

Thermal Analysis Excellence

DSC 3+, DSC 3



METTLER TOLEDO

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1 Introduction

Thank you for purchasing this innovative METTLER TOLEDO instrument.

The DSC 3 and the DSC 3+ are analytical instruments for differential scanning calorimetry (DSC). They are part of the METTLER TOLEDO STAR^e system.

1.1 About this document

User Manual and Reference Manual

This User Manual contains the most important operational information for your instrument. Additional information can be found in the Reference Manual, which can be downloaded here:

www.mt.com/ta-manuals

To obtain this User Manual in other languages, please contact your METTLER TOLEDO representative.

Product versions

This document refers to both product versions, the DSC 3 as well as the DSC 3+. These product names are only used where necessary. Where appropriate, the term "DSC module" is used for convenience and refers to both instrument versions.

Conventions and symbols used in this document

Buttons on the display are indicated by bold text, for example **One Click**.

Keys on the instrument are indicated by bold text in square brackets, for example [**Reset**].

The following symbols are used to indicate instructions:

- prerequisite
- 1, 2, 3 ... instruction steps
- ⇒ result

1.2 Software versions required for your instrument

STAR^e Software

The DSC 3 and DSC 3+ can only be operated in conjunction with the STAR^e Software from METTLER TOLEDO which is installed on a PC. There is no stand-alone mode.

You require version 14.00 or later of the STAR^e Software to operate the DSC 3 and DSC 3+.

References to the STAR^e Software are included in certain parts of this document.

Instrument software

This document refers to instruments running version 3.10 or later of the instrument software.

The instrument software version of your instrument is displayed in the **System info** dialog on the SmartSens terminal.

1.3 Hardware options

Your instrument can be expanded with the hardware options mentioned in this section.

- SmartSens Terminal
- Gas Controller
- Sample Robot
- Automatic Furnace Lid
- 400 W Power Amplifier
- Power Switch
- Peripheral Options Board
- Cooling options
 - Intracooler

- Cryostat
- Liquid nitrogen
- Hardware options for hyphenated techniques
 - Microscopy Kit for DSC
 - Photocalorimetry System for DSC

More information can be found in the Reference Manual which can be downloaded here:
www.mt.com/ta-manuals

1.4 METTLER TOLEDO support and service

METTLER TOLEDO offers you valuable support and services that help you optimally use your instruments:
<http://www.mt.com/ta-services>

Training

- Live Webinars
<http://www.mt.com/ta-webinars>
- On Demand Webinars
<http://www.mt.com/ta-ondemand>
- E-learning
<http://www.mt.com/ta-ettraining>
- In-class Training
<http://www.mt.com/ta-training>
- Technical Videos
<http://www.mt.com/ta-videos>

Applications

- UserComs
<http://www.mt.com/ta-usercoms>
- App
<http://www.mt.com/ta-app>
- Applications Handbooks
<http://www.mt.com/ta-handbooks>
- Applications Database
<http://www.mt.com/ta-applications>

Service

- Service and Support
<http://www.mt.com/ta-service>
- Good Thermal Analysis Practice™
<http://www.mt.com/gtap>

News

- Promotions
<http://www.mt.com/ta-promotions>
- TA News
<http://www.mt.com/ta-news>

2 Safety Information

The instrument should only be operated by qualified personnel. METTLER TOLEDO offers appropriate training courses. **See** [METTLER TOLEDO support and service ▶ Page 4].

The instrument is safe to use as described in the User Manual and Reference Manual provided with it. However, it is the responsibility of the users to assess if the instrument can be safely used for their own specific methods and purposes.

The instrument must not be modified by reconstructive measures compared to the factory original.

Two documents named "User Manual" and "Reference Manual" are available for this instrument.

- The User Manual is printed and delivered with the instrument.
- The electronic Reference Manual contains a full description of the instrument and its use.
- Keep both documents for future reference.
- Include both documents if you transfer the instrument to other parties.

Only use the instrument according to the User Manual and the Reference Manual. If you do not use the instrument according to these documents or if the instrument is modified, the safety of the instrument may be impaired and Mettler-Toledo GmbH assumes no liability.

2.1 Definition of signal words and warning symbols

Safety notes contain important information on safety issues. Ignoring the safety notes may lead to personal injury, damage to the instrument, malfunctions and false results. Safety notes are marked with the following signal words and warning symbols:

Signal words

WARNING

A hazardous situation with medium risk, possibly resulting in death or severe injury if not avoided.

CAUTION

A hazardous situation with low risk, resulting in minor or moderate injury if not avoided.

NOTICE

A hazardous situation with low risk, resulting in damage to the instrument, other material damage, malfunctions and erroneous results, or loss of data.

Note

(no symbol)
for useful information about the product.

Warning symbols



General hazard



Risk of electrical shock



Risk of burn



Risk of fire



Risk of explosion



Heavy load



Risk of poisoning



Risk of frostbite



Risk of injury

2.2 Instrument-specific safety notes

2.2.1 Intended use

The DSC 3+ and DSC 3 are intended for performing differential scanning calorimetry.

All other uses are deemed to be not intended without the written authorization of Mettler-Toledo GmbH, as is operation above and beyond the limits of use stipulated by Mettler-Toledo GmbH.

For the limits of use, **see** the chapter "Technical Data" in the Reference Manual.

2.2.2 Responsibilities of the instrument owner

The instrument owner is the person holding the legal title to the instrument and who uses the instrument or authorizes any person to use it, or the person who is deemed by law to be the operator of the instrument. The instrument owner is responsible for the safety of all users of the instrument and third parties.

Mettler-Toledo GmbH assumes that the instrument owner trains users to safely use the instrument in their workplace and deal with potential hazards. Mettler-Toledo GmbH assumes that the instrument owner provides the necessary protective gear.

2.2.3 Measures for your protection



WARNING

Danger of death or serious injury due to electric shock

Contact with parts that carry a live current can lead to death or injury.

- 1 Only use the METTLER TOLEDO power supply cable designed for your instrument.
- 2 Connect the power cable to a grounded power outlet.
- 3 Never open the instrument housing.
- 4 Make sure that the power plug is easily accessible.
- 5 Keep all electrical cables and connections away from liquids and moisture.
- 6 Check the cables and the power plug for damage and replace damaged cables and power plugs.



WARNING

Risk of explosion if the instrument is used in an explosive atmosphere.

The housing of the instrument is not gas tight. An explosion caused by a spark can be lethal.

- Never work in an environment subject to explosion hazards.



CAUTION

Risk of explosion or fire due to explosive or flammable gas mixtures.

Explosion or fire from gas mixtures produced in the sample chamber can seriously injure you.

- 1 Never use gases which may result in an explosive or a flammable gas mixture.
- 2 Never use explosive or flammable gases or gas mixtures to purge the measuring cell.



CAUTION

Risk of burns or damage from flammable samples.

Using flammable samples can cause burns or damage to the instrument and in its vicinity.

- Take suitable measures to minimize any risk. **See** chapter "Operation" for more information.



CAUTION

Risk of hot surfaces.

You can burn yourself by touching parts of the measuring cell, furnace or the crucibles.

- 1 Allow the measuring cell to cool down to room temperature before performing any task on the furnace.
- 2 Never place your fingers on or inside the furnace after an experiment.
- 3 Use tweezers to remove the furnace lid and crucibles.



CAUTION

Risk of surfaces on the instrument heating up unduly after switching off the cooling device prematurely.

You can burn yourself on hot surfaces on the measuring cell and in its surroundings. Hot surfaces on the instrument can cause a fire.

- Never switch off the instrument or the cooling device when the temperature in the furnace is above 100 °C.



CAUTION

Risk of toxic or corrosive gases from samples that react or decompose.

You can be poisoned if you inhale toxic gases. Corrosive gases can damage the measuring cell.

- 1 Place the instrument in a fume hood if you measure substances which form toxic gases.
- 2 Purge the furnace and sample chamber with an inert gas after experiments in which toxic or corrosive gases may have been produced. Do not use toxic or corrosive or gas mixtures to purge the measuring cell.



CAUTION

Risk of injury due to heavy load.

You can injure yourself by carrying the instrument alone.

- Never try to carry the instrument alone. At least two people are needed to carry the instrument.

It is advisable to wear protective clothing in the laboratory when working with the instrument and especially when handling liquid nitrogen.



A lab coat and suitable eye protection, such as safety spectacles, goggles or a face shield should be worn.



Use appropriate gloves when handling chemicals or hazardous substances, checking their integrity before use.

2.2.4 Measures for faultless operation



NOTICE

Risk of false operation.

False operation can cause damage to or failure of the instrument.

- 1 Use the instrument only indoors in a well-ventilated area, at altitudes of less than 3000 m above sea level.
- 2 Avoid the following environmental influences:
 - Powerful vibrations
 - Direct sunlight
 - Atmospheric humidity greater than 80% (non-condensing)
 - Corrosive gas atmosphere
 - Temperatures below 10 °C and above 31 °C
 - Powerful electric or magnetic fields
- 3 If the furnace is air cooled, ensure that the air vents on the sides of the instrument are not obstructed.
- 4 When using chemicals and solvents, comply with the instructions of the manufacturer and the general lab safety rules.
- 5 Have the instrument serviced only by METTLER TOLEDO Service.



NOTICE

Risk of damage if the instrument is used in a corrosive atmosphere.

Corrosion caused by the ingress of gases can damage the instrument.

- Never work in an environment subject to corrosive gases.

2.3 Information on cooling options

2.3.1 Liquid nitrogen cooling



WARNING

Risk of lack of oxygen in the ambient air.

Evaporation of liquid nitrogen into the ambient air can cause asphyxiation.

- 1 Only operate the liquid nitrogen Dewar in a well ventilated room of sufficient volume.
- 2 Ensure that the room is well ventilated.
- 3 Always shut down the liquid nitrogen Dewar if it is not required for longer periods. There is always the risk that liquid nitrogen could escape uncontrollably.



⚠ CAUTION

Risk of liquid nitrogen escaping.

Liquid nitrogen can cause severe cold burns or frostbite on your skin.

- 1 Always wear protective goggles, gloves and clothing when working with liquid nitrogen.
- 2 Make sure that you have been trained in the correct operation of the liquid nitrogen Dewar.
- 3 Take care when handling the tubing. Do not allow any tight bends in the tubing or stress when installing. Allow the tubing to be sufficiently slack.
- 4 Before moving the liquid nitrogen Dewar, shut down Dewar and let the tubing warm up to ambient temperature. Frozen tubing could break and liquid nitrogen could flow out.
- 5 Use a trolley or forklift when transporting the liquid nitrogen Dewar if it does not have wheels. Make sure the Dewar is supported from below.

2.3.2 Intracooler and cryostat



⚠ WARNING

Risk of electrical shock.

An electrical shock can be lethal.

- 1 Always use a grounded power supply cable and plug it into a grounded outlet to provide the cooling device with a grounded connection.
- 2 Never open the instrument housing.

Intracooler



⚠ CAUTION

Risk of severe burns and material damage due to coolant leaking and igniting.

If the intracooler is switched off when the furnace is hot, coolant could leak and ignite.

- Never switch off the intracooler if the cell temperature is above 200 °C.

Cryostat



⚠ CAUTION

Risk of poisoning by toxic coolant liquids.

- When handling coolant liquids, comply with the instructions of the manufacturer of these products and the general lab safety rules.



⚠ CAUTION

Risk of injury due to improperly secured coolant tube connections.

