Ver. 1.0

MODEL: DN-FGA
FORCE GAUGE

# Operating Manual

## DACELL CO., LTD.

Address: 681-1, Cheoksan-ri, Nami-myeon, Cheongwon-gun, Chungbuk
TEL: +82-43-260-2242
FAX: +82-43-260-2245
Website: http://www.dacell.com
E-Mail: info@dacell.com

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# 1. Special Features

Thank you for using our product. If you find any problem during use, refer to this Operation Manual for the appropriate action or call us.

This product is an indicator that amplifies the micro voltage signal of various sensors and indicates in digital; it is mainly used to measure the physical quantity of the load cell, pressure sensor, displacement sensor, and torque sensor of a strain gauge, etc., and has the following special features:

## 1-1. Method of Conversion

This product uses a 16-bit high speed A/D conversion device that detects the input signal of a sensor at a speed of 100 times/second.

Using a 12-bit D/A conversion device, it outputs the indication value in analog format.

## 1-2. Method of Calibration

It adopts two kinds of methods: the calibration method by the actual load (standard weight), and by the rate output of the sensor.

## 1-3. Hold Function

It is usable by selecting the Peak Hold and the Sample Hold.

## 1-4. Comparison Output

Setting of the highest value and the lowest value is possible; the comparison output is done by an open collector signal.

## 1-5. Data Back-up

All setting values are memorized, and the flash memory and input data can be saved even in a power outage, thus, resetting is not needed.

## 1-6. Electric Source

Nickel hydrogen (NimH), Charging Adapter (DC 9V)

## 2. Notes

For performance and safe use of this product, please be aware of the following notes. In particular, do not use this instrument for any other purpose than was it is intended for, and do not remodel it arbitrarily.

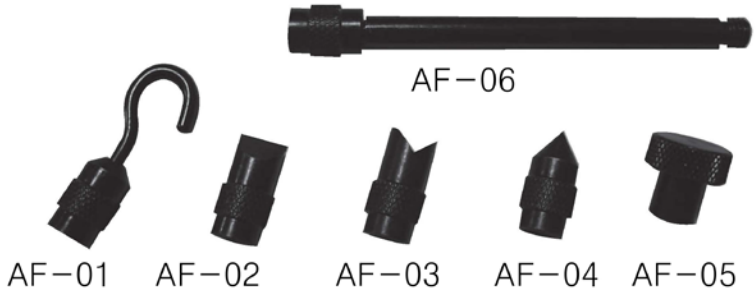
### 2-1. Notes before Use

- Key is activated by pressing lightly, so do not press it too hard.
- When washing it, do not use inflammables.
- Do not let it get wet.
- Avoid placing it in extreme temperatures.
- Do not install it near high voltage or electrical noise.
- Store it in a dry place.
- Do not use it near strong sunlight or where it is overly dusty.

## 3. Specifications

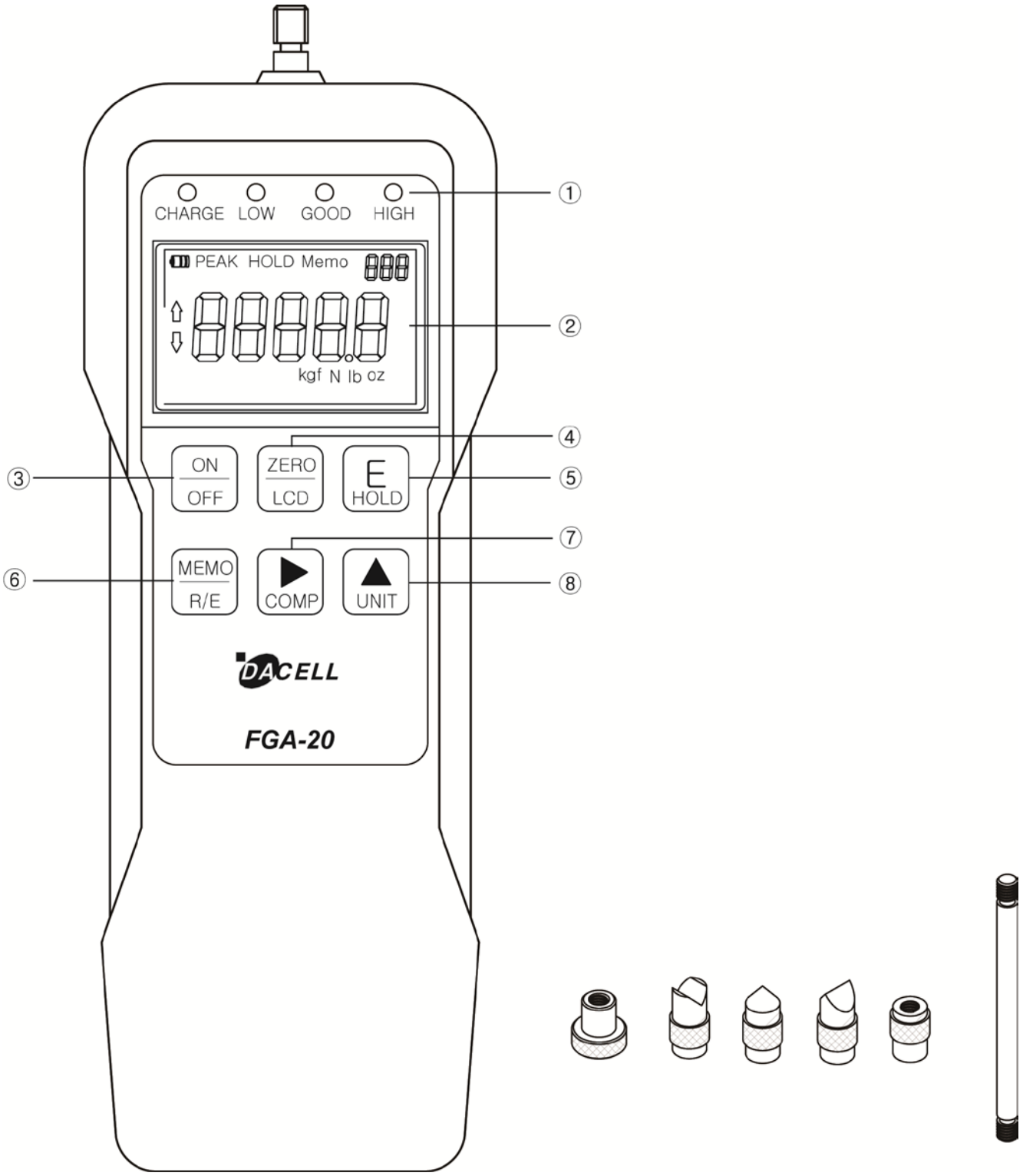
- A/D Transducer: 16-bit, 100 times/sec
- D/A Transducer: 12-bit
- Indication of Measuring Value: 5 Digit LCD (indicating forward/reverse direction)
- Indication of Measuring Unit: Kgf, N, lbf, ozf
- Condition indicating LED: Indication of charge and compare output condition
- Compare Output: High, Low, Good
- Analog Output: DC +/-1V
- Communication Output: USB
- Range of using temperature: -10℃ to 40℃, 80% RH and below (in locations without due condensation phenomenon)
- Weight: Approximately 600g
- Electric Source: Nickel hydrogen (NimH), Chargeable Adapter (DC 9V)
- Continuous Use Life: Approximately 40 hours
- Charging Time: Approximately 8 hours
- Option OP-01: USB cable, OP-02 :Analog out and open collector connector.

