# Thermo plus EVO2 series

Thermal Analysis Instruments

## Better functionality, better usability


Rigaku

Leading With Innovation

# Performance, Stability, Usability & Support

Rigaku has supplied more than 10,000 thermal analysis instruments into the marketplace. Our accumulated experiences and technologies imbue the Thermo plus EVO2 series with high functionality, stability, and user-friendliness, allowing us to achieve the No.1 share in the Japanese market. Our support team—uniting sales, engineering, and technical service—offers high-quality customer support, which is highly rated by our customers.

## Thermo plus EVO2 series


# STA: TG-DTA

Simultaneous Thermal Analyzer:
Thermogravimetric Differential Thermal Analyzer


# DSC

Differential Scanning Calorimeter


# TMA

Thermomechanical Analyzer

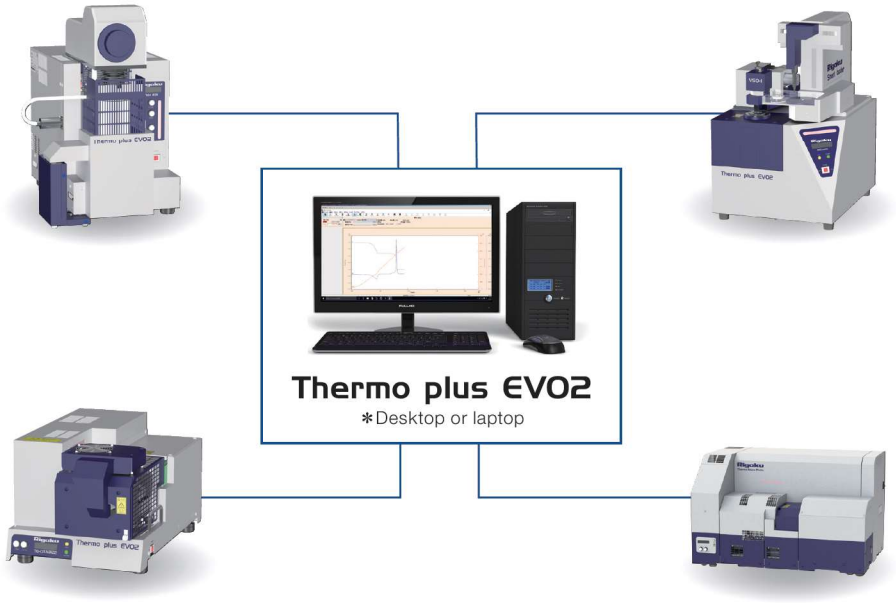
## CONTENTS

# Software & System

Thermo plus EVO2 series

# Connecting, expanding and highly functional Measurement & analysis software EVO2 software

A Thermo plus EVO2 station, comprised of a PC installed with measurement and analysis software (EVO2 software), is capable of controlling up to eight Rigaku thermal analysis instruments, and is compatible with older models of Rigaku instruments as well.




## 1 License-free

The Thermo plus EVO2 analysis software is license-free, and can be installed not only on the control PC, but also on a user's PC. Therefore, you can analyze your measurement results anytime, anywhere.

## 2 Excellent compatibility

Older model Rigaku instruments* can be operated from the EVO2 station through the EVO2 instruments.

*Thermo Plus 2 and Thermo plus EVO series

### ■ASCII Data Import/ Export Function

The Thermo plus EVO2 analysis software supports ASCII-formatted measurement data. ASCII converted data measured from other manufacturer's instrument can be analyzed by the EVO2 analysis software. Thermo plus EVO2 measurement data can also be exported in ASCII format.

## 3 Time saving with auto-measurement

Configuring continuous measurement mode with Smart loader through the EVO2 software will reduce the time associated with changing references and samples, as well as downtime.

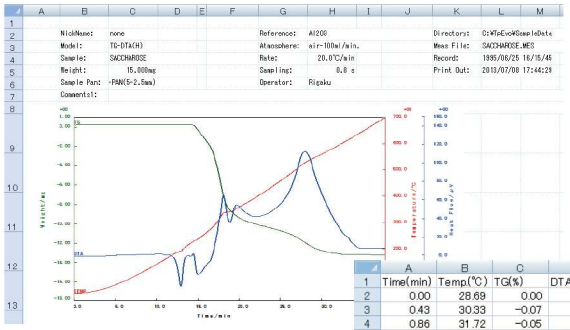
## 4 Instrument usage history list

Information such as date, time of use, instrument name, operator, temperature program and measurement results are automatically saved to the log file in Microsoft® Excel®. The usage conditions are clear, which makes management and maintenance easy.

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Date | Time | Equipment | Operater | Folder | File | Sample | Atmosphere |
| 2 | 2013/7/4 | 14:27:58 | TG-DTA | satou | D:¥2013¥1307¥ | ABC | Al2O3 | N2 500ml/min |
| 3 | 2013/7/4 | 13:45:24 | TG-DTA | tanaka | D:¥2013¥1307¥ | 123 | B | Air static |
| 4 | 2013/7/4 | 12:21:24 | TMA | suzuki | D:¥2013¥1307¥ | SSS | SiO2 | N2 500ml/min |
| 5 | 2013/7/4 | 11:34:10 | TG-DTA | yamada | D:¥2013¥1307¥ | TTT | Polymer | Ar 500ml/min |
| 6 | 2013/7/4 | 10:52:34 | TG-DTA | endou | D:¥2013¥1307¥ | 456 | ① | N2 500ml/min |
| 7 | 2013/7/4 | 10:03:44 | DSC | koizumi | D:¥2013¥1307¥ | SA | mmm | N2 50ml/min |
| 8 | 2013/7/3 | 17:29:06 | TG-DTA | yada | D:¥2013¥1307¥ | XXX | X | Air 300ml/min |
| 9 | 2013/7/3 | 16:54:43 | TG-DTA | simizu | D:¥2013¥1307¥ | www | Alloy | Air 300ml/min |
| 10 | 2013/7/3 | 16:35:55 | TG-DTA | hayashi | D:¥2013¥1307¥ | zzzz | Rubber | Air 300ml/min |

## 5 Word/Excel output

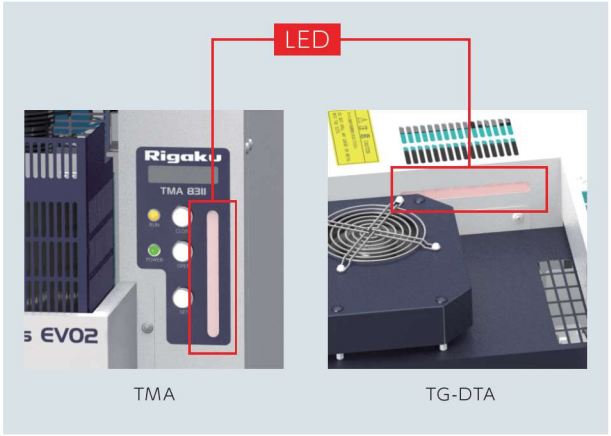
The measurement file can be directly exported to Microsoft® Word® or Microsoft® Excel®. The output style can also be modified using a layout editing function.
When the data is exported to Microsoft® Excel®, graphs will be automatically created in worksheet 1 and numerical text data will be created in sheet 2.



