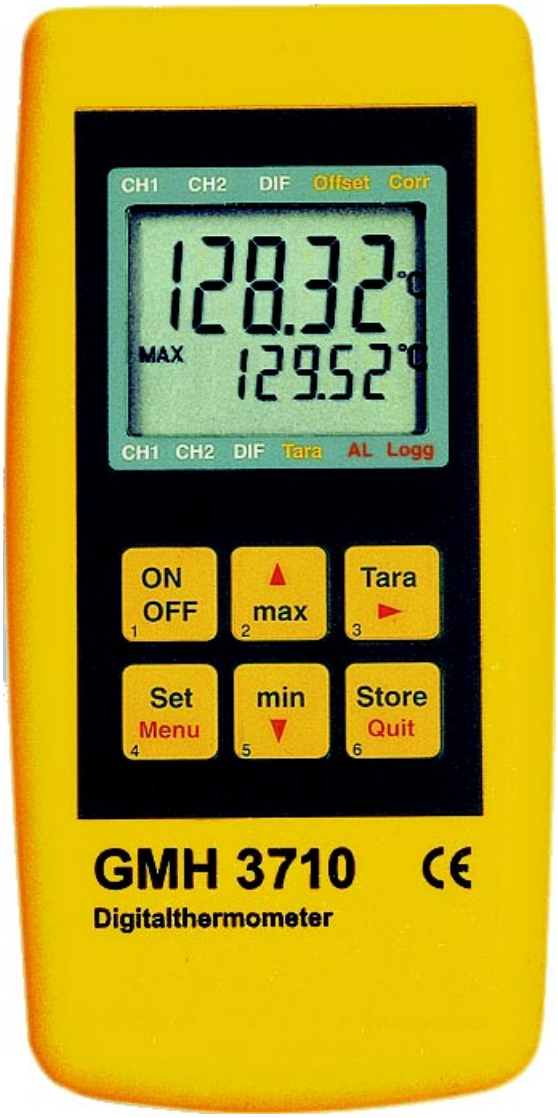
# Operating Manual Precision Thermometer

# GMH 3710

**from Version 1.0**

## For Pt100 4-Wire Temperature Probes



# 1 In General

## 1.1 Safety Instructions

This device has been designed and tested in accordance to the safety regulations for electronic devices.
However, its trouble-free operation and reliability cannot be guaranteed unless the standard safety measures and special safety advises given in this manual will be adhered to when using it.

1. Trouble-free operation and reliability of the device can only be guaranteed if it is not subjected to any other climatic conditions than those stated under “Specification”.
2. Transporting the device from a cold to a warm environment condensation may result in a failure of the function. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.
3. The circuitry has to be designed most carefully if the device should be connected to other devices. Internal connection in third party devices (e.g. connection GND and earth) may result in not-permissible voltages impairing or destroying the device or another device connected.
4. **Warning:** Operating the device with a defective mains power supply (e.g. short circuit from mains voltage to output voltage) may result in hazardous voltages at the device (e.g. at sensor socket)
5. Whenever there may be a risk whatsoever involved in running it, the device has to be switched off immediately and to be marked accordingly to avoid re-starting. Operator safety may be a risk if:
   - there is visible damage to the device
   - the device is not working as specified
   - the device has been stored under unsuitable conditions for a longer time
   In case of doubt, please return device to manufacturer for repair or maintenance.
6. **Warning:** Do not use these product as safety or emergency stop device, or in any other application where failure of the product could result in personal injury or material damage.
   Failure to comply with these instructions could result in death or serious injury and material damage.

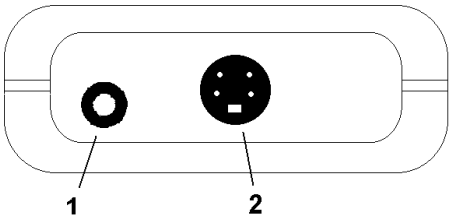
## 1.2 Operating And Maintenance

- **Battery Operation**
  The battery has been used up and needs to be replaced, if ⚠ and „bAt“ are shown in lower display.
  The device will, however, continue operating correctly for a certain time.
  The battery has been completely used up, if ´bAt´ is shown in the upper display.
  The battery has to be taken out, when storing device above 50°C.

