User Manual

Thermal Analysis Excellence

TGA/DSC 3+, TGA 2

METTLER TOLEDO

Table of Contents

1 Introduction

Thank you for purchasing this innovative METTLER TOLEDO instrument.

The TGA/DSC 3+ and the TGA 2 are analytical instruments for thermogravimetric analysis (TGA). They are part of the METTLER TOLEDO STARe 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 TGA/DSC 3+ and the TGA 2. These product names are only used where necessary. Where appropriate, the term "TGA module" is used for convenience and refers to all three 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

STARe Software

The TGA/DSC 3+ and the TGA 2 can only be operated in conjunction with the STARe 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 STARe Software to operate the TGA/DSC 3+ and the TGA 2.

References to the STARe Software are included in certain parts of this document.

Instrument software

This user manual refers to instruments running version 3.20 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.

- Gas Controller
- Sample Robot
- Power Switch
- Peripheral Option Board
- Hardware options for hyphenated techniques
  - TGA-MS
  - TGA-FTIR
  - TGA Sorption Analysis
  - TGA-FTIR/MS Support

- TGA-GC/MS System
- TGA-Vacuum Analysis

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-etraining
- 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 explosion

Heavy load

Risk of poisoning

Risk of injury

2.2 Instrument-specific safety notes

2.2.1 Intended use

The TGA/DSC 3+ and TGA 2 are intended for performing thermogravimetric analysis.

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 hot surfaces.

You can burn yourself by touching parts of the furnace, outlet tube or the crucibles.

1 Allow the measuring cell to cool down to room temperature before performing any task on the furnace or outlet tube.
2 Never touch the hot furnace, outlet tube or crucible you have just removed from the furnace.
3 Use tweezers to remove the crucibles.

⚠ 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 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 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 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 from toxic or corrosive coolant agents.

The coolant agent tubes could slip off from their connections.

– Use tube clamps to secure the coolant agent tubes on their connections.

⚠ CAUTION

Risk of injury when furnace closes.

Your fingers could get caught in the furnace.

– Keep your fingers away from the furnace when it is closing.

⚠ 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.

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 only fuses of the type specified in the reference manual.

2 Do not place any magnetic objects on or near the TGA module. This can cause disturbances of balance and affect the accuracy of the measured weight value.

3 Always purge the balance with an inert gas. Chemical reactions of the substance could form reactive gases which would damage the balance.

4 Do not exert excessive pressure on the crucible holder or bend it to a different position. The balance and the thermocouple under the crucible holder could be damaged.

5 Use the instrument only indoors in a well-ventilated area, at altitudes of less than 3000 m above sea level.

6 Do not open the furnace if the cell temperature is above 500 °C. This would cause a thermal shock to parts inside the furnace, in particular to the reflector disks. The parts could be damaged.

7 When using chemicals and solvents, comply with the instructions of the manufacturer and the general lab safety rules.

8 Avoid the following environmental influences:
- Vibrations
- Drafts
- 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

9 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.

NOTICE

Risk of reducing the lifetime of the furnace heating element during measurements at high temperatures.

1 Do not exceed a temperature of 1500 °C except for calibration purposes.

2 Do not use heating rates higher than 20 K/min above 1200 °C.

3 At temperatures above 1400 °C, do not use heating rates of less than 5 K/min or isothermal segments.

NOTICE

Risk of overpressure in furnace chamber.

Overpressure in the furnace chamber can cause damage to the instrument.

– Do not let overpressure build up in the furnace chamber.

2.2.5 Explosion limits of gases

⚠ 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.

Some gases can form explosive mixtures with oxygen. This must be taken into account when using gases in the TGA furnace. The following table summarizes the explosion limits of some of the most commonly used gases.

Gas	Explosion limits* in volume %	Corrosive	Flammable	Toxic
Ammonia	15 - 28	x	x	x
Argon	–	–	–	–
Carbon dioxide	–	–	–	–
Ethylene	2.7 - 34	–	x	–
Helium	–	–	–	–
Hydrogen	4.0 - 75.6	–	x	–
Nitrogen	–	–	–	–
Oxygen	–	–	–	–
Propylene	2 - 11.7	–	x	–

***Explosion limits** = lower and upper concentration limits of a flammable gas in a mixture with air or another gas containing oxygen between which the gas-air mixture can explode due to heat or sparks. These limits depend on the temperature and pressure and are given here for initial conditions of 0.1 MPa and 20 °C. (Source: MERCK catalog 1990/91)

2.2.6 Platinum poisons

At high temperatures, metallic substances in the sample can act as platinum poisons damage the crucible holder by forming an alloy with the platinum. This has a lower eutectic melting temperature, which can lead to destruction of the crucible holder.

The following metallic substances are platinum poisons and attack platinum:

- carbon
- phosphorus
- boron
- arsenic
- silicon
- antimony
- bismuth
- lead
- tin

To protect the platinum-rhodium disk of the crucible holder during measurements with metallic samples, we recommend the use of an alumina crucible.

2.3 Information on bath circulator

⚠ 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.

⚠ 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.

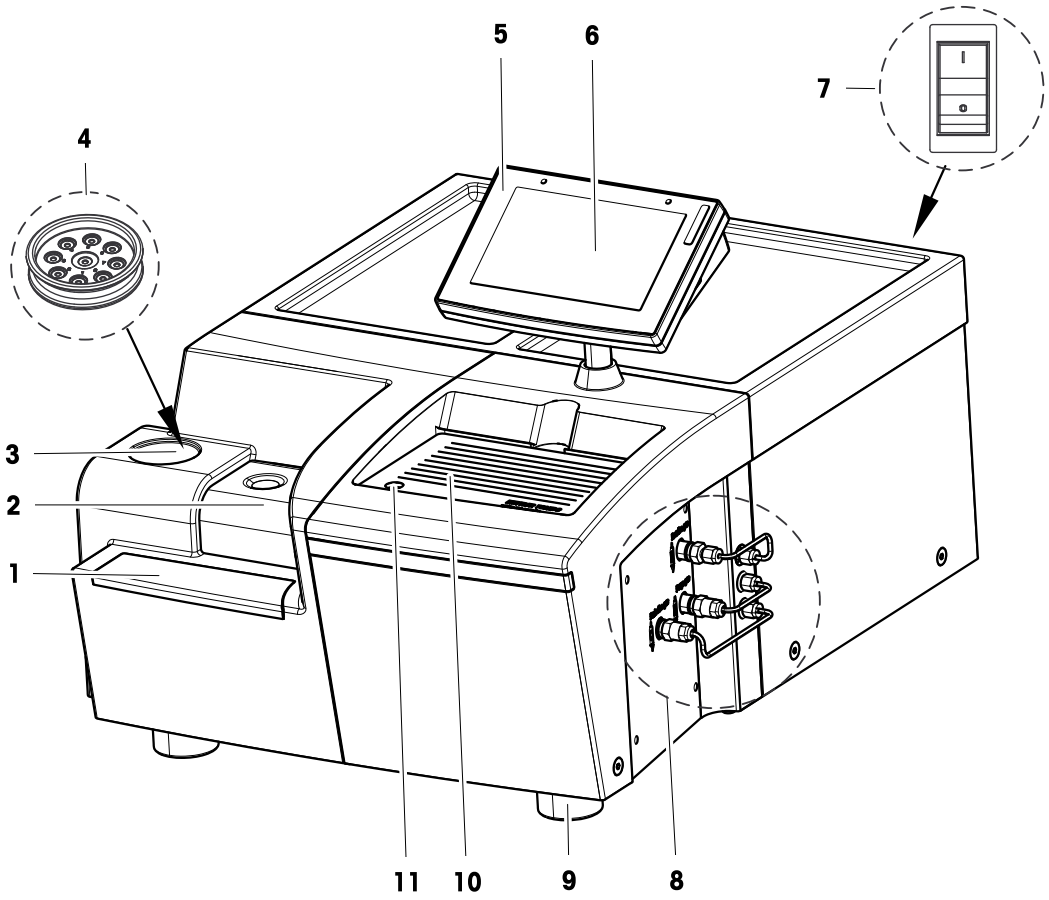
This symbol warns that exposed surfaces of the furnace can be hot or cold to the touch and can cause a skin burn.

