

Thermal Management / Heat-Sinking Solutions from Panasonic

Table of Contents

[What is PGS ?](#)

[What is PGS made of ?](#)

[PGS's General Characteristics](#)

[PGS's Features](#)

[PGS's Benefits](#)

[PGS's Thermal Characteristics](#)

[PGS versus Copper](#)

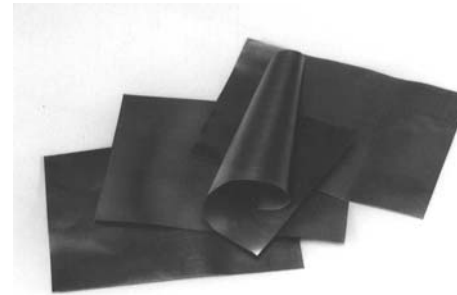
[PGS Available Options](#)

[PGS Typical Applications \(1 \)](#)

[PGS Typical Applications \(2 \)](#)

[PGS Data Sheet](#)

Panasonic's Thermally Conductive Pyrolytic Graphite Sheet (PGS)



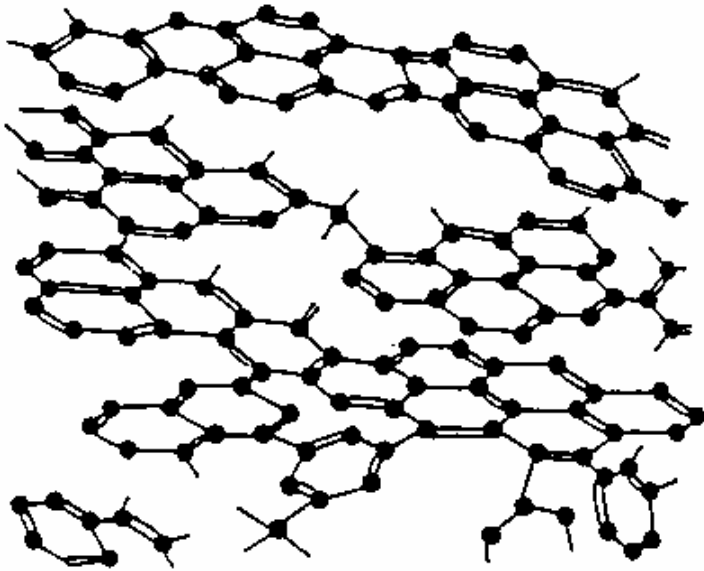
Panasonic Industrial Company
Product Management Dept.

2005

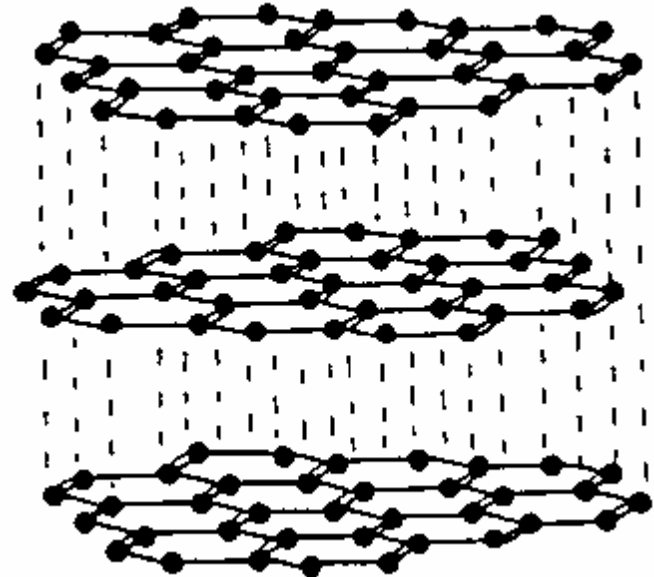
What is a ... Pyrolytic Graphite Sheet (PGS) ?

