DEWETRON

# DAQP-STG-S8

## TECHNICAL REFERENCE MANUAL

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## Isolated strain gage amplifier

- Input ranges: 0.05 mV/V to 1000 mV/V; 500 µV to 5 V; 25 mOhm to 100 kOhm
- Bandwidth: 50 kHz, 8 selectable low pass filter (10 Hz to 30 kHz)
- Isolation: 350 $V_{DC}$
- Bridge completion: Internal completion for ½ and ¼ bridge (120 and 350 Ohm)
- Shunt: Two internal shunts (59.88 kOhm, 175 kOhm)
- Bridge Excitation: 0 to 12V or 0 to 20mA 16 bit programmable
- TEDS: Support for TEDS sensors and DEWETRON MSI series

## Module specifications

| | **DAQP-STG-S8** |
|---|---|
| Gain | 0.5 to 10 000 |
| Voltage input ranges<br>Sensitivity @ 5 $V_{DC}$ excitation | ±0.5, ±1, ±2.5, ±5, ±10, ±25, ±50, ±100, ±250, ±500 mV, ±1 V, ±2V, ±5 V,±10 V<br>±0.1, ±0.2, ±0.5, ±1, ±2, ±5, ±10, ±20, ±50, ±100, ±200, ±400, ±1000 mV/V |
| Resistance | 25 mOhm to 100 kOhm |
| Input impedance | >100 MOhm (power off: 50 kOhm) shunted by <100 pF |
| Input noise | 7 nV * √Hz |
| Voltage input 1 year accuracy[1)]<br>Gain drift<br>Offset drift<br>linearity | ±0.03 % of reading ± 0.02 % of range ±10 µV<br>typical 10 ppm/K max. 20 ppm/K<br>typical 0.3 µV/°C + 10 ppm of range/°C, max 2 µV/°C + 20 ppm of range/°C<br>typical 0.02 % |
| Excitation voltage<br>1 year accuracy[1)]<br>Drift<br>Current limit<br>Protection<br>Voltage regulation<br>Voltage stability<br>Voltage noise | 0, 0.25, 0.5, 1, 2.5, 5,10 and 12 $V_{DC}$ software programmable (16 Bit DAC)<br>±0.03 % ±1 mV<br>±10 ppm/K ±50 µV/K<br>100 mA<br>Continuous short to ground<br><50 ppm of value ±50 µV<br><50 ppm of value ±200 µV in 8h<br><200 µVrms (@ 350Ω load) |
| Excitation current<br>1 year accuracy[1)]<br>Drift<br>Compliance voltage<br>Output impedance | 0.1, 0.2, 0.5, 1, 2, 5, 10 and 20 mA software programmable (16 Bit DAC)<br>0.05 % ±2µA<br>15 ppm/K<br>12 V<br>>1 MOhm |
| Amplifier noise | 10 Hz 0.5 $mV_{RMS}$ RTO<br>100 Hz 0.3 $µV_{RMS}$ RTI + 0.3 $mV_{RMS}$ RTO<br>1 kHz 0.5 $µV_{RMS}$ RTI + 0.3 $mV_{RMS}$ RTO<br>50 kHz 1.6 $µV_{RMS}$ RTI + 0.3 $mV_{RMS}$ RTO |
| Supported sensors | 4- or 6-wire full bridge<br>3- or 5-wire ½ bridge with internal completion (software programmable)<br>3- or 4-wire ¼ bridge with internal resistor for 120 and 350 Ohm (software programmable)[1)]<br>4-wire full bridge with constant current excitation (piezoresistive bridge sensors)<br>Potentiometric<br>Resistance<br>Resistance Temperature Detection: Pt100, Pt200, Pt500, Pt1000, Pt2000 |
| Bridge resistance | 80 Ohm to 10 kOhm @ ≤ 5 $V_{DC}$ excitation |
| Shunt calibration | Two internal shunt resistors 59.88 kOhm and 175 kOhm |
| Shunt and completion resistor accuracy | 0.05 % ±15 ppm/K |
| Automatic bridge balance | Input range 500 µV to 1 V: ±200 % of Range<br>2.5 V to 5 V : ±20% of Range |
| Bandwidth (-3 dB) | 50 kHz |
| Filters (low pass) | 10 Hz, 30 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz |
| Filter characteristics<br>Option S8 (DAQP-STG-S8) | 10 Hz to 30 kHz: Butterworth 80 dB/dec (4th order; ±1.5 dB @ f0)<br>50 kHz: Butterworth 60 dB/dec (3rd order; 0 to -3 dB @ 300kHz) |
| Typical SNR @ 100 kHz [1 kHz]<br>and 5 $V_{DC}$excitation | 66 dB [84 dB] @ 1 mV/V<br>82 dB [100 dB] @ 50 mV/V |
| Typical CMRR @ 0.1 mV/V [1 mV/V]<br>and 5 $V_{DC}$ excitation | 160 dB [160 dB] @ DC<br>128 dB [128 dB] @ 50 Hz<br>115 dB [110 dB] @ 400 Hz<br>110 dB [105 dB] @ 1 kHz |

