Differential Scanning Calorimeter DSC

Differential Scanning Calorimeter

Rigaku
POWERING NEW PERSPECTIVES

A new generation DSC with a whole new dimension

DSCvesta2

The long-awaited new DSC model, DSCvesta2, is now available. It will revolutionize and improve the accuracy and reliability of your research.

Featuring the Industry's Leading Measurement Temperature Range (-180°C to 725°C)

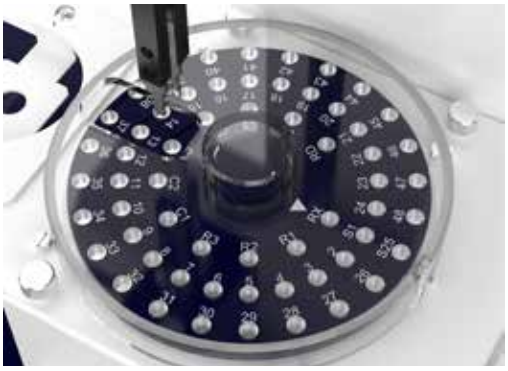
Leading the industry, DSCvesta2 covers a wide range from -180°C to 725°C. This unprecedented temperature range enables measurements of diverse samples, offering versatility like never before.
Moreover, with the use of the refrigerated cooling unit, continuous temperature from −95°C to 725°C is achievable without the need for liquid nitrogen refills, ensuring convenience across a broad temperature spectrum.
This cooling unit employs non-fluorinated refrigerants, exempt from fluorocarbon emission regulations, eliminating the need for cumbersome management and inspection.

The Sample being Measured Can be Observed in Real-time Images

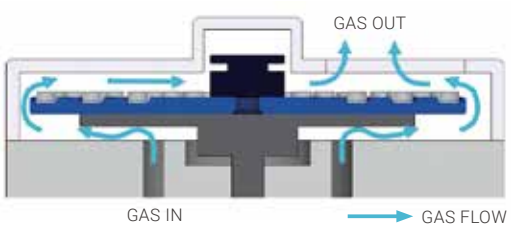
Improve the speed and quality of research and development. The sample image can also be displayed on the analyzed graph, allowing you to consider the results together.

Compact automatic sample changer

The automatic sample changer (ASC) holds up to 52 samples, 3 reference samples and allows for 1000 consecutive measurements, ensuring high throughput.



Standard gas flow designed tray section reduces atmospheric exposure—highly effective for testing moisture-sensitive powders.



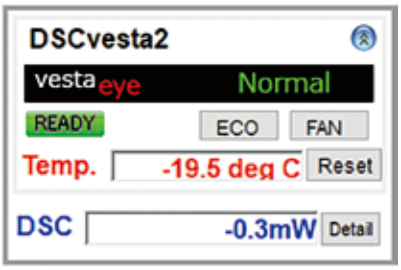
Don't Miss Even the Smallest Changes with Low Noise & New Sensor Technology

Our revolutionary χ sensor, coupled with a low-noise design, ensures that even the tiniest energy changes are not overlooked. (→Page 4: χ sensor)

Experience the Assurance of Self-Diagnostic Functionality

DSCvesta2 comes standard with the industry-first self-diagnostic feature "vestaeye." Before starting measurements, the device checks for any abnormalities, ensuring that it is operating normally. This allows you to use the device with peace of mind, knowing that any abnormalities will be detected early.

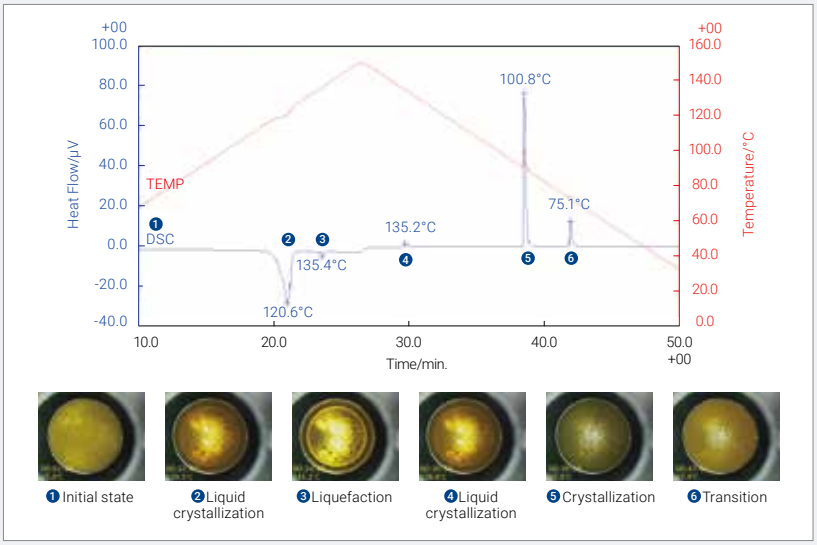
- Self-diagnosis begins upon device startup, ensuring peace of mind even during measurement initiation.
- Avoid sample loss due to errors during the process by detecting anomalies before starting measurements.
- Verify the device's normal operation before executing measurements after a period of inactivity or prior to nighttime operations.
- Identify specific areas of concern when abnormalities occur in the device.
- When anomalies occur in the device, generate field support reports with just one click.
- Achieve seamless service support through clear identification of device status.



