User's Manual

Model 701957 Bridge Head (DSUB-120 Ω, Shunt CAL, Enhanced Shield)
Model 701958 Bridge Head (DSUB-350 Ω, Shunt CAL, Enhanced Shield)

YOKOGAWA
Yokogawa Test & Measurement Corporation

IM 701957-01E
2nd Edition

Foreword

Thank you for purchasing the bridge head (701957/701958).
This User's Manual contains useful information about the function, procedures in connecting the gauge, and handling precautions of the bridge head. To ensure correct use, please read this manual thoroughly before operation.
Keep the manual in a safe place for quick reference in the event a question arises.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the device's performance and functions.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer as listed on the back cover of this manual.
- Copying or reproducing all or any part of the contents of this manual without YOKOGAWA's permission is strictly prohibited.

Revisions

- 1st Edition: February, 2003
- 2nd Edition: October, 2017

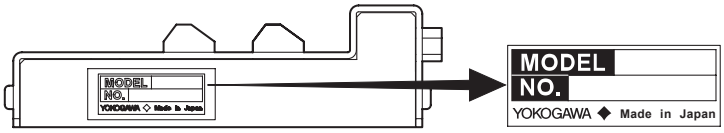
Disk No. DL40
2nd Edition: October 2017 (YMI)

Checking the Contents of the Package

Unpack the box and check the contents before using the device. If the contents are not correct or missing or if there is physical damage, contact the dealer from which you purchased them.

Bridge Head

Check that the model name given on the name plate match that on the order. When contacting the dealer from which you purchased the device , please quote the device No.



Model

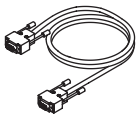
Model	Specifications	Description
701957	Bridge resistance 120 Ω	Shunt CAL, enchanced shield
701958	Bridge resistance 350 Ω	Shunt CAL, enchanced shield

No. (Device number)

When contacting the dealer from which you purchased the device, please quote this number.

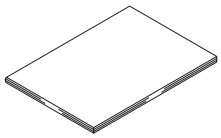
Standard Accessories

D-Sub cable
(for 701957, 701958)
B8023WP
Length: 5 m



Attaching Plate
B9947KR
2 Binding screws
(M4 × 5 mm)

This User' Manual



Conventions Used in this Manual and on the Device

Symbols Used on the Device

GND terminal

The operator must refer to an explanation in the User's Manual.

Symbols Used in this Manual

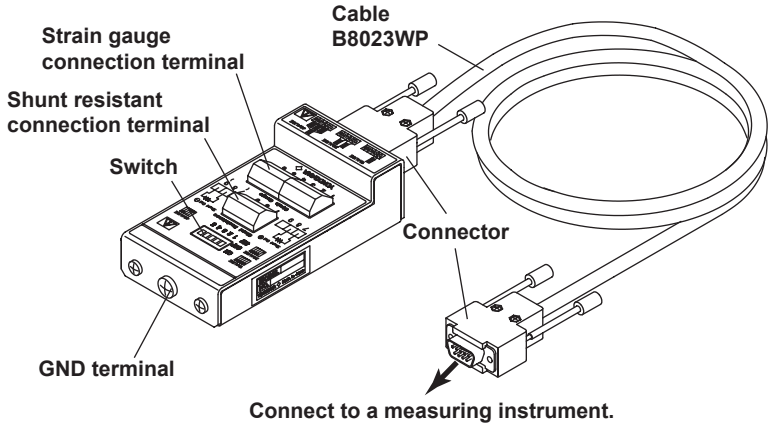
Note Provides important information for the proper operation of the device.