PGS (Pyrolytic Graphite Sheet) is a synthetically made, high thermally conductive sheet of an unique form of highly-oriented graphite polymer film ideal for providing thermal management / heat-sinking in limited spaces or provide supplemental heat-sinking in addition to other means.

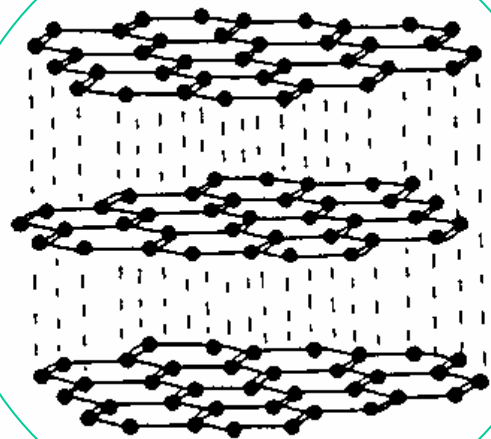
Ordinary Graphite



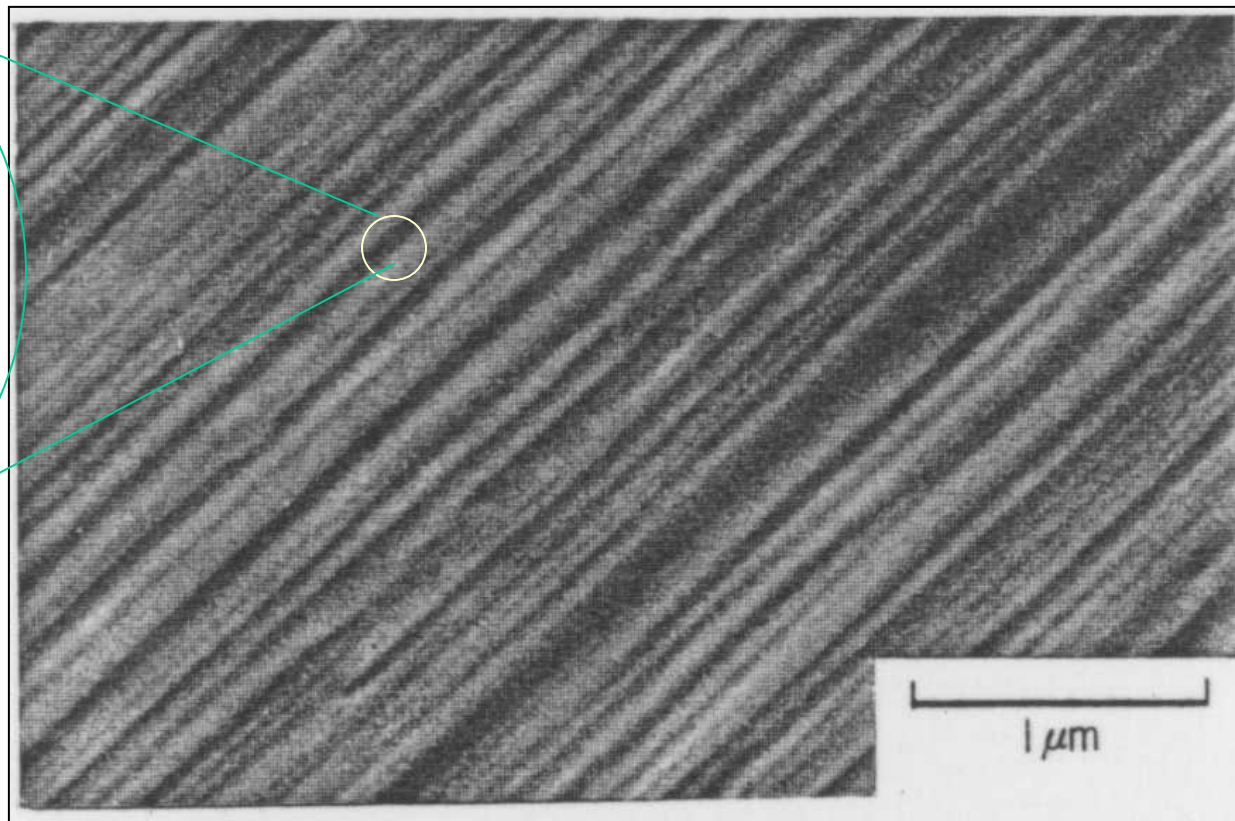
P G S[®] graphite sheet