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| | |
|---|---|
| Isolation | ±350 $V_{DC}$ continuous (for input, excitation and TEDS interface) |
| Common mode voltage | ±350 $V_{DC}$ input to housing |
| Over voltage protection | ±50 $V_{DC}$ input (+) to input (-) |
| Output voltage | ±5 V |
| Output resistance | < 1 Ohm |
| Output current | Max. 5 mA; short to ground protected for 10 seconds |
| RS-485 interface | Yes |
| Supported TEDS chips | DS2406, DS2430A, DS2431, DS2432, DS2433 |
| MSI support | MSI-BR-TH-x, MSI-BR-ACC, MSI-BR-V-200, MSI-BR-CH-50 |
| Power supply voltage | ±9 $V_{DC}$ (±1 %) |
| Power consumption | Typ. 1.7 W @ 350 Ohm, 2.15 W @ 120 Ohm (both full bridge @ 5 $V_{DC}$ excitation)<br>Absolute max.: 3 W (maximum excitation @ maximum current) |
| [1)] Conditions fo accuracy: module temperature is calibration temperature ±5 °C; humidity is 30 % to 90 % relative humidity. | |

## Front panel control

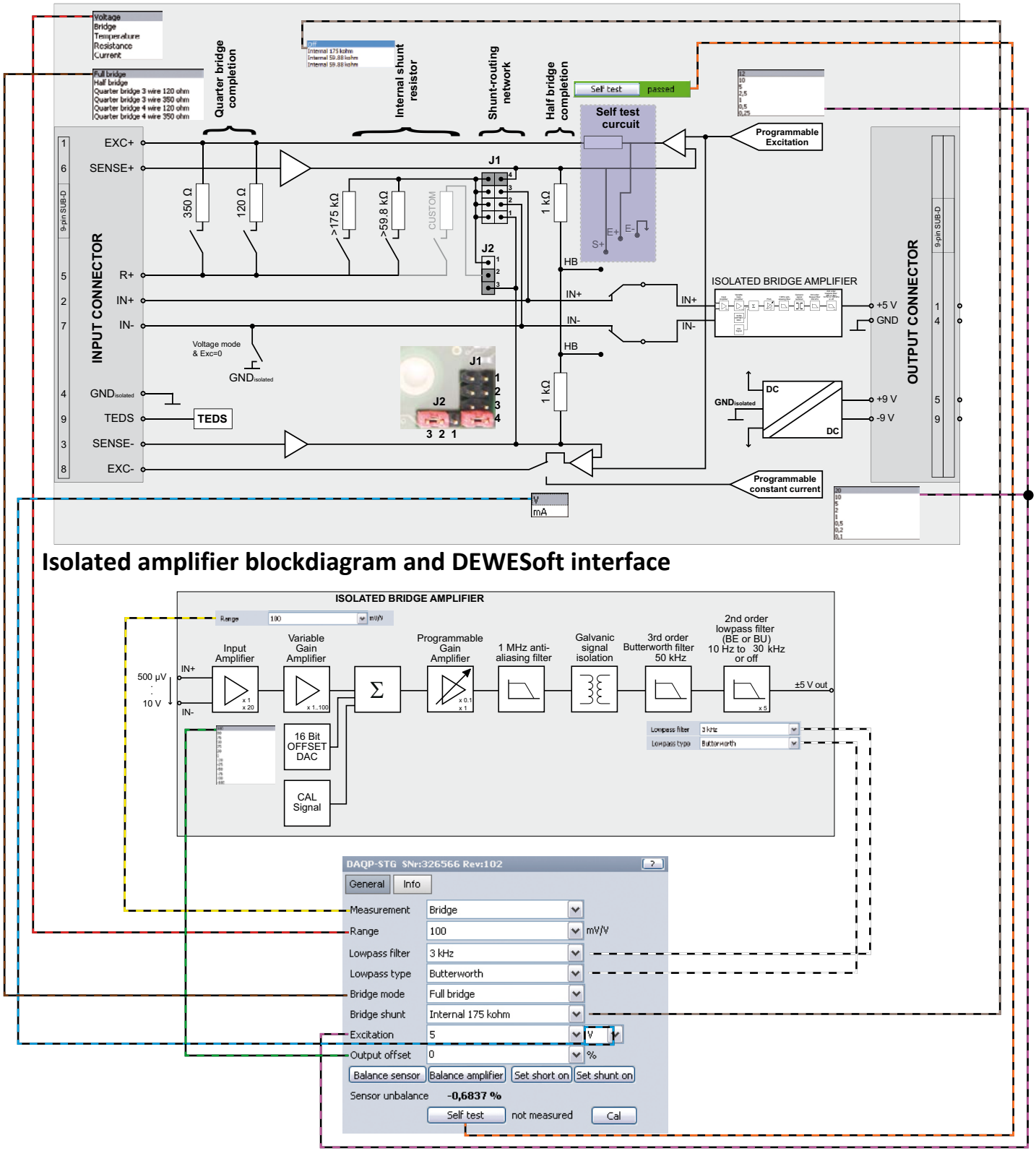
### LED indication:


Power LED: This LED is always on when the module is supplied.
Status LED: This LED is flashing three times when the Module receives a valid command.

### Push button operation

Module readdressing: Press the ID button for allowing the software to change the address.