  ***Hint: We recommend to remove the battery if device is not used for a longer period of time!***

- **Mains Operation**
  ***Attention:*** When using a power supply unit please note that operating voltage has to be 10.5 to 12 V DC. Do not apply overvoltage!! Simple 12V-power supplies often have excessive no-load voltage. We, therefore, recommend using regulated voltage power supplies. Trouble-free operation is guaranteed by our power supply GNG10/3000. Prior to connecting the plug power supply with the mains supply make sure that the operating voltage stated at the power supply is identical to the mains voltage.
- Treat device and probes carefully. Use only in accordance with above specification. (do not throw, hit against etc.). Protect plugs and sockets from soiling.
- To disconnect sensor plug do not pull at the cable but at the plug.
- When connecting the probe the plug will slide in smoothly if plug is entered correctly.
- **Selection of Output-Mode**: The output can be used as serial interface or as analogue output. This choice has to be done in the configuration menu.

## 1.3 Connections




1. **Output:** Operation as interface: Connect to optically isolated interface adapter (accessory: GRS 3100 or GRS3105)
   Operation as analogue output: Connection via suitable cable.
   Attention: The output mode has to be configured (p.r.t 2.7) and influences battery life!

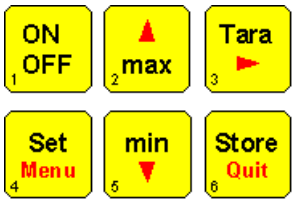
2. **Probe connection** Pt100 4-wire
3. The **mains socket** is located at the left side of the instrument

## 1.4 Display Elements


**1 = Main Display:** Currently measured temperature
**2 = Auxiliary Display:** Display of min, max or hold values

**Special display elements:**
**3 = Warning triangle:** indicates a low battery
**4 = Corr-arrow**: indicates that correction factor is activated
**5 = Offset-arrow**: indicates that zero point offset (offset) is activated
**6 = Min/Max/Hold**: shows if a min., max. or hold value is displayed in the secondary display

## 1.5 Pushbuttons




**key 1:** **On/Off key**
**key 4:** **Set/Menu**
press (Menu) for 2 sec.: configuration will activated
**keys 2, 5:** **min/max when taking measurements:**
press shortly: min. or max. measuring value will be displayed
press for 2 sec.: the min. or max. value will be deleted
**up/down for configuration:**
to enter values or change settings
**key 6:** **Store/Quit**:
- Measurement: Hold current measuring value ('HLD' in display)
- Menu: Acknowledge setting, return to measuring

**key 3:** no function

# 2 Device Configuration

For configuration of the device press "**Menu**"-key (key 4) for 2 seconds, the first menu will be shown.
Choose between the individual values that can be set by pressing the "**Menu**"-key (key 4) again.
The individual values are changed by pressing the keys "▲" (key 2) or "▼" (key 5).
Use key "**Quit**" (key 6) to leave configuration and to store settings.

## 2.1 'Unit': Selection of Temperature Unit °C /°F


**°C**: All temperature values are in degrees Celsius

**°F**: All temperature values are in degrees Fahrenheit

## 2.2 'Resolution': The Display Resolution


**0.1°**: Resolution 0.1°C

**0.01°**: Resolution 0.01°C

**Auto**: Resolution is selected automatically

## 2.3 'Offset': Zero Displadement


**-2.50°C...2.50°C respectively -4.50°F...4.50°F**: The zero point of the measurement will be displaced by this value to compensate for deviations in the temperature probe or in the measuring device

**oFF**: Zero displacement inactive (=0.0°)

## 2.4 'Scal': Scale Correction


**-2.000...2.000:** The scale of the measuring will be changed by this factor to compensate for deviations in the temperature probe or in the measuring device (factor is in %)

