



INSTRUMENTATION AMPLIFIER

WGA-650B

INSTRUCTION MANUAL

Thank you for purchasing KYOWA's product
WGA-650B Instrumentation Amplifier.

Read this Instruction Manual carefully in order to
make full use of the high performance of the
product.

Do not use the product in methods other than
described in this Manual.



Address: 2-4-3, Hitotsubashi, Chiyodaku, Tokyo 101-0003 Phone:03-5226-3551 Fax:03-5226-3563

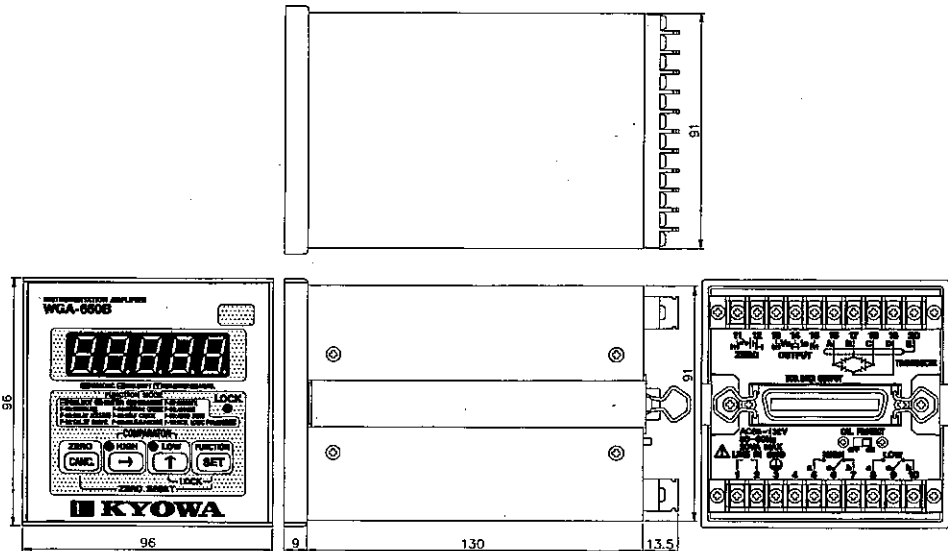
This Product is a copyright of KYOWA ELECTRONIC INSTRUMENTS CO., LTD. And may not be copied, in
whole or part, without consent of KYOWA.

The Manual has been complied with great care. However, if the need should arise for more information, contact
KYOWA or our representatives.

The contents of the Manual are subjected to change without notice.

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SAFETY PRECAUTIONS


PRIOR TO USE

This Instruction Manual describes details of WGA-650B Instrumentation Amplifier (hereinafter referred to as the WGA-650B).
For safe use of the WGA-650B, do not forget to read the "Safety Precautions" prior to use.
KYOWA ELECTRONIC INSTRUMENTS CO., LTD. assumes no liability for any damages resulting from the user's failure to comply with the safety precautions.



SAFETY SYMBOLS

For safety operation of the WGA-650B, the following "WARNING" and "CAUTION" symbols are used in "Safety Precautions" of this Instruction Manual.

 WARNING	Improper operation of the system may result in death or severe injury of the operator.
 CAUTION	Improper operation of the system may result in injury of the operator and physical damage of the system.

In addition, items in  **CAUTION** may lead to serious consequences. Take special attention to the Safety Symbols.

The following symbols are use in the WGA-650B to call operator's attention when operating the product.

Safety Symbols used in the WGA-650B.	
 WARNING	Indicates "Handling Precautions." This symbol is attached to the WGA-650B when it requires to refer to the Instruction Manual for securing safety of the operator and the product.
 CAUTION	Indicates "Protective Ground Terminal." Always connect to ground before operating the product.

WARNING

- 1) If the potential secondary damage generates in the System due to deterioration of the WGA-650B, always adopt another proper technical measures for safety.
Or, trouble may occur caused by erroneous output or malfunction of the instrument.
- 2) Installation and wiring work should be conducted more than 3 seconds after the power OFF.
Or, electric shock hazard or damage of the product may result.
- 3) Do not forget to put a cover on the terminal board.
Or, electric shock hazard may result.
- 4) Special care should be taken not to use the WGA-650B in environment with inflammable gas or vapor
Or, fire hazard may result.
- 5) If the WGA-650B is faulty, emitting smoke or offensive odor or producing abnormal sound, immediately turn OFF the power.
Or, electric shock or fire hazard may result.
Contact KYOWA'S representative for repair.
- 6) Do not put water or foreign matters into the WGA-650B. In case if any foreign matters are entered, immediately turn OFF the power.
Or, electric shock or fire hazard may result.
Contact KYOWA's representative for repair.
- 7) If the power cable is damaged, turn OFF the power and replace the cable with a new one.
Or, electric shock or fire hazard may result.
- 8) Always operate the WGA-650B with power voltage specified in this Instruction Manual.
Or, electric shock or fire hazard may result.
- 9) Do not operate the WGA-650B in environment with excessive moisture, dust or oil dust.
Or, electric shock or fire hazard may result.
- 10) Do not disassemble the WGA-650B.
Or, deterioration or malfunction of the instrument may result.
- 11) When it started thundering, do not touch the WGA-650B or cables.
Or, electric shock hazard may result.
- 12) Always ground a protective ground terminal.
Or, electric shock hazard or malfunction of the instrument may result.