## Input blockdiagram




## Isolated amplifier blockdiagram and DEWESoft interface

## Amplifier functions

### Input range overview

| Voltage | Strain gage | | | | | | | Resistance | Current source bridge | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Excitation | 0.25 V | 0.5 V | 1 V | 2.5 V | 5 V | 10 V | 12 V | 0.1 mA | 0.2 mA | 0.5 mA | 1 mA | 2 mA | 5 mA | 10 mA | 20 mA | 60 mA | Max. adjustable offset |
| Input range | Range | | | | | | | Range | | | | | | | | | |
| mV | mV/V | mV/V | mV/V | mV/V | mV/V | mV/V | mV/V | Ohm* | Ohm* | Ohm* | Ohm* | Ohm* | Ohm* | Ohm* | Ohm* | Ohm* | |
| 10000 | 40000 | 20000 | 10000 | 4000 | 2000 | 1000 | 833.3 | 1E+05 | 50000 | 20000 | 10000 | 5000 | 2000 | 1000 | 500 | | ±50 % |
| 5000 | 20000 | 10000 | 5000 | 2000 | 1000 | 500 | 416.7 | 50000 | 25000 | 10000 | 5000 | 2500 | 1000 | 500 | 250 | 166.67 | ±100 % |
| 2000 | 8000 | 4000 | 2000 | 800 | 400 | 200 | 166.7 | 20000 | 10000 | 4000 | 2000 | 1000 | 400 | 200 | 100 | 83.33 | ±200 % |
| 1000 | 4000 | 2000 | 1000 | 400 | 200 | 100 | 83.33 | 10000 | 5000 | 2000 | 1000 | 500 | 200 | 100 | 50 | 33.33 | ±200 % |
| 500 | 2000 | 1000 | 500 | 200 | 100 | 50 | 41.67 | 5000 | 2500 | 1000 | 500 | 250 | 100 | 50 | 25 | 16.67 | ±200 % |
| 250 | 1000 | 500 | 250 | 100 | 50 | 25 | 20.83 | 2500 | 1250 | 500 | 250 | 125 | 50 | 25 | 12.5 | 8.33 | ±200 % |
| 100 | 400 | 200 | 100 | 40 | 20 | 10 | 8.333 | 1000 | 500 | 200 | 100 | 50 | 20 | 10 | 5 | 4.17 | ±200 % |
| 50 | 200 | 100 | 50 | 20 | 10 | 5 | 4.167 | 500 | 250 | 100 | 50 | 25 | 10 | 5 | 2.5 | 1.67 | ±200 % |
| 25 | 100 | 50 | 25 | 10 | 5 | 2.5 | 2.083 | 250 | 125 | 50 | 25 | 12.5 | 5 | 2.5 | 1.25 | 0.83 | ±400 % |
| 10 | 40 | 20 | 10 | 4 | 2 | 1 | 0.833 | 100 | 50 | 20 | 10 | 5 | 2 | 1 | 0.5 | 0.42 | ±400 % |
| 5 | 20 | 10 | 5 | 2 | 1 | 0.5 | 0.417 | 50 | 25 | 10 | 5 | 2.5 | 1 | 0.5 | 0.25 | 0.17 | ±400 % |
| 2.5 | 10 | 5 | 2.5 | 1 | 0.5 | 0.25 | 0.208 | 25 | 12.5 | 5 | 2.5 | 1.25 | 0.5 | 0.25 | 0.125 | 0.0833 | ±400 % |
| 1 | 4 | 2 | 1 | 0.4 | 0.2 | 0.1 | 0.083 | 10 | 5 | 2 | 1 | 0.5 | 0.2 | 0.1 | 0.05 | 0.0417 | ±400 % |