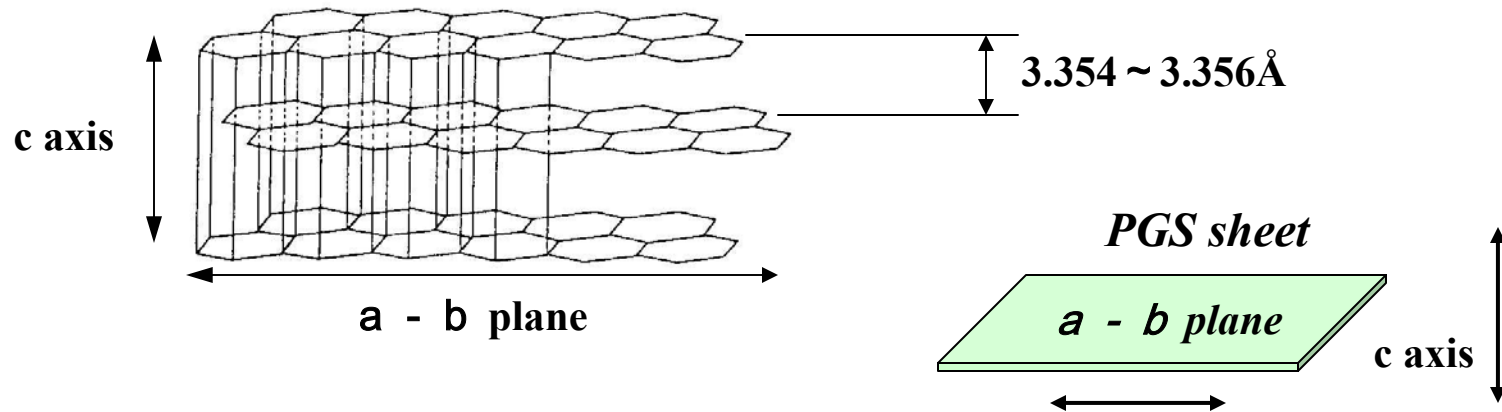
Microscopic View of PGS Structure



Lattice constant
 $3.354 \sim 3.356 \text{ \AA}$



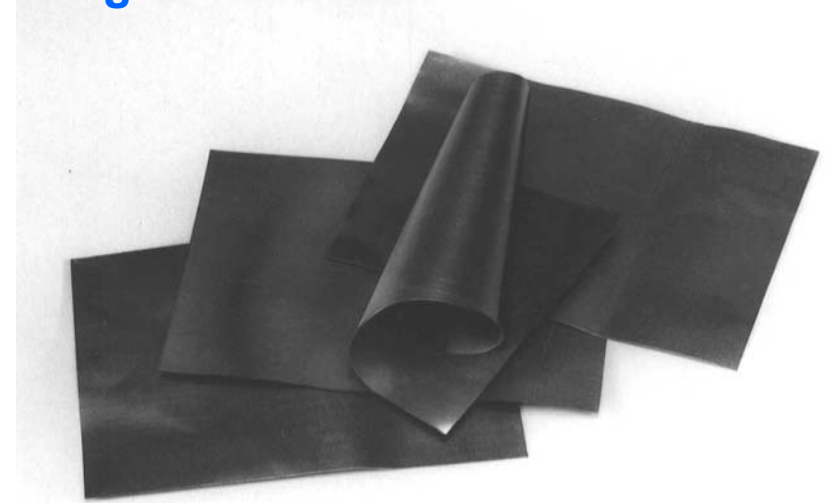
PGS's General Characteristics



Characteristics		Specifications
Thickness		0.10± 0.05 mm
Density		1 g/ cm ³
Thermal conductivity	a-b plane	600 to 800 W / (m· K)
	c axis	Approx. 15 W / (m· K)
Electrical conductivity		10000 S/ cm
Tensile strength		19.6 MPa