| | A | B | C | D |
|---|---|---|---|---|
| 1 | Time(min) | Temp.(℃) | TG(%) | DTA(μV) |
| 2 | 0.00 | 28.69 | 0.00 | −0.83 |
| 3 | 0.43 | 30.33 | −0.07 | −0.94 |
| 4 | 0.86 | 31.72 | −0.05 | −0.92 |
| 5 | 1.29 | 33.04 | −0.05 | −0.91 |
| 6 | 1.73 | 34.72 | −0.05 | −0.86 |
| 7 | 2.16 | 36.76 | −0.05 | −0.77 |
| 8 | 2.59 | 39.38 | −0.05 | −0.65 |
| 9 | 3.02 | 42.48 | −0.04 | −0.51 |

## 6 LED indicator for safety management

The LED light on the front panel of the main unit turns on when a heating process starts or when the electric furnace or sample temperature is higher than 60°C. This function allows you to confirm the state of the instrument and the time for sample exchange even at a distance.




## 7 ECO mode

ECO mode, which reduces power consumption, can be selected after measurement ends or when the instrument is in standby state. ECO mode quickly changes the instrument's state from standby to stable measurement, espcially in TG-DTA and TMA.

## 8 E-mail notification of system status*

Notifications about measurement completion, measured data and errors can be sent by e-mail. You can confirm the status and perform data analysis regardless of location.
*LAN board and connection to the corporate LAN is required.

## 9 Measurement data protection

During measurement, even if a connection error occurs between the EVO2 station and the instrument, the instrument will continue to perform the measurement in progress and the data will be stored in the module. The saved data can be imported after the measurement is completed, protecting the valuable measured data.

## 10 First Aid function

To facilitate quick and smooth recovery, when an error or problem occurs in the instrument, the First Aid function displays on the screen the error number, information about the error and troubleshooting measures. In addition, this function saves the error contents in log files, which can be easily sent to our technical service department for an immediate response.

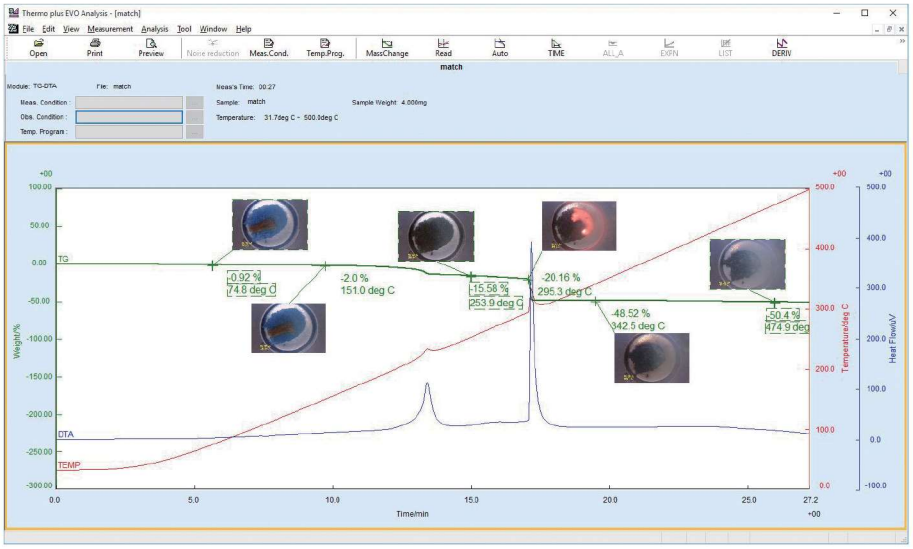
# Sample Observation

Thermo plus EVO2 series

# Thermal analysis reaches a new stage — Real-time observation of sample change

When investigation changes in sample shape, it used to be necessary to stop the measurement at the desired temperature you want to observe and remove the sample for visual observation, which has numerous disadvantages.
Rigaku's sample observation unit for TG-DTA and DSC enables observing a sample in real time during measurement. Any sample changes during measurement can be seen as they happen. The analysis results and sample images can be studied together, leading to new insights.

## Sample observation unit





- Real-time sample image display during measurement
- Thumbnail display of a selected point on the graph
- Slideshow display of the sample images while showing the measurement data graph
- Digital zoom function for observation images
- Sample length measurement function
- RGB display
- Side-by-side display of sample images
- Camera properties setting function

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

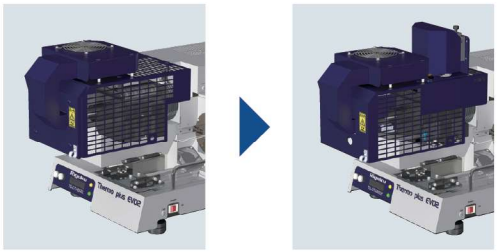
TG-DTA https://rigaku.com/products/thermal/tgdta
DSC https://rigaku.com/products/thermal/dsc-vesta

TG-DTA DSC

## Simple installation

The sample observation unit can be easily installed on the standard configuration of TG-DTA and DSC.*

*Not available for some instruments.

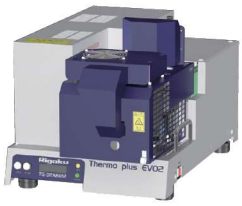


## Various combinations with extensive optional attachments

The sample observation unit can be installed without interfering with the automatic sample changer and various cooling units* of DSC.

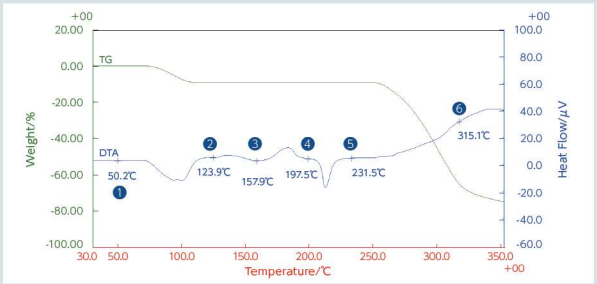
*Except $LN_2$ siphon cooling unit.


