

## Thermal Management / Heat-Sinking Solutions from Panasonic

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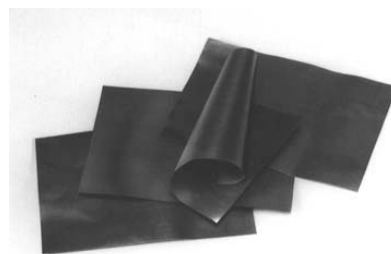
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# Panasonic's Thermally Conductive Pyrolytic Graphite Sheet (PGS)



Panasonic Industrial Company  
Product Management Dept.  
2005

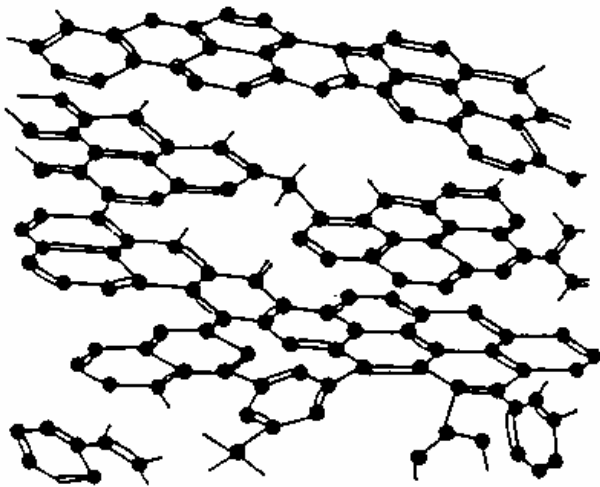
Rev. 1/6/05

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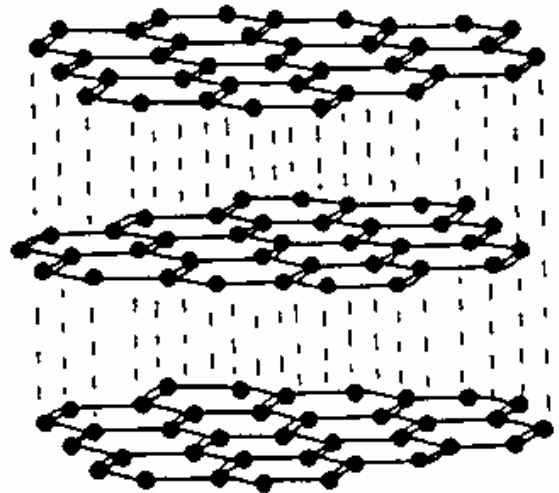
# *What is a ... Pyrolytic Graphite Sheet (PGS)?*

