Introduction to Evaluation Equipment for SiC Power Semiconductor & Power Module

2014/11/20 Disribution

by S. Usui, Risoh Keisoku K.K.

Introduction to Evaluation Tester

1) 350℃ Compact Thermal Shocker CHS350
for SiC power semiconductor Temp. Evaluation

2) 400℃ High Temp. Constant Temp. Chamber
HTC400 : for SiC High Temp. Storage Test

3) Compact Constant Temp. Chamber RK-10207PL
for large Element Power Module

4) 200A～2000A Large Current Source System
for Power Cycle test of IGBT/FET module

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Evaluation test for Power semiconductor RKKK (Risoh Keisoku K.K.) can help you

Test Item	Si module test condition	SiC module Test condition	RKKK products support :
Thermal Shock test	-40℃60M +125℃60M	-40℃60M>>30M +250℃60M>>30M	Compact Thermal Shock Tester CHS350
Temp. Cycle 500C、1000C	-40℃60M +125℃60M	-40℃60M>>30M +250℃60M>>30M	CHS350
High Temp. Storage	Ta=+125℃、1000H	Ta=+300℃、1000H	High Temp. Constant Temp. Chamber HTC400
Low Temp S.	Ta=-40℃、1000H	Same as left	Low –Cost Constant Temp.& Humidity Chamber TH series
High Temp. Bias	Tj=+125℃, Load, 1000H	Tj=+250℃, Load, 1000H	HTC400
Power Cycle	ΔTj=100℃, 5000C	ΔTj=200℃, 5000C	Large Current Source for Power Module PMPS
HighTemp/ Humidity	+85℃85%	Same as left	TH series

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1996 .....Established to develop/manufacture/sell of Measurement/Analysis/Control system suitable to Japan market.

2001 .....Formal Agent of Intelligent Instrumentation Inc
Developed/shipped OLED parameter test equipment & OLED Panel inspection equipment
Developed/shipped Abnormal Sound Detection and Alarm system (NAMAS)

2002 .....Developed/shipped OLED mother-glass Aging Large Current power supply Inspection system
Developed/shipped Multi-channel Isolation Measurement system (LIMS)

2003 .....Developed/shipped Compact Temperature Chamber for Light Emitting Device

2004 .....Developed/shipped OLED Lifetime measurement system
Developed/shipped Water-cooling Compact Temperature Chamber

2005 .....Developed/shipped several kinds of OLED Inspection system and JIGUs
Started selling Low-cost Constant Temperature Chamber

2006 .....Developed/shipped High-power LED Lifetime test system
Developed/shipped Solar cell parameter test system

2008 .....Developed/shipped 1000 channel LED lifetime test system
Developed/shipped Heat Cycle Lifetime test system LifeMAPS

2009 .....Developed Compact Thermal Shocker (for SiC evaluation, −40 to +350 dC supported) backuped by Economy & Industry Ministry

2010 .. ..Moved to current new-factory (Shibokuchi, Takatsu-ku, Kawasaki)

2011 .....Developed/shipped 200A Power Module Large Current Power Supply system (PMPS)

2012 .....Developed/shipped PMPS 500A system, IGBT driving signal system, 400°C High temp constant temp chamber,
Developed/shipped −70°C compact temp chamber

Feature of Risoh Keisoku K.K.

- Analog Measurement / Control Technology

  1987 World first LowCost 16bitADC Design / Develop / Mass Production（at BB)

  Multi-ch small current measurement, Large Current output

- Compact space Constant Temp. Tech.

  Palm-top size Compact Temp. Chamber：－70℃

  Large size Temp. Chamber：10～90℃

  Compact Thermal Shock Tester：－55℃～+350℃

- LargeCurrent Source Test Equipment

  Organic EL, Power LED Display Testers

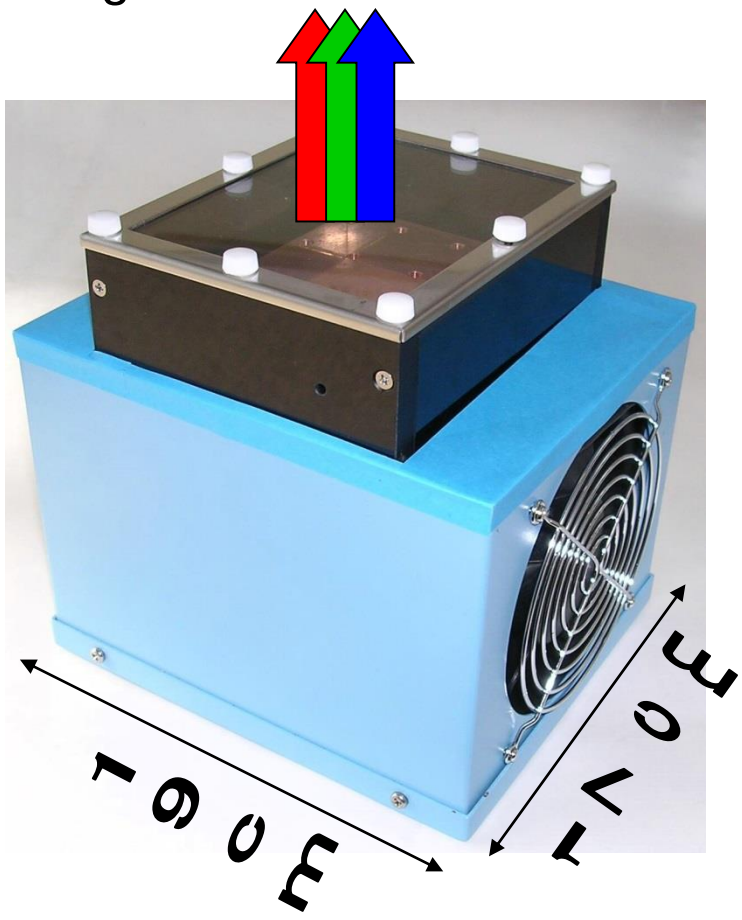
  Power LED power / Temp. cycle Lifetime Tester