## Sample observation TG-DTA




- Records the sample images clearly during measurement up to 1,000°C
- Ensures visibility with the devitrification protection unit (See page 15)
- Real-time observation of changes in sample shape during heating
- Corresponds with Smart loader's continuous measurement

Measurement example:
Thermal behavior of disaccharide hydrate

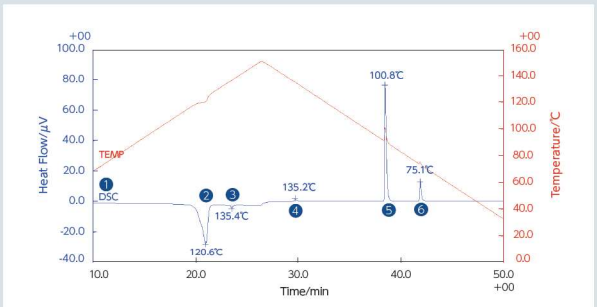


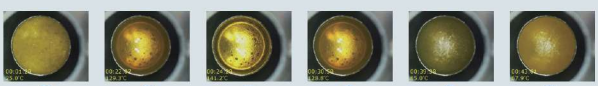

1 Initial state
2 Dehydration (volumetric shrinkage)
3 Amorphization (liquefaction)
4 Crystallization (whitening)
5 Fusion (transparent)
6 Combustion (Blackening, foaming)

## Sample observation DSCvesta


- Simultaneous sample observation, cooling and continuous measurement up to 350°C.
- When combined with a cooling unit, the sample observation can measure from -70°C.
- Real-time observation of changes in sample shape during heating
- Corresponds with Smart loader's continuous measurement

Measurement example:
Shape change in cycle measurement of azoxyanisole



1 Initial state
2 Liquid crystallization
3 Liquefaction
4 Liquid crystallization
5 crystallization
6 Transition

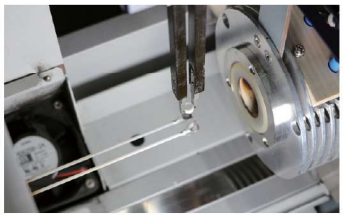
# TG-DTA8122

Thermogravimetric Differential Thermal Analyzer

TG uses the horizontal differential method. This method corrects and cancels fluctuations which cause drift and provides low noise levels and baseline stability. The influence of the atmospheric gas flow is minimized, hence even the slightest mass changes can be detected with high precision.


## Compact automatic sample changer : Smart loader

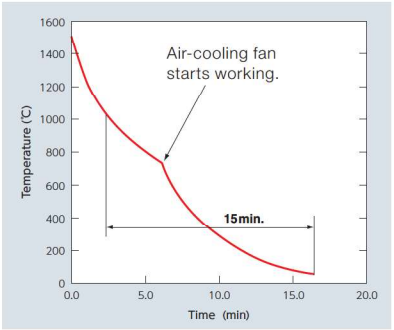
Smart loader is available with both standard and sample observation TG-DTA. It holds up to 24 samples, enabling single measurement and interruption measurement, as well as continuous measurements. All standard sample pans (ϕ5 mm) can be used. Three reference samples can be set and selected according to the measurement conditions. Reheating of the same sample is also achievable.




TG-DTA8122 Smart loader

## Cooling after completion of measurement

After measurement ends, the attached air-cooling fan automatically starts cooling the instrument down to room temperature. The cooling time from 1000°C to 50°C is 15 minutes leading to high throughput measurement.



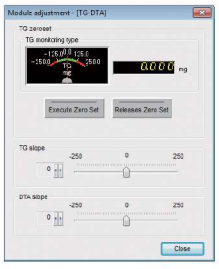

Cooling time after measurement

## Quantification of reaction energy

The DTA output can be converted to DSC output by measuring a standard sample. The conversion to DSC allows calculating the energy of reaction from the peak area.

## Replacing sample holders

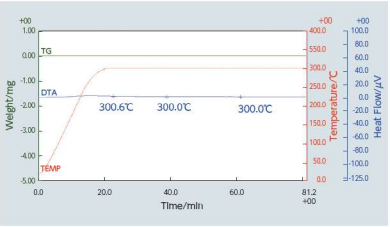
The TG-DTA uses a plug-in type holder for a smooth replacement. Maintenance is easy even when changing holders due to sample spillage, after which the baseline adjustment can be performed in the module adjustment window.




Baseline adjustment window

## Temperature hold control without preliminary measurements

Advance control mode enables non-overshoot temperature hold without performing a preliminary measurement.




Example of temperature hold at 300°C
(Advance control applied, 20°C/min heating rate)

## Dynamic TG: sample-controlled thermogravimetric analysis (SCTG)

The sample's rate in mass change is used as a parameter for controlling temperature.
Two measurement modes with different control methods can be selected, namely Constant Reaction Control (CRC) and Stepwise Isothermal Analysis (SIA). In the conventional constant-rate heating method, the temperature is forcibly raised during reaction. Hence, if multiple reactions occur continuously, the decrease in mass appears overlapped (Fig.2 ; constant-rate heating). In the dynamic TG method, the temperature is controlled according to mass loss rate without performing forcible temperature increase and ignoring the sample's reaction (Fig.1). Thru this method, we can obtain data with improved separation of reactions and resolution compared to the conventional constant-heating rate method (Fig.2).

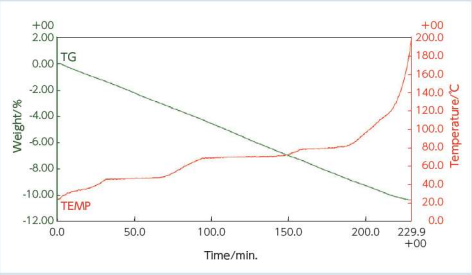



Figure 1

Dynamic TG (CRC method) measurement results for cyclodextrin
mass decrease rate 0.03%/min.

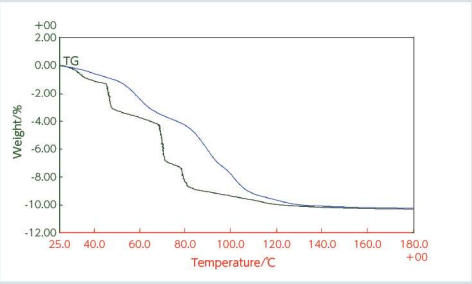
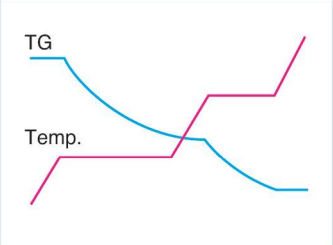


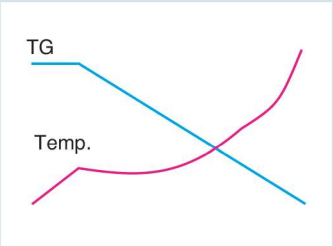

Figure 2

Comparing cyclodextrin measurement results of constant-rate heating method and dynamic TG method (abscissa axis is temperature)




### Stepwise Isothermal Analysis (SIA)

The temperature is increased at a constant rate, and when DTG exceeds the preset value, isothermal control starts automatically. When DTG is below the preset value, the temperature is increased at a constant rate. This sequence is repeated until the reaction ends.