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

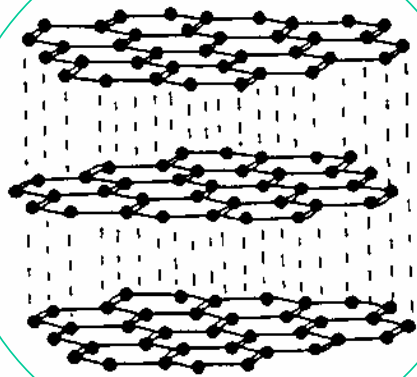


P G S<sup>®</sup> graphite sheet

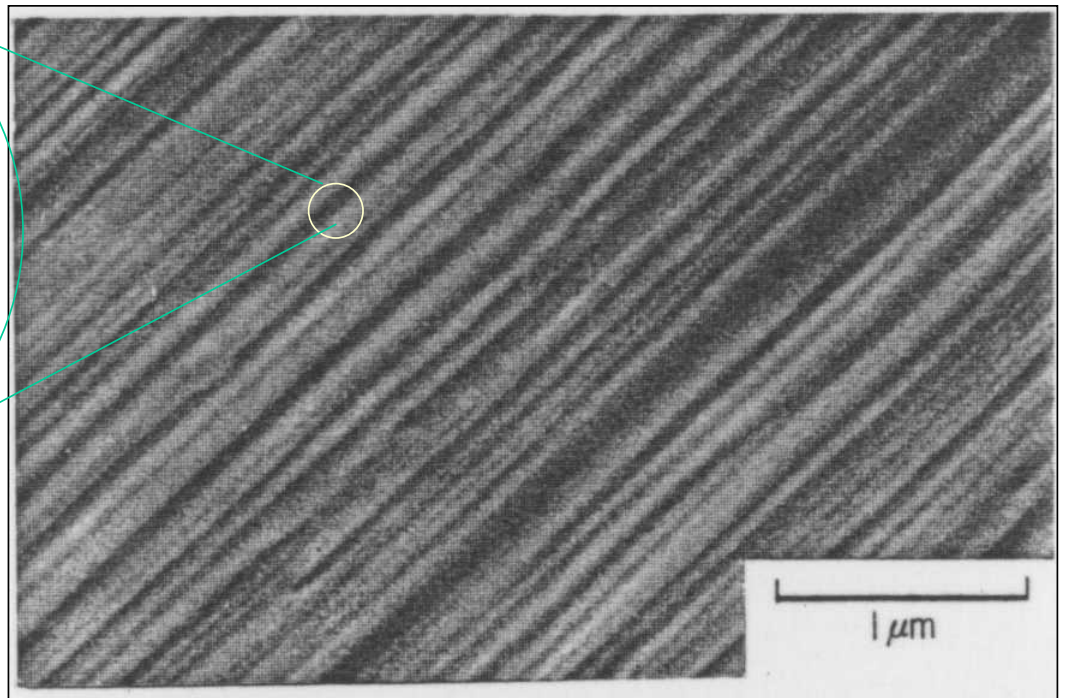


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# *Microscopic View of PGS Structure*

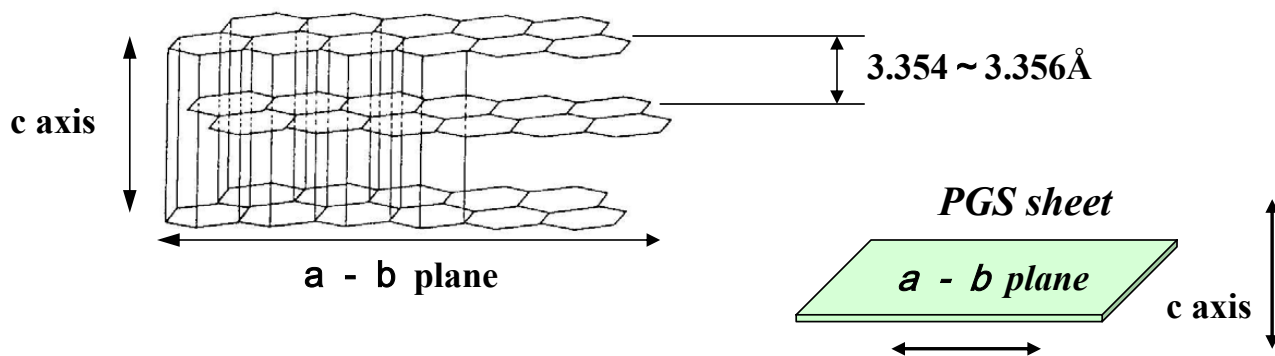


Lattice constant  
3.354 ~ 3.356 Å



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# PGS's General Characteristics

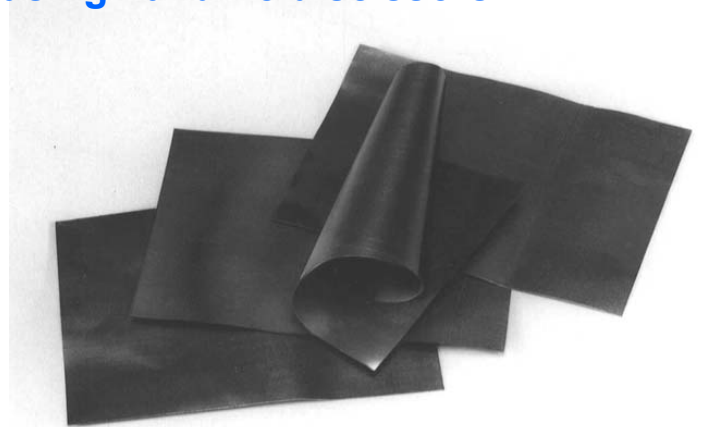


Characteristics		Specifications
Thickness		0.10± 0.05 mm
Density		1 g/ cm <sup>3</sup>
Thermal conductivity	a-b plane	600 to 800 W / (m· K )
	c axis	Approx. 15 W / (m· K )
Electrical conductivity		10000 S / cm
Tensile strength		19.6 MPa

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# *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 / cm<sup>3</sup> )**
  - 1/9<sup>th</sup> of copper and 1/3<sup>rd</sup> 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.