- Standard components




- Handy case

## 4. Front Panel



① Condition indicating LED

When each condition is as it should be, the corresponding LED lights up.

Charge indicators (during charging: red; after charging is complete: green)

② Measurement Value Indicating LCD

(Battery): This indicates battery condition; when it needs charging, it blinks. In order to prevent it from losing all charge, it turns off after a certain amount of time.

PEAK: This indicates peak hold condition.

HOLD: This indicates sample hold condition.

Memo: This indicates the point to save the measured value (max. 500).

⇧⇩ (arrows): ⇧: pull (symbol: +); ⇩: compression (symbol: −)

Kgf, N, lb, oz: They indicate the current measurement units, winch are converted in accordance by the unit.

③ ON/OFF

Power ON/OFF Key: Press it for 3 seconds, and the power turns on.

④ ZERO/LCD

Measuring Mode: Press the key briefly, and the current measured value becomes ZERO (0), and Analog output also becomes 0V. Press the key for a longer time, and the LCD window converts to forward/reverse direction.

Setting mode: Press the in the function setting mode, and it returns to the measuring mode.

⑤ E/HOLD

Measuring mode: Press the key, and HOLD moves. Press the key again, and HOLD releases.

Setting mode: This saves each setting value.

⑥ MEMO/R/E

Press the key briefly, and the current measured value is saved. Press the key for a longer time, and the saved value can be read or deleted.

⑦ ▶/COMP

Measuring Mode: Press the key, and the compare output value can be set.

Setting Mode: This moves the position of the blinking number line.

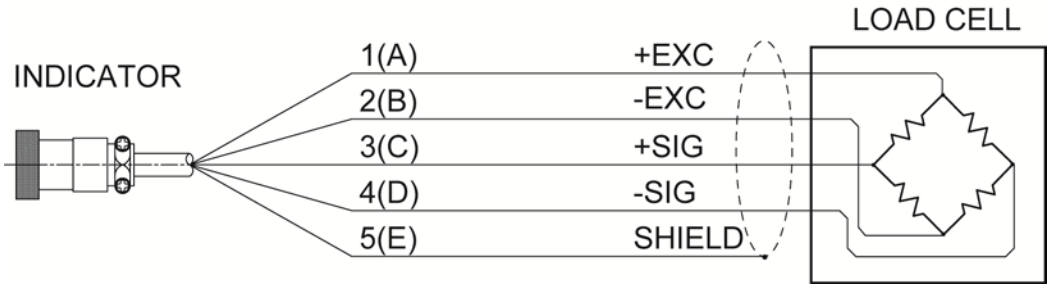
⑧ ▲/UNIT

Measuring Mode: Press the key, and the measuring unit and measured value are converted.

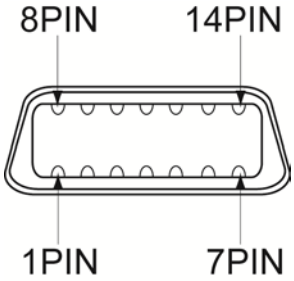
Setting Mode: This increases the numerical value of the blinking number.

## 5. Connection Diagram of Connector

① LOAD CELL connector




② I/O connector




| | | | |
|---|---|---|---|
| 1 | GND | DIGITAL GROUND | |
| 2 | IN1 | HOLD IN | |
| 3 | IN2 | ZERO IN | |
| 4 | IN3 | SPARE | |
| 5 | IN4 | SPARE | |
| 6 | GND | DIGITAL GROUND | |
| 7 | OUT1 | COMPARATE RY1 (LOW) | OPEN COLLECTOR OUTPUT<br>Active Low(Negative-logic output)<br>External Voltage 50V Max |
| 8 | OUT2 | COMPARATE RY2 (GOOD) | |
| 9 | OUT3 | COMPARATE RY3 (HIGH) | |
| 10 | OUT4 | SPARE | |
| 11 | VCC | Internal test voltage 3V | |
| 12 | N.C | | |
| 13 | ANALOG + | DC 0 ~ +/-1V OUTPUT | |
| 14 | ANALOG GND | ANALOG GROUND | |