Sample observation

DSCvesta2 supports sample observation measurements in the temperature range of -70°C* to 725°C. You can observe and capture real-time color and shape changes of the sample that were previously invisible during measurements. During analysis, you can examine the analysis results alongside the sample images, providing new insights. It also supports continuous measurements using ASC.

*When connected to the cooling unit (excluding LN_2 direct cooling units).



Measurement example: Shape change in cycle measurement of azoxyanisole

You can watch example videos of measurements with the sample observation unit here

https://rigaku.com/products/thermal-analysis/dsc/dscvesta2-sample-observation

χ sensor

The innovative DSCvesta2, equipped with the newly developed χ sensor, enables atmospheric measurements up to 600°C. The χ sensor, featuring a guided sample holder, enhances the reproducibility of sample pan positioning, ensuring precise measurements accessible to all. Additionally, our proprietary signal processing technology achieves a significant reduction in noise levels.
This DSC combines toughness with sensitivity, offering a groundbreaking solution.

Enhanced Durability

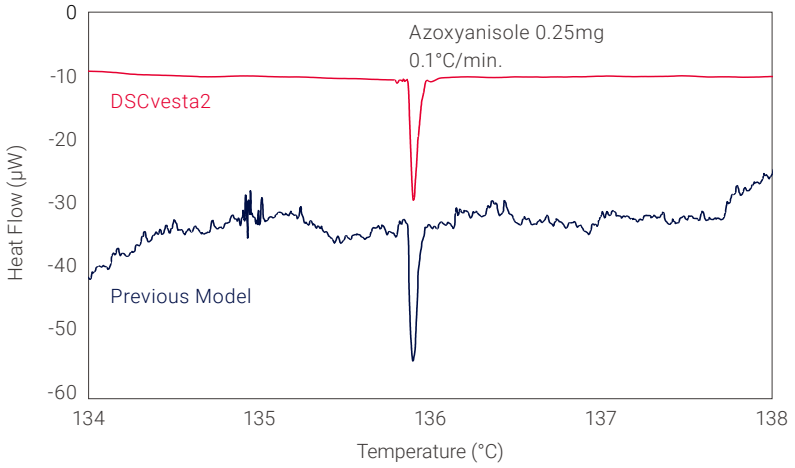
By adopting an embossed shape, the mechanical structure gains strength, making it more resistant to thermal expansion. This enhancement enables it to withstand continuous measurements over a wide range of temperature fluctuations.

Improved Reproducibility

The addition of guides that fit the sample pan ensures smooth and precise positioning of the sample set without any displacement. This prevents errors caused by repeated measurements or differences among operators, thereby achieving high reproducibility in repeated tests.

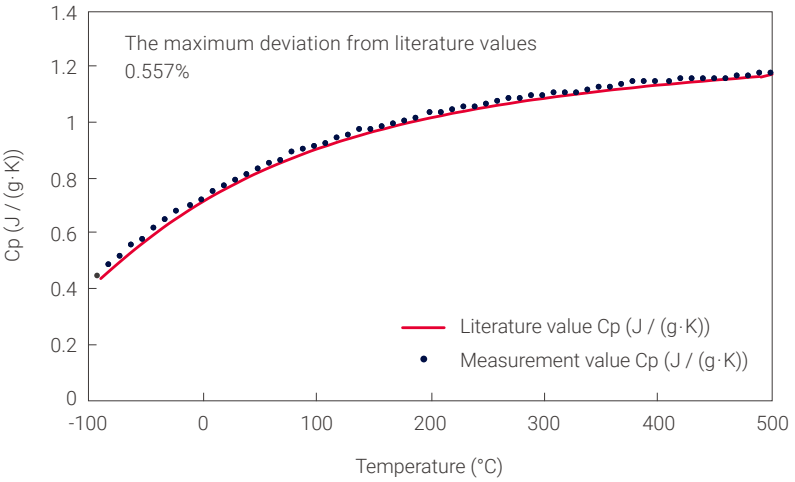
Sensitivity Comparison with Previous Model

DSCvesta2 achieves significantly higher sensitivity compared to the previous model. This enables more delicate measurements and allows for high-sensitivity testing even with minute samples. It facilitates easy comparison between different samples, making it effective for detecting subtle differences.