| 0.5 | 2 | 1 | 0.5 | 0.2 | 0.1 | 0.05 | 0.042 | 5 | 2.5 | 1 | 0.5 | 0.25 | 0.1 | 0.05 | 0.025 | 0.0167 | ±400 % |

not usefull in strain gage mode
Resistance mode

*) Ohm = mv/mA

### Free variable gain and excitation

The gain, excitation and offset values of this module are free programmable. So it is possible to normalize any physical sensor input signal to the ±5 V output of the module. By using these settings as power on default, standalone solutions could be easily realized.

- **Gain:** from 0.5 to 10000. The module input ranges are based on predefined gain values. The module automatically chose the best gain combination of the internal amplifiers to keep the overall noise and drift as low as possible.
- **Output offset:** Could be programmed from the positive to the negative full scale range except on the input ranges above 1V. Due to internal structure here the offset could be set from +20 % to – 20 %.
- **Excitation voltage:** The excitation voltage is programmable from 0 to 12 V in 185 µV steps. Setting the excitation to 0 V for example allows you to determine the noise of the sensor cabling. The sense terminals have to be connected to the excitation terminals all the time. Even if the remote sensing is not required.
- **Excitation current:** The current could be programmed from 0.1 mA to 20 mA in 0.3 µA steps. The maximum compliance voltage is 12 V. The compliance voltage is automatically balanced around the internal GND. This minimizes the common mode error.

### Power on default function

You can store the actual settings of the module in the internal EE-Prom memory. Once the module restarts, it comes up automatically with these setting. This is important for stand alone applications and for fail save reasons.

### Filter

The module has 8 selectable low pass filters from 10 Hz to 30 kHz. The highest filter is a 3rd order Butterworth filter with a guaranteed -3 dB bandwidth of 50 kHz. This filter structure is the same for all new generation modules (DAQP-LV, DAQP-HV2) to have low phase shifts between the different module times over the frequency range.

