WHITE PAPER

Selecting an appropriate Heat Sink

The Basics of Heat Sink Selection and Application

celduc® relais

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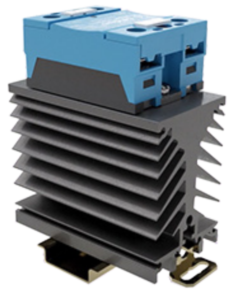
All electronic components are subject to **failure due to overheating.** Any increase in temperature can result in **a reduced lifespan.**



Heat sinks are an important element in circuit design because they provide an efficient path for heat to be transferred into the ambient air and away from electronic devices (Solid State Relays).

For any electronics design, "Thermal Management" is the key element which determines the optimal performance and efficiency of the system during its entire product life. **Mounting a SSR on the proper Heatsink allows it to reach its nominal current, while maximizing its useful life.**

This white paper will give you more insights into the **Selection of Heat Sinks.**

1- How do you select the proper Heat Sink ?

The heatsink can be **determined** either **by calculation** or **directly from the curves** provided by celduc.

How do you use thermal curves ?

Using the thermal curves given by celduc on its technical datasheets, is the easiest way to select the correct heat sink.

REMINDER

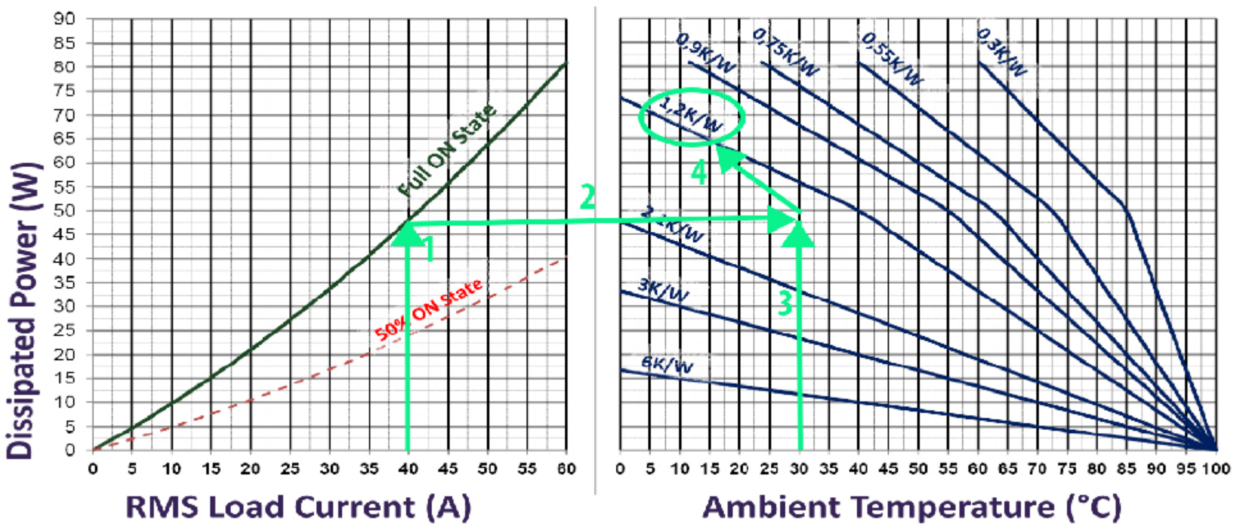
Beforehand, **two important values should be known:**

1- Load current / switching current (A)

2- Ambient temperature (°C)