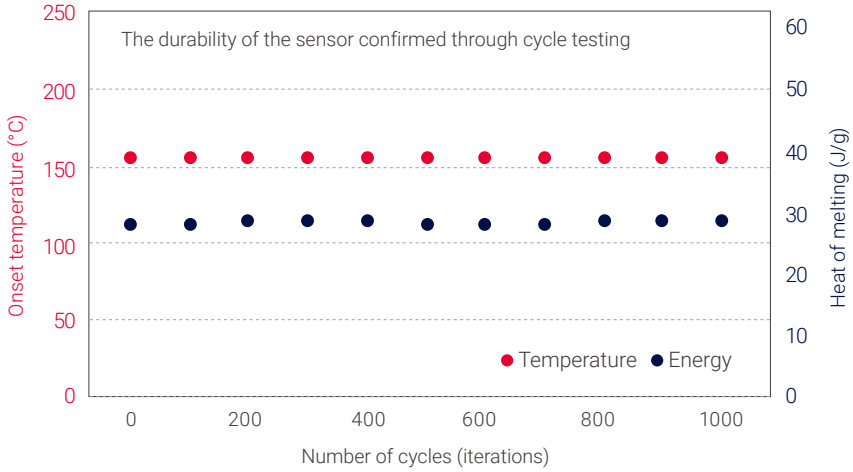
Highly Accurate Specific Heat Capacity Measurements

Specific heat capacity is a crucial parameter in the thermal properties of materials, requiring highly accurate data in various scenarios. The graph on the right depicts the specific heat capacity of sapphire, with the red curve representing literature values and the blue dashed line indicating measured values. The maximum deviation between literature values and measured values is only 0.557%, demonstrating that DSCvesta2 provides highly accurate data.



Enhanced Sensor Longevity

The graph on the right depicts the results of cycle tests measured in the atmosphere ranging from 100°C to 600°C, where the onset temperature and heat of melting of indium were monitored every 100 cycles. Even after 1000 consecutive cycles of measurement, no significant changes were observed in the onset temperature and heat of melting values, indicating that the sensor possesses robust durability against oxidation and thermal deformation.

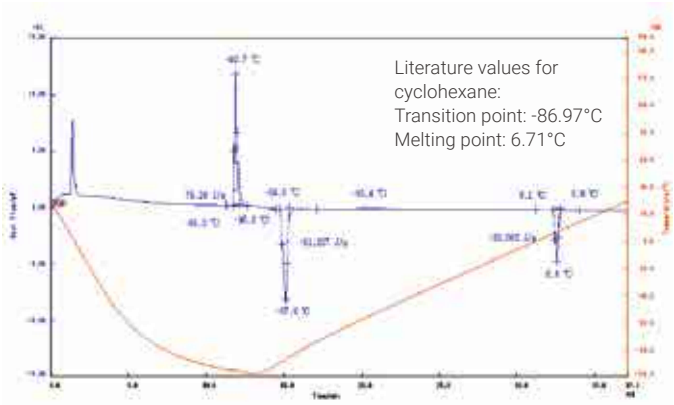


ΔBlock structure

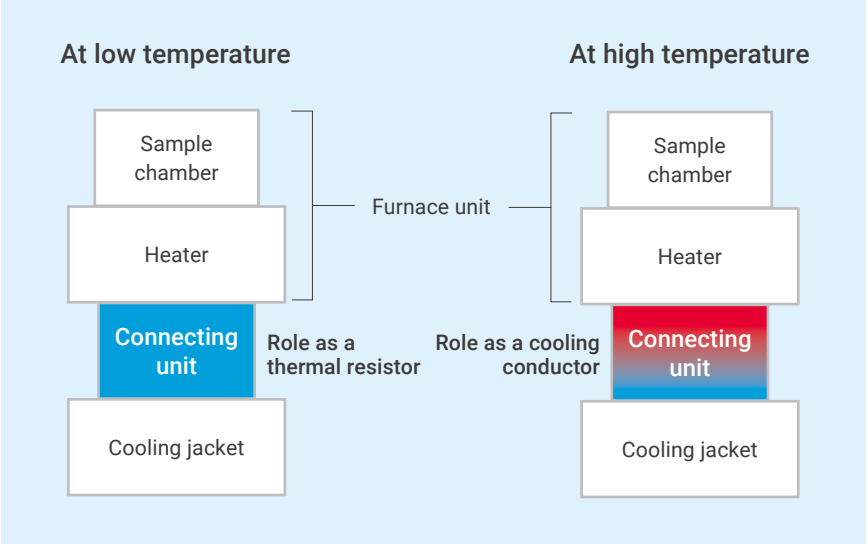
ΔBlock structure contributes to efficient cooling and heating with low power consumption.

Low temperature calibration

With the Refrigerated Cooling DSCvesta2, we have extended the minimum temperature to -95°C.
This expansion enables calibration of temperature and energy for solid-solid phase transitions at low temperatures using cyclohexane, a standard substance recognized globally for thermal analysis instruments, which was not achievable with any other DSC.
The Refrigerated Cooling DSCvesta2 ensures highly accurate measurements even at low temperatures.



ΔBlock structure adopts groundbreaking materials for the connection between the electrical furnace* and the cooling jacket. During low-temperature measurements, the connection facilitates cooling of the furnace unit. Conversely, during high-temperature measurements, the innovative ΔBlock structure reduces heat flow into the connection, enabling efficient temperature control in both high- and low-temperature scenarios. This reduces power consumption during temperature changes and expands the measurement temperature range of the refrigerated cooling unit.



*Furnace material: Silver

Optional attachments / DSCvesta2

Cooling units

Four different types of cooling units are available to meet your measurement purpose. Since all cooling units can be easily installed and removed, they can be readily exchanged according to your measurement requirements.