5. SPECIFICATIONS

5-1 SPECIFICATIONS

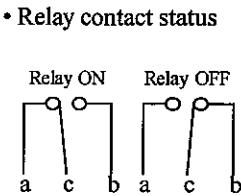
Model Name	WGA-650B	
Number of measuring channels	1	
Applicable Sensor	Strain Gage Transducer	
Applicable Bridge Resistor	87.5 to 350 Ω (Four 350 Ω resistor in parallel connection)	
Bridge Excitation	2 VDC, 10 VDC	
Measuring range	0 to 2.5 mV/V.	
Initial Adjustment Range	± 2 mV/V (For analog and digital adjustment)	
Calibration Function	Sensitivity registering calibration, actual load calibration (Selectable)	
Display	-1999 to 19999 (Decimal point can be set to any point) Character height: 15 mm, Color: Red, 7 seg LED	
Sampling Rate	4 times/second	
Non-Linearity	$\pm (0.03\% \text{ FS} + 1 \text{ digit})$	
Temperature Stability	Zero:	$\pm 0.5 \mu \text{ VRTI}/^\circ\text{C}$
	Sensitivity:	$\pm 0.0025\%/^\circ\text{C}$
Zero Compensation Function	Digital Zero function, Automatic Zero correction	
Additional Function	Setting range:	-1999 to 19999
High/Low Limit Comparator Function	Number of points:	2 (High and Low)
	Setting range:	-1999 to 19999
	Contact output:	Relay contact output (Transfer)
	Contact capacity:	250 VAC, 0.5 A (Resistance load)
Low Pass Filter	Analog filter:	1 Hz
	Smoothing function:	Moving average, minimum scale
D/A Output	Voltage output:	0 to 10 V (Load resistor 2 k Ω or more) Optional scaling available
	Current output:	4 to 20 mA (Load resistor 500 Ω or less) Corresponding to voltage output 0 to 10 V)
	Withstand voltage	500 VAC between output and mainbody
BCD Output (Only for WGA-650B-1)	Output format:	Insulated open collector output Can set BCD output logic.
	Drive capacity:	30 VDC, 20 mA
	Output:	BCD 5-digit display, minus code, OVER, printout command (EOC)
	Connector:	57-40360 (DDK made) or equivalent
Check Function	Transducer check, Self-check	
Operating Temp & Humidity Range	-10 to 50 $^\circ\text{C}$, 20 to 85% RH (Non-condensing)	
Power Supply	85 to 132 VAC or 170 to 264 VAC 50/60 Hz single phase, 20 VA or less	
Dimensions	96(W) \times 96(H) \times 139(D) (Protruded portions not included)	
Weight	Approx. 1.3 kg	

4-2-4 Setting High/Low Limit Comparator Function

High/low limit Comparator function is a function that compares the indicated value with the set value and outputs the result. The compared result is obtained as relay contact output from the rear terminal board and indicated on the HIGH/LOW LEDs on the front panel.

1) Relay Contact and LED Display Against High/Low Limit Comparator Conditions

Comparator Condition	High Relay	Low Relay	HIGH LED	LOW LED
Power OFF	ON	ON	OFF	OFF
Indicated Value ≥ High Limit	ON	OFF	ON	OFF
Low Limit < Indicated Value < High Limit	OFF	OFF	OFF	OFF
Indicated Value ≤ Low Limit	OFF	ON	OFF	ON



Setting High/Low Limit Value

- (1) Press the **[HIGH]** (or **[LOW]**) key for 2 seconds in the measuring mode. The current set value is indicated and the highest-order digit flickers.
At this time, the **[HIGH]** (or **[LOW]**) LED flickers.
- (2) Select the desired digit and move the flickering with the **[→]** key and change the numeric value with the **[↑]** key.
Decimal point position is determined by the calibration value.
- (3) Press the **[SET]** key to determine the setting

⚠ CAUTION

- 1) Before wiring, always confirm the rated power voltage of the WGA-650B and terminal arrangement. Then, conduct wirings in the correct manner.
- 2) Power consumption of the WGA-650B is maximum 20 VA. If it is unavoidably operated in environment with poor power condition, it is recommended to use an insulated constant voltage transformer or the like.
- 3) Special care should be taken when using the WGA-650B in environment with excessive vibration. If the WGA-650B is operated in a location with excessive vibration or with continuous vibration, it may cause measurement error and/or failure of the instrument. Take care not to drop it during transportation and avoid applying strong impact. Or, deterioration of the instrument may result.
- 4) Basically, the WGA-650B is designed to be used by connecting a strain gage type transducer to the input terminal. If it is used by connecting to transducers other than above, contact KYOWA for information.
- 5) Operate the WGA-650B by conforming to an operating environment specified in this Instruction Manual. Or, malfunction and/or failure of the instrument may result.