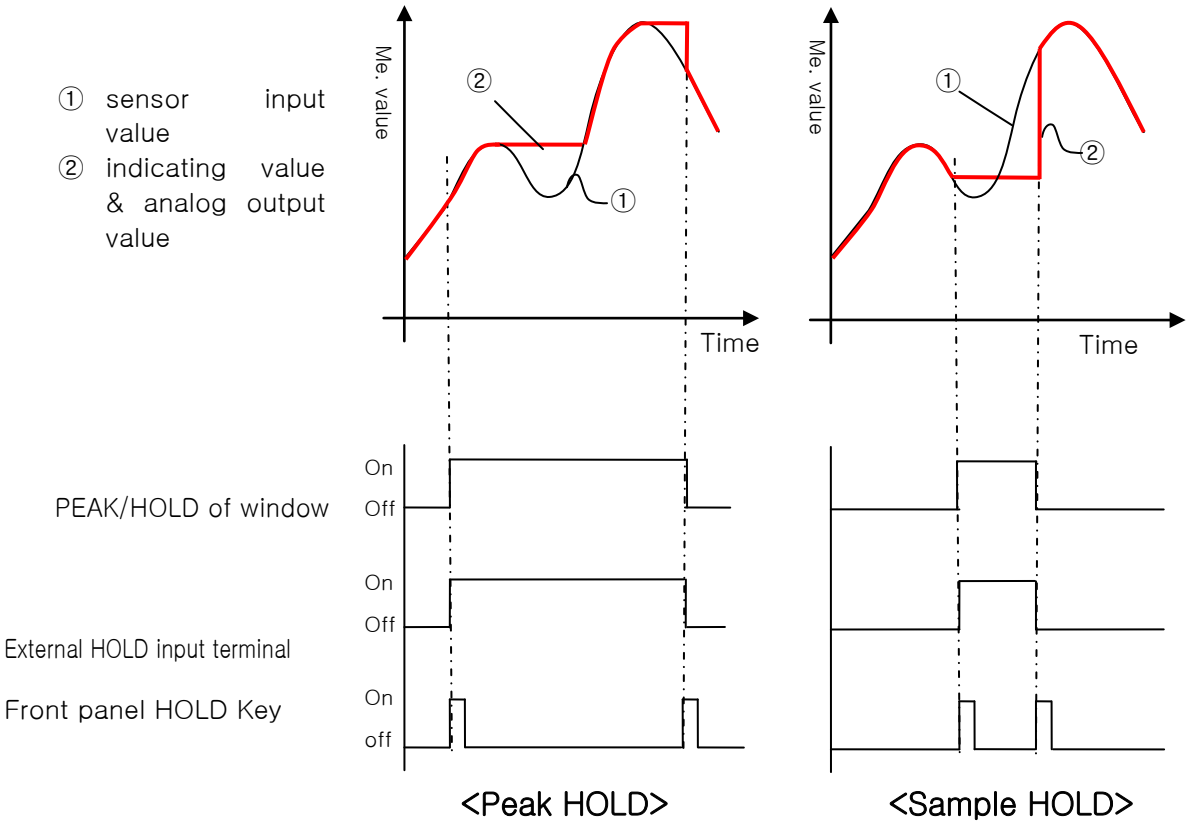
# 6. Components and Functions

## 6-1. How to use the Hold Mode

The Hold mode is divided into Peak Hold and Sample Hold. Select and use it as needed.

The method of inputting Hold is via the Hold key on the front panel; it can also be done by external input. For the correct method, refer to the figures below:

1) Peak Hold: Hold the maximum value among measured values.
   - Peak Hold Mode: Hold the maximum value of the forward direction (+), and indicate it.
   - Absolute Peak Hold Mode: Hold the maximum value of the absolute value (+/−), and indicate it.
2) Sample Hold: Hold the value of the time of inputting the Hold signal, and indicate it.



## 6-2. How to use the Compare Output Function

The Compare Output Function has 3 modes: Decision, High Limit, and Low Limit. Comparing each setting value, it is transmitted by an I/O Connector (Open Connector).

Under the High Limit and Low Limit modes, hysteresis can be used.

1) Decision Mode

Measured value ≤ Low Limit set value ⇒ RY1 ON (Low)
Measured value ≥ High Limit set value ⇒ RY3 ON (High)
Low Limit set value < Measured value < High Limit set value ⇒ RY2 ON (Good)

2) High Limit Mode

Measured value ≥ $1^{st}$ set value ⇒ RY1 ON
Measured value ≥ $2^{nd}$ set value ⇒ RY2 ON
Measured value ≥ $3^{rd}$ set value ⇒ RY3 ON
Measured value < $1^{st}$ set value − Hysteresis value ⇒ RY1 OFF
Measured value < $2^{nd}$ set value − Hysteresis value ⇒ RY2 OFF
Measured value < $3^{rd}$ set value − Hysteresis value ⇒ RY3 OFF

3) Low Limit Mode

Measured value ≤ $1^{st}$ set value ⇒ RY1 ON
Measured value ≤ $2^{nd}$ set value ⇒ RY2 ON
Measured value ≤ $3^{rd}$ set value ⇒ RY3 ON
Measured value > $1^{st}$ set value + Hysteresis value ⇒ RY1 OFF
Measured value > $2^{nd}$ set value + Hysteresis value ⇒ RY2 OFF
Measured value > $3^{rd}$ set value + Hysteresis value ⇒ RY3 OFF

* Note: In the case of setting the Offset value, the Compare Output moves as follows:

1) Decision Mode

Measured value ≤ (Offset − Low Limit set value) ⇒ RY1 ON (Low)
Measured value ≥ (Offset + High Limit set value) ⇒ RY3 ON (High)
(Offset − Low Limit set value) < Measured value < (Offset + High Limit set value) ⇒ RY2 ON (Good)

2) High Limit Mode

Measured value ≥ (Offset + $1^{st}$ set value) ⇒ RY1 ON
Measured value ≥ (Offset + $2^{nd}$ set value) ⇒ RY2 ON
Measured value ≥ (Offset + $3^{rd}$ set value) ⇒ RY3 ON
Measured value < (Offset + $1^{st}$ set value) − Hysteresis value ⇒ RY1 OFF
Measured value < (Offset + $2^{nd}$ set value) − Hysteresis value ⇒ RY2 OFF
Measured value < (Offset + $3^{rd}$ set value) − Hysteresis value ⇒ RY3 OFF

3) Low Limit Mode

Measured value ≤ (Offset + 1st set value) ⇒ RY1 ON

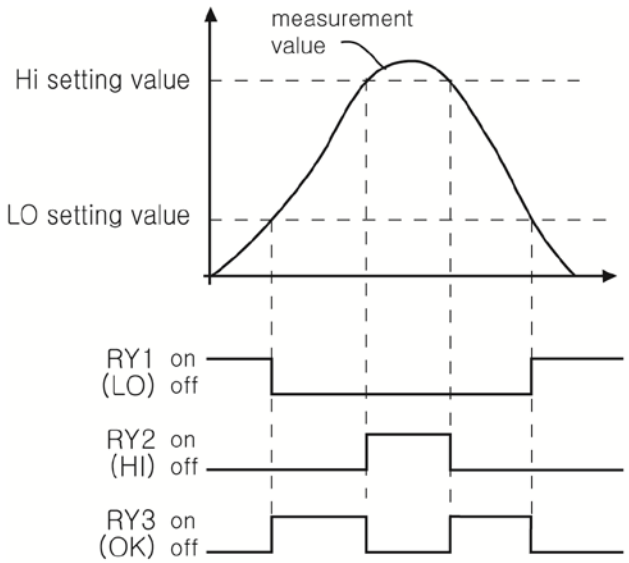
Measured value ≤ (Offset + 2nd set value) ⇒ RY2 ON