Contents

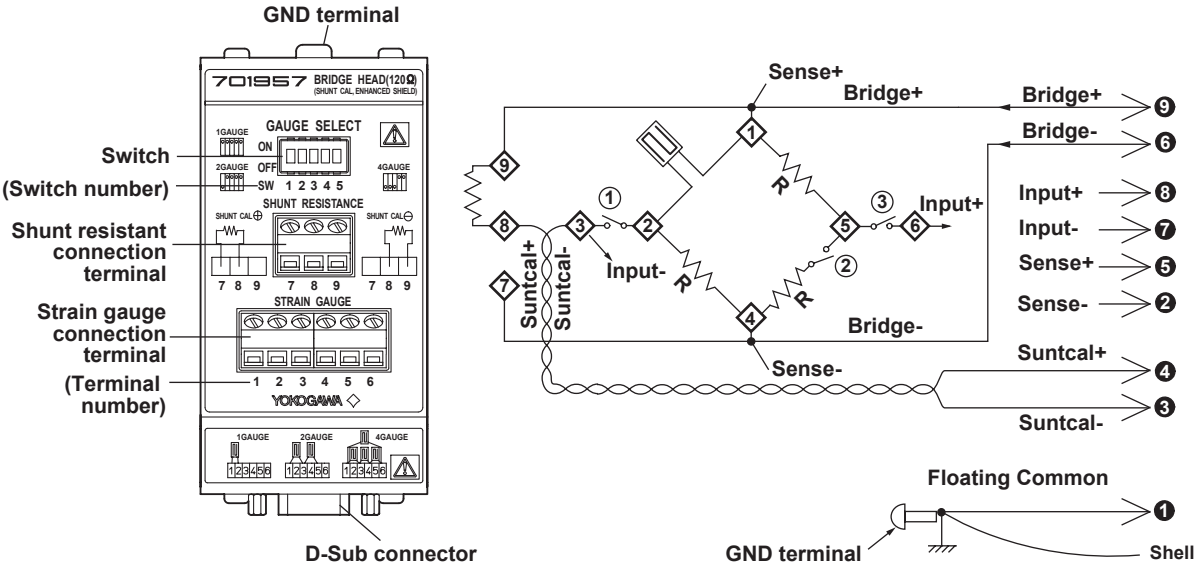
1 Construction of the Device

The bridge head is a converter for inputting the amount of change of the resistance of the strain gauge to the amplifier. Six types of connection methods (single-gauge, single-gauge three-wire, adjacent-side two-gauge, opposed-side two-gauge, opposed-side two-gauge three-wire, and four-gauge) are supported by setting the switch.

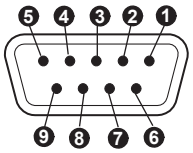
Names of the Parts



Terminals and Circuit Diagram



Pin assignments of the connector (Bridge head side)

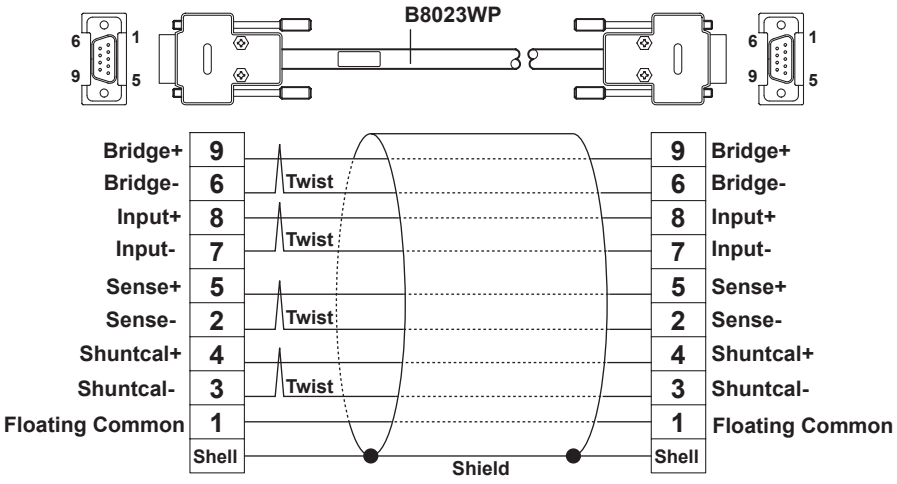


Pin symbol	Signal name
❶	Floating common
❷	Sense– (Sensing of the bridge voltage-)
❸	Shuntcal–(Shunt signal–)
❹	Shuntcal+(Shunt signal +)
❺	Sense+ (Sensing of the bridge voltage+)
❻	Bridge– (Bridge voltage –)
❼	Input– (Measurement signal –)
❽	Input+ (Measurement signal +)
❾	Bridge+ (Bridge voltage +)

◇ The numbers inside are the terminal numbers.
○ The numbers inside are the switch numbers.
● The numbers inside are the pin numbers of the connector.