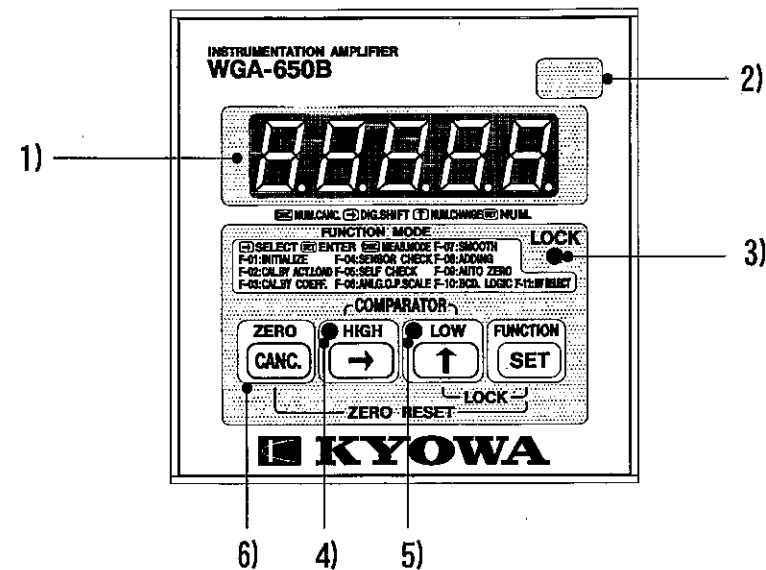
STANDARD ACCESSORIES

The following accessories are enclosed with the WGA-650B. After unpacking, check all the accessories are correctly prepared.

Unit label	1
AC Cord	1
Warranty	1
Instruction Manual	1

1. PARTS NAMES & PRINCIPAL FUNCTIONS

1-1 FRONT PANEL



- 1) Indicator
 - Indicates measured value, various selected functions, and set values.
 - Normally, measured value responding to the output from the transducer are indicated. However, if error occurs, the following appears.
 - OFL 1: When measured value exceeds the measuring range to the minus side.
 - OFL 2: When measured value exceeds the measuring range to the plus side.
 - OFL 3: When the indicated value is less than -1999.
 - OFL 4: When the indicated value exceeds 19999.
- 2) Unit Label
- 3) [LOCK] LED
 - When this [LOCK] LED is lit or flickering, no functions are set. Always turn OFF the [LOCK] LED before setting functions. However, set value is displayed even when the [LOCK] LED lit.
- 4) [HIGH] Limit LED
 - Lights up when the measured value exceeds the high limit value. Flickers when the high limit value is indicated.
- 5) [LOW] Limit LED
 - Lights up when the measured value is less than the low limit value. Flickers when the low limit value is indicated.
- 6) Operation Key
 - A pushbutton switch to operate the WGA-650B. For operation, see "4. OPERATION & FUNCTIONS."

4-2-3 Digital Zero Function

Digital Zero function is a function that defines the reference point of the indicator. It is as same setting the scale pointer to '0.'

There are 2 methods for defining the reference point (Zero); by key operation and by voltage input from the rear panel.

