	25:1
AH085	Hollow	85	34:1
AH102	Hollow	101.8	40:1
AH119	Hollow	119.4	46:1
AC000	Corrugated	to be specified	
AS000	Serrated	to be specified	
AH000	Hollow	to be specified	

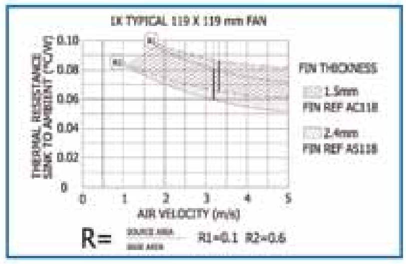
Table 4d - FF Fin Options

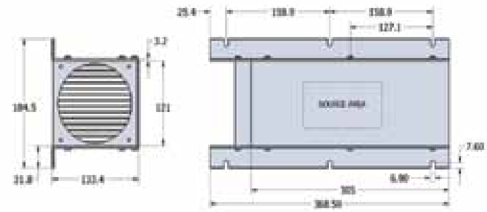
Fin Reference	Fin Style	Fin Height H (mm)	Ratio H to Space
AC070	Corrugated	70	10:1
AS070	Serrated	70	11:1
AC118	Corrugated	118	17:1
AS118	Serrated	118	27:1
AC000	Corrugated	to be specified	
AS000	Serrated	to be specified	

Air Cooled Fabfin® Standards

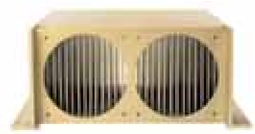
The range of standard Fabfin® forced convection cooled heatsinks (FFC series) was developed to incorporate standard 119mm square axial fans. The fin spacing of 8.51 mm was selected to provide a 20:1 ratio, the practical heat transfer limit for cooling Power Semiconductors in typical ambient conditions. The standard FFC series will accept 1, 2, 3 or 4 fans. Available in many finishes. The serrated fin thickness of 2.4mm provides near optimum performance when using industry standard axial fans. If some level of performance de-rating is acceptable (approximately 20%) then we recommend that corrugated fins be used. These have a thickness of 1.5 mm and are designated by ordering the 'AC' part numbers. The use of corrugated fins provides a weight savings of approximately 15% and will increase surface area by 7% compared with a straight fin of the same height. The push/pull (PP) option is common for applications where fan redundancy is important. We recommend the use of ball bearing fan(s), specifically for the "pull" end, in order to maximize the fan life due to the elevated operating temperatures. The additional weight of the fan can be offset by using the corrugated fins, if applicable. The adjacent graphs provide a performance guide for heat generating devices
 ranging in size from point source to 60% coverage.

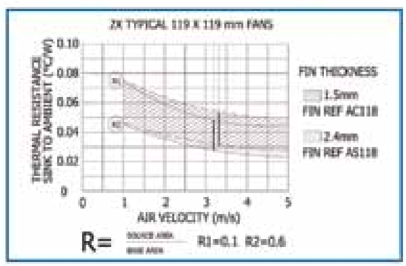


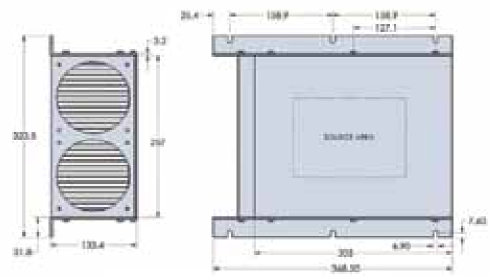




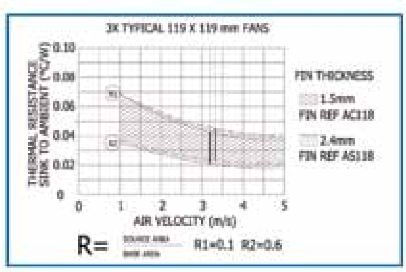
TECHNICAL DATA				
MODEL #	FFC305T13A14AS118B		FFC305T13A14AC118B	
FIN STYLE	SERRATED		CORRUGATED	
WT WITHOUT FAN	5.4	kg	4.7	kg
BASE AREA	38,774	mm²	38,774	mm²
TOTAL CSA	5,081	mm²	4,242	mm²
TOTAL PERIMETER	3,883	mm	3,748	mm

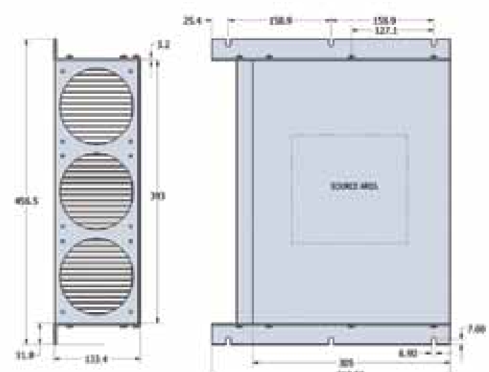






TECHNICAL DATA				
MODEL #	FFC305T13A30AS118B		FFC305T13A30AC118B	
FIN STYLE	SERRATED		CORRUGATED	
WT WITHOUT FAN	10.4	kg	8.8	kg
BASE AREA	78,387	mm²	78,387	mm²
TOTAL CSA	10,089	mm²	8,081	mm²
TOTAL PERIMETER	7,803	mm	7,529	mm





TECHNICAL DATA				
MODEL #	FFC305T13A46AS118B		FFC305T13A46AC118B	
FIN STYLE	SERRATED		CORRUGATED	
WT WITHOUT FAN	15.5	kg	13.2	kg
BASE AREA	115,993	mm²	115,993	mm²
TOTAL CSA	16,374	mm²	13,706	mm²
TOTAL PERIMETER	11,961	mm	12,578	mm

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Air Cooled - Hollowfin® Heatsink

The high fin density of the MF series with taller fins

The Hollowfin air cooled heatsink is characterized by the shape of its fins which when mounted on the DF (6.86 mm) base plate effectively duplicates the high fin density MF (3.43 mm) series, but with taller fins. A height to space ratio equivalent to 46:1 occurs when the fin height is 118 mm. The Hollowfin is an ideal candidate to be attached to a copper base plate to maximize performance. No glue is used in the process.