	Refrigerated cooling	LN_2 auto-filling cooling	LN_2 direct cooling	Bath circulator cooling
Cooling unit	 Continuous heating/cooling measurement without using liquid nitrogen. The optional Power ON/OFF unit reduces the waiting time before and after measurement.	 The supply of low-temperature nitrogen gas is controlled according to the temperature program. Suitable for continuous heating/cooling measurements over a wide range.	 Liquid nitrogen is supplied into the furnace directly. Suitable for heating measurements starting from -180°C.	 The unit can be connected to the circulator for continuous heating/cooling measurements.
Measurement temperature range	TC100 : −95℃ to 725℃ TC50 : -40℃ to 600℃	-150°C to 725°C	-180°C to 725°C	-10°C to 725°C
Heating rate (max)	50°C/min.	100°C/min.	20°C/min.	20°C/min.
Cooling rate / cooling time	20°C/min. (to -30°C)	20°C/min. (to -90°C)	From room temperature to -180°C Approx. 15 min.	10°C/min. (to 40°C)
External dimensions/ weight	TC100 W295×D500×H570 mm 60 kg TC50 W260×D300×H415 mm 25 kg	Controller W150×D250×H270 mm 4 kg Dewar φ480×H940 mm 25 kg	—	W230×D420×640 mm 32 kg
Note	Can be connected to the Power ON/OFF unit	Dewar capacity: 30L	—	Circulating fluid: JULABO Thermal H5

Safety cover

Ensures safety during measurement by covering the ASC and furnace. The cover is locked while measurement is performed, when samples are automatically changed or if the furnace is hot.
(A locking mechanism prevents the cover from opening during operation.)

ASC → Ref. page 2

Sample observation unit → Ref. page 3

UV irradiation unit

UV source	LED lamp	Mercury-xenon lamp
Measurement temperature range	RT to 150°C	
Irradiation wavelength range	365 nm, 405 nm	365 nm, 300 to 450 nm
Irradiation range	50 to 2000 mW/cm^2	2 to 100 mW/cm^2

DSCvesta

DSCvesta enables detection of minute peaks due to its low noise and stable baseline. It is also highly adaptable with easy connections to various cooling units and sample observation units, making it a DSC with excellent expandability.

The Refrigerated Cooling DSC allows for continuous measurements from -90°C to 725°C

It enables automatic controlled cycling temperature measurements within the range of -90°C to 725°C, facilitating analysis of heat reactions during both heating and cooling phases.

Variety of attachments and flexible system expandability

Our DSC accommodates multiple attachments such as sample observation units, UV irradiation units, and cooling units, offering high versatility as a multifunctional machine. Additionally, it can be connected with the Thermo plus EVO / EVO2 series, allowing control of up to eight units with a single measurement / analysis system (PC).

Don't miss even the slightest peaks with improved performance.

The incorporation of Rigaku's original new amplifier and calibration function in the software has significantly enhanced sensitivity and measurement range, enabling high-sensitivity measurements. The sensor utilizes a highly reliable conventional flat sensor design.

Flat sensor

Sample observation unit

Measurement temperature range: RT to 350°C
(w/cooling unit (minimum): -70°C to 350°C)
Sample observation section:
Connection: USB 2.0
Lighting: LED light built-in
epi-illumination type
Automatic sample changer: Applicable

Compact automatic sample changer

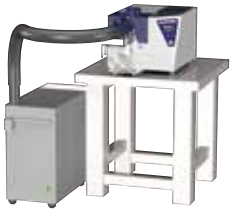
Automatic sample changer (ASC) holds up to 28 samples, enabling single measurement and interrupted measurement, as well as continuous measurements. All standard sample pans (φ5 mm) can be used. Three reference samples can be positioned and selected according to the measurement conditions.
Furthermore, it can be installed without interfering with cooling*/sample observation units.

*Excluding LN_2 siphon cooling units.

Optional attachments / DSCvesta

Cooling units

Four different types of cooling units are available to meet your measurement purpose. Since all cooling units can be easily installed and removed, they can be readily exchanged according to your measurement requirements.

	Refrigerated cooling	LN_2 auto-filling cooling	LN_2 siphon cooling	Bath circulator cooling
Cooling unit				
	Continuous heating/cooling measurement without using liquid nitrogen. The optional Power ON/OFF unit reduces the waiting time before and after measurement.	The supply of low-temperature nitrogen gas is controlled according to the temperature program. Suitable for continuous heating/cooling measurements over a wide range.	Liquid nitrogen is supplied from a siphon connected to a dedicated container to the furnace unit. This setup is suitable for measurements starting from low temperatures.	The unit can be connected to the circulator for continuous heating/cooling measurements.
Measurement temperature range	-90°C to 725°C	-150°C to 725°C	-170°C to 725°C	-10°C to 500°C
Heating rate (max)	50°C/min.	100°C/min.	20°C/min.	20°C/min.
Cooling rate / cooling time	10°C/min. (to -60°C)	10°C/min. (to -110°C)	From room temperature to -170°C Approx. 8 min.	10°C/min. (up 40°C)
External dimensions/ weight	W295×D500×H570 mm 60 kg	Controller W150×D250×H270 mm 4 kg Dewar φ480×H940 mm 25 kg	φ480×H940 mm 25 kg	W230×D420×640 mm 32 kg
Note	Can be connected to the Power ON/OFF unit	Dewar capacity: 30L	–	Circulating fluid: JULABO Thermal H5