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

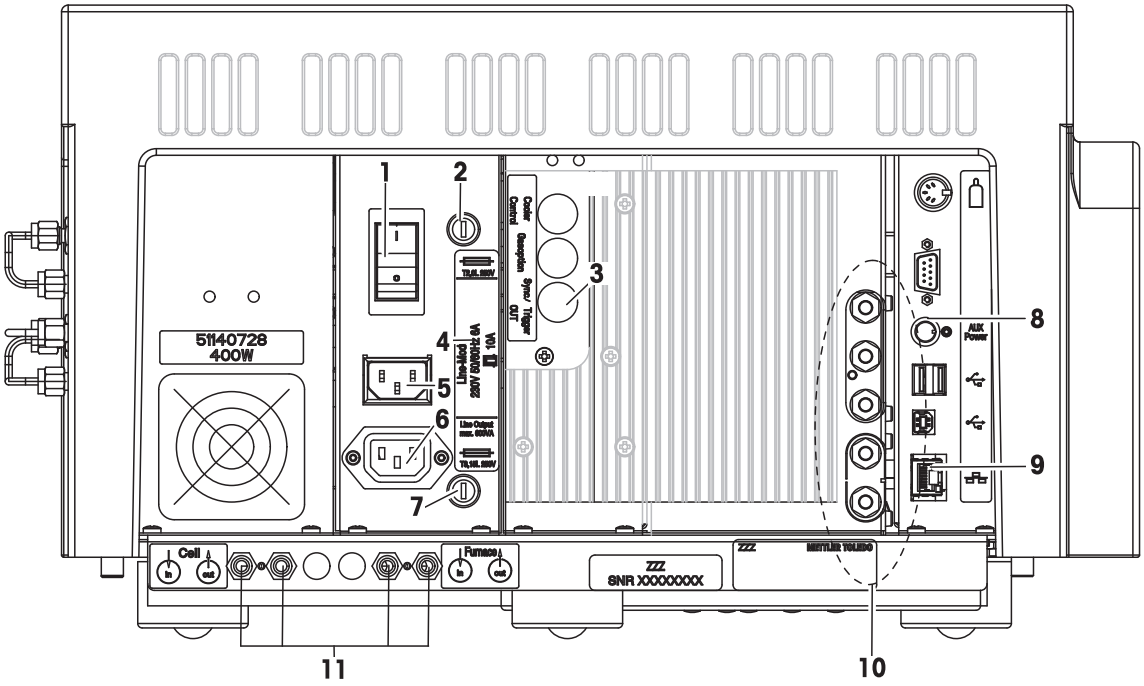
3.1 Overview of the TGA module

The figure below shows the basic configuration of the instrument.



1	Hand rest
2	Furnace opening
3	Surface for crucible tray
4	Crucible tray
5	SmartSens terminal
6	Touch screen
7	Main power switch
8	Gas connections
9	Screw feet
10	Glass cover with note paper underneath
11	Bubble level

3.2 Connections on the rear panel

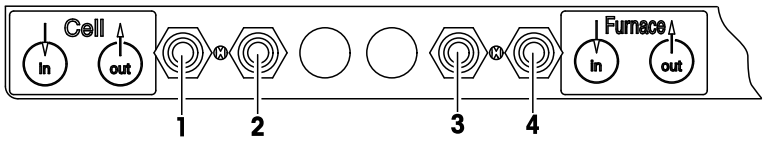


1	Main power switch
2	Fuse for electronics supply
3	Connection for triggering and synchronization external devices
4	Rating plate
5	Power supply inlet socket
6	Line output socket
7	Fuse for line output socket
8	Connection for Power Switch option
9	Ethernet connection
10	Gas connections
11	Coolant connections

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 the bath circulator.
- The instrument is connected via the Ethernet connection to the S**TA**R^{e} Software PC.

Coolant connections



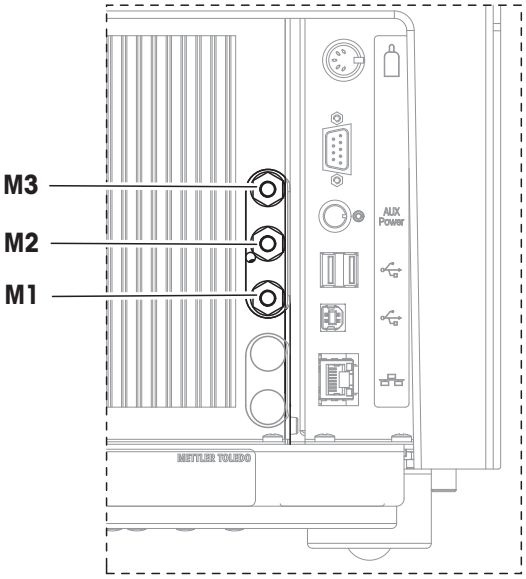
1	Balance cooling circuit inlet
2	Balance cooling circuit outlet
3	Furnace cooling circuit inlet
4	Furnace cooling circuit outlet

3.3 Gas connections

The use of the connections at the rear depends on the type of gas controller is installed. This can be a GC 301 or a GC 401. **See** also [Built-in gas controller ▸ Page 16].

GC 301

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



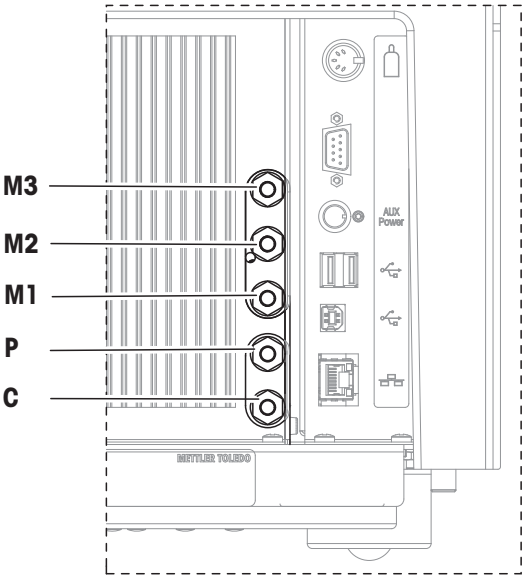
M1, **M2** and **M3** are the connections for method gases which can be used as reactive or purge gases. These gases are introduced close to the sample.

The connections for the purge gas and the protective gas are on the right side of the instrument and are labeled "Purge gas" and "Protective gas". See figure below.

The purge gas fills the furnace chamber and purges it. The protective gas is used to protect the balance.

GC 401

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



- **M1**, **M2** and **M3** are the connections for method gases which can be used as reactive or purge gases. These gases are introduced close to the sample.
- **P** is the connection for the purge gas that fills the furnace chamber and purges it.
- **C** is the connection for the cell gas which is used as protective gas for the balance.

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3.4 Built-in gas controller

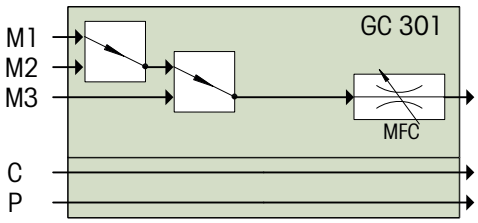
3.4.1 Gas controller types

The gas controller specified in your order is built into your TGA module. Two versions of gas controller are available: GC 301 and GC 401.

Gas controller type	TGA/DSC 3+	TGA 2
GC 301	standard	standard
GC 401	optional	optional

The mass flow controllers in both 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. Please see the schematics below that show the functional principle of each type of gas controller:

GC 301

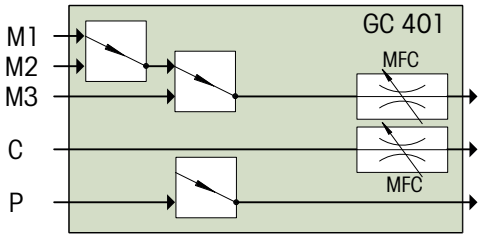


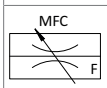
M1, M2, M3	Method gases used as reactive or purge gases
C	Cell gas used as protective gas for the balance
P	Purge gas
	Valve
	Mass flow controller

The GC 301 has two valves by which method gas M1, M2 or M3 is selected. On the rear side of the TGA module there are three connection for method gases, connections M1, M2 and M3. The mass flow of the method gas is controlled by a mass flow controller (MFC).

The cell gas and purge gas are connected on the right side of the instrument. **See** [Gas connections ▸ Page 14].

GC 401

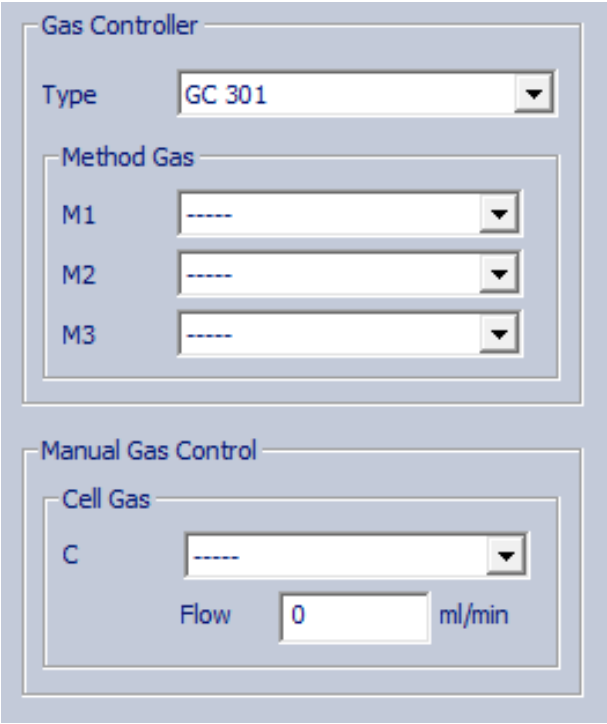


M1, M2, M3	Method gases used as reactive or purge gases
C	Cell gas used as protective gas for the balance
P	Purge gas
	Valve
	Mass flow controller

The GC 401 has two valves by which method gas M1, M2 or M3 is selected. On the rear side of the TGA module there are three connections for method gases, connections M1, M2 and M3. The cell gas is connected to connection C and the purge gas to connection P. The mass flow of the method gas and the cell gas is controlled by mass flow controllers (MFC). The purge gas flow can be switched on and off by a valve. There is a setting in the Method Window of the STARe Software is used for this. **See** the online Help to the Method Window for more information.