PGS's Features

- ◆ **Highly thermally conductive (600 to 800 W / (m•K))**
 - Conductivity is twice that of copper, ten times that of ordinary graphite
- ◆ **Light weight (Density 1.0 g / cm³)**
 - 1/9th of copper and 1/3rd of aluminum
- ◆ **Flexible sheet, easy to cut or trim**
 - Easy to cut into any shape, even using hand-held scissors
- ◆ **High heat resistance**
 - Stable up to about 500°C.



PGS's Benefits

Thermally conductive

More thermally conductive than copper, aluminum, or ceramic materials

Energy-saving

Does not use electricity

Environmentally Friendly

Pure carbon material, has no toxic substances

Thin and Light weight

Excellent heat transfer in any narrow space

Long life

Stable at normal atmospheric conditions and is maintenance-free

Flexible

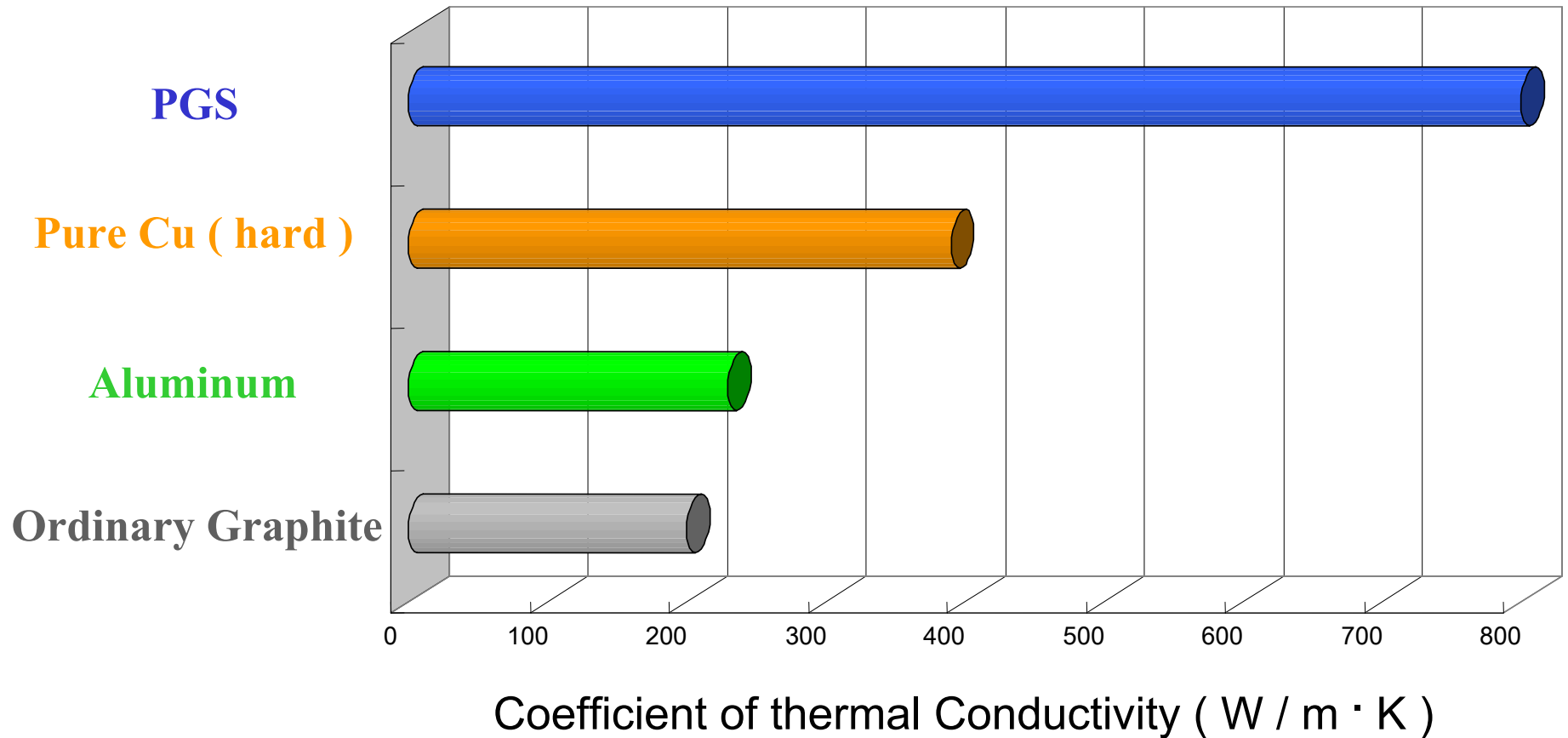
Flexible and can be easily cut into custom shapes

