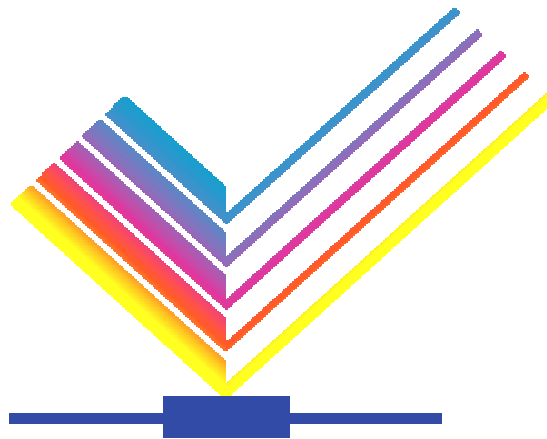


Thermally Conductive Polymers

Authors thank



Cool Shield

for information and photos

Thermally Conductive Polymers

- Injection-molding grade polymers
- A composite material consisting of high conductivity reinforcements, and engineering or commodity thermoplastics
- Grades range from 10 W/mK (stainless steel) to over 100 W/mK (die cast aluminum)
- Electrically conductive or insulating
- Manages thermal and EMI performance

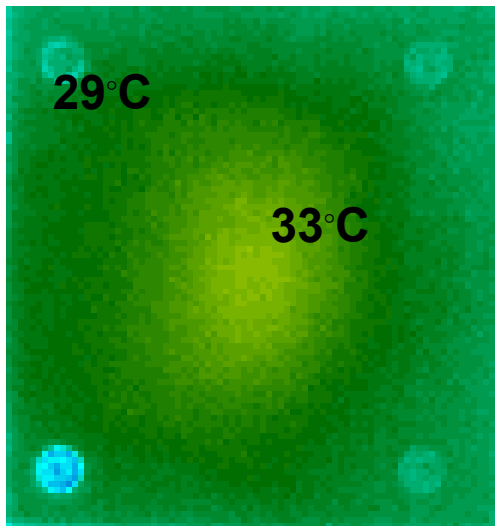
Thermal Conductive Plastic

Thermally
Conductive Plastic

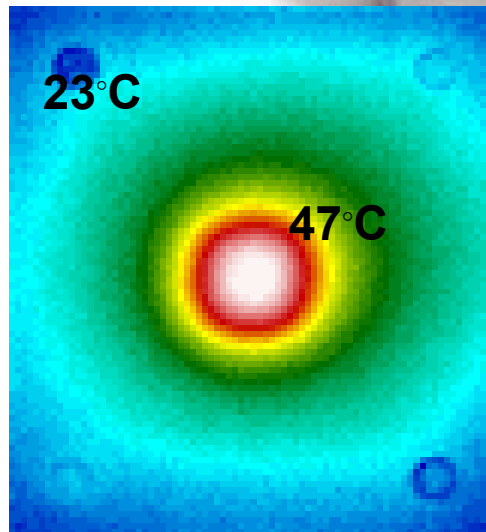


Conventional
Plastic

$\Delta T = 4^{\circ}\text{C}$



$\Delta T = 24^{\circ}\text{C}$



Courtesy of Cool Shield Inc.

Material Thermal Conductivity

Foamed plastic	0.02	W/mK
Plastic	0.2	W/mK
Glass	2.0	W/mK
CoolPoly[®] thermally conductive plastic	20	W/mK
Aluminum	200	W/mK
Diamond	2000	W/mK

Courtesy of Cool Shield Inc.