Gas controller settings in the Install Window of 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 STARe Software:



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 STARe Software.

Please consult the following topics in the online Help to STARe 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, CO_2
- Inert Hydrogen (4% Hydrogen, H2; 96% Argon, Ar)
- Nitrogen, N_2
- Oxygen, O_2
- 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 Cooling device

You must connect the TGA module to a cooling device to provide cooling of the furnace and the balance. The cooling of the furnace is part of the cell temperature control loop. The water cooling and high-precision heaters in the balance housing are used to control the balance temperature to guarantee a constant weight signal.

The balance should be operated at **22 °C** because it was adjusted at this temperature in the factory. The temperature difference to the bath temperature must be sufficient so that ambient temperature fluctuations can be compensated for. The bath temperature of the cooling device must therefore be set to **18 °C**.

3.6 Measuring cell and furnace types

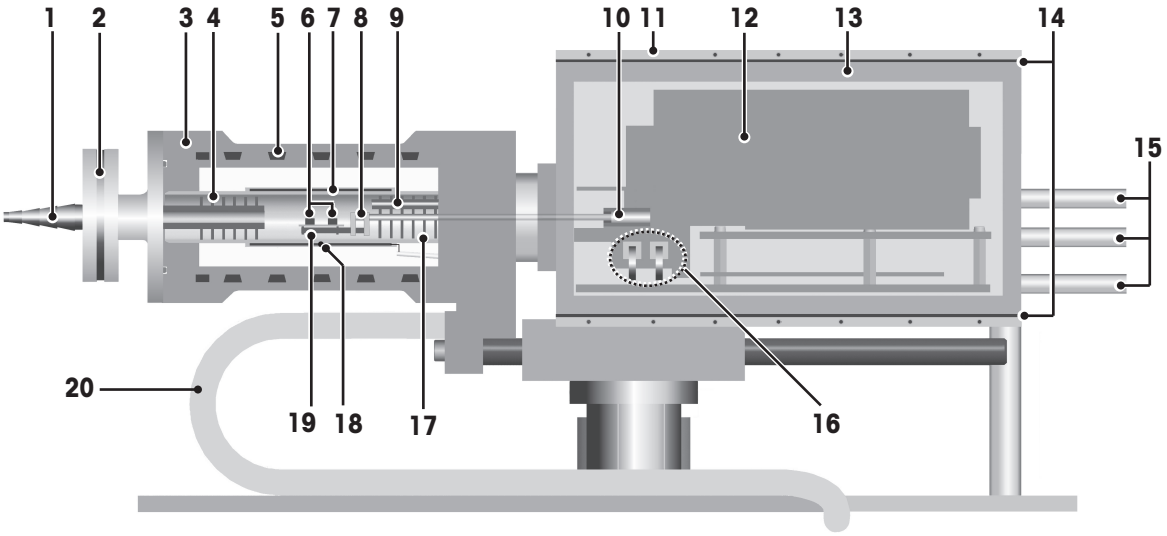
The TGA/DSC 3+ and TGA 2 measuring cells can be equipped with the following types of furnace.

Small furnace	SF
Large furnace	LF
High temperature furnace	HT

The following furnaces can be installed on each TGA module:

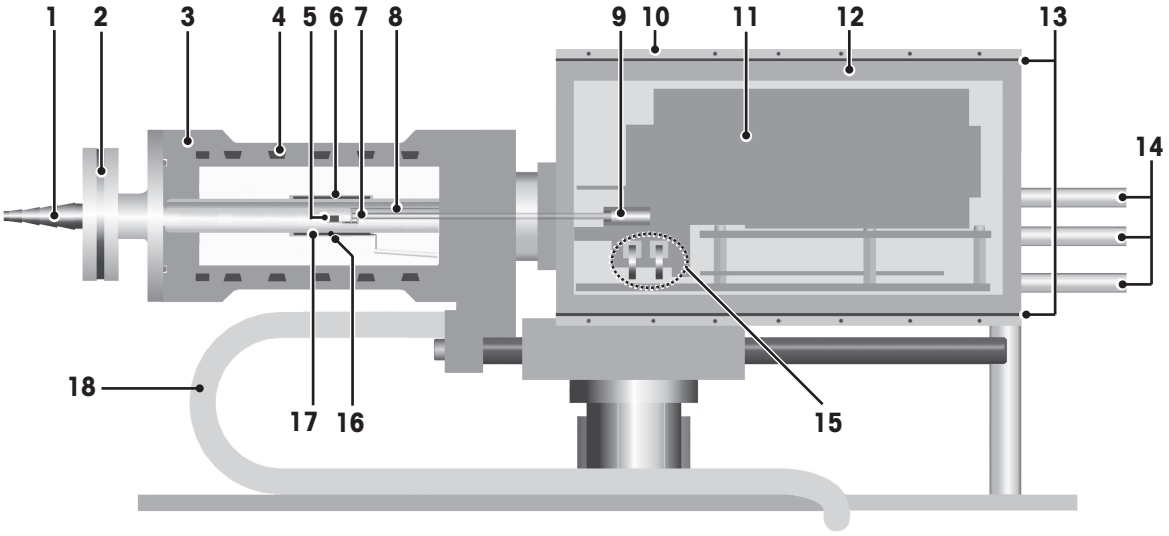
TGA module	SF	LF	HT
TGA/DSC 3+	x	x	x
TGA 2	x	x	-

All furnaces types in the TGA measuring cell have a horizontal design as shown in the following sections of the TGA measuring cell.



Section of TGA measuring cell with large furnace (LF) or high temperature furnace (HT)

1	Outlet tube fitting	**11**	Balance housing water cooling
2	Outlet clamp	**12**	Balance
3	Furnace	**13**	Balance housing
4	Reflector disks	**14**	Balance housing heating
5	Bifilar winding cooling duct	**15**	Gas connections
6	Sample and reference crucibles	**16**	Internal calibration weights
7	Furnace heating element	**17**	Reflector disks
8	TGA sensor	**18**	Cell temperature thermocouple
9	Reactive gas tube	**19**	Crucible holder with sample thermocouple
10	TGA sensor coupling mechanism	**20**	Water cooling tube



Section of TGA measuring cell with small furnace (SF)

1	Outlet tube fitting	**9**	Balance housing water cooling
2	Outlet clamp	**11**	Balance
3	Furnace	**12**	Balance housing
4	Bifilar winding cooling duct	**13**	Balance housing heating
5	Sample crucible	**14**	Gas connections
6	Furnace heating element	**15**	Internal calibration weights
7	TGA sensor	**16**	Cell temperature thermocouple
8	Reactive gas tube	**17**	Crucible holder with sample thermocouple
9	TGA sensor coupling mechanism	**18**	Water cooling tube

The internal diameter and volume of the furnace tube depends on the furnace type:

Furnace type	Diameter	Volume
Small furnace (SF)	12 mm	16 mL
Large furnace (LF)	20 mm	47 mL
High temperature furnace (HT)	20 mm	47 mL

The furnace is gastight. However, this does not absolve you from the responsibility of performing your own tests with the TGA to check its suitability for your methods and purposes.

3.7 TGA sensors

There are various different types of TGA sensor. The TGA sensor installed depends on the module, the type of furnace and the measurement requirements. The sensors that can be used on a particular furnace type are interchangeable.

The TGA sensor is connected to the balance and does not move when the furnace opens.

Note

- The TGA sensor should only be exchanged if it is damaged.
- After installing a different type of TGA sensor on your module, the instrument must be adjusted. We recommend that you call a METTLER TOLEDO service engineer to do this. Wrong adjustment of the module can lead to inaccurate or erroneous measurement results.

3.7.1 Sensors types

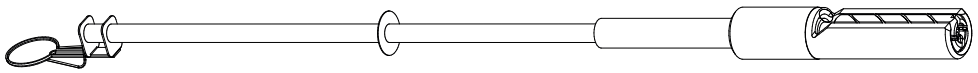
The TGA sensors all consist of a crucible holder, a ceramic support tube and a coupling.

The crucible holder attached to the end of the TGA sensor bears the sample and reference crucibles and, depending on the type, also acts as a weighing pan.