Wiring for Accessory Cable B8023WP

A wiring diagram for the accessory cable is given below. The connector shell connects to the shielding.



Note

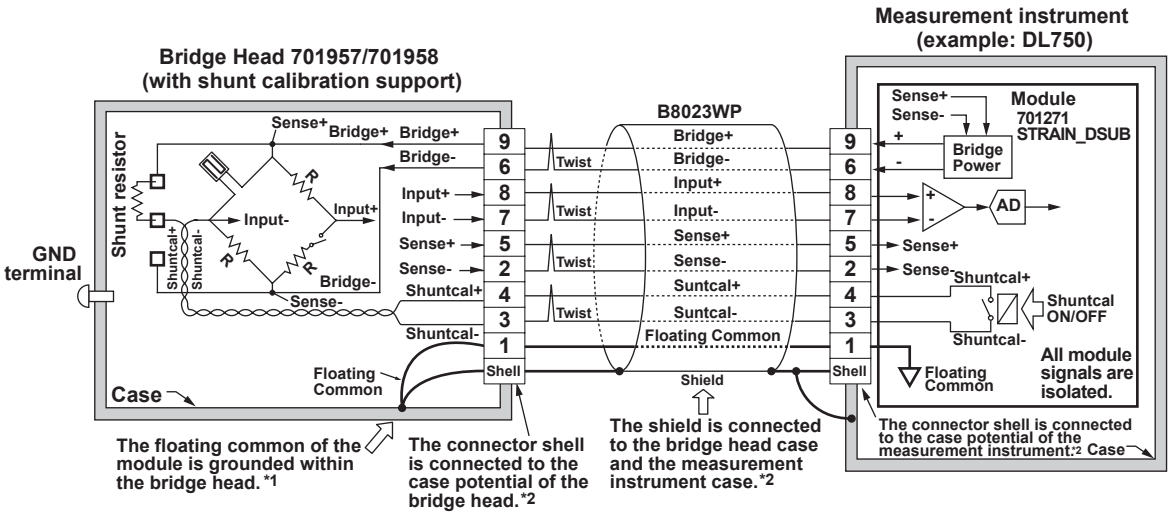
Check the shape and pin assignment of the connector before connecting it to the accessory cable.

Circuit Diagram for Bridge Head and Measuring Instrument

The circuit diagram below shows the bridge head connected to a measuring instrument (the DL750). Isolate the strain gauge before use.

CAUTION

Do not connect the strain gauge terminal to any items with electric potential.

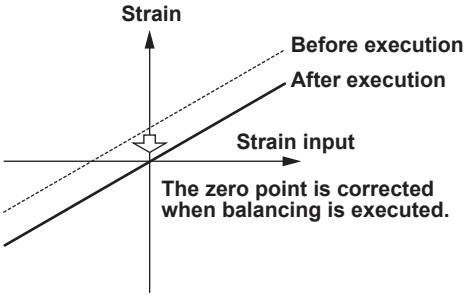


*1 The GND (floating common) of the module is connected to the case potential inside the bridge head.
*2 The bridge head case, the cable shield, and the measurement instrument case are connected as measures against noise.

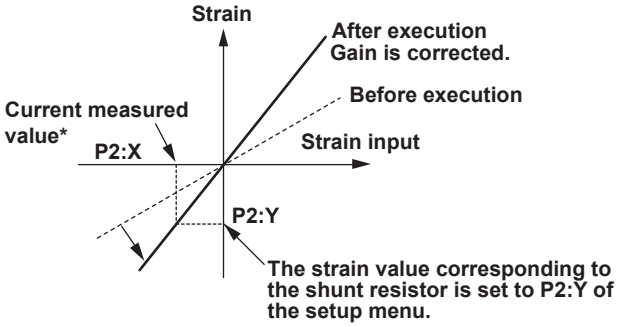
2 Shunt Calibration

This instrument supports shunt calibration. When executing shunt calibration, perform balancing without applying a load to the strain gauge, then turn on shunt resistance. The values from the shunt resistance are stored on the measuring instrument.