### Constant Reaction Control (CRC)

In order to achieve a constant DTG, the temperature is controlled automatically, and temperature decrease is also controlled. CRC is suitable for investigating reaction mechanisms, reaction-kinetic analysis and reaction simulation. This method also allows predicting the measurement duration.

# DSCvesta

Differential Scanning Calorimeter

The advanced furnace structure achieves an industry-leading wide temperature range of -170 to 725°C. Low noise and high sensitivity won't miss even minute peaks. Its excellent expandability allows easy installation of cooling units and a sample observation unit.


## Extensive measurement range

The new amplified model has expanded the full scale from the usual ±100 mW to ±400 mW allowing the measurement of samples with large change in calories.

## Measurement temperature range: -170 to 725°C (Industry-leading class)

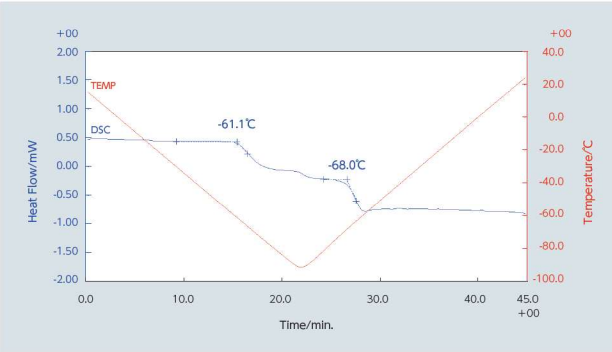
Enables measurements in a wide temperature range. The refrigerated cooling unit enables continuous measurement in the -90 to 725°C range, so various materials can be measured with this one unit.

## Various cooling units

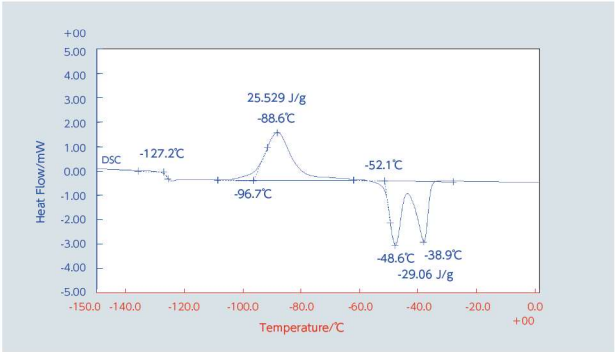
Four different types of cooling units are available to meet your measurement purpose. Since all cooling units can be easily installed and removed, they can be freely exchanged according to your measurement requirements.

| Cooling unit | Refrigerated cooling | $LN_2$ auto-filling cooling | $LN_2$ siphon cooling | Bath circulator cooling |
|---|---|---|---|---|
| |  Continuous heating/cooling measurement without using liquid nitrogen. The optional power ON/OFF unit reduces the waiting time before and after measurement to zero. |  The supply of low-temperature nitrogen gas is controlled according to the temperature program. Suitable for continuous heating/cooling measurements in a wide range. |  Liquid nitrogen is supplied into the furnace through the siphon connected to the dedicated container. Suitable for heating measurements starting from low temperatures. |  The unit can be connected to the circulator for continuous heating/cooling measurements. Tap water can also be used for circulation. |
| Measurement temperature range | -90 to 725°C | -150 to 725°C | -170 to 725°C | -10 to 500°C |
| Maximum heating rate | 50°C/min. | 100°C/min. | 20°C/min. | 20°C/min. |
| Maximum cooling rate<br>Cooling time | 10°C/min.<br>(To -60°C ) | 10°C/min.<br>(To -110°C ) | From room temperature<br>to -170°C Approx. 8 min. | 10°C/min.<br>(To 40°C ) |
| External dimensions/weight | W295×D500×H570 mm<br>60 kg | (Controller)<br>W150×D250×H270 mm<br>4 kg<br>(Dewar)<br>ϕ480×H940 mm<br>25 kg | ϕ480×H940 mm<br>25 kg | W230×D420×640 mm<br>32 kg |
| Power supply | Single phase 100 VAC<br>50/60 Hz 15 A<br>1 plug with grounding | Single phase 100 VAC<br>50/60 Hz 8 A<br>1 plug with grounding | Single phase 100 VAC<br>50/60 Hz 13 A<br>1 plug with grounding | Single phase 100 VAC<br>50/60 Hz 15 A<br>1 plug with grounding |
| Comments | Can be connected to the Power ON/OFF unit | — | — | Circulating heating medium: Ethylene glycol |

## Example of measurement with cooling unit




Measurement example: measurement of urethane rubber
with refrigerated cooling unit.
Controlled cooling to -80°C at 5°C/min. The glass transition at -70°C can be observed in both heating and cooling.




Measurement example: measurement of silicon rubber
with $LN_2$ auto-filling cooling unit.
By cooling down to -150°C, the glass transition at -130°C, crystallization at -100°C and melting at -50°C can be observed clearly.

## Compact automatic sample changer: Smart loader

Smart loader holds up to 24 samples, enabling single measurement and interruption measurement, as well as continuous measurements. All standard sample pans (ϕ5 mm) can be used. Three reference samples can be set and selected according to the measurement conditions. Smart loader can be installed without interfering with the cooling unit* and sample observation unit.

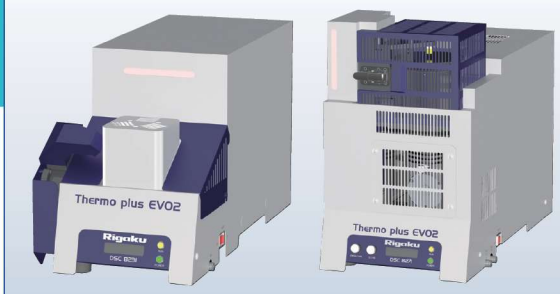
*Except $LN_2$ siphon cooling unit


DSCvesta Smart loader

# DSC8231/8271

Differential Scanning Calorimeter

DSC8231 is compact and easy to install with outstanding functionality. The high temperature DSC DSC8271 model allows measurement in a wide temperature range from room temperature to 1,500°C.




DSC8231 DSC8271

## Cooling units for various purposes: DSC8231

Three different types of cooling units are available to meet your measurement purpose.