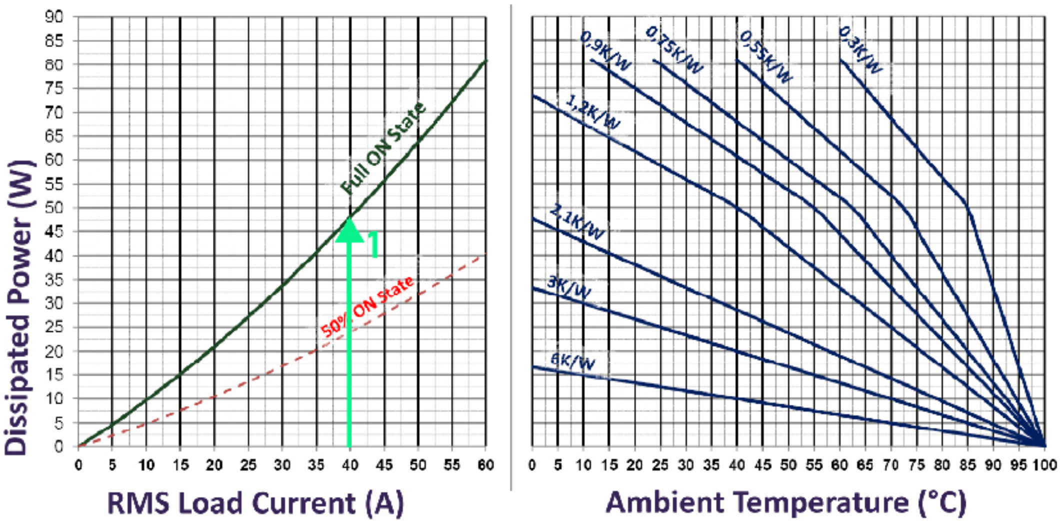
On our product datasheets, the thermal curves give the thermal resistance values of the heatsink that you should use. Let's take **two Heat sink selection examples :**

<u>Example for type 1 Thermal Curve</u>
Load current = 40A
Max. ambiant temperature = 30°C
SSR Part Number = SO965460

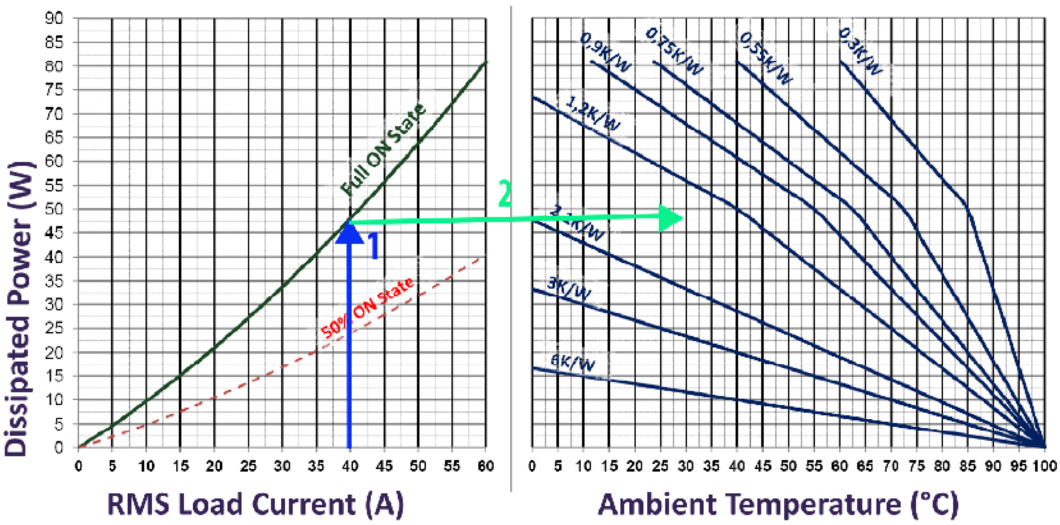


Please follow this procedure :