  IGBT module Evaluation Large Current Source ystem

Compact Temp. Chamber for Element

RK-10207P

Light Measurement tool



- -40 to +150℃ T-range
- Peltier thermal driving optimal for element Evaluation
- Top : Glass
- for Light Emitting Element
  （LED, OLED, LD etc.)
- Direct Thermal Transfer
- Speedy, Compact, Complete Air Cooling
- Palm-top size – on desk test
- Utility : Electric Power only
  No need for water / compressor

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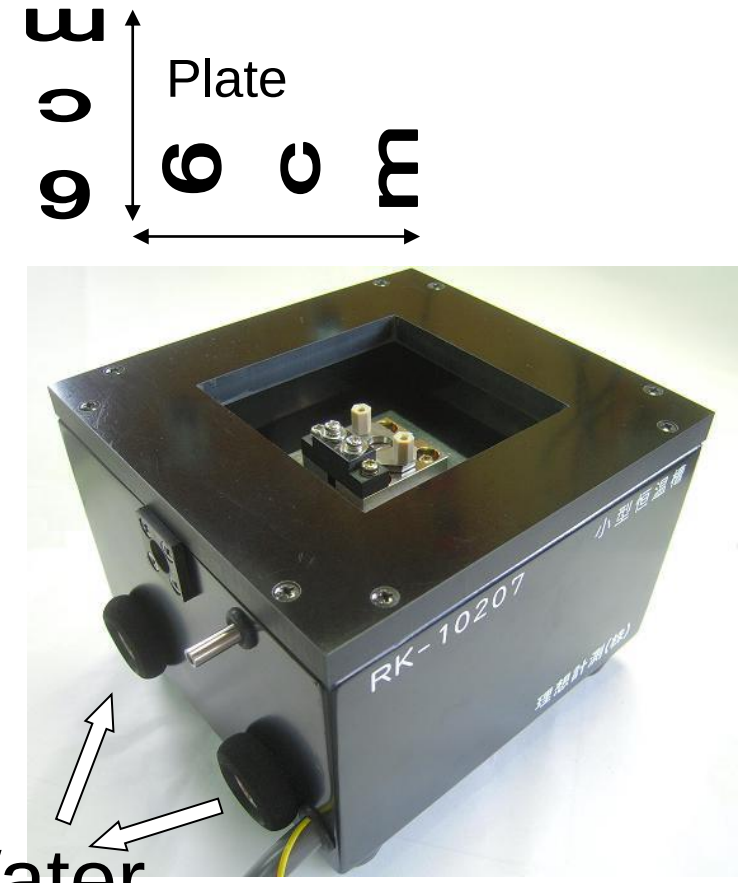
Water Cooling Compact Temp Chamber

RK-10207



- -70℃ to +120℃ T-range
- Optimal for Car element evaluation test
- Direct Thermal Transfer
- Speedy, Compact
- Water cooling method
- High Accuracy

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PV oriented Compact Temp. Chamber RK-10207P-120x120

- -40 to +150℃ T-range
- 120x120mm Plate
- Optimal for Solar Cell Evaluation
- Direct Thermal Transfer
- Speedy, Compact
- Complete Air Cooling
- On-desk size

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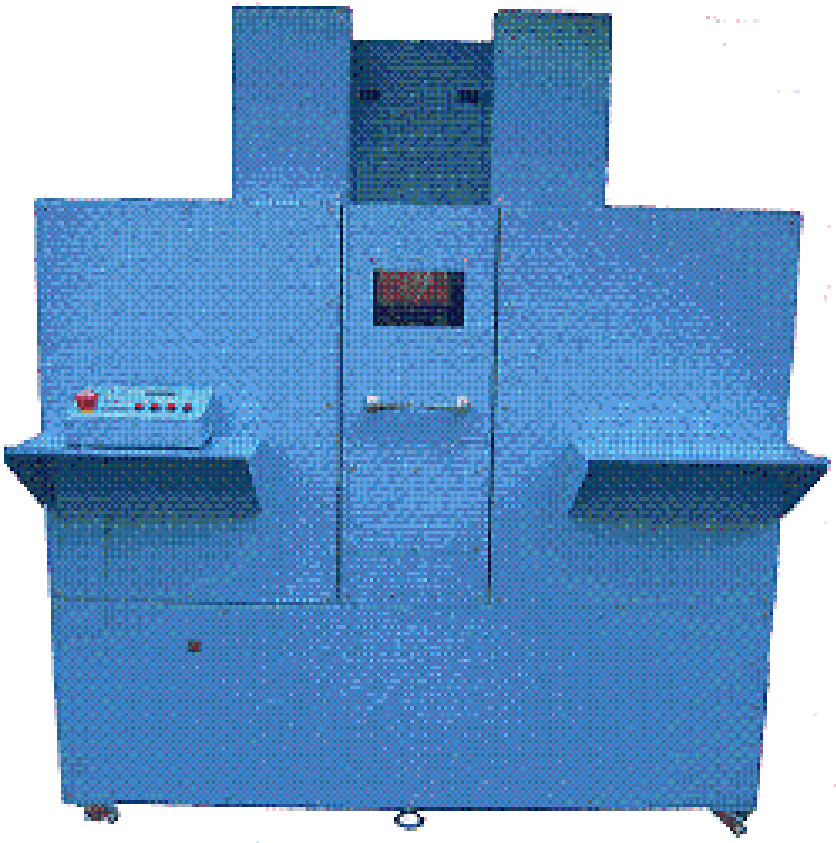
Small, High Performance, Large energy saving

Compact Thermal Shock Tester CHS350



- -55 to +350℃ T-range
- Test area size: 20x20x20cm^3
- Optimal for SiC Evaluation & High Temp. Material test
- Thermal Shock test, Thermal Cycle test,
- Speedy, Energy saving, Compact, Low cost
- Large Reduction of CO_2 Discharge

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Some parts of this CHS350 were developed with supports from 2009 Japan E/I Ministry, Yokohama National University, Kanagawa Industry & Technology Center and Kanagawa Academy of Science and Technology.