Safety cover

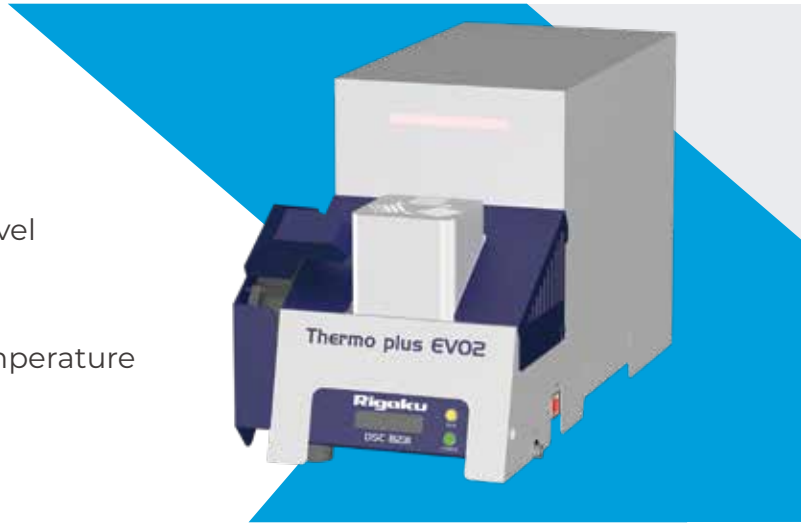
Ensures safety during measurement by covering the ASC and furnace. The cover is locked while measurement is performed, when samples are automatically changed or if the furnace is hot.
(A locking mechanism prevents the cover from opening during operation.)

UV irradiation unit

UV source	LED lamp	Mercury-xenon lamp
Measurement temperature range	RT to 150°C	
Irradiation wavelength range	365 nm, 405 nm	365 nm, 300 to 450 nm
Irradiation range	50 to 2000 mW/cm^2	2 to 100 mW/cm^2

DSC8231

DSC8231 is a compact and feature-rich entry-level model that is easy to set up.
By utilizing a LN_2 auto-filling cooling unit, measurements can be performed within a temperature range of -130°C to 500°C.



Optional attachments / DSC8231

Compact automatic sample changer

Automatic sample changer (ASC) holds up to 28 samples, enabling single measurement and interrupted measurement, as well as continuous measurements. All standard sample pans (φ5 mm) can be used. Three reference samples can be positioned and selected according to the measurement conditions. Furthermore, it can be installed without interfering with cooling*/sample observation units.

*Excluding LN_2 siphon cooling units.

LN_2 siphon cooling unit

The liquid nitrogen is supplied from a siphon connected to the liquid nitrogen container to the cooling jacket. This setup is utilized for measurements starting from low temperatures.
Measurement temperature range: -150°C to 500°C

LN_2 auto-filling cooling unit

By connecting the liquid nitrogen automatic supply system, liquid nitrogen is continuously supplied according to the temperature program. It's ideal for a wide range of heating and cooling measurements.
Measurement temperature range: -130°C to 500°C

Bath circulator cooling unit

For the cooling unit, circulating cooling refrigerant is circulated to provide continuous cooling. It can be used for continuous heating and cooling measurements.
Measurement temperature range:
Circulating fluid temperature to 500°C
Circulating fluid: JULABO Thermal H5

High temperature DSC

DSC8271

DSC8271 model allows measurement over a wide temperature range, from room temperature to 1,500°C. The mechanism is designed to independently cool the insulation section, which shortens the cooling time after measurement and contributes to improved throughput.

Sample pans

① Al pan φ5×2.5 mm

② Al pan φ5×5 mm

③ Sealable Al pan 25 µL

④ Alumina pan φ5×2.5 mm

⑤ Alumina pan φ5×5 mm

⑥ Pt pan φ5×2.5 mm

⑦ Pt pan φ5×5 mm

⑧ Qz pan φ5×2.5 mm

⑨ Qz pan φ5×5 mm

⑩ High-pressure sealable pan

Multi press

The multi press is a sample pan shaping tool with three functions: sample crimper, sample sealer and high-pressure sample sealer (For sample pan ⑩).
The head is changed depending on the application.

Sample sealer

Used to tightly seal liquid samples or samples that evaporate, sublimate, or dehydrate during measurement.
Pressure capacity is 0.3 MPa (3 atm). (For sample pan ③)

Sample crimper

Improves the thermal contact between the sample and the sensor plate. (For sample pan ①)

Optional attachment

Gas flow options

Multi gas controller

The flow rate can be programmed in synchronization with the temperature program. Up to four different gases can be freely selected and changed as required.

Compatible instrument: DSCvesta2

Flow meter

The flow meter controls the flow rate of the atmospheric gas (inert gas, air, etc.) supplied in the sample chamber. Three models with 200, 500 and 1,000 mL/min. full scale are available.