You could injure yourself if the coolant tubes slip off and the coolant used is toxic or irritating to eyes and skin.

- Secure the tube connections on the bath circulator with hose clamps.

2.4 Information on operation with sample robot



CAUTION

Risk of injury by moving sample robot gripper.

The moving sample robot gripper could injure your fingers.

- Keep your hands away from the sample robot gripper.

- Never switch off the instrument if the sample robot gripper is not in the idle position. Problems could arise the next time the sample robot is powered up.
- Never switch off the module during power-up. Problems could arise the next time it is powered up.
- Never open the sample robot if the gripper is stuck. Follow the directions in the operating instructions.
- Use only the crucible types without center pin corresponding to the gripper type.

2.5 Warning symbols on the instrument

The following warning symbols are applied on the instrument housing to warn users of possible hazards.



This symbol warns that exposed surfaces of the furnace can be hot or cold to the touch and can cause a skin burn.

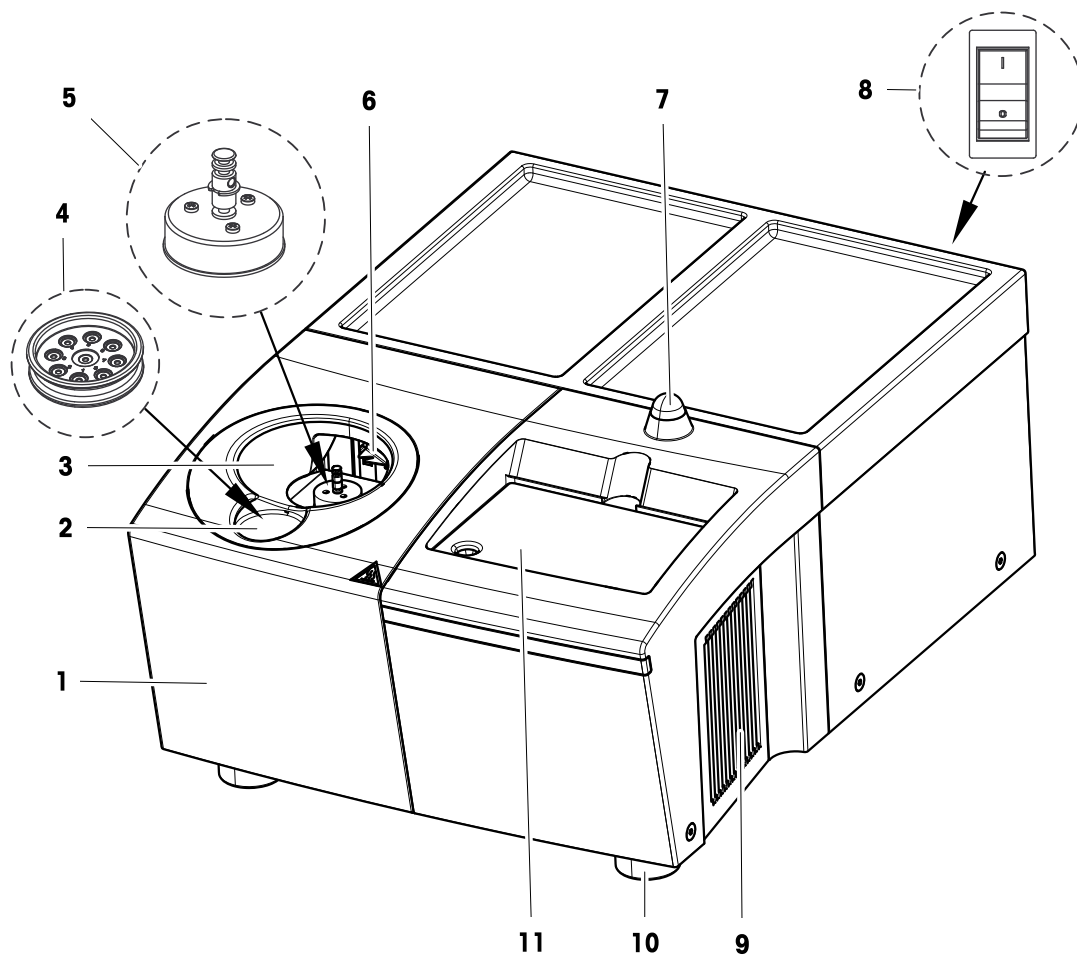


This symbol is applied if the sample robot is installed. It warns you that your fingers or other body parts could be injured by the sample robot gripper.

3 Design and Function

3.1 Overview of the DSC module

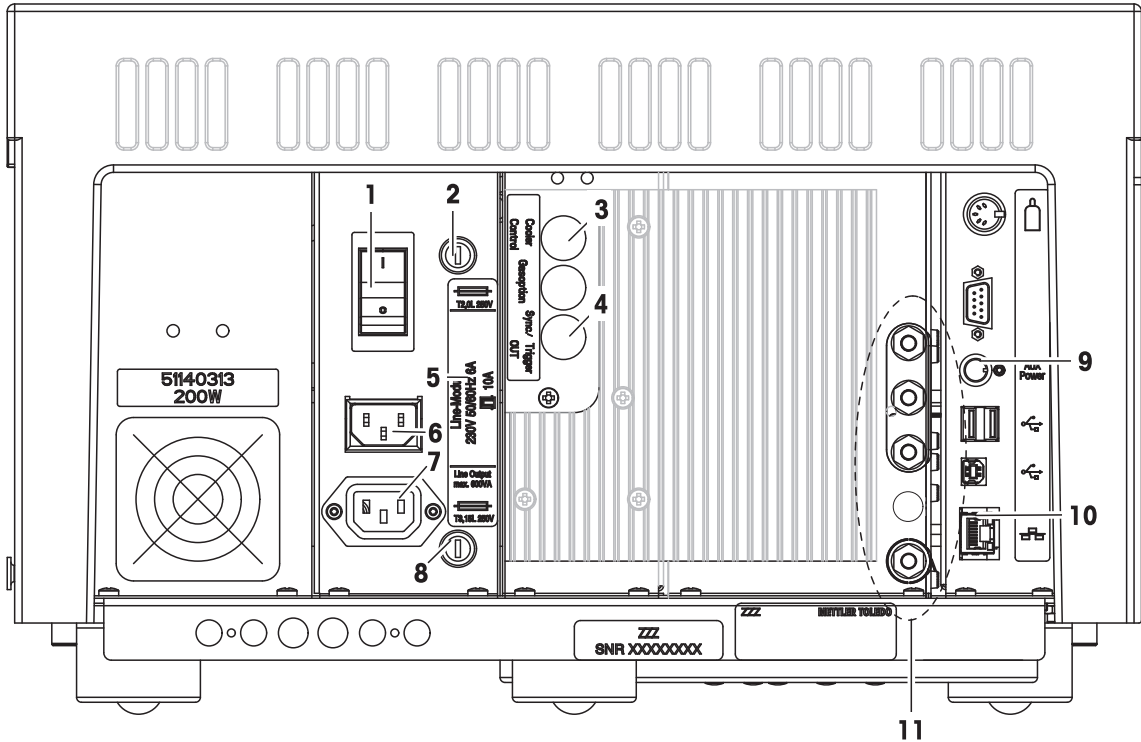
The figure below shows the basic configuration of the instrument.



DSC 3+ and DSC 3, basic configuration

1	Measuring cell	7	LED display
2	Surface for crucible tray	8	Main power switch
3	Measuring cell opening	9	Air vent
4	Crucible tray	10	Screw feet
5	Manual furnace lid	11	Glass cover with note paper underneath
6	Support for manual furnace lid		

3.2 Connections on the rear panel



1	Main power switch
2	Fuse for electronics supply
3	Connection for valve control of Liquid Nitrogen Cooling option
4	Connection for triggering and synchronization of external devices
5	Rating plate
6	Power supply inlet socket
7	Line output socket
8	Fuse for line output socket
9	Connection for Power Switch option
10	Ethernet connection
11	Gas connections

Notes

- The line output socket is connected to the main power switch. If you switch off the instrument, you also switch off any external device connected to the socket, for example an intracooler.
- The instrument is connected via the Ethernet connection to the **STAR^e** Software PC.

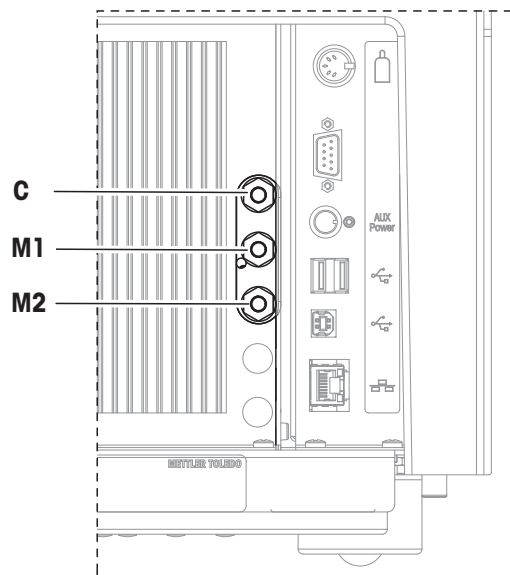
3.3 Gas connections

The use of the gas connections at the rear of your instrument depends on the type of gas controller installed. **See** also [Built-in gas controller ▶ Page 16].

The labels on the cooling fin next to the connections indicate how the gases should be connected:

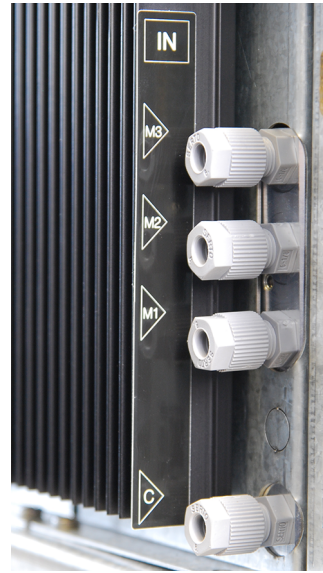
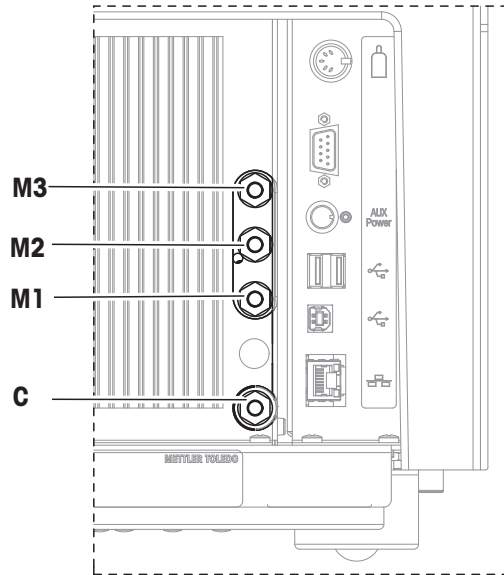
- The connections labeled **M1**, **M2** or **M3** are used for method gases. Method gases can be used as reactive or purge gases and are introduced close to the sample.
- The connection labeled **C** is used for the cell gas. The cell gas is used as dry gas to prevent condensation.

GC 005



- **C** is the connection for the cell gas.
- **M1** and **M2** are the connections for the method gases.
- A third method gas connection is not available.

GC 302 and GC 402



- **M1, M2** and **M3** are the connections for method gases.
- **C** is the connection for the cell gas.