“ Project Name : Development of Small Thermal Shock Tester for Temperature Characteristics Evaluation Test of Car Inverter Module etc.”

Project Manager: S.Karasawa, H.Kobayashi. KAST
General Research Representative: S.Usui, R.Ohira. RKKK
Sub-General Research Representative: K.U, I.Shinohara. YNU
Cooperator: T.Shinohara. KITC

2011 Win Incentive Prize at Kanagawa Industrial & Technology Dvelopment Award

2012 Win Kawasaki Entrepreneur Award

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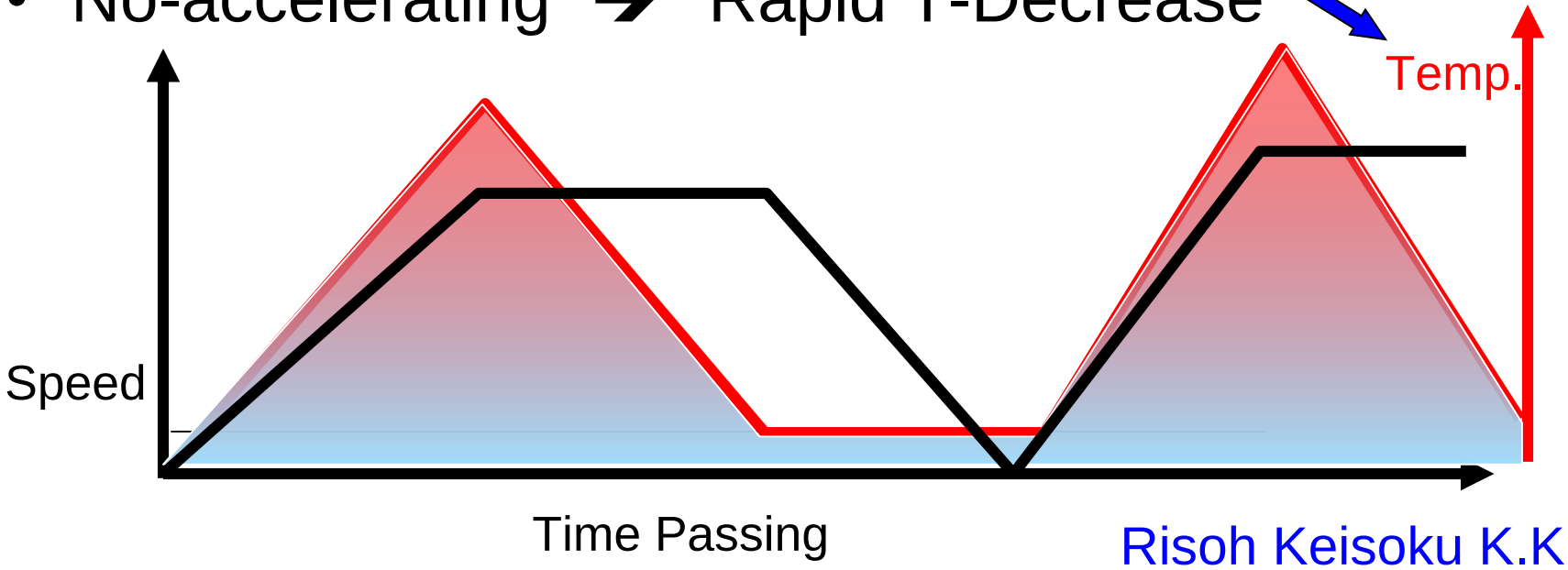
Environmental conditions of SiC Inverter for EV

- EV motor control << Mechatronical Integration >>
- Large Current, Large Power, Compact sizing, High Energy density
- Accelerating ➔ Rapid T-Increase
- No-accelerating ➔ Rapid T-Decrease



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Environmental conditions of SiC Inverter for EV

- Cars repeat always Accelerating / Decelerating
- SiC Inverter: Miniaturizing, Mechatronical Integration, Heat Concentration
- High / Low Temp. is repeated ultimately.（several 10s to several 100s in 24 hours）condition :

  Used in IC-historically most hazardous temp environment
- High Temp. Durability ➔ over than 300℃
- SiC Inverter, SiC semiconductor(module) need absolutely Environmental Durability Evaluation test
- Conventional Si-oriented Thermal Shocker is useless.
- Necessary for over 300℃ supporting Thermal Shocker

Conditions: Small, New method, Energy-saving, Speedy, Low Cost.

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CHS350 Outline

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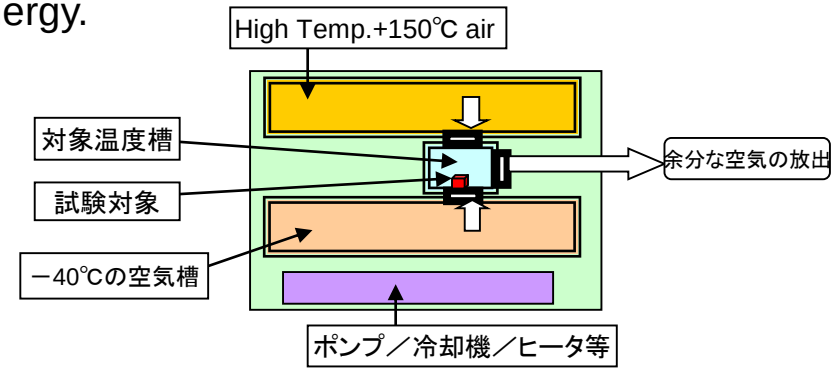
Compact Thermal Shocker for EV oriented Inverter module Temp.Character Evaluation

Thermal Shocker for Power module using new material such as SiC / GaN element with high durability, Compact & light weight, for purpose of additional energy saving of hybrid Car & EV.