2ch-FLOW COMPO Jr.

Enables gas flow, flow rate setting and switching of gases with precision specified in the measurement program. Gas types and full scale can be selected.

*This product cannot be used in certain countries and regions

Gas selector

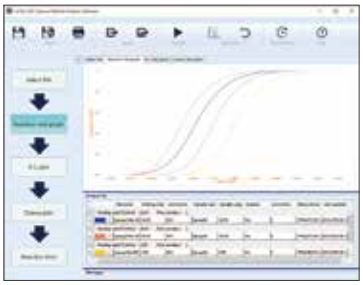
The gas selector links to the measurement program and switches the internal valves to control the gas flowing into the sample chamber.

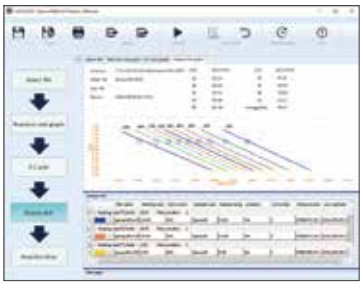
Note: Two flow meters are required separately.

Optional software

DSC Ozawa method

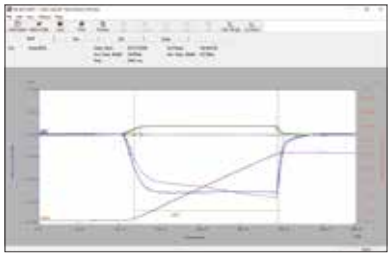
In this method, the activation energy can be estimated from more than three measurements with different heating rates, estimating the time to reach a defined degree of conversion.

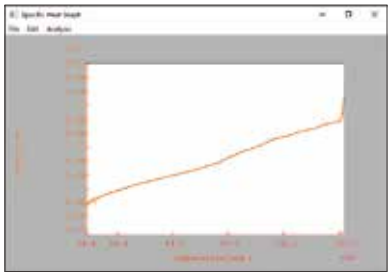




DSC Specific heat

The specific heat capacity at each temperature is calculated based on the amount of baseline shift from three different measurement results: sample pan, sample with a known specific heat and unknown sample.





DSC Purity

In this DSC measurement, the fusion peaks of a sample and high-purity material are compared, and the purity of the sample is calculated from the fusion fraction after correction.

Temperature modulated DSC

Dynamic DSC

The conventional method of applying a constant heating rate is modified by adding temperature modulation using a sine wave. This technique allows for the separation of overlapping reactions and facilitates the straightforward determination of specific heat capacity.

Separate observation is achievable

Even when enthalpy relaxation, glass transition, and recrystallization overlap, they can be distinguished from each other.

Your current DSC can be upgraded

Upgrades are available for your DSCvesta2, DSCvesta and DSC8231.

Modulation period as low as five seconds is supported!

Frequency-resolved analysis and more can be done with higher accuracy (maximum period of 200 seconds).

Easy specific heat capacity measurement

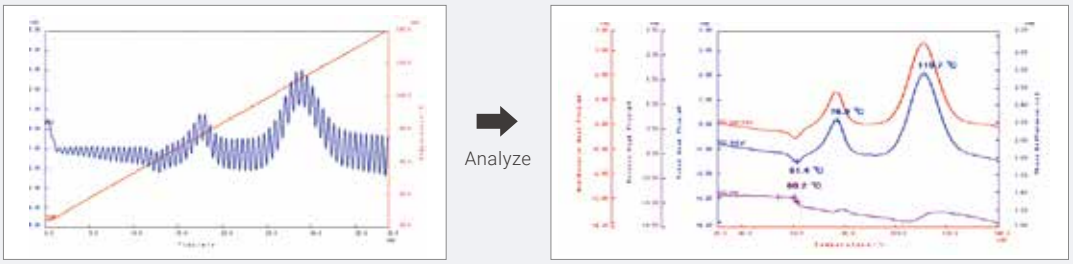
Specific heat capacity measurement is made easier compared to conventional DSC measurements.

Easy-to-read data

By utilizing the Non-reversible DSC zero sift function, the analyzed data can be easily visualized and separated.

Dynamic DSC Measurement Example

Sample: Pharmaceutical substance
Heating rate: 3°C/min., Cycle: 36 sec., Amplitude: 0.43°C