Heat resistant

Stable up to about 500 °C

Thermal Conductivity Characteristics

Comparison of thermal conductivity in the a – b plane

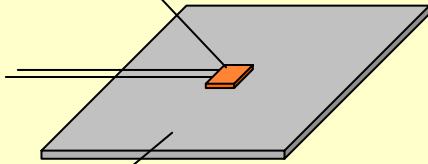


PGS's Performance vs Copper

[Test Condition]

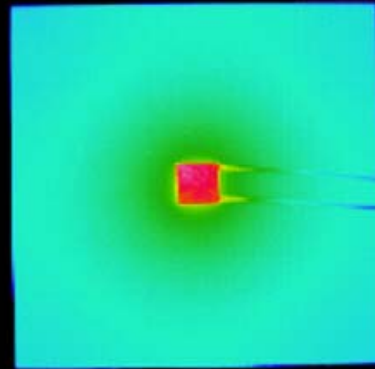
Amb. Temp : 25°C

Heater Power : 12W
10× 10mm

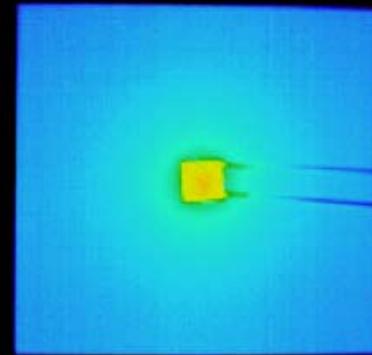


Copper or PGS 90× 90× 0.3mm

※ The surface of both heater and each sheet are coated black



Copper

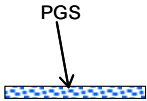
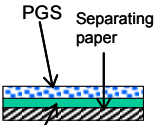
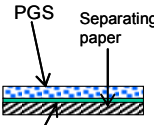
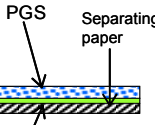
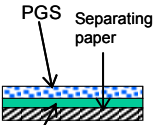
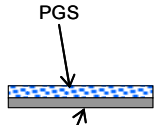
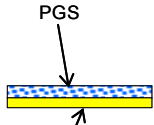
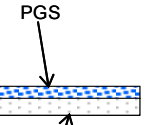
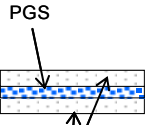


PGS Graphite Sheet



High thermal conductivity of PGS reduces the temp. of the heater because of heat spread, and high radiation of PGS makes all over the sheet getting lower temperature.