**oFF**: Scale correction factor inactive (=0.000)

## 2.5 'Power.off': Selection of Power-Off Delay


**1...120**: Power-off delay in minutes.
Device will be automatically switched off as soon as this time has elapsed if no key is pressed/no interface communication takes place

**oFF**: Power-off function inactive (continuous operation, e.g. mains operation)

## 2.6 'Out': Function of the Output


**OFF:** No output function, lowest power consumption

**SEr:** Output is serial interface

**dAC:** Output is analogue output 0...1V

## 2.7 'Address': Selection of Base Address when Output = Serial Interface


**01, 11, 21, ..., 91**: Base address of device for interface communication.

## 2.8 'dAC.0Volt': Output Offset When Output = Analogue Output


**-200.0...850.0°C respectively -328.0...1562.0°F**: Enter desired temperature value at which the analogue output potential should be 0V

## 2.9 'dAC.1Volt': Output Scale When Output = Analogue Output

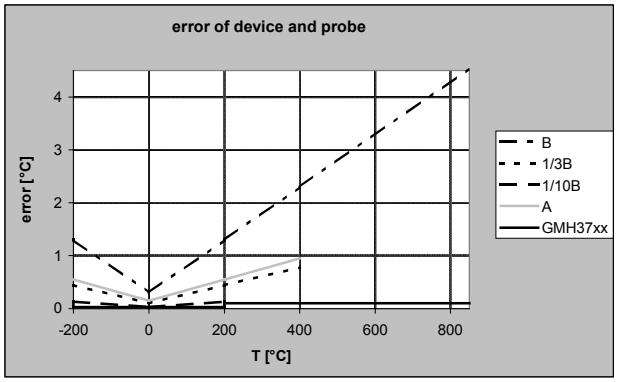

**-200.0...850.0°C respectively -328.0...1562.0°F**: Enter desired temperature value at which the analogue output potential should be 1V

***Hint:*** ***The settings will be set to the settings ex works, if keys 'Set' and 'Store' are pressed simultaneously for more than 2 seconds.***

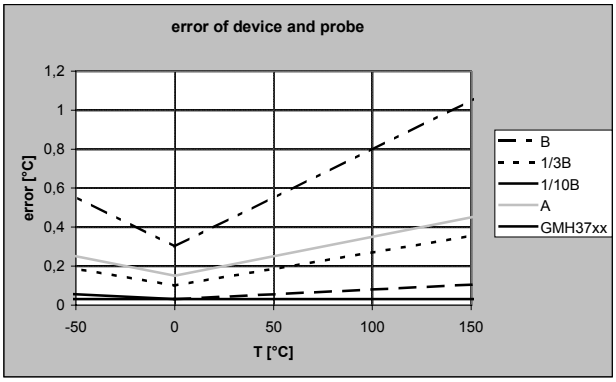
# 3 Some Basics Of Precision Temperature Measuring

- **Probe Precision/Device Precision**
  The device is very precise (please refer to technical data). To be able to use this high precision, the connected temperature probe has to be as precise as possible, too. The following precision classes are available as a standard at reasonable prices (Platinum resistor thermometers according to EN60751):

| Class | Error ranges |
|---|---|
| **B** | **± (0,3 + 0,005 • \|temperature\|)** |
| **1/3 B (=1/3 DIN)** | **± (0,1 + 0,0017 \|temperature\|)** |
| **1/10 B (=1/10 DIN)** | **± (0,03 + 0,0005 • \|temperature\|)** |
| A | ± (0,15 + 0,002 • \|temperature\|) |




***Error over measuring range***




***Error over range –50...150°C***

For applications demanding higher precision than given by this classes we suggest to adjust the device to the used probe or to get a calibration certificate for the device combined with the probe.
When demanding highest possible precision we suggest the usage of the instrument GMH3750.
**Attention:** if an adjusted or calibrated probe is replaced, also the adjustment or calibration certificate has to be renewed to maintain the referring overall precision!
Be careful when buying third party temperature probes: Besides the standard EN60751 there are some other obsolete or unusual standards on the market. If such a probe has to be connected, the GMH3750 should be used instead!