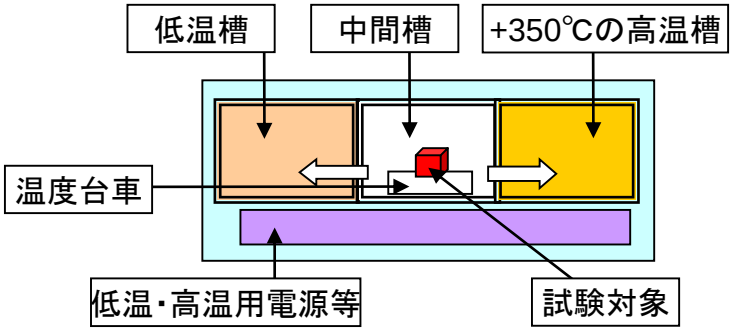
[Conventional technology]

In case of Air flow type, cycle test is repeated by 1) settle the target device in target temp. chamber, 2) generate high temp.air and low temp. air in 2 tanks, 3) flow in to target temp. chamber from each tank mutually. Since 2 air tanks are large and exchange large amount of high temp. air and low temp. air every cycle in to target chamber, it takes time and release airs every time into free air so that consumes large energy.

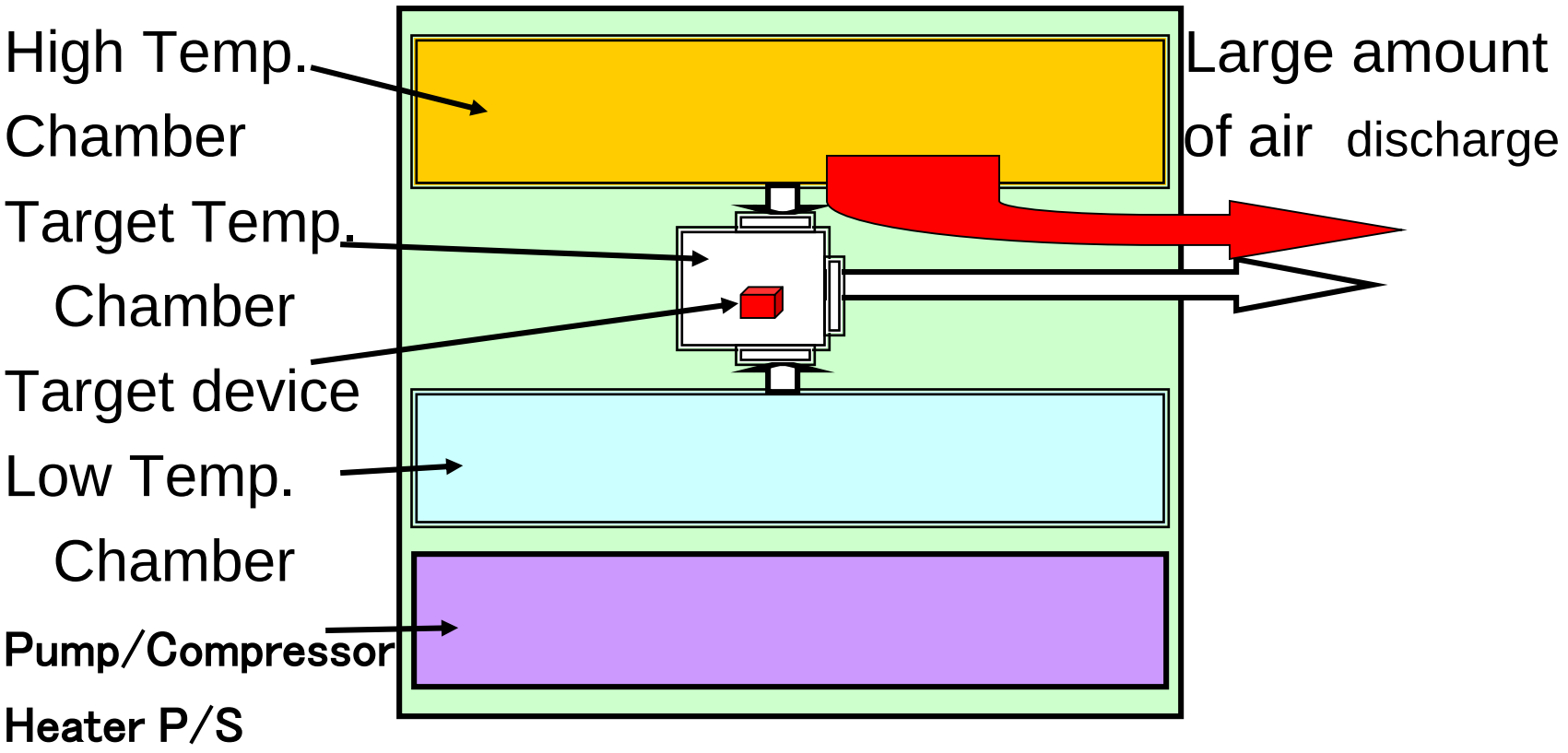


[New technology]

Settle the target device on the cart after generating low temp. of low temp. chamber with Peltier module and high temp. of high temp. chamber with heater. Moving the temp. cart between each chamber, Thermal shock cycle test is repeated. Eliminating air discharge saves large amount of energy and direct contact heat transfer method shortens time to the target temp. so that thermal chock cycle is performed with small size.