Performance can be modeled within R-Tools.

Features/Benefits:

- All that apply to Fabfin®
- 46 :1 fin height to spacing ratio at fin height of 118mm
- Highest performance all aluminum heatsink on the market
- No epoxy/glue used in fabrication process

Highlights:

- Copper baseplate/Aluminum fins available

Applications:

- Communications
- Industrial controls
- Medical
- Military
- Motor drives
- Power controls
- Solar energy
- Transportation
- Wind energy

Performance:

- Can be modeled on R-Tools

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Air Cooled Mixed Metals Heatsinks

Enhances heat spreading for high heat flux applications

Combination Fabfin® air cooled heatsinks are available with copper baseplates for concentrated heat sources and aluminum baseplates with copper fins for large area heat sources. Optimization is possible by mixing both aluminum and copper fins.

The heatsink was developed to enhance heat spreading for those semi-conductors developing high heat flux and limited allowable temperature rise. The combination heatsink is offered on MF and AF fin spacing as a standard configurable assembly. However, we do supply copper baseplates with DF (6.86 mm) spacing using a Hollowfin which effectively provides MF fin spacing with fins up to 118 mm high. No glue is used in the process.

Contact the Applications Department for Modeling Assistance at 905-795-0077 x258 or x340.

Features/Benefits:

- All that apply to Fabfin®
- Increased performance with use of copper
- Selective use of copper and aluminum fins
- Copper baseplate and aluminum fins
- Aluminum baseplate with Cu or Al/Cu fins
- Can also apply to dual baseplate

Highlights:

- Essentially any width, length or height

Performance:

- Typically 15 - 25% lower thermal impedance than a glued solution
- Can be modeled on R-Tools with assistance of our Application Department

Air Cooled Integrated Heatsink Modules

A consolidated approach for maximum cooling

Typically power modules and amplifiers are attached to an air cooled heatsink with a multitude of screws together with some form of TIM. The high thermal barrier at the interface can be eliminated by swaging a multitude of fins into a thick base plate and then machining the module features and requirements into the base plate.

Performance can be modeled within R-Tools.

Features/Benefits:

- All that apply to Fabfin®
- Thick baseplate is hogged out
- Detailed internal machining

Highlights:

- Eliminates interface between power supply and heatsink

Applications:

- Microwave
- Military

Performance:

- Can be modeled on R-Tools

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Air Cooled Copper Heatsinks

Maximum forced air cooling performance

An all copper Fabfin® heatsink provides maximum forced air cooling performance. The fabrication process is the same as that for an aluminum Fabfin heatsink and is offered on MF and AF fin spacing (3.43 mm and 5.49 mm respectively). While copper provides outstanding performance, the overall cost is high. Other fin spacing can be provided when fins are silver soldered into slots. No glue is used in the process.

Performance can be modeled within R-Tools.

Features/Benefits:

- All that apply to Fabfin®
- Swaged or soldered
- Fins can be taller than 118mm
- Spacing is variable
- Fin thickness is variable
- No epoxy/glue used in fabrication process

Highlights:

- Highest air cooled performance

Applications:

- Anywhere maximum performance is required but where weight is not an issue

Performance:

- Can be modeled on R-Tools

Air Cooled Dual Base Plate Heatsinks

Superb fin efficiency with a no-glue process

Dual base plate air cooled heatsinks (patented) increase fin efficiency with all aluminum or copper/aluminum assemblies. Mixed metal fin arrangements as well as dissimilar baseplates are available. Standard fin height, thickness and spacing are available but few mechanical constraints limit height, width, spacing or thickness of assembly. No glue is used in the process.

Performance can be modeled within R-Tools.

Features/Benefits:

- All that apply to Fabfin®
- Increased performance
- Mixed metals can be used

Highlights:

- Increased fin efficiency by splitting the thermal load

Performance:

- Increased fin efficiency by up to 30%
- Can be modeled on R-Tools

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Air Cooled Aluminum Extrusion Heatsinks

Aluminum extrusion air cooled heatsinks are the mainstay for cooling medium power semiconductors. Many shapes are available to fit diverse applications. Thousands of shapes exist in the marketplace. If you do not find your needs amid our existing offerings, we will tool a new shape to meet your needs with minimum order quantities.

Performance can be modeled within R-Tools.

Features/Benefits:

- Lowest cost

Air Cooled Heatpipes

Spreading heat to large area cooling banks via heat pipes

High heat losses from Press-Pack and IGBT power devices can be spread to large area cooling banks via heatpipes. Typical construction employs copper heatpipes and aluminum or copper "Evaporator" and "Condenser" sections.
If electrical insulation is required ceramic insulators can be built into the heatpipes. Working fluids are chosen to suit the application.

Full specifications can be found on our website.

Contact the Applications Department for Modeling Assistance at 905-795-0077 x258 or x340.

Features/Benefits:

- Increased surface area of cooling fins
- Moves thermal load to high performance air cooled bank
- Will transfer high thermal loads
- Copper tube heatpipes
- Working fluid options
- Copper or aluminum evaporator
- Copper or aluminum condenser

Highlights:

- Allows for maximum heat flux

Applications:

- Those applications where typical air cooled solutions cannot meet demand and liquid cooling is unacceptable

Performance:

- Heat transfer performance between air and liquid cooled
- Contact factory applications department

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Air Cooled Embedded Heatpipes

The "hot spot" heat evaporator

Typical applications combine the high performance of Fabfin® and the heat spreading of heatpipes. High heat flux in concentrated areas can be spread across a heatsink by placing the hot spot over one end of the heatpipe which becomes the "evaporator" and the heat is transferred to the cooler part of the heatsink where it condenses releasing the heat to the heatsink.