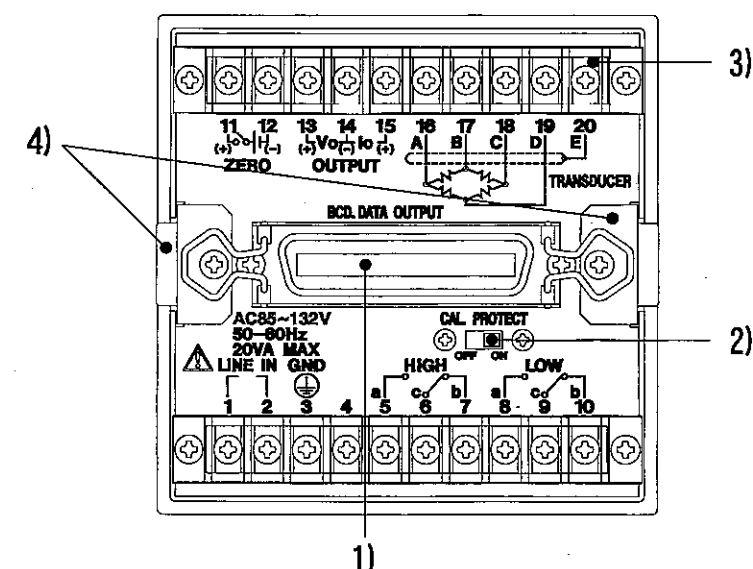
- 1) Key Operation
 - Press the [ZERO] key in the measuring mode for 2 seconds and the digital Zero function is activated to set the indication to '0.'
 - If the additional value is set, it indicates the determined additional value.
 - Press the [ZERO] and [SET] keys together for 2 seconds. Then, the digital Zero function is cancelled to return the indication to '0' obtained in the initial adjustment.
- 2) Operation From the Rear Panel
 - Apply DC voltage from 10 to 30 volts. 11 and 12 (Zero) of terminal board on the rear panel to activate the digital Zero function.
 - This function is also allowed when the [LOCK] LED is lit.
 - While applying the above voltage, since it is conducting digital Zero function, '0' is indicated on the indicator.
 - Set the applied voltage to 0 V or stop applying the voltage to return to measuring mode obtained after the digital Zero function.
 - Note that you cannot cancel the digital Zero function from the rear panel.
 - Adjusting values conducted by the above terminals shall be invalid with the power turned OFF.

Function Selecting Mode	Function Name	Key Operation & WGA-650B Movement in Function Setting Mode	Functional Description												
F-09	Auto Zero Compensation	Set Zero compensation range and press the SET key. • Zero compensation range - (Set value) to + (Set value)	• A function that automatically zeros the indicated value when the measured value exists in the preset range for more than 2 seconds.												
F-10	BCD Output Logic	Set the desired BCD data output logic and press the SET key. (Specified only for the WGA-650B-1) Display 0: Negative logic (Prior to shipment) 1: Positive logic	• A function that sets output logic of BCD data. • Open collector transistor output. • Output state is described in the following.												
		<table border="1"> <tr> <td></td><td></td><td>Negative Logic</td><td>Positive Logic</td></tr> <tr> <td>Signal is</td><td>output</td><td>Transistor: ON</td><td>Transistor: OFF</td></tr> <tr> <td>No signal</td><td></td><td>Transistor: OFF</td><td>Transistor: ON</td></tr> </table>			Negative Logic	Positive Logic	Signal is	output	Transistor: ON	Transistor: OFF	No signal		Transistor: OFF	Transistor: ON	
		Negative Logic	Positive Logic												
Signal is	output	Transistor: ON	Transistor: OFF												
No signal		Transistor: OFF	Transistor: ON												
F-11	BV Select	BV set value 10: 10 V 2: 2 V Select either of the above BV with the → key and press the SET key.	• A function that selects the bridge excitation voltage. • It is set to 10 (10 V) prior to shipment.												

4-2-2 [CAL PROTECT] Switch

- Setting the [CAL PROTECT] switch on the rear panel to ON side prohibits various functions such as 'F-01' Initial Adjustment, 'F-02' Actual Load Calibration, and 'F-03' Sensitivity Registering Calibration in order to protect erroneous operation of the above functions.
- If calibration is conducted with the [CAL PROTECT] switch turned to ON, the [LOCK] LED flickers to indicate that the [CAL PROTECT] switch is in ON state.
- Before conducting the above functions, F-01' Initial Adjustment, 'F-02' Actual Load Calibration, and 'F-03' Sensitivity Registering Calibration, do not forget to slide the [CAL PROTECT] switch to OFF. After completing the said functions, slide the [CAL PROTECT] switch to ON side to protect erroneous operation of the functions.

1-2 REAR PANEL



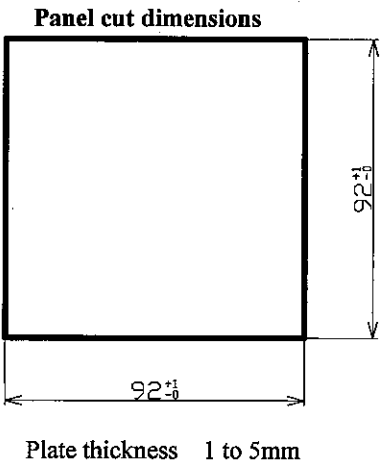
- 1) BCD Data Output Connector An interface to output BCD coded WGA-650B indication.
(Specified only for WGA-650B-1)
- 2) CAL Protect Switch A switch to prohibit the setting of CAL value.
- 3) Terminal Board..... Nos.1 & 2 Power supply input terminal
Connect the AC power line.
No. 3 Protective ground terminal
Do not forget to connect to earth ground to protect from electric shock hazard.
Nos.5 to 7 High limit relay output
No.5: a contact, No.7: b contact
Nos.8 to 10 Low limit relay output
No.8: a contact, No.10: b contact
No. 11 and 12 Digital Zero input
Nos.13 to 15 Analog output
No.13: Voltage output, No.14: Common,
No.15: Current output
Nos.16 to 20 Transducer connection terminals
No.16: Bridge excitation (+), No.17: Bridge output (-),
No.18: Bridge excitation (-), No.19: Bridge output (+),
No.20: Shield
- 4) Fitting Metal Fitting metal for fixing the WGA-650B to the panel.