Measured value ≤ (Offset + 3rd set value) ⇒ RY3 ON

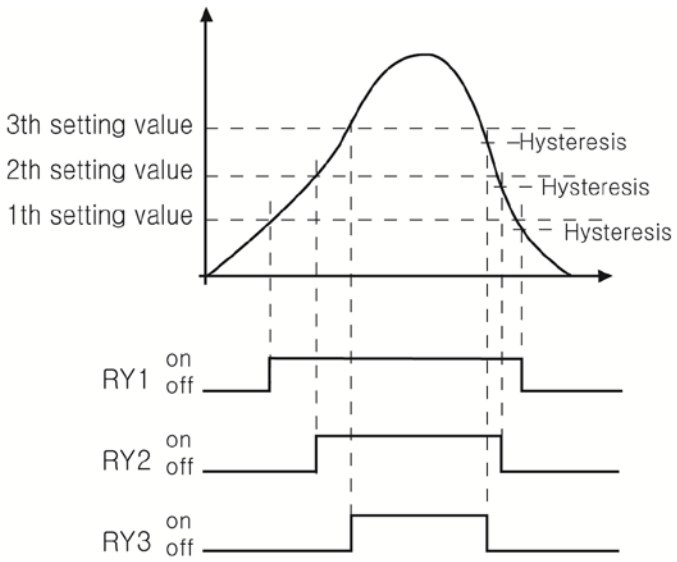
Measured value > (Offset + 1st set value) + Hysteresis value ⇒ RY1 OFF

Measured value > (Offset + 2nd set value) + Hysteresis value ⇒ RY2 OFF

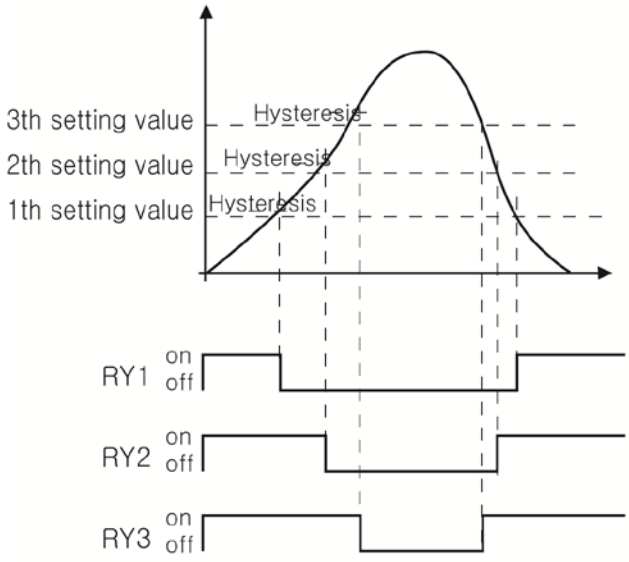
Measured value > (Offset + 3rd set value) + Hysteresis value ⇒ RY3 OFF