- $LN_2$ auto-filling cooling unit Measurement temperature range: -130 to 500°C
- $LN_2$ siphon cooling unit Measurement temperature range: -150 to 500°C
- Bath circulator cooling unit Measurement temperature range: 0 to 500°C (circulating medium: ethylene glycol)

# TMA8311

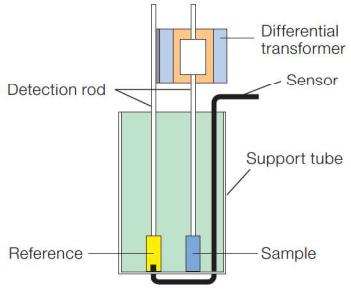
Thermomechanical Analyzer

Rigaku's TMA uses the differential dilatometric system, which cancels the thermal expansion/shrinkage of the detecting mechanism itself.
The differential dilatometric system achieves precise measurements with high reproducibility even in low expansion materials or thermal expansion/shrinkage of small samples.


## System with great expandability for various measurement purposes

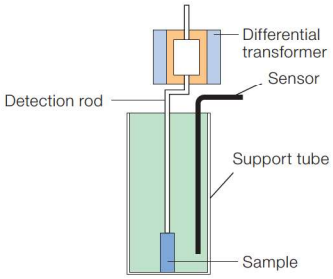
Multipurpose measurements (compression loading, tensile loading and penetration method) can be performed by simply changing the attachments. The load control can be set to constant loading, constant-rate loading (changing shrinkage or tensile load at a constant rate) and sine-wave cyclic (applying shrinkage at constant frequency and oscillation or tensile load).

### Differential compression loading method



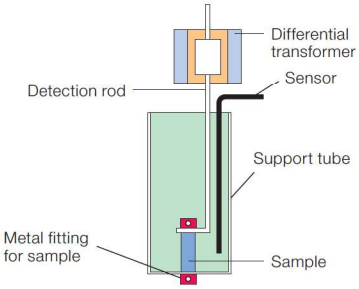

Suitable for the thermal expansion measurement of a rod-or plate-shaped materials in comparison to the reference. Continuously cancels the expansion of the support tube. Offers excellent reproducibility even for less expansive materials up to $10^{-7}$ order.

### Single rod compression loading method



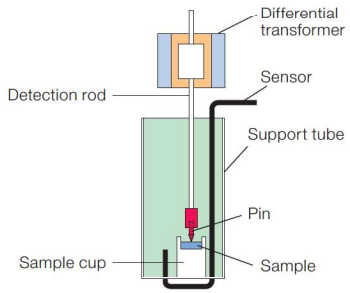

This method is best suited for measuring larger samples (max. ϕ12 mm) compared to differential compression loading method. Suitable for materials that have a large coefficient of linear expansion such as polymers.

### Tensile loading method



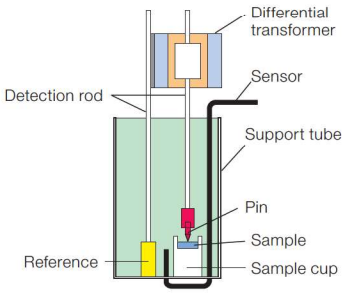

In this method, both ends of a fiber or film sample are attached to a metal fitting and a tensile load is applied during measurement. The metal fitting is designed so that its weight does not affect the load, enabling measurements with high precision.

### Penetration method



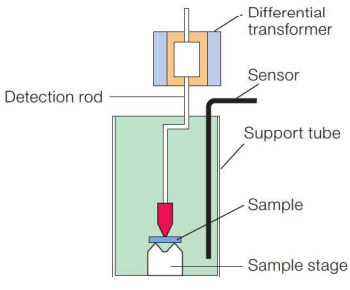

A pin is pressed against a sheet or film sample. The sample is heated while a constant load is applied, and then the temperature and the load at which the pin penetrates the sample are measured. Linear heating or isothermal heating can be selected according to the purpose of the measurement.

### Differential penetration method




This method uses Rigaku's unique differential system. As a distinct feature of this system, it can measure the glass transition or softening of a few micrometer thick materials with high precision. Measurement range is 1 μm full scale.

### 3-point bending method




Measures the bending of plate-like materials. Obtains information on deformation temperature and deformation amount.

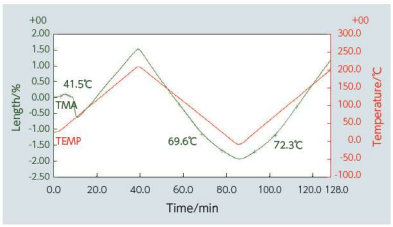
## Cooling units

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 freely exchanged according to the measurement needs.

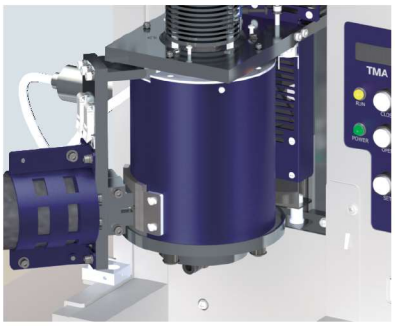
| | Refrigerated cooling | $LN_2$ auto-filling cooling |
|---|---|---|
| Cooling unit |  Supports continuous heating measurement without using liquid nitrogen. The optional power ON/OFF unit reduces the waiting time before and after measurement to zero. |  Liquid nitrogen is used as a cooling medium. The unit controls the supply of the low temperature nitrogen gas according to the temperature program. Suitable for continuous heating and cooling measurements in a wide temperature range. |
| Measurement temperature range | -70 to 600°C | -150 to 600°C |
| Heating rate | 20°C/min. | 20°C/min. |
| External dimensions/weight | W295×D500×H570 mm / 60 kg | (Controller) W150×D250×H270 mm 4 kg<br>(Dewar) ϕ480×H940 mm / 25 kg |
| Power supply | Single phase 100 VAC 50/60 Hz 15 A<br>1 plug with grounding | Single phase 100 VAC 50/60 Hz 15 A<br>1 plug with grounding |
| Comments | Can be connected to the Power ON/OFF unit | — |

## Example of measurement with cooling unit

During the first heating, a shrinkage at 40°C is caused by manufacturing conditions. As a result of having been a predetermined thermal hysteresis via first heating & cooling processes, it reveals the change in thermal expansion due to glass transition at 72°C.



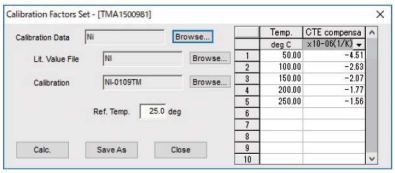

Measurement example:
Measurement of epoxy resin with refrigerated cooling unit




Refrigerated cooling TMA8311

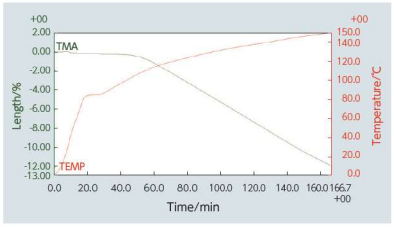
## Correction using a sample with known expansion coefficient

The measurement results of a sample with known expansion coefficients are compared to the literature values, allowing users to create and register a calculated calibration file obtained from the difference in expansion at each temperature. Using the registered calibration file to calibrate the expansion in the measurement results provides more accurate data. This function can also be used to manage the accuracy of data between multiple devices.