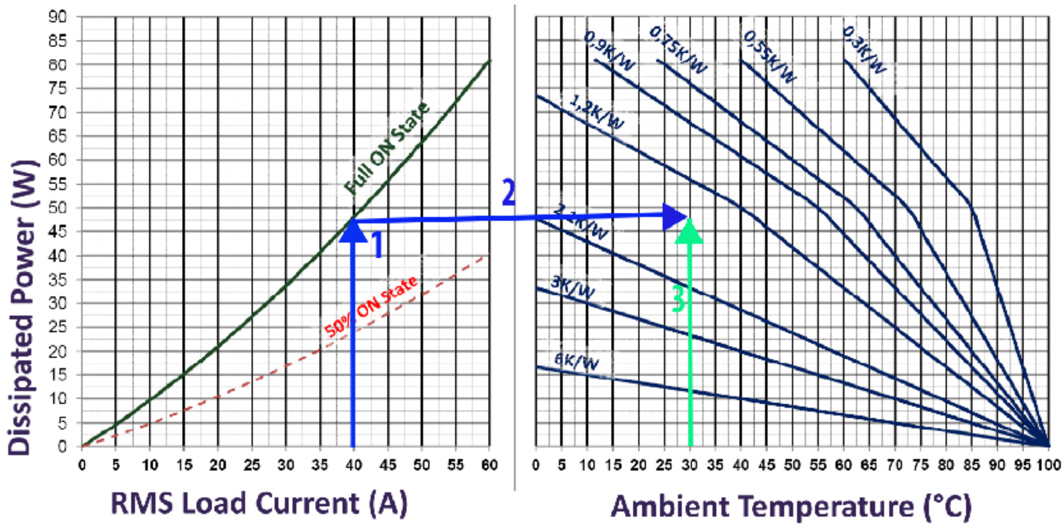
1- Find the load current value on the X-Axis
2-Plot a vertical line from the Load current value up to the curve **(1)**



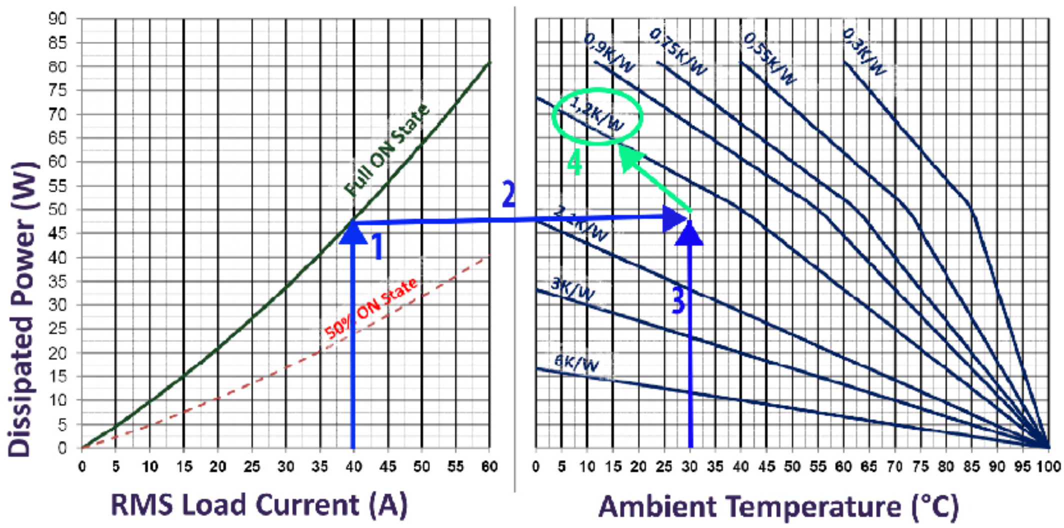
3- from the intersection point, plot a horizontal line to the right-hand curve **(2)**

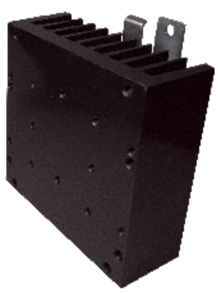


4- Find the ambient temperature on the X-Axis of the right-hand curve
5- Plot a vertical line from this point until you reach the horizontal line previously plotted **(3)**