Applications

- Composite Injection Molded Heat Sinks
- Thermal Interface Materials
- Molded EMI Shielding
- Hybrid Assemblies including, but not limited to, over-molding of heat pipes

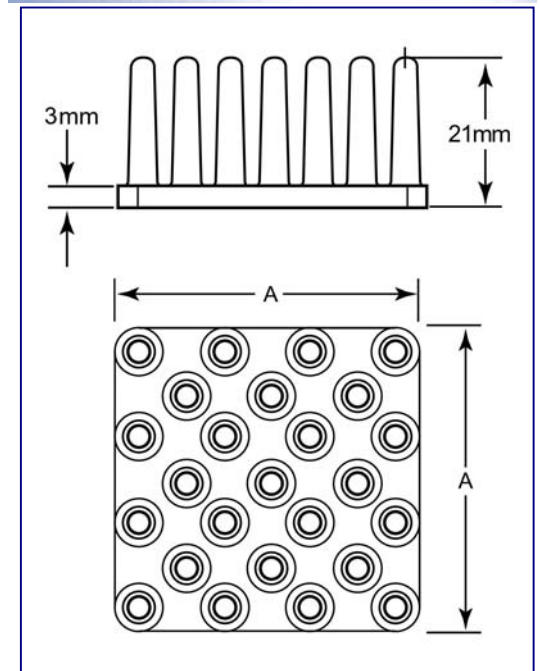
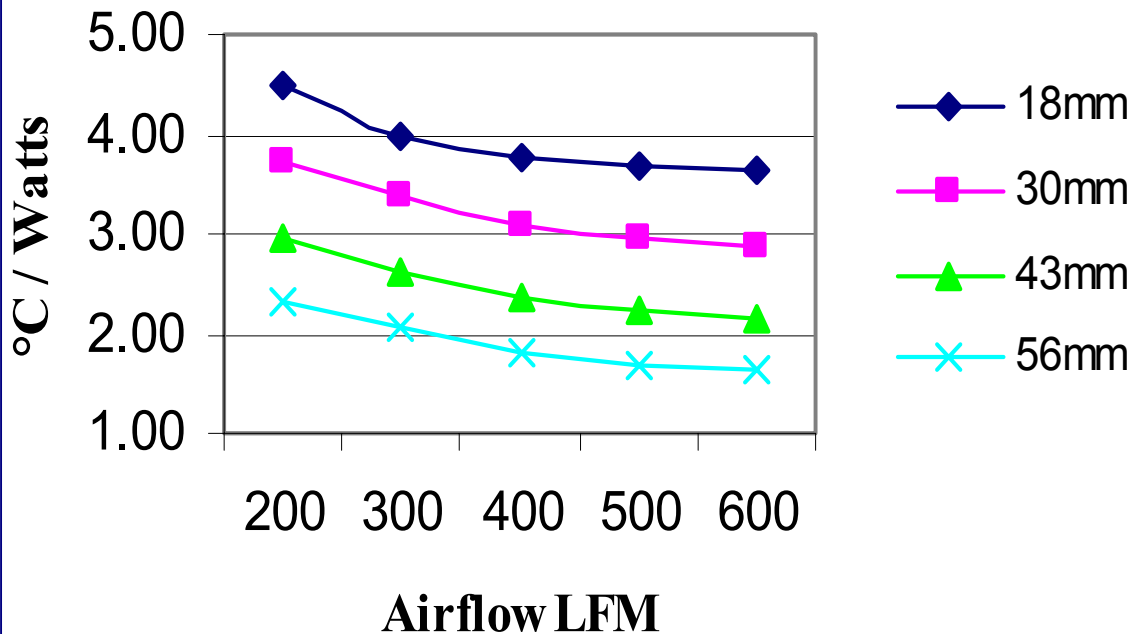
Courtesy of Cool Shield Inc.