## Dynamic TMA (Optional package)

With this unit, temperature control is performed with the sample's shrinkage rate as a parameter, not with the constant temperature heating rate. This method can be used as a simulation for ceramic sintering in creating sintered materials at a controlled shrinkage rate. The figure on the right shows the result of dynamic TMA measurement of the alumina before sintering. As you can see, the temperature is controlled so that the shrinkage rate is constant (0.1 %/min.).



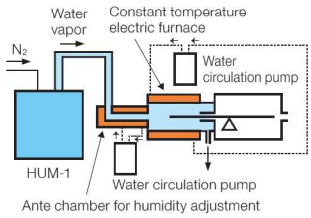

Measurement example:
Dynamic TMA measurement of alumina before sintering

# HUM-1 Humidity Generator

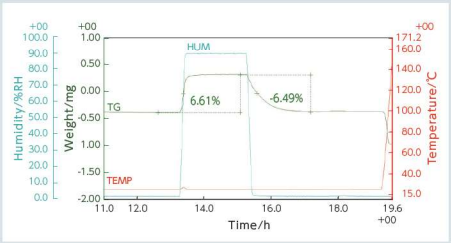
TG-DTA and TMA measurements in humid atmosphere can be performed by simply setting the target RH (relative humidity). The gas mixing method enables quick response to changes in water vapor concentration and stability. The circulator keeps the instrument at a constant temperature, allowing humidity control from dry to 90% RH range from room temperature to 85°C. Combining an instrument with HUM-1 enables the measurement of heating under constant humidity partial pressure. It also measures water absorption rate and swelling rate with changing humidity at a constant temperature.

## TG-DTA/HUM-1
Humidity Controlled TG-DTA

System configuration diagram*



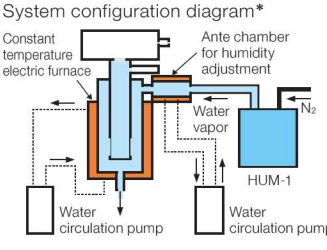

Measurement example:
Mass changes in α-cyclodextrin associated with change in controlled humidity



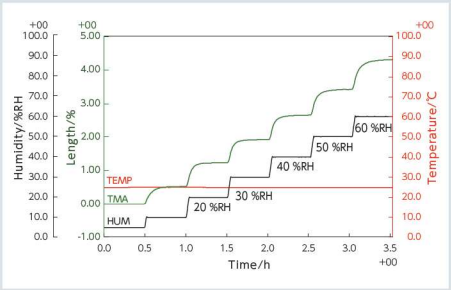

When the relative humidity changed from 25°C dry to 25°C 90% RH the 6.6% mass increase is observed. 6.5% mass loss is observed when RH is returned to dry conditions. When the sample was re-heated in dry conditions, 5.7% mass loss is observed.

## TMA/HUM-1
Humidity Controlled TG-DTA

System configuration diagram*




Measurement example:
Mass changes in α-cyclodextrin associated with change in controlled humidity




Change in degree of expansion when room temperature is held and the humidity is changed gradually.

*Measurements with a humidity generator require a bath circulator and, in some cases, may require two bath circulators, depending on the measurement.

## TG-DTA with Separate Controller

This is a TG-DTA where the mechanical component is housed separately from the control unit for a more flexible installation. This feature allows installing the instrument freely and placing the instrument inside the glove box easily.

Note: Able to insert through the ϕ300 mm port

## High Pressure DSC

The high-pressure DSC allows measurements under a pressure of up to 5 MPa. Supports high-pressure measurements in oxygen, nitrogen and hydrogen. This instrument can be used for evaluating aerospace materials and hydrogen infrastructure materials, to characterize plastics and their oxidation stability, and the degradation of rubber products.

# Various options to meet all your needs

## Optional attachments

For sample pan numbers and material, see page 16.

### Flow meter

The flowmeter controls the flow rate of the atmospheric gas (inert gas, air, etc.) supplied in the sample chamber. Three models with 200, 500 and 1000 mL/min F.S. are available.

Supported instruments: TG-DTA, DSC, TMA

### 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: Flow meter is an optional unit. Please contact us for details on flow rate and gas type.

Supported instruments: TG-DTA, DSC, TMA

### 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.

Supported instruments: TG-DTA, DSC, TMA

### Mass flow unit

Links to the station and measurement program to change gas and set flow rate. Air, $N_2$, Ar, can be selected from one unit.

Supported instruments: TG-DTA, TMA

### Gas flow unit

The gas flow unit supplies inert gas to quickly lower the residual oxygen level in TG-DTA / TMA. It also enables air flow supply from its internal pump.

Supported instruments: TG-DTA, TMA

### UV irradiation unit

Measurement temperature range: room temperature to 150°C

*Specifications such as the irradiation wavelength range and irradiation UV intensity vary depending on the selected irradiation device. Please contact us to confirm if the desired irradiation device can be installed.

Supported instruments: DSC*1

### Sample observation unit for TG-DTA

Measurement temperature range:
room temperature to 1000°C
Maximum heating rate: 100°C/min.
Pixel number:
maximum five million pixels
Sample observation section:
connection: USB 2.0
Lighting: LED light built-in epiillumination type
Automatic sample changer:
supported (optional)

Supported instruments: TG-DTA

### Sample observation unit for DSCvesta

Measurement temperature range:
room temperature to 350°C
(Minimum temperature with cooling unit: -70°C)
Pixel number:
maximum five million pixels
Sample observation section:
connection: USB 2.0
Lighting: LED light built-in epi-illumination type
Automatic sample changer:
supported (optional)

Supported instruments: DSC*1

### Devitrification unit

Ensures visibility by preventing the vitrification of the quartz protective tube of the TG-DTA sample observation unit.*3

Supported instruments: TG-DTA

### Safety cover

The safety cover ensures safety during measurement by covering the automatic sample changer and furnace. The cover is locked while measurement is performed, when samples are automatically changed or if the furnace is hot.

Supported instruments: TG-DTA, DSC*1

### Sample crimper

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

Supported instruments: DSC

### Sample sealer

The sample sealer is 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)

Supported instruments: DSC

### Multi sealer

The multi sealer is an electric sample pan shaping tool with 3 functions: sample crimper, sample sealer*2 and high pressure sample sealer. (For sample pan ⑩). The head is changed depending on the application.