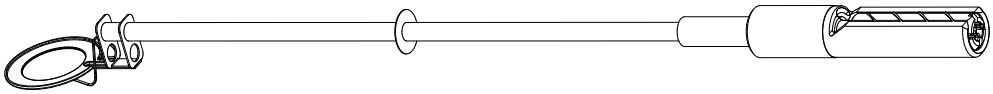
The ceramic support tube on the TGA sensors for the TGA/DSC 3+ encloses the thermocouple wires and bears the load of the crucible holder attached to its end. The mechanical coupling attached to the other end of the support tube engages in a socket inside the balance, thus connecting the TGA sensor to the balance mechanism. It thereby also establishes the electric connections for the thermocouples. The thermocouple wires that make contact inside the balance are visible on the flat upper side of the coupling.

The small reflector disk on the TGA sensor protects the balance from becoming warm through thermal radiation.

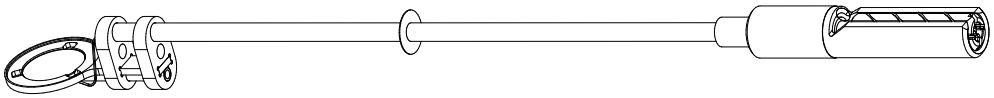
3.7.1.1 Sensors in the TGA/DSC 3+



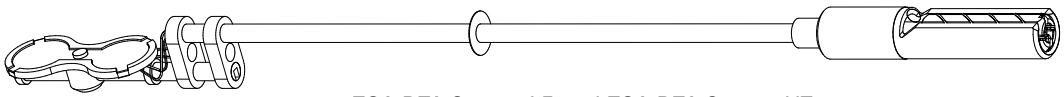
TGA SDTA Sensor SF



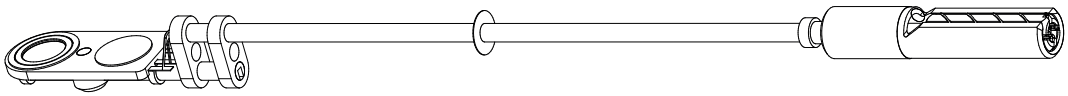
TGA SDTA Sensor LF



TGA SDTA Sensor HT

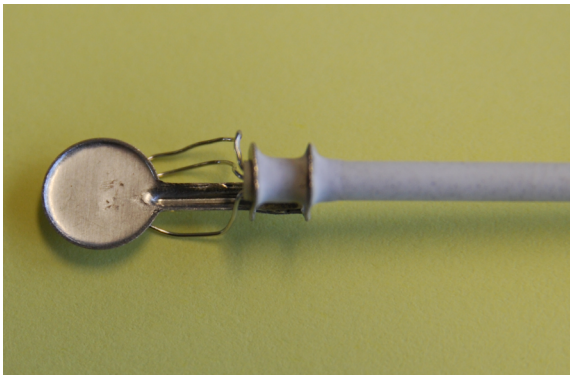


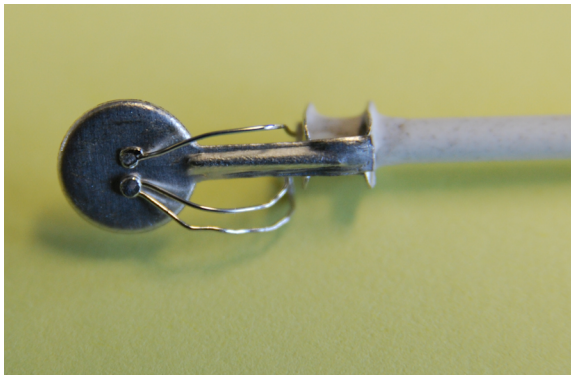
TGA DTA Sensor LF and TGA DTA Sensor HT



TGA DSC Sensor LF and TGA DSC Sensor HT

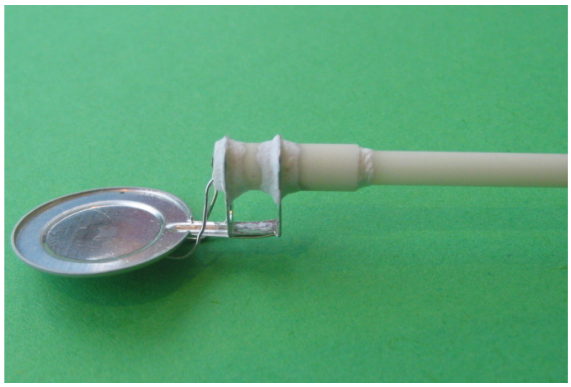
TGA SDTA Sensor SF

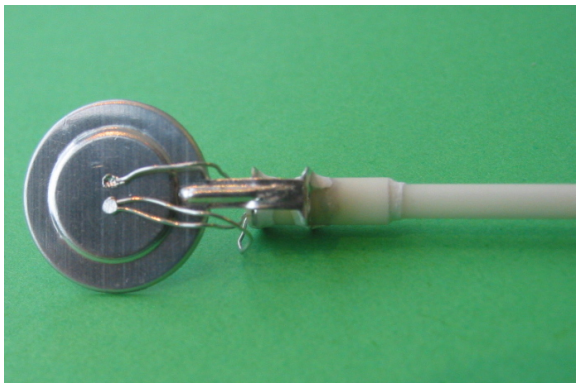




The crucible holder of the TGA SDTA Sensor SF consists of a platinum-rhodium disk. An R-type thermocouple is placed directly under the crucible holder and guarantees that the temperature is measured very close to the sample.

TGA SDTA Sensor LF

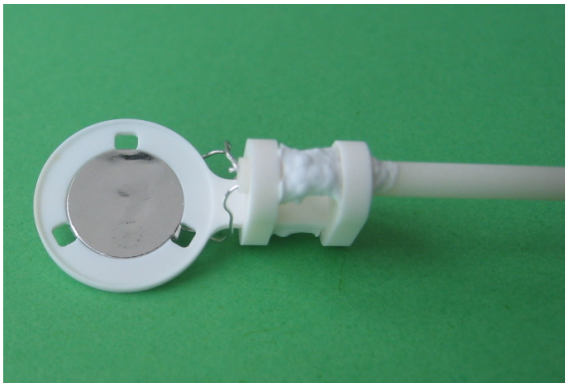


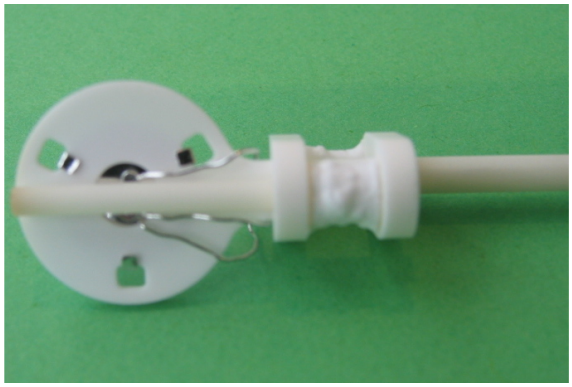


The crucible holder of the TGA SDTA Sensor LF consists of a platinum-rhodium disk, similar to that on the TGA SDTA Sensor SF, but larger in diameter and with a slight recess in which to place the crucibles.

The sample temperature sensor is the same as on the small furnace (i.e. an R-type thermocouple, see above) and is likewise placed directly under the crucible holder.

TGA SDTA Sensor HT

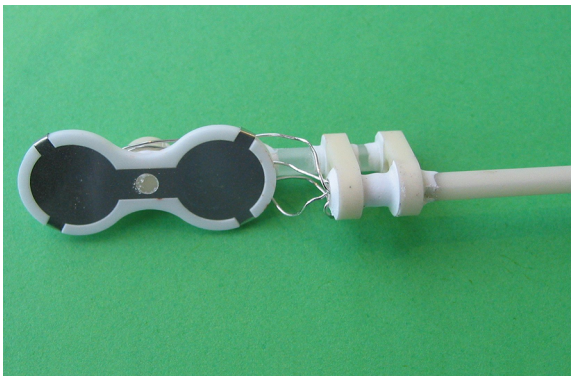


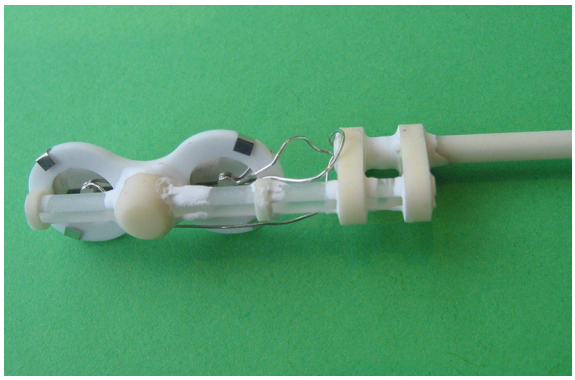


The crucible holder of the TGA SDTA Sensor HT consists of an alumina ring and a platinum-rhodium disk. The platinum-rhodium disk is fitted into the alumina ring.

The sample temperature sensor is the same as on the small furnace (i.e. an R-type thermocouple, see above) and is likewise placed directly under the crucible holder.