### Amplifier balance

The amplifier balance allows an automatically elimination of all internal amplifier offsets. It shorts the amplifier inputs IN+ and IN- to the internal isolated GND reference point. Then the output offset of the module is automatically adjusted to zero for all ranges. This function takes up to 8 seconds. Previously stored sensor offset values are cleared. The amplifier balance is mandatory after the module reaches temperature, to eliminate offset drift by temperature.

### Sensor balance

Typically every strain gage sensor has a certain offset. That comes from manufacturing tolerances or because of sensor mounting. By performing a bridge balance this sensor offset could be completely removed on the analog side up to 200 % of the actual range. This allows using the full dynamic of the AD-board instead of losing resolution because of digital offset shifting. Output offset and sensor balance may not exceed 200 % of range (20 % for ranges above 1 V).

### Internal completion resistors

The DAQP-STG has an internal half bridge completion and two internal quarter bridge completions for 120 Ohm and 350 Ohm strain gages. The used high precision resistors with low temperature drift allow a long-time stable measurement of almost every strain gage type without using an external completion network.

### Internal shunt

With two internal shunt resistors (59.88 kOhm and 175 kOhm) and one spare socket for a customised shunt, the DAQP-STG has wide flexibility in case of shunt calibration. A jumper network gives the possibility to connect the internal shunts to either Sense+ Sense – IN+ or IN- to be compatible to existing sensor types and correction calculation methods. This technology is used to correct the complete measurement chain gain error from the sensor input to the digital signal output. It is based on the known ratio between the shunt resistor and the strain gage resistance.

### Short

It switches the differential amplifier inputs IN+ and IN- from the input terminals to the internal isolated GND reference point. With this function the absolute sensor offset could be determined.

### CAL

It applies a high precision internal reference signal with 80% of the full scale value to the module. For ranges above 1V the reference signal level is 20 % of range.

### Self test

The self test function is a software controlled procedure that checks in the first step the amplifier itself. In the second step a basic sensor check will be performed. This test is only available in DeweSoft if an AD-Card is installed.

Part 1: Amplifier Test

- The amplifier offset is checked by using the Short function
- The 80% Cal signal is applied to the amplifier. The complete isolation amplifier including the AD-Card is checked by using this test signal.
- The self test circuit switches the amplifier input to the positive excitation voltage, so also the input amplifier is checked. Warning: if there is a short circuit on the excitation this test will fail.

Part 2: Basic Sensor Test

- Bridge Sensor: It is checked if the supply current doesn't exceed the maximum value, and if the excitation voltage is within the predefined value.