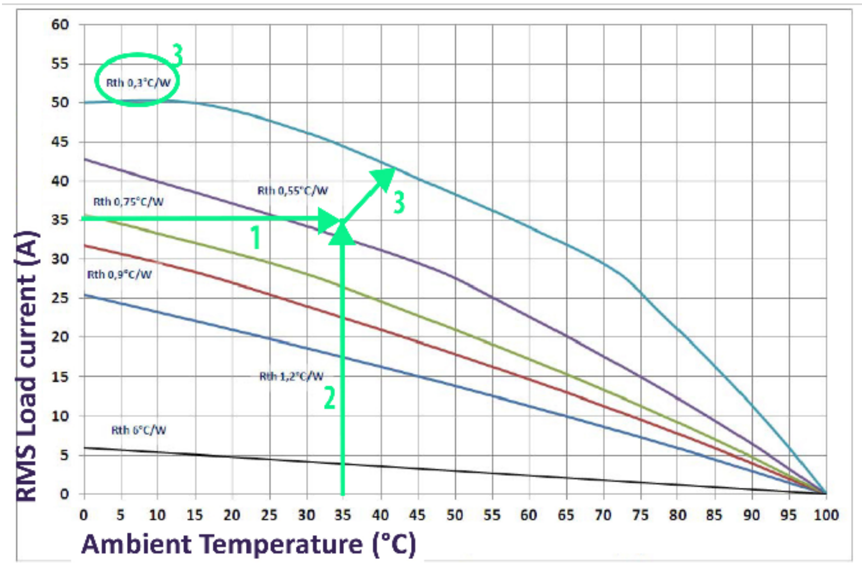


6- this point determines the type of heatsink to use **(4)**
7- select the heatsink corresponding to the curve located above this point.
In this example 1.2°C/W, which corresponds to Heat Sink celduc Part Number WF121000.

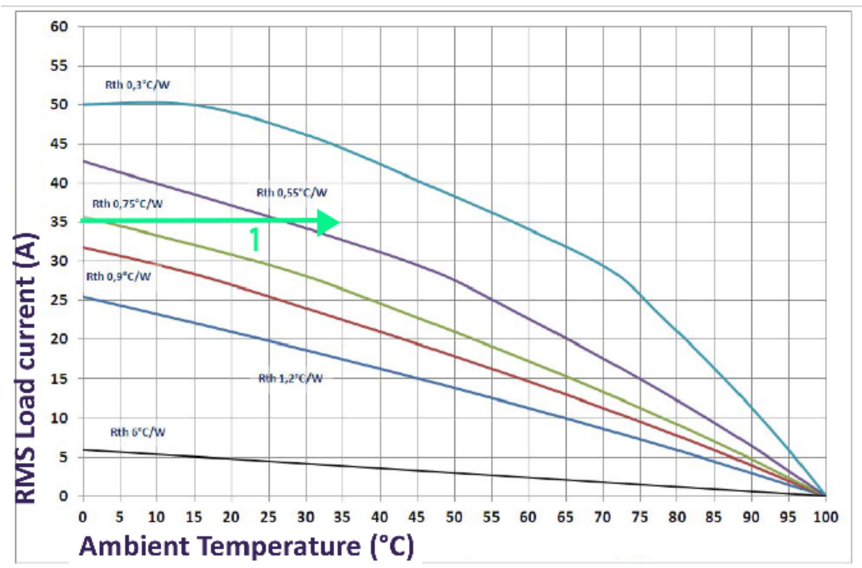




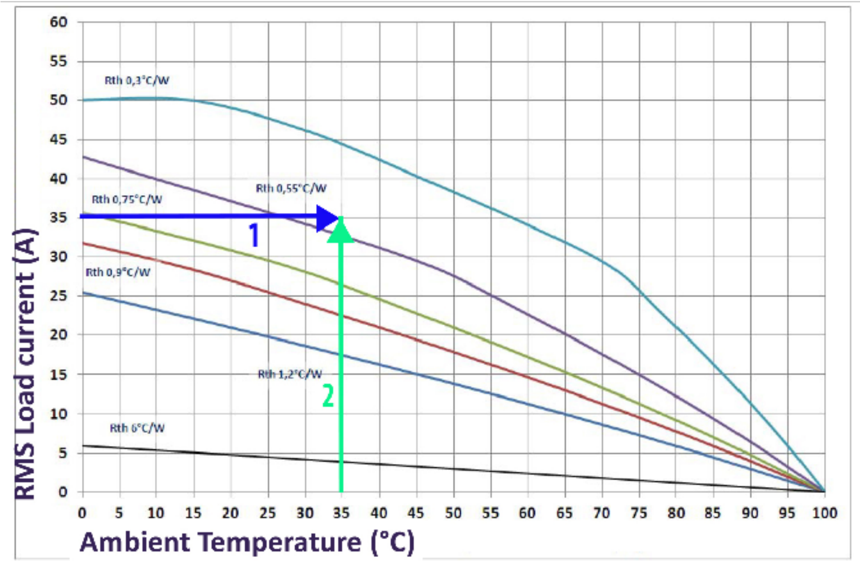
Example for type 2 Thermal Curve
Load current = 35A
Max. ambiant temperature = 35°C
SSR Part Number = SGT8658500