Conventional Air flow type Outline



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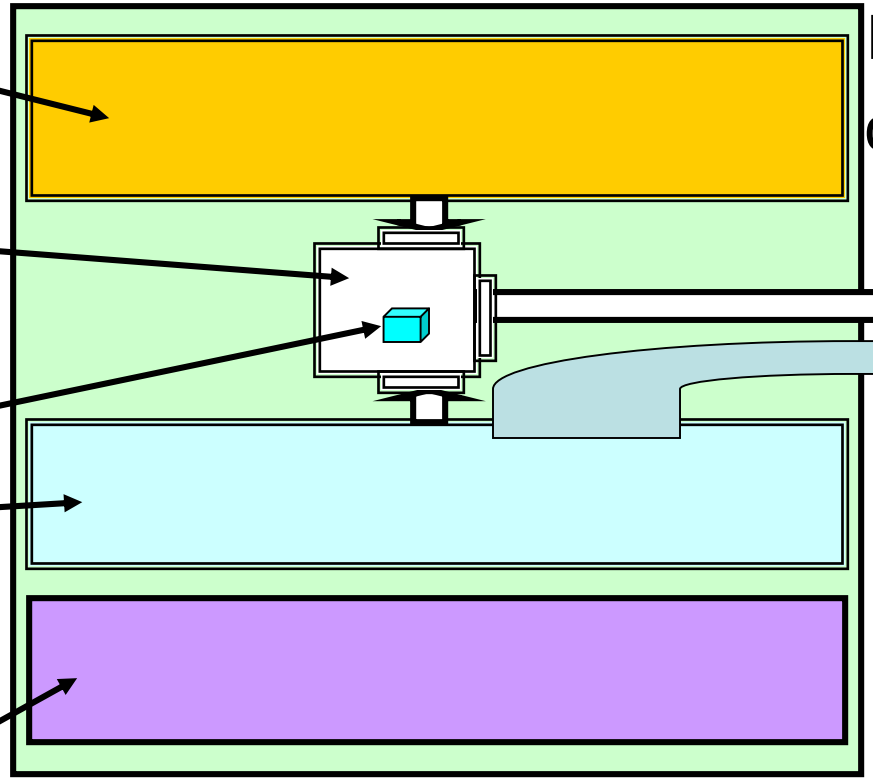
Conventional Air flow type Outline



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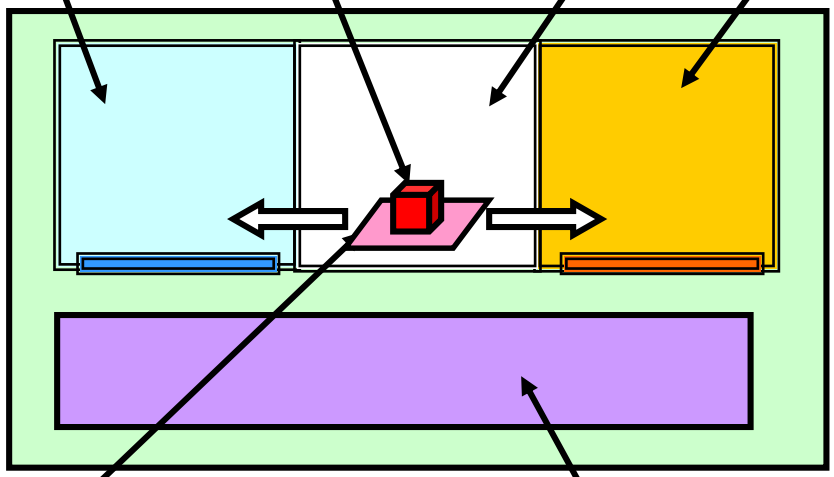
New Technology Outline



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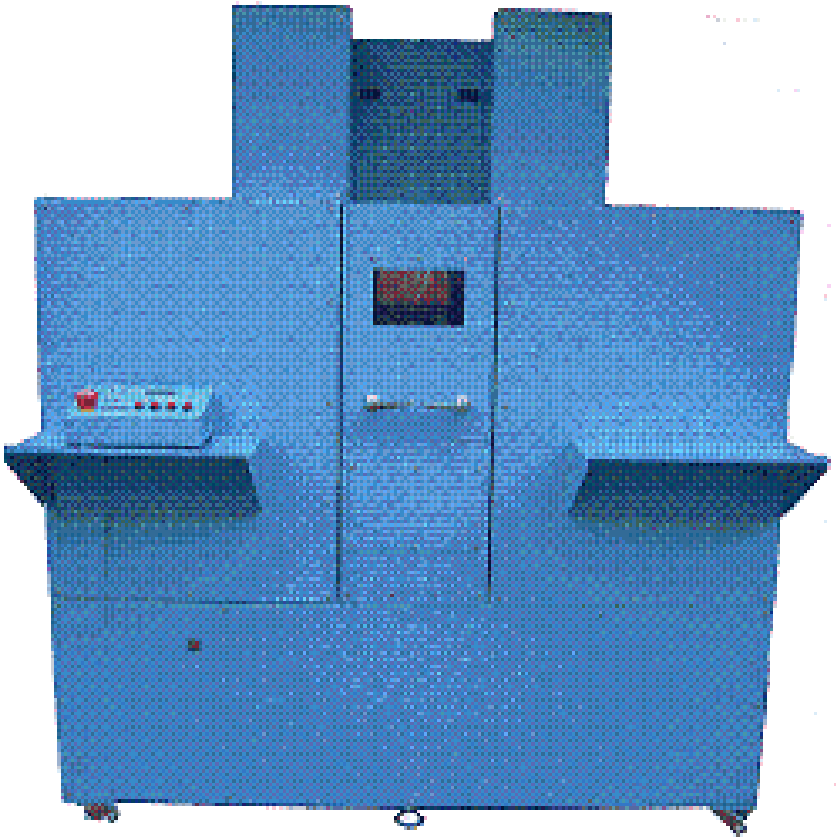
Small, High Performance, Large energy saving