## Signal connection

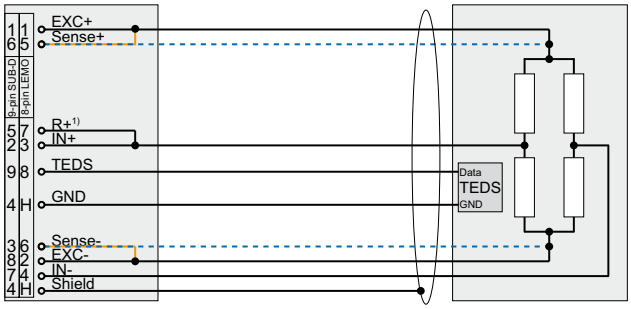
### DAQP-STG-D module

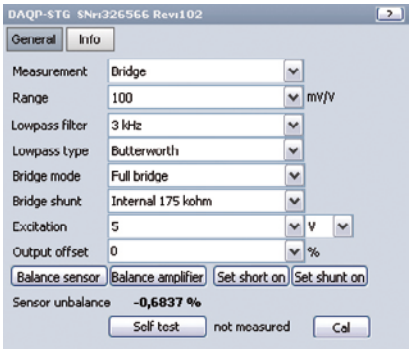
Signal connection via SUB-D connector

1 EXC+
2 IN+
3 Sense -
4 GND (isolated)
5 R+
6 Sense +
7 IN-
8 EXC-
9 TEDS

## Full bridge signal connection

### 6-wire and 4-wire sensor connection

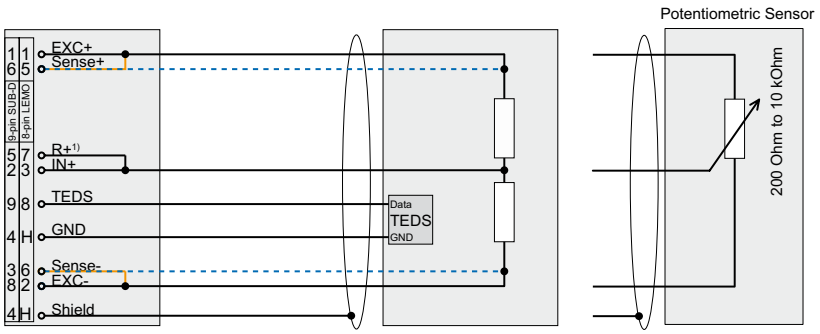


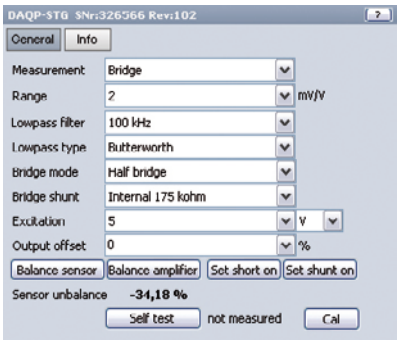




Voltage or current excitation is allowed.
Senses terminals have to be connected to the excitation also when 4-wire connection is used.
6-wire sensor connection: Sense+ is connected to EXC+ at the sensor
4-wire sensor connection: Sense+ is connected to EXC+ at the connector

## Half bridge signal connection

### 5-wire and 3-wire sensor connection, potentiometric sensors




5-wire sensor connection: Sense+ is connected to EXC+ at the sensor
3-wire sensor connection: Sense+ is connected to EXC+ at the connector

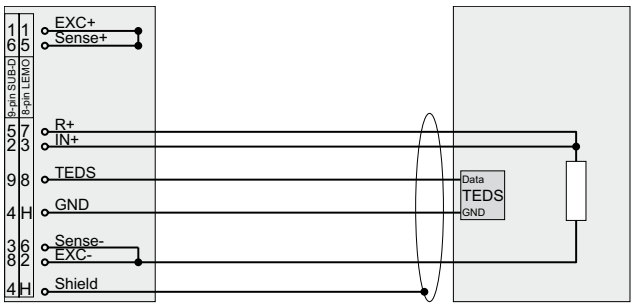
Voltage or current excitation is allowed.
Sense terminals have to be connected to the excitation also when 4-wire connection is used.
A potentiometer can be seen similar to a half bridge sensor with ±500 mV/V sensitivity. Therefore potentiometric sensors can be measured with bridge amplifiers. The advantages of using the DAQP-STG for potentiometric measurements is by adjusting the offset and range, you can focus on a certain potentiometer position with higher resolution. The scaling is ±500 mV/V equals ±50 % of potentiometer position.

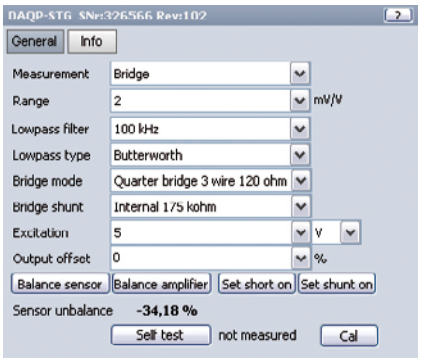
[1] 'R+' has to be connected only if shunt calibration is required, otherwise it can be left unconnected.