- **4-Wire-Measuring**
  When using resistance thermometers as the Pt100 a quite large measuring error can be caused by inadequate cables and connections. Using 4wire measuring avoids this kinds of errors mainly caused by unwanted resistances. It is suggested to use suitable probes and extensions only. (For pin assignment please refer to chapter 6)
- **Heat loss caused by probe construction:**
  Especially when measuring temperatures which deviate very much from the ambient temperature, measuring errors often occur if the heat loss caused by the probe is not considered. When measuring fluids therefore the probe should be emerged sufficiently deep and be stirred continuously. When measuring gases the probe should also emerge as deep as possible in the gas to be measured (e.g. when measuring in channel/pipes) and the gas should flow around the probe at sufficient flow.
- **Measuring Surface Temperature**
  If temperature of the surface of an object has to be measured, one should pay attention especially when measuring hot (or very cold) surfaces, that the ambient air cools (or heats) the surface. Additionally the object will be cooled (or heated) by the probe or the probe can have a better heat flow to the ambient temperature as to the objects surface. Therefore specially designed surface probes should be used. The measuring precision depends mainly on he construction of the probe and of the physics of the surface itself. If choosing a probe try to choose one with low mass and heat flow from sensor to handle. Thermally conductive paste can increase the precision in some cases.
- **Allowable temperature Range Of Probes**
  Pt100 Sensors are defined over a wide temperature range. Depending on probe materials and sort of sensor (e.g. hybrid sensors, wire wound resistors...) the allowable temperature ranges have to be considered. Exceeding the ranges at least causes a wrong measuring, it may even damage the probe permanently!
  Often it also has to be considered, that the temperature range is just valid for the probe tube, (plastic-) handles can't stand the same high temperatures. Therefore the tube length should be selected long enough, that temperature keeps low at the handle.
- **Self Heating**
  The measuring current of the instrument is just 0.3mA. Because of this comparably low current practically now self heating effect has to be considered, even at air with low movement the self heating is <= 0.01°C.
- **Cooling by Evaporation**
  When measuring air temperature the probe has to be dry. Otherwise the cold due to the evaporation causes too low measurings.

# 4 Special Functions

## 4.1 Display Resolution

Standard setting: 'Auto', i.e. the device automatically switches over to the optimum resolution between .01° and 0.01°. If temperatures to be measured are near the switching threshold, a fixed resolution may be better, e.g. for easy recording. In such a case please select the optimum resolution manually.

## 4.2 Zero Displacement ('Offset')

A zero displacement can be carried out for the measured temperature:

**temperature displayed = temperature measured - offset**

Standard setting: 'off' = 0.0°, i.e. no zero displacement will be carried out. Together with the scale correction (see below) this factor is mainly used to compensate for sensor deviations. Unless the factor is set to 'off', the offset arrow in the display shows an active zero displacement.

## 4.3 Scale Correction ('Scale')

The scale of the measuring can be influenced by this setting (factor is in %):

**displayed temperature[°C] = measured temperature[°C] * (1+Scal/100)**

**respectively displayed temperature[°F] = (measured temperature [°F]-32°F) * (1+Scal/100) + 32°F**

Standard setting: 'off' =0.000, i.e. temperature is nor corrected. Together with the zero displacement (see above) this factor is mainly used to compensate for sensor deviations.
Unless the factor is set to 'off', the Corr arrow in the display shows an active scale correction.

## 4.4 Output

The output can be used as serial interface (for GRS3100 or GRS3105 interface adapters) or as analogue output (0-1V). If none of both is needed, we suggest to switch the output off, because battery life then is extended.

### 4.4.1 Interface - Base Address ('Adr.')

By using an electrically isolated interface converter GRS3100 or GRS3105 (accessory) the device can be connected to a PC. With the GRS3105 it is possible to connect up to 5 instruments to a single interface (please also refer to GRS3105-manual). As a precondition the base addresses of all devices must not be identical. In case several devices will be connected via one interface make sure to configure the base addresses accordingly. In order to avoid transmission errors, there are several security checks implemented (e.g. CRC).