Compact Thermal Shock Tester CHS350



-55 to +350℃ T-range

Test area size: 20x20x20cm^3

Optimal for SiC Evaluation & High Temp. Material test

Thermal Shock test, Thermal Cycle test,

Speedy, Energy saving, Compact, Low cost

Large Reduction of CO_2 Discharge

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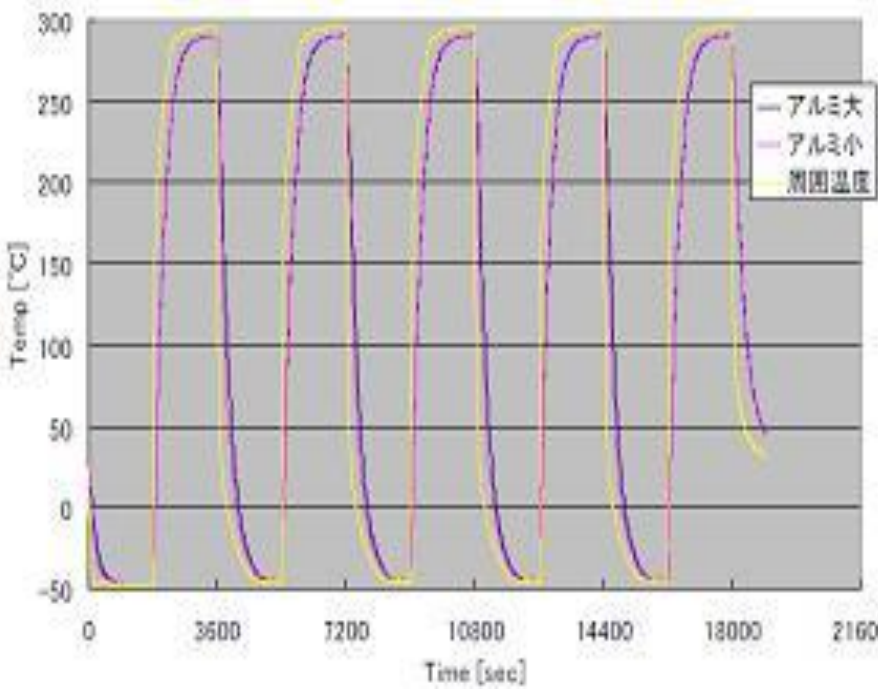
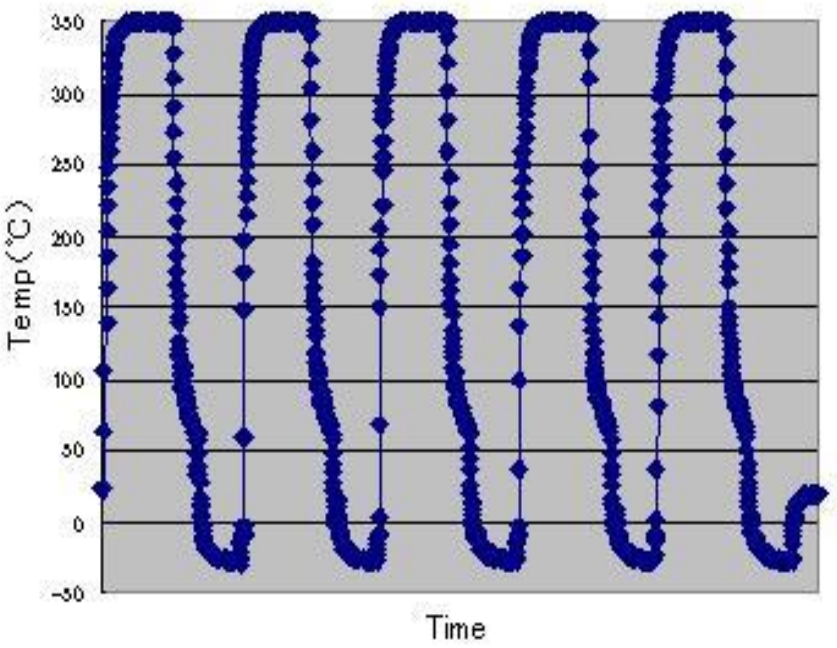
Temp. profile: Rapid & Accurate

- Test condition: Low Temp. - 40℃, High Temp.+350℃
- Exposed period：30 Minutes each
- Comparing data of Conventional machine and New designed CHS350

Conventional Air flow type



New method CHS350



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Features

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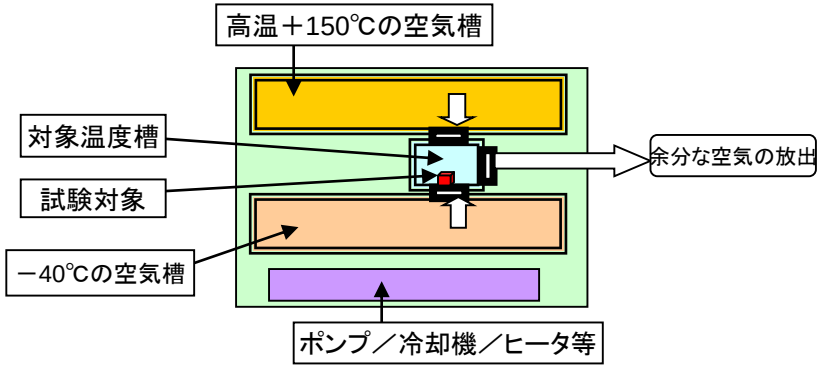
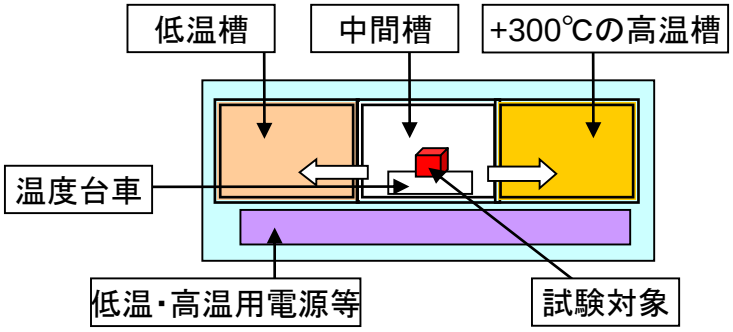
[Conventional Technology:
Air flow method]

1. 2 large air tanks and 1 test chamber
2. Air Flow transfer
3. Air Exchanging method
4. Large amount energy
5. Large Temp. error
6. Needs Time
7. Large and Heavy

[New Technology:
Direct Heat Transfer method]

1. 3 small chambers
2. Metal Direct Contact
3. Direct Heat transfer method
4. Small amount energy: Ecology
5. High accurate Temp.
6. Short Time
7. Small and Light