PGS's Available Options

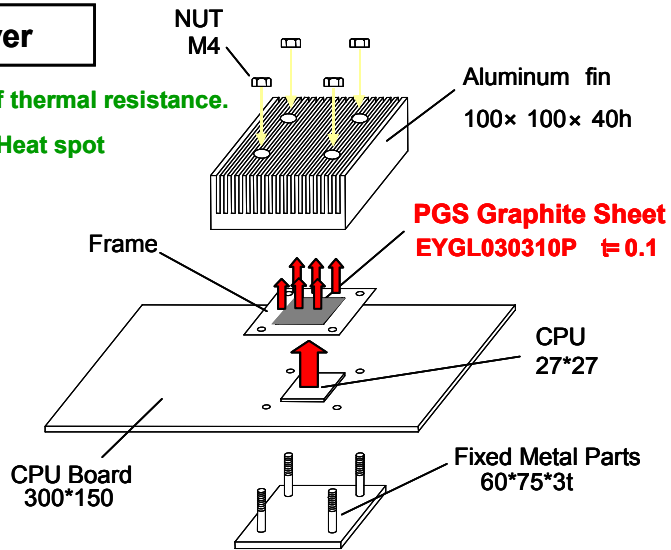
Type	①PGS only	Adhesive type				Insulation type		Multilayered type	
		② Double-sided adhesive tape attached type	③ Double-sided adhesive tape attached type	④ Acrylic adhesion attached type	⑤ Double-sided adhesive tape attached type (Heat-resistance type)	⑥ Polyester tape attached type	⑦ Polyimide tape attached type	⑧ Silicon layered One-sided type	⑨ Silicon layered Double-sided type
Structure									
Features	<ul style="list-style-type: none"> • Usable up to 400°C • Low thermal resistance • Conductivity 	<ul style="list-style-type: none"> • Insulation • Strong adhesion 	<ul style="list-style-type: none"> • Low thermal resistance 	<ul style="list-style-type: none"> • Low thermal resistance • Thin adhesive 	<ul style="list-style-type: none"> • Strong adhesion • High heat resistance 	<ul style="list-style-type: none"> • Insulation • High mechanical strength 	<ul style="list-style-type: none"> • High insulation • High heat resistance • High mechanical strength 	<ul style="list-style-type: none"> • Cushioning properties • One-side insulation 	<ul style="list-style-type: none"> • Cushioning properties • Both-side insulation
Thickness	100μ m	130μ m	110μ m	110μ m	130μ m	130μ m	130μ m	200μ m	300μ m
Thermal conductivity	600~ 800 W m·K	500~ 600 W m·K	550~ 650 W m·K	550~ 650 W m·K	400~ 500 W m·K	500~ 600 W m·K	500~ 600 W m·K	250~ 300 W m·K	250~ 300 W m·K
Withstand temperature	400°C	80°C	80°C	80°C	150°C	80°C	180°C	180°C	180°C
Standard sample	180× 230 mm	90× 115 mm	90× 115 mm	90× 115 mm	90× 115 mm	90× 115 mm	90× 115 mm	115× 180 mm	115× 180 mm
Part No.	EYGS182310	EYGA091210A	EYGA091210B	EYGC091210C	EYGA091210A T	EYGA091210P	EYGA091210K	EYGM121810SS	EYGM121810SW

Typical PGS Applications

For Server

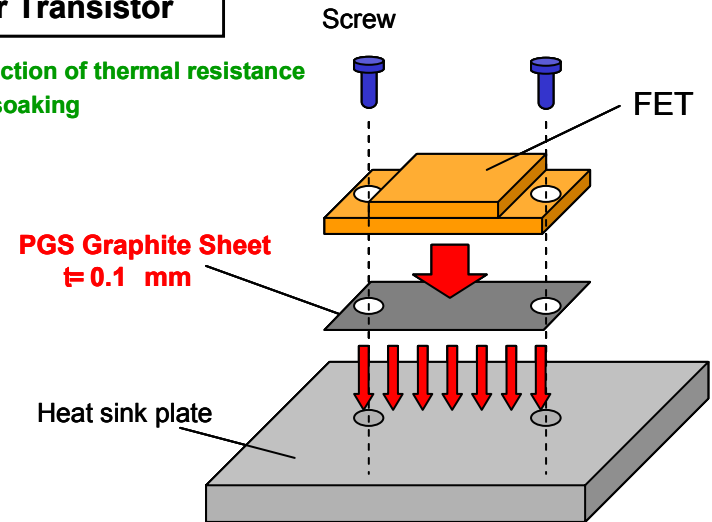
Reduction of thermal resistance.