Contact the Applications Department for Modeling Assistance at 905-795-0077 x258 or x340.

Features/Benefits:

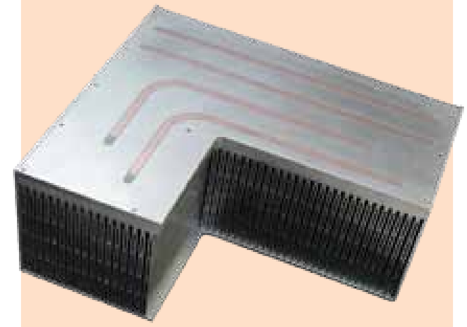
- Spreads thermal load
- Surface embedded copper heatpipes
- Integrated with Fabfin heatsinks
- Epoxy interface

Highlights:

- No dimensional constraints

Applications:

- High flux heat sources



Performance:

- Contact factory applications department

Liquid Cooled Aquasink® Heatsinks

Robust construction for reliable performance.

The Aquasink liquid cooled heatsink employs an aluminum body and copper tubes. These tubes are embedded in the aluminum body using a mandreling process that expands the copper tube into intimate contact with the aluminum body creating a very robust construction. A smear of specialty grease at the interface of copper and aluminum prevents the possibility of dissimilar metal corrosion. Heat transfer is equal from both mounting surfaces.

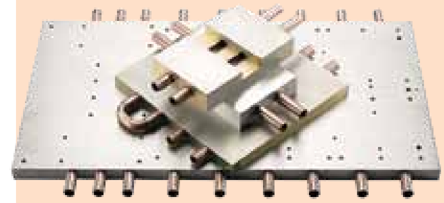
Performance can be modeled within R-Tools.

Features/Benefits::

- Aluminum body, straight copper tubes
- Tubes expanded into intimate contact with aluminum body
- Specialty grease prevents corrosion
- Heat transfer equal from both mounting surfaces
- Very rugged

Highlights:

- Practically no physical limitations



Performance:

- Can be modeled on R-Tools

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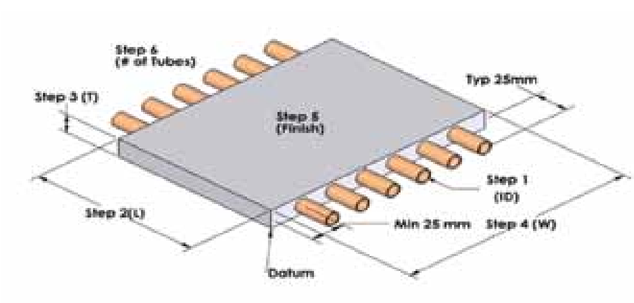
Liquid Cooled Aquasink® Heatsink Configurator

About Aquasink heatsinks

The Aquasink heatsink has been developed to provide the design engineer with a rugged, low cost, high performance heatsink. This Aluminum/ Copper liquid cooled cold plate is suitable for high power, isolated base semiconductors and other heat sensitive components. Aquasink's unique copper tube mandreling technology provides intimate long term contact of the tube with the aluminum cold plate. It is impossible to loosen Aquasink's copper tubes. The integrity of an Aquasink tube is never compromised by flycutting, guaranteeing that an Aquasink will survive the most rigorous of pressure tests.

Embedding process

The embedding process employed to manufacture Aquasink allows you to mount electronic components on both sides of the cooling plate with equal thermal efficiency.



** Please refer to the numbered steps illustrated in this diagram. Step numbers to the right correspond to the steps above.*

Base materials

The heat collecting semi-conductor mounting surface is fabricated from extruded 6063 aluminum alloy. Commercial grade ASTM B-75 copper tubes of a size to suit given applications are embedded within the aluminum plate by a proprietary mechanical process that provides an industry unique metal to metal bond between the aluminum and copper. This process is free of heat impeding glue or epoxy at the copper/ aluminum interface. The copper tube location can be specified for practically any dimension from the datum point.

** Tube location and thermal modeling can be performed on R-Tools.*

7 EASY STEPS TO CONFIGURE AQUASINK

STEP 1: Select tube diameter

Select tube nominal internal diameter (ID):
AA = 1/4" (6.35 mm)
AB = 3/8" (9.53 mm)
AC = 1/2" (12.7 mm)
AD = 5/6" (7.9 mm)
Part Number Example: AC

STEP 2: Select baseplate length

Select length (L) specified in mm (user defined):
eg. L = 250 mm
Maximum allowable length is 813 mm
Part Number Example: AC250

STEP 3: Select baseplate thickness

Select baseplate thickness (T) minimum 2x ID:
TA = 12.7 mm
TB = 19.1 mm
TC = 25.4 mm
TD = 15.9 mm
Part Number Example: AC250TC

STEP 4: Select baseplate width

Select baseplate width (W) specified in mm (user defined): eg. W = 230 mm
Maximum allowable width is 610 mm
Part Number Example: AC250TC230

STEP 5: Select a finish

Choose from the following finishes:
D = Degrease Only
Part Number Example: AC250TC230D

STEP 6/7: Number of tubes/select configuration

Select number of Tubes (user defined): eg. 6 tubes
Select tube configuration A,B,C,D,E or F
(visit website configuration details): eg. A
Part Number Example: AC250TC230D6A

Liquid Cooled Aquamax® Copper Heatsinks

Superb thermal performance in copper

Aquamax® copper provides additional performance over aluminum using the same proprietary channeling techniques as aluminum. The vacuum brazed, flux free joint ensures leak and corrosion free construction. Typical external finish is RoHS compliant electroless nickel.

Contact the Applications Department for Modeling Assistance at 905-795-0077 x258 or x340.