Item	Conventional Technology: Air flow Thermal Shocker	New Direct Heat Transfer method Thermal Shocker
Power & Running Cost	25kW/h 14M Jyen / 5 years	2.5kW/h (1/10 of left) 1.4M Jyen / 5 years
Temp. Range	High T.: +50 to +250℃ Low T.: -10 to -70℃	High T.: +50 to +350℃ Low T.: +20 to -55℃
T-Rising speed	RT➔+250℃: 4OM	RT➔+300℃: 1OM
Utility	Chilled water & High Pressure air	Chilled water & High Pressure air
Size	388W x 196H (+6) x 177D cm	160W x 135H (+40) x 60D cm
Weight	1000kg over	280kg

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Small, High Performance, Large energy saving

Compact Thermal Shocker CHS350

< for SiC Semiconductor & Module of EV & PV >

Ratio to convention 1/10 super energy saved

<< Thermal Shock test >>

- CO_2 Discharge : Large reduction
- Super Compact 1700cm^3
- 5 year running cost of the conventiona allows you to buy CHS350
- Innovational low cost

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400℃ High Temp oriented Constant Temp Chamber HTC400

RT to +400℃ T-range
SiC Power Semiconductor
High Temp Storage test,
High Temp Bias test
Inner size:
30x30x30 cm^3
Direct Heat Transfer method:
+/- 1.0℃(at 400℃)
Small outside size :
60Wx69Dx70Hcm^3

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Constant Temp Chamber HTC400
Inner view

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HTC400 Temp. Accuracy

Designated Temperature	Temp. Accuracy of Temp. Metal Plate
20℃	+0.3/−0.3
80℃	+0.2/−0.2
100℃	+0.2/−0.2
200℃	+0.2/−0.2
300℃	+0.3/−0.3
400℃	+0.4/−0.4

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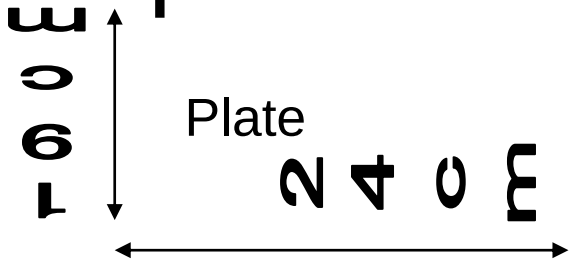
Large Element oriented Constant Temp. Chamber RK-10207PL



- +10 to +90℃ T-range
- Optimal to Largest Element Evaluation
- Direct Heat Transfer
- Speedy, Air cooling type (Water cooling: option)
- High Accuracy &
- Low cost

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OLED Aging Multi-ch Large Current Source P/S RK-10248

96 channel Aging Current Source

- Current : 2A/ch
- Compliance Voltage : 24V
- Ch number : 96ch
- Optimal for OLED mother glass aging
- For Light Emitting Element (LED, LD, etc.)
- Cycle Power Lifetime tester with integration to Compact Temp. Chamber

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Cycle Lifetime test Equipment

LifeMAPS

LifeMAPS

Current: 50mA/ch
Compliance Voltage:
120/80V
Ch number: 20ch
Temp. range:
+10℃ to +150℃
Integrated System of Compact Tem. Chamber & Multi-ch current power source
For Light Emitting Element:
Power LED, Laser Diode, etc.
1000 ch test with 50 sets

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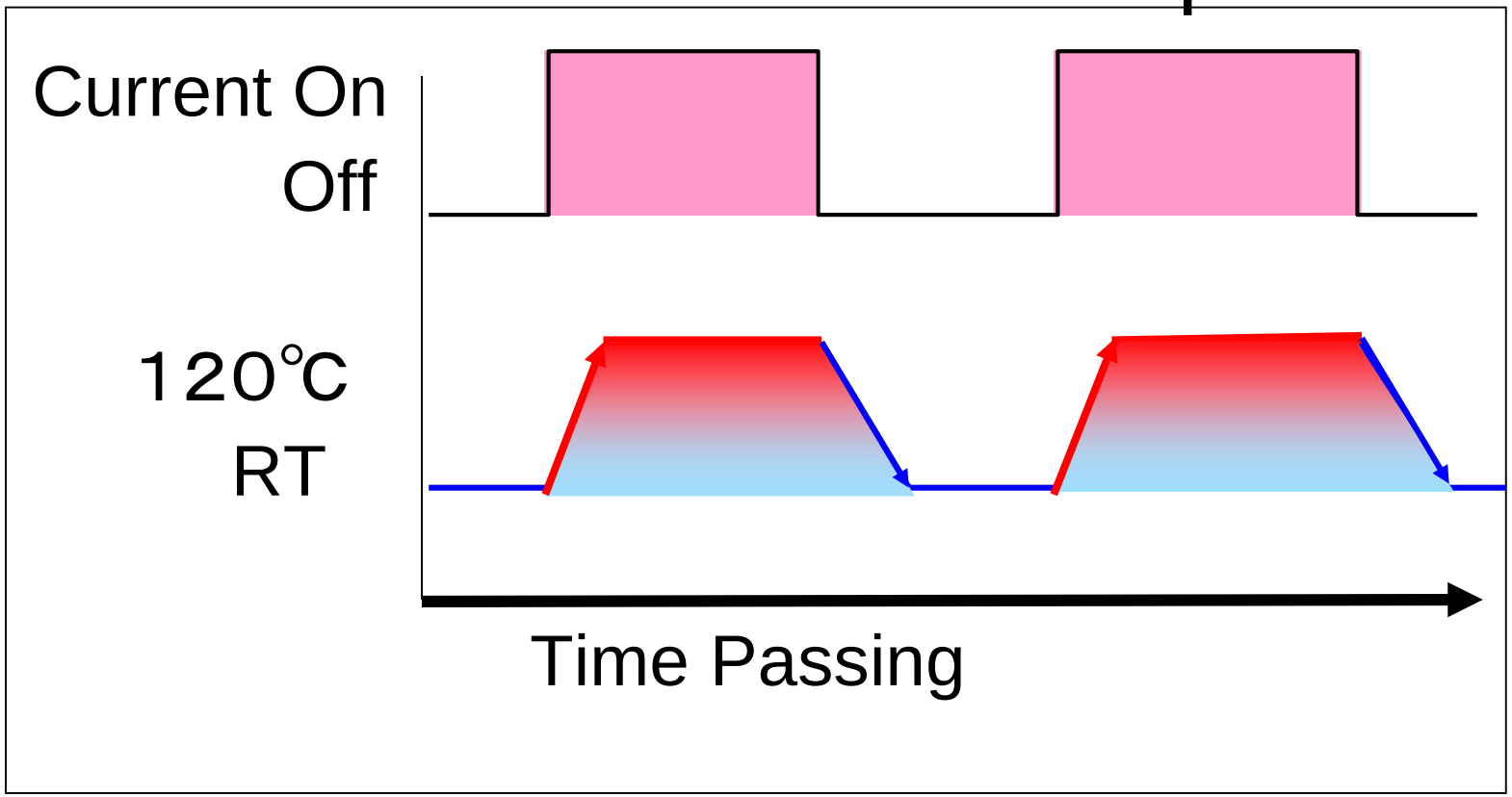
Cycle Lifetime test Equipment