Supported instruments: DSC

### Multi press

The multi press is a sample pan shaping tool with 3 functions: sample crimper, sample sealer and high pressure sample sealer. (For sample pan ⑩). The head is changed depending on the application.

Supported instruments: DSC

*1: Can be installed only to DSCvesta *2: The sealable Al pan sealed with the multi sealer cannot be used with Smart loader.
*3: Cannot be used with the 5 mm height sample pan.

# Various options to meet all your needs

## Analysis software

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

● DSC Ozawa method
In this method, the activation energy can be estimated from more than 3 DSC 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 3 different measurement results: sample pan, sample with a known specific heat and unknown sample.

● DSC Purity
In 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.

## Sample pans

A variety of sample pans for different sample shapes and changes in volume provides exceptional flexibility in choosing a sample pan for your measurement purpose.

| | | | | |
|---|---|---|---|---|
| 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 |
|  Lid |  |  Lid |  |  |
| 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 |
|  Lid |  |  |  |  Lid |

# STA Simultaneous Thermal Analyzer: Thermogravimetric Differential Thermal Analyzer

## Specifications

The specifications of the TG-DTA with separate controller are equivalent to the specifications of TG-DTA8122

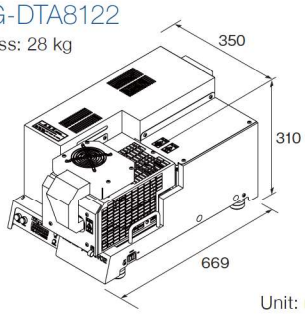
| Model | Thermo plus EVO2 series Thermogravimetric Differential Thermal Analyzer TG-DTA8122 | | |
|---|---|---|---|
| | Standard | High temperature | Sample observation |
| Measurement temperature range | Room temperature to 1100°C | Room temperature to 1500°C | Room temperature to 1000°C |
| Maximum heating rate | 100°C/min (room temperature to 1000°C ) | | |
| Measurement method | Horizontal differential triple coil balance system | | |
| Sample amount | Max. 1 g (90 µL) | | |
| TG range (F.S.) | ±250 mg | | |
| TG resolution | 0.1 µg | | |
| DTA range (F.S.) | 2000 µV | | |
| Measurement atmosphere | Air, inert gas, vacuum, water vapor | | |
| Automatic sample changer* | The number of samples: 24 reference sample: 3 calibration sample: 5 | | |

*: Option

## External dimensions

### TG-DTA8122

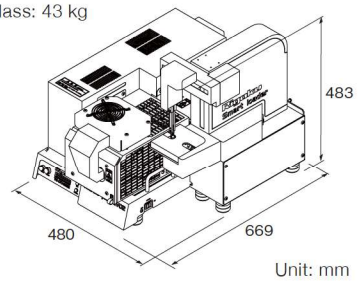
Mass: 28 kg




Unit: mm

### TG-DTA8122 Smart loader

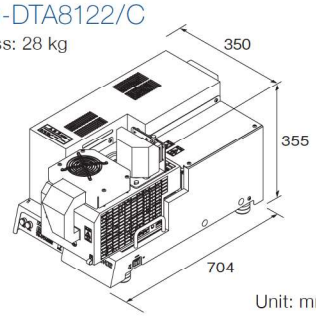
Mass: 43 kg




Unit: mm

### TG-DTA8122/C

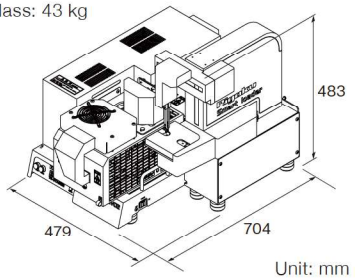
Mass: 28 kg




Unit: mm

### TG-DTA8122/C Smart loader

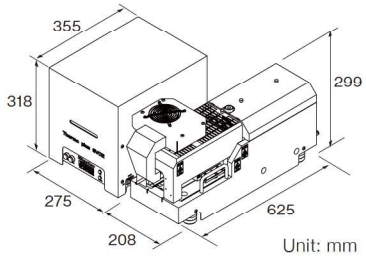
Mass: 43 kg




Unit: mm

### TG-DTA with separate controller

Mass: 31 kg (Main unit: 18 kg, controller: 13 kg)




Unit: mm

## Utility

Specifications of the TG-DTA with separate controller are equivalent to the specifications of TG-DTA8122.

| | | |
|---|---|---|
| TG-DTA | TG-DTA8122 | Single phase 100-240 VAC 50/60 Hz 15 A grounded 1-socket outlet |

# DSC Differential Scanning Calorimeter

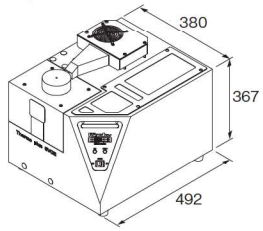
## Specifications

| Model | Thermo plus EVO2 Differential Scanning Calorimeter | | |
|---|---|---|---|
| | DSCvesta | DSC8231 | DSC8271 |
| Measurement method | Heat flux type | | |
| Measurement temperature range | -170 to 725°C *1 | -150 to 725°C (750°C at maximum) *1 | Room temperature to 1,500°C |
| DSC scale | ±400 mW | ±100 mW | ±100 mW |
| Maximum heating rate | 150°C/min *2 | 100°C/min *2 | 20°C/min |
| Noise level ( RMS ) | 0.1 µW | 0.5 µW or lower | 5 µW or lower |
| Measurement atmosphere | Air, inert gas | | |
| Maximum sample amount | 90 µL | | 45 µL |
| Cooling unit *3 | Refrigerated cooling, $LN_2$ auto-filling cooling, $LN_2$ siphon cooling, bath circulator cooling | $LN_2$ auto-filling cooling, $LN_2$ siphon cooling, bath circulator cooling | — |
| Automatic sample changer *3 | The number of samples: 24, reference sample: 3, calibration sample: 4 | | — |

*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 500°C
*2: When a cooling unit is used, the value varies depending on the cooling unit being used. *3: Option

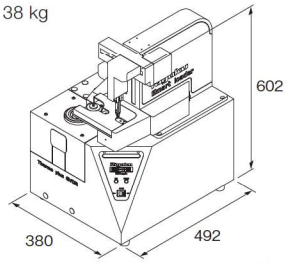
## External dimensions

### DSCvesta
Mass: 28 kg



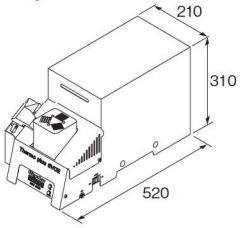

Unit: mm

### DSCvesta Smart loader
Mass: 38 kg



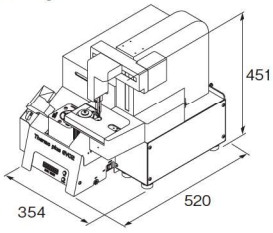

Unit: mm

### DSC8231
Mass: 15.5 kg



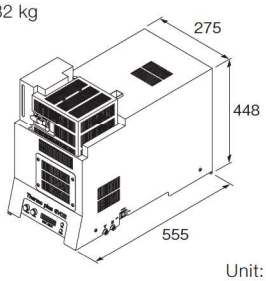

Unit: mm

### DSC8231 Smart loader
Mass: 30.5 kg




Unit: mm

### DSC8271
Mass: 32 kg




Unit: mm

## Utility

For utilities of each cooling unit, see page 10. Current value is the maximum current rating when connected to the 100 V power source.