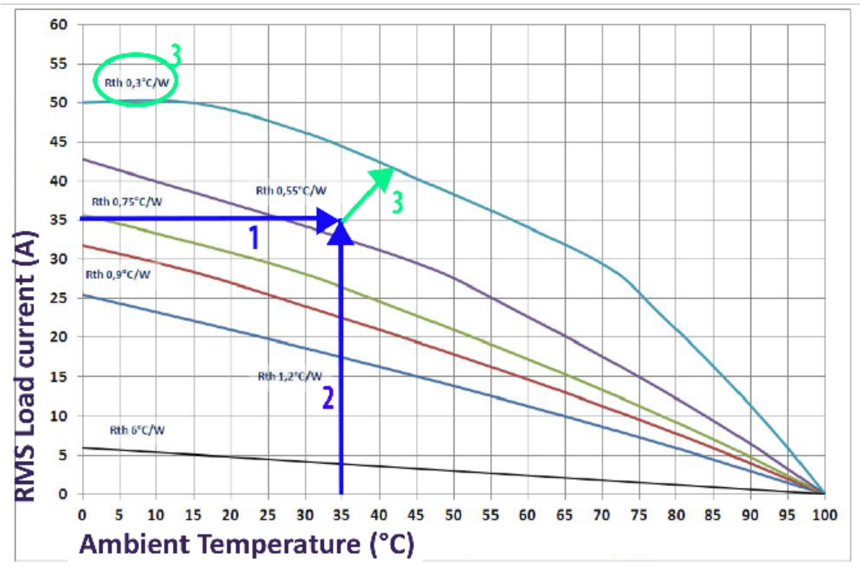
1- Find the Load current on the Y-Axis of the thermal curve
2- Plot a horizontal line from the Load current to the curve (1)



3- Find the ambient temperature on the X-Axis of the thermal curve
4- Plot a vertical line from this point until you reach the horizontal line previously plotted **(2)**



5- this intersection point determines the type of heatsink to use **(3)**
6- select the heatsink corresponding to the curve located above this point.
In this example 0.3°C/W**,** which corresponds to Heat Sink celduc part number WF031100.



How do you determine a Heat Sink using the calculation method ?

Here are the values you need to know :

REMINDER

Tjmax = Temperature limit of the power elements. This value is given in our products specifications and is usually 125°C or 150°C.

Tamb = Maximum Ambient Temperature (°C) inside the cabinet near the SSR + heatsink assembly, under balanced conditions.

Pd = Power Dissipation for the SSR (expressed in Watts)

Formula for AC SSRs (Thyristor or Triac) :	**Pd = 0,9 x Vto x Irms + rt x Irms^2**
Formula for DC SSRs (IGBT) :	**Pd=Vt x Ie + rt x Ie^2**
Formula for DC SSRs (MOSFET) :	**Pd = RDSon x Ie^2**

Vto = dropout voltage
rt = dynamic resistance
Irms = RMS (Root Mean Square) current

Then the PD value should be multiplied by the number of phases in the SSR :

x1 for single phase SSR
x2 for two-phase SSR
x3 for three-phase SSR

Rthjc = this value is given by celduc in the specifications of the solid state relay (in K/W)

Rthcr = thermal Resistance of the thermal interface (grease, celduc's thermal seal or others) (in K/W)

Heat Sink Rth =
((Tjmax - Tamb) / Pd) - Rthjc - Rthcr

2-celduc's range of heat sinks

celduc offers a **wide range of heat sinks.**

Thermal resistance : Heat sinks are rated by their thermal resistance and measured in **Kelvin per watt (K/W). The lower the thermal resistance is, the better the heat sink** will transfer heat. Thermal Resistance = Temperature/Power Dissipation.