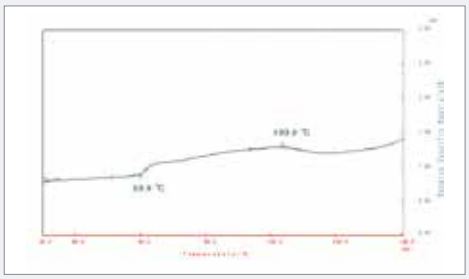


Dynamic DSC Measurement Results

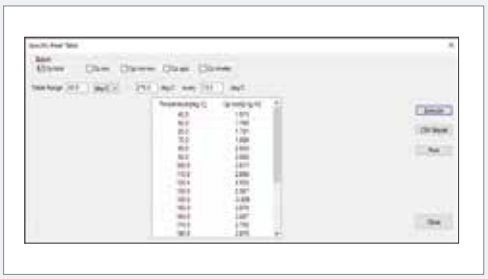
Dynamic DSC Analysis Results

Dynamic DSC measures with a sinusoidal temperature amplitude in addition to the constant heating/cooling rate. The obtained measurement results (left figure) can be separated into three DSC curves: the average of one cycle (DSC total), the component that follows the sinusoidal wave (DSC rev.), and the component that does not follow the sinusoidal wave (DSC non-rev.). In the analyzed results (right figure), the DSC total shows an endothermic peak at 61°C, and exothermic peaks at 77°C and 110°C, indicating no glass transition. However, the DSC rev. shows a shift in glass transition at 60°C. Since the glass transition is a change in heat capacity, it appears in the reversible component, DSC rev. Through dynamic DSC measurement, it is possible to separate and confirm the glass transition, which may overlap with non-reversible reactions such as enthalpy relaxation or crystallization in constant heating rate measurements.

Dynamic DSC Heat Capacity Analysis



Dynamic DSC Heat capacity plot (Cp rev.)



Dynamic DSC Heat capacity analysis table (Cp rev.)

With Dynamic DSC, it is possible to calculate the heat capacity of a sample through analysis.
By measuring a reference material, such as sapphire (Al_2O_3), under the same conditions as the sample, and calibrating the results with DSC rev., the heat capacity of the sample can be determined.

Specifications and Utilities

Specifications

Model	Differential Scanning Calorimeter			
	DSCvesta2	DSCvesta	DSC8231	DSC8271
Measurement method	Heat flux type			
Measurement temperature range	-180 to 725°C[*1]	-170 to 725°C[*1]	-150 to 725°C (750°C at maximum)[*1]	Room temperature to 1,500°C
DSC range (Measurement range)	±1000 mW	±400 mW	±100 mW	±100 mW
Maximum heating rate	150°C/min.[*2]	150°C/min.[*2]	100°C/min.[*2]	20°C/min.
Noise level (RMS)	≦0.05 µW	≦0.1µW	≦0.5µW	≦5 µW
Energy precision (σ/ave.)[*3]	±0.04%	—	—	—
Temperature precision (σ)[*3]	±0.03°C	—	—	—
Specific heat accuracy[*3]	±1%	—	—	—
Baseline repeatability[*3]	±5 µW	—	—	—
Dynamic range (DSC range / Noise level)	4×10^{7}	8×10^{6}	4×10^{5}	4×10^{4}
Self-diagnostic function	Yes	No	No	No
Measurement atmosphere	Air, inert gas			
Maximum sample amount	90 µL			45 µL
Cooling unit[*4]	Refrigerated cooling[*5], LN_2 auto-filling cooling, LN_2 direct cooling, Bath circulator cooling	Refrigerated cooling[*5], LN_2 auto-filling cooling, LN_2 siphon cooling, Bath circulator cooling	LN_2 auto-filling cooling, LN_2 siphon cooling, Bath circulator cooling	—
ASC[*4]	The number of samples: 52 (calibration sample: 4), reference sample: 3	The number of samples: 28 (calibration sample: 4), reference sample: 3		—

*1: Cooling unit is required for temperatures below room temperature that can be selected according to the measurement temperature range.
Inert gas flow is required for measurements above 600°C (DSCvesta2) or 500°C (DSCvesta, DSC8231).
*2: When a cooling unit is used, the value varies depending on the cooling unit being used.
*3: Values measured under our company's conditions
*4: Option
*5: The refrigerant used in the refrigerated cooling unit is non-chlorofluorocarbon (non-CFC).

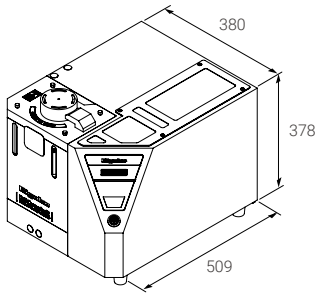
Utility

Current value is the maximum current rating when connected to the 100 V power source.

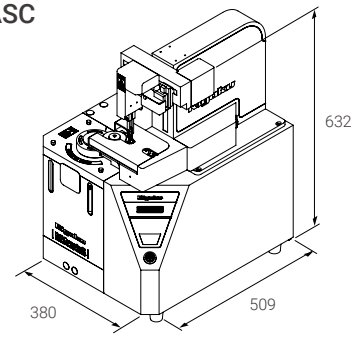
DSCvesta2	Single phase 100-240 VAC, 50/60 Hz, 5 A, grounded 1-socket outlet
DSCvesta	Single phase 100-240 VAC, 50/60 Hz, 5 A, grounded 1-socket outlet
DSC8231	Single phase 100-240 VAC, 50/60 Hz, 5 A, grounded 1-socket outlet
DSC8271	Single phase 100 VAC, 50/60 Hz, 15 A, grounded 1-socket outlet
Refrigerated cooling unit	TC100 Single phase 100 VAC, 50/60 Hz, 15 A, grounded 1-socket outlet TC50 Single phase 100 VAC, 50/60 Hz, 5 A, grounded 1-socket outlet
LN_2 auto-filling cooling unit	Single phase 100 VAC, 50/60 Hz, 8 A, grounded 1-socket outlet
Bath circulator cooling unit	Single phase 100 VAC, 50/60 Hz, 15 A, grounded 1-socket outlet
2ch-FLOW COMPO Jr.	Single phase 100 VAC, 50/60 Hz, 1 A, grounded 1-socket outlet
Gas selector	Single phase 100-240 VAC, 50/60 Hz, 0.5 A, grounded 1-socket outlet
Multi gas controller	Single phase 100-240 VAC, 50/60 Hz, 0.5 A, 1-socket outlet