Diffusion in Heat spot



For Transistor

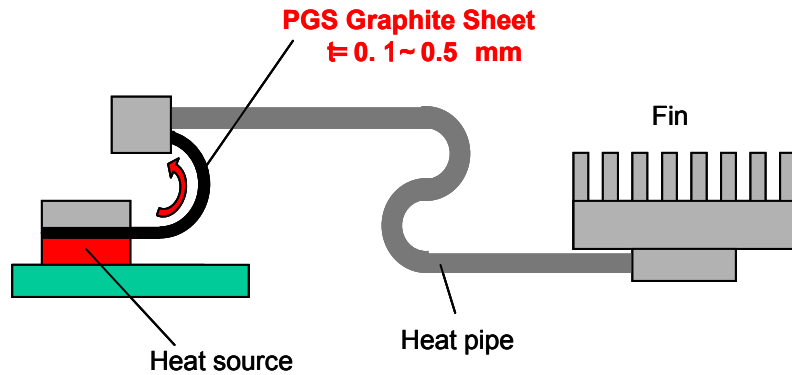
Reduction of thermal resistance
and soaking



Typical PGS Applications

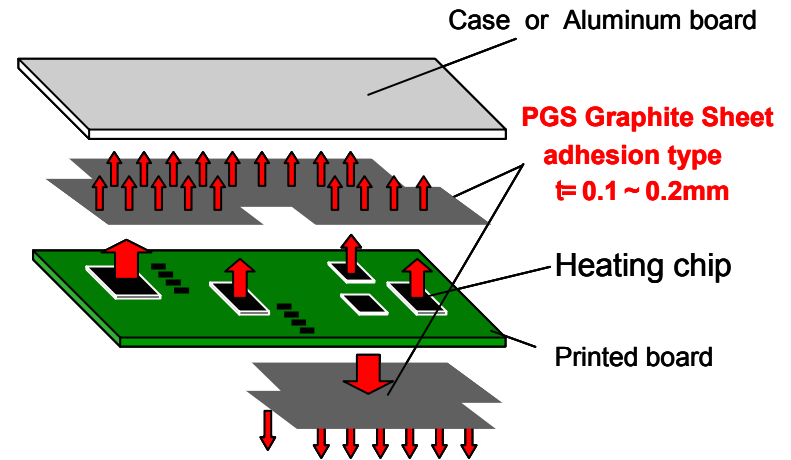
For Note PC

Thermal transfer (Heating chip to Heat pipe)



For PC card

Thermal transfer (Heat spot to case)



PGS Data Sheet

[PGS Data Sheet Hyperlink](#)

Panasonic

"PGS" Graphite Sheets

"PGS" Graphite Sheets

Type: EYG

PGS (Pyrolytic Graphite Sheet) is a heat sink sheet with high thermal conductivity and high flexibility. PGS is made of graphite with a structure that is close to a single crystal. This is achieved by highly oriented polymer film sheet, a process which has never been implemented before.

■ Features

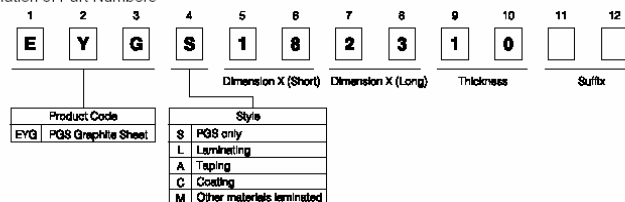
- Excellent thermal conductivity: 600 to 800 W/(m·K)
(Twice as high as copper, three times as high as aluminum)
- Lightweight: Specific gravity: 1.0 g/cm³
(1/9 that of copper, 1/3 that of aluminum)
- Flexible and easy to be cut or trimmed.
(withstands repeated bending)
- Low thermal resistance