Features/Benefits:

- Vacuum brazed copper construction
- Flux free
- Leak free
- Highest thermal performance
- Very rugged

Highlights:

- Custom channels
- Optimized channel design
- No physical constraints

Applications:

- Any high power semiconductor application

Performance:

- Contact factory applications department

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Liquid Cooled Aquasurf® Heatsinks

The lowest thermal resistance available

Copper tubes are embedded in the surface of an aluminum plate to provide the lowest thermal resistance between the semiconductor mounting surface and the cooling liquid. Tubes can be bent into complex arrays to ensure the copper surface is directly under the semiconductor chips.

Contact the Applications Department for Modeling Assistance at 905-795-0077 x258 or x340.

Features/Benefits:

- Aluminum body, copper tubes
- Copper tubes embedded in aluminum surface
- Copper tubes can be embedded both sides
- Copper tubes can be custom formed to suit application
- Epoxy interface between copper and aluminum
- Lowest cost

Highlights:

- Custom tube layout
- Exposed copper tubes minimizes thermal interface with semiconductors
- Parallel tube design option equalizes junction temperatures

Applications:

- Any high power semiconductor application

Performance:

- Contact factory applications department

Liquid Cooled Aquamax® Aluminum Heatsinks

Maximum thermal performance in aluminum

Aquamax provides maximum thermal performance in aluminum by employing proprietary channeling techniques to optimize coolant velocity at low head loss while providing uniform temperature across the mounting surface. Precision machining techniques used at the vacuum braze, flux free, interface ensure leak and corrosion free construction. Typical external finish is RoHS compliant trivalent chrome.

Contact the Applications Department for Modeling Assistance at 905-795-0077 x258 or x340.

Features/Benefits:

- Vacuum brazed aluminum construction
- Flux free
- Leak free
- Low weight
- High thermal performance
- Very rugged

Highlights:

- Custom channels
- Optimized channel design
- No physical constraints

Applications:

- Any high power semiconductor application

Performance:

- Contact factory applications department

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Press Pack Coolers

For demanding, high performance applications

Patented technology provides the highest performance vacuum brazed, flux free Press Pack Coolers in both aluminum and copper construction.

Full specifications can be found on our website.

Features/Benefits:

- Vacuum brazed construction
- Aluminum or copper
- Flux free
- Leak free
- Mixed metal adaptors
- Highest thermal performance

Highlights:

- Unique design
- Cools all sizes of press pack semiconductors

Applications:

- Any size press pack semiconductor

Performance:

- Contact factory applications department

Cooling Systems

The ultimate integrated cooling solution

To cool the hot fluid exiting a liquid cooled heatsink so that it may be recirculated requires a liquid-to-air heat exchanger working in conjunction with pumps and associated systems.

Full specifications can be found on our website.

Features/Benefits:

- Cools recirculating liquids
- Air cooled radiators
- Copper or aluminum tubes
- Copper or aluminum fins
- Control apparatus

Highlights:

- Compliments liquid cooled heatsinks

Applications:

- Any liquid cooled recirculating system

Performance:

- Contact factory applications department

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Product Materials & Tolerances

GENERAL MATERIALS

Baseplates: Aluminum - 6063-T5, 6061-T6
Copper - C11000
Fins: Aluminum - 6063-T5, 6061-T6, 1100-H14
Copper - C11000
Legs and Fan Bracket: Aluminum 6063-T5

Tolerances:

Places	Value
X	± 0.5 mm
XX	± 0.25 mm
XXX	± 0.13 mm

Drilled Hole Diameter: ± .13mm

Note: Tighter tolerances can be supplied if required at some additional cost. Dimensions are in mm unless otherwise stated. Dual measurement convention mm (inches).

FABFIN® (All fin spacings)

Cut to Length: < 305 mm ± 0.5
> 305 mm ± 1.0
Cut to Width: ± 0.5 mm
Angularity: Saw Cut ± 1/4°
Extrusion ± 1°
Machined ± 1/4°
Flatness (max.): Machined flycut 0.03/25 mm
Surface Roughness (max.): 1.6 rms or better
Overall Height: ± 0.75 mm Fin height "H" ≤ 100mm
± 1.00 mm Fin height "H" > 100mm
Baseplate Thickness: ± 0.75 mm

AQUAMAX® (Copper or Aluminum)

Contact the factory for complete details at 905-795-0077

AQUASINK® and AQUASURF®

Copper Tubes: Commercial ASTM B-75
Inlet/Outlet Adapters: Brass/Copper
Length (L) parallel to tubes:
≤ 305 mm ± 0.5 mm Aquasink-Max 813
> 305 mm ± 1.0 mm
No limit - Aquasurf
Width (W) transverse to tubes:
Up to 610 mm ± 0.5 mm - Aquasink
No limit - Aquasurf
Angularity: ± 1/4°
Flatness (max.): Machined (flycut) 0.03/25 mm
Unmachined 0.1/25 mm
Surface Roughness (max.): 1.6 rms or better
Locations of tubes from datum point: ± 1.0 mm

Nominal ID	6.35 (1/4)	7.93 (5/16)	9.53 (3/8)
OD*	8.07 ± 0.025	9.60 ± 0.025	11.50 ± 0.024

**after mandrel expansion process - Aquasink*

Finish-Copper Tubes: Natural
Leak Testing: To 120 psi for 5 min.; other specs contact factory.

EXTRUSION

The aluminum extrusions supplied by Mersen comply with the standard commercial tolerances established by "The Aluminum Association Inc.", which roughly translate into the following "rules of thumb" when applied to heatsink sections.