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# *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

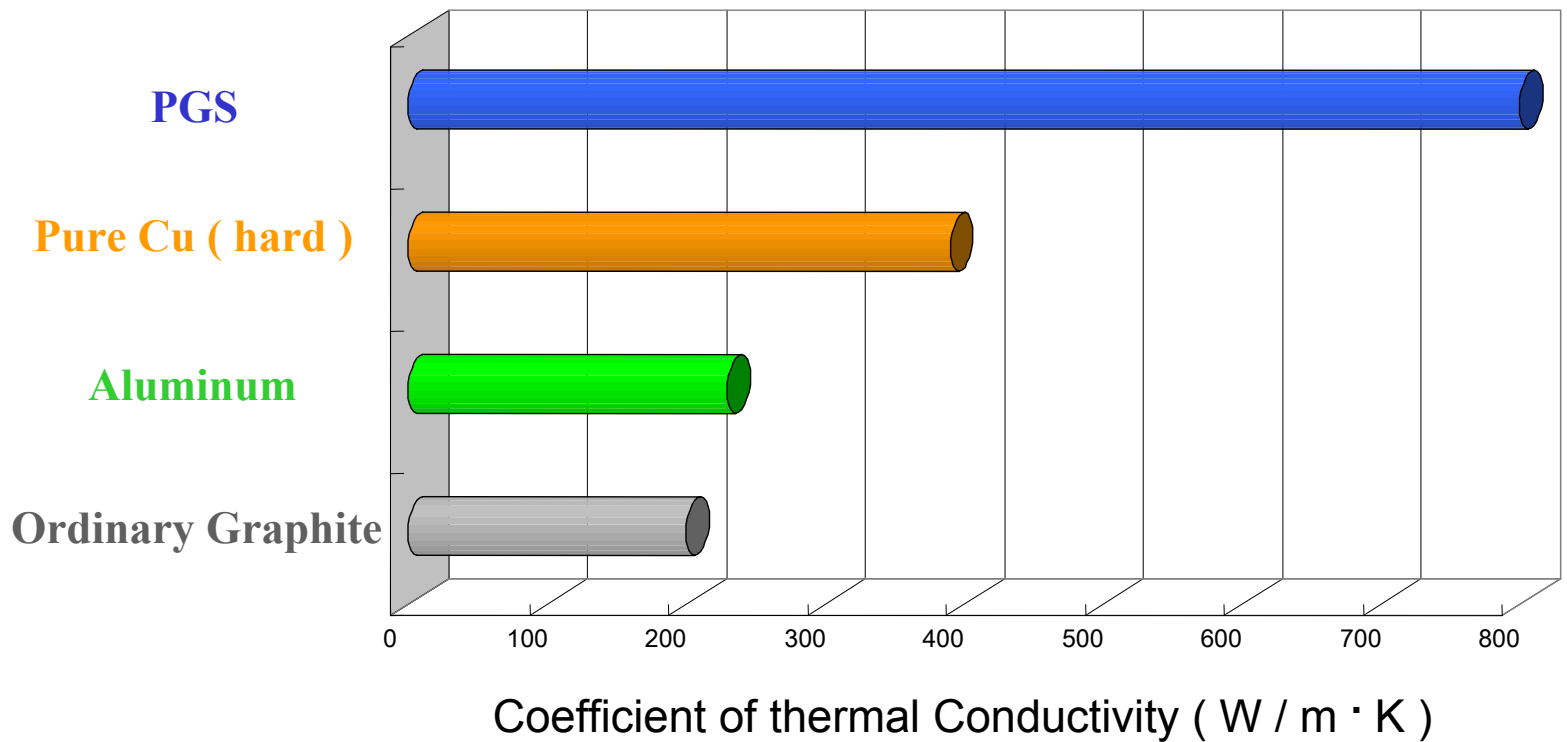
Heat resistant

Stable up to about 500 °C

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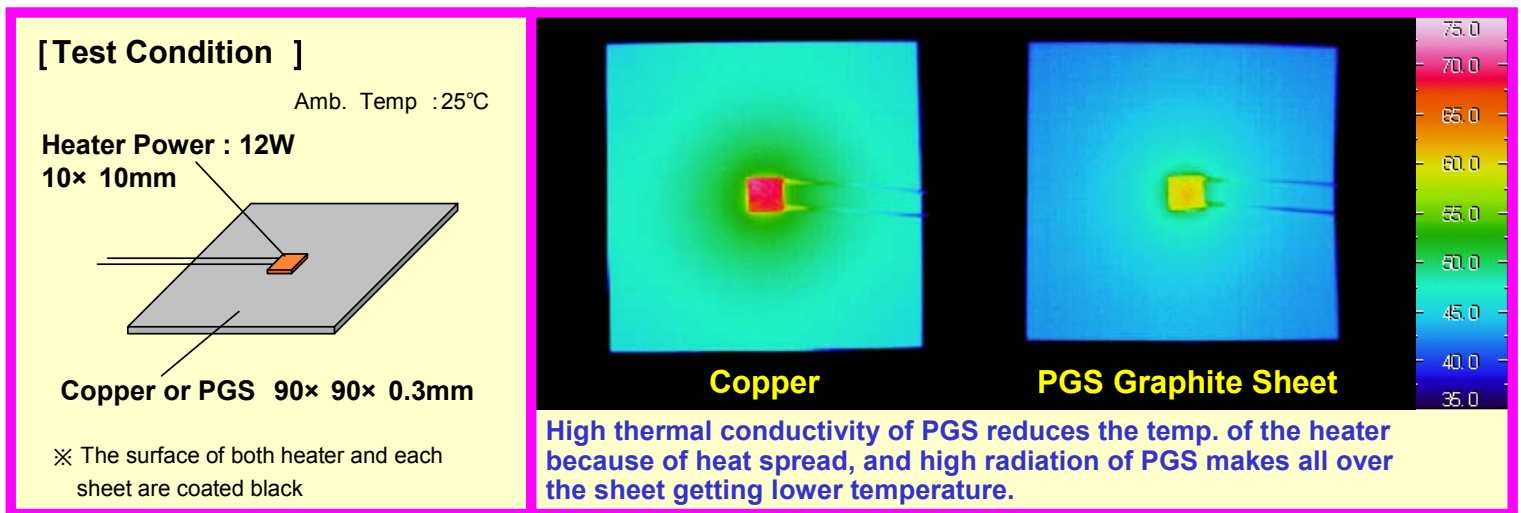
# *Thermal Conductivity Characteristics*

Comparison of thermal conductivity in the a – b plane



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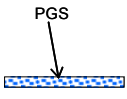
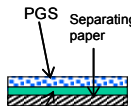
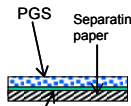
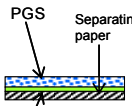
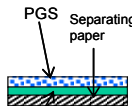
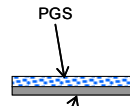
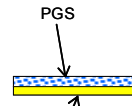
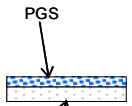
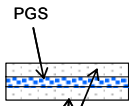
# *PGS's Performance vs Copper*