3.4 Built-in gas controller

3.4.1 Gas controller types

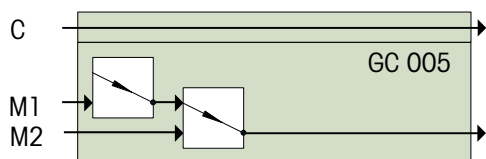
The gas controller specified in your order is built into your instrument. Three versions of gas controller are available: GC 005, GC 302 and GC 402. The version that can be installed depends on the type of instrument:

Gas controller type	DSC 3	DSC 3+
GC 005	standard	not available
GC 302	optional	standard
GC 402	optional	optional

The mass flow controllers in the GC 302 and GC 402 gas controllers should be operated at 1 to 3 bar. The pressure of the gas supply should be within this range. The permissible pressure limit is 5 bar.

The following schematics show the functional principle of each type of gas controller:

GC 005



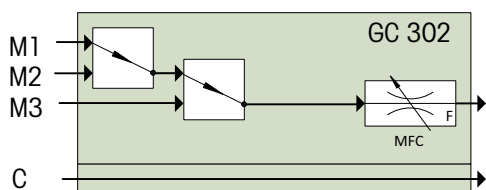
C	Cell gas
M1, M2	Method gases
	Valve

The GC 005 has two valves by which method gas M1 or M2 is selected. On the rear side of the instrument there are only two connection for method gases, connections M1 and M2. The cell gas is connected to connection C.

Note

As the GC 005 does not feature a mass flow controller, the flow rate cannot be measured and displayed. However, the gas flow symbol on the SmartSens terminal indicates whether the valves are open or closed.

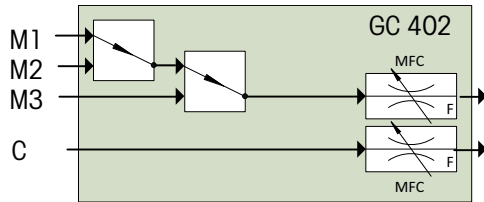
GC 302



M1, M2, M3	Method gases
C	Cell gas
	Valve
	Mass flow controller

The GC 302 has two valves by which method gas M1, M2 or M3 is selected. On the rear side of the instrument there are three connections for method gases, connections M1, M2 and M3. The cell gas is connected to connection C. The mass flow of the method gas is controlled by a mass flow controller (MFC).

GC 402



M1, M2, M3	Method gases
C	Cell gas
	Valve
	Mass flow controller

The GC 402 has two valves by which method gas M1, M2 or M3 is selected. On the rear side of the instrument there are three connections for method gases, connections M1, M2 and M3. The cell gas is connected to connection C. The mass flows of the method gas and the cell gas are controlled by two mass flow controllers (MFC).

Gas controller settings in the STARe Software

The settings to specify the use of the connected gases in an experiment and also the gas controller type can be defined on the **Module** tab in the Install Window of the STAR^e Software:

The screenshot shows the 'Gas Controller' settings window. It is divided into three main sections:

- Gas Controller:** A dropdown menu for 'Type' is set to 'GC 302'.
- Method Gas:** Three dropdown menus for 'M1', 'M2', and 'M3' are all set to a dashed line, indicating no selection.
- Manual Gas Control:** A dropdown menu for 'C' is set to a dashed line, indicating no selection.

The method and cell gas types to be used are defined under **Method Gas** and **Cell Gas**. The way the gas types are used during an experiment is specified in the method employed in the experiment. During the experiment, the valves in the gas controller are switched according to the gas settings in the segments of the method. After completion of the last segment in the method, the final purge gas is switched on if specified in the method.

Methods can be defined in the Routine Window or Method Window of the STAR^e Software.

Please consult the following topics in the online Help to STAR^e Software for more information:

- "Defining settings for the gas controller" in the online Help to the Install Window .
- "Defining gas type and gas flow" in the online Help to the Method Window.

3.4.2 Gases suitable for use

The following gases are approved for use on your instrument:

- Air
- Argon, Ar
- Carbon dioxide, CO₂
- Inert Hydrogen (4% Hydrogen, H₂; 96% Argon, Ar)
- Nitrogen, N₂
- Oxygen, O₂
- Helium, He

If the built-in gas controller of your instrument features a mass flow controller, a calibration certificate is shipped. The certificate confirms accurate mass flow readings with the above listed gases.

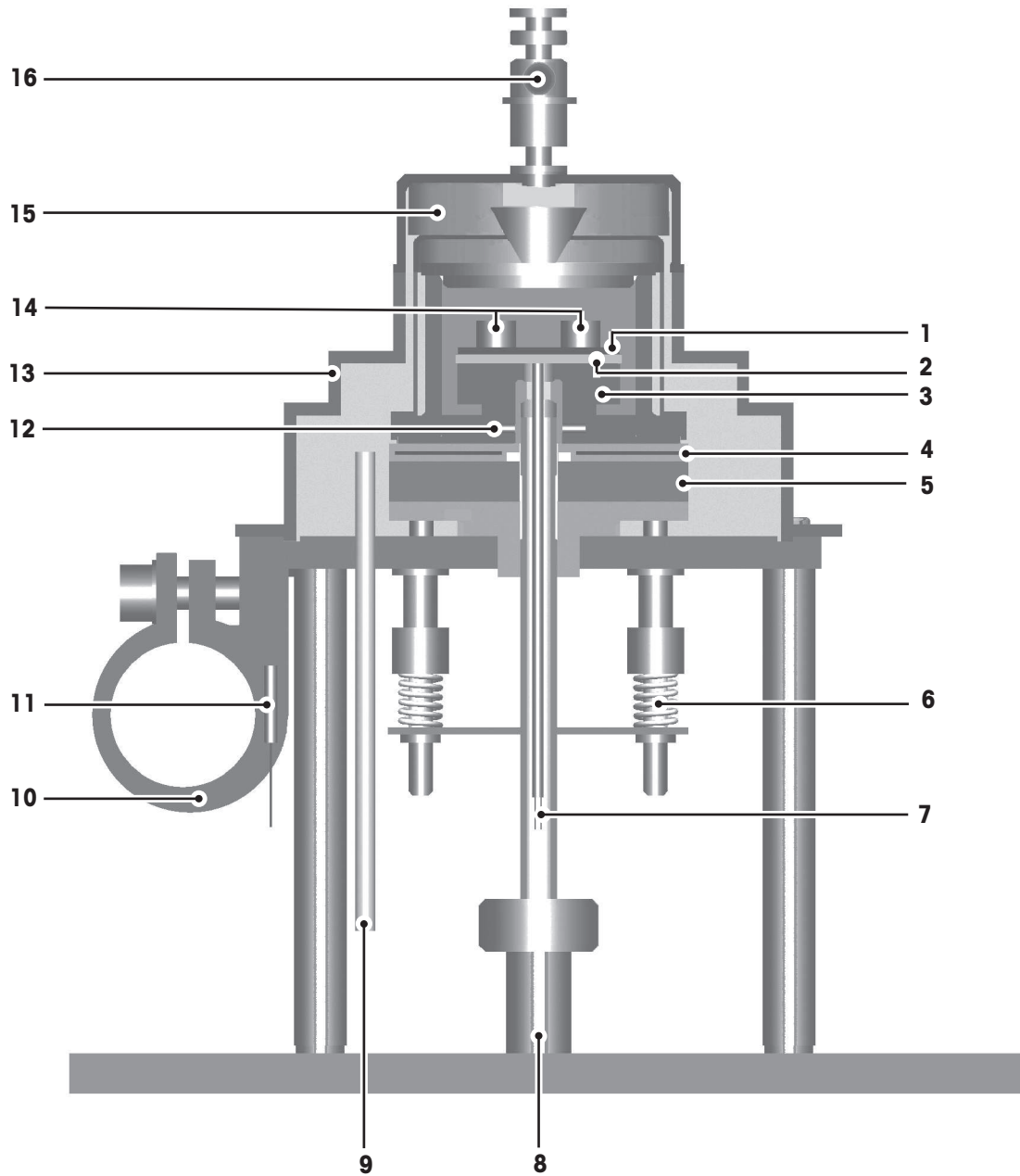
Note

The built-in gas controllers are adjusted and produce accurate mass flow readings for the above listed gases. Therefore there is no need to specify a flow factor for these gases on the **Gas** tab in the Install Window.

3.5 The measuring cell

3.5.1 Cross section of the measuring cell

The measuring cell essentially consists of the furnace, the furnace lid and the DSC sensor. Additional details can be seen in the following schematic.



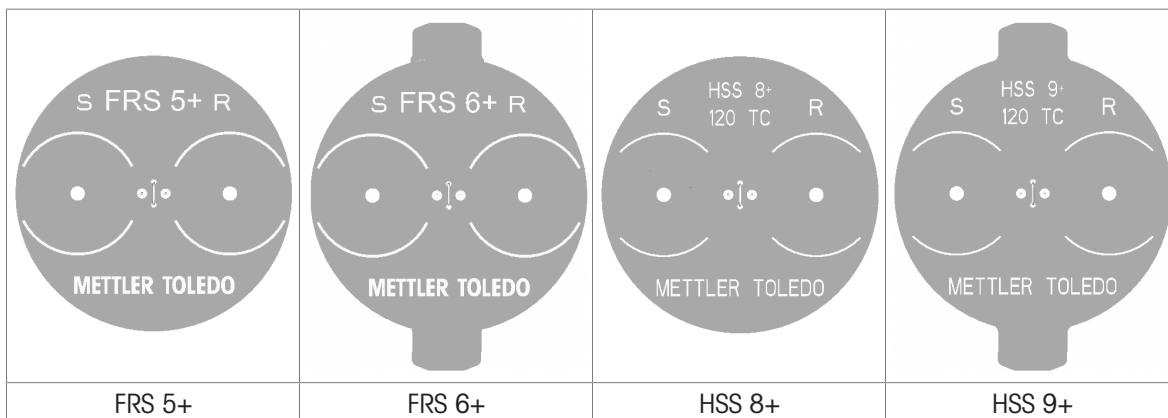
Section of measuring cell

1	DSC sensor
2	Ceramic disk
3	Furnace body
4	Heater plate
5	Thermal resistor to cooling device
6	Spring loaded furnace assembly
7	Wires for transmitting the DSC raw signal

8	Method gas inlet
9	Dry gas inlet tube for preventing condensation
10	Cooling flange for connection of cooling device
11	Temperature sensor of cooling flange (only with cooling option)
12	Temperature sensor for temperature control
13	Furnace housing
14	Crucible on DSC sensor, sample side (S) and reference side (R)
15	Furnace lid
16	Gas outlet in furnace lid

3.5.2 DSC sensors

There are four types of sensor: FRS 5+, FRS 6+, HSS 8+ and HSS 9+.