Balance



Shunt calibration



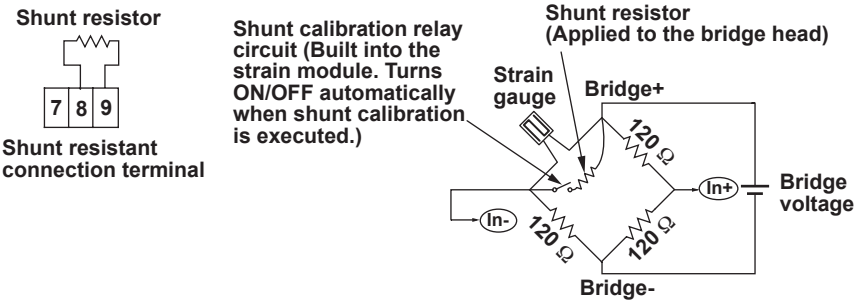
*** Automatically obtained when shunt calibration is executed.**

Shunt calibration is used to correct the gain of strain measurements by inserting a known resistance (shunt calibration resistance (shunt resistance)) in parallel with the strain gauge. With this instrument, the gain can be corrected on both the positive and negative sides. Make sure to notice whether the corresponding strain values are positive or negative.

When correcting the gain on the negative side (normal)

Shunt resistor insertion terminal: between 8 to 9

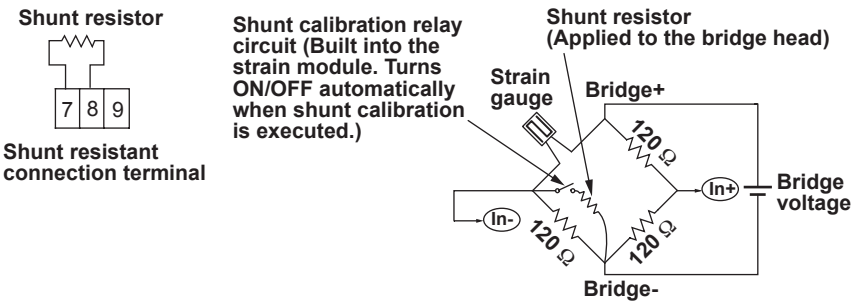
Set negative to the corresponding strain value.



When correcting the gain on the positive side

Shunt resistor insertion terminal: between 7 to 8

Set positive to the corresponding strain value.



For specific instructions on performing shunt calibration, refer to your measuring instrument's user's manual. For information on shunt resistance and the corresponding strain values, see page 13 in "Calculation of the Shunt Resistance."

3 Connecting the Strain Gauge

The bridge head can support six types of connection methods: single-gauge, single-gauge three-wire, adjacent-side two-gauge, opposed-side two-gauge, opposed-side two-gauge three-wire, and four-gauge.
Do not connect the strain gauge terminal to any items with electric potential.

CAUTION

Do not connect the strain gauge terminal to any items with electric potential.

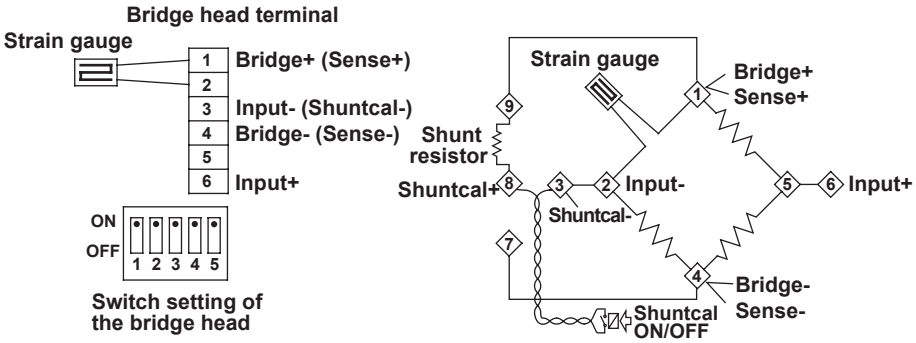
Use the lead wires included with the strain gauge or wires meeting the following specifications to connect the strain gauge and the bridge head.