Cutting to Length: ≤610mm ± 0.5mm
>610mm ≤ 1220mm ± 1.27mm
>1220mm ± 1.57mm
Flatness (max. deviation): 0.1mm/25mm of width up to 250mm
0.2mm/25mm of width over 250 mm
Roughness/Die Lines: Depth of defect <0.1mm
Angularity: ± 1°

MACHINED PARTS

Flatness (max. deviation): 0.03/25mm of width
Roughness: 1.6 rms or better
Angularity: ± 0.25°
Edge to Datum: ±0.25mm
Feature to Feature: ±0.13mm

Product Materials & Tolerances

GENERAL FINISH TYPE

Meets the requirements of:

Black Anodize:	MIL-A-8625, Type II, Class 2, Black
Clear Anodize:	MIL-A-8625, Type II, Class 1, Clear
Gold Chromate:	MIL-DTL-5541, Type I, Class 3, Gold
Trivalent Chromate:	MIL-DTL-5541, Type II, Class 3, Clear
Electroless Nickel:	ASTM-B-733
Tin Plated Copper:	Lead Free
Tin Plated Solderable Tabs:	Lead Free
Wash:	Degrease Only

AQUASINK®/AQUASURF® - Degrease only

AQUAMAX® - COPPER - Electroless Nickel; degrease

AQUAMAX - ALUMINUM - Trivalent Chromate

SURFACE FINISH FOR FABFIN ANODIZING

The entire family of Fabfin aluminum heatsinks can be anodized without worry of an inconsistent finish. Anodizing, by its nature, requires that hundreds of amperes of DC current be conducted through the entire heatsink body. Any resistance present in the interface (between the fin and the baseplate) would cause the fins to appear "off black" or "grey" once the processing is complete. This is yet another test of the interface between the fin and the baseplate which shows superior performance over alternative assembly techniques. Clip marks which show as white marks in a black anodize finish occur where the electrical contact(s) is/are made. Clip marks can be eliminated by inserting titanium screws into threaded holes in the heatsink to form the required electrical path. This process results in additional cost.

SURFACE "FINISH FREE"

"Finish Free" areas can be provided if required for electrical conductivity.

FABFIN®

OPERATING RANGE

The swaging process which the entire family of Fabfin heatsinks incorporates, allows all assemblies to successfully pass the harshest environmental and physical tests. Storage and operating temperatures of -40°C to +350°C demonstrate that Fabfin heatsinks are unmatched by other less robust methods of construction.

VIBRATION

Fabfin's durability of design has been independently tested, without failure, to the following parameters. All three axis tested, swept sine wave vibration resonance search from 5-200 Hz with a sweep rate of 0.5 oct./min., Input acceleration amplitude of 0.5 g, A one hour dwell at each resonant frequency, and a twelve hour durability sweep from 5-200 Hz with 0.3 g input.

WELDING

Welding baseplates together (after the addition of fins) to increase overall width beyond 521 mm is common practice since the fin to baseplate join is unaffected by the welding process. If your finish selection is black anodize, please note that a shade of black variance exists along the weld joints.

TEMPERATURE CYCLING

To determine the reliability of the metal displacement swaging process both the FF & MF series Fabfin assemblies were tested by an independent third party laboratory. The results showed that extensive temperature cycling, from -40°C to +120°C, and one time heating to +350°C, had no adverse effect on the performance of the heatsink.

FIN PULL TESTS

A fin pull test was completed, following the temperature cycling period, on a 50 mm length of fin perpendicular to the baseplate, exceeded 900 kgs (18kg/mm) and occurred without failure of the fin to baseplate interface.

MF & AF FABFIN

Specify blind holes wherever possible in the mounting surface. It should be recognized that some streaking may occur at the plugged holes and as such cosmetic requirements must be specified at time of RFQ.

DF & FF FABFIN

Specify that through holes are acceptable in the mounting surface to eliminate the need to plug holes when finishing. It should be recognized that deburring between the fins may leave minor scratches near the through holes and as such cosmetic requirements must be specified at time of RFQ.

RoHS

R-Tools® 3D Heatsink Modeling

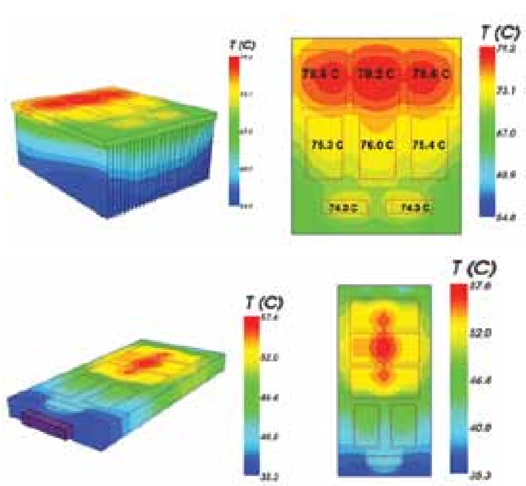
Powerful thermal modeling software

Mersen makes it easy and convenient to quickly and accurately model various heatsink configurations using the R-Tools online thermal modeling software program. R-Tools is completely interactive. It uses analytically based design tools allowing you to perform the thermal design of the heatsink concurrent with the optimization of the electrical and manufacturing elements prior to any prototype builds and testing. This invaluable resource reduces your design time and increases the reliability in your finished product.

Features/Benefits:

- Completely interactive on-line thermal design tool for heatsinks.
- Quick and accurate heatsink solutions.
- Analytical models for conduction heat transfer in the solid elements.
- Natural and forced convection heat transfer models in the cooling airflow.
- Reduction in design time and better reliability in the finished product.
- User-friendly approach introduces users to R- Tools.
- Colorful and clear graphics.
- Design tips and notes.
- Step by step approach.
- Liquid and air-cooled heatsinks.
- Graphical source layout.
- Parts library for semi-conductors, thermal interfaces, and fans.
- Fin optimizer solves for optimum heatsink configurations.
- Thermal design output details heatsink performance.
- Heatsink thermal map shows temperature profile of the heatsink baseplate.
- Hydraulic performance chart displays heatsink vs. fan performance curves.

Visit R-Tools under Resources at www.us-ferrazshawmut.mersen.com.



Need more support?

Mersen is a company that is easy to do business with. Our leading engineers will work with you to develop tailored solutions for removing damaging heat from your electronic systems.