Heat Sinks

21 mm high Series of Heat Sinks optimized for lower airflow or non-ducted applications

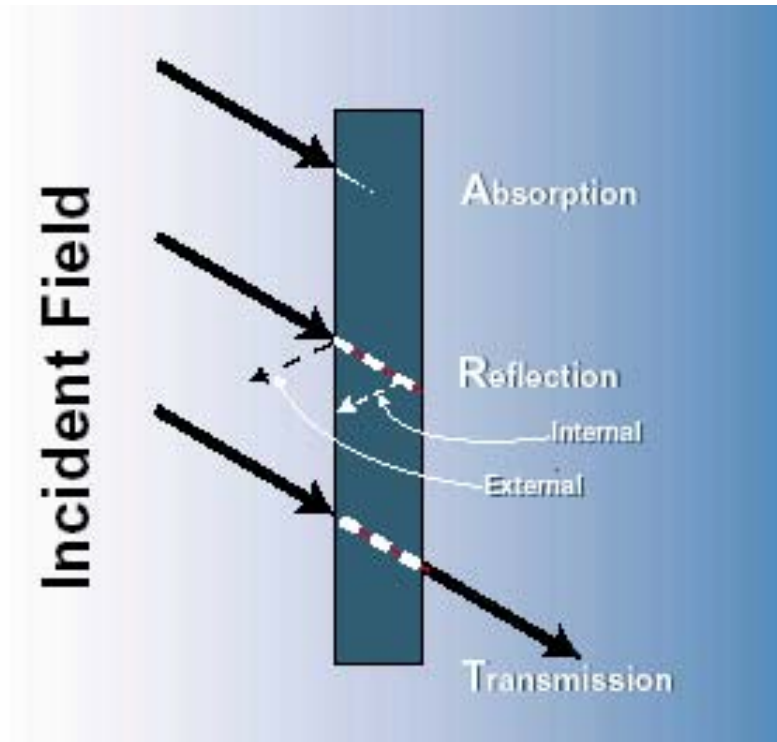


Forced Convection



Courtesy of Cool Shield Inc.

EMI Shield



Absorption: Energy loss as electromagnetic waves pass through a material

Reflection: Energy reflection when electromagnetic waves encounter a material

Transmission: Energy passing through a material with minimal disturbance

Most conventional heat sinks are antennas

Courtesy of Cool Shield Inc.

3D Gap Pads

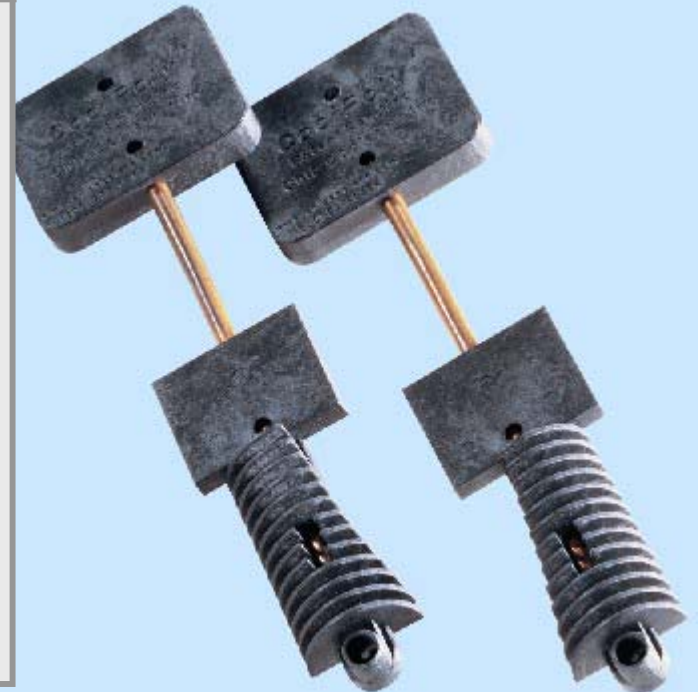


- Injection molded to net shape
- Ideal for multi-chip applications
- 3 Dimensional shape ensures the lowest thermal resistance possible
- Zero waste
- Extremely durable and highly serviceable

Courtesy of Cool Shield Inc.