TGA DTA Sensor LF and TGA DTA Sensor HT

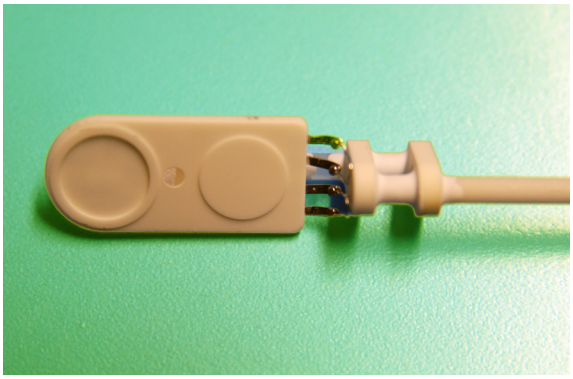


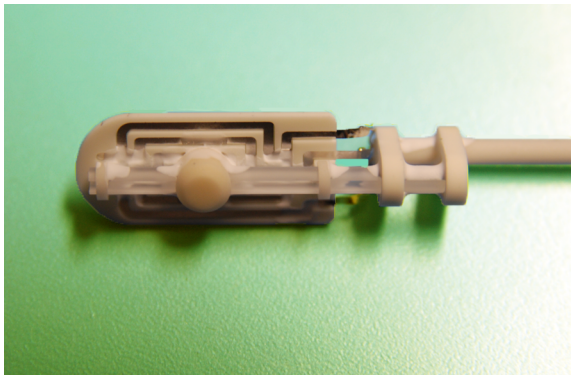


The TGA DTA Sensor LF and the TGA DTA Sensor HT feature a twin crucible holder. This consists of a twin platinum-rhodium disk which is fitted into an alumina frame. The sample crucible is placed on the right disk and the reference crucible on the left disk. An R-type thermocouple measures the temperature difference between the sample and reference side, thus producing a DTA signal. An additional R-type thermocouple positioned under the reference side disk measures the reference temperature.

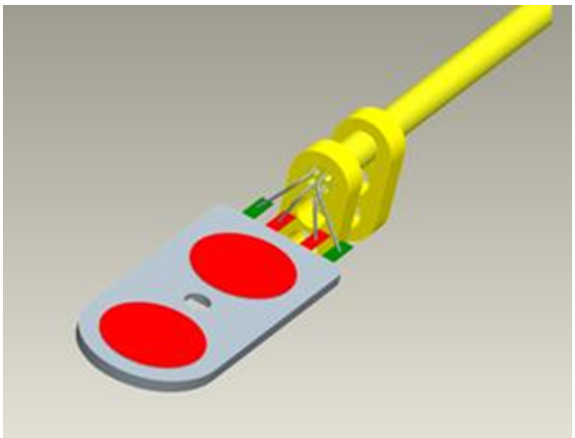
The TGA DTA Sensor HT is the high temperature version of this sensor type. It is made of high-temperature resistant materials and is suitable for the HT furnace.

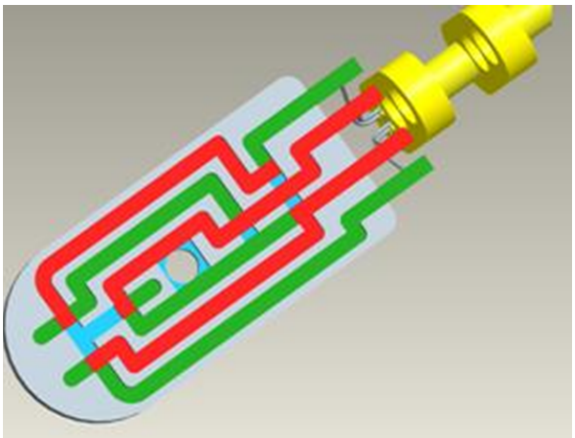
TGA DSC Sensor LF and TGA DSC Sensor HT





Similar to the TGA DTA Sensor LF and TGA DTA Sensor HT, the TGA DSC Sensor LF and TGA DSC Sensor HT also feature a twin crucible holder. The sample crucible is placed on the right side and the reference crucible on the left side.
The TGA DSC Sensor HT is the high temperature version of this sensor type. It is made of high-temperature resistant materials and is suitable for the HT furnace.

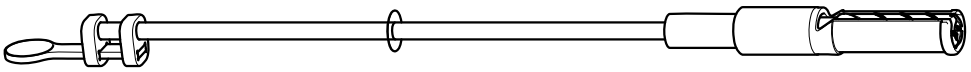




The electrical circuit, which is visible on the underside of the crucible holder, includes six R-type thermocouples. The hot and cold ends of the thermocouples are arranged on the sample and the reference side in different positions so that a DSC signal is measured.

3.7.1.2 Sensors in the TGA 2

Small furnace (SF)

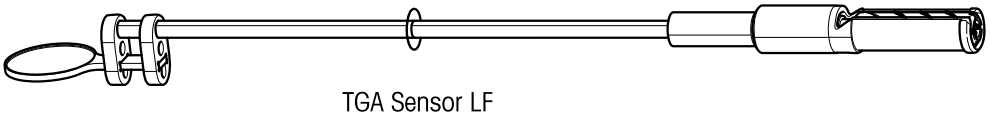


TGA Sensor SF

The TGA Sensor SF is the only type of TGA sensor available for this furnace type.

The crucible holder consists of a ceramic disk.

Large furnace (LF)



TGA Sensor LF

The TGA Sensor LF is the only type of TGA sensor available for this furnace type.

The crucible holder consists of a ceramic disk similar to that on the TGA Sensor SF, but larger in diameter.

3.7.2 Sensor and furnace types

The following tables show which sensors can be installed in the different furnaces.

TGA/DSC 3+	SF	LF	HT
TGA SDTA Sensor SF	x	-	-
TGA SDTA Sensor LF	-	x	-
TGA SDTA Sensor HT	-	-	x
TGA DTA Sensor LF	-	x	
TGA DTA Sensor HT	-	x	x
TGA DSC Sensor LF	-	x	
TGA DSC Sensor HT	-	x	x

TGA 2	SF	LF
TGA Sensor SF	x	
TGA Sensor LF		x

3.7.3 Sensor and crucibles types

The following tables show which crucibles can be used on the different sensors.

TGA/DSC 3+	≤ 70 µL	100 µL	150 µL	300 µL	600 µL	900 µL
TGA SDTA Sensor SF	x	x	-	-		-
TGA SDTA Sensor LF	x	x	x	x	x	x
TGA SDTA Sensor HT	x	x	x	x	x	x
TGA DTA Sensor LF	x	x	x	x	-	-
TGA DTA Sensor HT	x	x	x	x	-	-
TGA DSC Sensor LF	x	x	x	x	-	-
TGA DSC Sensor HT	x	x	x	x	-	-

TGA 2	≤ 70 µL	100 µL	150 µL	300 µL	600 µL	900 µL
TGA Sensor SF	x	x	-	-	-	-
TGA Sensor LF	x	x	x	x	x	x

3.8 Balance

The weight of the sample is measured by the internal METTLER TOLEDO microbalance. The accuracy of the weight signal depends on the type of balance installed. The measuring range and resolution of types of the METTLER TOLEDO microbalance that can be installed in the TGA/DSC and TGA are listed below.

Balance	Measuring range	Resolution
XP1	1 g	1 µg
XP5	5 g	1 µg
XP1U	1 g	0.1 µg
XP5U	5 g	0.1 µg

It is essential to control the temperature of the balance to ensure good reproducibility of the weight signal. A temperature-controlled bath circulator is required to thermostat the balance.

For more information, **see** the section "Bath circulator" in the chapter "Installation" of the Reference Manual.