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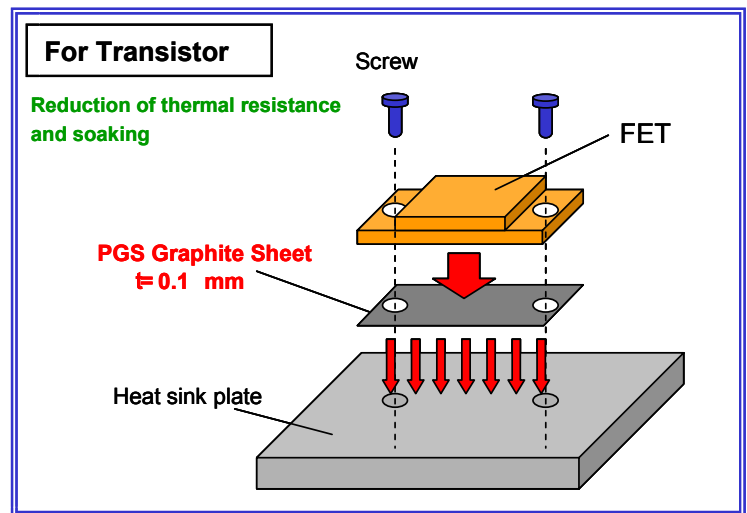
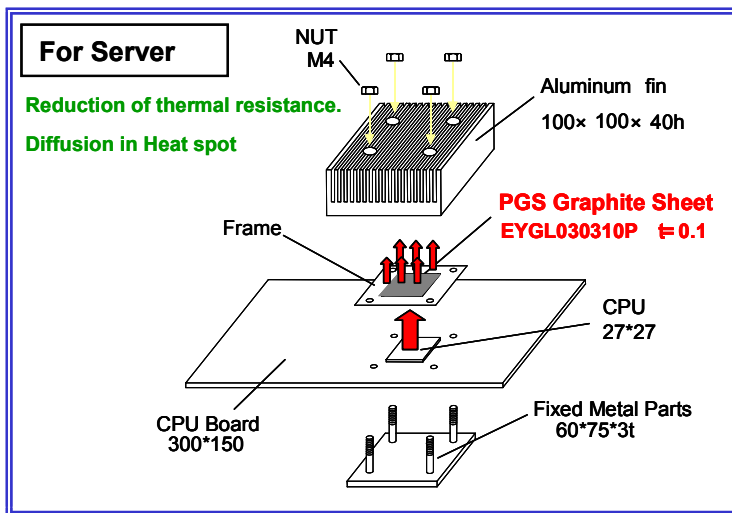


# PGS's Available Options

Type	① PGS 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		 PGS Separating paper Acrylic double-sided adhesive tape 30µm	 PGS Separating paper Acrylic double-sided adhesive tape 10µm	 PGS Separating paper Acrylic adhesive 10µm	 PGS Separating paper Acrylic double-sided adhesive tape (Heat-resistance type) 30µm	 PGS Polyester tape 30µm	 PGS Polyimide tape 30µm	 PGS Silicon 100µm	 PGS Silicon 100µm
Features	<ul style="list-style-type: none"> <li>Usable up to 400°C</li> <li>Low thermal resistance</li> <li>Conductivity</li> </ul>	<ul style="list-style-type: none"> <li>Insulation</li> <li>Strong adhesion</li> </ul>	<ul style="list-style-type: none"> <li>Low thermal resistance</li> </ul>	<ul style="list-style-type: none"> <li>Low thermal resistance</li> <li>Thin adhesive</li> </ul>	<ul style="list-style-type: none"> <li>Strong adhesion</li> <li>High heat resistance</li> </ul>	<ul style="list-style-type: none"> <li>Insulation</li> <li>High mechanical strength</li> </ul>	<ul style="list-style-type: none"> <li>High insulation</li> <li>High heat resistance</li> <li>High mechanical strength</li> </ul>	<ul style="list-style-type: none"> <li>Cushioning properties</li> <li>One-side insulation</li> </ul>	<ul style="list-style-type: none"> <li>Cushioning properties</li> <li>Both-side insulation</li> </ul>
Thickness	100µm	130µm	110µm	110µm	130µm	130µm	130µm	200µm	300µm
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