<Decision mode>



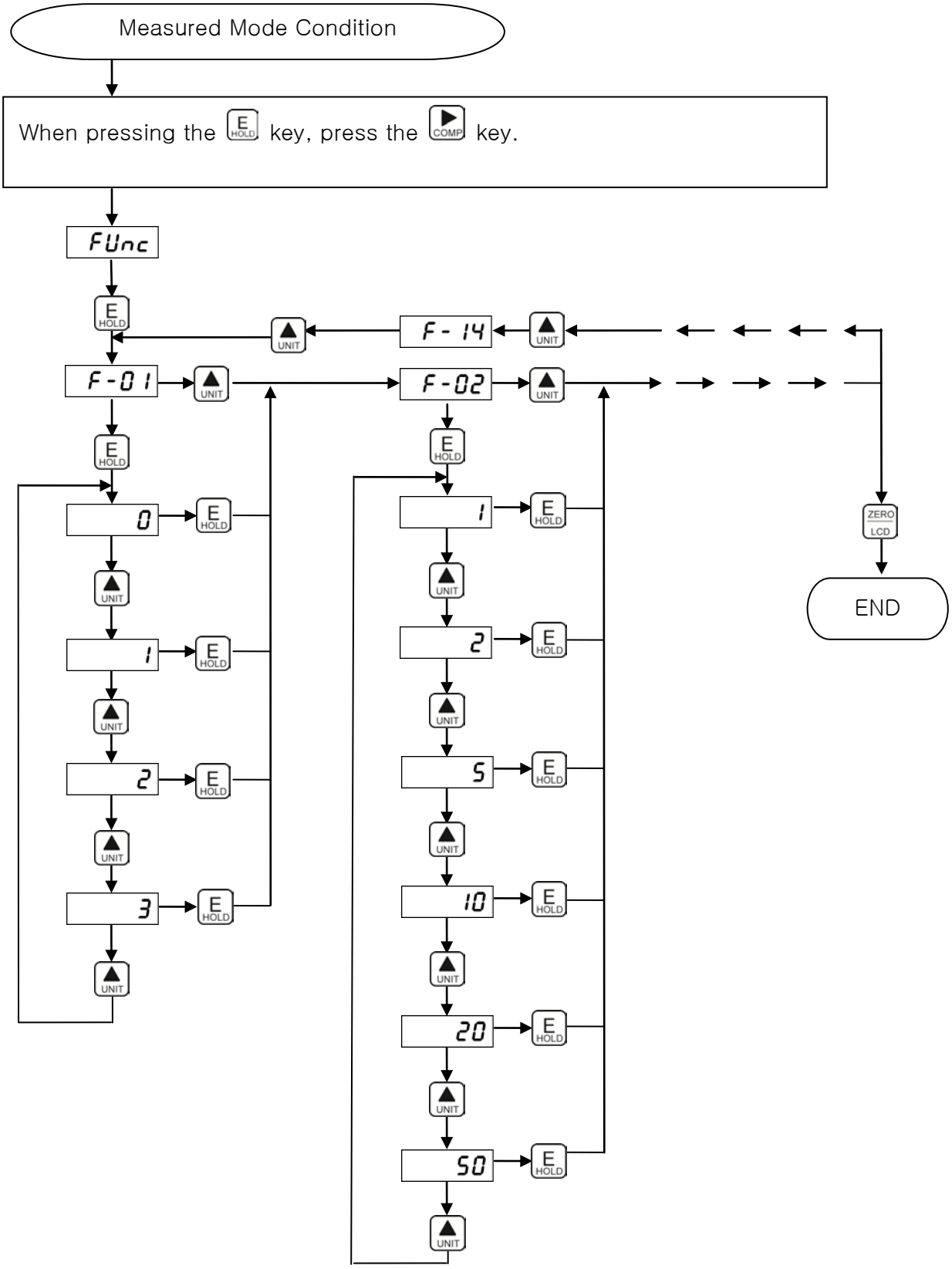

<High limit mode>



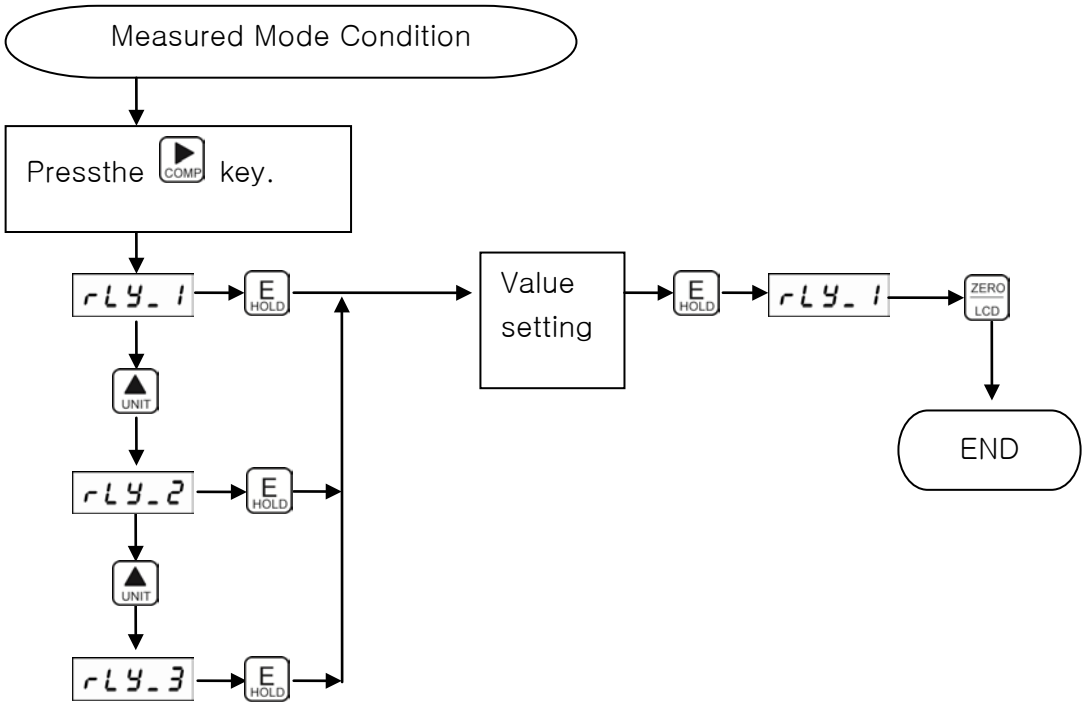

<Low limit mode>

## 7. Function Mode (Function Set-up)

1) How to Set up the Function



2) How to Set up the RELAY Output value



# Function mode list #

| Name | Function | Setting | Standard set value at delivery time |
|---|---|---|---|
| F-02 | Division | 1, 2, 5, 10, 20, 50 | 1 |
| F-03 | Display Filter | 4, 8, 16, 32, 64, 128 | 64 |
| F-04 | Hold Mode | Sample Hold (0), Peak Hold (1)<br>Absolute Peak Hold (2) | 2 |
| F-05 | Comparison Mode | Decision (0), High Limit (1), Low Limit (2) | 0 |
| F-06 | Hysteresis | 0 - 99 | 0 |
| F-08 | DAC Capacity | 0 - 99999 | 10000 |
| F-09 | ID Number | 0 - 32 | 1 |
| F-10 | Baud Rate | 2400, 4800, 9600 | 9600 |
| F-11 | Auto Zero Tracking | 0 - 99 | 0 |
| F-12 | Auto Zero Tracking Time | 0.0 - 5.0 sec. | 0.0 |
| F-20 | Comparison Absolute | No (0), Yes (1) | 1 |
| F-21 | Auto Power Off | No (0), Yes (1) | 1 |
| F-22 | Power On Zero | No (0), Yes (1) | 1 |
| F-23 | Zero Offset | 0 - 99999 | 0 |
| F-24 | Reverse Sign | No (0), Yes (1) | 0 |

## F-02. Division (Minimum Indicating Unit Set-up)

(Standard set value: 1)

| Display Data | Setting |
|---|---|
| 1 | Indicate 1 unit (0, 1, 2, 3, 4 …….) |
| 2 | Indicate 2 units (0, 2, 4, 6, 8 …….) |
| 5 | Indicate 5 units (0, 5, 10, 15 …….) |
| 10 | Indicate 10 units (0, 10, 20, 30 …….) |
| 20 | Indicate 20 units (0, 20, 40, 60 …….) |
| 50 | Indicate 50 units (0, 50, 100, 150 …….) |

## F-03. Display Filter (Indicating Speed Set-up)

(Standard set value: 64)

| Display Data | Setting |
|---|---|
| 4 | Average time: 1/32 of a second |
| 8 | Average time: 1/16 of a second |
| 16 | Average time: 1/8 of a second |
| 32 | Average time: 1/4 of a second |
| 64 | Average time: 1/2 of a second |
| 128 | Average time; 1 second |

## F-04. Hold Mode

(Standard set value: 2)

| Display Data | Setting | |
|---|---|---|
| 0 | Sample Hold | Hold the value of signal input time |
| 1 | Peak Hold (+) | Hold the max. value during signal input |
| 2 | Absolute Peak Hold (+/-) | Hold the max. absolute value during signal input |

## F-05. Comparison Mode

(Standard set value: 0)

| Display Data | Setting | |
|---|---|---|
| 0 | Decision Mode | RY1 (Low), RY2 (Good), RY3 (High) Output |
| 1 | High Limit Mode | RY1, RY2, RY3 Output |
| 2 | Low Limit Mode | RY1, RY2, RY3 Output |

## F-06. Hysteresis

(Standard set value: 00)

| Display Data | Setting | |
|---|---|---|
| 00 | 00 | Hysteresis is not used |
| 99 | 01 - 99 | Hysteresis value is used (Decision Mode is not applied) |

## F-08. DAC Capacity (Setting of Analog Output value)

(Standard set value: 10000)