Email:
sales.mis@mersen.com

Manufacturing:
905-795-0077

Applications support:
905-795-0077 x258 or x340

R-Tools® 3D Heatsink Modeling

Powerful 3D thermal modeling software

Heatsinks are used with semi-conductor devices to provide more surface area for heat dissipation. Power electronic designers require quick and accurate heat sink solutions. With the advent of the internet, and realizing the potential of providing interactive design capability on the Web, Mersen offers R-Tools; a completely interactive on-line thermal design tool for heatsinks. The R-Tools mathematical engine is located on a web server at us.ferrazshawmut.com/thermal/r-tools_front.cfm. R-Tools simulation can be run on an Internet browser, which is capable of utilizing Java Applets. R-Tools thermal modeling is based on a set of analytical models for conduction heat transfer in the solid elements coupled with natural and forced convection heat transfer models in the cooling airflow. The conduction heat transfer model in the baseplate of the heatsink is based on the steady state solution of the Laplace equation for general rectangular geometry. The solution is based on a general three-dimensional Fourier series solution, which satisfies the conduction equation in the base plate. For the forced convection air-cooled fins, an analytical model is used to predict the average heat transfer rate. The model used is a composite solution based on the limiting cases of fully developed and developing flow between parallel plates. Because the R-Tools is analytically based, the solution is achieved within a few seconds, a very short time compared to the several hours required for a full CFD simulation.

R-Tools provides an analytical method for quickly and accurately testing various heat sink configurations. The use of analytically based design tools allows the user to perform the thermal design of the heatsink concurrent with the optimization of the electrical and manufacturing elements prior to any prototype or testing. This approach results in a reduction in design time and better reliability in the finished product.

Free on-line registration

Users may register for R-Tools by visiting our website Selecting Resources > R-Tools. On the first screen of R-Tools, a menu on the left-hand side of the screen lists selections and options available for users such as: Simulation Menu button allows the user to start a new simulation.

User Option Menu gives the user two options for using R-Tools:

i) Step by step option is the default option for all new users. This user-friendly approach introduces users to the R-Tools concept of designing heatsinks on-line. Colorful and clear sketches are used to describe the basic dimensions and parameters of the heatsink design. When the user points the cursor in any text box, design tips and notes are displayed in green color at the bottom of the screen.

ii) For advanced users the Compact Pages option reduces the design screens down to four screens, which reduces the design and browsing time.

File Menu allow users to copy, rename and delete existing simulations.

On simulation screens, the left-hand side menu list the steps of navigating R-Tools through the designing of Mersen
heatsinks. Users have two options to navigate through R-Tools screens as follows:

a) Navigate step by step through any R-Tools screen by clicking the "Next" button on the bottom of each screen.

b) Display the desired R-Tools screen by clicking on the screen name on the left-hand side menu.

On the Web:

Visit R-Tools under Resources on our website.

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R-Tools® 10 Easy Steps

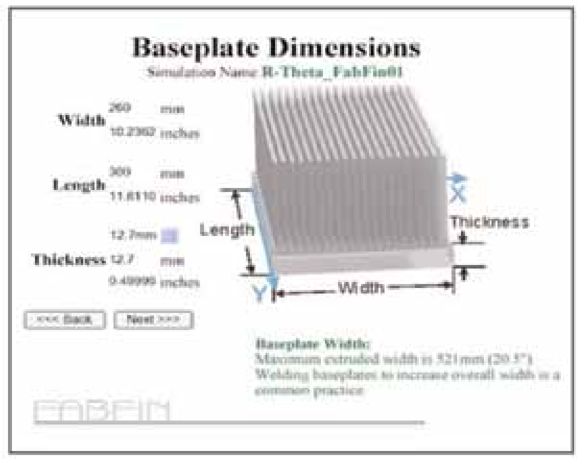
STEP 1: Starting simulation

To start a simulation on R-Tools, there are three options:

- “Create New Simulation” by typing a simulation name and selecting the product which is suitable for the applications: Examples: Extrusion, Fabfin, Aquasink.
- “Simulation Based on Known Part Number” by typing in a simulation name and the appropriate Mersen part number to generate a new simulation: Example: FF300T13A30AC118B.
- “Open Existing Simulation” by selecting the name of the simulation from the drop down list of your previously created simulations. Note: Click the next button to go to the next screen, baseplate dimensions.

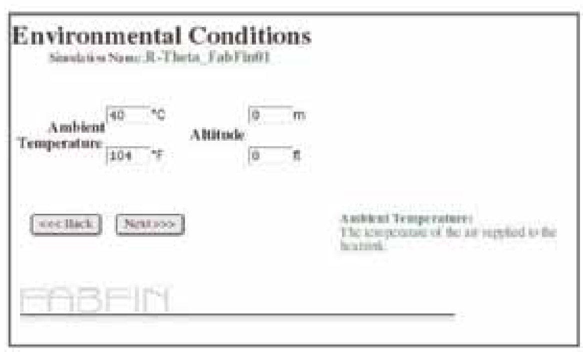
STEP 2: Baseplate dimensions

- The sketch on the right hand side of the screen demonstrates the three dimensions of the baseplate.
- Enter the dimensions by typing in the value (mm or inches) in the corresponding text box.
- The user can select a standard thickness or customized one by typing the value in the text box.
- The green design on the bottom right side of the screen will inform the user about Mersen manufacturing capabilities.



STEP 3: Environmental conditions

- “Ambient Temperature” is the temperature of the air cooling the heatsink. “Ambient Temperature” can be entered in ºC or ºF.
- “Altitude” of the application can effect the cooling capacity of the heatsink because it can change density of the cooling air.



Note: The name of the simulation will always appear on the top of the screen.