NOTICE

Formation of reactive gases

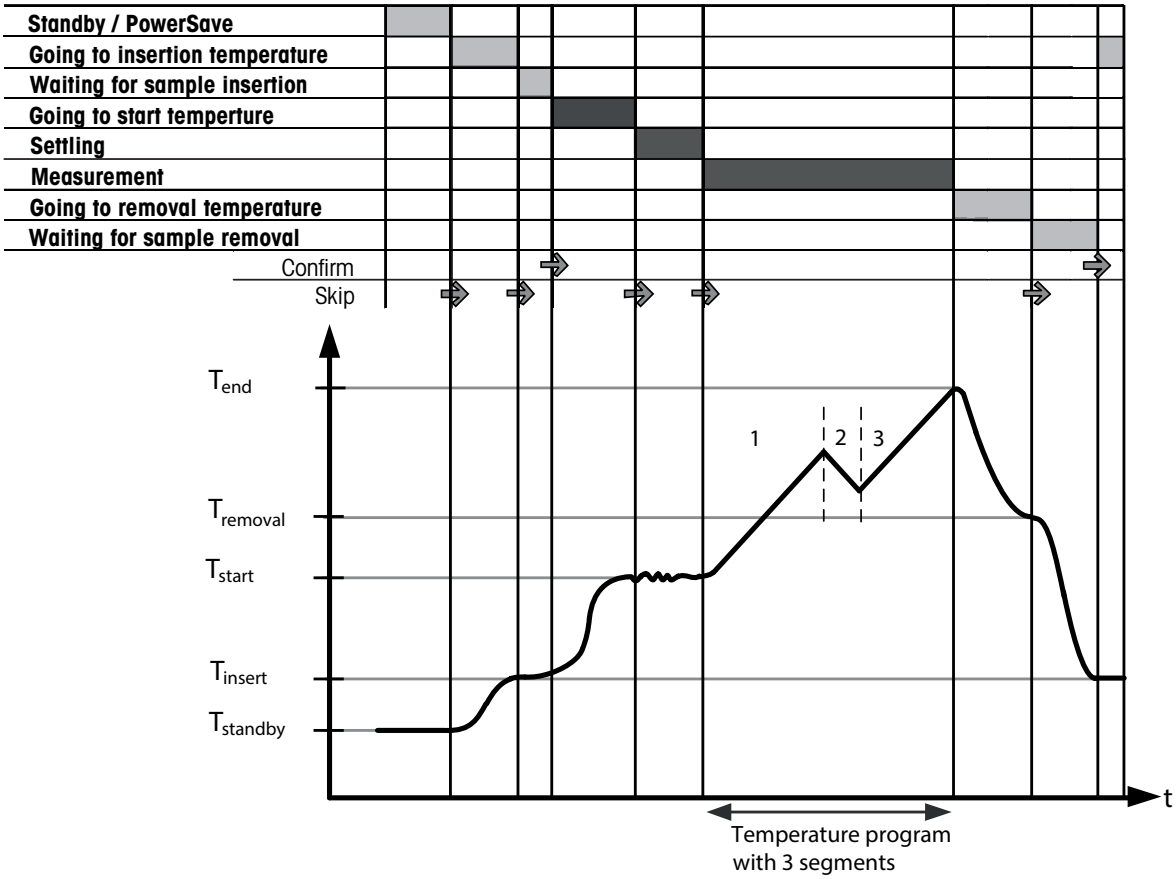
Sample decomposition often leads to the formation of reactive gases that can damage the balance.

– Always purge the balance with a protective gas.

The balance must be constantly purged with a protective gas, e.g. nitrogen, argon or air. We recommend the use nitrogen at a flow rate of 20 mL/min. Before you perform the first measurement, you must purge the balance at least overnight. We also recommend that you purge the balance with protective gas even during breaks, e.g. over the weekend. Otherwise, you will have to purge the balance again overnight before you can perform measurements with the highest accuracy.

3.9 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 STARe Software.

** Is defined in the method.

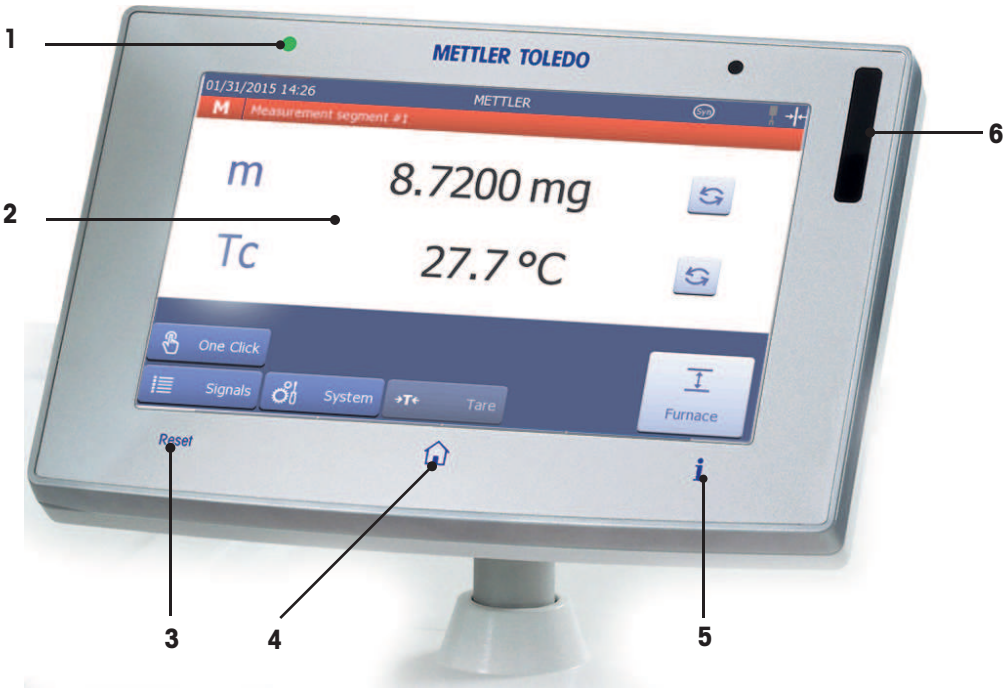
The following table gives an overview of the experiment stages and colors of the operating state indicator.

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 • **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

3.10 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.

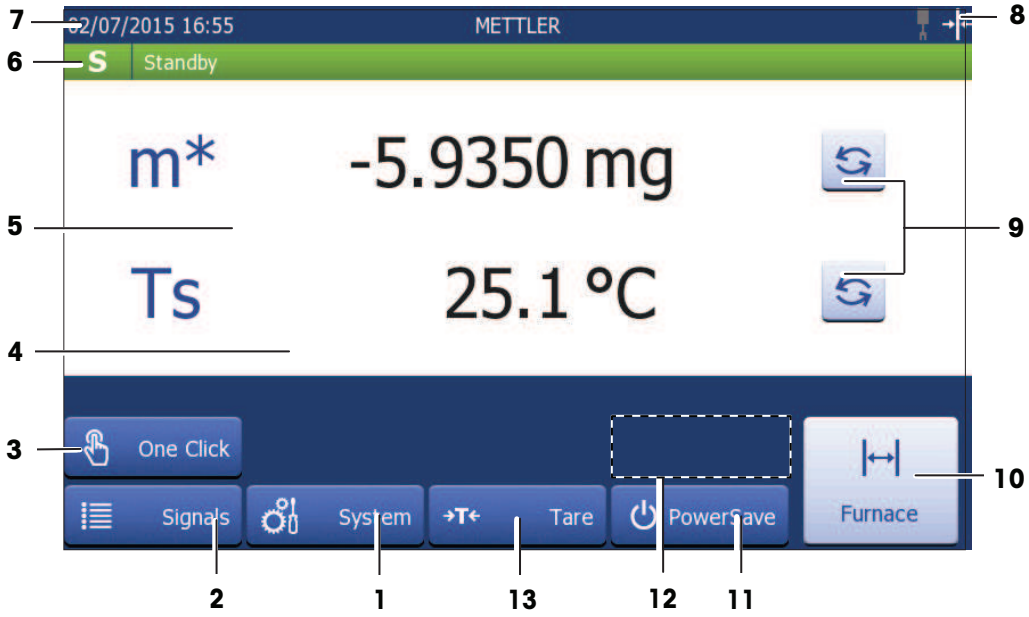
3.10.1 Overview of the SmartSens terminal



	Name	Explanation
1	Power indicator light	• Is on when instrument is switched on. • Flashes when screen saver is on or touch screen is switched off.
2	Touch screen	• 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	• Opens and closes the furnace. • Scrolls through the display of measurement values.

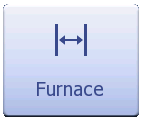
3.10.2 The touch screen

The Home screen on the touch screen is shown below.



Items on the touch screen

	Button	Name	Explanation
1	System	**System** button	Accesses the **System** dialog from where you can perform the following tasks: • 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	S Standby	State indicator	Indicates the state of the measuring cell and the stages of an experiment. **See** [State indicator and experiment stages ▸ Page 33]
7		Title bar	Displays the following: • Date and time • STARe 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.		
13		**Tare** button	This button is used to tare the sample crucible weight and manually weigh in the sample using the internal balance.

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	Indicates whether the furnace is open or closed.
 	Sample robot	• 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 STARe Software and a peripheral device has been established.
	Trigger connection	A trigger connection between the STARe 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

3.10.3 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 • settling or • measurement stage.
Green background	Experiment • is not yet in settling stage or • measurement is complete.
"A" before measurement	TA module • is approaching sample insertion state or • is ready for the sample to be inserted.
"A" after measurement	TA module • is approaching sample removal state or • is ready for the sample to be removed.

State indicator	Explanation
"M"	TA module • 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 • 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.