- Usable wire: single wire ϕ 0.14 to 1.5 mm^2, or stranded wire 0.14 to 1.5 mm^2 (AWG26 to 16)
- Normal length of bare wire : 6 mm

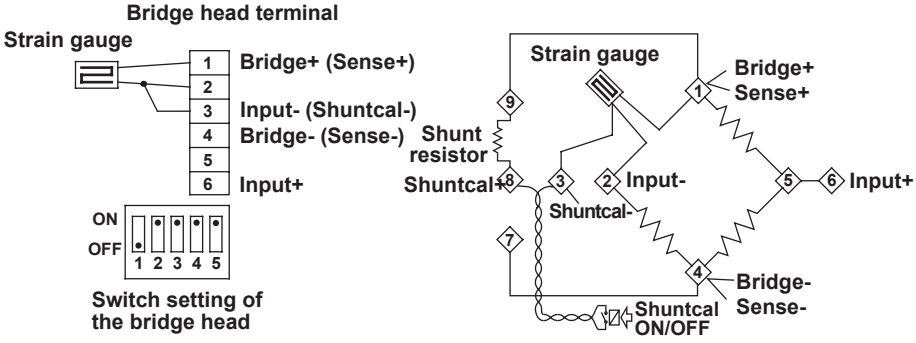
Note

- Isolate the strain gauge before use.
- Make the wires between the strain gauge and bridge head as short as possible.
- Proper measurements may not be possible in an environment where electromagnetic interference exists.
- If you are shielding the strain gauge, connect the shield wire to the floating common terminal of the bridge head.
- For the handling of the strain gauge, see the instruction manual that came with the shield gauge.