Over-molded Heat Pipe

	Die Cast Magnesium (glued on heat pipe)	Composite Overmolded Heat Pipe
Sink Weight (g)		26 12
Heat Pipe		
Heat pipe (mm)	3x160	3x160
Embedded length-source (mm)		14 14
Free length (mm)	51	51
Embedded length-sink (mm)		95 95
Thermal couple to sink		adhesive none
Thermal		
Power (W)		5.5 5.5
Die/Source temperature (°C)		71 71



Courtesy of Cool Shield Inc.

Microstepper Motor



- Integrated motor and controller
- Molded housing / heat sink
- 50% cost reduction compared to die cast aluminum
- Tighter tolerances and better aesthetics than metal

Courtesy of Cool Shield Inc.

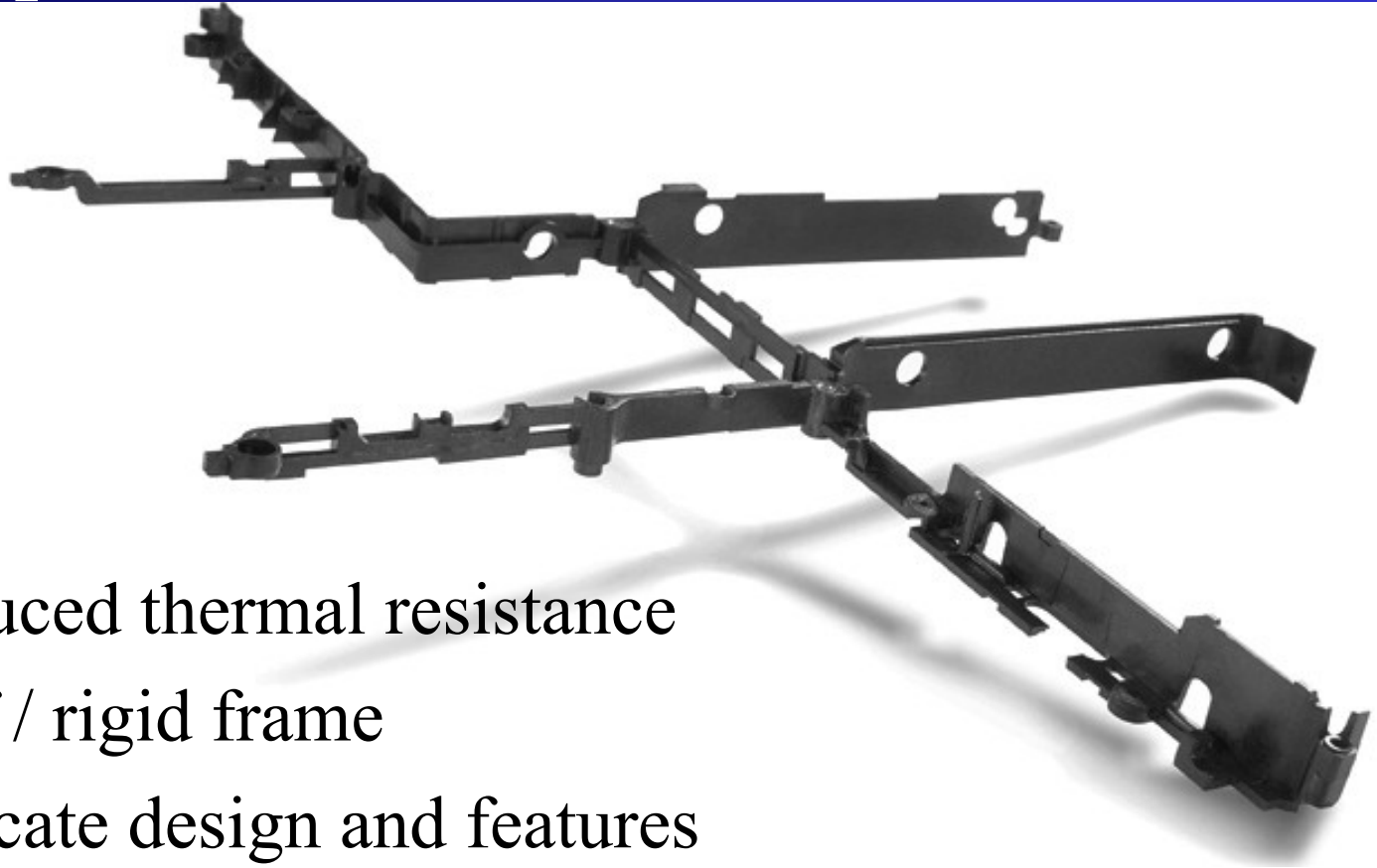
Enclosures



- Thermal management
- EMI / RFI shielding
- Portable electronics, automotive

Courtesy of Cool Shield Inc.

Laptop Frame

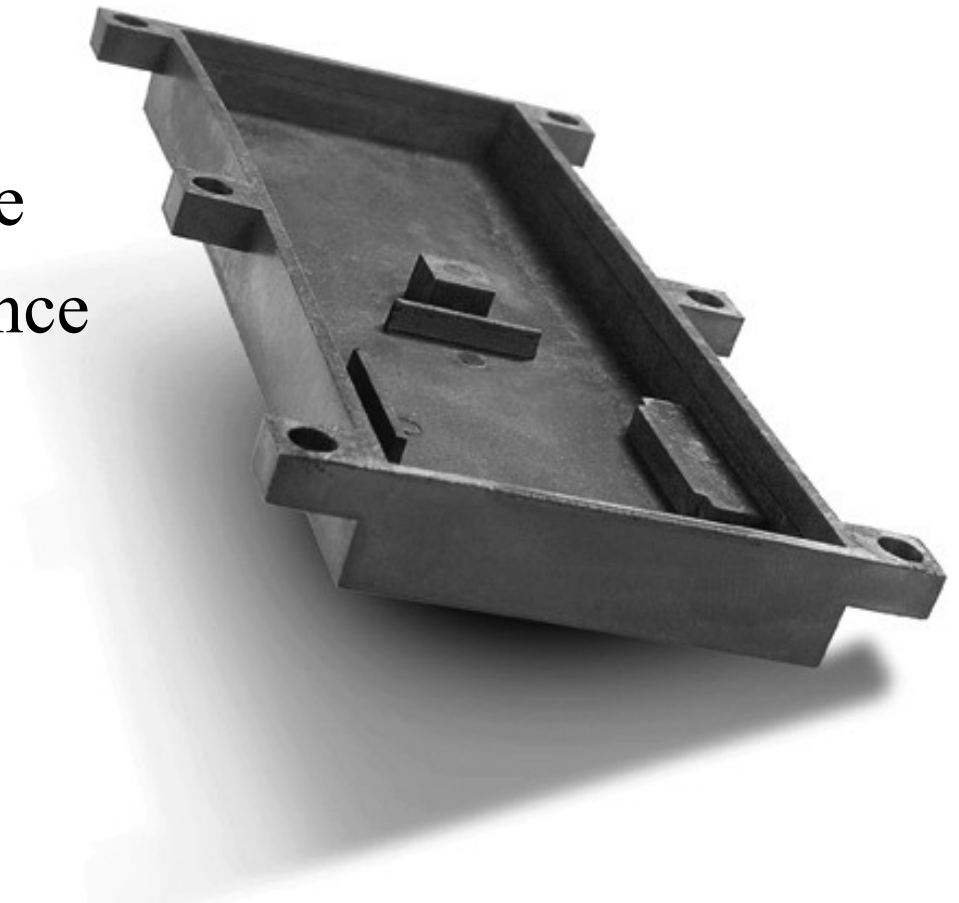


- Reduced thermal resistance
- Stiff / rigid frame
- Intricate design and features
- EMI/RFI shielding

Courtesy of Cool Shield Inc.

Radio Frequency (RF) Module

- Controlled CTE
- Dimensionally stable
- Low thermal resistance



Courtesy of Cool Shield Inc.

End Polymer Heat Sinks

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