■ Recommended applications

- Notebook personal computers, DVDs, DVCs, mobile phones
- Semiconductor manufacturing equipment
(Sputtering, Dry etching, Steppers)
- Optical communications equipment

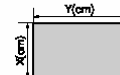


■ Explanation of Part Numbers



■ Dimensions in mm

Part No.	Dimension X (Short)	Dimension Y (Long)	Thickness
EYGS182310	18.0±0.5cm	23.0±0.5cm	0.10±0.05mm
EYGS121810	11.5±0.5cm	18.0±0.5cm	0.10±0.05mm
EYGS091210	9.0±0.5cm	11.5±0.5cm	0.10±0.05mm



■ Characteristics

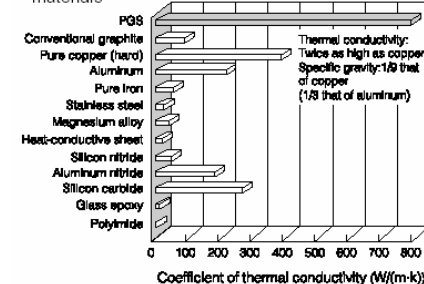
Characteristics	Specification
Thickness	0.10 ± 0.05 mm
Density	1.0 g/cm ³
Thermal conductivity	a-b plane: 600 to 800 W/(m·K)
Electrical conductivity	10000 S/cm
Extensional strength	19.6 MPa
Expansion coefficient	a-b plane: 9.3×10^{-7} 1/K c axis: 3.2×10^{-6} 1/K
Heat resistance	400 °C
Bending (angle 180, R5)	10000 cycles

Design and specifications are each subject to change without notice. Ask factory for the current technical specifications before purchase and/or use. Should a safety concern arise regarding this product, please be sure to contact us immediately.

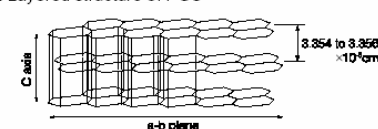
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"PGS" Graphite Sheets

■ Thermal conductivity of PGS compared to other materials



■ Layered structure of PGS



■ Dimensions in mm (not to scale)

Type	EYGS182310	EYGM121810SS	EYGM121810SW	EYGA091210K	EYGA091210A	EYGC091210C	EYGL121810P2	EYGM091210CT
	PGS only	One-sided type	Double-sided type	Polyimide tape attached	Double-side-adhesive tape attached type	Acrylic adhesive (one side) attached type	PET-covered type	Conductive adhesive tape type
Structure	PGS	PGS Silicon: 100µm	PGS Silicon: 100µm	PGS Polyimide tape: 80µm	PGS Acrylic double-sided-adhesive tape: 80µm Protective paper (separating paper)	PGS Acrylic adhesive: 10µm Protective paper (separating paper)	PGS PET film: 25µm	PGS Conductive adhesive tape Protective paper (separating paper)
Thickness (µm)	100±50	200±50	300±50	130±50	130±50	110±50	150±50 (1 pcs.) 350±50 (3 pcs.)	130±50
Thermal* resistance (°C/W)	0.4	1.0	1.4	2.4	1.7	0.8	2.0	1.6
Thermal* conductivity (direction of the sheet surface) (W/m·K)	600 to 800	250 to 300	250 to 300	500 to 600	500 to 600	550 to 650	500 to 600	500 to 600
Withstand temperature max. (°C)	400	180	180	180	80	80	105	80
Standard To be separately consulted sample, (± 5 mm)	180×230	115×180	115×180	90×115	90×115	90×115	To be separately consulted	90×115
Features	Usable up to 400°C Low thermal resistance Conductivity	Cushioning properties One-side insulation	Cushioning properties Both-side insulation	High insulation High heat resistance	Insulation Strong adhesion	Low thermal resistance	High insulation	Conductivity

*The above values are only for reference, they can be changed without notice.

Panasonic ideas for life