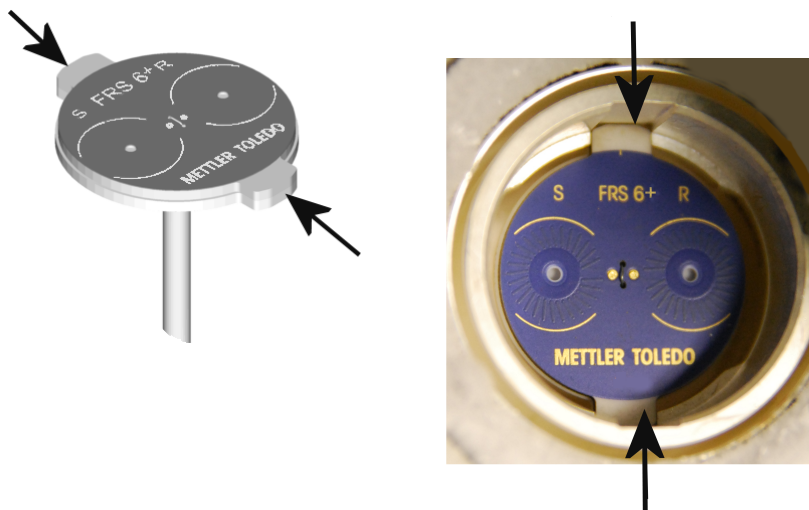
The following table shows which DSC sensor type can be installed on which DSC module.

DSC sensor	DSC 3+	DSC 3
FRS 5+	-	x
FRS 6+	x	-
HSS 8+	-	x
HSS 9+	x	-

The sensor type that best suits your type of application can be installed.

You can take advantage of the HSS 8+ or HSS 9+ high-sensitivity sensor with its 120 gold-gold/palladium thermocouples. The measuring cell can also be operated with the full-range FRS 5+ or FRS 6+ sensor. The sensor types can be replaced with each other. For further details, **see** the chapter "Technical Data" in the Reference Manual.

The FRS 6+ and HSS 9+ sensors feature two ears which hold the sensor in a fixed position in the furnace and protect it against rotation. The ears prevent rotational movement of the sensor during operation that could be caused for example by the sample robot.



Ears on sensor

3.6 LED display

On a DSC module without the SmartSens terminal, the LED display indicates the following operating states of the instrument:

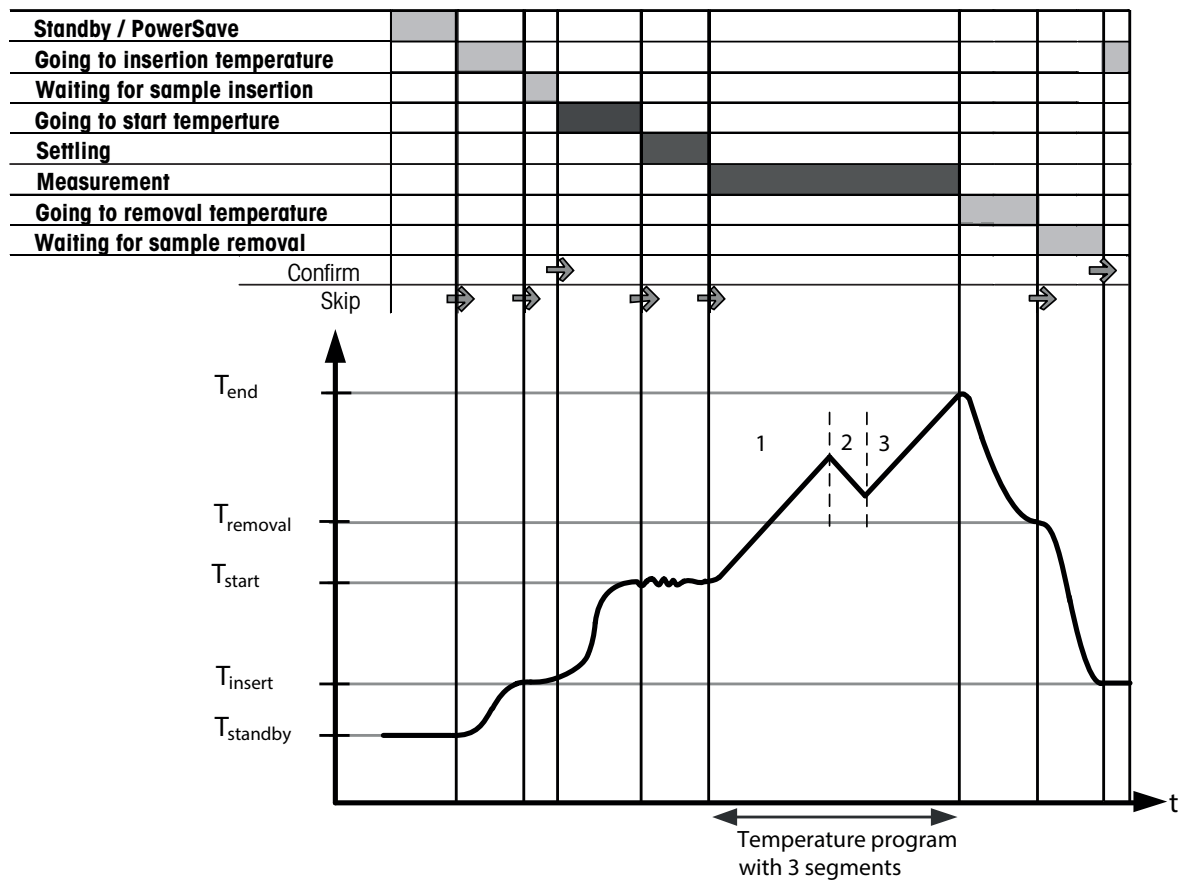
Display	Operating state
Green, continuously lit	Standby state
Green, flashing	<ul style="list-style-type: none">• Ready for sample insertion.• Ready for sample removal
Red, continuously lit	Measurement
Red, flashing	Error or warning

Notes

- The hardware option "SmartSens Terminal" replaces the LED display. The state indicator on the SmartSens terminal serves the same purpose as the LED display.
- For the One Click™ function, the SmartSens terminal needs to be installed.

3.7 Stages of an experiment

The following schematic shows the stages of the experiment in chronological order:



$T_{standby}$	Standby temperature *
T_{end}	End temperature of temperature program **
$T_{removal}$	Removal temperature **
T_{start}	Start temperature **
T_{insert}	Insertion temperature **

* Is defined in the module dataset of the STAR^e Software.

** Is defined in the method.

The following table gives an overview of the experiment stages and colors of the operating state indicator.

Experiment stage	Comment	Display
Standby/ PowerSave	State of the measuring cell is in the operating state defined by the end behavior after the previous experiment <ul style="list-style-type: none"> • Standby: The measuring cell is at standby temperature. • PowerSave: The furnace is switched off. 	Green
Going to insertion temperature		Green
Waiting for sample insertion	Must be confirmed.	Green
Going to start temperature		Red
Settling	The TA module settles the start temperature before the measurement.	Red
Measurement	This is the actual measurement stage.	Red
Going to removal temperature		Green
Waiting for sample removal	Must be confirmed.	Green

3.8 Hardware options

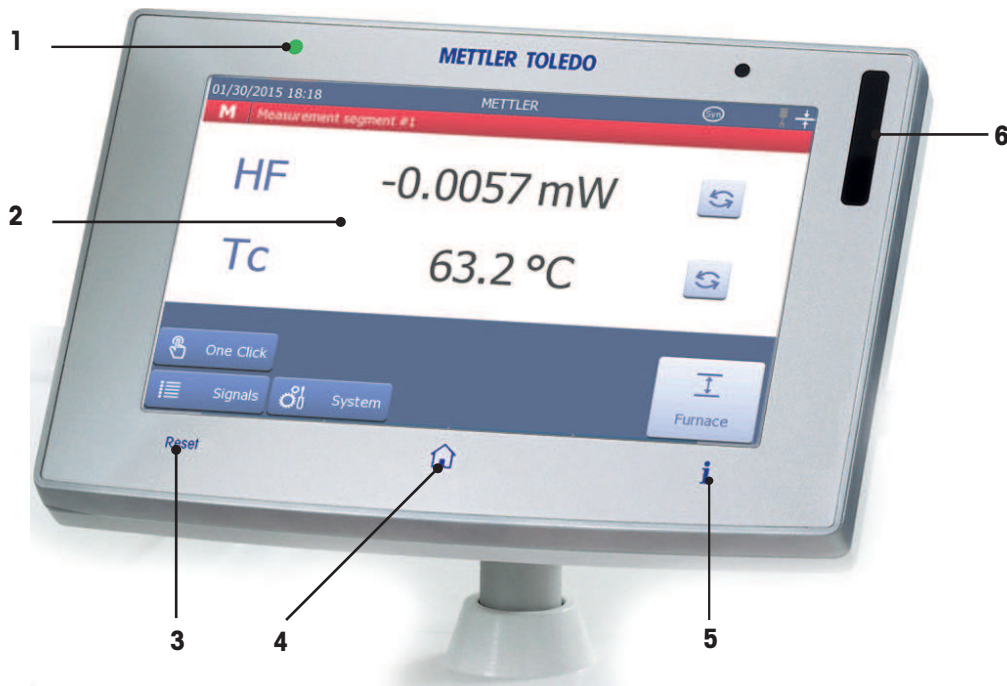
Your instrument can be expanded with the hardware options mentioned in this section.

For ordering information, **see** the chapter "Accessories and Spare Parts" in the Reference Manual..

3.8.1 Smartsens terminal

The SmartSens terminal helps you to operate the instrument. The main feature of the SmartSens terminal is the touch screen. The touch screen not only displays information. It also allows you to enter commands. This enables you for example to choose the information displayed on the screen, change terminal settings or perform certain operations directly on the instrument.

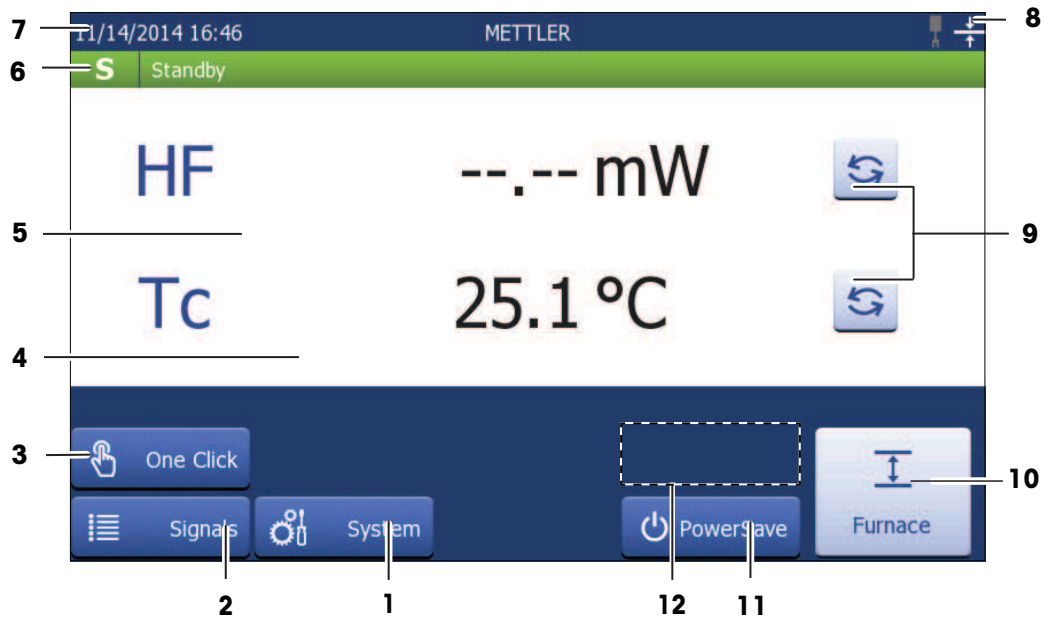
3.8.1.1 Overview of the SmartSens terminal



	Name	Explanation
1	Power indicator light	<ul style="list-style-type: none"> Is on when instrument is switched on. Flashes when screen saver is on or touch screen is switched off.
2	Touch screen	<ul style="list-style-type: none"> You can enter data or view details relevant for the current module. You can enter commands.
3	[Reset] key	Terminates an experiment that is in progress.
4	[Home] key	Displays the Home screen.
5	[Experiment] key	Displays information on the current experiment.
6	SmartSens sensor	<ul style="list-style-type: none"> Opens and closes the furnace. Scrolls through the display of measurement values.