3.11 Hardware options

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

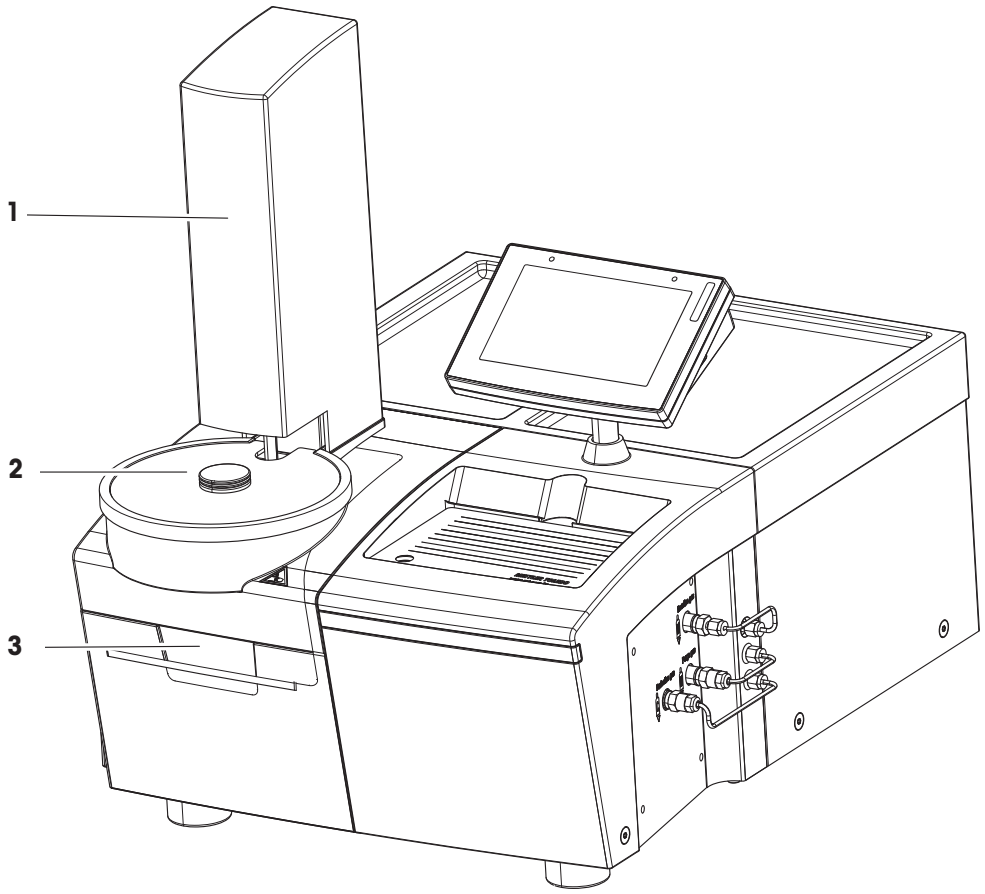
For ordering information, **see** the chapter "Accessories and Spare Parts" in the Reference Manual..

3.11.1 Sample robot

With the Sample Robot option you can automate sample measurements. It 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 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 and features a window through which the furnace can be observed (see figure below). When the furnace is open, the TGA sensor is visible.

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



1	Sample robot
2	Turntable with cover
3	Window

3.11.2 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.

3.11.3 Peripheral options board

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

- 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.

3.11.4 Hardware options for hyphenated techniques

Your TGA module can be combined with instruments from third party manufacturers to employ so-called hyphenated techniques. Such hyphenated or combined techniques are for example TGA combined with mass spectrometry or TGA combined with sorption analysis. The following hardware options are required to use the TGA module for hyphenated techniques:

The following hardware options are required to operate the TGA module with an additional external device from a third party manufacturer:

TGA-MS interface for the small or large furnace

The TGA with the small or large furnace can be connected online to a mass spectrometer using the TGA-MS interface.

TGA-FTIR interface for the small or large furnace

The TGA with the small or large furnace can be connected online to an FTIR spectrometer using the TGA-FTIR interface.

TGA sorption interface for the large furnace

The TGA with the large furnace can easily be converted to a TGA sorption analyzer using the TGA sorption interface.

TGA-FTIR/MS support for the small or large furnace

The TGA with the small or large furnace can be connected online to an FTIR spectrometer and mass spectrometer (serial connection) using the TGA-FTIR-MS interfaces.

TGA-vacuum analysis support for the small or large furnace

The TGA with the small or large furnace can be connected to a vacuum pump to carry out measurements under vacuum.

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
- Power supply and network cables
- Setting up and preparing the module for experiments
- Gas supply and connections
- Installing the cooling device
- Installing the Sample Robot
- Switching on an off

5 Operation

5.1 Using the SmartSens terminal

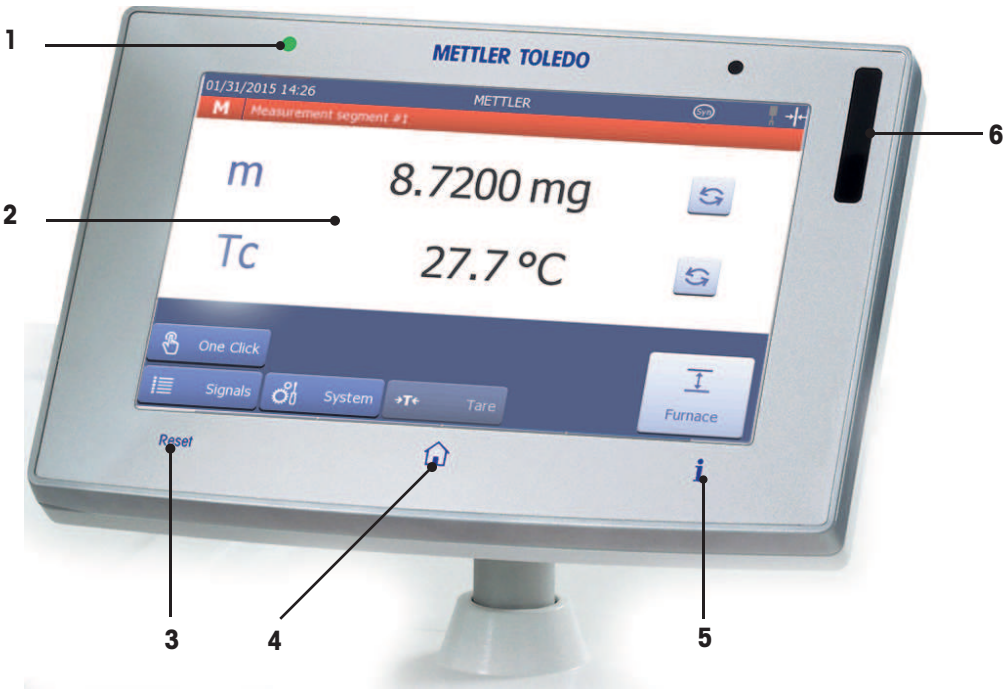
NOTICE

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.

5.1.1 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 STARe 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 39].

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.

5.1.2 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.

5.1.3 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.

5.1.4 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.

5.1.5 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.

5.1.6 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 STARe 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.

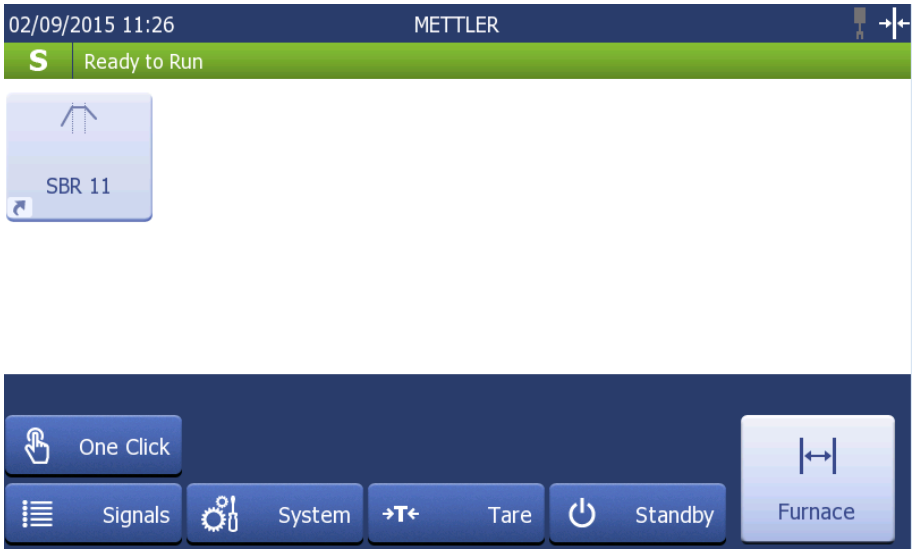
2 Click **Insert**.
   ➡ The **Open Method** dialog box opens containing a list of the available methods.

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**.