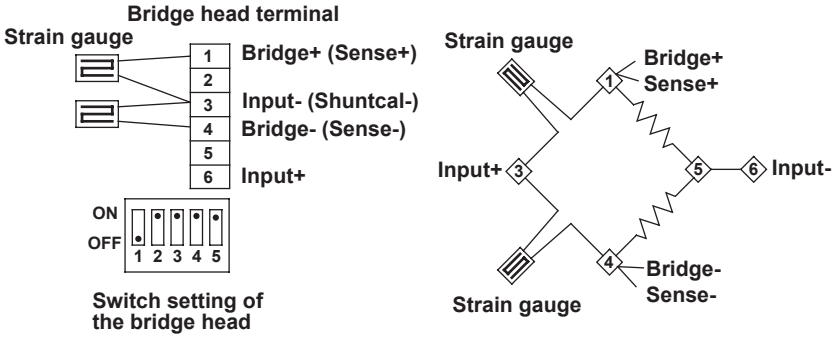
Single-gauge Method



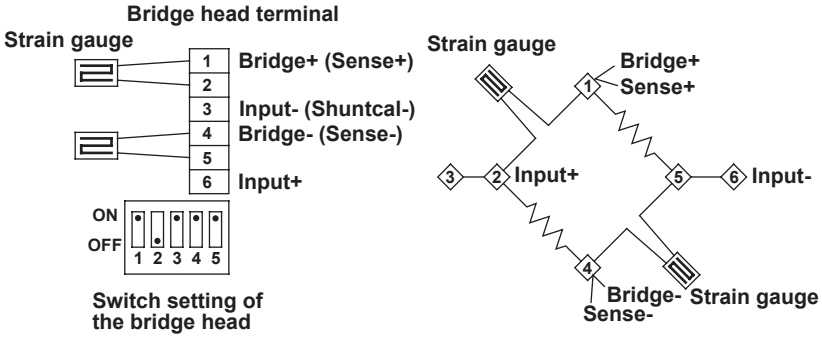
Single-gauge Three-wire Method



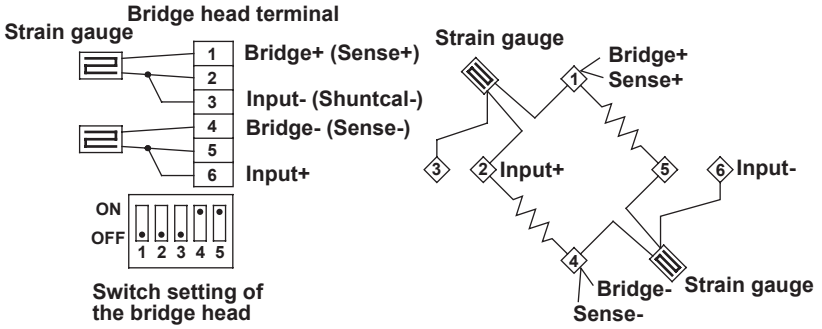
Adjacent-Side Two-gauge Method



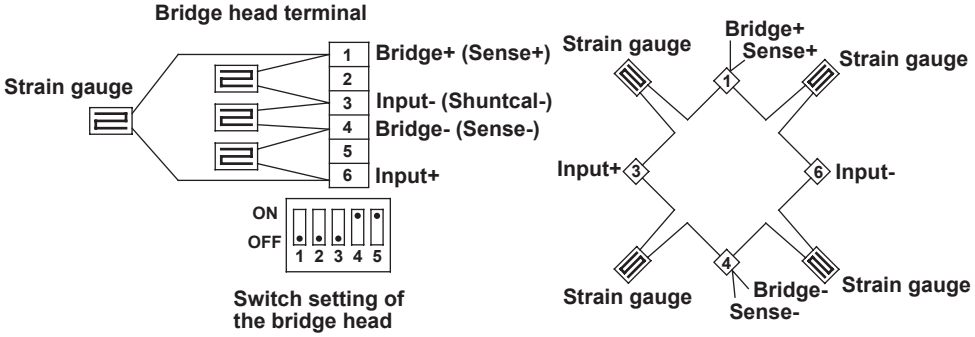
Opposed-Side Two-gauge Method



Opposed-Side Two-gauge Three-wire Method



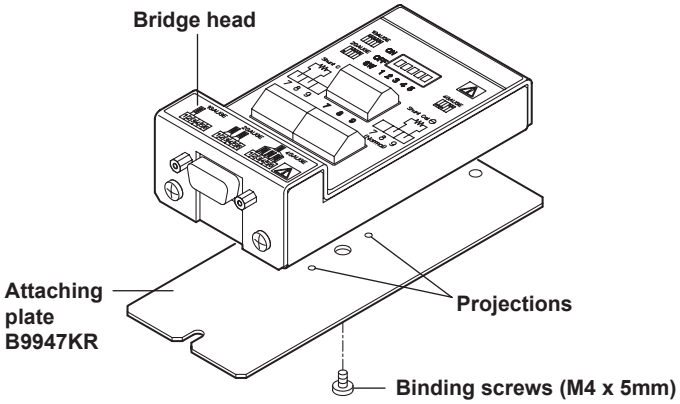
Four-gauge Method



4 Fixing the Device in Place

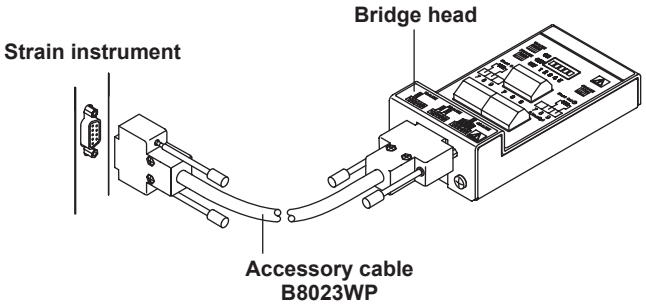
If necessary, you can use the accessory attaching plate, B9947KR, to fix the bridge head to the panel.

1. Align the small holes on the bottom side of the bridge head to the small projections of the attaching plate.
2. Screw the bridge head and the attaching plate together using the accessory binding screws (M4 × 5 mm).



5 Connecting to the Strain Instrument

The bridge head uses a D-Sub 9-pin connector. The accessory cable, B8023WP, is used to connect to the strain instrument.



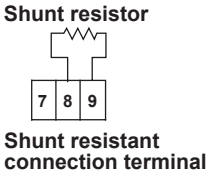
6 Calibrating Using a Shunt Resistor

Shunt calibration can be performed by combining with the YOKOGAWA's strain module (Model 701271 (STRAIN_DSUB) that supports shunt calibration.

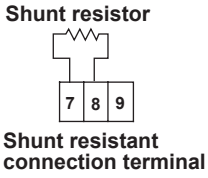
Connection procedures for the shunt resistor

The following two connection methods are available. In normal cases, connect the resistor in correcting the gain on the negative side.