<table>
<tr><th>Display Data</th><th>Setting</th></tr>
<tr><td>0<br><br>99999</td><td>Setting of Analog output value<br><Example of set value and output>
<table>
<tr><th colspan="2">Set value</th><th colspan="2">Voltage output (0 to +/−1V)</th></tr>
<tr><th>ZERO</th><th>CAPACITY</th><th>Indicating value</th><th>Output</th></tr>
<tr><td rowspan="3">0</td><td rowspan="3">+10000</td><td>−10000</td><td>−1V</td></tr>
<tr><td>0</td><td>0V</td></tr>
<tr><td>+10000</td><td>+1V</td></tr>
</table></td></tr>
</table>

## F-09. ID Number (Setting of Communication Equipment Number)

(Standard set value: 01)

| Display Data | Setting | |
|---|---|---|
| 00 | 00 | Equip. number is not set (Stream Mode: data is constantly transmitted) |
| 32 | 01 – 32 | Equip. number is set (Command Mode: data is transmitted by order) |

## F-10. Baud Rate (Setting of Communication Speed)

(Standard set value: 9600)

| Display Data | Setting |
|---|---|
| 2400 | 2400 bps |
| 4800 | 4800 bps |
| 9600 | 9600 bps |

## F-11. Auto Zero Tracking (Setting of Auto Zero Point Tracking Range)

(Standard set value: 00)

| Display Data | Setting | |
|---|---|---|
| 00 | 00 | Auto zero point is not used |
| 99 | 01 – 99 | Auto zero point tracking range is set |

## F-12. Auto Zero Tracking Time (Setting of Auto Zero Point Tracking Time)

(Standard set value: 0.0)

| Display Data | Setting | |
|---|---|---|
| 00 | 0.0 | Auto zero point is not used |
| 5.0 | 0.1 – 5.0 | Auto zero point tracking range is set (0.1 – 5.0 seconds) |

### F-20. Comparison Absolute (Setting of Comparison Output Absolute Value)

(Standard set value: 1)

| Display Data | Setting |
|---|---|
| 0 | Absolute value comparison is not used |
| 1 | Within the absolute value, comparison output is used |

### F-21. Auto Power Off (Setting of Auto Power Off)

(Standard set value: 1)

| Display Data | Setting |
|---|---|
| 0 | Auto power off is not used |
| 1 | Without pressing any key for 10 minutes, the power turns off (except while charging). |

### F-22. Power on Zero (Setting of Auto Zero Point when Power is On)

(Standard set value: 1)

| Display Data | Setting |
|---|---|
| 0 | When Power is on, Auto Zero Point is not used |
| 1 | When Power is on, Auto Zero Point is used |

### F-23. Zero Offset (Offset Setting)

(Standard set value: 0)

| Display Data | Setting |
|---|---|
| 0<br><br>99999 | 0: Offset is not used<br>1 - 99999: Offset value is set<br><br>It is used when measuring by adding an arbitrary value (self-weight, etc.)<br>Ex.: In the case the measured value = 100, offset = 20 is set,<br>indicating value = 120<br><br>**Note: In the case of setting the Offset value, know the comparison output movement.** |

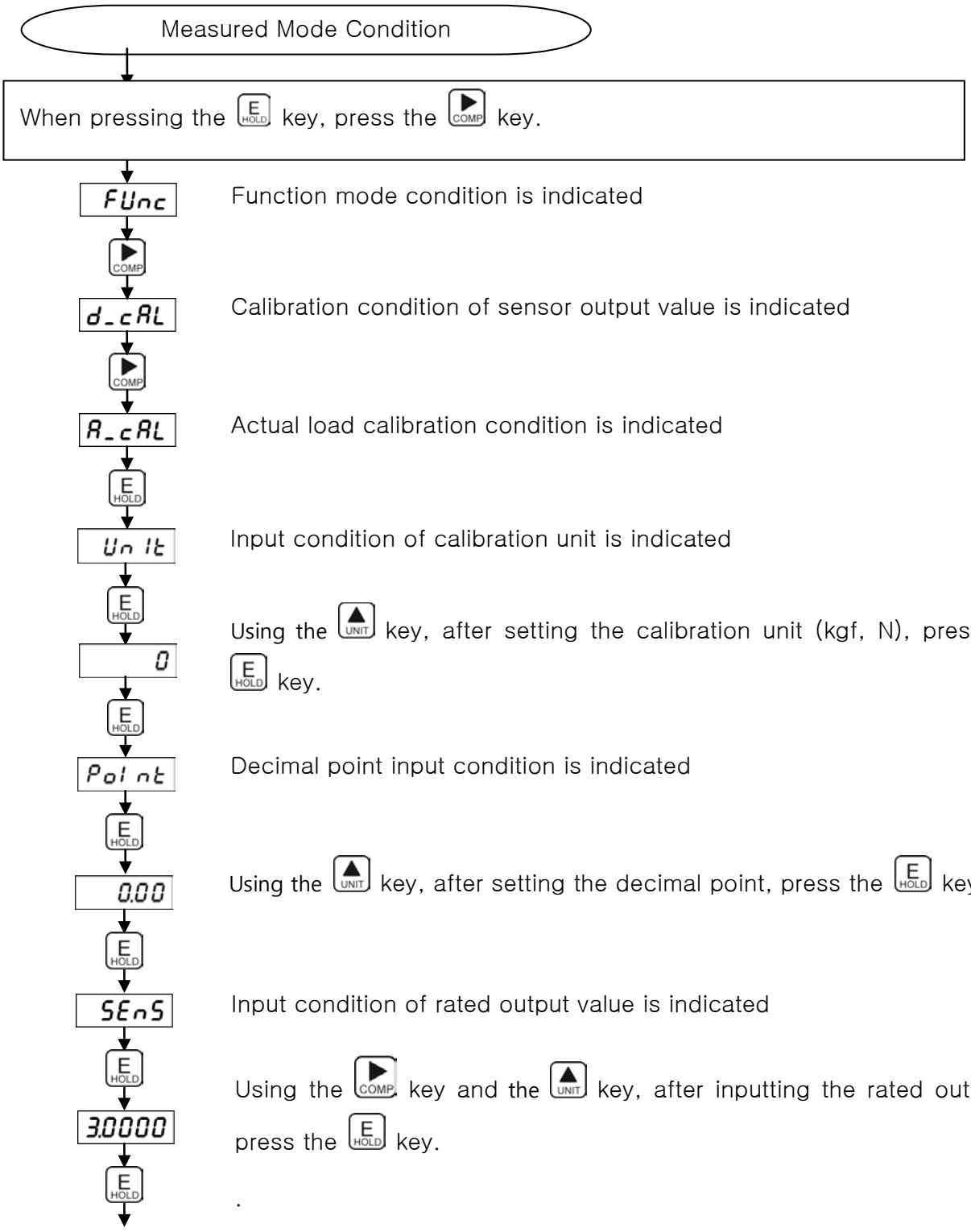
### F-24. Reverse Sign (Setting of Reverse Sign)