Dimensions (Unit: mm)

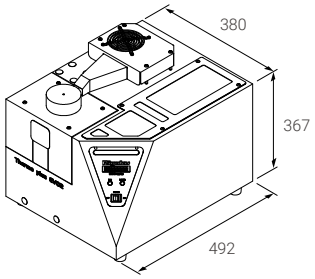
DSCvesta2
Weight: 32 kg



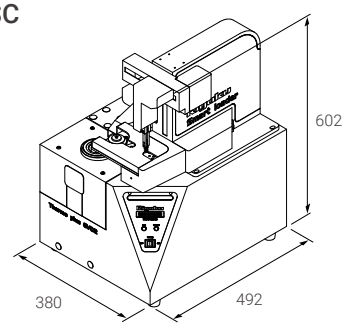
DSCvesta2+ASC
Weight: 42 kg



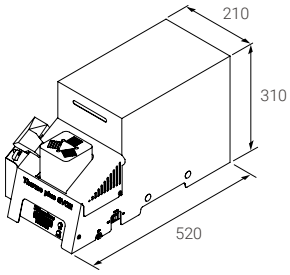
DSCvesta
Weight: 28 kg



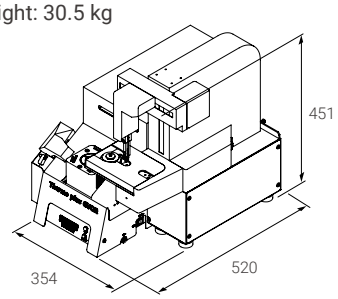
DSCvesta+ASC
Weight: 38 kg



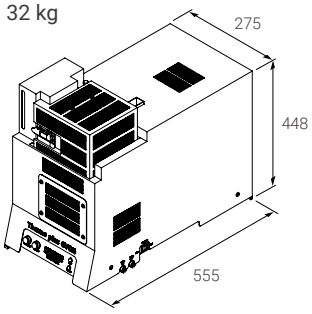
DSC8231
Weight: 15.5 kg



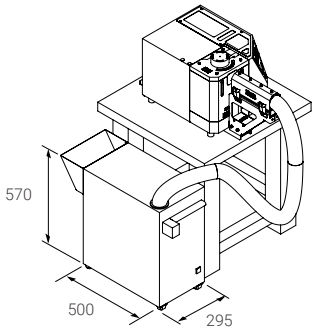
DSC8231+ASC
Weight: 30.5 kg



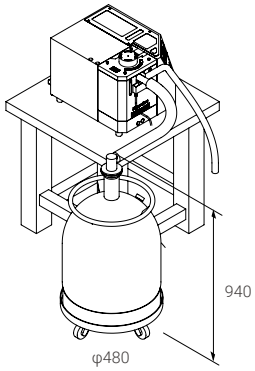
DSC8271
Weight: 32 kg



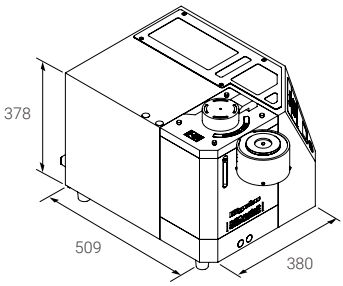
Refrigerated cooling unit



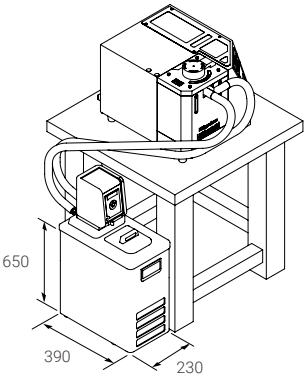
LN_2 auto-filling cooling unit



LN_2 direct cooling unit



Bath circulator cooling unit



Differential Scanning Calorimeter DSC

Differential Scanning Calorimeter

*The performance figures presented in this catalog represent test results obtained by Rigaku Corporation and Rigaku does not guarantee that identical results will be consistently achieved under different environmental and operating conditions.

* "DSCvesta" , "vestaeye" , "ΔBlock" and "xsensor" are trademarks or registered trademarks of Rigaku Corporation or its affiliates.
* Company names and product names mentioned in this document are generally trademarks or registered trademarks of their respective companies.

© Rigaku Holdings Corporation and its Global Subsidiaries. All rights reserved.
info@rigaku.com | rigaku.com

BTDSC00_ENGLA3

Specifications and appearance are subject to change without notice.