2. CONNECTION

2-1 INSTALLING TO THE PANEL

To install the WGA-650B to the panel, prepare a panel according to the specified panel cut dimensions as shown at the right. Then, install the WGA-650B by referring to the following instructions.

- 1) Cut out the panel according to the panel cut dimensions.
- 2) Remove screws of the fitting metals attached on both sides of the WGA-650B and then, pull out the fitting metals.
- 3) Set the WGA-650B into the cut out panel frame.
- 4) Set the fitting metals on both sides of the WGA-650B.
- 5) Tighten the screws and firmly fix the WGA-650B into the panel.







2-2 WIRING

- 1) Terminal Board
 - Remove the cover from the terminal board before conducting required wirings.
 - It is recommended to attach press-fit terminals to the connecting wires.
Use the press fit terminals having M3 screw hole and terminal width of 6 mm or less.
 - After completing wirings to the terminal board, do not forget to put a cover on the terminal board.
- 2) Connecting Transducers
 - Connect transducers to terminals Nos. 16 to 20 as described in the following.
(Cable colors are KYOWA's typical color codes.)
No.16: Bridge excitation + side (Red), No.17: Bridge output - side (White)
No.18: Bridge excitation - side (Black), No. 19: Bridge output + side (Green)
No.20: Shield
 - Use as short as possible 4-conductor shield cable for transducer wiring.
In addition, locate the transducer far apart from power lines and wirings interfered with noise.

NOTE

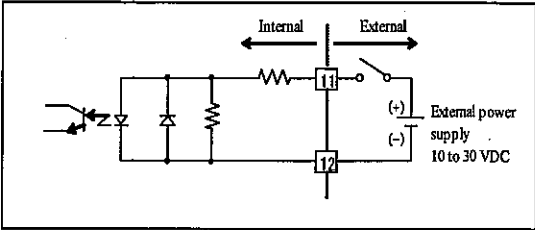
Bridge excitation voltage is set to 10 V prior to shipment.
Before connecting the transducer, check recommended applied voltage of the transducer and if the bridge excitation voltage is 2 V, change it to 10 V. (For how to change the bridge excitation voltage, see "4. OPERATION AND FUNCTIONS.")

Function Selecting Mode	Function Name	Key Operation & WGA-650B Movement in Function Setting Mode	Functional Description																
F-07	Smoothing	<p>Select either the number of moving averages or minimum scale with the  key to determine the numeric value. Press the  key to conduct the smoothing function.</p> <p>Display</p> <div></div> <table><tr><th>No. of moving average times</th><th>Minimum scale</th></tr><tr><td>01: None</td><td>01: Indicates every 1 scale.</td></tr><tr><td>02: 2 (0.5 sec)</td><td>02: Indicates every 2 scales.</td></tr><tr><td>04: 4 (1 sec)</td><td>05: Indicates every 5 scales.</td></tr><tr><td>08: 8 (2 sec)</td><td>10: Indicates every 10 scales.</td></tr><tr><td>16: 16 (4 sec)</td><td>20: Indicates every 20 scales.</td></tr><tr><td></td><td>50: Indicates every 50 scales.</td></tr><tr><td></td><td>00: Indicates every 100 scales.</td></tr></table>	No. of moving average times	Minimum scale	01: None	01: Indicates every 1 scale.	02: 2 (0.5 sec)	02: Indicates every 2 scales.	04: 4 (1 sec)	05: Indicates every 5 scales.	08: 8 (2 sec)	10: Indicates every 10 scales.	16: 16 (4 sec)	20: Indicates every 20 scales.		50: Indicates every 50 scales.		00: Indicates every 100 scales.	<ul style="list-style-type: none">A function that stabilizes the indicated value by smoothing varied signals from the transducer.The following 2 types are set for smoothing. <p>Number of moving averages: Number of average times to indicated the average of the measured value.</p> <p>Minimum scale: The minimum unit by which indicated value varies on the indicator.</p>
No. of moving average times	Minimum scale																		
01: None	01: Indicates every 1 scale.																		
02: 2 (0.5 sec)	02: Indicates every 2 scales.																		
04: 4 (1 sec)	05: Indicates every 5 scales.																		
08: 8 (2 sec)	10: Indicates every 10 scales.																		
16: 16 (4 sec)	20: Indicates every 20 scales.																		
	50: Indicates every 50 scales.																		
	00: Indicates every 100 scales.																		
F-08	Additional Value	<p>Set the desired value to be added and press the  key. Then, the entered value is added to the measured value.</p> <ul style="list-style-type: none">Conduct digital Zero function with additional value determined. Then, the preset value is displayed on the indicator.	<ul style="list-style-type: none">A function that displays the numeric value added with desired additional value																