## Quarter bridge signal connection

### 3-wire sensor connection

(Sense+ is connected to EXC+ at the connector)



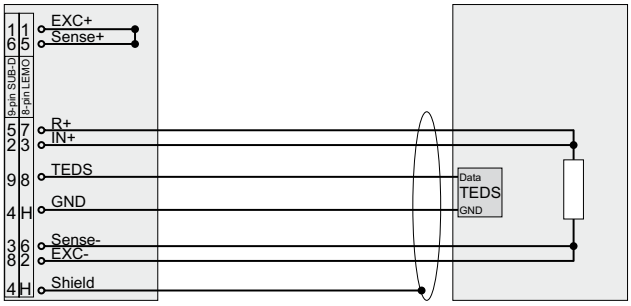



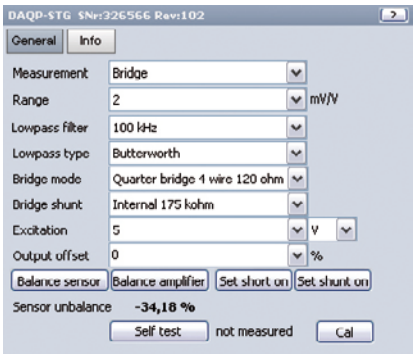

*Sense leads (SUB-D: pin 3 and 6) have to be connected!*

The 3-wire quater bridge is only able to compensate symmetric wire resistance!

### 4-wire sensor connection

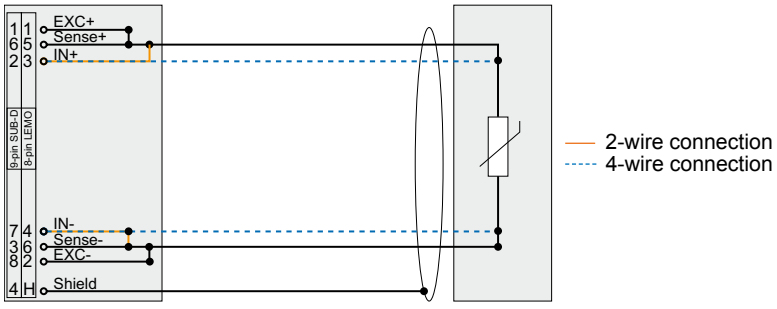
(Sense+ is connected to EXC+ at the sensor)

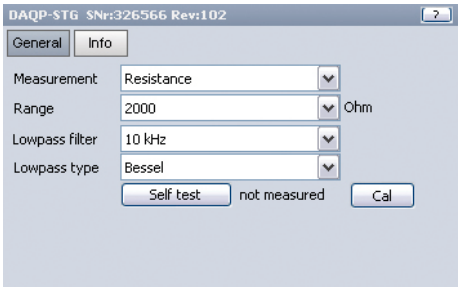



In the quarter bridge 4-wire mode the DAQP-STG internally adjusts its excitation in that way, that on the gage the resistor terminals exactly on the half of the excitation voltage. All wire resistances are compensated.

### Resistance, RTD 2-wire and 4-wire

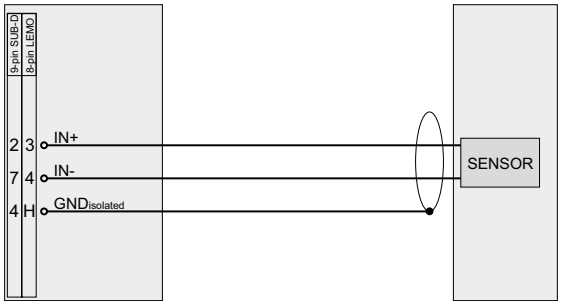


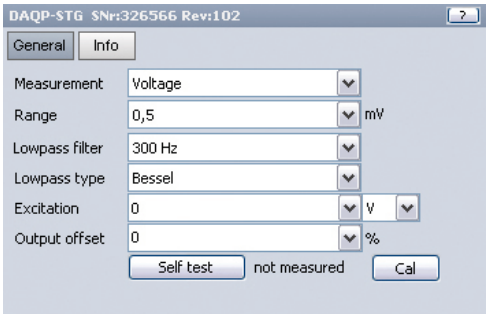




For resistance and RTD mode the 4-wire connection is recommended. The 2-wire connection will not compensate the wire resistance.