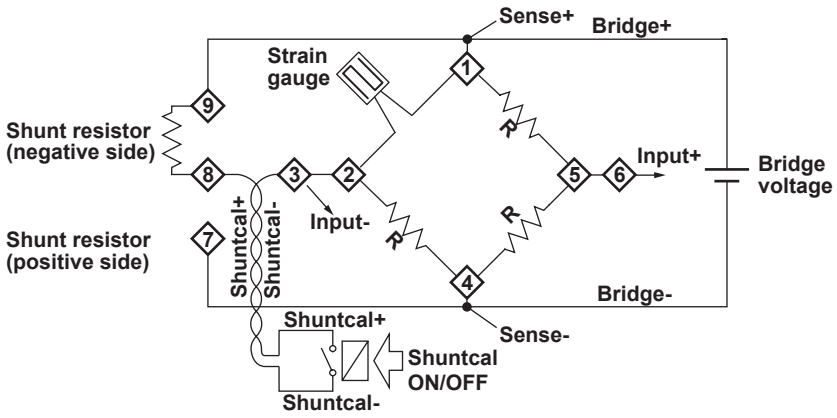
When correcting the gain on the negative side (normal)



When correcting the gain on the positive side



Example for single-gauge method



Calculation of the Shunt Resistance

Shunt calibration and shunt resistance

To execute shunt calibration, the shunt resistance (Rs) and the expected strain (ε) need to be calculated in advance. Use ε as given in the equation below (normally a negative value). With the DL750 (model 7071271), enter the value into "P2-Y" under the shunt calibration execution menu. However, when using the general method given for shunt calibration (the easy method), an error of 1 to 2% can be introduced as the strain value (ε) increases. Therefore, calculate using the detailed method whenever possible. Also, you must select a setting range value that will not result in an overrange.

Equation for Rs and e When Executing Shunt Calibration

- **General Equation**

  $\Delta R/R = K \times \varepsilon$ (1): Basic Equation of Strain

  $\Delta R = R - R//Rs$ (2): Equation of the change in resistance when the shunt resistance is ON

  Note:In this manual, the parallel equation of resistors are expressed as follows:

  $$R//Rs = \frac{1}{\frac{1}{R} + \frac{1}{Rs}} = \frac{R \times Rs}{R + Rs}$$

  If ΔR is cancelled out from (1) and (2),

  $Rs = R \times (1 - K \times \varepsilon) / (K \times \varepsilon)$ (Equation A): General equation used to calculate the shunt resistance (includes error)

  ε: Strain (strain you wish to generate when the shunt resistance is turned ON)
  K: Gauge factor
  R: Bridge resistance
  ΔR: Resistance change
  Rs: Shunt resistance (shunt resistance you wish to derive)

- **Detailed Equation**

$V_0=E\times(R_1\times R_3-R_2\times R_4)/\{(R_1+R_2)\times(R_3+R_4)\}$

(1): Basic Equation of Wheatstone Bridge

When shunt calibration is ON,

$V_0=E\times(R_1\times R_3-R'\times R_4)/\{(R_1+R')\times(R_3+R_4)\}$

(2): Equation when turned ON

$R'=R_2//Rs$ (3): Equation of combined resistance R'

$R_1=R_2=R_3=R_4=R$ (4): Since R_1 to R_4 are equal, we represent them as R

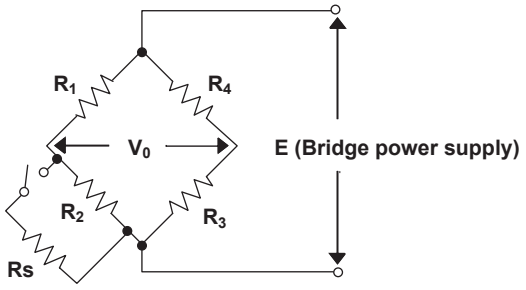
Also, from the basic equation of strain,

$V_0/E=K\times\varepsilon/4$ (5): Basic equation of strain

If V_0/E and R_1 to R_4 are cancelled out from (2), (3), (4), and (5),

$Rs=R\times(1-K\times\varepsilon/2)/(K\times\varepsilon)$ (Equation B): Detailed equation used to calculate the shunt resistance (no error)