3.8.1.2 The touch screen





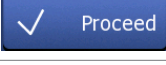

The Home screen on the touch screen is shown below.



Lorem ipsum







Items on the touch screen

	Button	Name	Explanation
1	 System	System button	Accesses the System dialog from where you can perform the following tasks: <ul style="list-style-type: none"> • Display system information. • Perform a self test of the system. • Change the touch screen settings. • Define the setup of your system, such as global settings and settings for your network.
2	 Signals	Signals button	Displays a list of the current measurement values. Toggles with One Click button.
3	 One Click	One Click button	Starts "One Click" experiments. Toggles with the Signals button.
4		Message area	Contains information or error messages.
5		Signal view area	Displays the measurement signals.
6	 Standby	State indicator	Indicates the state of the measuring cell and the stages of an experiment. See [State indicator and experiment stages ▶ Page 28]
7		Title bar	Displays the following: <ul style="list-style-type: none"> • Date and time • STAR[®] Software user name of the user currently using the instrument • Configuration symbols
8		Configuration symbols	See table below.

9		Scroll button	Scrolls through the list of measurement values.
10		Furnace button	Opens and closes the furnace.
11		PowerSave button	Switches the measuring cell to power save mode. Toggles with Standby button.
		Standby button	Switches the measuring cell to standby mode. Toggles with PowerSave button.
12		Proceed button	Confirms an experiment stage. Toggles with the Skip button.
		Skip button	Skips an experiment stage. Toggles with the Proceed button.
The Proceed and Skip buttons are not displayed in the Home screen in Standby and PowerSave states of the measuring cell. This is why these buttons are indicated by dashed lines in the above figure which shows the Home screen in the Standby state.			

Configuration symbols

Configuration symbols indicate how the instrument is configured and show the state or position of a device such as the sample robot or the furnace.

	Furnace position indicator	<ul style="list-style-type: none"> Indicates whether the furnace is open or closed. Available on DSC 3 and DSC 3+ only if the hardware option Automatic Furnace Lid is installed.
	Sample robot	<ul style="list-style-type: none"> Indicates whether the sample robot is active or not. If no symbol is displayed, the sample robot is not installed. The symbol flashes when the sample robot is performing a task.
	Synchronized connection	A synchronized connection between the STAR [®] Software and a peripheral device has been established.
	Trigger connection	A trigger connection between the STAR [®] Software and a peripheral device has been established.
	Gas flow	Indicates whether the valves in the gas controller controlling the gas flow are open or closed.
	Maintenance due	Symbol is shown as soon as the service interval has expired

3.8.1.3 State indicator and experiment stages

The state indicator in the title bar and the text next to it indicate the states of the TA module.

An experiment that is in progress on the TA module proceeds through a range of stages that correspond to different measuring cell states.

State indicator: Field at the left side of the title bar. Its background color and the character shown indicate the current measurement stage.

Text in the title bar: Contains information about the current state of the TA module.

The table below describes the texts that appear in the title bar and indicates how they relate to the color and character in the state indicator. The texts are listed according to the chronological order of the experiment stages.

Color	State	Text in the title bar
Green	S	Standby (standby temperature) The furnace is switched on and the measuring cell is at the standby temperature. No experiment is in progress on the TA module.
Green	A	Going to insertion temperature The TA module is approaching the temperature at which the sample is inserted.
Green	A	Waiting for sample insertion The TA module is ready for the sample to be inserted.
Red	M	Going to start temperature The TA module is approaching the start temperature.
Red	M	Settling The TA module is stabilizing the start temperature.
Red	M	Measurement Measurement is in progress.
Green	A	Going to removal temperature The TA module is approaching the temperature at which the sample is removed.
Green	A	Waiting for sample removal The TA module is ready for the sample to be removed.
Green	S	Final user temperature The TA module is approaching the temperature that was defined when the temperature end behavior was set, or the TA module has reached this temperature.

The table below contains a summary of the colors and letters that appear on the state indicator.

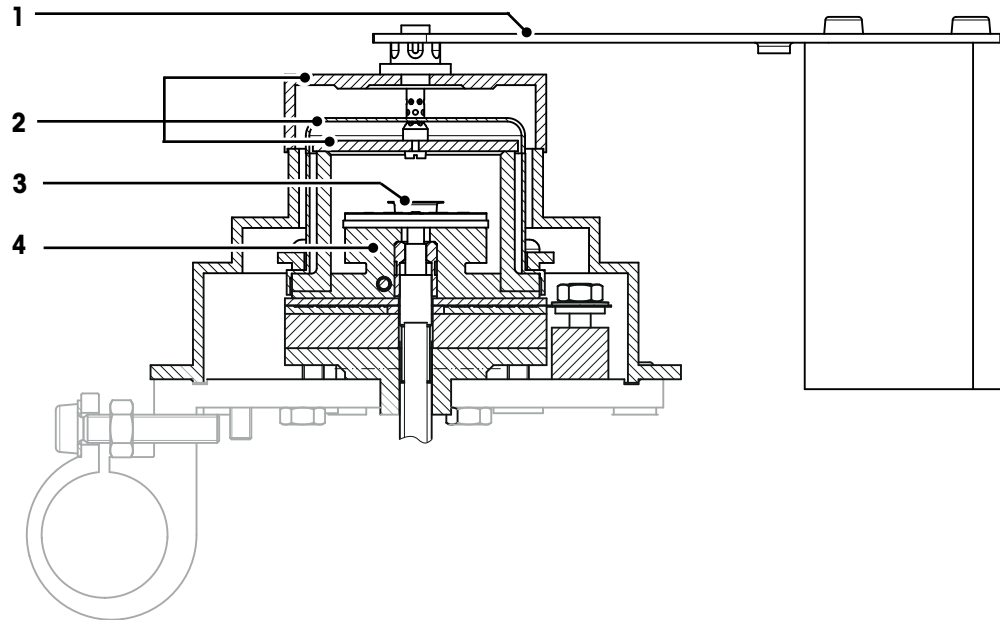
State indicator	Explanation
Red background	Experiment is in <ul style="list-style-type: none"> • settling or • measurement stage.
Green background	Experiment <ul style="list-style-type: none"> • is not yet in settling stage or • measurement is complete.
"A" before measurement	TA module <ul style="list-style-type: none"> • is approaching sample insertion state or • is ready for the sample to be inserted.
"A" after measurement	TA module <ul style="list-style-type: none"> • is approaching sample removal state or • is ready for the sample to be removed.

State indicator	Explanation
"M"	TA module <ul style="list-style-type: none"> • is approaching the start temperature or • is in the settling or measurement stage or • is performing a calibration or an adjustment.
"S"	TA module is maintaining <ul style="list-style-type: none"> • the standby temperature or • the final user temperature.
"OFF"	No experiment is in progress on the TA module and the furnace is in PowerSave mode.

3.8.2 Automatic furnace lid

The Automatic Furnace Lid hardware option allows you to open and close the DSC module measuring cell automatically. The automatic furnace lid is a multiple lid system consisting of three individual lids. The design eliminates any disturbances from outside. It is operated via the **Furnace** button on the SmartSens terminal. This SmartSens terminal hardware option must be installed to operate the automatic furnace lid.

Cross section of the measuring cell with the automatic furnace lid



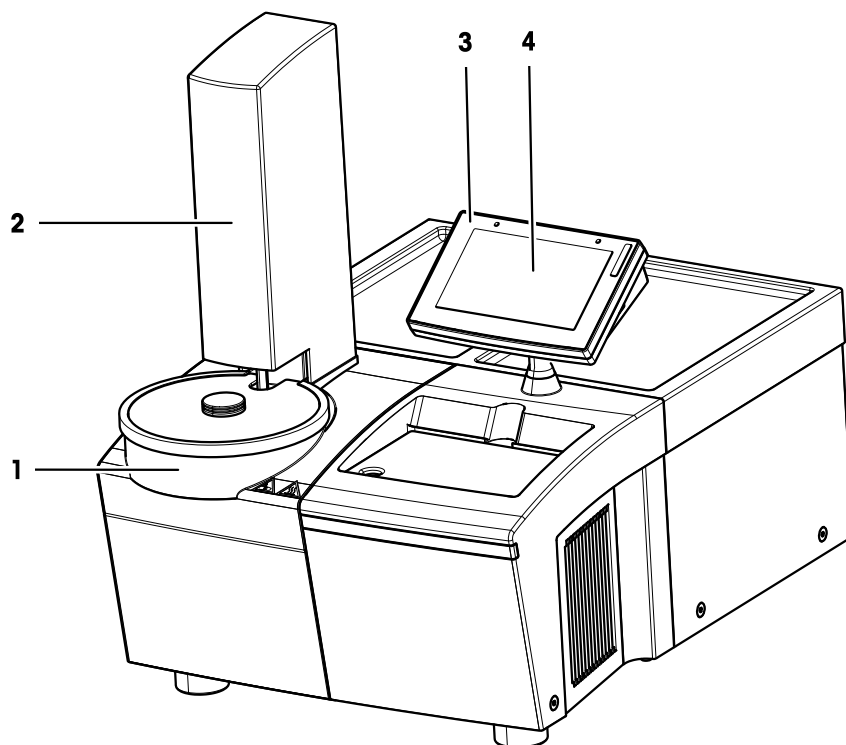
1	Heat protection shield
2	Automatic furnace lid system
3	Crucibles placed on DSC sensor
4	Furnace body

3.8.3 Sample robot

With the Sample Robot hardware option you can automate sample measurements. The sample robot fully automatically places the sample crucible on the turntable and removes it after the measurement. You can run up to 34 samples per turntable. The Sample Robot hardware option requires the Automatic Furnace Lid and SmartSens Terminal hardware options. It can be expanded with the Lid Piercing Kit option.

To install the sample robot, a conversion kit is required. It includes a special left front housing part that is installed with the sample robot.

The sample robot is installed on the left front housing as show below.



The DSC module equipped with the Smartsens Terminal and Sample Robot options

1	Turntable with cover
2	Sample robot
3	SmartSens terminal
4	Touch screen

3.8.4 400 W power amplifier

This hardware option equips the DSC module with a more powerful furnace power supply. This extends the measuring range and increases the maximum heating rate:

- temperature range RT to 700 °C
- maximum heating rate 300 K/min (at 700 °C)

3.8.5 Power switch

This hardware option is used to automatically switch on and off the power for an external device connected to the instrument, for example an intracooler or a bath circulator.



⚠ WARNING

Risk of electrical shock due to wrong installation

An electrical shock can be lethal.

- Never try to install the power switch yourself.
Have the power switch installed by a qualified specialist who is familiar with the local installation regulations.

3.8.6 Peripheral options board

The peripheral options board is an electronic component that needs to be installed in order to use the following feature(s):

- The electromagnetic valve on the liquid nitrogen cooling system can be automatically controlled. The TA module controls the flow of liquid nitrogen to the cooling flange by means of the electromagnetic valve via an electrical connection.
- An external device can be switched on and off automatically to synchronize or trigger it. This is done via an electric cable which is connected to the external device to transmit a binary signal from the TA module.