| RTD | max. Resistor | Range | Current | Accuracy |
|---|---|---|---|---|
| Type | Ω | Ω | Ω | |
| PT100 | 390.48 | 500 | 1 mA | 0.9 °C ±0.35 % of reading |
| PT200 | 780.96 | 1000 | 1 mA | 0.9 °C ±0.35 % of reading |
| PT500 | 1952.4 | 2000 | 1 mA | 0.85 °C ±0.35 % of reading |
| PT1000 | 3904.8 | 10000 | 0.5 mA | 1.6 °C ±0.6 % of reading |
| PT2000 | 7809.6 | 10000 | 0.5 mA | 1.4 °C ±0.6 % of reading |

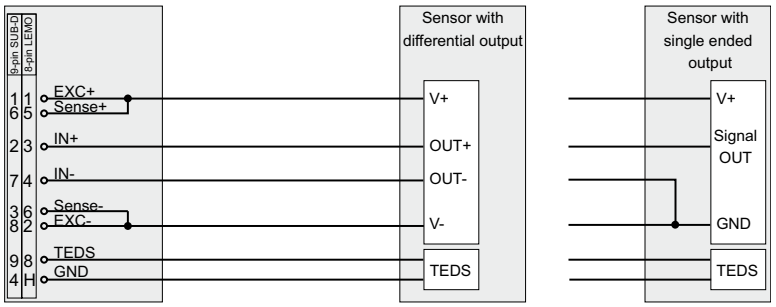
## Voltage measurement and µV measurement

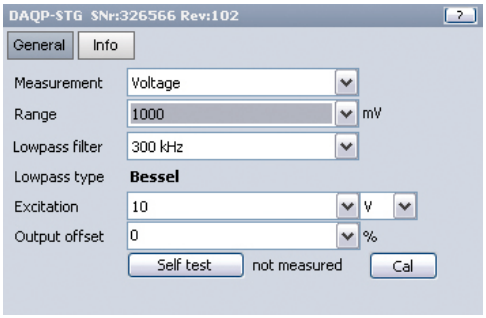



*CAUTION: If the excitation is not used for sensor supply it has to be deactivated by setting it to 0 V. This will internally connect the IN- to the $GND_{isolated}$ to improve the common mode rejection.*

## Sensor with sensor supply and voltage output




### Why to use more wire technology

- Sensitivity: For sensor wiring typically copper cables are used. For example a 120 Ohm full bridge connected with a 4 x 0.14 mm² cable will have an sensitivity error of 2.1 % just because of the 1.27 Ohm wire resistance. With the 6 wire technology this could be completely compensated.
- Temperature drift:

| | Initial error | | Drift because of 10 °C warm-up | |
|---|---|---|---|---|
| | Offset | Sensitivity | Offset | Sensitivity |
| 2-wire | 25183 µm/m | -4.97 % | 956 µm/m | -0.18 % |
| 3-wire | 0 µm/m | -2.6 % | 0 µm/m | -0.01 % |
| 4-wire | 0 µm/m | 0.0 % | 0 µm/m | 0.00 % |

## Cables and shielding

To keep the influence of electromagnetic disturbances as small as possible, shielded twisted pair cables are recommended. Connect the shield to the isolated GND (Pin4) to get the best result.

The twisted pairs for full bridge, half bridge, voltage and resistance mode are:

| | | | | |
|---|---|---|---|---|
| EXC+ | PIN1 | and | EXC- | PIN8 |
| Sense+ | PIN6 | and | Sense- | PIN3 |
| IN+ | PIN2 | and | IN- | PIN7 |
| R + | PIN5 | and | $GND_{isolated}$ | PIN4 |

If TEDS is used also the shield could be used as $GND_{isolated}$

For quarter bridge mode:

| | | | | |
|---|---|---|---|---|
| IN+ | PIN2 | and | Sense- | PIN3 |
| R + | PIN5 | and | EXC- | PIN8 |

## Supported MSI

MSI-BR-TH
MSI-BR-ACC
MSI-BR-CH-50
MSI-BR-RTD

**Notes**