The following standard software packages are available for data transfer:

- **EBS9M**: 9-channel software to record and display the measuring values
- **EASYControl**: Universal multi-channel software (EASYBUS-, RS485-, and/or GMH3000- operation possible) for real-time recording and presentation of measuring data in the ACCESS®-data base format.

In case you want to develop your own software we offer a **GMH3000-development package** including

- an universally applicable 32bit Windows functions library ('GMH3000.DLL') with documentation that can be used by all 'serious' programming languages.
- Programming examples for Visual Basic 6.0™, Delphi 1.0™, Testpoint™, Labview™

***Note: The measuring and range values read via interface are always in the selected display unit (°C/°F)!***

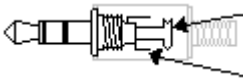
Supported interface functions:

| Code | Name/Function | Code | Name/Function |
|---|---|---|---|
| 0 | read nominal value | 199 | read meas. type in display |
| 3 | read system status | 200 | read min. display range |
| 6 | read min. value | 201 | read max. display range |
| 7 | read max. value | 202 | read unit of display |
| 12 | read ID-no. | 204 | read decimal point of display |
| 174 | delete min. value | 208 | read channel count |
| 175 | delete max. value | 214 | read scale correction |
| 176 | read min measuring range | 215 | set scale correction |
| 177 | read max measuring range | 216 | read zero displacement |
| 178 | read measuring range unit | 217 | set zero displacement |
| 179 | read measuring range decimal point | 240 | Reset |
| 180 | read measuring type | 254 | read program identification |
| 194 | set display unit | | |

### 4.4.2 Analogue Output – Scaling with DAC.0 and DAC.1

With the DAC.0 and DAC.1 values the output can be rapidly scaled to Your efforts.
Keep in mind not to connect low-resistive loads to the output, otherwise the output value will be wrong and battery life is decreased. Loads above ca 10kOhm are uncritical.
If the display exceeds the value set by DAC.1, then the device will apply 1V to the output
If the display falls below the value set by DAC.0, then the device will apply 0V to the output
In case of an error (Err.1, Err.2, no sensor, etc.) the device will apply slightly above 1V to the output.

**plug wiring::**

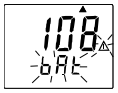
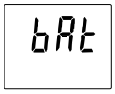


GND

+Uout

**Attention!**
The 3rd contact has to be left floating!
Only stereo plugs are allowed!

# 5 Fault and System Messages

| Display | Meaning | Remedy |
|---|---|---|
|  | low battery voltage, device will continue to work for a short time | replace battery |
| | If mains operation: wrong voltage | replace power supply, if fault continues to exist: device damaged |
|  | low battery voltage | replace battery |
| | If mains operation: wrong voltage | Check/replace power supply, if fault continues to exist: device damaged |
| No display or weird display<br><br>Device does not react on keypress | low battery voltage | replace battery |
| | If mains operation: wrong voltage | Check/replace power supply, if fault continues to exist: device damaged |
| | system error | Disconnect battery or power supply, wait some time, re-connect |
| | device defective | return to manufacturer for repair |
| ---- | Sensor error: no sensor connected | Connect sensor to socket |
| | sensor/cable or device defective | return to manufacturer for repair |
| Err.1 | Value exceeding measuring range | Check: Is the value exceeding the measuring range specified? ->temperature too high! |
| | Wrong probe connected | Check probe |
| | sensor/cable defective | -> replace |
| Err.2 | Value below display range | Check: Is the value below the measuring range specified? -> temperature too low! |
| | Wrong probe connected | Check probe |
| | sensor/cable defective | -> replace |
| Err.3 | Value exceeding display range | -> set resolution to 0.1° or Auto |
| Err.4 | Value below display range | -> set resolution to 0.1° or Auto |
| Err.7 | system error | return to manufacturer for repair |