3.8.7 Hardware options for hyphenated techniques

Your DSC module can be combined with instruments from third party manufacturers to employ so-called hyphenated techniques. Such techniques are DSC-microscopy and DSC-photocalorimetry. The following hardware options are required to use the DSC module for hyphenated techniques:

- Microscopy Kit for DSC: Useful for visually identifying thermal events.
- Photocalorimetry System for DSC: DSC photocalorimetry allows enthalpy changes in a material to be measured during and after exposure to light of certain wavelengths for different periods of time at different temperatures.

3.9 Cooling options

Cooling options allow you to extend the measuring range of the DSC modules to below room temperature.

Cooling option	Low temperature limit
Cryostat Cooling	-50 °C
Liquid Nitrogen Cooling	-150 °C
Intracooler	-100 °C

For further details on cooling options, **see** the section "Cooling Options" in the Reference Manual.

4 Installation and Putting into Operation

The instrument is installed by a METTLER TOLEDO service engineer.

For details, **see** the chapter "Installation and Putting into Operation" in the Reference Manual which can be downloaded here:

www.mt.com/ta-manuals

The Reference Manual includes the following information on installation of your instrument:

- Delivery and parts supplied
- Suitable location for installation
- Minimum requirements for the PC
- Gas supply and connections
- Power supply and network cables
- Installing the DSC module
- Installing the automatic furnace lid
- Installing the intracooler
- Installing the cryostat
- Installing the liquid nitrogen cooling
- Installing the sample robot
- Switching on an off

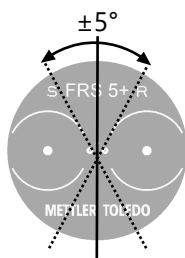
5 Operation

5.1 Preparing the DSC module for experiments

5.1.1 Making general preparations

To avoid inaccurate measurement results or artifacts on DSC curves, the following preparations should be made:

- Ensure that the air vents on the housing are free of dust to allow proper cooling.
- **NOTICE: Risk of damaging the DSC sensor and producing erroneous data. Never try to correct the position of the DSC sensor yourself. Have this done only by a METTLER TOLEDO service engineer.** If your instrument has a FRS 5+ or an HSS 8+ sensor, check that the DSC sensor is centered properly and not twisted. As a rule you can tell that the sensor is not properly positioned if it is twisted more than 5°. Should this be the case, call a METTLER TOLEDO service engineer to center it.



- Ensure that the DSC cell including the furnace and furnace lid are clean and free of any residues. For more information, **see** the chapter "Maintenance" in the Reference Manual.
- Ensure that the correct reference crucible (type) is placed on the right side of the DSC sensor which is labeled "R". **See** [Inserting the reference crucible ▶ Page 36].

Note

We recommend using a crucible with a centering pin.

- Before the measurement, set the purge gas flow rate to the appropriate value. The flow rate for nitrogen or air is typically 50 mL/Min.
- Perform an indium check once a month.
- Condition the measuring cell before the measurement. To do this, run your particular method without inserting a sample.
- If you have installed the Cryostat or Intracooler cooling option, let the cooling device run at least 30 minutes before starting your experiment to stabilize the temperature in the cooling system.
- Take the following measure to protect the DSC sensor from breaking during a measurement in which a strong exothermal reactions will occur:
Insert a sensor protection disk between the DSC sensor and the crucible on both the sample and on the reference side. This will protect the DSC sensor from large temperature gradients resulting from sudden heat release and lessen mechanical stress or shock. **See** the chapter "Accessories and Spare Parts" in the Reference Manual.
- Take the following measures to protect the instrument from being damaged during measurements in which flammable substances are used as samples:
 - Insert a sensor protection disk between the DSC sensor and the crucible as explained above.
 - Use only small quantities of the substances.
 - Use a suitable crucible, for example a high pressure crucible, to prevent any damage.
 - Dilute the flammable substance with an inert substance such as aluminum oxide.

To learn more about the corresponding maintenance tasks, **see** the chapter "Maintenance" in the Reference Manual.

If, despite these measures, measurement accuracy is impaired, please contact your METTLER TOLEDO service engineer.

5.1.2 Inserting the reference crucible

The following procedure applies to a DSC module without sample robot and automatic furnace lid.

- If you are using a sample robot, you have to swing it to the side to insert the reference crucible. **See** the section "Swinging the sample robot to the side" in the Reference Manual.
- With the automatic furnace lid you have to open the lid by pressing the **Furnace** button on the touch screen.
- In general, the reference crucible should be the same type as the sample crucible.
- If possible, you should use a reference crucible with a centering pin, especially if you are using the sample robot. If vibrations occur, a reference crucible without a centering pin could possibly move from the exact reference position.
- It is possible to use other crucible types than those supplied by METTLER TOLEDO. The crucible data for such crucibles must however be entered in the **Pan** tab of the Install Window of the STAR^e Software.



⚠ CAUTION

Risk of hot surfaces.

You can burn yourself by touching parts of the measuring cell, furnace or the crucibles.

- 1 Allow the measuring cell to cool down to room temperature before performing any task on the furnace.
- 2 Never place your fingers on or inside the furnace after an experiment.
- 3 Use tweezers to remove the furnace lid and crucibles.



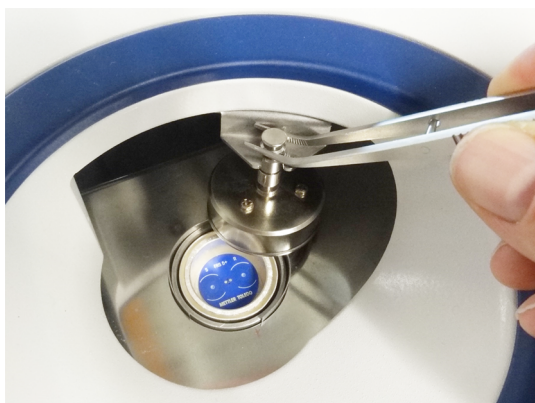
NOTICE

Risk of damage to the DSC sensor from hard objects

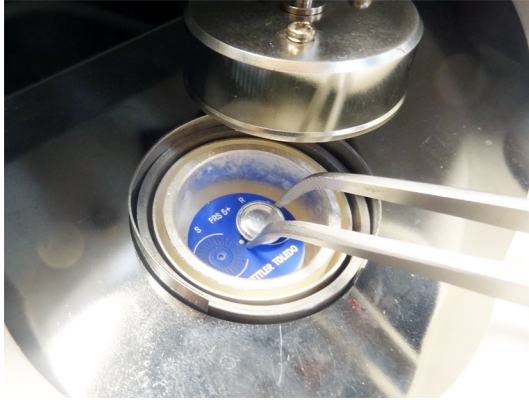
The wires on the surface of the DSC sensor could suffer damage if impacted by hard objects.

- 1 Avoid impacts of the DSC sensor surface with hard objects.
- 2 Do not move the crucibles on the DSC sensor surface.

- No experiment is running.
 - Correct reference crucible is available.
- 1 Remove the furnace lid using tweezers. Deposit it on the furnace lid support.



- 2 Place the reference crucible carefully on the right crucible position of the DSC sensor indicated with "R" (for "reference"). Do not move the crucible on the DSC sensor surface.



- 3 Place the furnace lid back on the furnace using tweezers.

5.1.3 Preparing the sample and sample crucible

The way you prepare a sample and load it into the sample crucible strongly depends on your type of application. There is no general procedure. A number of basic steps are listed below.

- Weigh in the sample by taring the weight of the empty crucible.
- Make sure that there is good contact between the crucible bottom and the sample. This is important to achieve good heat transfer.
- Keep the outer surfaces of the crucibles free from sample residues.
- Use the crucible sealing press to seal the crucible. **See** the chapter "Accessories and Spare Parts" in the Reference Manual.

Additional information about sample preparation can be found in the following document:

METTLER TOLEDO Thermal Analysis in Practice, Collected Applications (order number 51725244)

The following measures will ensure a longer lifetime of your instrument.

Sample preparation	Comment
<ul style="list-style-type: none"> • Do not overfill the crucible with sample material. 	
<ul style="list-style-type: none"> • Do not contaminate the measuring cell with sample material. <ul style="list-style-type: none"> – Use the funnel in the provided crucible handling box to fill in powder samples. – Keep the outer surfaces of the crucible and lid clean. 	<ul style="list-style-type: none"> • See the TA video on DSC sample preparation on www.mt.com for more information.
<ul style="list-style-type: none"> • With foaming samples, limit the sample size so that foam does not spill from the crucible. 	Hot foam can react with the DSC sensor material. After cooling down, foam residues can cause the crucible to stick to the DSC sensor.
<ul style="list-style-type: none"> • Reduce strong exothermic reactions of samples as far as possible. <ul style="list-style-type: none"> – Keep the amount of sample to a minimum. It is usually sufficient to use less than 1 mg of sample. – Dilute the sample with inert material, for example aluminum oxide powder. 	<ul style="list-style-type: none"> – ⚠ CAUTION: Measurements of samples that produce strong exothermic reactions are hazardous and can cause injury or damage. Ensure that such measurements are conducted safely.
<ul style="list-style-type: none"> • Whenever possible use a lid with the crucible and seal it. 	This improves heat transfer and prevents spilling of sample material.
<ul style="list-style-type: none"> • Choose the right crucible for your sample with regard to tightness, volume and material. 	See Chapter 7.3, page 75 in the METTLER TOLEDO handbook "Thermal Analysis in Practice, Collected Applications" (order number 51725244)
<ul style="list-style-type: none"> • Do not exceed the maximum temperature allowed for the crucible material. 	See the METTLER TOLEDO brochure on crucibles (order number 302086809). The table on page 10 contains the column "Max. temperature °C".
<ul style="list-style-type: none"> • Avoid measurements of samples which evolve compounds that can damage the DSC sensor. 	Such compounds can react with the ceramic surface material of the DSC sensor.

Crucible insertion and removal	Comment
<ul style="list-style-type: none"> • Do not move the crucibles on the DSC sensor surface. 	The thermocouple wires can be damaged.
<ul style="list-style-type: none"> • Avoid any impact of hard objects, for example tweezers, on the DSC sensor surface. 	The thermocouple wires can be damaged.
<ul style="list-style-type: none"> • Do not insert crucibles at temperatures higher than 200 °C. 	Insertion at higher temperatures than 200 °C can cause cracks in the DSC sensor and increase thermocouple resistance. This can lead to malfunction.

Cleaning	Comment
<ul style="list-style-type: none"> Heat-clean the DSC sensor from organic residues by heating to the maximum temperature under oxygen. 	Organic residues will be oxidized and decompose to water and carbon dioxide.
<ul style="list-style-type: none"> Clean the DSC sensor carefully with a Q-tip and some cleaning alcohol (isopropanol). 	This will remove dust and improve thermal contact.
<ul style="list-style-type: none"> Do not – under any circumstances - clean the DSC sensor with a glass fiber brush. 	A glass fiber brush will severely damage the thermocouple wires and cause the DSC sensor to malfunction.

See the chapter "Maintenance" in the Reference Manual.

Protection	Comment
<ul style="list-style-type: none"> Use protection disks (MT order number: 26947) between crucible and DSC sensor for measurements of strong exothermic effects. 	This will protect the DSC sensor from cracking due to high temperature gradients between the reference and the sample side.