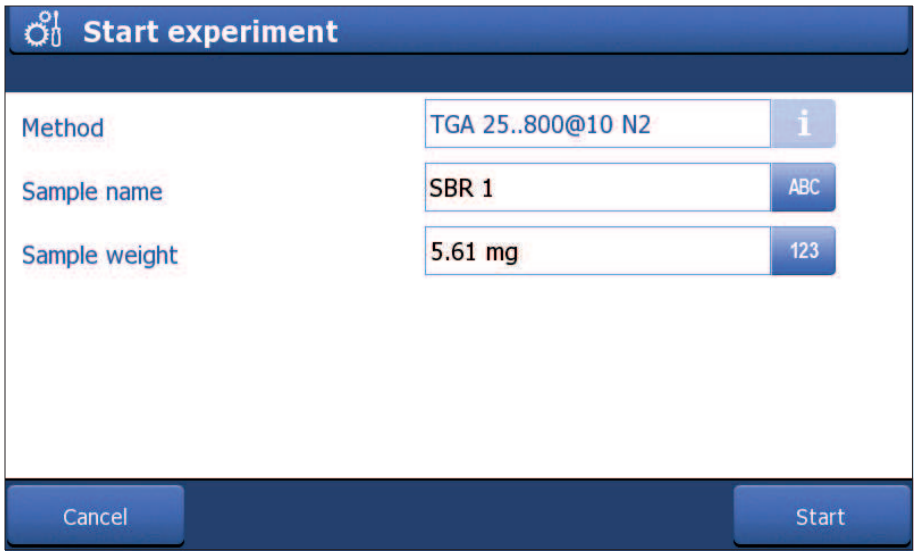
5 Change the short name in the **Short Name** box as desired.
The short name is used as the label of the one-click button on the TA module's touch screen and must not contain more than 12 characters.

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.

5.1.7 Taring the sample crucible weight

The **Tare** button is used to tare the sample crucible weight and manually weigh in the sample using the internal balance. **See** chapter "Weighing In" in the Reference Manual to see how do this.

5.2 Preparing the TGA module for experiments

5.2.1 General hints on performing experiments

- Install your TGA module on a stone or marble table to isolate it from vibrations. If such a table is not available, use a different sturdy table.
- If the table has drawers, avoid using them during the experiments to avoid noise or artifacts.
- Avoid touching the instrument during experiments to avoid noise or artifacts.
- Allow the instrument to cool down to room temperature before weighing samples with the internal balance.
- Run a blank curve with each type and size of crucible that will be used in your experiments.
- When inserting a sample crucible manually, gently place it on the sensor.
- During isothermal experiments, avoid large changes of room temperature.
- Do not place the TGA module near an air conditioner.
- Let the bath circulator run overnight before you start your first measurement. This will allow the TGA measuring cell to reach constant temperature.
- Take the following measures to protect the instrument from being damaged during measurements in which flammable substances are used as samples:
  - Insert a sapphire disk between the crucible holder and the crucible.
  - Use only small quantities of the substances.
  - Use a suitable crucible to prevent any damage.
  - Dilute the inflammable substance with an inert substance.

5.2.2 Hints on sample preparation

- Do not fill up the crucible to the maximum height.
- Do not allow any sample to stick to the outside of the crucible.
- For unknown samples, use a smaller sample amount to begin with, for example 2 to 5 mg. Remember, "Smaller samples make smaller messes". In addition, place a sapphire disc between the crucible and sensor to prevent sticking.
- If your sample foams, use a lid to help prevent overflow and contamination of the sensor.

5.2.3 Hints on using crucibles

- Be sure to know the melting temperature of the crucible you are using. This is especially important if you are using an aluminum crucible. Aluminum crucibles will melt above 660 °C and destroy the TGA sensor.
- Always use the same type of crucible for the sample and reference crucible.
- Properly clean reusable crucibles types before reusing them. Reusable crucible types are, for example, alumina or platinum crucibles.
- Be aware that metal samples can melt through an alumina crucible and contaminate the TGA sensor.
- Take note of the following information when using platinum crucibles:
  Above 1000 °C, platinum crucibles will stick to a platinum sensor. To avoid this, place a sapphire disk between the crucible and sensor.
  Carbon will react with platinum and shorten the life of the crucible.
  Platinum can form alloys with metals which can potentially destroy the pan and sensor.
- Take note of the following information when using sapphire crucibles:
  Because they are less porous than alumina pans, they are useful for melting metals such as iron or nickel.
  Platinum can form alloys with metals which can potentially destroy the crucible and TGA sensor.

For a list of all available crucibles please visit our website and download the brochure **Crucibles for thermal analysis** here: http://www.mt.com/ta-crucibles

5.2.4 Hints on using gases

- Remember to turn on the purge or reactive gases at least one hour before the actual measurement.
- Make sure that the protective gas that flows through the balance is flowing continuously at a rate of at least 20 mL/min.
- If the protective gas was turned off, allow 24 hours for the balance to stabilize after turning the protective gas back on.
- Use nitrogen, air or argon as the protective gas. Use the driest gases available, preferably 99.999% or better to minimize moisture in the gas.
- Set the flow of the reactive or purge gas to approximately 50 mL/min.
- If "dirty" decomposition products are created, use a purge gas in addition to a reactive gas.
- Remember to specify the value for the gas type and flow rate in the method.

5.3 Performing an experiment

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

- TGA module without sample robot
- 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 furnace, outlet tube or the crucibles.

1 Allow the measuring cell to cool down to room temperature before performing any task on the furnace or outlet tube.

2 Never touch the hot furnace, outlet tube or crucible you have just removed from the furnace.

3 Use tweezers to remove the crucibles.

NOTICE

Risk of cracks in alumina crucibles and crucible holder of the TGA sensor due to abrupt cooling

– Let the alumina crucible cool off before depositing it on any surface.

- Experiment is set up in the STARe Software. See the online Help to the STARe Software to see how to do this.
- Communication with the STARe Software is established.
- No experiment is running.
- Sample has been weighed in.
- 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.

4 Tap **Furnace** on the SmartSens terminal to open the furnace.

5 If applicable, place the reference crucible carefully on the left side of the TGA sensor using tweezers.

6 Place the sample crucible carefully on the TGA sensor using tweezers.

7 Tap **Furnace** on the SmartSens terminal to close the furnace.

8 Tap **Proceed** on the SmartSens terminal.

➡ The TGA module approaches the start temperature, passes through the settling stage and starts the measurement. At the end of the measurement the TGA module approaches the end temperature.

9 Wait until the measuring cell has reached the removal temperature.

10 Tap **Furnace** on the SmartSens terminal to open the furnace.

11 **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.

12 Tap **Furnace** on the SmartSens terminal.

➡ The experiment is completed. The TGA module approaches the state defined as end behavior. With the default setting the measuring cell approaches the insertion temperature.

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:

- General care for your system
- Calibration and adjustment
- Adjustment of the balance
- Replacing fuses
- Removing a blockage in the cooling circuit
- Cleaning the furnace by heating it out
- Reversing thermocouple poisoning
- Removing crucibles from the furnace chamber
- Removing crucibles sticking to the sensor
- Correcting a bent TGA sensor
- Replacing the TGA sensor

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
15	**The sample sensor temperature is too high.**	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.**	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.
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.

Code	Message text	Measures
56	**The TGA balance is not responding.**	Follow the standard procedure.
58	**The TGA balance is not responding.**	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.**	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.**	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.
116	**The humidity generator cannot be configured for operation with this instrument**	Follow the standard procedure.
120	**An unexpected response was received from the humidity generator (protocol error).**	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".**	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.**	This occurs if an experiment has already been started, but cannot be processed due to a communication error. 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 S**TA**R^{e} 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.
110	**The humidity generator is not connected.**	1 Check if the humidity generator is connected properly. 2 If the problem persists, inform your local service engineer.

Code	Message text	Measures
111	**A communication error with the humidity generator occurred.**	1 Check if the humidity generator is connected properly. 2 If the problem persists, inform your local service engineer.
114	**A pump failure was detected on the humidity generator.**	Follow the standard procedure.
115	**The humidity generator has stopped unexpectedly.**	Follow the standard procedure.
117	**The humidity set value was not accepted on the humidity generator.**	Follow the standard procedure.
118	**The set gas flow value for the humidity generator is out of range.**	Follow the standard procedure.
119	**The sample temperature value received by the humidity generator is out of range.**	Follow the standard procedure.
123	**The balance detected a load on the crucible holder.**	1 Confirm the error message. 2 Check that the TGA sensor is mounted correctly and the crucible holder is empty. 3 If the problem persists, inform your local service engineer.
124	**No zero weight offset has been saved yet.**	1 Confirm the error message. 2 Make sure that the crucible holder is empty. 3 If you are sure that the crucible holder is empty, Tap **OK**. Otherwise tap **Cancel**. 4 Restart the instrument. 5 If the problem persists, inform your local service engineer.

7.3.3 Errors without code

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

Code	Message text	Measures
54	**The cell gas flow is out of tolerance**	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 STARe 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.**	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.**	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.
112	**The water level in the humidity generator is low.**	1 Check the water level in the humidity generator. Consult the manufacturer's operating instructions for this. 2 If the problem persists, inform your local service engineer.
113	**The sensor is not connected to the humidity generator**	1 Check the sensor cable connection to the humidity generator. 2 If the problem persists, inform your local service engineer.
123	**The crucible holder is not empty. Make sure that the TGA sensor is mounted correctly and the crucible holder is empty.**	1 Make sure that the TGA sensor is mounted correctly and the crucible holder is empty. 2 Follow the standard procedure.

7.3.5 Warnings without code

Code	Message text	Measures
-	**The self test was successful.**	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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