LifeMAPS　Concept



Heat Cycle simultaneous to LED power On/Off

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Cycle Lifetime test Equipment

LifeMAPS　50 sets ➔ 1000ch

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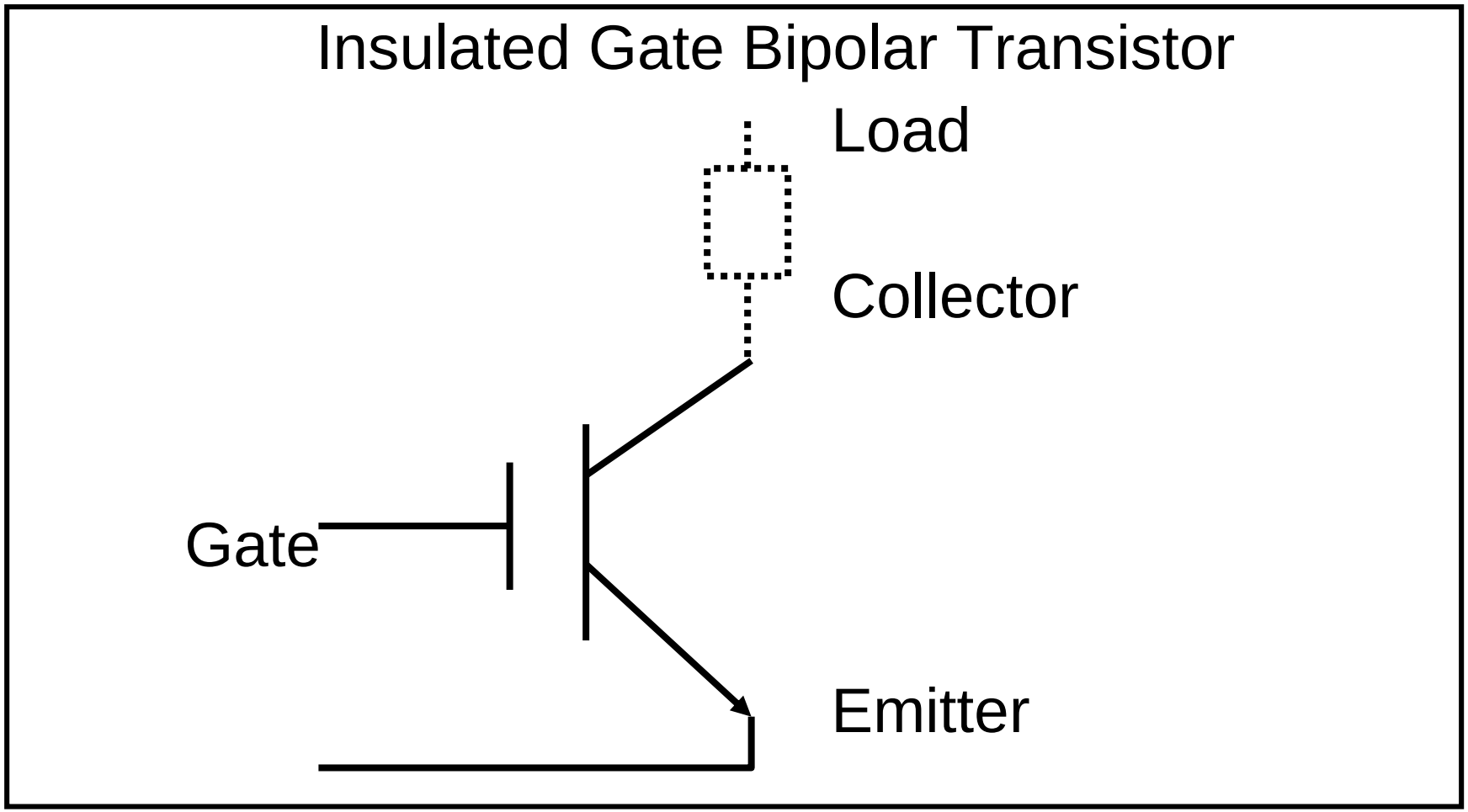
Power Module IGBT



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Large Current Cource System for Power Cycle test of IGBT/FET module RK-PMPS200/500

Current Source :
for IGBT Evaluation
Max Current : by model
200A, 500A, 800A, 1000A, 2000A
Current Control :
by Risoh Kiesoku Hybrid-IC
Cooling method : Complete Air cooling
Control signal: Gate signal output
Measurement signals:
Vce, Vf, Temp. inputs
Alarm signal: Limit detection

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Evaluation Tester for Power Semiconductor & Power module

1) 350℃ Compact Thermal Shocker CHS350
for SiC power semiconductor Temp. Evaluation

2) 400℃ High Temp. Constant Temp. Chamber
HTC400 : for SiC High Temp. Storage Test

3) Compact Constant Temp. Chamber RK-10207PL
for large Element Power Module

4) 200A～2000A Large Current Source System
for Power Cycle test of IGBT/FET module
PMPS200/500/1000/2000

5) Custom System to satisfy user specs & needs

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