5.2 Performing an experiment

The way you carry out an experiment depends on the configuration of your DSC module and your type of measurement application. The following instructions are based on the following assumptions:

- DSC module without sample robot, automatic furnace lid and SmartSens terminal
- Typical application, for example measurement of the glass transition of a substance



CAUTION

Risk of hot surfaces.

You can burn yourself by touching parts of the measuring cell, furnace or the crucibles.

- 1 Allow the measuring cell to cool down to room temperature before performing any task on the furnace.
- 2 Never place your fingers on or inside the furnace after an experiment.
- 3 Use tweezers to remove the furnace lid and crucibles.



NOTICE

Risk of inaccurate measurement results or artifacts due to dirty DSC sensor

- Keep the outer surfaces of the crucible and the DSC sensor free of sample residues.



NOTICE

Risk of damage to the DSC sensor from hard objects

The wires on the surface of the DSC sensor could suffer damage if impacted by hard objects.

- 1 Avoid impacts of the DSC sensor surface with hard objects.
- 2 Do not move the crucibles on the DSC sensor surface.



NOTICE

Risk of damaging the housing or breaking the glass cover from contact with hot furnace lid.

- Never place the hot furnace lid on the housing or the glass cover.

- Experiment is set up in the STAR^e Software. See the online Help to the STAR^e Software to see how to do this.
- Communication with the STAR^e Software is established.
- No experiment is running.
- The sample crucible is prepared.
- If necessary, the reference crucible is prepared.
- If a gas supply is connected, the gas flow is set as required.
- Tweezers are available.

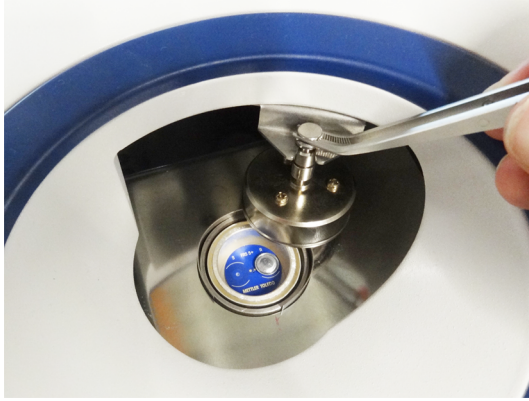
- 1 Send the experiment to the experiment buffer of the Module Control Window.

Note

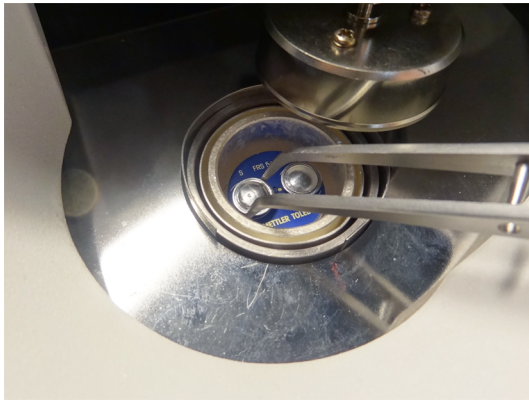
The experiment starts automatically if you have selected **Autostart** in the **Configuration** dialog box in the Module Control Window. See the online Help to the Module Control Window for more information.

- 2 If the experiment does not start automatically, click **Start** in bottom right corner of the Module Control Window.
- 3 Wait until the measuring cell has reached the insertion temperature. If you are using a gas, check the flow rate.

- Remove the furnace lid using tweezers. Deposit it on the furnace lid support.



- If necessary, remove any previous sample or reference crucible. Use tweezers to do this.
- If necessary, place the reference crucible on the right crucible position of the DSC sensor indicated with "R" (for "reference"). Use tweezers to do this. Do not move the crucible on the DSC sensor surface.
- Place the sample crucible carefully on the left crucible position of the DSC sensor indicated with "S" (for "sample"). Use tweezers to do this. Do not move the crucible on the DSC sensor surface.



- Place the furnace lid back on the furnace using tweezers.
- In the Module Control Window of the STAR^e Software, click **OK**.
 - ➔ The DSC module approaches the start temperature, passes through the settling stage and starts the measurement. At the end of the measurement the DSC module approaches the end temperature.
- Wait until the measuring cell has reached the removal temperature.
- Remove the furnace lid using tweezers.
- NOTICE: Damage to instrument housing parts or crucibles. Do not place hot crucibles on instrument housing parts. Do not place alumina crucibles on a cold surface.**
Carefully remove the sample crucible using tweezers. Deposit it on the crucible tray.



- In the Module Control Window of the STAR^e Software, click **OK**.
 - ➔ The experiment is completed. The DSC module approaches the state defined as end behavior. With the default setting the measuring cell approaches the insertion temperature.

5.3 Using the SmartSens terminal

If the SmartSens terminal is installed on your DSC module, you can perform certain operations directly on the instrument.



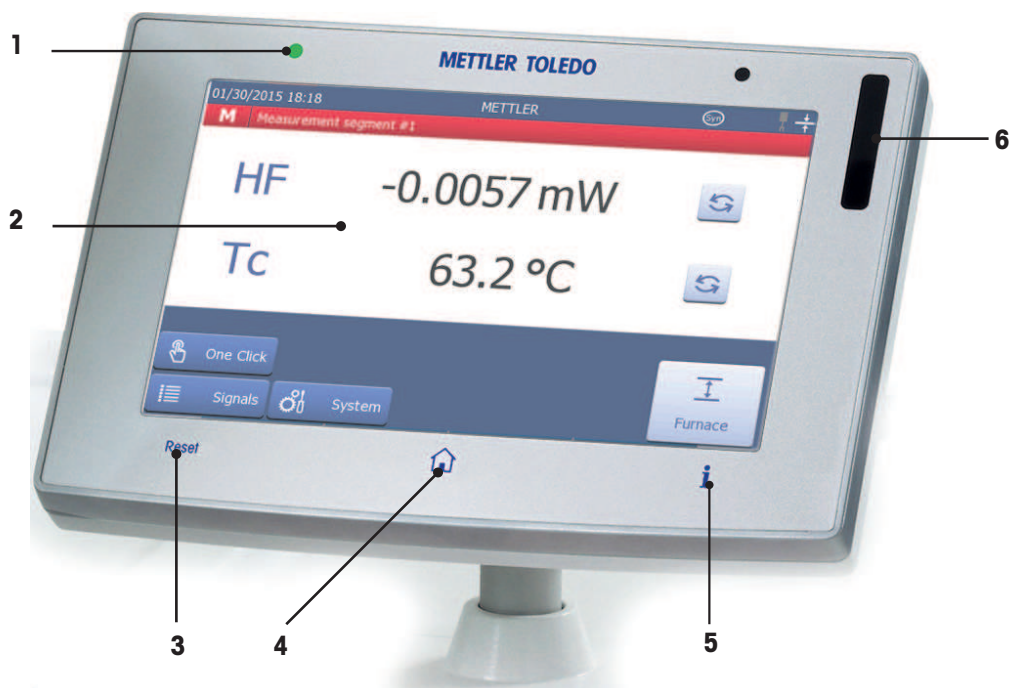
NOTICE

Risk of damage to the touch screen

The touch screen may be damaged by pointed or sharp objects.

- Never use pointed or sharp objects on the touch screen.

5.3.1 Using the keys and the SmartSens sensor



1	Power indicator light
2	Touch screen
3	[Reset] key
4	[Home] key
5	[Experiment] key
6	SmartSens sensor

Resetting an instrument

The [Reset] key has the same function as the **Reset** button in the Module Control Window of the STAR[®] Software.

- Press [Reset].
 - ➔ The instrument is switched to the next lower state:
Ready to Run → Standby
Standby → Power Save
Power Save → Power Save

To terminate an experiment with [Reset], see [Terminating an experiment ▶ Page 43].

Displaying the Home screen

The [Home] key is used to return to the **Home** screen from any point of the user interface.

- Press [Home].

Displaying information on the current experiment

The [**Experiment**] key is used to display information on the current experiment.

- Press [**Experiment**].

Using the SmartSens sensor

The SmartSens sensor is used to open and close the furnace or to scroll the display of measurement values.

- To open or close the furnace, move your hand sideways across the SmartSens sensor.
- To scroll the display of measurement values, hold your hand over the SmartSens sensor.

5.3.2 Confirming an experiment stage

- The furnace is closed.
- The experiment in progress is at one of the following stages:
 - **Waiting for sample insertion**
 - **Waiting for sample removal**
- Tap **Proceed**.
- ➔ The experiment moves to the next stage.

5.3.3 Skipping an experiment stage

Skipping the **Going to start temperature** or **Settling** experiment phases can distort the measurement results. The required thermal effect might not be achieved or the measurement might be inaccurate.

- The experiment in progress is at one of the following stages:
 - **Going to insertion temperature**
 - **Going to start temperature**
 - **Settling**
 - **Going to removal temperature**
- Tap **Skip**.
- ➔ The experiment moves to the next stage.

5.3.4 Terminating an experiment

You can prematurely terminate a running experiment at any stage.

Terminating an experiment while in progress can distort the measurement results. The measurement might be incomplete and the required thermal effect might not be achieved.

- An experiment is in progress on the instrument.
 - 1 Press [**Reset**] on the SmartSens terminal.
 - ➔ A warning is displayed indicating that experiments will not restart automatically following a reset.
 - 2 Tap **Yes** on the touch screen.
- ➔ The experiment is terminated and the instrument switches to **Standby** state. The curve measured up until this point is saved, except if you have switched off the automatic save function.

5.3.5 Switching between standby and power save states

Switching from standby state to power save state

- The TA module is in **standby** state.
- 1 Tap **PowerSave**.
 - ➔ A warning is displayed indicating that experiments will not restart automatically following a change of state on the TA module.
- 2 Tap **Yes**.
 - ➔ The TA module switches to power save state and switches the furnace off. The text **PowerSave** is displayed in the title bar.

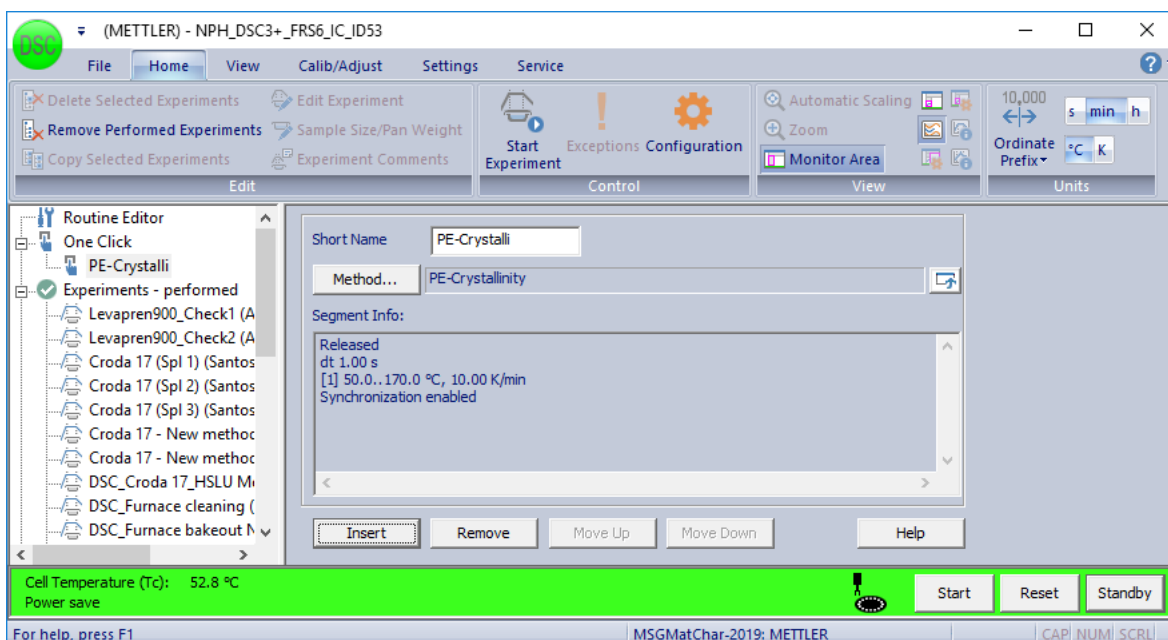
Switch from power save state to standby state

- The TA module is in **power save** state.
- 1 Tap **Standby**.
 - ➔ A warning is displayed indicating that experiments will not restart automatically following a change of state on the TA module.
- 2 Tap **Yes**.
 - ➔ The TA module switches to standby state and switches on the furnace. The text **Standby** is displayed in the title bar.