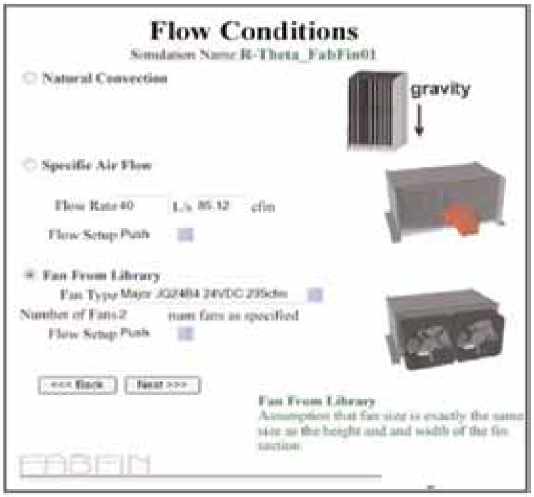
R-Tools® 10 Easy Steps

STEP 4: Flow conditions

The heatsink can be cooled using one of the heat transfer modes:

- "Natural Convection" mode where air moves through the heatsink due to the buoyancy effects.
- Forced convection mode which has two input options in R-Tools.
  1. "Specific Air Flow": The user has to enter the appropriate volumetric flow rate of the air cooling the heatsink, or
  2. "Fan From Library": The user can select a fan from the drop down list.
- For forced convection the user can select the flow direction:
  1. Push, or
  2. Impinging, or
  3. Push/Pull.

Note: By-pass air is not modeled in R-Tools. All air flow data entered is assumed to be presented to the face of the heatsink.

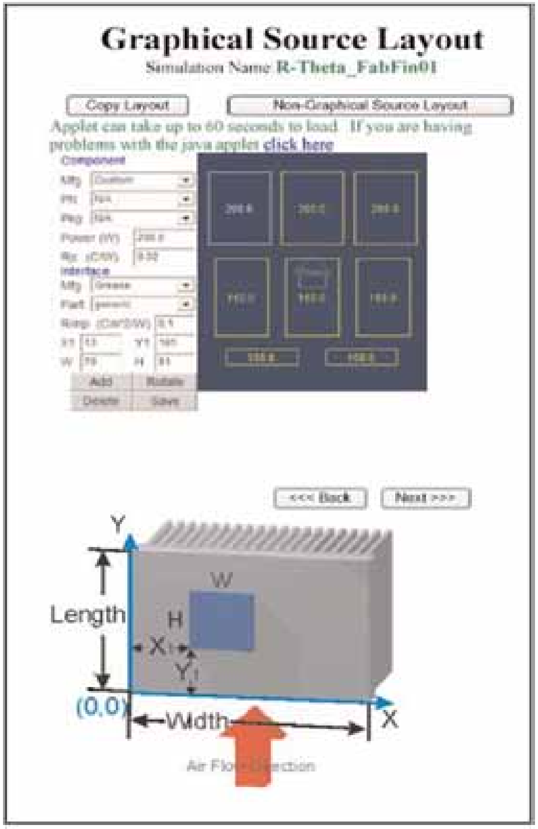


STEP 5: Graphical source layout

A sketch of the main dimensions of the heatsink and the locations of the heat source is shown at the bottom of the screen. To add a heat source on the baseplate of the heatsink, click "Add" button.

R-Tools allows two options for specifying the heat source: i.e. component:

1. Customize the specifications of the device by entering the dimensions, power dissipation and the thermal resistance, Rjc of the device in the corresponding text boxes on the screen.
2. Select an industry standard semiconductor from the drop-down list.
   - Users can change the dimensions (W, H) and the location (X1, Y1) of any source on the heatsink graphically or by typing the values in the corresponding text box.
   - To rotate the source on the heatsink, click "Rotate" button.
   - To delete a source, click on the "Delete" button.



STEP 6: Thermal interface material

Users can enter the thermal impedance, Rimp, of the interface material by:

- Typing its value in the textbox, or
- Selecting the manufacturer and the part number of the interface from the drop down lists.

STEP 7: Save

At this point, you must click "SAVE" before advancing to the "Next" screen!

STEP 8: Fin selection and optimizer

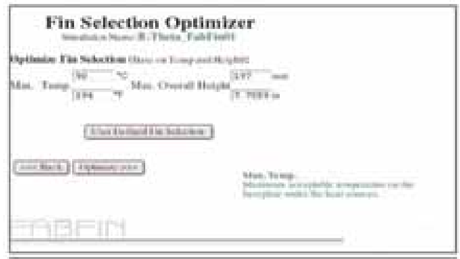
Users can select from the two following options:

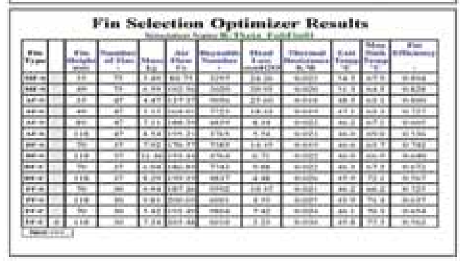
1. Fin optimizer: the user must enter

a) Thermal constraints i.e. Maximum Temperature allowed on the heatsink.

b) Physical constraints i.e. Maximum Height allowed for the heatsink.

- The fin optimizer will solve all fin configurations, which will meet the thermal performance i.e. maximum allowed temperature, and will list all the available selections in the "Fin Optimizer Results" table.
- Click on any header of the "Fin Optimizer Results" table to sort the table according to the header name ie: the user can sort the table by the mass of the heatsink by clicking on the "Mass" header.
- When selecting any configuration from the table a green design note will describe the main specification of the selected fin.