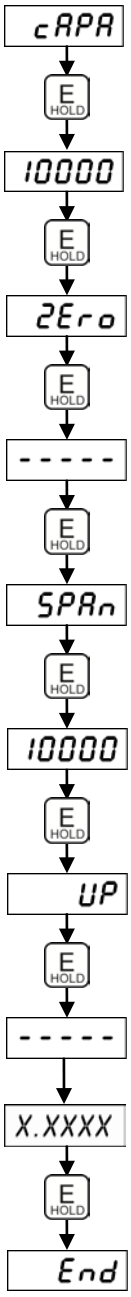
(Standard set value: 0)

| Display Data | Setting |
|---|---|
| 0 | Reverse sign is not used |
| 1 | Use of Reverse sign; Current indicating sign (tension(+)/pressure(-) are indicated. |

## 7-2. Actual Load Calibration

When using the calibrating method by adding the actual load (load, displacement, pressure) to the sensor, a standard load is needed.






Input condition of rated capacity is indicated

Using the COMP key and the UNIT key, after inputting the rated capacity, press the E HOLD key.

Indication of Zero point condition.

In the condition of a non-loading sensor, press the E HOLD key.

After about 1 second

Actual load condition is indicated

Using the COMP key and the UNIT key, after inputting the actual load value, press the E HOLD key.

After adding the actual load to the sensor, press the E HOLD key.

After about 1 second

Indication of calibration constant value (Record it exactly. It is needed for calibration in the future.)

Calibration is finished

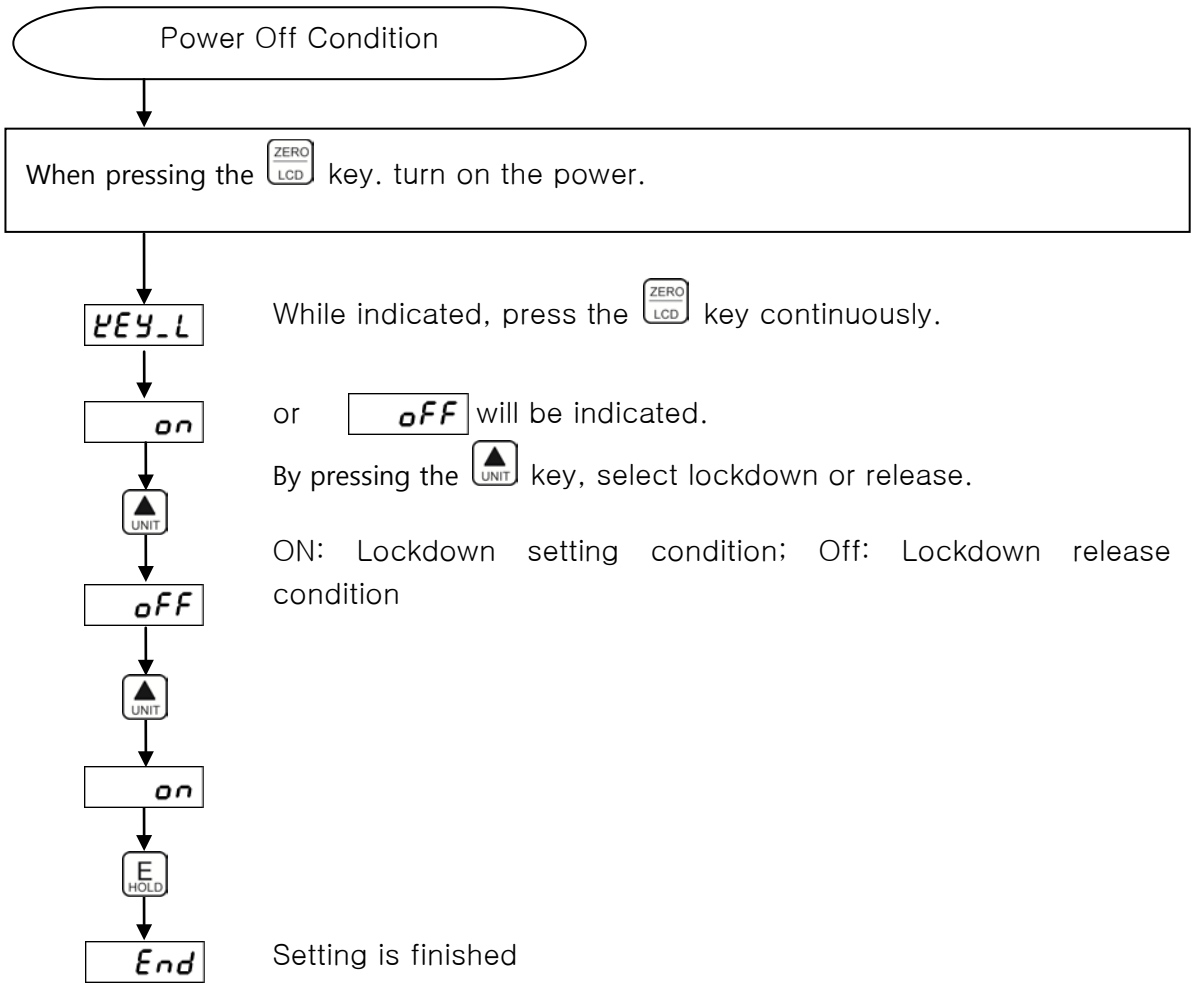
| Cal. Date | R.O | calibration constant value |
|---|---|---|
| | | |

## 7-3 Lockdown Setting

With the lockdown setting, improper operation by an unnecessary key pressing can be prevented. After finishing the calibration, using the lockdown setting is recommended.

Initial condition begins when it is powered off.

Corresponding function when lockdown is set: Calibration-related function



# 8. Communication (USB)

Before use, install a USB driver on the PC.
(http://www.silabs.com, search CP2102 drive)

1. Method: Half Duplex, Asynchronous Method
2. Baud Rate: Select among 2400, 4800, or 9600 bps
3. Parity: No Parity
4. Data Bit: 8-bit
5. Stop Bit: 1-bit

## 8-1. Stream Mode

When the equipment number (ID number of F-09) is 0, it operates under Stream Mode.