| | | |
|---|---|---|
| DSC | 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 100-240 VAC 50/60 Hz 15 A grounded 1-socket outlet |

# TMA Thermomechanical Analyzer

## Specifications

| Model | Thermo plus EVO2 Thermomechanical Analyzer TMA8311 | | | | | | |
|---|---|---|---|---|---|---|---|
| Measurement method | Compression loading | | | | Tensile loading | Penetration | |
| Type | Standard | | High temperature | | — | Penetration | Differential penetration method |
| Detection system | Differential expansion | Non-differential expansion *1 | Differential expansion | Non-differential expansion | Non-differential expansion | Non-differential expansion | Differential expansion |
| Sample size | Φ9 mm or smaller | Φ12 mm or smaller | Φ9 mm or smaller | Φ12 mm or smaller | Thickness: 10 to 200 µm | Φ5 mm or less | |
| | Length: 10 to 20mm | | | | Length: 10, 15, 20 mm Width: 5 mm | Thickness: 4 mm (max) | |
| Support pipe, detection rod material | $SiO_2$ | | $Al_2O_3$ | | $SiO_2$ | $SiO_2$ | |
| Maximum load | 1000 mN | | | | | | |
| Measurement temperature range *2 | Room temperature to 1100°C | | Room temperature to 1500°C | | Room temperature to 600°C | | |
| Maximum heating rate | 100°C/min (low temperature furnace: 20°C/min) | | | | | | |
| TMA (F.S.) | 5000 µm | | | | | | |
| Loading mode | 1. Constant loading (up to 1000 mN in the shrinkage or tension direction, 1 mN step)<br>2. Constant-rate loading (up to 1000 mN in the shrinkage or tension direction at a rate of 1 to 500 mN/min)<br>3. Sin-wave cyclic (oscillating from 1 to 1000 mN and a frequency of 0.01 to 1 Hz) | | | | | | |
| Measurement atmosphere | Air, inert gas, vacuum, water vapor | | | | | | |

*1: The specifications of the three-point bending method conform with the standard model (Non-differential expansion) for compression loading mode
*2: Option ($LN_2$ auto-filling cooling unit: -150 to 600°C refrigerated cooling unit: -70 to 600°C)

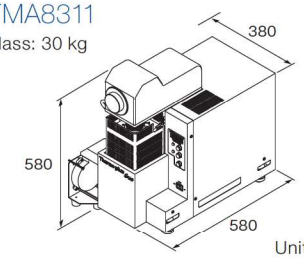
## Utility

For utilities of each cooling unit, see page 13. Current value is the maximum current rating when connected to the 100 V power source.

| | | |
|---|---|---|
| TMA | TMA8311 | Single phase 100-240 VAC 50/60 Hz 15 A<br>1 plug with grounding grounded 1-socket outlet |

## External dimensions

TMA8311
Mass: 30 kg




Unit: mm

# High Pressure DSC High Pressure DSC

## Specifications

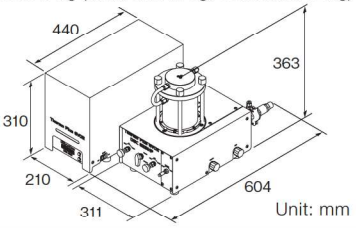
| | |
|---|---|
| Model | Thermo plus EVO2 High Pressure Differential Scanning Calorimeter DSC8231HP |
| Measurement method | Heat flux type |
| Measurement temperature range | Room temperature to 500°C |
| Maximum heating rate | 20°C/min. |
| Measurement atmosphere | Oxygen, inert gas, hydrogen |

## Utility

| | |
|---|---|
| High Pressure DSC | Single phase 100 VAC 50/60 Hz 5 A grounded 1-socket outlet |
| Water circulating pump | Single phase 100 VAC 50/60 Hz 13 A grounded 1-socket outlet |

## External dimensions

High Pressure DSC
Mass: 27 kg (Main unit 15 kg, controller: 12 kg)




Unit: mm

# HUM-1 Humidity Generator

## Specifications

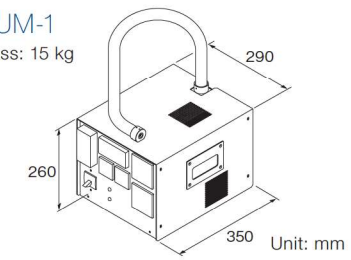
| | |
|---|---|
| Humidity generation method | Bubbling bath/dry gas combination method |
| Humidity range | Room temperature to 85°C, dry to 90% RH |
| Humidity sensor | Polymer type relative humidity sensor |
| Temperature measurement element | Pt resistance temperature sensor |
| Duration for continuous humidity | 40 hours at 85°C, 90% RH |

## Utility

| | |
|---|---|
| HUM | Single phase 100 VAC 50/60 Hz 5 A grounded 1-socket outlet |

## External dimensions

HUM-1
Mass: 15 kg




Unit: mm

# Related products

## Thermo Mass Photo

TG-DTA/Photoionization Mass Spectrometer

- The skimmer gas injection mechanism with double orifice structure detects even highly reactive gases with high sensitivity.
- Newly added fragment-free photoionization method (patented) enables choosing between electron impact ionization (EI) and photoionization (PI) modes.
- A safe and easily maintainable all-in-one system that consists of a gas injection interface and evacuation system installed into the main unit.

## TG-FTIR

Thermogravimetric differential thermal analysis - Fourier transformation infrared spectroscopic analysis combined system

- Can be connected to the FTIR of Thermo Fisher Scientific.
- The transfer line and FTIR gas cell can keep the temperature up to 300°C.
- Gas phase library for TG-FTIR.
- Mercury TGA function that automatically detects multiple gases evolving simultaneously.

## X-ray DSC

X-ray Diffractometer-Differential Scanning Calorimeter

- This system combines a theta-theta type X-ray diffractometer and DSC attachment. This combination enables simultaneous DSC and XRD measurement under the same temperature and atmosphere.
- The information on the temperature and energy of the phase transition and crystal state before and after the phase transition can be obtained at the same time.



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