5.3.6 Starting experiments with One Click™

You can start experiments directly on the touch screen of the TA module by using the One Click™ feature. You have to choose the method you want to use in the experiment first. This is done in the Module Control Window of the **STARe** Software. The One Click™ feature is not available if you are using the **STAR**® Software in the 21 CFR 11 compliance mode.

- Communication is established and the Module Control Window is open.
 - You have created and stored a method in the database.
- 1 In the left pane of the Module Control Window, click **One Click**.
 - ➔ A number of controls to choose a method now appears in the right pane of the Module Control Window.
 - 2 Click **Insert**.
 - ➔ The **Open Method** dialog box opens containing a list of the available methods.
 - 3 If the list of methods is very long, use the filter feature.
Click **Filter**, enter the appropriate filter criteria and confirm with **OK**.
 - ➔ The list now contains only the filtered methods.
 - 4 Select the desired method in the list and click **Open**.
 - ➔ The **Short Name** of the method is now listed under **One Click**. Details of the method are displayed under **Segment Info**.



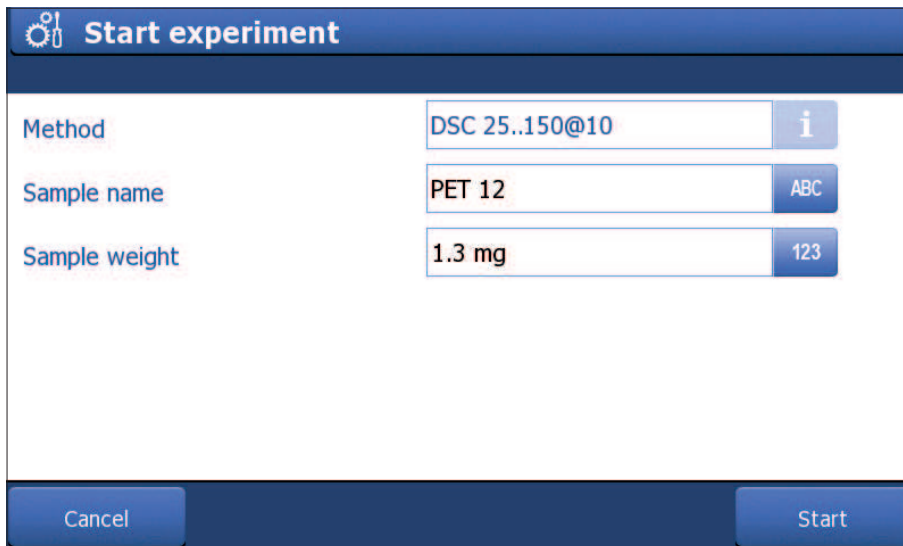
- 5 Change the short name in the **Short Name** box as desired.
The short name is used as the label of the one-click button on the TA module's touch screen and cannot contain more than 12 characters.
- 6 In the Home screen on the TA module's touch screen, tap **One Click**.

➔ The method appears as a one-click button on the touch screen.



7 Tap the one-click button representing the desired method.

➔ The **Start experiment** dialog appears on the touch screen.



8 Enter sample details.

9 Tap **Start**.

➔ The experiment is started on the TA module.

6 Maintenance

For details on maintenance of your instrument, **see** the chapter "Maintenance" in the Reference Manual which can be downloaded here:

www.mt.com/ta-manuals

The Reference Manual includes the following information for maintaining your instrument:

- Calibration and adjustment
- Cleaning the furnace
- Cleaning the sensor
- Centering the DSC sensor
- Replacing the DSC sensor
- Replacing fuses
- Maintaining the automatic furnace lid

7 Troubleshooting

7.1 Error messages and warnings

Error messages indicate a malfunction. There are errors of the "critical" type and errors of the "error" type. Critical errors occur when there is a severe malfunction on the instrument, whereas errors indicate a disturbance that is less severe.

A measurement is always interrupted when an error message occurs. In some cases, the problem can be overcome by the operator. In other cases, a METTLER TOLEDO service engineer must be called.

Warnings inform you about a deviation from the expected behavior. In some cases you can just confirm the warning, but in other situations you must take appropriate action.

Most error messages and warnings have a number code which should be reported to the METTLER TOLEDO service support.

7.2 Standard procedure

The following standard procedure must be followed where indicated in the list below under "Measures".

- 1 Let the instrument cool down or warm up to room temperature.
- 2 Switch off the instrument for at least one minute and then restart it.
- 3 If the problem persists, inform your local service engineer.

7.3 List of error messages and warnings

Some of the message texts listed below contain placeholder symbols such as %1 or %2. These symbols are replaced by the appropriate text when the message occurs.

7.3.1 Critical errors

Where indicated below, follow the standard procedure under [Standard procedure ► Page 48].

Code	Message text	Measures
9	The electromagnetic LN2 valve was not detected. Please check if the connector is plugged in.	<ol style="list-style-type: none">1 Check if the cable of the electromagnetic liquid nitrogen valve is connected properly.2 If the problem persists, inform your local service engineer.
13	The furnace temperature does not follow the heater input power as expected.	Follow the standard procedure.
16	The furnace sensor temperature is too low.	Follow the standard procedure.
18	A problem with the internal power supply has occurred. Disconnect the instrument from the power outlet and connect it again.	<ol style="list-style-type: none">1 Disconnect the instrument from the power outlet and connect it again.2 If the problem persists, inform your local service engineer.
25	The %1 device driver could not be opened.	Follow the standard procedure.
26	A read or write error with the instrument database occurred.	Follow the standard procedure.
29	The cooler temperature is too low.	Follow the standard procedure.
30	The %1 sensor reading is outside the permissible limits or the sensor is not installed or defective. No analyses can be conducted.	Follow the standard procedure.
31	The furnace sensor temperature is too high.	Follow the standard procedure.
36	The cooler sensor temperature is too high.	Follow the standard procedure.
42	The software watchdog was triggered.	Follow the standard procedure.

Code	Message text	Measures
44	An error occurred while writing data to the EEPROM on the mainboard.	Follow the standard procedure.
45	An error occurred while reading data from the EEPROM on the mainboard. Restart the instrument.	Follow the standard procedure.
63	The furnace power amplifier parameters are incorrect.	Follow the standard procedure.
74	A furnace power amplifier failure occurred.	Follow the standard procedure.
81	Timeout occurred during opening or closing of the furnace.	<ol style="list-style-type: none"> 1 Check if something is obstructing the furnace. 2 Check the furnace position. 3 If the problem persists, inform your local service engineer.
89	An error occurred with the AUX Power connection. Disconnect the connected device and restart the instrument.	<ol style="list-style-type: none"> 1 Disconnect the device connected to the external power switch. 2 Restart the instrument. 3 If the problem persists, inform your local service engineer.
97	Sample robot hardware error %1	Follow the standard procedure.
98	Sample robot software error	Follow the standard procedure.
99	An internal software error occurred.	Follow the standard procedure.

7.3.2 Errors

Code	Message text	Measures
5	The sample robot is not adjusted.	Follow the standard procedure.
6	SmartSens was deactivated because it detected too much light. Activate SmartSens again under "System>Setup>Global Settings".	<ol style="list-style-type: none"> 1 Activate SmartSens again by navigating to System>Setup>Global settings and selecting SmartSense activated . 2 If the problem persists, inform your local service engineer.
48	The experiment cannot be started.	<p>This occurs if an experiment has already been started, but cannot be processed due to a communication error.</p> <ol style="list-style-type: none"> 1 Switch off the instrument for at least one minute and then restart it. 2 Deactivate the connection to the instrument in the Connections tab in the Install Window of the STAR[®] Software. 3 Activate the connection again and start the experiment on the instrument. 4 If the problem persists, inform your local service engineer.
62	The gas controller is defective.	Follow the standard procedure.

7.3.3 Errors without code

Code	Message text	Measures
-	IP address %1 cannot be saved.	Follow the standard procedure.

Code	Message text	Measures
-	The instrument database is being updated. Please wait.	– Wait until the instrument database update has completed.
-	The instrument database is corrupt.	Follow the standard procedure.
-	A record could not be saved because it has no name.	Follow the standard procedure.

7.3.4 Warnings

Code	Message text	Measures
17	The instrument cannot proceed to the next experiment stages or cannot reach the set temperature within the specified time. The experiment will stop.	<ol style="list-style-type: none"> 1 Check whether the temperature specified in the experiment is in the permissible range. 2 Correct the temperature program if necessary. 3 Switch off the instrument for at least one minute and then restart it. 4 Repeat the experiment. If the problem persists, inform your local service engineer.
53	Communication with a gas controller failed.	Follow the standard procedure.
54	The cell gas flow is out of tolerance	<ol style="list-style-type: none"> 1 Check if sufficient gas is provided by the gas supply. 2 Check if the gas connections are tight. 3 Check the gas tubing for kinks, blockages or other obstructions of the gas flow. 4 Switch off the instrument for at least one minute and then restart it. 5 Activate the connection to the instrument in the Connections tab in the Install Window of the STAR^e Software. 6 If the problem persists, inform your local service engineer. The gas controller may be defective.
55	The purge gas flow is out of tolerance.	<ol style="list-style-type: none"> 1 Proceed as with warning 54. 2 Restart your experiment on the instrument. 3 If the problem persists, inform your local service engineer. The gas controller may be defective.
59	The typification of an electronics board ID is incorrect. You can continue to use the instrument.	<ol style="list-style-type: none"> 1 Inform your local service engineer and report the error number code and the problem. 2 Continue your work. If the problem persists, inform your local service engineer.
61	The gas controller configured on this TA module is not correct.	Follow the standard procedure.

7.3.5 Warnings without code

Code	Message text	Measures
-	The self test was successful.	<ol style="list-style-type: none"> 1 Confirm warning message. 2 Continue your work.
-	The method gas flow is out of tolerance.	Check the gas supply.

8 Technical Data

The technical specifications for the instrument can be found in the Reference Manual which can be downloaded here: www.mt.com/ta-manuals

9 Accessories and Spare Parts

A list of accessories and spare parts as well as ordering information can be found in the Reference Manual, which can be downloaded here:

www.mt.com/ta-manuals

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Im Langacher 44
8606 Greifensee, Switzerland
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