# 6 Probe pin assignment

The device is constructed for the connection of a Pt100 4-wire probe. The connection is be carried out as follows:

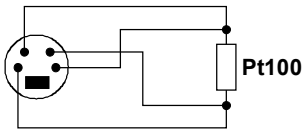
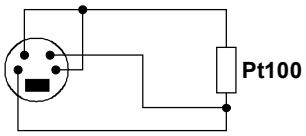
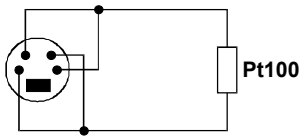



*figure shows view upon probe jack pins*

It is also possible to connect an 3- or 2-wire probe to the device. Please observe that in consequence of the cable resistance a increased measuring fault will occur. The connection of this probes should be carried out as follows:




*3-wire connection*




*2- wire connection*

# 7 Calibration Services

Calibration certificates can be issued by the factory. For this the device has to be sent to the manufacturer. Just the manufacturer can check the factory settings and correct them if necessary.

# 8 Specification

**Supported probes** Pt100 4-wire (2-wire possible)
**Sensor Curve** according to EN60751

**Probe connection** 4pole Mini-DIN socket

**Resolution** 0.01°C respectively 0.1°C, 0.01°F respectively 0.1°F

**Measuring Ranges**

| **0.01°C** | **0.1°C** | **0.01°F** | **0.1°F** |
|---|---|---|---|
| –199.99... +199.99°C | -200.0... +850.0°C | -199.99... +199.99°F | -328.0... +1562.0°F |

**Precision** Device without probe ±1Digit (at nominal temperature)

| **Range 0.01°C/F** | **Range 0.1°C/F** |
|---|---|
| ±0.03°C / 0.06°F | ±0.1°C / ±0.2°F |

**Measuring** 4-wire measuring with automatic compensation of thermovoltage errors, measuring current ca. 0.3mA

**Temperature drift** <=0,002K per 1K

**Nominal temperature** 25°C

**Ambient** Temperature **-**25 ... +50°C (-13 .. 122°F)
rel. humidity 0 ... 95%r.F. (not condensing)

**Storage temperature** **-**25 ... +50°C (-13 ... 122°F)

**Housing** Dimensions: 142 x 71 x 26 mm (L x W x D)
impact-resistant ABS plastic housing, membrane keyboard, transparent panel. Front side IP65,integrated pop-up clip for table top or suspended use.

**Weight** approx. 155 g

**Output:** 3.5mm audio plug, stereo
**Selectable as serial interface:** via optically isolated interface adapter GRS3100 or GRS3105 (p.r.t. accessories) directly connectable to RS232-interfaces.
**or analogue output:** 0..1V, freely scaleable (resolution 13bit, accuracy 0.05% at nominal temperature, cap. load <1nF)

**Power Supply** 9V-Battery, type IEC 6F22 (included) as well as additional d.c. connector (diameter of internal pin 1.9 mm) for external 10.5-12V direct voltage supply. (suitable power supply: GNG10/3000)

**Power Consumption**

| | |
|---|---|
| output off | ca. 0.90mA |
| output serial interface: | ca. 1.15mA |
| analogue output: | ca. 1.25mA |

**Display** Two 4 ½ digits LCD's (12.4mm high and 7 mm high) for temperature, min./ max values, hold function, etc. as well as additional pointing arrows.

**Pushbuttons** 6 membrane keys for on/off switch, menu operation, min. and max. value memory, hold-function etc.

**Min-/Max-Value Memory** Both the max. and the min. value will be memorised.
**Hold Function** Press button to store current value.
**Automatic-Off-Function** Device will be automatically switched off if no key is pressed/no interface communication takes place for the time of the power-off delay. The power-off delay can be set to values between 1 and 120 min.; it can be completely deactivated.

**EMC:** The GMH3710 corresponds to the essential protection ratings established in the Regulations of the Council for the Approximation of Legislation for the member countries regarding electromagnetic compatibility (2004/108/EG)
EN61326 +A1 +A2 (Appendix B, class B), additional error: < 1% FS.