E:	Bridge voltage
V_0:	Bridge output voltage
R_1 to R_4:	Bridge resistance (except, $R_1=R_2=R_3=R_4$)
Rs:	Shunt resistance (shunt resistance you wish to derive)
R':	Combined resistance when the relay is turned ON (R'=R//Rs)



Calculation Example

- **When Determining the Corresponding Shunt Resistance (Rs) from the Strain (ε)**
  Given a gauge factor (K) of 2,
  Detailed equation (equation B) Rs = R×(1–ε)/(2×ε) (6)
  General equation (equation A) Rs = R×(1–2×ε)/(2×ε) (7): Error of 1 to 2% present

Desired Strain ε (μSTR)	Derived by the Detailed Equation (6) Rs Value (Ω)		Rs value (Ω) Derived by the General Equation (7)	
	R=120 Ω	R=350 Ω	R=120 Ω	R=350 Ω
1,000	59,940	174,825	59,880	174,650
2,000	29,940	87,325	29,880	87,150
5,000	11,940	34,825	11,880	34,650
10,000	5,940	17,325	5,880	17,150

- **When Determining the Corresponding Strain (e) from the Shunt Resistance (Rs)**
  If we derive e from equation (6) and (7),
  Detailed equation (equation B) ε = 1/(1+2×Rs/R) (8)
  General equation (equation A) ε = 1/{2×(1+Rs/R)} (9): Error of 1 to 2% present

When the Bridge Resistance R is 120 W

RS Value (Ω)	Strain ε (μSTR) Derived by the Detailed Equation (8)	Strain ε (μSTR) Derived by the General Equation (9)
60,000	999	998
30,000	1,996	1,992
12,000	4,975	4,950
6,000	9,901	9,804

When the Bridge Resistance R is 350 W

RS Value (W)	Strain ε (μSTR) Derived by the Detailed Equation (8)	Strain ε (μSTR) Derived by the General Equation (9)
180,000	971	970
90,000	1,941	1,937
36,000	4,838	4,814
18,000	9,629	9,537

For the procedures related to performing the shunt CAL, see the manual that came with the strain module that you are using.
Shunt CAL may not operate correctly on some strain measurement instruments. Check this with the manual that came with the strain measurement instrument.

7 Specifications

Bridge resistance

Model 701957: 120 Ω
Model 701958: 350 Ω

Applicable gauge methods

Single-gauge
Single-gauge three-wire
Adjacent-side two-gauge
Opposed-side two-gauge
Opposed-side two-gauge three-wire
Four-gauge

Operating conditions

Temperature: 5 to 40°C
Humidity: 20 to 85% RH

External dimensions

Approx. 50(W) × 101(H) × 29(D) mm

Weight

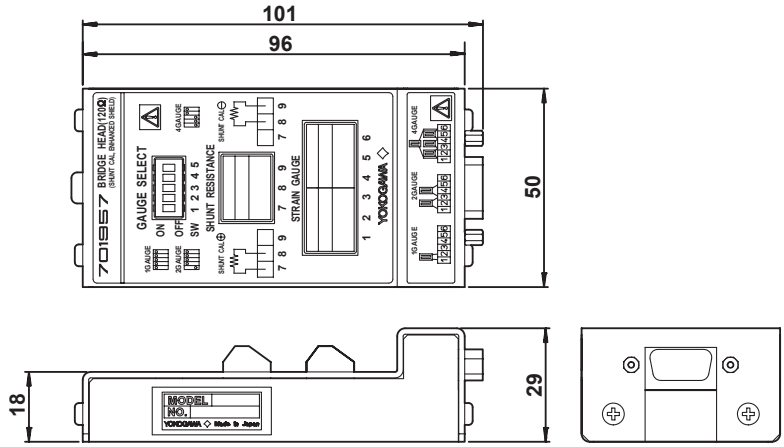
Approx. 100 g (Bridge head only)

Standard accessories

Cable (part no.: B8023WP):	1 piece, with D-Sub connector, 5 m in length
Attaching plate (part no.: B9947KR):	1 piece, with two M4 binding screws
User's manual:	1 piece, this manual

External drawings

Bridge head



Attaching plate