Function Selecting Mode	Function Name	Key Operation & WGA-650B Movement in Function Setting Mode	Functional Description
F-05	Self-Check	<p>'-----' is indicated.</p> <p>Pressing the SET key at this time alternately lights up the indicator and 3 LEDs lamps for 2 times. You can visually check whether or not the LED lamp is run out.</p> <p>Then, the self-check results are indicated for about 12 seconds.</p> <ul style="list-style-type: none"> If any faulty results appear on the indicator, contact KYOWA or our representative. 	<ul style="list-style-type: none"> A function that conducts self-diagnosis and displays the diagnosed results. The diagnosed results are described as follows. <p>Good : Normal E-01 : Faulty RAM E-02 : Faulty NOV RAM</p>
F-06	Analog Output Scale	<p>Set Zero scale value and press the SET key.</p> <p>Next, set full scale value and press the SET key to scale the analog output.</p> <ul style="list-style-type: none"> Zero scale value: Indicated value to define voltage output to 0V and current output to 4 mA. Full scale value: Indicated value to define voltage output to 10 V and current output to 20 mA. 	<ul style="list-style-type: none"> A function that defines and sets ZERO and full scale values of Analog output.

3) Connecting Zero External Input

- When using Zero external input, connect the external power supply and switch as shown in the right figure.
- Conduct calculation to have the indication Zero when pressing the switch. Release the switch to return to the measuring mode.
- Time required for pressing the switch should be more than 255 ms.



4) Connecting Analog Output

- Use voltage output having load resistance 2 kΩ or more.
- Use current output having load resistance 500 Ω or less.

5) Connecting BCD Output (Specified only for WGA-650B-1)

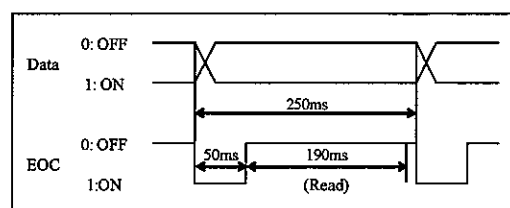
- Pin assignment of the BCD output is described in the following table.

No.	Signal Name	No.	Signal Name
1	COM	19	COM
2	Data 1 output	20	Data 10000 output
3	Data 2 output	21	Data 20000 output
4	Data 4 output	22	Data 40000 output
5	Data 8 output	23	Data 80000 output
6	Data 10 output	24	Unusable *1
7	Data 20 output	25	Unusable *1
8	Data 40 output	26	Unusable *1
9	Data 80 output	27	Unusable *1
10	Data 100 output	28	Minus output
11	Data 200 output	29	Over output
12	Data 400 output	30	EOC output
13	Data 800 output	31	Unusable *1
14	Data 1000 output	32	Unusable *1
15	Data 2000 output	33	Unusable *1
16	Data 4000 output	34	Unusable *1
17	Data 8000 output	35	Unusable *1
18	Blank	36	Blank

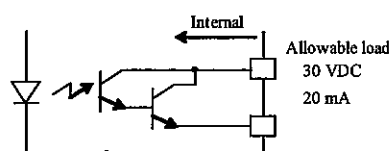
*1 These pins are used for adjusting the WGA-650B on KYOWA's side prior to shipment. Do NOT use.

For output connector, use 57-40360 (Daiichi Kogyo CO., Ltd. made) or equivalent.

Data Output Timing



When reading BCD data (Polarity, over output included) for negative logic, the data is read within 190 ms at the moment when the EOC output changes from ON (Low) to OFF (High).



Output: Open collector
• Signal output terminal: Collector
• COM terminal: Emitter

NOTE

- Example of BCD output negative logic.