Data +1234.5Kgf Transmission

| CODE | BYTE1 | BYTE2 | BYTE3 | BYTE4 | BYTE5 | BYTE6 | BYTE7 | BYTE8 | BYTE9 |
|---|---|---|---|---|---|---|---|---|---|
| ASCII | S | T | , | N | T | , | + | 0 | 1 |
| HEX | 53H | 54H | 2CH | 4EH | 54H | 2CH | 2BH | 30H | 31H |

| CODE | BYTE10 | BYTE11 | BYTE12 | BYTE13 | BYTE14 | BYTE15 | BYTE16 | BYTE17 |
|---|---|---|---|---|---|---|---|---|
| ASCII | 2 | 3 | 4 | . | 5 | K | C | LF |
| HEX | 32H | 33H | 34H | 2EH | 35H | 4BH | 0DH | 0AH |

1) BYTE1, BYTE2
   DATA Stable: ST
   DATA Unstable: US
   DATA OVERFLOW: OL
2) BYTE3 - BYTE6: Fixed letter (NT)
3) BYTE7 - BYTE14: DATA 8 BYTE (+/- included)
4) BYTE15; Measuring unit (K: Kgf; N: N; L: lbf; O: ozf)
5) BYTE16: CARRIAGE RETURN
6) BYTE17: LINE FEED

## 8-2. Command Mode

When the equipment number (ID number of F-09) is 1-32, it operates under the Command Mode.

1. Command Form (PC -> INDICATOR)

| CODE | BYTE1 | BYTE2 | BYTE3 | BYTE4 | BYTE5 |
|---|---|---|---|---|---|
| ASCII | I | D | 0 | 1 | P |
| HEX | 49H | 44H | 30H | 31H | 50H |

1) BYTE1, BYTE2; Fixed letter (ID)
2) BYTE3, BYTE4: Equipment number (1-32)
3) BYTE5: Command (P, H, R, Z)

2. Command Table

| Command | | Explanation of Command |
|---|---|---|
| ASCII | HEX | |
| P | 50H | Current value of order equipment is transmitted |
| H | 48H | HOLD operation of commanding equipment |
| R | 52H | HOLD release of commanding equipment |
| Z | 5AH | ZERO operation of current value of commanding equipment |

3. Transmission DATA Form (INDICATOR -> PC)

| CODE | BYTE1 | BYTE2 | BYTE3 | BYTE4 | BYTE5 | BYTE6 | BYTE7 | BYTE8 | BYTE9 |
|---|---|---|---|---|---|---|---|---|---|
| ASCII | I | D | 0 | 0 | 1 | , | + | 0 | 1 |
| HEX | 53H | 54H | 30H | 30H | 31H | 2CH | 2BH | 30H | 31H |

| CODE | BYTE10 | BYTE11 | BYTE12 | BYTE13 | BYTE14 | BYTE15 | BYTE16 | BYTE17 |
|---|---|---|---|---|---|---|---|---|
| ASCII | 2 | 3 | 4 | . | 5 | K | C | LF |
| HEX | 32H | 33H | 34H | 2EH | 35H | 4BH | 0DH | 0AH |

1) BYTE1, BYTE2: Fixed letter (ID)
2) BYTE3 - BYTE5; Equipment number (1-32)
3) BYTE6: Fixed letter (,)
4) BYTE7 - BYTE14: DATA 8byte (+/- included)
5) BYTE15: Measuring unit (K: Kgf; N: N; L: lbf; O: ozf)
6) BYTE16: CARRIAGE RETURN
7) BYTE17: LINE FEED

## 8-3. Memo Data Transmission

It operates under the Command Mode.

1. Command Form (PC -> INDICATOR)

| CODE | BYTE1 | BYTE2 | BYTE3 | BYTE4 | BYTE5 |
|---|---|---|---|---|---|
| ASCII | A | 0 | 0 | 1 | P |
| HEX | 41H | 30H | 30H | 31H | 50H |

1) BYTE1, BYTE2: Fixed letter (A)
2) BYTE3, BYTE4: Saving Data Address (1-500)
3) BYTE5: Command (P, D, U)

2. Command Table

| Command | | Explanation of Command |
|---|---|---|
| ASCII | HEX | |
| P | 50H | Data transmission of designated address |
| D | 44H | AD001 and up to designated address data transmission |
| U | 55H | At designated address, up to AD500 data transmission |

3. Transmission DATA Form (INDICATOR -> PC)

| CODE | BYTE1 | BYTE2 | BYTE3 | BYTE4 | BYTE5 | BYTE6 | BYTE7 | BYTE8 | BYTE9 |
|---|---|---|---|---|---|---|---|---|---|
| ASCII | A | D | 0 | 0 | 1 | , | + | 0 | 1 |
| HEX | 41H | 54H | 30H | 30H | 31H | 2CH | 2BH | 30H | 31H |

| CODE | BYTE10 | BYTE11 | BYTE12 | BYTE13 | BYTE14 | BYTE15 | BYTE16 | BYTE17 |
|---|---|---|---|---|---|---|---|---|
| ASCII | 2 | 3 | 4 | . | 5 | K | C | LF |
| HEX | 32H | 33H | 34H | 2EH | 35H | 4BH | 0DH | 0AH |

1) BYTE1, BYTE2: Fixed letter (AD)
2) BYTE3 - BYTE5: Saving Data Address (1-500)
3) BYTE6; Fixed letter (,)
4) BYTE7 - BYTE14: DATA 8byte (+/- included)
5) BYTE15: Measuring unit (K: Kgf; N: N; L: lbf; O: ozf)
6) BYTE16: CARRIAGE RETURN
7) BYTE17: LINE FEED

## 9. Product Check

| Trouble | Cause | Action | Comments |
|---|---|---|---|
| Display is shaking | • Load cell is broken<br>• Load cell insulation resistance<br>• Interference occurs | • Load cell input, output<br>• Check resistance<br>• Check load cell insulation resistance | • Insulation resistance (Cable & Case 1000 Mohm and more) |
| Weight increases at a fixed rate or does not return to zero | • Bad load cell | • Check load cell insulation resistance | |
| | • Imperfect access of load cell | • Check wire connection between load cell and this instrument<br>• Check cutting of load cell cable | |
| “OVER” or “UNDER” is indicated | • Load cell is broken<br>• Load cell connection is bad | • Check load cell condition and cable connection condition | |