Product reference	Thermal characteristics	Specifications	Dimensions mm	Relay type	Fig n°
WF031100	0.3K/W	ventiled for DIN rail or screw - fan supply 230Vac	110 x 120 x 145	SO, SC, SG, SG, SV	1
WF031200	0.3K/W	ventiled for DIN rail or screw - fan supply 24Vdc	110 x 120 x 145	SO, SC, SG, SG, SV	1
WF050000	0.55K/W	DIN rail adaptor as option	110 x 100 x 200	SO, SC, SG, SG, SV	2
WF071000	0.7K/W	DIN rail adaptor as option	110 x 89.5 x 120	SO, SC, SA, SU, SM, SG	3
WF115100	0.9K/W	for DIN rail or screw	110 x 100 x 90	SO, SC, SG, SV	4
WF112100	1K/W	for DIN rail or screw	49.5 x 117.5 x 120	SA, SU	5
WF108110	1.1K/W	for DIN rail or screw	89.8 x 81 x 98.02	SO, SC	6
WF121000	1.2K/W	for DIN rail or screw	100 x 40 x 100	SO, SC, SG, SV	7
WF124000	1.2K/W	DIN rail adaptor as option	90 x 100 x 69	SO, SC, SA, SU, SM	8
WF114200	1.75K/W	for DIN rail or screw	45 x 73 x 100	SO, SA, SU, SM	9
WF210000	2.1K/W	DIN rail adaptor as option	96 x 41 x 55	SO, SC	10
WF151200	2.2K/W	for DIN rail or screw	45 x 73 x 80	SO, SC, SA, SU	11
WF311100	3K/W	for DIN rail or screw	22.5 x 73 x 80	SA, SU	12

The Rth values are given for a temperature of 50°C in calm air. Other dimensions available on request.

3-Thermal interface materials

A Thermal Interface Material (TIM) helps improve the heat transfer between the relay and the heatsink. As there are cavities between both surfaces and as air is not a good conductor of heat, the TIM fills the voids between the contact surfaces to increase the heat transfer. Celduc® recommends aluminium thermal pads as they have very good thermal performance and are stable over the long term.

Thermal Interfaces available in our catalog include **thermal grease** (or phase change compound) and **thermal pads** (also named thermal seals).

Thermal seal mounted on an
okpac® style SSR

Thermal grease
(Part Number : 5TH15000)

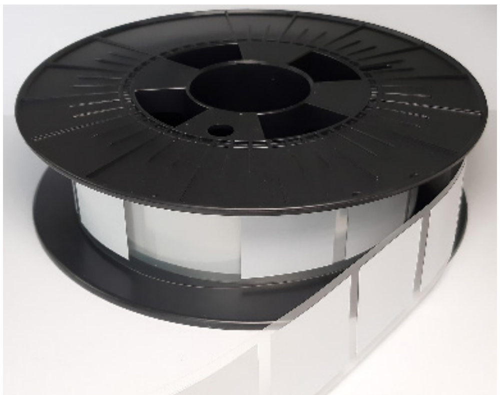
Use Conditions : the surface must be clean, flat and smooth (roughness < 100µm). celduc® guarantees surface flatness for its range of heatsinks.

Thermal grease application : the recommended paste thickness should be between 50 and 100µm thick, meaning that when applying the grease you should be able to see the heatsink surface though it.

For three-phase SSR applications, it's best to use thermal grease as thermal pads are limited in terms of power dissipation.

THERMAL SEALS FOR RELAY/HEATSINK

5TH15000	thermal grease for 30 relays SG/SVT ou 60 relays SC/SO
5TH21000	thermal precut film for SC/SO
5TH23000	adhesive thermal pads for SC/SO
5TH24000	adhesive thermal pads for SA/SU
1LWP2300	Assembling costs 5TH23000 on SC/SO + 5TH23000
1LWP2400	Assembling costs 5TH24000 on SA/SU + 5TH24000



1 roll of Adhesive thermal pads

4-Conclusion

Selecting a heat sink is relatively straight forward from a thermal viewpoint. As shown in this document, celduc's range of heat sinks offer an excellent solution to resolving cooling issues with Solid State Relays. Our R&D deparment is also available to help you determine the best SSR/Heat Sink combination for your needs. Do not hesitate to contact us for any assistance.

Thanks for reading

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