Signal Name	Operation of the Open Collector	Voltage When Connecting External Power Load Resistor
Data	0	OFF
	1	ON
Minus (Polarity)	+	OFF
	-	ON
Over output	Normal	OFF
	Over output	ON
EOC (End Of Conversion)	When data is converted	OFF
	When data conversion is finished	ON

Function Selecting Mode	Function Name	Key operation & WGA-650B Movement in Function Setting Mode	Functional Description
F-03	Sensitivity Registering Calibration	<p>Set rated output (Unit:mV/V) of the transducer and press the SET key. Then, set the required value to be indicated at this time and press the SET key. Next, set a decimal point and press the SET key to conduct calibration.</p> <ul style="list-style-type: none"> The above set decimal point position is fixedly displayed for the other functions. Before conducting the sensitivity registering calibration, check the following. (1)Always slide the [CAL PROTECT] switch to the OFF side. Calibration available range is indicated value of 1500 or less per 0.1 mV/V. 	<ul style="list-style-type: none"> A function that conducts calibration by registering the rated output and rated capacity of the transducer without applying the actual load. If it is set outside of the calibration range, error indication 'E-00' is displayed.
F-04	Transducer Check	<p>'-----' is indicated. Press the SET key and input BV value. Setting: 10 (10 BV) 2 (2 BV) Next, press the SET key and '-----' is indicated to check transducer connected state. Then, the checked results are displayed for about 12 seconds.</p> <ul style="list-style-type: none"> Note that transducers may not be correctly checked in the following cases. <ul style="list-style-type: none"> Bridge resistor of the transducer is outside the applicable range. Sensors other than strain gage transducers are used. If any abnormal results appear on the indicator, check the transducer and connection cables by referring to the indication. 	<ul style="list-style-type: none"> A function that checks the transducer connected state. Checked results are indicated as follows. Good: Normal A-nG: Bridge excitation (+) cable is faulty. b-nG: Bridge output (-) cable is faulty. C-nG: Bridge excitation (-) cable is faulty. d-nG: Bridge output (+) cable is faulty. S-nG: Short-circuit mode E-03: Initial value is faulty.

4-2 FUNCTION

4-2-1 Various Functions in Function Selecting Mode

- Function selecting mode has the following 11 functions.

F-01: Initial Adjustment	F-07: Smoothing
F-02: Actual Load Calibration	F-08: Additional Value
F-03: Sensitivity Registering Calibration	F-09: Auto Zero Compensation
F-04: Transducer Check	F-10: BCD Output Logic
F-05: Self-Check	F-11: BV Select
F-06: Analog Output Scale	

- For details of functions, see the following Table 4-2-1.

Table 4-2-1 Various Functions in Function Selecting Mode

Function Selecting Mode	Function Name	Key Operation & WGA-650B Movement in Function Setting Mode	Functional Description
F-01	Initial Adjustment	<p>'-----' is indicated. Press the SET key and '-----' is indicated to adjust initial value of the transducer.</p> <ul style="list-style-type: none"> Before adjusting the initial value, check the following. (1) Always slide the [CAL PROTECT] switch to the OFF side. 	<ul style="list-style-type: none"> A function that adjusts the initial value of the transducer. Conduct this function at least once when connecting transducers.
F-02	Actual Load Calibration	<p>Apply load to the transducer. Set a numeric value to be indicated at this time and press the SET key. Next, set a decimal point and press the SET key to conduct calibration.</p> <ul style="list-style-type: none"> The above set decimal point position is fixedly indicated to other functions. Before conducting the actual load calibration, check the following. (1) Always slide the [CAL PROTECT] switch to the OFF side. 	<ul style="list-style-type: none"> A function that applies the actual load to the transducer and sets the indicated value of that time. Before conducting the actual load calibration, do not forget to adjust the initial value.

3. BASIC OPERATION PROCEDURES

Procedures for operating the WGA-650B are roughly described in the following.
For details, see "4 OPERATION & FUNCTIONS."

Operation Items	Outline of Operation
1) Power ON	<ul style="list-style-type: none"> Power ON and the WGA-650B activates in measuring mode. (See "4-1-1 Key Operation in Measuring Mode.") <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>NOTE</p> <p>When using the WGA-650B in an environment of extremely low temperature, it may take about 1 to 2 minutes to power ON after turning ON the POWER switch.</p> </div>
2) Function Selecting Mode	<ul style="list-style-type: none"> Press the FUNCTION key 2 seconds or more to activate the function selecting mode. (See "4-1-2 Key Operation in Function Selecting Mode.")
3) Adjusting Initial Value	<ul style="list-style-type: none"> Set the indication to function 'F-01' and press the SET key. Always adjust the initial value once when connecting transducers. (See "4-1-2 Key Operation in Function Selecting Mode.")
4) Calibration	<ul style="list-style-type: none"> Set the indication to function 'F-02' to conduct the actual load calibration or set it to function 'F-03' to conduct sensitivity registering calibration. (See "4-2-1 Various Functions in Function Selecting Mode.")
5) Changing Mode	<ul style="list-style-type: none"> Press the CANC key to activate the measuring mode. (See "4-1-2 Key Operation in Function Selecting Mode.")
6) Setting High/Low Limit	<ul style="list-style-type: none"> Press the HIGH key 2 seconds or more to activate the high limit setting mode and then, set the high limit value. In the same manner, press the LOW key 2 seconds or more to set the low limit value. (See "4-2-4 High/Low Limit Comparator Function.")
7) Adjusting External Output	<ul style="list-style-type: none"> To activate analog output, set the analog output scale value with function 'F-06.' To activate BCD output, set BCD output logic with function 'F-10.'
8) Others	<ul style="list-style-type: none"> To settle the unstable indication, use function 'F-07 Smoothing.' To add or subtract the constant, use function 'F-08 Additional.' To set the indication to Zero, press the ZERO key 2 seconds or more. (See "4-2-3 Digital ZERO Function.")