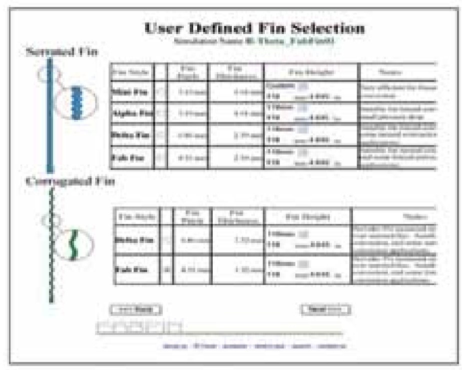


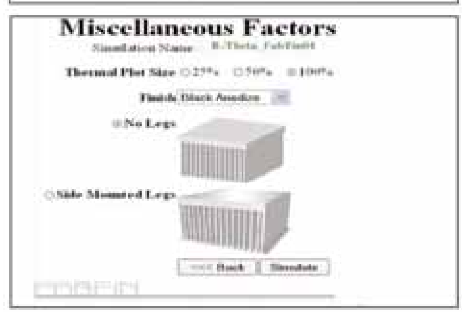


2. User defined fin selection:

For users familiar with the Mersen Fabfin® heatsink configuration, "User Defined Fin Selection" allows users to select the exact Mersen standard fin design as follows:

- MF is the recommended fin design for forced convection applications with maximum height of 49 mm.
- AF is recommended for forced convection applications, which require low pressure drop i.e. low noise levels.
- DF has three fin designs satisfying different application objectives as follows:
  i) Serrated Fin: for high power dissipation.
  ii) Corrugated Fin: for weight sensitive applications.
  iii) Hollowfin: for high power dissipation applications. Hollowfin with the advantage of lower pressure drop performance and lower weight.
- FF is a suitable selection for natural convection heat transfer. FF can be used for relatively low power dissipation forced convection applications. FF has two fin designs as follows:
  i) Serrated Fin: provides mechanical integrity.
  ii) Corrugated Fin: larger surface area to provide better cooling for natural convection.





Note: Fin height can be customized by the user with certain limitations for each group: MF: minimum of 25 mm and maximum of 49 mm; AF, DC, FF: minimum of 25 mm and maximum of 118 mm. Hollowfin is recommended as an alternative to a MF fin when a fin height higher than 49 mm is needed to dissipate more heat.

STEP 9: Miscellaneous factors:

On this page users can define the following:

i) "Thermal Plot Size" in the final simulation i.e. for large heatsinks it is better to reduce the display to 50% or 25% of the original size so that the display will appear inside the web page.

ii) Specify the "Finish" of the final product which can be one of the following:

- Degreased;
- Black anodized (recommended for natural convection;)
- Clear anodized;
- RoHS compliant clear tri-valent chrome.

iii) Mounting option where the user can select to attach legs for the heatsink for mounting.

Click "Simulate" for the full thermal simulation for Mersen heatsink.

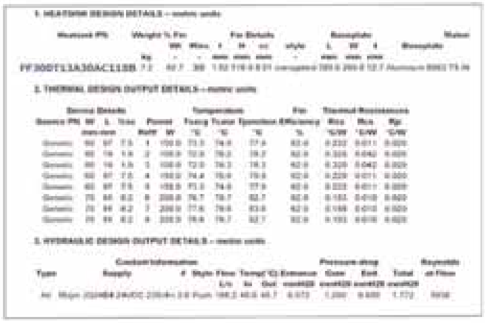
R-Tools® 10 Easy Steps

STEP 10: R-Tools simulation-design output summary

The summary contains three main sections

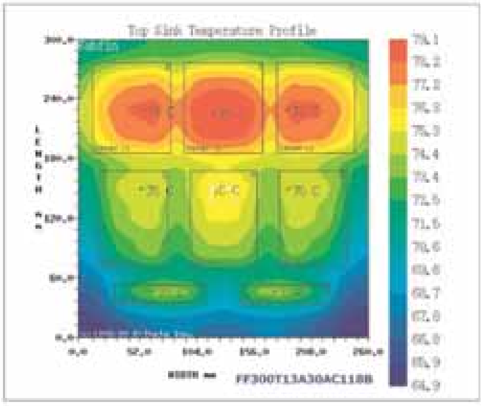
A) Numerical results summary (contains three sections)

1. Heatsink Design Details Section: The physical dimensions of the heatsink such as weight, fin height, fin spacing, baseplate thickness, fin material, baseplate material etc. It also generates a Mersen part number.



2. Thermal Design Detail Section: A full list of the heat sources is displayed. For each source the the following information is displayed:

- W & L: foot print of the heat source i.e. device;
- Power: heat dissipation;
- Tsavg: average temperature of the baseplate under the device;
- Tcase: average case temperature;
- Tjunction: average junction temperature;
- Fin Efficiency;
- Thermal Resistances associated with each device.



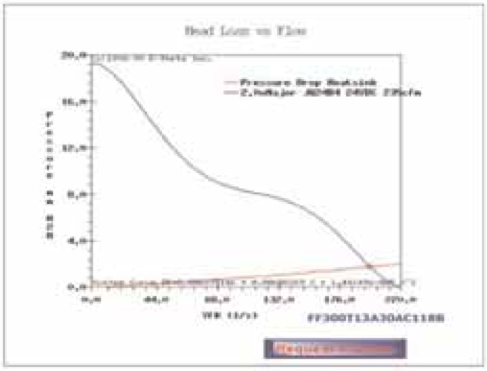
3. Hydraulic Design Details Section**:** This section displays three main sub-sections:

a) Coolant Information (if applicable):

- Coolant type air, water, Water/Glycol mix etc.;
- Supply: shows the fan name, number of fans used in the application and cooling style;
- Inlet and the outlet coolant temperatures (air or liquid);

b) Pressure drop through the entrance, the heatsink core, and exit section. The sum of the pressure drop through the three sections is displayed under total header.

c) Reynolds number, which is a measure of the turbulence level in the fluid flow.



B) Heatsink thermal map:

This shows a temperature profile of the heatsink baseplate. Hot spots on the heatsink baseplate are identified by the red color in the thermal map. The maximum temperature under each device is printed on the thermal map in the square which identifies the location of each device.

C) Hydraulic performance chart (fan should be selected):

This displays heatsink performance curve vs. fan performance hydraulic curve. Displaying the performance point of the system helps designers to determine the noise level and fan efficiency. A second degree equation which represents the heatsink performance curve can help designers include the designed heatsink in CFD models.