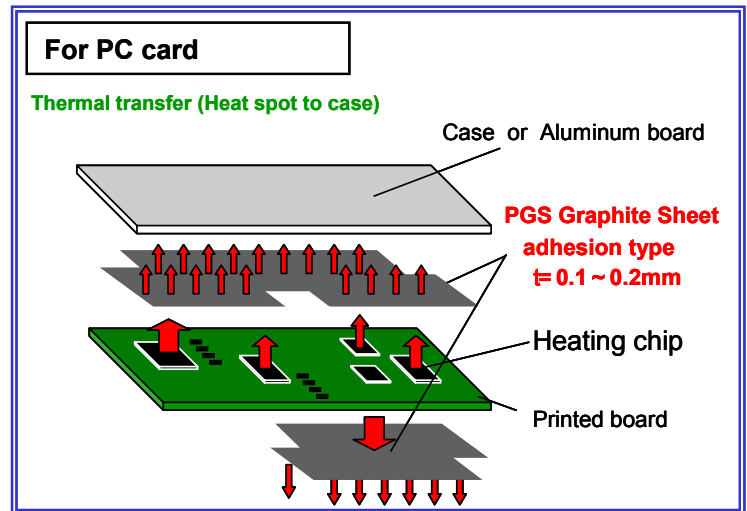
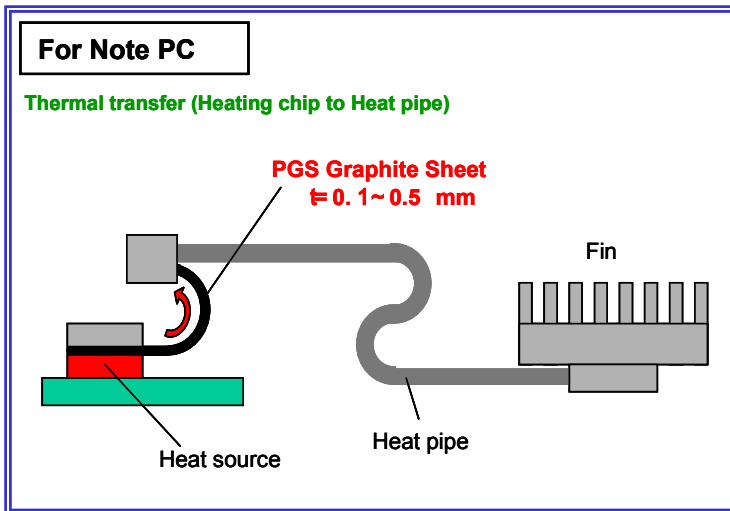
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# Typical PGS Applications



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# Typical PGS Applications



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# 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.



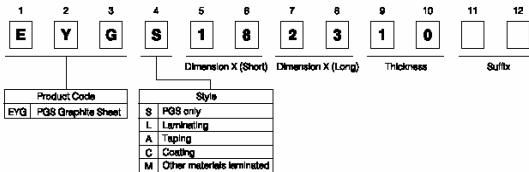
### Features

- Excellent thermal conductivity: 600 to 800W/(m·K) (Twice as high as copper, three times as high as aluminum)
- Lightweight: Specific gravity: 1.0g/cm<sup>3</sup> (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

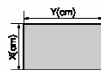
- Notebook personal computers, DVDs, DVCs, mobile phones
- Semiconductor manufacturing equipment (Sputtering, Dry etching, Steppers)
- Optical communications equipment

### 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

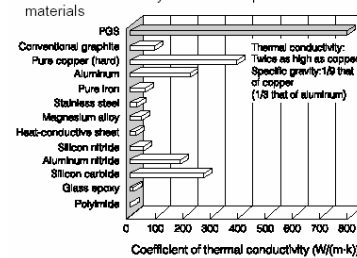
Characteristics	Specification
Thickness	0.10 ± 0.05 mm
Density	1.0 g/cm <sup>3</sup>
Thermal conductivity	a-b plane: 600 to 800 W/(m·K)
Electrical conductivity	10000 S/cm
Extensional strength	19.6 MPa
Expansion coefficient	a-b plane: 9.3 × 10 <sup>-7</sup> 1/K c axis: 3.2 × 10 <sup>-6</sup> 1/K
Heat 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.

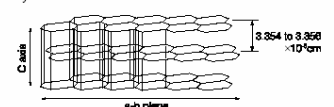
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"PGS" Graphite Sheets

### Thermal conductivity of PGS compared to other materials



### Layered structure of PGS



### Dimensions in mm (not to scale)

	EYGS182310	EYGM121810SS	EYGM121810SW	EYGA091210K	EYGA091210A	EYGC091210C	EYGL111111P1	EYGM091210CT
Type	PGS only	Silicon layered 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: 90µm	PGS Acrylic double-sided adhesive tape: 90µm 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.

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