NOTE

- When the [LOCK] LED is lit, no setting is allowed.
- Before setting the required items, always turn OFF the [LOCK] LED on the front panel as well as slide the [CAL Protect] switch on the rear panel to the OFF side.
- After setting is completed, turn ON the [LOCK] LED and slide the [CAL Protect] switch to the ON side.

4. OPERATION & FUNCTIONS

4-1 KEY OPERATION

4-1-1 Key Operation in Measuring Mode

- Power ON the WGA-650B and the measuring mode activates.
- In the measuring mode, by combining with a strain gage type transducer, the WGA-650B measures load, pressure, torque, displacement and other physical quantities and indicates the measured values on the indicator.
- Various key operations in the measuring mode moves the mode to high/low limit setting mode, function selecting mode, and to the [LOCK] state.
However, if it is in the [LOCK] state (with [LOCK] LED lit), key operations thereafter may be limited.
For details, see the following "Table 4-1-1".

Table 4-1-1 Key Operation in Measuring Mode

Key Operation	When [LOCK] LED is OFF	When [LOCK] LED is ON
Press the [ZERO] key for 2 seconds.	Digital Zero function activates to set the indication to Zero and to return to the measuring mode.	No function is operated.
Press the [HIGH] key for 2 seconds.	High limit setting mode is activated.	Measuring mode moves to the function selecting mode or high/low limit setting mode but no value is set or no function is activated.
Press the [LOW] key for 2 seconds.	Low limit setting mode is activated.	
Press the [FUNCTION] key for 2 seconds.	Function selecting mode is activated.	
Press the [ZERO] + [FUNCTION] keys at the same time for 2 seconds.	Digital Zero function is cancelled and return to the measuring mode.	No function is operated.
Press the [LOW] + [FUNCTION] keys at the same time for 2 seconds.	[LOCK] LED lights up and the WGA-650B returns to the measuring mode.	[LOCK] LED lights out and the WGA-650B returns to the measuring mode.

4-1-2 Key Operation in Function Selecting Mode

- Press the [FUNCTION] key for 2 seconds in the measuring mode to activate the function selecting mode. At this time, function 'F-01' is indicated on the indicator.
- Pressing the [] key in the function selecting mode selects various functions from 'F-01' to 'F-11.'
Select the desired function and press the [SET] key. Then, the selected function is determined to activate the function setting mode.
- There are 11 selective functions.

F-01: Initial Adjustment
F-02: Actual Load Calibration
F-03: Sensitivity Registering Calibration
F-04: Transducer Check
F-05: Self Check
F-06: Analog Output Scale

F-07: Smoothing
F-08: Additional Value
F-09: Auto Zero Compensation
F-10: BCD Output Logic
F-11: BV Select
- For details of functions, see "4-2-1 Various Functions in Function Selecting Mode."
- Press the [CANC] key in the function selecting mode to return to the measuring mode.
- In addition, when no key is operated for about 12 seconds, the WGA-650B returns to the measuring mode.

4-1-3 Key Operation in Function Setting Mode

- Select the desired function in the function selecting mode and press the [SET] key to activate the selected function mode.
- To set the desired numeric value(s), change the current numeric value with the [] or [↑] key and press the [SET] key to determine the desired value and to store it in the inner memory at the same time.
- When no numeric value(s) is set, "....." is indicated. Press the [SET] key in this state to activate the selected function.

• Numeric Value Setting Procedures

- (1) When setting a numeric value, setting available digits flicker.
- (2) Pressing the [] key moves the flickering digit to the right. The flickering digit next to the right end moves to the left end digit.
- (3) Pressing the [↑] key varies the numeric value of the flickering digit in due order as shown in the following.

Numeric value in left end digit

→ 1 → - → - → 1 → - → - → 1 → - → - →

Numeric value in other digits

→ 0 → 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 0 →

- (4) Decimal point is set in calibration functions 'F-02 and F-03.'

At this time, a decimal point moves to the right by pressing the [] key and after the right end, the decimal point moves to the left end.

Pressing the [CANC] key on the way returns to the previously set function selecting mode.

- When no key is operated for about 12 seconds, the WGA-650B returns to the measuring mode.